INCREASING PUBLIC EXPENDITURES: WAGNER'S LAW IN OECD COUNTRIES

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Abstract

The paper proposes a panel cointegration analysis of the joint development of government expenditures and economic growth in 23 OECD countries. The empirical evidence provides indication of a structural positive correlation between public spending and per-capita GDP which is consistent with the so-called Wagner's law. A long-run elasticity larger than one suggests a more than proportional increase of government expenditures with respect to economic activity. In addition, according to the spirit of the law, we found that the correlation is usually higher in countries with lower per-capita GDP, suggesting that the catching-up period is characterized by a stronger development of government activities with respect to economies in a more advanced state of development.

Key words: Fiscal policy, Wagner's Law, Panel cointegration

JEL Classification: E62, H50, C23

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1.Introduction

The role and dimension of the government in a country have been explored from different perspectives in the economic literature. The existence of an optimal government share in the economy has been subject to considerable theoretical debate and sustained empirical assessment. In particular, the literature has been providing possible determinants for the different size of government across countries. This kind of studies, in general, focus on different single aspects, which are supposed to be the driving force of the overall government size with respect to GDP: trade openness (Rodrik, 1998), country size (Alesina and Wacziarg, 1998), degree of economic development (Easterly and Rebelo, 1993; Stein et al. 1999), political organization (Persson and Tabellini, 1999; Milesi-Ferretti et al., 2002), business cycle volatility (Fatas and Mihov, 2001) to name the principal ones. Shelton (2007) provides a common empirical framework for the assessment of the hypotheses put forward by this literature.

Within this broad context, the analysis of the size of the government with respect to the degree of development has received a relatively larger attention. In particular, the long-run relation between government expenditures and economic growth has been a lively topic of empirical assessment. The existence of a positive covariance between the two variables was first postulated by the German political economist Adolph Wagner. The so called "law of increasing state activity" maintained that there is both and absolute and a relative expansion of the public sector (including central and local government's bodies and public enterprises), at the cost of the growth in the private sector (Wagner, 1911). This statistical association has been interpreted in a loose and a strict way. In a loose sense, Wagner's law points to a positive long-run co-movement between government expenditures and economic growth, while in a strict sense, it postulates a long-run elasticity of public spending above unity.

The idea behind Wagner's law is that goods and services provided by the government, including redistribution via transfers and, in particular, the activities of public enterprises, would increase with a county's industrialization since as the economy grows: 1) the administrative and protective functions of the state would substitute public for private activity; 2) there will be a need for increased provision of social and cultural goods and

services; 3) government intervention would be required to manage and finance natural monopolies and to ensure the smooth operation of market forces (Bird, 1971).

Wagner's law has been statistically tested not only from a cross-country perspective but also relying on standard time-series econometric approach. However, due to paucity of data when dealing with public finance, empirical works has long suffered of an inadequate methodological framework, especially in early cross-country analyses (Abizadeth and Gray, 1985; Ram, 1987). It is not surprising that results from these studies have generally been mixed supporting further investigation.[1] The use of integration and cointegration analysis has improved the reliability of the most recent works, allowing a distinction between a long-term relationship and short-run dynamics. However, the range of the investigation has been usually limited to single countries evidence or multi-country comparisons (Thornton; 1999, Islam; 2001, Akitoby et al.; 2006).

In this paper we try to make the best use of both cross-section and time-series dimensions of a dataset of 23 OECD economies over the period 1970-2006. We study the relationship between government expenditures and economic growth employing recent panel data techniques which, on the one hand, improve the power of stationarity and cointengration tests (low test power is a well known problem which arises when the number of observations over time is limited, which is usually the case when dealing with public finance data) and, on the other hand, allow to extract country-specific information on short-run dynamics while maintaining a common specification for the long-run equilibrium relationship.

In particular, to assess the validity of Wagner' law we rely on the pooled mean group (PMG) estimation procedure proposed by Pesaran et al. (1999). This panel technique lays between the traditional dynamic fixed effects modeling, which imposes all the slope coefficients to be identical across groups, and the mean group procedure, in which the pooled coefficients are averages of those of the country-specific equations estimated separately letting the coefficients completely free. In fact, the PMG procedure allows intercepts, short-run coefficients (including the adjustment coefficients) and error variances to differ freely across countries, but maintains a common specification for the long-run relationship (i.e., constrains the cointegrating vector to be the same across countries). In this way it is possible to exploit

[1] Peacock and Scott (2000) provide a critical survey on the empirical literature.

the cross-section dimension of the data set to improve the estimation precision, while allowing different short-run dynamics, including the speed of adjustment to temporary deviation from equilibrium. These features are relevant for the assessment of Wagner's law since not only the homogeneity across countries of the long-run relation between government spending and GDP growth is easily tested (loose Wagner's law), it is also possible to assess whether the equilibrium elasticity is statistically larger than one (strict Wagner's law). Recently, this technique has been successfully applied in both macroeconomic and financial empirical research (Bassanini and Scarpetta, 2002; Byrne and Davis, 2005; Loayza and Ranciere, 2006).

The paper provides empirical support to a strict version of the Wagner's law. In addition, also the spirit of the statement of the German economist seems to be backed by our results. In fact, the long-run elasticity of government expenditures with respect to GDP turns out to be significantly larger than one, this result being confirmed by several robustness checks. By looking at country specific cointegration relationships it is also evident that the economies which experienced a faster catching-up over the considered time span show a higher elasticity. This in turn suggests that indeed the role of government in the economy tends to grow as countries become richer. Not only the need for regulatory and protective functions grow stronger with economic development, but also the demand of some public goods such education and cultural services increase in wealthier economies and can be thought of as luxury goods. Finally, a recursive estimation procedure confirms the finding: in the first part of the time horizon, in which the rate of economic development was more robust in OECD countries, the elasticity of public spending was higher. Starting from a value of 1.30 in the first 20 years it slowly declined to 1.03 over the full sample.

The paper is structured as follows. Section 2 reviews the empirical framework of our analysis and briefly discusses the pooled mean group estimator properties; Section 3 presents the estimation results and the assessment of the Wagner's law; Section 4 deals with robustness checks and focuses on the EU countries sub-group; Section 5 concludes.

2. The empirical framework

Our empirical strategy is the following. We first run the relevant tests to assess the degree of integration of government expenditures and GDP time series and then we look for the

existence of a cointegration relationship. As a second step, we run the PMG estimation following Pesaran et al. (1999), jointly determining the different short-run dynamics and the common long-run relationship.

We rely on data for the 23 following OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Great Britain, Germany, Greece, Iceland, Ireland, Italy, Japan, South Korea, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland and USA. Data are gathered on yearly basis from 1970 to 2006, with the exception of Portugal (1978-2006) and South Korea (1974-2006). The main source for both public spending and GDP dynamics is *Economic Outlook* by OECD, while *Government Financial Statistics* by IMF has been used for Switzerland and New Zealand, and AMECO by European Commission for EU countries' population.

In the empirical literature Wagner's law has been tested with reference to different measures of both government spending and economic development. It is however common to rely on the broadest definition of government, including all public activities, while it is less clear whether the economy's GDP is the most appropriate counterpart or it has to be considered together with the demographic development (i.e., in per-capita term). In addition, also the nominal versus real definition of the two variables has been challenged by different authors. In this paper we propose a baseline analysis in which general government total expenditures and GDP per-capita are used in nominal terms. In a robustness section we check for changes in the definition of both public spending and economic development. In addition to some stability tests, we allow for the possibility of a level relationship between government expenditures and GDP and we consider both variables in real terms. Finally, we also consider the restricted sample of the 14 EU countries.

The assessment of the Wagner's law is conducted in the paper via the relatively new panel estimation technique of pooled mean group regressions proposed in Pesaran et al. (1999). This methodology, can be placed between two other general estimation procedures employed when dealing with panels with large time-series and cross-sectional dimensions. On the one hand, equations can be estimated country by country and the mean of the coefficients used as consistent estimate of the average of the parameters (Mean Group Estimation, MG). This estimator, however, does not exploit the cross-country dimension of the sample to take advantage of the opportunity given by the fact that at least some parameters may be the same across countries. On the other hand, there is the traditional

(dynamic) fixed effect estimator (FE) which allows the intercepts to differ across countries while all other slope parameters are constrained to be the same. However, this kind of pooling does not allow to differentiate between short- and long-run dynamics. In addition, it often leads to inconsistent parameter estimates (unless the slopes are indeed the same) and this inconsistency does not disappear when the size of both cross-section and time-series dimension increases.

A major advantage of PMG estimation methodology over the standard dynamic FE modeling is that it allows the short-run dynamic specification to vary across countries. With respect to the MG estimates it uses the cross-section dimension of the dataset to take into account the fact that certain parameters (i.e., the long-run elasticities) might be the same across group. In addition, the PMG estimation technique is well suited to empirically test the validity of the Wagner law for at least two other reasons. First, it allows to determining a testable unique long-run relationship across-countries. In particular, we can assess whether there are differences among countries in the cointegrating vector or the working hypothesis of a homogeneous long-run relation *à la* Wagner is valid (independently of being strict or loose). This is done by statistically comparing the MG and the PMG estimates via a Hausman-type test. Second, by starting from a general autoregressive distributed lags (ARDL) modeling, it allows for some degree of endogeneity in the variables. Adequately selecting the lag length of both government expenditures and GDP in the ARDL model is sufficient to correct for the problem of endogenous regressors and maintain the asymptotic distribution of the estimators of the long-run parameters (Pesaran and Shin, 1999).

As pointed out in Peacock and Scott (2000), the cointegrating relationship itself is the best econometric translation of the mutual evolution of government spending and economic development that Wagner had in mind when formulating his law. Cointegration refers to a joint long-run pattern and does not imply causality. Thus, a test of the (loose) Wagner's law is just the statistical evidence of a cointegrating relationship with a positive coefficient. In addition, the strict Wagner' law can be easily assessed by checking whether the long-run elasticity is significantly larger than 1.

To exploit the benefit of the PMG estimation we must however first check two conditions: 1) both government spending and per-capita GDP are non-stationary series; 2) a cointegrating relationship exists between the two I(1) variables.

Table 1

Stationarity and cointegrating properties of time series

	PER-CAPITA GDP				**PUBLIC EXPENDITURES**			
	Raw		*Demeaned*		*Raw*		*Demeaned*	
Ho: No unit root								
Hadri	14.107	(0.000)	12.872	(0.000)	14.135	(0.000)	12.136	(0.000)
Ho: Unit root (common process)								
Levin, Lin & Chu								
Level	-5.353	(0.000)	-0.195	(0.422)	-7.791	(0.000)	1.789	(0.963)
First difference	-6.259	(0.000)	-9.897	(0.000)	-6.586	(0.000)	-10.77	(0.000)
Breitung								
Level	7.602	(0.999)	3.465	(0.998)	6.055	(0.999)	5.573	(0.999)
First difference	-8.195	(0.000)	-6.104	(0.000)	-8.018	(0.000)	-9.372	(0.000)
Ho: Unit root (individual process)								
Im, Pesaran & Shin								
Level	2.415	(0.992)	4.348	(0.999)	0.786	0.7841	5.214	(0.999)
First difference	-10.55	(0.000)	-10.99	(0.000)	-6.843	(0.000)	-11.44	(0.000)
ADF - Fisher								
Level	48.342	(0.378)	40.359	(0.706)	64.249	0.0388	18.037	(0.999)
First difference	196.41	(0.000)	206.02	(0.000)	130.31	(0.000)	208.78	(0.000)
Pesaran CIPS								
P=1	-1.118				-1.337			
P=2	-1.457				-1.608			
P=3	-1.316				-1.585			
P=4	-1.316				-1.774			
Ho: No cointegration								
Pedroni - panel ADF				-3.042	(0.004)			
Pedroni - group ADF				-3.663	(0.001)			
Kao				-7.382	(0.000)			

Table 1 shows stationarity and cointegration tests. In the upper part we report the results stemming from the most commonly used panel unit root tests. They are run for both the

levels of the variables and for the first differences. In addition, given the possible existence of cross-country correlation of errors due to common factors (possibly affecting the variables in the same way) we run the tests also on demeaned variables. Finally, to control for higher degree of cross-country correlation, the cross-sectional augmented IPS test proposed by Pesaran (2007) is computed for 4 lags.[2] The tests have different null hypotheses, but, apart from the Levin-Lin-Chu test run on raw data, which however is valid under the strong assumption of a common unit root process for all the countries, they all clearly suggest that the two variables are integrated of order 1.

The next step following the assessment of the degree of integrations of the time series is that of looking for a cointegrating relationship among the non-stationary variables. This is done in order to avoid possible spurious correlation when relying on regressions involving variables in level. The Kao and the two Pedroni tests for panel cointegration are reported in the lower part of Table 1. The null hypothesis of absence of cointegration could be easily rejected in our sample at standard confidence values.

The two preliminary steps above are important to reassure us that we are employing the correct econometric estimation procedure. As already suggested, running a regression (single-country or panel) on the levels of variables can be misleading if the time series are non-stationary. Spurious correlation among variables is the most likely outcome even if they are not linked by any long-run relationship. On the other hand, regressing the first difference of the variables when instead a long-run equilibrium relationship does exist leads to the well known problem of omitted variables specification. In fact, what is missing in this kind of regressions is precisely the error correction term.

Our final methodological step starts from the general ARDL(p,q) model:

$$(1)\quad GEX_{it} = \alpha_{0i} + \alpha_{1i} t + \sum_{k=1}^{p} \lambda_{ik} GEX_{i,t-k} + \sum_{k=0}^{q} \delta_{ik} PCY_{i,t-k} + \varepsilon_{it},$$

in which *GEX* stands for total general government expenditures and *PCY* for per-capita GDP, both expressed in logs. The index *i* tracks the cross-sectional dimension of the dataset from 1 to 23, while *t* is the time index running from 1970 to 2006. The traditional dynamic

[2] The critical values tabulated by Pesaran (2007) of the CIPS test for a panel with T=30 and N=20 are -2.20 (5%) and -2.38 (1%).

FE estimation imposes slope homogeneity in equation (1) by simply setting $\lambda_{ik} = \lambda_k$ and $\delta_{ik} = \delta_k$ for each country; thus letting free only intercept and trend coefficients and neglecting the degree of stationarity of the time series.

However, the model can be equivalently written in the error correction representation to disentangle long-run and short-run developments:

$$(2)\ \Delta GEX_{it} = \alpha_{0i} + \alpha_{1i} t + \phi_i GEX_{i,t-1} + \beta_i PCY_{i,t-1} + \sum_{k=1}^{p} \lambda_{ik} \Delta GEX_{i,t-k} + \sum_{k=0}^{q} \delta_{ik} \Delta PCY_{i,t-k} + \varepsilon_{it}$$

where $-\frac{\beta_i}{\phi_i} = \theta_i$ stands for the long-run elasticity of public spending with respect to per-capita GDP in each country. The MG procedure runs separate estimation of (2) for the 23 economies and then averages the estimated coefficients across countries. In particular, we have for the long-run elasticity $\frac{1}{23}\sum_{i=1}^{23} \theta_i = \theta_{MG}$. The different approach of the PMG estimator is instead based on the homogeneity of this coefficient, so that for each economy we have $\theta_i = \theta$. Nevertheless, the speed of adjustment to long-run disequilibria is let free to vary across countries. Thus, equation (2) can be rewritten as:

$$(3)\ \Delta GEX_{it} = \alpha_{0i} + \alpha_{1i} t + \phi_i \left(GEX_i - \theta PCY_i\right)_{t-1} + \sum_{k=1}^{p} \lambda_{ik} \Delta GEX_{i,t-k} + \sum_{k=0}^{q} \delta_{ik} \Delta PCY_{i,t-k} + \varepsilon_{it}$$

According to Wagner's law the coefficient θ must be positive and, for the strict interpretation, larger than 1. In the next section we show the estimation results and all the relevant tests which prove that indeed Wagner's law holds in our sample.

3. Estimation results

Pooled estimates of the long-run elasticity θ and the adjustment coefficient ϕ_i are reported in Table 2 under the Pooled Mean Group, the Mean Group and the Dynamic Fixed Effect method. The lags of both endogenous and exogenous variables on the right hand side of the ARDL model (3) are chosen according to the Schwarz Bayesian Criterion and are allowed to

vary across countries. However, due to data constraints on the time series dimension of the data set we impose for both variables a maximum lag of 2 years.[3]

The long-run elasticity is estimated at a value just above unity, which is however significantly larger than one. In fact, due to a very small standard error, which in turn hints to a high estimation precision, even the estimated coefficient of 1.028 turns out to be statistically larger than one and thus support the strict Wagner's law. In the long-run an increase of per-capita GDP is associated to a more than proportional increase in total government expenditures. The same evidence derives from the alternative MG and FE estimates: in both cases the long-run elasticity of government expenditures with respect to per-capita GDP is significantly larger than 1.

Table 2

Pooled estimates of baseline model

	PMG	MG	FE
long-run coefficient	1.0281	1.1273	1.1416
(std error)	(0.0093)	(0.0446)	(0.0051)
adjustment coefficient	-0.2152	-0.3206	-
(std error)	(0.0330)	(0.0414)	
Hausman test	5.01		
(1% critical value)	(6.63)		

The adjustment coefficient is, as expected, negative and statistically different from zero, thus suggesting that any deviation of public spending from the value implied by the long-run equilibrium relationship with per-capita GDP brings about a correction in the opposite direction. In particular, the error correction coefficient is -0.22 under the PMG framework suggesting a relatively slow adjustment from lung-run disequilibria of between 4 to 5 years. Slightly larger is the same coefficient when estimated with the MG procedure. Finally, the Hausman test could not reject the null of equality of PMG and MG estimates, thus sustaining the homogeneous long-run coefficient hypothesis underling the PMG procedure and giving support to a broad validity of Wagner's law across countries.

[3] This restriction will be released in the robustness section without any implication for the results of the paper.

Before looking at the PMG estimates of the short-run dynamics in each country, it is worth spending few words about the single economy specifications obtained through MG estimation.[4] The long-run elasticity of public expenditures ranges from 0.74 in Belgium to 1.54 in Ireland. In the spirit of Wagner's law all the economies which experienced a more sustained growth of per-capita GDP show an equilibrium elasticity above the average. For countries like Greece, Ireland, Portugal and Spain the needs of government to adjust the supply of public goods and services to a changing demand, adapt public sector remunerations, revise type and size of transfers to private sector and provide all the regulatory and protective actions needed to ensure the smooth workings of a modern, specialized economy were more stringent than in countries in which this evolution had started well in advance. In addition, the relatively high average short-run ECT coefficient (Table 2) hints for some countries to a fast adjustment of public spending to deviations from equilibrium. While the "average" OECD economy is able to get back on the level of government expenditures foreseen by the cointegrating relationship in about three years, for Iceland, Greece, Korea and Switzerland the process takes less than 2 years, the ECT coefficient being larger than 0.50.

A detailed picture of the PMG country-specific estimations is reported in Table 3. The ARDL model selection based on the Schwarz Criterion is reported in the second column of the table. The third column provides the adjusted R-square: 17 countries display a coefficient above ⅔ and only one below ½. A battery of diagnostic tests shows that there is little evidence of misspecification in any country-specific model. In particular, the fourth column reports that there is no residual serial correlation (Godfrey test), the fifth shows a functional form misspecification only for the UK, Germany and Korea (RESET test), the sixth suggests evidence of non-normal errors for Finland, Korea and Sweden (Jarque-Bera test), while the last hints to heteroskedasticity in Australia, Finland, France, Japan and USA. All in all the general fit is fairly good.

[4] For the sake of brevity, the results of the full Mean Group estimation procedure are not reported. They are available on request.

Table 3

PMG estimation results

	Adjustment coefficient		Lag select.	Adjusted R-square	Auto correl.	Funct. form	Errors Norm.	Hetero sked.	Exoge neity
Australia	-0.236	(0.05)	(2; 0)	0.73	1.72	0.01	0.36	8.24	4.66
Austria	-0.214	(0.05)	(1; 0)	0.79	1.92	4.58	0.19	0.55	2.79
Belgium	-0.176	(0.06)	(1; 2)	0.76	0.63	0.35	5.29	0.14	6.07
Canada	-0.118	(0.05)	(2; 2)	0.84	1.53	1.28	0.03	2.82	12.61
Denmark	-0.141	(0.06)	(2; 0)	0.68	3.38	3.43	3.79	6.47	2.32
Finland	-0.135	(0.04)	(2; 0)	0.80	0.00	1.21	19.73	10.80	12.31
France	-0.265	(0.05)	(2; 0)	0.91	1.38	0.12	0.25	13.43	1.64
GBR	-0.395	(0.09)	(2; 2)	0.71	0.32	8.35	0.13	0.57	2.48
Germany	-0.188	(0.06)	(1; 0)	0.59	1.84	21.48	5.18	4.06	1.94
Greece	-0.100	(0.11)	(2; 0)	0.58	3.55	4.49	2.48	0.02	1.71
Iceland	-0.804	(0.06)	(2; 2)	0.93	1.87	1.05	0.42	3.27	9.97
Ireland	-0.179	(0.05)	(2; 0)	0.56	1.35	1.66	0.61	6.43	0.86
Italy	-0.131	(0.04)	(2; 0)	0.91	0.16	2.67	0.56	0.72	0.66
Japan	-0.225	(0.04)	(1; 0)	0.92	1.20	0.74	0.62	12.21	3.42
Korea	-0.383	(0.01)	(2; 0)	0.55	3.64	13.33	34.51	1.34	9.93
Netherlands	-0.372	(0.03)	(1; 1)	0.80	3.95	1.75	0.62	3.40	4.90
N. Zealand	-0.103	(0.05)	(1; 2)	0.75	1.23	0.45	0.43	1.65	3.14
Norway	-0.180	(0.03)	(2; 1)	0.81	0.07	0.31	0.50	0.03	7.50
Portugal	-0.149	(0.09)	(1; 1)	0.88	0.77	0.05	0.60	1.50	3.53
Spain	-0.019	(0.05)	(2; 1)	0.84	1.33	0.66	0.58	0.00	2.04
Sweden	-0.148	(0.08)	(1; 1)	0.47	0.80	4.18	8.89	2.87	0.15
Switzerland	-0.161	(0.04)	(1; 2)	0.50	1.01	3.71	1.33	6.57	1.18
USA	-0.125	(0.04)	(2; 1)	0.67	0.04	0.00	1.62	10.32	1.87
1% critical value					6.63	6.63	9.21	6.63	6.63

It is possible to observe that the speed of adjustment to the common equilibrium relationship differs largely across economies and it is significantly different from zero in all countries but Greece, Portugal and Spain. Note however that the latter circumstance is to be attributed to an estimated PMG long-run coefficient well below the one found in the single-country

specifications. As explained above, the estimated value of the elasticity of government expenditures to GDP was much larger and always significant in Greece (1.40), Spain (1.25) and Portugal (1.10) than the common cointegrating value of 1.03. When switching to the common restriction of a single OECD elasticity the model simply could not adjust the difference.

The ECT coefficient ranges from -0.1 in New Zealand to around -0.4 in UK, Korea and the Netherlands with a peak of -0.8 in Iceland. With the exception of the latter economy, the short-run dynamics hint, as expected, to an overall gradual adjustment of public spending to deviation from the equilibrium value predicted by the Wagner's law.

As already mentioned, the correct interpretation of Wagner's statement about the link of government spending and economic development points to the existence of a positive correlation of the time-series which, however, does not imply a strong causality from one variable to the other. The idea was that the economic development was associated with an increased role of government activities, but Wagner himself did not provide an articulated model of the growth process in which cause and effect were clearly delineated. Nevertheless, in the empirical literature Wagner's law has been often tested as a causality relationship from GDP growth to government expenditures. In this paper, the ARDL modeling technique employed is able to reduce the potential inefficiency introduced by the presence of endogenous variables. However, to shed some light on the direction of the long-run linkage we run a test of exogeneity on each country. The Wald exogeneity test results are reported in the last column of Table 3. Only for 5 countries the null hypothesis that government expenditures contain no additional information about the long-run determination of per-capita GDP (i.e., non-causality) could not be accepted. Thus there is ample evidence that per-capita GDP is weakly exogenous (or long-run forcing) to government expenditures and that the causality goes from the former to the latter variable.

4. Robustness analysis

The results of the PMG estimation provided clear evidence in favor of a strict Wagner's law in our advanced economies sample. In this section we run several robustness check of the relation between public spending and GDP growth. The left-hand-side of Table 4 proposes three adjustments of the baseline estimation. We first considered a smaller sample of 21

countries in which we did not include the two economies with the maximum and minimum estimated MG value for the long-run elasticity (Ireland and Belgium, respectively). We then let the model freely select the lag-length for each country according to the Schwarz Bayesian Criterion.[5] Finally, we consider demeaned variables in order to take into account possible cross-country errors' correlation. The results confirm the goodness of the baseline estimation: the long-run elasticity of government expenditures with respect to per-capita GDP is always significantly larger than one, thus supporting Wagner's law in its strict interpretation. Also the magnitude of the ECT coefficient is in line with the estimated horizon of 4 to 5 years to offset government disequilibrium spending levels.

As mentioned earlier, there is not a unique way to measure both government spending and economic growth which is consistent with the Wagner's law. However, some basic principles in the spirit of the law have to be followed (Peacock and Scott, 2000). Apart from the pair "nominal government expenditures" and "nominal per-capita GDP" we used in the previous section, there are two other possible strong candidates which have been often used in the empirical literature: "nominal government expenditures" and "nominal GDP"; "real government expenditures" and "real per-capita GDP". The estimation results based on these two sets of variables are reported in RHS of Table 4. Again, a strict reading of the law of increasing state activity is suggested by a long-run elasticity significantly larger than one.

Table 4

PMG estimates of alternative models

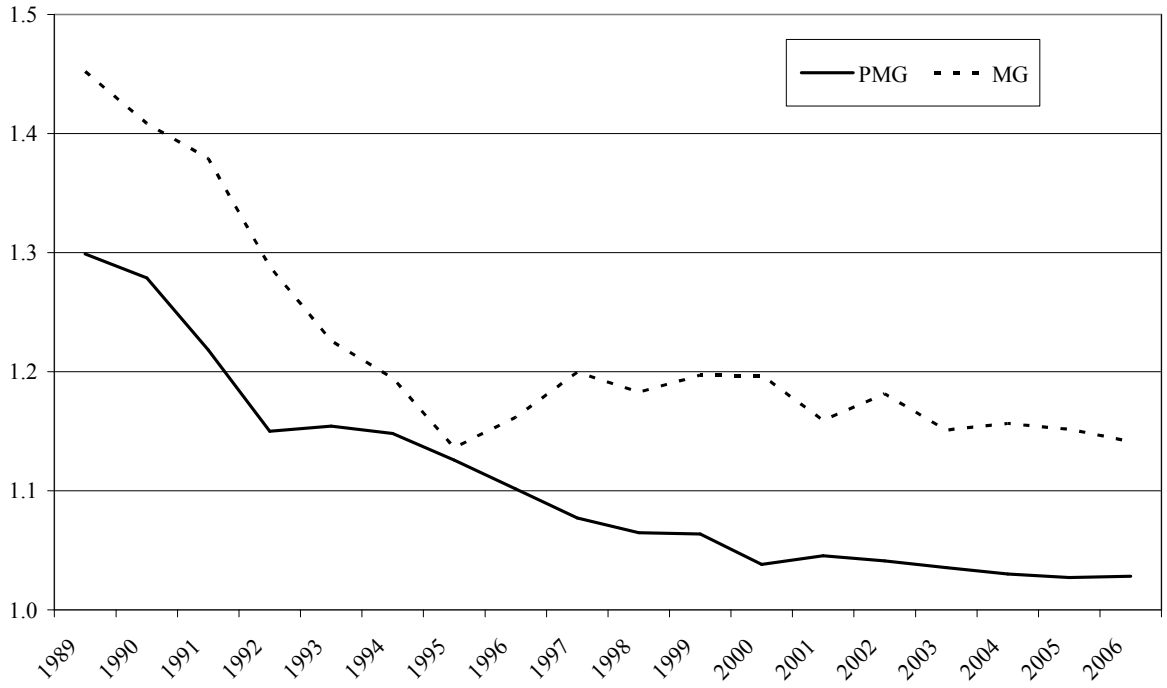
MODEL	*elasticity*	*ECT coeff.*	**MODEL**	*elasticity*	*ECT coeff.*
No outliers	1.0278	-0.2187	**Levels**	1.0165	-0.1697
	(0.0093)	(0.0362)		(0.0055)	(0.0317)
Free lags	1.0188	-0.2669	**Real variables**	1.0911	-0.1605
	(0.0053)	(0.0608)		(0.0455)	(0.0262)
Demeaned	1.1474	-0.2248	**EU-14**	1.0574	-0.2720
	(0.0194)	(0.0304)		(0.0221)	(0.0377)

[5] Only in five cases did the automatic selection reach a 4-lag length for at least one variable, suggesting that a lag order of two was generally enough for taking into account the short-run dynamics. This is not surprising given the already good fit of each single country estimation highlighted in the previous section.

Finally, we looked at the reduced sample of the 14 European Union countries. This sub-set is interesting since it is characterized by a common set of rules which goes beyond domestic legislation. In fact, in order to comply with the fiscal criteria established by the Maastricht Treaty, the majority of countries addressed the challenge of reducing the deficit/GDP ratio to the well-known 3% threshold within 1997. In addition, the *Stability and Growth Pact* sets the rules to have medium term balanced budgets across countries. The elasticity of government spending is slightly larger than the whole sample, but the difference is not statistically significant. Indeed, it seems that the fiscal discipline which characterizes European countries at least since mid-1990s has not led to a different government spending evolution with respect to other advanced economies. Public spending and GDP growth are linked by a positive long-run relation fully consistent with the strict Wagner's law.

Figure 1

Recursive pooled estimates of long-run elasticity



A different robustness check is implemented via recursive estimates of equations (2) and (3) to assess the stability of the model. We started from a 20-year sample and then added one year in each step. Figure 1 depicts the evolution of the PMG and MG estimates of the long-run elasticity θ. Even remaining always significantly larger than 1, the positive relation between government expenditures and per-capita GDP shows a clearly declining trend.

When the expansion of the economy was stronger public spending was increasing in a proportionally larger fashion. On average over the 1970s and 1980s the rate of growth of per-capita GDP was faster than in the following decades and the elasticity of public expenditures was at 1.30. The subsequent reduction in the speed of development led to a significant decline also in the long-run elasticity, suggesting that the size of government might be somehow approaching a stable level in OECD countries.

This development is supportive of the traditional interpretation of the positive correlation between the two variables. As already mentioned, Wagner's idea was that the economic evolution of a country would call for an expanding role of the government because of the increased need of administrative controls, market supervision and education and welfare services. However, the time in which the German economist was operating was that of the emerging industrial society in which the economic development was characterized by strong changes in the structure of the whole country and steep increase in the wealth of nations. In our sample, even though in a very minor way, the first two decades might be still considered (at least with respect to the following years) as characterized by important economic changes. In a world of less buoyant development as that of the OECD economies in the last two decades the relation between government size and GDP growth might have weakened. While some public goods and services might still be considered as luxury and increase more than proportionally with (per-capita) GDP, other aspects put forward by Wagner to sustain the law might have weakened. Besides, issues which were not relevant at that time may become significant for the joint development of the two variables in the most recent period. As suggested by Shelton (2007), the increasing share of the population over 65 is strongly supporting the growth of government spending (and thus the positive correlation with per-capita GDP) in many advanced economies since greying population calls for increased social security expenditures. In addition, there may also be at work a neglected supply-side explanation concerning the technology of taxation. The increasing share of public spending may be in fact related to an enhanced ability of raising taxes which allows the financing of the larger expenditures.

5. Conclusion

The paper has provided some new empirical evidence supporting the existence of a long-run positive correlation between public spending and GDP growth. Relying on recent contributions on the econometric technique dealing with panel data, we were able to exploit both the time-series and the cross-section dimension of a panel of 23 OECD advanced economies. In a first step we assessed the mean-reverting statistical properties of general government total expenditures and per-capita GDP time series. They turned out to be integrated of order 1 so that we could test for a long-run cointegrating relationship, which indeed happened to exist. We then set a panel ARDL model which was estimated via the pooled mean group (PMG) methodology proposed by Pesaran et al. (1999). This procedure is well suited to deal with testing the Wagner's statement that economic development is associated to a more than proportional contemporaneous growth in government expenditures. From a statistical point of view, the PMG estimation exploits the cross-section dimension of the dataset by imposing the homogeneity of the long-run parameters, while allowing the short-run dynamic specification to vary across countries. In addition, both the equivalence across groups and the magnitude of the long-run elasticity can be easily tested in the PMG framework. The latter property has been exploited to distinguish between a loose and a strict economic interpretation of the Wagner's law.

The hypothesis that the long-run elasticity is equal across countries turned out to be viable for our sample, thus suggesting a common development among the 23 countries and the widespread validity of the Wagner's law. In addition, the cointegrated term of the ARLD showed a coefficient linking the two variables which is statistically larger than one, supporting a strict interpretation of the law.

This evidence is robust to different model specifications with respect to both the sample properties and variables' definition. Even the sub-group of European countries, which are subject to a common set of supranational rules regarding public finances management, did not show a behavior which is statistically different from the whole sample.

In the spirit of the law we also found that the long-run elasticity is usually higher in countries with lower per-capita GDP, suggesting that the catching-up period was characterized by a stronger development of government activities with respect to economies in a more advanced state of development.

In addition, a recursive estimate showed a clear declining trend for the long-run correlation between public expenditures and GDP. Even maintaining a coefficient consistent with a more than proportional increase of the role of government in the economic activity of a country, the value is approaching the unit suggesting that maybe the relative weight of government in the set of OECD economies is close to a steady state value or even that the relative share may shrink below a one-to-one joint development.

However, while traditional channels for the expanding role of government may be less effective, nowadays other factors may have contributed to the upholding of the law in the most recent period of relatively subdued growth in per-capita GDP. From the supply-side, it is possible to mention the increased ability of governments in collecting taxes and thus the relatively ease in financing growing expenditures, from the demand-side, most advanced economies witnessed a increasing demand of social securities services due to fast-ageing population.

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