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Article

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The relationship between external debt and agriculture GDP growth in Ghana: an ARDL cointegrating bound testing approach

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ABSTRACT

The relationship between external debt and agriculture productivity is a topic of significant importance in developing economies. Agriculture is a fundamental sector in these economies, often providing livelihoods for a substantial portion of the population. External debt, on the other hand, is a commonly used financing mechanism for economic development. Understanding how these two variables interact is crucial for policymakers because it has far-reaching implications for food security, poverty reduction, and overall economic stability. The main objective of this study is to establish the relationship between external debt and agricultural GDP growth in Ghana. The Augmented Dickey Fuller and Phillips-Parron tests and the autoregressive distributed lag (ARDL) to co-integration bound testing approach were employed for the econometrics analysis from 1980 to 2019. The study revealed a direct and significant effect of external debt on agricultural GDP growth in Ghana. This implies that external funds were optimally channeled and used to stimulate agricultural output. The results indicate that external debt servicing has a positive effect on agricultural GDP growth, suggesting that Ghana is capable of always fulfilling its debt obligation. The study's key contributions are that the paper is the first to investigate the link between external debt and agricultural GDP growth in Ghana. Furthermore, the study has indicated that external debt is a catalyst to augment agriculture GDP growth in Ghana. Finally, we investigate the long-term effect of the variables of interest on agricultural GDP growth.

IMPACT STATEMENT

The finding that external debt has a positive and significant effect on agriculture GDP in Ghana carries substantial implications for both policymakers and stakeholders in the agricultural sector. This result underscores the critical role that external borrowing plays in driving agricultural growth and development in the country.

First and foremost, this finding suggests that external financing channels, such as loans and grants from international financial institutions or bilateral donors, can effectively stimulate investment in the agricultural sector. These funds can be utilized to finance crucial initiatives aimed at modernizing agricultural practices, improving infrastructure, enhancing productivity, and promoting value chain development. As agriculture remains a vital sector of Ghana's economy, contributing significantly to employment, food security, and rural livelihoods, the positive impact of external debt on agriculture GDP signifies the potential for sustainable economic growth and poverty reduction.

Moreover, the positive association between external debt and agriculture GDP implies that prudent debt management strategies, coupled with targeted investment in agriculture, can yield favorable outcomes for Ghana's overall economic performance. By strategically leveraging external resources to bolster agricultural productivity and competitiveness, Ghana can capitalize on its comparative advantage in the sector, diversify its export base, and reduce dependency on imports, thereby enhancing resilience to external shocks and fostering long-term economic sustainability.

Additionally, the significance of external debt in driving agricultural GDP underscores the importance of aligning debt-financed projects and programs with national development priorities, particularly those outlined in Ghana's medium to long-term agricultural

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development strategies. This entails ensuring that borrowed funds are allocated efficiently, transparently, and equitably across different segments of the agricultural value chain, with due consideration for environmental sustainability, social inclusivity, and gender equality.

1. Introduction

Many economies, especially emerging economies across the globe, borrow external funds to achieve their funding demands imperative to ensure growth. The external fund consists of external debt, which plays both positive and adverse responsibilities regarding the growth and development agenda in the recipients' economy, especially in developing economies. External debt could work as an economic stimulant imperative for the growth of key sectors, including manufacturing, health, and agriculture. However, when an economy accumulates debts more than a reasonable range, it brings about a situation in which a significant proportion of tax resources will be used in servicing the debt. According to Shabbir and Yasin (2015), an increase in accumulated debt servicing demands for more borrowing leading to a wider fiscal deficit.

In several emerging economies, including Ghana (Abille and Kiliç, 2023), the debt to gross domestic product (GDP) ratio is very high and alarming (Abille and Kiliç, 2023); hence, a significant proportion of revenue emanating from domestic and external sources is ordinarily spent on servicing the debt. According to the Finance Minister of Finance Ghana, more than 50% of central government total revenue and as well as 70% of tax revenues were being employed for debt servicing in 2022 and the situation is not different from other developing countries (World Bank, 2022). According to a report by the Ministry of Finance (April, 2020), the public debt stock of Ghana took an upward trend from approximately US\$39.12 billion in December 2019 to US\$43.17 billion by March 2020, representing approximately 59.30% of the country's total GDP. The effect of a high debt to GDP ratio is that government spending on key sectors of the economy (including agriculture) will dwindle (Shabbir & Yasin, 2015). For instance, the current government expenditure on agriculture as a percentage of Gross Domestic Product (GDP) in developing countries, including Ghana, is low due to their indebtedness to the rest of the world. The trend of government expenditure on agriculture over time is shown in Figure 1.

Over the periods indicated in the graph above, government expenditure on agriculture peaked around 2005–2012, although the trend declined slightly in 2006. However, expenditures fell drastically from 2013 to 2018. The lowest expenditure hovered around 0.65% in 2018, while the highest expenditure rate as a percentage of GDP was 3.8% in 2005, as shown in Figure 1. The decline in government expenditure on agriculture after 2012–2018 resulted from massive increases in government expenditure on public service, which accounted for about two-thirds of the total government expenditure from 2013 to 2015 (CAGD (Controller & Accountant General's Department), 2018). The increase in expenditure on the general public service was spent on the management of public debt, which accounted for 37.5% of

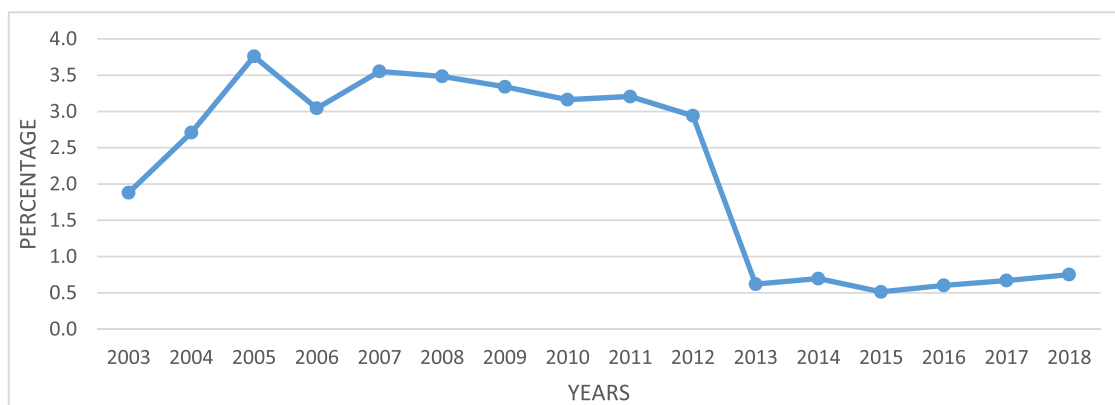


Figure 1. Trend of government expenditure on agriculture percentage of GDP (2003–2018). *Source:* Authors' computation based on World Bank Data, 2020.

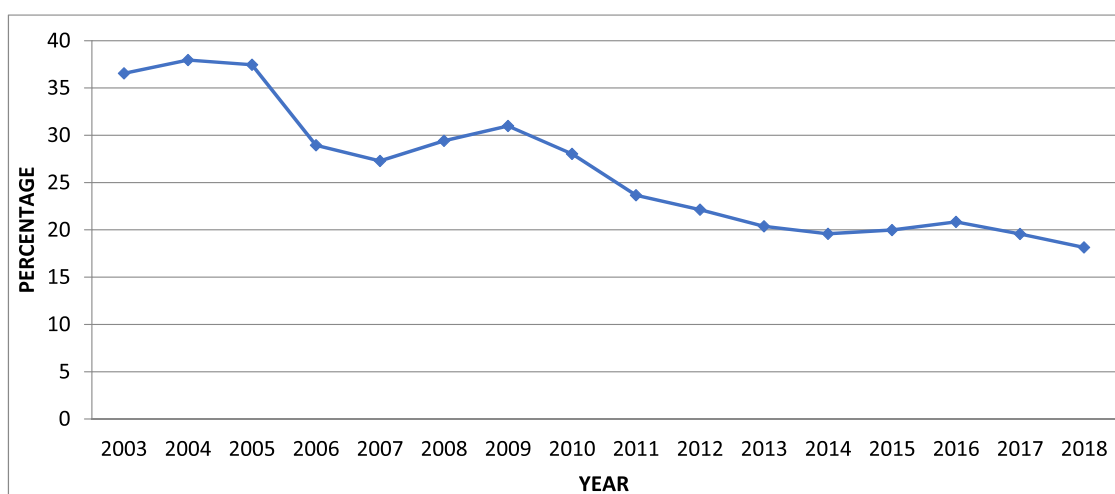


Figure 2. Trend of agricultural value added percentage of GDP (2003–2018). *Source:* Authors' computation based on World Bank Data, 2020.

it. With regards to agriculture value added in [Figure 2](#), you will realize that agriculture contribution to GDP has also followed the same trend; the performance of the sector fell from 36.55% in 2003 to 18.4% in 2018. Thus, the sector is now the second contributor to the country's GDP, even though, greater percentage of the working population are employed in the sector (World Bank, 2023). In theory, increase in foreign capital is expected to have increase investment into key sectors including agricultural to propel growth and development, however, with the higher level of debt to GDP of the country one would have expected a corresponding increase in agricultural expenditure leading to a significant increase in the productivity of the sectors.

Despite the potential link between external debt and agricultural productivity, relatively limited and sustained academic scholarship addresses this nexus, categorically in Africa and in the Ghanaian case, such examinations are almost nonexistent. However, previous studies on external debt linked the effect of debt on other variables such as economic growth (Azam et al., 2013; Cohen, 1993; Ramakrishna, 2015; Matuka & Asafo, 2019), exchange rate uncertainty, and human capital development (Zaghoudi, 2018). However, in developing countries, studies on the link between the external debt–agriculture GDP nexus are limited (see for instant, a panel study by Ehirim, 2009). However, what is lacking from the literature on the external debt–agriculture GDP growth relationship is a country-specific study in Africa, particularly, sub-Saharan Africa, hence creating a knowledge gap in context. Thus, the current study seeks to contribute to filling this gap by investigating the extent to which external debt impacts agricultural GDP growth in Ghana using the autoregressive distributed lag cointegration bound testing approach used by Pesaran et al. (2001) to specify an error correction model. The study employed the ARDL method, where the dependent variable (Agriculture GDP growth) is a function of the explanatory variables and the lag values of the dependent variable.

Ghana engages in the cultivation of a diverse range of crops across various climatic zones, ranging from dry savanna to wet forest bands running from east to west. Serving as the cornerstone of Ghana's economy, the agricultural sector relies on crops like yams, grains, cocoa, oil palms, kola nuts, and timber. Experiencing growth from 2.9% in 2016 to 6.1% in 2017, recording a growth of 4.8% in 2018, and projected to reach 6.9% in 2019, the agricultural sector's value added, representing its net output in 2018, amounted to 11.98 billion USD. Agriculture plays a significant role in society by sustaining livelihoods through food production, providing habitats, and generating employment opportunities. Additionally, it serves as a crucial source of raw materials for various products and contributes to robust economies through trade. Historically, agriculture has been a key driver of economic growth in Ghana, both before and after independence (World Bank, 2022). The country's economy is characterized by a mix of private and public enterprises, with the services sector contributing about three-fifths to the GDP, agriculture accounting for nearly one-fifth, and industry contributing approximately one-fourth to the overall economic landscape.

Agriculture has long been acknowledged by developing economies as a pivotal sector for achieving a crucial global objective – poverty reduction – in a sustainable manner. In Ghana, the agricultural sector plays a vital role in contributing to various facets of development. It serves as a major source of employment, particularly in rural areas, sustaining livelihoods for a significant portion of the population. The diverse skills required in agriculture encompass farmers, agribusiness entrepreneurs, researchers, and extension workers.

Ghana, like many developing nations, relies on borrowing from both multilateral institutions and bilateral partners to fund various development projects and meet budgetary requirements. These sources but not limited to the International Monetary Fund (IMF), World Bank, African Development Bank, as well as loans from other countries. Additionally, the government secures loans from commercial sources, such as international financial markets and commercial banks, which are utilized for infrastructure projects, budget support, and strategic initiatives. Eurobonds, foreign currency-denominated debt securities, are actively issued by Ghana, generating funds for diverse economic development purposes and often listed on international stock exchanges. A substantial portion of external debt is allocated to critical infrastructure projects, encompassing roads, bridges, energy facilities, and water and sanitation initiatives, reflecting investments in various sectors like energy, transportation, and economic growth. The agricultural sector also receives external debt funding aimed at modernizing farming practices, supporting agribusinesses, and enhancing overall agricultural productivity, aligning with the sector's significance in Ghana's economy (MoF, 2020).

However, the challenge arises from high levels of debt servicing, potentially diverting financial resources from vital sectors, including agriculture (World Bank, 2023). If a significant portion of the national budget is directed towards servicing debt, it may constrain funds available for agricultural investment. The taxation landscape in Ghana includes varying corporate income tax rates across sectors, with a standard value-added tax (VAT) rate of 15% applied to taxable goods and services. Recent developments include the introduction of three new taxes in Ghana in 2023, intended to generate revenue and meet IMF program conditions. Despite Ghana's GDP growth and a strengthening economy, concerns have been raised about the impact of these taxes on the agribusiness sector. Stakeholders, such as the Chamber of Agribusiness Ghana and the Peasant Farmers Association of Ghana, have advocated for tax exemptions on agricultural commodities before the implementation of these taxes. The level of taxes imposed on the agricultural sector is recognized as a factor influencing investment, as high taxes may discourage investment by reducing agricultural profitability, while a favorable tax environment can attract more investment, fostering increased productivity and growth in the sector. Approximately 39.49% of the total labor force of the country is involved in agriculture, compared to 41.38% in service and 19.13% in industry as at 2021 (World Bank, 2023). Unemployment is a key issue affecting livelihoods across the globe; thus, policies to enhance agriculture jobs in Ghana are important. Thus, a vibrant agriculture sector is expected to attract more youth into agriculture, which would help reduce unemployment. Agriculture shares of Ghana's GDP account for 18.8%; agriculture contributes about 40% to the total export earnings of the country, and about 90% of the country's food needs emanate from the agriculture sector (World Bank, 2022). In addition, the country is among the 36 heavily indebted economies listed by the International Monetary Fund (IMF, 2021). Therefore, it is imperative to discover the association between external debt and agriculture productivity. Hence, we revisited the issue by employing time series secondary data from 1980 to 2019 to ascertain robust results.

Thus, the hypothesis tested is that external debt has a more significant effect on agriculture GDP growth in Ghana. Thus, a study on the relationship between external debt and agriculture GDP growth can enrich the scientific community's knowledge by providing empirical insights, advancing economic theory, informing policy discussions, and contributing to a broader understanding of the complex interactions between debt, economic sectors, and long-term development.

The remaining chapters are as follows: section two discussed previous studies on the nexus between external debt and agricultural production as well as the theoretical foundation of the study. The econometrics analysis including data source, model estimation are discussed in section three. Presentation of results and discussions on the studied variables are done in section four. Conclusions and recommendations based on the finding are presented in section five.

2. Literature review

The Solow Growth Model, formulated by Robert Solow in (1956), stands as a well-established framework for examining economic growth. This model posits that economic output is influenced by factors such as the accumulation of capital, growth in the labor force, and technological advancements. In the context of understanding the correlation between external debt and economic growth, this model serves as the foundation. The impact of external debt on agricultural GDP growth in Ghana can encompass both favorable and unfavorable consequences. On one hand, external borrowing can be used to finance projects that enhance agricultural productivity, such as infrastructure development, research and development, and modernization of farming techniques. This aligns with the Solow model's emphasis on capital accumulation and technological progress. Conversely, excessive external debt can lead to debt servicing obligations that divert resources away from the agricultural sector. This can hamper capital accumulation, reduce investments in agricultural research, and hinder overall productivity. The Solow model predicts that diminishing returns to capital and technology can limit growth when debt burdens become excessive. Thus, the SGT with concentration on the studied indicators of our current study are worthy of examination in this context.

2.2. Empirical review

Empirical studies examining external debt and agricultural GDP growth nexus identified a strong connection between the studied variables (Olumo et al., 2023; Osuji et al., 2023). These studies provide valuable insights into the dynamics of this association. Several researchers have also explored this topic, employing diverse methodologies and perspectives. For instance, Mohamed (2005) examined the effect of external debt stock on agricultural productivity in Sudan. The study observed that while export earnings had a positive outcome on agricultural productivity, external debt stock and inflation together have an adverse effect on agricultural productivity. External debt resources are expected to support domestic revenue by promoting investment into key sectors of the economy, including propel growth. However, huge debt stocks or debts above a certain threshold and its servicing requirement could have a negative effect on agricultural production (Ayadi & Ayadi, 2008). Hameed et al. (2008) also examined the long- and short-term relationship between external debt stock and agricultural productivity in Pakistan. According to the results, constrained external debt servicing had an adverse effect on productivity per worker, thus negatively influencing agricultural productivity in the country. Likewise, Malik et al. (2010) investigated the external debt and agriculture growth nexus and reported that an increase in external debt stock leads to a fall in agriculture growth.

Furthermore, Ebhortemhen and Umoru (2019) investigated the impact of external debt on agricultural output in Nigeria. According to the results, external debt has a negative and significant effect on agricultural output. The paper advises that the central government must show sufficient commitment to effective debt management to ensure foreign capital is judiciously channeled and healthy used for the intended purpose, since such behavior would strongly guarantee that the output return would be adequate for servicing debt obligation and balance to stimulate in other key sectors of the Nigerian economy.

Ehirim (2009) and Obasi (2006) investigated the relationship between agricultural output and external debt management in Nigeria. According to the results, the coefficients of external debt, agricultural land under cultivation, external debt servicing payment, and credit maturity were statistically significant at 10%, whereas interest payment on external debt was strongly significant at 5%, keeping other variables the same. The study concluded that external debt had a positive and significant effect on agricultural output in Nigeria from 1970 to 2003. Matthew and Mordecai (2016) examined the effect of domestic debt on agricultural productivity. The results from the co-integration test revealed that agriculture productivity, domestic debt, government expenditure on agriculture, and interest rates are co-integrated. The outcome based on the parsimonious ECM model revealed a positive and significant effect of domestic debt on agricultural productivity. However, the interest rate has an indirect and significant effect on agricultural productivity. The Granger causality test result revealed a causal relationship between domestic debt, government expenditure on agriculture, and agricultural productivity. Thus, domestic debt,

government expenditure on agriculture, and interest rates are major determinants of agricultural productivity in Nigeria.

Ukpe et al. (2019) explored the effect of external debt and private investment on agricultural productivity. The empirical result was in agreement with the view of Keynesian theory. Thus, by reducing external debt and increasing private investment, the scenario -simulated data for agriculture productivity were lower than the baseline, suggesting that private investment alone cannot sustain productivity in the agriculture sector. Oshikoya (1989) investigated the relationship between external debt and agricultural productivity. The results reveal that the vital policy priority is to increase the share of agricultural sector investment spending financed via concessional external borrowing. Ramakrishna (2015) examined the effect of external debt on service and agriculture sectors in Ethiopia. According to the results, external debt has a significant and positive effect on service and agriculture sectors, contrary to the results of Brown et al. (1975) and Bezlepina and Lansink (2006), who all reported an adverse effect of external debt on agriculture productivity.

Finally, Adesola (2010) add to the body of literature on external debt servicing and agriculture productivity nexus. The study categorically investigates the effect of external debt servicing on agriculture production. According to the result, external debt servicing has a direct and significant effect on agriculture productivity. The paper advises that more external debt loan is required to enhance agriculture productivity. According to our figure, a percentage increase in external debt servicing will lead to 3.25 and 1.70% increase in agriculture productivity both for long run and short run respectively.

It is evidenced from the literature reviewed on the association between external debt and agricultural productivity reported mixed findings, while some studies found a positive association between the studied variables Ramakrishna (2012), others were of the view that there is an indirect association between the studies variables (Brown et al., 2014; Bezlepina & Lansink, 2006; Ukpe et al., 2019). Moreover, even though there are studies on the relationship between agricultural productivity and external debt in Sub-Saharan region, like Nigeria and Ethiopia, the literature on such association in our view are nonexistence in the case of Ghana and hence creating knowledge gap in a context. Ghana as advancing country has been augmenting the growth of the agriculture sector with policies like planting for food and agriculture, coupled with high debt to GDP ratio which is over 70% (World Bank, 2023). This notwithstanding raises a significant question: whether external debt has any significant effect on agricultural GDP growth. As such, we investigated the nexus between external debt and agricultural GDP growth. The effect of external debt on growth different economies as a result of variations in economic structure, therefore, the investigation in the context of Ghana is very imperative.

The Solow Growth Model, developed by Robert Solow (1956), focuses on the long-term growth of an economy, considering factors such as capital accumulation, labor force growth, and technological progress (Solow, 1956). While the model primarily addresses the aggregate economic output, it can be adapted to discuss the external debt and agricultural GDP growth nexus. In the Solow model, capital accumulation is a key driver of economic growth. The study conceptualized in Figure 3 that external debt can contribute to capital formation in agriculture by financing investments in machinery, irrigation, and technology. However, there is a diminishing marginal return to capital. Initially, external debt may lead to increased agricultural productivity, but excessive debt levels or inefficient use of borrowed funds could result in diminishing returns (Shabbir & Yasin, 2015). The Solow model considers the growth of the labor force. External debt might influence the labor-intensive nature of agriculture by facilitating investments in education, healthcare, and infrastructure in rural areas. Increased labor productivity due to external debt-funded improvements can positively impact agricultural GDP growth. The model highlights the importance of debt servicing. If a significant portion of the agricultural GDP is allocated to debt repayment, it may limit funds available for other productive investments. Managing debt effectively is crucial to avoid overburdening the agricultural sector. Thus, the assumption is tested using empirical data.

3.1. Empirical framework

For the purpose of the current study, we used 39 years' time series annual data of Ghana from 1980 to 2019. Data on agricultural GDP growth, agriculture export, external debt stock, external debt servicing,

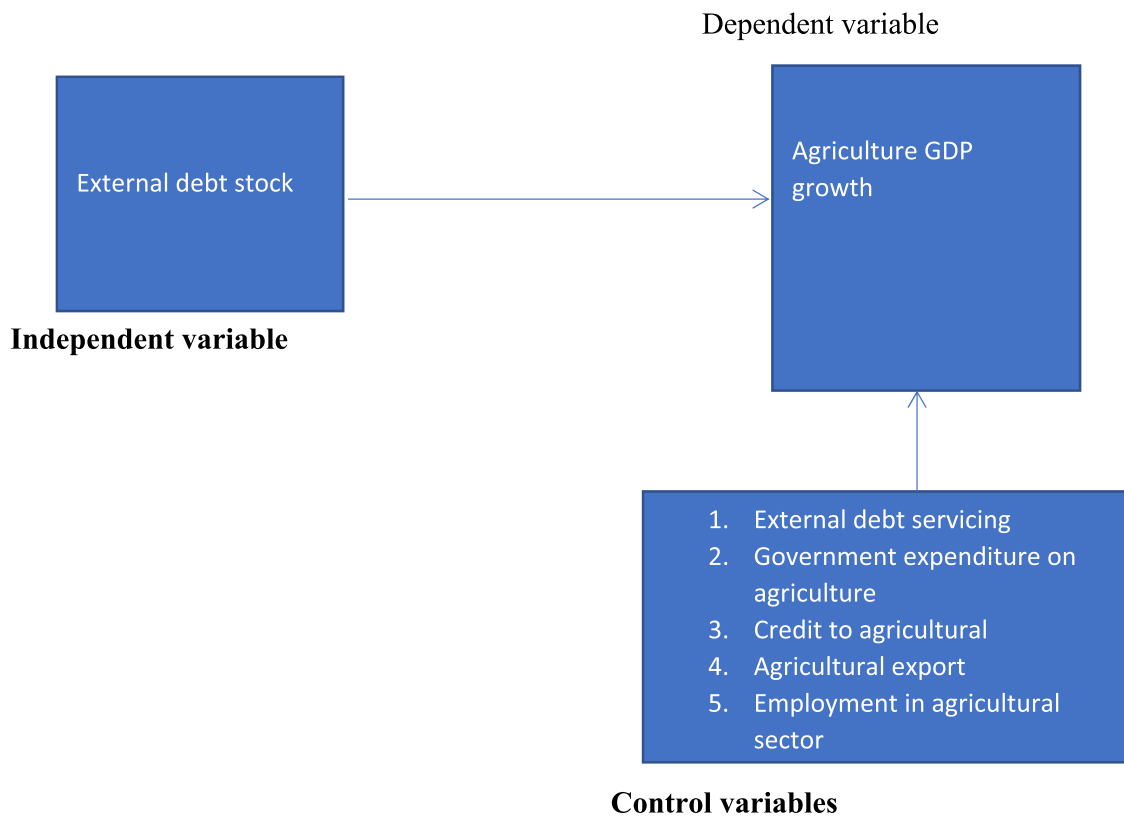


Figure 3. Conceptual framework. *Source:* Authors Estimations, 2023.

employment in the agricultural sector were sourced from the World Development Indicators. However, data on government expenditure on agriculture was sourced from ReSAKSS. Finally, data on credit to the agricultural sector was obtained from Ministry of Food and Agriculture Ghana Website and Ghana Statistical service website. The collected data was analyzed using EViews 12 software.

3.2. Model specification

In line with the Solow Growth Model, the model for the study is specified as:

$$AG_t = \beta_0 + \beta_1 AG_t + \beta_2 ED_t + \beta_3 SD_t + \beta_4 EMPLA_t + \beta_5 GEA_t + \beta_6 CRA_t + \beta_7 EX_t + \varepsilon_t \quad (2)$$

Where:

β_0 is the intercept,

$\beta_1 - \beta_7$ Are coefficients,

AG_t = Annual agricultural GDP growth over time

ED_t = External debt

SD_t = Servicing of external debt

$EMPLA_t$ = Employment (Labour supply) in the agricultural sector

GEA_t = Government expenditure on agricultural

CRA_t = Credit to the agricultural sector

EX_t = Agricultural export

ε_t = Error term.

3.3. ARDL bound testing approach

Following Pesaran et al. (1999) and Mawutor et al. (2023; Mawutor et al., 2023), the study used the ARDL for the econometrics analysis. This approach aims to investigate the long run association between external debt and agricultural GDP growth. Notable, the ARDL approach offers several advantages over

alternative cointegration methods as a result relevant for the purpose of the current study. It can be applied regardless of whether the underlying variables are purely stationary $I(0)$, integrated of order one $I(1)$, or mutually cointegrated as in the case of our study (Raza & Jawaid, 2014; Mawutor et al., 2023; Mawutor et al., 2023). Additionally, the ARDL approach demonstrates improved performance in small sample size situations. Furthermore, it permits the estimation of results even when the explanatory variables are endogenous.

We used the ARDL modeling to investigate the effect of external debt on agricultural GDP growth and this is justified in the context of literature for two reasons: one, time series data, including economic variables like external debt and agricultural GDP growth are often nonstationary, meaning their statistical properties change over time. ARDL models are particularly suitable for analyzing non-stationary data as they can accommodate variables that may have different order of integration (Bårdsen, 1989). Two, the literature suggests that there may exist long run or cointegration relationships between external debt and agricultural GDP growth (Bårdsen, 1989). Cointegration implies a stable and long run relationship between these variables. ARDL models allow researchers to test for cointegration and examine the existence of long run equilibrium relationship. The ARDL model is formulated as follows:

$$\begin{aligned} \Delta AG_t = & \forall_0 + \forall_1 \sum_{j=1}^p \Delta AG_{t-j} + \forall_2 \sum_{j=1}^p \Delta ED_{t-j} + \forall_3 \sum_{j=1}^p \Delta SD_{t-j} + \forall_4 \sum_{j=1}^p \Delta EMPLA_{t-j} + \forall_5 \sum_{j=1}^p \Delta GEA_{t-j} \\ & + \forall_6 \sum_{j=1}^p \Delta CRA_{t-j} + \forall_7 \sum_{j=1}^p \Delta EX_{t-j} + \gamma_1 AG_{t-1} + \gamma_2 ED_{t-1} + \gamma_3 SD_{t-1} + \gamma_4 EMPLA_{t-1} + \gamma_5 GEA_{t-1} + \gamma_5 EX_{t-1} \\ & + \omega_t \end{aligned} \quad (2)$$

Considering Equation (2), \forall_0 represent constant, ω_t is the error term, thus, the error correction dynamics is represented by summation sign and the second section of the equation is a representation of the long run association. The study employed the Schwarz Bayesian Criteria (SBC) to ascertain the lag of the model in each of the series. For the purpose of the ARDL estimation, the study in the first place estimates the F-statistics value by using adequate ARDL models. Two, the Wald test (F-statistics) test is utilized to ascertain the long run association between these variables. The null hypothesis posits cointegration, represented as ($H_0 = \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = 0$). Rejection of the null hypothesis occurs when the calculated F-test statistic surpasses the upper critical bound value. When the F-test statistic falls within the range between the upper and lower critical bounds, the results are considered inconclusive. Lastly, if the F-statistics are below the lower bound, we accept the null hypothesis of no cointegration. If the long run association is established between external debt and agricultural GDP growth, we proceed to estimate the long run coefficients. We estimate the long run coefficients as follows:

$$\begin{aligned} AG_t = & \varphi_0 + \varphi_1 \sum_{j=1}^p AG_{t-j} + \varphi_2 \sum_{j=1}^p ED_{t-j} + \varphi_3 \sum_{j=1}^p SD_{t-j} + \varphi_4 \sum_{j=1}^p EMPA_{t-j} + \varphi_5 \sum_{j=1}^p GEA_{t-j} + \varphi_6 \sum_{j=1}^p CRA_{t-j} \\ & + \varphi_7 \sum_{j=1}^p EX_{t-j} + \omega_t \end{aligned} \quad (3)$$

Specifically, any evidence of long run association between external debt and agricultural GDP growth will warrant the study to estimate the short run coefficients using the following model as:

$$\begin{aligned} \Delta AG_t = & \vartheta_0 + \vartheta_1 \sum_{j=1}^p \Delta AG_{t-j} + \vartheta_2 \sum_{j=1}^p \Delta ED_{t-j} + \vartheta_3 \sum_{j=1}^p \Delta SD_{t-j} + \vartheta_4 \sum_{j=1}^p \Delta EMPLA_{t-j} + \vartheta_5 \sum_{j=1}^p \Delta GEA_{t-j} \\ & + \vartheta_6 \sum_{j=1}^p \Delta CRA_{t-j} + \vartheta_7 \sum_{j=1}^p \Delta EX_{t-j} + \delta ECM_t + \omega_t \end{aligned} \quad (4)$$

Thus, the error correction term indicates the speed of adjustment necessary to restore any disequilibrium in the short run to equilibrium in the long run. The δ in the equation represent the coefficient of the error correction term that accounts for the speed of adjustment.

AG denotes annual agriculture GDP growth, measured as the annual growth rate of the agriculture sector as a percentage of GDP. ED is a measure of the total debt owe to Individuals, governments and organization. This variable is measured as the total debt stock as a percentage of GDP. It is presumed that increase in debt stock will boost agriculture production since investment into the sector will be boosted with the loan inflow. Hence, positive relationship is expected between agriculture GDP growth and external debt (Ramakrishna, 2012). SD represents repayment or servicing of external debt. We measured this variable as total debt servicing as a percentage of GDP. It is expected that servicing of loans will create liquidity constrain for the government, thus limiting the extent of investment into agriculture. Hence, negative correlation is expected. EMPLA is proxy of labour supply in the agriculture sector. This variable is measured as total employment in the agricultural sector as a percentage of the total population. Niang (2006) found a positive relationship between labour and agriculture productivity, on this premise, positive relationship is expected. GEA denotes government expenditure on agriculture it is measured as the total government expenditure on agriculture as a percentage of GDP. Government investment into the agricultural sector is hopeful to augment productivity of the sector (Ebenezer et al., 2019), hence government expenditure on agriculture is expected to have a positive correlation with agricultural GDP growth. CRA denotes credit to agriculture. This is measured as total credit to the agriculture sector as a percentage of GDP. It is expected that increase in credit to farmers will significantly boost the production capacity of the sector leading to a significant growth. According to Chandio et al. (2023) credit to agriculture support the growth of agriculture output, hence positive nexus is expected. EX is a proxy of agriculture export. This variable is measured as the total agriculture export as a percentage of GDP. Thus, agriculture export is expected to have a direct effect on agriculture GDP growth (Osifo et al., 2017).

Table 1 indicates the sources, measurement, expected coefficient and link to the data employed for the econometrics analysis and this can be found in the Appendix.

3.4. Augmented dickey fuller (ADF) test

The ADF model for checking unit root is specified as:

$$\Delta y_t = \mu + \vartheta y_{t-1} + \sum_{i=1}^k \beta_i \Delta y_{t-1} + \omega_t \quad (5)$$

Where:

$$\vartheta = \alpha - 1$$

α = Represent the coefficient of y_{t-1}

Δy_t = First difference of y_t

The alternative hypothesis is that $\vartheta \neq 0$ against the null hypothesis states that $\vartheta = 0$. Therefore, failure to reject the alternative hypothesis suggests that the model is not suffering from unit root problem.

Table 1. Variables, measurement, source and expected sign.

Variables	Measurement	Sources	Expected sign	Link to the source of data
AG	Agriculture value added (% of GDP)	World Development Indicators (WDI)	N/A	https://databank.worldbank.org/
ED	Total external debt stock (% of GDP)	WDI	+	https://databank.worldbank.org/
SD	Debt servicing (% of GDP)	WDI	-	https://databank.worldbank.org/
EMPLA	Employment in the agricultural sector (% of the total population)	WDI	+	https://databank.worldbank.org/
GEA	Government expenditure on agricultural (% of GDP)	ReSAKSS	+	https://www.resakss.org/
CRA	Credit to the agricultural sector (% of GDP)	Ghana Statistical Service/ MofA	+	https://statsghana.gov.gh
EX	total annual agricultural export (% of GDP)	WDI	+	https://databank.worldbank.org/

Source: Authors Estimations, 2023.

3.5 Phillips Parron (PP) test

We specified the PP model for checking unit root test

$$\Delta y_t = \theta y_{t-1} + \beta_i \forall_{t-i} + \pi_t \quad (6)$$

Where:

π_t Represent a 1(0) with zero mean while \forall_{t-i} represent a deterministic trend element.

The alternative hypothesis is that $\forall \neq 0$ and null hypothesis is that, $\forall = 0$.

4. Results and discussions

According to the results in Table 2, agriculture GDP growth has a mean value of 37.55, maximum values of 59.96 and standard deviation of 12.04 as compared to 60.66, 139.43 and 33.68 for external debt. Detailed discussion of the Table confirms that, normally, the data set is distributed.

4.1. Unit roots test results for the variables

According to Alemayehu et al. (2012) non-stationary is a significant constrained associated with time series macroeconomic data analysis. To prevent issue of inappropriate inference from non-stationary model, unit root test based on ADF and PP test statistics performed to observe the presence of unit root. The current study used 5% critical value. Hence, the results of the test performed presented in Tables 2 and 3, respectively.

The result from Table 2 confirms that both the ADF and PP tests accepted the presence of unit root in the variables including ED, SD, EMPLA, GEA, CRA and EX in their level forms because the pP-values are more than (0.05) 5% for both tests ADF and PP respectively. This implies that these variables are non-stationary. However, agriculture GDP growth is found to be stationary even at levels form, because both ADF and PP tests probabilities values are less than 5%. Modelling with variables with different order of integration is a very weak approach in econometrics unless when their linear combination makes them stationary or when they are cointegrated.

From Table 4, it is realized that all the variables are stationary at their first difference because all the probability values are less than 5%, suggesting that all the variables are not suffering from unit root problem after first differences, on this premise, when a model is estimated on using these variables, no

Table 2. Descriptive statistics.

	AGD	ED	SD	EMPLA	GEA	CRA	EX
Mean	37.55086	60.66121	4.388499	51.89550	3.453820	5.056285	9.089298
Median	36.73814	50.19574	3.645395	55.14600	3.103020	4.145000	8.595509
Maximum	59.96740	139.4387	10.76960	56.97800	12.20557	16.80000	21.08294
Minimum	18.27153	16.58442	0.813269	33.50400	0.512565	0.400000	2.140000
Std. Dev.	12.04378	33.68650	2.715401	7.632949	2.887045	3.243660	4.833624
Skewness	0.135797	0.666113	0.519444	-1.575991	1.753915	1.819041	0.309200
Kurtosis	2.121866	2.447617	2.319258	3.971739	5.834674	6.564953	2.231954
Jarque-Bera	1.408138	3.466590	2.571161	18.13212	33.90042	43.24088	1.620522
Probability	0.494569	0.176701	0.276490	0.000116	0.000000	0.000000	0.444742

Source: Authors Estimations, 2023.

Table 3. Unit root test at level.

Variables	Lags	ADF			PP		Lag length
		T-Stat	p-Value		T-Stat	p-Value	
AG	1	3.33	0.032	1 (1)	3.75	0.041	1 (1)
ED	1	1.66	0.263	1 (1)	2.19	0.280	1 (1)
SD	1	2.96	0.090	1 (0)	2.90	0.080	1 (0)
EMPLA	1	2.95	0.092	1 (0)	2.99	0.081	1 (0)
GEA	2	1.70	0.426	1 (1)	1.77	0.487	1 (1)
CRA	1	1.50	0.532	1 (1)	1.798	0.039	1 (1)
EX	1	1.82	0.379	1 (1)	1.98	0.371	1 (1)

Source: Authors Estimations, 2023.

Table 4. Unit root test at first difference.

Variables	Lags	ADF			PP		Lags
		<i>T</i> -statistic	<i>p</i> -Value		<i>T</i> -statistic	<i>p</i> -Value	
AG	1	6.10	0.000	1 (1)	4.19	0.001	1 (1)
ED	1	3.98	0.000	1 (1)	3.20	0.020	1 (1)
SD	1	4.90	0.000	1 (0)	6.19	0.000	1 (0)
EMPLA	1	4.01	0.000	1 (0)	3.60	0.008	1 (0)
GEA	2	3.98	0.010	1 (1)	3.75	0.002	1 (1)
CRA	1	2.94	0.039	1 (1)	3.14	0.011	1 (1)
EX	1	3.09	0.004	1 (1)	4.10	0.000	1 (1)

Source: Authors define, 2023.

Table 5. Lag length criteria.

No of lags	AIC	BIC	LM (serial correlation)
1	3.367	4.231	6.11 (0.0023)
2	1.493	1.893	2.01 (0.535)
3	5.943	5.231	8.39 (0.0002)
4	6.012	6.124	10.96 (0.000)

Source: Authors Estimations, 2023.

Table 6. Cointegration test.

Model	<i>F</i> -statistics	(<i>k</i>)	90%		95%		99%	
			1 (0)	1 (1)	1 (0)	1 (1)	1 (0)	1 (1)
AG	14.11	6	2.10	4.01	2.18	3.90	2.90	5.20

(*K*) is the number of predictors.

Source: Authors Estimations, 2023.

Table 7. Long run error correction model estimate.

Variables	Coefficients	Std. error	<i>t</i> -Statistics	<i>p</i> -Value
ED	4.26	0.10	42.6	0.000
SD	3.25	1.21	2.69	0.000
EMPLA	−2.45	2.15	−1.14	0.132
GEA	3.25	1.22	2.66	0.001
CRA	2.63	0.12	21.92	0.000
EX	2.31	1.51	1.59	0.217

Source: Authors Estimations, 2023.

spurious outcomes are probable. It can also be explained that all the variables are integrated at order I(1) and order I(0) processes. On the bases of the above result, the precondition for cointegration test by Pesasaran et al. (2001) is satisfied for the current examination.

To determine the optimal lags, the study run normal unrestricted VAR and ascertain for optimal lag lengths for each of the variables. The result for the optimal lags is presented in Table 4. Going by the result, lag 2 is found to be appropriate for the study. Hence, lag 2 was selected to perform the cointegration test.

The *F*-statistics estimated in Table 5 is greater than the upper bound, as such there is an evidence of long run nexus among the studied variables.

The study performed cointegration test to ascertain long run association among the studied variables reported in Table 6. The *F*-statistics estimated in Table 6 is greater than the upper bound, as such there is an evidence of longrun nexus among the studied variables. As such we estimated the long run nexus employing ARDL.

From Table 7, it was identified that external debt had a significant and positive effect on agriculture GDP growth, this is consistent with literature (Ramakrishna, 2012), however, contrary to the results of Ebhotemhen and Umoru (2019). The coefficient of 4.26 indicate that holding other factors constant, a percentage increase in external debt will increase agriculture GDP growth by 4.26%. This positive relationship could suggest that the external loans have been adequately channeled and utilized to boost production in the agriculture sector and this reasonable could have yielded returns for the repayment of the debt imperative to promote economic growth and development. The debt could also provide more credit available for farmers to acquire inputs such as seeds and fertilizer to augment productivity of the

sector (Chandio et al., 2023). Hence, the hypothesis that external debt has a significant effect on agriculture GDP growth is accepted.

In addition, the coefficient of debt servicing (3.25) shows a direct relationship with agriculture GDP growth contrary to the study's priori expectation reason that given by the results obtained, a percentage increase in debt servicing leads to 3.25% increase in agriculture GDP growth and this is consistent with literature (Adesola, 2010). This result suggesting that, Ghana is capable at all-time fulfilling her debt-servicing obligation. This result is consistent with previous studies, (Cohen, 1993; Ehirim, 2009). Moreover, employment in agriculture is found to have reduced (−2.45) agriculture growth contrary to literature (Emran, 2016). This result contradicts with the Neo-classical theory, which stipulates that labour is a key determinant of growth (Solow, 1957).

Furthermore, the result indicates that government expenditure on agriculture had a positive and significant impact on agriculture GDP growth (3.25 with a *t*-statistics of 2.66. Government expenditure increases agricultural productivity (Ebenezer et al., 2019). Another finding of the examination is that, credit to the agriculture sector had a positive impact (2.63) on agriculture GDP growth. This conforms to literature (Chandio et al., 2023). Thus, early growth theories, such as Harrod and Domar model explained that poor savings habit in emerging economies inhibits the extent of investible funds. Credit to agriculture sector is important to augment agriculture productivity. Thus, a percentage increase in credit to the agriculture sector will lead to about 2.63% increase in agriculture GDP growth. Export signal total agriculture goods exported annually. The result revealed that agricultural export promotes agriculture growth loosely (2.31 with a *t*-statistics of 1.59).

The result for the short run error correction model estimates for agriculture GDP growth for the entire period of 1980–2018 showed in Table 8 confirm goodness of fit, whereby R^2 suggests that 76% of variations in agriculture GDP growth is explained by the independents.

The Error Correction Model revealed that if agriculture GDP growth is out of equilibrium, 26% of the disequilibrium will be corrected for yearly. The result revealed that, the lag of agriculture GDP growth had a significant positive relationship with current agriculture GDP growth with a coefficient of 5.21 and it is significant at 5%. The coefficient of 5.21% indicate that a percentage increase in past agriculture GDP growth will influence present agriculture GDP growth by 5.21%, holding other factors constant. Thus, technological advancements have revolutionized agriculture production by enabling farmers to produce more food with fewer resources, making agriculture more sustainable and resilient (Chandio et al., 2023). The findings could also ensue due to the consumption of fertilizers and pesticides through technological development which significantly contributes to the increase in the productivity of the sector (Chandio et al., 2023).

Debt servicing increases agriculture GDP and this agrees with past studies (see, Adesola, 2010). More so, the coefficient of employment in the agriculture sector indicates a direct relationship with agriculture GDP growth (Emran, 2016, Solow, 1957). The coefficient of credit to the agriculture sector implies an indirect relationship with agriculture GDP growth. Thus, a percentage increase in credit to the agriculture sector will lead to 3.2% fall in agriculture GDP growth contrary to the result of (Chandio et al., 2023).

Table 8. Short run error correction model estimate.

Variables	Coefficients	Std. error	<i>t</i> -Statistics	<i>p</i> -Value
ECM	−0.26	0.08	3.25	0.011
DAG	5.21	2.22	2.34	0.010
DED	3.01	1.74	1.73	0.133
DSD	1.70	0.61	2.79	0.000
DEMPLA	3.21	1.76	1.83	0.041
DGEA	2.13	1.50	1.42	0.122
DGEA-1	1.73	2.13	0.81	0.331
DCRA	−3.22	0.15	−21.47	0.000
DEX	1.20	0.80	1.50	0.116
<i>R</i> -squared	0.80			
Adjusted <i>R</i> -squared	0.76			
DW-statistics	1.95			
<i>F</i> -statistics	21.32			
Prob (<i>F</i> -statistics)	0.00			
Arch effect	0.11			
Autocorrelation	0.10			
Heteroskedasticity	0.12			

Source: Authors Estimations, 2023.

Discussion of results

The study has further reaffirmed the assertion that even though the current debt to GDP ratio in Ghana is alarming, there is a strong positive connection between the studied variables. Our findings are consistent with literature (Ramakrishna, 2012). Utilizing external debt becomes a means to finance crucial investments within the agricultural sector. For instance, funds can be directed towards the enhancement of irrigation systems, the modernization of farming techniques, the provision of rural infrastructure, and the advancement of research and development in agriculture. These investments have the potential to bolster the sector's long-term productivity and output. Our findings are different from past external debt and agriculture GDP growth studies (Ebhortemhen and Umoru, 2019; Ukpe et al., 2019), where they obtained an indirect relationship between the studied variables using data from Nigeria. This serves as one of the novelties of the study. Another novelty of the study is that, it supports the Solow growth theory, which serves as the theoretical foundation of our examination.

Additionally, external debt can facilitate investments in transportation infrastructure, thereby enhancing access to markets for agricultural products. This, in turn, opens up fresh opportunities for farmers to market their produce, resulting in increased income and incentives for agricultural growth. External debt can also be channeled to encourage diversification within the agricultural sector (Ebenezer et al., 2019). This may involve transitioning from subsistence farming to the cultivation of higher-value crops or the raising of livestock, ultimately contributing to the progressive expansion of agricultural GDP over time. External debt can also play a role in supporting educational and training initiatives pertaining to agriculture. A well-educated and skilled agricultural workforce is more inclined to embrace innovative farming practices and technologies, ultimately leading to heightened agricultural productivity over the long haul.

In the short run, external debt can swiftly inject capital into the agricultural sector, proving invaluable during periods of financial strain or when rapid responses are required for crises like droughts or pest outbreaks (Ukpe et al., 2019). This immediate availability of funds can help stabilize the sector and prevent short-term setbacks. During economic shocks or crises, external debt can be mobilized to support safety net programs for farmers, safeguarding their livelihoods. This support can sustain agricultural production and avert short-term declines in agricultural GDP.

Ghana should adopt a strategic approach to external debt management, with a focus on sustainable borrowing practices and investments that have a high likelihood of enhancing agricultural productivity over the long term. Allocating a portion of external debt towards improving rural infrastructure, encompassing projects such as road construction, bridge development, and irrigation system enhancements, can generate lasting benefits for the agricultural sector. Utilizing external debt for targeted investments in agricultural education and training is pivotal. Policies should emphasize elevating the quality of agricultural education and training to underpin the sector's long-term growth.

We found external debt servicing to have increased agricultural GDP growth contrary to literature (see, Osuji et al., 2023), however, consistent with the findings of (Adesola, 2010). Servicing external debt refers to repaying the interest and principal on loans borrowed from foreign sources. While the direct impact of external debt servicing on agricultural GDP growth is typically negative, there are indirect scenarios or conditions under which it might contribute positively. For example, regular and timely servicing of external debt obligations can enhance a country's credibility in international financial markets. This may attract foreign investors, including those interested in investing in the agricultural sector. Increased foreign investment can lead to the adoption of advanced technologies, improved infrastructure, and enhanced productivity in agriculture. Also, External debt servicing may support a country's efforts to diversify its economy, reducing dependency on a single sector. Diversification strategies, if well-implemented, can contribute to overall economic resilience, including in agriculture. Reduced economic vulnerability can positively impact agricultural GDP by ensuring stability and minimizing risks associated with external shocks.

Also, government expenditure on agricultural has direct and statistically significant outcome on agricultural GDP. Government spending can be directed towards developing and maintaining critical agricultural infrastructure such as roads, irrigation systems, storage facilities, and rural electrification. These infrastructure investments enhance the efficiency of the agricultural value chain, reducing post-harvest losses, lowering transportation costs, and improving market access for farmers our findings are in line with literature. This in turn, leads to increased agricultural productivity and output (Ebenezer et al., 2019).

Table 9. OLS estimate.

Variables	Coefficients	Std. error	t-Statistics	p-Value
ED	2.23	0.09	24.60	0.000
SD	1.23	0.10	12.74	0.000
EMPLA	−0.44	0.06	−7.04	0.000
GEA	0.57	0.03	14.29	0.000
CRA	0.02	0.01	2.73	0.000
EX	0.04	0.05	7.91	0.000

Source: Authors Estimations, 2023.

Agricultural credit can have contrasting effects on agricultural GDP growth in the short run and long run due to various factors and dynamics just as in the case of our study. Over the long run, access to credit allows farmers to make substantial investments in their agricultural operations. They can purchase modern equipment, invest in irrigation systems, and adopt advanced farming techniques. These investments lead to increased agricultural productivity, which, in turn, contributes to higher agricultural GDP (Chandio et al., 2023). Access to credit facilitates the adoption of innovative farming technologies and practices. Farmers can invest in times, which often have a time lag before their full benefits are realized. As these technologies are integrated into farming systems, they boost yields and agricultural GDP in the long term. With credit, farmers can diversify their agricultural activities. They may transition from subsistence farming to cultivating higher-value crops, agribusiness ventures, or livestock production. Diversification strategies are typically associated with higher agricultural GDP over time. In some cases, farmers may use credit to invest in on-farm infrastructure like greenhouses or post-harvest handling facilities. These investments improve the overall efficiency of agricultural production.

However, in the short term, when farmers borrow credit, they incur debt, and a portion of their immediate cash flow may need to be allocated to debt servicing, including interest payments. This can temporarily constrain cash flow, leaving fewer resources available for productive investments in agricultural inputs and activities. This reduced liquidity can affect farmers' ability to optimize their operations and boost output immediately. This could be one of the possible reasons for the negative effect in the short run. Many agricultural investments financed by credit, such as purchasing machinery or adopting new technologies, require time to yield measurable results. Farmers might need time to select suitable investments, complete administrative procedures, and implement changes effectively. During this initial period, the impact on agricultural GDP may not be evident. Agricultural production often follows seasonal patterns. Farmers might require credit for specific inputs or activities related to a particular growing season. If the timing of credit disbursement does not align with these seasonal needs, the immediate effect on agricultural GDP may be limited. The immediate effect of credit can also be influenced by market dynamics. If farmers produce more in response to credit but cannot sell their surplus produce due to market constraints, this could lead to reduced prices and income in the short term.

To confirm consistency of the results, we estimated additional model by employing the OLS approach. The result is reported in the Appendix in Table 9. We found that the coefficient of the variables in Table 9 are consistent with the ARDL results in Table 7, indicating that the model is reliable and can be used for policy decision making.

5. Conclusion

The research employed an ARDL cointegrating bound testing approach to examine the correlation between external debt and agriculture GDP growth in Ghana, utilizing secondary time series annual data from 1980 to 2018. Ghana, situated in West Africa along the Gulf of Guinea, shares borders with Cote d'Ivoire to the west, Burkina Faso to the north, and Togo to the east, with a coastline along the Atlantic Ocean to the south (geographical coordinates approximately between 4° and 12° North latitude and 4° and 2° West longitude).

Key research findings and conclusions include:

The study identified a long-term cointegrating relationship between external debt and agricultural GDP growth in Ghana, indicating a stable and sustainable connection over time.

Both in the short and long run, the research uncovered a positive association between external debt and agricultural GDP growth. This implies that external debt can contribute to the prolonged growth and development of Ghana's agricultural sector.

The study also revealed a positive relationship between external debt services and agricultural productivity. This suggests that servicing external debt can positively impact the agricultural sector, potentially through investments in infrastructure and development projects supported by debt servicing. Therefore, effective management of external debt can enhance agricultural productivity. Policymakers should ensure efficient use of external debt, directing investments toward activities that boost agricultural productivity.

Also, when government allocates more funds to the agriculture sector, it tends to foster agricultural growth and productivity. Finally, we found a positive association between credit to the agricultural sector and agriculture GDP growth. This implies that increase access to credit for farmers and agricultural activities positively influences agricultural productivity.

These research findings are significant in several ways:

For policy implication, we provide valuable insights for policymakers in Ghana and other countries with agricultural economies. The positive association identified suggests that strategic investments in agriculture, external debt Management, credit accessibility can be used as policy tools to stimulate agriculture growth. The study also, highlights that external debt when managed efficiently, can be a sustainable source of financing for agriculture, potentially aiding in poverty reduction, food security, and overall economic development.

We added to the existing literature by empirically confirming the positive linkages between external debt, government expenditure, credit access, and agriculture productivity. It strengthens the evidence base for these relationships, offering insights for future research and policy formulation. In addition, the current examination significantly examined country-specific external debt and agriculture GDP growth nexus. This was attained through the adoption of the ARDL cointegration bound test approach. Finally, our findings distance from past external debt and agriculture GDP growth studies (Ebhortemhen and Umoru, 2019; Ukpe et al., 2019) who obtained an indirect relationship between the studied variables using data from Nigeria. Finally, through Solow Growth Theory lenses, our study contributes to known literature by highlighting the relevance of the studied variables in context.

Practical implications

The nexus between the studied variables can be influenced by many factors (for example, concessional or commercial), the type of agriculture sector, and the overall economic conditions of the country. In some cases, external debt can help finance investments in the agriculture sector, such as irrigation systems, fertilizers, and other inputs, which can lead to increased agricultural productivity and GDP growth. However, if a country's debt burden becomes too high or if debt is used to finance non-productive activities, such as consumption or military spending, could negatively influences agricultural productivity (Shabbir and Yasin, 2015; Adejuwon et al., 2010). Similarly, the relationship between agriculture GDP growth and external debt can be influenced by other factors such as government policies, access to credit, climate conditions, and international trade patterns. For example, if a country has policies that support smallholder farmers and encourage private investment in agriculture, it may experience higher agriculture GDP growth, even if it has a high level of external debt.

In light of the significant impact external debt can have on agricultural growth, it is crucial to adopt a focused and precise approach to its utilization. The ensuing policy recommendations are designed to maximize the positive effects of external debt on the agricultural sector:

Strategic Investment in Agricultural Infrastructure: Ghana should channel external debt toward the development and enhancement of crucial agricultural infrastructure, including irrigation systems, storage facilities, and transportation networks. Priority should be given to investments that directly enhance the efficiency and productivity of agricultural value chains.

Technology Adoption and Research: The country should allocate external debt to finance research and development initiatives aimed at promoting the adoption of modern agricultural technologies. Investments in smart farming practices, precision agriculture, and the development of climate-resilient crop varieties are essential to improve overall productivity.

Access to Finance for Smallholder Farmers: Establishing dedicated funds, facilitated by external debt, can provide smallholder farmers with affordable and accessible credit. Initiatives promoting financial inclusion should be implemented to empower farmers with the necessary resources for sustainable agricultural practices.

Limitation of the study and future studies

The study found that external debt support agriculture productivity in Ghana, however, high level of external debt stock can cause debt overhang issues, hence limiting funding of the sector, it is imperative to investigate the turning point of external debt that can cause a sustainable productivity of agriculture sector. Future studies can also, investigate the effect of other foreign capital on agriculture sector in Ghana for policy implication.

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Author contributions

Ernest Sogah: Conceptualized the idea and did the write up. Joseph Kwadwo Tuffour: Revised manuscript. John Kwaku Mensah Mawutor: Supervised and approved for submission. Freeman Christian Gborse: Worked on the data and methods.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

Data supporting the study would be made available on request.

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