Cointegration, Causality and Wagner's Law: A Test for Nigeria, 1970-2003

Omo Aregbeyen (Ph.D)*

This paper examines the validity of Wagner's Law (the tendency for public expenditure to grow relative to national income) against the contending Keynesian proposition (that it is the changes in public expenditure that trigger those of national income) using Nigeria's data over the period 1970-2003. Two variants of the models for investigating Wagner's Law were tested. The first relates total public expenditure to national income, while the second relates non-transfer public expenditure to national income. Deploying recent econometric advances of cointegration and causality techniques, we found a unidirectional causality from national income to total public expenditure i.e. a support for Wagner's Law. There is bi-directional causality between non-transfer public expenditure and national income. But, the causality from national income to non-transfer public expenditure was found to be stronger than the reverse direction following variance decomposition analysis. This therefore confirms the validity of Wagner's Law.

Key words: Wagner's Law, Cointegration, Error Correction, Causality, Nigeria
JEL Classification Numbers: H0, H5, C01
Author's e-mail: omoareg@yahoo.com

* *The author is of the Department of Educational Management, University of Ibadan, Ibadan.,Nigeria.* *The author would like to thank colleagues in the Department and anonymous reviewers for helpful comments. The views expressed in this paper are those of the author and do not necessarily represent the views of the institution to which he is affiliated or its policy. All the remaining errors are the author's responsibility.*

I. Introduction

The relationship between public expenditure and national income has been the subject of two contending propositions. The first and the more popular is Wagner's law. The second proposition is associated with Keynes. To Keynes, public expenditure is an exogenous factor and a policy instrument for increasing national income. Consequently, he believes that the causality of the relationship between public expenditure and national income runs from expenditure to income.

In contrast, Wagner's law proposes that there is a long-run tendency for public expenditure to grow relative to some national income aggregates such as the Gross Domestic Product (GDP). In other words, the causality of the link between public expenditure and national income runs from national income to public expenditure. Earlier studies by Peacock and Wiseman (1961), Musgrave (1969), Bird (1971), Beck (1982) validated Wagner's law. But following the emergence of modern time series econometrics techniques, that questions the validity of the results of these earlier studies, there has been renewed interests in the validation of Wagner's Law by employing these modern time series econometric techniques.

This study therefore examines the causal relationship between public expenditure and national income for the Nigerian economy (where the role of the government as a major actor to encourage economic development has always been significant) using modern time series econometrics techniques. There are two main reasons for the study. The first derives from the limitations of the two preceding studies by Aigbokhan (1996) and Essien (1997). The study by Aigbokhan was never intended primarily at testing Wagner's Law. In fact, the analytical framework of Aigbokhan was not based on the conventional Wagner's Law analytical framework (s) . He investigated the impact of government size (measured as expenditure share of GDP) on economic growth between 1960 and 1993 with emphasis on the effects of the structural adjustment programme. A regression analysis of a simple growth equation was carried out and augmented with Granger-Causality testing.

Aigbokhan reported a bi-directional causality between government total expenditure and national income. In contrast, Essien (1997) using data from 1960-1994 found no causality between public expenditure and national income in the three models (of the interpretations of Wagner's Law) tested. But he focused narrowly on government or public consumption expenditure. However, he agreed that it would be necessary to look at the total public sector expenditure in the context of overall economic growth.

This study attempts to redress these limitations. The sample period covered, however, differed from that of Aigbokhan (1996) and Essien (1997). Ours is from 1970-2003, which extends to the more recent years. The second objective and related to the first is to enrich the literature on Nigeria in this area by providing fresh insights in terms of Wagner's law in order to develop better theories of public expenditure in the case of Nigeria as have been done for Northern Cyprus, Turkey, Greece and other countries.

The rest of the paper is organized into five sections. In section II, we reviewed the different interpretations and formulations of Wagner's law and some empirical results. Stylized facts on public expenditure and national income in Nigeria are presented in section III. The methodological approach of the paper is indicated in section IV. Section V presented and discussed the empirical results, while the paper is concluded in section VI.

II. Wagner's Law: Interpretations and Empirical Results

Wagner's Law is named after Adolph Wagner's (1835-1907) observation of 1890 based on historical facts primarily of Germany, of increasing state activities. His observations led to the hypothesis that there are inherent tendencies for the activities of the different layers of government (such as central and state government) to increase both intensively and extensively. By this, he meant that

there was a functional relationship between the growth of the government activities such that the government sector grows faster than the economy.

Nitti (1903) pioneered the efforts at validating Wagner's hypothesis. His study supported Wagner's thesis and concluded with empirical evidence that this "Law" was not only applicable to Germany but to various governments which differed widely from each other- all kinds of governments, irrespective of the levels (say, the central or state governments), intentions (peaceful or warlike), and size etc., had indicated the same tendency of increasing public expenditure. Subsequent attempts at investigating Wagner's law have culminated in five different interpretations and formulations of the law.

In sequential order, Gupta (1967) tested Wagner's law by relating per capita expenditure and per capita national income. Goffman's (1968) formulation utilized public expenditure and per capita national income. With just a slight modification to that of Goffman's, Peacock and Wiseman also in 1968 tested the validity of Wagner's law with public expenditure and national income, respectively. Pryor (1969) formulation considered the logs of non-transfer real public expenditure and national income. Public expenditure share of national income and national income per capita was what Musgrave (1969) used for his formulation. Lastly, Mann (1980) made a formulation that is a modification of the Peacock-Wiseman (1968), by considering the public expenditure share of national income. According to Jackson et al. (1999), the formulation of Peacock-Wiseman (1968) and Pryor (1969) have been the most popular.

Given the recent advances in modern time-series econometric techniques, recent investigations of Wagner's law have been conducted in terms of cointegration analysis, error-correction mechanism and causality testing. Some of these studies are reviewed. Beginning with country specific studies, Jackson et.al. (1999) tested the validity of Wagner's law that there is a long-run tendency for public

expenditure to grow relative to national income during the period 1977-1996 for Northern Cyprus. The two most popular formulations of Wagner's law were experimented with. They reported mixed evidence in support of Wagner's law. On the one hand, they found a uni-directional causality (or reverse causality according to Wagner's law) from real government expenditure and non-transfer real government expenditure to national income (measured by GDP) at log difference which supports the Keynesian proposition. On the other hand, at log levels, they found a uni-directional causality from national income to non-transfer real government expenditure which supports the proposition of Wagner's law for Northern Cyprus over the period 1977-1996.

For Turkey, using aggregate data over the period 1950-1990, Demirbas (1999) investigates statistically the existence of a long-run relationship between public expenditure and national income (measured by GNP). The empirical results indicate that the growth of public expenditure in the case of Turkey is not dependent on and determined by economic growth as Wagner's law states. The findings of Halicioglu (2003) also for Turkey for the period 1960-2000 did not as well support the empirical validity of Wagner's law. However, the paper finds statistical evidence for an augmented version of Wagner's law.

Arghyrou (1999), investigates the existence and nature of long-run relationships between Greek national income and four categories of public expenditure. His results suggest that there exists a positive long-run relationship between GDP on the one hand, and public expenditure and "productive" public consumption on the other, with causality running both ways. There appears to be no long-run relationship between GDP and public sector personnel expenditure; and GDP and public-debt services expenditure. From that point of view, it would appear that in terms of output growth, the fiscal policy followed by Greece during the 1975-1990 period has rather been ineffective.

In a cross-country study, Chang et al.(2004) following Mann's (1980)study, empirically examined (using annual time series data) five different versions of Wagner's Law for ten countries during the period 1951-1996. The countries covered included three of the emerging industrialized countries of Asia: South Korea, Taiwan, and Thailand, and seven industrialized countries: Australia, Canada, Japan, New Zealand, USA, the United Kingdom, and South Africa. The analysis is an advance over previous works in two respects. First, the stationarity properties of the data, the order of integration using the Augmented Dickey-Fuller test and the Kwiatkowski et.at. tests were empirically investigated.

Second, the hypothesis of a long-run relationship between income and government spending is tested using bivariate cointegrated systems and by employing the methodology of cointegration analysis as suggested by Johansen and Juselius. Unidirectional Granger causality is found running from income to government spending for the newly industrialized countries of South Korea and Taiwan, and the industrialized countries of Japan, the United Kingdom, and the United States of America, supporting Wagner's hypothesis for those countries. For the five remaining countries in the study: Australia, Canada, New Zealand, South Africa and Thailand, no causal relationship between income and government spending is found.

Thornton (1999), had earlier on examined the long-run tendency for government expenditure to grow relative to GNP i.e. Wagner's Law for a sample of six European countries using data from the mid-19th century to 1913. With few exceptions, the results suggest that : nominal and real GNP, nominal and real government expenditure, and population were nonstationary in their levels but stationary in first difference; either nominal GNP and nominal government expenditure and/or real GNP and real government expenditure were cointegrated in five countries, and that these variables were cointegrated with population in the remaining country; and Granger causality was mainly

unidirectional from income to government expenditure. Thus, there is considerable support for Wagner's law in the 19th century Europe.

III. National Income and Expenditure Developments in Nigeria (1970-2003)

The developments in national income and expenditure in Nigeria over the past three decades are captured in Tables 1 and 2. The statistics show an increasing trend in both national income (proxied by Gross National Income) and public expenditure profile in Nigeria during the period under review, 1970-2003. The five year period averages computed and shown in Table 1 show that national income which amounted to about ₦9.65 billion during 1970-74 increased through ₦32.17 billion by 1975-79 to ₦55.61billion over 1980-1984 period.

A further increase of about 2.6 times over the 1980-84 period was recorded in the period 1985-89, with national income standing at ₦124.87billion. And by 1990-94, national income had increased to ₦549.18 billion, an increase amounting to about 340 per cent change. The national income level increased further and as a matter of fact quadrupled through ₦2,263.04 billion during the period 1995-99 to peak at ₦5,633.90 billion by 2000-2003.

The trend in total government expenditure mirrored closely that of the national income. From just ₦1.53 billion during 1970-74, total government expenditure increased significantly through ₦7.61billion and ₦11.56 billion during 1975-79 and 1980-84 periods, respectively, to ₦24.01 billion by 1985-89. It then shut up to ₦102.65 billion during 1990-94 period and further to ₦480.01billion by 1995-99. During 2000-2003, total government expenditure amounted to ₦990.80 billion. The trend of total non-transfer expenditure i.e. total expenditure less all transfer payments follows the same pattern.

The percentage changes in the national income and expenditure levels as reported in Table 1 are contained in Table 2. From the table, overall average of changes in national income amount to 27.21 per cent, while that of total expenditure and total expenditure minus transfer payments are 28.35 and 40.75 per cent, respectively. In reflection of this observed pattern, the overall average ratio of change in total non-transfer expenditure to that of change in national income is higher at 1.43 per cent compared to 1.10 per cent ratio between total expenditure and national income.

A major factor that underlined the observed increasing trend in both the national income and total government expenditure is the oil factor and the favorable trend in the price of crude oil in the international market in recent years. Nigeria as an oil producing country (of which oil sales account for well over 70 per cent of its income) has benefited immensely from the increase.

Table 2 also shows the period average percentages in national income and the two expenditure categories and the ratio of the changes in the expenditures to national income. While the cumulative average in national income is 27.21, those of the expenditures averaged 28.35 and 40.74 of total expenditure and total non-transfer expenditure, respectively. This implies that a percentage change in national income is accompanied by more than a percentage change in total expenditure and total non-transfer expenditure, respectively. Expressed differently, it implies that a percentage change in either total expenditure or total non-transfer expenditure is associated with less than a percentage change in national income. The ratios of these expenditures to national income illustrate this picture.

However, the ratio of total non-transfer to national income was higher than that of total expenditure to national income.

Table 1: Trend in National Income and Public Expenditure in Nigeria (1970-2003)

Period	National Income (₦ million)	Total Public Expenditure (₦ million)	Total Non-transfer Public Expenditure (₦ million)
1970-74	9,654.34	1,526.90	823.18
1975-79	19,887.64	4,290.11	3, 132.52
1980-84	55,611.42	11,555.44	8, 511.04
1985-89	124,868.50	24,012.22	12, 008.30
1990-94	549,177.00	102,645.10	39, 642.14
1995-99	2,263,035.00	480,005.20	295, 255.80
2000-03	5,633,898.00	990,801.7	683, 766.20

Source: Central Bank of Nigeria Statistical Bulletin (Various Issues)

Table 2: Change in National Income and Expenditure in Nigeria 1970-2003 (in Percentage)

Year	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-03	Average
Change in National Income	38.73	18.84	8.36	30.38	33.58	36.71	23.90	27.21
Change in total Expenditure	35.20	28.92	12.99	33.07	31.75	46.60	9.90	28.35
Change in total non-transfer Expenditure	94.34	35.64	9.86	37.05	42.48	50.99	14.83	40.74
Ratio change in total Expenditure/National Income	0.91	1.54	1.56	1.09	0.95	1.27	0.41	1.10
Ratio change in total non-transfer Exp/National Income	2.44	1.89	1.18	1.22	1.27	1.39	0.62	1.43

Source: Authors calculations

IV. Empirical Methodology

IV.1. The Data

Our empirical analysis employs total real national income (measured by real gross domestic product (GDP)), total public expenditure and total public expenditure less transfer payments over the period 1970-2003. The variables are in logarithmic form and are converted to real terms using the consumer price index. The data were sourced from various issues of the Central Bank of Nigeria Statistical Bulletin and Annual Reports and Statements of Accounts.

IV.2. Method of Analysis

With these annual data over the period 1970-2003, we investigate the evidence of Wagner's law using the two most popular formulations of Wagner's law. The formulations are given by the following equations:

$$LRE_t = \alpha_0 + \alpha_1 LRGDP_t + \mu_t \quad \ldots\ldots(1)$$

$$LRENT_t = \beta_0 + \beta_1 LRGDP_t + v_t \quad \ldots\ldots(2)$$

where:

LRGDP = the natural logarithm of real gross domestic product in million naira

LRE = the natural logarithm of real total public expenditure in million naira

LRENT = the natural logarithm of real total non-transfer public expenditure in million naira

To begin with, each time series was first tested for their orders of integration by using the Augmented Dickey – Fuller (ADF) test, which is widely regarded as the most efficient and indeed the most favorite among the tests for integration. On the basis of the results obtained from this test, if the test series are of the same order i.e. I (1) a cointegration test is conducted with the Johansen's method to determine whether a long-run equilibrating relationship exists between the series or variables given our empirical equations. Johansen cointegration test is performed, assuming a cointegrating relationship as specified by equations (3) and (4):

$$LRE_t = aLGDP_t + c = \varepsilon_t \quad \ldots\ldots(3)$$

$$LRENT_t = bLGDP_t + d = e_t \quad \ldots\ldots(4)$$

If the existence of cointegration or long-run relationship is established we conduct Granger causality test[1] in the context of an error correction model[2] by estimating a vector auto regressive (VAR) model as follows:

$$\Delta LRE_t = \gamma_0 + \alpha_0 \Delta LRE_{t-1} + \sum \beta_0 \Delta LGDP_t - 1 + \tau_0 ECT_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots (5a)$$

$$\Delta LRGDP_t = \gamma_1 + \alpha_1 \Delta LRE_{t-1} + \sum \beta_1 \Delta LGDP_{t-1} + \tau_1 ECT_{t-1} + v_t \ldots\ldots\ldots\ldots\ldots (5b)$$

$$\Delta LRENT_t = \lambda_0 + \varphi_0 \Delta LRENT_{t-1} + \sum \sigma_0 \Delta LRGDP_{t-1} + \delta_0 ECT_{t-1} + \varepsilon_t \ldots\ldots\ldots (6a)$$

$$\Delta LRGDPt = \lambda_1 + \varphi_1 \Delta LRENt_{t-1} + \sum \sigma_1 \Delta LRGDP_{t-1} + \delta_1 ECT_{t-1} + \eta_t \ldots\ldots\ldots (6b)$$

where γ, α, β, λ, φ, σ, δ are the coefficients and μ_t, v_t, ε_t, and η_t are the error terms. ECT_t (the error correction term) is equivalent to ε_t and e_t in equations (3) and (4), representing the disequilibrium residuals of the cointegrating equations (3) and (4) specified above. The Granger causality tests are associated with t-statistics[3] tests on the significance of the pair of β_0 and τ_0 in equation (5a); β_1 and τ_1 in equation (5b); σ_0 and δ_0 in equation (6); and σ_1 and δ_1 in equation (6b). For example, from equation (5a) a statistically significant coefficient on either ΔLRGDPt or ECT_{t-1} or both will suggest that national income cause expenditures thereby supporting the Wagner's Law. Likewise, from equation (5b), a statistically significant coefficient on either ΔLRE_{t-1} or ECT_{t-1} or both suggest that expenditure

---

[1] *Granger causality test is used to determine the direction of causality between two variables. The standard Granger causality test examines whether past changes in one variable (Y) help to explain current changes in another variable (X) over and above the explanations provided by the past changes in X. to determine whether causality runs in other direction, from X to Y, one simply repeats the experiment, but with Y and X interchanged. Four findings are possible: (i) neither variable Granger causes the other; (ii) Y causes X, but not vice versa; (iii) X causes Y, but not vice versa; and (iv) Y and X Granger causes each other.*

[2] *Cointegration and error-correction modeling framework provide a more comprehensive test of causality as it specifically allow for causal linkage between two variables stemming from a common trend or equilibrium relationship (Fasano and Wang, 2002).*

[3] *Because there is only one lagged value, a standard t-test replaces the joint significance tests such as F-test or Wald test.*

causes national income thereby supporting the Keynesian view. If the relevant coefficients from equations (5a) and (5b) are both statistically significant, then a bi-directional causality hypothesis is supported.

However, Gummell (1990), and Manning and Adriacanos (1993) have noted that in the absence of a long-run relationship or cointegrating relationship between variables, it is still of interest to examine the short-run linkages between them. The argument is that even though long run relationship between two macro variables may not be established for a given time period, it is still possible that the variables are causally related in the short-run.

In the absence of cointegrating relationship between our variables, we follow the practice of Mahdavi et.al. (1994) and Demirbas (1999) by applying the Granger causality test, using I (0) series. In other words, we use changes in GDP and public expenditure in order to apply Granger causality test. The causal models to do this are constructed as follows:

$$\Delta LRE_t = A_0 + \alpha_0 LRGDP_t + \sum_{i=1}^{m} \alpha_i \Delta LRGDP_{t-1} + \sum_{j=1}^{m} \beta_j \Delta LRE_{tj} + \mu_t \ldots\ldots\ldots (7a)$$

$$\Delta LRGDP_t = A_1 + \gamma_0 LRGDP_t + \sum_{i=1}^{m} \gamma_i \Delta LRGDP_{t-1} + \sum_{j=1}^{m} \omega_j \Delta LRE_{tj} + v_t \ldots\ldots\ldots (7b)$$

$$\Delta LRENT_t = B_0 + {}_0 LRGDP_t + \sum_{i=1}^{n} \varphi_i \Delta LRGDP_{t-1} + \sum_{j=1}^{n} \varsigma_j \Delta LRENT_{tj} + \varepsilon_t \ldots\ldots\ldots (8a)$$

$$\Delta LRGDP_t = B_1 + \lambda_0 LRGDP_t + \sum_{i=1}^{n} \lambda_i \Delta LRGDP_{t-1} + \sum_{j=1}^{n} \tau_j \Delta LRENT_{tj} + \upsilon_t \ldots\ldots (8b)$$

where in equations (7a&b) α_i and β_j are coefficients that describe the effects of m current and past values of $\Delta LRGDP_t$ and ΔLRE_t on ΔLRE_t, while γ_i and ω_j describe the effects of m current and past values of $\Delta LRGDP_t$ and ΔLRE_t on $\Delta LRGDP_t$, and the u_t and v_t are mutually uncorrelated white noise series. Similarly, in equations (8a&b), φ_i and ς_j are coefficients that describe the effects of n current and past

values of $\Delta LRGDP_t$ and $\Delta LRENT_t$ on $\Delta LRENT_t$, while λ_i and τ_j describe the effects of n current and past values of $\Delta LRGDP_t$ and $\Delta LRENT_t$ on $\Delta LRGDP_t$., with εt and υ_t also mutually uncorrelated white noise series.

The Granger causality was tested using F-test. If the set $\alpha_i, \omega_j = 0$ and $\varphi_i, \tau_j = 0$ for all i and j, then there is no causality, and the current value of each variable is solely affected by its own past history. However, if some α_i and $\omega_j = 0$, the ΔLRE and ΔLRENT are said to be caused by ΔLRGDP. Likewise, if some φ_i and $\tau_j = 0$, then ΔLRGDP is caused by ΔLRE and ΔLRENT. If both the set α_i , $\omega_j = 0$ and $\varphi_i, \tau_j = 0$, then there is bi-directional causality, and both variables are related to current and/or past effects of the other variable.

V. Empirical Results

All our empirical tests have been carried out using the E-views econometrics package, version 3.1. The results obtained are discussed sequentially below.

V.1. Test Results for Unit Roots

The results of our test for the orders of integration of each of the time series data using the Augmented Dickey-Fuller (ADF) test is contained in Table 3. The test results show that the three time series namely real gross domestic product or national income, total real public expenditure and total non-transfer real public expenditure are integrated of order one or are I(1) series.

Table 3: ADF Tests Results for Unit Roots

ADF Unit Root Test in Levels (ADF Regression with an Intercept)				
Variables	ADF (0)	ADF (1)	ADF (2)	ADF (3)
LRGDP	-0.8829	-0.8404	0.1455	0.3882
LRE	-1.1456	-1.0903	-0.1400	-0.0569
LRENT	-1.7417	-1.7879	-0.5035	-0.4399
5% CV	-2.9527	-2.9558	-2.9591	-2.9627
ADF Unit Root Test in Levels (ADF Regression with an Intercept and a Linear Trend)				
Variables	ADF (0)	ADF (1)	ADF (2)	ADF (3)
LRGDP	-3.0738	-3.1769	-2.2815	-1.9634
LRE	-3.2501	-3.2020	-2.3654	-2.0141
LRENT	-4.2745	-4.8696	-3.0005	-2.4746
5% CV	-3.5514	-3.5562	-3.5614	-3.5670
ADF Unit Root Test in First Difference (ADF Regression with an Intercept)				
Variables	ADF (0)	ADF (1)	ADF (2)	ADF (3)
LRGDP	-6.0138	-6.2823	-4.5282	-4.4282
LRE	-6.3488	-6.0262	-4.4444	-4.1501
LRENT	-6.6281	-6.8878	-5.1748	-4.7664
5% CV	-2.9558	-2.9591	-2.9627	-2.9665
1%CV	-3.6496	-3.6576	-3.6661	-3.6752

Notes: ADF test statistics are computed using regression with an intercept, a linear trend and m lagged first – differences of the dependent variable (m= 0,...3). Critical values taken from Mackinnon (1991) as reported by E-views, version 3.1.

V.2. Test Results for Cointegration.

Our cointegration test results in Table 4 show that cointegrating relationships are found in just one of our model formulation. The model is the model of non-transfer public expenditure and national income. The results indicate that non-transfer public expenditure and national income are subject to an equilibrating

relationship and positively related to each other over the long-run[4]. The degree of association is such that to maintain the long-run equilibrium, when national income (LRGDP) increased by 1 per cent, non-transfer public expenditure increased (less proportionately) by just about 0.1 per cent.

V.3. Test Results for Causality

Following the results from the cointegrating test, the Granger causality test for model 2 for which we found cointegrating relationship is conducted in the context of an error correction model. While the Granger causality for model 1 without cointegrating relationship was effected using the standard causality test.

The results from estimating the error-correction model for model 2 in Table 5 show a bi-directional causality between non-transfer public expenditure and national income. The results therefore suggest that neither the Wagner's Law nor the Keynesian hypothesis holds.

In the light of this, variance decomposition was calculated to further determine which direction of the causality is stronger. The results as reported in Table 6 show that the causality from national income to non-transfer public expenditure appears stronger. This pattern was observed throughout the whole period examined as innovations in the national income account for most of the variations in future expenditures in all the periods. On the average, 94 per cent innovations in non-transfer public expenditure are accounted for by national income. Combining the results from variance decomposition analysis along with the test for causality seems to confirm Wagner's Law.

---

[4] *Note that from the perspective of a typical structural equation, such as equations (3) and (4), the signs of the constant and LRGDP, are reversed because they are on the left t-hand side of the equations.*

Table 4: Johansen Cointegration Test: Estimated Cointegrating Vectors

Variables	Model 1 $LRE_t = \alpha_0 + \alpha_1 LGDP_t + \mu_t$	Model 2 $LRENT_t = \beta_0 + \beta_1 LRGDP_t + v_t$
LRE_t	1	-
$LRENT_t$	-	1
$LRGDP_t$	-0.98 (-49.10)	-0.11 (-22.03)
Constant	1.45	-0.94
Likelihood Ratio	14.45	23.69
Eigenvalue	0.35	0.52
No. of CE (s)	No	1*

Notes: 1. The cointegrating coefficients are normalized on LRE_t and $LRENT_t$.

2. t-ratios are in parenthesis

*3. *indicates the significance level at which the number of cointegrating equation (CE) is identified is 5 %.*

Table 5: Causality Test Based on Error-Correction for Model 2

	$\Delta LRENT_{t-1}$	$\Delta LRGDP_{t-1}$
ECTt-1	-1.36 (-3.44)	-5.33 (-1.98)
$\Delta LRENT_{t-1}$	-0.20 (-0.43)	-0.66 (-0.21)
$\Delta LRGDP_{t-1}$	0.03 (0.45)	0.10 (0.20)
Constant	0.03 (1.45)	0.22 (1.55)

Note: t-ratios are in parenthesis

The results from the standard causality test for model 1 for which we found no cointegrating relationship is reported in Table 7. We experimented with a lag period up to 4 lag period following Afxentiou and Serletis (1992) and Demirbas (1999). The 1 lag period produces the best result. From the table, and considering only I lag period result, there is a unidirectional causality from national income to total public expenditure. In other words, causality runs from national income to total public expenditure. This result contradicts that of Aigbokhan (1996) that reported bi-directional causality. However, the associated level of significance

indicates that the link from national income (measured by the growth rates) to expenditure is stronger. This therefore, implies the superiority of the Wagner's hypothesis.

Table 6: Proportion in Percent of Forecast Error Variance K-Periods Ahead Produced by Each Innovation

Error in:	No. of Periods	Innovations	
		$LRENT_t$	$LRGDP_t$
$LRENT_t$	1	0.0	100.0
	2	3.8	96.2
	3	5.6	94.4
	4	7.0	93.0
	5	8.0	92.0
$LRGDP_t$	1	9.0	91.0
	2	7.4	92.6
	3	7.3	92.7
	4	8.0	92.0
	5	8.6	91.4

Note: Variance decomposition depends on the order in which the variable enter the VAR system. We ordered our variables by considering first $RGDP_t$ and second $RENT_t$. This is informed by the fact that the t-statistics associated with causality was higher in the direction from $RGDP_t$ to $RENT_t$ than the reverse.

Table 7: Standard Causality Test for Model 1

Null Hypothesis	F-Values			
	No of Lags			
	1 Lag	2 Lag	3 Lag	4 Lag
ΔLRE does not cause ΔLRGDP	1.18 (0.29)	0.61 (0.55)	0.76 (0.53)	0.54 (0.71)
ΔLRGDP does not cause ΔLRE	4.06 (0.05)*	1.95 (0.16)	2.21 (0.11)	1.42 (0.26)

*Note: Probability values are in parenthesis, * Significant at 5% level of Significance.*

VI. Conclusion

This paper tested Wagner's Law for Nigeria using aggregate real data for the period 1970-2003 with two formulations of Wagner's Law. The first formulation relates national income and total public expenditure, while the second formulation relates national income and non-transfer public expenditure.

The empirical analysis commenced with the examination of the time series properties of the variables. In specific terms, we tested for the existence of unit roots and cointegration relationship. We found that the three variables; total public expenditure, non-transfer public expenditure and national income were non stationary in levels, but stationary at first differences, that is, they are integrated of order one (I(1)). The application of the Johansen's cointegrating test show that while there is cointegrating relationship between non-transfer public expenditure and national income, there is no cointegrating relationship between total public expenditure and national income. The inclusion of time trend into the cointegrating relationship did not change the results either.

Grounded on the theoretical postulates that even in the absence of a long-run relationship or cointegrating relationship between variables, it still remains of interest to examine the short-run linkages between variables. We therefore conducted the standard causality test for the relationship between total public expenditure and national income (for which we found no cointegrating relationship). The causality for the relationship between non-transfer public expenditure and national income (for which a cointegrating relationship was established) was conducted with the error-correction framework.

The results obtained from the standard causality test show a unidirectional causality from national income to public expenditure, indicating that Wagner's Law holds. In contrast, the results of the causality between national income and non-transfer public expenditure undertaken within the error-correction mechanism show bi-directional causality between non-transfer public expenditure and national income. But, the causality from national income to non-transfer public expenditure was found to be stronger than the reverse direction following variance decomposition analysis.

The conclusion from these results is that the postulation of Wagner's Law that there is a long-run tendency for public expenditure to grow relative to national income has a strong support in Nigeria during the period 1970-2003

References

Afentiou, P.C. and Serlestis, A. (1992), "Modeling the Relationship between Output and Government Expenditure in Canada", *Kero Economic Studies*, 29 (1), 17-43

Aigbokhan, B.E. (1996), "Government Size and Economic Growth: The Nigerian Experience", in Beyond Adjustment: Management of the Nigerian Economy, the proceedings of the 1996 annual Conference of the Nigerian Economic Society.

Arghrou, M.G. (1999), "Public Expenditure and National Income: Time Series Evidence from Greece", Paper presented at the international Economics and Finance Society conference (City University, London, April) and the 3rd conference on Macroeconomics analysis and international Finance (University of Crete, Rethymno, May).

Beck, M. (1982), "Towards a Theory of public Sector Growth", *Public Finance*, 39, 163-77.

Bird, R.M. (1971), "Wagner's Law: A pooled time series, cross section comparisons", *National Tax Journal*, 38, 209-281.

Demirbas, Safa (1999), "Cointegration Analysis-Causality Testing and Wagner's Law: the Case of Turkey, 1950-19990", Recent Economics Discussions papers, Dept. of Economics, University of Leicester, 99/3.

Fasano, Ugo and Wang, Qing (2002), "Testing the Relationship between Government spending and Revenue: Evidence from GCC Countries", IMF *Working Paper*, WP/02/201.

Goffmann, I.J. (1968), " On the Empirical Testing of Wagner's Law: A Technical Note" *Public Finance*, 23, 359-364.

Gummell, N. (1990), "Wagner's Law, Relative Prices and the Size of the public Sector", *The Manchester School*, 57 (4), 361-377.

Gupta, S. (1967), " Public Expenditure and Economic Growth: a Time series Analysis", *Public Finance*, 22, 423-461.

Halicioglu, R.F. (2003), "Testing Wagner's Law for Turkey, 1960-2000", *Review of Middle East Economics and Finance*, vol.1 no.2, pp.129-140.

Jackson, P.M., Fethi, M.D. and Fethi S. (1999), "Cointegration, Causality and Wagner's Law; A Test for Northern Cyprus, 1977-1996", Discussion papers in Public Sector Economics, University of Leceister., 99/2.

Mahdavi, S., Sohraabian, A. and Kholdy, S. (1994), "Cointegration, Error-Correction Models: The Temporal Causality between Investment and Corporate Cash Flow", *Journal of Post Keynesian Economics*, 16 (3), 478-498.

Mann, A.J. (1980), "Wagner's Law: An Econometric Test for Mexico, 1925-76", *National Tax Journal*, 33, 189-201.

Manning, L.M. and Adriacanos, D. (1993), "Dollar Movements and inflation: A Cointegration Analysis", *Applied Economics*, 25, 1483-1488.

Musgrave, R.A. (1969), Fiscal Systems, Yale University Press, New Haven.

Nitti, F.S. (1903), Principidi Scienza delle Finanze.

Peacock, A.T. and Wiseman, J. (1961), The Growth of Public Expenditure in the United Kingdom, Princeton University Press, Princeton.

Thornton, John (1999), "Cointegration, Causality and Wagner's Law in the 19th Century Europe", *Applied Economic Letters*, vol.6, no.7, pp.413-416.

Tsangyao Chang, WenRong Liu and Steven B. Caudilll (2004), "A Re-examination of Wagner's Law for ten Countries based on Cointegration and error-Correction Modeling Techniques", *Applied Financial Economics*, vol.14, no.8, pp.577-589.