# Testing Wagner's Law For The European Union Economies

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**Abstract**

*This paper examines the validity of Wagner's law in the EU-15 member-states for the time period 1949-1998. For investigating the existence of a long run and causal relationship between government expenditure and national income, three of the most advanced econometric methods, the Engle-Granger cointegration test, the Johansen maximum likelihood method and the Granger causality test have been applied to six alternative functional interpretations of the law. The results are very ambiguous and our main findings suggest that the validity or invalidity of Wagner's law is very sensitive to the method applied.*

## 1. Introduction

Wagner's law has been the subject of intensive investigations, especially during the post-war period, as the shrinkage of the public sector in favour of the private activities development is a fact. More specifically, the above law states that, during the process of economic development, government economic activity compared to private economic activity increases. Thus, higher levels of economic growth require higher levels of public expenses. Public sector expansion is a drag for further economic development. The examination of Wagner's law validity is nowadays interesting because, although most countries' governments especially since the mid 80s have applied restrictive public activity policy, the government expenditure share in these countries' GDP has continuously been increasing.

The purpose of this paper is to shed light on the relationship between government expenditure and economic growth, using six different interpretations of Wagner's law. The distinguishing feature of this study is the examination of the above law's validity, separately, in a set of countries-members of an economic union, the European Union, for a long time period, the post-war period 1949-1998. The choice of the specific set of countries was realized by the yardstick that these countries are members of the European Union and their economic harmonization suggests a common policy in all public activity issues. This fact implies that the public sector size of every country-member of the EU in relation to the private sector size should be approximately the same.

Wagner's law has drawn the attention of many economists, who have interpreted the law differently and represented it in various forms, using several econometric methods. Ram (1987) was the only one, who examined the existence of Wagner's law in such a great number of countries, dividing them according to their development level. Using time-series and cross-section data he 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. Payne and Ewing (1996), investigating the validity of the law in the seven greater world's countries, found that Wagner's law validity or invalidity varies by country. All other researchers focused on the examination of specific countries individually. The studies concerning the U.S.A. (Vatter and Walker [1986], Ganti and Kolluri [1979]), reveal that there is strong evidence in favour of Wagner's law, except for a study carried on by Bairam (1995), who, applying the Cochrane-Orcutt procedure and the likehood ratio test, 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 [1993-4]). Both Hayo (1994) and Murthy (1993 and 1994) employed the two-step Engle-Granger cointegration method and the Johansen maximum likelihood procedure; additionally, Hayo used McKinnon-White-Jack-Knife technique and Murthy the Dickey-Pentula sequential test. On the

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other hand, Ashworth (1994), employing the two-step Engle-Granger method and the Johansen maximum likelihood cointegration technique, argued that the weight of evidence is against a long run Wagner's law relationship for Mexico. The empirical findings of Masuo (1995), who applied the simultaneous estimation and testing of multiply structural changes and heteroscedasticity as well as the weighted average value of the slope regression coefficient, showed no supportive evidence on Wagner's law for Japan. In Greece, the opinions are dissenting. Georgakopoulos et al (1992), using ordinary least squares, the Hildreth-Lu method and the Ridge regression technique, strongly supported the existence of the law, a fact that has also been approved by Chletsos and Kollias (1997), with the use of the two-step Engle-Granger methodology and the Granger causality test, 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. Hondroyiannis and Papapetrou (1995) examined six alternative forms of the law by applying integration-cointegration techniques. Recently, Peacock and Scott (2000) offered a critical review of a considerable number of articles investigating Wagner's law existence.

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. However, Wagner's law validity occupied academicians during the past as well. At that time, where these econometric methods were unknown, the elasticity concept was used instead. More specifically, if the income elasticity was found to be greater than the unity, Wagner's law existed.

In this paper, we examine six alternative functional forms of Wagner's law in EU-15 for the post-war period 1949-1998, applying advanced econometric techniques. For this purpose, time-series annual data, derived from the International Financial Statistics, have been employed. We examine the long-run relationship between government expenditure and income using recent econometric techniques. In order to make the comparison with previous studies, we apply the two-step Engle and Granger analysis as well as the Johansen maximum likelihood approach; should this relationship exists, the error correction mechanism is applied. In addition, the causal flow between the two variables is investigated through the Granger causality test. Our research is hoped to provide additional empirical evidence of Wagner's law.

The present paper is divided into four sections. Section 2 analyses the alternative functional forms. Section 3 provides an overview of the applied empirical methodology and the data. Section 4 discusses the empirical results. Section 5 presents our concluding marks and section 6 makes suggestions for future research.

## 2. Alternative Functional Forms Of Wagner's Law

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:

$$(E)_t = A(GDP)_t^{\beta} \quad (1)$$

$$(C)_t = A(Y)_t^{\beta} \quad (2)$$

$$(E)_t = A\left(\frac{GDP}{N}\right)_t^{\beta} \quad (3)$$

$$\left(\frac{E}{GDP}\right)_t = A\left(\frac{GDP}{N}\right)_t^{\beta} \quad (4)$$

$$\left(\frac{E}{N}\right)_t = A\left(\frac{GDP}{N}\right)_t^{\beta} \quad (5)$$

$$\left(\frac{E}{GDP}\right)_t = A(GDP)_t^{\beta} \quad (6)$$

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".

By applying various econometric methods, in all previous alternative forms, we expect the validity of Wagner's law when the economic development influences the public sector size in the long term. In this case, the two variables are cointegrated and we reject the null hypothesis; thus, the public expenses are a function of economic development.

## 3. Data And Methodology Followed

### 3.1. 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 involves the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) unit root type of analysis (Dickey and Fuller 1979). If 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). 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 imply the presence of a causality relationship. A significant error-correction term, d, implies that $x_t$ and $y_t$ have a common trend.

### 3.2. The Johansen Maximum Likelihood Method

Many researchers (Greene [1997], Hondroyiannis and Papapetrou [1995]) argue that the two-step Engle-Granger cointegration method, despite its simplicity, reveals many disadvantages. First of all, the Engle-Granger method does not test for the maximum number of cointegrating relations or vectors, due to problems of the sample or other errors of specification. The method has no systematic procedure for the separate estimation of the multiple cointegrating vectors. Another serious defect of the Engle-Granger procedure is that it relies on a two-step estimator and any error introduced by the researcher in step one is carried into step two. The Johansen estimators circumvent the use of the two-step estimators and can estimate and test for the presence of multiple cointegrating vectors. All variables are treated as endogenous and this is very important since the test of cointegration should be invariant to the choice of the variable selected for normalization. Moreover, this test allows the researcher to test restricted versions of the cointegrating vectors and speed of adjustment parameters.

The methodology of Johansen (1988, 1991) estimates the number of cointegrating or long run relationships in the data. This number is called the cointegrating vector. If the vector *(*r) equals zero, no cointegrating equilibrium exists, and the equations should be differenced. If $r = 1$, then the data support one long-run equilibrium among the variables. When one ends to the number of cointegrating vectors, it can be checked whether these vectors meet the constraints of the economic theory, as far as the sign of the long-run relations' parameters is concerned. If the system contains N-endogenous variables, each of which is first order-integrated, then an N-dimensional vector autoregression can be expressed as a Vector Error Correction Model (VECM):

$$\Delta X_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta \Pi_{t-k+1} - \Gamma_{t-k} \Pi_{t-k} + u_t \qquad (7)$$

where $\mu$ is a vector of constants that allows for a deterministic drift and the $\pi$ matrix conveys the long-run information contained in the data. The Johansen methodology determines the number (or vector) *r* of cointegrating relationships, $0 <$ *vector* $(\Pi) = r < N$, as well as their long-run relationship. $\Pi = \alpha\beta'$. $\beta(p * r)$ and $\alpha(p * r)$ represent the long-run coefficients and error-correction estimates, respectively. The VECM is a VAR that builds in cointegration by incorporating error correction terms that account more fully for short-run dynamics and thus, if the long run equilibrium condition is valid and cointegration exists, it explains short-run fluctuations in the dependant variable.

### 3.3. The Granger Causality Test

The notion of causal relationship is the basis on which the empirical testing of theoretical proposition rests. If $\Omega_t$ is a universe of information up to and included period *t* then the Granger (1969) definition of causality is: Y causes X, given $\Omega_t$ , if $X_{t+1}$ can be predicted better using past Y ($Y_{s,}$ $s \leq t$), than by not using it. That is compared to the forecasting ability of $\Omega_t$, with and without Y. If past Y significantly contributes to forecasting $X_{t+1,}$ then Y is said to Granger cause X.

### 3.4. Data And Preliminary Diagnostics

It is important to mention that, for the purpose of our paper, 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). More specifically, the data have been derived by various volumes of the International Financial Statistics. It seems that all data have an increasing trend. The empirical analysis first starts with the two-step Engle-Granger cointegration method. 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).

## 4. Empirical Results

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.

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

**Table 1**
**The two-step Engle and Granger cointegration 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.** | | | | | | |

Notes: 1) Ho: no cointegration exists
2) ✓ cointegration exists, thus null hypothesis is rejected.

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 suggest that Darbin-Watson statistic is high enough and close to two. The R-squared is quite high, ranging between 0.7023-0.8928, related to other studies, for instance as the one carried on by Murthy [1994]. However, most studies (Nomura, 1995) find considerably high R-squares. After the implementation of the error correction procedure, the existence of Wagner's law in these cases is confirmed. 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 2 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.

The cointegration method ends in the fact that Wagner's law validity is restricted only in some EU countries and some certain equations. On the other hand, the Granger causality test reveals an extensive causal flow between the variables in most cases. As the Engle-Granger test seems to have many and serious disadvantages and as the Granger causality test confirms the existence of a causal relationship in a large number of equations, the application of another more advanced cointegration method is considered as essential. For this purpose, the Johansen maximum likelihood cointegration method has been employed. The results accruing from this test are presented on table 3.

**Table 2**
**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

**Table 3**
**Johansen Cointegration 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.** | ✓ | ✓ | | ✓ | ✓ | ✓ |

Notes: 1) Ho: no cointegration exists
2) ✓ cointegration exists, thus null hypothesis is rejected.

The results derived by the Johansen test are totally differentiated compared to those derived by the test, as cointegration in the former case exists in most EU countries. More specifically, there is a strong positive relationship between growth per capita income and the rise in public sector size in Denmark, Finland, Greece, Ireland, Spain and Sweden. Strong positive relationship is also observed in the cases of Austria, Belgium, the Netherlands, Portugal, the UK and Germany, with the exception of equation II for the first four countries, equation III for the fifth and equations III and VI for the last one. On the other hand, the law is invalid in France and Italy.

In order to confirm the long run relationship between the respective variables, an Error Correction Model is constructed. The Error Correction Model confirms Wagner's law validity. The Darbin-Watson statistic is relatively high in most cases. The error correction coefficient is negative and statistically significant. Statistic significance reveal the changes of the time lag coefficients as well.

## 5. 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 three of the most advanced econometric methods, the two-step Engle and Granger cointegration method, the Johansen maximum likelihood method and the Granger causality test, in order to investigate the long run and causal relationship between government spending and income. For this purpose, we have employed six alternative functional forms, using data for the EU-15 countries over the time period 1949-1998. The results, accruing from this study, are ambiguous accordingly to the method applied.

The major points that emerge from the Engle-Granger test are: in most of the EU countries, no long term relationship has been observed, except for some sub-cases in Finland, Italy and the Netherlands. In contrast, the Johansen test supports the existence of Wagner's law in most EU countries, with the exception of France and Italy. These differences are attributed to the disadvantages that characterize the Engle-Granger method and the different application of the two tests. As far as the Granger causality test is concerned, 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 three tests, we cannot totally reject the null hypothesis for the period 1949-1998 in EU-15, despite the privatization programs advanced in most European countries. Summarizing, we conclude that Wagner's law exists in the vast majority of the EU countries, relying upon the Johansen criterion, which is one of the most reliable econometric methods.

## 6. Suggestions for Future Research

This research investigates the existence of a long run and causal relationship between government expenditure and national income in the EU-15 member-states by applying three advanced econometric methods, the Engle-Granger cointegration test, the Johansen maximum likelihood method and the Granger causality test. Future research on this issue can be conducted by deploying one of the most updated methods for exploring causality, the non-linear Granger causality method. 🕮

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