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An Analysis of Public Expenditure Growth on Infrastructure in Nigeria

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Abstract: *Public expenditure in infrastructure has stimulated economic growth in Nigeria. The aim of this study is to critically analyze the Trends of public expenditure growth on infrastructure in Nigeria, using available time series data from 1970 to 2006. The specific objective of the study with an overriding aim of providing policy-relevant evidence are: to examine the trend in public expenditure on infrastructure in Nigeria between 1970 to 2006; to compare the trend in public expenditure between the military and democratic government in Nigeria between 1970 to 2006; to determine the relationship between expenditure on infrastructure and long-run economic growth; ascertain the factors that influence public expenditure growth in infrastructure; test for the stability of growth in public expenditure on infrastructure over time and derive policy recommendations based on the findings of the study. The model specification is based on the Ordinary Least Squares (OLS) multiple regression while the estimation procedures is that of the Johansen Maximum Likelihood (JML) and OLS estimators.*

Keywords: *Analysis, public expenditure, infrastructure, economic growth, Nigeria.*

JEL Classification: *013, 021, 054.*

1. Introduction

Public expenditure, particularly on infrastructure as an important instrument in the development process has gained attention in economic literature in recent time.Public expenditure has remained a central issue in economic development, especially in developing countries in Sub-Saharan Africa, whose economies are characterized by structural rigidities, weak support services and institutional framework, declining productivity, high level corruption cum policy instability. This gloomy picture has led to researches aimed at investigating whether public expenditure on infrastructure has yielded significant results over time. Several factors have influenced public expenditure on infrastructure, namely, rate of urbanization, openness, government revenue, external reserves, population density, type of government *ab initio*. Several studies have analyzed the impact of public spending on economic growth in the short and long-run in most developed and developing countries, using cross sectional data of many countries (Edame, 2009). Public expenditure, which refers to the expenses

Government incurs for its own maintenance, society and the overall economy is found to be continuously increasing overtime. This is because these fiscal operations are recognized as major tools for the management of the economy and stimulation of economic growth and development (NISER, 2004; Agenor and Doson, 2006).

Besides, government spending is varied ranging from education, defense, general administration, health, to water supply, electricity generation and supply, roads, telecommunications among others.

However, spending on infrastructure has been an issue for policy discourse among scholars the world over. Studies have shown that investment in infrastructure has tremendous positive impact on nation's economic growth and development. Such studies include that of Agenor and Dodson (2006), Adenikinju (2005), Sanchez – Robles (1998), Caning *et al.* (1994) and Aschauer (1989).

Therefore, a country with poorly developed infrastructure has a potential of increasing its gross output if it improves upon its infrastructural facilities. Investment in infrastructure according to Blejer and Khan (1984); Greene and Villarueva (1999) and Solano (1983) stimulates or crowds in private investment, reduces cost and opens new markets thereby engendering profits and employment. However, investment in infrastructure in developing countries has been reported to be suboptimal (Heller and Diamond, 1990; World Bank, 1994).

Deficiencies in infrastructure and inefficient delivery of social services such as roads, water, sanitation, shipping, transport, power, energy, information and telecommunications have led to crippling transaction costs that have affected trade thereby reducing the competitiveness of the countries products in the world market.

The need for investment in infrastructure and other public goods as a strategy for increasing urban and rural productivity and national economic growth and development has remained a subject of renewed attention in most developing economies. Several studies have been carried out to ascertain the direction of association between expenditure on infrastructure and economic growth of several developed and developing countries. Among this early studies include Aschauer (1989a), Ghali (1997), Balducci *et al.* (2004), Caldevon and Servan (2004) and Agenor and Dodson (2006). In these studies, they established positive effect of expenditure on infrastructure and economic growth. Most of these studies made use of the Ordinary Least Squares (OLS) technique of estimation, which may not be adequate where the data are non-stationary as it results in spurious regressions and long-run economic growth could not be established. Others who have used most recent econometric methods of analysis are Holten and Schwab (1991), Holtz-Eakin (1994), Garcia-Mila *et* al. (1996), Peirara (2000) and Fedderke *et al.* (2006) *inter alia.* Some of their results were contrary to those earlier obtained. In effect, there is no consensus on the direction of relationship between infrastructure and economic growth.

For Nigeria specifically, a number of studies that have been carried out on public expenditure in general had concentrated on the growth trend on public expenditure nationally and on State basis (Phillips, 1971; Olaloku, 1975; Lambo 1987; Olowoloni, 1981). Others considered the effect of public expenditure on infrastructure (specifically) on economic growth and obtained positive signs using the Ordinary Least Squares (OLS) analytical technique (Aigbokan, 1999; Odedokun 1997, Odedokun, 2001). None of these studies in Nigeria has considered the trends of public expenditure on infrastructure. However, some authors in other countries have empirically verified the factors that influence public expenditure on some infrastructure (telecommunication and Transport). Included here are Randolph *et al.* (1996), James *et al*. (2007), and Chakraborty and Mazumdar (2006), Fedderke *et al.* (2006). There is a near absence of published empirical study on the trends of public expenditure in Nigeria via cointegration and error correction approach. The importance of infrastructure in the economic growth process of any nation cannot be overemphasized. The use of cointegration and error correction modeling in this study will address the shortcomings of the Ordinary Least Squares and therefore provide reliable estimates of elasticity that will engender sound policy making.

The inadequacy of empirical information on the trend analysis of public expenditure on infrastructure in the study area makes it justifiable to carry out this study, given the importance of investment in infrastructure on the overall development of the economy. Essentially, the broad objective of the present study is to analyze the trend of public expenditure on infrastructure and economic growth using available time series data in the country from 1970 to 2006.

The remainder of this paper is organized as follows: section two provides a brief overview of infrastructure situation in Nigeria. The model and estimation procedures are presented in section three. Next is the empirical results and discussion, while the last section concludes and provides policy recommendations.

2. SOME THEORETICAL ISSUES

Earlier researchers concentrated their findings on the effects of public expenditure growth on employment and prices (Asibola, 2005; Nyong, 2000 and 1998; Fan, Hazell, and Thorat, 2006). There are several of such theories, but a few of these would be examined in this paper.

Samuelson's pure theory of public expenditure is particularly concerned with the proper way of allocating resources between the public and private sectors. Samuelson assumed that there are two kinds of goods, namely, private good M and Public good Y and two individuals G and P. He upheld that the model of budget determination is based on individual preference function. Samuelson further maintains that whereas there is rivalry in the consumption of private goods, and non-rivalry in the consumption of public goods.

According to Rostow (1961), in the early stages of economic growth and development, public sector investment as a proportion of total investment of the economy is found to be high. He affirmed that the public sector provides social over heads such as roads, transportation system, sanitation system, law and order.

Essentially, of Rostow's five stages of growth, the first three are relevant to developing countries with the take-off stage being central in Rostow's model. The plausible explanation for this is that as development expands, the rate of productive investment rises from 5% or less to over 10% of national income (Nyong, 2005; BECAO, 1992; Khan and Reinhart, 1990).

In a nutshell, Rostow's provocative application of a stage approach to development process provides broad-sweeping views of economic growth and development (Blejer and Khan, 1984, Brett, 1988; Landau, 1983).

Wagner's law of increasing state activity states that as per capita income in an economy grow; the relative size of the public sector will grow. He divides government expenditure into three categories, namely, administration and defense, cultural and welfare functions, and provision of direct services by government in cases of market failure.

Rather than allow for monopoly to emerge, government usually create statutory corporations such as NEPA (now Power Holding Company of Nigeria – PHCN), Water Boards, Nigeria Airways, NITEL, Post Office *inter alia* cushion harsh economic situation of her citizens (Taiwo, 1990; Landau, 1983; Lesser, 1991). He further posits that as the economy becomes industrialized, urbanization and high density living result. This invariably leads to externalities (market failure) and congestion which require government intervention and regulation (Nyong, 2005; Ayub, and Hegstad, 1986).

The growth in public expenditure on education, recreation, health, and welfare services is explained in terms of their income-elastic want (Meier, 1984; Swanson & Terferra, 1989; World Bank, 1981 Nyong, 2005). Wagner further submits that as real income increase public expenditure on education, health, transportation, road network etc would increase more than in proportion. This explains the rising ratio of government expenditure to gross national product GNP) as reported by Nyong (2005) in his public policy assessment of Nigeria expenditure situation.

Peacock and Wiseman theory of public expenditure is based on the political theory of public expenditure determination which state that "government like to spend more money, that citizens do not like to pay more taxes, and that government need to pay some attention to the aspiration and wishes of their people". Their contention was that government expenditure does not grow in a smooth and gradual manner, but in stepwise fashion (i.e. the displacement hypothesis).

The occurrence of unexpected social disturbance would necessitate an increase in government expenditure (Ajibola, 2005). For instance, the bomb blast in United States of America, London, Ikeja in Lagos – Nigeria in recent times, etc necessitated government spending money to repair the damage done to lives and property in the affected areas.

The arguments for public policy stance, in terms of expenditure as the key policy instrument, rest therefore on the fact that the functioning of the market cannot by itself, activate the signaling response and mobility of economic agents to achieve efficiency in both static (allocative efficiency) and dynamic (shift in the production frontier) terms (Arnat, 1998& Chakraborty, 2003)

The ideal of public expenditure proceeds from market failures of one kind or another. Markets fail to secure appropriate signals, responses and mobility due to:

a) Not all goods and services are traded. Markets can not determine the prices of public goods
b) State intervention is necessary also for securing income redistribution;
c) Information asymmetry between the providers and consumers of services such as social insurance can give rise to the problems of moral hazard and adverse selection;
d) Goods exhibiting externalities in consumption and production force a wedge between market prices and social valuation and the market will not ensure a socially desired supply; and
e) Some goods are characterized by increasing returns to scale. In such situations as natural monopolies; society can gain from lower prices and higher output when public sector is the producer or a subsidy is paid to the private sector to cover the losses of producing optimal output (Reo, 1998, Chakraborty, 2003 and Edame,2009)

The theoretical and empirical advancement towards public policy and development intervention in providing infrastructural development reflect the community's growing concern with social aspects of development, roads, water supply, electricity, steel-mills, dams and machine building industries have now been displaced from the commanding heights of development strategy, on the other hand, the so-called soft sectors such as education, health, telecommunication and transportation have occupied the centre stage of development (Mundle, 1998 and Edame, 2008). However, certain public goods such as defense, administration, a clean environment, etc that cannot be provided by market, because no consumer can be excluded once these services are provided and hence consumers will not "buy" these services (Mundle, S. 1998)

3. METHODOLOGY

The Model

The hypothesized structural relationship between public expenditure growth and the factors that influence it will consist of a number of regression equations with expenditure on the specified infrastructure being the dependent variable. The model for the trends of public expenditure on infrastructure was a modified version of Chakraborty and Mazumdar (2003), Fedderke *et al.* (2003) and Fan and Rao (2003).The structural form of the model is specified as follows:

$$FYit = \Phi Zit + \beta X\ it + Uit \quad (3.1)$$

Where:

FYit = growth of expenditure on the specified infrastructure

Z = Vector of conditioning variables; Zit = Vector of fiscal variables on infrastructure in time t; Φ = Vector of parameters of conditioning variables; β = Vector of parameters of fiscal variables; Uit = error term

Equation 3.1 would be specified as:

$$PE = \beta o + \beta 1\ GREV + \beta 3POPD + \beta 7EXTRES + \beta 9OPN + \beta 10URB + \beta 12PEt\text{-}1 + \beta 13DUM + Ut\ldots\ldots (3.2)$$

Where:

PE = Public expenditure (N million)

GREV = Government revenue (N million) ($\beta 1 > O$)

POPD = Population density ($\beta 3 > O$)

EXTRES=External reserves (N) ($\beta 7 > O$)

OPN = Openness. This is measured as fraction of imports and exports in GDP$(X_{+}M)$/GDP ($\beta 9 > O$)

URB = Rate of urbanization. This is the annual percentage of total population living in urban areas ($\beta10 > 0$)

PE_{t-1} = Lagged public expenditure ($\beta12 < O$)

DUM= Dummy, indicating transition from military to democratic rule between 1970-1983 and 1985-1999(military rule);=1 1979 -1983 and 1999 -2006 (Civilian rule)=2

Ut = Error term, assumed to be distributed as *white noise*.

Model implementation procedures

The estimation of the model follows the Johnasen procedure in co-integration.

This approach is necessary because it has been found that a large number of time-series data used in econometric analysis are non-stationary which means they have tendency to increase or decrease over time. The consequence of this behaviour is that the asymptotic convergence theorems, which underpin statistical estimation theory, are violated and hence such data cannot be used in regressions, since such regressions yield spurious results (Granger and Newbold, 1974; Philips, 1986 and Edame, 2010).

Tests for stationarity (unit root tests)

To carry out the unit root test for stationarity, the Dickey-Fuller (DF) and Augmented Dickey – Fuller (ADF) tests used to examine each of the variables for the presence of a unit root .

The DF test assumes that the data generating process is a first-order autoregressive (AR1) process, and if this is not, the autocorrelation in the error term biases the test. The ADF is used to avoid such bias in the test since it includes the first difference in lags in such a way that the error term is distributed as white noise. The test formula for the DF and ADF are shown in equations (3.3) and (3.4) respectively.

$$\Delta Yt = \alpha + \rho Yt\text{-}1 + \varepsilon t \quad (3.3)$$

$$\Delta Yt = \alpha + \rho Yt\text{-}1 + \Sigma\gamma\Delta Yt\text{-}j + \varepsilon t \quad (3.4)$$

Here the significance of ρ would be tested against the null that $\rho = 0$. Thus if the hypothesis of non-stationarity cannot be rejected, the variables are differenced until they become stationary, that is until the existence of a unit root is rejected. We then proceed to test for co-integration.

Tests for co-integration

The essence of co-integration test is to determine whether groups of non-stationary series are co-integrated or not. Engle and Granger (1987) pointed out that a linear combination of two or more a stationary non-stationary series may be stationary. Thus, if such a stationary linear contribution exists, the non-stationary time series are said to be co-integrated. The stationary linear combination is called the co integrated equation and may be interpreted as a long- run equilibrium relationship among variables.

To test for cointegration, we use the ADF and we also consider the vector error correction model in Eq 3.1. Information about the number of co-integrating relationships among the variables in Zt is given by the rank of the Π-matrix: if Π is of reduced rank, the model is subject to a unit root; and if () < r <n, where r is the rank of Π, Π can be decomposed into two (n x r) matrices α and β, such that $\Pi = \beta' Z t$, where β zt is stationary . Here , α is the error correction term and measures the speed of adjustment in Δ zt and β contains r district co integrating vectors, that is relationships between non-stationary variables, as earlier mentioned.

The Johansen method uses the reduced rank regression procedure to estimate α and β and the trace test and maximal-eigen value test statistics were used to test the null hypotheses of at most r cointegrating vectors against the alternative that it is greater than r. The interest here is in testing for the presence of a valid co integrating vector which gives a unique long-run equilibrium relationship. Once this is established, the vector error correction model of the form given in Equations 3.5 to 3.7 can be estimated. $\Delta \text{ Ln } PE_t = \delta_{10}$

$$+ \sum_{i=1}^{n} \delta_{11i} \Delta \text{ Ln PE}_{t-i} + \sum_{i=1}^{n} \delta_{12i} \Delta \text{ Ln GREV}_{t-i} + \sum_{i=1}^{n} \delta_{16i} \Delta \text{ Ln EXTRES}_{t-i} + \sum_{i=1}^{n} \delta_{18i} \Delta \text{ Ln OPN}_{t-i} + \sum_{i=1}^{n} \delta_{19i} \Delta \text{ Ln URB}_{t-i} - \alpha_1(\text{LnPE–LnGREV- Ln EXTRES –Ln OPN – Ln URB})_{t-i} + \text{Ln DUM} + U_{1t} \quad (3.5)$$

$$\Delta \text{ Ln EXTRES}_t = \delta_{20} + \sum_{i=1}^{n} \delta_{31i} \Delta\text{Ln PE}_{t-I} + \sum_{i=1}^{n} \delta_{32i} \Delta\text{LnGREV}_{t-i} + \sum_{i=1}^{n} \delta_{33i} \Delta\text{LnURB}_{t-i} + \sum_{i=1}^{n} \delta_{35i} \Delta\text{LnOPN}_{t-i} + \sum_{i=1}^{n} \delta_{36i} \Delta\text{LnPOPD}_{t-i} - \alpha_2 (\text{LnPE-LnGREV-LnURB-LnOPN-LnPODP-})_{t-1} + \text{LnDUM} + U2_t \quad (3.6)$$

$$\Delta \text{ Ln GREV}_t = \delta_{30} + \sum_{i=1}^{n} \delta_{41i} \Delta \text{ LnPE}_{t-i} + \sum_{i=1}^{n} \delta_{42i} \Delta\text{LnOPN}_{t-i} + \sum_{i=1}^{n} \delta_{43i} \Delta\text{LnURB}_{t-i} + \sum_{i=1}^{n} \delta_{44i} \Delta\text{LnPOPD}_{t-1} - \alpha_3(\text{LnPE–LnOPN-LnURB–LnPOPD})_{t-I} + \text{LnDUM} + U_{3t} \quad (3.7)$$

Where all the variables are as earlier defined and Δ is the first difference operator, δ_{10} to δ_{30} are the constant intercept term, while δ_{11} to δ_{44} are short – run coefficients and α_1 to α_3 are error correction mechanisms that measure the speed of adjustment from short-run disequilibrium to long-run steady – state equilibrium. U_{1t} to U_{3t} are error terms assumed to be distributed as white noise. All the estimations were performed using the Standard Version of Eviews Econometric Software.

The Data

The study made use of secondary time series data. The data were sourced from various issues of the Central Bank of Nigeria (CBN) Statistical Bulletin, World Bank, the International Financial Statistics (IFS) of the International Monetary Fund (IMF) and the Federal Bureau of Statistics (FBS).

4. RESULTS AND DISCUSSION

Tests for Stationarity

The results of the unit root tests are presented in Table 4.1. The null hypothesis of the presence of a unit root (non-stationarity) was tested against the alternative hypothesis of the absence of a unit root (stationarity), PE(public expenditure), GREV (Government Revenue), URB (rate of urbanization and DUM (Dummy – Administration) were not stationary at their levels as shown by the calculated ADF statistics which are lower in absolute terms than the standard critical values. Thus, they were differenced once each to make them stationary.

On application of the ADF test on their first differences, they all became stationary as indicated by the value of their respective ADF statistic which are both larger (in absolute terms) than the standard critical values, thus leading to the rejection of the null hypothesis. From the above results, it is evident that the variables are integrated of order 1, that is, are 1(1). Conversely, POPD (population density), OPN (openness) and EXTRESS (External reserves) were stationary at their levels as the null hypothesis of the presence of a unit root in the series was rejected as shown by the higher values (in absolute terms) of the calculated ADF statistics compared with their respective critical values. In this case, we say that these series are integrated of order zero that is 1 (0). We then proceed to discuss the results of the multivariate cointegration analysis. Since the time series are non-stationary, it became necessary to test for cointegration. By using the log-level form of the series, we estimate a multivariate cointegration relationship to establish the existence of a long-man equilibrium relationship.

Cointegration Tests

Table 4.2 shows the results of the multivariate cointegrating tests. The Johansen Maximum Likelihood method, which uses the trace test and maximal-eigen value test statistics to determine the rank r, of the long-man impact matrix of the error correction mechanism was employed. The test relations were estimated with intercept and linear deterministic trend in a vector Auto Regression (VAR) model of order I with a Lag Length of 1, which was found to be the most parsimonious for the data series. The Johansen cointegration tests are based on the Maximum Eigen value of the stochastic matrix as well as the Likelihood Ratio tests which is in turn based on the trace of the stochastic matrix.

From our results, it is evident that both the trace test and maximum eigen value test indicate one cointegrating equation as the null hypothesis of r=0 is rejected. Thus, we conclude that there is a unique long-man equilibrium relationship between public expenditure on infrastructure, government revenue, population density, openness, external measures, rate of urbanization and administration.

However, the Johanson model is a form of VECM and where only one cointegrating vector exists, its parameters can be interpreted as estimates of the long-run cointegrating relationship between the variables concerned (Hallam and Zanoli, 1993). Our cointegration coefficients normalized on the determinants of public expenditure on infrastructure in Nigeria are presented as long-run estimates in Table 4.3.

Vector Error Correction (VEC) Estimates

Table 4.3 shows the results of the VECM estimates for the determinants of public expenditure on infrastructure in Nigeria.

Both the long and short-run estimates, the parameter constancy (Chow test) cum diagnostics are presented (see Table 4.3). From the results, it can be observed that the model fits the observed data fairly well as indicated by the adjusted R^2 (0.9763) and F-statistic (152.3468) of the relevant error correction equation (Table 4.3). Moreso, the signs of the coefficients meet *a priori* expectations. Thus, this implies that government revenue population density openness and external reserves jointly explain public expenditure growth on infrastructure during the periods under investigation.

These results are over bearing and carry with them some relevant policy implications. In the short-man government revenue is inelastic (0.1201) but with the sign conjectured, while in the long-run, government revenue is 0.0909 (inelastic). Clearly, both coefficients are inelastic and suggest that 10% increase in government revenue increases public expenditure by 1.201% in the short-run while less than unity (0.909%) in the long-run (Table 4.3). This is an indication that a policy geared towards increasing public expenditure by increasing government revenue may not achieve its purpose, at least in the short-run.

In the same vein, the elasticity of the population density is -0.884 in the long-run, while the short-run estimate is 0.0248 both of which are inelastic and not significant respectively. Albeit the short-run estimate is appropriately signed in contrast to the long-run. This implies that a 10% rise in population density would reduce public expenditure by 0.884% in the long-run, while the same amount of increase in population density would increase public expenditure by 0.248% in the short-run (Table 4.3). Thus, a rise in population density would evoke a proportionate increase in public expenditure growth in the long-run.

By the same token, openness is 0.1461 and 0.0953 and is inelastic respectively for long and short-run estimates though with the signs conjectured. Only the short-run estimates were significant at 10% level. These results indicate that a 10% increase in openness would have a corresponding increase of 1.461% and 0.953% in public expenditure growth for long and short-run respectively.

Thus, this means policy actions to significantly encourage openness in the economy would be meaningful in the long-run compared to the short-run estimates. Moreso, the long-run (0.1749) and short-run (0.0403) elesticities of the external reserves are inelastic though not appropriately singed at the long-run. Clearly, the external reserve is more desirable in the short-run than the long-run estimates. Thus, increasing external reserves by 10%, for instance, would increase public expenditure growth by 0.403% in the short-run (Table 4.3).

The elasticity of rate of urbanization is – 2.0409 in the long-run, while the short-run estimates is – 0.0772 though with the expected signs, and not significant respectively.

This implies that, a 10% rise in rate of urbanization would reduce public expenditure growth by 20.409% in the long-run, while the short-run changes is 0.772% based on *a priori* consideration. In the theoretical sense, a 10% rise in the rate of urbanization, evokes a greater than proportionate (about 20%) increase in public expenditure growth, at least in the long-run while a 0.772% could be achieved in the short-run during the prescribed periods.

The dummy (Military – Civilian Administration) showed an inverse relationship, but significant at the 1% level and explain changes in public expenditure growth. This result indicates that the administration (Military/Civilian) impacted negatively though significantly on the growth in public expenditure during the periods under investigation.

The error correction coefficient (-0.9938), which measures the speed of adjustment towards long-run equilibrium carries the expected negative sign and it is very significant at the 1% level. The coefficient indicates a feedback of about 99.38% of the previous year's disequilibrium from the long-run elasticity of government revenue, population density, openness, external reserves and rate of urbanization. This implies that the speed with which government revenue, population density, openness, external reserves and rate of urbanization adjust

from short-run disequilibrium to changes in public expenditure growth in order to attain long-run equilibrium is

99. 38% within one year.

The strong significance of the ECM support cointegrating and suggest the existence of a long-run equilibrium relationship between public expenditure growth on infrastructure and the aforementioned variables, which determines it.

These facts suggest that short-run changes in government revenue population density openness, external reserves and rate of urbanization remarkably shaped public expenditure growth in Nigeria from 1970 to 2006.

Table 4.1. *Multivariate Cointegration Tests Results*

Trace Test					**Maximal Eigen-Value Test**			
Null Hypothesis	**Eigen values**	**Trace statistic**	**Critical value 5%**	**Critical value 1%**	**Null Hypothesis**	**Max-eigen value statistic**	**Critical value 5%**	**Critical value 1%**
r=0**	0.9885	388.8215	156.00	168.36	r=0**	151.9365	51.42	57.69
r ≤ 1	0.9088	116.8850	124.24	133.57	r ≤ 1	40.4017	45.28	51.57
r ≤ 2	0.8349	90.4833	94.15	103.18	r ≤ 2	38.2478	39.37	45.10
r ≤ 3	0.7088	64.2355	68.52	76.07	r ≤ 3	31.9489	33.46	38.77
r ≤ 4	0.5198	45.2866	47.21	54.46	r ≤ 4	24.9387	27.07	32.24
r ≤ 5	0.3631	27.3478	29.68	35.65	r ≤ 5	15.3399	20.97	25.52
r ≤ 6	0.2749	12.0079	15.41	20.04	r ≤ 6	10.9322	14.07	18.63
r ≤ 7	0.0311	1.0757	3.76	6.65	r ≤ 7	1.0757	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Table 4.2. *Estimates of Long and Short-run Vector Error Correction (VEC) on Public Expenditure on infrastructure in Nigeria*

Regressor	**Coefficient**			**Standard error**		**t-statistic**
			LONG-RUN ESTIMATES			
Ln PE (1)	1.000					
Ln GREV (1)	0.0909			0.0683		
Ln POPD (1)	-0.0884			0.0474		-1.8655
Ln OPN (1)	0.1461			0.0305		4.7868***

Ln EXTRES (1)	-0.1749			0.0457		-3.8256***
Ln URB (1)	-2.0409			0.6988		-2.9205***
Constant	-0.2983		**SHORT-RUN ESTIMATES**			
Error correction:	ΔLnPE	ln GREV	Ln POPD	Ln OPN	Ln EXTRES	Ln URB
Coint,Eq.1(ECM(-1))	-0.9938***	-0.1998	-0.0498	-0.3861	0.1168	0.0027
ΔLnPE (-1)	(0.0609) -0.0354	(0.1726) 0.2211	(0.2033) 0.0326	(0/3540) 0.0271	(0.2059) -0.0723	(0.0077) -0.0027
ΔLn GREV(-1)	(0.0405) 0.1201***	(0.1150) -0.7038	(0.1354) 0.2371	(0.2358) 0.4384	(0.1372) 0.1289	(0.0051) 0.0083
Ln POPD (-1)	(0.0557) *** 0.0248	(0.1580) 0.0208	(0.1860) -0.5549	(0.3240) 0.3686	(0.1884) 0.0527	(0.0070) 2.07E-05
Ln OPN (-1)	(0.0437) 0.9537	(0.1240) -0.0045	(0.1461) -0.0057	(0.2544) -0.5349	(0.1480) 0.0422	(0.0055) 0.0008
Ln EXTRES(-1)	(0.0211) 0.0403*	(0.0598) -0.0558	(0.0704) 0.0341	(0.1226) -0.6982	(0.0713) -0.2802	(0.0026) -0.1442
ΔLn URB (-1)	(0.0571) -0.772*	(0.1618) -3.0728	(0.1906) 10.6926	(0.3320) -6.6791	(0.1931) 1.7168	(0.0072) -0.3899
Constant	(1.1309)*** 0.2085	(3.2057) 0.0285	(3.7756) 0.0004	(6.5742) 0.0093	(3.8240) 0.0050	(0.1430) -0.0058
Ln DUM	(0.0520) -7.2893***	(0.1474) -0.9417	(0.1736) 0.2909	(0.3022) 1.0942	(0.1758) 0.0816	(0.0065) 0.0419
Diagnostics:	(0.3243)	(0.9192)	(1.0827)	(1.8852)	(1.0965)	(0.0413)
R^2	0.9827	0.5523	0..5478	0.7122	0.1817	0.4322
Adjusted R^2	09763	0.3845	0.3783	0.6043	-0.1251	0.2192
S.E equation	0.2982	0.8454	0.9958	1.7338	1.0085	0.0377
F-statistic	152.3468	3.2906	3.2315	6.6019	0.5922	2.0298
Log Likelihood	-1.1927	-36.6162	-42.1796	-61.0353	-42.612	69.1033
Akaike AIC	0.6583	2.7421	3.0693	4.1785	3.0948	-3.4766
Schwarz Criteria (Sc)	1.1073	3.1910	3.5183	4.6274	3.5437	-3.0277
Chow F(27,11)	1.8214					

Figures in parenthesis are standard errors: Chow (27, 11); critical value at 5% = 2.580; *= 1% significant**

The strong significance of the ECM support cointegrating and suggest the existence of a long-run equilibrium relationship between public expenditure growth on infrastructure and the aforementioned variables, which determines it. These facts suggest that short-run changes in government revenue, population density, openness, external reserves and rate of urbanization remarkably shaped public expenditure on economic growth in Nigeria from 1970 to 2006.

Fig.4.1 succinctly presented a graphical illustration of trend analysis for public expenditure in aggregate spanning 1970 to 2006. From the trend equation, about 4.2% of the public expenditure is used in pursuance of economic growth and infrastructure over time for the prescribed periods. Thus, the development in the sector is positive and is capable of enhancing growth in the economy, at least in the long-run.

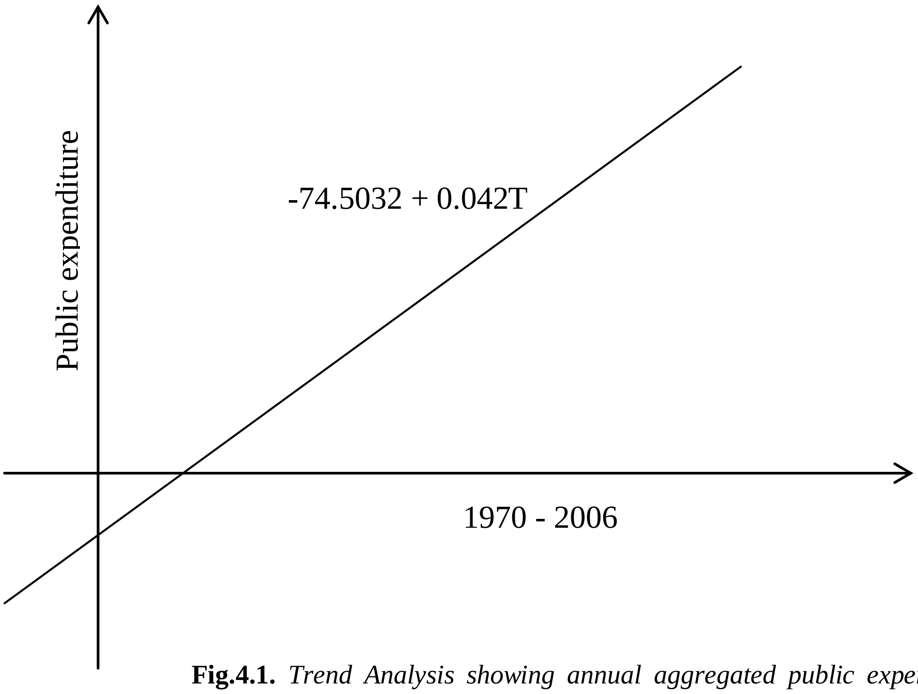

Fig.4.1. *Trend Analysis showing annual aggregated public expenditure on infrastructure in Nigeria*

In sum, based on the granger causality test results, there is a strong evidence that administration, external reserves, government revenue, population density and rate of urbanization could collectively or individually influence infrastructural growth vis-à-vis long-run economic growth.

Table 4.3. *Trend Analysis and annual growth rates for disaggregated and aggregated public expenditure on infrastructure in Nigeria between 1970-2006*

Public infrastructure	Trend equation	t-test	Growth rate (%)
Roads	Y = 354.28 + 0.181T	22.22***	18.10%
Water	Y = -296.496+0.1529T	10.76***	15.29
Electricity	Y = -98.3793+0.054T	10.05***	5.40
Transport	Y = -351.629+0.1796T	11.21***	17.96
Housing & Environment	Y = -69.0201+0.0385T	23.75***	3.85
-	Y = -74.5032+0.042T	20.24***	4.20

Notes: *** = significant at 1% level

Source: computed from Appendix data

Table 4.3. Presents annual growth trend analysis for disaggregated expenditure within the study periods. From our estimates, all the public expenditure on infrastructure were significant at the 1% level, albeit, the were low for an economy desirable of achieving growth beyond the subsistence level. Although, the level of significance for individual infrastructure cannot sustain any economy in the world. For instance, the annual growth rate in electricity supply is quite lamentable as it merely recorded 5.4%, while housing/environment had an annual growth rate of 3.85%.

Conclusions and Policy Recommendations

One interesting thing about this study is that it attempt to compare methodological empirics of studies conducted by early researchers to the present one, which made use of the vector error correction approach. The study analyzed the macroeconomic impact of public expenditure on infrastructure and economic growth in Nigeria from 1970 to 2006 using cointegration and error correction mechanism approach. (ECM)

Results indicate that the response of rate of urbanization, openness, government revenue, external reserves, population density and type of government to public expenditure is high, particularly in the short-run and with a higher adjustment toward long-run static equilibrium. Thus, short-run changes in rate of urbanization, openness, government revenue, external reserves, population density and type of government (administration), remarkably shaped growth on public expenditure in Nigeria. On the contrary, the Vector Error Correction (VEC) show that the level of public infrastructure (road construction, water supply, electricity supply, transport/ telecommunication and housing/ environment is very low, particularly in the short-run and with a weak adjustment toward long-run static equilibrium. This result is very informative as it clearly shows the deterioration in our public utilities, which suggests that expenditure in the aforementioned infrastructure, has not yielded positive results over time.

The results of the error correction mechanism (ECM) indicates a feedback of about 99.38% of previous year's disequilibrium from long-run elasticity of rate of urbanization, openness, government revenue, external reserves, population density and type of government.

The analysis further revealed that public expenditure on infrastructure in Nigeria has been stable between 1970 and 2006 based on the Chow test results and the switching regression test. This indicates that public expenditure have been having predictable effect on the variables which influence it.

The study has shown that rate of urbanization, government revenue, population density, external reserves and type of government jointly or individually influence public expenditure on infrastructure in Nigeria, as indicated by their inclusion in the parsimonious model. Based on this analysis and the results earlier discussed, it is concluded that although expenditure on infrastructure has significantly influenced its growth. It is pertinent too, to investigate whether huge public expenditure truly influences development.

The study recommends the need for government and it agencies to monitor the expenditure on infrastructure, adhere strictly to *due process* in accordance with the enabling fiscal policy and the Millennium Development Goal (MDG) blue prints. Specifically, these can be achieved via the following media;

- Government should adhered strictly on *due process* as a pre-condition for the released of funds for execution of contracts in the affected areas,
- Government should appraise the state of infrastructure and include same in the annual budget with a view to monitoring the implementation after disbursing funds to the affected ones.
- A project (infrastructure) policy should be evolved to guide prospective contractors on the need to utilize funds meant for project on public utilities
- As a matter of policy, the presidency in collaboration with states government should legislate against liquidity not spent on budgeted projects and retired same to the government treasury on specific interval of time. This will guide against corruption and facilitate swift implementation of projects as specified by the "white paper" empowering such project

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Table 4.1. *Results of Augmented Dickey-Fuller (ADF) Unit root Tests*

Variable level	ADF Statistic	Critical level 1%	Variable First Difference	ADF Statistic	Critical level 1%	Order of integration
PE	3.5845	-3.6892	Δ PE	-4.6481	-3.6998	1
GREV	-2.3444	-3.6268	Δ GREV	-4.8918	-3.7115	1
POPD	-4.4254	-3.6268	-	-	-	0
OPN	-6.3313	-3.6268	-	-	-	0
EXTRES	9.4235	-6892	-	-	-	0
URB	-3.0973	-3.6268	Δ URB	-5.1239	-3.6329	1
DUM	-1.4141	-3.6268	Δ DUM	-4.1228	-3.6329	1

Critical values of ADF tests are based on Mackinnon (1996) one-sided p-values. Lag length selection was automatic based on Eviews' schwarz information criteria

Table 4.2. *Results of Multivariate Cointegration tests*

←——Trace Test——→ ←—— Maximal Eigen-value Test

Null Hypothesis	Eigen values	Trace statistic	Critical value 5%	Critical value 1%	Null Hypothesis	Max-eigen value statistic	Critical value 5%	Critical value 1%
r=0**	0.9885	388.8215	156.00	168.36	r=0**	151.9365	51.42	57.69
r ≤ 1	0.9088	116.8850	124.24	133.57	r ≤ 1	40.4017	45.28	51.57
r ≤ 2	0.8349	90.4833	94.15	103.18	r ≤ 2	38.2478	39.37	45.10
r ≤ 3	0.7088	64.2355	68.52	76.07	r ≤ 3	31.9489	33.46	38.77
r ≤ 4	0.5198	45.2866	47.21	54.46	r ≤ 4	24.9387	27.07	32.24
r ≤ 5	0.3631	27.3478	29.68	35.65	r ≤ 5	15.3399	20.97	25.52
r ≤ 6	0.2749	12.0079	15.41	20.04	r ≤ 6	10.9322	14.07	18.63
r ≤ 7	0.0311	1.0757	3.76	6.65	r ≤ 7	1.0757	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Table4.3(a). *Summary Results Showing Long and Short-run Vector Error Correction (VEC) Estimates of the determinants of Public Expenditure Growth on Infrastructure in Nigeria*

Regressor	Coefficient			Standard error		t-statistic
			LONG-RUN ESTIMATES			
Ln PE (1)	1.000					
Ln GREV (1)	0.0909			0.0683		
Ln POPD (1)	-0.0884			0.0474		-1.8655
Ln OPN (1)	0.1461			0.0305		4.7868***
Ln EXTRES (1)	-0.1749			0.0457		-3.8256***
Ln URB (1)	-2.0409			0.6988		-2.9205***
Constant	-0.2983		**SHORT-RUN ESTIMATES**			
Error correction:	ΔLnPE	ln GREV	Ln POPD	Ln OPN	Ln EXTRES	Ln URB
Coint, Eq.1 (ECM(-1))	-0.9938***	-0.1998	-0.0498	-0.3861	0.1168	0.0027
ΔLnPE (-1)	(0.0609) -0.0354	(0.1726) 0.2211	(0.2033) 0.0326	(0/3540) 0.0271	(0.2059) -0.0723	(0.0077) -0.0027
ΔLn GREV(-1)	(0.0405) 0.1201***	(0.1150) -0.7038	(0.1354) 0.2371	(0.2358) 0.4384	(0.1372) 0.1289	(0.0051) 0.0083

Figures in parenthesis are standard errors: Chow (27, 11); critical value at 5% = 2.580; ***= 1% significant

Table 4.3 (b). *Summary Results Showing Long and Short-run Vector Error Correction (VEC) Estimates of the determinants of Public Expenditure Growth on Infrastructure in Nigeria*

Error correction	Δ Ln PE					
Ln POPD (-1)	(0.0557) *** 0.0248	0.1580) 0.0208	(0.1860) -0.5549	(0.3240) 0.3686	(0.1884) 0.0527	(0.0070) 2.07E-05
Ln OPN (-1)	(0.0437) 0.9537	(0.1240) -0.0045	(0.1461) -0.0057	(0.2544) -0.5349	(0.1480) 0.0422	(0.0055) 0.0008
Ln EXTRES(-1)	(0.0211) 0.0403*	(0.0598) -0.0558	(0.0704) 0.0341	(0.1226) -0.6982	(0.0713) -0.2802	(0.0026) -0.1442
ΔLn URB (-1)	(0.0571) -0.772*	(0.1618) -3.0728	(0.1906) 10.6926	(0.3320) -6.6791	(0.1931) 1.7168	(0.0072) -0.3899
Constant	(1.1309)*** 0.2085	(3.2057) 0.0285	(3.7756) 0.0004	(6.5742) 0.0093	(3.8240) 0.0050	(0.1430) -0.0058
Ln DUM	(0.0520) -7.2893***	(0.1474) -0.9417	(0.1736) 0.2909	(0.3022) 1.0942	(0.1758) 0.0816	(0.0065) 0.0419
Diagnostics:	(0.3243)	(0.9192)	(1.0827)	(1.8852)	(1.0965)	(0.0413)
R^2	0.9827	0.5523	0.5478	0.7122	0.1817	0.4322
Adjusted R^2	09763	0.3845	0.3783	0.6043	-0.1251	0.2192
S.E equation	0.2982	0.8454	0.9958	1.7338	1.0085	0.0377
F-statistic	152.3468	3.2906	3.2315	6.6019	0.5922	2.0298
Log Likelihood	-1.1927	-36.6162	-42.1796	-61.0353	-42.612	69.1033
Akaike AIC	0.6583	2.7421	3.0693	4.1785	3.0948	-3.4766
Schwarz Criteria (Sc)	1.1073	3.1910	3.5183	4.6274	3.5437	-3.0277
Chow F(27,11)	1.8214					

Figures in parenthesis are standard errors: Chow (27, 11); critical value at 5% = 2.580; ***= 1% significant

Table 4.4. *Result of Augmented Dickey – Fuller (ADF) unit root test on Level of Public Infrastructure (disaggregate) in Nigeria*

Variable Level	ADF Statistic	Critical Level 1%	Variable First Difference	ADF Statistic	Critical Level 1%	Order of integration
RC	2.9184	-3.6891	ΔRC	4.0110	-3.7114	1
WS	2.0018	-3.6701	ΔWS	5.5570	-3.6701	1
EC	0.1425	-3.6267	ΔEC	-5.4303	-3.6329	1
TT	2.8628	-3.6891	ΔTT	11.5959	-3.6701	1
HE	3.3108	-3.6998	ΔHE	8.1108	-3.6460	1
SAP	-1.1221	-3.6267	ΔSAP	-5.9160	-3.6329	1
DUM	-1.1221	-3.6267	ΔDUM	-5.9160	-3.6329	1

Table 4.5. *Results of Multivariate Cointegration tests for disaggregate Level of Public infrastructure*

Null hypothesis	Eigen value	Trace statistic	Critical value 5%	Critical value 1%	Null hypothesis	Eigen value	Max-Eigen statistic	Critical 5%	Level 1%
r=0**	0.7590	115.2838	68.52	76.07	R= ≤ 0**	0.759 0	48.3935	33.46	38.7 7
r= ≤ 1	0.5264	26.8901	47.21	54.46	R= ≤ 1	0.526	25.4144	27.07	32.2

						4			4
r= ≤ 2	0.4282	21.4757	29.68	35.65	R= ≤ 2	0.428 2	19.0104	20.97	25.5 2
r= ≤ 3	0.4113	12.4653	15.41	20.04	R= ≤ 3	0.411 3	11.0195	14.07	18.6 3
r= ≤ 4	0.1225	4.4458	3.76	6.65	R= ≤ 4	0.122 5	2.4458	3.76	6.65

*(**) denotes rejection of the hypothesis at 5% (1%) level

Table 4.6. *Summary Results Showing Long and Short-run Vector Error Correction (VEC) Estimates o Levels of Public infrastructure in Nigeria*

Regressor	**Coefficient**		**Standard error**		**t-statistic**
Ln RC (1)	1.0000		**LONG– RUN ESTIMATES**		
Ln WS (1)	-0.6015		0.2377		-2.5298
Ln EC (1)	3.3936		0.9809		3.4594***
Ln TT (1)	1.5426		0.1914		8.0559***
Ln HE (1)	-5.2483		3.6684		-1.4306
Constant	-0.4201				
			SHORT-RUN ESTIMATES		
Error corrections:	**Δ Ln RC**	**Δ LnWS**	**Δ Ln ES**	**Δ LnTT**	**Δ Ln HE**
Coint.Eq.1(ECM (-1))	-0.1645 (0.1334)	0.3660 (0.1923)	-0.0559 (0.0333)	-1.0775 (0.1468)	0.0043 (0.0113)
Δ Ln RC (-1)	-0.2963 (0.1939)	-0.2752 (0.2796)	0.0427 (0.0485)	0.4220 (0.2133)	0.0026 (0.0164)
Δ Ln WS (-1)	-0.0249 (0.1084)	-0.4564 (0.1563)	-0.0255 (0.0271)	-0.1832 (0.1193)	0.0087 (0.0092)
Δ Ln ES (-1)	0.6704 (0.7019)	0.8960 (1.0117)	-0.3917 (0.1755)	2.0957 (0.7721)	0.0284 (0.0596)
Δ Ln TT (-1)	0.0669 (0.7019)	-0.4159 (0.1811)	0.0477 (0.0314)	0.3345 (0.1382)	-0.0025 (0.0106)
Δ Ln HE (-1)	3.5113 (2.6951)	-0.8969 (3.8845)	-1.4070 (0.6740)	-2.3369 (2.9647)	0.0197 (0.2289)
Constant	0.0100 (0.1079)	-0.0052 (0.1555)	0.0102 (0.0270)	-0.0366 (0.1187)	0.0047 (0.0091)
Diagnostics:					
R^2	0.3076	0.5538	0.4231	0.7611	0.0445
Adjusted R^2	0.1538	0.4547	0.2949	0.7080	-0.1678
S.E. equation	0.6230	0.8979	0.1558	0.6853	0.0529
F- statistic	1.9998	5.5870	3.3008	14.3382	0.2095
Log Likelihood	-28.2375	-40.6667	18.8811	-31.4790	55.5929
AIC	2.0727	2.8039	-0.6988	2.2634	-2.8584
SC	2.3870	3.1181	-0.3846	2.5777	-2.5441

Notes: Figures in parenthesis are standard errors

Table 4.7. *Granger causality test for expenditure on infrastructure and Long-run economic growth*

Test	Variables	Causal variable	F= statistic	P – value
1.	DUM	GREW	29.8127	0.000047*
2.	DUM	PE	4.91771	0.03358**
3.	DUM	URB	1.12889	0.29573
4.	GREV	EXTRES	22.2040	0.000043*
5.	EXTRES	OPN	0.76233	0.38891
6.	EXTRES	PE	1.50692	0.22829
7.	GREV	PE	0.03157	0.86007
8.	GREV	POPD	0.03915	0.84436
9.	URB	GREV	9.80380	0.00364*
10.	PE	OPN	0.19913	0.65834
11	URB	POPD	0.84003	0.36604

* Indicates Significance at 1%
* Indicates Significance at 5%

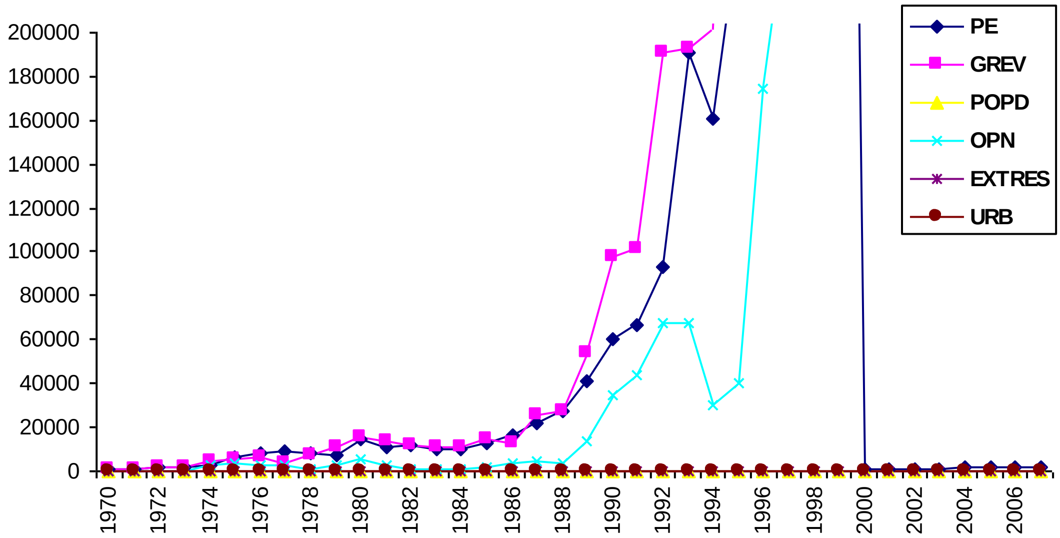

FIG. 4.1: TREND GRAPH SHOWING GROWTH OF PUBLIC EXPENDITURE ON INFRASTRUCTURE IN NIGERIA (1970-2006)

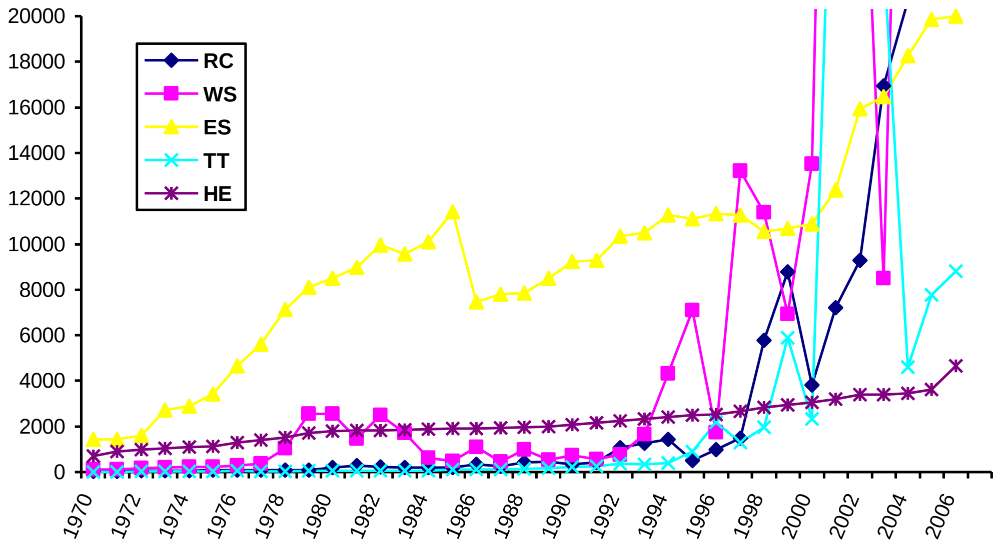

FIG. 4.2: TREND GRAPH SHOWING GROWTH OF INFRASTRUCTURE IN NIGERIA (1970-2006)

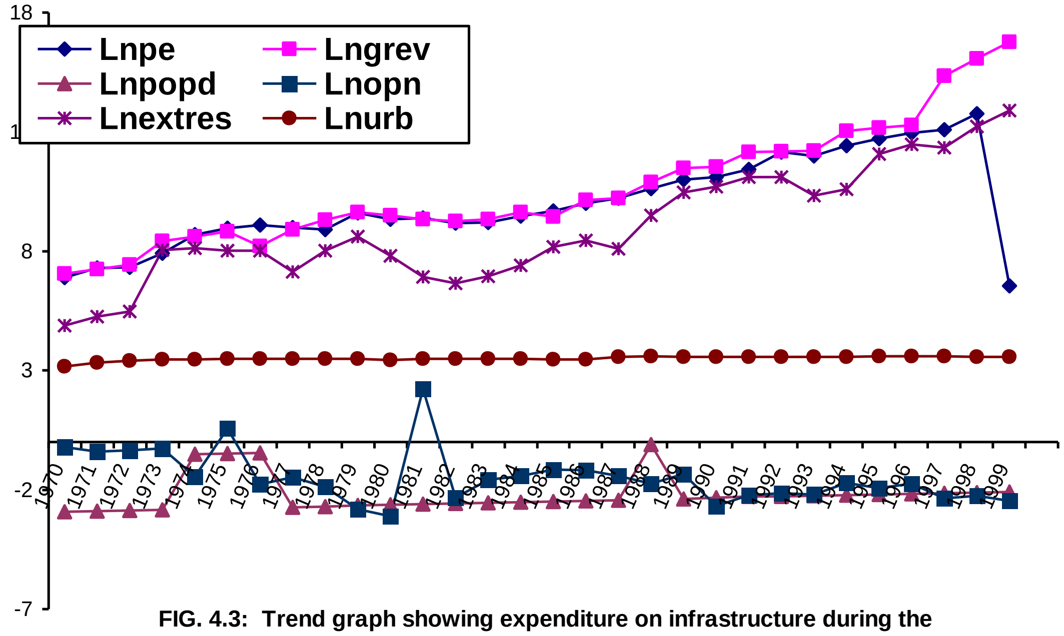

FIG. 4.3: Trend graph showing expenditure on infrastructure during the Military administration in Nigeria (1970-1983 and 1984-1999)

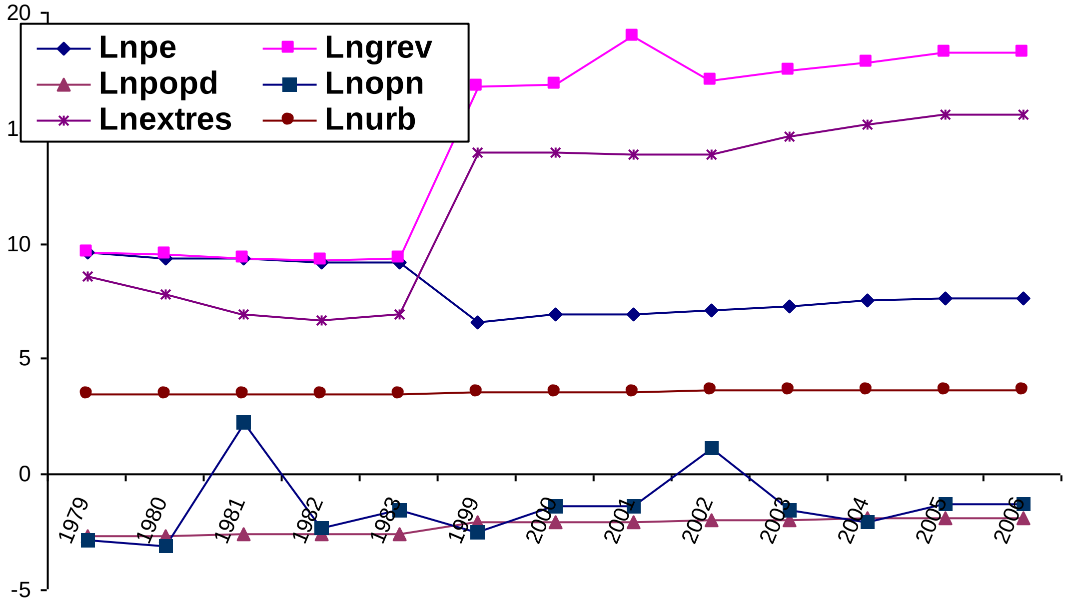

FIG. 4.4: Trend graph showing expenditure on infrastructure during the Civilian regime in Nigeria between 1979-1983 and 1999-2006