Wagner's law and Italian disaggregated public spending: some empirical evidences

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WAGNER'S LAW AND ITALIAN DISAGGREGATED PUBLIC SPENDING: SOME EMPIRICAL EVIDENCES

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ABSTRACT: Wagner's Law is the first model of public spending in the history of public finance. The aim of this article is to assess its empirical evidence in Italy for the period 1960-2008 at a disaggregated level, using a time-series approach. After a brief introduction, a survey of the economic literature on this issue is shown, before estimating the specifications of Wagner's Law for some specific items of public spending (for interests, for final consumption, for labour dependent income, for grants on production, and for public investments). We found a cointegration relationship for three out of five items. Moreover, Granger causality tests results show evidence in favour of Wagner's law only for spending for passive interests in the long-run, and for spending for dependent labour income in the short-run. Some notes on the policy implications of our empirical results conclude the paper.

KEYWORDS: public spending; economic growth; Wagner's Law; time-series; unit root; cointegration; causality; fiscal policy.

JEL Codes: C32; E60; H50; H60; N44.

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1. – Introduction

Wagner's Law is one of the first as well as the most important models for the determination of public expenditure. In this paper we propose an analysis at disaggregated level, studying the relationship between some individual items of expenditure to GDP. We will refer to the Italian case, since the early sixties until 2008. The data used were drawn from the data set BIP by Bank of Italy.

A point of debate among economists is whether the public sector should intervene or not in the short-term fluctuations in economic activity. If classical economists have always opposed such a kind of public action, the Keynesian school of thought invoked fiscal policies to support the economy during recessions. In fact, the classical economists believed that market forces were able to quickly bring economies to a long-run equilibrium, through adjustments in the labor market. Instead, the Keynesians took the fallibility of such self-regulatory mechanisms, precisely because of rigidities in the labor market. To this end, the school has prescribed Keynesian expansionary fiscal policies in order to avoid long slumps.

Wagner's Law (Wagner, 1883; 1912) suggests that during the process of economic development tends to expand public expenditure in national income. The reasons are varied: a) public functions to substitute for private activities, b) the development results in an expansion of expenditure on culture and welfare, public intervention might be necessary to manage natural monopolies. Therefore, the expansion of public spending can be seen as a product of economic development, and not vice versa (Bird (1971)).

Therefore, the Keynesian approach and the Wagnerian one represent two alternative positions to look at the causality between government expenditure and aggregate income. For the first of the two approaches, the direction of causality running from expenditure to income, while the second proceeds according to the opposite direction.

The paper is divided into six sections. Section 2 provides a survey of economic literature on this issue. Section 3 provides an overview of the applied empirical methodology and a brief discussion of the data used. Section 4 discusses the empirical results. Section 5 presents our concluding remarks and, finally, Section 6 makes suggestions for future researches.

2. – Wagner's model and the economic literature

As the Nitti (1972), Musgrave (1969), and Rostow (1971) models, also Wagner's model too may be included among the "society models".

We owe to Adolf H. Wagner – a German economist of the second half of the 19th century (a "socialist of the chair") – the first theory on the increase of public expenditure (Wagner, 1883, 1912; Chrystal and Alt, 1979; Jackson, 1979). This theory proposed by Wagner is a "society theory" that therefore makes the growth of public expenditure dependent upon the structural evolution of society. He examined the existence of a desirable limit to the size of the public sector, determining that a limit was in fact not possible. In his opinion, the development of spending is determined, essentially, by the increase of national income. An increase of this variable generates a more than proportional expansion of the public sector. It follows that what Wagner defined as "the law of increasing expansion of the public sector" (Wagner, 1912), arguing, in his final analysis, that the value of financial pressure would increase.

At the core of Wagner's thesis is, predominantly, the interaction existing between the growth of the public sector and that of private activities. With the increase of economic development, exchanges intensify among operators and the network of relationships becomes more and more complicated and controversial. All this can be addressed through legislation and arrangement of new and heftier controls. Moreover, since the processes of industrialization and urbanization create external diseconomies – such as the congestion effect or the deterioration of the environment –, the public sector has been called to find a remedy to these challenges (Wagner, 1883).

From a methodological point of view, the empirical evidence concerning the relationship between public income and expenditure is based on the assessment of the elasticity of expenditure to income. Only if such elasticity is superior to the unit and the coefficient sign is positive, could we then come to the conclusion that the link between the two variables exists and it is consistent with Wagner's hypothesis (Fossati, 1981, 1999; Diba, 1982; Jackson, 1980; Hadjimatheou, 1976).

The model proposed by Wagner has had a great influence in literature (Wagner, 1883, 1912). Although it has been long the fulcrum of the theoretical elaborations on determinants on public expenditure, with the passing of time it has also been subjected to an empirical assessment by different thinkers. The results obtained are contradictory, since with the changing of countries and the temporal intervals considered, the data-set used and of the methods applied, they lead us to conclude sometimes in favour of the existence of Wagner's Law, and sometimes against it.

Musgrave (1969) reaffirmed how the most plausible formulation of Wagner's model is in terms of a positive correlation between the share of public expenditure on domestic product and per capita income; in addition, he found that the cross-section evidence for high-income countries does not confirm Wagner's hypothesis. However, the analysis of historical series shows favourable evidence in at least 60% of case.

Musgrave (1969), Hinrichs (1965) and Gandhi (1971), working separately, reached the conclusion that cross-section analyses that include both developed and under-developed countries as well as more backward

countries support Wagner's hypothesis, while samples formed only by from less developed countries do not support this.

Benoit (1978) used the rank correlation coefficient by Spearman[1] and regression analysis to show that military expenditure has a positive impact on economic growth, in a sample of 44 less developed countries between 1950 and 1965. According Benoit (1978) in less developed countries only a small fraction of the cuts in military spending is directed towards productive investment. Therefore, the reduction of this type of expenditure would not necessarily increase economic growth. Indeed, he argued that in these countries, military spending increases economic growth through different channels, such as, for example, increasing the degree of human capital and research and development.

Kelley (1976) suggested how Wagner's Law must be modified in order to incorporate the relevant effects of demographic changes. This would result from the complex interaction of economic and demographic changes that do not necessarily require an increase of the public sphere and of state activity.

Lim (1983), and Faini, Annez and Taylor (1984), however, found empirical evidence contrary to that of Benoit (1978): in fact, defense spending would directly and adversely affects economic growth, as well as indirectly through its negative impact on the accumulation of savings.

Rotschild (1977), and Deger and Sen (1983) reached conclusions similar to those of Lim and Fiani *et al.*, highlighting the negative impact that military spending has on exports. While Deger and Smith (1985) arrived at similar conclusions by studying the negative impact of military expenditure on investment.

Singh and Sahni (1984), studying the causality link between public expenditure and national income for India during the period 1950-1981, found that the effect of the growth of public expenditure on that of national income is relatively low if compared to its effect on the growth of expenditure income. The conclusions they reach are that public expenditure and national income are linked by a causal mechanism of feedback; but that the empirical evidence suggests that such a causality relationship is neither of a Wagnerian nor a Keynesian type.

Biswas and Ram (1986) found no statistically significant relationship between the two variables (military spending and economic growth).

The elasticity of public spending concerning aggregate income for Italy has been calculated by Giarda (1988) to be equal to 0,63, whereas Bella and Quintieri (1989) calculated it to be equal to 0,81. According to these scholars, it can be claimed that during the period 1960-1985 the income growth determined around 40% of expenditure increase in real terms (that is the 2,95% per year on 7,4%). In any case, both the estimates agree in considering that public spending does not involve superior goods.

[1] See: GOSSET W.S. (1921), An experimental determination of the probable error of Dr Spearman's correlation coefficients, *Biometrika*.

Ram (1986a, 1986b, 1987) tests the relationship, still in terms of elasticity, between the share of public general expenditure, *ln(G/Y)*, and the per capita GDP, *ln(PCY)*, by breaking the analysis down into two parts (time-series and cross-section). The analyses on the historical series (carried out in 115 countries, in relation to the period 1950-1980) show, on the one hand, the great difference of the estimates for the different countries.

Henrekson (1993) noted how the crux of Wagner's Law originates from regressions to levels, invoking the causality test of Granger and Newbold (1974) in support of theses of erroneous inferences when variables are not steady. Indeed, he shown how income and the share of public expenditure on national product, – even if correlated – are not cointegrated, demonstrating this through the Swedish case in an empirical verification on data in historical series from 1861 to 1990. In this way, they reached the conclusion that correlations reported by other researchers are of spurious nature.

Easterly and Rebelo (1993) find strong evidence in favour of Wagner's Law in the cross-section analysis relating to 115 countries (in the period 1970-1988) as well as in the historical one concerning 26 countries (from 1870 to 1988). The correlation between per capita income and dimensions of public spending is often found, in both kinds of econometric analyses.

On the contrary Oxley (1994), analyzing data on Great Britain from 1870 to 1913, found evidence in favour of Wagner's Law, which resists and satisfies the causality test of Granger.

Koop and Poirier (1995) examine Wagner's hypothesis in terms of a long-term elasticity of the per capita government expenditure, with regard to per capita income, using a bivariate error-correction mechanism, corresponding to a co-integrated mechanism. Of 86 countries considered, only in one-third of them is Wagner's hypothesis supported by data. The two scholars conclude that their calculations are in clear contrast with "Wagner's Law".

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.

Ferris and West (1996) discovered that empirical evidence is unfavourable to Wagner's Law, using data referring to the post second world-war period.

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 the three African countries only Ghana showed 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.

Stein, Talvi and Grisanti (1998), by comparing the countries of Latin America to those of OECD, showed that the role of the public operator is more extensive in the richest countries. In other words, those countries with a greater aggregate income tend to have wider public apparatus.

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 and 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.

Kolluri, Panik and Wahab (2000) analyzed G-7 countries for the period 1960-1993. The results of the empirical estimates show the effects of national income on public spending in both the short and long-run (the series of expenditure and income are both stationary at first differences and cointegrated).

Dakurah, Davies and Sampath (2001), using the concept of cointegration and error correction model to study the relationship between military spending and economic growth in 62 countries, found no causal relationship between the two variables in the sample analyzed.

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.

Abu-Bader and Abu-Qarn (2003) investigated the causal relationship between government spending and economic growth for three Middle Eastern countries (Egypt, Israel and Syria) in the years 1967-1998, using techniques of multivariate cointegration and variance decomposition. They found a bidirectional causality, with a negative long-run relationship between the two variables in the cases of Israel and Syria, and a short-term unidirectional causality (from growth to spending) to Egypt. Instead, testing the causality for a trivariate system consisting of the share of government civilian expenditures in GDP, military spending and economic growth empirical findings show how military expenditure negatively affect economic growth in all three countries, while the civilian government spending has a positive impact on economic growth in two of them (Israel and Egypt), but it has a negative impact on long-term growth in Syria. Finally, military spending is exogenous relative to both civil and spending to economic growth. The policy prescription which they are received,

therefore, is that these three countries should reduce military spending.

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.

Dogan and Tang (2006) studied the direction of causality between aggregate income and spending for the Philippines, Indonesia, Malaysia, Singapore and Thailand in the period 1965-2005. Using the Johansen and Juselius's cointegration method in order to analyze the relationship between real GDP per capita and real public spending per capita, the empirical evidence suggests the existence of a long-run relationship between variables only for Indonesia. Instead, only for the Philippines they found causality running from expenditure to income. While, for the other four countries public expenditure does not play a significant role in promoting economic growth.

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.

While Shelton (2007), using a cross-country panel regressed various measures of public expenditure on a vector of explanatory variables through the "random effects method". He underlined how the richest countries tend to have populations with a higher average age which would push them to spend more in the area of social security and of other forms of protection and public assistance. Besides calculating the fraction of the population above 65 years old, it should be emphasized that countries with a greater national income would tend to have less plethoric and larger state machines – which constitutes the complete opposite to what Wagner's Law suggests. In short, it would be the health and social

expenditure that would "lead" the relationship between public expenditure and per capita income, that otherwise would not increase jointly. Another determinant of "Wagner's Law" would be the "taxation technology", that is, the expansion of the public operator would be made easier by the state skilfulness in increasing the tax revenue, which in turn depends on the tax system and its simplicity and efficiency.

Lamartina and Zaghini (2008) considered the joint development of public expenditure and aggregate income in 23 OECD countries, using panel cointegration. The empirical evidence provides findings of a structural positive correlation between public spending and per capita income, consistent with the Wagner's Law. The correlation is usually higher in countries with lower per capita income, suggesting that the period of catching-up is characterized by a stronger development of public activities than more mature economies.

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, 2010) studies the linkages between public expenditure at a disaggregate 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.

Tab. 1 – A comparison of studies about causality and cointegration analysis between public expenditure and GDP.

Authors	Countries	Study period	Causality	Cointegration relationship
Abdullah, Maamor (2010)	Malaysia	1970-2007	-	Yes
Afzal, Abbas (2010)	Pakistan	1960-2007	No, in any direction	No
Akitoby* et al. *(2006)	51 developing countries	1970–2002	-	Yes, for 21 countries
Albatel (2002)	Saudi Arabia	1964-1998	Y → G	Yes
Ansari* et al. *(1997)	Ghana, Kenya and South Africa	1957-1990	Y → G[b]	No
Asseery* et al. *(1999)	Iraq	1950-1980	Y → G	Yes
Babatunde (2008)	Nigeria	1970-2006	G → Y	No
Bağdigen, Cetintas (2003)	Turkey	1965-2000	No, in any direction	No
Burney (2002)	Kuwait	1969-1995	-	Yes
Chletsos, Kollias (1997)	Greece	1958-1993	Y → G	Yes
Chow* et al. *(2002)	UK	1948-1997	Y ⇆ G	Yes
Cotsomitis* et al. *(1996)	China	1952-1992	-	Yes
Demirbas (1999)	Turkey	1950-1990	No, in any direction	Yes
Dogan, Tang (2006)	5 South-East Asian countries	1960-2002	G → Y[c]	Only for Indonesia
Dritsakis, Adamopoulos (2003)	Greece	1960-2001	Y ⇆ G	Yes
Ghorbani, Zarea (2009)	Iran	1960-2000	Y ⇆ G	No
Halicioğlu (2003)	Turkey	1960-2000	Y ⇆ G	Yes
Henrekson (1993)	Sweden	1861-1990	-	No
Huang (2006)	China and Taiwan	1979-2002	No, in any direction	No
Karagianni* et al. *(2002)	EU-15	1949-1998	No, in any direction only for Greece	Yes, for 13 countries
Kumar* et al. *(2009)	New Zealand	1960-2007	Y → G	No
Magazzino (2010)	EU-27	1970-2009	No, in any direction only for 5 out of 11 countries[d]	Yes, for 7 out of 11 countries
Narayan* et al. *(2008)	Chinese provinces	1952-1989	Y ⇆ G[e]	Yes
Rehman* et al. *(2007)	Pakistan	1972-2004	-	Yes

Samudram* et al. *(2008)	Malaysia	1970-2004	$Y \rightarrow G$	Yes
Sideris (2007)	Greece	1832-1938	$Y \rightarrow G$	Yes
Sinha (2007)	Thailand	1950-2003	No, in any direction	Yes
Tan (2003)	Malaysia	1991Q1-2002Q3	$Y \rightarrow G$	Yes
Thornton (1999)	6 EU advanced countries	1850-1913	$Y \rightarrow G$	Yes, for 4 countries
Verma, Arora (2010)	India	1950-2008	-	Yes
Ziramba (2008)	Sud Africa	1960-2006	$Y \leftrightarrows G$	Yes

Notes: *a*: 1963-1988 for Ghana, 1964-1989 for Kenya, 1957-1990 for Saudi Arabia; *b*: for Ghana; *c*: for the Philippines; *d*: for Austria, Denmark, Ireland, the Netherlands and UK; *e*: for the full panel.

Sources: our elaborations.

Table 1 above presents a concise overview on cointegration and causality between public expenditure and national income discussed in several studies on Wagner's Law.

3. – Data and methodology

Most of time series have unit root as many studies indicated, including Nelson and Plosser (1982), and as proved by Stock and Watson (1988) and Campbell and Perron (1991) among others, that most of the time series are non-stationary. The presence of a unit root in any time series means that the mean and variance are not independent of time. Conventional regression techniques based on non-stationary time series produce spurious regression and statistics may simply indicate only correlated trends rather than a true relationship (Granger and Newbold, 1974). Spurious regression can be detected in regression model by low Durbin-Watson statistics and relatively moderate R^2.

One of the most widely used unit root test is the ADF unit root test (Dickey and Fuller, 1979, 1981). Alternatively, Phillips (1987) and Phillips and Perron (1988) proposed a nonparametric method to correct a wide variety of serial correlation and heteroskedasticity (PP). Perron (1989, 1990) demonstrates that if a time series exhibits stationary fluctuations around a trend or a level containing a structural break, then unit root tests will erroneously conclude that there is a unit root. PP and ADF tests have the same asymptotic distributions.

Elliott, Rothenberg, and Stock (DF-GLS, 1996) proposed a modified Dickey-Fuller t test (known as the DF-GLS test). Essentially, the test is an augmented Dickey-Fuller test, except that the time series is transformed via a generalized least squares (GLS) regression before performing the test. The augmented Dickey–Fuller test involves fitting a regression of the form

$$\Delta y_t = \alpha + \beta y_{t-1} + \delta t + \xi_1 \Delta y_{t-1} + + \xi_2 \Delta y_{t-2} + \ldots + + \xi_k \Delta y_{t-k} + \varepsilon_t \quad [1]$$

and then testing the null hypothesis H_0: β=0. The DF-GLS test is performed analogously but on GLS-detrended data. The null hypothesis of the test is that y_t is a random walk, possibly with drift.

Finally, the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992)test differs from those unit root tests in common use (such as ADF, PP, and DF-GLS) by having a null hypothesis of stationarity. The test may be conducted under the null of either trend stationarity (the default) or level stationarity. Inference from this test is complementary to that derived from those based on the Dickey-Fuller distribution.

The unit root test and the order of the integration would be performed on both the original series and the differences of the series using the PP test.

The non-stationary series with the same order of integration may be cointegrated if there exist some linear combination of the series that can be tested for stationarity. The Johansen and Juselius procedure (Johansen, 1988; Johansen and Juselius, 1990) is preferable to test for cointegration for more than two series.

Moreover, Johansen and Juselius procedure is considered better than Engle-Granger even in two time series case and has better small sample properties since it allows feedback effects among the variables under investigation where it is assumed in the Engle and Granger procedure that there are no feedback effects between the variables. The procedure is based on likelihood ratio (LR) test to determine the number of cointegration vectors in the regression. Johansen technique enables to test for the existence of non-unique Cointegration relationships.

Three tests statistics are suggested to determine the number of cointegration vectors: the first is Johansen's "trace" statistic method, the second is his "maximum eigenvalue" statistic method, and the third method chooses *r* to minimize an information criterion.

Having established the long-run equilibrium relationship between government expenditure and revenues, the short-run adjustments are estimated using the error correction model (ECM). The error correction model is based on the two following equations:

$\Delta X_t = \alpha_0 + \alpha_1 e_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta X_{t-i} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-i} + \varepsilon_t$	*[2]*
$\Delta Y_t = \beta_0 + \beta_1 u_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_i \Delta X_{t-i} + \eta_t$	*[3]*

where e_{t-1} and u_{t-1} represent the error-correction terms which are the lagged residuals from the cointegration relations. The error correction terms will capture the speed of the short-run adjustments toward the long-run equilibrium. Furthermore, the error correction model equations (2) and (3) allow to test for short-run as well the long-run causality between government expenditure and aggregate income.

The short-run causality is based on a standard F-test statistics to test jointly the significance of the coefficients of the explanatory variable in their first differences. The long-run causality is based on a standard t-test. Negative and statistically significant values of the coefficients of the error correction terms indicate the existence of long-run causality.

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 Italy. In our case, we considered variables such as the various chapters of public expenditure to GDP. Moreover, to eliminate the effect of prices on the number of variables, they were deflated by appropriate deflators.

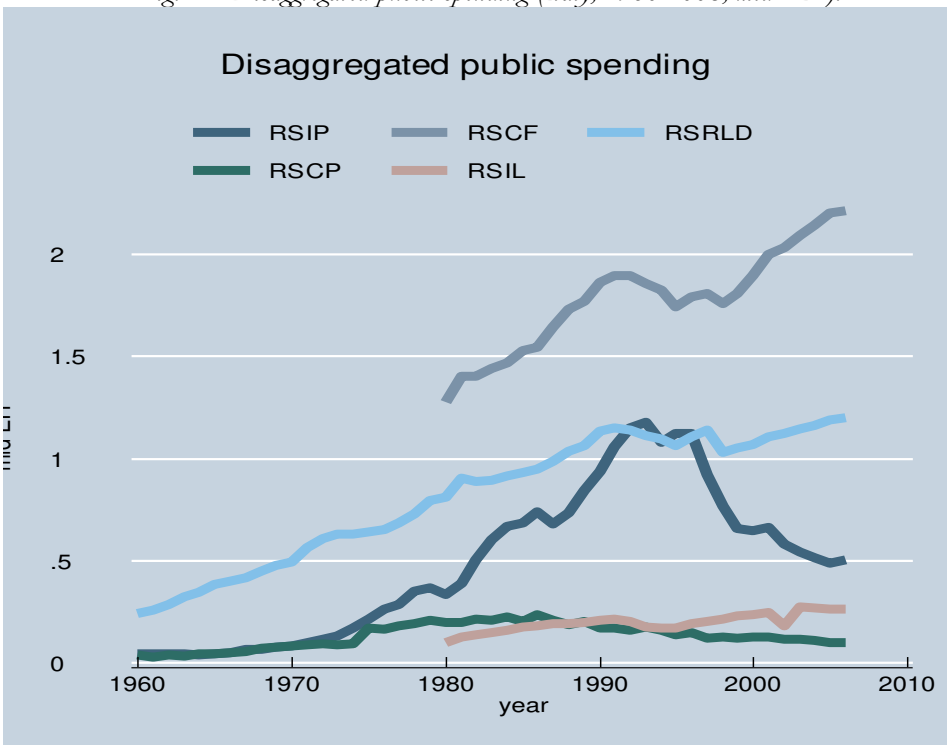
The data used in this work were taken from the Informative Public Base

(BIP), a database developed by the Bank of Italy, freely available on the web[2].

4. – Econometric results

We present and discuss an analysis of the Wagner's Law, applied to the Italian case. We disaggregate the different items of expenditure, according to their functional nature, in order to reveal any empirical evidence in favor of a model *à la* Wagner, but where the dependent variable instead of being constituted by the total public expenditure is, from time in time, the single item of expenditure (for passive interests, final consumption, for dependent labour income, for grants to production and for gross capital formation), while the explanatory variable is represented by the Gross Domestic Product. Figure 1 shows the evolution of the various items of public spending (in real terms) from 1960 to 2008.

Fig. 1 – Disaggregated public spending (Italy, 1960-2008, mld EIT).



Source: our elaborations on BIP data.

In Table 2 variables of the model are summed up. All series contains yearly data for real value of the variables.

[2] See: http://bip.bancaditalia.it/4972unix/homebipita.htm.

Tab. 2 – List of variables.

Variable	Explanation
RGDP	Gross Domestic Product at constant factor cost, mld EIT
RSIP	Real spending for passive interests, mld EIT
RSCF	Real spending for final consumptions, mld EIT
RSRLD	Real spending for labour dependent income, mld EIT
RSCP	Real spending for grants on production, mld EIT
RSIL	Real spending for public investments, mld EIT

Source: BIP (2009).

As a preliminary analysis, some descriptive statistics are shown in the following Table 3.

Tab. 3 – Exploratory data analysis (Italy, mld EIT, 1970-2008).

Variable	Mean	Median	Standard Deviation	Skewness	Kurtosis	Range
RGDP	7.6839	8.0588	2.5876	-0.3865	1.8534	8.3663
RSIP	0.4832	0.5015	0.3661	0.3529	1.9511	1.1401
RSCF	1.7794	1.8062	0.2523	-0.1535	2.3099	0.9336
RSRLD	0.8176	0.9046	0.3061	-0.4584	1.7894	0.9586
RSCP	0.1312	0.1262	0.0603	-0.1076	1.8184	0.2072
RSIL	0.1964	0.1926	0.0445	-0.0915	2.6270	0.1751

Source: our calculations on BIP (2009) data.

Correlation coefficients summarized in Table 4 indicate, especially, a strong positive correlation between real GDP and interest expenditure, as for expenditure for final consumption and real GDP, and expenditure for labour dependent income and real GDP, too. These findings indicate that higher values of real GDP are associated with higher values of various items of public expenditure.

Tab. 4 – Correlation matrix (Italy).

	RGDP	***RSIP***	***RSCF***	***RSRLD***	***RSCP***	***RSIL***
RGDP	1					
RSIP	0.9500	1				
RSCF	0.9605	0.2444	1			
RSRLD	0.9923	0.9574	0.9619	1		
RSCP	0.7773	0.8420	-0.8244	0.8110	1	
RSIL	0.8684	0.2080	0.8980	0.8402	-0.7212	1

Notes: Bonferroni adjustment applied.
Source: our calculations on BIP data.

Above all, we obtained log-transformations of the time-series. As a preliminary analysis, Inter-Quartile Range show the absence of outliers in our samples. Then, we applied time-series techniques on stationarity and unit root processes, in order to check some stationarity properties. Table 5 contains results of common unit root tests, for our variables.

Tab. 5 – Results for stationarity tests (Italy).

Variable	***Stationarity tests***				
	Deterministic component	**ADF**	**ERS**	**PP**	**KPSS**
RGDP	intercept, trend	NS: -1.882	NS: -0.306	NS: -2.157	NS: 0.620
ΔRGDP	intercept	DS: -5.679	DS: -4.972	DS: -5.679	DS: 0.108
RSIP	intercept	NS: -1.947	NS: -0.637	NS: -2.105	NS: 2.040
ΔRSIP	intercept	DS: -3.148	DS: -3.319	DS: -3.129	NS: 0.916
RSCF	intercept	NS: -1.831	NS: -0.063	NS: -1.757	NS: 1.220
ΔRSCF	intercept	DS: -4.454	NS: -1.594	DS: -4.452	DS: 0.200
RSRLD	intercept	LS: -5.574	NS: 0.411	LS: -5.638	NS: 1.490
ΔRSRLD	intercept	DS: -6.188	DS: -4.358	DS: -6.189	DS: 0.078
RSCP	intercept, trend	NS: -0.933	NS: -0.755	NS: -0.513	NS: 0.592
ΔRSCP	intercept	DS: -10.675	NS: -2.184	DS: -10.899	DS: 0.085
RSIL	intercept, trend	TS: -3.719	NS: -1.692	TS: -3.732	NS: 0.146
ΔRSIL	trend	DS: -6.434	DS: -2.436	DS: -6.531	DS: 0.222

Notes: NS: Non Stationary; TS: Trend Stationary; DS: Difference Stationary.
Source: our calculations on BIP (2009) data.

The second column presents results for Augmented Dickey and Fuller (1979) test; the third one for Elliott, Rothenberg and Stock (1992) test; the fourth column contains results for Phillips and Perron (1988) test; at last, in the fifth column there are results for Kwiatkowski, Phillips, Schmidt and Shin (1992) test. Here, results indicate that all series are clearly a I(1) process. Yet, public spending dependent labour income could be level-stationary, while spending for public investments could be trend-stationary.

The lag-order selection has been chosen according to the final prediction error (FPE), Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC). These statistics selected a model with two lags for *RSCF*, *RSRLD* and *RSCP*, while only one lag for *RSIP* and *RSIL*.

Cointegration tests have been subsequently applied, in order to be able to find the long-run relationship between each item of public spending and GDP. As is shown in Table 6, Johansen and Juselius cointegration method suggests that there is one cointegrating relationship in three cases (*RSIP*, *RSCP* and *RSIL*). In fact, the trace statistic and the maximum-eigenvalue statistic reject $r=0$ in favour of $r=1$ at the 5% critical value. As in the lag-length selection problem, choosing the number of cointegrating equations that minimizes either the SBIC or the HQIC provides a consistent estimator of the number of cointegrating equations. Yet, all these criteria suggest a rank=1 for our data. While, for *RSCF* and *RSRLD* we find the absence of cointegration (rank=0).

Tab. 6 – Results for cointegration tests (Italy).

Johansen and Juselius procedure				
Variable	**Trace statistic**	**Maximum-eigenvalue statistic**	**SBIC HQIC AIC**	**Rank**
RSIP	2.1172	2.1172	-6.7081	r=1
	(3.76)	(3.76)	-6.9347	
			-7.0694	
RSCF	8.3423	7.0705	-9.8690	r=0
	(15.41)	(14.07)	-9.9379	
			-9.9658	
RSRLD	50.6836	45.5309	-8.9983	r=0
	(15.41)	(14.07)	-9.1227	
			-9.1971	
RSCP	0.1349	0.1349	-6.2255	r=1
	(3.76)	(3.76)	-6.4522	
			-6.5869	
RSIL	3.1253	3.1253	-7.1740	r=1
	(3.76)	(3.76)	-7.3463	
			-7.4160	

Notes: 5% Critical Values in parenthesis.
Source: our calculations on BIP (2009) data.

Granger causality tests suggest a bi-directional flow, at 1% level, for public spending on interests and GDP, in the long-run; a unidirectional flow, in the direction from GDP to spending on dependent labour income (at 5% level), in the short-run; a unidirectional flow, but in the opposite direction to the previous case, for the spending for grants on production (at 1% level), both in the short-run and in the long-run; spending for investments Granger-cause GDP in the long-run (at 1% level), too. While, for the spending for final consumptions, no form of Granger causality has been found (see Table 7).

Tab. 7 – Results for short and long-run causality tests (Italy).

Dependent variable	**Lags**	**Log-likelihood**	**FPE**	**Causality in the long-run**	**Causality in the short-run**
RSIP	1	167.2909	0.0000	RGDP → RSIP RSIP → RGDP	-
RSCF	2	134.3066	0.0000	-	-
RSRLD	2	209.5180	0.0000	-	RGDP → RSRLD
RSCP	2	156.7134	0.0000	RSCP → RGDP	RSCP → RGDP
RSIL	1	93.2312	0.0000	RSIL → RGDP	-

Source: our calculations on BIP (2009) data.

For all our equations, a Lagrange-multiplier (LM) test for autocorrelation in the residuals of Vector Error-Correction Model (VECM) clarifies as at the 5% significance level we cannot reject the null hypothesis that there is no serial correlation in the residuals for the orders 1,…,5 tested. Checking the eigenvalue stability condition in a VECM, the eigenvalues of the companion matrix lie inside the unit circle, and the real roots are far from 1. As regard the Wald lag-exclusion statistics, we strongly reject the hypothesis

that the coefficients either on the first lag or on the second lag of the endogenous variables are zero in all two equations jointly. The Jarque and Bera normality test results present statistics for each equation and for all equations jointly against the null hypothesis of normality. For our models, results suggest normality. Finally, the analysis of ARCH effects shows the absence of this problem for the estimated models.

5. Conclusions and policy implications

The purpose of this paper is to contribute to the literature on Wagner's Law on Italy at a disaggregated level, using recent econometric techniques. Wagner's Law is empirically tested employing time-series data. So, we study the relationship between real GDP and five different items of real government spending for Italy, using annual data for 1970-2008. The time-series properties of the data were assessed using several unit root tests (ADF, DF-GLS, PP, and KPSS). Empirical results indicate that all series are clearly a I(1) process. Yet, public spending dependent labour income could be level-stationary, while spending for public investments could be trend-stationary. Cointegration analyses reveals that three out of five spending series (for passive interests, for grants on production, and for public investments) share a common trend – and a long-run relationship – with real aggregate income. Granger causality tests results show evidence in favour of Wagner's Law (Y→G) only for spending for passive interests in the long-run, and for spending for dependent labour income in the short-run. While, the causality flow is in line with Keynesian hypothesis (G→Y) for spending for passive interests, for grants on production and for public investments in the long-run, and for grants on production in the short-run. On the basis of empirical results in this paper, one may tentatively conclude that Wagner's Law finds a very weak support in Italy. Our Granger causality tests results show that the relationship between several items of government spending and national income is more Keynesian than Wagnerian.

Yet, we find no clear evidence of government spending causing national income. In other words, the Keynesian proposition of government spending as a policy instrument to encourage and lead growth in the economy is not completely supported by the data for Italy. Certainly, this result is subject to the time period examined and statistical methods used; nevertheless, it is particularly discouraging for those who see Government as a major actor to encourage economic growth, especially in countries with a critical framework on public finance, like Italy.

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