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Causality between Government Expenditure and National Income: Evidence from Sudan

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This study aims to determine the nature and direction of causality between government expenditure and national income in Sudan using Granger causality test and Error Correction Model (ECM) for the period 1970-2008. The result of cointegration test shows a long-run relationship between government expenditure and national income in Sudan. The causality test indicates that the direction of causality running from government expenditure to national income, both in the short and long-run. Thus, the results support the Keynesian proposition, which states that public spending is an important exogenous factor for stimulating national income. Moreover, the study concludes that fiscal policy in Sudan plays a vital role in stabilizing the economy and achieving economic goals.

1. Introduction

The causal relationship between government expenditure and national income has been one of the debatable issues among the economists and policy makers, for a long time. Theoretically, there are two conventional views on the relationship between the two variables. First, Wagner (1890) observed that as the real income per capita of industrializing nation increases, the share of public expenditures in total expenditure also increases. This observation led to the so called Wagner's law, which assumes a unidirectional causality running from national income to government expenditure. On the other hand, Keynes (1936) argued that public expenditure is an exogenous factor and important fiscal policy instrument that affect national income. In other words, according to the Keynesian thought changes in government expenditure cause

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changes in income, implying that the direction of causality runs from government spending to national income without any feedback.

As a result of such debate, empirically there are extensive studies on the relationship between government expenditure and income, used different specifications, different sample periods, and data from different countries. However, all these findings were failed to reach a definite answer for the question of causality between the two variables. In other words, some empirical results confirm the Wagner view rather than the Keynesian hypothesis, while other findings advocate the Keynesian view. Therefore, the lack of consensus both in theoretical and empirical literature on the nature of the relationship between government spending and income is one of the motivations of this study.

Moreover, the simultaneity of increasing in government spending and disappointing economic growth of the developing countries, in last decades has raised many questions regarding the role of government spending in economic performance (see Scully, 1989). In Sudan for instance, the government size has undergone obvious expansion during the last four decades, with annual increase amounted on average about 20%. On the other hand, the growth rate of national income of the country has experienced low and fluctuated rates (see, Appendix).

Given the issues noted above, the ultimate objective of this study is to examine the causal relationship between government expenditure and national income in Sudan, using the Granger causality test and error correction (ECM) model. The dearth of studies on such issue in Sudan lead this paper contributes to the ongoing literature on the relationship between government expenditure and income. The study also provides decision makers in Sudan with some policy implications regarding the government spending measure.

The rest of the paper is organized as follows: Section (2) reviews the theoretical literature and previous studies on the relationship between government spending and national income. Section (3) discusses the data and methodology. While section (4) presents the empirical results, section (5) ends with conclusion and policy implications.

2. Previous Empirical Studies

Influenced by the substantial increase in the size of government in both developed and developing nations after the World War II, a large body of empirical literature has grown aimed at testing the causality between government expenditure and national income. Most of these studies used individual countries time series data, employing cointegration and Granger causality techniques; whereas, a few others approached the question adopting cross-section and panel data regressions. Nevertheless, still their results are inconclusive regarding the causality between government spending and national income.

Singh and Sahni (1984) examined the direction of causality between national income and public expenditures in India, using annual data covering the period of 1950-1981. They employed Granger's causality test, and found no evidence of causality between government spending and national income. Therefore, their finding neither confirms the Wagner's law nor the Keynesian view.

Abizadeh and Yousefi (1998) examined the Wagner's law in South Korean over the period 1961-1992. Initially, they conduct Granger type causality tests, and then estimate a government expenditure-growth equation. Their results pointed out that economic growth significantly causes the government expenditure; hence, the Wagner's paradigm is satisfied. Further, the results of the growth equation estimations revealed that government expenditures did not contribute to economic growth in South Korea.

In the same vein, Islam (2001) examined the relationship between government expenditures and real GDP per capita for the USA, using annual data for the period 1929-1996. He found that there is a long-run relationship between the two variables using Johansen-Juselius's cointegration approach. Moreover, Wagner's hypothesis is strongly supported by their results of Engle-Granger (1987) error correction approach. For the case of Malaysia, Tang (2001) investigated the causal relationship between national income and Government expenditure during the period 1960 to 1998. He found that no long run relationship among the variables, indicated by cointegration test. Further, the study revealed a unidirectional causality running from national income growth

to Government expenditure growth. Thus, he concluded that Wagner's law is supported only in the short run.

In the context of cross-section approach, many studies have addressed the casual relationship between government expenditure and income, Ansari et al. (1997); Al-Faris (2002); Dogan and Tang (2006) and Mo (2007), among others. For example, Ansari and others (1997) examined the causality between government expenditure and national income for three African countries (Ghana, Kenya, and South Africa) using standard Granger test and its modified version - the Holmes- Hutton (1990) causality test. The study uses annual data on per capita government expenditure and national income for the period from 1957 to 1990. The study finds that for the three countries under investigation, there is no long run equilibrium relationship between government expenditure and national income over the sample period. For these countries, also 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 satisfied.

Dogan and Tang (2006) examined the direction of causality between national income and government expenditure for five south East Asian Countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand). Using Granger causality test, a unidirectional causality runs from government expenditures to national income has been found only in the case of Philippines. Whereas, for the other countries, their results rejected the hypothesis of causality from government expenditure to national income and vice versa.

Interestingly, Al-Faris (2002) used a multivariate cointegration and Granger causality tests, examined the causality between government expenditure and Growth for Gulf Cooperation Council (GCC) countries. He found that there exists a long-run relationship between national income and total spending, capital spending and current spending. Moreover, for the majority of the gulf countries, the Wgner's law is satisfied, while the Keynesian hypothesis is rejected. Al-Faris argued that despite the huge size of government in Gulf countries as a result of oil wealth, the government expenditure does not cause the economic growth and could not be considered as an important fiscal policy tool.

Abu-Bader and Abu-Qran (2003) investigated the causal relationship between government expenditures and economic growth for Egypt, Israel and Syria. They found long-run bidirectional causality between the two variables in Israel and Syria. A unidirectional short-run causality from economic growth to government expenditure was found in the case of Egypt. Abu-Bader and Abu-Qran concluded that those countries have been suffered the burden of military spending.

The above discussion has made it clear that the literature on the causality between government expenditure and national income is extensive and diverse. However, there is a dearth of studies on such issue in the Arab countries in general and Sudan in particular. Therefore, this study will be a significant contribution to ongoing literature on the relationship between government spending and income, in developing countries.

3. Methodology and Data

3.1. Econometric Methodology

To examine the direction of causality between government expenditure and income in the short-run and long-run, the paper uses Granger causality test and error correction model. The starting point in the causality test is to determine the order of integration of each variable. It is well known that when dealing with time series data, stationarity tests are pre-tests to avoid the problem of spurious regression (Engle and Granger, 1987). Using the specification provided in equation (1) below, we test for stationarity of the series using Augmented Dickey Fuller (ADF) (1979 and 1981), and Phillips and Perron (1988) tests:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 trend + \sum_{j=1}^{\rho} \beta_j \Delta y_{t-j} + \mu_t \qquad (1)$$

Where Δy_t indicates the first difference of y_t and ρ is the lag length of the augmented terms for y_t. Equation (1) allows us to test whether the variable y_t is a stationary series. The null hypothesis in the stationarity test is that y_t is non-stationary or has a unit root.

After determining the order of integration of the variables through unit root test, the next step is to check the presence of a long-run relationship between variables, using cointegration test. This because one of the purposes of this study to determine the long-run relationship between the two variables. Also, the presence of cointegration between the variables indicates existence of Granger causality in at least one direction (Engle and Granger, 1987). Therefore, the study employs Johansen and Juselius (1990) multivariate cointegration test, specified as a VAR model with k order:

$$y_t = A_1 y_{t-1} + \cdots A_k y_{t-k} + B x_t + \varepsilon_t \quad (2)$$

Where y_t is ($n \times 1$) vector of non-stationary I(1) variables, x_t is d-vector holding deterministic term (intercept, trend, dummies, etc), A_t is an ($1 \times n$) matrix of parameters, and ε_t is a white noise term. This VAR specification can be rewritten in first difference to yield the following vector error-correction model (VECM):

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \, \Delta y_{t-i} + B x_t + \varepsilon_t \quad (3)$$

Where

$$\Pi = \sum_{i=1}^{k} \mathrm{A}_i - I \; and \; \Gamma_i = - \sum_{j=i+1}^{p} A_j$$

Equation (4) is simply an error correction representation of the VAR system embodied in equation (3). In Engle Granger representation theorem (1987), the matrix Π has a reduced rank $r < k$, it can be expressed then as $\Pi = \alpha B'$. Where α and B are ($n \times r$) matrices and r is the rank to be tested. Also, α represents the speed of adjustment to disequilibrium (error correction model), while B' is matrix of long-run coefficients and each column of B' gives an estimate of the co-integration vector.

The number of cointegrating relations varies between 0 and n – 1, therefore the Johansen procedure for testing co-integration focuses then on the rank of Π. Johansen and Juselius (1990) developed two likelihood ratio test statistics. The first one is the maximum eigenvalue (ME) test and is given by $j_{ME} = -TLn(1 - \lambda r)$ where T is the sample size and λr is the maximal eigenvalue. This tests the null hypothesis of r co-integration vectors against the alternative hypothesis that $r + 1$ exist. The second test is likelihood ratio (LR) test which tests the null hypothesis of r cointegration relations against the alternative of k cointegration relations, where k is number of endogenous variable, for $r = 0,1, \dots, k - 1$. The test based on the trace stochastic matrix and given by $j_i = -T\sum Ln(1 - \lambda i)$.

Having examined the properties of the data, the next step is to test causality using Granger type causality test and error correction model. First, the study employed the standard Granger causality (1969) test, specified as follows:

$$LY_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} LY_{t-i} + \sum_{j=1}^{q} \delta_{1j} GE_{t-j} + \varepsilon_1 \quad (4)$$

$$LGE_t = \alpha_2 + \sum_{i=1}^{p} \beta_{2i} LY_{t-i} + \sum_{j=1}^{q} \delta_{2j} GE_{t-j} + \varepsilon_2 \quad (5)$$

Where: LY_t is the natural logarithm of real GDP as proxy of the national income

LGE_t is the natural logarithm of real total government expenditure
ε_1 and ε_2 are white noise error term, and q and p denote the lag order.

The Granger causality test is based on ordinary least squares (OLS) estimates of equation (4) and (5) and conventional Fisher-Snedecor F-test of joint statistical significance. Since the causality test sensitive to the lag order, the optimal lags length were specified based on the Akaike Information Criterion (AIC) and Schwartz information Bayesian Criterion (SBC). The null hypothesis for equation (4) is that LGE does not Granger cause LY. This hypothesis will be rejected if the coefficients of the lagged LGE (Summation of δ_{1j} as a group) are found

to be jointly significant (different from zero). The Null hypothesis for equation (5) is that LY does not granger cause LGE. This hypothesis would be rejected if the coefficient of the lagged LGE (Summation β_{2i} as a group) is found to be jointly significant. If both of these null hypotheses are rejected, then a bidirectional relationship is said to exist between the two variables (Government expenditure (GE) and National Income (Y).

In addition to Granger causality test, we will use the error correction model to test the causal relationship between the two variables in the long-run[2]. This test type causality depends on the error correction term derived from the cointegration equation. If the LY and LGE are cointegrated, an ECM representation could have the following form:

$$LY_t = \alpha_1 + \rho_1 e_{t-1} + \sum_{i=1}^{p} \beta_{1i} LY_{t-i} + \sum_{j=1}^{q} \delta_{1j} GE_{t-j} + \varepsilon_1 \qquad (6)$$

$$LGE_t = \alpha_2 + \rho_2 e_{t-1} \sum_{i=1}^{p} \beta_{2i} LY_{t-i} + \sum_{j=1}^{q} \delta_{2j} GE_{t-j} + \varepsilon_2 \qquad (7)$$

Where e_{t-1} represent one period lagged error-correction term captured from cointegration regression, ρ is the error correction coefficient. The error correction based causality test provides inference of long-run causal relationships, which is obtained through the significance of the coefficients of ρ_s. However, there are four possibilities to be considered, first, if ρ_1 is negative and significantly different from zero, this will indicate long-run unidirectional causality from GE_t to Y_t . Second, if ρ_2 is negative and significantly different from zero, this will suggest long-run unidirectional causality from Y_t to GE_t . Third, if ρ_1 and ρ_2 are negative and significant, then there is log-run bidirectional causality

[2] - The (ECM) has an advantage in testing causal relationships over the standard Granger test. This because the latter suffering from the following two methodological deficiencies: First, these standard tests do not examine the basic time series properties of the variables, if the variables are co-integrated, then these tests in incorporating differenced variables will be miss-specified unless the lagged error correction term is included, see (Granger, 1988). Second, these tests turn the series stationary mechanically by differencing the variables and consequently eliminating the long-run information embodied in the original form of the variables.

between Y_t and GE_t. Fourth, if ρ_1 and ρ_2 are positive and insignificant, this imply that the two variables are independent.

3.2. Data Definition and Sources

The data used in this study are annual time series data on real GDP and real total government expenditure[3] covering the period 1970-2008. This period is chosen because since 1970 the Sudan economy has suffered from many economic problems, particularly budget imbalance and augmentation of the government size. The data were sourced from various issues of the Central Bank of Sudan (CBOS) and the Central Bureau of Statistics (CBS) of Sudan[4].

4. Empirical Results

In this section we present and discuss the results of the empirical analysis, first we test for time series properties using unit root and cointegration tests. Next, the results of causality on the relationship between government expenditure and income will be presented and discussed.

4.1. Unit root and Cointegration Test

Before conducting the Granger causality test, variables were tested for a unit root using Augmented Dickey-Fuller (*ADF*) and Philips-Peron (*PP*) unit root tests, through the estimation of equation (1). A number of lag two are chosen according to the minimum Akaike Information Criterion (*AIC*). The results of unit root test for each variable with constant and trend were presented in Table (1). The results show that the two series are nonstationary at level. When taking the variables in their first difference, the results show that all are stationary; therefore, we can conclude that all the series are integrated of order one.

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[3] - According to the literature on the relationship between government expenditure and income, GDP is used as proxy for the national income, see Dogan and Tang (2006).

[4] - See the plot of real GDP growth and real government expenditure in the Appendix. A visual inspection shows upward trend of the data, implying that the variables may move together.

Table 1: Results of the ADF and PP -unit root tests

Variable	*ADF*		*PP*	
	Level	First Difference	Level	First Difference
GDP	-1.16	-3.25*	-1.34	-7.05***
GE	-0.41	-3.58**	-0.71	-7.19***

Notes: 1. *, **, *** indicate significance at 10, 5 and 1 per cent respectively

Having determined the order of integration of the variables, we test for cointegration to examine whether a linear combination of these series converge to equilibrium or not. Therefore, equation (3) of Johansen-Juselius multivariate cointegration was estimated with intercept term. Before undertaking the cointegration tests, the relevant order of lags (*p*) of the vector autoregressive (*VAR*) model was determined by Schwarz Information Criterion (*SIC*) and Akaike Information Criterion (*AIC*). The results of trace and maximal eigenvalue statistics obtained from the Johansen- Juselius (*JJ*) method using the assumption of linear deterministic trend in the data are presented in Table (2). The results of JJ multivariate cointegration test indicated that both trace and maximum eigenvalue test statistics simultaneously identify two cointegration relations between total government expenditure and national income, implying that there is long-run relationship between the two variables in Sudan. Thus, the existence of cointegration justifies the using of ECM to examine the causality between the two variables.

Table 2: Cointegration Test Results

Null Hypothesis	**Eigenvalue**	**Trace statistics**	**95%**	**Maximum Eigenvalue**	**95%**
None	0.4095	22.20*	15.49	17.91*	14.26
At most 1	0.1187	4.29*	3.84	4.29*	3.84

Note: 1. * denote rejection of null hypothesis at 5% level of significance.
2. Based on SIC. AIC a number of lag three was chosen in the cointegration analysis

4.2. Causality Test

Under this subsection we report the results of the direction of causality between government expenditures and National income in Sudan using Granger causality and ECM. First, the Granger test was performed through the estimation of VAR model of equation (4) and (5). The results of granger causality test within VAR structure in the first difference between the two variables are presented in table 3:

Table 3: Granger Test results

Direction of causation	F-value	p-value	decision
GE → GDP	4.85	0.0076	Do not reject
GDP → GE	0.76	0.5247	Reject

Note: As in the cointegration test a number of lag three was used in the Granger causality test.

The result of Granger causality test reject the null hypothesis that the government spending does not cause the national income, implying a unidirectional causality running from the former to the later. On other hand, the null hypothesis that the causation runs from national income to the government expenditure is rejected. Thus, the Granger causality test indicates only one a short-run unidirectional causality running from Government expenditure to the national income in Sudan, supporting the Keynesian paradigm, while the Wagner's view is refuted.

To examine the causal relationship between the variables in the long-run, we estimate the error correction model of equation (6) and (7). The results of error correction model between the variables are displayed in table 4. The table shows the error term coefficients, t-test value and the decision of the test.

Table 4: ECM results

Direction of Causation	ECMt-1	t-value	P-value	Decision
GE → GDP	-1.20	-3.40	0.0016	Do not reject
GDP → GE	2.00	2.8	0.0081	Reject

Similar to the Granger causality test, the result of error correction model indicates a unidirectional causality runs from government expenditure to the national income. As reported, the error correction term is negative and significant in the (national income on government spending) equation, but in the (government spending on national income) is positive albeit it's significant. Thus, this result suggests that for Sudan government expenditure causes national income in the long-run.

5. Conclusion and Policy Implications

This paper aims to examine the causality between government expenditure and national income in Sudan, using the traditional Granger causality test and error correction model. The results of both Granger causality test and error correction model (ECM) indicates a one directional causation running from government expenditure to national income, in both short and long-run. The significance of this result is that the increasing in government spending result in expansion of national income in Sudan. Therefore, the study supports the Keynesian proposition that public expenditure is an exogenous factor and important policy instrument for increasing of national income. On the other hand, the study does not advocate the Wagner's law, since no evidence of causation running from income to the government spending is found. The interpretation of this result is that government spending in Sudan is a decisive component of national income compared to private spending (consumption and investment). This finding also is consistent with the actual situation in most developing countries, where public sector is a leader one in stimulating economic growth and development, while the private sector is weak and suffering from the crowding out of public sector.

The main policy implication of this paper is that the government spending is one of the important policy tools to achieve the economic stabilization in Sudan. Therefore, policy makers should use government expenditure to expand the national income while keeping inflation at low levels. Also to avoid the unfavorable impact of public expenditure, government spending needs to be allocated for infrastructures and the promotion of productive sectors such as, agriculture and manufacturing. Moreover, the private sector should be enhanced through liberalization and privatization policies to play its effective role in the economy.

Finally, to provide a complete picture on the relationship between government spending and national income, this issue needs further research on the following directions. First, a study using disaggregated data on government spending would be useful to understand the nature of public expenditure in Sudan. Second, it would be important to test the complementarily and substitutability of government spending to private sector spending. Finally, to understand the origin of causality between government expenditure and national income, an empirical study needs to be conducted to identify channels through which government spending causes national income in Sudan economy.

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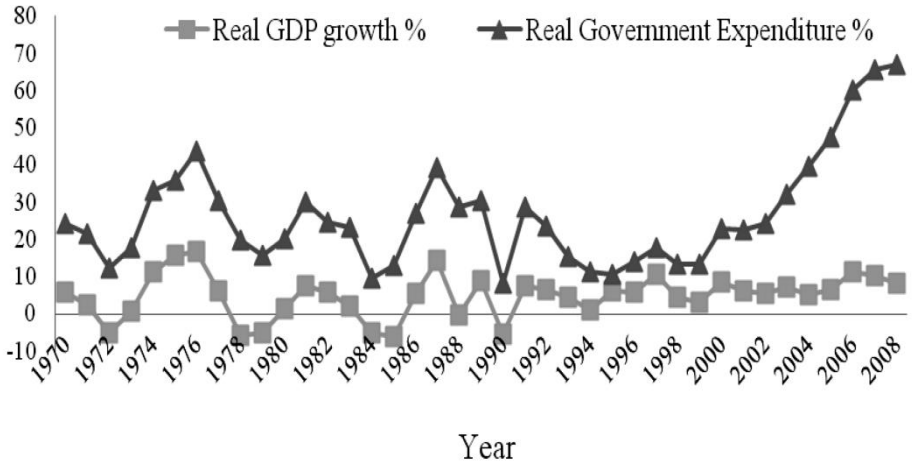
Appendix

The plots of Real GDP growth and Real government expenditure, over the period (1970-2008).



Source: Central Bank of Sudan, Annual Reports.