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Public Sector Participation in the Development of The EU Economies

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Abstract

This paper tests statistically the long run and causal relationship between government spending and income, applying six alternative functional forms, by employing two of the most advanced econometric methods, the two-step Engle and Granger cointegration method and the Granger causality test, using data for the EU-15 countries over the time period 1949-1998. There is limited support in favour of Wagner's law in most European countries.

1. Introduction

Towards the end of the nineteenth century, Adolph Wagner proposed an observation, well known as "Wagner's Law", according to which, during the process of economic development, government expenditure and activity increases. More specifically, Wagner's law states that government economic activity compared to private economic activity increases as the economy develops. This law has been the subject of extensive discussions and research, especially during the latest decades, as the shrinkage of the public sector in favour of the private activities development is a fact. Should this causal flow, running between public sector growth and economic development, exists, governments should reconsider their views and bend their policies towards the expansion of their expenses, in order to be able to achieve higher levels of growth.

All previous studies examined the existence of Wagner's law in various time periods, in several countries, using different econometric methods. In most of the recent studies[1], post-war data have been used, with the exception of two researches (Vatter and Walker [1986], Ganti and Kolluri [1979]) concerning the U.S.A, whose data start from 1929. The data that have been used are annual, while the examined time periods range between thirty to forty years. Most of the studies have followed a time-series approach, except for Ram (1987), who has followed both the previous and a cross-section approach. The set of countries has been as wide as 115 countries (Ram, 1987) or as narrow as one country. Ram was the only

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1 For a critical review of studies including the period between 1965-1980, see Karagianni Stella, 1984, Determinants of the Magnitude and Structure of the Expenditures of the Hellenic Public Sector.

one, who examined the existence of Wagner's law in such a great number of countries, dividing them according to their development level as well as their geographic position. All the other researchers focused on the examination of specific countries individually. No study has paid any attention to the examination of the above law for the European economies, engaged in an economic union.

In their attempt to examine the existence of a short- and long- run relationship between government expenditure and economic development as well as the causal flow running between these two variables, researchers carried on unit root, co-integration and causality tests. As far as the unit root tests are concerned, their interest was laid on the *Dickey-Fuller* (Hondroyiannis and Papapetrou [1995], Hayo [1994], Murthy [1993,1994]), *Phillips-Perron* (Hondroyiannis and Papapetrou [1995]), *Dickey-Pentula Sequential* (Murthy [1994]) and *Kwiatkowski tests* (Hondroyiannis and Papapetrou [1995]). Co-integration was examined either through the *two-step Engle and Granger co-integration methodology* (Chletsos and Kollias [1997], Ashworth [1994], Hayo [1994], Murthy [1994]) or the *Johansen and Juselius co-integration test* (Hondroyiannis and Papapetrou [1995], Ashworth [1994], Hayo [1994], Murthy [1994], Ganti and Kolluri [1979]). In respect of the direction of causality, the *Granger causality test* (Ram [1986], Chletsos and Kollias [1997]) has been put forward.

The aim of this paper is to investigate the validity of Wagner's law in the European Union countries, for the time period 1949-1998. The investigation is done on the basis of time-series annual data for each country, using six alternative functional forms. The data are derived from the International Financial Statistics. The methodology employed for the examination of co-integration is that of *the two-step Engle and Granger analysis* and the *error correction approach*. In order to examine the causal relationship between the two variables, the *Granger causality test* has been used.

The remainder of the paper is organized as follows. Section II briefly reviews the empirical findings of the relationship between government expenditure and economic development as tested by various researchers. Section III provides an overview of the empirical methodology. Section IV presents the alternative functional forms and the empirical results. Section V concludes.

2. Literature Overview

Wagner's law postulates that as per capita income rises in industrializing nations, their public sector will grow in relative importance. Three reasons seem to stand up for this aspect; during the development process, a relative increase in the administration, justice and legislation expenses is observed; such a relative increase is observed in the cultural and welfare expenses (education and redistribution of income; at last, the technology improvement and the increasing returns, accruing from the investments, may lead to public expenses increase in order to keep developing private monopolies under control.

Wagner's law has drawn the attention of many scientists, who have interpreted the law differently and represented it in various forms, using several econometric methods. Ram (1987) provided a spherical view as far as the validity of Wagner's law is concerned, examining a set of 115 countries, using both time-series and

cross-section data, found that in the time-series case the hypothesis is supported in about 60% of the countries, whereas in the cross-section case the hypothesis is refuted. The studies (Vatter and Walker [1986], Ganti and Kolluri [1979]), concerning the U.S.A., reveal that there is strong evidence in favour of Wagner's law, except for a study carried on by Bairam (1995), who found out that the above law is valid only in the non-defense government expenditure case. In Mexico, a strong positive relationship between growth per capita income and the rise in public sector size has been found (Hayo [1994], Murthy [1993,1994]). On the other hand, Ashworth (1994) argued that the weigh of evidence is against a long run Wagner's law relationship for Mexico. The empirical findings of Masuo (1995) showed no supportive evidence on Wagner's law for Japan. In Greece, the opinions are dissenting. Georgakopoulos et al (1992) strongly supported the existence of the law, a fact that has also been approved by Chletsos and Kollias (1997) only in the case of military and defense expenditures. However, Hondroyiannis and Papapetrou (1995) as well as Georgakopoulos and Loizidis (1994) failed to prove the long run relationship between government spending and income in post-war Greece. Thus, in a study of a single economic framework, the overall results are inconclusive. This is because of the different stage of economic development and because of the different econometric approach followed. In our paper, we propose the most recent econometric techniques applied to all the European countries for a single period of time.

3. Empirical Methodology

The two-step Engle and Granger Co-integration Analysis: The procedure for testing whether two series are cointegrated is taken in two steps. The first is to determine the order of integration and the second is to test for cointegration. The first test is represented by a unit root test. This basically involves the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) unit root type of analysis (Dickey and Fuller 1979). For the price variable xt, the test procedure is to employ DF and ADF regression given by:

$$\textbf{ADF:} \qquad \Delta x_t = \alpha + \beta T + \varrho x_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta x_{t-1} + u_t \qquad (1)$$

where $\Delta x_t = x_t - x_{t-1}$, T denotes a time trend and k is large enough to ensue that the residuals u_t are white noise. The test for unit root is a test of the null hypothesis H_o: $\varrho=0$.

For the DF test γ_i, i = 1,k, are considered equal to zero.

If two series have unit roots the second step of the cointegration test can be conducted. When two price variables are integrated of order one, I(1) and there is a linear combination between these variables that is stationary, the two sets of price are said to be cointegrated and hence there exist a form of long run integration. In cointegration tests, the null hypothesis is non-cointegration against the alternative of cointegration. Hence, a large test statistic rejects non-cointegration.

According to Granger Representation Theorem, when two variables are cointegrated, then, they are represented by an error-correction-mechanism (Engle and Granger 1987):

$$\Delta x_t = \alpha + \sum_{i=1}^{m} b\Delta y_{t-i} + \sum_{i=1}^{n} c_i\Delta x_{t-i} + dz_{t-1} + u_{1t} \quad (2)$$

$$\Delta y_t = c + \sum_{i=1}^{m} b\Delta y_{t-i} + \sum_{i=1}^{n} c_i\Delta x_{t-i} + dz_{t-1} + u_{2t}$$

where z_{t-1} are the estimated residuals from the equation of cointegration:

$$z_t = x_t - \delta y_t \quad (3)$$

The error-correction model shows the long run dynamics of the adjustment process between two variables. Change to one variable series, x_t can be related to the period's error from equilibrium, to the current and lagged changes of the other variables series, y_t, and to its own past changes. If some of the b_i are statistically significant, then current changes of one variable series, implying the presence of a causality relationship. A significant error-correction term, d, implies that x_t and y_t have a common trend.

The optimal lag length of the error-correction equations is determined by using Akaike's (1973) Final Prediction Error (FPE) criterion:

$$PE = [(t + g + 1)/(t - g - 1)]*(SSE/T) \quad 4)$$

where T is the number of observations, g = m + n and SSE is the sum of squares error.

The Granger Causality test: The notion of causal relationship is the basis on which the empirical testing of theoretical proposition rests. The standard Granger causality test used in order to test the presence and direction of causal relationship between two variables x and y is based on the estimation of the following regression:

$$x_{t-1} = \delta_o + \sum_{i=1}^{R} \delta_{xi}\Delta x_{t-i} + \sum_{i=1}^{L} \delta_{\gamma i}\Delta y_{t-i} + \mu_t \quad 5)$$

And the null hypothesis that Y does not Granger cause X is rejected if the coefficients of $\delta\gamma_i$ in equation (5) are jointly significant based on a standard F-test. Thus, if Ω_t is a universe of information up to and included period t then the Granger (1969) definition of causality is: Y causes X, given Ω_t , if X_{t+1} can be predicted better using past Y (Y_s, $s \leq t$), than by not using it. That is compare the forecasting ability of Ω_t, with and without Y. If past Y significantly contributes to forecasting X_{t+1} then Y is said to Granger cause X. When ΔY_t replace ΔX_t in

equation (5) then the null hypothesis that X does not Granger cause Y is rejected if δx_i are jointly significant. The possible conclusions that one can draw from using Granger causality test for two variables X and Y are: ***(a)*** neither Granger causes the other; ***(b)*** Y causes X but not vice versa; ***(c)*** X causes Y but not vice versa; and ***(d)*** both variables Granger cause each other.

4. Empirical Results

The initial idea of Wagner's law, where the public sector size is assumed to be a function of economic development, has raised strong disagreements among researchers about the precise formulation of the law. In this paper, six alternative functional forms of the law are being examined:

$$(E)_t = A(GDP)_t^{\beta} \quad \text{(I)}$$

$$(C)_t = A(Y)_t^{\beta} \quad \text{(II)}$$

$$(E)_t = A\left(\frac{GDP}{N}\right)_t^{\beta} \quad \text{(III)}$$

$$\left(\frac{E}{GDP}\right)_t = A\left(\frac{GDP}{N}\right)_t^{\beta} \quad \text{(IV)}$$

$$\left(\frac{E}{N}\right)_t = A\left(\frac{GDP}{N}\right)_t^{\beta} \quad \text{(V)}$$

$$\left(\frac{E}{GDP}\right)_t = A(GDP)_t^{\beta} \quad \text{(VI)}$$

where E stands for government expenditure, GDP stands for gross domestic product, C stands for government consumption, Y for national income, N for the population.

The first formulation was adopted by Peacock and Wiseman (1961), who interpreted the law as follows: "public expenditures should increase by a higher rate than GDP". The second formulation was created by Pryor (1968), who stated that "in developing countries, the share of public consumption expenditure to the national income is increasing. In the same year, Goffman expressed the law in a different way: "during the development process, the GDP per capita increase should be lower than the rate of public sector activities increase". According to Musgrave (1969), in the fourth equation, "the public sector share to GDP is increasing as the GDP per capita raises, during the development process". Gupta (1967) considered per capita government expenditure as a function of per capita GDP (fifth equation). At last, Mann (1980), in his attempt to verify empirically the existence of Wagner's law, adopted the sixth formulation, according to which "public expenditure share to GDP is a function of GDP".

It is important to mention that, for the purpose of our research, all the variables involved, have been expressed in a logarithmic form. The data that have been used are annual and cover the time period 1949-1998, for all EU-15 countries

(Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and UK). The validity of Wagner's law nowadays is essential in order to examine whether government expenditures, and up to a certain extent the public sector expansion, is considered as a prerequisite for the economic development of a country, especially during the recent years where privatization has become a world-wide phenomenon. The choice of the specific set of countries was realized so that to explore how this law is conducted when the countries involved constitute an economic union.

During the cointegration analysis process, two steps have followed. At the first step, unit root tests have been conducted both in levels and in first differences, using the ADF test. The ADF statistic suggests that all variables are integrated of order one, I(1), whereas the first differences are integrated of order zero, I(0). In the null hypothesis, the examined variable has a unit root, which means that it is non-stationary. Following the above procedure, the series have been proved to be stationary in first differences[1] and thus the second step comes next. In order to be able to find the long run relationship between the dependent and independent variables, in all functional forms of Wagner's law, cointegration tests have been carried on. The results accruing from the application of the cointegration regression process are reported on table 1.

Table 1: *The two-step Engle and Granger cointegration test*

	Equations					
Countries	**I**	**II**	**III**	**IV**	**V**	**VI**
Austria						
Belgium						
Denmark						
Finland		π				
France						
Germany						
Greece						
Ireland						
Italy	π			π	π	π
Luxembourg						
Netherlands		π				
Portugal						
Spain						
Sweden						
U.K.						

Notes: **1)** H_o: no cointegration exists **2)** π means that cointegration exists, thus null hypothesis is rejected.

The empirical results of the relevant tests of cointegration suggest that the null hypothesis of non cointegration can be rejected in favour of cointegration

[1] All results are available upon request by the author.

only in the case of Finland and Netherlands in the second equation as well as in Italy in the first, fourth, fifth and sixth equation. More specifically, in Finland and Netherlands, it seems that government consumption and national income are related in the long run. On the other hand, in Italy, government consumption and national income and additionally, government expenditure and per capita GDP seem to be the only variables that are not related in the long term. In all other cases, where the variables are not cointegrated, Wagner's law is invalid, as no long run causal relationship between them exists.

According to the Engle and Granger analysis, the series that revealed to be stationary and cointegrated were expressed in an error correction model (ECM), in order to confirm the long run relationship between the respective variables. The changes that affect the dependent variable, in all cases, are due to the short-term changes of the independent variable as well as the error of the last period. The results of the ECM are presented on table 2. From table 2, it can be derived that the Darbin-Watson statistic is high enough and close to two. The R-squared is not very high, ranging between 0.7023-0.8928. After the implementation of the error correction procedure, the existence of Wagner's law in these cases is confirmed.

Table 2: *Error correction mechanism*

	Finland	Netherlands		Italy			
Constant	-1.482	0.1373 **Constant**	-1.6 **Constant**	-1.6 **Constant**	-1.438 **Constant**	-1.438
t-ratio	-1.472	0.48457	-1.444	-1.444	-1.276	-1.276
lnC(-1)	-0.442	-0.0643 **ln[E/N](-1)**	-0.43 **ln[E/GDP](-1)**	-1.043 **ln[E](-1)**	-0.355 **ln[E/GDP](-1)**	-0.355
	-1.605	-0.5101	-1.674	-1.674	-1.544	-1.544
dlnC(-1)	0.3819	0.417 **dln[E/N](-1)**	-0.132 **dln[E/GDP](-1)**	-1.132 **dln[E](-1)**	-0.164 **dln[E/GDP](-1)**	-0.164
	1.2639	1.5919	-0.496	-0.496	-0.626	-0.626
dlnC(-2)	-1.644	-0.2524 **dln[E/N](-2)**	-0.108 **dln[E/GDP](-2)**	-0.108 **dln[E](-2)**	-0.14 **dln[E/GDP](-2)**	-0.14
	-0.604	-0.8942	-0.478	-0.478	-0.631	-0.631
dlnC(-3)	0.0352	0.0415 **dln[E/N](-3)**	-0.036 **dln[E/GDP](-3)**	-0.036 **dln[E](-3)**	-0.044 **dln[E/GDP](-3)**	-0.044
	0.1137	0.1404	-0.151	-0.151	-0.189	-0.189
dlnC(-4)	0.1684	-0.1298 **dln[E/N](-4)**	0.0354 **dln[E/GDP](-4)**	0.0354 **dln[E](-4)**	0.0432 **dln[E/GDP](-4)**	0.0432
	0.5468	-0.5495	0.1646	0.1646	0.2017	0.2016
dlnC(-5)	-0.294	0.0175 **dln[E/N](-5)**	-0.127 **dln[E/GDP](-5)**	-0.128 **dln[E](-5)**	-0.085 **dln[E/GDP](-5)**	-0.085
	-1.208	0.0704	-0.653	-0.653	-0.443	-0.443
dlnC(-6)	0.1723	-0.2162				
	1.0165	-0.9217				
dlnC(-7)	-0.058					
	-0.442					
lnY(-1)	0.5079	0.0442 **ln[GDP/N](-1)**	0.4888 **ln[GDP/N](-1)**	0.0592 **ln[GDP](-1)**	0.3985 **ln[GDP](-1)**	0.0434
	1.5678	0.5485	1.5919	1.1589	1.4614	1.0039
Y	0.5027	0.121 **dln[GDP/N]**	-0.233 **dln[GDP/N]**	-1.233 **dln[GDP]**	-0.255 **dln[GDP]**	-1.255
	1.7203	0.084	-0.646	-3.419	-0.706	-3.475
dlnY(-1)	0.0447	0.1489 **dln[GDP/N](-1)**	0.9006 **dln[GDP/N](-1)**	0.7686 **dln[GDP](-1)**	0.9468 **dln[GDP](-1)**	0.7832
	0.1141	0.8847	1.8923	1.6679	2.0726	1.7382
dlnY(-2)	-0.049	0.2019 **dln[GDP/N](-2)**	0.5311 **dln[GDP/N](-2)**	0.4228 **dln[GDP](-2)**	0.5984 **dln[GDP](-2)**	0.4588
	-0.127	1.2318	0.9826	0.8238	1.1318	0.9116
dlnY(-3)	0.3531	0.1742 **dln[GDP/N](-3)**	-0.036 **dln[GDP/N](-3)**	-0.071 **dln[GDP](-3)**	-0.048 **dln[GDP](-3)**	-0.091
	1.0101	1.1335	-0.076	-0.146	-0.105	-0.196
dlnY(-4)	0.1295	0.1708 **dln[GDP/N](-4)**	0.8781 **dln[GDP/N](-4)**	0.9134 **dln[GDP](-4)**	0.8459 **dln[GDP](-4)**	0.8892
	0.3582	1.2175	1.9104	1.9016	1.879	1.893
dlnY(-5)	-0.269	0.1361 **dln[GDP/N](-5)**	0.0415 **dln[GDP/N](-5)**	-0.086 **dln[GDP](-5)**	0.0246 **dln[GDP](-5)**	-0.06
	-0.729	1.1654	0.0875	-0.167	0.0522	-0.118
dlnY(-6)	0.2981	0.1156 **dln[GDP/N](-6)**	0.6422 **dln[GDP/N](-6)**	0.6422 **dln[GDP](-6)**	0.5751 **dln[GDP](-6)**	0.5751
	0.8576	1.4241	1.2976	1.2976	1.1738	1.1738
R-squared	0.7849	0.8928 **R-squared**	0.7929 **R-squared**	0.7038 **R-squared**	0.7974 **R-squared**	0.7023
DW	2.3275	1.8633 **DW**	1.8407 **DW**	1.8406 **DW**	1.9136 **DW**	0.9136

By applying the Granger causality test, the causal flow between the public sector size and economic development, expressed by different economic indicators in each form of equation, has been examined. The null hypothesis declares that no Granger causality exists, whereas the alternative suggests that Granger causality exists. Table 3 provides a summary view of the results on causality. The validity of Wagner's law is dependent upon the bi-directional flow of causality, while in the case of unidirectional flow Wagner's law is partly existent. On the contrary, no Granger causality induces Wagner's law invalidity. Wagner's law is completely valid only in Finland and Italy, due to the bi-directional causality flow in all equations. In Austria, Belgium, Denmark, France, Germany, Ireland, Luxembourg, Netherlands, Spain, Sweden and UK the law is valid either partly, either wholly. In Portugal, the law is not valid at all in half of the cases, while in Greece the law does not exist in any of the cases.

Additional observations may also be derived, by examining each equation separately. Only in the first and fifth equation the law is verified in most countries, except for few countries it is partly verified while in one –Greece- it does not exist at all. Equations II and IV seem to be the weakest to confirm Wagner's law.

Table 3: *Granger causality test*

	Equations					
Countries	**I**	**II**	**III**	**IV**	**V**	**VI**
Austria	⇔	∅	⇔	⇨	⇔	⇨
Belgium	⇔	⇔	⇦	∅	⇦	⇨
Denmark	⇔	⇔	⇦	∅	⇦	⇨
Finland	⇔	⇔	⇔	⇔	⇔	⇔
France	⇔	⇔	⇦	⇨	⇔	⇨
Germany	⇔	⇔	⇦	⇨	⇔	⇨
Greece	∅	∅	∅	∅	∅	∅
Ireland	⇨	⇨	⇔	⇔	⇔	⇔
Italy	⇔	⇔	⇔	⇔	⇔	⇔
Luxembourg	⇦	∅	⇦	⇦	⇦	⇦
Netherlands	⇔	⇔	⇔	⇨	⇔	⇨
Portugal	⇦	⇔	∅	∅	⇦	∅
Spain	⇔	⇔	⇔	⇨	⇔	⇨
Sweden	⇔	⇦	⇔	⇔	⇔	⇔
U.K.	⇨	∅	⇨	⇔	⇨	⇔

⇔ Granger causality exists on both directions
⇨ Granger causality exists only from the dependent towards the independent variable
⇦ Granger causality exists only from the independent towards the dependent variable
∅ No Granger causality exists

Conclusion

This paper examines the validity of Wagner's law, the proposition that there is a long run tendency for the public sector to grow relative to national income in the European economies. We employed two of the most advanced econometric methods, the two-step Engle and Granger cointegration method and the Granger causality test, in order to investigate the long run and causal relationship between government spending and income, applying six alternative functional forms, using data for the EU-15 countries over the time period 1949-1998. The major points that emerge from this work are: in most of the EU countries, no long term relationship has been observed, except for some sub-cases in Finland, Italy and Netherlands; patterns of causality between income and government expenditure display dramatic differences across various countries. There is limited support for the pattern of causality; Wagner's law is completely verified only in two countries – Finland and Italy. Summarizing the results accruing from the two tests, we discover that both tests for the certain equations – equation II for Finland and Netherlands, and equations I, IV, V, VI for Italy - lead to the same results, that is the verification of Wagner's law. In all other cases, there is no strong support for Wagner's law; especially in Greece the weigh of evidence is against a long run Wagner's law existence. The same result is applied for the case of Portugal as well, which is at a parallel stage of development with Greece.

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