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PUBLIC SECTOR GROWTH: AN ECONOMETRIC TEST OF WAGNER'S LAW

by

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This study makes use of recent developments in econometric technique to test Wagner's Law of increased state activity according to which Government Expenditure must increase at a rate faster than National Output. It makes use of three different interpretations of the Law, namely, increasing relative share for the public sector in the total economy as per capita real income grows, total government expenditure as a function of real income, and relating per capita total government expenditure to per capita income. In all cases the variables were not cointegrated hence a long run equilibrium relationship could not be established between public spending and income. A causality test performed on the models confirmed that public expenditure does not cause growth in income and there was no existence of a feedback relationship. Thus increased public expenditure may not be an appropriate policy instrument to promote economic growth except where the expenditure is on productive ventures.

I. INTRODUCTION

In recent years, there has been much interest in or concern about the size of government. Such concern has centered around the implication of expansion of public sector for economic activity. Such expansion, it is argued, would increase aggregate demand and would jeopardize the ability of market forces to function well in the allocation of resources **(Lermes, 1984 in Abizadeh & Basilevsky, 1990)**. Also of concern has been the measurement of the size of government and an attempt to establish the relationship between growth in income and the scale of government activity in relation to the amount of resources that could be allocated to enable it function appropriately. Within the context of global interest in economic growth, it becomes necessary to look at the behaviour of governments in terms of their revenue and expenditure policies, and the economic effects of budgetary policies, how this revenue and expenditure are determined with a view to assessing the impact of public sector on economic growth. To do this requires the study of government expenditure on the basis of empirical data and historical fact.

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In Nigeria, a developing economy, it becomes imperative to study public sector expenditure in order to ascertain the extent to which the allocation of expenditure to investment has contributed to increase in output and aggregate demand. Government expenditures could be functionally broken down into two components. The first such component is for production meant to increase the level of goods and services available to the economy and the other, transfer payments, which include payments on public debts, pensions and gratuity etc., which are regarded as unproductive.

Wagner (1893), on the basis of empirical findings, came up with a view that there was a long-run tendency for state activities to grow relative to growth in National Income. According to this view, he deduced his "**Law**" of increase in state activity (otherwise known as Wagner's Law), according to which government expenditure must increase at a rate faster than National Output. This law has culminated in a vast literature with various interpretations. The most common interpretation is that growth in public expenditure increases demand, brought about by an increase in per capita income.

Various studies abound on Wagner's Law. These studies dwell on the following:

- an appropriate measure of public sector growth;
- correct interpretation of the Law;
- finding an index of government size to facilitate comparison between countries; and
- testing the law by adopting a cause-effect relation to estimate the income elasticity of government expenditure. While some of those that tested the Law have found evidence to support the Law, others have refuted it. Even among those that have confirmed the Law, their results have been conflicting.

Starting from the premise that the inconsistencies in the results obtained in the past was due to the fact that the underlying process generating the data was not considered, we shall proceed to test Wagner's Law for the Nigerian economy, i.e. the extent to which the size of Government would grow relative to increase in National Output, using time-series data and taking into consideration the data generating process. This would be done by:

a) Examining the nature of the relevant macroeconomic variable in the study for stationarity;
b) Examining whether or not there exists a long-run equilibrium relationship between Government expenditure and increase in National Output, using three interpretations of Wagner's Law. The existence of this long run equilibrium relationship would lead us to obtaining stable income elasticity for government expenditure; and

c) Determining whether growth in government spending could coincide with the period of growth in national output by carrying out causality test to verify the likelihood that growth in income is caused by growth of government. This would be an added evidence to support Wagner's proposition.

On the basis of the above objectives we would then deduce from the results whether growth could be promoted by increasing the scale of government activities.

The paper has been divided into four sections. Section I is the introduction. Section II reviews some existing literatures; section III provides the theoretical and analytical framework; while section IV discusses the results. Section V summarizes and concludes the paper.

II. LITERATURE REVIEW

Two major concerns of economists in public sector growth are first, the extent to which economy is being controlled by the public sector. The other area has to do with the establishment of a cause and effect relationship between variables that could allow government to grow. Allocation of resources by market forces could be jeopardized if the size of government is large. A question then arises as to the appropriate measure of government size. A turning point of the study of public sector expansion or growth is due to Wagner (1893). He proposed that there was a long-run tendency for the public sector to grow, and particularly state activities. He concluded that government expenditure would increase at a rate faster than National output. He opined that increased industrialization opens up possibilities which lead to a corresponding expansion of those functions which government alone can perform **(Abizadeh & Basilevsky, 1990)**. **Bird (1971)** went further to specify the necessary conditions for the operation of the law as:

i) Rising per capita income;
ii) Technological, institutional change; and
iii) Democratization of the polity.

Several commentators abound on Wagner's Law. Peacock & Wiseman (1961) noted that so long as increased state activity is an accompaniment of social progress, increased government size must necessarily follow. Indeed, **Beck** (1976) had even suggested that the real size of the public sector may have peaked in many mature economies, indicating that in real terms the era of public-sector growth, in most developed economies, may have ended and hypothesized a declining real public sector size.

Even though Wagner was not the first economist to make this hypothesis, he was, however, the first to attempt to use empirical evidence to support his view.

Since this paper is merely looking at the cause-effect relationship to test the validity of this law, it would be appropriate to examine the literature based on this approach.

Various studies have utilized a single independent variable in a regression equation to test the validity of the Law, while others have included more than one independent variable. Different versions of the hypothesis exist concentrating on income elasticity assumption. However, they have given rise to different results, some vindicating Wagner's Law and others either rejecting or failing to confirm it. No overall consistent conclusion has emerged. For instance, **Musgrave** (1959) regressed nominal spending with Gross Domestic Product (current prices or deflated by GDP deflator) as distinct from the general postulation where it is expected that if the ratio of government expenditure to output (G/GDP) increases as the ratio of output to population (GDP/N) increase, the elasticity value for the relationship would exceed zero.

Gupta (1967) used the double logarithmic function fitted at different sub-periods, with per capita total government expenditure and Gross National Product (GNP) as dependent and independent variables, respectively to test, among others, whether a social upheaval is associated with a change in the "income elasticity" of government expenditure, and if such a change was observed whether it was statistically significant. His conclusion was that significant change in income elasticity was associated with each major upheaval and no generalization could be made about the direction of change.

The study by **Hemning** and **Tussing** (1974) used Indirect Least Squares (ILS) to examine income elasticity estimate of demand for public expenditure in U.S.; and even though it showed some improvements by eliminating the bias associated with regressing, it was still subject to simultaneous bias.

Ganti and **Kolluri** (1979) deviated from the Ordinary Least Squares (OLS) and system estimation procedure and cast their model in the mold of **Zellner's** (1970) reformulated errors - in - variables framework, called regression models containing unobservable independent variables and derived, directly, efficient estimates of the gross private expenditure elasticity of government expenditure before deriving the income elasticity of government expenditures. They claimed their estimates showed improvement over ILS and concluded that there was evidence in favour of **Wagner's** hypothesis.

Abizadeh and **Gray** (1985) used panel data for 55 countries, divided into three groups, according to their level of development, from 1963-79. Using 5 regressors, they upheld **Wagner's Law** for the wealthier groups, but not for the poorest ones. This tended to contradict Beck's hypothesis indicated previously. It became clear that no unique test of **Wagner's Law** existed, and where strong evidence existed, it was fraught with methodological shortcomings. This was as a result of the fact that all tests so far ignored the time series properties of the data used.

In recognition of this fact, **Henrekson** (1993) tried to solve this problem by first looking at the stationarity of the variables used. In particular, he tested Wagner's Law using the interpretation that government civilian expenditure relative to GDP reflects better GDP per capita. Using Swedish data from 1861-1990, he concluded that the two variables are not cointegrated and thus, constant elasticity estimate could not be obtained from the relation, and as such Wagner's Law was a spurious relationship.

It is considered necessary to look critically at the Nigerian data for evidence of Wagner's Law. The question here is, does Wagner's Law hold for a developing country like Nigeria? Or is it truly a spurious relationship? Also, would the three measures yield different conclusions?

Granger and **Newbold** (1974) had concluded that regression results of non-stationary series may, most of the time, be "spurious" or "nonsensical" to the extent that a relationship would be accepted as existing between two variables as measured by their R^2 and adjusted R^2, when in actual fact no such relationship exists. The Durbin Watson (DW) test would indicate the presence of autocorrelation, while the estimated parameters would become very unstable. A way out of the non-stationarity problem had been assuming stationarity around a deterministic trend, by including a time trend in the regression equation. However, **Nelson** and **Polsser** (1982) argued that the time series being examined belong to "difference" stationary class. A short-term solution to this problem was taking the first difference as a way of inducing stationarity which had often led to loss of long run valuable information.

Owing to increased cost in modeling, traditional econometric method assumes that the correct functional form, specification and dynamic structure of the model being estimated, not to mention the composition of the set of explanatory variables, was known a priori and with certainty. What remains was to simply quantify the parameters of the model and to ensure that the error term, ex post, met the requirements of classical regression model (**Adam**, 1992).

As the forecasting performance of several large scale macroeconometric models becomes poor, single mechanistic time series methods provided severe competition. Growing empirical successes in time series analysis pioneered by **Box** and **Jenkins**, (1970) also provided renewed challenge to econometric study. Consequently, it was believed that simpler and cheaper time series method could be as accurate as those from large-scale econometric methods.

A new time series analogue called cointegration and error correction technique has become more attractive, of recent, in econometrics as it combines both the changes (difference variables) and the levels (the estimated error term from the cointegration regression). The new technique ensures that all its components are stationary. It also preserves the long-run relationship, while specifying the system in a short run dynamic way.

It is necessary at this point to mention some merits of the new methodology. The merits include stable parameter estimates, since analysis are based on stationary time series data. It is also data admissible and existence of theory consistency would enhance the forecasting and policy formulation capabilities of the model. This recent technique would be used to investigate Wagner's Law, using Nigerian data.

III. ANALYTICAL FRAMEWORK

III.1 The Model

As earlier mentioned, there have been various interpretations of Wagner's Law. Three of the interpretations would be used in this study. There seems to be a consensus in the literature, that the law should be interpreted as predicting an increasing relative share for the public sector in the total economy as per capita real income grows. Thus,

$$\frac{GCE}{GDP} = f\left(\frac{RGDP}{N}\right) \quad (1)$$

where GCE represents a nominal measure of public spending, N is the total population and RGDP and GDP are real and nominal GDP, respectively. If GCE/GDP increases as RGDP/N increases, then the income elasticity of government expenditure exceeds zero.

The volatility in the terms of trade in developing economies would have meant that GNP would be an appropriate measure of income. **Laidler** (1985) however, showed that since the two (GNP and GDP) move together, the results would not change significantly. GCE is total government expenditure and would comprise of government consumption expenditure, which measures the flow of resources to government, and government transfer outlays consisting of all current expenditure other than consumption.

Musgrave (1959) used the relationship

$$GCE = f(GDP) \quad (2)$$

The GDP here is either in current prices or deflated by the GDP deflator. He assumed that elasticity estimates, larger than unity, are equivalent to estimates in excess of zero in (1).

Lastly, **Gupta** (1967) double log form was specified thus:

$$\text{Log}\frac{GCE}{N} = f\,(\text{Log}\frac{GDP}{N}) \text{ ------------------------------ } (3)$$

The double log form ensures that income elasticities of expenditure was obtained directly.

For the purpose of this study we adopt the three models mentioned above and specify all the three equations in log form. Thus,

$$\text{Log}\,(\frac{GCE}{GDP}) = a_o + a_1\,\text{Log}\,(\frac{RGDP}{POP}) \text{ ------------------------------ } (4)$$

$$\text{Log}GCE = b_o + b_1\,\text{LogRGDP} \text{ ------------------------------ } (5)$$

$$\text{Log}\,(\frac{GCE}{POP}) = c_o + c_1\,\text{Log}\,(\frac{RGDP}{POP}) \text{ ------------------------------ } (6)$$

where

GCE = total government expenditure, comprising consumption expenditure and transfers;

RGDP = gross domestic product deflated by GDP deflator;

POP = population; and

a_o, b_o, c_o are the intercepts, while a_1, b_1 and c_1 are income elasticities of government expenditure. A priori a_1, b_1 and $c_1 > 0$.

We shall then proceed to test for stationarity and cointegration in the variables. If cointegrated, implying a long run equilibrium relationship between government expenditure and income as postulated, we would proceed tq specify on error correction model to obtain income elasticities for the three models and compare the results. Thus, one would infer that the law has been properly tested without fear of spurious regression.

Following **Engel** and **Granger** (1987), a homogeneous non-stationary series which can be transformed to a stationary series by differencing d times is said to be integrated of order d. Thus Y_t, a time series, is integrated of order d denoted $Y_t \sim I(d)$. If Y_t is stationary, then no differencing is required, that is, $Y_t \sim I(0)$.

A test for order of integration of Y_t has been proposed by **Dickey-Fuller** (1979), **Banerjee et al** (1993) etc. The test proposed by Dickey-Fuller, hereafter denoted DF is called the unit root test and would be used in this study. The DF class of unit root tests is based on the regression equation;

$$\Delta Y_t = \delta Y_{t-1} + \mu_t\,;\ \mu_t \sim N(o, \sigma^2),\ Y_O = 0 \text{ ------------------------------ } (7)$$

which could be written as $Y_t = (1 + \delta)\,Y_{t-1} + \mu_t$. The null hypothesis is

$H_o: \delta = 0$, implying non-stationarity of the series, with the alternative

$H_1: \delta < 0$.

Hence, the test involves testing the negativity of δ in the OLS regression of (7). Rejection of the null hypothesis implies that Y_t is integrated of order zero i.e. the series is stationary. The t-statistic in the regression equation (7) does not possess limiting normal distribution. Dickey (1976), and Mackinnon (1990) had tabulated critical values for the distribution of the t-statistic in the regression. These are simulated values and tabulated, according to whether the model is estimated with a constant trend or both. If Y_t is integrated of order 1, $[Y_t \sim I(1)]$, then its first difference is integrated of order zero $[Y_t \sim I(0)]$ and the test could be repeated.

One demerit of the DF test is that it assumes that the underlying process generating the observation is an autoregressive process of order 1 [AR(1)]. If it is not, then autocorrelation in the error term in (7) will bias the test. In order to overcome this problem, the **Augmented Dickey-Fuller** (ADF) test would also be used. It is identical to the standard DF test, but is constituted with a regression model of the form:

$$\Delta Y_t = \beta Y_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-i} + \mu_t \text{ ------------------------- } (8)$$

where the lag, k is set so as to ensure that any autocorrelation in ΔY_t is absorbed and that a reasonable degree of freedom is preserved, and also the error term is white noise. The testing procedure is the same as the DF.

The concept of cointegration derives from the fact that if two series X_t and Y_t are I(d), then X_t and Y_t are said to be cointegrated if there exists a unique value b which ensures that the residual, $(Y_t - \beta X_t)$ is I(0). The residual, denoted ϵ_t, is called the disequilibrium error and must be stationary.

Testing for cointegration, therefore, means examining the order of integration of the residual from the OLS regression of (4,5 & 6). If the residuals are stationary then the series are cointegrated. Thus, the equation of the regression of the residual for this test is;

$$\Delta \hat{u}_t = \beta \hat{u}_{t-1} + \varepsilon_t \text{ ------------------------- } (9)$$

for the DF and

$$\Delta \mu_t = \beta \mu_{t-1} + \sum_{i=1}^{K} \beta_i \Delta \mu_{t-i} + \varepsilon_t \text{ ------------------------- } (10)$$

where

μ_t is the residual from our static regression and β is the coefficient in the regression, for the ADF which now would be used to examine the negativity of β. The null hypothesis is the same as in the test for order of integration, but here residual stationary implies cointegration of the series.

III.2 Model For Causality

To further investigate the implication of Wagner's Law, it would be appropriate to revisit the concept of "Causality" introduced by **Granger** (1969), building on an earlier work by Wiener (1956). It covers two concepts, "simple" and "instantaneous" causality and assumes that the time series has autoregressive representations[1]

A Granger-causality test for the three equations would regress the autoregressive distributed lag form of the variables in the equations. In this study, we would test for the simple causality. The null hypothesis for the causality test is that Y does not cause X and thus, there is no causality in which case the coefficients in the causality regression are not different from zero. Absence of causality implies that there is no feedback mechanism. Symmetrically[2], if X does not cause Y, then there is no feedback from X to Y. The symmetry[2] inherent in the concept of causality is preserved by this feedback mechanism. If at least one of the coefficients in the regression equation is significant, we reject the null hypothesis. The test statistics is distributed as F and since we are testing at the level of the order of integration of our variables, Fuller (1976) showed that the estimates in the causality regression equation possess limiting distribution.

If there is co-movement between government size and National Income, it would be pertinent to know which variable is causing the other. Lack of causality would cast doubt about our ability to predict one using maximum information of the other. The variable names are as stated in the variable definition below, however "D" is added to variable names to indicate that the regression is at the first difference of the variables. Noting that for simple causality, the change in the value of the lagged independent variable does not have to affect the dependent variable in the same period, and that the current value of the independent variable does not enter the model, the following specification emerges:

(i) DLPRGDP causes DLREXIN thus,

$DLREXIN_t = f(DLREXIN_{t-1}, DLPRGDP_{t-1}, DLPRGDP_{t-2}, DLPRGDP_{t-3})$ -- ---(11)

DLREXIN causes DLPRGDP, and

$DLPRGDP_t = f(DLPRGDP_{t-1}, DLREXIN_{t-1}, DLREXIN_{t-2}, DLREXIN_{t-3})$ -------(12)

(ii) DLRGDP causes DLGCE, thus,
$DLGCE_t = f(DLGCE_{t-1}, DLRGDP_{t-1}, DLRGDP_{t-2}, DLRGDP_{t-3})$, and ------------(13)

DLGCE causes DLRGDP, means regress
$DLRGDP_t = f(DLRGDP_{t-1}, DLGCE_{t-1}, DLGCE_{t-2}, DLGCE_{t-3})$ ----------------- (14)

(iii) DLPRGDP causes DLPGCE, thus
$DLPGCE_t = f(DLPGCE_{t-1}, DLPRGDP_{t-1}, DLPRGDP_{t-2}, DLPRGDP_{t-3})$ ------- (15)
and,

DLPGCE causes DLPRGDP implies
$DLPRGDP_t = f(DLPRGDP_{t-1}, DLPGCE_{t-1}, DLPGCE_{t-2}, DLPGCE_{t-3})$ -------- -(16)

The lag was chosen such that the dynamics in the model is not constrained by too short a lag and that adequate degree of freedom was preserved.

III.3 Source of Data and Definition of Variables

Data for this work were all obtained from International Financial Statistics, published by IMF. They are annual data and span 1960 - 1994. The choice of data period was determined by availability and accessibility. The variable names and their definitions are:

LGCE	=	Logarithm of Total Government Consumption Expenditure
LRGDP	=	Logarithm of GDP deflated with GDP Deflator (1985 = 100);
LPRGDP	=	Logarithm of per capita deflated GDP;
LPGCE	=	Logarithm of per capita Government Consumption expenditure; and
LREXIN	=	Logarithm of ratio of Government consumption expenditure to Gross Domestic Product (current prices)

ECM_1, ECM_2 and ECM_3 represent the residual from the static regression of the three models. Data analysis was done using the software, **Microfit** version 2.2.

IV. EMPIRICAL RESULTS

IV.1 Results from Stationarity Tests

Table 1 Unit Root Tests on Annual Data for Variables without Trend

Variable	DF	ADF	Order of integration
LGCE	-4.2384(-2.9528)	-3.3677(-1.9558)	1
LRGDP	-4.0313 (-2.9528)	-3.9298(-1.9558)	1
LPRGDP	-4.3646 (-2.9528)	-3.7577(-1.9558)	1
LPGCE	-4.3280 (-2.9528)	-3.5217(-1.9558)	1
LREXIN	-4.9668 (-2.9528)	-3.8809(-1.9558)	1

Critical Values for DF and ADF are in parenthesis.

The results in Table 1 show that all the variables indicated in the table achieved stationarity in their first difference, hence they are integrated of order 1 i.e. are I(1) variables. Any specification of the three models earlier stated at their previous levels would have led to spurious interpretation.

IV.2 Testing for Cointegration

We would proceed to test for cointegration between the variables in the models along the rules earlier specified.

Table 2 (a) Result for Static Regression

Variable	CONS TANT	LPRGDP	LRGDP
LREXIN	-1.8852(0.003)	-0.31523(-0.272)	
LGCE	-15.0156 (0.000)		3.5435(0.000)
LPGCE	-6.4756 (0.000)	4.7597(0.000)	

Table 2 (b) Diagnostic tests for the static Regression

	1	2	3
Serial Correlation	27.5320	22.1504	26.0378
Functional Form	4.4093	1.2663	0.018229
Normality	2.4071	1.3550	2.9097
Heteroscedasticity	11.7439	0.02312	0.10393
R^2 Adj.	0.00727	0.89958	0.57664
DW	0.20510	0.40235	0.23819
F	1.2492	305.5754	47.3100

Table 3 Residual Stationarity Tests

	DF	ADF	Critical Values
ECM_1	-0.80749	-0.66003	
ECM_2	-1.8605	-2.3226	
ECM_3	-1.4526	-1.7532	
DF			-2.9499
ADF			-2.9528

The results in Table 3 show that the residuals from the static regression of the three models are not stationary. Hence, the variables are not cointegrated. This implies that, irrespective of the specification, there is no long run relationship between government consumption expenditure and National Income.

Theory suggests that since the variables are of the same order, the deviations of the variables from their long run path would have been stationary. Since they are not, it would be fair to conclude that any regression at their levels would be spurious. The occurrence of spurious relationships between variables is not a new phenomenon. The parameters from an OLS regression would be significant with very high R^2, but accompanied by low value of Durbin-Watson statistics (Table 2b). A careful look at the results from the battery of diagnostic test (Table 2b) confirms this, as there is the presence of high serial correlation among the variables as shown, especially by the DW statistics and the X^2 test for serial correlation. The admixture of low and high explanatory power of the model might be misleading.

A look, also, at the static regression shows inconsistencies in the results for the three models. For instance in model(1), the 'a priori' expectation of a positive relationship between government expenditure and output was not met. Models (2) and (3) however, met 'a priori' expectations about the signs of the parameters, and even the parameter estimates where highly significant as to lead to believe that Wagner's Law holds. Wagner's proposition, using the three different models, was tested at the levels of the variables without taking cognizance of stationarity as well as cointegration of the variables, thus the inconsistencies in the results. The parameters are not likely to be stable and thus, the results, even though consistent with theory, are misleading.

Casting doubt on this law stems also from the fact that government expenditure is a component of National Output, thus, they are highly correlated and we are in fact regressing a component against the total. A way out of the problem would have been the use of Gross private product as proxy for income, even though the conclusion about spurious relationship would not have changed.

It becomes therefore, reasonable to conclude that Wagner's Law could not be verified for the Nigerian economy using its three interpretations, in particular after attaining stationarity in the data.

Another evidence that national output does not grow with growth in government expenditure could be seen in Fig. 2a & 2b below, the two most likely confirmation of this law. The main features are that public expenditure and Output are growing in the same direction, but with public expenditure growing at a faster rate. However, some critical points would be ignored if such a conclusion is drawn, as a closer look would show that during a period of lull this tendency breaks down.

Between 1965 and 1967, Nigeria was passing through a period of internal crisis, and the economy suffered. The immediate consequence was that both expenditure and income were not growing significantly, with income growing more than expenditure in absolute terms. As soon as the civil war started in full gear, expenditure rose sharply, overtook income in the process, while real output tended to stabilize. This growth in expenditure came as the war had to be financed (and a war time is not a period for any meaningful contribution to income). The post war years showed expanding scale of government activity, mainly reconstruction, relative to income, which was exhibiting epileptic up and down movements. Also, during the SAP period of 1986 to 1993, another pattern emerged with the two

SOME RELEVANT CHARTS FOR MODEL 1

Fig 1b

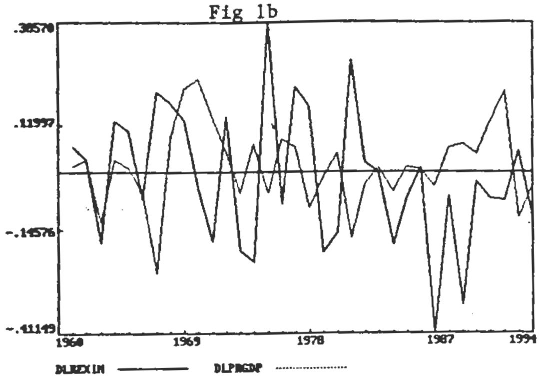


Fig 1a

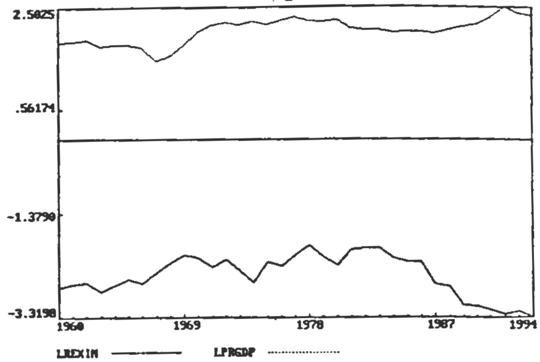


Fig 1d

Autocorrelation function of residuals, sample from 1960 to 1994

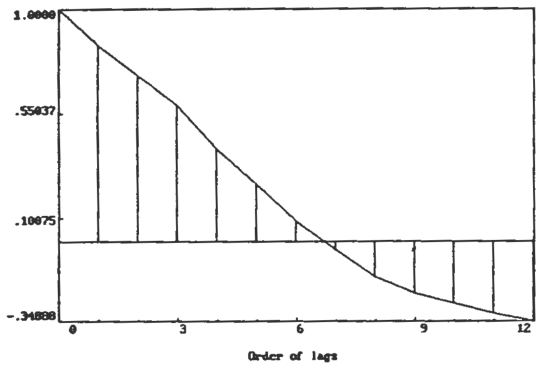


Fig 1c

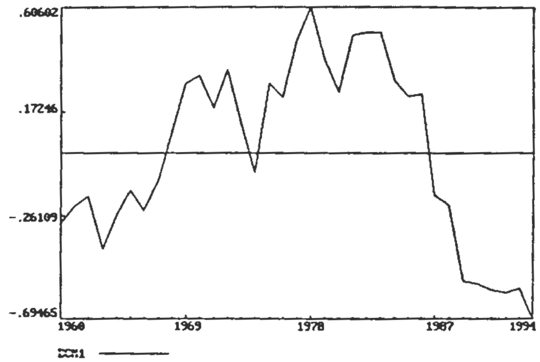
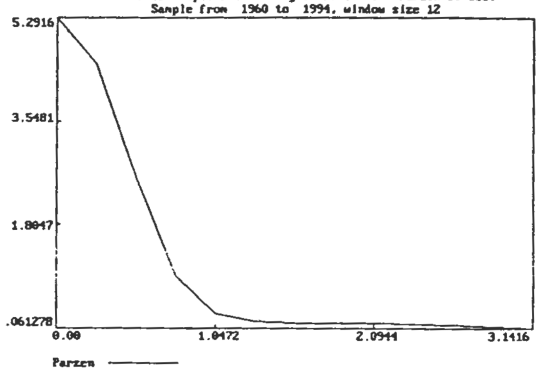


Fig 1e

Standardized Spectral Density of Residuals (Parzen Window)
Sample from 1960 to 1994, window size 12



SOME RELEVANT CHARTS FOR MODEL 2

Fig 2b

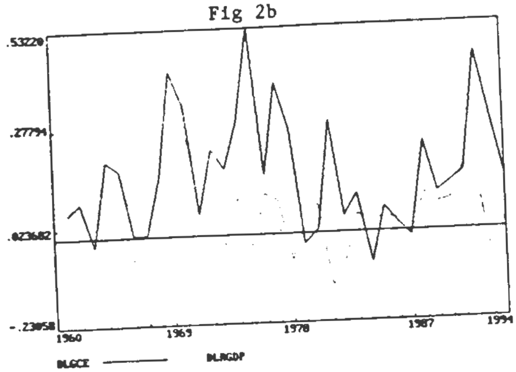


Fig 2a

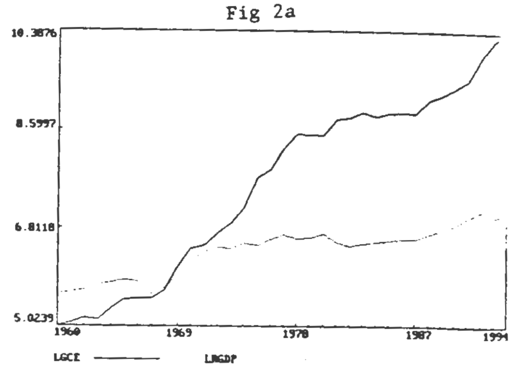


Fig 2d

Autocorrelation function of residuals, sample from 1960 to 1994

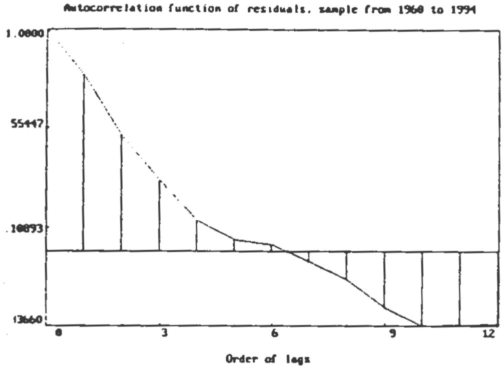


Fig 2c

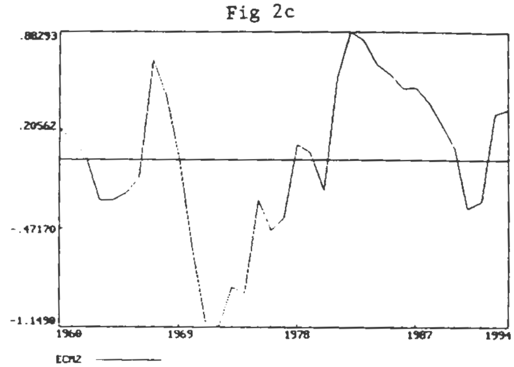
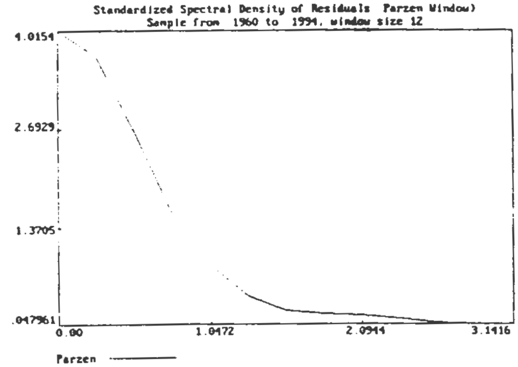


Fig 2e

Standardized Spectral Density of Residuals Parzen Window)
Sample from 1960 to 1994, window size 12



SOME SELECTED CHARTS FOR MODEL 3

Fig 3b

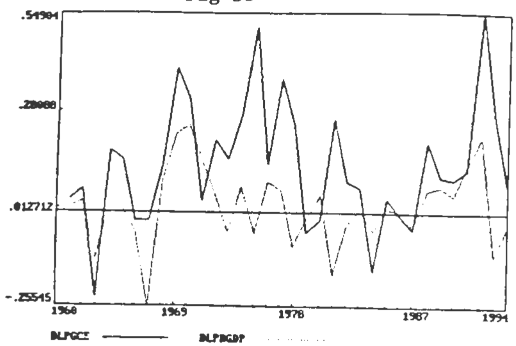


Fig 3a

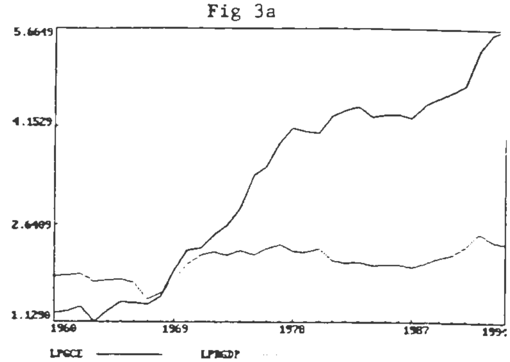


Fig 3d

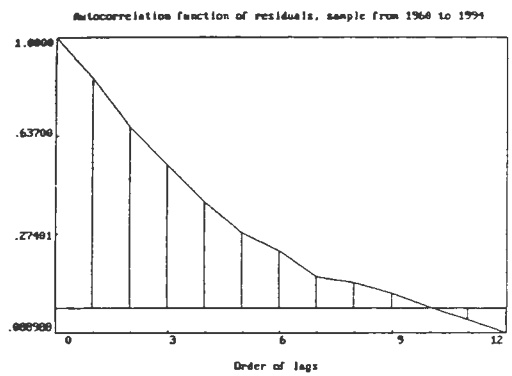


Fig 3c

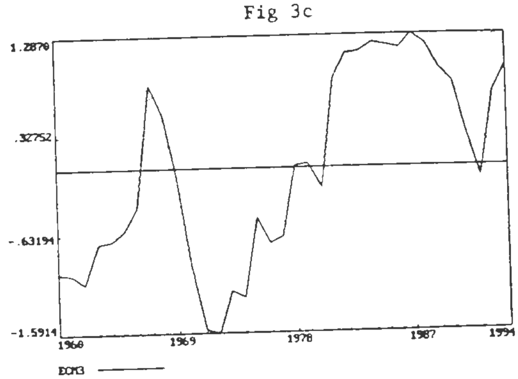
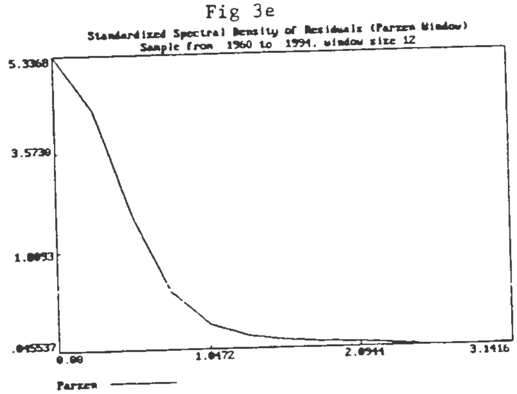


Fig 3e



variables growing at the same rate even with the resulting expansion in economic activities.

When stationarity was induced by differencing, and wild swings ironed out, the real pattern of the variables emerged (Fig. 1b, 2b, 3b). The residual plot showed no pattern, thus confirming that there exists no significant relationship between the variables (Fig. 1c, 2c, 3c). And finally, the autocorrelation function did not decay as the lag increased (Fig. 1d, 2d, 3d), a further confirmation of non-stationarity of the variables in the model.

IV.3 Causality Tests

Below are the results for causality test carried along the rules earlier specified.

Table 4 Results from Causality Test

		INDEPENDENT VARIABLES	
MODELS	DEPT. VARIABLES	DLPRGDP	DLRGDP
MODEL 1	DLREXIN	0.813 (0.249)	
MODEL 2	DLGCE		0.051 (0.221)
MODEL 3	DLPGCE	0.114 (0.456)	

Level of Significance = 5%
Values in table 4 show the calculated probabilities of rejecting the null hypothesis, with those in parenthesis for a two way causality to test the existence of a feedback.

Under the null hypothesis that Y does not cause X, we observe that the test is not significant for all three models. Also, we could not establish the existence of a feedback mechanism. Suffice to say that causality test has confirmed what was determined already, that public sector expenditure and income do not move in sympathy.

V. SUMMARY AND CONCLUSION

Using three different interpretations of Wagner's Law, an attempt was made to verify them and hence derive income elasticity of government expenditure. In doing this, a single equation, single regressor model was adopted. The major findings of this study are:

(i) Using the traditional econometrics method, that is, running OLS regression at its levels, the parameter estimates yielded different signs in the three models.

(ii) Positive significant relationship was established in models 2 and 3.

(iii) Stemming from (2) one would have been misguided to support the law.

(iv) Even though the variables were found to be stationary, that is, integrated of order 1, they were not cointegrated. Thus, the long-run tendency for public sector spending whether as a proportion of total output, its per capita value or at its singular definition, to grow with growth in income could not be established, using the new econometric technique.

(v) The implication therefore, is that the relationship is spurious, that is, the estimates of the parameters showed inconsistent values that any policy decision from the result could be misleading;

(vi) The battery of diagnostic tests, particularly the various charts confirmed the position in (v).

(vii) Further analysis requires testing for causality as a confirmatory test. If causality was established, then one would have been inconclusive in disregarding the law.

However, the test could not establish causality. The result confirmed the heuristic view that growth of government perse, would be unlikely to cause growth of income, a view confirmed by the cointegration result. Accordingly, I did not have enough evidence to lend support for this law. Perhaps it would be necessary to look at public sector expenditure in the context of overall economic growth. This I leave for further studies. Thus, for the Nigerian economy, even though there has been a tremendous expansion in public spending, a greater percentage has been allocated to transfers, and what is left has often been channeled to expenditure on day to day running of the government, social services and economic services that are not contributing much to growth in output.

Any policy of expanding government consumption expenditure based on growth in income, in the long run, would be misleading. Rather, the economic characteristic of the policy period should be a major consideration. Finally, for the Nigerian economy, with huge debt burden as a consequence of financing deficit from internal and external sources, a long run policy to boost income should not be based on expenditure outlays.

FOOTNOTES

1. The unidirectional causality from Y to X (Y causes X, and X may or may not cause Y) could be functionally written thus:
   Suppose Y_t and X_t possess autoregressive representations of the form:

$$y_t = \sum_{i=1}^{q} \alpha_i y_{t-i} + \mu_t$$

and

$$x_t = \sum_{j=1}^{p} \beta_j x_{t-j} + \nu_t$$

respectively, then Y_t causes X_t could be written as;

$$x_t = \sum_{j=1}^{p} \beta_j x_{t-j} + \sum_{i=0}^{q} \alpha_i y_{t-i} + \nu_t$$

for instantaneous causality, and

$$x_t = \sum_{j=1}^{p} \beta_j x_{t-j} + \sum_{i=1}^{q} \alpha_i y_{t-i} + \mu_t$$

for simple causality. The coefficient in the equation would be significantly different from zero for causality to exist.

2. Symmetry is assumed inherent in the specification. Thus, Y does not cause X and X may or may not cause Y.

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