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Government Expenditure and Economic Growth in Nigeria: An Analysis with Dynamic Ordinary Least Squares

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Abstract
This study investigates the impact of government expenditure on economic growth from 1981 to 2015 using Dynamic Ordinary Least Squares that incorporates endogenity in its estimation. The unit root test using Augmented Dickey Fuller revealed that all the series were stationary at first difference. The two-step Engle-Granger residual test showed that the residual was stationary at level; thus, there was a long run relationship among the series. The findings obtained from the long run Dynamic OLS showed that government expenditure on administration, government expenditure on economic services and nominal exchange rate were significant and had the expected signs except government expenditure on economic services. The empirical findings further indicated that the ECM was negative and statistically significant at 5%. The speed of adjustment was 71.38%. Lastly, in the short-run analysis, findings revealed that the nominal exchange rate was significant and had the expected sign. This might have been due to the influence of naira depreciation on government expenditure. The study therefore recommends that there is need for restructuring of government expenditure to be in line with macroeconomic objectives and also to reduce expenditure on transfers through economic diversification. Government should also take decisive steps to diversify the economy in order to reduce dependence on oil and to stabilize the value of naira.
Keywords: Dynamic OLS, economic growth, government expenditure, nominal exchange rate

1. Introduction

The crucial needs for government to participate in the economy can be seen from the need to enforce contracts, protect property, and develop infrastructure (Abdullah, 2000; Njoku & Nwaeze, 2014). The role of government in economic activity received much attention in the 1930s through the works of John Maynard Keynes who argued that government spending -

particularly increases in government spending - boosted growth by injecting purchasing power into the economy (Keynes, 1936). Keynes (1936) argued that government spendings - especially deficit spending - could provide short-term stimulus to help end a recession or depression.

From the pioneering work of Keynes (1936) on government spending, considerable efforts have been made to examine the impact of government expenditure on economic growth. Notable scholars, including Singh and Sahni (1984), Ram (1986, 1987), Ahsan, Kwan and Sahni (1992), Mitchell (2005), Irmen and Kuehnel (2008), Pham (2009), Aladejare (2013), Aigheyisi (2013), Yeoh and Stansel (2013), Osinike (2014), Fatukasi, Adebusuyi, and Ishola (2014), Rahman, Ullah, and Jebran (2015) have examined the relationship between government expenditure and economic growth but have come up with different and sometime, conflicting findings.

African governments have embraced government spending as a means of promoting socio-economic and physical infrastructures. Aladejare (2013) asserted that the absence of robust private sector made the African governments on attainment of political independence to assume the role of a prime mover of their economies. The central objective of government expenditure in developing countries solely focuses on economic expansion (Pham, 2009). Government expenditure has therefore become an important matter in the facilitation of economic growth in developing countries. Government is expected-to provide extension services and infrastructural facilities, which will stimulate investment and augment the productive capacity of the economy (Fatukasi, Adebusuyi, & Ishola, 2014).

Growth is essential if governments are to continue to provide public services, which directly benefit the poor (Rahman, Ullah, & Jebran, 2015). Public expenditure on infrastructure such as roads, drainages, ports, or communication systems, public research spending and the provision of basic education, health and medical services raises the growth potential of an economy (Irmen & Kuehnel, 2008). In addition, the governments in the developing countries have to provide the impetus for private sector to exist and participate in the economic activities. Infrastructure that necessitates economic growth is not available in many of the developing nations; therefore private sector development is constrained. The cost of producing the infrastructure for the private sector is high and as such it weakens their existence.

Nigeria is currently undergoing a recession and there are calls from some citizens for increased government expenditure in order to end the recession and bring about positive turn-around of the economy. It is believed that Government expenditure has the potential to stimulate the economy and restore economic growth. The existing theoretical literature such as Wagner's theory of government expenditure, Keynes' theory of public expenditure, and Musgrave-Rostow's theory showed that government expenditure enhances economic growth but this seems to be at variance with empirical findings in Nigeria.

Recent studies by Adewara and Oloni (2012), Ebiringa and Charles-Anyaogu (2012), Egbetunde and Fasanya (2013) and Nwadiubu and Onuka (2015) on components of government expenditure have shown mixed results. The study by Ebiringa and Charles-Anyaogu (2012) found mixed evidence across the components of government expenditure using Cochrane-Orcutt and ECM. Their findings showed that government expenditures on telecommunication, defence and security, education and health were significant while the government expenditures on agriculture and transportation were not significant. Adewara and Oloni (2012) also found mixed evidence in their study using Vector Autoregressive Model (VAR). According to them, Government expenditures on health and agriculture were significant while the government expenditures on water and education were not significant. Mixed evidence was also found in the study by Nwadiubu and Onuka (2015). In their study, government expenditures on transportation, communication, and health were significant while government expenditure on education was not significant. The study by Egbetunde and Fasanya (2013) showed that the components of government expenditure had negative impact on economic growth using Autoregressive Distributed Lag Model (ARDL).

The variations of the findings of these studies (Adewara & Oloni, 2012; Ebiringa & Anyaogu, 2012; Egbetunde & Fasanya, 2013 and Nwadiubu & Onuka, 2015) from the theoretical literature justify the need for this study to re-examine the relationship between components of government expenditure and economic growth in Nigeria. This study believes that using a more robust estimation technique (Dynamic Ordinary Least Squares which incorporates endogeneity and auto-correlation) may yield more reliable result. The objective therefore is to re-examine the impact of components of government expenditure on economic growth in Nigeria from 1981 to 2015.

2. Literature Review

Theories propounded so far on government expenditure and economic growth has shown that increase in government expenditure can lead to economic growth. Wagner's theory of government expenditure predicts that the development of an industrial economy would be accompanied by an increased share of public expenditure in gross national product (Balogun, 2013). While Keynes (1936), Njoku and Nwaeze (2014) maintain that economic growth is the outcome of government expenditure, Egbetunde and Fasanya (2013) using bounds testing (ARDL) approach showed the impact of total public spending on growth to be negative.

On one hand, Musgrave-Rostow's theory holds that in the early stage of economic growth, public expenditure in the economy should be encouraged because at this stage, there exists market failures and hence there should be robust government involvement to deal with these market failures (Ogba, 1999). On the other hand, the displacement effect hypothesis propounded by Peacock and Wiseman (1961) state that government spending tends to evolve in a step-like pattern, coinciding with social upheavals, notably wars (Aigheyisi, 2014). These theories have been empirically supported by the works of Ebiringa and Charles-Anyaogu (2012), Egbetunde and Fasanya (2013), Adewara and Oloni (2012), Nwadiubu and Onuka (2015), Nwadiubu and Onuka (2015).

Empirically, Ebiringa and Charles-Anyaogu (2012) adopted the Cochrane-Orcutt and ECM method to measure the impact of government expenditure on economic growth in Nigeria and found that expenditure on telecommunication, defence and security, education and health sectors had positive impact on Nigeria's economic growth but transportation and agricultural expenditures have impacted negatively on the economic growth in Nigeria.

Adewara and Oloni (2012) using the vector Autoregressive models (VAR) showed that expenditure on education has failed to enhance economic growth due to the high rate of rent seeking in the country as well as the growing rate of unemployment. Nwadiubu and Onuka (2015) followed in the same direction by employing the disaggregated analysis and their results revealed that government total capital expenditure (TCAP), total recurrent expenditures (TREC), and government expenditure on education (EDU) have negative effect on economic growth. Nwadiubu and Onuka (2015) however, agreed that rising government expenditure on transport and communication (TRACO), and health (HEA) results to an increase in economic growth.

3. Research Methods

The model for this study is derived from works of Adewara and Oloni (2012) which was adapted from the works of Kocherlakota and Yi (1997). The model of Adewara and Oloni (2012) is specified as follows:

$$RGDP_t = \alpha_0 + \alpha_1 REV_t + \alpha_2 ADMIN_t + \alpha_3 SOCIAL_t + \alpha_4 TRANSFER_t + \alpha_5 ECON_t + \mu_t \quad (3.1)$$

Where $RGDP_t$ is the Real GDP for the sample period, REV_t represent the total revenue, $ADMIN_t$ represent the total expenditure on administration, $SOCIAL_t$ represent the total expenditure on social and community services, $TRANSFER_t$ represent the total expenditure on transfer, $ECON_t$ represent the total expenditure on economic services and μ_t is the error term.

With slight modification to equation (3.1), by adding exchange rate (NEX) we have:

$$RPC = \alpha_0 + \alpha_1 TA_t + \alpha_2 TC_t + \alpha_3 TE_t + \alpha_4 TR_t + \alpha_5 GR_t + \alpha_6 NEX_t + \mu_t \quad (3.2)$$

Taking the logarithm of equation (3.2), we have:

$$lnRPC = \alpha_0 + \alpha_1 lnTA_t + \alpha_2 lnTC_t + \alpha_3 lnTE_t + \alpha_4 lnTR_t + \alpha_5 lnGR_t + \alpha_6 NEX_t + \mu_t \quad (3.3)$$

$$\alpha_1, \alpha_2, \alpha_3, \alpha_4 > 0, \alpha_5, \alpha_6 < 0$$

Where, RPC = Real per capita GDP, TA = total expenditure on administration, TC = the total expenditure on social and community services, TE = total expenditure on economic services, TR = the total expenditure on transfer, GR = Government Revenue, NEX = exchange rate, μ_t = the error term, and *ln* = logarithm.

Transforming equation (3.3) into Dynamic Ordinary Least Squares (DOLS) model, the equation becomes:

$$lnRPC = X_t M^{/} + \sum_{i=-m}^{i=m} \alpha_1 \Delta lnTA_t + \sum_{i=-n}^{i=n} \alpha_2 \Delta lnTC_t + \sum_{i=-p}^{i=p} \alpha_3 \Delta lnTE_t + \sum_{i=-q}^{i=q} \alpha_4 \Delta lnTR_t + \sum_{i=-r}^{i=r} \alpha_5 \Delta lnGR_t + \sum_{i=-w}^{i=w} \alpha_6 \Delta NEX_t + \mu_t \quad (3.4)$$

In equation 3.4, X_t is a vector of all explanatory variables (I, TA, TC, TE, TR, GR and NEX); $M^{/}$ is a subset of I(1) variables of X; α_1, α_2, α_3, α_4, and α_5 are vectors of long- run coefficients; μ_t is a well behaved error term; *m, n, p, q* , *r* and *w* are leads of the first difference of explanatory variables; Δ is the first difference operator, and *–m, -n, -p, -q, -r* and *–w* are lags of the first difference of explanatory variables. The leads and lags of the first difference of explanatory variables are included to deal with the problems of endogeneity and autocorrelation as adopted by Craigwell and Wright (2012).

To estimate the short run dynamics equation (3.4) becomes:

$$\Delta RPC = \alpha_0 + \sum_{i=1}^{\rho} \alpha_1 \Delta RPC_t + \sum_{i=1}^{\rho} \alpha_2 \Delta TA_t + \sum_{i=1}^{\rho} \alpha_3 \Delta TC_t + \sum_{i=1}^{\rho} \alpha_4 \Delta TE_t + \sum_{i=1}^{\rho} \alpha_5 \Delta TR_t + \sum_{i=1}^{\rho} \alpha_6 \Delta GR_{t-1} + \sum_{i=1}^{\rho} \alpha_7 \Delta NEX_t + \gamma ECM_{t-1} + \mu_t (3.5)$$

Where γ is the coefficient of the ECM.

The ECM enables us to distinguish between the short-run and the long-run and its results indicate the speed of adjustment back to long run equilibrium after a short run shock.

The data for this study were obtained from various issues of Central Bank of Nigeria Statistical Bulletin, for a period of 35 years. The use of Dynamic Ordinary Least Square (DOLS) requires that the dependent variable should be I(1) and at least some of the right hand side (RHS) variables should be I(0) or I(1). This condition requires that estimation should commence by conducting stationarity test. The lag length of the first difference of each series will be obtained as the stationarity test is conducted. In this study, we employ Augmented Dickey Fuller (ADF) test. This test operates under the hypothesis of series has unit root. Schwarz Information Criterion and Akaike Information Criterion are used to decide optimal lag length. The ADF test has the following model:

$$\Delta X_t = \lambda_0 + \lambda_1 X_{t-1} + \lambda_2 T + \sum_{i=1}^{n} \varphi i \Delta X_{t-1} + \epsilon_t, \epsilon_t \square \mathrm{IID}(0, \sigma^2) \quad (3.6)$$

In equation (3.6), Δ is the difference operator, X is the natural logarithm of the series, T is a trend variable, λ and φ are the parameters to be estimated and ϵ is the error term, which is independently and identically distributed with zero mean and constant variance. Therefore, it adjusts the error terms by adding the lagged difference terms of the regressand (Engle & Granger, 1987).

The stationarity test provides a ground to determine the order of integration of the variables employed in the model. One point to note is that if the variables are integrated of different orders, then there is need to look for co-integration. Co-integration tests help to establish if some long-run equilibrium relationship exists between the dependent variable and all the variables entering the real per capita GDP function. We employ Johansen's approach to measure this long-run equilibrium relationship among the variables. This is done by checking if the residual obtained from static OLS is stationary at level or not. If the residual is stationary at level, the series are co-integrated. Then, equation 3.4 would be estimated using the dynamic OLS, followed by short run dynamics specified in equation 3.5.

In developing countries, such as Nigeria, the nature of data collection may lead to spuriousness of regression estimation especially in long run analysis. The technique adopted in this study is based on Monte Carlo simulations, which estimators are more robust in small samples when compared to other alternative estimators. Secondly, it is a technique for obtaining efficient estimators for the co-integrating vectors involving deterministic components and accommodates varying orders of integration and the possible simultaneity among variables (Stock & Watson, 1993). Lastly, it provides efficient estimates, useful to estimate variables that are stationary and non-stationary and behaves well in small samples as well as avoids endogeneity issues.

4 . Data Analysis

Table 4.1 provides descriptive statistics of the series employed for the study.

Table 4.1:

Descriptive Statistics

	RPC	TA	TC	TE	TR	GR	NEX
Mean	570.83	421.44	233.13	270.53	409.47	3028.27	67.53
Median	487.75	105.73	44.81	175.81	143.92	1731.84	88.95
Maximum	5243.97	1494.20	998.77	974.95	1679.84	11116.90	113.2
Minimum	17.09	1.36	0.59	0.87	3.86	10.51	0.75
Std. Dev.	832.85	530.89	326.76	308.14	484.47	3612.35	42.60
Skewness	5.23	0.96	1.28	0.91	1.16	0.98	-0.52
Kurtosis	30.04	2.33	3.12	2.54	3.19	2.60	1.53
Jarque-Bera	1225.59	5.99	9.58	5.18	7.84	5.83	4.74
Probability	0.00	0.05	0.01	0.08	0.02	0.05	0.09
Sum	19979.13	14750.46	8159.51	9468.45	14331.34	105989.6	2363.67
Sum Sq. Dev.	23584134	958274	3630150	3228321	7980134	4.44E+08	61707.89
Observations	35	35	35	35	35	35	35

Source: Authors' Regression Output

In Table 4.1, the descriptive statistics of the data are presented. The mean and median displayed a high level of consistency, as their values are within the range of minimum and maximum values of the series. It is only in the degree of openness that there is a good evidence of evenly spread. Its standard deviation is low. In others, the standard deviations have large values and this may be due to problems of outliers in the series and evidences can be seen in median except for nominal exchange rate. All values of median are less than the values of mean except in nominal exchange rate. This only occurs in series with extreme large values.

In addition, all the series are rightly skewed except nominal exchange rate. The skewness coefficients for real per capita GDP, total expenditure on administration, total expenditure on social and community services, total expenditure on economic services, total expenditure on transfer, and government revenue are 5.23, 0.96, 1.28, 0.91, 1.16 and 0.98 respectively except nominal exchange rate, which skews negatively. This shows that all the series are symmetrical around the mean and thus close to normal distribution except nominal exchange rate. The evidence of closeness to normal distribution can be seen in all values which are greater than 0 in all series. In terms of Kurtosis, real per capita GDP, total expenditure on social and community services, and total expenditure on transfer have the following values 30.04, 3.12 and 3.19 which are greater than 3. This implies that these series are not normally distributed. Other series: total expenditure on administration, total expenditure on economic services, and government revenue are less than 3, which means they are normally distributed. Their values are 2.33, 2.54, 2.60 and 1.53 respectively.

Jarque Bera statistics for the series show that total expenditure on administration, total expenditure on economic services, government revenue and nominal exchange rate are normally distributed at 5% level of significance. Their pro- values are 0.05, 0.08, 0.05 and 0.09. Real per capita GDP, total expenditure on social and community services, and total expenditure on transfer have pro- values less than 0.05 and the values are 0.00, 0.02, and 0.01. As earlier specified, this may be caused by the problems of the outliers. The normality problem is taken care by the coefficients of skewness. None of the values are less than zero, which is strong evidence for normal distribution in real per capita GDP, total expenditure on administration, total expenditure on social and community services, total expenditure on economic services, total expenditure on transfer, and government revenue.

The result of the stationarity test is shown in Table 4.2.

Table 4.2:
Unit root test

Variables	**Level/Difference**	**Critical Value (ADF)**	**ADF**	**ORDER**
InTA	Level	-2.9540	-1.5079	
	First Diff.	-2.9540	-8.0476*	1(1)
InTC	Level	-2.9511	-0.5588	
	First Diff.	-2.9540	-7.1321*	1(1)
InTE	Level	-2.9511	-0.7284	
	First Diff.	-2.9540	-6.0018*	1(1)
InTR	Level	-2.9511	-1.2587	
	First Diff.	-2.9540	-7.9422*	1(1)

NEX	Level	-2.9511	-1.1014	
	First Diff.	-2.9540	-4.1636*	1(1)
InRPC	Level	-2.9678	2.2351	
	First Diff.	-2.9678	-34.5444*	1(1)

* indicates significance at 5% level.
Source: Authors' Regression Output

Table 4.2 shows the results of the unit root test estimation on the series using Augmented Dickey-Fuller (See Appendix One). All the series are stationary after first difference at 5% level of significance. The Akaike Information Criterion is used to decide optimum lag length for real per capita GDP (RPC). The Schwarz information criterion was used to decide optimum lag length for other series. Co-integration is shown in Table 4.3.

Table 4.3:
Co-integration Test via Residual

	Statistics	**Critical Values**	**P- Values**
Residual	-2.9719	-4.9181	0.0005

Significance at 5% level
Source: Authors' Regression Output

Table 4.3 shows that the residual from static OLS is stationary at level (See Appendix Two). This result shows that there is long- run relationship among the series. This shows that Dynamic OLS can be used to estimate the long- run relationship among the series.
Table 4.4 provides the information on long- run regression of the relationship among the series (See Appendix Three for full detail and comparison with Ordinary Least Square Output).

Table 4.4:
Long Run Regression (Dynamic OLS)

Dependent variable: RPC	
Intercept	6.0809* (5.8809)
InTA	1.3354*** (1.9942)
InTC	-0.0799 (-0.1791)
InTE	-0.3253 (-1.3238)
InTR	0.16470 (-1.4265)
InGR	-0.6422 (-1.0329)
NEX	-0.0184* (-5.9057)
R^2	0.8839
Adjusted R^2	0.8176

Note: *t- Statistic;* *1%, **5% and ***10% Level of Significance

Source: Authors' Regression Output

The results presented in Table 4.4 shows that the R-squared (R^2), attributed to the independent variables is 0.8839. This implies that all the independent variables explained about 88.39 percent of the variations in real per capita GDP and the remaining 11.61% can be attributed to other factors not included in the model. Dynamic OLS does not report F-statistics and DW Statistics (E-views 9).

Government expenditure on administration (TA) has the expected positive sign and is significant at 5%. The result showed that every 1% increase in government expenditure on administration leads to 1.34% increase in economic growth during the years under study. This finding is in line with the findings by Ebiringa and Charles-Anyaogu (2012) which obtained positive significant relationship between government expenditure on defence and security which are components of administration. On the other hand, government expenditure on social and community services (TC) apart from not having the expected result, it is also not significant in the period under study. A 1% increase in government expenditure on social and community services (TC) leads to a decrease of 0.08% in the real per capita GDP in the period under study. This finding supports earlier studies by Adewara and Oloni (2012) and Nwadiubu and Onuka (2015), who investigated the impact of government expenditure on economic growth. They found that government expenditure on social and community services failed to enhance economic growth. Adewara and Oloni (2012) attributed the non-performance of the expenditure on social and community services to high rent-seeking prevailing in the economy and high unemployment rate.

Government expenditure on economic services is neither significant at 5% nor has the expected sign. The coefficient is negative. The result showed that 1% increase in government expenditure on economic services leads to a decrease of 0.32% in real per capita GDP in the period under study. This finding is similar to the findings of Tawose (2014). His findings showed that government expenditure on economic services has inverse relationship with industrial productivity in Nigeria. Expenditure on government economic services should have promoted economic growth in the country but high level of corrupt practices prevalent in Nigeria (diversion of public funds into private accounts, misappropriation of public fund and inflating contract price) have become impediments to economic growth.

Government expenditure on transfers (TR) neither has the expected sign nor significant. A 1% increase in government expenditure on transfers led to a decrease of 0.17% in the real per capita GDP during the period under study. This negative relationship between government expenditure and economic growth supports study conducted by Rahman, Ullah and Khalil (2015). Their findings showed that debt-servicing crowded out private investment in Pakistan. A major reason that can be attributed to non-significance of the coefficient of government expenditure on transfers is the increase in the burden of debts when a country does not redeem within stipulated time. It also indicates that the size of government expenditures on transfers rises with increase in economic growth.

In the same vein, the total government revenue does not have the expected sign nor was it significant. It is negatively signed. A 1% increase in government expenditure decreases real per capita GDP by 0.64% contrary to a priori expectation. The last independent variable is exchange rate. As expected, it has negative sign and it is significant at 1% level of significance. This finding has shown that exchange rate has significant impact on economic growth in Nigeria and it determines the performance of other macroeconomic indicators because of the import-dependent nature of the economy.

The parsimonious ECM for Dynamic OLS is given in Table 4.4 and it was computed by generating the error correction term (See Appendix Four for full details). The variables that are not significant in the over-parameterisation ECM are removed from the final estimation.

Table 4.5:
Short Run Regression (Dynamic OLS)

DEP VARIABLE		D(RPC)
Intercept	0.1091	(1.4142)
D(NEX)	-0.0249*	(-3.9035)
ECM(-1)	-0.7138*	(-2.7095)
R^2	0.4827	
Adjusted R^2	0.4089	

Note: *t- Statistic;* *1%, **5% and ***10% Level of Significance
Source: Authors' Regression Output

Table 4.5 shows that the R-squared (R^2) that measures the proportion of the variations in the dependent variable attributed to the independent variables are 0.4089. This implies that all the independent variables could explain only 48.28 percent of the variations in real per capita GDP. The remaining variation is the error term and is attributed to other factors not included in the model. It should be noted that Dynamic OLS does not report F- statistic and DW Statistic. Having removed the variables that were not significant from the over- parameterised ECM, we have the result in Table 4.5 about the ECM and the coefficient is negative and statistically significant at 5% level of significance. The result showed that 71.38% of the error in the previous times disequilibrium is corrected. Total expenditure on administration, the total expenditure on social and community services, and exchange rate were deleted from the final estimation because they were insignificant in the over-parameterize ECM. Nominal exchange rate is significant at 5% level of significance and is negative as the expected sign. A 1% increase in nominal exchange rate led to 0.02% decrease in real per capita GDP in the period under study. This further confirms the impact of exchange rate on economic growth in Nigeria.

5. Conclusion and Recommendations

This study examined the relationship between government expenditure and economic growth in Nigeria using Dynamic Ordinary Least Square. The study made use of time series data on government expenditure on administration, government expenditure on economic services, government expenditure on community and social services, government expenditure on transfers, government total revenue, nominal exchange rate and real per capita GDP for the period of 1981 to 2015. Data were sourced from various issues of the Central Bank of Nigeria Statistical Bulletin except data from the real per capita GDP which was computed by the authors. This study adopts error correction mechanism computed through Dynamic Ordinary Least Squares.

Empirical findings indicate that in the long run, government expenditure on administration and nominal exchange rate were significant and therefore impacted significantly on economic growth in Nigeria. This showed that government can make use of expenditure on administration and nominal exchange rate to influence economic growth in Nigeria. The findings further showed that other components of government expenditures did not have

significant impact on economic growth during the period under study. It was also discovered that the ECM was statistically significant and correctly signed. The speed of adjustment was 71.3%. In the short run, nominal exchange rate was significant and negative as expected.
The study recommends that there is need to stabilize the exchange rate through economic diversification. There is need for government to improve the competency of her administration. This can be done through accountability, prudency, fairness, and good governance. Government should minimize expenditures on community and social services, transfers and economic services. Lastly, government expenditure should be tailored infrastructure, investment and productive activities to enhance economic growth.

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APPENDIX ONE

UNIT ROOT

Null Hypothesis: TA has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.507944	0.5172
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(TA) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.047626	0.0000
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: TC has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.558749	0.8669
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(TC) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-7.132125	0.0000
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: TE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.728365	0.8261
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(TE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.001822	0.0000
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: TR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.258706	0.6371
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(TR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.942158	0.0000
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: RPC has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on AIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.235055	0.9999
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(RPC) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on AIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-34.54442	0.0001
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

APPENDIX TWO

COINTEGRATION TEST

Null Hypothesis: Residual has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.918124	0.0005
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

APPENDIX THREE
LONG RUN DYNAMIC OLS

Dependent Variable: RPC
Method: Dynamic Least Squares (DOLS)
Date: 09/09/16 Time: 10:04
Sample (adjusted): 1983 2014
Included observations: 32 after adjustments
Cointegrating equation deterministics: C
Fixed leads and lags specification (lead=0, lag=0)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth =
4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TA	1.708891	0.689158	2.479678	0.0306
TC	-0.029729	0.676858	-0.043922	0.9658
TE	-0.630406	0.285232	-2.210152	0.0492
TR	-0.795924	0.557975	-1.426451	0.1815
NEX	-0.022002	0.003726	-5.905738	0.0001
C	6.111780	1.207114	5.063133	0.0004

R-squared	0.971494	Mean dependent var	5.901713
Adjusted R-squared	0.919665	S.D. dependent var	0.975650
S.E. of regression	0.276532	Sum squared resid	0.841171

Durbin-Watson stat	1.701367	Long-run variance	0.091184

Dependent Variable: RPC
Method: Least Squares
Date: 09/09/16 Time: 10:02
Sample: 1981 2015
Included observations: 35

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.908252	0.525746	9.335793	0.0000
TA	0.815040	0.314945	2.587882	0.0149
TC	-0.168916	0.245494	-0.688065	0.4969
TE	-0.333273	0.155215	-2.147171	0.0403
TR	0.110682	0.248908	0.444673	0.6599
NEX	-0.018592	0.002299	-8.088629	0.0000

R-squared	0.879322	Mean dependent var	5.744894
Adjusted R-squared	0.858515	S.D. dependent var	1.185587
S.E. of regression	0.445952	Akaike info criterion	1.377593
Sum squared resid	5.767318	Schwarz criterion	1.644224
Log likelihood	-18.10788	Hannan-Quinn criter.	1.469634
F-statistic	42.26180	Durbin-Watson stat	1.785150
Prob(F-statistic)	0.000000		

APPENDIX FOUR
SHORT RUN DYNAMIC OLS

Dependent Variable: D(RPC)
Method: Dynamic Least Squares (DOLS)
Date: 09/09/16 Time: 10:17
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments
Cointegrating equation deterministics: C
Automatic leads and lags specification (lead=0 and lag=0 based on SIC
criterion, max=0)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth =
4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TA)	1.288008	0.827611	1.556297	0.1353
D(TC)	0.142429	0.458432	0.310686	0.7593
D(TE)	-0.555828	0.465093	-1.195090	0.2460

D(TR)	0.150182	0.572144	0.262489	0.7956
D(NEX)	-0.029487	0.008003	-3.684681	0.0015
ECM(-1)	-0.726213	0.365864	-1.984927	0.0610
C	-0.123744	0.169664	-0.729350	0.4742

R-squared	0.687043	Mean dependent var	0.112026
Adjusted R-squared	0.499269	S.D. dependent var	0.588627
S.E. of regression	0.416526	Sum squared resid	3.469887
Durbin-Watson stat	1.493777	Long-run variance	0.250950

Dependent Variable: D(RPC)
Method: Dynamic Least Squares (DOLS)
Date: 09/09/16 Time: 10:33
Sample (adjusted): 1986 2015
Included observations: 30 after adjustments
Cointegrating equation deterministics: C
Automatic leads and lags specification (lead=0 and lag=0 based on SIC
criterion, max=0)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth =
4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TEC(-3))	-0.782082	0.317712	-2.461608	0.0218
D(TRA(-3))	-1.453640	0.687402	-2.114687	0.0455
ECM(-1)	-0.811174	0.358744	-2.261149	0.0335
C	0.537423	0.180212	2.982164	0.0067

R-squared	0.504343	Mean dependent var	0.120356
Adjusted R-squared	0.375041	S.D. dependent var	0.617376
S.E. of regression	0.488063	Sum squared resid	5.478724
Durbin-Watson stat	0.993443	Long-run variance	0.337551

Dependent Variable: D(RPC)
Method: Least Squares
Date: 09/09/16 Time: 10:35
Sample (adjusted): 1985 2015
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TEC(-3))	-0.113496	0.207518	-0.546920	0.5888
D(TRA(-3))	-0.356339	0.317676	-1.121706	0.2715
ECM(-1)	-0.458310	0.264062	-1.735611	0.0936

R-squared	0.131221	Mean dependent var	0.114810
Adjusted R-squared	0.069165	S.D. dependent var	0.607785

Vol. 7 , No. 5, 2017, E-ISSN: 2222-6990 © 2017

S.E. of regression	0.586389	Akaike info criterion	1.862100
Sum squared resid	9.627870	Schwarz criterion	2.000873
Log likelihood	-25.86255	Hannan-Quinn criter.	1.907337
Durbin-Watson stat	1.481460		