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INFRASTRUCTURAL EXPENDITURE, ECONOMIC GROWTH AND POVERTY REDUCTION: WHAT IS THE SYNERGY IN NIGERIA?

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Abstract
In recent years, infrastructure expenditure had received increased considerable attention due to its significant role in driving economic growth by encouraging private investment, raising the marginal efficiency of production, generation of jobs and income with the attendant effect on poverty reduction in countries of the world. This paper examines the synergy between infrastructural expenditure in promoting economic growth and poverty reduction in Nigeria. The Autoregressive Distributed Lag Approach (ARDL) to co-integration was employed to determine the long run relationship among the study's variables. The result of the ARDL model shows that, the relationship between infrastructure expenditure, economic growth and poverty reduction in Nigeria is inconclusive. This is because the F- statistics value is not greater than the upper bound of the Narayan critical value at 5% but rather, falls in between the upper and lower bound values. Therefore, we do not reject the null hypothesis that the joint coefficients of our long-run variables are not zero. The regression model result shows that, economic growth and poverty have a positive relationship while a negative relationship exists between poverty, social and economic infrastructure expenditure in Nigeria. In addition, economic infrastructure exerts greater effect with 6% on poverty reduction than social infrastructure expenditure with 1% in Nigeria. The result further reveals that, economic growth and economic infrastructure are statistically significant in the explanation of poverty reduction in Nigeria while social infrastructure expenditure is not statistically significant. The study concluded by recommending for feasible and non-discriminating fiscal and economic policy that should ensure adequate government infrastructural spending on social and economic infrastructure such as; education and health sector, road construction, water, electricity etcetera in order to achieve the desired goal of inclusive growth which should have direct and positive effect on majority of people in Nigeria. Perhaps, create jobs for the jobless labour force and therefore, poverty reduction in the country. In addition, emphasis should be given by the government to economic infrastructure in Nigeria not only because it bring about economic growth but also that it exerts greater influence on poverty reduction in Nigeria.

Keywords: ARDL model, Economic Growth, Infrastructure Expenditure, Poverty Reduction.
JEL Classifications: H54

Introduction

In recent years, infrastructure expenditure had received increased considerable attention due to its significant role in driving economic growth by encouraging private investment, raising the marginal efficiency of production, generation of jobs and income with the attendant effect on poverty reduction in countries of the world (Calderón and Servén, 2014). This apparent increased attention emanates from the growing realization that human and physical infrastructures are critical elements for economic growth and poverty reduction (Jerome, 1999). From economic literature, infrastructure expenditure consists of economic and social infrastructure. Economic infrastructure expenditure is the flow of investment

expenditure overtime on physical assets such as; electricity, road construction, telecommunication, and water supply etcetera while social infrastructure expenditure is the flow of investment expenditure on education, health and recreation which has both direct and indirectly impact on the quality of life. Directly, it enhance the level of productivity in economic activities and indirectly, it streamlines activities and outcomes such as recreation, education, health and safety. The indirect benefit of improved primary health care, for example, is improved productivity, which in turn leads to higher economic growth and real incomes (Un-Habitat, 2011).

Poverty on the other hand, often appears an elusive concept, especially from the perspective of research and policy making in developing countries. The best definition of poverty remain a matter of considerable academic argument (Jerome and Ariyo, 2004). According to World Bank (1994), poverty is the economic condition in which people lack sufficient income to obtain certain minimal levels of health services, food, housing, clothing and education which are necessities for standard of living. This definition of poverty lead to two perspectives which are "income poverty" and "lack of basic need poverty". Income poverty occurs when an individual does not have enough money to meet up with the a certain standard of living while lack of basic need poverty occurs when one is unable to meet some of the basic needs such as food, shelter and clothing.

However, there are three schools of thought about investment in infrastructure as a poverty reduction strategy. The first school, believes that investment in social infrastructure, which encompasses investment in education and health, is more relevant to the goal of poverty reduction than physical infrastructure (Jerome and Ariyo, 2004). The second school, opinioned that investments in both physical and social infrastructure reduce poverty. The last school, holds that investment in infrastructure in general has no effect on poverty reduction. The school who hold the antagonistic and third view, based their preposition on three adduced reasons. Firstly, the presumption that though investment in infrastructure is important for economic growth, it has little or no relevance to poverty reduction. Secondly, the actual benefits from infrastructure have been significantly lower than anticipated. Thirdly, there is a view on the understanding that developing countries is characterized by weak governance and institutions and as such, the tendency for government official to be corrupt is very high and in this scenario, decisions to invest in infrastructure may be distorted, thereby lowering the contribution of infrastructure to growth and diverting benefits intended for the poor (Ali and Pernia, 2003).

Infrastructure expenditure has the potential to affect growth and poverty reduction in two ways; it can raise the overall growth performance of the economy, and in addition, it can also increase the chance of the poor to contribute to growth process mainly by strengthening human capabilities and reducing transaction costs (World Bank, 1994; Sourya, Sainasinh & Onphanhdala, 2014). Moreover, growth is important but it must be inclusive to provide benefit for all. Inadequate infrastructure impacts severely on economic growth and human development with huge fiscal needs. For example, Africa countries needs an estimated US $93 billion per year to develop its infrastructure, with two-third required for new physical infrastructure and the remainder; one-third for maintenance and operations. Nigeria is unfortunately not an exception, it requires an annual investment of US $10 billion over the next decade in order to reduce its infrastructural deficit (Sanusi, 2012). The infrastructure investment needed to fully realize Nigeria's potential for inclusive growth is no doubt huge one and the attainment of sustainable development goals (SDGs) of ending extreme poverty, decent work and economic growth, industry, innovation and infrastructure by year 2030. Nigeria is a country with the largest population in Sub-Sahara Africa with about one-fifth of the Sub-Sahara population and accounts for 29 percent of Sub-Sahara Africa's population with an estimated of 49.1 percent of Nigeria's population living below poverty line in 2017 (World Bank, 2018).

Therefore, this study investigates the synergy in infrastructural expenditure for promoting economic growth and poverty reduction in Nigeria by employing a more robust econometric methodology. The justification for this study, is that these aspects is of considerable interest to policymakers who, in addition to looking for policies that will lay the foundations for faster and more poverty reduction in Nigeria. However, this paper is structured into five sections. Following the introductory section, is section two which is the literature review, methodology is section three, section four is the results and discussions and section five concludes the paper.

Literature Review

Ambia and Sujarwato (2018) used panel regression to investigated infrastructure expenditure and poverty reduction in Indonesia from the period 2006 to 2015. Their findings reveal that infrastructure expenditure in education and health have significant negative influence on poverty reduction, while road infrastructure expenditure has

no significant impact on poverty reduction in Indonesia. In another similar study, Pramono and Marsisno (2018) used spatial autoregressive model and panel data from the period 2011 and 2015 to investigate the effect of infrastructure on poverty reduction in Indonesia. Their findings reveal that infrastructure of electricity, health, sanitation and building of high school has a significant negative impact on the percentage of the underprivileged people. While the building of elementary school has a significant positive impact on the percentage of the underprivileged people.

Mustapha, Tukur & Ajayi (2017) used seemingly unrelated regression estimation technique to examine the impact of infrastructure development on economic growth and poverty in Nigeria. The study used capital expenditure as a proxy for infrastructure development of the three sectors and finds that economic growth, employment rate and real wages reduce poverty. The study recommended the need to increase capital expenditure in education, health and transport as this will help increase economic growth, employment and wages and therefore, reduces poverty in Nigeria. Siyal et al. (2016) used vector autoregressive to investigate the role of infrastructure investment and institutional quality on living standards in Pakistan. Findings reveal that infrastructure investment in social and physical infrastructure help in reduction of poverty by enhancing the living standards of the people when targeted to the poor native. The study concludes that infrastructure investment facilitates institutions to increase the productivity of skilled labour and reduction in their cost and time thereby resulting to an increase in economic growth. They recommend that government should increase the infrastructure investment especially social infrastructure expenditure such as health and education of the active population to improve institution quality and living standard of the people in Pakistan.

In a similar study, Faridi, Chaudhry & Ramzan (2015) used ordinary least square estimation technique to examine the role of infrastructure in poverty alleviation in Pakistan. Infrastructure was divided into two components namely; physical and social infrastructure in order to find their relative impact on poverty. Finding reveals that both physical and social infrastructure has significant and positive impact on poverty reduction in Pakistan. The study recommended that government and policy makers should make a feasible and non-discriminating policy to enhance the physical and social infrastructure in the country in order to achieve the desired goals of economic growth and poverty reduction in Pakistan. Sidiq (2015) used panel regression estimation technique and panel data for 26 province level from the year 2000 to 2008 in Indonesia to investigate the role of basic infrastructure in poverty alleviation. Findings reveal that, road, electricity transmission, number of health care center, and number of schools have significant positive impact on poverty rate through economic growth. The study concludes that, if Indonesian government is serious about reducing poverty then, policy focus should be more on the poor by providing them with the basic infrastructure and improve their accessibility of the infrastructure.

In another study, Calderón and Servén (2014) use theoretical approach to investigate infrastructure, growth, and inequality in developing countries. Their findings reveal positive effects of infrastructure development on income growth and, more tentatively, on distributive equity. The study concludes that, the precise mechanisms through which these effects accrue and their full impact on welfare remain relatively unexplored. Agung, Savio & Mulatsih (2013) used panel data regression and panel two stage least square estimation technique to study the impacts of infrastructure on economic growth and inequality in Indonesia land boarders. Their findings reveal that infrastructure has a positive impact on growth of per capita income. Social infrastructure is more dominant in the influence of growth of per capita income in the land boarders of Indonesia.

In summary, the literature reviewed shows that on one hand, infrastructure is key to economic growth and poverty reduction by enhancing the living standard of the poor. On the other hand, the lack of infrastructure in an impediment to not only economic growth but also a major constraint to poverty reduction. Most of the empirical literature reviewed were on the link between infrastructure development and poverty reduction using panel studies on Indonesia and Pakistan economy living little to be known about Nigeria to the best of our knowledge. It appears the literature on the subject matter in Nigeria is not comprehensively explored due to it multidimensional, complexity and measurement issues of the subject matter. Mustapha, Tukur & Ajayi (2017) who study the Nigerian economy however, use aggregate capital expenditure as proxy for infrastructure development which may be considered too broad for infrastructure development. Capital expenditure encompasses expenditure not only on infrastructure development but on other items such as; expenditure on administration, economic services, social and community services as well as transfers. In which each classification has sub-components not less than four. This study fill this gap by disaggregating infrastructure expenditure into social and economic infrastructure expenditure using public infrastructure expenditure flow over a period of time and shedding light on which

expenditure, social or economic infrastructure is capable of enhancing not only economic growth but also poverty reduction in Nigeria.

Methodology

This paper investigate the synergy between infrastructure expenditure in promoting economic growth and poverty reduction in Nigeria. Annual data from Central Bank of Nigeria (CBN) statistical bulletin, National Bureau of Statistic (NBS) and World Development Indicate were used. The data spans from 1981 to 2017. Real consumption expenditure per capita were used as proxy for poverty (POV_t), real gross domestic product ($RGDP_t$) for economic growth, expenditure on health and education as proxy for social infrastructure expenditure (SIE_t), expenditure on road construction, transport and communication as proxy for economic infrastructure (EIE_t).

The functional relations of the variables included in the model were express by eq. (1) as:

$$POV_t = f(SIE_t, EIE_t, RGDP_t) \quad \text{.....Eq. (1)}$$

Where the explanatory variable SIE_t represents social infrastructure expenditure; EIE_t represents economic infrastructure expenditure and $RGDP_t$ represents economic growth. The study adapts Ambia and Sujarwoto (2018) for Indonesia economy. The specification of the econometric model which incorporates a drift parameter and a stochastic error term in the model is given by eq. (2) as:

$$POV_t = \alpha_0 + \alpha_1 SIE_t + \alpha_2 EIE_t + \alpha_3 RGDP_t + \mathrm{U}_t \quad \text{.....Eq. (2)}$$

Where the dependent variable POV_t represents poverty. The explanatory variable SIE_t represents social infrastructure expenditure; EIE_t represents economic infrastructure expenditure and $RGDP_t$ represents economic growth. The drift parameter is denoted by α_0 while U_t stochastic error term in eq. (2).

This study beyond updating the literature review, it departs from previous study in two critical aspects. First, it provides a categorization of infrastructure expenditure into social and economic infrastructure to examine which of the infrastructure expenditure exerts greater impact on poverty reduction in Nigeria. Second, it measures infrastructure in monetary or financial terms as opposed the physical measure of infrastructure which data are complex and not easily available in developing countries like Nigeria. Therefore, this study adopts the Autoregressive Distributed Lag (ARDL) model approach to co-integration analysis, which was first used by Pesaran and Shin (1995) and later Pesaran, Shin & Smith (2001). The choice of the ARDL modeling approach over the OLS was informed by the appealing properties of the ARDL approach. First, it has the appealing feature of small sample size. Secondly, it has the merit of been used irrespective of the order of stationarity in the series (that is, whether the series is stationary at level or first difference and perhaps even if it is the combination of both). Lastly, the ARDL model has the potential of providing information about the long-run relationships between the variables while retaining the information about short-run adjustment in the variables. Therefore, in the spirit of Pesaran and Shin (1995) and Pesaran, Shin & Smith (2001) we develop the ARDL model in equation (3) as follows:

$$POV_t = \rho_0 + \Sigma_{i=1}^{q} \rho_{1i} \Delta SIE_{t-i} + \Sigma_{i=1}^{q} \rho_{2i} \Delta EIE_{t-i} + \Sigma_{i=1}^{q} \rho_{3i} \Delta RGDP_{t-1} + \mathrm{U}_t \quad \text{.....} Eq.(3)$$

Next is to replicate eq. (3) into an unrestricted error correction ARDL model which will enable us to determine the rate of adjustment of the variables to long-run equilibrium. This is constructed in equation (4) below:

$$POV_t = \rho_0 + \Sigma_{i=1}^{q} \rho_{1i} \Delta SIE_{t-i} + \Sigma_{i=1}^{q} \rho_{2i} \Delta EIE_{t-i} + \Sigma_{i=1}^{q} \rho_{3i} \Delta RGDP_{t-1} + ecm_{t-1} + \mathrm{U}_t \quad \text{.....} Eq.(4)$$

Having developed the unrestricted error correction ARDL model with no linear trend, we proceed by determining the optimal lag length of the ARDL model. The lag length selection criteria for the model will be based on the lowest AIC and SIC values. It should be born in mind that, the selection procedure will start from general to specific (i.e. the highest possible lag length to a specific lag length that satisfies the optimal criteria). The information for the optimal selection is presented in table 2 in the next section.

$$POV_t = \rho_0 + \Sigma_{i=1}^{q} \rho_{1i} \Delta SIE_{t-1} + \Sigma_{i=1}^{q} \rho_{2i} \Delta EIE_{t-1} + \Sigma_{i=1}^{q} \rho_{3i} \Delta RGDP_{t-1} + ecm_{t-1} + \mathrm{U}_t \quad \text{.....} Eq.(5)$$

The model with the optimal lag was subjected to residual and stability diagnostics test. The results of the diagnostics test are shown in next section [table (2)]. The coefficient diagnostics will also be conducted to test for the joint null hypothesis of the variables, in order to establish the long-run relationship among the variables. The stated hypothesis of the ARDL model is given by:

$$H_n^0 : \rho_1 = \rho_2 = \rho_3 = 0; H_n^1 : \rho_1 \neq \rho_2 \neq \rho_3 \neq 0$$

The H^0 which suggests the absence of long-run relationship among the variables and it will be tested against the H^1 that suggests the presence of co-integration among the variables. The F-statistics computed from Wald test-coefficient diagnostics will be used to draw the inference, as presented in the next section [in table (2)]. The F-statistics were compared against the Narayan (2005) critical values, under case III. The decision rule of the bound test provides that if the value of the F-statistics is greater than the upper bound critical value, co-integration exist. On the other hand, if it is less than the lower bound critical value, co-integration doesn't exist. However, if the computed F-statistics falls in between the upper and lower bounds, it is inconclusive. The estimates of the ARDL models are presented in the next section.

Results and Discussion

Pre-estimation evaluation of the data involves testing for stochastic properties of the series. Three unit root tests were used namely; Augmented Dickey-Fuller (ADF) 1979, Phillips-Perron (PP) 1988 and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) 1992 tests. The choice of these three unit root tests is to allow for robustness and comparison of results. Unit root tests have been used to ascertain the presence of unit root or otherwise in the variables used in the study. The result of the stationarity test showed the absence of a unit root in poverty, social infrastructure and economic infrastructure expenditure. On the other hand, the result also showed that Real Gross Domestic Product (RGDP) has unit root. However, RGDP became stationary at first difference I(1), therefore, the outcome of the unit root test has satisfied the requirement that ensure there is no series that is I(2). The result is presented table1.

Table 1: Unit – Root Test Result

Variables	ADF–STATISTICS		PP- STATISTICS		KPPS- STATISTICS		Order of Integration
	level	1st Difference	level	1st Difference	Level	1st Difference	
POV_t	3.6973	-	3.6973	-	0.3488	0.0758	I(0)
SIE_t	5.1969	-	5.1969	-	0.1910	0.0134	I(0)
EIE_t	5.2803	-	5.2803	-	0.0828	-	I(0)
$RGDP_t$	3.0269	8.1972	3.0269	8.1972	0.5291	0.0531	I(1)

Critical Values are: 1% = 4.23; 5% = 3.54; 10% = 3.20

Source: *Extract from the ADF, PP and KPPS test results estimated using E-views version 10*

Table 1 reveals that all the variables in the series are mixture of order I(0) and I(1) variable. Hence, ARDL method – which accommodates such a specification remain the most appropriate methodology for this analysis and it means we can proceed with the bound test. The result of the bound test conducted is presented in table-2. The optimal lag length of 1-period obtained was based on the minimum value of AIC and SIC which were found to be 0.91 and 1.80 respectively. The developed model was diagnosed for serial correlation and heteroskedasticity using the residual diagnostics test and the result shows that there is no serial correlation and heteroskedasticity in the model. The stability test also shows that the model is stable. The result for stability is extended to appendix-I.

Table 2: Result of ARDL Co-integration (Wald Test).

$POV_t = f(\Delta SIE_t, EIE_t RGDP_t)$	Sig. level	Critical values for bound test:	
Optimal lag length: 1		Case III	
F-statistics		Lower bound	Upper bound
	1%	5.018	6.610
	5%	3.548	4.803
4.55**	10%	2.933	4.020
Diagnostics test	P-value	F-statistics	Comment
B-G (x^2) *sc*	0.3951	4.55	No serial correlation

B-P-G(x^2het)	0.3823	1.0529	No heteroskedasticity
Cusum	Stable	Stable	Robust

**indicates value is statistical significant at 10% level (at k=3).
Source: E-views Output version 10

The result of the bound test presented in table 2 shows that the F-statistics of the model which has unrestricted intercept and no linear trend is not greater than the upper bound of the Narayan critical value at 5%. Therefore, we do not reject the H^0 that the joint coefficients of our long-run variable are not zero. This means that, infrastructure expenditure, economic growth and poverty have no long-run relationship but rather the result suggests the relationship is inclusive in the long-run as the F- statistic value falls in between the upper and lower bound values. As such, the results does not suggest the presentation and interpretations of the long-run and short-run coefficients.

The study therefore, resulted to ordinary least square technique in order to examine the short-run relationship amongst the variables since the condition for interpretation of the coefficients of the bound test was not met. The justification for this is that, OLS is a best linear unbiased estimator. The result is presented in table 3 below;

Table 3: Regression Result

Variables	Coefficient(α_i)	t-Statistic
Constant	-7.322	(-14.55)
$RGDP_t$	0.525	(11.21)
SIE_t	0.014	(-0.345)
EIE_t	0.063	(-1.721)
R-square 0.81		
Adjusted R-square 0.79		
Durbin-Watson Stat 1.95		
F-statistic = 45.8	Prob(F-statistic) = 0.00	

Source: E-views Output version 10

Table 3 is the estimates of regression result for equation (2) using poverty as independent variable, including the coefficients and their t-statistic in parentheses. The coefficient of determination is reported as a measure of the goodness of fit (R^2). The result shows economic growth and poverty have a positive relationship while a negative relationship exists between poverty, social infrastructure expenditure and economic infrastructure expenditure in Nigeria. The result also shows that 81% variation in poverty reduction is explained by economic growth, social and economic infrastructure expenditure while 19% variation is explained by other variables as capture in the model with the error term. In addition, economic infrastructure exerts greater effect with 6% on poverty reduction than social infrastructure expenditure with 1% in Nigeria. The constant, economic growth and economic infrastructure coefficients are statistically significant in the explanation of poverty reduction in Nigeria while social infrastructure expenditure is not statistically significant in explanation of poverty reduction in Nigeria in the short-run.

Conclusion and Recommendations

The substance of this paper is rooted in the endogenous growth model of Barro (1990) where the production function used in the study introduced infrastructure as one of the factors of production leading to growth of an economy. This study extends the relation to answer the question what is the synergy between infrastructure expenditure, growth and poverty in Nigeria. The result from the ARDL model shows that, in the long-run relationship between infrastructure expenditure, economic growth and poverty in Nigeria is inconclusive. While in the short-run, the OLS result shows that economic growth and poverty have a positive relationship while a negative relationship exists between poverty, social and economic infrastructure expenditure in Nigeria. This implies that, economic growth in Nigeria is not inclusive that is, employment oriented and income generation and appear not to be targeted to the majority of people in Nigeria. In addition, economic infrastructure exerts greater effect on poverty reduction than social infrastructure expenditure in Nigeria.

Based on the findings of this paper, these recommendations are made;

1. Government should implement feasible and non-discriminating fiscal policy that is efficient, effective and would ensure adequate infrastructural expenditure on social and economic infrastructure which

should have direct and positive effect on majority of people in Nigeria.

2. Economic policy that is not only growth oriented but an inclusive growth type that would create jobs for the jobless labour force therefore reduction of poverty in Nigeria.
3. Attention should be given more by government to economic infrastructure expenditure in Nigeria as findings have shown that it exerts greater influence on poverty reduction than social infrastructure expenditure in Nigeria.

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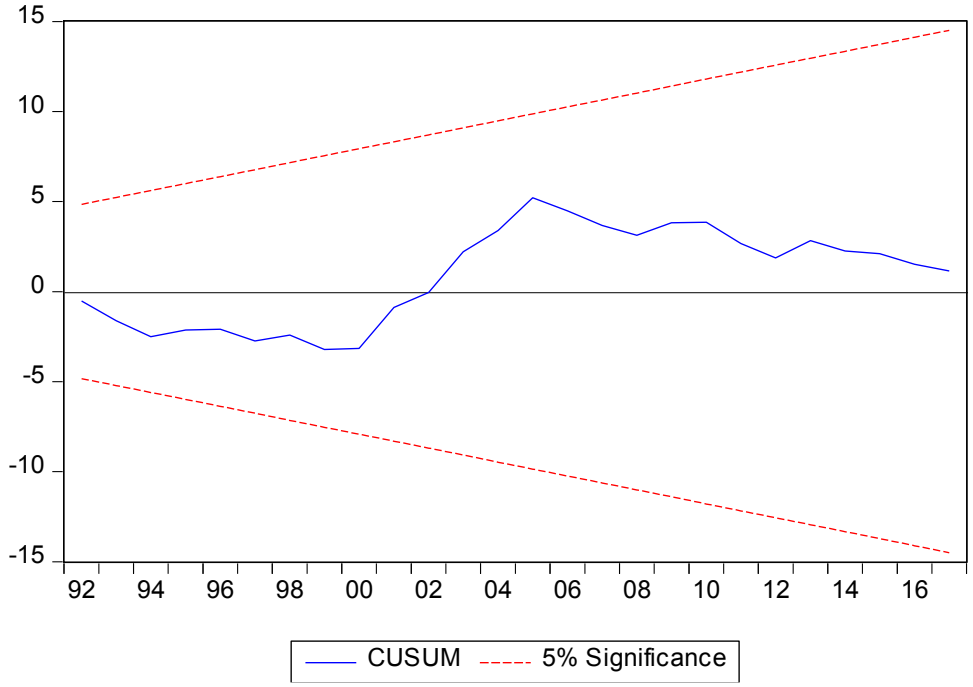
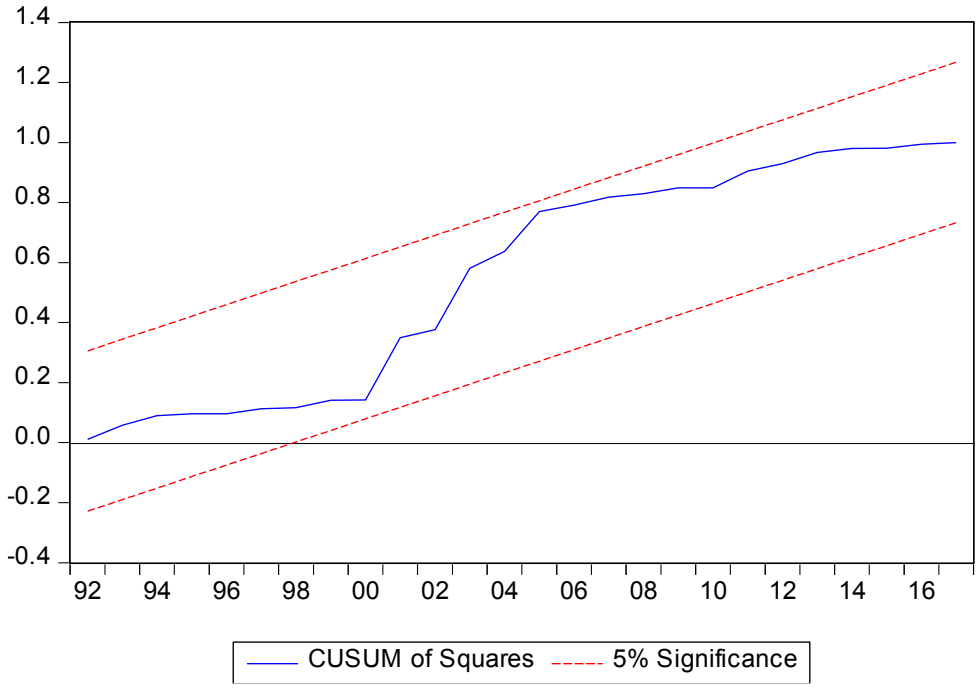
Appendix I: Cusum Plot



Appendix II: Cusum Squares Plot



Appendix III: Graph of Economic Infrastructure Expenditure (EIE), Poverty (POV), Real Gross Domestic Product (RGDP) and Social Infrastructure Expenditure (SIE) in Nigeria.