Investigating Wagner's Law for Nigeria: A Robust Estimate Between ARDL and Engle-Granger Two-step Cointegration and Error Correction Models

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Abstract

This study titled "Investigating Wagner's Law for Nigeria: A Robust Estimate Between ARDL and Engle-Granger Two-Step Cointegration and Error Correction Models" *examined whether there is empirical evidence that Wagner's law holds in the Nigeria economy using time series annual data over the period from 1981 to 2015 for Nigeria. Two techniques were applied; the Engle-Granger two-step and Autoregressive distributed lag (ARDL). The two approaches were used to test for cointegration and estimation of error correction in order to validate the existence of long-run relationship and short-run dynamics of the variables. In particular, the study keeps a special focus to examine the validity of five versions of Wagner's hypothesis, which support the existence of long-run relationship between government expenditure and economic growth. Real Gross Domestic Product (RGDP) was used as a proxy for economic growth in the study. Based on the result findings, the co-integration test found a long-run relationship between real gross domestic product and real government expenditure by ARDL techniques for all the five versions considered and only Goffman model for Engle-granger approach. Error correction models showed a desirable negative sign for the estimated coefficients of the error correction terms in the five versions for both techniques. However, the error correction terms estimates were insignificant for Engle-Granger techniques but were all significant with ARDL versions. Diagnostic test on the residuals of the models built using the two techniques revealed that Engle-Grange technique was not void of heteroskedasticity thereby violating one of the important assumptions of the classical linear regression model. Comparing the results of cointegration by both approaches to Johansen cointegration, it was revealed that the cointegrations results by ARDL models were consistent since Johansen cointegration also revealed one cointegrating equation in all the models. Also, the results from Toda-Yamamoto granger causality showed that, the real gross domestic product does granger cause real* *government expenditure for the five versions of Wagner's law which coincided with the long-run results by ARDL error correction terms for all the versions of the law. Hence, evidence that Wagner's Law is valid for Nigeria economy. However, based on the result of this study, it is recommended among others that, the use of autoregressive distributed lag (ARDL) model by Statisticians and Econometricians should be encouraged and if Engle-Granger two-step approach will be used, the diagnostic tests should be performed, to see to the fulfillment of all the desirable properties of a good model.*

Keywords: Wagner's law, Cointegration, Error Correction, Engle-Granger, ARDL

1. Introduction

Economic growth means an increase in capacity to produce goods and services, compared from one period of time to another. Economic growth is a process by which a nation wealth increases over time. The most widely used measures of economic growth is the rate of the growth in a country's total output of goods and services gauged by the gross domestic product (GDP). Economic growth can also be referred to as the increase of per capita gross domestic product (GDP) or other measures of aggregate income, typically reported as the annual rate of change in the real GDP. Economic growth is primarily driven by improvement in productivity, which involves producing more goods and services with the same inputs of labour, capital, energy and materials (Wikipedia, 2015).

Bhatia (2008) defines Public expenditure as the expenses which a government incurs for (i) its own maintenance, (ii) the society and the economy, and (iii) helping other countries. Public expenditure refers broadly to expenditure made by local, state and national government agencies as distinct from those of private individuals. Public Expenditure also comprises of government payments for the goods and services acquired and for the works done pursuant to their respective laws, social security contributions, interest payments of domestic and foreign debts, general borrowing expenditures, payments resulting from the discounted sale of borrowing instruments, economic, financial and social transfers, donations and grants, and other expenditures.

Wagner's law, also known as the law of increasing state spending, is a principle named after the German economist Adolph Wagner (1835–1917). The law predicts that the development of an industrial economy will be accompanied by an increased share of public expenditure in gross national product.

The relationship between government spending and national output is important for many policy-related issues. For instance, recessionary (expansionary) periods impede (enhance) central authorities' abilities to stimulate their economy via fiscal measures unless the share of government spending to GDP increases (reduces). Long run estimates of the relationship between government expenditure and national output would permit the identification of a benchmark against which one can identify the fiscal policy stance adopted by particular governments. The government spending and national output relationship is also relevant for the debate on the sustainability of public finances, especially during the phase when governments struggle to retain government spending. Therefore, the identification of this relationship provides theoretical framework against which to formulate and judge fiscal policy adjustment plans concerning medium term budgetary objectives.

In the context of the Nigerian economy, this study investigated the validity of Wagner's law by using two popular methods used in the literatures for estimating the law. It examined the robustness of the methods; the Engle-Granger and Autoregressive Distributed Lag (ARDL) approaches to co-integrations and error correction modeling. Five versions of the Wagner's law are considered in the study. Also, robustness of the two approaches was examined using Johansen cointegration Approach and Toda and Yamamoto granger causality test.

2. Empirical Literature on Public Expenditure and Economic Growth in Nigeria

In Nigeria, many authors have also attempted to examine government expenditure-economic growth relationship using GDP as a proxy for economic growth and by applying ARDL and Engle-Granger cointegration and error correction model. Below are some literatures concerning Nigeria.

Oyinlola (1993) examined the relationship between the Nigeria's defence sector and economic development, and reported a positive impact of defence expenditure on economic growth.

Fajingbesi and Odusola (1999), empirically investigated the relationship between government expenditure and economic growth in Nigeria. The econometric results indicated that real government capital expenditure has a significant positive influence on real output. However, the results showed that real government recurrent expenditure affects growth only by little.

Ogiogio (1995), study revealed a long-term relationship between government expenditure and economic growth. Moreover, the author's findings showed that recurrent expenditure exerts more influence than capital expenditure on growth.

Aigbokhan (1996) in his study using the Engle Granger two step procedures and standard causality tests, reported a bi-directional causality between government total expenditure and national income and thereby establishing the validity of Wagner's law in Nigeria.

Essien (1997) in his study of public spending concluded that the variables, public spending and real income were not cointegrated and hence could not establish a long run relationship. In addition, causality tests performed on his models confirmed that public expenditure does not cause growth and there was no feedback mechanism.

Akpan (2005), used a disaggregated approach to determine the components that include capital, recurrent, administrative, economic service, social and community service, and transfers of government expenditure that enhances growth, and those that do not and concluded that there was no significant association between most components of government expenditure and economic growth in Nigeria.

Babatunde (2007), tests Wagner's Law for Nigeria using annual time series data between 1970 and 2006. It adopts the Bounds Test approach based on Unrestricted Error Correction Model and Toda Yamomoto Granger causality tests. Empirical results from the Bounds Test indicate that there exists no long-run relationship between government expenditure and output in Nigeria but rather found a weak empirical support in the proposition by Keynes.

This study seeks to examine the robustness of the techniques in use for investigating Wagner's law in Nigeria and draw valid conclusion on the more robust techniques.

3. Theoretical Framework

In empirical terms, Wagner Law investigates the relationship between government size and the economy. However, alternative strands of the literature have tested several specifications of Wagner's Law, using different variables to approximate the theoretical variables of government expenditure and economic growth.[1] Nevertheless; five of the specifications are predominant in the literature, since most authors test for the validity of one or more of them. Following the example of Huang (2006) who considered China and Taiwan economy, the five different versions of the Wagner's law to be tested are as follows:

Functional Form	Version	
$\ln RGE_t = a_1 + b_1 \ln(RGDP_t) + \varepsilon_t$	Peacock and Wiseman (1967)	(1)
$\ln(\frac{RGE_t}{P_t}) = a_2 + b_2 \ln(\frac{RGDP_t}{P_t}) + \varepsilon_{2t}$	Gupta (1967)	(2)
$\ln(\frac{RGE_t}{P_t}) = a_2 + b_2 \ln(\frac{RGDP_t}{P_t}) + \varepsilon_{2t}$	Goffman (1968)	(3)
$\ln\frac{RGE_t}{RGDP_t} = a_3 + b_3 \ln(\frac{RGDP_T}{P_t}) + \varepsilon_{3t}$	Musgrave and Musgrave (1969)	(4)
$\ln(\frac{RGE_i}{RGDP_t}) = a_5 + b_5 (RGDP_t) + \varepsilon_{5t}$	Mann (1980)	(5)

In this case,

RGE = real government expenditures, R*GDP* = real gross domestic product, *P*= population, R*GDP/P* = real GDP per capita, R*GE/P* = real government expenditures per capita, and R*GE/RGDP* = the ratio of real government expenditures to RGDP. The only noticeable difference in the five models is however with respect to the measurement of government expenditure and economic output. For example, the size of government is measured by government expenditures (in the models of Peacock-Wiseman, 1967 and Goffman, 1968), real government expenditures per capita (in the models of Gupta, 1967; Michas, 1975), or real government expenditures as proportion of RGDP (in models of Musgrave 1969 and Mann, 1980). The economy is measured by RGDP (in models of Peacock-Wiseman, 1967 and Mann, 1980) or RGDP per capita (in models of Goffman, 1968; Gupta, 1967; Michas, 1975; and Musgrave, 1969). All variables are expressed in logarithm terms. The existence of long run relationship among the variables is a confirmation of the Wagner law

4. Data and Methodology

Data on real gross domestic product, real government expenditure and Population for Nigeria were used for the study periods 1981-2015. The stationary properties of the test series data was investigated using the Augmented Dickey-Fuller (ADF) test. The Co-integration and Error Correction Models are conducted to determine whether groups of non-stationary time series variables used for this study are co-integrated or not using Engle-Granger and ARDL approaches. Finally, the robustness of the two approaches were examined by comparing the results obtained by methods to the estimates by Johansen cointegration and Toda Yamamoto causality test.

This Study uses annual data from 1981 to 2015 which translates into 34 years annual observations. Data on estimated population for Nigeria were obtained from World Bank (2016) website (publication of World Bank national accounts data, and Organization of Economic Cooperative and Development (OECD) National Accounts data files). Annual time series data were collected on real domestic product and real government expenditure for Nigeria and the data were obtained from the Federal Ministry of Finance and Central Bank of Nigeria contained in Central Bank of Nigeria Statistical Bulletin (2015).

5. Analytical Procedures, Results and Discussions

Unit Root Tests

In order to perform cointegration test, the series have to be stationary. To investigate whether a series is stationary or not, unit root test was conducted using Augmented Dickey-Fuller test at level and at first difference of each series on the condition that the null hypothesis is non-stationary, so rejection of the unit root hypothesis supports stationarity.

The hypothesis tested is:

H_o: $\gamma = 0$ (not stationary)

H_1: $\gamma \neq 0$ (stationary)

$\alpha = 0.05$

Test statistic= ADF test statistic

Critical region: Reject H_0 if, ADF test statistic > MacKinnon critical value for rejection of hypothesis of a unit root at 5% significance level

Table 1: Results of Augmented Dickey-Fuller Test at Level (Intercept but no trend)

Variables	Calculated Value	Significance Level		Remark
		99%	95%	
$\ln RGDP$	0.554741	-3.653730	-2.95711	not stationary
$\Delta\ln RGDP$	-4.483257	-3.653730	-2.95711	Stationary
$\ln RGDPP$	0.208850	-3.653730	-2.95711	not stationary
$\Delta\ln RGDPP$	-4.507845	-3.653730	-2.95711	Stationary
$\ln RGE$	-2.28444	-3.653730	-2.95711	not stationary
$\Delta\ln RGE$	-7.647091	-3.653730	-2.95711	Stationary
$\ln RGEP$	-2.270679	-3.653730	-2.95711	not stationary
$\Delta\ln RGEP$	-7.632908	-3.653730	-2.95711	stationary
$\ln GGDP$	-2.652906	-3.653730	-2.95711	not stationary
$\Delta\ln GGDP$	-7.228944	-3.653730	-2.95711	stationary

ln: natural log, RGDP: real gross domestic product, RGE: real government expenditure, RGDP: real gross domestic product per capital, RGEP: real government expenditure per capita, and GGDP: ratio of real government expenditure to real gross domestic product

In table 1 Are the results of unit root test, at level and after first difference. The results revealed that the time series contained unit root at level but after first difference the series become stationary, therefore the time series are I(1).

Table 2: Engle-Granger Residuals ADF Cointegration Tests

Models		t-Statistic	Test Critical Value (5%)	Remarks
lnRGE	lnRGDP	-1.1111	-1.95133	Not Stationary
lnRGE	lnRGDPP	-1.9933	-1.95133	Stationary
lnRGEP	lnRGDPP	-1.86586	-1.95133	Not Stationary
lnGGDP	lnRGDP	-1.1111	-1.95133	Not Stationary
lnGGDP	lnRGDPP	-1.86586	-1.95133	Not Stationary

Tables 2 showed the results of Engle-Granger's residuals ADF test for cointegration. It was revealed that all the values of t-statistic are greater than the test critical value at 5% which suggest no cointegration except in the second model by Goffman.

Engle-Granger Error Correction Model: if there is evidence of a long-run relationship, we then estimate the error correction model (ECM), which incorporates variables both in their levels and first difference and captures the short-run disequilibrium situations as well as the long-run equilibrium adjustments between the variables. In this study, the Engle-Granger (1987) two-step error correction model procedure was adopted. The models are specified below:

$$D\ln RGE_t = b_0 + b_1 D\ln RGDP_t + b_2 U_{t-1} + \varepsilon_t \tag{3}$$

$$D\ln RGE_t = b_0 + b_1 D\ln RGDPP_t + b_2 U_{t-1} + \varepsilon_t \tag{4}$$

$$D\ln RGEp_t = c_0 + c_1 D\ln GDPP_t + c_2 U_{t-1} + \varepsilon_t \tag{5}$$

$$D\ln GGDP_t = d_0 + d_1 D\ln RGDP_t + d_2 U_{t-1} + \varepsilon_t \tag{6}$$

$$D\ln GGDP_t = e_0 + e_1 D\ln RGDPP_t + e_2 U_{t-1} + \varepsilon_t \tag{7}$$

where D denotes the first difference operation on the respective variables; a_1, b_1, c_1, d_1 and e_1 are the coefficients showing the short run equilibrium relationship connecting the independent and the dependent variable; a_2, b_2, c_2, d_2 and e_2 are the coefficient showing the long run relationship connecting the explanatory variables and the dependent variables. It has an a priori expectation sign of minus. U_{t-1}, is the residual obtained from the linear regression of the I(1) variables and lagged by one as a requirement of the granger representation theorem. Lastly ε_t is the disturbance term for the models.

Table 3: Error Correction Model (ECM) for Engle-Granger Model

Model	Version	Intercept	Short-run income elasticity	Error term
1.	Peacock and Wiseman(1967)	0.1633 (0.0124)	0.4267 (0.6804)	-0.0039 (0.9434)
2.	Goffman(1968)	0.1735 (0.0006)	0.4650 (0.6689)	-0.0036 (0.9261)
3.	Gupta(1967)	0.14737 (0.0029)	0.4824 (0.6562)	-0.0061 (0.8860)
4.	Mann(1980)	0.16329 (0.0124)	-0.5733 (0.5803)	-0.0039 (0.9434)
5.	Musgrave(1969)	0.14737 (0.0027)	-0.5176 (0.6330)	-0.0061 (0.886)

Table 3 is the results of short-run dynamics and error correction terms for the five version of Wagner's law. The error correction terms coefficients take negative signs but are insignificant. These further strengthen the first results that, there is no long-run relationship between the time series variables.

Autoregressive Distributed Lag (ARDL) Bound Test for Cointegration

The first step in the ARDL bounds testing approach is to estimate the following equations

$$\Delta RGE_t = \lambda_0 + \lambda_1 RGE_{t-1} + \lambda_2 RGDP_{t-1} + \sum_{i=1}^{p} a_i \Delta RGE_{t-i} + \sum_{i=1}^{p} b_i \Delta RGDP_{t-i} + ecm_{t1} \quad (10)$$

$$\Delta RGE_t = \lambda_0 + \lambda_1 RGE_{t-1} + \lambda_2 RGDPP_{t-1} + \sum_{i=1}^{p} a_i \Delta RGE_{t-i} + \sum_{i=1}^{p} b_i \Delta RGDPP_{t-i} + ecm_{t2} \quad (11)$$

$$\Delta RGEP_t = \lambda_0 + \lambda_1 RGEP_{t-1} + \lambda_2 RGDPP_{t-1} + \sum_{i=1}^{p} a_i \Delta RGEP_{t-i} + \sum_{i=1}^{p} b_i \Delta RGDPP_{t-i} + ecm_{t3} \quad (12)$$

$$\Delta GGDP_t = \lambda_0 + \lambda_1 GGDP_{t-1} + \lambda_2 RGDP_{t-1} + \sum_{i=1}^{p} a_i \Delta GGDP_{t-i} + \sum_{i=1}^{p} b_i \Delta RGDP_{t-i} + ecm_{t4} \quad (13)$$

$$\Delta GGDP_t = \lambda_0 + \sum_{i=1}^{1} a_i \Delta GGDP_{t-i} + \sum_{i=1}^{3} b_i \Delta RGDP_{t-i} + ecm_{t4-1} \quad (13)$$

$$\Delta GGDP_t = \lambda_0 + \sum_{i=1}^{1} a_i \Delta GGDP_{t-i} + \sum_{i=1}^{3} b_i \Delta RGDPP_{t-i} + ecm_{t5-1} \quad (14)$$

All coefficients of the short-run model are coefficients relating to the short-run dynamics of the model's convergence to equilibrium. The error correction term indicates the speed of adjustment to restore equilibrium in the dynamic model. The ECM coefficient ψ shows how quickly variables converge to equilibrium and it is expected to be statistically significant and the coefficient should have a negative sign. According to Banerjee et al (1998), the highly significant error correction term further confirms the existence of a stable long-run relationship.

Table 5: ARDL Short-run and Error Correction Model (Peacock and Wiseman) Dependent Variable D(GE)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.256032	0.104258	2.455750	0.0220
D(GE(-1))	-0.007977	0.234255	-0.034053	0.9731
D(GDP(-1))	-0.498524	1.185079	-0.420667	0.6779
D(GDP(-2))	-1.921267	1.187985	-1.617248	0.1195
D(GDP(-3))	1.394287	1.108320	1.258019	0.2210
ECM1(-1)	-0.790034	0.340939	-2.317233	0.0297

Table 6: ARDL Short-run and Error Correction Model (Goffman): Dependent Variable D(GE)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.229445	0.076863	2.985117	0.0066
D(GE(-1))	-0.008314	0.234545	-0.035446	0.9720
D(GDPP(-1))	-0.511407	1.189307	-0.430004	0.6712
D(GDPP(-2))	-1.903442	1.192575	-1.596078	0.1241
D(GDPP(-3))	1.400959	1.114355	1.257193	0.2213
ECM2(-1)	-0.785155	0.341161	-2.301418	0.0308

Table 7: ARDL Short-run and Error Correction Model (Gupta) Dependent Variable D(GEP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.230646	0.100411	2.297030	0.0311
D(GEP(-1))	-0.006786	0.234485	-0.028939	0.9772
D(GDP(-1))	-0.511796	1.186572	-0.431323	0.6702
D(GDP(-2))	-1.922250	1.189849	-1.615541	0.1198
D(GDP(-3))	1.391380	1.110513	1.252916	0.2228
ECM3(-1)	-0.789740	0.341208	-2.314543	0.0299

Table 8: ARDL Short-run and Error Correction Model (Mann) Dependent Variable D(GGEP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.259902	0.105582	2.461605	0.0218
D(GGDP(-1))	-0.061399	0.240308	-0.255501	0.8006
D(GDP(-1))	-1.683502	1.278462	-1.316818	0.2009
D(GDP(-2))	-1.773309	1.256627	-1.411166	0.1716
D(GDP(-3))	1.487825	1.174814	1.266434	0.2180
ECM4(-1)	-0.704920	0.348842	-2.020742	0.0551

Table 9: ARDL Short-run and Error Correction Model (Musgrave) Dependent Variable D(GGEP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.208906	0.073762	2.832176	0.0094
D(GGDP(-1))	-0.060628	0.241313	-0.251241	0.8039
D(GDPP(-1))	-1.689167	1.286480	-1.313015	0.2021
D(GDPP(-2))	-1.761846	1.263883	-1.393994	0.1766
D(GDPP(-3))	1.488039	1.183467	1.257355	0.2212
ECM5(-1)	-0.697474	0.349793	-1.993964	0.0581

In tables 5, 6, 7, 8, and 9 above, the error correction terms are represented by ECM1, ECM2, ECM3, ECM4 and ECM5. The error correction parts showed the long-run components of the models. All the coefficients carried the desirable negative signs with three of the models being significant at 5% and two at 10%. These results are further indication that government expenditure and gross domestic product are cointegrated. It also shows that 79%, 78.51%, 78.97%, 70.49% and 69.74% of deviation of gdp from its long-run equilibrium level is corrected each year in the models respectively.

Models Diagnostic Checking

The models that are used in this research, the estimates of the short-run dynamics are further tested with the diagnostic tests of Normal Distribution, Serial Correlation, and Hetroskedasticity to be void of model misspecifications.

The Hypothesis tested here were

1. H_0 : Residuals are not serially correlated

   H_1 : Residuals are serially correlated

2. H_0 : Residuals are homoskedastic

   H_1 : Residuals are heteroskedastic

3. H_0 : Residuals are normally distributed

   H_1 : Residuals are not normally distributed

Decision criteria: Reject H_0 if P-value<0.05 significant value otherwise H_0 is retained

Table 10: Diagnostic Test on the Residual for Error Correction Models

ENGLE-GRANGER MODELS

Model		Breusch-Godfrey Serial CorrelationLM TEST	Breusch-pagan Gofrey Heteroskedasticity	Jacque-Bera test for Normality
GE	GDP	2.480912(0.1152)	8.184954(0.0167)	0.9663(0.6168)
GE	GDPP	2.403675(0.1211)	7.99(0.0184)	1.023(0.5996)
GEP	GDPP	2.3618(0.1243)	8.0449(0.0179)	1.1003(0.57688)
GGDP	GDP	2.480912(0.1152)	8.184955(0.0167)	0.9966(0.6188)
GGDP	GDPP	2.361797(0.1243)	8.044938(0.0179)	1.1003(0.5769)

ARDL MODELS

GE	GDP	3.1191(0.3736)	2.827084(0.7266)	0.0148(0.9926)
GE	GDPP	3.1016(0.3762)	2.9313(0.7106)	0.01397(0.993038)
GEP	GDPP	3.1357(0.3712)	2.84724(0.7235)	0.0144(0.9928)
GGDP	GDP	4.308589(0.2300)	3.018543(0.6971)	0.027521(0.9863)
GGDP	GDPP	4.2456(0.2361)	3.131854(0.6797)	0.03169(0.98429)

Table 10 indicated the results of the model diagnostic tests of the residuals for serial correlation, heteroskedasticiy and normality tests. The showed that all the models considered using ARDL approach pass the entire test that characterized a good ordinary least squared method, however, the Engle-Granger's approach, failed the heteroskedasticity test which is one of the important assumptions the should be fulfilled.

Model Robustness Test

To check the robustness of the obtained results from Engle-Granger co-integration and error correction model and Autoregressive Distributed Lag (ARDL) model, the Johansen co-integration, Toda-Yamamoto granger causality and error variance decomposition were used justify and validate the results of our analyses using the Engle-Granger co-integration and error correction model and Autoregressive Distributed Lag (ARDL) model.

Johansen's Cointegration Test

The first test statistic is the trace test while the second is the maximal eigenvalue test. In determining the number of cointegrating vectors, a sequential procedure is used:

1. First test $H_0(r_0 = 0)$ against $H_1(r_0 > 0)$. If this null is not rejected then it is concluded that there are no cointegrating vectors among the n variables in Y_t.

2. If $H_0(r_0 = 0)$ is rejected then it is concluded that there is at least one cointegrating vector and proceed to test $H_0(r_0 = 1)$ against $H_1(r_0 > 1)$. If this null is not rejected then it is concluded that there is only one cointegrating vector.

3. If the $H_0(r_0 = 1)$ is rejected then it is concluded that there is at least two cointegrating vectors

4. The sequential procedure is continued until the null is not rejected.

Table 11: Trace and Max-Eigen Cointegration test for the Five Model of Wagner

Model	Null Hypothesis	Trace statistic (Critical value (5%))	Max-Eigen statistic (Critical value (5%))
RGE – RGDP	r=0*	20.624 (15.49471)	17.4983 (14.2646)
	r<=1	3.1257(3.841466)	3.1257 (3.8415)
RGE - RGDPP	r=0*	20.9222(15.49471)	17.28127 (14.26460)
	r<=1	3.640914(3.841466)	3.640914 (3.841466)
RGEP - RGDPP	r=0*	20.80184 (15.49471)	17.19256 (14.2646)
	r<=1	3.60928 (3.841466)	3.609280 (3.841466)
GGDP - RGDP	r=0*	20.62407 (15.49471)	17.49834 (14.26460)
	r<=1	3.125730 (3.841466)	3.125730 (3.841466)
GGDP - RGDPP	r=0*	20.80184 (15.49471)	17.19256 (14.26460)
	r<=1	3.609280 (3.841466)	3.609280 (3.841466)

In table 11 above, the maximal eigenvalue test and the trace test of the five versions indicated one cointegrating equation, denoting the rejection of the null hypothesis of no cointegrating equation. The existence of a cointegrating equation established the existence of long-run relationships between the variables.

Granger Causality Tests

The Granger Causality test is a statistical proposition test for determining whether one time series is helpful in forecasting another. The Toda-Yamamoto granger causality test has been performed in this study so as to search for direction of causation among gross domestic product, total exports, total imports, labour forces, and gross fixed capital formation.

The results of the granger causality test based on Toda-Yamamoto procedure are reported in the table below. The values in the parentheses are probability values whereas rests of the estimates are $\chi^2 - statistics$.

Table 12: Results of Granger Causality Test Based on the Toda-Yamamoto Procedure

Equation-Excluded	Chi-Square	Degree of Freedom	Probability-value
RGE – RGDP	0.019952	2	0.9901
RGDP – RGE	6.310155	2	0.0426
RGE – RGDPP	0.38962	2	0.9807
RGDPP – RGE	6.778434	2	0.0337
RGEP – RGDPP	0.050675	2	0.9750
RGDPP – RGEP	6.706728	2	0.0350
GGDP – RGDP	0.694606	2	0.7066
RGDP – GGDP	6.310155	2	0.0426
GGDP – RGDPP	0.755947	2	0.6852
RGDPP – GGDP	6.706728	2	0.0350

The granger causality results in table 12 above, showed the direction of causality between the fiscal variables. The results revealed that growth in the economy can translate into increase in government expenditure but reverse is not the case for Nigeria. This is a further validity of Wagner's hypothesis for Nigeria that the development of an industrial sector in Nigeria can be accompanied by an increased share of public expenditure in gross national product.

6. Conclusions

The study investigates the validity of Wagner's law in case of Nigeria over the period 1981 to 2015 by examining a robust estimate between ARDL and Engle-Granger's cointegration and error correction models. The results obtained from the methods were compared for consistence with the results of Johansen cointegration and the Toda-Yamamoto causality test. To assess the response of government expenditure to economic growth the study considered five models of Wagner's law, namely, Peacock and Wiseman (1967), Goffman (1968), Gupta (1967); Michas (1975), Musgrave (1969) and Mann (1980) based on the work of Huang (2006).

ADF test results revealed that the time series variables incorporated in this study exhibit consistent trend over the period, and they do not reject the null hypothesis of non-stationarity in levels. However, the null hypothesis at first difference is rejected and revealed that all the variables became stationary.

Based on the results of Engle-Granger's cointegration, the variables considered by each of the five versions were not cointegrated only the Goffman version revealed the existence of long run relationship between government spending and gross domestic product per capital. However, in contrast, the ARDL cointegration test results showed the existence of long-run relationship for all the five model considered, hence evidence for possibility that Wagner,s hypothesis may hold in the case of Nigeria.

Error Correction models for each of the five versions by Engle-granger's two-step procedure were not statistically significant though the sign of the coefficients of the error terms were negative as desired. Again all the error terms with ARDL model were statistically significant and carried the desired negative signs.

The residuals of the models from the two approaches considered were diagnosed of serial correlation, heteroskedasity and normality. The Engle-Granger estimates of the five versions were not void of heteroskedasity which is one of the serious problems in ordinary least square regression estimate.

Lastly, to determine the most robust test, the results from the two approaches were compared with the results of Johansen cointegration and Toda-Yamamoto causality test. It was revealed that Johansen revealed one cointegrating equation in all the five versions, an indication that ARDL is more robust and more reliable than Engle-Granger's cointegration for the period under consideration. Also the Toda-Yamamoto causality test revealed causation from output to government spending, a further verification of Wagner's law holding in case of Nigeria that the development of an industrial sector in Nigeria economy can be accompanied by an increased share of public expenditure in gross national product which is strengthened by the results from the ARDL models.

7. Recommendations

Based on the findings of the study, the following were recommended:

- Government should ensure management of government spending and increase in national income at the same time.
- The use of autoregressive distributed lag (ARDL) model should be encouraged among Statisticians and Econometricians since the results from Engle-Granger's cointegration and error correction models are inconsistent and may lead to misleading conclusions which is not so with ARDL.

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