Causal relationship between Education and Economic Growth in Sierra Leone

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Abstract

This paper was spurred by the need to explore the causal relationship between economic growth, government expenditure in education, and tertiary education in Sierra Leone from 2000 to 2014. In other words, the study is aimed at exploring the value addition that expenditure on education is making to growth in the Sierra Leone economy. The study commences with initial diagnostics of the basic unit root test, which revealed the presence of I(1) and I(2) for the three variables, which is sufficient for the unrestricted Vector Autoregression (VAR) model to be utilized as the main estimation technique. Other relevant post-diagnostic test outcomes like Heteroskedasticity, Serial LM Correlation, and Normality were also carried out, which indicates the model's robustness. A 10-period innovation impulse response shock shows a rapid response of immediate reaction to the variables themselves. There is even a more revealing response to the shock to government investment and RGDP, which confirms that growth in tertiary education is highly hinged on the need to boost investment in the education sector. This is highly needed to catalyze a sustained level of growth in the Sierra Leone economy. Variance Decomposition shock also manifests a similar pattern, with the resulting outcome revealing economic growth (RDGP) as a major catalyst to boost human resource capacity. The conclusion finally proffers policy action in support of the establishment of Public-Private Partnership (PPP) to facilitate meaningful economic growth and competitiveness in the country's education sector, particularly at the tertiary level.

Keywords: *Education, Growth, Investment, Causal Relationship, Sierra Leone*

JEL Classification: *I25, J24*

1. Introduction

A popular quotation by Benjamin Disraeli (15th June 1874) as highlighted here was used as a means to express the worth of education to society: "*Upon the education of the people of this country, the fate of this country depends"* (Whyte, 1994). Education is proving to be an essential asset for self-empowerment and most importantly, as a form of consumer and capital goods given the fact that it offers utility to consumers, while also serving as a valuable input in the production of other valuable goods and services (Jackson, Jackson, & Jackson, 2020; Zivengwa et al, 2013: 107). Human resource capital is an essential factor in the production of goods and services - in this regard, investment in skills development is considered very critical in paving the way for a country's developmental progress. As emphasized by Zivengwa et al (ibid), education contributes to economic growth in two ways:

- *Firstly, education affects economic growth by making individual workers more productive.*
- *Secondly, education indirectly affects economic growth through knowledge creation and technological innovation – this can be championed through means of acquiring quality education itself or as a direct input that contributes meaningfully towards development in research, capable of producing new skills*.

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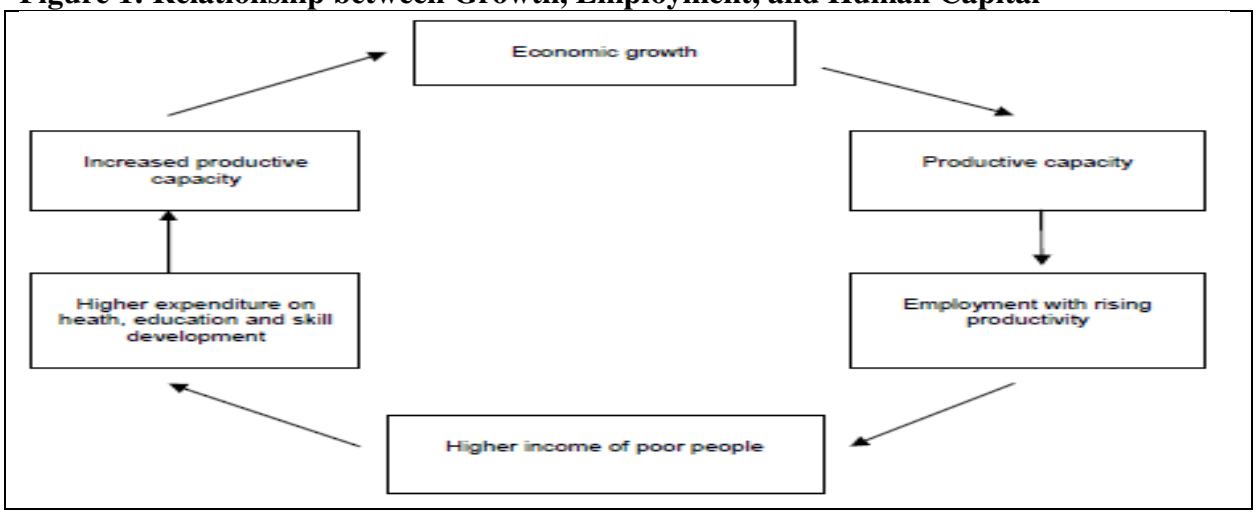
There is a high degree of mutuality that exists between human resource development and economic growth. Such an analogy is illustrated in the virtuous circle diagram provided in Figure 1 below - the diagram indicates that education is considered very important in its contribution to the economic growth of a nation. This implies that an increased growth rate in an economy has the potential of improving the employment rate, which also implies that part of the reward from investment in education can be reinvested in developing future capacity for human up-skilling. More importantly, the impact of this is likely to result in a reduction in the poverty rate, with the potential of empowering human skillsets towards meaningful future investment opportunities. This can only be achieved on the proviso of ceteris paribus conditions, notably the existence of a stable political economy environment, and supported by effective resource management in all sectors of an economy (Jackson, 2017a; Jackson, 2017b).

Figure 1: Relationship between Growth, Employment, and Human Capital



Source: Islam (2004) and excerpted from Selim (2006)

The motivation for this study is borne out of the author's thirst to discover the influence of education on growth in Sierra Leone. Sierra Leone, once perceived as the Athens of West Africa has witnessed a noticeable slump in the quality and standard of human capacity, which is needed to boost investment and sustained growth on a national scale (Jackson, 2016; Jackson, 2016b). Given years of ill-managed affairs in the country, it is almost easy for anyone to attribute the situation to an inept state of decades of governance, which is also giving rise to a brain drain of skilled workforce for greener pastures in other parts of the world (Jackson, 2016a). Such a low level of investment is resounding itself in all corners of the economy, with a noticeable dwindling gap in the area of Research and Development (R&D) when compared to similar economies in the West African Monetary Zone (Jackson, 2017).

Given the aforementioned discourse, it is therefore the aim of this study to explore the following research question: *Is there causality between investment, education, and growth in Sierra Leone?*

The undermentioned objectives are hereby set to assist the researcher in answering the above-stated research question:

- *To assess the causal relationship between economic growth and education using initial diagnostic test outcomes.*
- *To utilise the appropriate econometric technique in observance of shock responses between government investment, education, and growth in Sierra Leone.*

- *To proffer policy recommendations that support future scope for growth and development to harness a higher level of human development potential in Sierra Leone.*

Given the aforementioned introduction, the rest of the paper is detailed as follows: Section two provides a background to education and economic growth in Sierra Leone (2000-2014). Section three provides a review of relevant literature, sub-sectioned into theoretical and empirical literature relating to education, investment in tertiary education, and economic growth. Section four provides an outline of the methodology (highlighting the model specification, causality, and initial test outcomes), while section five provides the outcome of the empirical VAR result, post estimation results, and both Impulse and Variance Decomposition analysis. Section six concludes the study, with some pointers for policy action by state actors.

2. Historical Brief of Education and Economic Growth in Sierra Leone and Data Description

2.1. Briefing on Sierra Leone's Education Provision and Challenges

Sierra Leone has a long history as the first country in the West African Sub-region to experience a westernised form of education, with the relics of Fourah Bay College (FBC) established as the first constituent institution within the University of Sierra Leone framework. The University of Sierra Leone was later mandated to accommodate specialised constituent institutions like Njala University College (now an independent institution of its own – renamed as Njala University), Institution of Public Administration and Management (IPAM – originally known as the Civil Service Training College) and College of Medicine and Allied Health Sciences (COHMAS). With the need to expand higher education provision across the country, other institutions were also established, namely Milton Margai Teachers College (now Milton Margai Technical University – MMTU), Freetown Teachers College, Makeni Teachers College (Now Ernest Bai-Koroma University), Bumbuna Teachers College (now part of the Eastern Technical University of Sierra Leone), University of Makeni and many more. Given the need to expand education provision across the country after the civil crisis, there was an expanded awareness from state actors to increase the existing education provision, which also gave rise to the establishment of new emerging educational institutions across the country (ranging from primary to higher education establishments).

More recently, and particularly after the 2018 elections (Presidential and Parliamentary), a commitment was made to increase spending on education as enshrined in the Sierra Leone People's Party manifesto (SLPP, 2018). Despite challenges faced on the part of the government (e.g., low real sector base and the emerging shock of COVID-19) to increase its revenue base, more so from domestic sources to honour planned expenditures, the priority to continue with the free education system for primary and secondary education provision is stull championed (Ministry of Finance, November 2019). The higher education sector is also realizing gains from the government's increased spending on education, with commitments to expanding the existing higher education provision and as well as upgrading some institutions to the standard of a university status (SLPP, 2018). More important in the government's determination to raise the standard of education across the country, there is an effort made to clamp down on examination malpractices across the education spectrum. This is highly needed to resurrect the country's profile as the "*Athens of West Africa*", with the return of high-quality graduates transiting across the education ladder, and most importantly, the need for final year graduates from HEIs to add substantial value to work output.

2.2. Data Description

Figures 2, 3, and 4 below illustrate the three variables (sourced from the Bank of Sierra Leone Dataware system) to be utilised for the empirical analysis in this study, particularly about their pattern/trend throughout the scoping period (2000-2014).

Figure 2: Tertiary Education Spending

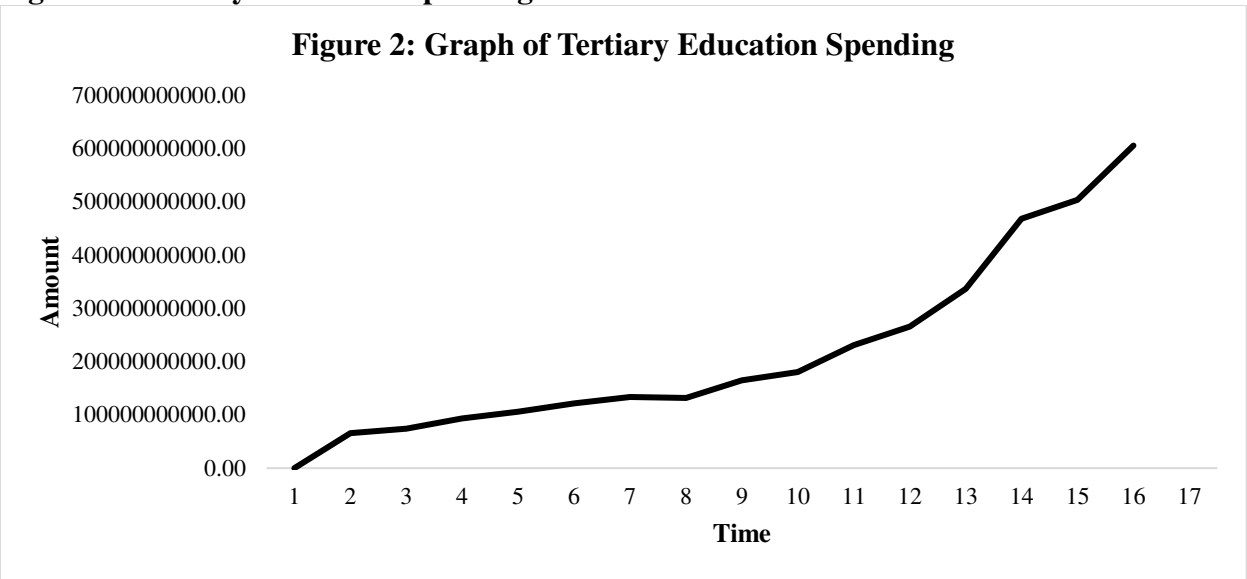
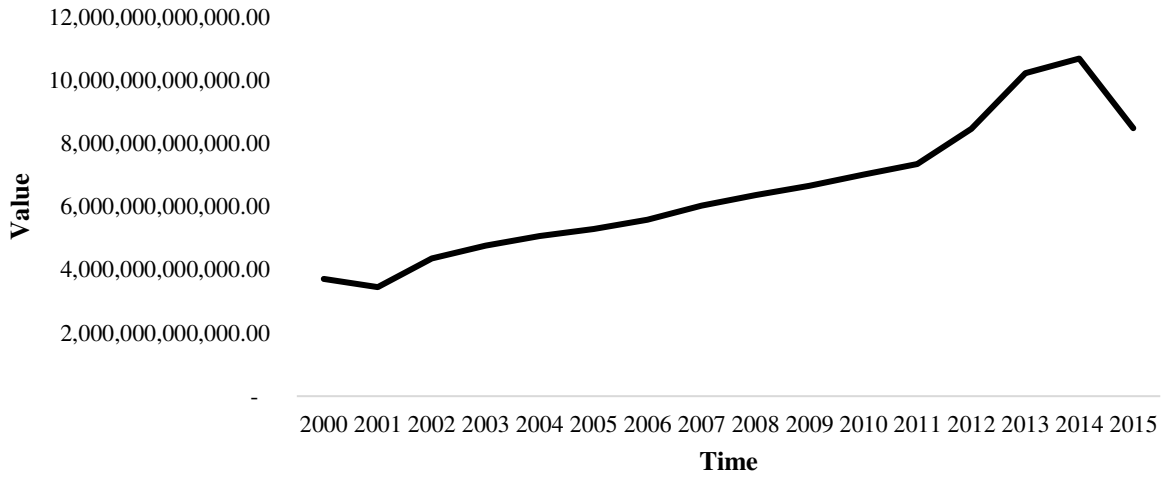


Figure 2 above is an illustration of the level of tertiary education spending over time, which manifest an increase in uptake of higher education courses across the country. Given the expansion of tertiary education establishments in Sierra Leone after the civil crisis in 2002, it is quite evident to see the upward trend in spending on education throughout the period under investigation. This is also an attestation of increased demand for students' enrolment at higher education institutions across the country, particularly in terms of the need for people to empower themselves in tertiary education learning, supposedly needed to compete in the world of work. Despite spending on tertiary education being shown to be rising, this is still not consistent with the level and standard of output from graduates graduating from universities. Equally, investments in innovation in technology are also proving to be a concern for graduates, which is required in the current information age to compete in the job market (Jackson, 2016).

Figure 3: Graph of GDP Per Capita (RGDP)



Evidence from Figure 3 shows that GDP per capita is rising gradually, despite a fall in 2001. This could be explained as on account of the aftermath of a brutal war that was experienced in the 1990s and throughout the early part of the 2000 millennium. GDP Per Capita is a clear measurement of a country's standard of living. In reality, the situation as depicted in Figure 3 above is indicative of the contribution of the country's natural wealth sector to continue generating revenue from various sources in addressing core developmental objectives (Jackson, 2016c). One question that can be raised from the above representation is: does the upward trajectory reflect reality as far as education standards and investment in tertiary education are concerned? In reality, the increased level of GDP growth does not seem to be reflective of the real investment needed to support a reasonably sustained level of growth in the country, particularly in the area of human skills, which are needed to compete in the world of work when it comes to the accreditation of prior learning (Warburton and Jackson, 2020). The growth rate around 2013-14 slowed down on account of perturbed incidences of twin shocks (commodity price slump and the Ebola epidemic) experienced in the country (Jackson & Jabbie, 2019; Jackson & Jabbie, 2020). The lagged state of diversifying real sector operation in the country during the boom time of mineral exploration is a real attestation of the present-day structural problem the country is experiencing, with a rising debt burden, both domestically and internationally (Jackson, Tamuke & Sillah, 2021; Jackson & Jabbie, 2020; Jackson, Tamuke & Jabbie, 2019).

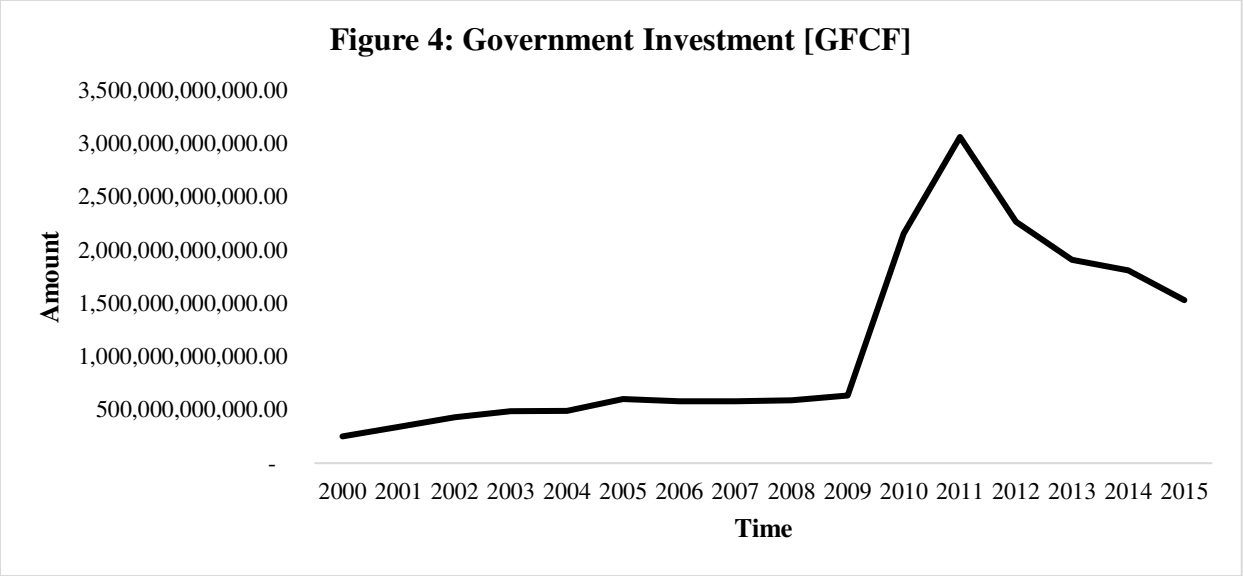


Figure 4 illustrates government investment in the economy and for which most of it is expected to be diverted towards education. The figure above manifests a slow pace in investment from 2000 to 2009. This low level of investment could be attributed to the legacy of a brutal civil war the country went through for nearly two decades. Investment growth took a steep rise from 2009-to 2011 and thereafter slowed down until 2014. This can be attributed to perturbed events in the global economy, and the over-reliance of the country to continue its importation of essential or basic commodities in a bid to sustain lives in the domestic economy. As already explained, high debt burden particularly that which is owed to international institutions, and also, mismanagement in the public services could be cited as evidence of the slow growth rate experienced in the country (Jackson, 2018 & 2017a).

3. Literature Review

3.1. Theoretical Review

Drawing from Lucas's (1988) and Loening (2002) studies, human capital is thought to be an independent factor of production, which according to Zivengwa et al (2013) is also an important element in the endogenous growth model as stated in Equation 1 below.

$$Y_t = A.K^{\alpha}H^{\theta}L^{(1-\alpha-\theta)} \quad \text{Eqn. 1}$$

This is also known as the Cobb-Douglas growth model; typically, Y is Output; A is the total factor of productivity or technological change; K is physical capital; H is human resource capital and L is the active labour force.

According to Zivengwa et al (2013), originally cited in Lucas (1988), it is a well-known fact that the growth rate in human capital is a critical factor for growth – such (human) investment is highly hinged on the need to devote time and effort incapacitating human skills development. Lucas's model was later protracted by Rebelo (1991) to accommodate physical factors, which is also an important element for growth and development. Knowledge, which is construed to be an exogenous factor in the Cobb-Douglas model is very important in supporting the innovative transformation of skills as expressed by Saffa & Jabbie (2020) and by Romer (1990) in an earlier proposition. Some authors like Benhabib & Spiegel (1994) also supported the idea of incorporating human resource capital accumulation as a key element for real economic growth in a nation.

It is a widely held belief that the growth of an economy is highly hinged on factors like the stock of physical capital, which in this case could be likened to land, buildings and also,

components like total factor productivity or innovations, and as well as, human capital stock, which in this case is quality education as expressed in the Cobb-Douglas expression in equation 1 above. In that vein, investment in education is construed as a very important engine for economic growth in the world economy (Asongu & Odhiambo, 2019). On that note, investment in education should be made sufficient enough to capacitate human potential at all levels, with the ultimate goal of transforming skillset to sustaining a high growth rate in an economy (Jackson et al, 2020; Jabbie, et al, 2020; Saffa & Jabbie, 2020).

In as much as theoretical propositions have stressed the need for investment in formal education as the key driver for economic growth (Sakamota & Powers, 1995; Schultz, 1971), effort should also be devoted to vocational education (Jackson, Jackson, and Jackson, 2020; Wall and Hindley, 2018; Wall et al; 2017). This is equally important in supporting well-balanced economic growth at the national level and also, in facilitating human innovative skillset beyond national borders.

The need to transform human skills or knowledge is highly relevant as a way of facilitating growth and development in a nation. Ilhan (2001) also made added value to the theoretical literature about the importance of education for transformative development. This should be promoted at all levels, and in an equitable manner that supports both formal and vocational education equitably to facilitate prospects for economic growth and development in a nation (Jackson & Jackson, forthcoming; Jackson, Jackson & Jackson, 2020). Both Lucas (1988 and 1998) and Mankiw (1992) also reiterated the importance of investment in human capital as a means for sustained economic growth an economy.

3.2. Empirical Literature

Suri et al (2011) carried out empirical research that explored the two-way relationship between economic growth (EG) and human development (HD). In this, they developed a panel data strategy to estimate the strength of the relationships – the outcome proved that HD plays an important role in determining growth trajectory, which is a yardstick measure of sustained growth. The study emphatically proved that, despite the relevance of HD as a major factor in determining the measurement of basic human well-being, it also came out as a critical input for economic growth. Findings from the study also illustrate the empirical relevance of endogenous growth, which seem to be consistent with threshold effect models. In terms of policy implication, the outcome proves that early focus on HD is needed to support a well-balanced economic growth, due to its direct impact on sustaining EG.

In close reference to the study at hand, Zivengwa et al (2013) investigated the causation between education and economic growth in Zimbabwe around 1980 to 2008. The empirical study was done using Pairwise Granger Causality and Vector Autoregression (VAR) model, with Unit Root Tests, given the non-stationary nature of macroeconomic time series data. The findings confirmed a uni-directional causality between education and economic growth in the Zimbabwean economy running from education to economic growth. The outcome was proven through granger causality tests, variance decomposition, and impulse response functions. The result suggests that investment in education is an important factor in economic growth. Equally, the study also shows evidence of transmission running from education to economic growth through physical capital investment, which indicates that an increase in human resource capital also supports the increased level of output on physical investment. The recommendations from this study suggest that both government and private sector should create partnerships through schemes like “Public-Private Partnerships [PPP]” to make it possible to improve the level of the education system.

Amassoma & Nwosa (2011), examined the causal relationship between human capital investment and economic growth in Nigeria to support a sustained level of development in Africa between 1970 and 2009. Vector Error Correction (VEC) and Pairwise Granger causality methodologies were utilised for this study. The variables were tested for stationarity using Augmented Dickey-Fuller and Philip Perron test - results show stationarity at the first level/difference. Co-integration test was also accomplished, and the results indicated an absence of co-integration running between Investment in human capital and economic growth. The VAR model and pairwise estimation show no causality between human capital development and economic growth. The recommendations indicate that increased budgetary allocation is needed to boost the education and health sector, and also the creation of solid vocational institutions to help facilitate rapid growth in human resource capital, which is needed to support economic growth. There was also an observed labour incongruity considered necessary to support a sustained level of economic growth. This means that policy-makers should endeavour to collaborate with employers and institutions to provide an update on the labour market and qualifications offered in a bid to add value to the education system. This is considered vital to ensure investment in education is visibly seen as making a valuable contribution to economic growth.

Empirical studies to address causal relationships between education and economic growth seem to be an ongoing exploration by researchers, both in the area of economics and in public policy. A real attestation to this relationship is a study conducted by Bils & Klenow (2000) who indicated some form of opposite causation moving from higher economic growth to additional education, which is considered vital given the causal effect of education on growth in cross-country association. Equally, De Meulemeester & Rochat (1995) equally made use of the Granger causality test between higher education enrolments and economic growth in six countries – Sweden, the United Kingdom, Japan, France, Italy, and Australia. Data for this study covered 1885-1987. The study outcome shows a uni-directional short-run causality moving from higher education enrolments to economic growth in countries like Sweden, the United Kingdom, Japan, and France. On the other hand, a bi-directional causality was found to exist between higher education enrolments and economic growth in Australia and Italy. Similar studies involving uni-directional and bi-directional relationships were also carried out by authors like Katircioglu (2009), and this time in association with Northern Cyprus & Jaoul (2004).

Despite efforts made to address concerns around the topic, an empirical exploration of a similar study in the case of Sierra Leone (with a focus on higher education investment) is very timely in support of the government's flagship on quality education, which is the ultimate way forward in addressing development prospect in the current age of transformational technology (Asongu et al, 2019; Asongu & Le Roux, 2017; Jackson, 2015). This study intends to contribute to the existing literature by providing empirical evidence in ascertaining causal relationships. The use of econometric model techniques like VAR to explore outcomes from Impulse Response and Variance Decomposition in a bid to understand the nature of the relationship between human capital and growth will be utilised. It is expected that the outcome of this study will make a valuable addition to policy recommendations geared towards capacitating a high and sustained growth rate in Sierra Leone.

4. Methodology, Model Specification, Causality, and Initial Test Outcomes

The methodological approach for this study is rooted in the foundation of ***Cobb-Douglas'*** production function and for which the Vector Autoregression technique is to be applied as the proffered empirical technique in ascertaining the causal relationship between the identified

variables. To digress into the details of the methodology, the process will commence by determining Unit Roots and Granger Causality tests for all the variables (both dependent and independent) as outlined in Section 5.1.

4.1. Unit root

Table 1: Unit Root Test Results

Variable	ADF Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Result
LGFCF_INVEST	-6.569930	-4.121990	-3.144920	-2.713751	Stationary (2) Prob: 0.0000
LRGDP	-5.288429	-4.057910	-3.119910	-2.701103	Stationary (1) Prob: 0.0013
LTERTIARY_ED	-7.717829	-4.121990	-3.144920	-2.713751	Stationary (2) Prob: 0.0001

Critical Value: ** 1%, ** 5% and *** 10% respectively*

Note: Trends and constant options have been used for first and second differencing.

The ADF test [refer to Table 1 above] was utilised with the following variables: Government (Capital) investment in Education [LGFCF_INVEST], Real Gross Domestic Product [LRGDP], and Expenditure on Tertiary Education [LTERTIARY_ED], with data spanning from the year 2000 to 2014. The result from the unit root tests shows that LRGDP is stationary at the first difference, while both LGFCF_INVEST and LTERTIARY_ED are stationary at the second difference. This then makes it more obvious to use the unrestricted VAR model given the fact that the variables are stationary at different levels. In furtherance, a diagnostic outcome like Pairwise Granger causality (a reference to Table 2) was also carried out as one of the core objectives of the study to establish the direction of and strength of causality between the variables.

Table 2: Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LTERTIARY_ED does not Granger Cause LRGDP	13	13.3928	0.0028
LRGDP does not Granger Cause LTERTIARY_ED		0.89846	0.4446
LGFCF_INVEST does not Granger Cause LRGDP	13	8.31859	0.0111
LRGDP does not Granger Cause LGFCF_INVEST		1.78350	0.2288
LGFCF_INVEST does not Granger Cause LTERTIARY_ED	13	1.11229	0.3748
LTERTIARY_ED does not Granger Cause LGFCF_INVEST		7.19245	0.0163

Source: EVIEWS Output

Results in Table 2 above (Pairwise Granger Causality Tests) indicate a uni-directional relationship running between all the variables; this also supports a priori expectation, particularly in the case of LRGP and LGFCF_INVEST, which indicate that investment is a vital indicator for economic growth in an economy. This is also considered important to support a high level of investment and growth in the Sierra Leone tertiary education system.

4.3. Vector Autoregression (VAR) Specification

As mentioned earlier, this study is set to utilise VAR as the main empirical approach having established evidence of Unit Roots (at different levels) and Causal relationships between education and economic growth in Sierra Leone. As emphasised in various empirical undertakings (Jackson & Jabbie, 2020; Jackson et al, 2020), there seems to be evidence of a weak theoretical base for the use of VAR methodology, but its relevance has been utilised to address a strong level of inter-dependence among variables. This is hereby represented as shown in Equation 2 below, also linked with the Cobb-Douglas theory as the foundational base for this study. All variables in the VAR system equation as represented in Equation 2 are treated as exogenous components, and this is

normally shown through a system of simultaneous equation analysis. The benefit of utilising VAR comes with its embedded feature of incorporating innovation through impulse response functions and variance decomposition analytics (Zivengwa et al, 2013).

$$\boldsymbol{X_t = \sum_{i=1}^{n} \beta_i X_{i-1} + \mu_i} \quad \text{Eqn. 2}$$

On application to the variable at use for this study, Eqn. 2 is now represented as:

$$\boldsymbol{X_i = (LGFCF\_INVEST_i, LGDP_i, \text{LTERTIARY\_ED}_i)} \quad \text{Eqn. 3}$$

The representation as specified in Eqns. 2 and 3 are a form of a 3x3 vector of variables and parameter $\beta_1 - \beta_n$ matrix coefficient. Where μ_i on the other hand is a vector of the error term. If a VECM was to be constructed, all variables in equation 3 should be of I(1) order, which is a first difference equation. According to Table 1 above, the variables are of varying order of integration - hence, the unrestricted VAR is hereby considered the preferred model estimation for this study (see estimation outcome in Section 5).

4.4. VAR Innovation Technology

4.4.1 Impulse Responses

The impulse response function innovation technique determines how each variable responds over the period to external change or shock. In short, the impulse response function describes the reaction of a system as a function of other independent variables that seem to have parameterized the dynamic behaviour of a system (Jackson & Jabbie, 2020; Zivengwa et al 2013). Where the impulse response function shows a stronger and persistent reaction of growth outlook to shock in education for example, then shock in other variables will lend support to the hypothesis that education is certainly a strong determinant of economic growth in Sierra Leone. Impulse response reaction for the three variables certainly helps in understanding the degree of causal effects in the estimation.

4.4.2. Variance Decomposition

This allows the conclusion to be inferred out of movement within a particular period on account of prior shocks emanating from other variables in the VAR series. Such outcome of shock can be traced through the equation system in a bid to determine its effects on the variables within the VAR systems equation, and this is also inclusive of future outcomes to the shocked variable (Zivengwa et al, 2013). The variance decomposition technique makes it possible to decompose the forecast errors for each variable emanating from a particular shock period, thereby giving an indication of which variables are more influential in terms of determining future strengths of the relationship (Jackson et al, 2020; Jackson & Jabbie, 2020).

5. Model Estimation and Analysis

5.1. VAR Estimation Result

Table 3: Vector Autoregression Estimates

Standard errors in ( ) & t-statistics in [ ]

	D(RGDP)	D(GFCF_INVEST)	D(TERTIARY_ED)
D(RGDP(-1))	-0.167166	-0.262316	0.015378
	(0.27253)	(0.50548)	(0.02232)
	[-0.61340]	[-0.51894]	[0.68888]
D(GFCF_INVEST(-1))	-0.104115	0.077043	0.030102
	(0.21189)	(0.39302)	(0.01736)

	[-0.49136]	[0.19603]	[1.73438]
D(TERTIARY_ED(-1))	10.93926	-4.236217	-0.004458
	(3.75603)	(6.96676)	(0.30766)
	[2.91245]	[-0.60806]	[-0.01449]
@TREND	2.71E+10	4.58E+10	4.13E+09
	(2.9E+10)	(5.5E+10)	(2.4E+09)
	[0.92052]	[0.83860]	[1.71302]
R-squared	0.585108	0.102845	0.639385
Adj. R-squared	0.446811	-0.196206	0.519180
Sum sq. resids	9.81E+23	3.38E+24	6.58E+21
S.E. equation	3.30E+11	6.12E+11	2.70E+10
F-statistic	4.230804	0.343905	5.319122
Log likelihood	-360.8534	-368.8846	-328.3258
Akaike AIC	56.13129	57.36686	51.12705
Schwarz SC	56.30512	57.54069	51.30088
Mean dependent	5.56E+11	1.13E+11	4.08E+10
S.D. dependent	4.44E+11	5.60E+11	3.90E+10

Source: EVIEWS Output

The most appropriate lag length of 1 as shown in Table 1 was selected based on the AIC criterion. The outcome from the VAR estimation as shown in Table 3 indicate that most of the variables are insignificant, except Tertiary Education (Tertiary_Ed) on Growth (GDP), which indicates a unit increase in Tertiary Education will increase RGDP by 10.94 units under ceteris paribus condition. The R^2 and adjusted- R^2 values, which are indicators of the explanatory power of the model reflect that approximately 58.5% and 44,7%, respectively of the difference in the dependent variable is explained by the independent variables. The F-Statistic also indicates that the variables are jointly significant in the explanation of the outcome in the dependent variable.

5.2. Diagnostic Test Results

Table 4: Stability Test Outcome

Endogenous variables: D(RGDP) D(GFCF_INVEST) D(TERTIARY_ED)

Root	Modulus
-0.576416	0.576416
0.240917 - 0.373102i	0.444124
0.240917 + 0.373102i	0.444124

Source: EVIEWS Output

The diagnostic test outcome in Table 4 shows that the model is stable, with all Modulus values less than one (1).

Table 5: Serial Correlation

Lag	LM-Stat	Prob.
1	10.89938	0.2827
2	12.04099	0.2110

Chi-square prob. with 9 df.

Source: EVIEWS Output

Table 6: Heteroskedasticity Test

Chi-sq	Df	Prob.
59.88408	48	0.1166
Source: EVIEWS Output		

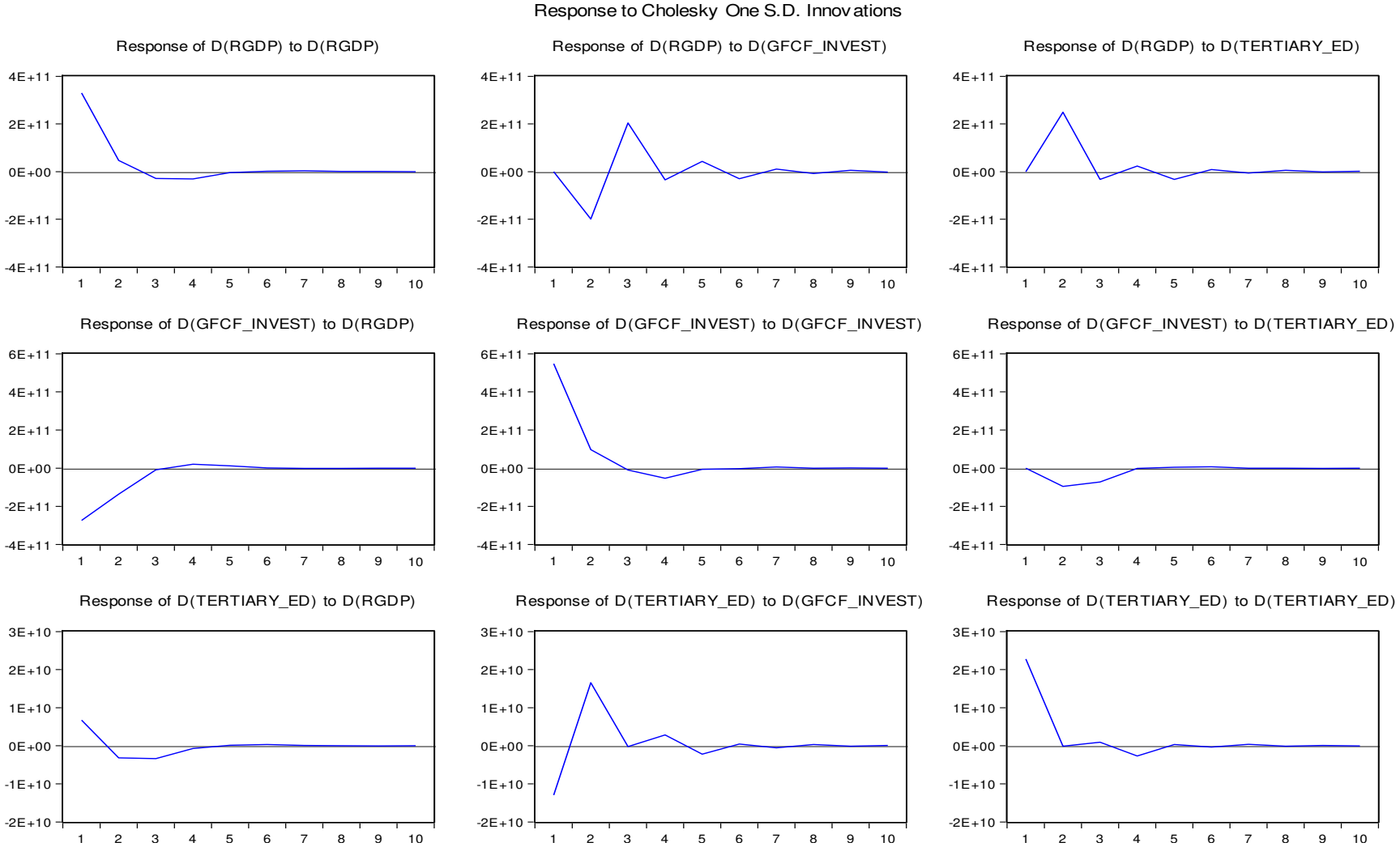
Table 7: VAR Residual Normality Tests

Included observations: 13				
Component	**Skewness**	**Chi-sq**	**Df**	**Prob.**
1	0.699661	1.060640	1	0.3031
2	0.048115	0.005016	1	0.9435
3	0.164605	0.058706	1	0.8086
Joint		1.124362	3	0.7712
Component	**Kurtosis**	**Chi-sq**	**Df**	**Prob.**
1	3.837617	0.380035	1	0.5376
2	3.085975	0.004004	1	0.9495
3	2.217268	0.331863	1	0.5646
Joint		0.715901	3	0.8695
Component	**Jarque-Bera**	**Df**	**Prob.**	
1	1.440674	2	0.4866	
2	0.009020	2	0.9955	
3	0.390568	2	0.8226	
Joint	1.840263	6	0.9338	
Source: EVIEWS Output				

The post estimation diagnostic test outcomes in Tables 4-7 shows that the VAR model utilised is very appropriate and reliable in determining the effect of education on economic growth in Sierra Leone.

5.3. Impulse Response Function and Variance Decomposition

Figure 5: Impulse Response / Variance Decomposition



Source: EVIEWS Output

Table 8: Variance Decomposition

Figure 3a: Variance Decomposition of D(RGDP):				
Period	**S.E.**	**D(RGDP)**	**D(GFCF_INVEST)**	**D(TERTIARY_ED)**
1	1.08E+11	100.0000	0.000000	0.000000
2	1.51E+11	57.42002	41.78468	0.795300
3	2.43E+11	24.48569	74.54019	0.974122
4	4.90E+11	16.89925	79.20360	3.897146
5	5.15E+11	20.80386	73.99135	5.204789
6	5.76E+11	17.74817	76.75357	5.498265
7	6.24E+11	18.70591	74.76560	6.528493
8	6.31E+11	19.22186	74.33336	6.444779
9	6.31E+11	19.26571	74.26753	6.466760
10	6.48E+11	18.67321	75.01472	6.312065
Source: EVIEWS Output				

Table 9: Variance Decomposition of D(GFCF_INVEST)				
Period	S.E.	D(RGDP)	D(GFCF_INVEST)	D(TERTIARY_ED)
1	4.90E+11	2.774464	97.22554	0.000000
2	6.38E+11	16.13627	76.37484	7.488891
3	8.01E+11	11.42914	82.96391	5.606951
4	8.99E+11	15.08316	76.61863	8.298210
5	9.06E+11	14.89816	76.87901	8.222826
6	9.09E+11	14.95523	76.40649	8.638280
7	9.10E+11	14.90929	76.47391	8.616800
8	9.47E+11	14.65560	77.17818	8.166214
9	9.53E+11	15.18278	76.47146	8.345767
10	9.77E+11	14.76098	77.04877	8.190245
Source: EVIEWS Output				

Table 10: Variance Decomposition of D(TERTIARY_ED)				
Period	**S.E.**	**D(RGDP)**	**D(GFCF_INVEST)**	**D(TERTIARY_ED)**
1	1.64E+10	42.34553	7.894465	49.76000
2	1.90E+10	32.12379	25.29418	42.58203
3	3.84E+10	18.32988	68.30239	13.36774
4	3.97E+10	19.69790	66.44424	13.85786
5	5.25E+10	16.63190	71.97565	11.39246

6	5.40E+10	18.63600	69.31337	12.05062
7	5.46E+10	18.32213	69.38330	12.29457
8	5.47E+10	18.36783	69.21967	12.41249
9	5.56E+10	18.02889	69.96530	12.00581
10	5.71E+10	18.23126	70.04798	11.72077
Cholesky Ordering: D(RGDP) D(GFCF_INVEST) D(TERTIARY_ED)				
Source: EVIEWS Output				

5.4. Analysis of Estimation Results

5.4.1. Analysis of Impulse Response Function Outcome

Figure 5 shows the impulse response functions for tertiary education (LTERTIARY_ED), Government investment in education (LGFCF_INVEST), and economic growth (LGDP). The response of the shock to variables themselves seems to be very highly significant in the initial periods as shown in Figure 5. The response of economic growth to government investment in education is rather weak or one could say insignificant throughout most of the time, except in periods three and five. The response of government investment in education to growth seemed rather insignificant throughout the shock period. This could be linked with the situation faced by successive governments' efforts to make substantial progress in attracting possible investments in the country. There is a significant response of tertiary education to economic growth, while on the other hand, tertiary education to investment is insignificant. On the whole, the outcome indicates that investment generally in education has been very low. This is affecting the scope for expanding tertiary education provision, which is also likely to impact the quality of graduate output and ultimately, slow-paced growth in the country. The outcome clearly shows that government needs to make a tremendous investment in the education system, which ultimately would impact directly on tertiary education and its overall impact resulting in a higher level of growth prospects in the Sierra Leone economy.

5.4.2. Analysis of Variance Decomposition Outcome

Tables 8-10 indicate evidence of the variance decomposition (VD) for the three variables utilised in the VAR model. The outcome shows that own shock to the system explains most of the error variance despite shocks imposed are been affected by other variables in the model. Table 8 indicate variance decomposition for economic growth (RGDP). Outcomes from the VD indicate that less than 7% of the shocks in RDGP can be explained by tertiary education, while investment in education (LGFC_INVEST) seems to be a strong influence on growth over the long-term period of shocks imposed. This confirms that government investment in education (both public and private) is a possible catalyst for investment over a longer-term period, which could explain the current action of the 2018 regime's insistence on free education for both primary and secondary education during their first term of office. This is also impactful on future standards in tertiary education provision, with the high scope of improving economic growth in the country.

The result from Table 9 shows that on average, just about 8% of government investment **(GFCF_INVEST)** is explained by tertiary education, while the outcome of economic growth is about 15% on average. This also speaks to the fact that government should focus more of its investment effort on promoting tertiary education to a high standard to make it worthwhile for the overall impact to translate highly into sustained economic growth for the Sierra Leone economy.

Table 10 shows that on average, investment in tertiary education (**TERTIARY_ED)** translated into a higher level of economic growth (on average 42%) for the first two periods of shocks, but at a diminishing pace of 18% over the remaining shock periods. On a more realistic note, a shock to tertiary education indicates a high level of government investments generally to ensure the outcome is worthwhile for the higher scope of economic growth throughout the country.

6. Conclusion, Policy Recommendations and Limitations of the Study

The empirical outcome from the initial granger causality test shows the uni-directional relationship between all the variables, which implies a strong indication to utilise the selected variables and their significance in addressing Sierra Leone's prospect for sustained economic growth. Outcomes from both the Impulse Response Function and Variance Decomposition indicate that government investment should be directed towards the tertiary education sector given its importance as an engine for economic growth in Sierra Leone. This is an affirmation that a high level of resource investment is required to enable the country to make the necessary growth expected at the Sub-Saharan African region level to start with. Such investments would be needed in areas connected with resource capacity in a bid to ensure tertiary education institutions in Sierra Leone can compete internationally through high-quality graduate outputs. Equally, there is a need for investments to be directed at capacitating human potential, which so far has received a welcoming boost from the incumbent 2018 regime through its free education package for primary and secondary schools throughout Sierra Leone (Jackson, Jackson & Jackson, 2020; SLPP, 2018). While the effort is to ensure resources are poured across the spectrum of the education system, an effort must be made to ensure a quality assurance system is set in place to monitor a high standard of delivery and where possible, through competitive assessment of higher education institutions across the country by courses and an overall ranking of institutions. This is very important to make sure tertiary education institutions in Sierra Leone are placed at par with the international system set up to rank institutions globally (Jackson, 2016).

Outcomes from the study have significant implications for the country's growth prospect, particularly at a level that is sustainably capable of ensuring graduates from Sierra Leone are well equipped to compete at the international level for high-caliber jobs or even in pursuing further studies. In this vein, investment in human capital can only be made to translate into economic growth where government investment is targeted judiciously, with a focus on Higher Education Institutions (HEIs) incapacitating quality resources for educators in a bid to narrow the skills gap across the country. The outcome of this study lends serious support to the 2018 regime change, which is aimed at boosting quality education, in addressing the country's hope of sustained growth. Here, the focus is to ensure human skillsets are targeted to challenge the ongoing creative destruction speculations in areas of technology innovation and many more (Jackson, 2020a; Jackson, 2020b).

Owing to a plethora of reasons, notably the legacy of nearly two decades of civil war and more notably, non-prudent actions of people in a position of trust (Jackson & Jabbie, 2020), it is evident that resources will need to be directed at capacitating higher education staff in a bid to equip them with the right level of skillset required to compete at international level. Equally, government investments should be directed at equipping middle-manpower skills potential. This will require a high proportion of resources directed in establishing vocational training centres across the country to support essential services that do not necessarily require graduate-level qualifications, but with the hope of ensuring qualifications earned at every level are sufficient to warrant points for progression to a degree level.

The way forward with this is to ensure education (be it vocational or formal academic) is made an essential part of the Sierra Leone government's charter. This should also ensure equality of opportunity is availed to all citizens, particularly the under-represented, mostly females and those already classed in the special education needs category. Evidence from empirical and other forms of studies has availed the contribution of women as critical in the effort to champion economic growth through their empowerment in the "*Science, Technology, Engineering and Mathematics (STEM)*" curriculum (Jackson & Jackson, 2020). The outcome of such an effort towards widening participation in the education system will also serve as a way of reducing the poverty level, and as well as a preferred option for embracing the United Nations Sustainable Development Goals (SDG) agenda earmarked for 2030 – a notable example of the SDG agenda include high growth prospect, job creation as enshrined in SDG8 charter and many more see Jackson & Jabbie, 2019).

On a final note, the effort of the government to champion growth and development with the right level of investments in education is a laudable venture. To minimise unwanted failures or bureaucracy, the government should endeavour to facilitate Public-Private Partnership (PPP) collaboration with those in the private sector to facilitate a high standard of delivery and output for graduate completion rate (also enshrined in the 2018 manifest for the regime/government). Resources utilised should regularly be monitored to ensure the system is efficiently managed and judiciously utilised for the right causes. Efforts should also be made to champion innovation in much-needed areas of real sector development to make it worthwhile for the country to minimise heavy dependence on imports of inelastic goods and services in particular, which is currently denting Sierra Leone's hope of attaining a sustained level of low / single-digit inflation (Jackson, Jabbie, Tamuke & Ngombu, 2020).

The study is limited in its use of 14 years of data on account of problems inherent in collecting annual data on GDP and tertiary education. It is hoped that future studies of this nature would make use of updated data about improving the quality of education in the country as a whole.

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