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THE RELATIONSHIP BETWEEN GOVERNMENT EXPENDITURE AND ECONOMIC GROWTH IN AFRICA: EVIDENCE FROM DYNAMIC COMMON CORRELATED EFFECTS PANEL ESTIMATORS

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Abstract

The study on the relationship between government expenditure and the economy growth in Africa by employing a dynamic common correlated effects estimator, the ECM-ARDL approach. This model is robust to both heterogeneity and cross-section dependency. Three versions of Wagner's hypothesis were investigated. The two estimators were considered, the dynamic common correlated effects - mean group (DCCEMG) and the dynamic common correlated effects – pooled mean group (DCCEPMG) estimators. Based on the results from residual cross-sectional dependence test and the residual mean square error, the DCCEMG was preferred. ECM-ARDL(1 2) was considered the most preferred optimal lags for model (I & II) and ECM-ARDL(1 1) for model III. The coefficient for the three models, lnRGDP for Peacock-Wiseman (model I), lnRGDPp for Gupta (model II) and lnRGDP for Goffman (model III) were positive and statistically significant in predicting real government expenditure and real government expenditure per capita as the case may be except for model II which was not statistically significant. For the three versions error correction mechanism showed the appropriate sign and were statistically significant at 1% level, suggesting causation running from economy growth to government expenditure. The coefficient expressed as percentage were 23.07%, 20.17% and 57.67% for model (I, II & III) respectively and indicated the speed of adjustment to equilibrium by the system annually. The results also suggested broad adoption of Wagner's hypothesis among Africa countries.

Keywords: Wagner's Hypothesis, Government Expenditure, Economy Growth, Dynamic Common Correlated Effect, ECM-ARDL, DCCEMG, DCCEPMG

1. Introduction

The relationship between public expenditure and economic growth has been debated over a century ago, dated back to the days of Wagner's [1]. Wagner suggested a law which predicted that the development of an industrial economy will be accompanied by an increased share of public expenditure in gross national product. Africa countries for decades have witness escalation of this debate as increased government spending and low output rates have become a major issue of their economies. The thrust of this study is to investigate whether it is government expenditure that determines growth or it is economic growth which drives government spending. There are varied opinions to what Wagner law really specified, but we are considering two views that is, Wagner proposed: (a) an increase in absolute level of public expenditure; and (b) the proportion of public sector in the total economy [2].

Better understanding of the relationship between public expenditure and output is relevant for policy formulation in two major aspects. First, it improves the understanding of long-term and structural public finance issues. Secondly, the dynamic relationship between government expenditure and GDP helps the comprehension of policy-relevant issues over short and short to medium term horizon [3]. Many researches had been undertaking regarding the relationship between government expenditure and economic growth in Africa and other regions using panel data analysis. For instance, causal relationship between the government's public expenditure and military burden and economic growth for Egypt, Israel, and Syria was examine by Abu-Bader and Abu-Qarn, [4] applying multivariate cointegration and variance decomposition approach.

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In the two variable frameworks, they reported a negative relationship between government expenditure and economic growth in a pairwise and long-run relationship. Furthermore, they observed using three-way framework that military burden has a negative effect on economic growth in all countries, while, civilian government expenditure has a positive impact on the economic growth for only Israel and Egypt. In [5] relationship between government expenditure and economic growth for 30 OECD countries for the Olanrewaju period 1970 – 2005 was investigated. Their finding revealed that in 16 countries, there was a uni-directional and positive relationship from government expenditures to economic growth. Thus, their result was in line with Keynesian hypothesis. Also, they find positive relationship from government expenditure to economic growth in 10 countries. Therefore, Wagner's law was confirmed. However, in 4 countries, no relation was found.
The effect of government expenditure on the growth of the economy in a non-homogenous group of 15 underdeveloped countries for the period of 1972-1999 was examined using generalized method of moment (GMM) [6]. The result of the study revealed that, for countries with heavy government spending, government expenditure exerted significant impact on economic growth and those with small government spending did not affect the growth of the economy. Thus, Wagner's hypothesis holds. Also [7] confirmed Wagner's law when they examine relationship between government expenditure and economic growth for 5 countries: Azerbaijan, Kazakhstan, Kyrgyzstan, Turkmenistan and Uzbekistan for the period 1990 – 2012. They found that government expenditure has a positive effect on the economic growth using panel analysis.
Panel methods and Granger causality testing was employed by Kiraz, and Gumus, E.[8] to study the effects of government expenditures (defense, education and health) on economic growth for 29 OECD member countries for the period 1995-2013. They found that there was bidirectional causation between economic growth and government expenditures. The result supported both Wagner's and Keynesian hypotheses. Furthermore, VAR methodology and Granger causality tests was used in [9] to examine the effect of government expenditure on economic growth for Spain and Armenia between 1996 and 2014. They concluded that government expenditure have positive effect on economic growth.
Panel data analysis was employed by Gumus and Mammadov [10] to study the relationship between real government expenditure and economic growth in the Southern Caucasus countries for the period 1990-2016. According to their result, there was a positive relationship between real government expenditures and economic growth in the Southern Caucasus. They also found bidirectional causality between economic growth and real government expenditures. This study seeks to employed dynamic common correlated effects estimators in understanding the relationship between government expenditure and the economic growth in Africa countries.

2. 0 Data Application

Data used for this study are annual data from 1991 to 2019 for 24 Africa countries namely: Benin, Burkina Faso, Botswana, Cameroon, Republic of Congo, Comoros, Algeria, Egypt, Gabon, Kenya, Morocco, Madagascar, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sudan, Senegal, Eswatini, Togo, Uganda and South Africa. Data on real government expenditure (RGE), real government expenditure per capita (RGEp), real gross domestic product (RGDP) and real gross domestic product per capita (RGDPp), all in 2000 constant U.S dollars and for 29 years period on each of the indicators and on each of the countries respectively. The data was obtained from the World Bank's World Development Indicator (WDI) updated on 16/9/2020 [11].

2.1 Model Specification

If the explanatory variables are correlated with the common factors, leaving the factors out leads to an omitted variable bias. This situation renders the OLS residuals not identically independently distributed anymore and OLS becomes inconsistent [12]. Pesaran [13] developed a model that can be estimated consistently by approximating the common factors with cross sectional averages which in a dynamic model added the floor of $\sqrt[3]{T}$. This study adopted the model approach as suggested by Peasaran [13] and Chudik and Pesaran [14] as:

$$\ln RGE_{i,t} = \alpha_i + \lambda_i \ln RGE_{i,t-1} + \beta_{0,i} \ln RGDP_{i,t} + \beta_{1,i} \ln RGDP_{i,t-1} + \sum_{l=0}^{PT} \delta'_{i,l} \bar{z}_{t-l} + \varepsilon_{i,t} \quad (1)$$

where $\bar{z}_t$ represent the cross sectional averages of the dependent and independent variables lnRGE and lnRGDP respectively. The estimator is refers to as common correlated effects mean group estimator (CCEMG Estimator).

2.2 Pre-Estimation Techniques

To understand the nature of the analysis to be carryout especially time series observations, we investigate the data collected for the presence of unit root which means to establish whether the data is non-stationary or stationary. To know the type of unit root test to be used, one needs to understand whether the variables are cross-sectional dependent in case of panel data with large cross section and Time. This employed the use of the following techniques:

2.2.1 Cross-Sectional Dependence Test

The cross-sectional dependence test which were based on a standard panel data model

$$y_{it} = \beta_i x_{it} + u_{it}, \qquad i = 1,2, \cdots, N; \qquad t = 1, \cdots, T \tag{2}$$

began with the work of [15] LM tests. Their work was based on the Lagrange Multiplier (LM) test statistic to test the existence of a dependence between the cross-sections. That is,

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij} \tag{3}$$

[16] scaled the work in [15] for cases where the number of cross-sectional units is very large and LM test was expanded to:

$$LMs = \sqrt{\frac{1}{N(N-1)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T_i\hat{\rho}_{ij}^2 - 1)} \tag{4}$$

The work in [16] produced the CD test static by solving the probable size distortion in LM and LMS tests as:

$$CDS = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \tag{5}$$

where $\hat{\rho}_{ij}$ is the pair-wise correlation coefficients of the OLS residuals, obtained from individual ADF regressions. The CDS statistic under the null hypothesis of cross-section independence and it is identically independently distributed that is, $CD \sim N(0,1)$ for $T_{ij} > 3$ and sufficient large N. This study applies the CDS test also as a diagnostic test for various models as provided by Baltagi et al [17].

2.2.2 CIPS Test for Unit Root

The CIPS is one of the most popular second-generation tests due to Peasran [18] which was proposed to get rid of cross-sectional dependence.

Let y_{it} be the observation on the i^{th} cross-section unit at time t and suppose that it is generated according to the simple dynamic linear heterogeneous panel data model:

$$y_{it} = (1-\varphi_i)\mu_i + \varphi_i y_{i,t-1} + \mu_{it} \tag{7}$$

where $i = 1,2,3 \cdots, N$ and $t = 1,2,3 \cdots, T$

And that, initial value y_{i0}, has a given density function with a finite mean and variance, and the error term μ_{it}, has the single factor structure

$$\mu_{it} = \gamma_i + \tau_t + \varepsilon_{it} \tag{8}$$

In which τ_t is the unobserved common effect, and ε_{it} is the individual-specific (idiosyncratic) error. It is convenient to write (7) and (8) as:

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \gamma\tau_t + \varepsilon_{it} \tag{9}$$

The unit root hypothesis of interest $\varphi_i = 1$, can now be expressed as

$H_0 : \beta_i = 0$ for all i

Against the possibly heterogeneous alternatives,

$H_1 : \beta_i < 0 \quad i = 1,2,3 \cdots, N_1, \ \beta_i = 0, \ i = N_1 + 1, N_1 + 2, \cdots, N$

under the null hypothesis of unit root, the cross-sectionally augmented IPS (CIPS) test depends on the simple average of the individual ($CADF_i$) statistics. It is defined by

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \tag{10}$$

2.2.3 Panel Cointegration Test: Westerlund Test

To investigate long-run relationship among variables in the presence of cross-sectional dependence, Westerlund [19] suggested a test called Westerlund panel cointegration test used to detect whether the error correction exists for individual units in the panel as well as the entire panel. The error correction which represents the speed of adjustment towards equilibrium is given by:

$$\Delta Y_{it} = \delta_i g_t + \varepsilon_i (Y_{i,t-1} - \beta_i X_{i,t-1}) + \sum_{j=1}^{p} \phi_{ij} Y_{i,t-j} + \sum_{j=0}^{p} \phi_{ij} X_{i,t-j} + v_{it}$$

The group-mean tests was employed by [19] based on G_τ and G_α statistics and the panel tests based on P_τ and P_α statistics to examine the null hypothesis of no cointegration

$$G_\tau = \frac{1}{N} \sum_{i=1}^{N} \frac{\varepsilon_i}{Se(\hat{\varepsilon}_i)} \tag{11}$$

$$G_\tau = \frac{1}{N} \sum_{i=1}^{N} \frac{T\varepsilon_i}{\varepsilon_i'} \tag{12}$$

$$P_\tau = \frac{\hat{\varepsilon}_i}{Se(\hat{\varepsilon}_i)} \tag{13}$$

$$G_\tau = T\hat{\varepsilon}$$

The G_τ and G_α statistics are used for detecting whether cointegration manifests itself in at least one cross-sectional country. The P_τ and P_α statistics revealed if cointegration appears in the whole panel.

2.3 Estimation Techniques

The panel ARDL (p, q) estimation models were developed in line with the three versions of Wagner's hypotheses, namely the Peacock-Wiseman [20], Gupta [21], and Goffman [22]. In line with the peasaran et al. [23], the ARDL models, including the long-run relationship are specified as:

2.3.1 Error Correction Approach (ECM-ARDL)

The Error Correction Models, with the short run relationships between the variables, are as specified below:

$$\Delta lnRGE_{i,t} = \delta_i (lnRGE_{i,t-1} - \theta_{0,i} - \theta_{1,i} lnRGDP_{i,t-1}) + \beta_{0,i} \Delta lnGDP_{i,t} + \sum_{l=1}^{PT} \delta_{i,l}' \bar{z}_{t-1} + \varepsilon_{i,t} \tag{14}$$

$$\Delta lnRGEp_{i,t} = \delta_i (lnRGEp_{i,t-1} - \theta_{0,i} - \theta_{1,i} lnRGDPp_{i,t-1}) + \beta_{0,i} \Delta lnGDPp_{i,t} + \sum_{l=1}^{PT} \delta_{i,l}' \bar{z}_{t-1} + \varepsilon_{i,t} \tag{15}$$

$$\Delta lnRGE_{i,t} = \delta_i (lnRGE_{i,t-1} - \theta_{0,i} - \theta_{1,i} lnRGDPp_{i,t-1}) + \beta_{0,i} \Delta lnGDPp_{i,t} + \sum_{l=1}^{PT} \delta_{i,l}' \bar{z}_{t-1} + \varepsilon_{i,t} \tag{16}$$

where

$$\theta_i = \frac{\beta_{0,i} + \beta_{1,i}}{1 - \lambda_i} \tag{17}$$

$$\delta_i = (1 - \lambda_i) \tag{18}$$

δ_i is the error-correction speed of adjustment parameter and $(lnRGE_{i,t-1} - \theta_{0,i} - \theta_{1,i} lnRGDP_{i,t-1})$, $(lnRGEp_{i,t-1} - \theta_{0,i} - \theta_{1,i} lnRGDPp_{i,t-1})$ and $(lnRGEp_{i,t-1} - \theta_{0,i} - \theta_{1,i} lnRGDP_{i,t-1})$ are the error correction terms. In general, a long run relationship exists if $\delta_i \neq 0$ (Shin et al., 1999). $\beta_{0,i}$ captures the immediate or short run effect of $x_{i,t}$ on $y_{i,t}$ where $x_{i,t}$ are the $lnRGDP_{i,t}$ and $lnRGDPp_{i,t}$ and $y_{i,t}$ are $lnRGE_{i,t}$ and $lnRGEp_{i,t}$. The long or equilibrium effect is captured by θ_i. The long run effect measures how the equilibrium changes and δ represents how fast the adjustment occurs [24].

3. RESULTS AND DISCUSSION

Table 1 is the descriptive statistics having mean, standard deviation (Std. Dev.), Min (Minimum) and Maximum (Max). From the Table it was revealed that real government expenditure has the highest mean value of 23.51835 than the real GDP for the periods under consideration. But it showed that real GDP was more erratic with the standard deviation of 1.4960 and the highest in the list.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnRGE	696	23.51835	1.443605	20.30775	26.81004
lnRGEp	696	7.296407	.8721584	5.549632	9.119369
lnRGDP	696	23.50977	1.490601	20.12543	26.89705
lnRGDPp	696	7.285191	0 .959415	5.301467	9.388428

where, lnRGE is the natural log real government expenditure, lnRGEp is the natural log real government expenditure per capita, lnRGDP is the natural log real gross domestic product and lnRGDPp is the natural log gross domestic product per capita.

Table 2 reported the result of cross-section dependence test by Pesaran [16]. It was revealed that the real government expenditure, real government expenditure per capita, real gross domestic product and real gross domestic product per capita are all significant at 1% significance level which indicated the rejection of null hypothesis of cross-section independence. Therefore, there is strong presence of cross-sectional dependence in the panel.

Table 2: Results of Cross-Sectional Dependence Test

Variable	CD-Test	P-Value
lnRGE	86.01269	0.0000
lnRGEp	68.06034	0.0000
lnGDP	86.48362	0.0000
lnGDPp	52.28721	0.0000

where, lnRGE is the natural log real government expenditure, lnRGEp is the natural log real government expenditure per capita, lnRGDP is the natural log real gross domestic product and lnRGDPp is the natural log gross domestic product per capita...

To avoid running spurious regressions, the study conducted a unit root tests on the variables as reported in Table 3. It was revealed from Cross-sectional Augmented Dicky-Fuller (CADF) test proposed by Pesaran [25] and Cross-sectional augmented Im-Pesaran-Shin (CIPS) test by Pesaran [18] which handle both heterogeneity and cross-sectional dependence that the level values of lnRGE and lnRGEp are significant at 5% and 1% respectively hence, leading to the rejection of null hypothesis of unit root. But, lnRGDP and lnRGDPp are not statistically significant leading to the retention of the null hypothesis of unit root in the panel. However, the first difference of the variables are significant at 1%, indicating that the series lnRGDP and lnRGDPp are both I(1). With CIPS test, it was revealed that lnRGE, lnRGEp and lnRGDP are I(0) but, lnRGDPp was not statistically significant but became significant after first difference. Hence lnRGDPp is I(1) variable.

Table 3: Panel Unit Root Tests Results

Variable	CADF_Test (level)	CADF_Test (First Difference)	CIPS Test (Level)	CIPS Test (First Difference)
lnRGE	-1.814**	-10.449***	-2.278**	-5.444***
lnRGEp	-2.979***	-11.182***	-2.192**	-5.415***
lnGDP	-0.508	-10.978***	-2.546***	-5.470***
lnGDPp	-0.566	-8.228***	-1.640	-4.476***

where, lnRGE is the natural log real government expenditure, lnRGEp is the natural log real government expenditure per capita, lnRGDP is the natural log real gross domestic product and lnRGDPp is the natural log gross domestic product per capita.

Table 4 is results of the test of no cointegration between the variables. The results for the three versions of Wagner hypothesis showed high probability of rejection of the null hypothesis that the variables are not cointegrated and retaining the alternative hypothesis that there is cointegration in both groups and panels. Hence, an indication of long-run relationship between lnRGE and lnRGDP as suggested by Peacock and Wiseman [20], lnRGEp and lnRGDPp as proposed by Gupta [21] and lnRGEp and lnRGDP of Goffman [22].

Table 4: Westerlund ECM Panel Cointegration Test Results

Statistics	Peace-Wise			Gupta			Goffman		
	value	z value	P value	value	z value	P value	value	z value	P value
G_t	-2.960	-6.429	0.000	-2.863	-5.894	0.000	-2.436	-3.546	0.000
G_a	-18.232	-9.972	0.000	-14.944	-6.999	0.000	-11.525	-3.908	0.000
P_t	-14.188	-6.874	0.000	-13.900	-6.590	0.000	-12.170	-4.883	0.000
P_a	-16.286	-12.738	0.000	-11.172	-7.280	0.000	-10.980	-7.072	0.000

Table 5 showed the results of dynamic common correlated effect pooled mean group estimator, it was observed that for the three models (I), (II) and (III), the long run impact of RGDP and RGDPp are positive, although for model I, the impact was not statistically significant, but not so for Model I and II on government expenditure in Africa. From the results, a 1% increase in RGDP will bring about 1.7780% increases in RGE, a 1% increase in RGDPp will foster the growth of RGEp by about 2.1288% and a 1% increase in RGDPp will improve RGE by 1.2867%. Furthermore, the short run impact of RGDP and RGDPp are positive and statistically significant at 1% level except for model I. These implies that, a 1% increase in RGDP will bring about 0.0774% increases in RGE but not statistically significant on the short run, but a 1% increase in RGDPp will bring about 0.3309% increases in RGEp and 1% increase in RGDPp will bring about 0.3768% increase in RGE and are statistically significant on the short run. Also, for the error correction term, it was observed that the signs are negative as required but only model III was statistically significant at 1% level; model I and II are not statistically significant. That is, based on the coefficient of error correction, the system speed of adjustment to equilibrium level are 24.36%, 15.59% and 39.17% annually. Here, from the result of no cross-sectional dependence, the null hypotheses of no cross-sectional dependence were retained for the three models. Although, on a sad note for model I and II, the adjusted R squares are just 0.12 and 0.08, which indicated that, only 12 % and 8% variability in RGE and RGEp were determined by model I and II, however, for model III 50% variation in RGE was determined by the parameters used in the model.

Table 5: Estimate of Dynamic Common Correlated Effect Panel (ARDL) Model (DCCEPMG)

Variable	Peacock-Wiseman ARDL(2 1)	Gupta ARDL(2 1)	Goffman ARDL(1 1)
lnRGDP	1.7780(0.001)		
lnRGDPp		2.1288(0.008)	1.2867(0.000)
ΔΔ lnRGE	0.3568(0.000)	0.4013(0.000)	
Δ lnRGDP	0.0774(0.168)		
Δ lnRGDPp		0.3309(0.001)	0.3768(0.000)
Error Correction Term	-0.2436(0.264)	-0.1559(0.726)	-0.3917(0.000)
CD-Statistics	-0.16(0.8699)	-0.62(0.5345)	-1.95(0.0516)
Adj.R^2	0.12	0.08	0.50
RMSE	0.04	0.04	0.05

Based on the results from Table 6, the results of the dynamic common correlated effect mean group estimator, it was observed that for the three models (I), (II) and (III), the long run impact of RGDP and RGDPp are positive, although for model II, the impact was not statistically significant, but not so for Model I and III on government expenditure in Africa. From the results, a 1% increase in RGDP will bring about 2.5715% increases in RGE, a 1% increase in RGDPp will enhance the growth of RGEp by about 1.6882% but not statistically significant and a 1% increase in RGDPp will improve RGE by 1.2620%. For the short run impact of RGDP and RGDPp are positive and statistically significant at 1% level except for model I. These implies that, a 1% increase in RGDP will improve RGE by about 0.0824% but not statistically significant on the short run, but a 1% increase in RGDPp will bring about 0.3163% and 0.3110% increases in RGEp and RGE respectively and are statistically significant on the short run. Also, for the error correction term, it was observed that the signs are negative as required and are all statistically significant at 1% level. That is, based on the coefficient of error correction, the system speed of adjustment to equilibrium level are 23.07%, 20.17% and 57.67% annually. Also, from the result of no cross-sectional dependence, the null hypotheses of no cross-sectional dependence were retained for the three models. Concerning the models, the adjusted R squares are 68%, 70% and 55% for the three models respetively, which indicated that, about 68%, 70% and 55% variation in RGE, RGEp and RGE were determined by model I, II and III respectively.

Table 6: Estimate of Dynamic Common Correlated Effect Panel (ARDL) Model (DCCEMG)

Variable	Peacock-Wiseman ARDL(2 1)	Gupta ARDL(2 1)	Goffinan ARDL(1 1)
LnRGDP	2.5715(0.000)		
LnRGDPp		1.6882(0.114)	1.2620(0.000)
ΔΔ lnRGE	0.3694(0.000)	0.3873(0.000)	
Δ lnRGDP	0.0824(0.330)		
Δ lnRGDPp		0.3163(0.017)	0.3110(0.016)
Error Correction Term	-0.2307(0.000)	-0.2017(0.000)	-0.5767(0.000)
CD-Statistics	-1.00(0.3183)	-1.24(0.2157)	-1.00(0.3165)
Adj.R^2	0.68	0.70	0.55
RMSE	0.04	0.04	0.04

4. Conclusion

In modeling relationship between government expenditure and economic growth, three versions of Wagner's hypothesis were investigated, the Peacock-Wiseman (model I), the Gupta (model II) and the Goffinan (model III). The method of dynamic common correlated effects ECM-ARDL model was employed. Two methods of estimations were run, the mean group estimates and pooled mean group estimates. The estimators were subjected to some statistical screening in order to adopt preferred model estimation. The dynamic common correlated effect mean group was the most appropriate estimation based on the results of residual cross-sectional dependence test and the adjusted R-squares. Based on the findings of the study, it was concluded that, the variables under consideration, government expenditure and economic growth were co-integrated for the three models and therefore, evidence of long-run relationship between them. The error correction terms for the three models have negative sign and were significant, hence evidence of broad relevancy of Wagner's hypothesis in African.

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