Government Expenditure and Economic Growth Nexus: Wagner's law or Keynesian Hypothesis for Tanzania?

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Abstract

This study investigates the validity of Wagner's law and Keynesian hypothesis of the long-run relationship between government expenditure and economic growth in Tanzania using annual time series data from 1978 to 2014. The data series were tested for stationarity using Phillips-Perron unit root test and the results revealed that they were all stationary and integrated of order one *I(1).* The Johansen test of cointegration revealed that there are cointegrating vectors in the system which indicates the existence of long-run equilibrium relationship among the variables. The Granger causality test was performed within vector error correction model and the results revealed strong support for both Wagner's law and Keynesian hypothesis when government expenditure was taken at its aggregate level. At the disaggregated levels, the results depict that recurrent expenditure and development expenditure from foreign sources promote economic growth hence supporting the Keynesian hypothesis. Wagner's law was only supported in one instance where causality runs from economic growth to development expenditure from domestic sources. These results highlight the need for policy makers to direct development expenditure from domestic sources to sectors that stimulate economic growth.

Keywords: Government expenditure, Economic growth, Wagner's law, Keynesian hypothesis, Causality analysis and Tanzania

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1.0 Introduction

The main purpose of this study is to investigate the relationship between government expenditure and economic growth of Tanzania. Such relationship has long been an important subject of debate in literatures and empirical analysis. The debate is whether economic growth promotes government expenditure or it is the latter that promotes the former. The theoretical and empirical literatures mainly focus on two approaches namely Wagner's law (1883) and Keynesian hypothesis (1936). The former contends that economic growth promotes government expenditure while the latter holds that it is government expenditure that causes economic growth. However, this debate in literatures remains inconclusive and the empirical results from various studies differ from country to country, and even across countries with similar social and economic status. This study intends to contribute to the body of knowledge and the growing debate by testing the validity of Wagner's law and Keynesian hypothesis for Tanzania.

Tanzania like many other developing countries has witnessed a growing trend of its expenditure which could be attributed to high demand for provision and/or improvement of public services and infrastructures. The total government expenditure in actual terms has been growing from an average of Tsh5.08 billion in 1960's to Tsh63.4 billion in 1980's and from Tsh691.6 billion in 1990's to Tsh13.4 trillion in early 2010's (URT, 1966, 1990, 2000, 2014). As part of total expenditure, recurrent expenditure increased from an average of 68.0% in 1960's to 76.7% in 1990's (URT, 1966, 2000). Looking into these trends, it can be observed that recurrent expenditure previously constituted an increasingly large share of total spending since 1960's to 1990's compared to development expenditure.

However, the portion of recurrent expenditure has been declining in recent years with a remarkable decline from 72.0% in 2000's to 45.1% in early 2010's (URT, 2008, 2014). This decline might have been a result of the increased government ambition to improve infrastructures in early 2010's. It is also observed that the portion of foreign funds in total development expenditure has been declining from 82.70% in 1990's to 74.40% in 2000's, and to 52.28% in early 2010's (URT, 2000, 2008, 2014). Conversely, Tanzanian economy has been growing from an average annual growth rate of 2.55% in 1980's to 4.16% in 1990's, and an average annual growth rate of 6.96% in 2010's (URT, 1990, 2000, 2014). These trends show a proportionate increase in government expenditure and economic growth of Tanzania over the years. But these observations cannot precisely tell the nature of the relationship and the direction of causality among these variables.

To understand the nature of the relationship among the variables, various empirical studies have been conducted in different countries. However, these studies provide different and mixed results about the relationship among the variables. Some studies revealed bidirectional causality between government expenditure and economic growth (see Keho, 2015; Odhiambo, 2013; Cheng and Lai, 1997). Evidences of unidirectional causality supporting Wagner's hypothesis were found in various studies (see Thabane and Lebina, 2016; Masan, 2015; Ahmad, 2014; Srinivasan, 2013; Mutuku and Kimani, 2012; Rehman, et al. 2010). Moreover, other studies revealed the evidences of unidirectional causality supporting the Keynesian hypothesis (see Kamasa and Ofori-Adebrese, 2015; Akpan and Abang, 2013; Sevitenyi, 2012; Chimobi, 2005; Dogan and Tang, 2006; Loizides and Vamoukas, 2005). On the contrary, there are some studies that did not support either Wagner's or Keynesian hypotheses (see Chipaumire, et al. 2014; Oteng-Abayie, 2011; Bağdigen and Çetintaş, 2004) for the specific countries. Basing on these mixed empirical results, it can be asserted that the

causal relationship between government expenditure and economic growth is country specific.

Besides, previous studies done in Tanzania mainly focused on sectorial government expenditure (see Kapunda and Topera, 2013), private investment, government investment and consumption spending (see Kweka and Morrissey, 2000), private investment (see Moshi and Kilindo, 1999) and taxation (see Osoro, 1997). This study brings in new knowledge in the causality analysis in Tanzania by using different components of government expenditure which are recurrent expenditure and development expenditure from domestic and foreign sources.

On the part of methodology, some previous studies employed the OLS estimation technique (see Akpan and Abang, 2013; Kapunda and Topera, 2013; Moshi and Kilindo, 1999) while others employed the cointegration and Granger causality tests (see Thabane and Lebina, 2016; Mutuku and Kimani, 2012; Kweka and Morrissey, 2000; Osoro, 1997) to investigate the relationship among the variables. Despite using cointegration test and Vector Error Correction Model (VECM) to examine causal relationship among the variables, this study distinguishes itself from previous studies done in Tanzania by taking a step further to employ the innovation accounting techniques to explain the interactions between the variables. Lütkepohl (2005) suggests that an impulse response function is an essential tool in empirical causality analysis. Therefore, introducing the innovation accounting technique in the causality analysis is another contribution of this study.

The remainder of the paper is organized as follows: Section2 provides the theoretical and empirical literature review, section 3 deals with data and methodology, section 4 presents the empirical results and discussion, and lastly section 5 gives the conclusion and policy recommendation.

2.0 Theoretical Literature Review

The nexus between government expenditure and economic growth has spurred an intense debate among researchers and academicians for many years. The thrust of their inconclusive debate centers on whether causality between the two variables runs from government expenditure to economic growth or from economic growth to government expenditure. Such views stem from two main strands of theories which perceive the functional relationship between government expenditure and economic growth differently. The first one is Wagner's law which considers government expenditure to be an endogenous factor driven by economic growth, and the second is the Keynesian hypothesis which in contrast asserts that economic growth is explained by the government expenditure of a country. The two theories or schools of thought are briefly explained under this subsection.

According to Keynesian hypothesis, government expenditure is one of the key instruments of fiscal policy for any government. An expansionary fiscal policy that increases government expenditure would stimulate economic growth of a country. When governments increase their spending, production also increases; and this in turn leads to an increase in aggregate demand, which ultimately leads to an increase in GDP. It is further averred that increasing government expenditure would offset a slower pace of economic activities. The advocates of this school of thought often anchor their arguments on the presumed positive multiplier effects that government expenditure has on aggregate demand. Moreover, government expenditure is viewed as a powerful and appropriate stabilizing policy instrument that is used to mitigate short-run fluctuations in output and employment (Odhiambo, 2013; Zagler and

Durnecker, 2003). Another argument for the Keynesians is that, in times where demand is low, the government should increase its expenditure in the economy in order to stimulate aggregate demand and thereby output through the multiplier effect. The Keynesian hypothesis plainly contends that causality runs from government expenditure to economic growth. Following and emulating Thabane and Lebina (2016), we illustrate the Keynesian hypothesis in equation (1):

$$EG = \beta_0 + \beta_1 C + \beta_2 I + \beta_3 GE + \beta_4 NX \quad (1)$$

Where *EG* is economic growth, *C* is consumption, *I* is investment, *GE* is government expenditure, and *NX* is net export. In the Keynesian hypothesis views, government expenditure *(GE)* is an exogenous variable and a change in *GE* would lead to a change in *EG.*

In contrast Wagner's law emphasizes that, it is economic growth that influences government expenditure. According to Wagner's law, there is a propensity for government expenditure to increase as the national income increases. This school of thought maintain that an increase in government expenditure is a natural consequence of economic growth, therefore, suggesting that causality runs from economic growth to government expenditure, and not in the opposite direction (Odhiambo, 2013; Rehman, et al. 2010). Basically Wagner proposed three reasons why government expenditure would increase as the economy grows. Firstly, as industrialization progresses, states would increase spending in administrative and protective functions due to increasing complexities of economic life and urbanization. Secondly, as per capita income increases demand for the services provided by the government also increases rapidly, raising the share of public sector expenditure in GDP. Thirdly, changes in technology and growing scale of firms would tend to create monopolies whose effect governments have to offset leading to the increase in government expenditure in social functions (Rehman, et al. 2010). Again, following Thabane and Lebina (2016), we express Wagner's hypothesis in equation (2):

$$GE = \beta_0 + \beta_1 EG + \beta_2 X_1 + ... + \beta_n X_n + \mu_t \quad (2)$$

Where *GE* is government expenditure, *EG* is economic growth, $X_1 ... X_n$ stand for other explanatory variables, and μ_t is the error term. In the views of Wagner, economic growth is the exogenous variable and Government expenditure is the endogenous variable.

On the other hand, the views of the classical economists are not far different from those of Wagner's hypothesis. The classical economists consider government expenditure as a destabilizing force in development of the economy of a country rather than a driving force of economic growth as the Keynesian economists postulate. Moreover, the neoclassical growth model of Solow (1956) and its reformulated version by Cass (1965) and Koopmans (1965) leaves very little or no room for public spending in economic growth process. Government expenditure is believed to leave the short-run growth rate or equilibrium levels of different macroeconomic aggregates unchanged and without any possibility for positive effect. According to classical economists, government expenditure unless financed by the increase in money supply would not affect either employment or the price level. The reason here is that, increase in government expenditure while money supply is fixed, would force the government to compete with private firms in the money market hence pushing interest rate high. Therefore, according to the Classical view an increase in government spending with money supply constant will not lead to an increase in income but will only substitute private business investments with the public programs (Chipaumire, et al. 2014; Akpan and Abang, 2013; Froyen, 2008).

3.0 Data and Methodology

To investigate causality between government expenditure and economic growth, we use annual time series from 1978 to 2014 for Tanzania. The annual time series data for Gross Domestic Product (GDP) which is a proxy for economic growth were taken from the National Accounts Main Aggregates Database, 1970-2014. The annual time series data for Total Government Expenditure (GEX) along with other components of expenditure, which are Recurrent Expenditure (REX), Development Expenditure from Domestic Sources (DED) and Development Expenditure from Foreign Sources (DEF), were taken from Tanzania Economic Surveys (various issues). All the variables included in this study are at their current prices.

3.1 Unit Root Test

The first step in our analysis is to solve the problem of non-stationarity of the series by testing them for stationarity both at levels and at their first differences. This study employs Phillips-Perron test which has an extra advantage over the standard Dickey-Fuller test as it is adjusted to take into account serial correlations by using Newey-West (1994) covariance matrix. Following Ozughalu and Ogwumike (2013), the Phillips-Perron unit root test based on the following regression was employed:

$$\tilde{t}_\alpha = t_\alpha\left(\frac{\gamma\circ}{f\circ}\right)^{1/2} - \frac{T(f\circ - \gamma\circ)\left(Se\left(\hat{\alpha}\right)\right)}{f\circ^{1/2}\, s} \qquad (3)$$

Where $\hat{\alpha}$ is the estimate; $\tilde{t}_\alpha$ is the t-ratio of α; $Se\left(\hat{\alpha}\right)$ is the coefficient standard error; T is the number of observations; and s is the standard error of the test regression. Moreover, $\gamma\circ$ is a consistent estimate of the error variance in the standard Dickey-Fuller test equation (calculate as $(T-k)s^2/T$, where k is the number of regressors). The other term $f\circ$, is an estimator of the residual spectrum at frequency zero.

3.2 Johansen Cointegration test

The next step is to investigate the long-run relationship between the variables using the Johansen cointegration test. Rehman, et al. (2010) suggests that this is the appropriate method for testing cointegration in cases of three or more variables. This test proposes two different likelihood ratio tests, namely the trace statistic and maximum eigen-value statistic test, to determine the presence or absence of cointegrating vectors. This study uses both likelihood ratio tests just to ensure that the cointegration results are robust. The null hypothesis of *r* cointegrating vectors is tested against the alternative, and the trace statistic is therefore defined as:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{k}\ln\left(1-\hat{\lambda}_i\right) \qquad (4)$$

The maximum eigen-value statistics adopted from Rehman, et al. (2010) can be defined by the following regression:

$$\lambda_{\max}(r, r+1) = -T\ln\left(1-\hat{\lambda}_{r+1}\right) \qquad (5)$$

Where λ_j is the eigen-value, T is the total number of observations, and *r = 1, 2,..,n*.

3.3 The Granger Causality Test

In light of the objectives raised in the introductory part, two models are specified to investigate the causal relationship between government expenditure and economic growth of

Tanzania. The first model examines the causal relationship between total government expenditure and economic growth, while the second model examines the causal relationship between different components of government expenditure (recurrent expenditure, development expenditure from domestic sources and from foreign sources) and economic growth. We perform Granger causality tests within error correction modeling framework if our variables are cointegrated. This is because Granger causality test on the basis of multivariate vector error correction model (VECM) is more appropriate than the causality within the first difference vector autoregressive (VAR) model if variables are cointegrated (Gujarati, 2004).Thus, to accomplish this objective, our first model is specified as follows:

Model I

$$\Delta GDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i} \Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i} \Delta GEX_{t-i} + \varphi_1 ECT_{t-1} + \varepsilon_{1t} \quad (6)$$

$$\Delta GEX_t = \alpha_2 + \sum_{i=1}^{k} \gamma_{2i} \Delta GEX_{t-i} + \sum_{i=1}^{k} \gamma_{2i} \Delta GDP_{t-i} + \varphi_2 ECT_{t-1} + \varepsilon_{2t} \quad (7)$$

Where Δ represents first difference operator, GDP_t is gross domestic product at time t, GEX_t is total government expenditure at time t, ECT_{t-1} represent one period lagged error correction term, $\beta's$ and $\gamma's$ are coefficients of the respective variables, $\varphi's$ are coefficients of the error correction term, $\alpha's$ are constant terms, and $\varepsilon's$ are error terms that are assumed to be white noise. The null hypothesis of "GEX_t does not Granger-cause GDP_t" can be rejected if $\beta_{2i} \neq 0$. Moreover, if $\gamma_{2i} \neq 0$ it implies that there is causality running from economic growth to government expenditure.

The second model examines causal relationship between different components of government expenditure (recurrent expenditure, domestic sources development expenditure, and foreign sources development expenditure) and economic growth of Tanzania. For this purpose the following model is specified:

Model II

$$\Delta GDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i} \Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i} \Delta REX_{t-i} + \sum_{i=1}^{k} \beta_{3i} \Delta DED_{t-i} + \sum_{i=1}^{k} \beta_{4i} \Delta DEF_{t-i} + \varphi_1 ECT_{t-1} + \varepsilon_{1t} \quad (8)$$

$$\Delta REX_t = \alpha_2 + \sum_{i=1}^{k} \gamma_{1i} \Delta REX_{t-i} + \sum_{i=1}^{k} \gamma_{2i} \Delta DED_{t-i} + \sum_{i=1}^{k} \gamma_{3i} \Delta DEF_{t-i} + \sum_{i=1}^{k} \gamma_{4i} \Delta GDP_{t-i} + \varphi_2 ECT_{t-1} + \varepsilon_{2t} \quad (9)$$

$$\Delta DED_t = \alpha_3 + \sum_{i=1}^{k} \lambda_{1i} \Delta DED_{t-i} + \sum_{i=1}^{k} \lambda_{2i} \Delta DEF_{t-i} + \sum_{i=1}^{k} \lambda_{3i} \Delta REX_{t-i} + \sum_{i=1}^{k} \lambda_{4i} \Delta GDP_{t-i} + \varphi_3 ECT_{t-1} + \varepsilon_{3t} \quad (10)$$

$$\Delta DEF_t = \alpha_4 + \sum_{i=1}^{k} \vartheta_{1i} \Delta DEF_{t-i} + \sum_{i=1}^{k} \vartheta_{2i} \Delta DED_{t-i} + \sum_{i=1}^{k} \vartheta_{3i} \Delta REX_{t-i} + \sum_{i=1}^{k} \vartheta_{4i} \Delta GDP_{t-i} + \varphi_4 ECT_{t-1} + \varepsilon_{4t} \quad (11)$$

Where REX_t represent recurrent expenditures at time t, DED_t represents domestic sources development expenditure at time t, and DEF_t is foreign sources development expenditure at time t, $\alpha_1, \alpha_2, \alpha_3$, and α_4 are constant terms in a multivariate VEC model, $\beta's, \gamma's, \lambda's$ and

$\vartheta's$ are coefficients of the respective variables, $\varphi's$ are coefficients of the error correction term, and $\varepsilon's$ are error terms that are assumed to be white noise.

4.0 Empirical Results and Discussion

4.1 Unit Root Test Results and Order of Integration

The Phillips-Perron (PP) unit root test was used to test both the level series and the first differenced series for stationarity. The PP test results reported in Table 1 reveal that the variables GDP, GEX, REX, DED, and DEF were not stationary at their levels as their respective test statistics are greater than their corresponding critical values. However, they became stationary at their first difference as their respective test statistics are less that their corresponding critical values at 0.01 level of significance. Since all variables were stationary and integrated of order one, further econometric analyses suggested for this study could be carried out.

Table 1: Phillips-Perron (PP) Test Results

Variable	Level		First Difference	
	Test Statistic	Critical Value	Test Statistic	Critical Value
lnGDP	-2.235	-3.675	-5.522***	-3.682
lnGEX	-0.830	-3.675	-4.889***	-3.682
lnREX	-1.342	-3.675	-5.218***	-3.682
lnDED	0.584	-3.675	-7.695***	-3.682
lnDEF	-0.543	-3.675	-9.559***	-3.682

Note: *** indicates the rejection of null hypothesis at the 0.01 level of significance

4.2 The Johansen Cointegration Test

Having confirmed that all the series were stationary and integrated of the same order *I(1),* the next step was to check if there were any long-run relationships between the variables by using Johansen test of cointegration. Since Cointegration analysis is very sensitive to number of lags, it was important to determine the optimal lag through the lag order selection criteria. Based on this test, the Adjusted Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), and Hannan-Quin Information Criteria (HQIC) selected lag length of 4, while only Schwarz Bayesian Information Criteria (SBIC) selected lag zero. We therefore, chose lag length of 4 for this study because it was selected by most of the selection criteria. The Johansen cointegration test was then employed using lag 4 and the test results are reported in Table 2.

Table 2: The Johansen Cointegration Test Results

	Ho	Trace Statistics	Critical Values 5 percent	Max-Eigen Statistics	Critical Values 5 percent
Model I	r=0*	30.4349	15.41	22.0191	14.07
	r≤1*	8.4158	3.76	8.4158	3.76
Model II	r=0*	74.4959	47.21	34.4012	27.07
	r≤1*	40.0947	29.68	17.8870	20.97
	r≤2*	22.2077	15.41	15.2529	14.07
	r≤3*	6.9548	3.76	6.9548	3.76

Note: * indicates the rejection of null hypothesis at 0.05 level of significance

From the test results in Table 2, the λ_{trace} and $\lambda_{\max}$ statistics for Model I reveal that the null hypothesis of at most one cointegrating vectors $(r \leq 1)$ was rejected in favor of the alternative since 8.4158 λ_{trace} statistic exceeds the 5 percent critical value of 3.76. The λ_{trace} test results are confirmed by the $\lambda_{\max}$ test results and therefore we conclude that the variables in our first model *(Model I)* are cointegrated. Looking at our cointegration result in Table 2 for the second model *(Model II)*, it is revealed that the null hypothesis of at most three cointegrating vectors $(r \leq 3)$ was rejected in favor of the alternative at 0.05 level of significance. This is confirmed by the fact that λ_{trace} statistic is 6.9548 which is greater than the 5 percent critical value of 3.76. Yet again, the λ_{trace} test results are confirmed by the $\lambda_{\max}$ test statistic results and we therefore conclude that there are four cointegrating vectors in our second model *(Model II)*.

4.3 Granger Causality Analysis within Vector Error Correction Model

The Johansen cointegration analysis confirmed that all variables are bound together by a long-run equilibrium relationship. The existence of such a relationship implies causality but does not tell the whole story about the direction of causality. Granger causality test within the vector error correction model was employed to test for the direction of causality since it allows the inclusion of the lagged error correction term derived from the cointegrating equations (Narayan and Smyth, 2008). Therefore, the vector error correction model results for our first model *(Model I)*, in which government expenditure is taken at its aggregate level, are reported in Table 3.

The lagged explanatory variables are presented in the first column and the dependent variables in the first row of Table 3. Columns numbered 1, 2, and 3 represent the coefficient estimates for each lag with their corresponding p-values in parentheses. The results reveal that for the dependent variable GDP, the error correction term is found to be negative and statistically significant at 0.01 level of significance. This implies that changes in GEX are equilibrated by the growth of GDP. In other words, causality runs from GEX to GDP in the long-run. The results also confirm the existence of short-run causality running from GEX to GDP, since the lagged GEX is found to be significant at 0.01 level.

Moreover, for the dependent variable GEX, the error correction term is also found to be significant at 0.05 level implying that there is long-run causality running from GDP to GEX. Short-run causality running from GDP to GEX is also confirmed by the results since the lagged GDP is significant at 0.05 level. Generally, the empirical results in Table 3 report the

short-run and long-run bidirectional causality between government expenditure and economic growth, hence supporting both the Wagner's law and Keynesian hypothesis for Tanzania.

Table 3: Vector Error Correction Model Estimates for Model I

Variables	GDP			GEX		
	1	2	3	1	2	3
GDP	0.6480	0.4829	0.3195	-0.8738	-0.5585	-0.7873
	(0.031)**	(0.044)**	(0.070)*	(0.124)	(0.219)	(0.018)**
GEX	0.1319	0.3025	0.3096	-0.5786	-0.6111	-0.3853
	(0.165)	(0.003)***	(0.001)***	(0.001)***	(0.001)***	(0.034)**
ECT_{t-1}	-1.7445			1.3804		
	(0.000)***			(0.048)**		
Constant	-0.0021			-0.0027		
	(0.851)			(0.900)		
Sample			1984-2014	No. of obs		31
Log Likelihood			73.87911			
Det(Sigma_ml)			0.0000292			

Note: ***, ** and * indicate significance at 0.01, 0.05 and 0.1 levels respectively

Moreover, Table 4 reports the vector error correction model results for our second model *(Model II)* where government expenditure is disaggregated. The lagged explanatory variables are presented in the first column and their respective number of lags in the second column. Columns numbered 1 to 4 represent the coefficient estimates of the lagged explanatory variables with their corresponding p-values in parentheses, and the dependent variables are presented in the first row of the table. A close examination of the results in Table 4 reveals that there exists long-run causality running from the components of expenditure to GDP.

The existence of long-run causality is supported by the statistically significant negative sign of the adjustment coefficient of the components of government expenditure. Hence, supporting the Keynesian Hypothesis that government expenditure (in its disaggregated levels) promotes economic growth of Tanzania in the long-run. The results also reveal long-run causality running from GDP, REX and DEF to DED since the coefficient estimate of the error correction term is statistically significant at 0.1 level of significance. However, the results reveal no evidence of the existence of long-run causality running from the lagged independent variables GDP, DED, and DEF to REX and from GDP, DED, and REX to DEF since the corresponding p-values of coefficient estimates of the error correction terms are greater than 0.01, 0.05, and 0.1 levels of significance.

Turning to short-run causality analysis, the results in Table 4 confirm the existence of short-run causality running from REX to GDP and from DEF to GDP since their respective lagged coefficient estimates are statistically significance at 0.01 level. The results accentuate that recurrent expenditure and development expenditure from foreign sources promote economic growth, hence supporting the Keynesian hypothesis for Tanzania. It is in only one instance Wagner's law is found to relevant for Tanzania. This is supported by the short-run causality running from GDP to DED. Such empirical findings highlight that economic growth of Tanzania promotes only one category of development expenditure (from domestic sources) which is very logical in the sense that the share of expenditure on development that depends on domestic sources would increases as the country's economy grows. However, the results

reveal no evidence of short-run causality running from DED to GDP, from GDP to REX, and from GDP to DEF since their respective lagged coefficients are statistically insignificant at 0.01, 0.05, and 0.1 levels. Therefore, Keynesian hypothesis is not supported for the case of short-run causality running from development expenditure (domestic sources) to economic growth of Tanzania. Wagner's law is also not supported in Tanzania for the case of short-run causality running from economic growth to recurrent expenditure and to development expenditure (foreign sources).

Table 4: Vector Error Correction Model Estimates for Model II

Variables		GDP	REX	DEF	DED
		1	2	3	4
GDP	1	0.8435	0.1295	-1.8315	-4.6027
		(0.015)**	(0.864)	(0.508)	(0.194)
	2	0.6033	0.4318	0.9707	-4.9831
		(0.027)**	(0.468)	(0.657)	(0.075)*
	3	0.2911	-0.4823	-3.0533	-1.4913
		(0.169)	(0.296)	(0.072)*	(0.492)
REX	1	0.0995	-0.8392	2.0147	0.3881
		(0.333)	(0.000)***	(0.014)**	(0.712)
	2	0.3837	-0.4539	1.5034	-1.3554
		(0.006)***	(0.137)	(0.18)	(0.344)
	3	0.4791	-0.2535	0.0685	-2.2861
		(0.000)***	(0.302)	(0.939)	(0.047)**
DED	1	0.0110	0.0312	-0.1649	-1.0019
		(0.637)	(0.540)	(0.377)	(0.000)***
	2	0.0025	0.1102	0.1120	-0.7525
		(0.931)	(0.079)*	(0.627)	(0.011)**
	3	-0.0111	0.0264	0.2878	-0.3105
		(0.659)	(0.630)	(0.153)	(0.228)
DEF	1	0.1254	-0.0728	-0.8682	-0.7125
		(0.000)***	(0.167)	(0.000)***	(0.004)***
	2	0.0768	-0.1389	-0.8859	-0.6555
		(0.006)***	(0.022)**	(0.000)***	(0.022)**
	3	0.0284	-0.0898	-0.5625	-0.4035
		(0.142)	(0.033)**	(0.000)***	(0.042)**
ECT_{t-1}		-2.0548	0.9688	-0.9389	7.5887
		(0.000)***	(0.251)	(0.762)	(0.056)*
Constant		0.0042	-0.0052	-0.0171	0.0003
		(0.665)	(0.805)	(0.827)	(0.998)
Sample		1984-2014	Number of obs		31
Log likelihood		76.0291			
Det(Sigma_ml)		8.71E-08			

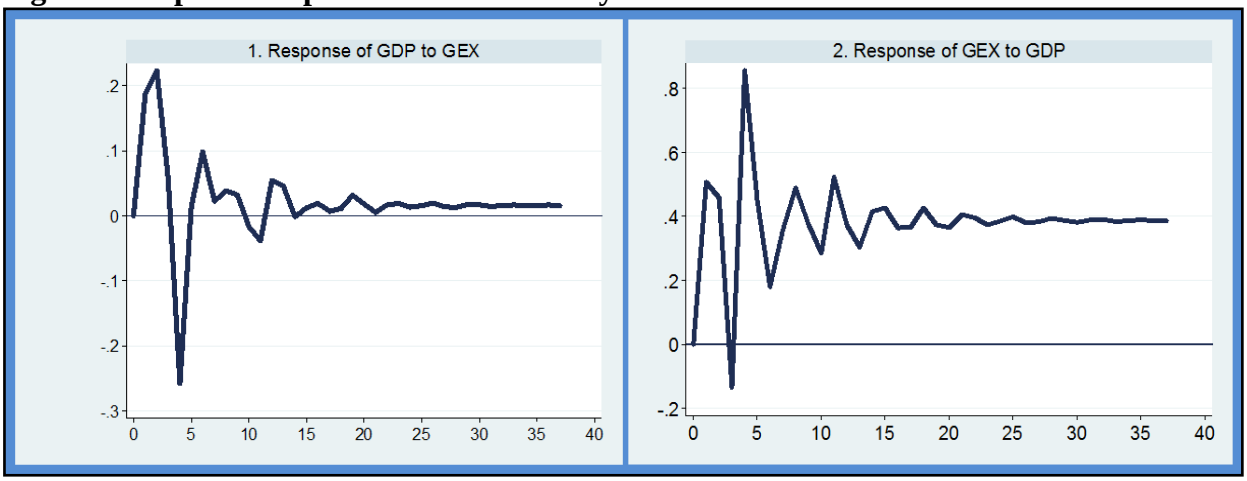
Note: ***, ** and * indicate significance at 0.01, 0.05 and 0.1 levels respectively

4.4 Innovation Accounting Techniques: Impulse Response Functions

Since our variables are cointegrated, we can now use the vector error correction model results to estimate the impulse response functions to get the information about the effect of shocks in our system and the interaction between the variables. The impulse response functions intend to explain how a variable responds to a shock with one size standard deviation created by another variable. The results for the impulse response functions for our first model *(Model I)* are reported in Figure 1 in a graphical presentation. The results report that, a one standard

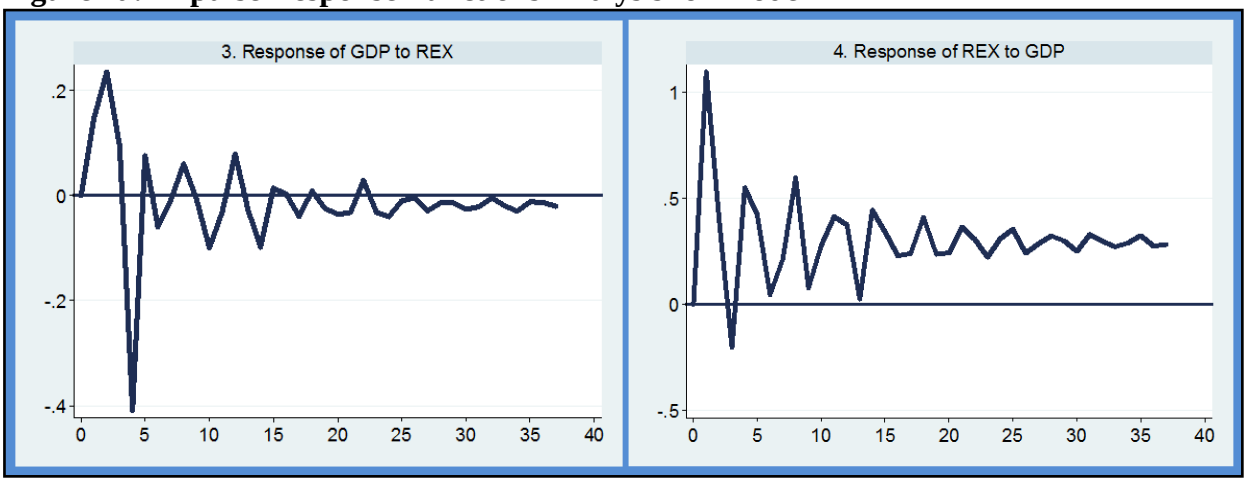
deviation innovation of a shock to government expenditure leads to positive changes in GDP *(see number 1)*. The impact starts to dwindle from the second year and it hits negative by the end of the third year. The negative impact fizzles out at the end of the fifth year and fizzles out completely from the thirteenth year to border the positive for the remaining years. The response of government expenditure to a shock in GDP *(see number 2)* is positive and permanent in almost all the years, implying that there is significant positive impact of GDP on government expenditure. The impulse response function results for our first model *(Model I)* confirms our previous results of the bidirectional causality between government expenditure and economic growth. Moreover, the impulse response function results for this model *(Model I)* have added to our knowledge that the nature of the causality between the two variables is a positive one.

Figure 1: Impulse Response Functions Analysis for Model I



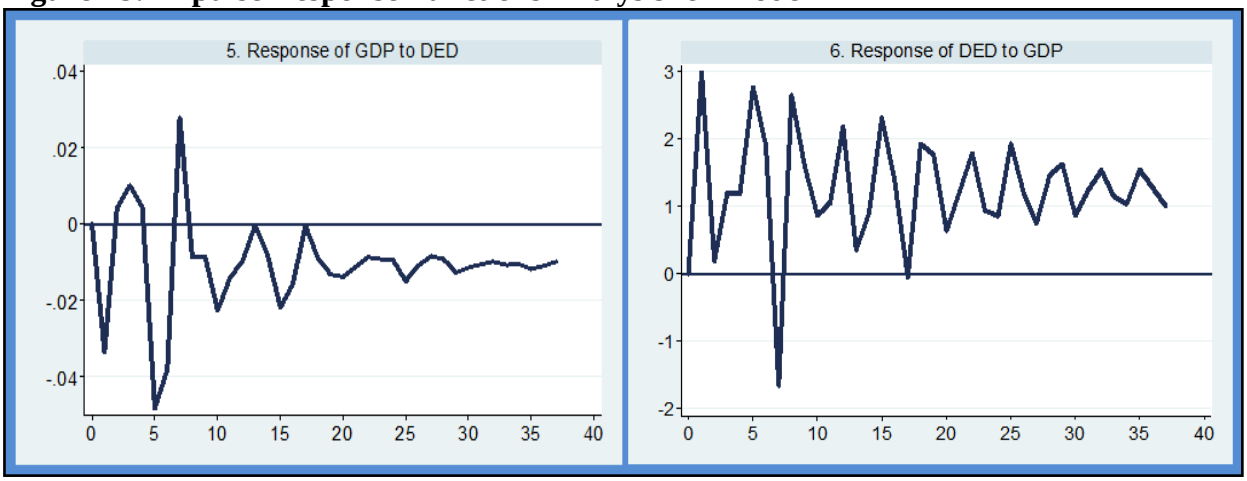
Turning to our second model *(Model II)* the impulse response function results are reported in Figures 2a, 2b, and 2c. The results report that the impact of one standard deviation shock to recurrent expenditure on GDP *(see number 3)* is found to be mixed as the graph keeps oscillating to the positive and negative periodically but from the twenty second year GDP responds negatively in virtually all the periods These results from the twenty second year onwards corroborate the findings of Kapunda and Topera (2013) who revealed in their study that recurrent expenditure has negative impact on economic growth of Tanzania. A unit shock in GDP creates a significant response in recurrent expenditure *(see number 4)* and this effect is significant and permanent as it does not taper off to zero as time goes on.

Figure 2a: Impulse Response Functions Analysis for Model II



The impact of one standard deviation shock to domestic sources development expenditure on GDP is almost negative in all the years *(see number 5)*. The negative impact of this category of development expenditure on GDP implies that the former doesn't have any positive contribution to economic growth of Tanzania. The results support our previous short-run and long-run causality analyses which revealed that domestic sources development expenditure does not promote economic growth. The results again corroborate those of Kweka and Morrissey (2000) who revealed that productive expenditure has negative impact on economic growth of Tanzania. A one standard deviation innovation of shock to GDP leads to a positive impact on domestic sources development expenditure in almost all the years *(see number 6)*. This confirms our causality analysis results that causality runs from GDP to domestic sources development expenditure.

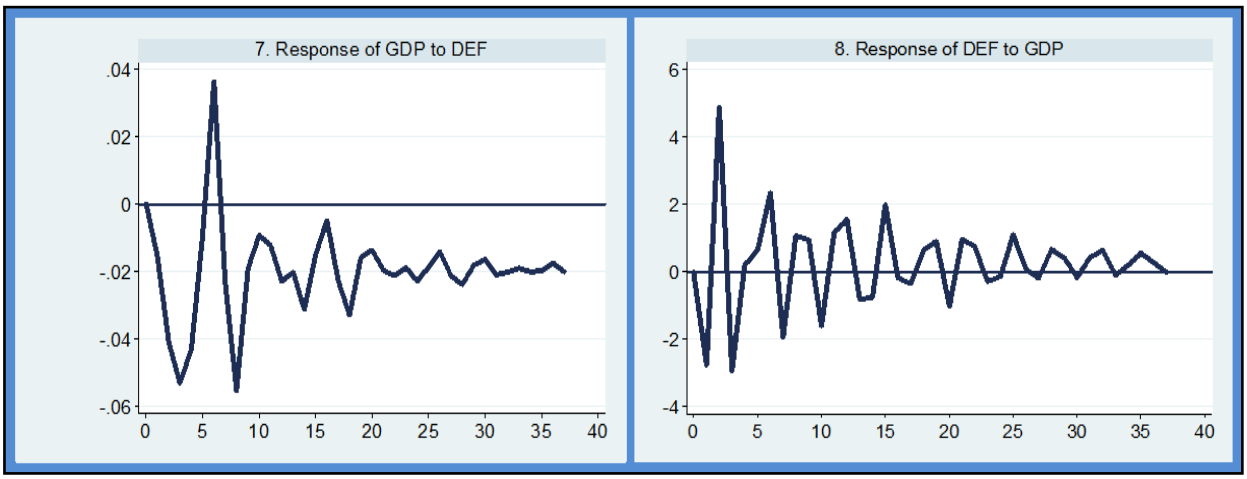
Figure 2b: Impulse Response Functions Analysis for Model II



The response of GDP to a unit shock in foreign sources development expenditure *(see number 7)* is significantly negative in almost all the years and it does not taper off to zero as time goes on. This might be attributed to the fact that there are some unfavorable conditions attached to donors' budget support that could impact growth negatively. These results support our short-run causality results which revealed that causality runs from foreign sources development expenditure to GPD but the relationship between the two variables is now

confirmed to be negative. Lastly, the impact of one standard deviation shock to GDP of foreign sources development expenditure *(see number 8)* is found to be mixed as the graph keeps swinging to the positive and negative occasionally. However, the impact of GDP on foreign sources development expenditure in found to be insignificant as the graph gradually lessens to zero implying that GDP doesn't have any substantial contribution to foreign sources development expenditure. The results support our previous short-run causality analysis which revealed no causality running from GDP to foreign sources development expenditure in Tanzania.

Figure 2c: Impulse Response Functions Analysis for Model II



5.0 Conclusion

This study examined the short-run and long-run causality between economic growth and government expenditure both at aggregated and disaggregated levels with the purpose of testing the validity of the Wagner's law and Keynesian hypothesis in the context of Tanzania. Government expenditure was taken in its aggregate level in the first model but disaggregated in the second model, into recurrent expenditure, development expenditure from domestic sources and development expenditure from foreign sources. This was done to differentiate this study from previous studies done in Tanzania (see Kapunda and Topera, 2013; Kweka and Morrissey, 2000; Moshi and Kilindo, 1999) and Osoro, 1997) that took different components of expenditure. The study results reveal bidirectional causality between government expenditure and economic growth, hence supporting both the Wagner's law and Keynesian hypothesis in the short and long-run when government expenditure was taken at its aggregate level. The results corroborate the findings of Keho (2015) and Odhiambo (2013) who both reported bidirectional causality between government expenditure and economic growth. At the disaggregated levels of expenditure, the study results affirm a strong support for the Keynesian hypothesis as recurrent expenditure and development expenditure from foreign sources promote economic growth. Wagner's law is supported only in one instance where short-run causality runs from economic growth to development expenditure from domestic sources. This is explainable since the share of development expenditure from domestic sources is likely to increase as the country's GDP increases.

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