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WAGNER'S LAW AND AUGMENTED WAGNER'S LAW IN EU-27. A TIME-SERIES ANALYSIS ON STATIONARITY, COINTEGRATION AND CAUSALITY

COSIMO MAGAZZINO *

ABSTRACT: The relationship between public expenditure and aggregate income has long been debated in economic literature. According to Wagner, expenditure is an endogenous factor or an outcome. On the other hand, Keynes considered public expenditure as an exogenous factor to be used as a policy instrument to influence growth. "Augmented" version of Wagner's Law, where public deficit appears as further explanatory variable, is also investigated. The aim of this paper is to assess empirical evidence of these hypotheses in EU-27, for the period 1970-2009. After a brief introduction, a survey of the economic literature on this issue is offered, before evaluating some specifications of "Wagner's Law" due to several researchers. Few notes on the empirical evidence' comparisons conclude the paper.

SUMMARY: 1. Introduction; 2. Literary Review; 3. Alternative Functional Forms Of Wagner's Law; 4. Data and methodology; 5. Empirical results; 6. Concluding remarks and policy implications; 7. Suggestions for future researches.

KEYWORDS: Wagner's Law; public expenditure; EU-27; correlation; unit root tests; cointegration analysis; causality.

JEL Classification: C32; C33; E60; H50; H60; N43.

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1. Introduction

The purpose of this essay is to assess the existence of "Wagner's Law", one of the first and best known models of the dynamics of public spending. According to Wagner, the incidence of the latter on national income is set to increase over time. Due to its important policy implications, the relationship between government expenditure and economic growth as postulated by Wagner has been one of the most extensively investigated relationships in public economics over the last three decades. As far as the EU-27 case is concerned, in the period 1970-2009. The data used are taken from the Eurostat database of the European Union.

A synthesis of the literature that, over the years, has taken shape on the model initially proposed by A. H. Wagner at the end of the 19th century is followed by an overview of different econometric specifications of "Wagner's Law" and by a discussion on the various methods used by scholars in their empirical analyses are discussed.

Afterwards, we discuss several formulations of this law, suggested by economic literature. Our econometric analysis shows results on correlation, stationarity, cointegration and Granger-causality. As regard to cointegration, two alternative procedures – the Engle and Granger test and the Johansen and Juselius procedure – have been applied.

The results of the estimates regarding policy changes are commented with methodological caution, derived from the "error theory"[1]. However, we are unable to comment on the inevitable and irreducible presence of value judgments in the modelling of the theory.

The paper is divided into seven sections. Section 2 provides a survey of the economic literature on this issue. Section 3 analyses the alternative functional forms of Wagner's Law that has been estimated. Section 4 provides an overview of the applied empirical methodology and a brief discussion of the data used. Section 5 discusses the empirical results. Section 6 presents some concluding remarks and, finally, Section 7 gives suggestions for future researches.

2. Literary Review

[1] See: ROMAGNOLI G.C. (2005), L'errore nelle scelte di macroeconomia, *Rivista della Scuola Superiore dell'Economia e delle Finanze*, 12, 96-151.

The notion that there is a long-run tendency for government activities to grow relative to total economic activity was proposed by Wagner in the late 19^{th} century (Wagner, 1883; 1912). Wagner stated that during the industrialization process, as the real income per capita of a country increases, the share of its public expenditure in total expenditure increases. Three main reasons are advocated to support this hypothesis: the administrative and regulatory functions of the state, the cultural and welfare services and the state participation to finance large-scale projects for technological needs. In other words, Wagner's Law states that government grows because there is an increasing demand for public goods and for the control of externalities.

Based on these arguments, this law also implies causality running from national income to public sector expenditure. Hence, public expenditure is considered as endogenous to the growth of national income, in contrast to the Keynesian view, which considers public spending as an exogenous policy instrument which can affect growth in national product.

The validity of the law has been assessed empirically for a large number of developing and developed countries using both time series and cross sectional data sets. The studies cover country-specific analyses as well as of groups of economies, mainly for the post-Second World War period.

The role of the public sector is often criticized on the grounds that government is less efficient than market forces in allocating economic resources. In addition, the regulatory process and, for that matter monetary and fiscal policies, can potentially distort the incentive system. A rapid expansion of public expenditure can also lead to structural changes which favour a relative growth of the public service sector (Bacon and Eltis, 1978).

As summed up in Sideris (2007), the empirical works on Wagner's Law can be divided in two groups, based on the different types of the econometric methodology they apply: *a)* early studies which are performed until the mid 1990s, assume stationary data series and apply simple OLS regressions to test alternative versions of the law (Ram, 1987; Courakis *et al.*, 1993); *b)* cointegration-based studies, which are performed from the mid 1990s and on, test for cointegration between government expenditure and national income (and occasionally population); early studies of this group use the Engle and Granger (1987) methodology, whereas more recent works apply the Johansen (1988) technique. Most of the recent studies also perform Granger causality tests to indicate the direction of causality between the variables (Henrekson, 1993; Murthy, 1994; Ahsan *et al.*, 1996; Biswal *et al.*, 1999; Kolluri *et al.*, 2000; Islam, 2001; Al-Faris, 2002; Burney, 2002; Wahab, 2004). However, the empirical studies have produced mixed and sometimes contradictory results. Some of these conflicting findings (which are well documented in Bohl, 1996), have been attributed to the different econometric methodologies used, and to the different features characterizing different economies during alternative time periods.

Oxley (1994) uses data for the British economy referring to the period 1870-1913 and provides evidence consistent with Wagner's hypothesis.

Cotsomitis *et al.* (1996) test for the long-run validity of Wagner's hypothesis applied to People's republic of China for 1952-1992. They find that evidence supports this secular validity, as estimated residuals of cointegrating regressions are stationary.

Ansari *et al.* (1997) apply both the Granger and Holmes and Hutton statistical procedures to test the income-expenditure hypothesis for three African countries (Ghana, Kenya and South Africa), from 1957 to 1990. For all these countries, a long-run relationship between government expenditure and national income cannot be established. In fact, over this period, government expenditure has deviated substantially and persistently from national income. Moreover, in the short run, of these three African countries only Ghana shows evidence of government expenditure being caused by national income, finding support for Wagner's hypothesis. Finally, the authors find no evidence of government expenditure causing national income. In other words, the Keynesian proposition is not supported by the data.

Clethsos and Kollias (1997) investigate empirically the traditional Wagner's hypothesis in the case of Greece using disaggregated data of public expenditures and employing an error correction approach. The empirical findings suggest that Wagner's Law is valid only in the case of military expenditures.

Asseery *et al.* (1999) analyze the Iraq's experience; they suggest that there is some evidence for the existence of Wagner's Law when income and several forms of expenditure are denoted in nominal terms. When expenditure in real terms is examined, the chain of causality runs in the opposite direction. In the case of spending on economic services, there is unidirectional causality. So, the results of these Granger causality tests are to downplay the support for the existence of Wagner's Law in Iraq and to raise interesting questions regarding the use of real or nominal values.

Demirbas (1999) tested Wagner's Law using aggregate Turkish data for the period 1950-1990. According to the test results, there is no cointegrating relationship between the variables. Including time trends into cointegration regressions did not change the results either. These findings show that the support of Wagner's Law found by many early researchers may be spurious. In a test on Turkish data it cannot find any long-run positive relationship between public expenditure and GNP variables. Yet, in the absence of a long-run relationship between variables, it still remains of interest to examine the short-run linkages between them. However, there is no evidence to support either Wagner's Law in any of its versions or Keynes' hypothesis.

Thornton (1999) analyses the experience of six presently developed economies (Denmark, Germany, Italy, Norway, Sweden and the UK) for the period beginning around the mid 19th century and ending in 1913, and reports results in favour of the law.

Albatel (2002) studies the relationship between government expenditure and measures of economic development and growth in Saudi Arabia. The results confirm the validity of Wagner's hypothesis.

Burney (2002) analyzes the long-run equilibrium relationship between public expenditure and the relevant socioeconomic variables in Kuwait, on the basis of time-series data covering the period from 1969-94. Empirical results show little support for the existence of a long-run equilibrium relationship between public expenditure and the relevant socioeconomic variables.

Chow *et al.* (2002) using UK data for the period 1948 to 1997 included a "third" variable, money supply, which re-establishes the long run link between the income and public spending variables. Multivariate causality results also indicate unidirectional causality from income and money supply to government spending in the long run, thus providing strong support for Wagner's hypothesis. These findings suggest that omitted variables may mask or overstate the long run linkages between economic development and public spending.

Karagianni *et al.* (2002) employ 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, they employ 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 and Granger test are that 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. As far as the Granger causality test is concerned, patterns of causality between income and government expenditure display dramatic differences across various countries. Moreover, there is limited support for the pattern of causality; Wagner's Law is completely verified only in two countries – Finland and Italy.

Florio and Colautti (2005) analyze the experience of five economies (USA, UK, France, Germany and Italy) for the period 1870-1990. They observe that the increase in the public expenditure to national income ratio is faster for the period until the mid 20th century and develop a model based on Wagner's Law.

Halicioglu (2005) tests the validity of Wagner's Law for Turkey, and his empirical results show that Wagner's Law does not hold in the case of the adopted traditional form, since neither co-integration nor causality tests were in line with the proposed implications of the law. Yet, he find a positive long-run relationship between the share of government in GDP and real per capita income growth, which supports the law. However, further analysis on the basis of the block Granger causality test reveals that the law does not hold for Turkey, or at least the direction of flows has been rejected.

Akitoby *et al.* (2006) examine the short- and long-term behavior of government spending with respect to output in 51 developing countries using an error-correction model. They find evidence that is consistent with the existence of cyclical ratcheting and voracity in government spending in developing countries, resulting in a tendency for government spending to rise over time. So, the researchers derive three main policy conclusions: first, the long-term and short-term elasticity of capital spending in relation to GDP is relatively high; second, there may be scope for fiscal rules or fiscal responsibility laws in some countries that limit the discretion for pro-cyclical fiscal policy; third, in many countries, there is a long-term relationship between the level of output and government spending.

Sideris (2007) investigates the long-run tendency for government expenditure to grow relative to national income using Greek data from 1833 to 1938. Cointegration analysis validates the existence of long-run relationship between the variables, as expressed by the six most popular versions of the Law. Moreover, Granger causality tests indicate causality running from the variables approximating income to the government expenditure variable.

Using Bangladesh data from 1976 to 2007 in a bivariate as well as a trivariate framework incorporating population size as a third variable, Kalam and Aziz (2009) empirically investigates Wagner's Law. The estimated results provide evidence in favour of the law for Bangladesh, in both the short-run and long-run. There is a long-run cointegration relation among real government expenditure, real GDP and the size of population where government expenditure is positively tied with the real GDP (1.14), per capita GDP (1.51) and population size (0.21). Both the real GDP and GDP per capita Granger cause total government expenditure to change. Population size also comes up as a significant stimulus for public spending to grow in both the long-run and short-run.

Kumar *et al.* (2009) examine the case of New Zealand. Results provide consistent results concerning the impact of income on shares of government spending in output with income elasticities ranging from 0.56 to 0.84. This implies that a 1 percent increase in per capita income leads to a 0.56 to 0.84 percent increase in the share of government expenditure of income. These results imply that per capita income increases by more than the increase in the share of the government spending in income.

Magazzino (2009a, 2009b, 2010a; 2010b) studies the linkages between public expenditure at a disaggregated level and GDP for Italy. Empirical evidence suggests that only for gross public investment expenditure the hypothesis is satisfied. Instead, Granger-causality exhibits unclear results: the direction of causality from public spending to aggregate income is observed for these categories of public expenditure: final consumption, public wages, gross public investment, and contribution to production.

Finally, Murthy (1994) suggests a broad interpretation of the law to allow for the addition of more explanatory variables related to economic development and government expenditure, such as the degree of urbanization, budget deficits, etc. into Wagner's functional forms, which would also reduce the omitted variable bias and mis-specification in econometric estimations.

In this paper, we examine six alternative functional forms of Wagner's Law in EU-27 for the post-war period 1970-2009, applying advanced econometric techniques. For this purpose, time-series annual data, derived from the Eurostat database, have been employed[2]. We examine the long-run relationship between government expenditure and aggregate income. 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 variables is investigated through the Granger causality test. Our research is hoped to provide additional empirical evidence either of Wagner's Law or Augmented Wagner's Law.

[2] See: www.ec.europa.eu/eurostat.

3. Alternative Functional Forms Of Wagner's Law

In the last Sixties five different versions of Wagner's Law appeared, almost contemporaneously. The simple idea according to which the public sector size is assumed to be a function of economic growth, conducted to dissimilar view among researchers about the precise formulation of the law, and the appropriate equation to be estimated. Here, in table 1, six alternative functional forms of the law are being examined, plus the so-called "Augmented" version of Wagner's Law:

Table 1 – Seven Versions of Wagner's Law.

	Functional Form	Version
[I]	lnE = α + β lnGDP	Peacock-Wiseman (1961)
[II]	lnFCE = α + β lnGDP	Pryor (1968)
[III]	lnE = α + β ln(GDP/Pop)	Goffman (1968)
[IV]	ln(E/GDP) = α + β ln(GDP/Pop)	Musgrave (1969)
[V]	ln(E/Pop) = α + β ln(GDP/Pop)	Gupta (1967)
[VI]	ln(E/GDP) = α + β lnGDP	"Modified" version of P-W suggested by Mann (1980)
[VII]	ln(E/GDP) = α + β ln(GDP/Pop) + γ ln(BDef/GDP)	Murthy (1994)

Source: our elaboration.

where *E* stands for government expenditure, *GDP* stands for gross domestic product, *FCE* stands for final consumption expenditure, *Pop* for Population, and *BDef* for Budget Deficit.

The formulation *[I]* 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 the following 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 (formulation *[V]*). Then, Mann (1980), in his attempt to analyze empirically the existence of Wagner's Law, adopted the last formulation, according to which "public expenditure share to GDP is a function of GDP". Of the several versions of Wagner's Law, the last formulation is often used and is considered to be most appropriate one (Halicioglu, 2003). Finally, we consider the last formulation of Wagner's Law suggested by economic literature, and then renamed "Augmented version". The inclusion of the last explanatory variable into equation *[VII]* is justified because it does not contradict the spirit of the law. It is normally expected that as economic development progresses, the budget deficit ratio would increase in the case of developing countries since government revenue increases less in proportion to the expenditure. This problem would be further alleviated if developing countries were adopting financial and economic liberalization policies (Murthy (1994)).

Yet, it should be underlined that earlier studies of the growth of public expenditure have not looked at the time series properties of the variables examined. There was an implicit assumption that the data were stationary. However, recent developments in time series analysis show that most macroeconomic time series have a unit root (a stochastic trend) and this property is described as difference stationarity, so that the first difference of a time series is stationary (Nelson and Plosser, 1982). So that, in testing Wagner's Law, the non-stationary property of the series must be considered first. If both series are I(1), it is necessary to perform cointegration tests. If a pair of I(1) variables are cointegrated, one then proceeds to build an error correction model in order to capture the short-run and long-run causal relationship between the two series. As we mentioned above, to eliminate early studies' methodological shortcomings, cointegration analysis will be applied in this study.

4. Data and methodology

For the purpose of this paper, all the variables analyzed have been expressed in a logarithmic form. The data that have been used are annual and cover the time period 1970-2009, for all EU-27 countries (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and UK). More specifically, the data have been derived by Eurostat database, that can be freely consulted on the internet.

Granger (1981) introduced a remarkable link between non-stationary processes and the concept of long-run equilibrium. Engle and Granger (1987) further formalized this concept by introducing a very simple test for the existence of cointegrating relationships. This procedure consists of five different steps: 1. Pretesting the variables for their order of integration; 2. Estimating the long-run (possible cointegrating) equilibrium relationship; 3. Checking for the order of integration of the residuals; 4. Estimating the Error-Correction Model; 5. Assess model adequacy.

Despite its simplicity, many researchers (Greene, 1997; Hondroyiannis and Papapetrou, 1995; Asteriou and Hall, 2007) argued that Engle and Granger approach reveals many disadvantages. In fact, there are important shortcomings of this methodology. First of all, when estimating the long-run relationship, one has to place one variable in the left-hand side and use the others regressors. The test does not say anything about which of the variables can be used as regressors and why. Moreover, when there are more than two variables there may be more than one cointegrating relationship, and the Engle and Granger procedure using residuals from a single relationship cannot treat this possibility. A third problem is linked with the two-step estimator involved: any error introduced in the first step is carried into the second one.

Johansen (1988) developed a methodology that tests for the rank of $\mathbf{\Pi}$ and provides estimates of $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ through a procedure known as reduced-rank regression, linking it with the analysis of non-stationary data. This procedure consist of five different steps: 1. Pretesting all variables to assess their order of integration; 2. Setting the appropriate lag length of the model; 3. Choosing the appropriate model regarding the deterministic components in the multivariate system; 4. Determining the rank of $\mathbf{\Pi}$ or the number of cointegrating vectors; 5. Testing for weak exogeneity.

So, from the multiple equation approach we can obtain estimates for cointegrating vectors, while with the simple equation we can have only a linear combination of the two long-run relationship.

The concept of Granger causality, put forward in Granger (1969), bears similarities with the concept of exogeneity in the sense that it allows us to draw inference on the dynamic impact of one variable on another. Such inference can be given an economically meaningful interpretation. This concept of causality draws upon the concept of forecastability. For example, for a bivariate series, the variable $y_{2,t}$ is said to be Granger-non-causal for $y_{1,t}$ if

$$E(y_{1,t} / Y_{1,t-1}, y_{2,t-1}) = E(y_{1,t} / Y_{1,t-1}) \qquad [1]$$

That is, the past of $y_{2,t}$ does not help in forecasting $y_{1,t}$.

5. Empirical results

First of all, as a preliminary exploratory analysis of the data, we studied pairwise correlation between variables of each equation. It is important to notice that econometric analysis was conducted, involving countries with congruous time dimension for their available data.

In table 2 variables of the model are summed up.

Tab. 2 – List of variables.

Variable	***Explanation***
E	Real total expenditure of general government
E/Pop	Real total expenditure of general government per capita
E/GDP	Cyclically adjusted total expenditure of general government, share of GDP
FCE	Real final consumption expenditure of general government
GDP	Total GDP, in millions of 1990 US$ (converted at Geary-Khamis PPPs)
GDP/Pop	Total GDP, in millions of 1990 US$ per capita
BDef/GDP	General government budget deficit, share of GDP

Sources: Eurostat database.

In table 3 some preliminary descriptive statistics are shown.

Tab. 3 – Exploratory data analysis.

Variable	***Mean***	***Median***	***Standard Deviation***	***Skewness***	***Kurtosis***	***Range***
E	96.8292	98.8812	26.4258	0.3558	3.7917	165.5284
E/Pop	0.0338	0.0106	0.0652	3.2449	13.5026	0.3720
E/GDP	46.2168	45.7430	6.8825	0.1659	2.7162	41.5205
FCE	66.8713	23.6063	102.6285	2.1647	6.9888	472.2451
GDP	258006.5	96097.0	369505.5	1.9304	5.7864	1716872.9
GDP/Pop	32.2514	14.2816	53.2353	3.2225	14.4338	327.9095
BDef/GDP	2.8928	2.80	3.7696	0.3636	3.5941	22.80

Source: our elaborations on Eurostat database.

While, in table 4 we show correlation results.

Table 4 – Pairwise correlations for 11 members of EU (1970-2009).

				Equation		
Country	**I**	**II**	**III**	**IV**	**V**	**VI**
Austria	0.9822	0.9704	0.9830	0.0783	0.9786	0.0725
	-0.3815	-0.4253	-0.3815	0.5339	-0.3726	0.5339
	-0.4594	-0.4594	-0.4606	-0.4606	-0.4606	-0.4594
Belgium	0.9397	0.9348	0.8929	0.0643	0.9531	0.1738
	-0.6674	-0.5612	-0.6674	0.7144	-0.6945	0.7144
	-0.7214	-0.7214	-0.7296	-0.7296	-0.7296	-0.7214
Denmark	0.9537	0.9786	0.8926	0.4447	0.9503	0.5766
	-0.5949	-0.8641	-0.5949	0.8006	-0.5874	0.8006
	-0.7365	-0.7365	-0.6894	-0.6894	-0.6894	-0.7365
Finland	0.9299	0.9411	0.8987	0.4008	0.8975	0.4687
	0.0827	-0.4112	0.0827	0.8615	0.0905	0.8615
	-0.4161	-0.4161	-0.4809	-0.4809	-0.4809	-0.4161
France	0.9848	0.9734	0.9761	0.6742	0.9790	0.7048
	0.1942	-0.0647	0.1942	0.7557	0.2000	0.7557
	0.0688	0.0688	0.0602	0.0602	0.0602	0.0688
Germany	0.9031	0.9683	0.9000	0.4186	0.7494	0.4180
	-0.2773	-0.2400	-0.2773	0.6596	-0.0462	0.6596
	-0.1788	-0.1788	-0.1441	-0.1441	-0.1441	-0.1788
Ireland	0.9632	0.9184	0.9648	-0.8373	0.9733	-0.8408
	-0.4153	-0.2030	-0.4153	0.9054	-0.4399	0.9054
	-0.7185	-0.7185	-0.7045	-0.7045	-0.7045	-0.7185
Italy	0.9234	0.9110	0.8755	0.0150	0.9070	0.1196
	-0.5644	-0.7298	-0.5644	0.6154	-0.6011	0.6154
	-0.7835	-0.7835	-0.8059	-0.8059	-0.8059	-0.7835
Netherlands	0.9374	0.9394	0.9457	-0.1809	0.9227	-0.2078
	-0.8039	-0.8392	-0.8039	0.8967	-0.7712	0.8967
	-0.8835	-0.8835	-0.8848	-0.8848	-0.8848	-0.8835
Portugal	0.9884	0.9931	0.9891	0.9189	0.9873	0.9164
	-0.6376	-0.6462	-0.6376	-0.4657	-0.6378	-0.4657
	-0.7014	-0.7014	-0.7114	-0.7114	-0.7114	-0.7014
UK	0.9544	0.9506	0.9540	0.0445	0.9424	0.0505
	0.1933	-0.0707	0.1933	0.8665	0.2238	0.8665
	-0.0807	-0.0807	-0.0894	-0.0894	-0.0894	-0.0807

Source: our elaborations on Eurostat database.

Notes: Bonferroni correction applied. The first number above refers to pairwise correlation coefficients between expenditure and income, the second one to expenditure and deficit, and the last one to income and deficit.

As it can be noticed, there is a strong positive correlation between government expenditure and national income, for all countries, either with per capita data or not. Yet, if we consider the public expenditure/GDP ratio, in this case correlation is not significant (equations *IV* and *VI*). As to correlation between expenditure and budget deficit, the sign changes when one analyzes different formulations of the law, or if we consider different countries. Notwithstanding, it seems to be a stronger and positive correlation between the share of public expenditure on income and deficit/GDP ratio (equations *IV* and *VI*). Yet, for Denmark, Italy, the Netherlands and Portugal a significant correlation between final consumption expenditure and deficit exists (equation *II*). Finally, the correlation between income and deficit seems relevant only for Belgium, Denmark, Ireland, Italy, the Netherlands and Portugal.

With regard to the stationarity of time-series considered here, we applied four different stationarity tests suggested by econometric literature on time-series. In table 5 we show results of stationarity analysis. The third column presents results for Augmented Dickey and Fuller (1979) test; the fourth one for Elliott, Rothenberg and Stock (1992) test; the fifth column contains results for Phillips and Perron (1988) test; at last, in the sixth column there are results for Kwiatkowski, Phillips, Schmidt and Shin (1992) test. Public expenditure in volume (*E*) seems to be non-stationary in most cases, while for Belgium and the Netherlands it could be trend-stationary. Final consumption expenditure (*FCE*) is trend-stationary in most cases, except for Finland, France, Portugal, and UK, where we have a I(1) process. The share of public expenditure on income (*E/GDP*) is clearly non-stationary for all countries, but this is not clear for Germany, Italy, and Portugal. Per capita expenditure (*E/Pop*) results as a I(1) process, and it could be trend-stationary only for Italy and the Netherlands. Analyzing GDP data, these variable is trend-stationary for an half of our sample, while for the others countries we can consider it as non-stationary. Per capita GDP (*GDP/Pop*) is a I(1) process for a lot of countries, while it seems to be trend-stationary for Cyprus, Estonia, France, and UK. Finally, public deficit/GDP ratio (*BDef/GDP*) can be considered as non-stationary, since only for Cyprus, the Netherlands, and Portugal we found a trend-stationary process.

Table 5 – Stationarity tests for EU-27 members (1970-2009).

Country	***Stationarity tests***				
	Deterministic component	**ADF**	**ERS**	**PP**	**KPSS**
Austria	constant	E: NS	E: NS	E: LS	E: NS
	constant, trend	FCE: TS	FCE: NS	FCE: TS	FCE: NS
	constant	E/GDP: NS	E/GDP: NS	E/GDP: NS	E/GDP: NS
	constant	E/Pop: NS	E/Pop: NS	E/Pop: NS	E/Pop: NS
	constant, trend	GDP: TS	GDP: NS	GDP: TS	GDP: TS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
	constant	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS
Belgium	constant, trend	E: TS	E: NS	E: TS	E: NS
	constant, trend	FCE: TS	FCE: TS	FCE: NS	FCE: TS
	constant	E/GDP: LS	E/GDP: NS	E/GDP: LS	E/GDP: NS
	constant, trend	E/Pop: NS	E/Pop: NS	E/Pop: NS	E/Pop: NS
	constant, trend	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
	constant	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS
Bulgaria	constant	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Cyprus	constant, trend	GDP: TS	GDP: TS	GDP: TS	GDP: TS
	constant, trend	GDP/Pop: TS	GDP/Pop: TS	GDP/Pop: NS	GDP/Pop: TS
Czech Republic	constant	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Denmark	constant	E: NS	E: NS	E: LS	E: NS
	constant, trend	FCE: TS	FCE: NS	FCE: TS	FCE: TS
	constant	E/GDP: NS	E/GDP: NS	E/GDP: NS	E/GDP: NS
	constant, trend	E/Pop: TS	E/Pop: NS	E/Pop: NS	E/Pop: NS

	constant, trend	GDP: TS	GDP: NS	GDP: TS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
	constant	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS
Estonia	constant, trend	GDP: TS	GDP: NS	GDP: TS	GDP: NS
	constant, trend	GDP/Pop: TS	GDP/Pop: NS	GDP/Pop: TS	GDP/Pop: NS
Finland	constant	E: NS	E: NS	E: LS	E: NS
	constant	FCE: NS	FCE: NS	FCE: NS	FCE: NS
	constant	E/GDP: NS	E/GDP: NS	E/GDP: NS	E/GDP: NS
	constant	E/Pop: NS	E/Pop: NS	E/Pop: NS	E/Pop: NS
	constant, trend	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
	constant	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS
France	constant	E: NS	E: NS	E: NS	E: NS
	constant	FCE: NS	FCE: NS	FCE: NS	FCE: NS
	constant, trend	E/GDP: TS	E/GDP: NS	E/GDP: NS	E/GDP: NS
	constant, trend	E/Pop: NS	E/Pop: NS	E/Pop: NS	E/Pop: NS
	constant, trend	GDP: TS	GDP: NS	GDP: TS	GDP: NS
	constant, trend	GDP/Pop: TS	GDP/Pop: NS	GDP/Pop: TS	GDP/Pop: NS
	constant	BDef/GDP: LS	BDef/GDP: LS	BDef/GDP: NS	BDef/GDP: LS
Germany	constant	E: LS	E: NS	E: LS	E: NS
	constant	FCE: LS	FCE: NS	FCE: LS	FCE: NS
	constant	E/GDP: LS	E/GDP: NS	E/GDP: LS	E/GDP: LS
	constant	E/Pop: LS	E/Pop: NS	E/Pop: NS	E/Pop: NS
	constant, trend	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant	GDP/Pop: NS	GDP/Pop: NS	GDP/P op: NS	GDP/Pop: NS
	constant	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: LS	BDef/GDP: NS

Greece	constant, trend	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Hungary	constant	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Ireland	constant, trend	E: NS	E: NS	E: NS	E: NS
	constant, trend	FCE: TS	FCE: NS	FCE: TS	FCE: NS
	constant	E/GDP: NS	E/GDP: NS	E/GDP: NS	E/GDP: NS
	constant, trend	E/Pop: NS	E/Pop: NS	E/Pop: NS	E/Pop: NS
	constant, trend	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
	constant	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS
Italy	constant	E: LS	E: NS	E: LS	E: NS
	constant, trend	FCE: TS	FCE: NS	FCE: TS	FCE: NS
	constant	E/GDP: LS	E/GDP: NS	E/GDP: LS	E/GDP: NS
	constant, trend	E/Pop: TS	E/Pop: NS	E/Pop: TS	E/Pop: NS
	constant, trend	GDP: TS	GDP: NS	GDP: TS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: TS	GDP/Pop: NS
	constant, trend	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS
Latvia	constant	GDP: LS	GDP: NS	GDP: NS	GDP: NS
	constant	GDP/Pop: LS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Lithuania	constant, trend	GDP: TS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: TS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Luxembourg	constant	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Malta	constant	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS

Netherlands	constant, trend	E: TS	E: NS	E: TS	E: NS
	constant	FCE: LS	FCE: NS	FCE: LS	FCE: NS
	constant	E/GDP: NS	E/GDP: NS	E/GDP: NS	E/GDP:NS
	constant, trend	E/Pop: TS	E/Pop: NS	E/Pop: TS	E/Pop: NS
	constant, trend	GDP: TS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: TS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
	constant	BDef/GDP: TS	BDef/GDP: TS	BDef/GDP: NS	BDef/GDP: NS
Poland	constant, trend	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Portugal	constant	E: LS	E: NS	E: NS	E: NS
	constant	FCE: NS	FCE: NS	FCE: NS	FCE: NS
	constant, trend	E/GDP: TS	E/GDP: NS	E/GDP: TS	E/GDP:NS
	constant	E/Pop: LS	E/Pop: NS	E/Pop: LS	E/Pop: NS
	constant	GDP: LS	GDP: NS	GDP: LS	GDP: NS
	constant	GDP/Pop: LS	GDP/Pop: NS	GDP/Pop: LS	GDP/Pop: NS
	constant, trend	BDef/GDP: TS	BDef/GDP: TS	BDef/GDP: TS	BDef/GDP: NS
Romania	constant	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Slovakia	constant	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS
Slovenia	constant	GDP: LS	GDP: NS	GDP: LS	GDP: LS
	constant	GDP/Pop: LS	GDP/Pop: NS	GDP/Pop: LS	GDP/Pop: LS
Spain	constant, trend	GDP: NS	GDP: NS	GDP: TS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: TS	GDP/Pop: NS
Sweden	constant, trend	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS	GDP/Pop: NS

UK	constant	E: NS	E: NS	E: NS	E: NS
	constant	FCE: NS	FCE: NS	FCE: NS	FCE: NS
	constant	E/GDP: NS	E/GDP: NS	E/GDP: NS	E/GDP: NS
	constant, trend	E/Pop: NS	E/Pop: NS	E/Pop: NS	E/Pop: NS
	constant, trend	GDP: NS	GDP: NS	GDP: NS	GDP: NS
	constant, trend	GDP/Pop: TS	GDP/Pop: TS	GDP/Pop: NS	GDP/Pop: TS
	constant	BDef/GDP: TS	BDef/GDP: NS	BDef/GDP: NS	BDef/GDP: NS

Source: our calculations on Eurostat database.
Notes: LS: Level Stationary; NS: Non Stationary; TS: Trend Stationary.

In order to be able to find the long-run relationship between the dependent and independent variables, in all seven functional forms of Wagner's Law discussed above, cointegration tests have been carried on. Moreover, in cointegration equations we include a specific dummy variable for each country, to control the entry in the EU, so considering the change in economic conditions. In table 6 we report the results accruing from the application of Engle and Granger cointegration procedure.

Table 6 – Results for the two-step Engle and Granger cointegration test.

	Equations					
Country	**I**	**II**	**III**	**IV**	**V**	**VI**
Austria	*C*	*C*	*C*	*C*	*C*	*C*
	C	*C*	NC	NC	*C*	NC
Belgium	NC	*C*	*C*	*C*	*C*	*C*
	C	*C*	*C*	*C*	*C*	*C*
Denmark	NC	*C*	NC	NC	*C*	NC
	C	*C*	NC	*C*	*C*	*C*
Finland	*C*	*C*	*C*	*C*	*C*	*C*
	C	*NC*	*C*	*C*	*C*	*C*
France	*C*	*C*	*C*	*C*	*C*	*C*
	C	NC	*C*	*C*	*C*	*C*
Germany	NC	*C*	*C*	*C*	NC	*C*
	NC	*C*	*C*	NC	NC	NC
Ireland	NC	*C*	NC	NC	NC	NC
	C	*C*	*C*	*C*	*C*	*C*
Italy	NC	*C*	NC	NC	NC	NC
	NC	*C*	NC	NC	NC	NC
Netherlands	NC	*C*	NC	NC	NC	NC
	NC	NC	*C*	NC	NC	NC
Portugal	*C*	*C*	*C*	*C*	*C*	*C*
	C	*C*	*C*	*C*	*C*	*C*
UK	*C*	*C*	*C*	NC	*C*	NC
	NC	*C*	NC	NC	NC	NC

Source: our elaborations on Eurostat database.
Notes: the first result refers to Wagner's Law, the second one to the Augmented version of the law. NC stands for Not Cointegrating, while C for Cointegrating.

According to these results, empirical evidence is contradictory: in most cases the series are cointegrated. Yet, only for Belgium, Finland, France and Portugal we can find robust evidence in favour of Wagner's Law, either in his traditional version or in the Augmented one.

On the basis of Engle and Granger cointegration procedure, the series that revealed to be cointegrated were expressed in an Error Correction Model (ECM), in order to confirm the long-term relationship. The results of the ECM show *d* Durbin-Watson statistic close to 2, so that we can conclude for the absence of serial correlation. Moreover, R^2_{adj} are quite high, ranging between 0.72-0.91. After the implementation of the error correction procedure, the existence of Wagner's Law in these cases is confirmed. It is important to underline the opposite result obtained with respect to Karagianni *et al.* (2002), where the null hypothesis of non-cointegration can be rejected in favour of cointegration only in the case of Finland and the Netherlands in the second equation, as well as in Italy in the first, fourth, fifth and sixth equation. Moreover, it should be noted that applying the Engle and Granger procedure in a multivariate case results in a straining, since we are assuming that only one cointegration vector exists among more than two variables.

As discussed in Section 4, since the Engle and Granger test seems to have many and serious disadvantages, Johansen and Juselius cointegration procedure has been applied (see table 7).

Table 7 – Results for Johansen and Juselius cointegration test.

	Equations					
Country	**I**	**II**	**III**	**IV**	**V**	**VI**
Austria	rank=0	*rank=1*	rank=0	rank=0	rank=0	rank=0
	rank=1	rank=0	*rank=1*	*rank=1*	rank=0	*rank=1*
Belgium	*rank=1*	rank=0	*rank=1*	*rank=1*	*rank=1*	*rank=1*
	rank=0	rank=0	*rank=1*	*rank=1*	rank=0	rank=0
Denmark	*rank=1*	*rank=1*	rank=0	rank=0	rank=0	*rank=1*
	rank=0	*rank=2*	rank=0	*rank=1*	rank=0	rank=0
Finland	rank=0	rank=0	rank=0	rank=0	rank=0	rank=0
	rank=1	rank=0	*rank=1*	rank=0	rank=0	rank=0
France	*rank=1*	rank=0	*rank=1*	rank=0	rank=0	*rank=1*
	rank=1	*rank=1*	*rank=2*	*rank=1*	*rank=2*	*rank=1*
Germany	rank=0	*rank=1*	rank=0	*rank=1*	rank=0	rank=0
	rank=2	rank=0	*rank=2*	rank=0	*rank=1*	rank=0
Ireland	rank=0	*rank=1*	rank=0	rank=0	rank=0	rank=0
	rank=1	*rank=2*	*rank=1*	*rank=1*	rank=0	*rank=1*
Italy	rank=0	*rank=1*	*rank=1*	*rank=1*	*rank=1*	*rank=1*
	rank=0	*rank=1*	rank=0	rank=0	rank=0	rank=0
Netherlands	*rank=1*	rank=0	*rank=1*	*rank=1*	*rank=1*	*rank=1*
	rank=0	rank=0	*rank=1*	rank=0	*rank=1*	*rank=1*
Portugal	*rank=1*	rank=0	*rank=1*	rank=0	*rank=1*	rank=0
	rank=2	rank=0	rank=0	rank=0	rank=0	rank=0
UK	rank=0	rank=0	rank=0	rank=0	rank=0	rank=0
	rank=0	rank=0	rank=0	rank=0	rank=0	rank=0

Source: our elaborations on Eurostat database.

Notes: the first result refers to Wagner's Law, the second one to the Augmented version of the law. Rank=0 implies no cointegration, whereas rank=1 implies that a cointegration relation exists (since null hypothesis is rejected).

Now, results are deeply different to those derived by the previous test. In fact, results suggest that the null hypothesis of non cointegration can be rejected in favour of the alternative of cointegration only in the case of Belgium, Denmark, France, the Netherlands and Portugal in the first equation referring to Wagner's Law, as well as in Austria, Finland, France, Germany, Ireland and Portugal for Augmented Wagner's Law. These results are quite different for the estimates about equation *II*. In general, concluding for validity or not of the Wagner's Law is very linked with the specification of the law used by researcher. In fact, results for six different equations are sensibly different. Moreover, this happens when we estimate the Augmented version of the law, too. Only for Belgium, Italy and the Netherlands we found clear evidence in favour of traditional Wagner's Law; while empirical evidence is clear pro-Augmented Law only for Austria, France and Ireland. In all other cases, where the variables are not cointegrated, Wagner's Law is invalid, as no long-run causal relationship between them exists.

As Karavitis (1987) argued, the necessity of causality tests in the field of public expenditure growth can be considered by using Wagner's Law as an example. Despite its several interpretations, the original formulation of Wagner's Law appears to imply that in the wake of economic development, government expenditure increases not merely in size but also as percentage of national income. As clarified in Ansari *et al.* (1997), the causality in Wagner's Law runs from national income to public expenditure. In other words, support for Wagner's Law requires unidirectional causality from aggregate income (*GDP* and *GDP/Pop*) to public expenditure (*E*, *E/GDP*, *E/Pop*, *FCE*). On the one hand, public expenditure is seen as an exogenous factor, which can be used as a policy instrument to influence growth. On the other hand, public expenditure is seen as an endogenous factor or as an outcome, not a cause of growth in national income. The former hypothesis is associated with Keynes, and the latter with Wagner. The standard empirical approach used to evaluate the two different hypotheses has been to apply causality testing techniques in the Granger (1969) framework (Zellner, 1979; Granger, 1988).

Four findings are possible in a Granger causality test: (*i*) neither variable Granger causes the other. In other words, independence is suggested that when the sets of X and Y coefficients are not statistically significant in both regressions; (*ii*) unidirectional causality from X to Y: that is, X causes Y, but not vice versa (in this case Wagner's Law applies); (*iii*) unidirectional causality from Y to X: that is, Y causes X, but not vice versa (Keynesian modelling is valid in that case); (*iv*) X and Y Granger cause each other. If (*iv*) is found to be true, there is a feedback effect (or bilateral causality) between two variables (Miller and Russek, 1990; Gujarati, 1995). So, neither the Keynesian or Wagnerian approach is completely valid. In the public finance literature, the casual link between public expenditure and national income was first examined by Singh and Sahni (1984).

In table 8 below results for Granger causality test on Wagner's Law are shown. Empirical evidence seems to be most favourable to Wagner's hypothesis rather than the Keynesian one. In fact, we can conclude that aggregate income Granger-causes public expenditure (at least with four formulations) in Belgium, Finland, France, Germany, Italy, and Portugal. Indeed, the vice versa is true only for Ireland. None of this countries show a bi-directional causality flow.

Table 8 – Results for Granger causality test.

	Equations					
Country	**I**	**II**	**III**	**IV**	**V**	**VI**
Austria	0.4373	*0.0273*	0.3491	0.1857	0.4304	0.1799
	0.4715	0.9339	0.4446	0.8477	0.4449	0.7189
Belgium	*0.0004*	*0.0001*	*0.0124*	0.1308	*0.0046*	0.1452
	0.2637	0.4262	*0.0009*	0.1072	*0.0024*	0.1078
Denmark	0.2575	0.5833	0.1300	0.1839	*0.0946*	0.2681
	0.6618	0.2165	0.9001	*0.0496*	0.2309	0.1449
Finland	*0.0048*	*0.0171*	*0.0110*	0.3965	*0.0208*	0.4828
	0.5910	0.5347	0.3444	0.4940	0.3372	0.3187
France	*0.0094*	*0.0388*	*0.0298*	0.2107	*0.0722*	0.1518
	0.9207	0.1535	0.1421	*0.0836*	*0.0532*	0.1278
Germany	*0.0523*	*0.0122*	*0.0437*	0.7577	*0.0437*	0.8017
	0.5445	0.1215	0.6912	0.8491	0.7320	0.7728
Ireland	0.7069	0.2124	0.8565	*0.0309*	0.9289	*0.0227*
	0.0017	*0.0160*	*0.0002*	*0.0012*	*0.0016*	*0.0015*
Italy	*0.0027*	*0.0128*	*0.0044*	0.1059	*0.0137*	0.1085
	0.2498	*0.0315*	0.5017	0.2040	0.8675	0.2711
Netherlands	0.2226	0.6338	*0.0517*	0.2117	*0.0421*	0.1897
	0.0836	0.8318	0.2541	0.2757	0.2912	0.2506
Portugal	*0.0514*	*0.0210*	*0.0224*	0.1952	*0.0350*	0.2432
	0.3934	0.1638	0.4374	0.6501	0.3644	0.7184
UK	*0.0635*	0.5396	0.1262	0.5969	0.1502	0.5716
	0.6720	0.1872	0.6701	0.9347	0.6061	0.9319

Source: our elaborations on Eurostat database.

Notes: the first number above represents P-Value of Granger-causality Wald test for the coefficients on the lags of income in the equation for expenditure; indeed, the number below shows us P-Value of Granger-causality Wald test for the coefficients on the lags of expenditure in the equation for income. Null hypothesis is that the coefficients on the lags of all endogenous variables are jointly zero.

Finally, in table 9 results for Granger causality tests on Augmented version of the law are presented. Causality moves from income to expenditure in Belgium and Ireland, while it follows the opposite direction in Denmark, Finland, France, and Ireland. In Austria, Germany, Italia, the Netherlands, Portugal, and UK the law does not exist in any of the cases. Only in Ireland subsists a bi-directional causality flow, which confirm both Wagnerian and Keynesian hypothesis.

Table 9 – Results for Granger causality test for Augmented Wagner's Law.

	Equations					
Country	**I**	**II**	**III**	**IV**	**V**	**VI**
Austria	0.3613	*0.0268*	0.2815	0.3202	0.3083	0.4057
	0.6374	0.1866	0.6995	0.6307	0.6808	0.6403
	0.3581	0.6254	0.3241	0.1787	0.3343	0.1913
Belgium	*0.1324*	*0.0100*	*0.0029*	0.4002	*0.0017*	0.3561
	0.1516	0.5638	0.2889	0.2559	0.3260	0.4140
	0.1718	0.5177	0.1955	0.5090	0.1092	0.5000
Denmark	0.4350	*0.0979*	*0.0941*	0.4213	0.6385	0.4609
	0.0676	0.1189	*0.0013*	*0.0039*	*0.0029*	*0.0106*
	0.5833	0.7510	*0.0782*	0.2789	0.5482	0.2947
Finland	*0.0641*	*0.0237*	0.1669	*0.1000*	0.1717	0.1327
	0.2815	0.6425	*0.0980*	*0.0276*	*0.0914*	*0.0169*
	0.0018	*0.0794*	*0.0289*	*0.0007*	*0.0304*	*0.0010*
France	*0.0061*	0.1994	*0.0178*	0.1595	0.1166	0.1790
	0.0831	0.1204	*0.0016*	*0.0287*	*0.0012*	*0.0338*
	0.0033	0.1496	*0.0037*	0.1914	*0.0148*	0.1654
Germany	0.1173	*0.0140*	0.1300	0.4978	0.1250	0.5405
	0.1315	0.7771	0.1870	0.3785	0.1646	0.8496
	0.3531	0.1028	0.4258	0.8095	0.4082	0.7817
Ireland	0.7069	0.1998	*0.0830*	*0.0482*	*0.0496*	*0.0745*
	0.0065	*0.0143*	*0.0200*	0.3364	0.1430	*0.0055*
	0.0876	*0.0319*	*0.0055*	*0.0210*	*0.0070*	*0.0615*
Italy	*0.0068*	0.5261	*0.0106*	0.1413	*0.0086*	0.1432
	0.8998	0.4345	0.6192	0.9039	0.8374	0.8213
	0.6839	0.3571	0.4278	0.2116	0.4443	0.2277
Netherlands	0.1126	0.8761	*0.0640*	*0.0233*	0.1029	*0.0350*
	0.3010	0.2896	0.1329	0.3018	0.1752	0.2382
	0.3761	0.2432	0.3138	0.1080	0.2224	*0.0697*
Portugal	*0.0111*	*0.0075*	0.1388	0.2826	0.1762	0.3565
	0.4112	*0.0633*	0.1398	0.1855	0.1135	0.1664
	0.0796	*0.0120*	*0.0151*	*0.0183*	*0.0154*	*0.0195*
UK	0.3328	0.3261	0.3448	0.2079	0.3631	0.1953
	0.7186	0.9396	0.7280	0.2713	0.7085	0.2638
	0.4110	0.2212	0.4313	0.4181	0.4327	0.4010

Source: our elaborations on Eurostat database.

Notes: the first number above represents P-Value of Granger-causality Wald test in the equation for expenditure; indeed, the second number shows P-Value of Granger-causality Wald test in the equation for income; the third number represents P-Value of Granger-causality Wald test in the equation for deficit. Null hypothesis is that the coefficients on the lags of all endogenous variables are jointly zero.

Moreover, it's interesting to notice how, in the equation of public budget deficit, in a number of cases we found that the explanatory variables (aggregate income and public expenditure) Granger causes the dependent one. In fact, this is true for Finland, France, Ireland and Portugal.

Wagner underlined how his law would function for developing countries, although a number of econometric estimation of it consider advanced economies. In order to shed some light on this crucial aspect of Wagner's theory, we estimated the law for two different sub-sample of our panel: rich countries (the oldest member of UE) and poor countries (the new members). A third estimate regards the whole 27-countries panel. If Wagner's hypothesis is valid, only for poor sub-sample GDP might be a statistical significant explanatory variable in a public expenditure equation. Moreover, we used the *[VI]* specification equation (see table 10).

Table 10 – Panel estimation results comparison.

Sample	***Regression method***	β_{GDP}
EU-27	Panel GLS	0.0465*** (0.0122)
Poor	Panel GLS	0.0914*** (0.0260)
Rich	Panel GLS	-0.0874 (0.0607)

Source: our elaborations on Eurostat database.

Notes: Robust Standard Error in brackets. *Poor* group includes Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, The Netherlands, Spain, Sweden, and UK. *Rich* group includes Bulgaria, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, and Slovenia.

As is shown in the table above, for rich country panel the empirical evidence does not support Wagner's Law. On the contrary, for poor sample we are able to reach a different conclusion, in favour of the law, as suggested by Wagner (1883).

6. Concluding remarks and policy implications

This paper has examined the empirical evidence of Wagner's Law – which stated a long-term tendency for public sector to grow relative to aggregate income – and that of Augmented Wagner's Law, according to which subsists a long-term relationship among public expenditure on one side and aggregate income and public deficit on the other side. We applied several time-series econometric techniques, in order to check correlation among variables, data stationarity, cointegration – in order to detect some possible spurious relationship – and Granger causality. For this purpose, we have employed six alternative functional forms, using data for the EU-27 countries over time period 1970-2009. Results, accruing from this study, are ambiguous accordingly to the method applied, as shown in several previous studies. Yet, here we have shown how for the "Augmented" version of the law too, empirical evidence is deeply due to each equation chosen. Dividing EU-27 into two different groups, namely "Rich" for older member and "Poor" indicating new comers, empirical evidence is in favour of Wagnerian hypothesis, according to which the law is appropriate for developing countries, since public expenditure should be determined by aggregate income in a initial step of the development process.

With regard to Keynesian hypothesis, we find no clear evidence of government expenditure causing national income. In other words, the Keynesian proposition of government expenditure as a policy instrument to encourage and lead growth in the economy is not supported by the data used. So, as Ansari *et al.* (1997), Demirbas (1999) and Dogan and Tang (2006) conclude, these findings are rather discouraging for those who think government as a major actor to encourage economic growth. Probably, a new "Augmented" version of the law, which considers some relevant omitted variables, should be thought, including urbanization and industrialization' effects, focusing econometric estimates on less developed countries.

7. Suggestions for future researches

Future research on this issue can be conducted in order to explore causality, by non-linear Granger causality method. Another interesting field of research might be represented by study on Wagner's Law in homogeneous panel group. Moreover, studies on Wagnerian hypothesis should be related with that on optimal size of Government, in order to assess the effectiveness of public expenditure on economic growth. Finally, few studies investigated the relationship between different kinds of public expenditure and aggregate income, especially using the Augmented version of the law. So, focusing on disaggregated data could be the topics of future researches.

References

Abu-Bader S., Abu-Qam A.S. (2003), Government Expenditures, Military Spending and Economic Growth: Causality Evidence from Egypt, Israel and Syria, *Journal of Policy Modeling*, 25(6-7), 567-583.

Ahsan S.M., Kwan A.C.C., Sahni B.S. (1996), Cointegration and Wagner's Hypothesis: Time Series Evidence for Canada, *Applied Economics*, 28, 1055-1058.

Akitoby B., Clement B., Gupta S., Inchauste G. (2006), Public spending, voracity, and Wagner's Law in developing countries, *European Journal of Political Economy*, 22, 4, December, 908-924.

Albatel A.H. (2002), Wagner's Law and the Expanding Public Sector in Saudi Arabia, *Administrative Sciences*, 14(2), 139-156.

Al-Faris A.F. (2002), Public Expenditure and Economic Growth in the Gulf Cooperation Council Countries, *Applied Economics*, 34, 1187-93.

Ansari M.I., Gordon D.V., Akuamoah C. (1997), Keynes versus Wagner: public expenditure and national income in three African countries, *Applied Economics*, 29, 543-550.

Asseery A.A., Law D., Perdikis N. (1999), Wagner's Law and public expenditure in Iraq: a test using disaggregated data, *Applied Economics*, 6, 39-44.

Arpaia A., Turrini A. (2008), Government expenditure and economic growth in the EU: long-run tendencies and short-term adjustment, *Economic Papers*, 300, February.

Bacon R., Eltis W. (1978), *Britain's Economic Problem: Too Few Producers*, London: Macmillan.

Benoit E. (1973), *Growth and Defense in Developing Countries*, Lexington: Lexington Books.

Bird R.M. (1971), Wagner's Law: a Pooled Time Series and Cross Section Comparison, *National Tax Journal*, 38, 209-218.

Biswal B., Dhawan U., Lee H.Y. (1999), Testing Wagner versus Keynes Using Disaggregated Public Expenditure Data for Canada, *Applied Economics*, 31, 1283-1291.

Biswal B., Ram R. (1986), Military Expenditures and Economic Growth in Less Developed Countries: An Augmented Model and Further Evidence, *Economic Development and Cultural Change*, 34(2), 361-372.

Bohl M. (1996), Some International Evidence on Wagner's Law, *Public Finance*, 51, 185-200.

Burney N.A. (2002), Wagner's hypothesis: evidence from Kuwait using cointegration tests, *Applied Economics*, 34, 49-57.

Chang T. (2002), An Econometric Test of Wagner's Law for Six Countries Based on Cointegration and Error-Correction Modelling Techniques, *Applied Economics*, 34, 1157-1169.

Chang T., Liu W., Caudill S.B. (2004), A Re-examination of Wagner's Law for Ten Countries Based on Cointegration and Error-Correction Modelling Techniques, *Applied Financial Economics*, 14, 577-589.

Chletsos M., Kollias C. (1997), Testing Wagner's Law using disaggregated data in the case of Greece: 1958-93, *Applied Economics*, 29, 371-377.

Chow Y.-F., Cotsomitis J.A., Kwan A.C.C. (2002), Multivariate cointegration and causality tests of Wagner's hypothesis: evidence from the UK, *Applied Economics*, 34, 1671-1677.

Clements B., Faircloth C., Verhoeven M. (2007), Public Expenditure in Latin America: trends and key policy issues, *CEPAL Review*, 93, December, 37-60.

Cotsomitis J.A., Harnhirun S., Kwan A.C.C. (1996), Co-integration Analysis and the Long-Run Validity of Wagner's Hypothesis: Evidence from the People's Republic of China, *Journal of Economic Development*, 21, 2, December.

Courakis A.S., Moura-Roque F., Tridimas G. (1993), Public Expenditure Growth in Greece and Portugal: Wagner's Law and Beyond, *Applied Economics*, 25, 125-134.

Dakurah H., Davies S., Sampath R. (2001), Defense Spending and Economic Growth in Developing Countries: A Causality Analysis, *Journal of Policy Modeling*, 23(6), 651-658.

Deger S., Sen S. (1985), Military Expenditure, Spin-off and Economic Development, *Journal of Development Economics*, 13(1-2), 67-83.

Deger S., Smith R. (1985), Military Expenditure and Development: The Economic Linkages, *IDS Bulletin*, 16, 49-54.

Demirbas S. (1999), Cointegration Analysis-Causality Testing and Wagner's Law: The Case of Turkey, 1950-1990, typescript, May.

Dickey D.A., Fuller W.A. (1979), Distribution of the estimators for autoregressive time series with a unit root, *Journal of the American Statistical association*, 74, 427-431.

Dogan E., Tang T.C. (2006), Government Expenditure and National Income: causality Test For Five South East Asian Countries, *International Business & Economics Research Journal*, 5, 10, October, 49-58.

Dritsakis N., Adamopoulos A. (2004), A Causal Relationship between Government Spending and Economic Development: An Empirical Examination of the Greek Economy, *Applied Economics*, 36, 457-464.

Elliott G., Rothenberg T.J., Stock J.H. (1996), Efficient test for an autoregressive unit root, *Econometrica*, 64, 813-836.

Engle R.F., Granger C.W.J. (1987), Co-integration and error-correction: representation, estimation and testing, *Econometrica*, 55, 251-276.

Florio M., Colautti S. (2005), A Logistic Growth Theory of Public Expenditures: A Study of Five Countries over 100 Years, *Public Choice*, 122, 355-393.

Goffman I.J. (1968), On the Empirical Testing of Wagner's Law: A Technical Note, *Public Finance*, 23, 359-364.

Granger C.W.J. (1969), Investigating Causal Relations by Econometric Models and Cross-Spectral Methods, *Econometrica*, 37, 424-438.

Gujarati D.N. (1995), *Basic Econometrics*, New York: McGraw-Hill.

Gupta S. (1967), Public Expenditure and Economic Growth: A Time Series Analysis, *Public Finance*, 22, 423-461.

Halicioglu F. (2005), Testing Wagner's Law for Turkey, 1960-2003, *Public Economics*.

Hamilton J.D. (1994), *Time Series Analysis*, Princeton: Princeton University Press.
Henrekson M. (1993), Wagner's Law - A Spurious Relationship?, *Public Finance*, 48, 2, 406-415.
Holmes J.M., Hutton P.A. (1990), On the Causal Relationship between Government Expenditures and National Income, *The Review Of Economics and Statistics*, 72, 87-95.
Hondroyiannis G., Papapetrou E. (1995), An Examination of Wagner's Law for Greece: A Cointegration Analysis, *Public Finance*, 50, 1, 67-79.
Islam A.M. (2001), Wagner's Law Revisited: Cointegration and Exogeneity Tests for the USA, *Applied Economics Letters*, 8, 509-515.
Iyare S.O., Lorde T. (2004), Co-integration, Causality and Wagner's Law: Tests for Selected Caribbean Countries, *Applied Economics Letters*, 11, 815-825.
Johansen S. (1988), Statistical analysis of cointegration vectors, *Journal of Economics Dynamics and Control*, 12, 231-254.
Johansen S., Juselius K. (1990), Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money, *Oxford Bulletin of Economics and Statistics*, 52, 169-210.
Kalam M.A., Aziz N. (2009), Growth of Government Expenditure in Bangladesh: An Empirical Enquiry into the Validity of Wagner's Law, *Global Economy Journal*, 9, 2, 5.
Karagianni S., Pempetzoglou M., Strikou S. (2002), Testing Wagner's Law For The European Union Economies, *The Journal of Applied Business Research*, 18, 4, 107-114.
Karavitis N. (1987), The Causal Factors of Government Expenditure Growth in Greece, 1950-80, *Applied Economics*, 19, 789-807.
Kolluri B.R., Panik M.J., Wahab M.S. (2000), Government expenditure and economic growth: evidence from G7 countries, *Applied Economics*, 32, 1059-1068.
Koop G., Poirier D.J. (1995), An Empirical Investigation of Wagner's Hypothesis by Using a Model Occurrence Framework, *Journal of the Royal Statistical Society*, Series A, 158, 1, 123-141.
Kumar S., Webber D.J., Fargher S. (2009), Wagner's Law Revisited: Cointegration and Causality tests for New Zealand, *University of the West of England Discussion Papers*, 0917.
Kwiatkowski D., Phillips P.C.B., Schmidt P., Shin Y. (1992), Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root?, *Journal of Econometrics*, 54, 159-178.
Lamartina S., Zaghini A. (2008), Increasing Public Expenditures: Wagner's Law in OECD Countries, *Center for Financial Studies Working Papers*, 13.
Loizides J., Vamvoukas G. (2005), Government Expenditure and Economic Growth: Evidence from Trivariate Causality Testing, *Applied Economics*, 8, 125-152.
Magazzino C. (2009a), Spesa pubblica disaggregata e "Legge di Wagner", *Economia, Impresa e Mercati Finanziari*, VII, 3, September-December, 7-31.
Magazzino C. (2009b), "Legge di Wagner" e spesa pubblica disaggregata: un ap-

proccio VAR, *Economia Pubblica*, October-December.

Magazzino C. (2010a), "Wagner's Law" in Italy: Empirical Evidence from 1960 to 2008*, Global & Local Economic Review*, 14, 1, January-June, 91-116.

Magazzino C. (2010b), Wagner's Law and Augmented Wagner's Law in EU-27, *C.R.E.I. Working Papers*, 05/2010.

Mann A.J. (1980), Wagner's Law: An Econometric Test for Mexico, 1925-76, *National Tax Journal*, 33, 189-201.

Miller S.M., Russek F.S. (1990), Cointegration and Error-Correction Models: The Temporal Causality between Government Taxes and Spending, *Southern Economic Journal*, 57 (1), 221-229.

Muhlis B., Hakan Ç. (2003), Causality Between Public Expenditure and Economic Growth: The Turkish Case, *MPRA Paper*, 8576.

Murthy V. (1994), Wagner's Law, Spurious in Mexico or Misspecification: a reply, *Public Finance*, 49, 2, 295-303.

Musgrave R.A. (1969), *Fiscal Systems*, New Haven: Yale University Press.

Musgrave R.A., Peacock A.T. (1967), *Classics in the Theory of Public Finance*, London: Macmillan.

Narayan P.K., Nielsen I., Smyth R. (2008), Panel Data, cointegration, causality and Wagner's Law: Empirical evidence from Chinese provinces, *China Economic Review*, 19, 2, June, 297-307.

Nelson C.R., Plosser C.I. (1982), Trend and random walk in macroeconomic time series: Some evidence and implications, *Journal of Monetary Economics*, 10, 2, 139-162.

Oxley L. (1994), Cointegration, causality and Wagner's Law: A Test for Britain 1870-1913, *Scottish Journal of Political Economy*, 41, 286-298.

Park W.K. (1996), Wagner's law vs the Keynesian paradigm: the Korean experience, *Public Finance*, 51, 71-91.

Peacock A.T., Scott A. (2000), The Curious Attraction of Wagner's Law, *Public Choice*, 102(1-2), 1-17.

Peacock A.T., Wiseman J. (1961), *The Growth of Public Expenditure in the United Kingdom*, London: Oxford University Press.

Peacock A.T., Wiseman J. (1979), Approaches to the Analysis of Government Expenditure Growth, *Public Finance Quarterly*, 7, 3-23.

Phillips P.C.B., Perron P. (1988), Testing for a unit root in a time series regression, *Biometrika*, 75, 335-346.

Pryor F.L. (1969), Public Expenditures in Communist and Capitalist Nations, London: George Allen and Unwin.

Ram R. (1986a), Comparing Evidence on Wagner's Hypothesis from Conventional and 'Real' Data, *Economic Letters*, 20, 259-262.

Ram R. (1986b), Causality between Income and Government Expenditure: A Broad International Perspective, *Public Finance*, 41, 393-413.

Ram R. (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, 2, May, 194-204.

Rostow W.W. (1971), *Politics and the Stages of Growth*, Cambridge: Cambridge University Press.
Rotschild K. (1977), Military Expenditure, Export and Growth, *Kyklos*, 26, 804-813.
Sideris D. (2007), Wagner's Law in 19th Century Greece: A Cointegration and Causality Analysis, *Bank of Greece Working Papers*, 64, December.
Singh B., Sahni B.S. (1984), Causality between public expenditure and national income, *The Review of Economics and Statistics*, 66, 630-644.
Thornton J. (1999), Cointegration, Causality and Wagner's Law in 19th Century Europe, *Applied Economic Letters*, 6, 7, July, 413-416.
Wagner A.H. (1912), *Les fondements de l'economie politique*, in 5 voll., Paris: Girard & Brière, vol. III.
Wagner A.H. (1883), *Finanzwissenschaft*, Leipzig.
Wahab M. (2004), Economic Growth and Government Expenditure: Evidence from a New Test Specification, *Applied Economics*, 36, 2125-2135.
Yuk W. (2005), Government Size and Economic Growth: Time-Series Evidence for the United Kingdom, 1830-1993, *Econometrics Working Paper*, January.
Zellner A. (1979), Causality and econometrics in Brunner K., Meltzer A. H. (eds.), *Carnegie Rochester Conference Series on Public Policy*, New York: North-Holland.
Ziramba E. (2009), Wagner's Law: An Econometric Test for south Africa, 1960-2006, *South Africa Journal of Economics*, 76, 4, 596-606.