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IS WAGNER'S LAW A MYTH OR A REALITY? EMPIRICAL EVIDENCE FROM NIGERIA

Matthew Abiodun Dada [1] Oguntegbe Abraham Adewale [2]

1. PGS Department of Economics, Faculty of Social Sciences Obafemi Awolowo University, Ile-Ife Nigeria.
2. Department of Business Administration and Management Studies, the Polytechnic, Ibadan Oyo State, Nigeria.

ABSTRACT: *This study attempted to examine the long-run relationship and direction of causality between economic growth and government spending with consideration for exchange rate, consumer prices and monetary policy rate. This was with a view to examining the empirical validity of Wagner's Law in Nigeria during the period 1961 to 2011. Times series data on variables such as real GDP, total government expenditure, exchange rate, inflation rate and monetary policy rate during the period (1961-2011) were used. These data were sourced from Central Bank of Nigeria (CBN) Statistical Bulletin 2011 Edition augmented with World Development Indicator (WDI) Latest version and CBN Annual Reports (Various Years). The study identified the order of integration of the variables used in the study using Phillips-Perron unit root test. The test was conducted with a drift and Time Trend. The study also employed Johansen multivariate cointegration tests to determine if a group of I(1) variables converge to a long-run equilibrium. Vector Error Correction Mechanism was employed to model causal relation between economic growth and government spending. The results showed that variables are individually integrated of order one that is, a I(1) process. Johansen multivariate cointegration test showed that variables are cointegrated. Both the Trace test and Maximum-Eigen test suggest one cointegrating vector. The result of VECM estimates provided evidence in support of long-run causality running from real GDP to government spending. However, while evidence exists for long-run causality running from real GDP to government spending such evidence does not exist for short-run causality in this same direction. This indicates that Wagner's Law is supported only in the long-run. Some policy implications were drawn. The study therefore concludes that government expenditure was employed as an endogenous factor determined by economic growth and that Wagner's law is never a Myth but a Reality in Nigeria during the period under investigation.*

KEYWORDS: Wagner's Law, Economic Growth, Government Spending, Long-run Causality, Short-run Causality, Cointegration

INTRODUCTION

Wagner's law originally states that as population of a country rises, government activities expand both intensively and extensively calling for an increase in government spending. This implies that government expenditure is a function of population growth. The policy implication of this

situation is that a very effective policy to control population growth has to be put in place first in order to check the excessive growth of government spending.

Wagner was the first to model a relationship between government expenditure and economic growth of a country. He argued that public spending is an endogenous factor, which is determined by the growth of national income (Wagner, 1890). This view is what is popularly known as Wagner's law in the empirical literature. This relationship he postulated between the government expenditure and national income in the late 19th century popularly known as Wagner's "law", which basically states that as per capita income increases overtime, public sector's importance will grow (Bird, 1971, p.2). According to Wagner, there are three reasons why the share of government spending GDP would increase in importance as an economy grows. First, as population grows and industrialization progresses public sector activity will substitute for private sector activity because state's administrative and protective functions would increase in importance during the industrialization process. State's role in maintaining law and order as well as its role in activities related to economic regulation is likely to become more pronounced due to the increasing complexity of economic life and urbanization, which occur during industrialization. Furthermore, public spending on cultural and welfare services (including education and income redistribution) would also increase as a country industrializes due to the high income elasticity of demand for these services - an implicit assumption in Wagner's work. This means that as per capita income increases demand for the services mentioned above, which are usually provided by the government increases rapidly, raising the share of public sector expenditure in GDP. Finally, technological change and growing scale of firms would tend to create monopolies whose effects the state will have to offset. Due to market failure argument, as civilization continues, there will be a growing inefficiency in the workings of the market system which will necessitate government intervention leading to an increase in government spending.
Another rationale for the law can be found in public choice models, such as the one analyzed by Meltzer and Richard (1981). In their model government spending is undertaken to satisfy the median voter, which would generate a relationship between economic growth and government expenditure if the position of the decisive median voter in the income distribution shifts towards the lower end. For example, as economy grows incomes of skilled workers might increase faster than the incomes of unskilled workers, leading to increased inequality. In the Meltzer- Richard model this would imply more votes for redistribution, and eventually a higher level of government spending (Oxley, 1994, p.288).

Although, a great number of studies have been carried out to confirm if Wagner's law holds using panel, cross-sectional and country-specific data. These studies have used different econometric techniques, sample size as well as different measures of economic growth and government spending. While the findings of most of these studies were mixed, this paper also observed that studies on empirical investigation of validity of Wagner's law using the VECM framework on aggregate government expenditure and real GDP with consideration for these three key macroeconomic variables namely exchange rate, inflation rate and monetary policy rate are scarce especially for a developing-open economy like Nigeria, hence the motivation for this study.

The remaining aspect of this paper is organized as follows: The next section gives a brief review of the related literature. Section 3 describes the data and methods used in the analysis. Section 4 reported the empirical findings while section 5 draws the conclusion.

LITERATURE REVIEW

Islam (2001), used annual data for the period of 1929-1996 in his study which re-examined Wagner's hypothesis for the USA and found that the relative size of government expenditure and real Gross National Product per capita are cointegrated by using Johansen-Juselius's cointegration approach. Moreover, Wagner's hypothesis was strongly supported by the result of Engle-Granger (1987) error correction approach. Ansari et al (1997) attempt to determine the direction of causality between government expenditure and national income for three African countries Ghana, Kenya, and South Africa, using standard Granger testing procedures and the Holmes-Hutton (1990) causality test, which is a modified version of the Granger test. The study uses annual data on per capita government expenditure and national income for the period from 1957 to 1990. Both variables were deflated by using the GDP deflator for each country. The study finds that in Ghana, Kenya and South Africa there was no long-run equilibrium relationship between government expenditure and national income over the sample period. For these countries, there was no evidence of Wagner's hypothesis or the reverse being supported in the short run, except for Ghana where Wagner's law was supported. Abizadeh and Yousefi (1998) used South Korean data to test Wagner's law. They first conduct Granger type causality tests, and then estimate a growth equation and a government expenditure growth equation by using annual data for the period of 1961-1992. They excluded government expenditures from the GDP to obtain the private sector GDP, and use this in their tests. After comparing the results of the estimations, concluded that government expenditures did not contribute to economic growth in Korea.

Singh and Sahni (1984) use the Granger causality test to determine the causality direction between national income and public expenditures in India. Total (aggregate) as well as disaggregate expenditure data for the period of 1950-1981 were used. Data used in the study were annual and deflated by using implicit national income deflator. The study found no causal process confirming the Wagnerian or the opposite view.

Komain and Brahmasrene, (2007) attempted to find out the association between government expenditure and economic growth in the Thailand economy, by employing the Granger causality test. The results revealed that government expenditure and economic growth are not co-integrated. Moreover, the results indicated a unidirectional causality running from government expenditure to economic growth. The study provided no evidence in support of Wagner's law in Thailand.

Loizides and Vamvoukas, (2005), conducted a study using a trivariate causality test to examine the relationship between government expenditure and economic growth. Data set on Greece, United Kingdom and Ireland were used. The results of their study indicated that government expenditure growth granger caused economic growth in all the countries involved in the study.

The study found that short-run and long-run relationships existed for Ireland and the United Kingdom. The results also indicated that economic growth granger causes public expenditure growth for Greece and United Kingdom, when inflation is included.

Liu, et al (2008), conducted a study to find out if there existed a causal relationship between GDP and public expenditure for the US data during the period 1947-2002. The causality results revealed that total government expenditure causes growth of GDP. On the other hand, growth of GDP does not cause expansion of government expenditure, meaning there was no reverse causation. The result of their findings also indicated that public expenditure raises the US economic growth. The study concluded that, judging from the result of causality test; Keynesian hypothesis exerts more influence than the Wagner's law in US.

This study differs from prior studies by using VECM framework in the exploration of causality relation between government expenditure and economic growth in Nigeria with special consideration for exchange rate, consumer prices and monetary policy rate.

DATA AND METHODOLOGY

The data on annual real gross domestic product (RGDP), aggregate government expenditure (AGEXP), exchange rate (EXCRATE), inflation rate (INFRATE) and monetary policy rate (M2PCGDP) were sourced from Central Bank of Nigeria Statistical Bulletin, 2011 Edition augmented with World Development Indicators (WDIs) Latest version and CBN Annual Reports (Various Years).

The use of annual data is appropriate here because government spending is not very sensitive to seasonal and cyclical fluctuations (Ergun Dogan, 2006). This makes the relationship between the two variables of interest (real GDP and aggregate government expenditure) very stable over different quarters in a year. (Singh and Sahni, 1984).

Hakkio and Rush (1991) argue that increasing the number of observations by using monthly or quarterly data do not add any robustness to the results in tests of cointegration. What matters more is the length of the period under consideration. The study covers the period 1961-2011.
To find out the relationship between government expenditure and economic growth, the ordinary least square (OLS) method of estimation was used. This method of analysis makes use of the common multiple regression analysis based on the following models:

$$\mathbf{RGDP}_t = \mathbf{f}(\mathbf{AGEXP}_t, \boldsymbol{EXCRATE}_t, \boldsymbol{INFRATE}_t, \boldsymbol{M2PCGDP}_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{1}\boldsymbol{a})$$

$$\mathbf{AGEXP}_t = \mathbf{f}(\mathbf{RGDP}_t, \boldsymbol{EXCRATE}_t, \boldsymbol{INFRATE}_t, \boldsymbol{M2PCGDP}_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{1}\boldsymbol{b})$$

The exact linear form of equations 1a and 1b becomes

$\mathbf{LRGDP}_t = \gamma_0 + \gamma_1 \mathbf{LAGEXP}_t + \gamma_2 EXCRATE_t + \gamma_3 INFRATE_t + \gamma_4 M2PCGDP_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2a)$

$\mathbf{LAGEXP}_t = \lambda_0 + \lambda_1 \mathbf{LRGDP}_t + \lambda_2 EXCRATE_t + \lambda_3 INFRATE_t + \lambda_4 M2PCGDP_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2b)$

Expressing equations 2a and 2b in stochastic form, we have

$\mathbf{LRGDP}_t = \gamma_0 + \gamma_1 \mathbf{LAGEXP}_t + \gamma_2 EXCRATE_t + \gamma_3 INFRATE_t + \gamma_4 M2PCGDP_t + U_{1t} \ldots\ldots\ldots\ldots (3a)$

$\mathbf{LAGEXP}_t = \lambda_0 + \lambda_1 \mathbf{LRGDP}_t + \lambda_2 EXCRATE_t + \lambda_3 INFRATE_t + \lambda_4 M2PCGDP_t + U_{2t} \ldots\ldots\ldots\ldots\ldots (3b)$

Where:

$\mathbf{LRGDP}_t$ = Log of real GDP during the time t

$\mathbf{LAGEXP}_t$ = Log of aggregate government expenditure during the time t.

$\gamma_0, \gamma_1, \gamma_2, \gamma_3, \gamma_4, \lambda_0, \lambda_1, \lambda_2, \lambda_3$ **and** λ_4 are regression parameters

U_{1t}, U_{2t} are the error terms assumed to be uncorrelated with zero mean and constant variance.

Bearing in mind the focus of this study which is to determining the direction of causality between economic growth and government spending with consideration for exchange rate, consumer prices and monetary policy rate within the framework of VECM which is a restricted form of VAR, there is need to specify the VECM form of equations 3a and 3b, but before this, there is need to consider the condition necessary for the use of VECM. For this model to be appropriate for the study, the variables must meet certain assumptions. One of these assumptions is that the first difference of the variables must be stationary which implies variables must be I(1). Another assumption is that the individual I(1) variables must cointegrate, that is cointegration must exist between real GDP and government spending among other variables. If this second assumption materialized, then one way causality either from real GDP to government spending or from government spending to real GDP must have been established. However, if the individual I(1) variables fail to cointegrate, the idea of causality tests is said to be evasive. In order to avoid this, we use Phillips-Perron unit root test to identify the order of integration [I(d)] of each of the variables. The PP test was designed to be robust for the presence of autocorrelation and heteroscedasticity. The unit root test is set to be conducted with a drift and time trend. The regression equation for the Phillips-Perron [AR(1)] process is given by

$\Delta Y_t = \alpha + \delta_t + \phi Y_{t-1} + \epsilon_t$ **…….....(4)**

Where $\epsilon_t \approx \mathbf{N}(0, \sigma^2)$

After ascertaining the order of integration [I(d)] which is assumed to be I(1), there is need to find out if individual I(1) variables cointegrate. This study employed Johansen cointegration technique. By Johansen's cointegration test, we consider a VAR of order p i.e. VAR(P)

$X_t = A_1 X_{t-1} + A_2 X_{t-2} + \ldots\ldots\ldots\ldots + A_p X_{t-p} + BY_t + \varepsilon_t$ **……....(5)**

Where

X_t is a k-vector of non-stationary, I(1) variables, Y_t is a d-vector of deterministic variables, ε_t is a vector of innovations

Using the first difference of X_t, the VAR model become

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + BY_t + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (6)$$

Where

$$\Pi = \sum_{i=1}^{p} A_i - I, \quad \Gamma_i = -\sum_{j=i+1}^{p} A_j, \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (7)$$

According to Granger's representation theorem, if the coefficient matrix Π has reduced rank τ < k, then there exist k X τ matrices α and β each with rank τ such that Π = $\alpha\beta'$ and $\beta' X_t$ is stationary. The cointegrating rank (τ) is the number of cointegrating relations and each column of β is the cointegrating vector. Also, the elements of α in Π = $\alpha\beta'$ are referred to as adjustment parameters in vector error correction model. Johansen cointegration technique estimates the Π matrix in an unrestricted form and then test whether the restrictions implied by the reduced rank of Π can be rejected.

After establishing the cointegration of the individual integrated (I(1)variables, the study proceeded by specifying the VECM which is a restricted VAR to model causality relationship once there is evidence of cointegration. By cointegration, variables converge to a long-run equilibrium after a short-run deviation. The VECM has cointegration relations built into its specification so that it restricts the long-run behaviour of the endogenous variables to converge to their long-run relation while giving room to short-run adjustment. This study followed the VECM specification suggested by Hendry as used in Mishra, et al. (2010) but differ in the introduction of exogenous variables which have to interact with the variables of interest. These variables only enter the model as complementary explanatory variables that may contribute to the causality relation we are trying to explore.

We therefore specify the unique form of VECM as

$$\boldsymbol{\Delta Y_t = \beta_0 + \varphi_1 ECM^y_{t-1} + \sum_{i=1}^{n} \beta_{1i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta Q_{t-i} + \Omega' \Delta R_t + e_{1t}} \dots\dots\dots (\mathbf{8})$$

$$\boldsymbol{\Delta Q_t = \gamma_0 + \Psi_1 ECM^q_{t-1} + \sum_{i=1}^{n} \gamma_{1i} \Delta Y_{t-i} + \sum_{i=1}^{n} \gamma_{2i} \Delta Q_{t-i} + \phi' \Delta R_t + e_{2t}} \dots\dots\dots (\mathbf{9})$$

Where Δ is the first difference operator; Y_t represents RGDP, Q_t represents AGEXP R_t is a vector of additional exogenous variables, $\boldsymbol{e_{1t}}$ and e_{2t} are white noise error terms. Q_t is said to Granger-cause Y_t or Y_t is said to Granger-cause Q_t if (φ_1, Ψ_1 are non-zero) or the coefficients of the lagged independent variables [$summation\ of\ \beta_{2i}\ in\ equation$ (8) and $summation\ of\ \gamma_{1i}$ in equation (9)] are jointly significant.

The estimation of vector error correction model in equations 8 and 9 required the selection of the appropriate lag length to include in the VAR, hence there is need to determine the maximum lag length 'n'. The study use criterion such as Akaike (AIC), Schwarz (SIC), Hannan-Quinn (HQIC). All the criterion selected the same maximum lag length of 1, hence the study used this as the number of lag length to include. It should be recalled that including too many lags consumed degrees of freedom talk less of introducing the possibility of multicollenearity. Also,

insufficient lagged terms may lead to specification errors, bearing this in mind, the study considered lag selection as crucial to the study.

EMPIRICAL RESULTS

This section presents and discuses the result obtained from unit root test, cointegration and vector correction estimates.

Results of the unit root test

The result of Phillips-Perron unit root test as shown in Table 1 indicates that all variables are non-stationary at level. The hypothesis of a unit root can not be rejected at the level of each of the study variables. This is not shocking indeed as Time series data are generally believed to be non-stationary. We therefore test the hypothesis of unit root on the first differences of the variables. Using the first difference of each variable, the hypothesis of unit root was rejected for each of the variables included in the study. This shows that all variables are I(1) i.e. integrated of order one.

Table 1: Results of Phillips-Peron unit root test

Variables	PP-Statistics	5% critical value	Remark	Order of integration
LRGDP	-1.152	-3.502	NS^	
ΔLRGDP	-6.431*	-3.504	S^	I(1)
LAGEXP	-2.130	-3.502	NS^	
ΔLAGEXP	-7.828*	-3.504	S^	I(1)
EXCRATE	-1.494	-3.502	NS^	
ΔEXCRATE	-6.362*	-3.504	S^	I(1)
INFRATE	-1.765	-3.502	NS^	
ΔINFRATE	-4.157*	-3.504	S^	I(1)
M2PCGDP	-3.158	-3.502	NS^	
ΔM2PCGDP	-16.081*	-3.504	S^	I(1)

(*) indicates significant at 5% level, S = Stationary, NS = Non-stationary, (^) indicates test conducted with drift and time trend

Results of Johansen Cointegration Test

After identifying the order of integration of the series used in this study, we found it necessary to find out if individual I(1) variables cointegrate. To explore this, the study employed Johansen multivariate cointegration technique. The result as shown in Table 2 indicates that variables converge to a long-run equilibrium. Both the Trace and Maximum Eigen tests reject the hypothesis of no cointegration. The two tests established one cointegrating vector. The existence of cointegration justified the use of VECM to model the causal relations between economic growth and government spending. While this finding is in conflict with those of Komain and

Brahmasrene (2007), Chimobi (2009), it agrees with the findings of Islam (2001), Aregbeyen (2006) and Ranjan and Sharma (2008).

Table 2: Results of Johansen cointegration test

Hypotesized Number of Cointegrating Equations	**Eigen Value**	**Trace Statistic**	**Critical Value At 5% (p-value)**	**Maximum Eigen Statistic**	**Critical Value At 5% (p-value)**
None*	0.580	71.686	69.819(0.035)	42.537	33.877(0.004)
At most 1	0.238	29.149	47.856(0.761)	13.288	27.584(0.868)
At most 2	0.178	15.861	29.797(0.722)	9.631	21.132(0.779)
At most 3	0.074	6.230	15.495(0.668)	3.780	14.265(0.882)
At most 4	0.049	2.451	3.841(0.118)	2.451	3.841(0.118)

(*) ***denotes rejection of the hypothesis of no cointegration at the 5% level***

Result of VECM Estimate

The result of VECM estimates is shown in Table 3. From this result, there is evidence of long-run causality running from real GDP to government spending. However, while evidence exists for long-run causality running from real GDP to government spending such evidence does not exist for short-run causality in this same direction. This indicates that Wagner's Law is supported only in the long-run. While this finding is in conflict with those of Loizides and Vamvoukas (2005), Burney (2002), Huang (2006), Olugbenga and Owoeye (2007), Babatunde (2010), Ergun (2006), Chimobi (2009) and Liu, et al (2008), it conforms with the findings of Chang (2002) and Aregbeyen (2006)

Table 3: Result of VECM estimate

Independent variables	$\Delta LRGDP_t$	$\Delta LAGEXP_t$
ECM_{t-1} **(standard error)** **[t-statistic]**	-0.2619 (0.0859) [3.0477]	0.0013 (0.0799) [0.0161]
$\Delta LRGDP_{t-1}$ **(standard error)** **[t-statistic]**	0.0864 (0.1351) [0.6394]	0.1062 (0.1257) [0.8448]
$\Delta LAGEXP_{t-1}$ **(standard error)** **[t-statistic]**	0.2207 (0.1641) [1.3454]	-0.2145 (0.1526) [1.4057]
C **(standard error)** **[t-statistic]**	-0.2744 (0.1588) [1.7279]	0.3560 (0.1477) [2.4099]
$\Delta EXCRATE_t$ **(standard error)** **[t-statistic]**	-0.0026 (0.0010) [2.4992]	-0.0003 (0.0010) [0.2710]
$M2PCGDP_t$ **(standard error)** **[t-statistic]**	0.0025 (0.0027) [0.9303]	0.0036 (0.0025) [1.4364]
$INFRATE_t$ **(standard error)** **[t-statistic]**	0.0182 (0.0074) [2.4263]	-0.0084 (0.0070) [1.2080]
VECM DIAGNOSTIC TESTS **Residual Serial Correlation Tests (LM-Stat = 2.80; p=0.59)** **White Heteroscedasticity Tests (χ^2 - Stat = 40.48; p=0.405)**		

SUMMARY, RECOMMENDATIONS AND CONCLUSION

This study attempted to investigate empirically the direction of causality between economic growth and government expenditure in Nigeria between1961 to 2011. This is with a view to answer the question of whether Wagner Law is a myth or a reality in Nigeria.

The study begins by first examining the order of integration of each of the variables used in the study and later proceeded to finding out if the linear combination of individually integrated series of order one converge to a long-run equilibrium, that is, if they cointegrate. After resolving the issue of cointegration of the variables, we finally employed the vector error correction mechanism to model the causality relationship between government expenditure and economic growth.

The results showed that variables are individually integrated of order one that is, a I(1) process. Johansen multivariate cointegration test showed that variables are cointegrated. Both the Trace test and Maximum-Eigen test suggest one cointegrating vector. Since there exists a cointegration relation among the integrated variables, we used a restricted VAR to examine the direction of causality between government expenditure and economic growth. The result of VECM estimate showed that there exists a long-run causality running from real GDP to government spending. However, while evidence exists for long-run causality running from real GDP to government spending such evidence does not exist for short-run causality in this same direction. This implies that there is no short-run causality running from real GDP to government spending.

The study contributes to knowledge by revealing the nature of causality between government expenditure and economic growth when there is consideration for three key macroeconomic variables namely exchange rate, inflation rate and monetary policy rate. The finding on causal direction between the two variables helps to answer the question of whether Wagner's law holds or not in Nigeria. It serves as the first attempt to test Wagner's law using the framework of VECM on aggregate government expenditure and real GDP with consideration for three key macroeconomic variables namely exchange rate, inflation rate and monetary policy rate within the time frame of 1961-2011. The study revealed that government expenditure was only employed as an endogenous factor determined by economic growth. The implication of this is that fiscal policy does not exert the expected influence on the economy. The increase in government spending over the year has been as a result of growth and not the cause of growth. Growth has been the cause of increase in government spending but increase in government spending has not been the cause of economic growth attained over the period of study. This put a doubt on the efficacy of Keynesian fiscal policy as a veritable tool of economic growth. There is need for urgent overhauling of the Nigeria fiscal system to address the problem of unproductive spending. Unproductive components of government business should be properly identified and funding should be stopped. More funds should be channeled towards the productive sectors. There is need for cost and benefit analysis of any project before embarking on it to avoid inefficiency in the government business. Above all, corruption must be given a serious attack. The war against corruption and corrupt practices should be re-launched and all the loop holes should be blocked to ensure a corruption-free society. Both the politicians and the bureaucrats need to maintain a high level of credibility and sincerity in the way and manner in which they handle government business. Effective legal system should be put in place to deal ruthlessly with any politician or agent of government involved in any act of indiscipline such as fraud, mismanagement of funds, money laundering, giving and collection of bribes, any act of dishonesty and double standard in government business and other bastardizing behaviour capable of dragging the economy into sludge.

The study concludes that Wagner's Law is supported in the long-run, hence Wagner's law is never a short-run but a long-run phenomenon and is said to be a reality and not a myth in Nigeria during the period under investigation.

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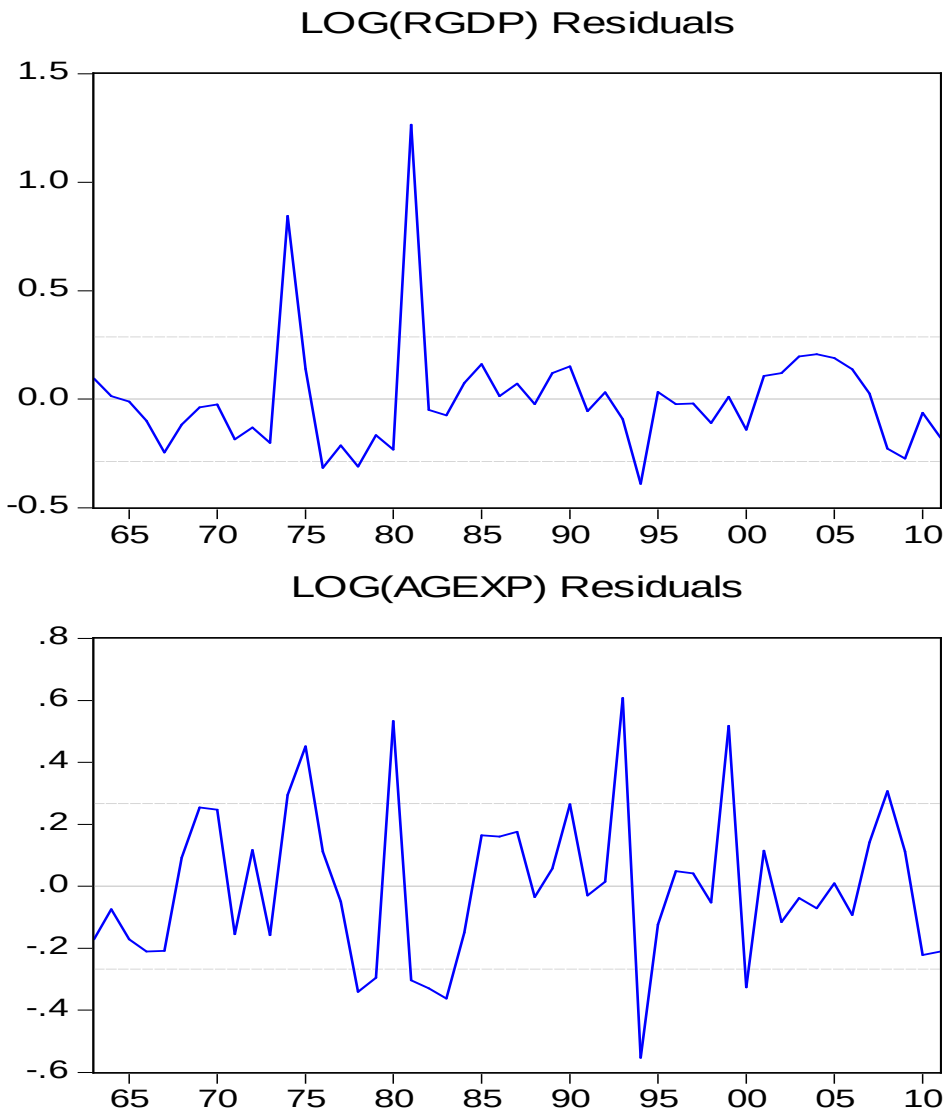
APPENDIX

Graphs of VECM Residuals



VECM Residual Correlation Matrix

	LOG(RGDP)	LOG(AGEXP)
LOG(RGDP)	1.0000	0.0817
LOG(AGEXP)	0.0817	1.0000

VECM Residual Covariance Matrix

	LOG(RGDP)	LOG(AGEXP)
LOG(RGDP)	0.0822	0.0062
LOG(AGEXP)	0.0062	0.0711

Diagnostic Test

1. VECM Residual Autocorrelation Test

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 06/27/13 Time: 19:24
Sample: 1961 2011
Included observations: 49

Lags	LM-Stat	Prob
1	2.801344	0.5916
2	2.083622	0.7204
3	4.545395	0.3372
4	0.905432	0.9238
5	2.820585	0.5883
6	9.490315	0.0499
7	6.976194	0.1372
8	5.110419	0.2762
9	2.353213	0.6711
10	0.619703	0.9608
11	1.368946	0.8496
12	8.010494	0.0912

Probs from chi-square with 4 df.

2. VECM Residual Heteroskedasticity Tests (White Heteroscedasticity Tests)

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 06/27/13 Time: 19:30
Sample: 1961 2011
Included observations: 49

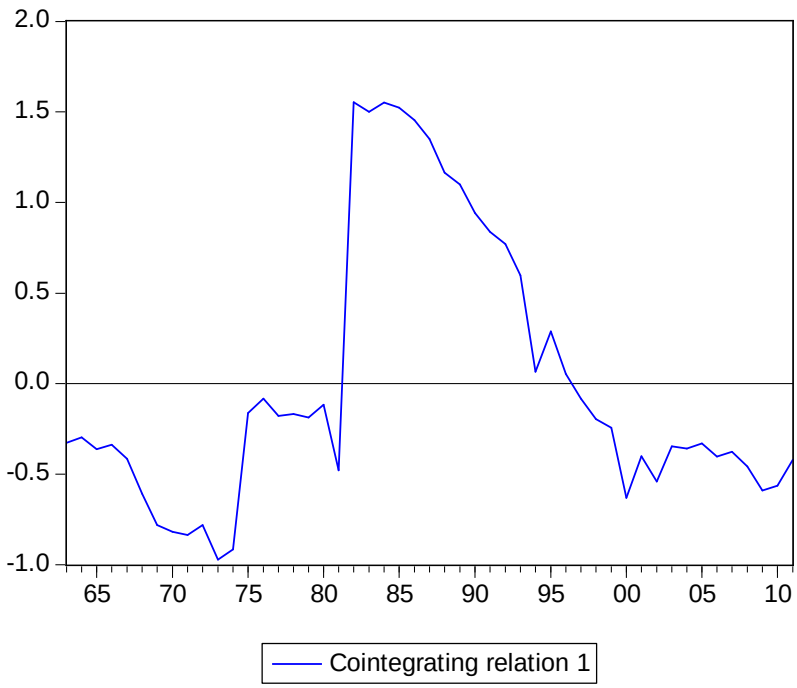
Joint test:

Chi-sq	df	Prob.
40.48405	39	0.4047

Individual components:

Dependent	R-squared	F(13,35)	Prob.	Chi-sq(13)	Prob.
res1*res1	0.341035	1.393354	0.2114	16.71072	0.2129
res2*res2	0.329975	1.325913	0.2450	16.16879	0.2401
res2*res1	0.151390	0.480300	0.9212	7.418098	0.8793

Cointegration Graph



Estimation Proc:

==========

EC(C,1) 1 1 LOG(RGDP) LOG(AGEXP) @ EXCRATE M2PCGDP INFRATE

VAR Model:

==========

D(LOG(RGDP)) = A(1,1)*(B(1,1)*LOG(RGDP(-1)) + B(1,2)*LOG(AGEXP(-1)) + B(1,3)) + C(1,1)*D(LOG(RGDP(-1))) + C(1,2)*D(LOG(AGEXP(-1))) + C(1,3) + C(1,4)*EXCRATE + C(1,5)*M2PCGDP + C(1,6)*INFRATE

D(LOG(AGEXP)) = A(2,1)*(B(1,1)*LOG(RGDP(-1)) + B(1,2)*LOG(AGEXP(-1)) + B(1,3)) + C(2,1)*D(LOG(RGDP(-1))) + C(2,2)*D(LOG(AGEXP(-1))) + C(2,3) + C(2,4)*EXCRATE + C(2,5)*M2PCGDP + C(2,6)*INFRATE

VAR Model - Substituted Coefficients:
==========
D(LOG(RGDP)) = - 0.261890037035*(LOG(RGDP(-1)) - 0.589520341341*LOG(AGEXP(-1)) - 5.1701043538) + 0.0864070794604*D(LOG(RGDP(-1))) + 0.220742894111*D(LOG(AGEXP(-1))) - 0.274375494371 - 0.00259817609143*EXCRATE + 0.00252718177034*M2PCGDP + 0.0181738009414*INFRATE

D(LOG(AGEXP)) = 0.00128991234284*(LOG(RGDP(-1)) - 0.589520341341*LOG(AGEXP(-1)) - 5.1701043538) + 0.106199383557*D(LOG(RGDP(-1))) - 0.214540591444*D(LOG(AGEXP(-1))) + 0.355961349773 - 0.000262099029474*EXCRATE + 0.00362948826391*M2PCGDP - 0.00841630953168*INFRATE