

ANALYSIS OF THE MACROECONOMIC EFFECT OF THE PRODUCTIVITY OF SOCIAL OVERHEAD CAPITAL (SOC) INVESTMENT ON NIGERIA'S ECONOMIC GROWTH, 1980-1998

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ABSTRACT

This study examined the quantitative macroeconomic impact of Social Overhead Capital (SOC) investment on Nigeria's economic growth. Utilizing a time series data spanning the period 1980-1998, two functional forms (linear and double-loglinear models) were fitted to data. The double-loglinear regression equation, which was selected as the 'lead' equation, showed that with the exception of the number of telephones installed, other variables (electricity generation/supply in kilowatt hours, road mileage/surface area and the structural adjustment programme) significantly influenced the growth of Nigeria's Gross Domestic Product (GDP). The results inform that investments in Social Overhead Capital very significantly impacted on Nigeria's economic growth during the period, 1980-1998 ($P < 0.01$ and 0.15 respectively).

Key Words: Social Overhead Capital (SOC) Investment, Nigeria's Economic Growth.

INTRODUCTION

A large part of the nation's income is claimed by government, while a substantial share of output is produced by or for the government. Total government expenditures-federal, state and local-account for between 25 and 30 percent of national income. Infact, the Federal Government alone in 1998 spent ₦432.3 billion whereas state and local governments added another ₦181.2 billion. A good percentage of the money was spent to produce or to purchase goods and services-defence, health care, highways, power, and telecommunications, police, education, courts and other public services. Expenditures on the above class of activities are generally justified on the basis of public goods, merit goods or external effects. Some of the allocation function (for example, setting prices for electric

power) relates to the regulation of monopoly. An economist would define public goods as the goods which are non-rival in consumption and not subject to exclusion. They are non-rival in consumption up to certain limits; example of goods classified in this category are parks, national defence, highways, etc. This simply means that they are not "used up " in consumption. For instance, the fact that one is watching the sunset or strolling in a park leaves not less sunset or park for another to enjoy. Exclusion is another technical term with a simple meaning: the ability to prevent non-payers (also called free riders) from consumption (Amacher, et al. 1986). National defence, street light, and monthly/quarterly immunization of children against infection by communicable, contagious diseases are all services for which it is hard, or at least expensive, to prevent non-payers from reaping the benefits.

A pure public good enjoys both non-rivalry and non-exclusion. Some economists would extend this definition to include goods with weak rivalry or high cost of exclusion. Examples might include fire services, education and highways. The problem with all of these is that the benefits spill over to non-payers as well. As a result the private market may not produce enough of them because not all the beneficiaries pay.

Finally, along with public goods, there are public "bads" - noise, litter, and pollution. These are activities in which it is possible for us to pass some of the costs along to other people (negative external effects). The focus of the present paper is on government expenditures in the supply of basic services (public goods) to its citizens. The term Social Overhead Capital (SOC) can be defined as all government expenditures in the supply of basic services which are indispensable in the political, economic and social life of the people (Islam, 1974; Wells, 1974; Begg et al. 1984; ADB, 1998). Cootner (1963), Wells, (1974) and Amacher, et al. (1986) noted that there are three essential elements involved in the usual definition of SOC, namely: first, it is postulated that this group of production units (industries) produces services which are essential to, and pre-requisite for, initiation of an industrial expansion. Second, these services must be 'rigidly immobile' so that the capacity for producing them must be constructed within the country to be developed. Third, these investments are characterized by such properties as important economies of scale, long periods of gestation and exceptional durability.

Although most economists emphasize the importance of SOC in economic growth, the nature and direction of empirical causation between SOC and economic growth is not definite. Keynes (1937) did suspect that in the nineteenth century, improvements in transportation, standard of housing and public service were of such a character that they did tend somewhat to increase the period of consumption of durable and consumer goods.

Consequently, we could assume, from Keynes speculation, that investments of SOC by prolonging the life span of durable consumer and producer goods do in fact reduce the fixed cost per unit of service or output of such goods.

Hirschman (1958), while considering the sequence of SOC and the investment in "Directly Productive Activity (DPA)" was emphatic on the nature (and direction) of causation when he said,

From the point of view of the economy as a whole, the objective is to obtain increasing output of DPA at minimum costs in terms of resources devoted to both DPA and SOC.

Cootner (1963), Amacher et. al. (1986), Begg et. al. (1984), and Wells (1974) put the connection on the entire realm of pecuniary external economies. Thus, after analyzing the United States economy, Cootner concluded as follows:

The effect of social overhead capital investment on manufacturing did not work through the lower cost of social overhead services to industry, but through reducing the costs of inputs into manufacturing by aiding in the expansion of the supply of these inputs.

From the point of view of such eminent economists, we can theoretically and perhaps tentatively conclude that investments in SOC do affect economic growth through the reduction of unit service costs of capital goods (fixed cost) and the reduction of the costs of variable material inputs (variable costs). Put differently, we could say that SOC investments could shift the entire total cost curve of the industry downwards and move the optimum output point to the right at given price level. If this phenomenon holds within the entire national economy, or if such a shift in one industry is not offset by a negatively fu

compensatory shift in some other sector(s) of the economy, the aggregate effect would be an increase in the Gross Domestic product (GDP). Fundamentally, economic growth is identified with net *incremental positive changes* in the level of GDP. In spite of the above connotation, it should, however, be borne in mind that such changes could be due to both qualitative and quantitative factors, the former of which "are extremely difficult to assess" (Panic, 1967, Gittinger, 1972). Indeed, efforts to measure the effect of qualitative factors on economic growth, though successful (Adelman and Morris, 1968; Amacher et. al. 1986) are as yet inconclusive (Papanek, 1971, ADB, 1998). The present paper shall limit its analysis to those quantitative aspects which can be captured by the extent and quality of data availability. The concern in this paper is primarily to assess the relative contributions of the sectoral components of "hard public utilities" to Nigeria's economic growth. In doing this the paper attempts to predict/indicate the percentage or proportionate growth in GDP that is accounted for or explained by SOC investment. Additionally, to the extent that it is possible to establish such empirical relationship, the paper will attempt to derive the implications of the relationship on national economic planning.

THEORETICAL FRAMEWORK

From the standpoint of the limitations referred to above, namely, the extreme difficulty of assessing the qualitative impact of SOC investments on GDP, the only alternative is to rely on those aspects of quantitative data that will enable the paper to determine the effects of SOC investments on Nigeria's economic growth. The exercise would be successful only if the type of quantitative data that is needed is known and a full identification of the structural and/or functional relationships in the growth matrix are assessed. Two approaches can be adopted. The first is that of estimating the direct functional relationship between the rate of growth of capital formation as a proportion of the GDP and the rate of growth of GDP.

The second is estimating the direct functional relationship between capital and economic growth via the rate of growth of unit service output of SOC investment projects.

If a cue from Aboyade's (1966) is taken, then it is possible to adopt the first approach or alternative. In taking the first route Aboyade had concluded as follows:

We note that broadly speaking, while the investment to gross domestic product ratio was rising during the 1950s (see table 3, p. 20), the growth rate of the economy was falling (see tables 2a and 2b, pp. 17-18). On the face of it, this represents an indictment of development theories which hold capital formation as the key to economic growth.

Following from Kuznets (1955) emphasis on capital utilization and the views held by Cootner (1963), Wells (1974), Begg et. al. (1984) and Keynes (1937) respectively, it is possible that the unit service output of SOC investment projects might yield a different result. However, this approach might require the computation of aggregate quantity index of total SOC input into different economic activities, an exercise which might be quite unfruitful and elusive owing to the difficulties of pricing unit capital inputs at competitive market prices (Griliches, 1966; ADB, 1998). Bearing in mind these intractable problems, this paper restricts its area of focus to include investments in power (electricity generation), road and telephone services in which case it looks at quantities such as kilowatt hours of electricity, the number of telephone installations and road mileage exclusive of user costs. The analysis spans the period 1980-1998 primarily because of the availability or data at 1984 constant prices.

ECONOMIC MODEL

The following definitions of terms as applicable

to this paper are presented below:

- Y - The annual rate of growth of GDP.
- E - Electricity production in Kilowatt hours.
- T - The number of telephones
- R - Road mileage (Tarred).
- A - Total surface area of the country.
- T - Time from 1980 to 1998.
- YE - Estimated annual rate of growth of GDP.

Given the above definitions, our economic model can be stated in the form:

$$Y = f(X_1; X_2; X_3; X_4) \dots\dots\dots\text{Eq. 1}$$

Where $Y = (GNP)_t / (GNP)_{t-1}$

- $X_1 = R_t/A_{t-1}$
- $X_2 = E_t/E_{t-1}$
- $X_3 = T_t/T_{t-1}$
- $X_4 = (0, 1)$ variables for regulated (1980-1985)

and the SAP or deregulated (1986-1998) economic policy regimes. The graphical relationships would be a multiple linear or log-linear hypothesis of the forms:

$$Y = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + U \text{Eq.} \dots\dots\dots 2$$

$$\text{or } \text{LN}Y = a + b_1 \text{LN}X_1 + b_2 \text{LN}X_2 + b_3 \text{LN}X_3 + b_4 X_4 + U \dots\dots\dots\text{Eq. 3.}$$

where the "a" and the "bj's" are parameters to be estimated and U is the error term.

To proceed the link relatives of GDP and hard core utilities (electricity production and telephone supply) as well as the road-mileage-surface-area-ratios are first estimated. The estimation of these link relatives provides the paper with the basis for making inferences as to the annual rate of changes in GDP as represented by the annual rate of growth in electricity production, telephone supply and road-mileage-surface area ratios respectively. The nature of such statistical

parameters (differences) affords the focus for the further enquiry into, for instance, how much fluctuation in the annual rate of growth of GDP will the amounts of the electricity produced, the number of telephones installed and the road-mileage-surface area constructed explain. The determination of the YE relationship with the independent variable is thus important for our analysis of results and the implications arising therefrom.

In table I the paper presents the link relatives of the GDP hard core utilities and the road mileage-surface area ratios. From the table, the following observations are aptly applicable. During the period under review, the average annual rate of change in GDP is 1.0204 and represents an unweighted (1) average annual (positive) growth rate (or productivity) of 2.40 percent. This estimate is much less than the average annual rate of change at 1.0480 (4.80 percent growth rate) and .0614 (6.14 percent growth rate) in electricity production (in kilowatt hours) and telephone supply (in total number installed) respectively. In addition, the coefficient of variation of the link relative of GDP which is estimated at 1.999 percent is less than the corresponding value of 4.580 percent for electricity production but greater than the corresponding value of 0.1682 percent for the number of telephones installed.

Given these statistical relationships and/or differences, an investigation of how much of the fluctuations in the annual rate of growth of GDP that the combined effect of electricity production, number of telephones and road-mileage surface area ratios can explain was carried out.

EMPIRICAL ANALYSIS

Methodology and Significance Tests:

Models (2) and (3) were empirically estimated with annual data for the period, 1980-1998 using the ordinary least squares (OLS) multiple regression method. In essence, both the linear

TABLE 1: LINK RELATIVES OF GDP HARD CORE PUBLIC UTILITIES AND ROAD-MILEAGE-TOTAL - SURFACE AREA RATIOS

YEAR (OBSERVATIONS)	GDP AT 1984 CONSTANT PRICES (Y)	ROAD (X ₁) MILEAGEKILOS/ TOTAL SURFACE AREA)	ELECTRICITY PRODUCTION (X ₂) (KILOWATT HOURS)	TELEPHONE INSTALLED (NO.) (X ₃)	DUMMY (TRIED) X ₄
1980					
1981	0.882	0.1402	0.745	1.130	0
1982	0.997	0.1563	1.704	1.058	0
1983	0.946	0.1596	1.022	1.079	0
1984	0.949	0.1610	0.898	1.119	0
1985	1.094	0.1625	1.147	0.348	0
1986	1.0.31	0.1632	1.173	3.118	1
1987	0.995	0.1681	1.013	1226.528	1
1988	1.090	0.1700	1.001	0.978	1
1989	1.074	0.1753	1.144	1.521	1
1990	1.082	0.1759	0.920	1.018	1
1991	1.047	0.1762	1.054	1.012	1
1992	1.030	0.1779	1.050	0.002	1
1993	1.027	0.1823	1.149	376.515	1
1994	0.010	0.1866	0.960	1.077	1
1995	1.024	1.1910	0.984	0.999	1
1996	1.034	0.1960	0.959	1.159	1
1997	1.032	0.2014	0.977	1.319	1
1998	1.024	0.2074	0.964	1.129	1
Average (mean) variation	1.0204	0.1751	1.0480	90.0614	
Coefficient of variation (CV)	1.999	471.102	4.580	0.0682	
	Y =	F (X ₁ =R/ A _t -1	X ₂ =E _t /E _{t-1}	X ₃ = T _t /T _{t-1}	X ₄ = 0 for 1980-1985 1 for 1986-1998

Sources:

Survey Data: The figures were derived from Annual Abstract of Statistics, Federal Office of Statistic (FOS), (1980-1998); the Central Bank of Nigeria (CBN) Annual Report and Statement of

Accounts, (1980-1998); World tables, 1992; and African Development Bank (ADB), 1998: African Development Report (Human Capital Development), Oxford University Press Inc., New York.

and double log-linear forms of the equations were estimated. The variables are as previously defined. The a priori expectations are that growth of GDP should vary directly, with the growth of investments in hard-core utilities supply to the (Nigerian) economy. Again, the Structural Adjustment programme (SAP) policy should positively affect the growth of the Nigerian economy, through increases in her GDP

Symbolically, the expected a priori relationships are as follows:

$$\frac{dy(\text{GDP})}{dX_1} > 0; \quad \frac{dy(\text{GDP})}{dX_2} > 0;$$

$$\frac{dy(\text{GDP})}{dX_3} > 0; \quad \text{And } \frac{dy(\text{GDP})}{dX_4(\text{SAP})} > 0.$$

The regression equations presented in table 2 (series A and B) reflect different combinations of explanatory variables for the two functional forms - double log-linear and linear. For each functional form the regression coefficients are above the t-values which are in parentheses (brackets). Other test statistics reported in the table are the R^2 and the adjusted R^2 values, Durbin Watson Statistic (DW) and F-statistic. The estimated models indicate good results. However, the linear functional form is not as good as the double log-linear equation in terms of R^2 and R^2 values and statistical significance of variables. Therefore, the double log-linear equation presented in table 2 (series A) are discussed in the text while the linear equation, though presented (series B) are not discussed.

The Estimated Double Log-Linear Equation

Table 2 (series A) contains the double log-linear regression equation. The value which measures the over-all goodness-of-fit of the equation is satisfactory. Its value (0.539663 or 0.540) shows that the explanatory variables in the equation explain significant proportions (more than half) of the variations in dependent variable, LNY. The overall regression equation is significant as indicated by the F-statistic (3.81). The D.W tests for serial correlation show that the values of the estimates do not fall within the region of auto-correlation.

The performance of individual variables in terms of expected signs and statistical significance is very satisfactory. For example, the variable

TABLE 2: REGRESSION RESULTS FOR THE PRODUCTIVITY OF SOCIAL OVERHEAD CAPITAL (SOC) INVESTMENT

EQUATION NO.	DEPENDENT VARIABLE	CONSTANT	INDEPENDENT VARIABLES							
			LN X_1	LN X_2	LN X_3	X_4	R_2	R^2	DW	F
DOUBLE LOG linear (Series A)	LNY	0.102	0.075	0.138	-0.003	0.07	0.540	0.4	1.75	3.810**
		0.371	(2.183)**	(-0.841)	(2.00)**					
		CONSTANT	X_1	X_2	X_3	X_4	R_2	R^2	DW	F
		T								
LINEAR (SERIES B)	Y	0.827	0.214	0.102	-3.74	0.07	0.49	0.33	1.71	3.063**
		0.243	(1.791)	(-0.985)	(2.159)**					

*** Significant at the 1% level

** Significant at the 5% level

From table 2 the regression equations based on the variables and the resultant parameters can be rendered as follows:-

Double = Log Linear (Series A)

$$\text{Log } Y = 0.12 + 0.075 \log x_1 + 0.138 \log x_2 - 0.003 \log x_3 + 0.065 x_4$$

$$(0.371) \quad (0.512) \quad (2.183)** \quad (-0.841) \quad (2.001)**$$

$$R^2 = 0.540 \quad R^2 = 0.398 \quad DW = 1.748 \quad F = 3.810***$$

Linear (Series B)

$$Y = 0.827 + 0.214X_1 + 0.102X_2 - 3.740X_3 + 0.073X_4$$

$$(5.403)*** \quad (0.243) \quad (1.791) \quad (-0.985) \quad (2.159)**$$

$$R^2 = 0.485 \quad R^2 = 0.327 \quad DW = 1.708 \quad F = 3.063**$$

representing electricity production for the supply of industrial and private (domestic) needs has the expected positive sign and the coefficient is statistically significant at the 95 percent confidence level in the equation. This means that increased domestic production of electricity to supply industrial and private demand increases the country's GDP. The structural adjustment policy variable (X4) also has the correct positive sign and the coefficient is statistically significant at the 95 percent level of confidence. Consequently, the structural adjustment policy of the Federal Government impacted positively on the country's GDP as far as investments in hard core utilities (SOC) are emphasized in the package. In all, it is only the variable representing telephone supply (X₃) which has the unexpected (negative) sign, thus tending to underscore the necessity for more telephone installations (services) to supply both industrial, domestic and public needs as there are urgent effective domestic demands. Gearing government policy towards this end would tend to enhance the growth of national income and therefore that of the total economy. As for the provision of infrastructure (road mileage/surface area coverage) its positive sign which is however not statistically significant is an indication to the fact that active pursuit of this goal is a sine qua non to the growth of the economy.

On balance, the result are in consonance with studies in government policy in recent years in favour of the provision of some public goods through the guiding hand of the market mechanism. In other words, a regime of "guided deregulation" is expected to usher in a faster growth rate of the economy, particularly in the area of production, distribution and supply of basic services which are indispensable to the political, economic and social life of the nation.

POLICY IMPLICATIONS

This study has posited a clear functional relationship between the service outputs of SOC

hard core investment projects and rate of economic growth in Nigeria. In recent years, Nigeria's perspective (development) plans have tended to attach more importance to the achievement of targeted annual rates of growth for the sectors of the economy in particular and the overall economy in general. This is a rationale for efficient utilization and allocation of resources for the growth of the economy. Consequent upon this (new) development, priority in the allocation of SOC resources should be given to those projects which contribute to the planned annual rates of growth.

The findings of this study tend to lend support for the concern often shown in official circle whereby priority attention is paid to road development, rural and urban electrification and their possible linkage through the revamping of the communications and transportation networks. Such concern is therefore not a misplaced emphasis. Since, according to Cootner (1963):

"Industrial and economic growth will come to those areas which have major products to sell in the world markets no matter what the source of their comparative advantage"

It is of vital necessity that road construction should be vigorously pursued.

The vital questions which these results pose for policy under economic growth may now be stated:

1. Can these SOC investments continue to play the same role in Nigeria's economic growth and in the future?
2. If not, what problems, internal and external, do they face and what policy instruments are required to combat them successfully?

the growth potentials of an economy that is in a hurry and in dire need to attain a self-sufficiency and self-reliance status in the very near future?

4. If not, what are the likely options for a comprehensive solution?

These are some of the vital questions and/or policy issues to which we need to address ourselves. Answers to these questions will enable us to formulate development, regulatory, supervisory and compensatory policies that are conducive to progress under economic growth.

SUMMARY AND CONCLUSION

The results of the economic analysis undertaken here show that SOC investments account for a sizeable proportion of the variabilities in the growth generating variables that should be of interest to policy makers. The results pose major questions to policy makers and planners alike as to likely future performance, realistic policy instruments, scope of SOC investment growth and productivity stimulation and/or motivation.

The policy-oriented questions have to be effectively solved and/or contained during subsequent plan period. In the light of this need, our perspective plans have to devote considerable attention to a resuscitation of the SOC investment projects as well as lay the foundation for a 'modern' Nigerian economy that will replace the current traditional orientation. This will enable the basic SOC investment components to continue to make significant contributions to the overall economic growth of Nigeria. However, we need more studies on the responses of GDP components to the growth of SOC investment service outputs, not just the

nature of functional relationship existing between the rate of economic growth and utilisation of SOC. This approach will be more useful and informative for policy formulation since GDP component responses are less aggregative.

NOTES:

- (1) The rate of growth in income should in real terms be computed by the weighted average method whereby the sectoral rates of growth are weighted by investments in each sector. However, such weighted averages might not differ significantly from the unweighted average rate of growth..

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