

# Long-Run and Short-Run Causality Between Government Tax Revenue and Economic Growth in Ghana

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**Abstract** The study investigates the causal flow between government tax revenue and economic growth in Ghana using time series data from 1970-2021. The study employs the Auto- Regressive Distributed Lag (ARDL) bounds test approach and Granger Causality test to investigate the long run and short run relationship between government tax revenue and economic growth. Findings of this study indicated that there is significant correlation between total tax revenue and economic growth with 87% speed of adjustment in the short run towards equilibrium level in the long run. Empirically, the analysis also indicates the evidence of long run equilibrium correlation. Thus, the Granger Causality test indicated positive and statistically significant unidirectional causal flow from tax revenue to economic growth. Based on the findings, the policy makers should consider the tax revenue-led growth policies for effective formulation and implementation to enhance the nature of the Ghanaian economy. Hence, to curb the persistent budget deficit, the outlook is that policymakers should employ efficient, ideal and buoyant tax system which would then bring substantial increase in gross tax revenue of the government leading to optimum mobilization of resources for higher economic growth in Ghana. This can only be sustained via efficient allocation of the tax revenue collected to productive sectors and similarly using the distributive principle through societal welfare maximization. Efficient tax regulation system has to be adopted to mitigate the issue of tax evasion, especially among firms and corporate entities. Also, tax rates should be frequently revised to avoid discouraging investments.

**Keywords:** *Economic growth, causality, tax revenue, Ghana*

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## 1. Introduction

Economic growth comes from accumulation of both physical and human capital, and from innovations that lead to technical progress. Innovation and accumulation raise the productivity of inputs into production as well as increasing the potential level of output. Growth rate can be affected by policy through the effect that taxation has on economic decisions. It is in this regard that Todaro and Smith [1] described economic growth as 'the steady process by which the productive capacity of the economy is increased over time to bring about rising levels of national output and income'. This means that economic growth is predominantly a quantitative measure that is the rate of change of real GDP.

Goode [2] refers to taxes as compulsory payments from households and firms to governments. The tax system becomes the government's main fiscal policy instrument used to achieve the desired financial objectives in a country (Ali-Nakyea, [3]). According to Okpe, [4], taxation as a fiscal instrument transfers resources from

private –to- public sectors for accomplishment of economic and social goals. Thus, taxation provides the government with the required fund needed to finance economic growth and development. Taxation as a source of revenue mobilization constitutes a paramount aspect of achieving higher economic growth in developed, and less developed countries. According to Romer and Romer, [5], taxation and economic growth reduces long term reliance on aid and warrants good governance by promoting accountability of governments to their citizens when combined effectively. Therefore, tax revenue becomes an essential instrument in the domain of governments to fulfill expenditure requirements and helps in achieving sustain growth targets (Takumah, [6]).

The extent to which taxation stimulates economic growth has continued to attract varied debate among researchers, economic policy makers, tax administrators and specialists in recent years (Babatunde et al. [7]; Stoilova, [8]). This is also evident in West Africa, with declining revenue sources and hence a need to improve the tax revenue-GDP ratio (Oboh et al. [9]). In order to meet the key objectives of taxation, the taxes must possess certain attributes captioned as cannons of taxation (Adam

Smith, [10]). Thus, a good tax system must be economically efficient, convenient, certain and equitable (Ayuba, [11]; Osiegbu et al., [12]). The tax policy is beneficial if it is designed to mobilise additional revenue and to afford the fiscal authorities the opportunity to realise a wider set of socio-economic objectives example stabilization of prices, incentive to industrial development and prohibition of consumption of certain goods and services. The tax policy measures also reflect the government desire to make taxation a main policy instrument to accelerate economic growth.

Irrespective of the significant role of taxation to economic growth, most of the developing countries governments' find it difficult to mobilize sufficient revenue to finance developmental projects due to wide spread of tax avoidance and evasion (Cottarelli, [13]). Investigating the causal flow of taxation and economic growth in Ghana is worthwhile to policy point of view since the country continues to suffer from persistent budget deficit, retarded economic growth whereas the rate of taxation continues to increase. Based on this, the Ghana government often has to complement the insufficient revenue mobilized with public debt with its negative effect. Mostly, there is a low level of economic growth in the developing countries since they are constrained with inadequate tax revenue, high rate of inflation, declining foreign aid and high incidence of vicious cycle of poverty etc.

Since the wealth of nation creation is affected by tax revenues, the government should concentrate on tax reforms. The tax reforms in Ghana have undergone broadly three main overlapping stages, namely: restoration of the tax base, strengthening production incentives and enhancing efficiency & equity in the tax administration. This was done in order to expand the revenue generating policy for the Ghanaian government as well as removing existing distortions and then strengthening economic incentives. Despite taxation being envisioned as a key to achieving Ghana beyond Aid policy objective, the tax revenue to GDP rate remains abysmally low. The contribution of tax revenue to the national economy was 13.2 per cent realised in 2018 (Ghana Revenue Authority) which is far lower than the accepted [Table 1](#) % tax revenue to GDP as recommended by OECD.

Ghana was among the developing countries that experienced fiscal imbalance in the 1970s and 1980s. The public debt with respect to gross domestic product (GDP) ratio was relatively high and consequently tax policy has for the most part been geared towards filling a financing gap. The fiscal imbalance resulted in undesirable impacts on domestic prices, interest rates and balance of payments. In most cases, measures that were adopted to address these failed. Indicators of the World Bank indicates that tax revenue in Ghana as a ratio of Gross Domestic Product (GDP) was 14.31 per cent in 2007, lower than the sub-Saharan African average of 18 per cent. Also, in 2012, it was 17.31 per cent as compared to 26.9 per cent in sub-Saharan African.

Earlier studies present mixed findings on the link between tax revenue and economic growth. The causal flow can be negative, positive or neutral (Takumah, [6]). Therefore, the mixed results obtained from earlier empirical studies do not guarantee a univocal conclusion on the influence of taxation on economic growth. The link

is mostly affected by institutional and economic policy frameworks and dependent on the estimation method used since the propositions based on optimal tax model are grossly insufficient for the less developed countries (Kusi [14]). According to Stoilova [8] tax burden and structure would have different impacts on economic growth in different countries based on the periods.

Whereas Solow & Swan [15] neoclassical growth model suggests that the steady state growth is not influenced by taxation, Romer [16] endogenous growth model portrays that tax policies and government expenditure can have long term growth impact. In theory, it is usually assumed that taxation can have both negative and positive impact on economic growth. The negative impact is mostly due to distortions in choices and the influences of discouragement factors inherent in taxes (Easterly and Rebelo, [17]). Similarly, it is assumed that higher taxes introduce distortions in the economy and result in loss of efficiency (Feldstein, [18]). The positive impact is indirectly due to the greater spending power of the taxpayers as a result of tax cut particularly in direct taxation (Engen and Skinner [19], Keynes [20], Dritsaki and Katerina [21]). The theory, however, remains inconclusive on the role of taxation in economic growth. The obvious approach to investigate the exact nexus between taxation and economic growth is by taking the theory to data (Myles [22]). Most of the empirical studies on taxes and growth nexus are cross-country based (see Kneller et al., [23]; Widmalm, [24]; Macek, [25]; and Kalas et al., [26]). These findings cannot be solely applied directly to Ghana.

Agyemang [27] using empirical data from Ghana discovered that economic growth drives indirect taxes, and consequently indirect taxes cause government expenditure. Other studies such as: Devarajan et al [28], Barro [29], Skreb [30] and Hansson et al. [31] analyzed the effect of tax revenue on economic growth and arrived at contradictory results. Though the theory emphasizes more especially a negative correlation between taxation and economic growth, the empirical research provides ambiguous and non-consensual results. These results would not allow the researcher to draw univocal conclusions about the effect of taxation on economic growth.

The inconsistent nature of these findings may be due to: varied definitions of state in different countries and periods, difficulty in measuring individual tax variables – marginal tax rate (Engen and Skinner, [19], challenges in sorting out the effect of individual tax variables on growth as a result of complex interactions of fiscal variables, problems in separating the effect on growth of other economic variables from the effect of fiscal variables and lack of empirical data allowing unambiguous acceptance otherwise rejection of a conclusion of some theoretical model.

The nature of the causal link between taxation and economic growth is very crucial as compared to the exact effect of tax policy measures on economic growth for policy makers. This is because if there is a causal flow from taxation to economic growth, policymakers could possibly use taxation as a fiscal tool to influence economic activities -policy implication for Keynesian theory. But if there is no causal flow between these two macroeconomics variables posited by the classical growth

theory in the long run, then taxation would be ineffective as a fiscal policy measure. Notwithstanding this evident policy importance of the causal flow between taxation and economic growth, the literature remained discreet about it.

This paper attempts to fill the existing gaps by adding to the literature through documenting the nature of the causal flow between taxation and economic growth in a specific country- Ghana using most current data set. The paper sheds on new insight into taxation –growth nexus debate by shifting from the existing emphasis of “effect” to “causal flow” with the intention to improve policy making.

This study proceeds as follows. Section 2 provides a review of the relevant literature. Section 3 looks at an overview of the general tax system and economic growth in Ghana. Section 4 presents the methodology. Section 5 discusses the empirical results, whereas Section 6 gives the conclusion and the policy recommendations for the study.

## 2. Literature Review

### 2.1. Theoretical and Empirical Literature Review

The theoretical growth literature since mid-1980s used endogenous growth rate of output in the long run. In the neo-classical growth model by Solow [15], taxes do not affect the steady –state growth rate. This means that though tax policies may be distortionary, they have no long- term impact on economic growth rate and total factor productivity. However, in the endogenous growth theory by Romer [16], government expenditure can induce growth and revenue from taxation may have long run sustainable growth impact. This is because the spillover effects and learning by doing by which firms’ specific decisions to invest in capital as well as research and development may yield positive external impact and benefit the rest of the economy. In the neoclassical growth theory, if the enticement to save or invest is affected by tax policy in the new capital, the equilibrium capital output ratio would change hence the level of output path but not its slope.

According to Barro [29] and Barro & Sala-i-Martin [32], fiscal policy can determine both the steady state growth rate and the output path level. The endogenous growth theory advocates the motivation of growth rate and level of per capita output within the economic policies – taxation. Romer [16] postulated that the drivers of economic growth are primarily because of endogenous factors but not external factors. The growth of the economy in the long run basically depends on policy measures which would have critical repercussions on openness, change, competition and innovation as posited in the endogenous growth theory. Further, the endogenous growth theory contends that economic growth is generated directly from within a system based on internal influences. Specifically, the improvement of human capital of a nation would lead to economic growth through the means of development of new forms of technology, efficient and effective means of production which are not disrupted by tax policies in the endogenous growth theory. Again, in

recent times productivity and economies of the industrialized countries as compared to the pre- industrialized eras evidently portrays that growth was created and sustained from within an economy.

Barro [33] pointed out the mechanism through which tax policy might cause level of output growth and the steady state growth rates. His findings were one of the first attempts to establish a relationship between growth and fiscal policies. He posited four kinds of public finances: distortionary versus non -distortionary taxes, and productive versus non-productive spending. Direct income and profit taxes are distortionary since they influenced the investment decision and consequently output or growth. Consumption taxes were considered non-distortionary, except for the case whenever households face the endogenous choice of leisure or labour.

Harberger [34] posited that: tax policy can discourage growth of productivity by reducing research and development as well as economic development. Also, high tax on labour supply can distort human capital efficiently by discouraging workers in the employment sectors. Taxes may also reduce labour force participation and hours of work due to a reduction in working incentive. Taxation can affect the marginal productivity of capital by distorting investment from high tax sectors to low ones and as a result would hinder economic growth.

Agell et al. [35] argued that different uses of government tax revenue spending affect growth in diverse ways and in similar manner the argument holds to the ways tax revenue should be raised. Thus, tax structure varies across countries with the prime aim of attaining maximum revenue with minimum distortion. Countries have diverse philosophies about tax policy and ways of collection as well as varied uses of their tax revenue which may affect growth differently.

Absolute empirical studies have been conducted to test the adequacy of the theories mentioned. Most of the studies in the developed countries test the correlation between tax revenue and economic growth. The results suggested that economic development was the strongest determining factor for the tax growth. Easterly et al. [17] for instance showed how the distortion in the tax structure influenced the growth rate. They postulated that any policy change that led to a rise in economic incidence as well as deadweight loss distorted economic growth. Likewise, Kneller et al. [23] found evidence on how taxes can affect economic growth rate negatively. However, change et al. [36] posited that an increase in income tax would lead to a corresponding increase in economic growth if the time preference were endogenously determined.

Podovana et al. [37] examined the robustness of the association between tax variables and economic growth by including progressively additional policy and control variables in the growth regression. The result revealed that growth is sometimes retarded by distortionary tax whenever the level of tax policy changes. But the non-distortionary tax would not affect the growth as the tax policy is steady. Similarly, Koch et al. [38] investigated the implication of taxation on economic growth using two –stage modeling technique. The result showed that the effect of tax in developing economies is larger than in the

developed economies. The changes in economic growth are strongly correlated with the changes in tax burden.

In the developing countries, Colombage et al. [39] examined the causal impact of the economic growth on the tax revenue in Malaysia. Using the vector error correction model (VECM), they posited that taxes affect the allocation of resources and distorted the growth of the economy. The findings of their study clearly indicated that there was a unidirectional link between economic growth and total government tax revenue with 21 percent speed of adjustment in the short run to reach equilibrium level in the long-run. Similarly, Chigbu et al. [40] assessed the causality between economic growth and taxation for the period 1970-2009 in Nigeria. The findings indicated that taxation is a very important instrument of fiscal policy that contributes to economic growth. Likewise, Canicio et al., [41] conducted a study to examine the causal relationship between government tax revenue growth and economic growth for the period 1980- 2012 in Zimbabwe. Granger Causality test, Johansen's cointegration test and vector error correction model was applied to serve the purpose. The findings of the study clearly revealed that there is an independence association between economic growth and total government tax revenue with 30 percent speed of adjustment in the short run towards equilibrium level in the long run.

Takumah et al., [6] explored the causal flow of tax revenue on economic growth in Ghana. Using Toda-Yamamoto test and a quarterly dataset in the period 1986Q1-2014Q4, the findings depicted strong evidence of unidirectional causality between tax revenue and economic growth. They built on multivariate setup to allow for key control variables to intermediate the link between tax revenue and economic growth. Also, Bekoe et al [42] examined tax reforms and revenue mobilization in Ghana using the proportional adjustment approach in estimating tax buoyancies and elasticities. The findings revealed that the reforms had a positive influence on the overall tax structure and the selected individual taxes recorded buoyancies and elasticities of more than unity during the reform period in exception of excise duties.

Babatunde et al [7] examined the relationship between taxation and economic growth in Africa. The results of the study showed that tax revenue has significant positive effect on growth in Africa. Similar studies like Ogundana et al., [43] used regression analysis on collected data in Nigeria on direct tax revenue & economic growth. The findings indicated that the direct taxes had a positive significant impact on growth. However, Grdinić et al., [44] analyzed the relationship between tax structures and economic growth in CEE countries using the Pooled Mean Group estimator (PMG) sample for 20 selected countries in the period from 1990 to 2010. They found out that all the tax forms have a negative effect on economic growth.

Nwanakwere [45] investigated the relationship between tax and economic growth spanning from 1981-2014 in Nigeria using the ARDL model. The results showed no cointegration among the variables. The short run results indicated that total tax is insignificant while the decomposed taxes are significant. Similarly, Akoto [46] assessed the effectiveness of the tax system in Ghana as a tool for economic development. The study indicates that the percentage of Ghana's tax revenue to Gross Domestic

Product (GDP) from 1990 to 2016 is 14.56 %. Actually, this is inadequate to contribute immensely to the fortunes of the country's growth.

To conclude, the empirical literature on the tax growth nexus debate has yielded mixed reactions. This is due to the various lag length specifications used, time period, and methodology. Mostly, the methodology employed in these studies has been to test for granger causality within a vector autoregressive model. But some of the studies test for granger causality within an error correction model. In addition, Castro et al. [47] employed VAR method. The result showed that an increase in net -tax often yields a positive though small and hardly significant output response. Although most of the studies have addressed these issues, discussion in the developing context is rare and as the developing countries are progressing rapidly, the analysis of this would assist the government in policy formulation.

### 3. Overview of the General Tax System and Economic Growth in Ghana

#### 3.1. Overview of Tax Revenue Performance

The fiscal performance in Ghana prior to Economic Recovery Programme in 1983 was below expectation and very much disappointing. From 1970 to 1982, the macroeconomic projections and analyses were not exhaustively achieved to provide a base for effective, consistent, and fiscal policy formulation. As a substitute, fiscal policy measures were taken on an ad hoc basis, not coordinated and haphazardly implemented. This led to severe deterioration in the country's public finances. A rapid growth in government spending accompanied by a relatively low growth in revenue resulted in persistent budgetary deficits. This was mainly financed by the banking system. Unfortunately, this action led to a sharp increase in the money supply causing rapid growth in the rate of inflation and an increasingly over-valued exchange rate. In an attempt to suppress inflationary pressure through official control of domestic prices added a further setback to the economic policy implementation by the government.

The price control system in addition to the over-valued exchange rate created severe distortions in the economy (World Bank, [48]). These as a result destroyed motivations for production and exports and stimulated speculation and smuggling. The World Bank [48] also found that economic activity shifted from the monetary to the subsistence sector. This indicated a withdrawal from monetized economy by some people as well as the collapse of the organized markets. These developments led to a sharp contraction of the productivity of the tax system and consequently in the ability of the government to generate enough revenue to meet its expenditure requirements.

Ghana experienced significant improvement in tax revenue performance from almost all sources after embarking on fiscal reforms. These increases consequently contributed to the massive restoration of fiscal discipline. For instance, the budget deficit was reversed from 2.6 per cent of GDP to a surplus of 1.5 per

cent in 1983 and 1991 respectively. That outcome was achieved due to the improvement in revenue generation from tax-to GDP ratio of 5.4% to 13.13% over the same period. The budget moved back again into a deficit amounting to 8.4 per cent in 1997, however, this was reduced to 0.89 per cent in 2011. The tax revenue performance experienced an upward trajectory from 1990 to reach historical levels of 22.36% of GDP in 2004. Since then, tax revenue has declined continuously, so that tax -to-GDP ratio averaged 15.24% over the period 2005 to 2015. The contribution of tax revenue to the national economy was 13.1 per cent realised in 2018 (Ghana Revenue Authority) which is far lower than the accepted 1% tax revenue to GDP as recommended by OECD.

### 3.1.1. Overview of Macroeconomic Performance

The fiscal performance in Ghana prior to Economic Recovery Programme in 1983 was very much disappointing, and most macroeconomic projections over the period 1970 to the early part of the 1980s were generally not achieved. The period witnessed several years of negative growth and significant fiscal policy changes or reversals. The lowest growth rate of -12.4 per cent was experienced in 1975- year characterized with the oil -price shock and policy reversals from a market -oriented stance to an inward-looking protectionist regime.

Ghana recorded the highest growth of 14.4 per cent in 2011. This was as a result of the inclusion of oil revenues as well as the strong export performance of cocoa and gold. Despite the phenomenal stride in economic growth in 2011, the country failed to maintain the momentum, as growth rate declined to 7.2 per cent in 2012. The fall in real GDP growth rate translated into a decrease in the real per capita GDP growth rate from 14.4 per cent in 2011 to 7.2 per cent in 2012. But Ghana's overall macroeconomic performance further worsened in 2014 to 2015 with a high twin- deficits lingering. The period was characterized by increasing government debt and inflation, a sharp depreciation of its currency as well as a weaker pace of economic growth. Macroeconomic issues continued to be driven by a large wage bill and increasing interest costs. The fiscal deficits also declined slightly only to a projected value of 9.4 per cent of GDP in 2014 from 10.4 per cent of GDP in 2013. In spite of the slight increase in the revenue, interest costs increased from 4.6 per cent of GDP to 6.2 per cent. As a result, the government continues to add to its stock of public debt to finance the fiscal deficit.

On average from 2011 to 2019, the Ghanaian economy grew at 6.6% per year. Thus, averagely a rise from GDP growth rate of 5.8% in the previous decade (Sherillyn Raga, [49]). This is indeed above the average growth rate recorded in the lower-middle-income countries (LMICs) of 5% and sub-Saharan African countries of 3.5% from 2011 to 2019 (World Bank, [48]). Traditionally, Ghana's strong growth was anchored by major commodity exports and the mining sector. The contribution of the mining and utilities sector from 2000 to 2010 to Ghana's GDP (in terms of overall value added) has improved by almost 10 percentage points. Thus, on average from 2000 to 2011 it was 4.7 % then to 14.2 % from 2011 to 2019 (UNDESA, [50]). The sharp increase in output during that year was

due to promotion of Ghana's oil production in 2011. Subsequently, the GDP growth trajectory has generally followed the development of the mining sector in Ghana.

However, the COVID-19 pandemic adversely affected Ghana's economy in 2020. Significantly, growth decelerated to 0.4% in 2020 from 6.5% in 2019 (World Bank, [51]). Inflation increased to almost 10% and that of the unemployment rate accelerated to 4.5%. The current account increased marginally to 3.1% of GDP in 2019 from 2.7% of GDP. The fall in oil exports was offset by an improvement in export value based on higher gold prices, steady remittances, and contraction in imports as a result of weaker demand and COVID-19-related trade interruptions (IMF, 2021a). Yet, the resilient economic growth prior to the pandemic in Ghana coupled with fiscal and monetary policy feedback assisted in cushioning the influence of Covid-19 pandemic on lives and livelihoods (IMF, 2021a).

In 2020, the fiscal response broadened the fiscal deficit to 15% from 7.5% in 2019. Also, in 2020, government debt increased by 16% points to 78.9% of GDP. Based on this, IMF and World Bank debt sustainability findings classify Ghana as at high risk of debt distress (IMF, 2021a). According to Fitch Ratings [52], there is a significant risk that the public finances in Ghana could fall short of the goals stated in the budget. This may come as a result of limited ability to absorb any new shocks and unclear majority in parliament.

Therefore, the findings of Stephen D. Younger [53] concluded that Ghana is in a macroeconomic crisis. This was brought primarily by a large and prolonged fiscal deficit of 6 percent of GDP and an electric energy crisis as large as 4 percent of GDP.

## 4. Data and Model Specification

### 4.1. Data

This study examines the empirical causal flow between economic growth and tax revenue using time series data from the period 1970 – 2021. Usually, studies conducted to ascertain the relationship between economic growth and taxes mostly used gross domestic product (GDP) changes as a measure of economic growth (Colombage, [39] and Koch et al., [54]). Likewise, this study would utilize per capita GDP growth as a proxy for economic growth and total tax revenue (TTR) as a measure of government tax revenue. The per capita GDP growth captures the average level of national income adjusted for inflation per person. It gives signal of average living standards. The total tax revenue constitutes revenue from direct tax, indirect tax and custom duty. These data sets are obtained from Ghana Revenue Authority, Bank of Ghana, Ghana Statistical Service, and World Development Indicators.

### 4. 2. Model specification

The study adopts endogenous growth model. In this model, GDP per capita growth is expressed as a function of Total Tax Revenue.

$$GDP_t = \beta_0 + \beta_1 TTR_t + \varepsilon_t \quad (1)$$

From equation (1), following the study by Akhor [55] and Arnold et al., [56] the log-linear empirical model for the study is specified as:

$$\ln GDP_t = \beta_0 + \beta_1 \ln TTR_t + \varepsilon_t \quad (2)$$

Where,  $\beta_1$  represents partial elasticity of the variable in the model with respect to GDP per capita growth,  $t$  is the time and  $\varepsilon$  is the error term.

### 4.3. Estimation techniques

The technique employed in this study is Auto-Distributed Lag ARDL model by Pesaran, Shin, & Smith [57] to investigate both the short run and the long run relationship of the time-series variables. The ARDL technique is applicable irrespective of whether the series are stationary at: levels (I(0)), first difference (I(1)) or fractionally integrated. Further, the ARDL model produces robust results as well as performs better for a study with a small sample size (Narayan, [58] & Odhiambo, [59]). Hence, the study used ARDL bounds testing technique to estimate the cointegration between the variables.

Prior to using the ARDL model, the study undertakes series of tests such as unit root test, optimum lag selection, and F-bounds test.

#### 4.3.1. Unit Root Test

According to Gujarati [60] several techniques can be employed to model the dynamics correlation between time series variables. But it is vital to examine the features of individual series before embarking on further analysis. Thus, a major problem which is often associated with time series data is based on its non-stationary property. The use of non-stationary variables is possible to give misleading results especially in classical linear regression. Whenever a time series data is non-stationary, applying the conventional OLS technique would easily result in inaccurate conclusion. This would lead to a high t-statistic and  $R^2$  rendering the estimates significant however with spurious results. Therefore, using a time series data, there is a need to make the observations independent and stationary. Most macroeconomics variables are non-stationary and these series are made stationary by differencing the variable. Differencing the variable some number of times to get a stationary series is known as the order of integration.

In this paper, the Augmented Dickey Fuller (ADF) and Phillip-Perron (PP) tests are used to test the stationarity properties of the variable. Generally, ADF test yields superior results than the PP test whenever the data set has no missing observations as well as structural breaks. However, if the data set has some missing observations and structural breaks then the PP test yields superior result than the ADF test (Greene, [61]). Specifically, the PP test is non-parametric and generalizes the ADF procedure by allowing for less restrictive assumption. Cheung and Lai [36] posited that the ADF test has low power in small samples and is very sensitive to the lag length chosen. The PP test is employed as a robustness check of the ADF results. The level of integration for each variable is determined by testing the null hypothesis against the

alternative hypothesis. If the p-value of the ADF and PP test statistics is  $p < 0.10$ ,  $p < 0.05$ ,  $p < 0.010$ , the series is stationary or has no unit root.

#### 4.3.2. Optimal Lag Length Determination

The vector autoregressive model based on the Akaike information criterion (AIC) was used to determine the optimum order of lag length. Most of the studies demonstrated the importance of choosing the correct lag length. Estimating the model would be inefficient and inconsistent if the chosen lag length is different from the true lag length. Greene, [61] employed- Akaike Information Criterion (AIC)) developed by Akaike in 1971 which was found to be nearly unbiased estimator for choosing lag order as well as large sample size measure of thirty and more. However, the Schwarz Information Criterion (SIC) is for small sample measure of less than thirty observations. Based on this, the AIC is chosen in this study. According to Engle et al. [62] the ordinary least squares regression model was run starting with lag zero upwards since is the most recommended methodology used to determine the lag length. The lag gives the minimum Akaike value chosen as the optimal lag length.

#### 4.3.3. F-bounds test

The study estimated the F-bounds test after obtaining the optimal lag to ascertain if there was a long-run relationship between the variables. Whenever the computed value of the F-statistic is greater than the value of the upper critical bounds, reject the null hypothesis of no cointegration. However, if the F-statistic is less than the lower bounds value, do not reject the null hypothesis. The decision becomes inconclusive when the computed value of the F-statistic lies between lower and upper bounds.

#### 4.3.4. ARDL—bounds test for cointegration

Following Johnston and DiNardo [63], the generalized ARDL (p, q) is specified in the form:

$$\begin{aligned} \Delta GDP_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta GDP_{t-1} + \\ \sum_{i=0}^q \alpha_{2i} \Delta TTR_{t-1} + \beta_1 GDP_{t-i} + \beta_2 TTR_{t-i} + \varepsilon_t \end{aligned} \quad (3)$$

Where, GDP= Gross domestic product per capita growth (a measure for economic growth), TTR=total tax revenue,  $\Delta$  = the difference operator;  $\alpha_0$  = constant,  $\alpha_1$  and  $\alpha_2$  : parameters of the short run dynamics,  $\beta_1$  and  $\beta_2$  = The long run relationship,  $\varepsilon \sim iid(0, \sigma)$  = the error term (white noise).

The long run relationship is established using the F-statistics to test the significance of the one lagged level variables. The joint significance of the model to be tested from equation (3) is specified as:

$$H_0: \beta_1 = \beta_2 = 0 \text{ and } H_1: \beta_1 \neq \beta_2 \neq 0 \quad (4)$$

The null hypothesis test whether long run relationship does not exist whereas the alternate hypothesis test

whether there exist long run relationship between the variables.

**4.3.5. Causality analysis based on the error correction model**

The study embarked on causality analysis after ascertaining the cointegration result. Causality from scientific point of view according to Berzuini et al., [64] is concerned with the effects of causes, suitable for empirical studies of cause-effect relations. Cointegration implies causality in at least one direction but it cannot describe the direction of causality of the variables under study (Menegaki, [65]). Hence the study used the Error correction model (ECM) Granger causality test by Engle and Granger [66] to fill this gap. This is done to disclose the direction of causality.

The study included the lagged error correction term

$ECM_{t-1}$  to test for causality as in Equation (5).

Causality in this incidence was investigated via the significance of the coefficient of lagged ECM and the joint significance for the lagged first difference of the explanatory variables using the Wald test (Islam et al., [67]; Odhiambo, [68]).

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta GDP_{t-1} + \sum_{i=0}^q \alpha_{2i} \Delta TTR_{t-1} + \phi ECM_{t-1} + \epsilon_t \tag{5}$$

Where:  $\phi$  is the speed of adjustment;  $ECM_{t-1}$  represents the error correction factor and  $\alpha_{1i}$  and  $\alpha_{2i}$  are the short run coefficients to be estimated.

The coefficient ( $\phi$ ) on the convergence variable

$ECM_{t-1}$  is anticipated to be negative and significant.

The negative sign indicates that with any deviation from the long run, the variable would definitely return to equilibrium.

The study refers to Equation (5) to determine the short-run causality by the F-statistic (Wald test). Conversely, the long-run causality is determined by the t-statistic on the coefficient of the lagged ECM (Odhiambo, [68]). Diagnostic and stability tests are conducted to ascertain reliability and model perfection.

**Table 1. Descriptive statistics of the variables**

Variables	LGDP	LTTR
Mean	0.303914	1.835866
Median	0.344492	2.144778
Maximum	1.053081	4.752303
Minimum	-0.387851	-1.624519
Std Dev	0.305203	2.058384
Skewness	0.220086	-0.236835
Kurtosis	2.443015	1.703832
Jarque - Bera	1.091962	4.126230
Probability	0.579273	0.127058
Sum	15.80351	95.46504
Sum sq. Dev	4.750595	216.0842
Observations	52	52

Source: author's computation using E-Views 12

**5. Discussion of Results**

**5.1. Descriptive statistics**

Table 1 presents the descriptive statistics of the variables in question.

**5.2. Unit Root Test for stationarity at Levels**

Results from testing the variables at levels are shown in Table 2. It is obvious from the results that gross domestic product (GDP) per capita growth has one per cent significant probability value with the absolute calculated statistical value greater than the critical values. Since the TTR is not stationary at levels, the study proceeds to test for its stationarity at first difference.

**Table 2. Results of Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root test at levels**

Variable	Augmented Dickey Fuller test		Phillips-Perron test	
	t-statistic	critical values	Adj.t-statistic	critical values
$\Delta GDP$	-5.614501*** (0.0000)	-3.565430	5.612618***	-3.565430
		-2.919952		-2.919952
		-2.597905		-2.597905
$\Delta TTR$	-1.201854 (0.6667)	-3.568308	-1.466332 (0.5424)	-3.565430
		-2.921175		-2.919952
		-2.598551		-2.597905

Source: author's computation \* p<0.10, \*\* p<0.05, \*\*\* p<0.010

**5.3. Unit Root Test for stationarity at First Difference**

**Table 3. Results of Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root test at First Difference**

Variable	Augmented Dickey Fuller test		Phillips-Perron test	
	t-statistic	critical values	Adj.t-statistic	critical values
$\Delta TTR$	4.857725*** (0.0002)	-3.568308	4.884347*** (0.0002)	-3.568308
		-2.921175		-2.921175
		-2.598551		-2.598551

Source: author's computation \* p<0.10, \*\* p<0.05, \*\*\* p<0.010

Table 3 presents result of TTR which is integrated at order one (at first difference) since it is not stationary at levels. After first differencing, the TTR becomes statistically significance with the calculated statistical value greater than their critical values in absolute terms for both PP and ADF tests at 1 per cent level. We then reject the null hypothesis that the variable TTR is stationary at first differencing

**5.4. Optimal Lag Length Determination**

The study employed the vector autoregressive model based on the Akaike information criterion (AIC) to estimate the optimal lag length. The optimal lag length is lag one which meets the minimum AIC requirement value from 0-3 as in Table 4.

**Table 4. Results of Optimal Lag Length Determination**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-107.2195	NA	0.324675	4.550811	4.628777	4.580274
1	54.06943	302.4167*	0.000463*	-2.002893*	-1.768993*	-1.914502*
2	56.71000	4.731019	0.000490	-1.946250	-1.556417	-1.798931
3	60.42884	6.353015	0.000497	-1.934535	-1.388768	-1.728289
4	61.12964	1.138806	0.000573	-1.797069	-1.095368	-1.531895

Source: author's computation \* p<0.10, \*\* p<0.05, \*\*\* p<0.010

### 5.5. ARDL Bounds Test for Cointegration

Table 5 presents cointegration results. The null hypothesis of no cointegration or no levels of correlation is rejected at the 1%, 5% and 10% levels when GDP per capita growth is the dependent variable. The study developed restricted constant and no trend model. The results from the ARDL bounds test confirmed cointegration among the concerned variables for Ghana during 1970–2021 since the F-statistic value of 12.11519 is greater than the value of the upper critical bounds (Table 5).

**Table 5. Results of the F-Bounds test**

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	12.11519	10%	3.02	3.51
k	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Source: author's computation \* p<0.10, \*\* p<0.05, \*\*\* p<0.010

### 5.6. Long Run Estimate of the ARDL Model

Based on the F-bounds test for cointegration test results, the long-run coefficient was estimated. The long-run estimates reported in Table 6 are based on case 2: restricted constant and no trend of ARDL long-run form.

Based on 1970–2021-time series data from Ghana, the analysis revealed long-run relationship between economic growth (i.e., GDP per capita growth), and total tax revenue (TTR) in Ghana. The long-run coefficients are reported in Table 6 which shows that the coefficient of TTR is positive and significant as expected. With the economic growth as the dependent variable, TTR inflow is positive and significant at 10% level, implying that the TTR inflow has a positive impact on the economic growth of Ghana. Thus, if the TTR inflow increases by 1 unit, then the GDP per capita growth in Ghana can be expected to rise by approximately 4.59% per year in the long run. This result shows that Ghana should examine efficient Tax revenue policies to boost economic growth.

**Table 6. Results for Long Run estimates of the ARDL Model**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTRR	0.045921	0.023889	1.922280	0.0605
C	0.214335	0.065938	3.250531	0.0021

Source: author's computation \* p<0.10, \*\* p<0.05, \*\*\* p<0.010

### 5.7. Short Run Estimate of the ARDL Model and ECM

The ECM is executed after cointegration analysis to predict the directions of causal relationships between the variables in short and long run. Table 7 reports results from the ECM analysis.

**Table 7. Results for Short Run estimates of the ARDL Model**

Variable	Coefficient	Standard Error	t-statistic	P-Value
LGDP(-1)*	-0.871405	0.144603	-6.026185	0.0000
LTTR**	0.040016	0.021974	1.821048	0.0748
CONST	0.186773	0.065339	2.858501	0.0063
ECM(-1)*	-0.871405	0.141622	-6.153046	0.0000
R-squared	0.430800	Mean dependent var	-0.005375	
Adjusted R-squared	0.430800	S.D. dependent var	0.385938	
S.E. of regression	0.291172	Akaike info criterion	0.389610	
Sum squared resid	4.239064	Schwarz criterion	0.427488	
Log likelihood	-8.935043	Hannan-Quinn criter.	0.404084	
Durbin-Watson stat	1.956376			

Source: author's computation \* p<0.10, \*\* p<0.05, \*\*\* p<0.010

The lagged coefficient of the ECM (-0.871405) implies that the speed of adjustment from the short-run imbalance to the long-run equilibrium is approximately 87%. Henceforth, any deviation from the long-run equilibrium level of economic growth in one period will be corrected by 87% in the given period. Precisely, the system will recover any shock in Ghana's economic growth in the short run toward long-run equilibrium as stipulated. The findings have policy implications for the country's economic prosperity as evident on how the Ghanaian government usually relying on tax revenue to reach sustainable growth in the economy as well as to defray recurrent expenditure. In this regard, Ghana should continue to implement prudent macro-economic policies



that stimulate tax revenue inflow for accelerating economic growth and development in the country.

### 5.8. Serial correlation, Heteroscedasticity and Normality Test

The chi square test results for heteroscedasticity, Jarque–Bera normality and serial correlation hypotheses were rejected (Table 8). This indicates that the data set is serially uncorrelated, stable and has homoscedastic variance.

Table 8a. Test for heteroscedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	0.677446	Prob. F(2,48)	0.5127
Obs*R-squared	1.400053	Prob. Chi-Square(2)	0.4966
Scaled explained SS	1.369931	Prob. Chi-Square(2)	0.5041
Heteroskedasticity Test: ARCH			
F-statistic	0.017256	Prob. F(1,48)	0.8960
Obs*R-squared	0.017969	Prob. Chi-Square(1)	0.8934

Table 8b. Test for Serial correlation and Normality

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	0.029997	Prob. F(1,47)	0.8632
Obs*R-squared	0.032529	Prob. Chi-Square(1)	0.8569

$$\chi^2_{Hetero} = 1.400053(0.4966) \quad \chi^2_{Serial} = 0.032529(0.8569)$$

$$\chi^2_{Normality} = 0.093513(0.954320)$$

The study performed Breusch—Godfrey for the serial correlation LM test, Breusch—Pagan—Godfrey for the heteroskedasticity test, and Jarque—Bera for normality to ascertain the reliability of the model. The Results of diagnostic tests depict that the model is free from serial correlation at up to 1 lag and does not suffer from heteroskedasticity. The Jarque—Bera test through EViews 12 also confirmed that the time-series data used follow a normal distribution.

### 5.9. Pairwise Granger Causality Test

Table 9 indicates the causal flow between economic growth and tax revenue. The result shows that the null hypothesis was not rejected since Economic growth does not

Granger cause tax revenue. However, the Granger cause hypothesis of tax revenue to economic growth was rejected.

Table 9. Pairwise Granger Causality Test Results

Direction of Causality	F-Statistic	P-value	Decision
LTTR ⇒ LGDP	3.19771	0.0801	Reject
LGDP ⇒ LTTR	2.29092	0.1367	Do not Reject

The findings of this study therefore imply that there was unidirectional causal relationship from tax revenue to economic growth at 10 % significance level in Ghana for the period 1970-2021. Therefore, the study assumes that the findings obtained from the causality analysis confirm with the existing findings that taxation can influence economic growth (Takumah et al. [6])

## 6. Conclusion

The paper attempts to assess the causal link between economic growth and tax revenue in Ghana. This is done to determine the role of economic growth in nurturing tax revenue growth in the long and short run. An empirical test was conducted to observe the time related nature of the association between tax revenue collected and economic growth directional movement. It is crucial in determining the causal ordering between these macroeconomic aggregates to ensure a sharpening of taxation as well as its effectiveness in managing fund for the corresponding expenditure and eradication of poverty (Taha & Loganathan, [69]).

The analysis is based on the neoclassical growth and endogenous growth theories. This study used ADF and PP unit root tests to ascertain the stationarity of variables. To examine the long-run correlation between the variables, the study employed the ARDL bounds test techniques since it is relatively more efficient. Further, the study applied the ECM and Pairwise Granger causality to investigate the direction of the nexus between the variables

The findings of this study reveal that total tax revenue has a positive and statistically significant correlation with economic growth in the short and long run. Besides, the findings indicate that there is unidirectional causality running from tax revenue to economic growth in Ghana. Approximately deviation from the long-run equilibrium level of economic growth in the previous year will be corrected by 87% in the subsequent year. The finding corroborates with the existing findings that taxation can influence growth of the economy in Ghana. For that reason, Ghanaian policymakers should continue to develop, devise, and enforce prudent and efficient macroeconomic policies that promote tax revenue inflows to stimulate the growth of the country’s economy in order to attain desired economic objectives. Policy makers should be proactive in directing tax revenue collection towards productive infrastructural development with the aim of attracting both local and foreign private investment through which the multiplier process will drive growth with a large margin. Allocation of tax revenue should be efficient, equitable and productive. Equitable redistribution of income must be the main concern of the government.

Based on the findings, the study further recommends that the Ghanaian government should ensure fiscal

discipline and effective use of tax revenue to attain macroeconomic growth. Also, there should be effective and efficient administration of tax system in such a way to curb tax evasion and avoidance. Moreover, accountability of the revenue realized from taxation should be ensured to expedite smooth flow at all economic levels towards the desired economic objectives. Furthermore, the tax scope should be broadened in order to increase the revenue from taxation rather than excessive increasing of the tax rate. Additionally, there should be diversification of the economy from a single sector to multiple sectors as a way of increasing the capacity base of the country's revenue generation process to attain maximum growth. To ensure buoyancy of the tax revenue, the study recommends a shift of the policy from the government side to induce the responsiveness between tax revenue and economic growth.

The study only focuses on total tax revenue and GDP; however there are several ways to extend the research. The composition of taxation changes with development so it would be worthwhile if further studies look at the decomposition of revenue for the examination. Also, the study can be extended to cover other developing countries for comparison purposes.

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