Tax Revenue And Economic Growth Nexus in The Gambia: Evidence From The ARDL Model

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29 July 2024

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Abstract:

This research paper investigates the nexus between tax revenue and economic growth in The Gambia from 2004Q1 to 2020Q4. The study employs the Autoregressive Distributed Lag (ARDL) model and bound test to analyze the dynamic relationship between tax revenue and economic growth. The bound test of cointegration confirms that tax revenue has a significant impact on both short-term and long-term economic growth in The Gambia. Furthermore, the findings reveal that tax revenue has both positive and negative effects on economic growth in the short run. Initially, tax revenue has an immediate negative impact on economic growth, but over time, within the short run, this impact becomes positive. This suggests the presence of a non-linear effect of tax revenue on economic growth in the short term. However, in the long run, tax revenue has a detrimental effect on economic growth. From a policy standpoint, these results emphasize the need for cautious utilization of tax revenue to avoid hindering long-term economic growth in The Gambia.

Keywords: Tax revenue, aggregate income, economic growth, ARDL model, bounds testing, cointegration, The Gambia

1. Introduction

The economic growth model from the Harrod-Domar model (1939) to the Solow model (1956) and then the Endogenous growth model (Barro, 1990) have emphasized the importance of capital accumulation and technological progress in determining the standard of living of a country. It is this recommendation that most government looks for ways to mobilize resources such as tax revenue so that they can undertake public investments. The World Bank [1] emphasizes that maintaining tax revenues at a level exceeding 15% of a nation's gross domestic product (GDP) plays a crucial role in fostering economic growth and alleviating poverty. This level of taxation enables countries to secure the financial resources required for future investments and attain sustainable economic development. The concept of a "tipping point" further supports the importance of maintaining a sustainable level of tax-to-GDP ratio. According to this proposition, a minimum tax-to-GDP ratio of 12.9 percent is necessary for a state to effectively carry out its fundamental functions and finance development programs (Gaspar, Jamarillo, and Wingender 2016).

The average tax-to-GDP ratio in The Gambia is 10 percent of GDP. This is lower than the regional average of Sub-Saharan Africa (SSA) of 17 percent. Moreover, the structural peers[2] of The Gambia have an average tax-GDP ratio of 10.8 percent of GDP. The aspirational peers[3] have a tax-GDP ratio of 13.6 percent. This indicates that there is room for improvement in terms of tax collection. A substantial opportunity for enhancing domestic revenue generation is presented by a structural tax gap ranging from 5 to 7 percent of GDP World Bank (2020). However, the effectiveness of taxes as a tool for promoting growth and development remains inconclusive, with studies showing mixed impacts on economic growth. To shed light on this issue, this study aims to investigate the impact of tax revenue on economic growth in The Gambia from 2004Q1 to 2020Q4.

Most of the empirical results from past studies are distorted by model misspecification and endogeneity problems. To find a cure for these deficiencies, this study uses the ARDL regression model and bound test to cointegration that determines the short-run and the long-run impacts of tax revenue on economic growth in The Gambia. Hence, study has two main

[1] https://www.worldbank.org/en/topic/taxes-and-government-revenue

2 Structural peers are countries that share several features with The Gambia, such as (i) rapid population growth and a high level of urbanization, (ii) fragility, (iii) the weak capacity of the public administration, (iv) a small economy and a lack of regional integration, and (v) economic sectors that are highly vulnerable to shocks (tourism and agriculture). The use of these criteria resulted in the identification of the following countries: Guinea, GuineaBissau, Eritrea, Liberia, and Togo

[3] Aspirational peers are countries that dealt successfully with a youth bulge, managed to strengthen the capacity of the public sector, and made progress toward higher levels of regional integration (see table A.2). The use of these criteria resulted in the identification of the following countries: Senegal, Rwanda, Comoros, Mauritania, and Uganda.

contributions to the best of our knowledge. First, it is the only paper that used the ARDL model and bound test to find the dynamic relationship between tax revenue and growth for the Gambia. Secondly, the use of the ARDL bound test model bound helps to solve the problem of model misspecification and the endogeneity problems that previous studies suffered from.

The result of the bound test to cointegration confirms that there is a long-run relationship between economic growth and tax revenue and the impact of tax revenue on growth in the long-run is negative. In the short run, tax revenue has both negative and positive impact on growth.

2. Literature Review

The growth literature has extensively explored the connection between fiscal policy and economic growth. Nevertheless, the theoretical analysis of the impact of fiscal policy on economic growth remains inconclusive (Tosun 2005). The neoclassical growth models of public policy assign the responsibility of determining the level of output to fiscal policy rather than the long-term rate of growth. The equilibrium growth rate is influenced by exogenous factors like population growth and technological progress, while fiscal policy only impacts the transition process towards this equilibrium state (Tosun 2005). However, endogenous growth models of public policy, as explored by various scholars such as Barro & Sala-i-Martin (1992), Stokey & Rebelo (1995), and Mendoza et al. (1997), propose mechanisms through which fiscal policy can influence both the level of production and the growth rate at equilibrium. These models suggest that taxation can have both a negative and a positive effect on the growth rate. The positive effect arises indirectly through tax-financed spending, particularly on public goods that generate positive externalities such as infrastructure, education, and public health. In this case, taxation can positively impact the economic growth rate. On the other hand, the negative effect of taxation on growth arises from its impact on individuals' decision-making, leading to sub-optimal outcomes. Engen and Skinner (1996). identify five potential mechanisms through which taxes can affect economic growth, including hindering investment rates, distorting labour supply choices, discouraging research and development spending, diverting resources to less taxed sectors with lower productivity, and distorting the efficient utilization of human capital through high taxes on labour supply.

Different empirical research has examined the impact of taxes on the growth of the economy. The findings are inconclusive, as they differ depending on the countries, methodologies used, and the specific tax variables considered.

According to Keho (2010), who utilized the Scully regression models and quadratic, it is concluded that there is a strong correlation between higher taxes and decreased economic growth in Cote d'Ivoire. Saibu (2015) also reported a similar negative relationship between the tax burden and the economic growth rate in Nigeria and South Africa. In a separate study, Keho (2013) employed the linear programming methodology and discovered that higher taxes are linked to reduced economic growth.

Chigbu et al. (2011), and Confidence and Ebipanipre (2014) also found similar results in their respective studies. These collective findings suggest that tax reform plays a crucial role in fostering positive and significant economic growth in Nigeria.

According to Keho (2011), there is a strong correlation between different tax revenues and long-term production in Cote d'Ivoire, except for direct taxes. The study reveals a two-way causality between tax revenues and long-term GDP growth, indicating a positive relationship between taxes and economic development. However, direct taxes do not have a significant impact on GDP in both the short and long term. These findings suggest that tax revenues are dependent on economic activity, and shifting the tax burden from direct taxes to indirect taxes could potentially stimulate growth.

In a study conducted by Ugwunta and Ugwuanyi (2015), panel data analysis with a fixed unobservable effect was employed. The results indicate that taxes on income, profits, capital gains, payroll and labour, property taxes, estates, fixed assets, and financial transactions have a negative and insignificant effect on economic growth in sub-Saharan African countries. Conversely, indirect taxes have a positive but insignificant impact. N'Yilimon (2014) also obtained similar results using the unit root test on panel data, suggesting no nonlinear relationship between taxation and economic growth in the West African Economic Monetary Union (UEMOA) countries. Edame (2014) focused on the impact of VAT on economic growth in Nigeria and found a significant and negative relationship between the two variables.

Dackehag and Hansson (2012) investigated the impact of income tax on GDP growth using a different dataset from a diverse economic environment. Specifically, they examined the influence of statutory tax rates on personal income and corporate income on GDP growth using panel data from 25 affluent OECD countries. Their findings revealed that both personal and corporate income taxation hurt GDP growth. However, the correlation between corporate income tax (CIT) and GDP growth was found to be more robust.

Jalata (2014) conducted a comprehensive study using both theoretical and empirical evidence to examine the influence of VAT on the GDP growth of Ethiopia. The study utilized time series macroeconomic data, including VAT, total tax revenue excluding VAT, non-tax revenue, revenue from the foreign sector, and GDP growth. Through the application of multiple regressions and descriptive statistics, the obtained time series data was analyzed. The findings of the study revealed that VAT has a positive impact on the overall GDP growth of the Ethiopian economy, surpassing the effects of sales tax. However, it was also observed that VAT still exhibits regressive characteristics like sales tax.

Njogu (2015) employed secondary time series data from Kenya, encompassing VAT rates, consumer price indices, unemployment rates, and GDP growth rates. The study utilized multiple regression analysis and revealed that there is a noteworthy inverse association between VAT rates and GDP in Kenya. Specifically, the findings indicated that for each unit decrease in VAT, there is a 7% increase in the incident rate of GDP.

Dehghan and Nonejad (2015) investigated the influence of tax rates on GDP growth in Iran. The study encompassed various macroeconomic variables, including GST, population growth, trade openness, corporate income tax, inflation rate, business tax revenue, and GDP. The analyses were conducted using the autoregressive distributed lags method, and the results indicated that GST, CIT, and business tax revenue had a negative and statistically significant impact on Iran's GDP growth.

Immanuella (2016) examined the impact of VAT on the growth of Nigeria's GDP. By analyzing data specifically obtained from Nigeria, the researcher employed multiple regression analysis to demonstrate a positive and statistically significant relationship between VAT revenue and GDP growth. Additionally, the study revealed that VAT and total tax revenue are positively related and statistically significant within the Nigerian context.

Kolahi and Noor (2016) conducted a study to examine the effects of VAT on GDP growth and its sources in selected developing countries. The study utilized panel data from 19 developing countries and employed the generalized method of moments (GMM) for analysis. The variables analyzed in the study included VAT, productivity growth, capital accumulation growth, and GDP growth. The findings revealed a positive relationship between VAT revenue and GDP growth while indicating a negative impact of VAT on capital accumulation growth.

Hakim, Karia, and Bujang (2016) conducted a study that examined the impact of taxes on goods and services on the growth of GDP in different developed nations. Their research revealed a significant and positive correlation between commodity tax and GDP growth in the chosen developed countries.

Simionescu and Albu (2016) conducted a study on the impact of the standard VAT rate on the growth of GDP in five countries in Central and Eastern Europe (CEE-5). They examined various panel data models, including the random effect model, fixed effect model, and dynamic panel. The results of their analysis indicate a positive relationship between VAT and GDP growth. Additionally, they discovered a bilateral Granger causality between GDP growth and the VAT rate.

Etale and Bingilar (2016) conducted a study to explore the impact of income tax on GDP growth in Nigeria. The study utilized three variables: VAT, CIT, and GDP. The analysis employed the multiple regression technique. The findings revealed a positive relationship between CIT and GDP growth in Nigeria. Furthermore, the study recommended that the government should enhance the administration of the tax system to expand tax revenue and encourage voluntary compliance.

Babatunde, Ibukun, and Oyeyemi (2017) investigate the impact of taxation on economic growth in Africa from 2004 to 2013. The findings of the study indicated that tax revenue is positively related to GDP and promotes economic growth in Africa, with statistical significance at the 5% level. Therefore, the study concluded that tax revenue has a significant positive relationship with Gross Domestic Product.

Odum, Odum, and Egbunike (2018) conducted a study to examine the relationship between income tax and GDP growth in the context of the Nigerian fiscal policy framework. They utilized time series data and employed various statistical methods such as the Granger Causality test, Pearson Coefficient Correlation, OLS regression, Johansen Cointegration test, and Error Correction Model (ECM) to analyze the dataset. The results of their analysis indicated a positive and statistically significant relationship between income tax and GDP growth at a 5% level of significance.

Oboh, Chinonyelum, and Edeme,(2018) analyze the impact of tax revenue, both direct and indirect, on the economic growth of selected ECOWAS countries (Nigeria, Ghana, Sierra Leone, Benin, and Burkina Faso). The study utilizes the Seemingly Unrelated Regression Estimate (SURE) analysis, using data from 2000-2015 sourced from the World Bank World Development Indicators, 2016. The findings indicate that total tax revenue has a positive and significant effect on economic growth. Specifically, a $1 increase in total tax revenue leads to a 43.2 percent increase in economic growth. However, a $1 increase in direct tax revenue dampens growth by -3.08 percent, suggesting that direct tax is unproductive in these countries. On the other hand, a $1 increase in indirect tax revenue corresponds to a 47.7 percent increase in economic growth. For countries where indirect tax is unproductive, it is recommended to focus on broadening the indirect tax base rather than increasing direct tax rates.

Maganya (2020) examine the impact of taxation on economic growth in Tanzania by employing the recently developed autoregressive distributed lag model (ARDL) bounds testing procedure for the period spanning from 1996 to 2019. The findings reveal that domestic goods and services (TGS) taxes exhibit a positive relationship with GDP growth and are statistically significant at a 1% level. Conversely, income taxes demonstrate a negative association with GDP growth and are statistically significant at a 5% level. The pairwise Granger causality results indicate the presence of bidirectional causality between TGS and GDP growth at a 1% significance level.

Dumisani Pamba (2022) investigated the relationship between different components of tax revenue and economic growth in South Africa. The study utilized time series data spanning over 22 years. The stationarity of the variables was determined using the Phillips-Perron (PP) unit root test, and the existence of both long-run and short-run equilibrium conditions was examined using the Autoregressive Distributed Lag (ARDL) model. The results show all variables were found to be cointegrated, indicating a long-run relationship with economic growth. The ARDL findings indicated that company income tax, personal income tax, and taxes on international trade and transactions have a positive long-run and short-run association with economic growth. On the other hand, capital gain tax, foreign direct investment, and gross savings have a negative long-run and short-run relationship with economic growth.

Kessy and Sukartini (2023) evaluate the impact of taxation on economic growth specifically in Africa. Spanning a period of eleven years, from 2008 to 2018, the study incorporates multiple variables from 21 African countries. Gross Domestic Product (GDP) serves as the dependent variable, serving as a proxy for economic growth. Independent variables encompass a range of factors that influence GDP, categorized into three groups: the supply side, which includes human capital (population and literacy rate) and economic activities (trade and services); the demand side, which includes variables such as consumption, government expenditures, net exports, and gross capital formation; and lastly, taxation variables, which encompass tax revenue, corporate tax rate, number of tax payments, personal income tax, and taxes on income, profits, and capital gains. Tax revenue and corporate tax rate demonstrate a positive impact on GDP, while personal income tax rate and taxes on income, profits, and capital gains exhibit a negative influence on GDP. Overall, taxation appears to have a beneficial effect on the economies of African countries, as emerging nations utilize taxation as an internal mechanism to generate revenue and enhance economic growth.

3. Data and Method

The main objective of this study is to find the effect of tax revenue (t) on economic growth(g) in both the short run and the long run. Therefore, there is a need for a model that captures both the short-run and the long-run impact of tax revenue (independent variable) on economic growth (dependent variable). One of the models that capture both the short-run and the long-run dynamic of an independent variable on a dependent variable is the Autoregressive Distributed Lag (ARDL) regression model in an error correction (EC) form. The basic ARDL regression model with order P and q, denoted by ARDL (P, q) is shown in equation [1] below with economic growth defined as a function of tax revenue:

Economic growth (g)= f (tax revenue, t)

$$g_t = \beta_0 + \beta_1 g_{t-1} + \cdots + \beta_p g_{t-p} + a_0 t_t + a_1 t_{t-1} + a_2 t_{t-2} + \cdots + a_q t_{t-q} + u_t \quad [1]$$

Equation [1] has to be modified to serve the objective of this study, that is, to find the effect of tax revenue on economic growth in both short-run and the long run, and also to test the existence of a cointegration relationship. The modification involves transforming equation [1] into an error correction model (ECM) as in equation [2] below:

$$\Delta g_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i}\,\Delta g_{t-i} + \sum_{i=0}^{k} \beta_{2i}\,\Delta t_{t-i} + EC_{t-1} + u_t \quad [2]$$

Where; EC_{t-1} is the error-correction term and is defined as:

$$EC_{t-1} = g_{t-1} - \delta_0 - \delta_1 t_{t-1} \qquad [3]$$

If equation [3] is substituted into equation [2], we have an unrestricted ECM in equation [4] which Peseran et el. (2001) called “conditional ECM”.

$$\Delta g_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i}\,\Delta g_{t-i} + \sum_{i=0}^{k} \beta_{2i}\,\Delta t_{t-i} + \delta_0 g_{t-1} + \delta_1 t_{t-1} + u_t \quad [4]$$

Tax revenue is not the only variable that affects economic growth, thus, equation [4] is augmented to include other necessary control variables that have an important impact on economic growth. Hence, this study models economic growth (g) as a function of gross fixed capital creation (k), household consumption (c), export (x), import (i), and tax revenue (t).

Economic growth (g) = f (c, k,x,i,t)

$$\Delta g_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i}\,\Delta g_{t-i} + \sum_{i=0}^{k} \beta_{2i}\,\Delta c_{t-i} + \sum_{i=1}^{k} \beta_{3i}\,\Delta k_{t-i} + \sum_{i=0}^{k} \beta_{4i}\,\Delta x_{t-i} + \sum_{i=1}^{k} \beta_{5i}\,\Delta i_{t-i} + \sum_{i=0}^{k} \beta_{6i}\,\Delta t_{t-i} + \delta_7 g_{t-1} + \delta_8 c_{t-1} + \delta_9 k_{t-1} + \delta_{10} x_{t-1} + \delta_{11} i_{t-1} + \delta_{12} t_{t-1} + u_t \qquad [5]$$

Equation [5] shows the ARDL regression model that captures both the short-run and the long-run impacts of independent variables on growth. The short-run impacts of independent variables on growth g are captured by β_i while the long-run impacts are captured by δ_i. The ARDL regression model in the form of equation [5] is also used to test for the existence of long-run (cointegrating) relationships using the bounds test of Pesaran and Shin (1999) and Pesaran et al. (2001).

The ARDL regression model in equation [5] can be estimated regardless of whether the time series are stationary or non-stationary, or even a mixture of stationary and non-stationary. However, none of the variables in equation [5] should be I (2) as this invalidates the methodology. Thus, this study uses the Augmented Dicker Fuller (ADF) test to test the stationarity of the variables (Dickey & Fuller, 1981 & 1979). When conducting an ADF test the researcher must make two choices. The researcher must choose a model from three of the ADF models that describe the true data-generating process of the variable. Since the data-generating process of the variable is mostly not known, this study used all three models of ADF to test the stationarity of the variables. Secondly, the researcher must choose the number of lagged variables. The trick here is to include a lagged variable that will eradicate serial correlation from the model.

Table 1: ADF Model Specification

ADF Model Specification	Hypothesis
$\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^{\rho} \beta_i \Delta y_{t-1} + u_t$ [6] $\Delta y_t = \propto_0 + \gamma y_{t-1} + \sum_{i=1}^{\rho} \beta_i \Delta y_{t-1} + u_t$ [7] $\Delta y_t = \propto_0 + \gamma y_{t-1} + a_2 t + \sum_{i=1}^{\rho} \beta_i \Delta y_{t-1} + u_t$ [8]	H_0: $\gamma = 0$ There is a unit root, variable is non-stationary. H_A: $\gamma < 0$ There is no unit root, variable is stationary.

Equations [6], [7] and [8] are the three different types of ADF models that will be used to test the stationarity of the variables in equation [5]. Equation [6] has no constant and no trend, equation [7] has constant but no trend, and equation [8] has both constant and trend. The ADF is a normal t-test on the coefficient (γ) of the lagged value of the dependent variable (y_{t-1}) in equations or models (6), (7), and (8). The t-test does not have the traditional t-distribution; hence, special critical values were originally calculated by Dickey and Fuller. These special critical values were tabulated by MacKinnon (1991).

. In all the ADF models, the focus is on whether $\gamma = 0$. The null hypothesis of there is a unit root (non-stationary) is tested against an alternative hypothesis of there is no unit root (stationary). The null hypothesis is rejected when the ADF test statistics are less than the critical values. After confirming that the level of stationarity of each variable in equation [5], that is, none of the variables is integrated at I (2), the model can be estimated after selecting the maximum lags level for each of the variables using information criteria such as AIC, SC(BIC), HQ etc. The lower the information criteria the better.

Since the long-run impact of tax revenue would be estimated then there is a need to test whether there is a long-run relationship (cointegration) between tax revenue and economic growth. This study used the bounds test proposed by Pesaran et al. (2001) to test the existence of cointegration. The advantage of the bounds test relative to other types of cointegration tests is that all the variables do not need to be integrated at the same level, however, none of the variables should be integrated above the first difference, I (1). Moreover, endogeneity is less of a problem if the model is free from residual correlation.

Haug (2002) has outlined that one has a better result under the ARDL model approach and bounds testing to cointegration relative to traditional cointegration tests such as Engle and Granger (1987), Johansen and Juselius (1990) and Hansen and Phillips (1990) under a small sample size.

The bound test for cointegration using the ARDL model uses the F-test to determine the joint significance of the lagged levels of the variables in the equation [5]. The null hypothesis of there is no cointegration is tested against the alternative hypothesis of there is cointegration. Mathematically, this can be stated as:

$H_0: \delta_7 = \delta_8 = \delta_9 = \delta_{10} = \delta_{11} = \delta_{12} = 0$ There is no cointegration/no long-run relationship.

$H_A: \delta_7 \neq \delta_8 \neq \delta_9 \neq \delta_{10} \neq \delta_{11} \neq \delta_{12} \neq 0$ There is a cointegration/long-run relationship.

Peterman et al. (2001) give two pairs of critical values for the F-test. One set assumes that the entire variables are integrated at I (0) while the other set assumes that all the variables are integrated at I (1). If the calculated F-statistics is greater than the upper critical value, that is, if the computed F-statistic is greater than the critical values of I (I), we reject the null hypothesis of no cointegration and accept the alternative hypothesis of there is a cointegration and vice-versa. If the F-statistics is between the critical values of I (0) and I (0), the cointegration test is inconclusive.

The ARDL model and bounds test for cointegration of Pesaran et al. (2001) requires that the errors of equation [5] be serially independent, this will influence the maximum lags that would be selected for each variable in equation [5]. After estimating equation [5], the LM test is used to test the null hypothesis that errors of equation [5] are serially independent against the alternative hypothesis that errors are not serially independent. Moreover, the ARDL model requires that that equation [5] is dynamically stable since it has an autoregressive structure. The study used CUSUM and CUSUMSQ stability tests (Brown, Durbin, & Evan, 1975). to test the dynamic stability of the equation [5]. Diagnostic tests such as normality tests, heteroskedasticity, and model misspecification are carried out to ensure that the assumptions of the model are not violated.

Table 2: Diagnostic Tests

Test	Method	Hypothesis
Normality	Jarque-Bera	Ho: Residuals are normally distributed Ha: Residuals are not normally distributed
Serial Correlation	Breusch-Pagan Godfrey LM	Ho: There is no serial correlation Ha: There is a serial correlation
Heteroskedasticity	Breusch-Pagan Godfrey LM	Ho: Homoskedascity Ha: Heteroskedasticity
Misspecification	Ramsey Reset	Ho: Correct Specification Ha: Misspecification

Note: Decision Rule: Reject Ho if the probability value is less than 0.05

In Table 2, the probability value determines whether to reject the null hypothesis. Reject Ho if the value of the probability is less than 0.05. The computation of each test's statistic and its critical value may also serve as the basis for the decision rule to reject the null hypothesis. The null hypothesis is rejected in favor of the alternative hypothesis and vice versa if the computed statistic for each test is greater than the crucial value.

The World Development Indicator (WDI) database of the World Bank and the Data Warehouse of the Central Bank of The Gambia were the two data sources that were used for this study. The empirical studies make use of quarterly data from 2004Q1 through 2020Q4. The data range is informed by the availability of the data.

Table 3: Diagnostic Tests

Variable	Name of the variable	Source
g	Economic growth	WDI-World Bank
c	Household consumption	WDI-World Bank
k	Capital formation	WDI-World Bank
x	Export	WDI-World Bank
i	Import	WDI-World Bank
t	Tax revenue	GRA & CBG-Datawarehouse

GRA-Gambia Revenue Authority; CBG-Central Bank of The Gambia

4. Empirical Results

Table 4 displays the descriptive statistics for the variable used in the empirical analysis. Tax revenue, the primary interest-related variable, has a minimum value of GMD513 million and a maximum value of GMD2,902.69 million. GDP variable, on the other hand, ranges in value from GMD 40,2006.72 million to GMD 61, 729.22 million. During the study period, 2004Q1 to 2020Q4, the economic growth is more volatile than the tax revenue in terms of standard deviation.

Table 4: Descriptive Statistics

Variables	Mean GMD' million	Standard. Deviation	Min GMD' million	Max GMD 'million
g	49, 080.40	6, 689.11	40,206.72	61,729.22
c	41, 177.35	6,847.77	3, 1575.00	53, 909.23
k	92,74.69	5,355.27	4, 169.00	24, 607.01
x	8, 530.81	2,179.60	5, 735.00	13, 786.62
i	15, 306.75	5,664.00	9, 751.00	27, 942.24
t	1, 287.55	6, 45.10	513.00	2, 902.69

Source: Authors computation using data from GRA and World Bank-WDI for the period 2004Q1 to 2020Q4.

Table 5: Correlation Analysis Result

	g	c	k	x	i	t
g	1	0.989233	0.892004	0.540563	0.935659	0.942518
c	0.98923312	1	0.8514074	0.5889381	0.9345812	0.9384137
k	0.89200448	0.8514074	1	0.3318882	0.9422053	0.9251413
x	0.54056375	0.5889381	0.3318882	1	0.5566609	0.5508871
i	0.93565918	0.9345812	0.9422053	0.5566609	1	0.9611214
t	0.94251806	0.938413	0.9251413	0.5508871	0.9611214	1

Source: Authors computation using data from GRA and World Bank-WDI for the period 2004Q1 to 2020Q4.

Even though Table 5 shows that a very strong positive linear relationship exists between tax revenue and growth (a correlation of 0.94), it is vital to remember that correlation assumes a linear relationship, hence, one cannot draw a strong conclusion that tax has a positive relationship with economic growth, particularly when the functional form is unknown. It is essential to conduct inferential studies such as ARDL and bound test to cointegration to establish the true relationship between taxation and economic growth.

Bound testing requires that no variable is integrated above I (1), hence, the ADF unit root test was used to test the stationary of the variables. Table 6 shows the result of the ADF unit root test at the level using different models. Table 6 shows that all the series are non-stationary at level. To ensure that none of the variables was integrated above I (1), an ADF test was carried out at first difference and the result is presented in Table 7, and the results show that none of the variables is integrated above I (1) regardless of which model is used so the condition of bounds testing is met.

Table 6. ADF Unit Root Test (Level)

Variables	None Model [6] t-statistics	Constant Model [7] t-statistics	Constant &Trend Model [8] t-statistics	SIC Lag
g	2.275549	0.215199	0.302582	1
c	2.112560	-0.201875	-2.432607	1
k	2.321808	1.323512	-0.802085	1
x	-0.592585	-1.8764	-1.850122	1
i	2.32180	1.323512	-0.802085	1
t	3.252819	1.785206	-0.650779	6

Source: Authors computation. The critical values at 5% significance for Models (6), (7) and (8) are -1.946, -2.910, and -3.485 respectively. The optimal lag lengths were chosen according to SIC. ***p < 0.01, **p < 0.05, *p < 0.

Table 7: ADF Unit Root Test (First Difference)

Variables	None Model [6] t-statistics	Constant Model [7] t-statistics	Constant &Trend Model [8] t-statistics	SIC Lag
$\Delta \boldsymbol{g}$	-8.062258***	-8.618119***	-8.665095***	0
$\Delta \boldsymbol{c}$	-8.062258***	-8.573619***	-8.538647***	0
$\Delta \boldsymbol{k}$	-8.062258***	-8.435546***	-8.885013***	0
$\Delta \boldsymbol{x}$	-8.062258***	-8.00318***	-8.01326***	0
$\Delta \boldsymbol{i}$	-8.062258***	-8.765694***	-9.2867***	0
$\Delta \boldsymbol{t}$	-9.510716***	-9.794359***	-9.815773***	0

Source: Authors computation. The critical values at 5% significance for Models (6), (7) and (8) are -1.946, -2.906, and -3.479 respectively. The optimal lag lengths were chosen according to SIC. ***p < 0.01, **p < 0.05, *p < 0.1.

After confirming the stationary of the series, equation (5) was estimated. The results give short-run coefficients, bounds testing for cointegration, and long-run coefficients which are presented in Tables 8, 9, and 10, respectively. To save space, in Table 8 only the coefficients of the variable of interest (tax revenue) are reported. The coefficients of the other variables are reported in the appendix section.

Table 8 shows that tax revenue has both negative and positive effects on growth in the short run. The tax revenue (t) in the current quarter has a negative impact on growth, however, tax revenue in the past six quarters has a positive impact on growth, but the impact of the fourth quarter is not statistically significant. This shows that tax revenue has an immediate negative impact on current income, however, as time passes within the short run, the impact becomes positive. In the immediate short run, for every 1 percent increase in tax revenue, on average, income decreases by 0.08 percent. In the medium short run (6 quarters), on average, a 1 percent increase in tax revenue causes income to increase by 0.01 percent.

Table 8: The Impact of Tax Revenue on Growth in the Short-Run.

Variables	Short-Run Coefficients
Tax revenue: t	**-0.080898**** *(0.003967)* *[-2.264573]*
Tax revenue: t(-1)	**0.027373***** (0.008012) [3.416556]
Tax revenue: t(-2)	**0.028858***** (0.00681) [4.236899]
Tax revenue: t(-3)	**0.030432***** (0.007302) [4.167555]
Tax revenue: t(-4)	**0.010315** [0.006982] [1.477380]
Tax revenue: t(-5)	**0.018243***** (0.005879) [3.103214]
Tax revenue t(-6)	**0.012029**** (0.005227) [2.301171]
CointEq (-1)	**-0.553850 ***** (0.106476) [-5.201630]

Source: Authors computation using data from GRA and World Bank-WDI for the period 2004Q1 to 2020Q4. The estimated model is based on AIC with the lag orders of (1, 5, 5, 5, 6, 6, 7). Standard errors in ( ); t-statistics in [ ]; ***p < 0.01, **p < 0.05, *p < 0.1

From Table 9 below, the F-statistics (3.117161) is greater than the upper critical bound value at a 10 percent significance level (3.00), hence, there exists a long-run level relationship between the variables. That is, tax revenue and other independent variables in this study have a long-run impact on aggregate income.

Table 9: Cointegration Test

Dependent Variable	F-statistics	Decision
$\mathbf{F_y(y \backslash c, k, x, i, t)}$	3.117161	There is cointegration

The impact of tax revenue on income in the long run is negative and it is shown in Table 10 below. The empirical result shows that with an increase in tax revenue by one percent, on average, the income will reduce by 0.08 percent in the long run.

Table 8: The Long-Run Coefficients.

Variables	The Long-Run coefficients
Tax revenue: t	**-0.077278*** ** (0.009600) [-8.050000]
Consumption: C	**0.898233*** ** (0.018166) [-49.44547]
Investment : k	**0.092339*** ** (0.007590) [12.16562]
export: x	**-0.009417** (0.008509) [-1.106758]
Import: i	**-0.072199*** ** (0.012643) [5.710544]
Constant: c	**1.733924*** ** (0.160576) [10.79813]

Source: Authors computation using data from GRA and World Bank-WDI for the period 2004Q1 to 2020Q4. The estimated model is based on AIC with the lag orders of (1, 5, 5, 5, 6, 6, 7). Standard errors in ( ); t-statistics in [ ]; ***p < 0.01, **p < 0.05, *p < 0.1

The diagnostic test results for equation (5) are displayed in Table 11. The model passed all the standard diagnostic tests. The figures for CUSUM and CUSMQ tests are presented in Figures 1 and 2 below. From both figures, the plots of both statistics are well within the critical bound; this means that all the coefficients in the error correction model are stable.

Table 11: Diagnostic Tests

Tests	F-statistic	P-value
Normality (Jarque-Bera)	2.978277	0.225567
Serial Correlation (LM tests)	0.626110	0.5435
Heteroskedasticity	0.615373	0.9086
Ramsey RESET	0.225585	0.8234

Normality Test (Jarque-Bera) Ho: Residuals are normally distributed; Serial Correlation (LM test) Ho: There is no serial correlation; Heteroskedasticity (LM test) Ho: Homoskedascity; Misspecification (Ramsey RESET) Ho: Correct Specification. Decision Rule: Reject Ho if the probability value is less than 0.05.

Figure 1: Plot of CUSM Test

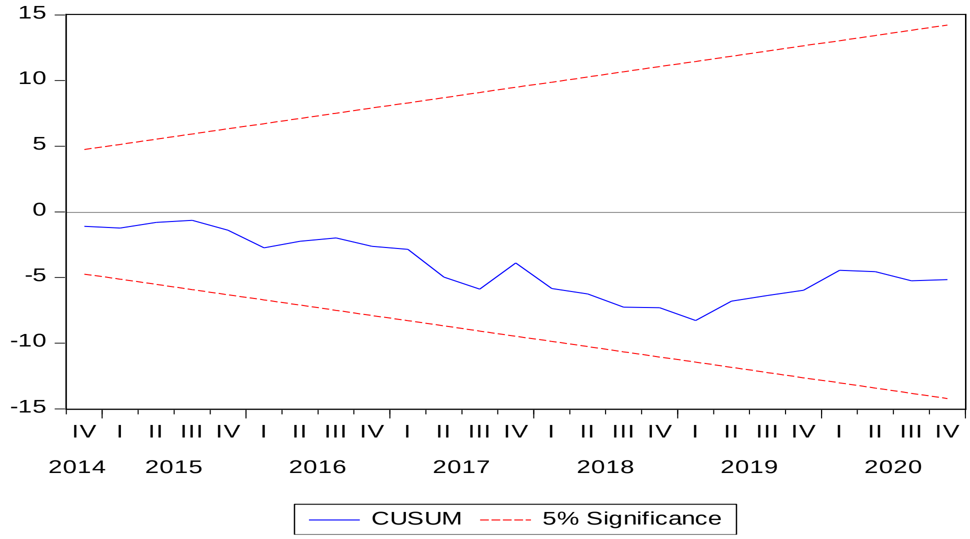
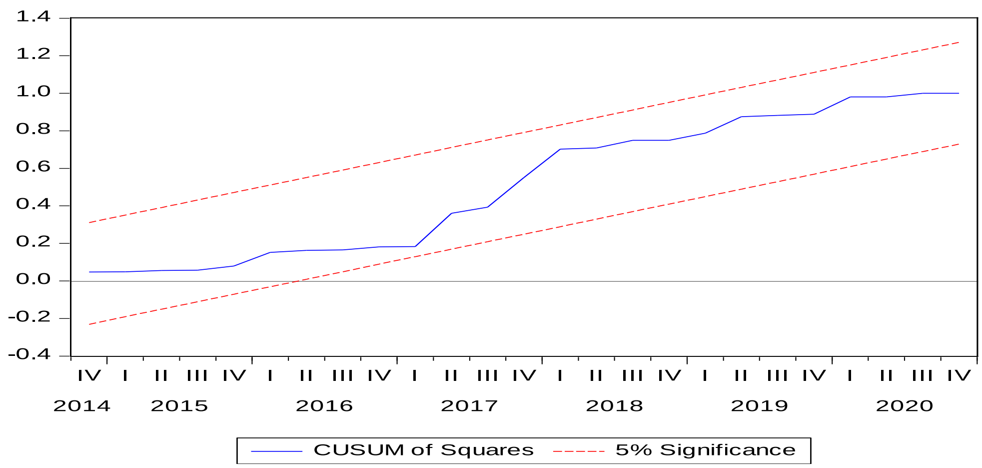


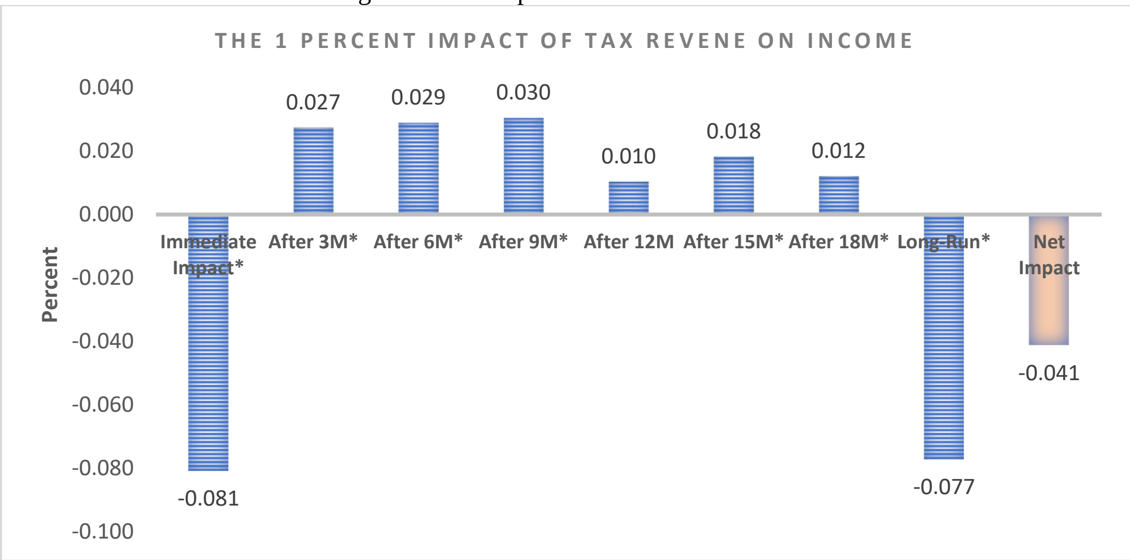
Figure 2: Plot of CUSUMQ Test



5. Discussion

The empirical results in Figure 3 show that the impact of tax revenue on income depends on the time horizon:

Figure 3: The Impact of Taxe Revenue on Income



M means month; * means statistically significant

- Immediate Impact: A 1 percent increase in tax revenue, on average, immediately leads to a decrease in income by 0.081 percent (Figure 3).
- After 3 months Impact: A 1 percent increase in tax revenue, on average, after 3 months causes income to increase by 0.027 percent (Figure 3).
- After 9 months Impact: A 1 percent increase in tax revenue, on average, after 9 months causes income to increase by 0.030 percent (Figure 3).
- After 12 months Impact: A 1 percent increase in tax revenue, on average, after 12 months causes income to increase by 0.010 percent (Figure 3), however, the relationship is not statistically significant.
- After 15 months Impact: A 1 percent increase in tax revenue, on average, after 15 months causes income to increase by 0.018 percent (Figure 3).
- After 18 months Impact: A 1 percent increase in tax revenue, on average, after 18 months causes income to increase by 0.012 percent (Figure 3).

- Long-run Impact: A 1 percent increase in tax revenue, on average, in the long-run causes income to decrease by 0.077 percent (Figure 3).
- Net Impact: Figure 3 also shows that the net impact[4] of tax revenue on income is negative (-0.041).

The empirical results show that on average tax revenue has a net negative impact on growth in The Gambia. This can be attributed to the fact that the tax revenue that the government collects is spent mainly on recurrent expenditures rather than public investments. Recurrent expenditures (wages & salaries, goods & services etc.) stimulate aggregate demand in the short run which in turn drives income in the short run. However, in the long run, the high tax rate discourages private investment, and in the end, both public and private investments are contracted, and this hurts productivity and growth. The negative long-run and immediate short-run impacts outweigh the positive impacts in the short-run, hence, the net impact of tax revenue on income becomes negative (-0.041).

6. Conclusion

While the government can raise revenue through tax to pay its current expenditure, the tax revenue has long-term consequences on the economy by dragging growth down. Hence, it is recommended to focus on broadening the tax base rather than increasing tax rates. Moreover, it is recommended that a greater portion of tax revenue is used on public investments in physical infrastructure and human capital than re-current expenditure so that the productivity of the country will be enhanced and this in turn will lead to higher economic growth and poverty alleviation.

Limitation

To have more observations, the study transformed yearly data into quarterly data for all the variables except tax revenue which is already in quarterly data. The data transformation from yearly to quarterly data might have distorted the true relationship between tax revenue and economic growth. The next study could use annual data provided that the tax revenue has 30 observations. Moreover, other advanced estimation methods such as wavelet can be

[4] Statistically significant short run impacts plus the long-run impact.

employed to find the relationship between tax revenue and growth in both the time and frequency domains.

Credit author statement:

Both authors wish to acknowledge that Alfusainey Touray was responsible for the development of section 3 (data and method) to 4 (empirical results) of the study while Ndey Jahateh was responsible for section 1 and 2 of the study. Both authors equally contributed to section 5 (discussion) and 6 (conclusion) of the paper. All authors contributed to the writing and reading of the final manuscript.

Declaration of Competing Interest:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(CONL)	0.962215	0.014919	64.49708	0.0000
DLOG(CONL(-1))	0.037608	0.016142	2.329896	0.0282
DLOG(CONL(-2))	0.052600	0.016015	3.284325	0.0030
DLOG(CONL(-3))	0.048597	0.017050	2.850347	0.0086
DLOG(CONL(-4))	-0.030059	0.018484	-1.626187	0.1165
DLOG(EX)	-0.004464	0.003069	-1.454787	0.1582
DLOG(EX(-1))	-0.000657	0.002784	-0.235926	0.8154
DLOG(EX(-2))	0.000503	0.002559	0.196539	0.8458
DLOG(EX(-3))	-0.000112	0.002638	-0.042529	0.9664
DLOG(EX(-4))	-0.020167	0.005885	-3.426588	0.0021
DLOG(EX(-5))	-0.008612	0.005967	-1.443185	0.1614
DLOG(IM)	-0.098750	0.008249	-11.97143	0.0000
DLOG(IM(-1))	-0.008640	0.008157	-1.059136	0.2997
DLOG(IM(-2))	-0.011966	0.007250	-1.650531	0.1113
DLOG(IM(-3))	-0.008222	0.007983	-1.029964	0.3129
DLOG(IM(-4))	0.028256	0.012019	2.350870	0.0269
DLOG(IM(-5))	0.020896	0.009954	2.099227	0.0461
DLOG(IN)	0.149015	0.003722	40.03664	0.0000
DLOG(IN(-1))	0.030002	0.007009	4.280302	0.0002
DLOG(IN(-2))	0.031771	0.006961	4.564271	0.0001
DLOG(IN(-3))	0.037516	0.007864	4.770633	0.0001
DLOG(IN(-4))	-0.025352	0.008072	-3.140902	0.0043
DLOG(TR)	-0.008984	0.003967	-2.264573	0.0325
DLOG(TR(-1))	0.027373	0.008012	3.416566	0.0022
DLOG(TR(-2))	0.028858	0.006811	4.236899	0.0003
DLOG(TR(-3))	0.030432	0.007302	4.167555	0.0003
DLOG(TR(-4))	0.010315	0.006982	1.477380	0.1521
DLOG(TR(-5))	0.018243	0.005879	3.103214	0.0047
DLOG(TR(-6))	0.012029	0.005227	2.301171	0.0300
CointEq(-1)*	-0.553850	0.106476	-5.201630	0.0000