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A Time Series and Panel Analysis of Government Spending and National Income

Alimi, R. Santos

Economic Department, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria

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R. Santos Alimi

Economics Department,
Adekunle Ajasin University,
Akungba-Akoko, Ondo State, Nigeria.
santos4rd@gmail.com

ABSTRACT

This study examined the causal relationship between government spending and national income in panel of three African countries – Nigeria, Ghana and South Africa - during the period 1970 to 2012 using Johansen Fisher Panel Cointegration Test and then on a country-by-country basis using time series Johansen-Juselius cointegration techniques. The panel cointegration results indicate a long run relationship between government spending and national income in the whole panel. The Johansen-Juselius cointegration test suggests an existence of long run relationship between government spending and national income only for Ghana as predicted by Wagner, thus suggesting government spending is not an important factor in economic growth in the long run in Nigeria and South Africa. We found an evidence of bi-directional causality granger causality tests for the whole panel. Furthermore, the result from the causality test shows that there is a bi-directional causality that runs from national income to government expenditure and vice versa for Nigeria and South Africa. However, for Ghana, there was a uni-directional causality that runs from government expenditure to national income and there is no feed-back mechanism. We concluded that Government spending enhances National Income enormously and vice-versa in the short run for Nigeria and South Africa.

Keywords: Government Expenditures, National Income, Panel Data Analysis

1.   INTRODUCTION

The purpose of this study is to explore the direction of causality between public expenditure and national income in Nigeria, Ghana and South Africa in the contexts of Wagner's law and the Keynesian paradigm. The first and the most popular theoretical explanations about the relationship between public expenditure and national income were advanced by Wagner (1883). He stated that during the industrialization process, as real income per capita of a nation increases, the share of public expenditures in total expenditure increases. According to Wagner, the size of government activity is related to economic development and thus implies that causality run from national income to public expenditure. The second proposition is associated with Keynes, who argued that public expenditure is an exogenous factor and a policy instrument for increasing national income. Therefore, he posits that the causality of the relationship between public expenditure and national income runs from expenditure to income. It could be inferred that the focus of both approaches is only to the unidirectional causal link between the public expenditure and national income (Jamshaid et al. 2010). The relationship between public expenditure and economic growth is especially important for developing countries, most of which have experienced increasing level of public expenditure over time.

In theoretical front, the relationship between government expenditures and economic growth is ambiguous. For instance, certain functions of government such as the protection of lives and properties, provision of certain public goods like defence, roads, education, health, power and the operation of judiciary system to resolve disputes should enhance economic growth. In traditional Keynesian macroeconomics, many kinds of public expenditures can contribute positively to economic growth, through multiplier effects on aggregate demand; high levels of government consumption are likely to increase employment, profitability and investment. On the other hand, in attempt to finance rising government expenditure, government may resort to more borrowing or imposing higher taxes. Higher taxes in turn will reduce income and subsequently dampen economic stimulus in the short run and reduce capital accumulation in the long run. Moreso, government activity sometimes produces misallocation of resources and impedes the growth of national output.

In this study, we use time series and panel data to examine the direction of causality between government expenditures and national income and establish whether government expenditure is endogenous, an outcome of growth of national income or government expenditure is an exogenous factor that can influence growth. The remainder of the paper is organized as follows: The next section consider briefly the trend of Public Expenditure and National Income for the sample countries and introduce the theoretical framework and review of the related literature in section 3. While section 4 describes the data and methods used in the analysis. Empirical findings are reported in Section 5, and conclusions are discussed in the final section.

2. Trend of Public Expenditure and National Income in Nigeria, Ghana and South Africa

Figure 1-3 present the ratio of government expenditure to gross national income for the three countries under this study for the period 1970 to 2012. The magnitude of public expenditure is one of the applied ways to measure the size of government in the economy. In Nigeria, a glance at Figure 1, reveals that the ratio of government spending to gross national income is above 16 percent in 1977, 1982, 1978 and 1994. On average over the study period, the ratio is 11.74 percent.
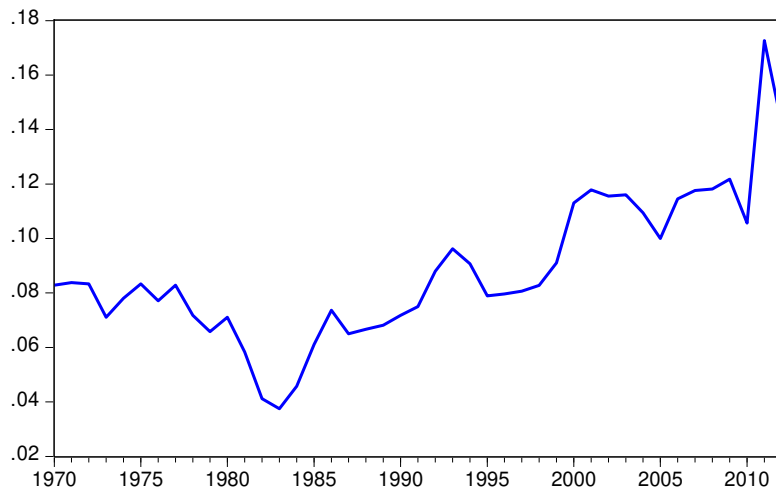
Figure 1: Ratio of Government Expenditure to Gross National Income for Nigeria (1970-2012)
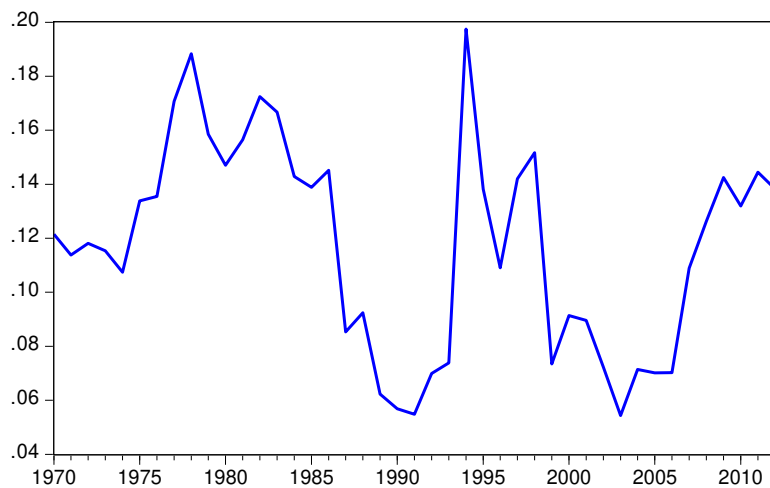
Source: Authors

The trend is different in case of Ghana. Figure 1 shows that Ghana only recorded ratio of government spending to gross national income that is above 11 percent on average in the last 10 years and average 8.76 percent over the study period.

Figure 2: Ratio of Government Expenditure to Gross National Income for Ghana (1970-2012)

Source: Authors

South Africa shows a relatively stable upward trend between 1980 and 1994 and the ratio of government spending to gross national income has been on increase since 2009.

Figure 3: Ratio of Government Expenditure to Gross National Income for South Africa (1970-2012)
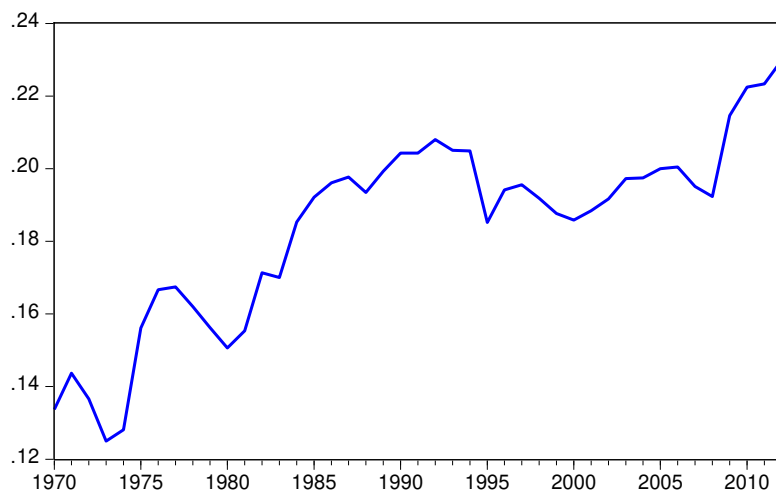
Source: Authors

3. Literature Review and Theoretical Framework

Many empirical studies have been investigated the validity of Wagner's law both at the single country and cross country level. These studies have different forms and different econometrics techniques to find out the relationship between government expenditures and national income. In sum we can group their findings of directions of granger causality under four categories, each of which has important implications for economic policy; Neutrality

hypothesis (i.e the two economic variables of interest are not correlated e.g Bağdigen, Cetintaș (2003)), Wagner's hypothesis (i.e the unidirectional causality running from GDP to public spending e.g Mutuku and Kimani (2012)), Keynesian hypothesis (i.e the unidirectional causality running from public spending to GDP e.g Omoke (2009)), and Feedback hypothesis (i.e there exists a bi-directional causality flow between GDP and public spending e.g Narayan et al. (2008)).

Sevitenyi (2012) investigated the relationship and the direction of causality between government expenditure and economic growth in Nigeria using annual data from 1961-2009, using cointegration and the Toda-Yamamoto Granger Causality test. He found that there was a unidirectional causality running from total government expenditure to economic growth, which supports the Keynesian hypothesis and at the disaggregate level, his results showed that all the variables except total recurrent expenditure cause economic growth implying that government expenditure promotes growth in Nigeria. Thus he findings do not support the existence of Wagner's law both at the aggregate and the disaggregate levels in Nigeria.

Chimobi (2009) employed cointegration and granger causality to test for the direction of causality between Government expenditure and National Income in Nigeria using annual data for the period 1970-2005, found no long-run relationship between Government expenditure and National Income in Nigeria. His results of Granger Causality test reveals that causality runs from Government expenditure to National Income and concluded that that Government expenditure plays a significant role in promoting economic growth in Nigeria. Akonji , Olateju and Abba (2013) investigated the linkages between the different components of government expenditure and real gross domestic product for Nigeria. Using Granger causality, Error correction model and Cointegration techniques, their result is rather mixed. Their finding revealed that the total capital expenditure and real gross domestic product support Wagner's law through the granger causality test showing a unidirectional causality. Whereas, total recurrent expenditure and real gross domestic product provide support for a bi-directional causality, however, the link from total recurrent expenditure to real gross domestic product is stronger.

Ogbonna (2012) examined the validity of Wagner's law in Nigeria for the time period 1950-2008 and the empirical results point to the fact that Wagner's Law is supported for Nigerian economy during the period under review. Chude and Chude (2013) investigate the effects of public expenditure in education on economic growth in Nigeria for the period of 1977 to 2012, with particular focus on disaggregated and sectoral expenditures analysis. Their reports indicate that total expenditure education have positive relationship on economic growth in Nigeria in the long run and conclude that economic growth is clearly impacted by government expenditures. In the study of Akinlo (2013) provides support for Wagner's law in Nigeria. He further states that there is a long-run relation among real government spending, real GDP and population size, and found a unidirectional causality that runs from both real gdp and gdp per capita to government spending implying that expenditure rationalization policies may not necessarily have adverse effect economic growth.

Alm and Embaye (2011) estimated the determinants of real per capita government spending in the Republic of South Africa, Using multivariate cointegration techniques and found that per capita government spending, per capita income, the tax share, and the wage rate are cointegrated, a result that supports the notion that government spending is associated not only with per capita income and the true cost of government service provision as given by the wage rate but also to the fiscal illusion caused by budget deficits. Lesotho (2013) analysed the dynamics of government spending growth in Lesotho using the multivariate cointegration techniques for the period 1980-2010. The results indicate that government spending is positively related to income and population while negatively related to tax share in the long-run. Muse, Olorunleke and Alimi (2013) investigated whether there is statistical evidence for

a causal relationship between federal government expenditures and growth in real per-capita GDP in the Nigeria, using time series data (1961-2011). They adopted Toda and Yamamoto's Granger non-causality tests and investigate Granger causality in detail in the context of a Vector Autoregressive Model and found that the Toda and Yamamoto's causality test results does not support Wagner's Law over the period being tested. However, using VAR Granger causality test they found a weak empirical support in the proposition by Keynes that public expenditure is an exogenous factor and a policy instrument for increasing national income in the short run.

Applying Granger causality tests to investigate the causal links between government expenditure and national income for Indonesia, Malaysia, Philippines, Singapore, and Thailand, Dogan (2006) found Support for the hypothesis that causality runs from government expenditures to national income only in the case of Philippines. He added that there is no evidence for this hypothesis and its reverse for the other countries. Grullón (2014) investigated Wagner's Law for Chile, Colombia, Honduras, Panama, and Paraguay during the period 1980-2012 using the bounds test approach to co-integration and provided evidence of a long-run relationship between gross domestic product and government expenditure in these countries. He obtained estimates of the long-run coefficient show above- unity elasticities for all five countries. Moreover, Granger Pairwise causality tests show causal linkages running from gross domestic product to government spending. Combined, all these results confirm the validity of Wagner's Law for this sample of Latin American countries. In case of Indian, Srinivasan, (2013) found a one-way causality that runs from economic growth to public expenditure in the short-run and long-run, thus supporting the Wagner's law of public expenditure.

Ansari et al (1997) investigated the direction of causality between government expenditure and national income for three African countries Ghana, Kenya, and South Africa, using standard Granger testing procedures and the Holmes-Hutton (1990) causality test, and found in their study that there is no long run equilibrium relationship between government expenditure and national income over the sample period for the three countries. They concluded that there is no evidence of Wagner's hypothesis or the reverse being supported in the short run, except for Ghana where Wagner's law is supported.

Gadinabokao & Daw (2013) study on South Africa confirm a long-run positive relationship between the government spending and economic growth. Ziramba (2008) tests the long-run relationship between the two variables using the autoregressive distributive lag approach to cointegration and the Granger non-causality test procedure developed by Toda and Yamamoto. They found a long-run relationship between real *per capita* government expenditure and real *per capita* income and short-run causality found bidirectional causality, thus concluded that Wagner's law finds no support in South Africa. Loizides & Vamvoukas (2004) use combined analysis of bivariate and trivariate tests to offer a rich menu of possible causal relationship between government expenditure and economic growth using data on Greece, UK and Ireland. Their analysis showed that government size Granger causes economic growth in all countries of the sample in the short run and in the long run for Ireland and the UK. Moreso, their result showed that economic growth Granger causes increases in the relative size of government in Greece, and, when inflation is included, in the UK.

4. METHOD AND MATERIALS

Annual time series data, which covers the period 1970 to 2012, are utilized in this study. The data for the bivariate model are Total Government expenditure and Gross National income at constant prices obtained from World Bank national accounts data, and OECD National Accounts data files. In this study we first test for stationarity in the panel data so that the times series behaviour of the individual variables are well approximated and to determine the

order of integration of the variables. Augmented Dickey-Fuller (ADF) and Philip Perron (PP) tests are employed for the individual country and the whole panel to check whether the variables have a unit root. Since the use of panel data increases the predictive power of tests, the Im, Pesaran, and Shin (1997) test for integration is done to confirm the results of the PP panel unit root test whilst the ADF test and Phillips- Perron (PP) tests are done for the individual countries. The variables under review must be integrated of order 1, a necessary condition for application of cointegration test. If the variables are integrated of different orders; one might conclude that they are not co-integrated. Once the order of integration has been determined, the Johansen and Juselius cointegration test is carried out for individual countries whilst the Johansen Fisher Panel cointegration test was used for the panel.

Model Specification

The long-run relationship between government expenditure and national income in the context of the hypotheses to be evaluated may be specified as follows:

$$Lgni_t = \theta + \psi Lgex_t + \varepsilon_t \tag{1}$$

Where:
Lgni refers to log of national income,
Lgex is log of government expenditure,
θ is the constant and
ε is the error term.

5.   ESTIMATION RESULTS AND PRESENTATIONS

Unit Root Test Results

We start the individual country time series analysis by assessing the unit root properties of both government expenditures and national income for each country. Using Augmented Dickey-Fuller unit root test, government expenditures was found to be non-stationary at levels but stationary at first differences , therefore I(1) for the three countries in the sample. National Income exhibited similar unit root properties for the countries. These results were reiterated by the results of the Phillips-Peron test. The panel of three countries was tested for the presence of unit roots. The Phillip - Perron-Fuller –Fisher Chi-square test showed that both government expenditure and national income are non-stationary at levels but become stationary when they are differenced. The results of the PP-Fisher Chi-square test are confirmed by the Im, Pesaran and Shin test. The variable are integrated of order one. The results of both tests are presented in the Table 1.

Table 1: Results of unit root tests

Variable level	Nigeria		Ghana		South Africa		Panel	
	ADF Test	PP	ADF Test	PP	ADF Test	PP	PP-Fisher	Im, Pesaran & Shun
Lgex	-1.0568	-1.0906	0.6778	0.7751	-0.6139	-0.6025	0.30355	1.0382
ΔLgex	-7.2826***	-7.2448***	-5.4088***	-5.3716***	-6.0439***	-6.0746***	23.7131	-5.1447***
Lgni	1.1641	0.8789	2.9974	3.2090	0.2584	0.2584	0.0543	2.0337

ΔLgni	-5.3400***	-5.3991***	-1.2040	-4.8433***	-5.1317***	-5.1094***	18.4207***	-4.1148
ADF Critical values: -3.4533 at 1% (***) and -2.8715 at 5% (**)								
(PP) Critical values: -3.4529 at 1% (***) and -2.8714 at 5% (**)								

Following from the results presented in tables 1, our variables of interest are integrated of order one, l(1), it therefore necessary to determine whether there is at least one linear combination of the variables that is l(0).

Following the technique described earlier, we determine the appropriate lag length and conducted the cointegration test. Optimal lag length of one is selected by Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan – Quinn Information Criterion for all countries of our study.

Cointegration Test Results

The Cointegration test performed for the long run relationship among series by using Johansen and Juselius cointegration test is presented in Table 3. Both Trace and Max-Eigen tests do not support the presence of long run relationship between government expenditure and national income for Nigeria and South Africa at 5% significance level (as predicted by Wagner). However, for Ghana, the result shows a cointegration rank of two in trace test at 1% significance level and Max-Eigen statistics test supports a cointegration rank of one, thus there is evidence of long run relationship for series in Ghana.

Table 3: COINTEGRATION RANK TEST ASSUMING LINEAR DETERMINISTIC TREND

		Nigeria			Ghana		
	Null Hypothesis	Test Statistics	0.05 Critical Value	Probability Value	Test Statistics	0.05 Critical Value	Probability Value
Trace Statistics	r=0	11.4121	15.4947	0.1874	17.7199	15.4947	0.0227**
	r=1	0.0041	3.8414	0.6791	7.1413	3.8414	0.0075***
Max-Eigen Statistics	r=0	11.2410	14.2646	0.1425	10.5785	14.2646	0.1766
	r≤1	0.1711	3.8414	0.6791	7.1413	3.8414	0.0075***
Trace	No of Vectors	0			2		
Max-Eigen	No of Vectors	0			1		

		South Africa			Panel (Johansen Fisher Panel Cointegration Test)		
	Null Hypothesis	Test Statistics	0.05 Critical Value	Probability Value	Test Statistics	Probability Value	
Trace Statistics	r=0	12.7446	15.4947	0.1245	12.50	0.0517	
	r=1	0.07575	3.8414	0.7831	1.467	0.9617	

Max-Eigen Statistics	r=0	12.6689	14.2646	0.0880	14.58	0.0238
	r≤1	0.0757	3.8414	0.7831	1.467	0.9617
Trace	No of Vectors	0			1	
Max-Eigen	No of Vectors	0			1	

[a]Denotes rejection of the null hypothesis at 0.05 level

The Fisher trace statistic from the Johansen Fisher panel cointegration test statistic is significant at the 10% level and Fisher Max-eigen is significant at the 5% level. Thus, the panel cointegration tests reject the null hypothesis of no cointegration, providing evidence in support of the belief that government spending and national income are co-integrated for the whole panel, therefore there is evidence of a long run relationship between them. We therefore proceed to test for causality and the result is presented in Table 4.

Table 4: Results of Granger causality Test

Country	Null Hypothesis	F-Statistic	Prob. Value	Conclusion
Nigeria	Lgni does not Granger Cause Lgex	9.2793	0.0041	Bi-directional causality
	Lgex does not Granger Cause Lgni	4.8847	0.0330	
Ghana	Lgni does not Granger Cause Lgex	0.09479	0.7598	Uni-directional causality from government expenditures to national income
	Lgex does not Granger Cause Lgni	8.7068	0.0053	
South Africa	Lgni does not Granger Cause Lgex	15.1932	0.0004	Bi-directional causality
	Lgex does not Granger Cause Lgni	4.78493	0.0348	
Panel	Lgni does not Granger Cause Lgex	15.1933	0.0004	Bi-directional causality
	Lgex does not Granger Cause Lgni	4.7849	0.0348	

The Granger causality test result in Table 4 shows the existence of a bi-directional causality that runs from national income to government expenditure and vice versa for both Nigeria and South Africa. The decision on the direction of causality was made from the probability values of the tests. The finding from Nigeria data is neither Wagnerian nor Keynesian. However for Ghana, we found that there was evidence of a uni-directional causality that runs from government expenditure to national income and there is no feed-back mechanism. This result leads a support for Keynesian hypothesis for Ghana. Lastly, the results of the Panel Granger causality test provide evidence of bi-directional causality running from government spending and there is a feed-back mechanism 5% critical level. From the panel data evidence, we can conclude that neither Wagner law nor Keynes hypothesis is absolutely supported.

OLS Long Run Coefficient Estimates

Based on the cointegration test results, we therefore estimate the long-run relationships using the Ordinary Least Squares (OLS) model for Ghana and established the short-run causality of the model for both countries.

Table 5:   OLS Long Run Coefficient Estimates for Ghana

Regressors	Coefficients (Dependent variable = Lgni)	Probability Value
Constant	2.1884	0.0000
Lgex	0.4207	0.0000
Lgex(-1)	0.1893	0.0428
R-squared	0.9518	
Adjusted R-squared	0.9493	
Durbin-Watson stat	0.4523	
Prob(F-Statistic)	0.0000	

Table 5 reported the regression analysis using OLS with the HAC or Newey-West standard error that take into account the problem of autocorrelation. The variable is statistically significant and the result shows that a 10 percent rise in government expenditure will lead to about 4.3 percent increase in national income in the current period. The regression analysis further reveal that lagged government spending has a positive significant but marginal impact on national income.

6.   SUMMARY AND CONCLUSION

This study examined the causal relationship between government spending and national income in Nigeria, Ghana and South Africa during the period 1970 to 2012 and employed the co-integration test, Granger-Causality test and Ordinary Least Square Regression analysis techniques. The cointegration test result revealed that there is a long run relationship between government expenditure and national income as predicted by Wagner from panel analysis and time series for only Ghana. For both Nigeria and South Africa, the study suggests that government spending is not an important factor in economic growth in the long run. Furthermore, the result from the causality test shows that there is a bi-directional causality that runs from national income to government expenditure and vice versa for Nigeria and South Africa. However, for Ghana, there was a uni-directional causality that runs from government expenditure to national income and there is no feed-back mechanism. The result is thus an indication that Government spending enhances National Income enormously and vice-versa in the short run for Nigeria and South Africa.

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