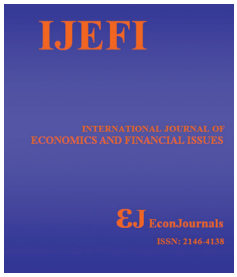

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Testing Wagner's Law in the Presence of Structural Changes: New Evidence from Six African Countries (1960-2013)

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ABSTRACT

This study re-examines the relationship between government expenditure and national income in order to test the validity of Wagner's law for six African countries over the period from 1960 to 2013. The empirical analysis uses the Gregory and Hansen (1996) cointegration test which allows for a structural break in the long run relationships. We find supporting evidence of Wagner's law in Ghana over the period 1960-2013 and in Cote d'Ivoire for the period 1960-1995. Evidence for Kenya for the period 1960-1991 supports both Wagner's law and Keynesian view. The results for the other three countries do not advocate Wagner's law or its reverse in the long run.

Keywords: Wagner's Law, Structural Change, Gross Domestic Product, Cointegration, Granger Causality
JEL Classifications: C32, E62, H50, O55

1. INTRODUCTION

Over the past three decades, a growing body of empirical studies has been devoted to test the validity of Wagner's law. According to Wagner's law, government activities tend to increase along with economic development. This is due to social, administrative and welfare issues which increase in need and complexity as an economy develops (Wagner, 1883). Wagner's law suggests a one-way long-run causality running from economic growth to government expenditure. An alternative view postulated by Keynes (1936) contends that the causality runs from government spending to economic growth, i.e., growing government expenditure lead to a higher level of aggregate demand, which in turn promotes economic growth.

Wagner's law has been tested in different ways. In early time series analyses, government expenditure is regressed on gross domestic product without taking into account the dynamic properties of the series. More recently, new econometric test specifications have been implemented taking into consideration non-stationarity and cointegration. However, the empirical literature has yielded mixed and conflicting results across countries and methodologies. For instance, studies by Ahsan et al. (1996), Islam (2001), Chang (2002), Tan (2003), Narayan et al. (2012) and Srinivasan (2013) presented results supporting Wagner's law. In contrast, the studies by Ghali (1999), Burney (2002), and Huang (2006) reported empirical evidence contradicting Wagner's hypothesis. The studies by Biswal et al. (1999) and Samudram et al. (2009) found evidence supporting both Wagner's Law and Keynesian view. Contrastingly, there are some studies (Singh and Sahni, 1984; Afxentiou and Serletis, 1996; Sinha, 1998; Bagdigen and Cetintas, 2003; Dogan and Tang, 2006) that found no empirical support for both propositions.

Studies on sub-Saharan African countries have also yielded mixed results. For instance, Ansari et al. (1997) investigated the direction of causality between government expenditure and national income for Ghana, Kenya, and South Africa. They found that there is no long run relationship between government expenditure and national income. In the short-run, only Ghana shows evidence supporting Wagner's law. The results obtained by Olomola (2004), Aregbeyen (2006), Ogbonna (2012), Akonji et al. (2013), and Akinlo (2013) for Nigeria, Menyah and Wolde-Rufael (2012) for South Africa, Mutuku and Kimani (2012) for Kenya, and Salih (2012) for Sudan are consistent with Wagner's law. In contrast, 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 empirical evidence for both hypotheses both in the short run and long run for Nigeria. Besides, the results obtained by Frimpong and Oteng-Abayie (2009) supported neither Wagner's law nor Keynesian view for Gambia, Ghana and Nigeria.

An important reason of the lack of consensus in empirical literature about the validity of Wagner's law may stem from the presence of structural changes during the sample period. Cointegration with structural breaks means the significant change of the long-run parameters or the change of the existence of long-run relationships between variables. Since government expenditure and economic growth can be affected by economic and fiscal policy changes as well as external shocks, the long-run relationships may exhibit structural changes. It is well known by now that such structural changes lower the power of standard tests of stationarity and cointegration (Gregory et al. 1996).

This paper re-examines the validity of Wagner's law for six African countries using cointegration test with structural break. Given that African countries have witnessed important policy changes during the period 1960-2013, this method would yield more reliable results. The remainder of the study is outlined as follows. Following the introduction, Section 2 describes the econometric methodology. Section 3 analyses the empirical results and Section 4 concludes.

2. ECONOMETRIC METHODOLOGY

2.1 Data and Model

Wagner's law hypothesizes that the share of government expenditure in national income increases with economic development. To test this proposition, the empirical model is specified as follows:

$$g_t = \alpha + \theta y_t + \mu_t \quad (1)$$

where g is the natural logarithm of the share of government expenditure in gross domestic product (GDP) and y is the natural logarithm of real per capita GDP. The residual term μ is expected to be stationary as indication of long-run relationship. Wagner's law requires that the coefficient on income is positive, $\theta > 0$, suggesting that public expenditure grows faster than income rendering the demand for public goods similar to the demand for superior goods.

The study uses annual time series data on government expenditures as share of GDP and real per capita GDP for a sample of six selected African countries, including Benin, Cote d'Ivoire, Ghana, Kenya, Senegal and South Africa. 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 1960 to 2013 and were obtained from the World Development Indicators, available online. Data were also transformed to natural logarithms.

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 relationship between the variables. The third step determines the direction of causation among them.

2.2 Cointegration Test with Structural Break

Standard cointegration techniques are widely used to test the existence of long run relationship between government expenditure and economic growth. However, it has been demonstrated that the potential presence of structural breaks may bias these tests towards non-rejection of the null hypothesis of no cointegration. The period of this study is long and during this period countries may experience many economic and financial policy changes. Therefore, it is appropriate to consider the possible structural breaks in estimating the long run relationship between government spending and economic growth.

Gregory and Hansen (1996a, 1996b) extend the Engle-Granger's procedure by allowing the existence of one-time change in the cointegration relationship. They propose a residual-based two-stage estimation procedure to test for the null of no cointegration against four alternatives of cointegration with a structural break. In this study, we specify the long-run relationships as follows:

Model 1: Level shift (C) $g_t = \beta_0 + \beta_1 d_t + \theta y_t + \mu_t \quad (2)$

Model2: Levelshiftwithtrend(C/T) $g_t = \beta_0 + \beta_1 d_t + \alpha t + \theta y_t + \mu_t \quad (3)$

Model 3: Regime shift with trend (C/S)

$$g_t = \beta_0 + \beta_1 d_t + \alpha t + \theta_1 y_t + \theta_2 d_t y_t + \mu_t \quad (4)$$

Model 4: Regime shift (C/S/T)

$$g_t = \beta_1 + \alpha_1 t + \theta_1 y_t + \beta_2 d_t + \alpha_2 t d_t + \theta_2 d_t y_t + \mu_t \quad (5)$$

Where d_t is a dummy variable allowing for structural break such that $d_t = 1$ if $d_t > \tau$ and $d_t = 0$ if $d_t > \tau$, where τ denotes the break date. The value of τ is determined using a grid search procedure with all values in the central 80% of the sample being considered. The residual μ_t obtained by the model at each value of τ is saved and employed in a standard Dickey-Fuller testing regression. The statistic of the cointegration test with structural break is the smallest value of the conventional ADF test statistic across all values of every possible breakpoint. Critical values are provided by Gregory and Hansen (1996a, 1996b).

2.3. Granger-Causality Test

The existence of cointegration between government spending and income suggests the existence of Granger-causality in at least one direction, but it does not indicate the direction of causality. To shed light on the causal relationship between the variables, we perform the Granger causality test. In the presence of cointegration, Granger-causality is modeled within a dynamic error correction

representation in which an error correction term is incorporated into the model. Accordingly, the Granger causality tests will be based on the following equations:

$$\Delta g_t = \alpha_1 + \sum_{j=1}^{p} \beta_{1j} \Delta g_{t-j} + \sum_{j=1}^{p} \gamma_{1j} \Delta y_{t-j} + \lambda_1 \hat{\mu}_{t-1} + e_{1t} \quad (6)$$

$$\Delta y_t = \alpha_2 + \sum_{j=1}^{p} \beta_{2j} \Delta g_{t-j} + \sum_{j=1}^{p} \gamma_{2j} \Delta y_{t-j} + \lambda_2 \hat{\mu}_{t-1} + e_{2t} \quad (7)$$

Where $\hat{\mu}_{t-1}$ stands for the lagged error correction term derived from the long-run relationship. In the absence of cointegration, this term is not included. An error correction model enables one to distinguish between long-run and short-run Granger causality. The long-run causality is performed by testing the significance of the coefficients λ_i, while the short-run causality examines the significance of the sum of lagged dynamic terms.

3. EMPIRICAL RESULTS

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) KPSS 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 1. They show that all the variables are non-stationary in their level but become stationary after taking the first difference. Therefore, all series are I(1).

Given the results of unit root tests, we further investigate the long run relationship between the two variables. We first apply the maximum likelihood-based trace and maximum-eigenvalue tests of Johansen (1995) and calculate the *p*-values according to MacKinnon et al. (1999). The tests are applied under the hypothesis that there is linear deterministic trend in data. The outcomes of the tests are reported in Table 2. As we can see from this Table 2, we find mostly evidence against cointegration. We find support for cointegration between government expenditure and income only for two countries out of six, i.e., we reject the null hypothesis of no cointegration for Ghana and South Africa. For the other four countries, we cannot reject the null hypothesis of no cointegration with both the trace and maximum-eigenvalue tests.

Table 1: Results of unit root tests

Country	PP test				KPSS test			
	g	y	Δg	Δy	g	y	Δg	Δy
Benin	−1.96	−2.76	−8.04	−9.49	0.14	0.13	0.08	0.22
Cote d'Ivoire	−2.20	−2.57	−5.60	−5.59	0.20	0.16	0.28	0.30
Ghana	−2.57	−0.67	−6.61	−4.57	0.15	0.24	0.12	0.15
Kenya	−2.56	−1.66	−6.86	−7.28	0.21	0.20	0.41	0.17
Senegal	−2.04	−1.19	−7.21	−9.93	0.19	0.22	0.23	0.39
South Africa	−1.83	−2.28	−6.11	−4.05	0.24	0.14	0.32	0.27

Notes: *g* and *y* are the symbols for log of government expenditure as share of GDP and real per capita GDP, respectively. Critical values at the 5% level are for PP test: −3.49 (level) and−2.91 (difference), and for KPSS test: 0.146 (level) and 0.463 (first difference), KPSS: Kwiatkowski–Phillips–Schmidt–Shin, PP: Phillips and Perron

In the next step, we test for structural breaks by applying the Gregory and Hansen (1996a) cointegration test. The results in Table 3 show that government expenditure and real per capita GDP are cointegrated in all countries. Given this evidence, we further estimate the long run relationships between the two variables. Results are reported in Table 4. From this Table, two set of elasticities can be computed. For the first period, long-run elasticity is simply the parameter estimated θ_1. The elasticity for the period after the break is obtained by adding to the corresponding θ_1, the value of θ_2. In other words, long-run income elasticity for the period after the break is equal to $\theta_1 + \theta_2$. According to the figures in Table 3, the slope on per capita income is positive and significant for Cote d'Ivoire and Kenya only before the break date, lending credence to Wagner's law. The income elasticity is positive and significant for Ghana before and after the year 1990 and also consistent with Wagner's law. The implication of these findings is that structural break should be considered when modeling long-run relationship between government expenditure and per capita GDP over long period.

The results of the Granger-causality tests are presented in Table 5. The empirical evidence in this Table 5 shows that in the long-run, real per capita GDP Granger-causes government spending in all countries except Senegal where government spending causes per capita GDP over the period 1960-1993. Evidence from Kenya indicates bi-directional causality between public expenditure and per capita GDP over the period 1960-1991 and unidirectional causality from per capita GDP to public spending over the period 1992-2013. With respect to the short-run causality, the results suggest a unidirectional causality running from per capita income to government spending in Benin for the period 1960-1981, and from government spending to per capita income in South Africa for the period 1960-1988.

Wagner's law says not just that a causal relationship running from income to public spending exists, but also that the coefficient on income in the estimated relationship is positive and significant. Therefore, evidence of causality from income to public spending does not necessarily lend support for Wagner's law. The findings of this study indicate that government spending follows Wagner's law in Ghana over the period 1960-2013 and in Cote d'Ivoire only for the period 1960-1995. Also, government spending in Kenya has followed both Wagner's law and Keynesian paradigm during the period 1960-1991. In contrast, the results for the other three countries do not advocate Wagner's law or its reverse.

4. CONCLUSION

This paper tested the validity of Wagner's Law for six African countries using time series data for the period 1960-2013. The Gregory and Hansen (1996) cointegration test was used to unravel the long-run relationship between the share of government spending in national output and real per capita

Table 2: Johansen cointegration tests

Country	Trace statistic		Max-eigen statistic		Cointegration
	r=0	r=1	r=0	r=1	
Benin	14.19 (0.64)	3.93 (0.75)	10.26 (0.59)	3.93 (0.75)	No
Cote d'Ivoire	18.79 (0.29)	6.42 (0.40)	12.36 (0.38)	6.42 (0.40)	No
Ghana	25.22 (0.06)	4.96 (0.60)	20.26 (0.03)	4.96 (0.60)	Yes
Kenya	21.59 (0.15)	7.87 (0.26)	13.72 (0.27)	7.87 (0.26)	No
Senegal	13.87 (0.66)	5.36 (0.54)	8.51 (0.77)	5.36 (0.54)	No
South Africa	29.12 (0.01)	9.00 (0.18)	20.12 (0.03)	9.00 (0.18)	Yes

Notes: r is the number of cointegrating vectors. Figures in (.) are the MacKinnon-Haug-Michelis (1999) P values. *Indicates that the null hypothesis is rejected at the 5% level

Table 3: Gregory and Hansen cointegration test results

Country	Dependent variable: Government spending				Dependent variable: Income			
	C	C/T	C/S	C/S/T	C	C/T	C/S	C/S/T
Benin	−5.78* [1981]	−5.97* [1981]	−5.73* [1981]	−6.11* [1981]	−4.14 [1982]	−3.78 [1973]	−4.94 [1988]	−4.30 [1987]
Cote d'Ivoire	−2.94 [1995]	−5.86* [1995]	−3.07 [1983]	−6.05* [1995]	−3.03 [1984]	−3.55 [1995]	−4.11 [1984]	−4.10 [1980]
Ghana	−3.88 [1998]	−3.96 [1998]	−4.64 [1986]	−5.95* [1990]	−3.03 [2006]	−3.06 [2006]	−3.05 [1998]	−3.08 [1995]
Kenya	−3.74 [2007]	−4.59 [2007]	−5.47* [1989]	−6.50* [1991]	−3.61 [1969]	−3.84 [1968]	−4.36 [1991]	−5.40 [1997]
Senegal	−4.45 [1965]	−4.47 [1969]	−5.87* [1983]	−4.98 [1966]	−2.58 [2005]	−4.71 [2003]	−2.93 [1994]	−7.25* [1993]
South Africa	−3.63 [1982]	−4.76 [1996]	−4.16 [1982]	−6.18* [1993]	−2.34 [1983]	−3.04 [1983]	−2.29 [2004]	−3.17 [1988]

Notes: Figures reported in this Table are ADF. *Denotes rejection of the null of no cointegration at the 5% level. Time breaks are given in [.]. 5% critical values for level shift (C), Level shift with trend (C/T), Regime shift (C/S), and regime and time shift (C/S/T) models drawn from Gregory and Hansen (1996a, 1996b) are −4.61, −4.99, −4.95 and−5.50, respectively

Table 4: Long-run estimates

Country	Model	Break date	Dependent variable	Long run equation						
				β_1	α_1	θ_1	β_2	α_2	θ_2	$\theta_1+\theta_2$
Benin	1	1981	g	7.95 (7.40)	-	−0.95 (−5.33)	0.50 (13.19)	-	-	−0.95 (−5.33)
Cote d'Ivoire	4	1995	g	−3.19 (−4.38)	0.02 (8.66)	0.77 (7.64)	10.03 (2.19)	−0.01 (−2.11)	−1.47 (−2.32)	−0.69 (−2.12)
Ghana	4	1990	g	−6.37 (−2.65)	0.01 (0.96)	1.43 (3.74)	−1.56 (−0.42)	−0.05 (−2.85)	0.57 (0.83)	2.01 (3.49)
Kenya	4	1991	g	−2.20 (−2.72)	−0.01 (−0.99)	0.83 (5.89)	12.98 (6.41)	0.01 (2.53)	−2.17 (−6.30)	−1.34 (−4.27)
Senegal	4	1993	y	6.80 (2.57)	−0.01 (−10.34)	−0.02 (−1.72)	−0.26 (−1.10)	0.02 (15.18)	−0.21 (−2.06)	−0.24 (−2.29)
South Africa	4	1988	g	2.30 (3.26)	0.02 (19.93)	−0.001 (−0.02)	1.34 (0.44)	−0.02 (−2.75)	−0.10 (−0.27)	−0.10 (−0.28)

Note: Long-run equation is $g_t=\beta_1+\alpha_1 t+\theta_1 y_t+ \beta_2 d_t+\alpha_2 td_t+\theta_2 y_t d_t+\mu_t$. g denotes government spending as share of GDP (in log) and y is real per capita GDP (in log). Figures in parentheses are t-statistics, GDP: Gross domestic product

Table 5: Results of Granger causality tests

Country	Lag	Short-run causality				Long-run causality: $ECT_{t-1}=0$	
		Income causes public spending		Public spending causes income		Public spending	Income
		Sum	P	Sum	P		
Benin							
1960-1981	3	2.54*	0.03	0.35	0.40	−0.92 (−2.84)*	−0.11 (−0.68)
1982-2013	4	−0.72	0.56	−0.11	0.27	−1.14 (−6.22)*	0.03 (0.48)
Cote d'Ivoire							
1960-1995	3	−0.14	0.82	−0.26	0.44	−0.63 (−2.26)*	0.10 (0.61)
1996-2013	5	2.05	0.31	−0.49	0.11	−0.52 (−2.04)*	0.23 (1.65)
Ghana							
1960-1990	1	0.13	0.79	−0.07	0.33	−0.36 (−2.22)*	0.10 (1.71)
1991-2013	3	−1.60	0.44	0.04	0.59	−1.09 (−3.94)*	−0.01 (−0.24)
Kenya							
1960-1991	1	0.01	0.97	−0.17	0.28	−0.40 (−1.77)**	0.42 (2.62)*
1992-2013	1	0.08	0.85	−0.06	0.51	−0.87 (−3.35)*	0.08 (0.71)
Senegal							
1960-1993	1	−0.16	0.90	−0.03	0.23	−0.14 (−0.07)	−1.13 (−4.19)*
1994-2013	1	0.97	0.17	0.03	0.70	0.03 (0.04)	−0.20 (−0.64)
South Africa							
1960-1988	1	0.03	0.89	−0.23*	0.03	−0.83 (−4.94)*	0.09 (0.92)
1989-2013	1	−0.06	0.82	−0.14	0.26	−0.65 (−3.06)*	0.05 (0.39)

Note: Sum indicates the sum of lagged dynamics terms of the other variable. Probability is the P value that sum equal zero. Statistics for long-run causality are coefficients on ECT_{t-1} with t-statistics in parentheses. *,**Denote statistical significance at the 5% and 10% levels, respectively

income. This test allows for a structural break in the long run relationship. The results from the cointegration test indicate a long-run relationship between government size and income in all countries, but the income elasticity is positive and significant in only three countries, as predicted by Wagner's law. In addition, the Granger causality test results show a short run positive causal relationship running from per capita income to government spending in Benin over the period 1960-1981, thereby providing support for Wagner's Law. We also found evidence of public spending negatively causing income in South Africa over the period 1960-1988. In the long run, the results give support to Wagner's law in Ghana over the period 1960-2013 and in Cote d'Ivoire for the period 1960-1995. Results for Kenya for the period 1960-1991 support both Wagner's law and Keynesian view. For the other three countries the results support neither Wagner's law nor Keynesian view in the long run. The conclusion from these results is that the postulation of Wagner's law that there is a long run tendency for public expenditure to grow relative to national income is not a myth for African countries but it is not also a general rule.

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