THE LONG RUN RELATIONSHIP BETWEEN GOVERNMENT EXPENDITURES AND ECONOMIC GROWTH: CASE OF JORDAN

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ABSTRACT

Using data from the Jordanian economy, the paper conducts a causality test of the Wagner's Law which states that there is a relationship between the growth in government expenditures and the economic growth. The findings of the study show that the growth in the economy Granger causes the growth in the government sector. Thus, the Wagner's Law applies to the case of Jordan. Using co-integration technique and the VAR model, the study suggests that there is a uni-directional relationship between the economic growth and the growth in the government expenditures.

INTRODUCTION

The size of the government expenditures in Jordan has increased since 1969. With respect to the government services, its contribution to the GDP in the years 1969, 1980, and 1990 was 27.2 percent, 28.5 percent, and 30.9 percent, respectively (Penn Tables). The purpose of this paper is to examine the relationship between the government size and the economic development in the case of Jordan. This goal will be achieved using the methodology suggested by Wagner (1893), and Islam and Nazemzadeh (2001). This analysis will be in the framework of "Wagner's Law" that suggested that there is correlation between the relative size of government sector and the economic development in the country. That is, there is a tendency for the government sector to grow as the national income grows. So this paper will test empirically whether or not a causal relationship exists between the size of the government sector and the growth of the economy.

Review of the literature shows mixed support of "Wagner's Law" which suggests that there is a relationship between the relative size of the government and the economic growth. Conte and Darrat (1988) conducted an empirical study on the OECD countries for the period 1960-1984 to test whether there is Granger causality relationship between the growth in the public sector and economic growth in these countries. Their findings showed that the growth in the government sector had mixed impact on the rate of economic growth, and that in most of the OECD countries had no clear effect on the growth rate in their real income. Other study on the Canadian economy for the period 1947-1986, Afxentious and Serletis (1991) have empirically tested the Granger-Sims causality relationship between government expenditure and gross domestic product. Their findings indicated that neither Wagner's hypothesis, which runs from GDP to government spending, nor the reverse causality, which runs from the government spending to GDP, is statistically supported. In addition, Yousefi and Abizadeh (1992) tested Wagner's Law using data over the period 1950-1985 for each of the randomly selected 30 states of the U.S. economy. The empirical findings of their study indicated that Wagner's Law is valid for 70 percent of the cases considered in the study, i.e., in 21 out of the 30 states selected randomly. In another study, Abizadeh and Yousefi (1998) have empirically tested the Wagner's Law on the South Korean economy and they concluded that government expenditures have not contributed to economic growth in the case of South Korea. An empirical study on the U.S. economy by Islam and Nazemzadeh (2001) shows that a long run relationship exists between the relative size of the government and the economic development. It also shows that there is a uni-directional causal relationship between the relative size of the government and the economic development and that relationship goes from economic development to the relative size of the government.

The paper will be organized as follows. Section 2 presents the data used in the study. Methodology will be discussed in section 3, while the empirical results will be discussed in section 4. Finally, summary and conclusion will be presented in section 5.

DATA

Data used in the study were extracted from various sources. These include the Central Bank of Jordan, Jordan Department of Statistics, and the international financial statistics. The study covers the case of Jordan over the period of 1969-1999. This study uses the relative size of government expenditures (GSIZE) and the real GDP (RGDP) to examine the causal relation between them. Note that LGSIZE and LRGDP are used as proxy for "ln GSIZE" and "ln RGDP", respectively.

METHODOLOGY

Vector Autoregression (VAR) for Short-run Equilibrium

Causal relationships are evaluated by a VAR framework, which treats all variables within the system as being endogenous. Essentially, this approach estimates a system of structural equations in an unrestricted reduced form. The system's responses to random shocks are traced by the decompositions of variance or error term and innovation accounting. At the same time, the dynamic interactions among the variables of the system are examined by analyzing the impulse response function. Such a nonstructural (or as some argue, semi-structural) model is particularly suited for investigating the causal chains within a system of equations. The model sheds light into the exogenity of a variable and reveals the dynamic response of one variable to random shocks in innovations of another variable in the system.

The VAR representation in the form:

$$x_t = A + \mathrm{B}(L)u_t = A + \sum_{s=0}^{\infty} B(s)u_{t-s} \tag{1}$$

where x_t is a linear combination of current and past one-step-ahead forecast errors or "innovations," A is a 2x1 vector of constants, *B(L)* an identity matrix with a lag operator and u_t a vector of unorthogonalized innovations that shows the unexpected changes in stock price or LGSIZE. Thus *B(s)* represents the dynamic response of each endogenous variable x_t to a shock after *s* periods, u_{t-s}.

Since this study is interested in the moving average (MA) representation with orthogonalized innovations, we chooses a matrix *G* such that $G^{-1}\Sigma G^{-1'} = I$. This gives a vector of orthogonalized innovations $v_t = G^{-1}u_t$ satisfying $E[v_t v_t'] = I$. The Choleski decomposition allows us to obtain a lower triangular *G* as a solution to $GG' = S$. Thus one has the following MA representation with orthogonalized innovations:

$$x_t = A + \sum_{s=0}^{\infty} B(s)Gv_{t-s} = A + \sum_{s=0}^{\infty} C(s)v_{t-s} \tag{2}$$

where v_t is a vector of orthogonalized innovations. Using equation (6), impulse responses are derived and confidence bands generated by Monte Carlo Integration. The coefficients of *c(s)* represent responses to shock in particular variables, such as LRGDP and LGSIZE. The variance of each element in x can be allocated to sources in elements of v because v is serially and contemporaneously uncorrelated.

VAR models are essentially for testing a short-run relation between LRGDP and LGSIZE. For the long run relationship between the two variables, we apply co-integration test.

Unit Roots and Co-integration Tests for Long-run Equilibrium

The two variables x_t and y_t are said to be cointegrated if (1) the two are nonstationary and integrated of the same order (that is, the same order of differencing is required to produce stationarity); (2) there exists a long-run equilibrium relationship; and (3) the error term is stationary. The application of the co-integration technique thus presupposes the nonstationarity of variables under consideration. Therefore, this study first tests for unit root in spot and forward premium rates for all countries under study before it tests for co-integration.

The unit root tests, developed by Fuller (1976), Dickey and Fuller (1979; 1981), Said and Dickey (1984), and later refined by Phillips and Perron(1988), examine whether a time series is stationary by taking into account the heteroscedasticity in the time-series data. If the unit root hypothesis is rejected, it means that a time series is stationary. If the unit root hypothesis is not rejected, the series is non-stationary. Testing for the presence of one unit root can be made by the following model (Fuller, 1976; Dickey & Fuller, 1979; 1981):

$$Y_t = \beta_2 y_{t-1} + e_t \qquad t = 1, 2, \ldots ,T \qquad (3)$$
$$Y_t = \beta_0 + \beta_2 y_{t-1} + e_t \qquad t = 1, 2, \ldots ,T \qquad (4)$$
$$Y_t = \beta_0 + \beta_1 t + \beta_2 y_{t-1} + e_t \qquad t = 1, 2, \ldots ,T \qquad (5)$$

where Y_t is the variable being tested for unit roots, β_1 or β_2 are the regression coefficients, and e_t is the random error term which is normally distributed with a mean of zero and variance σ^2. The *t*-test statistic for the null hypothesis

$$H_0: \beta = 1 \text{ is } (\beta-1)/s(\beta)$$

where $s(\beta)$ is the standard error of the regression coefficient β. The Z_t statistics is modification of the Dickey-Fuller t-statistics suggested by Phillips & Perron, 1988 which allows for autocorrelation and conditional heteroscedasticity in the error term of the Dickey-Fuller regression. The $Z_{\text{ته}}$ statistics, also suggested by Phillips & Perron (1988), is a similar modification of the test statistics $N(\beta\text{-}1)$, where N is the number of observations. Fuller (1976) tabulates the critical values of the sample distribution of the regression using the Monte Carlo experiments. Then, the critical values are compared with the calculated values to test the null hypothesis. If the null hypothesis fails to be rejected, this conclusion implies the presence of a unit root in the time series, rendering it nonstationary (random walk). If the null hypothesis of a unit root in government spending and real GDP is not rejected, this result implies that the consecutive changes in government spending and real GDP over the period are random. On the other hand, to examine the long-run relationship between government spending and real GDP the co-integration test will be applied.

The co-integration technique, pioneered by Granger (1983) and Engle and Granger(1987), offers an alternative in time-domain time series analysis. The co-integration analysis is a convenient tool to examine the presence of an equilibrium relationship between two sequences of random variables consistent with short-run dynamics. In this approach, the existence of a long-run relationship between two nonstationary processes is tested by examining the stability of deviations from the relationship. This process uses coefficients estimated by fitting static regressions.

It is frequently of interest to test whether the set of variables is cointegrated. This test may be desired because of the economic implications as to whether or not a system being tested is in equilibrium in the long-run. Testing for co-integration combines the problems of unit root tests and tests with parameters unidentified under the null hypothesis.

In a bivariate case, if two variables are integrated in the same order, they may be cointegrated, i.e., there may exist a long-run equilibrium relationship between them. This relationship is true if, and only if, there exists a stationary vector zt which is a linear combination of the two series x_t and y_t.

A variable z is said to be integrated of order $d[z\sim I(d)]$ if it has a stationary, invertable, non-deterministic autoregressive moving average (ARMA) representation after differencing d times. Two variables x and y, where both are $I(1)$ processes can be considered. Following Granger (1986), if there exists some constant a, such that

$$Z_t = x_t - ay_t$$

if $I(0)$, then x and y are said to be cointegrated of order zero, where a is the co-integration parameter.

Number of tests have been proposed in the literature to determine if x and y are cointegrated (a useful summary is given in Granger, 1986). The present study concentrates on two tests: the augmented Dickey-Fuller (ADF) and Phillips and Perron test of residuals from the cointegrating regression. The cointegrating regression for the present model has the following form:

$$x_t=\alpha+\beta y_t+\epsilon_t \tag{6}$$

Stock, 1984 has demonstrated that when x_t and y_t are cointegrated, *OLS* estimates of β are consistent and highly efficient.

Given *OLS* estimates of the residual series ϵ_t, tests of co-integration proceed by setting the null hypothesis that x_t and y_t are not cointegrated.

$$H_0: x_t\,,\, y_t \text{ not cointegrated}$$

The test of H_0 is enforced by constructing DF and ADF statistics. These tests are computed by first running the following regression (Granger & Engle, 1987 stated that the procedure can also be used to determine the order of integration of a raw data series, although the critical values differ):

$$\Delta\varepsilon_t = \alpha + \beta_0\varepsilon_{t-1} + \sum_{j=1}^{\rho}\beta_j\Delta\varepsilon_{t-1} + g_t \tag{7}$$

The test statistics are computed as the ratio of β_0 to its estimated standard error. The order of ρ is set to ensure that the estimated residual series, g_t, are white noise. If $\rho = 0$, the estimated t ratio is known as the DF statistics; for $\rho > 0$, the t ratio is known as the ADF statistics.

EMPIRICAL RESULTS

VAR Model Results: Granger Causality Test Results

Table 1 reports the causality test results between LGSIZE and real LRGDP. When the LGSIZE is the dependent variable, given LRGDP, all of the lags of

LGSIZE are important in explaining the movement of LGSIZE. On the other hand, given LGSIZE , the zero coefficients of all lags in LRGDP can be rejected, which implies that past values of LRGDP shock do matter in the movement of the LGSIZE in the presence of past lags of the LGSIZE. When the LRGDP is the dependent variable, given LGSIZE, all of the lags of LRGDP are important in explaining the movement of LRGDP. On the other hand, given LRGDP, the zero coefficients of all lags in LGSIZE cannot be rejected. This result implies that past values of the LGSIZE shock does not matter in the movement of LRGDP in the presence of past lags of LRGDP.

Table 1
F-statistics for tests in which all lags of designated variables have zero coefficients

Equation	Variable	
	$LGSIZE_{t-4}$	$LGDP_{t-4}$
LGSIZE	6.54^{a}	3.34^{b}
LGDP	1.54	7.54^{a}

[a, b] indicate F statistics is significant at 1% and 5%, respectively.

The Granger test shows that the null hypothesis "LRGDP" does not Ganger cause LGSIZE is rejected. However, the reverse null hypothesis "LGSIZE" does not Granger cause "LRGDP" could not be rejected. Thus, the test shows clear uni-directional Granger causality flowing from the LRGDP variable to the LGZISE variable. This result is quite consistent with Wagner's Law in that economic progress as measured per capita real income Granger causes growth of the public sector as measured by the relative share of the public sector in the economy, but not the other way.

One can note that this kind of statistical causal relationship is misleading since *OLS* results are fairly robust in the VAR. To capture the refined causal relationships among variables, variance decomposition's (innovations) results will be introduced in the next section.

Variance Decomposition (Innovation) Results

In Table 2, LRGDP and LGSIZE seem Granger-causally prior in the sense that most of the 24-month forecast error variances are accounted for by the innovations in the two-variable system. Table 2 indicates that LGSIZE appears to be explained by LRGDP. On the other hand, LRGDP does not appear to be explained by LGSIZE. When the LGSIZE is the dependent variable in the VAR system, 24.04% of the 24-month of forecast error of LGSIZE is explained by the innovations of LRGDP. Furthermore, when LRGDP is the dependent variable in the VAR system, 95.95% of the 24-month of forecast error of LRGDP is explained by the innovations of LRGDP. This indicates that LRGDP cause movement and explain the changes in LGSIZE.

Table 2

Percentage of 24-Month Forecast Error Variance Explained by Innovations in Each Variable Based on Two-Variable Innovation Accounting Using LLGSIZE and LGDP

	By Innovations in Variables	
Explained	LGSIZE	LGDP
	(%)	(%)
LGSIZE	75.94	24.04
LGDP	5.05	95.95

Time Path Between LGSIZE And LRGDP

The impulse response function, or moving average representation, is suggested as an alternative descriptive device of the VAR system because autoregressive systems are very difficult to define succinctly; there are complex patterns of cross-equation feedbacks and estimated lagged coefficients that tend to oscillate. The impulse response function may yield a reasonable economic interpretation. The impulse response function is computed by artificially imposing a one standard deviation shock to one variable and by measuring the response of each variable in the system.[1]

The pattern of dynamic responses of each of the two variables (LGZISE and LRGDP) to innovations in a particular variable using the simulated responses of the estimated VAR system is estimated. To facilitate the interpretation, the time paths of impulse responses of the two variables to a shock in one variable are plotted.[2]

In addition to the uni-directional causality between LGSIZE and LRGDP, the study finds a consistent positive response of LGSIZE to shocks in LRGDP and a weak consistent positive response of LRGDP to shocks in LGSIZE. Hence, LGSIZE is not a good indicator in predicting fluctuations in LRGDP in the case of

Jordan. But it may take a number of years before the effect of LGSIZE shocks are fully reflected in LRGDP as evidenced by the variance decomposition analysis.

The time path of the response between LRGDP and the unpredicted movement in LGSIZE can be tested due to the long memory of information contained in LRGDP and LGSIZE. To estimate the time path between LRGDP and LGSIZE, we use the VAR models for the two variables.

The response of the LRGDP to the unexpected movements (innovations or shocks) in the LGSIZE and the bands of plus or minus two standard errors are shown in Figure 1.[3] To derive the time path, the VAR models are applied over a forecast period of 24 months (two years). Figure 1 shows that an unexpected movement in the LGSIZE causes small changes in the LRGDP over time. This is shown in the impulse response function. As we can see from the graphs in Figure 1, the initial short run response of there is a low positive response in LRGDP towards a positive shock in LGSIZE at one standard deviation. Also, in the short-run, there is a low positive response in LGSIZE towards a positive shock in LRGDP at one standard deviation

From Figure 1 we conclude that after a transitory period of a positive shock to LRGDP, the impulse function in the Jordanian economy would later become a large positive and permanent in the long run. This positive long run effect of LRGDP on LGSIZE, support the uni-directional causality between the two variables in the short-run as well as in the long-run.

Unit Root and Co-integration Results

Table 3 reports the unit root results using both the ADF and PP tests. The ADF and PP test reveals that the null hypothesis of unit root is accepted for GSIZE and RGDP variables because the calculated values are less than the corresponding McKinnon (1991) critical values for the levels of the variables. For the first difference of the variables, the calculated values exceed the critical values, thus rejecting the null of unit roots for the first differenced series.

Table 3 also indicates that the null hypothesis cannot be rejected; the levels of GSIZE and RGDP contain stochastic trends. Thus, it is entirely possible that the inference using the *t*-distribution, which indicates that the RGDP have significant forecasting ability for GSIZE, could be highly misleading. The findings that unit roots in GSIZE and RGDP cannot be rejected indicate that the usual methodology of regressing the level of GSIZE on the RGDP is not able to provide evidence that the RGDP has any ability to forecast future GSIZE. Thus, this paper looks at another methodology, such as co-integration, to examine the relationship between RGDP and GSIZE.

Table 3.
Unit Root tests for LGSIZE and GDP

Variable	ADF	PP	Accept/Reject H_0
LGSIZE	-2.15	-1.60	Accept
RGDP	-0.57	-0.33	Accept

Given that the GSIZE and RGDP are all $I(1)$ processes, one can then proceed to test for co-integration. The present study concentrates on two tests: ADF and PP tests of residuals from the co-integration regression. The ADF and PP tests on the residual from the long-run equation are presented in Table 4.[4] The results from both tests suggest that the residual series is stationary. This is because the null of unit root is rejected at the 1% Mckinnon critical value. Based on this result, it is concluded that the LGSIZE and LRGDP variables are co-integrated.

The conclusion from Table 3 is that the hypothesis of no co-integration between LGSIZE and LRGDP could be rejected in the case of Jordan on the basis of the Augmented Dickey-Fuller test results. These results mean LGSIZE and LRGDP have ability to predict each other.

SUMMARY AND CONCLUSION

This paper investigates the applicability of Wagner's Law in the Jordanian economy. Using co-integration technique and the VAR model, the study suggests that there is a uni-directional relationship between the economic growth and the growth in the government expenditures. Thus, the findings of this study support the hypothesis of the Wagner's Law which states that the growth in the economy causes the growth in the government expenditures.

The results of the VAR model shows that, in the short run, economic growth explains the movements in the government expenditures. Furthermore, the findings of the time path analysis conclude that after a transitory period of a positive shock to real GDP, the impulse function in the Jordanian economy would later become a large positive and permanent in the long run. This positive long run effect of real GDP on the government expenditures support the uni-directional causality between the two variables in the short-run as well as in the long run.

The unit root results indicate that the government expenditures and economic growth are non-stationary in their levels but stationary in the first difference. On the other hand, findings of the co-integration analysis show that government expenditures and economic growth are co-integrated. Thus, these results support the Wagner's hypothesis as a long-run equilibrium.

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ENDNOTES

1 Given the VAR system, the typical random shocks are the positive residual of a one standard deviation unit in each equation. For example, the residual in the LRGDP is referred to as the LRGDP innovation in the sense that it cannot be predicted from past values of variables in the system.

2 Due to space limitations, impulse responses of the two variables (LGSIZE and LRGDP) can be requested from the authors.

3 Figure 1 is available from the Authors upon request.

4 Table 4 is available from the Authors upon request.