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EDUCATION, HEALTH AND ECONOMIC GROWTH NEXUS: NEW EVIDENCE FROM SIERRA LEONE

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Abstract:
This study investigates the impact of health and education spending on economic growth in Sierra Leone. The study utilizes the autoregressive distributed lag estimation technique with quarterly time series data spanning from 2000Q1 to 2022Q4. The unit root test result confirms a mixture of I(0) and I(1) variables, while the bound test establishes cointegration. The long-run findings suggest that education spending has a significant negative impact on economic growth, while health expenditure is growth-enhancing. Also, the result indicates that foreign direct investment inflows boost growth, but inflation impedes growth in the long run. The short-run dynamics show that lagged economic growth has a positive impact on the current growth rate. Furthermore, the findings confirm a positive relationship between health spending and economic growth, while the lagged value of health spending and the current level of education expenditure stifle growth. The short-run findings for both FDI and inflation corroborate with the long-run results. The result of the error correction term (ECT) indicates that any disequilibrium to the model is corrected at an adjustment speed of 11.8% towards long run equilibrium. The findings of this study emphasize the need for more government spending to strengthen the health sector and also ensure accountability and transparency in the disbursement and utilization of funds for the education sector.

JEL: C22, H51, H52, O55

Keywords: education, health, economic growth, ARDL, Sierra Leone, quarterly data

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1. Introduction

The nexus between human capital and economic growth constitutes a longstanding focal point in economic inquiry. Government spending in human capital, especially health and education, plays a pivotal role in enhancing a country's economic growth and development. The relationship between education, health and growth is crucial for an economy like Sierra Leone, where the level of education, health and social well-being is far below that of other countries. Additionally, the Sierra Leone economy is characterised by low GDP per capita, poor health facilities, low life expectancy, high illiteracy rate and endemic poverty. Thus, the main issue relates to the impact of government spending on economic growth. Studies have shown that government expenditure will boost private sector spending and stimulate economic growth. It is critical to note that if government expenditure significantly affects economic growth, then the size of government can be an important factor in explaining the observed disparity in growth among different economies. A country is considered to possess greater human capital if its population is highly educated, skilled and healthy. Therefore, a highly educated, innovative, creative and healthy workforce can put an economy on track to high productivity and sustainable economic growth.

Health has a significant economic value because of its role in the individual's welfare and for economic development (WHO, 1999). Expenditure on health will improve food productivity and information about diseases. Also, a healthy workforce is an important conduit in the performance of daily life activities, boosts economic activities and promotes economic growth. A study by Arora (2001) suggests that an improvement in health will increase economic growth by 40%, while an increase in the mortality rate will decrease economic growth in developing countries. Similarly, a highly educated workforce will bring about a change in the values, tradition, culture and reforms in an economy. A well-educated workforce will increase the return on research and development and ensure that discoveries are more readily absorbed in the productive structure of the economy. Education develops a person's capability for learning, interpreting information and adapting knowledge to individual or local conditions. As a result, education is essential for a country's social and economic development. No country can achieve long-term economic progress unless its workforce is better educated and healthy (Salgur, 2013).

The theoretical paradigm on government expenditure and economic growth nexus is anchored on four schools of thought, namely, the Keynesian, Classical, endogenous and Wagner schools of thought. The Keynesian school emphasize the role of government in promoting growth. The theory suggests that government spending will induce an increase in aggregate demand, hence boosting economic growth. Thus, the theory further affirms that government spending has the potential to increase economic activity, create more jobs, promote consumer spending and enhance economic growth. Furthermore, the Keynesian doctrine suggests that during recessionary periods, the government should pursue deficit financing as a counter-cyclical measure to stabilize the economy. The Classical school proposed that an increase in government spending will

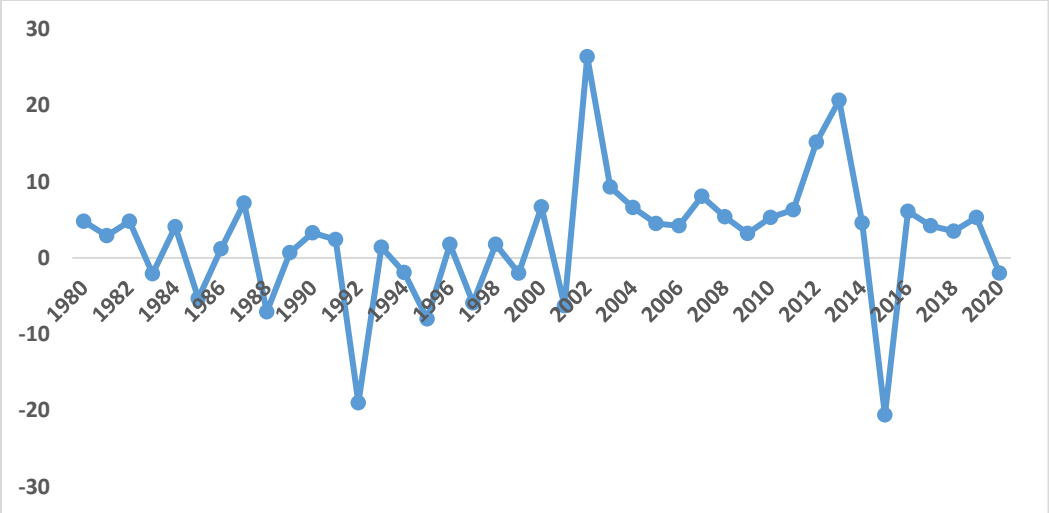
distort market mechanisms, resulting in inefficiencies and misallocation of resources. Also, the classical school suggests that an increase in taxation to fund government spending may crowd out resources available for private investment and consumption, with an adverse impact on growth. Thus, the classical school advocates for minimal government intervention. Proponents of Wagner's school hypothesize a positive relationship between government spending and economic growth. The theory suggests that as the income of an economy increases, the demand for public goods and services also increases, resulting in higher government spending. The theory emphasized that government spending on infrastructure, education and healthcare will increase productivity and boost economic growth. The Endogenous growth theory focuses on the role of technological progress and knowledge accumulation as key determinants of economic growth. Proponents of the endogenous growth theory argue that government intervention can promote innovation and resolve the market failure issue, thereby promoting the efficient allocation of resources and ensuring sustained economic development.

The empirical literature is abounding, albeit with conflicting results on the nexus between government expenditure and economic growth. Several empirical studies confirm a positive relationship between government spending and economic growth. These studies suggest that government spending in human capital, especially on education and health, is important for long-run growth. Such findings corroborate with the Keynesian theory and Wagner's theory, which emphasized the important role of government in fostering long-term growth. The empirical works by Kumar and Choudhary (2019), Hongyi and Huang (2009), Baldacci *et al.* (2004), Bloom *et al.* (2004), Krueger and Lindahl (2001) support the positive relationship between government spending and economic growth, suggesting that increase in government expenditure will boost economic growth. However, other studies found a negative relationship between government expenditure and growth. They suggest that government spending on human capital hinders long-term growth. Proponents in support of the inverse relationship between government expenditure and economic growth include Bils and Klenow (2000); Abdullah (2013), Buthelezi (2023), Nguyen and Bui (2022). This view is consistent with the classical schools, which emphasized that government spending may hinder growth. The study by Wong Sing Yun (2021) examines the relationship between education expenditure, healthcare expenditure, and economic growth in Malaysia from 1980 to 2012. Using the VECM, their findings confirm a positive relationship between public education investment and healthcare spending on economic growth. Also, the study by Hongyi and Huang (2009) on China for the period 1978-2005, reveals that government spending on both health and education foster economic growth in China, while the study by Ogundari and Awokuse (2018) confirms that government spending on health is more important than education for growth for a panel of 35 countries over the period 1980-2008.

Sierra Leone's growth trajectory remained positive in the early 1980s, with an average growth rate of 2.7 percent (see Figure 1) between 1980-1985, propelled by increased economic activity in the mining and industrial sectors, as well as government

investment in basic infrastructure following the hosting of the Organization of African Unity (OAU) Summit in 1980. The growth momentum slowed between 1986 and 1990, following a contraction of the economy by -0.9 percent, partly due to poor export performance, high inflation rate, which peaked at 179 percent in 1987, huge budget deficit, fall in real interest rate and weak exchange rate. The country slumped into recession in the 1990s following the civil war, which lasted for 10 years (1991-2000), as well as the military coup d'état of April 1992 and May 1997, respectively, which affected economic activities in the agriculture, mining and service sectors. The post-war period witnessed a resurgence in economic activities in the agriculture, mining, services and manufacturing sectors due to the emergence of economic reform programmes and heightened security. Thus, growth rebounded as the country recorded an increase in growth rate from 3.8 percent in 2000 to 5.0 percent in 2010 (Tarawalie and Jalloh, 2021). Following an increase in economic activities in the mining sector, iron ore production and export surged significantly, resulting in an impressive real GDP growth rate of 15.2 percent in 2012, which further increased to 20.7 percent in 2013. The outbreak of the Ebola Virus Disease (EVD) and fall in iron prices dwarfed the growth momentum, with a decline in real GDP to 4.6 percent in 2014 and a contraction of the economy by 20.1 percent in 2015. However, since 2016, the country witnessed positive growth trajectory, which was reversed in 2020 due to the COVID-19 pandemic, which caused a slump in growth to -2.0 percent. Notwithstanding the setback in 2020, growth momentum rebounded in 2021 following the resuscitation of economic activities. However, it is worthy to note that in spite of the effort made by the authorities during the post-war era in terms of attracting foreign investment, increase in government spending on human capital and basic social amenities, re-branding of the economy, yet growth remains sluggish, while the country continue to witness abject poverty, poor infrastructure, high inflation, large budget deficit and weak external sector performance

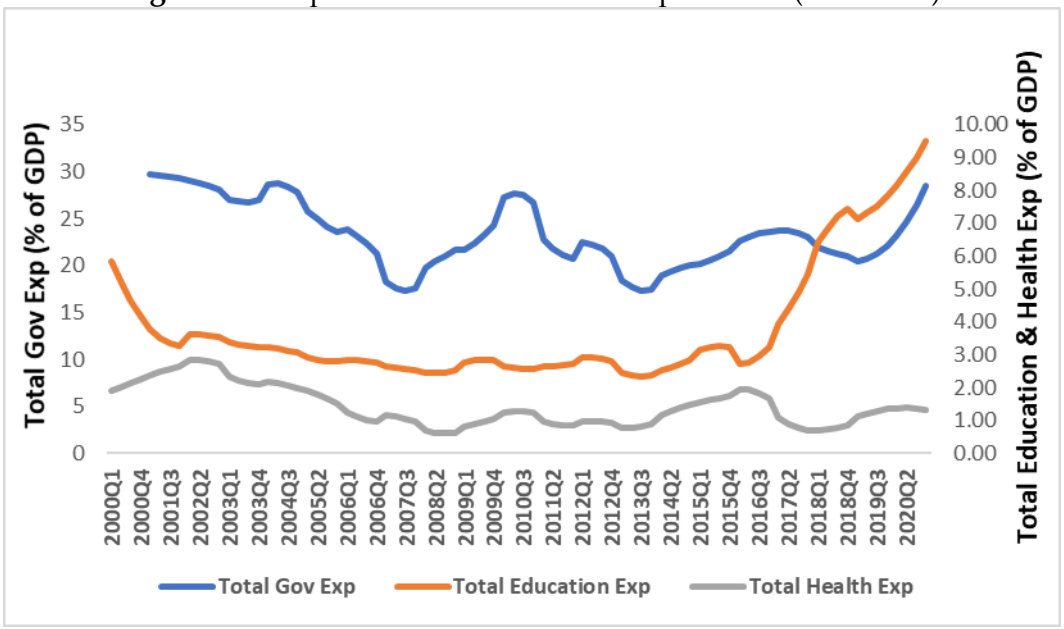
Figure 1: GDP Growth (%)



Source: World Development Indicators, 2023

Government spending during the post-war period continues to increase largely on account of high demand for education and healthcare services, improvement in basic infrastructure, including road network and power supply, as well as the provision of basic goods and services. As evident in Figure 2, total expenditure remains high, averaging over 20% of GDP during the review period. The surge in total expenditure was largely driven by the government's quest to rebuild the damaged and dilapidated infrastructure following the end of the civil war, the implementation of the disarmament, demobilization and reintegration (DDR) and the adoption of various economic recovery programmes. Further analysis of the graph shows that education expenditure, although relatively stable, it however witnessed modest increases between 2001 and 2012, averaging 3.0 percent of GDP. The modest increase was a result of government investment in the construction and rehabilitation of schools within the country, the recruitment of more teachers and the supply of school furniture. Since 2018, there has been a significant increase in government spending on education, due to a rise in investment in education projects, an increase in teachers' salaries, the establishment of new tertiary institutions across the country, and the introduction of the "Free Quality Education Programme (FQE)". Following the end of the civil war, government spending on health care services increased between 2000 and 2002, averaging 2.5 percent of GDP. The reconstruction and rehabilitation of health care facilities, as well as the recruitment of health care personnel, contributed to the surge in government spending in the health sector. As evident from Figure 2, between 2010 and 2016, the country witnessed a rise in government spending on health, driven by the government's adoption of the Free Healthcare Initiative (FHCI) program in 2010 for pregnant women, lactating mothers and under-five children, and the fight against the Ebola disease. Furthermore, since 2019, there has been a rise in government spending in the health sector following the outbreak of the COVID-19 pandemic.

Figure 2: Components of Government Expenditure (% of GDP)



Source: International Monetary Fund (IMF) Reports on Sierra Leone (2001 – 2022)

In spite of the growing literature on the impact of health and education spending on economic growth, the empirical evidence has produced mixed and inconclusive outcomes. Furthermore, studies on Sierra Leone are limited in scope and coverage and do not provide a clear link between the health, education and economic growth relationship. In contrast with other studies that focus only on total government expenditure, this study uses both education and health spending to assess the impact of human capital on growth in Sierra Leone. In addition, the authorities continue to pursue several reform measures in the education and health sectors, with a view to enhance efficiency and increase productivity. Despite the high government spending in these sectors, the country's growth performance remains sluggish. Hence, the aim of this paper is to examine the impact of health and education expenditure on economic growth in Sierra Leone. The study utilizes quarterly time series data for the period 2000Q1 to 2022Q4 within the autoregressive distributed lag framework. Following the introduction, the rest of the paper is organize as follows. Section 2 reviews the empirical literature, while Section 3 provides the methodology and data. Section 4 presents the results and discussion of key findings, and Section 5 concludes the study and proffers recommendations.

2. Literature Review

Empirical studies on the impact of health and education expenditure on economic growth have been largely documented in the literature, albeit with conflicting and inconclusive results. While some studies found positive impacts, others established negative relationships. The empirical literature is classified into three parts. The first part deals with the impact of health and education expenditure on growth. In this regard, the study by Ojo and Ojo (2022) provides new evidence concerning the relationship between health and education expenditure on economic growth. They utilize an error correction model (ECM) and the principal component analysis (PCA) to investigate the impact of health and education expenditure on economic growth in Nigeria from 1981 to 2019. Their finding suggests that government expenditure on education and health has a positive and considerable impact on economic growth. Similarly, Yun (2021) employs the Johansen co-integration technique and the Vector Error Correction Model to examine the link between education expenditure, health care expenditure, and economic growth in Malaysia from 1980 to 2012. The empirical results depict a long-term positive relationship between education and healthcare spending on economic growth. Eggoh, Houeninvo, and Sossou (2015) use traditional cross-section and dynamic panel techniques to examine the relationship between human capital (education and health) and economic growth for a large sample of 49 African countries from 1996 to 2010. Within the framework of a GMM approach, the researchers discover that public expenditures on education and health harm economic growth. Using country-specific data, Berihun (2014) investigates the impact of government expenditure on economic growth in Ethiopia over the period 1975–2013, with a particular focus on sectoral expenditure on agriculture, defense, health and education sectors. The findings show that expenditure on the health and education

sectors positively affected economic growth, while expenditure on agriculture and defense impacted growth negatively.

The second group of empirical literature relates to studies on the relationship between education expenditure and economic growth. The study by Okerekeoti (2022) investigates the impact of government education spending on economic growth in Nigeria from 1999 to 2020. The findings provide evidence of a positive relationship between public education spending and growth. Similarly, using Nigerian data, Ayeni (2018) examines the relationship between educational expenditure and economic growth. Employing the Auto Regressive Distributed Lag (ARDL) model, the study concludes that recurrent expenditure impacts economic growth positively, while the effect of educational capital expenditure on economic growth was insignificant. Furthermore, within the framework of cointegration and error correction technique Ogujiuba and Adeniyi (2004) examine the impact of government education expenditure on economic growth in Nigeria over the period 1970 to 2003. Their empirical findings show that expenditure on education promotes growth in Nigeria. Employing an OLS estimation technique, Odeleye (2012) analyse the impact of government education expenditure on economic growth in Nigeria using data from 1985 to 2007. His findings conclude that government recurrent education expenditure has a positive impact on growth. Nuru1 and Gidey (2020) examine the effect of government educational expenditure on economic growth in Ethiopia using quarterly data from 1998Q1-2015Q4. Utilizing the VAR model, the results from the impulse responses indicate a positive relationship between education expenditure and growth. Using similar VAR methodology for Ghana, Owusu-Nantwi (2015) analyse the nexus between public education spending and economic growth from 1970 to 2012. The result supports a positive relationship between public education spending and economic growth. Douanla and Abomo (2015) also employ the VAR model to analyse the relationship between government education expenditure and economic growth in Cameroon from 1980 to 2012. Their findings reveal that government education expenditure and growth are positively related both in the long run and the short run.

Furthermore, Gheraia *et al.* (2021) examine the relationship between government education expenditure and economic growth in Saudi Arabia for the period 1990 to 2017 using the quantitative method. The results establish a positive relationship between education spending and growth. In addition, Sunde (2017) utilizes the ARDL bounds approach and the Granger causality test to evaluate the impact of public education expenditure on economic growth in Mauritius. Using data from 1976 to 2016, the study confirms that public education spending promotes growth. Yousra, Aziz and Monir (2014) employ the Johansen Cointegration and Granger causality to examine the impact of government education spending on economic growth in Algeria. Employing data from 1974 to 2012, the findings reveal that education expenditure boosts growth. Using similar methodology, Bosupeng (2015) analyse the impact of government education on economic growth in Bostwana from 1960 to 2013. The empirical findings unveil that government education expenditure dampens growth. Using data for 49 African countries, Eggoh *et al.* (2015) assess the nexus between public education expenditure and economic growth using a GMM model for the period 1996 to 2010. Their results indicate that public

education expenditure has a negative relationship with growth both in the long run and the short run.

The last set of empirical literature focuses on the relationship between health expenditure and growth. A study by Ercelik (2018) employs the ARDL estimation technique to evaluate the nexus between health expenditure and growth in Turkey from 1980 to 2015. The result confirms that public health spending supports long-run growth. Similarly, using data for Turkey, Atilgan, Kilic and Ertugrul (2017) employ the ARDL to examine healthcare spending on growth for the period 1980 to 2015. They disintegrated healthcare expenditure into private health spending and public health spending within the same time period. Their findings reveal that both healthcare spending (private and public) positively drive growth in Turkey's economy. Utilizing the ARDL technique, Boachie (2017) examines the relationship between economic growth and health spending in Ghana for the period 1982 to 2012. The findings suggest that expenditure on health promotes growth both in the long and short run. Ogundipe and Lawal (2011) analyse the impact of health expenditure on economic growth in Nigeria using OLS estimation with data from 1970 to 2010. Their findings reveal that government health expenditure hinders growth in Nigeria. Employing data for Algeria from 1974 to 2014, Taiba, Boussalem, and Boussalem (2014) use the Error Correction Model (ECM) to examine the relationship between public spending on health and economic growth in Algeria. Their findings establish a positive relationship between health expenditure and growth.

Using panel data from 1995 to 2014, Aboubacar and Xu (2017) evaluate the link between public health expenditure and economic growth in Sub-Saharan Africa using the GMM estimation. The result concludes that public health expenditure significantly fosters the growth of the region. Atems (2019) employs a similar methodology to investigate the relationship between public healthcare expenditure and economic growth in the United States using data from 1963 to 2015. The findings provide evidence of a positive relationship between healthcare expenditure and growth. David *et al.* (2003) utilize the non-linear two-stage least squares estimates (2SLS) to assess the relationship between public health expenditure and economic growth in 104 countries from 1960 to 1990. Their findings conclude that health expenditure is positively correlated to economic growth. In a similar vein, Halici-Tuluce *et al.* (2015) examine the relationship between public health spending and economic growth for 19 low-income and 25 high-income countries for the periods 1995 to 2012 and 1997 – 2009, respectively. The study confirms that in both scenarios, health expenditure exhibits a negative relationship with economic growth.

Within the Sierra Leone context, Tarawalie and Pokawa (2024) investigates the relationship between investment in human capital, military expenditures and economic growth in post-war Sierra Leone with quarterly data from 2000Q1 to 2020Q4. Employing an ARDL estimation methodology, the study reveals that military spending positively influences long-run economic growth, while spending on human capital has a dampening effect on growth. Using data for the same year, Bangura (2024) examines the impact of government fiscal expenditures on Sierra Leone's economic growth for the period 2008 to 2022. The study employs a casual-comparative research design as well as

the Ordinary Least Squares and Prais-Winsten AR (1) regression models. The results reveal that government expenditure on capital projects, education, and consumption has a positive and significant effect on Sierra Leone's economic growth. Furthermore, Songo–Davies (2024) investigates the effect of recurrent expenditure on economic growth in Sierra Leone, with data for the period 1992 to 2022. Employing the Autoregressive Distributed Lag (ARDL) technique, the results show that public consumption has a negative effect on economic growth in Sierra Leone, while real exchange rate, inflation and public consumption have a negative effect on real GDP growth. Also, Jackson (2022) explores the causal relationship between economic growth, government expenditure in education, and tertiary education in Sierra Leone from 2000 to 2014. Employing the unrestricted Vector Autoregression (VAR) model, the impulse response results in a strong response to the shock to government investment and RGDP. Also, the Variance Decomposition reveals economic growth (RDGP) as a major catalyst to boost human resource capacity.

Thus, discussions on the empirical studies of the growth effect concerning education and health care are quite mixed, and the results depend not only on proxy variables used for education and health, but also on the empirical methodology. Furthermore, studies that have been conducted on the education, health and economic growth relationship in Sierra Leone are limited in scope and coverage, as evident in the various empirical research works discussed above. The study by Tarawalie and Pokawa (2024) used human capital as an independent variable, which combined both education and health spending. However, this current study deviates from Tarawalie and Pokawa (2024), since it investigates the impact of both health and education expenditure on growth. Thus, this study contributes to the empirical debate regarding the education, health and economic growth nexus in Sierra Leone.

3. Data and Model Specification

In order to investigate the impact of health and education expenditure on growth, this study adopts the model of Echekoba, and Amakor, (2017), Ogunjimi, and Adebayo, (2018), albeit with some modifications based on theoretical discussions and the structure of the Sierra Leone economy. The functional form of the model used in this study is represented as follows:

$$RGDP = f(THE, TEE, MS, FDI, REER, CPI) \quad (1)$$

For estimation purposes, Equation 1 is expressed in log form as follows:

$$RGDP_t = \beta_0 + \beta_1 THE_t + \beta_2 TEE_t + \beta_3 MS_t + \beta_4 FDI_t + \beta_5 REER_t + \beta_6 CPI_t + \mu_t \quad (2)$$

Where RGDP is the real GDP, THE is total government health expenditure as a percent of GDP, TEE is total government education expenditureas a percent of GDP, MS is the money supply growth rate, FDI is foreign direct investment as a percent of GDP,

REER is the real effective exchange rate, and CPI is the CPI inflation rate measured by the consumer price index, μ_t is the error term and t is the time period.

The study employs the Autoregressive Distributed Lag (ARDL) model to investigate the impact of health and education expenditure on economic growth in Sierra Leone, a framework suitable for estimating variables with mixed order of integration. The ARDL is premised on a pretesting of the variables for stationarity using the unit root test. Additionally, the ARDL requires the determination of an optimal lag length using various selection criteria. Subsequently, the bound test for cointegration is conducted in order to determine the long-run relationship among the variables. Once cointegration is confirmed, the study will estimate the ARDL short-run error correction model and a long-run model.

Thus, to conduct the ARDL cointegration Bounds Testing Approach, Equation 2 is transformed into an unrestricted ARDL model as specified below:

$$\Delta RGDP_t = \alpha_0 + \Sigma_{i=1}^{m}\delta_1\Delta RGDP_{t-1} + \Sigma_{i=1}^{n}\delta_2\Delta THE_{t-1} + \Sigma_{i=1}^{n}\delta_3\Delta TEE_{t-1} + \Sigma_{i=1}^{n}\delta_4\Delta MS_{t-1} + \Sigma_{i=1}^{n}\delta_5\Delta FDI_{t-1} + \Sigma_{i=1}^{n}\delta_6\Delta REER_{t-1} + \Sigma_{i=1}^{n}\delta_7 CPI_t + \gamma_1 RGDP_{t-1} + \gamma_2 THE_{t-1} + \gamma_3 TEE_{t-1} + \gamma_4 MS_{t-1} + \gamma_5 FDI_{t-1} + \gamma_6 REER_{t-1} + \gamma_7 CPI_{t-1} + \mu_{t\,3} \quad (3)$$

Where Δ is the first difference operator, α is the constant, $\delta(1, 2, \ldots\ldots 7)$ are the short-run coefficients, $\gamma(1, 2, \ldots\ldots 7)$ are the long-run coefficients to be estimated, "$m\ and\ n$" are the maximum lags, and the μ is the error term.

To confirm cointegration, we test the coefficients of the long run to ascertain the existence of a long-run relationship. We specify the null and alternative hypotheses:

H_0: $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = 0$, there is no cointegration

H_1: $\gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq \gamma_6 \neq \gamma_7 \neq 0$, there is cointegration

With reference to the above hypothesis, the study proceeds with the computation of the F-statistic, which is compared with the upper and lower bounds of the critical values (see Pesaran *et al.*, 2001). The lower bound is built on the assumption that all the explanatory variables in the model are integrated of order zero I(0), whilst the upper bound postulates that the explanatory variables are integrated of order one, I(1). Thus, if the F-statistic exceeds the upper critical bound value, we accept the alternative hypothesis, confirming cointegration. But if the F-statistic is below the lower bound critical value, we accept the null hypothesis, indicating the absence of cointegration. If cointegration is established, we re-specify Equation 3 into a short-run ECM as follows:

$$\Delta RGDP_t = \alpha_0 + \Sigma_{i=1}^{m}\gamma_1\Delta RGDP_{t-1} + \Sigma_{i=1}^{n}\gamma_2\Delta THE_{t-1} + \Sigma_{i=1}^{n}\gamma_3\Delta TEE_{t-1} + \Sigma_{i=1}^{n}\gamma_4\Delta MS_{t-1} + \Sigma_{i=1}^{n}\gamma_5\Delta FDI_{t-1} + \Sigma_{i=1}^{n}\gamma_6\Delta REER_{t-1} + \Sigma_{i=1}^{n}\gamma_7\Delta CPI_{t-1} + \lambda ECT_{t-1} + \mu_t \quad (4)$$

The short run ECM as specified in Equation 4, is expressed in first difference which include the error correction term (ECT), representing the speed of adjustment that corrects for any disequilibrium.

The study utilizes quarterly time series data from 2000Q1 to 2022Q4. The quarterly data were generated from annual data series using the linear low-to-high frequency conversion method in Eviews. Data for the study were obtained from the World Bank Economic Output website and the International Financial Statistics of the IMF.

4. Empirical Results and Discussion

4.1 The Unit Root Test

To proceed with the ARDL estimation procedure, the study performs the unit root test to ascertain the stationarity of the variables, including RGDP, THE TEE, MS, FDI, REER and CPI. The rationale is to avoid the estimation of spurious regression and also to validate the use of the ARDL methodology, which is more appropriate for variables with mixed integration. The Augmented Dickey-Fuller (ADF) unit root test is utilized in this study, and the result is presented in Table 1. The test was conducted at the level and first difference (if applicable) using the intercept as well as the intercept and trend.

The result confirms that THE and REER are stationary in levels, that is, they are integrated of order zero [I(0)]. The result further suggests that RGDP, TEE, MS, FDI and CPI are stationary in first difference. This implies they are integrated of order one, i.e I(1)

Table 1: Unit Root Test Results (ADF Test)

Augmented Dickey-Fuller (ADF) Test					
Variables	**At Level**		**1st Difference**		**Order of Integration**
	Intercept	**Trend and Intercept**	**Intercept**	**Trend and Intercept**	
RGDP	0.2614	0.3604	0.0003***	0.0013***	I(1)
THE	0.0192**	0.0173**	-	-	I(0)
TEE	0.2359	0.3424	0.0182**	0.0412**	I(1)
MS	0.7712	0.2852	0.0042***	0.0282**	I(1)
FDI	0.1210	0.3636	0.0131**	0.0465**	I(1)
REER	0.00173***	0.0044***	-	-	I(0)
CPI	0.7498	0.7589	0.0443**	0.0351**	I(1)

Note: ***, **, and * represent significance level at 1%, 5% and 10% respectively.
Source: Computed by the Authors.

4.2 Optimal Lag length

The study also performs the lag length selection criteria to obtain the appropriate lag length for the model. The study employs five (5) selection criteria, including the Log Likelihood (LogL), Sequential Modified Likelihood Ratio (LR) test statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Criterion (HQ). The lag length result is presented in Table 2. Critical analysis of the result confirms lag length two (2) as the most preferred

lag length for the model, as evident by strong improvement in the AIC, SC, HQ and FPE criteria.

Table 2: Optimal Lag Length Selection Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-19.12017	NA	0.207611	1.261403	1.589068	1.382236
1	-12.7562	10.06391*	0.182077	1.041918	1.480541	1.197854
2	-12.15624	0.920914	0.165516*	1.030523*	1.440104*	1.181564*
3	-12.11556	0.060545	0.173580	1.075142	1.525682	1.241287
4	-11.84648	0.387980	0.180228	1.109138	1.600636	1.290388

Source: Authors' computation.

4.3 Cointegration Test

The bound test of the cointegration approach test for the existence of any long-run relationship between the variables. The F-test is used to test the joint significance of the coefficients of the lagged level variables. It tests the null hypothesis of no cointegration against the alternative of cointegration. The calculated F-statistic is compared with the critical value tabulated by Pesaran *et al.* (2001). The bound test result is reported in Table 3. The results show an F-statistic of 5.305, which exceeds both the lower and upper critical bound, indicating statistical significance at the 1%, 5% and 10% levels, respectively. The result confirms the existence of cointegration, indicating the existence of a long-run relationship.

Table 3: Bounds Test for Cointegration Results

Test statistic	Value	Sig.	I (0)	I (1)
f-statistics	**5.305**	10%	2.24	3.13
k	6	5%	2.55	3.31
Asymptotic: n=1000		1%	3.23	4.34

Source: Authors' computation

4.4 Long Run Analysis

The existence of cointegration, as evident from the ARDL bound test result, provides a justification for the estimation of a long-run model, and the regression result is presented in Table 4.

Table 4: Results of the Long Run Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TEE	-0.392791	0.083009	-4.731923	0.0000
THE	0.225119	0.085502	2.632909	0.0104
MS	-0.402271	0.300521	-1.338518	0.1021
REER	-0.298898	0.182510	-1.637710	0.1058
FDI	0.055824	0.017432	3.202386	0.0045
CPI	-0.306729	0.145954	-2.101546	0.0428
Cons.	21.44682	0.827424	25.91999	0.0000

Source: Authors' computation.

Critical analysis of the result in Table 4 reveals a negative relationship between total education expenditure (TEE) and real GDP (RGDP). Specifically, a one-percentage increase in education expenditure results to a decline in economic growth by 0.4%. A similar result was obtained by Devarajan and Vinay (1993), Devarajan *et al.* (1996), and Eggoh *et al.* (2015). Plausible reasons for the negative relationship might be due to leakages within the education sector, as well as misallocation and mismanagement of resources meant for the sector. Thus, the budget allocation to the education sector is mostly not fully utilized for the intended purpose; rather, such funds are being diverted for other uses.

However, the findings show that total health expenditure has a positive impact on economic growth in the long run, a result consistent with the empirical works of Chakroun (2024). Mustafa and Ansari (2021). The result confirms that a percentage increase in health spending will boost economic growth by 0.2%. Government spending in the health sector centred around the construction and renovation of health facilities, recruitment of health workers, increase wages and salaries of health workers and the implementation of numerous healthcare projects, this generates a rise in income and workers' productivity, as well as a decrease in both maternal and child mortality rates, with positive impact on growth.

In terms of the control variables, the findings suggest that inflation (inf) has a negative impact on economic growth, while foreign direct investment (FDI) inflows have a positive effect on growth. Hence, a one-percentage point increase in domestic prices will decrease economic growth by 0.3%, a result that bodes well with the findings by Ojo and Ojo (2022). Inflation increases the cost of production, thereby reducing profitability, which may dampen the growth potential of the economy. Additionally, high domestic prices will reduce consumption by households, which will adversely affect aggregate demand with negative consequences on output growth. Also, the results reveal a positive relationship between FDI inflows and economic growth. A one-percentage point increase in FDI inflows will enhance growth by 0.1%. FDI inflows in Sierra Leone are largely towards the mining, telecommunication and services sectors, resulting in an increase in economic activities in these sectors, with a positive impact on output growth.

4.5 Short Run Analysis

The study estimates the short-run ARDL error correction model (ECM), and the results are presented in Table 5, with variables in first difference. The error correction term (ECT) is statistically significant with a negative sign. The result suggests that any disequilibrium to the model is corrected at an adjustment speed of 11.8% towards long run equilibrium, a result that denotes a weak speed of adjustment. Furthermore, the adjusted R-squared value indicates that about 80% of any disturbance to the dependent variable is accounted for by the explanatory variables, while the F-statistics show a good fit of the model. Also, a Durbin-Watson statistic of 2.04 suggests no evidence of autocorrelation in the model.

Table 5: Short run ADRL (ECM) Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.117834	0.019974	-5.899340	0.0000
RGDP(-1)	0.657479	0.059161	11.11341	0.0000
TEE	-0.432650	0.215462	-2.008011	0.0492
THE	0.051924	0.016694	3.110311	0.0027
THE(-1)	-0.035471	0.017901	-1.981560	0.0516
REER(-1)	0.537651	0.429452	1.251947	0.1103
FDI	0.015771	0.003088	5.107835	0.0000
FDI(-1)	-0.014233	0.003380	-4.210333	0.0001
CPI	-0.379756	0.109998	-3.452404	0.0010
R-squared	0.826470	**Mean dependent var**		0.013193
Adjusted R-squared	0.795391	**S.D. dependent var**		0.029252
S.E. of regression	0.013232	**Akaike info criterion**		-5.664720
Sum squared resid	0.011730	**Schwarz criterion**		-5.277641
Log likelihood	239.5888	**Hannan-Quinn criter.**		-5.509529
F-statistic	26.59179	**Durbin-Watson stat**		2.045702
Prob(F-statistic)	0.000000			

Source: Authors' computation.

The short-run findings further reveal a positive relationship between previous years' growth and current period growth rate. Hence, a one-percentage point increase in lagged RGDP will boost economic growth by 0.7% in the current period. Also, the result suggests that an increase in education spending will dampen economic growth, a result that is consistent with the long-run findings. Thus, a percentage increase in education spending will decrease economic growth by 0.4%. Also, the findings confirm a positive relationship between health spending and economic growth, a result that corresponds with the long-run analysis. However, the lagged value of health spending impedes growth. The result further indicates that FDI inflow exhibits a positive impact on growth, a finding that corroborates the long-run analysis. Consistent with the long-run results, inflation exerts a dampening impact on economic growth.

4.6 Diagnostic Tests

The study performs the heteroskedasticity and stability tests, respectively, which are discussed as follows:

4.6.1 Heteroskedasticity Test

The study conducts the Breuch-Pagan-Godfrey Heteroskedasticity Test to examine whether the residuals in the regression model exhibit constant variance, i.e they are homoskedastic. The null hypothesis of the Breuch-Pagan-Godfrey Test states that the residuals are homoskedastic, i.e, they have a constant variance, against the alternative hypothesis that the residuals are heteroskedastic. The result of the Breuch-Pagan-Godfrey test is presented in Table 6. It is evident from the result that the F-statistic is 0.6186 with a probability of 0.1356, indicating that the null hypothesis is accepted, with no statistically significant evidence of heteroskedasticity in the residuals. Intuitively, the result shows that the variance of the error terms is constant in the model, and the effect of

heteroskedasticity, which results in biased standard errors and biased estimated parameters in the models, does not exist. Thus, the residuals are homoskedastic, confirming that the standard errors remain accurate and the model estimates are reliable.

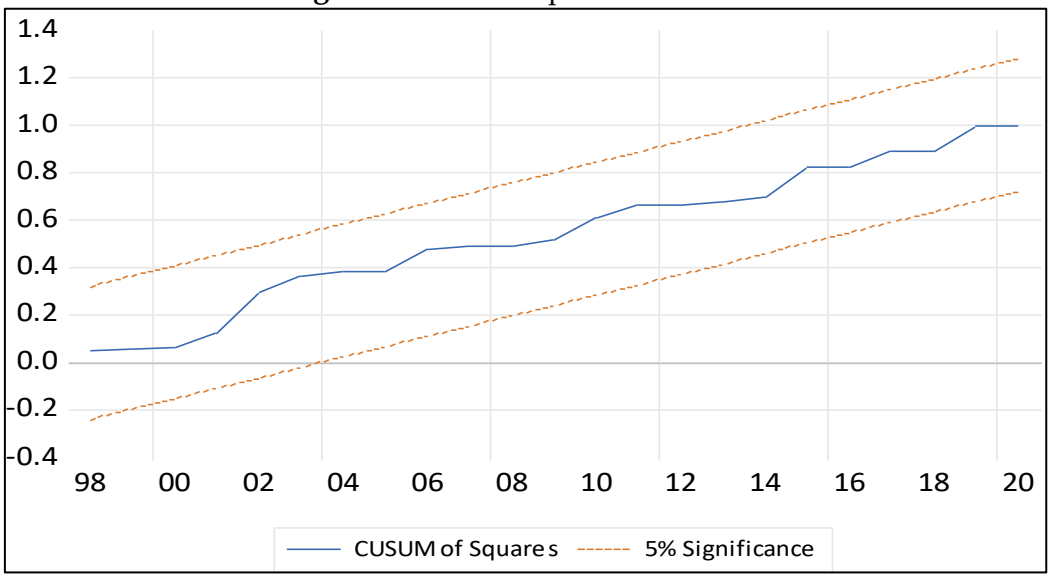
Table 6: Breuch-Pagan-Godfrey Heteroskedasticity Test Result

F-statistic	0.6186	**Prob. F(20,59)**	0.1356
Obs*R-squared	28.29531	**Prob. Chi-Square(20)**	0.1026
Scaled explained SS	72.92752	**Prob. Chi-Square(20)**	0.7801

4.6.2 Stability Test

To evaluate the stability of the model, the study used the CUSUM of squares test. Critical evaluation of the CUSUM squared test result as presented in Figure 3, confirms that the model is stable, since the test statistic lies within the 5% significance bound level.

Figure 3: CUSUM squared test result



5. Conclusion

The main focus of this study was to investigate the impact of health and education spending on economic growth in Sierra Leone. The study employed the autoregressive distributed lag estimation technique with quarterly time series data spanning from 2000Q1 to 2022Q4. The unit root test result confirmed a mixture of I(0) and I(1) variables, which further justified the choice of the ARDL modelling technique. Also, the existence of Cointegration was profound, which validates the estimation of long-run and short-run models, respectively.

The long-run regression results indicated that education spending had a significant negative impact on economic growth, while health expenditure enhanced economic growth during the study period. Furthermore, foreign direct investment inflows boost growth in the long run, but inflation dampened growth. The short-run dynamics revealed that previous years' growth had a positive impact on the current

growth rate. Also, the short-run findings confirmed a positive relationship between health spending and economic growth, a result that corroborates the long-run analysis. However, the lagged value of health spending and education spending stifled growth. The result further indicated that FDI inflow exhibited a positive impact on growth, a result that is consistent with the long-run findings, while inflation exerted a dampening impact on economic growth.

The result of the error correction term (ECT) indicated that any disequilibrium to the model is corrected at an adjustment speed of 11.8% towards long run equilibrium. Also, the adjusted R-squared value revealed that about 80% of any disturbance to the dependent variable is accounted for by the explanatory variables, while the F-statistics show a good fit of the model, and the Durbin-Watson statistics of 2.04 confirmed no autocorrelation in the model. Also, the CUSUM Squared result confirmed stability of the model, while the Breuch-Pagan-Godfrey Test indicated that the residuals are homoskedastic, validating that the standard errors remained accurate with reliable estimates.

The findings of this study emphasize the need for more government spending to strengthen the health sector. The government should invest more in the health sector by providing basic facilities in the various healthcare centres and also strengthening the capacity of the health workers. Also, the government should strengthen the Monitoring and Evaluation Unit at the Ministry of Education, as well as the audit service, to ensure accountability and transparency in the disbursement and utilization of funds for the education sector. In addition, the government is encouraged to implement prudent policies to mitigate the negative impact of inflation on growth and promote more FDI inflows.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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