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GOVERNMENT EXPENDITURE AND ECONOMIC GROWTH: EVIDENCE FROM TRIVARIATE CAUSALITY TESTING

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This paper seeks to examine if the relative size of government (measured as the share of total expenditure in *GNP* can be determined to Granger cause the rate of economic growth, or if the rate of economic growth can be determined to Granger cause the relative size of government. For this purpose, we first use a bivariate error correction model within a Granger causality framework, as well as adding unemployment and inflation (separately) as explanatory variables, creating a simple 'trivariate' analysis for each of these two variables. The combined analysis of bivariate and trivariate tests offers a rich menu of possible causal patterns. Using data on Greece, UK and Ireland, the analysis shows: i) government size Granger causes economic growth in all countries of the sample in the short run and in the long run for Ireland and the UK; ii) economic growth Granger causes increases in the relative size of government in Greece, and, when inflation is included, in the UK.

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I. Introduction

The size of government expenditures and its effect on long-run economic growth, and vice versa, has been an issue of sustained interest for decades.

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The received literature, essentially of an empirical nature, has proceeded at two levels.

One set of studies has explored the principal causes of growth in the public sector. Wagner's Law -the "Law of increasing expansion of public and particularly state activities" (Wagner, 1893)- is one of the earliest attempts that emphasises economic growth as the fundamental determinant of public sector growth. Empirical tests of this hypothesis, either in the form of standard regression analysis (see, for instance, Ganti and Kolluri, 1979; and Georgakopoulos and Loizides, 1994, to cite only a few) or in the form of error-correction regression (see, for instance, Kolluri, Panik and Wanab, 2000, and the literature cited therein), have yielded results that differ considerably from country to country.

The other set of studies has been directed towards assessing the effects of the general flow of government services on private decision making and, more specifically, on the impact of government spending on long-run economic growth. Macroeconomics, especially the Keynesian school of thought, suggests that government spending accelerates economic growth. Thus, government expenditure is regarded as an exogenous force that changes aggregate output. Here, again, empirical work, either in standard regression forms (see, for instance, Landau, 1983) or error-correction regressions (see, for instance, Ghali, 1998, and the literature cited therein) finds diverse results.

Although each line of enquiry has thrown interesting light on the phenomena, in neither case has the assumed causative process been subjected to rigorous empirical pre-testing. Purely a priori judgements for choosing between the two competing postulates are rendered difficult for at least three reasons: Firstly, there is the possibility of feedback in macro relations, which tend to obscure both the direction and the nature of causality. Secondly, as demonstrated by Ahsan, Kwan and Sahni (1992), in the public expenditure-national income nexus, failure to account for omitted variables can give rise to misleading causal ordering among variables and, in general, yields biased results. Thirdly, if co-integration among the variables of the system is admitted, then the error-correction terms would provide an additional source of causality. Indeed, a principal feature of cointegrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. Thus, omission of the error correction terms would entail a mispecification error and potentially bias the results. In the context of trivariate systems such an outcome is very possible because the introduction of a third variable in the system can alter the causal inference based on the simple bivariate system.

Singh and Sahni (1984) initially examined the causal link between government expenditure and national income. Subsequently, their work has generated many other studies, the results of which range the full continuum from no causality to bi-directional causality between these two variables. Ram (1986, 1987), among the existing causality studies, suggested that differences in the nature of underlying data, the test procedure and the period studied may explain the diversity in results. A few years later, Ahsan, Kwan and Sahni (1992) added various other factors that may explain the inconsistency amongst the results obtained by different authors, one of which is the influence of 'omitted' variables. It is suggested that failure to account for omitted variables can give rise to a misleading causal ordering among the variables. To the best of our knowledge, this study is the only one that examines the causal link between public sector size and *GNP* within a trivariate framework. Recently, various other studies have used the cointegration test results, but in the context of a bivariate approach, to either validate or invalidate Wagner's Law (see, for instance, Hondroyiannis and Papapetrou,1995; Bohl, 1996; Chletsos and Kollias, 1997; Kolluri et al., 2000, and the literature cited therein). The only study that follows a methodology similar to ours is Ghali (1998). That study uses multivariate cointegration techniques but puts the emphasis on a different place.

A significant weakness of many of the previous studies on this topic (save for Ghali's, 1998 study) was the failure to adjust for the co-integration result of the time series in the case of the trivatiate framework, that renders traditional statistical inference invalid. Indeed, as we will discuss below, the introduction of a third variable in the system can alter not only the causal inference based on the simple bivariate system, but also the magnitude of the estimates.

The principal aim of this paper is to empirically evaluate the causal link between the size of the public sector and real per capita income within the bivariate and trivariate frameworks, by resorting to recent developments in the theory of cointegrated processes. The combined analysis of bivariate and trivariate tests offers a rich menu of possible causal patterns. To this end, we employ cointegration analysis, error-correction modelling and multivariate causality tests. We conducted three different specifications: i) in the first, we test for a causal link between the size of the public sector, as measured by the ratio of government expenditure relative to *GNP* (hereafter denoted as G_t), and real per capita income (hereafter denoted as Y_t) at the bivariate level; ii) in the second we include G_t, Y_t and the unemployment rates; and iii) in the third we substitute the unemployment rates by the inflation rates. The last two specifications are intended to investigate whether, by switching to a trivariate system from the bivariate one, the causality results would leave unchanged the causal link between G_t and Y_t in every case examined. Should Granger causality of a certain pattern be robust to the specification changes from *bivariate* to *trivariate* system, one would have more confidence in the predictive power of the underlying causal process. Besides, since trivariate tests incorporate more information than bivariate ones, the causal inferences drawn appear more reliable.

A question that naturally arises is how do we determine which variable has to be included in the specification of the system. This is difficult to answer, given that the studies in these areas are empirical in orientation. In principle, any variable that is intimately connected with the size of public sector as well as national income could be used. In this paper, we decided to use unemployment and inflation rates for two reasons. First, during the period examined these variables were at the centre of interest of economic policies. Indeed, compared with the relatively placid and successful decades of the 1950s and 1960s in most European countries, the 1970s and afterwards was accompanied not only by rising unemployment on a scale not previously experienced since the inter-war years, but also by very strong inflationary pressures. We therefore expect inflation and unemployment to play an important role in the formation of the causal process between *G* and *Y*. Secondly, various empirical studies find that both unemployment and inflation are intimately connected with the size of public sector growth and national income. For example, Abrams (1999) presents evidence that the rise in US government outlays (as a percent of GDP since 1949) is responsible for increases in the unemployment rate, which have contributed to slow down the growth of the US economy. On the other hand, a number of authors, such as Fischer (1993), Burdekin, Goodwin, Salamun and Willet (1994), and Clark

(1997), estimate time-series regressions of growth and inflation across countries and find inflation to be inversely related to growth.

We applied trivariate causality tests using time series data drawn from three European countries over the period from early 1950s to mid-1990s. One developed country, the United Kingdom, and two developing countries; namely, Ireland and Greece were selected for investigation. Since empirical work on this topic covers both developed and developing nations, it is of interest to test whether similar or different results hold between these two categories of countries.

The rest of the paper proceeds as follows. In section II we briefly outline the data set and provide some stylised facts of the main characteristics of the variables that we used in the analysis. Section III considers some theoretical issues as well as some empirical results of past studies. In section IV we present the econometric methodology. Section V provides the empirical results of our study, while section VI concludes.

II. Data and some Stylized Facts

The data set used in this study relates to the UK, Greece and Ireland and consists of annual observations. Income, Y_t, is measured as real per capita Gross National Product (*GNP*) at market prices in year *t*. Real government expenditure is measured as the Public Authorities spending on goods and services (excluding transfer payments), i.e. consumption and gross fixed capital formation. Public sector size G_t, is measured as the ratio of real government expenditure to *GNP*. Unemployment rate UN_t, is calculated as the unemployed persons divided by the working population. P_t, is the wholesale price index and its change, $\Delta \ln P_t$, gives the inflation rate $\dot{P}_t$. For the UK and Ireland, data for Y_t, G_t, and P_t, come from the IMF's *International Financial Statistics*, while data for UN_t, are taken from the *European Economy* published by the European Commission. The statistical data for Greece come from the National Accounts and the Labour Force Organization and cover the time period 1948-1995. For the UK and Ireland, the annual time series runs from 1950 through 1995. Note, however, that in UK and Ireland, data for the UN_t series cover the period 1960 to 1995, since data are not available before 1960. All variables are expressed in natural logarithms; hence their first differences approximate the growth rates.

In the choice of government size we follow the procedure adopted by practically all scholars to date and relate government spending to *GNP*. Practices, however, are more varied as to which types of public expenditures one should relate to *GNP* and whether one should use deflated or undeflated data. Researchers have also used differing approaches regarding the inclusion of transfer payments in the size of the public sector. For example, Ram (1986) argued that transfer payments should be excluded to make government spending compatible with Wagner's ideas. Musgrave and Musgrave (1980) also excluded transfer payments from government expenditure for the reason that their inclusion overstates the size of government. Recent works by Ahsan, Kwan and Sahni (1996) and Ghali (1998), utilise an aggregate measure of G_t inclusive of transfer payments in their analysis. However, since the intention of this paper is to investigate the causal chain between the size of public sector and economic growth, transfer payments were excluded, in order to be able to differentiate the effects of income redistribution and provision of public services on growth.

Opinions differ concerning the choice of whether one should use deflated or undeflated measures of government size.[1] As it is possible to find viable arguments both in favour and against the use of deflated ratios, we have decided to use deflated measures of government size in this paper.

Before proceeding to the estimation of the causal link between G_t and Y_t, it is of interest to have a bird's eye view of the basic characteristics of the variables used in this study.[2] The evolution of G_t, Y_t and growth rates of *GNP*, together with unemployment and inflation rates, during the period 1960-1995 reveals some interesting findings. First, government spending in Greece during the 1960s was around 19.0 per cent of *GNP*, some 3 percentage points lower than in the UK and 1 percentage point lower than in Ireland. During the 25 years since then, the rise in spending in Greece has been more than in Ireland and in the UK, with the result that now spending is highest there. It was only after the Maastricht Treaty (1992) that public spending control in Greece

[1] See, for instance, Cullis and Jones (1987).

[2] To conserve space, this set of data is omitted but it is available upon request.

became an important objective of economic policy with the aim of gaining admission to the European Monetary Union.

Second, in terms of the level of economic development, the UK is by far the more developed country. Throughout most of the period, and especially during the 1960s, real per capita income in the UK was nearly twice the levels of Ireland and Greece. However, these differences have changed substantially over time. On average, real per capita incomes in Greece and Ireland rose around 1 per cent a year during the period, whereas in the UK there was an absolute contraction at the rate of 0.5 per cent per annum. Real per capita incomes in Greece, which had been previously rising, were reversed after the early 1980s, and between 1986 and 1990 fell on average by about 12 per cent. On the contrary, in Ireland real per capita income increased by 6 per cent during the same period. By the mid 1990s, real per capita income levels in Ireland were about 30 per cent higher than those in Greece, and only 10 per cent lower than those of the UK.

Third, relating growth rates of public spending to the growth rates of *GNP* among these countries, two general remarks are in order. First, growth rates of *GNP* declined everywhere from the rates prevailing in the 1960s, but in Greece this reduction was much greater. Second, and less obvious, during the period growth rates of government expenditures in the UK and Ireland declined in much the same way as the growth rates of *GNP*, whereas in Greece government spending grew at a faster rate than *GNP* (some 3 percentage points). Even in this very rudimentary way, we observe a long-run constraining relationship between the growth of *GNP* and the growth of expenditure in the UK and Ireland. Thus, the fact to be explained in these two countries is not the high variability of government expenditure but rather its remarkable stability with respect to the trend growth of national income.

Finally, for much of the 1970s and early 1980s inflation was one of the overriding issues in all three countries, often running into double figures. All three economies displayed significant deterioration in inflation performance after 1974. However, whereas Irish and British inflation fell significantly after 1985, inflation in Greece persisted. Nevertheless, one problem that refused to go away was unemployment. In fact, until the middle of the 1990s unemployment was on an upward trend, rising into double figures in Ireland and close to 10 percent in the UK and Greece.

III. Theoretical Issues and Empirical Evidence

The substantial growth of the size of government expenditures in both the developed and developing nations since World War II, and its effect(s) on long-run economic growth (or vice versa), has spawned a vast literature that offers diverse attempts to explain the observed phenomenon.

On the one hand, public finance studies have been directed towards identifying the principal causes of public sector growth.[3] Wagner's Law of public expenditure is one of the earliest attempts that emphasize economic growth as the fundamental determinant of public sector growth. The literature on this topic is immense to say the least. Some studies find a significant positive relationship between public sector growth and economic growth only for developing nations but not for developed countries. Others even report a negative relationship between government spending and *GNP*.

On the other hand, macroeconomics, especially the Keynesian school of thought puts the emphasis on a different place. The analysis bears upon the question of the role of government in economic growth. A considerable amount of attention has been directed towards assessing the effect of the general flow of government services on economic growth.[4]

During the last twenty years or so, studying the underlying causal process

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[3] Henrekson and Lybeck (1988) provide an excellent survey of various hypotheses concerning the sources of growth of government expenditures.

[4] Several studies have examined the relationship between the growth rate of real per capita output and the share of government spending and find diverse results. For example, Landau (1983), in a cross-section study of over 100 countries in the period 1961-76, reported evidence of a negative relationship between the growth rate of real per capita *GDP* and the share of government consumption expenditure in *GDP*. By contrast, Ram (1986), utilising a two-sector model, in a cross-section study of 115 countries and in the two-decade period from 1960 through 1980, found that growth of government size has a positive effect on economic growth. Barro (1991) reports mixed results. In his cross-section study of 98 nations between the years 1960 and 1985, he found that increases in government consumption expenditure measured as a percent of national income reduce per capita growth. However, when the share of public investment was considered, Barro found a positive but statistically insignificant relationship between public investment and the output growth rate. Finally, in the United States, Razzolini and Shughart (1997) present evidence that growth in the relative size of government is responsible for a decrease in the US growth rate.

between government spending and *GDP*, or their close variants, has made parallel efforts. The principle reason that led researchers to this field of analysis was the difficulty of a possible feedback in macro relations, which tend to obscure both the direction and the nature of causality.

It is clear that knowledge of the true nature of the causative process between government spending and *GDP* will help determine the robustness of the estimated relationship. Should the causality be Wagnerian, the estimates derived from macro-econometric models would evidently suffer from simultaneity bias. On the other hand, if the causality were Keynesian, the estimates reported in public finance studies would similarly be biased. Nevertheless, knowledge of the precise causative process has important policy implications. For example, if the causality were Wagnerian, public expenditure is relegated to a passive role, if Keynesian, it acquires the status of an important policy variable.

Singh and Sahni (1984), using the Granger-Sims methodology, initially examined the causal link between government expenditure and national income in a bivariate framework. Their empirical results, based on data for India, suggest that the causal process between public expenditure and national income is neither Wagnerian nor Keynesian. Similarly, Ahsan, Kwan, and Sahni (1992) have used the same approach, but in a trivariate framework. Their interesting results indicate that while the US data fail to detect any causality between public expenditure and national income at the *bivariate* level, there was strong evidence of indirect causality from *GDP* to public spending via both money stock and budgetary deficits. Bohl (1996) applied tests of integration, cointegration and Granger causality in a bivaritate context, and found support to Wagner's law for only the United Kingdom and Canada, out of the G7 countries,[5] during the post-World War II period. Hondroyiannis and Papapetrou (1995), and Chletsos and Kollias (1997), applied the same methodology in Greece, and found mixed results. To our knowledge, Ghali's (1998) study is the only one that uses multivariate cointegration techniques, and examines the dynamic interactions between government size and economic growth in a five-variable system, consisting of the growth rates of *GDP*, total

[5] These countries are Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

government spending, investment, exports, and imports. Using data from ten OECD countries, Ghali's study shows that government size Granger-causes growth in all countries of the sample. More recently, Kolluri, et. al. (2000), using a bivariate framework, estimated the long-run relationship between gross domestic product and government spending in the G7 countries for the period 1960-1993. Most of their empirical findings confirm Wagner's Law for the G7 countries; that is, government spending tends to be income elastic in the long run. This disparate evidence calls for a re-examination of the differences in the causality results.

As we mentioned in the introduction, the focus of this paper is to empirically evaluate the causal link between G_t and Y_t within the bivariate and trivariate frameworks, by resorting to recent developments in the theory of cointegrated process. Models that use only levels of variables or first differences (see for instance Singh and Sahni, 1984, and Ahsan et al., 1992), are mispecified because they ignore interim short-run corrections to long-run equilibrium. Besides, in the case of the trivariate approach this problem, as we will show below, is even stronger because the third variable can alter the causal inference based on the simple bivariate system.

IV. Econometric Methodology

The notion that there is a long-run tendency for the public sector to grow relative to national income or vice-versa has been an issue in economics that is rarely questioned. Thus, if the variables Y_t and G_t are considered as stochastic trends and if they follow a common long-run equilibrium relationship, then these variables should be cointegrated. According to Engle and Granger (1987), cointegrated variables must have an ECM representation. The main reason for the popularity of cointegration analysis is that it provides a formal background for testing and estimating short-run and long run relationships among economic variables. Furthermore, the ECM strategy provides an answer to the problem of spurious correlation.[6]

If Y_t and G_t are cointegrated, an ECM representation could have the following form:

[6] For a useful discussion of spurious correlations and ECM strategy, see Enders (1998).

$$\Delta Y_t = a_0 + a_1 E_{t-1} + \sum_{i=1}^{n} a_{2i}[1-L]\Delta Y_{t-i} + \sum_{i=1}^{n} a_{3i}[1-L]\Delta G_{t-i} + u_t \quad (1)$$

$$\Delta G_t = b_0 + b_1 C_{t-1} + \sum_{i=1}^{n} b_{2i}[1-L]\Delta Y_{t-i} + \sum_{i=1}^{n} b_{3i}[1-L]\Delta G_{t-i} + e_t \quad (2)$$

where L and D are the lag and difference operators, respectively, and E_{t-1}, C_{t-1} are error-correction terms. The error correction term E_{t-1} in (1) is the lagged value of the residuals from the OLS regression of Y_t on G_t and the term C_{t-1} in (2) corresponds to the lagged value of the residuals from the OLS regression of G_t on Y_t. In (1) and (2), DY_t, DG_t, u_t and e_t are stationary, implying that their right-hand side must also be stationary. It is obvious that (1) and (2) compose a bi-variate VAR in first differences augmented by the error-correction terms E_{t-1} and C_{t-1}, indicating that ECM model and cointegration are equivalent representations.

According to Granger (1969; 1988), in a cointegrated system of two series expressed by ECM representation causality must run in at least one way. Within the ECM formulation of (1) and (2), G_t does not Granger cause Y_t if all $a_{3i} = 0$ and $a_1 = 0$. Equivalently, Y_t does not Granger cause G_t if all $b_{2i} = 0$ and $b_1 = 0$. However, it is possible that the causal link between Y_t and G_t estimated from the ECM formulation (1) and (2) could have been caused by a third variable. Such a possibility may be explored within a multivariate framework including other important variables, such as the unemployment rates UN_t or inflation rates $\dot{P}_t$, which represent considerable determinants of real *GNP* and government expenditures. Thus, the causal relationship between Y_t and G_t can be examined within the following ECM representation:

$$\Delta Y_t = \alpha_0 + \alpha_1 E_{t-1} + \sum_{i=1}^{n} \alpha_{2i}[1-L]\Delta Y_{t-i} + \sum_{i=1}^{n} \alpha_{3i}[1-L]\Delta G_{t-i} + \sum_{i=1}^{n} \alpha_{4i}[1-L]\Delta Z_{t-i} + u_t \quad (3)$$

$$\Delta G_t = \beta_0 + \beta_1 C_{t-1} + \sum_{i=1}^{n} \beta_{2i}[1-L]\Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{3i}[1-L]\Delta G_{t-i} + \sum_{i=1}^{n} \beta_{4i}[1-L]\Delta Z_{t-i} + e_t, \quad (4)$$

where Z_t could be the macroeconomic state of the economy. Regarding unemployment rates UN_t, or inflation rates, $\dot{P}_t$ as 'third' variables, the system captures the response of Y_t and G_t to changes in UN_t, or $\dot{P}_t$. The difference between the ECM models (1) and (2), and (3) and (4) is that the introduction of UN_t, and $\dot{P}_t$ could alter the causal inference based on the simple bivariate system. This occurs in one of three ways. First, the coefficients a_{2i} and a_{3i} (b_{2i} and b_{3i}) need not be similar to a_{2i} and a_{3i} (b_{2i} and b_{3i}), respectively, either in direction or in magnitude. Second, Y_t and G_t can be related through UN_t or $\dot{P}_t$ even though the parameters a_{3i} and b_{2i} are statistically insignificant. In other words, any spurious causality that arises in the bivariate system may be removed due to the presence of UN_t or $\dot{P}_t$. Finally, we may also find direct causality between G_t and Y_t in a trivariate context, which may or may not be detected, in a bivariate framework. In this latter scenario, the third variable itself explains the causation. Thus, causality tests reported in earlier studies (see, for instance, Hondroyiannis and Papapetrou,1995; Bohl, 1996; Chletsos and Kollias, 1997; and Kolluri et al., 2000) might simply be artefacts of mispecified models.

V. Empirical Results

To test formally for the presence of a unit root for each variable in the model, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests of the type given by regression (5) and (6) were conducted. The ADF test is conducted using the regression of the form:

$$\Delta W_t = a_0 + a_1 t + \rho W_{t-1} + \sum_{i=1}^{k} \lambda_i \Delta W_{t-i} + u_t, \tag{5}$$

where DW_t are the first differences of the series *W*, *k* is the lag order and *t* stands for time. Equation (5) is with constant and time trend.

PP tests involve computing the following OLS regression:

$$W_t = a_0 + a_1 W_{t-1} + a_2 (t - T/2) + u_t, \tag{6}$$

where a_0, a_1, a_2 are the conventional least-squares regression coefficients. The hypotheses of unit-root to be tested are $H_0 : a_1 = 1$ and $H_0 : a_1 = 1, a_2 = 0$.

Akaike's Information Criterion (AIC) is used to determine the lag order of each variable under study. Mackinnon's (1991) tables provide the cumulative distribution of the ADF and PP test statistics. Tests for stationarity indicate that the null hypothesis of a unit root cannot be rejected for the levels of the variables. Using differenced data, the computed ADF and PP tests suggested that the null hypothesis is rejected for the individual series, at the one or five percent significance level, and the variables Y_t, G_t, UN_t, and $\dot{P}_t$ are integrated of order one, I(1).

Having determined that the variables are stationary in first differences, we perform the Johansen cointegration test (1991) to examine whether the variables in question have common trends. The Johansen procedure sets up a VAR model with Gaussian errors, which can be defined by the following Error-Correction representation,

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 X_{t-2} + ... + \Gamma_{k-1}\Delta X_{t-k+1} + \Pi_k X_{t-k} + \mu_t + u_t, \qquad (7)$$

$$t = 1, 2, ..., T,$$

where D is the difference operator, X_t is a p x 1 vector of non-stationary variables (in levels), m_t is the deterministic element of the VAR model and u_t is the vector of random errors which is distributed with mean zero and variance matrix $\Lambda[u_t - N(0, \Lambda)]$. The Johansen technique determines whether the coefficient matrix P contains information about the long-run properties of the VAR model (7). The null hypothesis of cointegration to be tested is,

$$H_0(r): \Pi = ab', \qquad (8)$$

with a_{pxr}, b_{pxr} full rank matrices. The null hypothesis (8) implies that in a VAR model of type (7) there can be r-cointegrating relations among the variables X_t. In this way, model (7) is denoted by H_1, a is named the matrix of error-correction parameters, and b is called the matrix of cointegrating vectors, with the property that $b¢X_t$ is stationary $[b¢X_t - l(0)]$ even though X_t is non-stationary $[X_t - l(1)]$.

As we mentioned above, in the case of the UK and Ireland the system $[Y_t, G_t, \dot{P}_t]$ is tested for cointegration over the period 1950-1995, while the system $[Y_t, G_t, UN_t]$ is tested for the period 1960-1995, given that data for unemployment series are not available before 1960. Cointegration tests cover the period 1948-1995 for Greece. In determining the number of cointegrating vectors r, we use the maximum eigenvalue statistics, λ_{max}. The null hypothesis to be tested is that there can be r cointegrating vectors among the three-variable systems $[Y_t, G_t, UN_t]$ and $[Y_t, G_t, \dot{P}_t]$. In order to check the robustness of the results to the order of the VAR, we carry out the Johansen cointegration tests using one and two year lag lengths. As to the cointegration test results, the λ_{max} rank tests indicate that each group of the series is cointegrated. The LR-tests are statistically significant, at the one and five percent levels, thus rejecting the null hypothesis of noncointegration.[7]

Having verified that each group of the series Y_t, G_t, and $\dot{P}_t$, Y_t, G_t and UN_t, is cointegrated, we next investigate the causal pattern between Y_t and G_t, within the ECM models. In Table 1 we employ Hendry's general-to-specific strategy to estimate the bivariate ECM model (1) and (2), whereas Tables 2 and 3 present the same methodology in the case of trivariate ECM models of the form (3) and (4). Five lags are used for each independent variable. The lag length is reduced to five years to conserve degrees of freedom. The error-correction terms E_{t-1} and C_{t-1} serve as measures of disequilibrium, representing stochastic shocks in the dependent variables, Y_t and G_t, respectively. They represent the proportion by which the long-run disequilibrium in the dependent variables is corrected in each short-term period. The coefficients on E_{t-1} and C_{t-1} are expected to be negative and statistically significant. The coefficients on the lagged values of ΔY_t, ΔG_t, ΔUN_t and $\Delta \ln P_t$ are short-run parameters measuring the immediate impact of independent variables on ΔY_t and ΔG_t. The rationale of Hendry's general-to-specific approach is to re-estimate the basic model by dropping the lagged variables with insignificant parameters from the system. In the restricted model we include lagged values of independent variables significant at the 10 percent level. The restricted equations are nested within the unrestricted models.[8] In this sense, when equations are special cases of a general model, they appear to be nested within the general model.

The various specification and diagnostic tests applied in the restricted

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[7] Detailed regression results are available from the authors and will be supplied on request.

[8] In order to conserve space, we present only the results of the restricted models. Unrestricted models are available upon request.

equations $\mathrm{D}Y_t$ and $\mathrm{D}G_t$ appear significant and robust, indicating that the estimated ECM models fit the data adequately. Choosing 1975 as the sample breaking values of the parameter yield a stable solution, which is not sensitive to changes in the sample range.[9] The RESET (Regression Specification Test) statistics reveal no serious omission of variables, indicating the correct specification of the model. The ARCH (AutoRegressive Conditional Heteroskedasticity tests suggest that the errors are homoskedastic and independent of the regressors. The BG (Breusch-Godfrey) tests reveal no significant serial correlation in the disturbances of the error term. The JB (Jarque-Bera) statistics suggest that the disturbances of the regressors are normally distributed. In sum, specification and diagnostic testing ensure that the general model is congruent and that the congruency is maintained through the restricted equations.

Table 1 presents the ECM results within the bivariate system for Greece, UK and Ireland.[10] Several conclusions are apparent. The essential result in Greece is that economic growth Granger causes public spending expansion but not the other way round. Thus, there is a high degree of support for this Wagner type phenomenon in the data for Greece; public spending tends to be income elastic in the long run.[11] Note, however, that real per capita income growth never enters significant in the restricted equation. This fact is an indication that expenditure plans are too "sticky" to change in the light of short-term fluctuations in income. Nevertheless, the Keynesian view about the causal effects of public expenditures on economic growth has become apparent in the short run.

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[9] Note that in all three countries, varying the sample breaking date, the Chow F-statistics show the stability of the ECM models over the chosen sub-periods.

[10] To avoid overburdening the analysis with symbols, in this part, the time subscript is omitted from all variables.

[11] Hondroyiannis and Papapetrou (1995) cast doubt on the validity of Wagner's hypothesis in Greece, whereas Chletsos and Kollias (1997) found mixed results. Note, however, that the findings of these studies are not directly related to our results, merely because they defined government size as the ratio of total spending (including transfer payments) to *GNP*. Even in that case, their results may be artefacts of mispecified models. This may happen because they use standard Granger causality tests, in a bivariate context, without allowing for the influence of the error correction terms.

Table 1. Bivariate Estimates of Restricted ECMs

Variables	Greece		United Kingdom		Ireland	
	DY_t	DG_t	DY_t	DG_t	DY_t	DG_t
Constant	0.01 (1.31)	---	---	---	0.00 (0.01)	-0.00 (-0.42)
DY_t (-1)	0.33 (2.35)*	---	0.40 (2.56)	---	0.25 (1.58)	---
DY_t (-2)	---	---	0.38 (2.59)*	---	---	---
DY_t (-3)	0.34 (2.41)*	---	---	---	0.30 (2.01)*	---
DY_t (-5)	---	---	---	---	0.30 (2.08)*	---
DG_t (-1)	0.16 (2.28)*	-0.14 (-1.04)	-0.15 (-1.18)	0.94 (4.207)*	---	0.72 (4.70)*
DG_t (-2)	---	---	0.26 (2.68)*	-0.61 (-4.135)*	---	-0.56 (-3.39)*
DG_t (-4)	---	---	---	---	0.23 (3.09)*	---
E_{t-1}	-0.02 (-1.16)	---	-0.46 (-3.39)*	---	-0.99 (-5.18)*	---
C_{t-1}	---	-0.30 (-3.17)*	---	-0.47 (-1.69)	---	0.01 (1.24)
$\bar{R}^2$	0.30	0.21	0.23	0.41	0.54	0.40
DW	2.05	---	---	---	1.86	2.04
SER	0.03	0.06	0.02	0.01	1.95	0.04
Chow (1975)	1.43	0.26	1.09	0.25	0.76	1.31
JB	0.02	2.62	1.61	0.48	0.08	0.77

Table 1. (Continued) Bivariate Estimates of Restricted ECMs

	Greece		United Kingdom		Ireland	
	DY_t	DG_t	DY_t	DG_t	DY_t	DG_t
RESET (1)	0.00	0.14	1.61	1.93	0.91	0.24
ARCH (2)	0.20	0.01	2.50	0.79	1.20	0.14
ARCH (3)	0.28	0.01	2.02	0.75	0.79	0.15
BG(2)	0.09	0.40	0.35	0.78	0.74	0.05
BG(3)	0.07	0.26	0.27	0.54	0.50	0.27

Notes: * is significant at the 5% level. Asymptotic t-statistics in parentheses. The error-correction term E_{t-1} (lagged one period) is the residual series from the regression of Y_t on G_t. Likewise, C_{t-1} (lagged one period) is the residual from the corresponding regression of G_t on Y_t. $\bar{R}^2$ is the adjusted R^2. DW is the Durbin-Watson statistic. SER is the standard error of the regression. Chow is the F-statistic for structural change in 1975. JB is the Jarque-Bera test for the normality of the regression residuals. RESET is the Ramsey F-statistic for omitted variables. BG is the Breusch-Godfrey F-statistic. ARCH is the Autoregressive Conditional Heteroskedasticity F-statistic. In RESET, BG and ARCH tests, numbers in parentheses are the lag lengths.

By contrast, for Ireland and the UK, our estimates show one-way causality running from G to *Y*. These results are consistent with the Keynesian notion suggesting that the causal linkage flows from D*G* to D*Y* both in the long run and the short-run. The fact that public spending in these two countries is income inelastic in the long run simply indicates some long-run proportionality between the size of public sector growth and *GNP*. This of course was only to be expected given that, as we mentioned in section II, in these countries government size kept pace with national income and, indeed, during the 1980s income has grown just a little faster than public sector size. The behaviour of the institutions that determine public expenditure, perhaps, explains its stability.

Indeed, at least in the UK, the institutional procedures adopted for expenditure planning deliberately target expenditure growth on the expected growth of national income. For instance, following the 1961 Plowden Report, expenditure planning in Britain was institutionalised in the Public Expenditure Survey Committee system. The intention of this system was to plan public expenditure over a five-year horizon in relation to prospective resources. Real public expenditure was projected as a stable share of the anticipated future level of real income. On the contrary, the whole process of budgeting in Greece -one year non-zero budgeting- has incentives to facilitate and maintain bureaucratic growth and to supply a level of expenditures higher than that which would result from simple majority rule.

Note that the sign of coefficient estimate C_{t-1}, in the regression D*G* for Greece, is negative and statistically significant, which supports convergence of the size of public sector growth to its conditional mean, determined by *GNP* growth. That is, the sign is in accord with convergence toward the long-run equilibrium and the results support Wagner's Law for Greece. It indicates that about one third (30 percent) of any disequilibrium between actual and equilibrium public sector size, in any period, is made up during the current period. Thus, the size of public sector growth in Greece responds mainly to the trend level of real per capita income, rather than to its short-term variations. This sort of sluggish adjustment process is, as we noted above, an indication that expenditure plans are too rigid to change in line with short-term fluctuations in income.

Similarly, the coefficients E_{t-1} in the regression D*Y* for the UK and Ireland are statistically significant and they support convergence of real per capita income growth to its conditional mean determined, in part, by government spending growth. It is hardly surprising, however, that in the UK the long run growth effect of public sector size on economic growth is quite sluggish as compared to that of Ireland. Indeed, in the UK, the response of real per capita income growth to its previous period disequilibrium is only half of that in Ireland. This is probably due, as we mentioned above, to inherent infrastructure rigidities, institutional procedure for bargaining and planning, or perhaps financial constraints**,** leading to delay in the implementation of public sector projects. By contrast, in Ireland, sustained economic growth has had the inevitable effect of stimulating demand for improved administration services, increased developmental activities, and provision of better activity.

Table 2 presents the ECM results of unemployment within the tri-variate system for Greece, UK and Ireland. Comparing the results in Tables 1 and 2 we can easily note some remarkable similarities and differences among the three countries. First, all three experienced a growth slowdown because of the unemployment. Nevertheless, the long-run causal effects continued to hold in all three economies. Specifically, in Greece, Hendry's general-to-specific restrictions estimates indicate, again, an obvious one-way causality running from DY to DG in the long run and unidirectional causality from DY to DG in the short run, indicating that government spending contributed cyclically to the economic growth of the economy. This finding can, also, be interpreted as evidence that Greek governments adapted the actual level of expenditures to the desired level partially to avoid jeopardising the goal of economic stability. Indeed, the short-run dynamics of unemployment supports the contention that public spending in Greece responded to the unemployment target.

Second, the results for the UK and Ireland show, like the bivariate ones, that public sector size Granger causes output growth in the long and the short run. Nevertheless, in Ireland, when unemployment is introduced into the system, the positive short-run influence of expansive demand policies, whose most immediate impact on output growth might be expansionary, after unemployment sets in the consequences are negative. This counter-cyclical effect between growth and government spending simply means that, during the period examined, aggregate supply shocks (e.g. increases in oil prices) that move output and employment in the opposite direction, have dominated

Table 2. Trivariate Estimates of Restricted ECMs: The Case of Unemployment

Variables	Greece		United Kingdom		Ireland	
	DY_t	DG_t	DY_t	DG_t	DY_t	DG_t
Constant	---	---	---	---	0.06 (0.18)	0.00 (0.32)
DY_t (-1)	---	---	0.97 (6.76)*	---	---	---
DY_t (-2)	---	---	---	---	---	0.00 (1.41)
DY_t (-3)	0.70 (7.32)*	---	---	---	---	---
DY_t (-4)	---	---	---	0.17 (1.32)	---	---
DY_t (-5)	---	---	---	---	0.29 (2.07)*	---
DG_t (-1)	0.23 (3.24)*	---	---	0.58 (5.19)*	-0.25 (-3.36)*	0.74 (4.05)*
DG_t (-2)	---	---	---	---	---	-0.63 (-3.25)*
DG_t (-3)	---	---	---	0.38 (2.24)*	---	---
DG_t (-4)	---	---	---	---	0.13 (1.84)	---
DG_t (-5)	---	---	0.06 (1.94)*	---	---	---
DUN_t (-1)	-0.09 (-2.62)*	---	0.59 (4.15)*	-0.08 (-3.91)*	-0.80 (-2.18)*	0.11 (1.54)
DUN_t (-2)	---	---	-0.39 (-2.36)*	---	---	-0.11 (-1.62)
DUN_t (-3)	0.11 (3.18)*	---	-0.29 (-1.90)	---	---	---
DUN_t (-4)	---	---	-0.35 (-2.75)*	0.04 (1.73)	---	---
E_{t-1}	0.03 (0.77)	---	-0.39 (-2.69)*	---	-0.92 (-5.57)*	---

Table 2. (Continued) Trivariate Estimates of Restricted ECMs: The Case of Unemployment

	Greece		United Kingdom		Ireland	
	DY_t	DG_t	DY_t	DG_t	DY_t	DG_t
C_{t-1}	---	-0.41 (-4.01)*	---	-0.15 (-1.65)	---	0.03 (1.12)
$\bar{R}^2$	0.34	0.26	0.47	0.50	0.55	0.44
DW	---	---	1.84	---	1.90	2.02
SER	0.03	0.06	0.13	0.03	0.96	0.04
Chow (1975)	0.53	0.23	0.31	0.64	1.43	0.89
JB	1.07	0.38	0.54	1.20	0.31	0.50
RESET(1)	0.75	0.22	0.94	0.80	0.10	0.01
ARCH(2)	1.51	0.03	1.38	0.50	0.18	0.50
ARCH(3)	1.19	0.13	1.00	0.73	0.13	0.67
BG(2)	0.28	0.87	0.24	0.08	0.55	0.13
BG(3)	0.19	0.63	0.27	0.13	0.78	0.14

Notes: * is significant at the 5% level. Asymptotic t-statistics in parentheses. The error-correction term E_{t-1} (lagged one period) is the residual series from the regression of Y_t on G_t and UN_t, and (lagged one period) is the residual from the corresponding regression of G_t on Y_t and UN_t. For the remaining test statistics, see Table 1.

aggregate demand shocks (e.g. fiscal policies) that move output and employment in the same direction. Indeed, the public sector regression in Ireland shows that the short-run dynamics of unemployment do not support the view that the size of the public sector responded to unemployment levels through public spending on goods and services.[12]

Third, the sign of the unemployment coefficient in the public sector regression for the UK is the opposite of that indicated by stabilization policy. Expenditures should be increased, not cut, when unemployment is high. This counter-cyclical fiscal policy response to unemployment in the UK may, in part, well reflect the fiscal restraint adopted by the British authorities during the 1970s and 1980s. Given the overriding problems of inflation and budgetary deficits, during the aforementioned periods, authorities were forced to adopt an uneasy compromise mix of policies in an attempt to gain some trade off between inflation, employment and growth. The problem with this line of policy, however, was that it failed to eradicate inflation and left a residue of unemployment and slow growth (see Aldcroft, 2001).

Finally, Table 3 gives estimation results for inflation as a third variable in the system for all countries in the sample. Comparing these results with those of the bivariate systems (Table 1) we observe three remarkable points that are worth mentioning. First, perhaps the more salient aspect of our findings is that, while in the UK our tests reveal no causal link between economic growth and public spending at the bivariate level, in the case of trivariate system with inflation as third variable, we do discern a causal chain. That is, inflation explains the causation. This finding validates Wagner's Law, because real output seems to be an important determinant of long and short-run government size growth. An important implication of the reported reciprocity is that the estimates of the coefficients of national income used in public finance studies and those of the public expenditure reported in macro-econometric models would be asymptotically biased as well as inconsistent. Second, the results for Greece and Ireland support, like the bivariate ones, unidirectional causality

[12] It is interesting to note, however, that when we include transfer payments to total government expenditures, public sector size in Ireland Granger causes economic growth procyclically. Presumably, such a finding is the result of income redistribution and not that of the public sector size growth.

Table 3. Trivariate Estimates of Restricted ECMs: The Case of Inflation

Variables	Greece		United Kingdom		Ireland	
	DY_t	DG_t	DY_t	DG_t	DY_t	DG_t
Constant	0.10 (8.15)*	-0.02 (-1.51)	---	-0.02 (1.84)	0.07 (0.21)	-0.00 (-0.06)
DY_t (-1)	-0.33 (-2.37)*	---	0.44 (3.33)*	0.46 (2.09)*	---	---
DG_t (-1)	---	0.33 (2.20)*	-0.13 (-1.44)	0.76 (4.2)*	---	0.64 (3.98)*
DG_t (-2)	---	0.35 (2.94)*	---	---	---	-0.64 (-4.13)*
DG_t (-4)	---	---	---	---	0.28 (3.40)*	---
$D\ln P_t$ (-1)	-0.47 (-6.69)*	0.66 (3.09)*	0.15 (3.05)*	0.41 (3.18)*	---	0.01 (2.10)*
$D\ln P_t$ (-2)	---	-0.48 (-2.13)*	---	-0.48 (-3.15)*	-0.20 (-1.66)	---
$D\ln P_t$ (-3)	---	---	---	0.25 (1.82)	-0.27 (-1.86)	0.01 (2.44)*
$D\ln P_t$ (-5)	---	---	---	---	---	0.01 (3.20)*
E_{t-1}	0.01 (1.04)	---	-0.55 (-4.00)*	---	-0.97 (-5.81)*	---
C_{t-1}	---	-0.82 (-4.80)*	---	-0.28 (-2.77)*	---	0.01(1.00)
$\bar{R}^2$	0.54	0.50	0.17	0.50	0.53	0.54
DW	1.79	2.06	---	1.83	1.85	2.18
SER	0.02	0.05	0.02	0.03	0.97	0.04
Chow(1975)	0.79	1.97	0.33	1.31	0.44	0.84

Table 3. (Continued) Trivariate Estimates of Restricted ECMs: The Case of Inflation

	Greece		United Kingdom		Ireland	
	DY_t	DG_t	DY_t	DG_t	DY_t	DG_t
JB	0.15	1.68	2.94	0.30	0.38	0.12
RESET(1)	0.25	1.07	1.63	0.24	0.01	0.04
ARCH(2)	1.29	0.41	3.12	0.96	1.55	0.25
ARCH(3)	1.92	0.35	2.36	1.51	0.97	0.16
BG(2)	0.63	0.16	0.56	0.71	0.54	1.04
BG(3)	0.83	0.22	0.60	0.84	0.35	0.86

Notes: * is significant at the 5% level. Asymptotic t-statistics in parentheses. The error-correction term E_{t-1} (lagged one period) is the residual series from the regression of Y_t on G_t and $D\ln P_t$, while C_{t-1} (lagged one period) is the residual from the corresponding regression of G_t on Y_t and $D\ln P_t$. For the remaining test statistics, see Table 1.

in the long run, running from DY to DG in the case of Greece and from DY to DG in the case of Ireland.

Third, in Greece, when inflation is introduced into the system, the positive short-run influence of expansive demand policies, whose most immediate impact on real per capita income might be expansionary (see Table 1), after inflation sets in the consequences are negative.[13] This important result does not necessarily contradict our conclusion that there is evidence supporting the Keynesian view about the causal effect of government spending on real output. However, at the very least, it qualifies the results of this policy if it is not a genuinely counter cyclical policy, but rather it is ultimately based on inflationary finance that leads to an inflation bias.[14] On the other hand, in the UK an increase in government spending initially causes real per capita income to rise, as firms increase their production to meet demand; but when output rises above the full employment level, there is upward pressure on the price level, which gives rise to inflation. This is a Keynesian prediction that inflation is procyclical and lagging. By contrast, in Ireland, public sector size growth continued to have a procyclical effect on economic growth, despite the counter cyclical effects of inflation. Nevertheless, the sign of the inflation coefficient, in the government size equation, is the opposite of that indicated by stabilization policy. That is, expenditures should be cut, not increased, when inflation is high. Why the procyclical effects of inflation on government spending should have been so severe, during the period examined, is hard to say. A variety of explanations present themselves, including differential cost increases in the public sector and overzealous application of inflation supplementation. These findings are, again, in line with the Keynesian notion, which indicates a powerful effect of government spending on real per capita income growth.

[13] This negative (and statistically significant) relationship between growth and inflation, does not mean that inflation is "detrimental to growth" –it simply means that over the period examined inflation has been on average countercyclical, i.e. that aggregate supply shocks (e.g. increases in oil prices) have dominated aggregate demand shocks (e.g. fiscal policies).

[14] Our sincere thanks to a referee of this Journal for pointing out this finding to us.

VI. Conclusions

Utilising annual data drawn from the UK, Greece and Ireland, this paper has examined the relationship between government size growth and income growth in both bivariate and trivariate systems, based on cointegration analysis, ECM strategy and Granger causality tests. On the basis of our empirical results, the following broad conclusions emerge. First, in all countries public expenditure Granger causes growth in national income either in the short or the long run. This is born out by the bivariate as well as the trivariate analysis. The analysis generally rejects the hypothesis that public expansion has hampered economic growth in these countries. The underlying growth rates impact of the public sector has been positive, which means that public spending fosters overall economic development. Second, Greece is supportive of the Wagner hypothesis that increased output causes growth in public expenditure. This is apparent in a bivariate test as well as in trivariate system. Third, while causality from national income to public spending is the distinctive feature of the Greek case, British data also indicated a similar pattern when a trivariate model (with inflation as an additional variable) is adopted. By contrast, the results for Ireland do not indicate any Wagnerian-type causality effect. Finally, we believe that while other potential variables, like real interest rate or public debt over *GNP*, remain unexplored, the present study indicates the likely dimensionality of a macro model that would explain the behavioural relationship between real per capita income and the size of the public sector.

References

Abrams, Burton A. (1999), "The Effects of Government Size on the Unemployment Rate," *Public Choice* **99**: 395-401.

Ahsan, Syed M., Andy C. Kwan, and Balbir S. Sahni (1992), "Public Expenditure and National Income Causality: Further Evidence on the Role of Omitted Variables," *Southern Economic Journal* **58**(3): 623-34.

Ahsan, Syed M., Andy C. Kwan, and Balbir S. Sahni (1996), "Cointegration and Wagner's Hypothesis: Time-series Evidence for Canada," *Applied Economics* **28**: 1055-58.

Aldcroft, Derek H. (2001), *The European Economy 1914-2000*, 4th Edition, London, Routledge.

Barro, Robert J. (1991), "Economic Growth in a Cross-section of Countries," *Quarterly Journal of Economics* **106**: 407-44.

Bohl, Martin T. (1996), "Some International Evidence of Wagner's Law," *Public Finance* **51**: 185-200.

Burderkin, Richard C. K., Thomas Goodwin, Suyono Salamun, and Thomas D. Willet (1994), "The Effects of Inflation on Economic Growth in Industrial and Developing Countries: Is There a Difference?", *Applied Economics Letters* **1**: 175-77.

Chletsos, Michael, and Christos Kollias (1997), "Testing Wagner's Law using Disaggregated Public Expenditure Data in the Case of Greece: 1958-1993," *Applied Economics* **29**: 371-377.

Clark, Todd E. (1997), "Cross-country Evidence on Long-run Growth and Inflation," *Economic Inquiry* **35**: 70-81.

Cullis, John G., and Phillips R. Jones (1987), *Microeconomics and the Public Economy: A Defence of Leviathan*, Oxford, Basil Blackwell.

Enders, Walter (1998), *Applied Econometric Time-Series*, New York, John Wiley and Sons.

Engle, Robert F., and Clive W. J. Granger (1987), "Cointegration and Error-correction: Representation, Estimation, and Testing," *Econometrica* **55**: 251-76.

Fischer, Stanley (1993), "The Role of Macroeconomic Factors in Growth," *Journal of Monetary Economics* **32**: 485-512.

Ganti, Subrahmanyam, and Bharat R. Kolluri (1979), "Wagner's Law of Public Expenditures: Some Efficient Results for the United States," *Public Finance / Finances Publiques* **34**: 225-33.

Georgakopoulos, Theodore A., and John Loizides (1994), "The Growth of the Public Sector: Tests of Alternative Hypotheses with Data from Greece," *The Cyprus Journal of Economics* **7**: 12-29.

Ghali, Khalifa H. (1998), "Government Size and Economic Growth: Evidence from a Multivariate Cointegration Analysis," *Applied Economics* **31**: 975-987.

Granger, Clive W. J. (1969), "Investigating Causal Relationship by Econometric Models and Cross-spectral Methods," *Econometrica* **37**: 424-38.

Granger, Clive W. J. (1988), “Some Recent Developments in a Concept of Causality,” *Journal of Econometrics* **39**: 199-211.

Henrekson, Martin, and Johan A. Lybeck (1988), “Explaining the Growth of Government in Sweden: A Disequilibrium Approach,” *Public Choice* **57**: 213-232.

Hondroyiannis, George, and Evangelia Papapetrou (1995), “An Explanation of Wagner’s Law for Greece: A Cointegration Analysis,” *Public Finance* **50**: 67-79.

Johansen, Soren (1991), “Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models,” *Econometrica* **59**: 1551-80.

Kolluri, Brahat R., Michael J. Panik, and Mahmoub S. Wahab (2000), “Government Expenditure and Economic Growth: Evidence from G7 Countries,” *Applied Economics* **32**: 1059-1068.

Landau, Daniel (1983), “Government Expenditure and Economic Growth: A Cross-section Study,” *Southern Economic Journal* **49**: 783-92.

Mackinnon, James G. (1991), “Critical Values for Cointegration Tests in Long-run Economic Relationships,” in R.F.Engle and C.W.J.Granger, eds., *Readings in Cointegration*, Oxford, Oxford University Press.

Musgrave, Richard A., and Peggy B. Musgrave (1980), *Public Finance in Theory and Practice*, New York, McGraw Hill.

Ram, Rati (1986), “Government Size and Economic Growth: A New Framework and some Evidence from Cross-section and Time-series Data,” *American Economic Review* **76**: 191-203.

Ram, Rati (1987), “Wagner’s Hypothesis in Time-series and Cross-section Perspectives: Evidence from ‘Real Data’ for 115 Countries,” *The Review of Economics and Statistics* **69**: 194-204.

Razzolini, Laura, and William F. Shughart II (1997), “On the (Relative) Unimportance of Balanced Budget,” *Public Choice* **90**: 215-233.

Singh, Balvir, and Balbir S. Sahni (1984), “Causality between Public Expenditure and National Income,” *The Review of Economics and Statistics* **66**: 630-44.

Wagner, Adolph (1893), *Grundlegung der Politischen Okonomie*, 3rd ed., Leipzig, C. F. Winter.