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Relationship among Government Revenue, Expenditure and Gross Domestic Product in Nigeria: Generalized Two Stage Principal Component Approach

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Abstract: This study examined the relationship between gross domestic product (GDP) and some selected government revenue/expenditure namely; oil revenue, non-oil revenue, administrative expenditure, economic expenditure, social expenditure and transfer expenditure for the period 1981–2013. The econometric techniques employed in this study include Augmented Dickey-Fuller (ADF) test, Co-integration analysis, Generalized Two-Stage Principal Component analysis (GT-PC). ADF reveals that all the variables in their natural logarithm form are not stationary in their original level but stationary after first difference. Co-integration test shows that the variables are integrated of the same order. The Long run estimates revealed that the model suffers the problem of Autocorrelation and Multicollinearity and this necessitated the use Generalized Two-stage PC1 method to handle the problem jointly. Results revealed that there exists a positive relationship between GDP, government revenue and expenditure.

Keywords: Unit Root Test, Co-integration Test, Generalized Two-Stage Principal Component

1. Introduction

Gross domestic product (GDP) is an economic indicator for measuring the total output of goods and services of a country during a certain period of time. It is used for comparing the economic performance of countries, but very often the comparison is broadened to evaluate and make estimates of living standards, progress or social welfare between countries, although GDP was not originally developed for this purpose.

The relationship between public expenditure and economic growth has continued to generate series of debate among scholars in economic literature (Abu and Abdullahi, 2010). Wagner (1883) shows that there exist long-run tendencies for public expenditure to grow relatively to Gross Domestic Product (GDP). However, Keynes (1936) raised the idea that during depression the use of fiscal policies raises economic activities. Thus, public expenditure on all sectors of the Nigerian economy is expected to lead to economic growth in the sense that capital and recurrent expenditure ought to boost the productive base of the economy which in turn leads to growth. The interest by economists in Nigeria and other jurisdictions on the role of government expenditure are inconclusive. Barro (1990) endogenized government spending in a growth model and analyzed the relationship between size of government and rates of growth and saving. He concluded that an increase in resources devoted to non-productive government services is associated with lower per capita growth. Therefore, government expenditure which enhances economic growth should be tailored towards productive services. This necessitates the need to determine whether the behavior of Nigerian public expenditure and the economy can be hinged on the Wagner's (1883) Law of Ever-increasing State Activity, or the Keynes (1936) theory and Friedman (1978) or Peacock and Wiseman's (1979) hypotheses. In Nigeria, some authors contend that the link between public expenditure and economic growth is weak or non-existing

while others have reported varying degree of causality relationship between them (Onakoya *et al.,* 2012).

Furthermore, government expenditure has been on the increase owing to the huge receipts from production and sales of crude oil, and the increased demand for public (utilities) goods like roads, communication, power, education and health in Nigeria. The rising government expenditure has not translated into meaningful growth and development, as Nigeria still ranks among the poorest countries in the world. In addition, many Nigerians have continued to wallow in abject poverty while more than 50 percent live on less than US$2 per day (Louis, 2012). Couple with this, are dilapidated infrastructures (especially roads and power supply) that have led to the collapse of many industries, including high level of unemployment and abandonment of elephant projects. Another problem has also been on how to channel public expenditure into those areas of the economy where its effects will be optimal in terms of growth, consumption and distribution. More so, contributors have undermined the relationship between the specific components of public expenditure and economic growth (Louis, 2012). The longrun relationships between the government revenues and expenditures in Nigeria over the period 1970 to 2008 was examined by Omo and Taofik (2012) using Autoregressive Distributed Lag (ARDL) bound test. The results indicate that there is the existence of a long run relationship between government expenditures and revenues when government expenditure is made the dependent variable. However, when revenue was made the dependent variable, no evidence of a long run relationship was found which confirmed the tax- spend hypothesis. Mansour *et al.* (2012) states that oil is one of the main sources of energy that always had an effective role on the world economy and the macroeconomic variables, especially in the oil exporting countries to justify their influence. It is important to evaluate the effect of this on Nigeria economic growth.

The objective of this paper is to investigate the relationship some selected government revenue/expenditure namely; oil revenue, non-oil revenue, administrative expenditure, economic expenditure, social expenditure and transfer expenditure on economic growth whose proxy is taken as gross domestic product.

2. Data and Methodology

This paper uses an annual data for gross domestic product (GDP) and some selected government revenue/expenditure namely; oil revenue, non-oil revenue, administrative expenditure, economic expenditure, social expenditure and transfer expenditure for the period 1981 – 2013. Data was extracted from Central Bank of Nigeria, Statistical Bulletin. The variables are transformed into logarithmic form. The long run model is specified as follows:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \varepsilon_i \quad (1)$$

where Y is the Total Gross Domestic Product (GDP), X_1 is the Oil Revenue (OIR), X_2 is the Non-Oil Revenue (NOR), X_3 is the Administrative Expenditure (ADE), X_4 is the Economics Expenditure (ECE), X_5 is the Social Expenditure (SCE), X_6 is the Transfer Expenditure (TFE) and ε_i is the error term.

Engle and Granger (1987) Co-integration Test is used to examine whether there exists a long run relationship among the variables in equation (1). Generalized Two-Stage Principal Component analysis is used to model the relationship among the variables. The subsection briefly explains each of the methodology.

2.1. Co-integration Test

Engle and Granger (1987) Co-integration Test basically follows two steps. The long-run relationship in equation (1) is estimated using OLS and residuals are obtained. Second, an Augmented Dickey-Fuller (ADF) test is performed on the residuals to determine its stationarity. The null hypothesis is that the residuals are non-stationary implying no co-integration, while the alternative hypothesis is that they are stationary implying co-integration. ADF t-statistic on the residuals is used to test the null hypothesis. The generated p-value is used to decide whether the null hypothesis is rejected which implies co-integration.

2.2. Generalized Two-Stage Principal Component Analysis

This analysis combines Two Stage Least Square (TS) and Principal component regression to jointly handle the problem of autocorrelation and multicollinearity. This concept was adopted from the work of Ayinde *et al.* (2015). The procedures are as follows:

i. Use the ρ obtained from OLS estimator to transform the model
ii. Apply OLS estimator to estimate the transformed data sets and carryout a diagnostic test to check if the problem of autocorrelation has been handled.
iii. If the problem of autocorrelation has been solved, then applied Principal component regression to the transformed data. The component is extracted by taking the components whose eigenvalue is greater than or equal to one.

3. Empirical Results

3.1. Unit Root Test

It is required that the variables are integrated of the same order to carry out co-integration tests. This paper employs the Augmented Dickey-Fuller (ADF) test. The null hypothesis is that there is a unit root. Table 1 presents the test results for the variables. The results show that the variables are not stationary at original level but become stationary after first differencing. Thus, the variables have the same order of integration, I (1).

Table 1. *Augmented Dickey Fuller (ADF) Test.*

Variable Status	Variable Name	Variable (Natural log)	Statistic	Intercept	Intercept and Trend	Without Intercept
Original	Gross Domestic Product (GDP)	ln(Y)	Value	-0.7599	-0.9621	6.3761
			p-value	0.8168	0.9355	1.0000
	Oil Revenue (OILR)	$\ln(X_1)$	Value	-1.3509	-1.9336	2.7484
			p-value	0.5925	0.6139	0.9978
	Non-Oil Revenue (NOILR)	$\ln(X_2)$	Value	-0.4493	-3.0839	2.9299
			p-value	0.8881	0.1271	0.9986
	Administrative Expenditure (ADME)	$\ln(X_3)$	Value	-1.5257	1.7007	3.4405
			p-value	0.5071	1.0000	0.9996
	Economics Expenditure (ECE)	$\ln(X_4)$	Value	-0.9392	-3.3222	1.8745
			p-value	0.7623	0.0808	0.9832
	Social Expenditure (SCE)	$\ln(X_5)$	Value	-1.1064	-3.9848	2.4703
			p-value	0.6989	0.0196	0.9957
	Transfer Expenditure (TFE)	$\ln(X_6)$	Value	-0.8155	-2.4566	3.4141
			p-value	0.8006	0.3458	0.9996
1st Differencing	Gross Domestic Product (GDP)	$\Delta\ln(Y)$	Value	-4.6989	-4.7560	-2.4183
			p-value	0.0007	0.0032	0.0013
	Oil Revenue (OILR)	$\Delta\ln(X_1)$	Value	-5.0200	-5.1479	-4.8367
			p-value	0.0003	0.0013	0.0000
	Non-Oil Revenue (NOILR)	$\Delta\ln(X_2)$	Value	-7.1821	-7.0440	-5.2219
			p-value	0.0000	0.0000	0.0000
	Administrative Expenditure (ADME)	$\Delta\ln(X_3)$	Value	-5.7214	-5.9641	-5.3375
			p-value	0.0000	0.0002	0.0000
	Economics Expenditure (ECE)	$\Delta\ln(X_4)$	Value	-6.9132	-6.8554	-5.8721
			p-value	0.0000	0.0000	0.0000
	Social Expenditure (SCE)	$\Delta\ln(X_5)$	Value	-4.7901	-4.8674	-6.2740
			p-value	0.0007	0.0028	0.0000
	Transfer Expenditure (TFE)	$\Delta\ln(X_6)$	Value	-7.6897	-7.6216	-2.3918
			p-value	0.0000	0.0000	0.0185

3.2. Co-integration

Engle and Granger co-integration test was employed to examine the existence of a long-run relationship in equation (1). The result shows that a long run relationship exists among the variable. The Engle Granger statistic and p-value are -7.994463 and 0.0000.

3.3. Long Run Regression Estimates

Results from Table 2 showed that 99.3% of the variability in GDP is accounted for by predictor variables. F-Statistics of 650.259 (0.000) revealed that the overall model is significant. The regression coefficients of some explanatory variables (OIR, NOR, ADE and TFE) shows a positive coefficient which have positive effect on economic growth and some explanatory variables (ECE and SCE) shows a negative coefficient which have negative effect on the economic growth. However, non-oil revenue (NOR) and administrative expenditure (ADE) were significant because its p-value is less than the 5% level of significant; while the remaining independent variables (OIR, ECE, SCE and TFE) were insignificant because their p-value is greater than the 5% level of significant. Further diagnostic checks shows that the model suffers model suffers the problem of Autocorrelation and Multicollinearity and this necessitates the use of Generalized Principal Components Method to handle the problem jointly.

Table 2. *Long Run regression output based on OLS estimates.*

Variable	Coefficient	Std. Error	t-ratio	p-value	VIF
Constant	2.612	0.531	4.923	0.000 ***	
*ln*oir	0.193	0.166	1.165	0.255	120.233
*ln*nor	0.374	0.129	2.911	0.007 ***	64.082
*ln*ade	0.514	0.214	2.397	0.024 **	201.974
*ln*ece	-0.172	0.109	-1.573	0.128	59.754
*ln*sce	-0.008	0.108	-0.077	0.939	61.750
*ln*tfe	0.098	0.172	0.569	0.574	82.944
R-squared	0.993	Adj. R-squared		0.992	
F-Statistic	650.259 (0.000)	Durbin-Watson		1.1950 (0.0020)	
Shapiro Wilk	0.9437 (0.0871)	White Test		31.6001 (0.2472)	
		RHO		0.396	

3.4. Generalized Two Stage Principal Component

The original data is transformed using $\hat{\rho} = 0.396$ to correct the problem of autocorrelation. A new data is obtained after the transformation and the variables were change (for instance LOGOIR changed to LOGOIRT). Table 3 gives a summary statistics of the analysis indicating that the problem of autocorrelation has been handled since DW p-value = 0.2190 but problem of multicollinearity still occur since VIF > 10.

Table 3. *Transformed Data (Generalized Two Stage Estimate).*

Variable	Coefficient	Std. Error	t-value	p-value	VIF
Const.	1.27333	0.345620	3.684	0.0011	
*Ln*oirt	0.196094	0.176909	1.108	0.2778	43.325
*Ln*nort	0.458389	0.132829	3.451	0.0019	22.575
*Ln*adet	0.463269	0.243927	1.899	0.0687	81.754
*Ln*ecet	-0.263551	0.120171	-2.193	0.0374	23.534
*Ln*scet	-0.0336411	0.104868	-0.3208	0.7509	19.084
*Ln*tfet	0.200856	0.184425	1.089	0.2861	29.844
R-squared	0.979036		Adj. R-squared	0.974198	
F-Statistic	202.3673(1.53e-20)		Durbin-Watson	1.817934 (0.2190)	

To handle the problem of multicollinearity, this necessitates the use of Principal Component as alternative to Ordinary Least Square to obtain the long run regression estimates. Results of selection of the component and estimates are provided in Table 4 and 5 respectively.

Table 4. *Eigenvalues.*

	F1	F2	F3	F4	F5	F6
Eigenvalue	5.788	0.091	0.058	0.036	0.020	0.008

Component 1 is selected since its eigenvalue is greater than 1.

Table 5. *Generalized Two Stage Principal Component 1 (GT-PC1) Estimates.*

Model	B	Standard error
Intercept	2.285	0.258
*Ln*oirt	0.158	0.005
*Ln*nort	0.164	0.005
*Ln*adet	0.160	0.005
*Ln*ecet	0.145	0.004
*Ln*scet	0.139	0.004
*Ln*tfet	0.198	0.006
R^2	0.975	MSE (0.050)
Adjusted R^2	0.974	RMSE (0.223)

4. Conclusion

It was revealed that there exists a positive linear relationship among variables (oil revenue, non-oil revenue, administrative expenditure, economic expenditure, social expenditure, transfer expenditure and gross domestic product). The R-squared value of 0.974 indicates that about 97.4% of the variability in GDP is accounted for by the predictor variables.

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