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Threshold Cointegration, Asymmetric Causality and Wagner’s Law: The African Experience Revisited

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Abstract

This study re-examines the Wagner's law of public expenditure for six sub-Saharan African countries while relaxing the assumption of a symmetric adjustment process underlying standard cointegration tests and error-correction models. The empirical methodology uses threshold cointegration tests to establish that there is a long-run relationship between government expenditure and per capita GDP for five countries, with income being positively related to public spending. Furthermore, the results of asymmetric Granger-causality tests provide support for Wagner’s law in the long run for five countries (Cameroon, Cote d’Ivoire, Ghana, Kenya, and Senegal), while the Keynesian view holds only in the short run for three countries (Benin, Cameroon, and Cote d’Ivoire). The short run evidence for two countries (Kenya and Senegal) support both Wagner’s law and Keynesian view.

Keywords: Wagner’s law, threshold cointegration, asymmetric error-correction model, causality

1. Introduction

The relationship between government expenditure and economic growth is a subject of debate in theoretical and empirical economic literature. Theoretically, two conventional views describe this relationship. First, the Wagner’s law stresses that as a country develops, the share of public spending tends to rise to meet the increased protective, administrative and social functions of the state (Wagner, 1958). This view suggests a unidirectional causality running from per capita income to government expenditure. On the other hand, the Keynesian view argues that increases in public spending stimulate economic growth, especially in times of recession (Keynes, 1936). This line of though suggests that causality is running from public expenditure to per capita income.

An extensive empirical research has examined the validity of these two competing views. The empirical methodology made use of either the Engle-Granger method or the multivariate approach of Johansen and Juselius (1990). Recently, there is a growing body of empirical studies using the bounds test developed by Pesaran et al. (2001). The empirical evidence from this literature is however mixed and controversial across countries, data, model specifications and econometric techniques. While some studies (Ram, 1987; Ahsan et al., 1996; Cotsomitis et al., 1996; Thornton, 1999; Islam, 2001; Al-Faris, 2002; Chang, 2002; Aregbeyen, 2006; Narayan et al., 2008; Srinivasan, 2013; Bayrak and Esen, 2014) found support for Wagner’s Law, other studies (Ansari et al., 1997; Biswal et al., 1999; Ghali, 1999; Burney, 2002; Huang, 2006) reported results contradicting Wagner’s law. Some other studies (Singh & Sahni, 1984; Ahsan et al., 1992; Afxentiou & Serletis, 1996; Sinha, 1998; Bagdigen & Cetintas, 2004; Dogan & Tang, 2006) showed no evidence for both propositions. Richter and Paparas (2013) used Greek data from 1833 to 2010 and provided evidence in favor of Wagner’s law. On the contrary, Ogbonna (2015) reexamined the case of Greece using data for the period 1948-2010 and failed to find evidence supporting either Wagner’s law or Keynesian hypothesis. Hassan et al. (2008) used the ARDL bounds test to provide strong support for Wagner’s law in Turkey over the period 1950-2005. Bayrakdar et al. (2015) also confirmed the validity of Wagner’s for Turkey over the period 1998-2014. Narayan et al. (2008) used cointegration and Granger causality tests and found mixed evidence in support of Wagner’s law for Chinese provinces. Magazzino (2012) also found evidence in favor of Wagner’s law in the case of Italy for the period 1960-2008. Narayan et al. (2012) found evidence of Wagner’s law for 15 Indian states using panel techniques. Samadi and Abolhasan Belgi (2013) used recent developments in econometrics to examine the validity of Wagner law for a panel of Organization of Islamic Conference member states. Controlling for cross-sectional dependence, their estimation results confirm the Wagner's law in all countries. Magazzino et al. (2015) investigated the case of 27 European Union member countries for the period 1980-2013 using panel methods that account for cross-section dependence. Their results supported Wagner's law in eight countries, and Keynesian view in four countries. For 12 countries, there is no causal relationship public expenditure and GDP. Atasoy and Gür (2016) applied the ARDL model and the Kalman filter and found that Wagner's law holds for China during the period 1982-2011.

Studies on African countries have yielded mixed and conflicting results. Ansari et al. (1997) found that there is no long run relationship between government expenditure and national income in Ghana, Kenya and South Africa. In the short-run, only Ghana shows evidence supporting Wagner's law. Olomola (2004), Aregbeyen (2006), Ogbonna (2012) and Akinlo (2013) for Nigeria, Menya and Wolde-Rufael (2012) for South Africa, Mutuku and Kimani (2012) for Kenya, and Salih (2012) for Sudan found evidence supporting Wagner's law. On the contrary, the studies by Omoke (2009), Chimobi (2009), Sevitenyi (2012), and Muse et al. (2013) for Nigeria, Ebaidalla (2013) for Sudan, and Gadinabokao and Daw (2013) for South Africa provided support for the Keynesian view. Ayo et al. (2011) found supportive evidence for both hypotheses both in the short run and the long run in Nigeria. Besides, Frimpong and Oteng-Abayie (2009) supported neither Wagner's law nor Keynesian view for three West African Monetary Zone countries (Gambia, Ghana and Nigeria). Kamasa and Ofori-Abebrese (2015) applied the VAR approach and found results supporting Wagner's law in Ghana over the period 1980-2010. Keho (2015) applied a frequency domain analysis to ten African countries. He found evidence supporting Wagner's law in Cameroon, Ghana and Nigeria. The Keynesian view holds for Gabon, Senegal and South Africa. Odhiambo (2015) employed the ARDL approach to examine the case of South Africa. He found that both government expenditure and economic growth cause each other in the short run while in the long run Wagner's law holds. More recently, Keho (2016) reexamined the validity of Wagner's law in six African countries over the period 1960-2013. He applied a cointegration techniques that control for structural breaks. He found supporting evidence of Wagner's law in Ghana over the period 1960-2013 and in Cote d'Ivoire for the period 1960-1995. For Kenya, the evidence supports both Wagner's law and Keynesian view for the period 1960-1991. For Benin, Senegal and South Africa, the results do not support Wagner's law or Keynesian theory. Thabane and Lebina (2016) applied the ARDL bounds testing procedure to examine the economic growth and government expenditure nexus in Lesotho for the period 1980 to 2012. Their results are consistent with Wagner's law and fail to support the Keynesian view. Udo et al. (2016) examined the case of sixteen West African economies for the period 1970-2012. Their results support Wagner's law for Guinea and Cape Verde, while Keynesian view holds for Togo, Mauritania, Liberia and Sierra Leone. However, there is bidirectional causality between economic growth and government expenditure in Nigeria, Mali, Ghana, Gambia, and Cote d'Ivoire. For Benin, Guinea Bissau, Senegal, Burkina Faso and Niger, there is no relationship between the two variables. Paul and Furahisha (2017) used cointegration technique and found strong support for both Wagner's law and Keynesian view in the case of Tanzania for the period 1978-2014.

A major limitation of most empirical works using cointegration tests is that they implicitly assume the adjustment process of the variables to be strictly symmetric. This assumption indicates that, regardless of a positive or negative equilibrium error, the adjustment speed remains identical. The state of the economy and whether or not economy is growing or decreasing does not matter. If government expenditure behaves differently when income is decreasing than when it is increasing, then standard cointegration techniques may not be accurate in characterizing the true relationship between government spending and economic growth. Balke and Fomby (1997) and Enders and Granger (1998) showed that the power of standard cointegration tests fall under an asymmetric adjustment process.

While empirical tests of Wagner's law have been extensive, no recent studies have considered asymmetry in testing this hypothesis for African countries. The main contribution of this paper is to reexamine the relationship between government expenditure and income by using nonlinear cointegration and asymmetric modeling. In particular, we employ the threshold autoregression approach developed by Enders and Granger (1998) and Enders and Siklos (2001). These methods are suitable for testing whether public spending behaves asymmetrically over the business cycle. It is widely acknowledged that there is a very close connection between the budget and the business cycle through automatic fiscal stabilizers. To the extent that business is asymmetric, the change in public spending may also be asymmetric. Recent studies suggested the possibility that fiscal policy may have nonlinear growth effects, in the sense that both the size and the sign of the response of real variables to fiscal policy could be different depending on the initial conditions in which such policy is implemented (e.g. Bertola & Drazen, 1993; Giavazzi et al. 2000; Perotti, 1999).

The remainder of the study is organized as follows. Section 2 presents the econometric methodology of the study. Section 3 analyses the empirical results. Finally, Section 4 provides summary and gives some policy implications.

2. Econometric Methodology

The empirical analysis proceeds in three steps. First, we begin by testing for unit roots to ascertain the order of integration of the variables. Second, we test for possible cointegration between the variables. The third step determines the direction of causation among the variables. Wagner's law requires unidirectional causality running from income to public spending.

2.1 Unit Root Test

Standard unit root tests such as augmented Dickey-Fuller and Phillips and Perron (1988) are widely used to ascertain the order of integration of variables. However, these tests exhibit lower power in detecting non-linearity. Therefore, this study employs a newly developed test proposed by Kapetanios et al. (2003) (henceforth, KSS) to determine whether government expenditure and income are non-linear stationary. The KSS test is based on testing the presence of non-stationarity against non-linear but globally stationary exponential smooth transition autoregressive (ESTAR) process:

$$\Delta z_t = \gamma z_{t-1}\left(1-\exp\left(-\theta z_{t-1}^2\right)\right)+\sum_{i=1}^{p}\phi_i \Delta z_{t-i} + \nu_t \tag{1}$$

where z_t is the variable considered, v_t an *i.i.d.* error with zero mean and constant variance, and $\theta \geq 0$ is the transition parameter. We are interested in testing the null hypothesis of $\theta = 0$ against the alternative of $\theta > 0$. Under the null hypothesis, z_t follows a linear unit root process, whereas it is a non-linear stationary ESTAR process under the alternative. Because the parameter γ is not identified under the null, it is not feasible to directly test the null hypothesis. Kapetanios et al. (2003) proposed a first-order Taylor series approximation to $1-\exp\left(-\theta z_{t-1}^2\right)$ under the null of $\theta = 0$ and replaced Eq.(1) by the following regression:

$$\Delta z_t = \xi + \delta z_{t-1}^3 + \sum_{i=1}^{p}\phi_i \Delta z_{t-i} + \nu_t \tag{2}$$

The null hypothesis to be tested is then expressed as $\delta = 0$ (non-stationarity) against the alternative $\delta < 0$ (non-linear ESTAR stationarity). The estimated critical values for different values of *p* are tabulated in Kapetanios et al. (2003).

2.2 Threshold Cointegration

If the variables are I(1), we proceed with long-run relationship and cointegration tests. We employ the threshold cointegration approach proposed by Enders and Granger (1998) and Enders and Siklos (2001). This approach is a residual-based two-stage estimation procedure. Following Engle and Granger (1998), the cointegration relation is estimated as follows:

$$g_t = \beta_0 + \beta_1 y_t + e_t \tag{3}$$

where *g* is the natural logarithm of real per capita government expenditure and *y* is the natural logarithm of real per capita GDP. The residual term *e* is expected to be stationary.

The second stage tests for the stationarity of the residual term *e* using unit root tests. Pippenger and Goering (1993), Balke and Fomby (1997), Enders and Granger (1998) and Enders and Siklos (2001) showed that standard tests for unit-root and cointegration all exhibit low power in the presence of asymmetric adjustment towards the long-run relationship. If government spending behaves differently when income is decreasing than when it is increasing, then standard cointegration tests are no longer reliable. Enders and Granger (1998) and Enders and Siklos (2001) replace the standard ADF auxiliary regression with the following Threshold Autoregressive (TAR) process:

$$\Delta e_t = I_t \rho_1 e_{t-1} + \left(1-I_t\right)\rho_2 e_{t-1} + \sum_{i=1}^{p}\phi_i \Delta e_{t-i} + \varepsilon_t \tag{4}$$

where I_t is the heaviside indicator function such that $I_t=1$ if $e_{t-1} \geq \tau$ and $I_t=0$ if $e_{t-1} < \tau$; τ is the value of the threshold. It is also possible to allow the adjustment to depend on the previous change in e_{t-1} rather than on the previous level e_{t-1}. In this case, the heaviside indicator becomes $I_t=1$ if $\Delta e_{t-1} \geq \tau$ and $I_t = 0$ if $\Delta e_{t-1} < \tau$.

Once Equation (4) is estimated, the null hypothesis $\rho_1 = \rho_2 = 0$ of no cointegration is tested through the F-statistic. However, the distribution of this statistics is not standard. The appropriate critical values are tabulated by Enders and Siklos (2001). The rejection of $\rho_1 = \rho_2 = 0$ implies the existence of a cointegration relationship between the variables. This enables us to proceed with a further test for symmetric adjustment ($\rho_1 = \rho_2$) by using a standard F-test. Rejecting both the null hypotheses of $\rho_1 = \rho_2 = 0$ and $\rho_1 = \rho_2$ implies the existence of threshold cointegration with asymmetric adjustment.

In most cases, the value of the threshold is unknown, and it has to be estimated along with ρ_1 and ρ_2. To obtain a consistent estimate of the threshold, we follow a grid search procedure. Typically, the residual series is sorted into an increasing order. The central 80% of observations are then considered as potential thresholds. For each of these potential thresholds, Equation (4) is estimated by OLS and the consistent estimated threshold is found by selecting the value that minimises the sum of squared residuals.

2.3 Short-Run Dynamics and Granger-Causality

Under the assumption of threshold cointegration, the short-run dynamics of the series is examined with an asymmetric error correction model. In most studies applying threshold cointegration, only the speed of the adjustment to the long-run relationship changes with regimes, while the autoregressive coefficients remain constant. In this study, we relax this assumption, allowing the speed of the adjustment as well as the short-run dynamics to vary across regimes. Thus, our asymmetric error correction model is specified as follows:

$$\Delta g_t = A_{11}^{+}(L)\Delta g_{t-1}^{+} + A_{11}^{-}(L)\Delta g_{t-1}^{-} + A_{12}^{+}(L)\Delta y_{t-1}^{+} + A_{12}^{-}(L)\Delta y_{t-1}^{-} + \alpha_1^{+} e_{t-1}^{+} + \alpha_1^{-} e_{t-1}^{-} + \mu_{1t} \tag{5}$$

$$\Delta y_t = A_{21}^{+}(L)\Delta g_{t-1}^{+} + A_{21}^{-}(L)\Delta g_{t-1}^{-} + A_{22}^{+}(L)\Delta y_{t-1}^{+} + A_{22}^{-}(L)\Delta y_{t-1}^{-} + \alpha_2^{+} e_{t-1}^{+} + \alpha_2^{-} e_{t-1}^{-} + \mu_{2t} \tag{6}$$

where $e_{t-1}^{+} = I_t e_{t-1}, e_{t-1}^{-} = (1-I_t)e_{t-1}, A_{ij}(L)$ are p*th* order lag polynomials in the lag operator L, $\Delta g_t^{+} = \max(\Delta g_t, 0)$, $\Delta g_t^{-} = \min(\Delta g_t, 0)$; Δy_t^{+} and Δy_t^{-} are similarly defined. The choice of the appropriate lag length is based on the AIC.

The estimated coefficients on e_{t-1}^{+} and e_{t-1}^{-} determine the rate at which positive and negative deviations adjust to long-run relationship. The null $\alpha^{+} = \alpha^{-}$ indicates symmetry in the long-run adjustment, and can be tested by using a standard F-test. On the other hand, short-run symmetry $A_{ij}^{+}(L) = A_{ij}^{-}(L)$ can also be tested using a standard F-test. In the absence of short-run asymmetry, we estimate the following threshold error-correction model:

$$\Delta g_t = A_{11}(L)\Delta g_{t-1} + A_{12}(L)\Delta y_{t-1} + \alpha_1^{+} e_{t-1}^{+} + \alpha_1^{-} e_{t-1}^{-} + \mu_{1t} \tag{7}$$

$$\Delta y_t = A_{21}(L)\Delta g_{t-1} + A_{22}(L)\Delta y_{t-1} + \alpha_2^{+} e_{t-1}^{+} + \alpha_2^{-} e_{t-1}^{-} + \mu_{2t} \tag{8}$$

The short-run Granger causality tests are performed by testing whether all the coefficients of Δy_{t-i} or Δg_{t-i} are jointly statistically different from zero based on standard F-tests, while long-run causality Granger causality analysis tests whether the α_i coefficients of the error-correction are significant.

3. Data and Empirical Results

This study uses annual data on real per capita government expenditures (G) and real per capita GDP for a sample of six African countries: Benin, Cameroon, Cote d'Ivoire, Ghana, Kenya and Senegal. The GDP deflator was used to express data in constant 2005 US dollars. Meanwhile, the effect of population growth was removed by using per capita values. Data cover the period from 1965 to 2013 and were obtained from the World Development Indicators, available online. Data were also transformed into natural logarithms.

Table 1 reports some descriptive statistics on the variables. The standard deviations of variables indicate significant fluctuations in per capita income and public spending over the time period under study. Also evident from the Table is the positive association between the two variables. However, correlation does not mean causality. Our goal in this study is to find out whether this positive association implies that higher government spending induces higher income or higher income leads to higher public spending.

Table 1. Descriptive statistics of variables

	GDP					Gouvernement expenditure					Corr.
Country	Mean	Med.	Std.	Min	Max	Mean	Med.	Std.	Min	Max	
Benin	478.4	464.3	47.3	411.8	582.8	67.4	66.7	7.65	49.5	87.1	-0.13
Cameroon	912.3	907.8	177.2	640.7	1356.1	84.7	84.8	18.4	54.1	120.1	0.68
Cote d'Ivoire	1231.5	1131.4	246.6	940.1	1836.6	159.9	156.8	74.8	70.8	327.3	0.89
Ghana	456.9	440.3	95.5	320.8	769.3	55.8	52.1	24.0	18.8	153.3	0.90
Kenya	503.6	511.2	65.2	322.9	632.4	79.3	76.2	20.5	32.5	109.2	0.79
Senegal	739.1	729.5	54.6	635.1	837.4	120.0	119.0	20.1	94.7	166.2	0.47

As a first step of our empirical analysis, we test for the order of integration of the series by means of the well-known Phillips and Perron (PP) (1988) and Kwiatkowsk et al. (1992) tests. These tests have been performed under the models with constant and trend for the level series and with constant for series in first difference. The results of these tests are reported in Table 2. They show that all the variables are non-stationary in their level but become stationary after taking the first difference, except government spending (g) for Benin. Table 3 presents the results of the non-linear ESTAR stationary test of Kapetanios et al. (2003), which provide similar evidence that the series are all integrated of order one or I (1), except the public spending variable for Benin.

Table 2. Results of conventional linear unit root tests

	PP				KPSS			
	g	y	Δg	Δy	g	y	Δg	Δy
Benin	-3.655	-2.410	-12.400	-8.066	0.132	0.170	0.274	0.339
Cameroon	-2.040	-1.619	-6.791	-5.170	0.131	0.141	0.093	0.114
Cote d'Ivoire	-2.556	-2.643	-5.822	-4.499	0.156	0.106	0.268	0.202
Ghana	-0.979	-0.231	-5.483	-4.596	0.207	0.228	0.329	0.393
Kenya	-2.823	-2.968	-4.808	-6.130	0.130	0.158	0.288	0.299
Senegal	-1.834	-1.451	-5.317	-9.459	0.096	0.211	0.158	0.367

Note. g and y are the symbols for log of real per capita government expenditure and real per capita GDP, respectively.

Table 3. Results of the KSS nonlinear unit root test

	Level		First difference	
Country	g	y	Δg	Δy
Benin	-4.811	-2.698	-5.867	-6.202
Cameroon	-2.229	-0.937	-4.594	-4.585
Cote d'Ivoire	-2.202	-2.847	-3.930	-4.328
Ghana	-1.511	0.201	-3.689	-3.185
Kenya	-2.910	-1.141	-4.070	-3.251
Senegal	-2.019	-1.825	-4.515	-6.076

Note. g and y are the symbols for log of real per capita government expenditure and real per capita GDP, respectively. Critical values at the 5% level are -3.40 in level and -2.22 in first difference, and are taken from Kapetanios et al. (2003).

Given the unit root tests results, we further test for threshold cointegration between the two variables. We estimate the long-run relationships and use the residuals to test for threshold cointegration. We exclude Benin from the cointegration analysis. For this country, government expenditure is mean-reverting in the long-run regardless of real income. For the rest of the countries, the results of the threshold tests are reported in Table 4. The empirical evidence in this Table shows that the null of no cointegration (ρ_1=ρ_2=0) can be rejected for all countries, suggesting the existence of stationary long-run relationships between government spending and per capita income. In addition, the F-statistics reject the null hypothesis of symmetric adjustment (ρ_1=ρ_2) in favor of asymmetric threshold adjustment toward the long run relationship. Note that the point estimates of ρ_1 and ρ_2 suggest substantially faster convergence for negative (below threshold) deviations from long run equilibrium than positive (above threshold) deviations, except for Cameroon and Ghana. For example, for Cote d'Ivoire, negative deviations from the long run relationship resulting from decreases in government spending or increases in income are eliminated at a rate of 91 percent per year, while positive deviations are eliminated at only 6.5 percent per year. Similarly, for Kenya, negative deviations from the long run relationship stemming from decreases in government spending or increases in income are eliminated much faster than positive deviations. In that sense, decreases in government spending and increases in real per capita GDP are reversed quickly whereas increases in government spending and decreases in real per capita GDP linger for a while for Cote d'Ivoire, Kenya and Senegal. On the other hand, for Cameroon and Ghana positive deviations from the long run relationship stemming from increases in government spending or decreases in real per capita income are eliminated relatively quickly.

Table 4. Results of threshold cointegration tests

Country	Flag	AIC	ρ1	ρ2	Φ (ρ1= ρ2=0)	ρ1= ρ2	τ	β1
Cameroon	TAR	-2.60	-0.615 (-3.91)	-0.187 (-1.08)	8.21*	3.345**	0.083	0.614 (9.19)
Cote d'Ivoire	MTAR	-1.73	-0.065 (-0.67)	-0.909 (-5.65)	16.49*	19.088*	-0.069	1.959 (12.41)
Ghana	MTAR	-1.23	-0.974 (-3.37)	-0.448 (-3.41)	10.16*	3.048**	0.173	1.937 (13.84)
Kenya	TAR	-2.75	-0.168 (-1.56)	-0.463 (-3.81)	8.20*	3.506**	-0.070	1.202 (6.23)
Senegal	MTAR	-3.90	-0.560 (-2.85)	-1.130 (-5.49)	15.11*	8.742*	-0.033	0.863 (6.52)

Note. Numbers in parentheses are t-statistics. * (**) indicates significance at 5% (10%) level. Critical values are based on Enders and Siklos (2001).

Having established cointegration between the variables as well as asymmetric adjustment in the long-run relationships, it is possible to estimate the asymmetric version of the standard error correction model. For Benin, where government expenditure is stationary, we estimate a dynamic model of the form:

$$g_t = A_{11}(L)g_{t-1} + A_{12}^{+}(L)\Delta y_{t-1}^{+} + A_{12}^{-}(L)\Delta y_{t-1}^{-} + \alpha_1^{+}e_{t-1}^{+} + \alpha_1^{-}e_{t-1}^{-} + \mu_{1t} \tag{9}$$

$$\Delta y_t = A_{21}(L)g_{t-1} + A_{22}^{+}(L)\Delta y_{t-1}^{+} + A_{22}^{-}(L)\Delta y_{t-1}^{-} + \alpha_2^{+}e_{t-1}^{+} + \alpha_2^{-}e_{t-1}^{-} + \mu_{2t} \tag{10}$$

The results of the Granger-causality tests are presented in Table 5. The point estimates of the error correction terms for GDP are not significant for all countries. This indicates that real per capita GDP is weakly exogenous to the public spending. The results also suggest a long run unidirectional causal relationship running from per capita GDP to government expenditure in Cameroon, Cote d'Ivoire, Ghana, Kenya and Senegal. These findings favor Wagner's law.

With respect to the short-run causality, the F-statistics suggest that public expenditures cause per capita GDP in Benin, Cameroon and Cote d'Ivoire. There is evidence of short-run bidirectional causality between public expenditures and per capita GDP for Kenya and Senegal. Conversely, no short-run causal relationship exists between the two variables in Ghana. This finding suggests that the movements of government spending and per capita income do not have significant impacts upon each other in the short-run.

Table 5. Tests of exogeneity, Granger-causality and symmetry in error correction models

	Eq.	α+a	α-a	F11b	F12c	(α+=α-=0)	Symmetry (α+=α-)	p
Benin	Δg	-	-	11.48	0.49	-	-	2
				(0.001)	(0.611)			
	Δy	-	-	0.90	8.84	-	-	2
				(0.413)	(0.000)			
Cameroon	Δg	-0.868	0.037	1.66	0.99	8.38	9.59	4
		(-3.68)	(0.12)	(0.181)	(0.426)	(0.001)	(0.004)	
	Δy	-0.039	0.227	4.19	3.33	0.70	1.33	4
		(-0.21)	(0.98)	(0.007)	(0.021)	(0.501)	(0.255)	
Cote d'Ivoire	Δg	-0.004	-0.429	3.45	0.29	2.89	4.27	1
		(-0.03)	(-2.40)	(0.070)	(0.590)	(0.066)	(0.044)	
	Δy	0.041	0.021	11.92	4.15	0.51	0.07	1
		(0.98)	(0.33)	(0.001)	(0.047)	(0.601)	(0.792)	
Ghana	Δg	-0.843	-0.426	2.77	1.02	5.23	4.14	1
		(-2.27)	(-2.53)	(0.103)	(0.316)	(0.009)	(0.048)	
	Δy	0.077	0.023	5.95	0.20	0.36	0.24	1
		(0.74)	(0.49)	(0.019)	(0.649)	(0.695)	(0.623)	
Kenya	Δg	-0.036	-0.444	2.38	3.13	3.99	3.28	3
		(-0.29)	(-2.71)	(0.080)	(0.015)	(0.028)	(0.078)	
	Δy	-0.033	-0.003	1.76	3.03	0.06	0.03	3
		(-0.34)	(-0.03)	(0.138)	(0.042)	(0.938)	(0.860)	
Senegal	Δg	-0.024	-0.634	8.08	4.83	7.98	10.55	3
		(-0.16)	(-3.94)	(0.000)	(0.006)	(0.001)	(0.002)	
	Δy	-0.055	-0.328	3.89	2.61	1.99	3.12	3
		(-0.35)	(-1.90)	(0.017)	(0.034)	(0.151)	(0.086)	

Note. (a) The entries are estimated error correction terms given the threshold adjustment with t-statistics in parentheses.

(b) The entries are estimated F-statistics that the variable does not Granger cause itself with the p-values in parentheses.

(c) The entries are estimated F-statistics that the variable does not Granger cause the other variable with p-values in parentheses.

In light of these findings, we can conclude that government expenditures in Benin, Cameroon and Cote d'Ivoire follow the Keynesian view in the short-run while Kenya and Senegal exhibit evidence supporting both Wagner's law and Keynesian view. Wagner's law holds in the long-run in Cameroon, Cote d'Ivoire, Ghana, Kenya and Senegal. Thus, the Keynesian view holds only in the short-run and not in the long-run. These findings suggest that restrictions on public spending limit the ability of the countries to use fiscal policy to stabilize their economies during recessions. Also, the growth in government spending is influenced by per capita economic growth. This link operates through tax revenues, since how much the government can increase its expenditures is determined by its revenues. Governments mobilize more tax revenues from growing economic activity to make up their spending. Our findings for Ghana and Kenya contradict with those provided by Ansari et al. (1997) and Frimpong and Oteng-Abayie (2009). Ansari et al. (1997) found that in Ghana and Kenya there is no long run relationship between government expenditure and national income and that Wagner's law is supported only in the short-run for Ghana. The findings of Frimpong and Oteng-Abayie (2009) do support neither Wagner's hypothesis nor Keynesian view for these two countries.

4. Conclusion

Wagner's law of increasing government size has been the topic of a burgeoning empirical literature in the past few decades. A number of studies have used the Granger causality test to examine the causal relationship between government expenditure and national income. The evidence from these studies is inconclusive and controversial across countries and methodologies.

This study re-examined the validity of Wagner's law and its reverse for six sub-Saharan African countries over the period 1965 to 2013. It relaxed the implicit assumption of a symmetric adjustment process underlying conventional cointegration tests and allows the possibility of asymmetry in the relationship between public expenditure and economic growth. The empirical methodology used threshold cointegration and asymmetric Granger-causality tests. We found that there is a long-run cointegration relationship between government expenditure and per capita GDP for five countries, with per capita GDP positively related to public spending. In addition, the results of Granger-causality tests provide support for Wagner's law in the long-run for five countries (Cameroon, Cote d'Ivoire, Ghana, Kenya, and Senegal) whereas the Keynesian paradigm is confirmed only in the short-run for three countries (Benin, Cameroon, and Cote d'Ivoire). The short-run government expenditure movements in Kenya and Senegal are consistent with both Wagner's law and Keynesian doctrine.

The findings suggest that government spending can be used as a policy instrument to stimulate economic growth in the short-run. Therefore, restrictions on public spending limit the ability of the countries to use fiscal policy to stabilize their economies during recessions. This is particularly relevant for member countries of monetary unions, namely Benin, Cameroon, Cote d'Ivoire and Senegal.

The results presented in this paper provided the first evidence of asymmetric relationship between government expenditure and national income for a sample of sub-Saharan African countries. It has added to our understanding of the government spending-economic growth nexus and calls for the need to revise traditional linear specifications on Granger-causality.

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