GRANGER CAUSALITY BETWEEN GROWTH IN THE EDUCATION SECTOR AND SOCIO-ECONOMIC SERVICES IN NIGERIA

Alabi, Oluwapelumi[1]* Olarinde O. B[1]

[1]Department of Mathematics and Statistics Rufus Giwa Polytechnic, P.M.B. 1019, Owo, Ondo State, Nigeria.

E-mail: oluwapelumialabi@yahoo.com

Abstract

The relationship between two variables has been mush studied using the concepts of Granger causality. In this study, Nigeria economic data from 1981 to 2015 is used to investigate the causal relationship between education sector growth and socio-economic services (education, health, road & construction and transport & communication), employing unit root test, Johansen co-integration and Granger causality approaches. The result of the study showed that there is long run Granger causality between the education growth and the recurrent expenditure on socio-economic services.

Keywords: Education growth, Socio-economic, Granger causality, Unit root, Johansen co-integration.

Introduction

The relationship between two variables has been mush studied using the concepts of Granger causality. Granger causality is a term for a specific notion of causality in time-series analysis. The idea of Granger causality is a pretty simple one: A variable *X Granger-causes Y* if *Y* can be better predicted using the histories of both *X* and *Y* than it can using the history of *Y* alone.

Granger introduced the concept of Granger causality in 1969 and it has been widely used in econometric studies to test availability and the direction of the causality (Granger 1969). Furthermore, Johansen's cointegration analysis is employed to determine any long-term relationship between the variables before the causality test. The first step in time series analysis is to investigate the

stationarity of variables, also called 'the unit root test'. Accordingly, the existence of a unit root at frequency zero would imply that the stochastic trend is non-stationary (Torraleja *et al,* 2009; Aniefiok and Udensi, 2016; Essien, M-epbari, Nwikiabeh and Piabari, 2016). Gujarati and Porter (2009) point out that it is so often to meet non-stationary time series and the estimates of non-stationary variables will lead to spurious regression. Thus, their economic interpretation will not be meaningful. Furthermore, unrelated time series may appear to be related using conventional testing applications such as ordinary least squares regression. To this end, we utilise the Augmented Dickey–Fuller test (ADF), and the Phillips–Perron test (PP) to examine whether the data are non-stationary (Dickey and Fuller 1981; Phillips and Perron 1988). The augmented Dickey–Fuller (ADF) unit root test is one of the most accepted and widely used tests to investigate the stationarity of series (Park et al. 2016).

Regression analysis based on time series data implicitly assumes that the underlying data is stationary (Gujarati and Porter 2009) and it is usually the case that time series variables of macro economy are non-stationary. Alternatively, cointegration analysis allows for spurious results to be avoided by using non-stationary data, but all those series have to be integrated into the same order. Despite the range of different cointegration tests in the literature, the Engle–Granger (Engle and Granger 1987) and Johansen (1988, 1991) tests are widely used. In this study, the Johansen cointegration test is employed to test the existence of a long-run equilibrium relationship among the variables and employed Granger causality analysis to determine the direction of causality between education sector growth and socio-economic services.

The adequacy of socio-economic service determines a country's success in education and another; failure to improve quality and efficiency of the entire education system, coping with population growth reducing poverty, or improving environmental conditions. A good socio-economic service in a country reduces outbound education, provide access at all levels of education and improve the quality and efficiency of the entire education system.

Relevant literature on Granger causality formulate econometric models in continuous time offers several advantages in the context of causality testing: they can take account of the interaction among variables during the unit observation period; they can be represented as a causal chain where each of the variables responds directly to the stimulus of only a proper subset of the other variables while there is interaction between all the variables during the observation period; they allow a clear distinction to be made between stock and flow variables; and their form does not depend on the unit observation period. Considered from a continuous time perspective, the problem that spurious Granger causality relationships can arise due to temporal aggregation.

Ashipala and Haimbodi (2003) look at the relationship between public investment and economic growth in South Africa, Botswana and Namibia using the VECM methodology. They find that the effect of public

investment on growth is not significant however, it has the correct sign. On the other hand, private investment is shown to have a long run growth impact in South Africa and Namibia. However, they find evidence indicating a reverse causality from GDP growth to public investment. The causality is negative in the case of Botswana suggesting that as the economy grows investment in public goods declines, which contradicts both the Keynesian theory and Wagner's law.

Loizides and Vamvoukas (2005) employed the trivariate causality test to examine the relationship between government expenditure and economic growth, using data set on Greece, United Kingdom and Ireland. The authors found that government size granger causes economic growth in all the countries they studied. The finding was true for Ireland and the United Kingdom both in the long run and short run. The results also indicated that economic growth granger causes public expenditure for Greece and United Kingdom, when inflation is included. McCories and Chambers (2006) formulating models in continuous time offers a basis for correcting for the effects of temporal aggregation in observed discrete data through a discrete time analogue, in a way that does not rely on our positing a definite time unit in which the data are generated. In an empirical application, they showed that imposing these restrictions, and precisely, matters in testing for Granger causality. Their results complement those in the fixed-interval time aggregation literature, especially those recently obtained by Marcellino (1999) and Breitung and Swanson (2002).

Hooi and Russell (2010) employed annual data for Malaysia from 1970 to 2008 to examine the causal relationship between economic growth, electricity generation, exports and prices in a multivariate model. Their first major finding of the study is that there is unidirectional Granger causality running from economic growth to electricity generation. The second major result is that neither the export-led nor handmaiden theories of trade are supported. The third main finding is that there is no causal relationship between prices and economic growth.

Nurudeen and Usman (2010) applied cointegration and error correction methods to determine the relationship between government expenditure and economic growth in Nigeria. Their results show that government total capital expenditure, total recurrent expenditures, and government expenditure on education have negative influence on economic growth. On the contrary, increasing government expenditure on transport and communication results to an increase in economic growth. Pradhan (2010) explores the nexus between transport infrastructure (road and rail), energy consumption and economic growth in India over the period 1970-2007. He finds evidence of unidirectional causality from transport infrastructure to economic growth.

Siyan et al (2015) carry out co-integration test to determine the long run relationship between economic growth and road transportation in Nigeria. Their result show that road transportation has an impact in the economic development in Nigeria. From the result, economic growth in Nigeria depended on the level of good

and accessible road transportation and the level of road transport infrastructures that will complete the business activities and facilitate trade of Small and Medium scale Enterprises in Nigeria. A recent work, Harun (2016) examine the effect of health and social service sector growth on the flow of inbound health tourism between 2004:Q1 and 2015:Q4 by employing Granger causality and Johansen cointegration approaches. Their findings suggested that there is a long-run Granger causality from domestic health and social work expenditures to health tourism income whereas this is non-existence in the opposite direction. However, this study will investigate the granger causality between education sector growth (amount of gross domestic product in education sector) and socio-economic services and the direction of the relationship of the variables.

Materials and Method

The study is based on time series data obtained from National Bureau of Statistics bulletin Republic of Nigeria that covers the period from 1981 to 2015. The GDP_t in the education sector (EGDP) is used as a proxy variable for economic growth of the education sector, which is reported in current basic prices. And the recurrent expenditure on socio-economic services i.e health ($HEXP_t$), education ($EEXP_t$), road & construction ($RCEXP_t$) and transport & communication ($TCEXP_t$).

The following model was used to investigate the relationship between education sector growth and socio-economic services.

The model formulation of rooted in the theoretical framework as

postulated by Bloch and Tang (2003), the model was specified as follows:

$$EGDP_t = f(HEXP_t, EEXP_t, RCEXP_t, TCEXP_t, \beta_i) + u_t$$

Where $EGDP_t$ is the amount of the gross domestic product in education, $HEXP_t$ is the recurrent expenditure on health, $RCEXP_t$, is recurrent expenditure on road & construction, $TCEXP_t$ is transport and communication, β_i is the parameter to be estimated and u_t is the error term.

Unit Root Test

For the purpose of thi study, Augmented Dickey–Fuller test (ADF), and the Phillips–Perron test (PP) are used to examine the stationarity of the data (Dickey and Fuller 1981; Phillips and Perron 1988).

i.   Augmented Dickey–Fuller test (ADF): The ADF test here consists of estimating the following regression (Gujarati and porter 2009):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t$$

where Δ is the first difference operator, t is the time trend, k denotes the number of lags used, and ε_t is the error term. β_i, δ and α_i are parameters. The null hypothesis that series Y_t is non-stationary can be rejected if δ is statistically significant with negative sign (Huarng et al. 2006). In addition, m shows the optimal lag order, which is chosen

carefully using the Schwarz criterion (AIC) in empirical method.

ii. The Phillips–Perron test (PP): this is a complementary feature of the ADF unit root test Phillips and Perron use nonparametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms. Since the asymptotic distribution of the PP test is the same as the ADF test statistic (Gujarati and Porter, 2009).

Now that we know the problems associated with non-stationary time series,
the practical question is what to do. To avoid the spurious regression problem that may arise from regressing a non-stationary time series on one or more non-stationary time series, we have to transform non-stationary time series to make them stationary. Alternatively, to avoid spurious results co-integration analysis could be adopted, using non-stationary data, but all series have to be integrated to the same order. For the purpose of the study Johansen co-integration test would be used.

$$EGDP_t = \beta_0 + \beta_1 HEXP_t + \beta_2 EEXP_t + \beta_3 RCEXP_t + \beta_4 TCEXP_t) + u_t$$

Ganger Causality

Granger causality test can be assess by regressing each variable on lagged values of itself and the other and it can be implemented as follows:

$$EGDP_t = \alpha_1 + \sum_{h=1}^{n} \beta_{1h}'' EGDP_{t-h} \sum_{i=1}^{p} \beta_{2i} HEXP_{t-i} + \sum_{j=1}^{q} \beta_{3j} EEXP_{t-j} + \sum_{k=1}^{r} \beta_{4k} RCEXP_{t-k} + \sum_{l=1}^{s} \beta_{5l} TCEXP_{t-l} + u_{1t}$$

$$HEXP_t = \alpha_2 + \sum_{h=1}^{n} \gamma_{1h} HEXP_{t-h} \sum_{i=1}^{p} \gamma_{2i} EGDP_{t-i} + \sum_{j=1}^{q} \gamma_{3j} EEXP_{t-j} + \sum_{k=1}^{r} \gamma_{4k} RCEXP_{t-k} + \sum_{l=1}^{s} \gamma_{5l} TCEXP_{t-l} + u_{2t}$$

$$EEXP_t = \alpha_3 + \sum_{h=1}^{n} \delta_{1h} EEXP_{t-h} \sum_{i=1}^{p} \delta_{2i} HEXP_{t-i} + \sum_{j=1}^{q} \delta_{3j} EGDP_{t-j} + \sum_{k=1}^{r} \delta_{4k} RCEXP_{t-k} + \sum_{l=1}^{s} \delta_{5l} TCEXP_{t-l} + u_{3t}$$

$$RCEXP_t = \alpha_4 + \sum_{h=1}^{n} \lambda_{1h} RCEXP_{t-h} \sum_{i=1}^{p} \lambda_{2i} EEXP_{t-i} + \sum_{j=1}^{q} \lambda_{3j} HEXP_{t-j} + \sum_{k=1}^{r} \lambda_{4k} EGDP_{t-k} + \sum_{l=1}^{s} \lambda_{5l} TCEXP_{t-l} + u_{4t}$$

$$TCEXP_t = \alpha_5 + \sum_{h=1}^{n} \varphi_{1h} TCEXP_{t-h} \sum_{i=1}^{p} \varphi_{2i} RCEXP_{t-i} + \sum_{j=1}^{q} \varphi_{3j} EEXP_{t-j} + \sum_{k=1}^{r} \varphi_{4k} HEXP_{t-k} + \sum_{l=1}^{s} \varphi_{5l} EGDP_{t-l} + u_{5t}$$

where *n, p, q, r, s* denote the number of lagged variables, ε_{it} are error terms that are assumed to be normally distributed and white noise.

Analysis and Result

Table 1: **Stationarity (Unit root) test**

Variables	Augmented Dikey-Fuller (ADF)			Philips-Perron (PP)		
	t-Statistics	P-value	Order of integration	t-Statistics	P-value	Order of integration
EGDP	14.31696	0.0000	Stationary at level.	14.31696	0.0000	Stationary at first diff.
EEXP	4.850758	0.0001	Stationary at level.	-5.087712	0.0000	Stationary at first diff.
HEXP	2.181846	0.0444	Stationary at level.	-6.075018	0.0000	Stationary at first diff.
RCEXP	2.710985	0.0154	Stationary at level.	-9.896061	0.0000	Stationary at first diff.
TCEXP	-2.797766	0.0089	Stationary at level.	-2.142164	0.0399	Stationary at level.

Table 2a: **Johansen co-integration rank test (trace statistic)**

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.939774	212.4471	69.81889	0.0000
At most 1 *	0.891897	119.7287	47.85613	0.0000
At most 2 *	0.603026	46.31450	29.79707	0.0003
At most 3 *	0.380868	15.82634	15.49471	0.0446
At most 4	0.000150	0.004952	3.841466	0.9429

Trace statistics indicates 4 co-integrating equations at 0.05 level * denotes the rejection of the hypothesis at 0.05

Table 2b**: Johansen co-integration rank test (Maximum Eigenvalue statistic)**

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.939774	92.71837	33.87687	0.0000
At most 1 *	0.891897	73.41420	27.58434	0.0000
At most 2 *	0.603026	30.48816	21.13162	0.0018
At most 3 *	0.380868	15.82139	14.26460	0.0281
At most 4	0.000150	0.004952	3.841466	0.9429

Maximum eigenvalue indicates 4 co-integrating equations at 0.05 level * denotes the rejection of the hypothesis at 0.05.

Table 3**: Long Run Regression**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HEXP	8.898184	0.812444	10.95237	0.0000
RCEXP	-5.330769	0.683506	-7.799155	0.0000
TCEXP	1.293628	0.636589	2.032126	0.0514
C	9.691390	14.36278	0.674757	0.5052

R-squared	0.959226	Mean dependent var	386.5712
Adjusted R-squared	0.953602	S.D. dependent var	560.3538
S.E. of regression	120.7013	Sum squared resid	422495.3
Durbin-Watson stat	1.332180	Long-run variance	4031.503

Table 4: **VAR Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-828.3894	NA	5.93e+15	50.50845	50.73519	50.58474
1	-659.9343	275.6539	1.01e+12	41.81420	43.17466	42.27195
2	-569.4489	120.6471*	2.14e+10*	37.84539*	40.33957*	38.68460*

LR sequential modified likelihood ratio (LR) test statistic (each test at 5 % level), *FPE* final prediction error, *AIC* Akaike information criterion, *SC* Schwarz information criterion, *HQ* Hannan–Quinn information criterion * indicates lag order selected by the criterion.

Table 5: **VAR Granger causality/block exogeneity Wald tests (χ^2 statistics)**

Effect Cause	EGDP	EEXP	HEXP	RCEXP	TCEXP
EGDP	-	2.67 (0.2636)	10.55*(0.0051)	7.33* (0.0256)	3.78 (0.1508)
EEXP	12.76 *(0.0017)	-	2.83 (0.2434)	6.02 (0.0493)	10.04* (0.0066)
HEXP	17.89* (0.0001)	1.59 (0.4517)	-	5.78 (0.0557)	6.29 *(0.0431)
RCEXP	27.11* (0.0000)	1.75 (0.4169)	2.19 (0.3354)	-	1.11 (0.5740)
TCEXP	2.92 (0.2317)	2.76 (0.2514)	1.42 (0.4918)	1.41 0.4939)	-

*denotes statistical significance at 5% level. Figures in parenthesis are p-values.

EGDP

EEXP

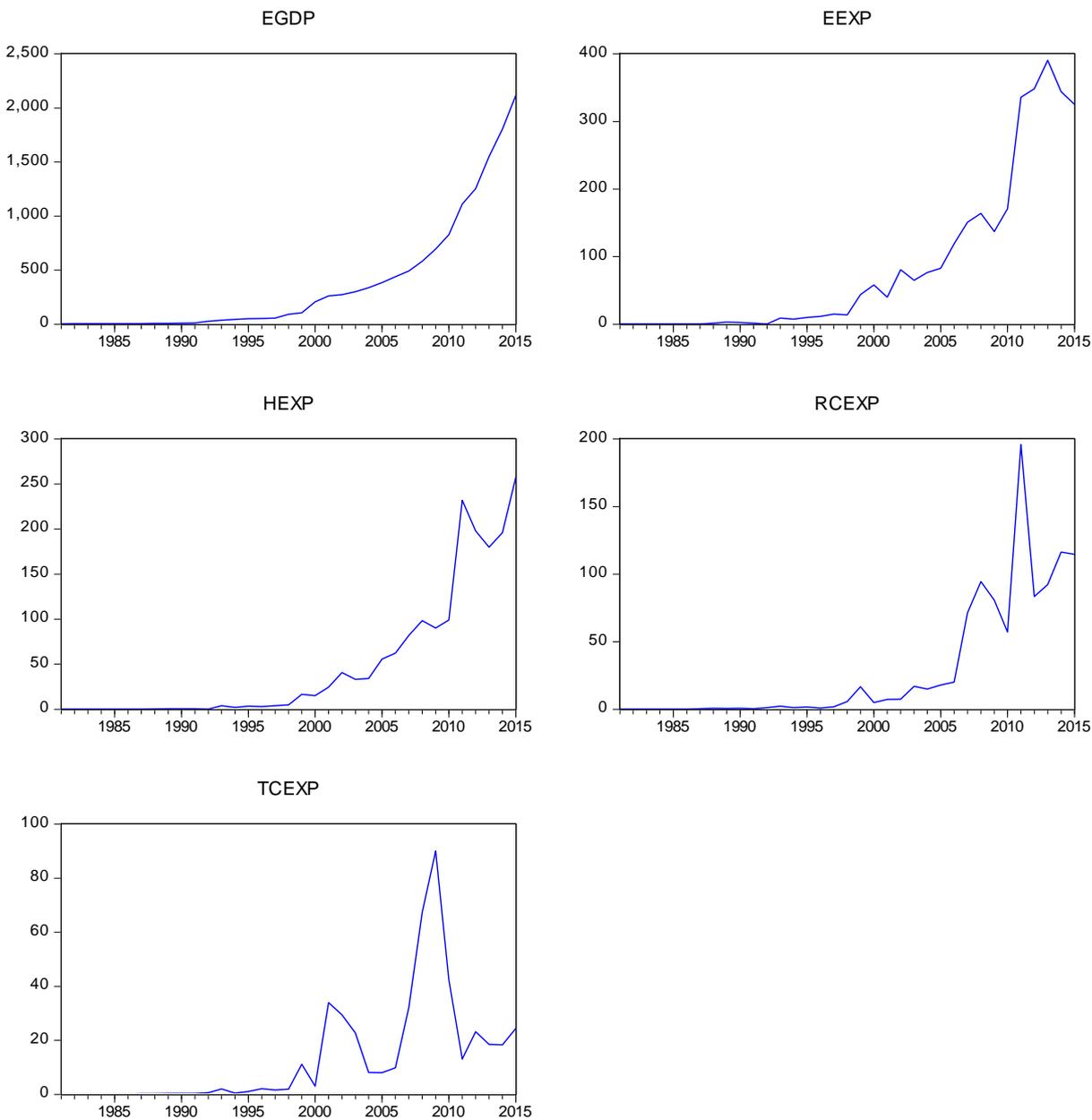## HEXP

RCEXP

TCEXP

Figure 1: Time series plot for the amount of original value (in billion naira)

Discussion of Results

Time series plots for all variables employed in the study are provided in Fig.1. It displays the amount of GDP in education (HGDP), recurrent expenditure on education (EEXP), health (HEXP), road & construction (RCEXP), and transport & communication (TCEXP). All the variables show an upward fluctuating movement especially after 1998. There is a significant drop in 2010 except HGDP that show upward trend.

From the analysis, the unit root test was conducted to ascertain the stationarity of the data using both the Augmented Dickey Fuller (ADF) and the Philips-Perron (PP). The results of the test in table 1 show that all the variables in the model are stationary at 0.05 significant level. Knowing the unit-root properties of the variables,

co-integration test was conducted to ascertain the long-run relationship between education sector growth and socio-economic services (education, health, road & construction and transport and communication). The Johansen co-integration test result in Table 2a and 2b reveal the empirical reality of four (4) co-integrating equations at 0.05 significant level. The hypothesis which states there is no long-run relationship between growth in education and socio-economic services is rejected at 0.05 significance level. Therefore, there is a long-run relationship between growth in growth in education sector and socio-economic services in Nigeria.

The empirical analysis from table 3 shows the estimation results of the equation used in the study, the R-squared of 0.96 is the coefficient of determination indicates that 96 percent variation in education growth can be explain by the socio-economic services. The Adjusted R-squared is a standardized measure which controls the effect of any differences that may due to chance. The adjusted R-square of 95 percent suggests that the model in used is fit in explanation the variation in amount GDP in education sector put in consideration the losses of degree of freedom cause by the number of independent variables (education, health, road & construction, transport & communication), that is the independent variables are statistically significant in determining the total variation in education sector growth in Nigeria. The t-statistic suggests that each parameter in the model employed in the study is statistically significant at 0.1 level of significance.

$$EGDP_t = 9.7 + 0.81EEXP_t + 8.9HEXP_t + -5.3RCEXP_t + 1.3TCEXP_t$$

From the model of the study it can be observed that the government recurrent expenditure on education, health and transportation & communication contribute positively to the education sector growth in Nigeria, given its coefficient (0.81, 8.9 and 1.3 respectively) of the equation it is statistically significant at 0.1 level of significant and it is capable of determining the variation in education sector growth in Nigeria. This implies a unit change in EEXP, HEXP and TCEXP will cause 0.81, 8.9 and 1.3 unit change in amount of Gross Domestic Product in education (EGDP) in Nigeria. The recurrent expenditure on road and construction from the model can be seen to have a negative relationship on amount of Gross Domestic Product in education in Nigeria and statistically significant in determining the variation in education sector growth, given its coefficient (-5.3) which is less than 0.1 level of significant. This implies that a unit change in RCEXP will cause 5.3 unit decrease change in amount of Gross Domestic Product in education (EGDP) in Nigeria.

Having considered the unit root test, co-integration test and the long run relationship regression. VAR Granger causality test was applied to investigate the direction of causality among variables and the results are shown on Table 4. Several hypothesis concerning Grangaer causality relationship between HGDP and EEXP, HGDP and HEXP, HGDP and RCEXP, EGDP and TCEXP, EEXP and HEXP,

EEXP and RCEXP, EEXP and TCEXP, HEXP and RCEXP, HEXP and TCEXP, RCEXP and TCEXP were considered.

According to the findings, the χ^2 statistics test rejects the null hypothesis of no Granger causality from HEXP and RCEGDP to EGDP, from EEXP and HEXP to RCEXP and from EEXP to EGDP, which indicate that there is bidirectional Granger causality from recurrent expenditure on health and road & construction to education sector growth, also that there is unidirectional Granger causality from recurrent expenditure on education and health to recurrent expenditure on transport & communication, and from recurrent expenditure on education to education sector growth, at 0.05 level of significance.

Conclusion

Granger (1988) pointed out that if co-integration exists in a pair of I (1) series, there must be causation in at least one direction. The study investigates the relationship between education sector growth and socio-economic services, and to identify any possible direction of causality between them. The main result of the study shows that socio-economic service has much to contribute to education sector growth. Furthermore, it sends an important message to policymakers about the developments of socio-economic sectors in providing potential as a service sector. Another finding of the study is that there are both bidirectional and unidirectional causality from education sector growth to recurrent expenditure on some socio-economic services in Nigeria. This can be explained by the economic contribution of education sector growth to the whole sector, which is still limited. However, the revenue collected through fees constitutes an insignificant proportion of the revenue of the institutions, using the fund allocated for socio-economic service appropriately may improve quality of education, education sector growth such that outbound education may also be reduce to minimum in Nigeria.

References

1. Aniefiok and Udensi (2016). Socio-Economic Development and Self-Help Projects in Mkpat-Enin Local Government Area of Akwa-Ibom State, Nigeria. *Equatorial Journal of Social Sciences and Human Behaviour,* 1(1): 84-94.

2. Barro, R. (1991). Economic Growth in Cross-Section of Countries. *Quarterly Journal of Economics,* 106 (2): 407-443.

3. Breitung, J. and Swanson, N. R. (2002). Temporal aggregation and spurious instantaneous causality in multiple time series models. *Journal of Time Series Analysis,* 23, 651- 665.

4. Dickey, D. A. and Fuller, W. A. (1981). Distribution of the estimators for autoregressive time series with a unit root. *Econometrica,* 49 (4):1057–1072.

5. Engen, E. M. and Skinner, J. (1992). Fiscal Policy and Economic Growth. NBER Working Paper 4223.

6. Essien, J. M., M-epbari, N., Nwikiabeh, L. B. M. and Piabari, N. (2016). Impact of government

spending on small and medium scale businesses in Nigeria. *Equatorial Journal of Marketing and Insurance Policy,* 1 (2): 41-56.

7. Gujarati, D. N. and Porter, D. C. (2009). *Basic Econometrics*, 5th edn. McGraw-Hill, New York

8. McCrorie, J. R. and Marcus J. C. (2006). Granger causality and the sampling of economic processes, *Journal of Econometrics* 132, 311–336.

9. Johansen, S. (1988). Statistical analysis of cointegration vectors. *J. Econ. Dyn. Control*, 12, 231–234.

10. Laudau, D. (1986). Government and Economic Growth in LDCs: An Empirical Study. *Economic Development and Cultural Change,* 35: 35-75.

11. Loizides, J. and Vamvoukas, G. (2005). Government Expenditure and Economic Growth: Evidence from Trivariate Causality Testing. *Journal of Applied Economics,* 8 (1): 125-152.

12. Marcellino, M. (1999). Some consequences of temporal aggregation in empirical analysis. *Journal of Business and Economic Statistics*, 17, 129–136.

13. Park, S., Lee, J. and Song, W. (2016). Short-term forecasting of Japanese tourist inflow to South Korea using google trends data. *J. Travel Tour Mark*. doi: 10.1080/10548408.2016.1170651.

14. Phillips, P. and Perron, P. (1988). Testing for a unitroot in time series regression. *Biometrica,* 75 (2):335–346.

15. Torraleja, F. A. G., Vázquez, A. M. and Franco, M. J. B. (2009). Flows into tourist areas: an econometric approach. *Int. J. Tour Res.*, 11 (1):1–15.