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The tax-spend nexus in Nigeria: Evidence from Nonlinear Causality

Olalekan Bashir Aworinde
Tai Solarin University of Education, Nigeria & University of Bath, UK.

Abstract

The study investigates the linear and nonlinear causal linkages between the tax-spend nexus in Nigeria for the periods 1961-1992, 1993-2012 and1961-2012. Employing a nonparametric causality test of Diks and Panchenko (2006) as well as the parametric causality test using the VAR model, results show that there is evidence of uni-directional linear causality from government revenue to government expenditure in the first period and uni-directional nonlinear causality from government revenue to government expenditure in the second and third periods. However, the nonlinear causal relation evidence that government revenue Granger cause government expenditure disappears after the VAR filtering. The policy implication of this result is that government should intensify efforts to improve her revenue accompanied with appropriate fiscal expenditure reforms.

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Contact: Olalekan Bashir Aworinde - lekanawo2002@yahoo.com.
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1 Introduction

The reoccurrence of large fiscal deficits in both developed and developing countries has generated a renewal of interest among researchers, not least because the control of these deficits is a necessary condition for sustainable economic growth. A major source of concern in developing countries particularly in Africa is how government expenditure has been used, expenditure on white elephant projects that do not generate enough income to offset the interest and principal on loans incurred to finance the deficits. Over the past two decades, most African countries have witnessed low growth production capacity, output, revenue and a sustained high level of unemployment; all this may be traced to excessive government spending to un-productive sectors of the economy as well as unstable polity, and this call for the need to assess the empirical relationship between the government revenue and expenditure.

The existing research on the government expenditure and revenue hypotheses has, to date, focused mainly on a linear causal relationship and has ignored the possibility of a nonlinear causal relationship. This remains a major gap to be filled in the tax-spend debate literature. In view of this, the main contributions of this paper are; first, the study test for the unit root properties of the series using the Ng-Perron unit root tests that circumvent the problems of the traditional unit root tests. Second, this study examines the possibility of structural breaks using the Gregory-Hansen (1996) and Hatemi-J (2008) one and two structural breaks cointegration tests, as well as the Hansen (1992) tests for parameter instability. Third, we examine not only linear, but also nonlinear causality between government revenue and expenditure in Nigeria. In particular we used a new nonparametric methodology by Diks and Panchenko (2006), which overcame the potential over-rejection issue that flawed the famous non-linear Granger causality of Hiemstra and Jones (1994).

The rationale for using this approach is based on the argument given by Ewing et al. (2006). They give four possible explanations for the existence of asymmetries in the budgetary adjustment process. First, there is the notion that fiscal policy makers may be behave differently to deficits and surplus. There is the tendency that policymakers will be more aggressive in their response to deficits than surplus. Second, given the close relation between budget and business cycles due to the presence of automatic stabilizers and the observation that business cycles display asymmetric behaviour, such asymmetries could be transferred to the budgetary adjustment process. Third, the behaviour of taxpayers' response to changes in either the effective tax rate or the effective tax base may lead to asymmetric changes in the budget. Fourth, some elements of tax revenues are highly responsive to certain internal and external developments. For instance, asymmetric changes in interest and exchange rates in the international market can lead to differences in trade tax revenue.

The remainder of the paper is organized as follows. Section 2 provides the theoretical linkages and the empirical evidence on the tax-spend debates in Nigeria. Section 3 provides a description of both the linear Granger causality and the Diks and Panchenko nonparametric test for nonlinear Granger causality. Section 4 is devoted to data and results. Section 5 concludes.

2 Tax-Spend hypothesis and literature for Nigeria

The relationship between government revenue and government expenditure has been a central issue over the years both in theoretical and empirical literature. There are four major hypotheses on the government revenue-expenditure nexus they are; tax-and spend hypothesis; spend-and-tax hypothesis; fiscal synchronization hypothesis; and the fiscal independence or institutional separation hypothesis. First, the tax-and-spend hypothesis is attributed to Friedman (1978). It states that changes in government revenue bring about changes in government expenditure, and this is featured by a unidirectional causality running from government revenue to government expenditure. Second, the spend-tax hypothesis is credited to Peacock and Wiseman (1979). It states that changes in government expenditure leads to changes in government revenue and that the direction of causality is from government expenditure to government revenue.

Third, the fiscal synchronization hypothesis is connected to Musgrave (1966), and Meltzer and Richard (1981). The hypothesis is premised on the fact that government revenue and expenditure choices are jointly determined. Thus, it is expected that there should be a bidirectional feedback mechanism between government expenditure and revenue. Lastly, the fiscal independence or institutional separation hypothesis is due to Baghestani and McNown (1994). Their hypothesis is based on the fact that government expenditure and revenue decisions or choices are considered separately. Thus, the is no feedback mechanism between government revenue and expenditure.

Concerning the causal relationship between government revenue and expenditure in Nigeria, the results have been mixed, with studies finding support for the four hypotheses. The tax-spend hypothesis has been supported in studies by Wolde-Rufael (2008), Obioma and Ozughalu (2010), Ojuguiba and Abraham (2012) and Magazzino (2013). The fiscal synchronization hypothesis has been supported by Ghartey (2010) and Aregbenyen and Insah (2013). Also, there is evidence for the spend-tax hypothesis in the study by Dada and Adesina (2013). The fiscal independence hypothesis has been supported in studies by Dada (2013) and Milehem (2012). To the best of our knowledge, the literature on the causal relation between government expenditure and revenue have either being conducted with a VAR or VECM framework, using either the pairwise Granger-causality or the Toda-Yamamoto causality test. The VECM approach that the adjustment process is symmetric, whereas the adjustment process might be asymmetric. To account for the possibility of an asymmetric adjustment process, the study employs the Diks and Panchenko (2006) nonlinear causality test.

3 Methodology

3.1 A linear Granger causality

Consider two variables changing over time, X_t and Y_t. Linear Granger causality investigates whether past values of X_t have significant linear predictive power for current values of Y_t given past values of Y_t. If so, X_t is said to linearly Granger cause Y_t. Bidirectional causality exists if Granger causality runs in both directions.

The test for linear Granger causality between government expenditure and revenue involves the estimation of the following equations in a vector autoregression (VAR) framework:

$$EXP_t = \sum_{i=1}^{\rho_1} \alpha_i EXP_{t-i} + \sum_{j=1}^{\rho_2} \beta_j REV_{t-j} + \varepsilon_{1t} \tag{1}$$

$$REV_t = \sum_{i=1}^{\rho_3} \delta_i REV_{t-i} + \sum_{j=1}^{\rho_4} \varphi_j EXP_{t-j} + \varepsilon_{2t} \tag{2}$$

EXP_t and REV_t are, respectively, government expenditure and revenue; α, β, δ and φ are the parameters to be estimated; $(\varepsilon_1, \varepsilon_2)$ are zero-mean error terms with a constant variance-covariance matrix; the optimal lag lengths are determined using the Bayesian information criterion (BIC).

Linear causal relationships are inferred from Eqs. (1) and (2). To test for linear Granger non-causality at specific lags we examine the statistical significance of the individual β and φ coefficient estimates. Furthermore, we test for cumulative linear Granger non-causality by testing the null hypothesis that $\Sigma\beta_j = 0$ in Eq. (1) or $\Sigma\varphi_j = 0$ in Eq. (2) using a T-statistic.

3.2 The Diks and Panchenko nonparametric nonlinear causality test

The study used the nonparametric test developed by Diks and Panchenko (2006, hereafter DP test) for testing nonlinear Granger causality. The test is better, because it overcame the over-rejection issue observed in the previously popular test advocated by Hiemstra and Jones (1994, hereafter HJ test).

The general setting for this approach is summarized as follows. The null hypothesis for the Granger test for non-causality from one series (X_t) to another series (Y_t) is that $X_t^{\ell_X}$,does not contain additional information about Y_{t+1}, that is,

$$H_0 : Y_{t+1} \Big| (X_t^{\ell_X}; Y_t^{\ell_Y}) \sim Y_{t+1} \Big| Y_t^{\ell_Y} \tag{3}$$

For a strictly stationary bivariate time series Eq. (3) comes down to a statement about the invariant distribution of the (ℓ_X +ℓ_Y +1)-dimensional vector $\mathbf{W_t}$ =($\mathbf{X}_t^{\ell_X}$, $\mathbf{Y}_t^{\ell_Y}$, Z_t) where $Z_t = Y_{t+1}$. To keep the notation compact, and to bring about the fact that the null hypothesis is a statement about the invariant distribution of ($X_t^{\ell_X}, Y_t^{\ell_Y}, Z_t$) we drop the time index and also $\ell_X = \ell_Y$ =1 is assumed. Hence, under the null, the conditional distribution of Z given (X, Y)=(x, y) is the same as that of Z given $Y = y$. Further, Eq. (3) can be restated in terms of ratios of joint distributions. Specifically, the joint probability density function $f_{X,Y,Z}(x, y, z)$ and its marginals must satisfy the following relationship:

$$\frac{f_{X,Y,Z}(x, y, z)}{f_Y(y)} = \frac{f_{X,Y,}(x, y)}{f_Y(y)} . \frac{f_{Y,Z}(y, z)}{f_Y(y)} \tag{4}$$

This explicitly states that X and Z are independent conditionally on $Y = y$ for each fixed value of y. Diks and Panchenko (2006) show that this reformulated H_0 implies:

$$q = E\left[f_{X,Y,Z}(X, Y, Z)f_Y(Y) - f_{X,Y}(X, Y)f_{Y,Z}(Y, Z)\right] = 0 \tag{5}$$

Let $\hat{f}_W(Wi)$ denote a local density estimator of a d_W-variate random vector $\mathbf{W}$ at W_i defined by $\hat{f}_W(Wi) = (2\varepsilon_n)^{-d_W}(n-1)^{-1}\Sigma jj \neq iIij^W$ where $Iij^W = I(\|W_i - W_j\| < \varepsilon_n)$ with $I(.)$ the indicator function and ε_n the bandwidth, depending on the sample size n. Given this estimator, the test statistic is a scaled sample version of q in Eq. (5):

$$T_n(\varepsilon_n) = \frac{n-1}{n(n-2)} \cdot \sum_i \left(\hat{f}_{X,Z,Y}(X_i, Z_i, Y_i) \hat{f}_Y(Y_i) - \hat{f}_{X,Y}(X_i, Y_i) \hat{f}_{Y,Z}(Y_i, Z_i) \right) \quad (6)$$

For $\ell_X = \ell_Y = 1$, if $\varepsilon_n = Cn^{-\beta}(C > 0, \frac{1}{4} < \beta < \frac{1}{3})$ then Diks and Panchenko (2006) prove under strong mixing that the test statistic in Eq. (6) satisfies:

$$\sqrt{n} \frac{(T_n(\varepsilon_n) - q)}{S_n} \underrightarrow{D} N(0,1) \quad (7)$$

where $\underrightarrow{D}$ denotes convergence in distribution and S_n is an estimator of the asymptotic variance of $T_n(.)$.

4 Data and Results

In this section, we examine the issue of linear and non-linear Granger causality for revenue and expenditure nexus in Nigeria using the Dicks and Panchenko (2006) approach described in the last section. We use data on total (i.e., inclusive of debt interest) government expenditures, and total government revenues, both of them as a ratio to GDP, which are denoted by EXP_t and REV_t, respectively. The annual data on government expenditures, revenue and GDP come from the Nigerian Central Bank statistical bulletin, and the sample period is from 1961-2012.

The study begins the analysis, by testing for the order of integration of the government revenue and expenditure. The modified version of the Dickey-Fuller and Phillips-Perron tests proposed by Ng and Perron (2001) were used to circumvent the problems of the conventional unit root tests. DeJong et al (1992), Schwert (1989) and Ng and Perron (1995) argue that most traditional unit root tests suffer from three problems. First, they have low power when the root of the autoregressive polynomial is close to but less than unit (DeJong et al., 1992). Second, most of the tests suffer from severe size distortions when the moving-average polynomial of the first differences series has a large negative autoregressive root (Schwert, 1989). Third, implementing the unit root tests often implies the selection of an autoregressive truncation lag, k, which is strongly associated with size distortions and/or the extent of power loss (Ng and Perron, 1995).

Trying to circumvent these problems, Ng and Perron (2001) proposed a methodology which is robust against the three problems noted above. This consists of a class of modified tests, M_α^{GLS} and MZ_t^{GLS} using the modified Akaike information criterion.

Table 1 shows the results of the two tests, M_{α}^{GLS} and MZ_{t}^{GLS} for the government revenue and expenditure variables using the three periods. As shown in the table, the null hypothesis of non stationarity for both the government revenue and expenditure in levels cannot be rejected in any of the periods, but were stationary in their first differences. The results show that both the government revenue and expenditure follow a unit root process, thus gives way for testing for possible long-run co-integrating relationship among the variables. Thus, we estimate the Engle-Granger and the Phillips-Ouliaris cointegration test, as well as the Gregory and Hansen (1996) and the Hatemi-J (2008) tests for one and two-structural break co-integration tests for period III.

Panel A of Table 2 reports tests for non-cointegration between government expenditure and revenue using the procedures advocated by Engle and Granger (1987) and Phillips and Ouliaris (1990). At best, one is only able to reject the non-cointegration null at the 10% significance level. One possibility is that potential structural breaks have not been allowed for, and this is contributing to the presence of low test power. Panel B reports the Gregory and Hansen (1996) and the Hatemi-J (2008) cointegration tests based on structural breaks in the constant and linear trend. Results provide evidence of cointegration with the rejection of the null at the 1 percent level of significance. In addition, the study also conduct a formal structural break test using the Hansen (1992) parameter instabillity test.

4.1 Hansen Parameter Instability Test

The estimation periods for this study cover a volatile time of oil price changes and overbloated government expenditure in Nigeria. Thus, it is expedient to examine the cointegrating relationship for structural breaks. Hansen (1992) offers three tests (L_c, Mean$F$ and Sup$F$) for parameter instability based on the full modified statistics. The test is based on the null of cointegration and the alternative hypothesis of no cointegration. Thus, the absence of cointegration is captured by an alternative hypothesis of parameter instability. It should be noted that the Sup$F$ is more appropriate if we are interested in a regime shift, while the L_c and Mean$F$ is more adequate if interest is on the stability and specification of the model. More importantly, the graphical illustration provides insight concerning the placement of the structural break.

Table 3 presents the Hansen (1992) parameter instability test. Given that the constant and trend are included in the specification, the data find support for parameter stability and figure 1 also confirms this. From figure 1, there is gradual convergence for the relationship between government revenue and expenditure between 1961 and1991, but remain unstable in 1992, and this was a period of political unrest in Nigeria and later returned to stability gradually afterwards. The break of 1992 is also consistent with the Hatemi-J (2008) cointegration tests. Thus, the sample size of 1961-2012 is divided into two subsamples (1961-1992 and 1993-2012), since break was achieved in 1992. The causality test is then performed over subsamples without structural breaks so as to obtain a more convincing results.

4.2 Causality testing on VAR-raw data

Next, we estimate the parametric linear causality testing using the Granger's test based on a VAR model of government revenue and expenditure. The lag lengths of the VAR specification were set using the Wald exclusion criterion. To implement the nonparametric causality test of DP, the study follow the suggestion of Diks and Panchenko (2006) by setting the bandwidth to 1.5.

Based on the results presented in Table 4, we were able to make the following remarks. The linear Granger tests show no evidence of causality between government revenue and expenditure in periods II and III, but there is evidence of unidirectional causality from government revenue to government expenditure in the first period covering 1961-1992. However, the nonlinear causality test revealed a uni-directional nonlinear causality from government revenue to government expenditure in Nigeria in the second and third period. This result is consistent with the tax-spend hypothesis.

4.3 Causality testing on VAR-filtered residuals

The results from the causality testing on raw data show evidence of nonlinear unidirectional causal relations from government revenue to government expenditure. Following Bekiros and Diks (2008), we reapplied the linear causality and the nonparametric DP test to the residuals obtained from the VAR model to show that the detected causality was strictly linear and nonlinear in nature. The causality on the filtered residuals was investigated with a VAR specification and the lags were determined using the Schwartz Information Criterion (SIC).

The linear and nonlinear causality tests after the VAR filtering shows that the nonlinear causal relations discovered on the unidirectional causality from government revenue to government expenditure have now died out. This implies that the detected non-linear causality in periods II and III might not be strictly nonlinear in nature.

5 Conclusion

This paper investigates the existence of linear and nonlinear causal relations between government expenditure and revenue nexus in Nigeria. This study contributed to the revenue-expenditure literature in several ways. First, we examine the government expenditure and revenue long-run relationship using the Gregory-Hansen and the Hatemi-J cointegration tests that account for one and two structural breaks and the Hansen parameter stability test. Second, we employed a new nonparametric nonlinear Granger causality as well as the linear causality using the VAR model. In sum, results show evidence of uni-directional linear causality from government revenue to government expenditure in period I and uni-directional nonlinear causality from government revenue to government expenditure in Nigeria in period II and III. The linear and nonlinear causality tests after the VAR filtering shows that the causal relations on the unidirectional causality from government revenue to expenditure have now disappeared. These conclusions, apart from offering a much better understanding of the dynamic linear and nonlinear relationships underlying the revenue and expenditure nexus, may have important implications for government fiscal policy in Nigeria. The policy implication of this result is that government should intensify efforts to improve her revenue accompanied with appropriate fiscal expenditure reforms. In addition, Nigeria should try to diversify the economy, by concentrating on other sectors of the economy such as agriculture and manufacturing because oil which is the main source of revenue is a resource that is depletable.

References

Aregbeyen, O. & Insah B (2013). A Dynamic Analysis of the Link between Public Expenditure and Public Revenue in Nigeria and Ghana, *Journal of Economics and Sustainable Development* **4**(4), 18–29.

Baghestani, H. & McNown R (1994). Do revenues or expenditures respond to budgetary disequilibria?, *Southern Economic Journal* **61**, 311–322.

Bekiros, S. D. & Diks C (2008). The relationship between crude oil spot and futures prices: Cointegration, linear and nonlinear causality, *Energy Economics* **30**, 2673–2685.

Dada M A (2013*a*). Empirical Investigation of Government Expenditure and Revenue Nexus; Implication for Fiscal Sustainability in Nigeria, *Journal of Economics and Sustainable Development* **4**(9), 135–146.

Dada, M. A. & Adesina J (2013*b*). Empirical Investigation of the Validation of Peacock-Wiseman Hypothesis; Implication for Fiscal Discipline in Nigeria, *Public Policy and Administration Research* **3**(6), 44–55.

DeJong D N, Nankervis J C, Savin N E & Whiteman C H (1992). Integration versus trend-stationarity in time series, *Econometrica* **60**, 423–433.

Diks, C. & Panchenko V (2006). A new statistic and practical guidelines for nonparametric Granger causality testing, *Journal of Economic Dynamics & Control* **30**, 1647–1669.

Engle, Robert F & Granger C W J (1987). Co-integration and Error Correction: Representation, Estimation, and Testing, *Econometrica* **55**(2), 251–76.

Ewing B T, Payne J E, Thompson M A & Al-Zoubi O M (2006). Government Expenditures and Revenues: Evidence from Asymmetric Modeling, *Southern Economic Journal* **73**(1), 190–200.

Friedman M (1978). The limitations of tax limitation, *Policy Review* pp. 7–14.

Ghartey E E (2010). Cointegration and Causal Relationship between Taxes and Spending for Kenya, Nigeria and South Africa, *International Economic Journal* **24**(2), 267–282.

Gregory, A.W. & Hansen B (1996). Residual-based tests of cointegration in models with regime shifts, *Journal of Econometrics* **70**, 99–126.

Hansen B (1992). Tests for parameter instability in regressions with I(1) processes, *Journal of Business and Economic Statistics* **10**, 321–335.

Hatemi-J A (2008). Tests for cointegration with two unknown regime shifts with an application to financial market integration, *Empirical Economics* **35**, 497–505.

Hiemstra, C. & Jones J (1994). Testing for linear and nonlinear Granger causality in the stock price-volume relation., *Journal of Finance* **49**, 1639–1664.

Magazzino C (2013). Revenue and expenditure nexus: A case study of ECOWAS, *The Open-Access, Open-Assessment EJournal* **7**(Economics, No. 2013-13), 1–27.

Meltzer A & Richard S (1981). A rational theory of the size of government, *Journal of Political Economy* **89**, 914–927.

Mileham P (2012). Empirical Investigation of Government Expenditure: Implication For Fiscal Sustainability In Nigeria, *American Journal of Economics and Development* **2**(3), 16–25.

Musgrave R (1966). *Principles of budget determination, in Public Finance*, Random House, New York.

Ng, S. & Perron P (1995). Unit root tests in ARMA models with data dependent methods for the selection of the truncation lag, *Journal of the American Statistical Association* **90**, 268–281.

Ng, S. & Perron P (2001). Lag length selection and the construction of unit root tests with good size and power, *Econometrica* **69**, 1529–1554.

Obioma, E.C.& Ozughalu U (2010). An Examination of the Relationship between Government Revenue and Government Expenditure in Nigeria: Cointegration and Causality Approach, *Central Bank of Nigeria Economic and Financial Review Volume 48/2 June 2010* **48**(2), 35–57.

Ogujiuba, K & Abraham T (2012). Testing the Relationship between Government Revenue and Expenditure: Evidence from Nigeria, *International Journal of Economics and Finance* **4**(11), 172–182.

Peacock A & Wiseman J (1979). Approaches to the analysis of government expenditures growth, *Public Finance Quarterly* **7**, 3–23.

Phillips P & Ouliaris S (1990). Asymptotic properties of residual based tests for cointegration, *Econometrica* **58**, 165–193.

Schwert G (1989). Tests for unit roots: A Monte Carlo investigation, *Journal of Business and Economic Statistics* **7**, 147–159.

Wolde-Rufael Y (2008). The Revenue-Expenditure Nexus: The Experience of 13 African Countries, *African Development Bank* pp. 273–293.

Figure 1 Expenditure and Revenue, 1961–2012

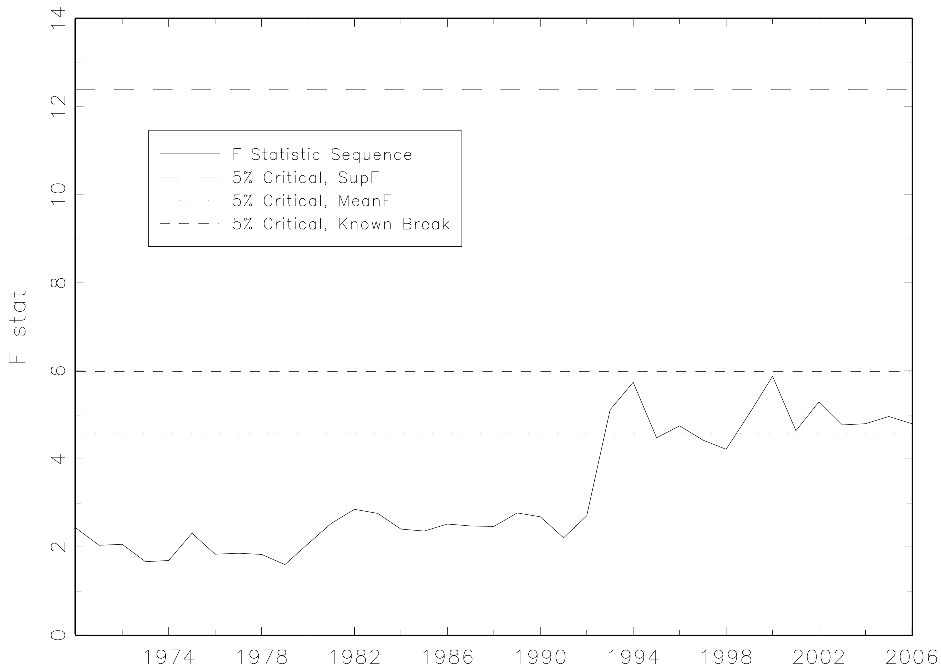

Table 1: Ng-Perron test of unit roots

Variable	P I $\bar{M}Z_{\alpha}^{GLS}$	$\bar{M}Z_{t}^{GLS}$	P II $\bar{M}Z_{\alpha}^{GLS}$	$\bar{M}Z_{t}^{GLS}$	P III $\bar{M}Z_{\alpha}^{GLS}$	$\bar{M}Z_{t}^{GLS}$
I(2) vs I(1)	Case: $p = 0, \bar{c} = -7.0$					
Δrev	-14.321	-2.676	-8.771	-2.091	-24.27	-3.45
Δexp	-14.334	-2.645	-7.712	-1.960	-21.60	-3.28
I(1) vs I(0)	Case: $p = 1, \bar{c} = -13.5$					
rev	-10.640	-2.241	-7.665	-1.945	-3.87	-1.33
exp	-8.751	-1.983	-8.053	-2.004	-12.23	-2.41

Critical Values	Case: $p = 0, \bar{c} = -7.0$			Case: $p = 1, \bar{c} = -13.5$		
	1%	5%	10%	1%	5%	10%
$\bar{M}Z_{\alpha}^{GLS}$	-13.8	-8.10	-5.70	-23.8	-17.3	-14.2
$\bar{M}Z_{t}^{GLS}$	-2.58	-1.98	-1.62	-3.40	-2.90	-2.62

Note: The autoregressive truncation lag, k, has been selected using the modified Akaike information criterion, as proposed by Perron and Ng (1996). The critical values are taken from Ng and Perron (2001), Table 1.

PI: 1961-1992, PII: 1993-2012, PIII: 1961-2012

Table 2: Cointegration tests on Nigeria government expenditure and revenue 1961-2012

Panel A: Engle–Granger and Phillips–Ouliaris Cointegration Tests

	τ(Engle–Granger)	τ(Phillips–Ouliaris)
	-3.233	-3.054
	(0.0809)	(0.115)

Panel B: Gregory-Hansen and Hatemi-J Cointegration Tests

$EXP = f(REV)$	ADF	Tb	Z_t^*	Tb
One break	-5.85***	1968	-5.90***	1968
Two breaks	-6.56***	1968, 1992	-6.20**	1968, 1992

Note: Engle-Granger and Phillips-Ouliaris refer to the non-cointegration tests advocated by Engle and Granger (1987) and Phillips and Ouliaris (1990). In each case, p-values are reported in parentheses.

For the one-break test, the 1, 5 and 10 per cent critical values are -5.45, -4.99 and 4.72 respectively (Gregory and Hansen 1996). For the Two-break test, the corresponding 1, 5 and 10 per cent critical values are -6.50, -6.01 and -5.65 per cent respectively (Hatemi-J 2008). The results are generated using the GAUSS10.0 software. The codes were obtained from Hansen's web page for the one-break test and from Hatemi-J for the two-break test.

***, ** and * denote significance at the 1, 5 and 10 per cent levels, respectively.

Tb denote the structural break period.

Table 3: Hansen (1992) parameter instability tests

Model	L_c	$Mean\ F$	$Sup\ F$
(EXP, REV)	0.261 [0.20]	3.272 [0.20]	5.878 [0.20]

Note: The probability of parameter estimates is in parenthesis. It is stable if the estimated probability is greater than or equal to 0.20

Table 4: Causality Results (Pairwise)

Variables	Panel A: Linear Granger Causality		Panel B: Non-Linear Causality	
	Raw Data	VECM Residuals	Raw Data	VECM Residuals
Period I : 1961-1992				
EXP→REV	3.172 [3]	0.007 [2]	-0.837 [1]	0.171 [1]
REV→EXP	6.802* [3]	0.058 [2]	-0.877 [1]	-1.758 [1]
Period II : 1993-2012				
EXP→REV	2.226 [2]	0.283 [2]	0.577 [1]	0.174 [1]
REV→EXP	0.478 [2]	0.452 [2]	1.585* [1]	-0.240 [1]
Period III : 1961-2012				
EXP→REV	2.501 [1]	0.0795 [1]	0.061 [5]	-1.315 [1]
REV→EXP	2.420 [1]	0.0001 [1]	1.541* [5]	-0.355 [1]

Note: ***, ** and * denotes p-value statistical significance at 1, 5 and 10 per cent respectively.
Panel A: Linear Granger Causality. All data were found to be cointegrated and the lag lengths of VAR specification are set using the Wald exclusion criterion. The number of lags chosen are in parenthesis [] using the Schwartz Information Criterion (SIC).

Panel B: Non-Linear Causality. The number of lags used for the nonlinear causality test are in parenthesis [].