The Relationship between Government Expenditure and GDP: Empirical Testing of Wagner's Law in the Jordanian Economy

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Abstract

The aim of this paper is to examine the nature of the relationship between government expenditure and GDP in the Jordanian economy for the period from 1976 to 2016. The Vector Auto-Regression (VAR) model is used to assess the validity of Wagner's and Keynesian laws of the relationship between these two variables. The study finds a short run causal relationship running from economic growth to(current and capital) government expenditures.

I. Introduction

The nature of the relationship between government expenditure and GDP has been a subject of considerable theoretical debate for a long time. In 1890's, Wagner predicted a positive impact of economic development on government expenditure in the long run. In Contrary, Keynes in his "General Theory of Employment, Interest and Money" in 1930's argued that the causality runs from government expenditure to economic growth. Therefore, from the Keynesian point of view, the government expenditure could be used as a stabilization policy instrument.

On the other hand, based on the ideas of Adam Smith who emphasized the virtue of free market, capitalists claim that inefficient large government could crowd out private consumption and private investment (Gokmenoglu and Alptekin, 2013), under the pretext of increasing the government intervention in the supply and demand mechanisms of the market, which in turn reduces the capital accumulation and hence lowers the growth rate in the long-run,

And thereafter in the last two decades, modern time-series econometric techniques have started revealing mixed results for the validity of Wagner's law as differing the functional forms of the law. Halicioglu (2003) adopts an augmented version of Wagner's law where public deficit is introduced as further explanatory variable in the model, in order to reduce the omitted variable bias and misspecification errors in econometric estimates.

Several arguments regarding the causal relationship between economic growth and government expenditure have appeared in the literature. Originally, Wagner suggested a more-than-proportionate increase in the government expenditure when economic growth increases. Whereas the fiscal stimulus argument predicted an inverse relationship between government expenditure and economic growth. The budget stickiness argument predicts a muted response of government expenditure to short-run fluctuations in economic activity due to some defined bureaucratic and institutional considerations for the country (Wahab, 2004).

Theories and empirical literature that use causality test to define the relationship between government expenditure and GDP have different views and findings about this relationship. However, the case of reallocation of government consumption to investment can raise the growth rate has received a wide consensus among scholars. (Govindaraju et al, 2011).

II. Theoretical Framework and Literature Review

In order to estimate the Wagner's relationship, and to investigate its validity, Vector Autoregression (VAR) models were used by some researchers (Halicioglu, 2003; Yuk, 2005; Ghali, 1997). And a modified version of Autoregressive-Distributed Lag (ARDL) regression were adopted by others (Jobarteh, 2017; Govindaraju *et al*, 2011). Others such as Chow *et al*, 2002; Wahab, 2004; Sánchez-Juárez *et al*, 2016) relied on Error Correction models (ECM) to investigate the aforementioned relationship between government expenditures and economic Growth.

Conventionally, the functional forms employed by researchers to test the relationship between government expenditure and GDP specified the share of government expenditure in GDP for the expenditure variable, and per capita GDP for the income variable. For example, Ghali (1997) used this approach, and he decomposed government expenditures into investment and consumption. Halicioglu (2003) added the budget deficit to GDP ratio in the functional form. The per capita government expenditure is affected by per capita GDP and money supply according to Chow *et al* (2002). Sánchez-Juárez et al, (2016) followed the same specification, while Wahab (2004) used the Government expenditure and GDP levels. Whereas, Yuk (2005) estimated share of government expenditure in GDP, and GDP plus share of exports in GDP. Jobarteh (2017) estimated various functional forms.

Bivariate regressions adopted under the pretext of omitted variables may mask the long run linkages between economic development and government expenditure (Chow et al, (2002). Whereas, Multivariate regressions adopted under the pretext of avoiding misspecification and generating misleading results from the model, Govindaraju *et al*, (2011) added real terms of capital stock and labor to the model. While, Sjoberg (2003) added transfers, private consumption, private investment, and interest rates.

The empirical evidence on the relationship between government expenditure and GDP has been mixed. Some researchers found empirical support for Wagner's hypothesis. Ghali (1997) argued that the causality runs from output growth to government spending, and government can face its deficit by shrinking its size and limiting its role in the economy. Chow *et al* (2002) claimed that causality runs from income and money supply to public spending in the long run. Then Wahab (2004) suggested that government expenditure increases less than proportionately with GDP during an economic expansion, and decreases more than proportionately during an economic recession. Gokmenoglu and Alptekin (2013), and Jobarteh (2017) found empirical support for the validity of Wagner's hypothesis. Therefore, they concluded that the government should channel its expenditures toward the productive sectors of the economy so as to promote economic growth.

Another group of researchers found empirical support for the Keynesian hypothesis. Sánchez-Juárez et al (2016) argued that efficient management of government expenditures is one of the keys to enhance economic growth in Mexico. Similarly, Govindaraju *et al*., (2011) drew the evidence from Malaysia employing a multivariate regression model. Other studies take the size of government as a different detour of the government expenditure-GDP relationship. According to Sjoberg (2003) government might inhibit economic growth as it spends too much. Mo (2007) argued that government expenditures affect the growth rate of real GDP through total factor productivity, investment and aggregate demand. Government consumption might have negative marginal effects on productivity and GDP growth, while government investment raises the growth rate. Terasawa and Gates (1998) found that government expenditures (including government investments) and GDP growth is expected to be positively related for developing countries and negatively related for industrialized countries, while transfer payments and social welfare programs are likely to reduce economic growth for all countries. Ultimately, the reallocation of government consumption to investment can raise the growth rate.

Some researchers showed by means of Granger-causality tests the validity of both hypotheses. Yuk (2005) suggested a bidirectional relationship between GDP growth and government spending indirectly through exports' share of GDP (i.e. export-led growth hypothesis). Govindaraju *et al.*, (2011) found that bivariate model, aggregate government spending Granger causes the real GDP which give support to Wagner's law. However, in multivariate framework, they found support for the Keynesian hypothesis suggesting that omitted variables bias can significantly alter the validity of Wagner's hypothesis.

III. Data and Methodology

Data on government expenditure (current and capital), real GDP, labor and capital variables for the time period (1976 – 2016) will be gathered for Jordan. The sources of economic data are the Central Bank of Jordan (CBJ) publications and the Department of Statistics (DOS). All variables are expressed in the form of natural logarithm of real values.

The Model

In line with the neoclassical growth model that originally introduced by Solow (1956) and developed later by Mankiw, Romer and Weil (1992), output (y) is determined by physical capital (k) and labor force (l). Hence, relying on the standard production function model $y_t = f(A_t, L_t, K_t)$, where A is the total factor productivity. In order to capture the short-run linear interdependencies among multiple time series, so the dynamic relationship between the real GDP and the government expenditure is examined, Vector Auto-Regression Model (VAR) has been run. This type of model shows the change in dependent variable as a function of changes in previous changes in that variable and other independent variables, though all the variables in this model are considered as endogenous. The conventional model of the VAR with the lag length (i), and its reflection on the components of the government expenditure are defined as follows:

$$Y_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} Y_{t-i} + \sum_{i=0}^{n} \beta_{2i} X_{t-i} + \sum_{i=1}^{n} \beta_{3i} Z_{t-i} + \cdots + \mu_{it} \quad \ldots \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$G_t = \beta_{01} + \sum_{i=1}^{n} \beta_{11} G_{t-i} + \sum_{i=1}^{n} \beta_{21} T_{t-i} + \sum_{i=1}^{n} \beta_{31} K_{t-i} + \sum_{i=1}^{n} \beta_{41} Y_{t-i} + \mu_{1t} \quad \ldots\ldots\ldots\ldots\ldots (a)$$

$$Y_t = \beta_{02} + \sum_{i=1}^{n} \beta_{12} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{22} T_{t-i} + \sum_{i=1}^{n} \beta_{32} \Delta K_{t-i} + \sum_{i=1}^{n} \beta_{42} \Delta G_{t-i} + \mu_{2t} \quad \ldots\ldots\ldots (b)$$

$$\Delta Y_t = \beta_{03} + \sum_{i=1}^{n} \beta_{13}\Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{23}\Delta L_{t-i} + \sum_{i=1}^{n} \beta_{33}\Delta K_{t-i} + \sum_{i=1}^{n} \beta_{43}\Delta Gi_{t-i} + \mu_{3t} \text{ .....(c)}$$

Where Y, L, K, G, Gc, Gi are the endogenous variables, βs are the coefficients, n is the time period, and μ's are residual vectors.

Preliminary Tests

First of all, the performing of preliminary tests is essential in order to avoid spurious regression and thus to choose the appropriate econometric model. The initial step of statistical analysis is testing the stationarity of the data applying unit root tests. For this reason, the Augmented Dickey-Fuller (ADF) test is used to determine the degree of integration and to ensure the constancy of the variance and the mean of each variable. The results of the ADF test revealed that natural logarithm of all variables are non-stationary at the level, and are stationary at the first difference (I(1)) except the natural logarithm of capital government expenditure that is stationary at the level (I(0)). The following table 1 shows the results of the ADF test for all time series.

Table 1: The results of Augmented Dickey-Fuller test

Variable	Level	statistics	critical	Sign. At	Lag
Ln(Y)	I(1)	-4.203	-3.610	0.0020	0
Ln(L)	I(1)	-3.832	-3.610	0.0056	0
Ln(K)	I(1)	-5.649	-3.610	0.0000	0
Ln(G)	I(1)	-6.772	-3.610	0.0000	0
Ln(Gc)	I(1)	-7.004	-3.610	0.0000	0
Ln(Gi)	I(0)	-3.612	-3.606	0.0098	0

The null hypothesis of non-stationary cannot be rejected whenever the t-stat. is larger than the critical value, the test equation for the ADF was determined based on the graph of each variable.

Afterward, in order to eliminate the effect of serial correlation of residuals, the appropriate lag length for each model should be selected. This could be done by many criteria such as Schwarz Information Criterion (SIC), which is used and its results show that the best lag selection for all models is one lag.

Subsequently, in order to ensure that the models rely on an empirically meaningful relation, Johansen cointegration test (Johansen, 1988) is used to detect the number of cointegration vectors and to test the long-run relationship between the considered variables. The results of trace and Maximum Eigen-value tests show that the null hypothesis of non-cointegration is accepted. Specifically, Empirical results indicate at five percent level that at least there is no a cointegration equation in each model, which is required to consider a common cointegration between the variables. Expressly, Trace test shows that there is no cointegration equation in all models, also the Max-Eigen value test shows that there is no cointegration equation in all models. Table 2 shows the result of Johansen cointegration tests.

Table 2: Johansen cointegration tests

Model	Null hypothesis	Trace test		Maximum Eigen Value test	
		Statistics	critical	Statistics	Critical
One	R=0	39.45703	47.85613	23.77755	27.58434
	r≤1	15.67948	29.79707	11.48548	21.13162
	R≤2	4.194003	15.49471	4.149928	14.26460

Trace test indicates (no) cointegration equation at 0.05 level
Max-Eigen value test indicates (no) cointegration equation at 0.05 level

Model	Null hypothesis	Trace test Statistics	Trace test critical	Max Eigen Statistics	Max Eigen Critical
Two	R=0	44.59310	47.85613	22.40858	27.58434
	r≤1	22.18452	29.79707	17.74066	21.13162
	R≤2	4.443859	15.49471	4.381701	14.26460

Trace test indicates (no) cointegration equation at 0.05 level
Max-Eigen value test indicates (no) cointegration equation at 0.05 level

Model	Null hypothesis	Trace test Statistics	Trace test critical	Max Eigen Statistics	Max Eigen Critical
Three	R=0	41.06074	47.85613	21.42088	27.58434
	r≤1	19.63985	29.79707	15.70686	21.13162
	R≤2	3.932992	15.49471	3.887076	14.26460

Trace test indicates (no) cointegration equation at 0.05 level
Max-Eigen value test indicates (no) cointegration equation at 0.05 level

As a results of the three preliminary tests above, Vector Auto-Regression Model (VAR) has been run obviously because it is the best approach. The conventional VAR in equation 1 is adapted to measure the short run dynamics of the time series in each model.

Table 3: results of the regressions

Model	Hypoth.	
One	**Wagner**	$Ln(G) = 0.99\ Ln(Y_{t-1}) + 0.53\ Ln(G_{t-1}) - 0.67\ Ln(L_{t-1}) + 0.02\ Ln(K_{t-1})$
	Keynes	$Ln(Y) = 1.13\ Ln(Y_{t-1}) + 0.08\ Ln(G_{t-1}) - 0.26\ Ln(L_{t-1}) + 0.04\ Ln(K_{t-1})$
Two	**Wagner**	$Ln(Gc) = 0.41\ Ln(Y_{t-1}) + 0.49\ Ln(Gc_{t-1}) - 0.04\ Ln(L_{t-1}) + 0.06\ Ln(K_{t-1})$
	Keynes	$Ln(Y) = 1.19\ Ln(Y_{t-1}) + 0.10\ Ln(Gc_{t-1}) - 0.35\ Ln(L_{t-1}) + 0.03\ Ln(K_{t-1})$
Three	**Wagner**	$Ln(Gi) = 2.58\ Ln(Y_{t-1}) + 0.39\ Ln(Gi_{t-1}) - 2.29\ Ln(L_{t-1}) - 0.09\ Ln(K_{t-1})$
	Keynes	$Ln(Y) = 1.22\ Ln(Y_{t-1}) + 0.01\ Ln(Gi_{t-1}) - 0.29\ Ln(L_{t-1}) + 0.04\ Ln(K_{t-1})$

Table (3) above reports the results for Wagner and Keynes hypotheses, according to the partial quality indicators, the results of the regressions are consistent with the hypotheses indicating that the response of G, Gc and Gi to Y is positive and statistically significant, whereas the response of Y to G, Gc and Gi is positive but not statistically significant as evidenced by the parameters.

In model one, a one percent increase in real GDP is associated with a 0.998 percent increase in government expenditure in average ceteris paribus in the short run, while a one percent change in government expenditure is associated with a 0.079 percent increase real GDP in average ceteris paribus in the short run.

According to model two, a one percent increase in real GDP is associated with a 0.41 percent increase in current government expenditure in average ceteris paribus in the short run, while a one percent change in government expenditure is associated with a 0.10 percent increase real GDP in average ceteris paribus in the short run.

For model three, a one percent increase in real GDP is associated with a 2.58 percent increase in capital government expenditure in average ceteris paribus in the short run, while a one percent change in government expenditure is associated with a 0.01 percent decrease real GDP in in average ceteris paribus in the short run.

Diagnostic test

Table 4: the results of the diagnostic tests

		Adjust. R^2	Wald test (overall sig.)	Serial Correlation (LM)	Heteroscedasticity
One	Wagner	96.1%	0.000	0.9878	0.1681
	Keynes	98.7%	0.000		
Two	Wagner	98.4%	0.000	0.8905	0.3598
	Keynes	98.7%	0.000		
Three	Wagner	38.6%	0.000	0.8503	0.5045
	Keynes	98.7%	0.000		

According to impartial quality indicators, the results of the regressions are not spurious. For instance, almost all the adjusted R2 are high, which means that in average, 98% of the variation in the dependent variables are explained in the variation of the independent variables. In addition, the results of testing overall significance for each model, using the Wald test pointing out the rejection of the null hypothesis, that is, at least one of the dependent variables are not statistically significant. Besides, the probability values of the Serial Correlation (LM) test indicate that the null hypothesis of no serial correlation within the residuals vector cannot be rejected. Moreover, the probability values of the White Heteroscedasticity test indicate that the null hypothesis of Homoscedasticity cannot be rejected.

Causality test

After ensuring that the condition of stationarity in the time series growth is achieved and the cointegration between real GDP and government expenditure (both current and capital) exist, now, we can measure the causal relationship and its direction between these variables in the short-run, thus measuring the ability to predict the future values of a time series using prior values of another time series by means of Granger causality test (Granger, 1988). Here, we can distinguish between three possible outcomes, which are the existence of unidirectional causality from one variable to another, the existence of bidirectional causality between both variables, or the absence of causality between them. The results of the causality test shows that we cannot accept the null hypotheses of the existence of causality relationship running from real GDP to government expenditure (both current and capital), also, the results shows that we cannot reject the null hypotheses of the existence of causality relationship running from government expenditure (both current and capital) to real GDP.

Null Hypothesis:	Obs.	Lag	F-Statistic	Prob.
G does not Granger Cause Y	38	2	0.02386	0.9764
Gc does not Granger Cause Y	38	2	0.21874	0.8047
Gi does not Granger Cause Y	38	2	0.26046	0.7723
Y does not Granger Cause G	38	2	3.83136	0.0319
Y does not Granger Cause Gc	38	2	5.10744	0.0117
Y does not Granger Cause Gi	38	2	2.58074	0.0909

Conclusion and policy implications

Wagner’s law and the Keynesian theory was examined using test specification that distinguishes between types of government expenditures (current and capital), three proxies are adopted and the relationship between them and real GDP was experimented.

The results of the regressions indicate that the total government expenditure seems to respond slowly to real GDP. Specifically, when the real GDP increases, the current expenditure of the government increase inelastically in the short run (indeed the operational expenditures including wages and salaries cannot be rising in the short run) and the capital expenditure of the government increase elastically by a greater range (which could be in many fields, such as, Education, health, infrastructure, etc…), so, eventually the response of government expenditure increase inelastically. Whereas, the real GDP seems to response -at a smaller ranges- inelastically to the increase in government expenditure (current and capital) taking into account that this response is statistically insignificant.

By Granger causality test, the results showed that Wagner's law is valid for Jordan, whereas the Keynesian hypothesis cannot be accepted.

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