Wagner or Keynes for Ghana? Government Expenditure and Economic Growth Dynamics. A 'VAR' Approach

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Abstract: This paper analysed empirically the causal relationship between government expenditure growth and GDP growth in Ghana from 1980 – 2010. The study employed vector autoregressive (VAR)/Granger causality analysis developed by Sims (1980) and Granger (1969). The cointegration results provided evidence of a unique cointegrating vector. Granger causality test conducted revealed that causality exist only from GDP growth to government expenditure growth and not the vice versa. This implication supports Wagner's law of expanding state activities for Ghana. This result means that in estimating government expenditure, GDP growth must be taken into account so as to avoid the problem of misspecification and biasness of estimates generated. The findings also suggest that government must focus on policies that would create the enabling environment for growth to thrive rather than increasing its expenditure with the aim of increasing GDP growth.

Keywords: Granger causality, Cointegration, Unit root, Government Expenditure, GDP growth.

1. INTRODUCTION

Governments all over the world spend in order to develop their economies. The great depression in the early 1930s gave birth to Keynesian ideas of government spending as a channel to boost employment and economic growth. Ever since, the relationship between government expenditure and economic growth has not been without controversy in empirical literature. According to Keynes, increase in government expenditure lead to rapid economic growth. Adolph Wagner (1863) in his very classic book called *Grundlegung der Politischen Ökonomie* formulated a 'law of expanding state activity' and concluded that it is increase in national income that causes more government expenditure. He explained that as nations develop, they begin to experience increases in the complexity of legal relationships and communications, increases in the levels of urbanization as well as increases in population density and cultural and welfare expenditures.

Chih-Hung Liu *et al*. (2008) studied on the causal relationship between GDP and public expenditures for US federal government for the period covering 1974-2002. Their finding revealed that total expenditures does cause the growth of GDP but not the other way. Thus they offered support for the Keynes theory as against that of Wagner. Dogan (2006) analysed the direction of causality between national income and government expenditures for Malaysia, Singapore, Thailand, Philippines and Indonesia. By employing Granger causality tests, he found that causality runs from government expenditures to national income for Philippines only. There was causality for other countries.

Tang, Tuck Cheong (2001) studied the relationship between national income and Government expenditure in Malaysia from 1960 - 1998. Using the Johansen multivariate cointegration, the study revealed that no long run relationship among the non-stationary variables existed. Also, a unidirectional causality was observed from national income growth to Government expenditure growth. Therefore, they concluded that Wagner's hypothesis is supported by the data, in the short run. Islam (2001), using annual data for the period 1929-1996 to examine the Wagner's hypothesis for the USA and employing Engle-Granger procedure found support for Wagner's hypothesis. Abizadeh and Yousefi (1998) used a data spanning 1961 – 1992 to test Wagner's law in South Korea. Using the Granger type causality tests, they found that government expenditures did not contribute to economic growth in Korea

Using a time series data spanning 1977 – 1996, Jackson and Fethi (1998) studied the causal relationship between economic growth and government spending in Northern Cyprus. Their result was mixed. Singh and Sahni (1984) by employing the Granger-Sims strategy examined the causal link between government expenditure and national income in a bivariate framework for India. Their finding suggested that the causal process between public expenditure and national income is neither Wagnerian nor

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Keynesian. Also, Bohl (1996) applied tests of integration, cointegration and Granger causality in a bivariate context, and found support to Wagner's law for only the United Kingdom and Canada, out of the G7 countries, during the post-World War II period. Hondroyiannis and Papapetrou (1995), and Chletsos and Kollias (1997), applied the same methodology in Greece, and found mixed results.

With respect to Ghana, Ansari *et al*. (1997) studied on the direction of causality between government expenditure and national income for Ghana, Kenya, and South Africa, for the time period from 1957 – 1990. By adopting Granger testing procedures and the Holmes- Hutton (1990) causality test, the study found no long run relationship between government expenditure and national income for the countries involved over the sample period. Ghatey (2006) on the other hand in his study found that economic growth results in more than proportionate share in growth of government expenditures in Ghana. These few studies conducted on Ghana shows inconclusive results about the angle of causation. Moreover these works were done some years back and as such current data must be used to empirically test the real direction of causality.

According to Loizides and Vamvoukas, (2005), adequate knowledge on the dynamic relationship and the precise causative process between government spending and economic growth help determine the robustness of the estimated relationship and improve the understanding of long-term, structural public finance issues as well as the comprehension of policy-relevant issues. The study reported that, should the causality be Wagnerian, the estimates derived from macro-economic models would suffer from simultaneity bias. Thus, public expenditure is relegated to a passive role. However, if the causality is Keynesian, the estimates reported in the public finance studies would similarly be biased but it acquires the status of an important policy variable. It is in the light of these arguments that this paper seeks to find the empirically causal relationship between government expenditure and economic growth in Ghana by employing the VAR approach developed by Granger (1969) and Sims (1980).

2. METHODOLOGY

2.1. Data Type and Sources

The data consist of annual general government expenditure, measured as a percentage of GDP and annual GDP growth rate. General government final consumption expenditure here includes all government current expenditures for purchases of goods and services. It is also made up of most expenditure on national defence and security but excludes government military expenditures that are part of government capital formation. Also, data that are used for this study is obtained from Bank of Ghana, World Bank National Accounts data as well as OECD National Accounts data files. The sample period is from 1980 – 2010.

2.2. Estimation Strategy

The study employed vector autoregressive (VAR)/Granger causality analysis developed by Sims (1980) and Granger (1969) to test for Granger causality between government expenditure growth and economic growth in Ghana. The investigative procedure of the study consists of three main steps. First, Augmented Dickey-Fuller, or ADF, (*p*) test (Dickey and Fuller 1979; 1981) is used to test for unit roots. The second is the Johansen test of cointegration and finally Granger causality analysis developed by Sims (1980) and Granger (1969) to estimate a one-sided Granger causality for each equation. Also, instead of arbitrarily choosing the lag lengths, the final prediction error (FPE) criterion as defined by Schwarz information criterion is employed to select the optimum lag for each equation in the system.

2.2.1. Test for Stationarity

An ADF test here consists of estimating the following regression

$$\Delta Z_t = \beta_1 + \beta_2 t + \delta Z_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Z_{t-i} + \varepsilon_t$$

Where Z_t is the time series under consideration, ε_t is pure white noise error, t is trend, β_1 is drift and $\delta = \rho - 1$. The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term is serially uncorrelated. If the null hypothesis that $\delta = 0$ is rejected, it means the series is stationary. Unfortunately, under the null hypothesis that $\delta = 0$ (i.e., $\rho = 1$), the *t* value of the estimated coefficient of Z_{t-1} does not follow the *t* distribution even in large samples; that is, it does not have an asymptotic normal distribution. Dickey and Fuller have shown that under the null hypothesis that $\delta = 0$, the estimated *t* value of the coefficient of Z_{t-1} follows the **τ (tau) statistic.** These authors have computed the critical values of the *tau statistic* on the basis of Monte Carlo simulations.

3.2.2. Testing for Cointegration Using Johansen's Methodology

Johansen's methodology takes its starting point in the vector autoregression (VAR) of order *p* given by

$$y_t = \boldsymbol{\mu} + \boldsymbol{A}_1 y_{t-1} + \cdots + \boldsymbol{A}_p y_{t-p} + \varepsilon_t \tag{1}$$

where y_t is an $n\,x\,1$ vector of variables that are integrated of order one - commonly denoted *I*(1) and ε_t is an $n \times 1$ vector of innovations. This VAR can be re-written as

$$\Delta y_t = \boldsymbol{\mu} + \boldsymbol{\Pi}_1 y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \tag{2}$$

Where

$$\boldsymbol{\Pi} = \sum_{i=1}^{p-1} A_i - I$$

$$\Gamma_i = \sum_{j=i+1}^{p} A_j \tag{3}$$

If the coefficient matrix Π has reduced rank, $r < n$ then there exist $n\,x\,1$ matrices α and β each with rank *r* such that $\Pi = \alpha\beta^{1}$ and $\beta^{1} y_t$ is stationary. *r* is the number of cointegrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of β is a cointegrating vector. It can be shown that for a given *r*, the maximum likelihood estimator of β defines the combination of y_{t-1} that yields the *r* largest canonical correlations of Δy_t with y_{t-1} after correcting for lagged differences and deterministic variables when present. Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the Π matrix: the trace test and maximum eigenvalue test, shown in equations (4) and (5) respectively.

$$\mathrm{J}_{trace} = -T \sum_{i=r+1}^{n} \ln(1-\lambda_i) \tag{4}$$

$$\mathrm{J}_{\max} = -T \ln(1-\lambda_{r+1}) \tag{5}$$

Here *T* is the sample size and λ_i is the *i:th* largest canonical correlation. The trace test, tests the null hypothesis of *r* cointegrating vectors against the alternative hypothesis of *n* cointegrating vectors. The maximum eigenvalue test, on the other hand, tests the null hypothesis of *r* cointegrating vectors against the alternative hypothesis of *r* + 1 cointegrating vectors. Neither of these test statistics follows a chi square distribution in general; asymptotic critical values can be found in Johansen and Juselius (1990) and are also given by most econometric software packages. Since the critical values used for the maximum eigenvalue and trace test statistics are based on a pure unit-root assumption, they will no longer be correct when the variables in the system are near-unit-root processes.

It has been found that the trace test is the better test, since it appears to be more robust to skewness and excess kurtosis. Therefore, make your decision on the basis of the trace test (Bo Sjo, 2008). Furthermore, the trace test can be adjusted for degrees of freedom, which can be of importance in small samples.

3.2.3. Granger Causality Test

To analyse the causal relationship between government expenditure growth and GDP growth, this paper focuses on causality among these variables using the method developed by Granger (1969). Granger causality test is one of the most interesting and widely used VAR applications. The intuition behind it is simple: If previous values of variable X significantly influence current values of variable Y, then one can say that X granger causes Y. This means that X is very useful in predicting Y. A brief explanation of this method is provided below.

A general specification of the Granger causality test in a bivariate (X, Y) context can be expressed as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \cdots + \alpha_i Y_{t-i} + \beta_1 X_{t-1} + \cdots + \beta_i X_{t-i} + \varepsilon_t \tag{3.32}$$

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + \cdots + \alpha_i X_{t-i} + \beta_1 Y_{t-1} + \cdots + \beta_i Y_{t-i} + \varepsilon_t \tag{3.33}$$

Since the independent variables are identical for each equation, this specification assures us that the error term is not correlated between the two equations and allows us to use OLS.

In the model, the subscripts denote time periods and ε_t is the error term or white noise error. The constant parameter α_0 represents the constant growth rate of X in equation 3.32 and Y in equation 3.33, and thus the trend in these variables can be interpreted as general movements of these time-series in response to say, a change in economic fundamentals.

Therefore this test involves the examination of the statistical significance of the parameters of X in equation 3.32 and those of Y in equation 3.33. For example, the null hypothesis of X not Granger-causing Y is tested using the joint parameter restrictions

$\beta_1 = \beta_2 = \cdots \beta_i = 0$. Acceptance of this restriction raises evidence for the above null of non-causality.

3. EMPIRICAL RESULTS AND DISCUSSIONS

3.1. Testing for Unit Root/Stationarity

The Unit Root test is taken to assess if the variables under study are stationary. The results are presented in Tables **1** and **2**.

Table **1** reports of the Augmented Dickey-Fuller Test under the null hypothesis of a unit root for the levels of the variables (government expenditure growth and GDP growth). The hypothesis of a unit root against the stationarity alternative is not rejected at 5% level of significance for both government expenditure growth and GDP growth. That is for Government expenditure, an ADF statistic of 2.577 is lower than the critical value of 3.574 resulting in a P-value of 0.292. This indicates that Government expenditure is not stationary at its level. For GDP growth, the ADF statistic of 3.389 is also less than the critical value of 3.574, which also indicates the non-stationarity at its level. However, as Table **2** indicates, the hypothesis of unit root at their first difference was rejected at 5% level of significance. An ADF statistic of 4.795 for Government expenditure is greater than the critical value of 3.574. Likewise, the ADF statistic of 6.232 for GDP growth is greater than the critical value of 3.574. This means that Government expenditure and GDP growth variables are stationary at their first difference. Therefore the variables are said to be *I*(1) variables.

3.2. Cointegration Test

The study employed the Johansen cointegration to test for the relationship among the variables. VAR lag length selection based on Schwarz information criterion was adopted. Cointegration results from the trace statistic are shown in Table **3**.

From the trace statistic test, the null hypothesis of no cointegration is rejected at 5%. That is the trace statistic of no cointegration among the variables is 17.717, which is greater than the critical value of 15.495. Also the null hypothesis of at most one cointegrating equation is also rejected. That is, the trace statistic of 7.934 is greater than the critical value of 3.841 at 5%. This means that there are two cointegrating equations. This implies that government expenditure growth is cointegrated with GDP growth,

Table 1: Unit Root Tests for the Variables at their Levels

VARIABLE	ADF STATISTIC	P-VALUE	CRITICAL VALUE (5%)	DECISION
Gexpend	-2.577	0.2923	–3.574	Non Stationary
gdpgrowth	-3.38878	0.0725	–3.574	Non Stationary

Table 2: Unit Root Tests of First Difference for the Variables

VARIABLE	ADF STATISTIC	P-VALUE	CRITICAL VALUE (5%)	DECISION
Gexpend	-4.795	0.0032	–3.574	Stationary
gdpgrowth	-6.232	0.0001	–3.574	Stationary

gexpend = government expenditure growth.
gdpgrowth = GDP growth.
ADF = Augmented Dickey-Fuller.

Table 3: Sample (adjusted): 1982 – 2010; Included observations: 29 after adjustments; Trend assumption: Linear deterministic trend; Series: GEXPEND GDPG; Lags interval (in first differences): 1 to 1; Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None*	0.286237	17.71744	15.49471	0.0228
At most 1*	0.239471	7.938508	3.841466	0.0048

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level.
*denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.

Table 4: VAR Lag Order Selection Criteria; Endogenous variables: GDPG GEXPEND; Exogenous variables: C; Sample: 1980 2010; Included observations: 25

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-86.78391	NA*	4.166365	7.102713	7.400223	7.129758
1	-81.93187	8.539590	3.900558	7.034550	7.327080*	7.115685
2	-76.27995	9.043064	3.447235	6.902396	7.389947	7.037622
3	-70.78261	7.916173	3.119220*	6.782609*	7.465179	6.971925*
4	-66.85548	5.026728	3.255116	6.788438	7.666029	7.031845
5	-64.73433	2.375689	4.022548	6.938746	8.011357	7.236243
6	-61.62555	2.984428	4.757151	7.010044	8.277675	7.361631

*indicates lag order selected by the criterion.
LR: sequential modified LR test statistic (each test at 5% level).
FPE: Final prediction error.
AIC: Akaike information criterion.
SC: Schwarz information criterion.
HQ: Hannan-Quinn information criterion.

and that there exists a linear combination of the variables that are stationary. This indicates that there exists a long-run equilibrium relationship among the variables such that the two variables move together in the long run even if they deviate from each other in the short-run. This confirms the common trend argument that if two series are each *I*(1), then their linear combination is *I*(0).

3.3. Granger Causality Test

To know the direction of causality between GDP growth and government expenditure growth, the study adopted the Granger Causality test developed by Granger (1969). Knowing that the residuals that are derived from Granger Causality test may be sensitive to the lag length selection, the minimum final prediction error suggested by Schwarz Bayesian criterion (SC) was used. This is shown in Table **4**. In determining the optimal lag selection, the lag length with the smallest statistic is the ideal. It is shown in Table **4** that the lag length of one(1) with a statistic of 7.327080 is selected to be the best with respect to the Schwarz information criterion (SC). This is because lag one(1) has the minimum (lowest) statistic compared to all the other lag length statistics.

The F-Statistics and the probability values that were constructed under the null hypothesis of non-causality are reported in Table **5**. The null hypothesis that GDP growth does not Granger causes Government expenditure is rejected at 5% with F-Statistic of 9.43704 and p-value of 0.0048. The results show granger causality exists from GDP growth to government expenditure growth and therefore means that GDP growth provides useful information in estimating government expenditure in Ghana. On the other hand, the null hypothesis that Government expenditure does not granger cause GDP growth is not rejected at 5% given an F-statistic of 0.18270 and a p-value of 0.6725. Thus the results show a one-way causal link running only from GDP growth to Government expenditure.

The one-way causal link from GDP growth to Government expenditure growth leads to the acceptance of Wagner's theory to that of the Keynes' for Ghana. That is, the results seem to agree with the Wagner's law that GDP growth causes growth in government expenditure. Wagner outlined three reasons to support his theory. First, as nations develop, they experience increases in the level of complexities of legal relationships and communications. This is as a

Table 5: Pairwise Granger Causality Tests; Sample: 1980- 2010; Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GDPG does not Granger Cause GEXPEND	30	9.43704	0.0048**
GEXPEND does not Granger Cause GDPG		0.18270	0.6725

**indicates acceptance at 5% significance level.
GDPG = GDP growth.
GEXPEND = Government expenditure growth.

result of the immense division of labour that accrues with industrialization. Second, an increase in urbanization and population density leads to greater public expenditure on law and order, and economic regulation. This normally is due to the associated risk of more conflict in densely populated urban communities. Owing to the substitution of the private activity for public, there would be an expansion in the administrative and protective functions. Lastly, he predicted there would be an expansion of ‘cultural and welfare’ expenditures. This is owed to the premise that as incomes begin to rise, society begin to demand for more education, entertainment, as well as more equitable distribution of wealth and income.

In Ghana over the study period, government has always been involved in setting up institutions with regards to legal and communication matters. Further, increased urbanization and population density has led to the greater public expenditure incurred on law and order, and economic regulation. Lastly, there has been also a huge demand on the government to provide more education and equitable distribution of public services over the study period and all these results in increased government expenditures.

4. CONCLUSION AND RECOMMENDATIONS

The paper empirically analysed the causal relationship between government expenditure growth and GDP growth in Ghana from 1980 – 2010. Since the variables are non-stationary and possesses unit root, the Johansen cointegration technique was applied. The cointegration results provided evidence of a unique cointegrating vector. In other words, a long-run stable relationship exists between government expenditure growth and GDP growth. This study found that causality exists from GDP growth to government expenditure growth. This means that there is information contained in GDP growth rate concerning the future path of government expenditure growth. This implication supports Wagner’s law of expanding state activities. He asserted that increase in economic growth results in increase in government expenditure. This result also means that in estimating government expenditure, GDP growth as a variable must be taken into consideration. This is to avoid the problem of misspecification and biasness of estimates that would be generated.

The result of this study confirms that of Ghatey (2006) who found that economic growth results in more than proportionate share in growth of government expenditures in Ghana and Bohl (1996) who applied tests of integration, cointegration and Granger causality in a bivariate context, and found support to Wagner’s law for only the United Kingdom and Canada, out of the G7 countries, during the post-World War II period. It also concur the study of Dogan (2006) who analysed the direction of causality between national income and government expenditures for Indonesia, Malaysia, Philippines, Singapore, and Thailand. Using Granger causality tests, the study found support for the hypothesis that causality runs from government expenditures to national income for only in the case of Philippines. The results is however contrary to Ansari *et al.* (1997) who attempt to determine the direction of causality between government expenditure and national income for three African countries Ghana, Kenya, and South Africa, for the period 1957 – 1990.

The findings of the study suggests that government must focus on policies that would create the enabling environment for growth to thrive rather than increasing its expenditure with the aim of increasing GDP growth. Such policies include continuing reforms in the financial sector to attract more private investment, strengthening state institutions, empowering Ghana Investment Promotion Centre (GIPC) to attract foreign investment, maintaining a low and stable inflation, among others.

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