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Wagner in Ireland: An Econometric Analysis

STEPHEN MOORE
University College Cork

Abstract: This paper presents an econometric analysis of Wagner's Law in Ireland for the period 1970-2012. To estimate the long run relationship between government expenditure and gross national product per capita the bounds testing procedure of Pesaran and Shin (2001) is employed. The analysis is performed using both real and nominal variables. The paper finds that although government expenditure has been rising over the period in question the rate of growth has not outpaced growth in GDP per capita, thus weighing against Wagner's Law. Results are robust across a selection of the most prominent model specifications in the literature, and to the volatility in government spending during the recent crisis. Some policy considerations are also explored.

I INTRODUCTION

Prior to the turn of the 19th century, Adolphe Wagner (1835-1917) codified his thoughts on recently observed increases in government expenditure,[1] into what is best described as a loose empirical proposition but which, with the passage of time, has taken on the mantle of a stylised fact. This "Law of Increasing State Activity" proposes that, as a country experiences social progress due to industrialisation, the state is required to take a proportionally greater part in society's economic life.

Although a major plank of German Financial theory[2] for many years, it was not until the translation of his works into English (Musgrave and Peacock, 1958) that his ideas made an impact in the Anglo-economic oeuvre. At that time,

[1] Increases in state expenditure in Prussia, Bavaria, Switzerland, Britain and Northern America.
[2] Finanzwissenschaft.

Email: stephen.moore@ucc.ie

public expenditure theory was stymied by inertia. Concerning the determinants of government expenditure, scholars opined that "… [d]escription, and the statement of rather obvious generalities, may about exhaust the possibilities" (Harriss, 1952, p. 261), and that "… [g]overnment is the most troublesome of the three [forms of expenditure] because we have no theory of government expenditure" (Domar, 1957, p. 20). Wagner's ideas provided a catalyst to break the academic turpitude of the time.

The next twenty or more years saw a flurry of activity in the area of public expenditure – a redaction of Wagnerian theory from various sources, and a variety of efforts at specifying and testing the theory. Most of these earlier studies used cross-sectional data, either with descriptive statistics or using Ordinary Least Squares (OLS) to regress some measure of government expenditure on some measure of progress, usually GDP per capita. Post Engle and Granger (1987), and the cointegration revolution, research tended toward using time series data with cointegration procedures (Henrekson, 1993). Indeed, cointegration seems tailor-made to discover a putative long-run equilibrium relationship between what would appear to be two cointegrating vectors. Despite being conceptually straightforward however, the "Law" has thus far resisted either proof or refutation despite some heavy econometric analysis (Dollery and Singh, 1998).

Evidence for the Irish case has been limited to a small number of panel investigations (Lamartina and Zaghini, 2011; Magazzino, 2012), and a trivariate three-country comparison (Loizides and Vamvoukas, 2005); none in notable Irish journals. The strongest pro-Wagnerian evidence comes from Lamartina and Zaghini (2011), who find that Ireland has the highest long run elasticity (1.54), of government expenditure with respect to GDP per capita, of 23 OECD countries studied. In light of such a notable result, this paper will replicate the particular formulation of the "Law" chosen by Lamartina and Zaghini, and also their use of both real and nominal variables, but will concentrate exclusively on Irish data.

Since the advent of the Great Recession, there has been an implicit acceptance that there needs to be a greater emphasis on the relationship between government expenditure and economic growth. It is now clear that the fiscal rules in the Maastricht Treaty, and the Stability and Growth Pact, allowed member states too much room for manoeuvre. Those agreements involved public debt and deficit rules. The numerical measure used in the deficit rule is the General Government Balance as a percentage of Gross Domestic Product. The measure suffers from being both a balance measure and being a ratio. This can be illustrated by the case of Ireland during the 21st century when large GDP growth rates increased the denominator of the ratio, and the resulting increase in taxes facilitated large expenditure increases because the nominator was expressed as a balancing item. In real terms, public expenditure increased by 46 per cent between 2000 and 2007.

The International Monetary Fund now explicitly recognises that expenditure control is crucial to fiscal discipline. The IMF (2013) documents the success of expenditure control rules in a global context. The expenditure rules are part of the IMF's *Medium Term Expenditure Framework* (*MTEF*). According to the IMF, the *MTEF* means "Spending should also become less volatile. Since the path of spending should reflect the medium-term rather than the short-term availability of resources, total expenditures should be less volatile, with an MTFF having the main influence in this connection." (IMF, 2013, p. 36)

A medium term expenditure framework was included in the *National Recovery Plan 2011-14* (Department of Finance, 2011). Three of the five key features of the *MTEF* explicitly involve expenditure control. It is arguable that if the *MTEF* was in place since 2000 then Ireland would not have needed assistance from the Troika. The current study of Wagner's Law demonstrates that while the long-term relationship between government expenditure and GDP for Ireland was not unsustainable, it is possible that the public finances can appear unsustainable in the medium term. The results lend support for medium term rules to guide Irish budgetary policy. The new "expenditure benchmark" "… provides that… government expenditure (including the local authority and other subsectors) does not grow faster in real terms than the potential growth rate of the economy" – in effect, legislating explicitly for Wagner's Law (Department of Finance, 2014).

The rest of the paper is organised as follows: Section II briefly reviews a selection of the relevant literature while Section III presents and summarises the data under consideration. Section IV discusses the methodology while in Section V results are presented. The paper concludes with Section VI.

II LITERATURE REVIEW

Wagner himself was inexplicit in the terms of his own "Law" and as such the academic interpretation has ramified into a number of different "flavours". In light of this it is worth quoting the author at some length, before attempting to parse out what the "Law" meant in its original formulation.

> The law of increasing expansion of public, and particularly state, activities becomes for the fiscal economy the law of the increasing expansion of fiscal requirements. Both the state's requirements grow and, often even more so, those of local authorities, when administration

> is decentralised and local government well organised… The law is the result of empirical observation in progressive countries… its explanation, justification and cause is the pressure for social progress and the resulting changes in the relative spheres of public and private economy, especially compulsory public economy. Financial stringency may hamper the expansion of state activities, causing their extent to be conditioned by revenue rather than the other way around, as is more usual. But in the long run the desire for development of a progressive people will always overcome these financial difficulties. (Wagner, 1883, p. 8)

Ultimately for Wagner, industrialisation brings with it, through increased wages and so on, a desire for social progress. Social progress acts upon society in a number of ways which require increased state participation in economic life, and because of this the share of government expenditure increases (Peacock and Wiseman, 1961).

The manner in which social progress requires more of the state is tripartite in nature. First, industrialisation creates a more complex society with a greater number of complex interactions; urbanisation and congestion follow. The architecture of policing and governance must be increased, both to oil the wheels of commerce and to mitigate the negative externalities which weaken social cohesion (Gemmell, 1993).

Second, he proposed that distributional issues would increase with social progress and its concomitant inequity. Thus, "cultural and social welfare" services would increase. Although there has been some argument as to whether or not Wagner envisaged transfers as being included in his estimation of government expenditure (Henrekson, 1993), it is certain that he foresaw health, education and other public goods, wherein it is difficult to capture the private benefits of provision, as being in greater demand as society progressed (Gemmell, 1993).

Third, he thought that entry into some large-scale industries would be so onerous as to be either prohibitive, or as would encourage monopoly power. In these cases the state would become an active producer of goods and services. He evidently felt that these public enterprises would be profitable and make a return to the exchequer. This aspect of Wagner's Law (WL) is probably the most neglected (Gemmell, 1993), and indeed all subsequent confirmations or refutations of the "Law" can at best be considered partial in the absence of the incorporation of such things as public utilities (Musgrave, 1969).

2.1 *Early Testing*

The somewhat inchoate nature of WL is immediately problematic for researchers wishing to test the theory empirically. Indeed, Wagner himself might have been bemused at the econometrical wringer his rather simple "Law" has been spun through over the last half century. The first formulations, wishing to capture both social progress and the size of government, expressed government spending as a function of gross domestic product (Peacock and Wiseman, 1961).

$$G = f(GDP) \tag{1}$$

Subsequent versions retain the bivariate structure and the essence of the variables, differing only in the exact choice of government expenditure or the exact representation of GDP (Gupta, 1968; Bird, 1970; Herber, 1975). The most important determinations of WL are shown below in Table 1. Each version is generally double logged so that the estimated coefficients provide elasticities. Scholars are wont to test the expansion of government relative to society using the elasticity of G with respect to GDP. For versions one and three we would require an elasticity greater than unity as proof; for versions four and six an elasticity of greater than zero would suffice (Michas, 1975).

2.2 *Some Issues with Testing*

If we look at the regressand generally used in versions (4) and (6), G/GDP, it is clear that effects approximating Wagner's proposition can be obtained by increasing the relative price of government services as well as the real output ratio. If, as seems likely, the relative prices of government services increase as society progresses (Baumol, 1967; Beck, 1985), this would overestimate the government share in GDP and provide false evidence for Wagner. Wagner alluded to price impacts (Wagner, 1883, p. 7) but it is not clear whether he considered real or nominal variables as being more appropriate.

What we can say however, is that there has been some damning empirical evidence that WL does not hold once real prices are taken into consideration (Ram, 1987). Whether this actually disproves WL or can be subsumed into the theory is another matter. The inclusion of real variables was considered important by some of the earliest and most important Wagnerian scholars, who held that the law was in effect when "… real per capita output of public goods is increasing at a more rapid rate than is real per capita income" (Herber, 1975, p. 147).

Why then, would the inclusion of real variables alter the weight of evidence for or against Wagner? One possible explanation has its foundation in the so-called Baumol's disease (Baumol, 1967) – the notion that there is constant upward pressure on the wage level of some workers who do not produce a concomitant uplift in terms of output or efficiency.

Baumol's classic example is that of a group of musicians playing a half hour horn quintet. The average wage of these musicians has been steadily increasing over the centuries, but any efforts to increase efficiency by playing the score in, say, twenty minutes, are unlikely to be met with enthusiasm from consumers. The public sector contains many such enterprises wherein gains from efficiency are hard to come by. It is simply more difficult to make steady, secular efficiency gains in education or social welfare than it is in an area like manufacturing.

The left hand side of our regressions, government expenditure, does not contain likely private sector efficiency gains. The right hand side, GDP per capita, contains both the public and private sector. Real output should increase in the regressor at a faster pace than in the regressand. With that in mind we would expect Wagner's Law to face a more strenuous challenge in real variables; hence, we test in both current and constant prices. We test in current prices because expenditure decisions are made in nominal terms, and we test in real variables because the polity's sense of welfare, of social progress, is measured in constant prices.

Table 1: *Popular Versions of Wagner's Law*

Version	*Form*	*Instances*
(1) Peacock-Wiseman	$G = f(GDP)$	(Peacock and Wiseman, 1961) (Musgrave, 1969)
(2) Pryor	$C = f(GDP)$	(Pryor, 1968)
(3) Goffman	$G = f(GDP/N)$	(Goffman, 1968) (Mann, 1980)
(4) Musgrave	$G/GDP = f(GDPR/N)$	(Musgrave, 1969) (Murthy, 1993) (Ram, 1987)
(5) Gupta	$G/N = f(GDP/N)$	(Gupta, 1967) (Michas, 1975)
(6) Peacock-Wiseman (share version)	$G/GDP = f(GDP)$	(Mann, 1980)

G = nominal total Government expenditure
C = government consumption expenditure
N = population
GDP = nominal GDP
GDPR = real GDP

Due to the unavailability of long term data many of the early investigations of WL consisted of cross sectional studies (Gupta, 1968; Musgrave, 1969). Issue has been taken with this from some quarters – "… there is nothing in any conceivable formulation of Wagner's Law which tells us country A must have a higher government expenditure ratio than country B simply because the level of average per capita income is higher in A than B at a particular point in time" (Bird, 1971, p. 10). Indeed most modern research uses time series.

Those that have used both have had mixed results; some show no difference (Gemmell, 1990), others find that results are inconsistent across methods (Ram, 1987). This paper follows the modern usage of time series data.

A further difficulty with testing Wagner is that he did not expect the change in G to be continuous, expecting it instead to be constrained at times by taxation (Wagner, 1883, p. 8). In fact, social change in the historical record is rarely smooth. This presents a difficulty for regression analysis as the short periods under consideration may fail, given the general paucity of time series data, to capture the longer term rise in G and in so doing unfairly dismiss WL. It is also the case that structural breaks in the regression coefficients may render tests of non-stationarity unreliable.

Wagner himself did not actually descry a chain of causation from GDP to G but rather thought that causation could run both ways (Peacock and Scott, 2000). (Indeed, bi-directional causality has been in evidence for the Irish case (Magazzino, 2012) but this was found to be atypical.) This particular aspect of the "Law" has become more ignored as time goes by. Modern papers tend to use various cointegration techniques, followed by some test for causality. The latter is unnecessary as Wagner himself might have been satisfied with a positive correlation, and a relative increase in G/GDP (Peacock and Scott, 2000). In recent years, some researchers have been framing the argument as a Wagner v Keynes[3] proposition and finding in favour of one or the other based on causality tests (Magazzino, 2012; Menyah and Wolde-Rufael, 2013; Pahlavani, *et al.*, 2011; Richter, *et al.*, 2012). This is surely based on a misreading, or non-reading, of the original.

2.3 *Empirical Findings*

To date there have been scores of papers testing WL, but as yet no consensus has emerged. Facchini has counted, in his investigation of Wagner, Keynes and Baumol, 107 papers testing Wagner (and 41 testing the Keynes v Wagner proposition described earlier) (Facchini, 2014). There is extraordinary diversity in the results, which has been attributed to the different methodological techniques used in testing (Bohl, 1996). Prior to 1993 OLS was the preferred method of investigation, but from there onward cointegration, unit root and causality tests were in the ascendancy (Facchini, 2014). However, it does not appear that this is the sole reason for the lack of consensus, nor does it appear to be the level of socio-economic development of a country. Table 2 summarises both possibilities.

[3] "Keynes" is taken to mean that a rise in G causes a rise in GDP while "Wagner" is taken to mean that causality runs in the other direction.

Table 2: *Aggregate Empirical Results from (Facchini, 2014)*

	Developing Countries	*Developed Countries*	*Mixed Sample*
1967-1992	12 countries studied 50% support WL	32 countries studied 46.87% support WL	6 countries studied 33.33% support WL
1993-2012	54 countries studied 46.29% support WL	73 countries studied 52.05% support WL	9 countries studied 44.44% support WL
1967-2012	66 countries studied 46.96% support WL	105 countries studied 50.47% support WL	15 countries studied 40% support WL

Studies focusing on the possible difference between industrialising and developed countries have produced conflicting results. Abizadeh and Gray (1985) tested 55 countries stratified by level of development and found support for wealthier countries but not for poorer. Kuchuch (2012) finds support for developing European countries over time but not for advanced. Peters (1995) tests the US, Barbados, Thailand and Haiti, four economically diverse countries, and finds support for all four using Johansen and Juselius (Johansen, 1988; Johansen and Juselius, 1990, 1992).

Some studies have used cross-sectional data (Abizadeh and Gray, 1985; Michas, 1974), some time series (Islam, 2001; Henrekson, 1993), and some use both (Ram, 1987). Although Ram found that results broke down in cross-sectional studies, Gemmell (Gemmell, 1990) found that they did not. A comparison between these kinds of studies is not scientific however, as *ceteris paribus* conditions generally do not exist.

Perhaps the most significant question in model specification involves the inclusion of real variables. Research involving nominal variables tends to support Wagner. However, Ram (1986); Hondroyiannis and Papapetrou (1995); Wagner and Weber (1977); Gemmell (1990) and Henrekson (1993), all include real variables and all dissent. There are some who find support with constant prices but, in the sample studied, they are fewer (Gupta, 1967). A selection of results can be seen in Tables A1, A2 and A3 in Appendix 1. Of course, the individual authors may not agree with my interpretation of their results.

Lamartina and Zaghini (2011) include Ireland in a 23 country panel (1970-2006) using the Pooled Mean Group procedure (Pesaran and Shin, 1999a). The authors proceed on the basis that Wagner's Law is best tested using co-integration analysis, and that further testing for causality is unnecessary, an opinion shared by this paper. They find that, in their sample, Ireland has the highest long-run elasticity of G to GDP per capita; a figure of 1.54, citing Ireland's position as a relative laggard in economic terms as a probable cause for this.

Maggazino (2012) fails to corroborate the strength of these results. Testing two definitions of the "Law" for the EU-27 (1970-2009) he fails to find a cointegrating relationship for Ireland in a number of cases, although he does find Ireland is unique in his sample in displaying a bi-directional causal relation between G and GDP. Loizides and Vamvouka (2004) muddy the water for the Irish context (1960-1995) in finding only that G Granger causes GDP in both the long and short run; the Keynesian argument so often misguidedly set in opposition to Wagner.

In other work on the cyclicality of Irish fiscal policy (Lane, 1998; Benetrix and Lane, 2012), Philip Lane has drawn attention to the inappropriate relationship between national income and public spending in the shorter-run. In Lane (1998) it is explicitly stated that he does "not address the "levels" characteristics of Irish fiscal policy. In Lane (1998), and Benetrix and Lane (2012), dummy variables are used to deal with possible structural changes in the level of public expenditure to GDP. The focus is on the cyclicality element. It is, therefore, significant that one of the leading researchers of Irish fiscal policy should call for a debate on the optimal long-run level of public spending once the crisis is over.

III DATA

Following Lamartina and Zaghini (2011), this paper uses the third formulation (Equation 3) of Wagner's Law (Goffman, 1968), where G is the broadest available measure of Total Government Expenditure, GDP represents

$$\ln(G) = \alpha + \beta \ln\left({}^{GDP}/_{n}\right) \tag{3}$$

Gross Domestic Product and n represents population. All data series are sourced from the Central Statistics Office of Ireland (CSO). The period covered is 1970-2012 inclusive (Central Statistics Office, 2012; CSO Ireland, 2013a; Ciaran Judge, 2014).

Figures on GDP collected prior to 1995 were subjected to a slightly different accounting treatment relating to Financial Intermediation Services Indirectly Measured (FISIM). There is an overlap of the two procedures at 1995. Therefore, historical figures on GDP from 1970-1995 have been smoothed by the 1995 conversion factor. The difference is slight, for example, the unaltered figure for 1970 is about €29 million lower than the altered amount. Total Government Expenditure is reckoned under the ESA95 definition and is the most replete measure available from the CSO, as are population figures. Real figures are constant at 2005 prices. A UN government consumption expenditure deflator was used to transform the CSO measure of G; likewise a UN GDP deflator was used to transform the CSO GDP series (United Nations, 2013).

From 2008 to 2012 inclusive, the Irish state pumped a considerable amount of liquidity into floundering banks. Figures in Table 3 are compiled from Table 22 of the National Income and Expenditure Accounts 2012 (CSO Ireland, 2013b). It is highly unlikely that Wagner would have envisaged the socialisation of private debt as an element of social progress and so these figures are excised from Total Government Expenditure for those years.

Results are not changed significantly by the inclusion of the unaltered figures.

Table 3: *Recapitalisation of Financial Institutions*

Year	*2009*	*2010*	*2011*	*2012*
Amount €million	4,000	31,575	6,825	280

3.1 *Visual Examination of the Series*

Wagner's Law has been tested in the literature in both a loose sense (WL1), and a strict sense (WL2). In the loose interpretation an absolute increase in government expenditure over time is taken as evidence for the "Law". For the stricter reckoning, it is required that the increase in government expenditure be larger than the increase in social progress. In a field not often unified by consensus it is generally agreed that Wagner must have had the latter form in mind (Gemmell, 1993; Durevall and Henrekson, 2011).

Figure 1 plots both G and GDP per capita (in log form) over time. Both sets of variables are trending upward, albeit with real variables showing much lower levels of growth, giving preliminary support of WL1. Figure 2 gives us our first tentative evidence for WL2 – a scatter plot of G on GDP per capita and a slope exceeding unity. This relationship breaks down in real variables as can be seen in Figure 3 with a slope of approximately .77.

3.2 *Summary Statistics of the Series*

Our visual inspection of the data is borne out by summary statistics. Over the period under consideration (in level form) there has been an enormous increase in both nominal G and GDP per capita of 8,221 per cent and 4,542 per cent respectively. Interestingly, G has grown at a slightly faster annual rate at 11.1 per cent than the 9.6 per cent managed by GDP per capita; further tentative evidence in favour of WL2. As expected all measures are at their lowest at the beginning of the period, and their highest just prior to the

Figure 1: *Log G and Log GDP Per Capita Over Time*

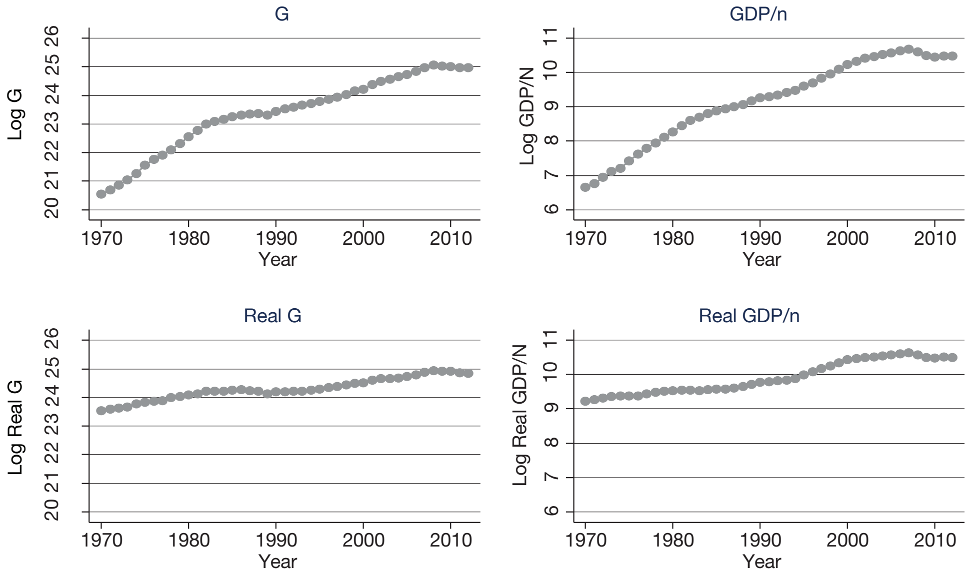


Figure 2: *Scatterplot of Log G on Log GDP Per Capita*

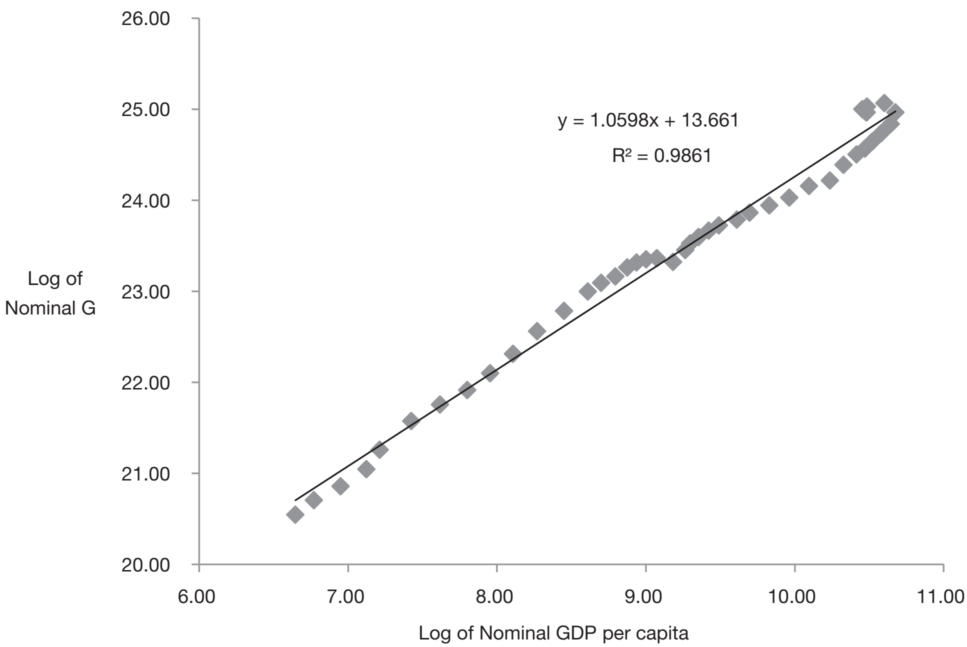
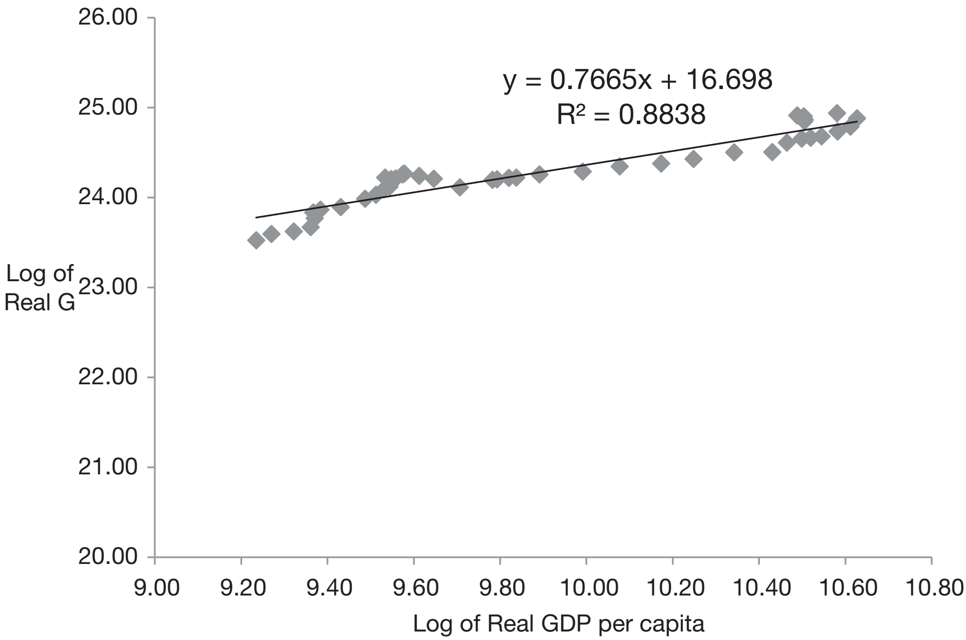


Figure 3: *Scatterplot of Log Real G on Log Real GDP Per Capita*



recession beginning in 2007/2008; a smooth Wagnerian arc tracing the state's trend social progress through time.

Table 4: *Summary Statistics at Current Prices*

	Government	*GDP/n*
Total % change	8221%	4542%
Average annual growth	11.1%	9.6%
Minimum	836m (1970)	770 (1970)
Maximum	77.1bn (2008)	43,342 (2007)

A similar picture emerges from the real data. The real growth in G and GDP per capita has been much lower than the nominal rate at between 277 per cent and 256 per cent respectively. The annual growth rates are almost the same for both real G and real GDP per capita with G growing 0.1 of a percentage point higher. Evidence for WL2 here then, is perhaps somewhat less impressive but still apparent.

Table 5. *Summary Statistics at 2005 Prices*

	Government	*GDP/n*
Total % change	277%	256%
Average annual growth	3.2%	3.1%
Minimum	16.5bn (1970)	10,249 (1970)
Maximum	67.8bn (2008)	41,228 (2007)

IV METHODOLOGY

This paper follows the bounds testing procedure of Pesaran and Shin (1999a, 2001) which has been shown to be superior to the Johansen cointegration procedure in small samples (Narayan and Smyth, 2005). In order to proceed with the analysis we must first determine if any of the time series are I(2) as this would nullify the method (Pesaran *et al.*, 2001). Structural breaks, as suggested by CUSUM, rolling regression and Quandt Likelihood Ratio tests (not reported here), cause conventional unit root tests to be unreliable (Perron, 1989) creating a bias in the test statistic toward non-rejection. Therefore, ADF, Philips-Perron and KPSS tests on the four series in question may provide conflicting evidence on the stability of the processes, and their order of integration. Fortunately, a number of tests of non-stationarity have been developed which allow for the presence of one (Perron and Vogelsang, 1992), or two (Clemente, *et al.*, 1998) structural breaks.

Having procured evidence that the data is not I(2) we can formulate the unrestricted, or conditional, Error Correction Model. The standard ECM can be seen below in Equation (7). Here, the long-run relationship is given by the coefficient δ_0 on the lagged variable z. This z variable is no more than the residual estimated from the relationship in levels in Equation (8). In the conditional ECM (Pesaran *et al.*, 2001), rather than adding the lagged residual z, we add the lagged dependent and independent variables from the original OLS regression (Equation 9). The coefficients on these, δ_1 and δ_2, are not restricted as they are in the usual model (7).

$$\Delta G_t = \beta_0 + \Sigma\, \beta_i \Delta G_{t-i} + \Sigma\, \alpha_j \Delta GDP/n_{t-j} + \delta_0 z_{t-1} + e_t \tag{7}$$

$$G_t \quad = \alpha_0 + \alpha_1 GDP/n_t + z_t \tag{8}$$

$$\Delta G_t = \beta_0 + \Sigma\, \beta_i \Delta G_{t-i} + \Sigma\, \alpha_j \Delta GDP/n_{t-j} + \delta_1 G_{t-1} + \delta_2 GDP/n_{t-1} + e_t \tag{9}$$

One strength of this particular approach is that it can incorporate variables of different lag lengths. These can be chosen with the usual information criteria and by visual inspection of correlograms. Care must be taken to produce a parsimonious model. Lags with insignificant coefficients are of questionable validity and may possibly be discarded.

It is a necessary condition of this procedure that the residuals are sufficiently white. A Breusch-Godfrey test with the appropriate number of lags is run followed by a close inspection of the residual plots. A number of additional lags of the dependent variable may be added if necessary. It may then be necessary to check the dynamic stability of the model by obtaining the inverse roots of the associated characteristic equation and checking that they all lie inside the unit circle.

We can then proceed to the bounds test proper. Essentially we wish to know if the coefficients on the two lagged level terms are equal to zero. This is achieved through an F test. The test statistic's distribution is non-standard and we must use the critical values provided by Pesaran *et al.* (2001). Similar to the Durbin Watson d tests for serial correlation, we are provided with two critical bounds. The lower critical value assumes that all variables are I(0), the upper critical value assumes that all variables are I(1).

A test statistic falling below the lower value provides evidence that no cointegration is possible. An F statistic exceeding the upper value provides evidence of cointegration. For values between the bounds the test is inconclusive. If cointegration is present, the long run relationship is given by minus the ratio of the coefficient of the lagged independent to the coefficient of the lagged dependent variable.

$$-\left(\frac{\delta_2}{\delta_1}\right)$$

V RESULTS

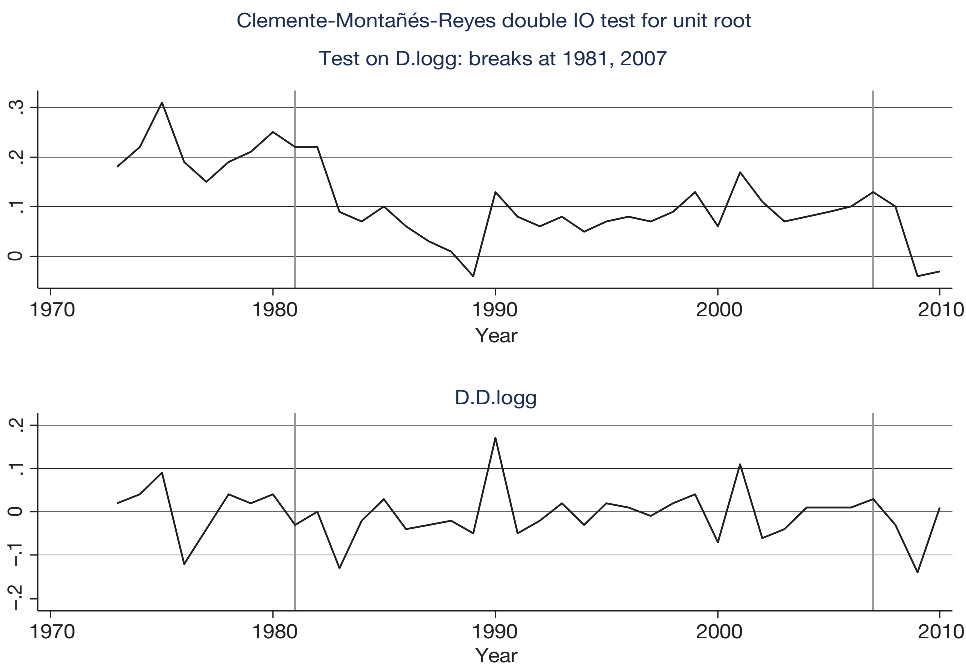
5.1 *Order of Integration*

In attempting to determine the order of integration, the Clemente, Montanes and Reyes (1998) test for non-stationarity in the presence of two structural breaks was used. The test has two possible modalities. The *innovative outlier* form presumes that structural breaks occur gradually over time, while the *additive outlier* form assumes a sudden change in the mean. Under an *innovative outlier* process the log of nominal government spending is I(1), at the 5 per cent level of significance, with structural breaks at 1981 and 2007 (Figure 4). Under the same conditions, the log of nominal GDP per capita is I(1) at the 10 per cent level with breaks at 1981 and 2006 (Figure 6).

Real variables fare somewhat differently. The log of real government spending has no breaks under an *innovative outlier* model but is I(1) by a KPSS test statistic of .216. It does show breaks at 1984 and 1991 under the *additive outlier* formulation (Figure 5). Real GDP/n similarly has no *innovative outlier* breaks but is I(1) under KPSS, and has breaks at 1991 and 2002 under the *additive outlier* (Figure 7).

These results are not unambiguous however. For instance, the same innovative outlier process marks the log of nominal GDP per capita as I(0) with breaks at 1996 and 2003. Or, in another example, the log of nominal G is shown to have only one significant structural break at 1984. Performing the Perron and Vogelsang test for unit root with one structural break reports the log of nominal G as being I(1). The results for real variables do appear to be more consistent. It must be said however, that irregularities abound in both unit root and structural break testing.[4] The beauty of the bounds testing procedure is that it can accommodate series that are non-homogenous in this respect. Uncertainty regarding the order of integration is therefore not fatal to the methodology.

Figure 4: *Unit Root Test of Log G*



[4] Hence "[y]ou probably don't know the break date even if you think you do" (Stock and Watson, 2006, p. 597).

Figure 5: *Unit Root Test of Log Real G*

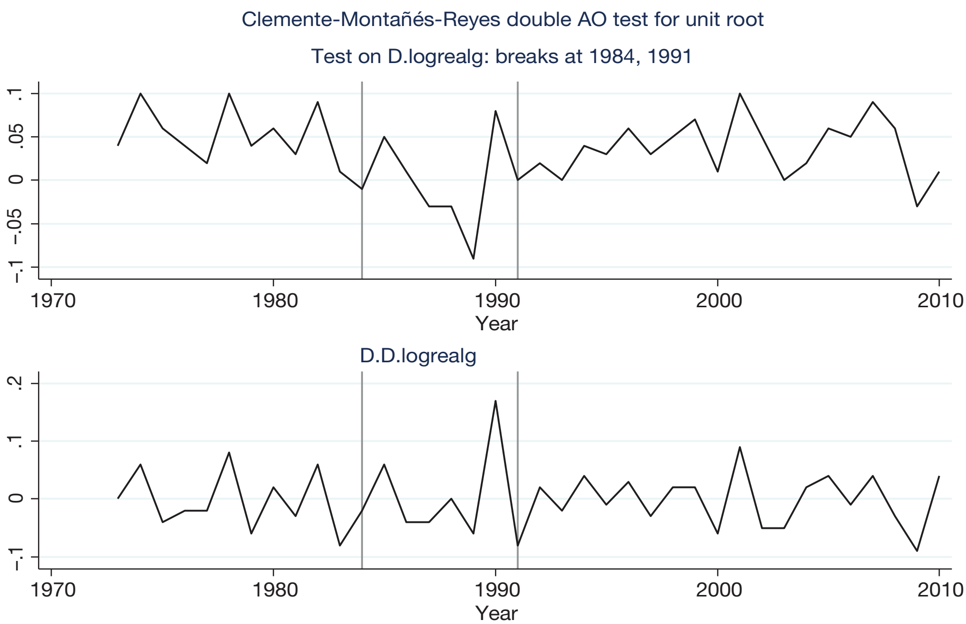


Figure 6: *Unit Root Test of Log GDP/n*

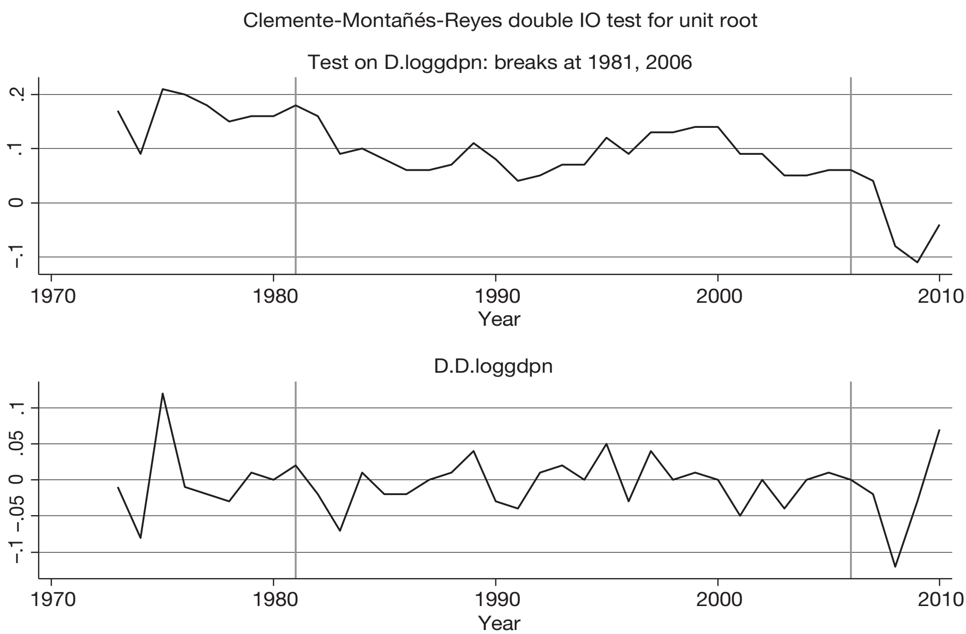
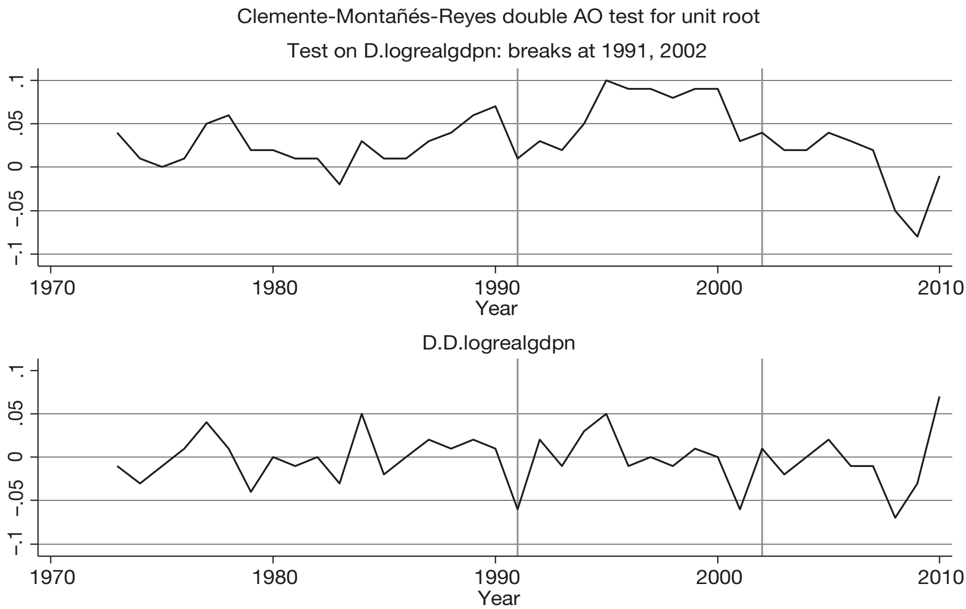


Figure 7: *Unit root test of Log Real GDP/n*



Moreover, the break dates offered by the tests are intuitively appealing. For nominal figures, 1981 was the year following Charles Haughey's infamous "we are living away beyond our means" oration (Wikipedia, 2014),[5] while 2006-07 was the beginning of the end for the Irish economic boom. Real figures are perhaps more difficult to interpret save to suggest that the early 1990s saw the start of Celtic Tiger phase I and its associated rise in real incomes.

5.2 *The Conditional Error Correction Model*

We now wish to fit the conditional ECM reproduced here as Equation (9). An appropriate lag length is chosen by the usual information criteria.

$$\Delta G_t = \beta_0 + \Sigma\, \beta_i \Delta G_{t-i} + \Sigma\, \alpha_j \Delta GDP/n_{t-j} + \delta_1 G_{t-1} + \delta_2 GDP/n_{t-1} + e_t \qquad (9)$$

After running all possible combinations of the model (512 in total) with up to four lags on both nominal G and GDP/n, and comparing AIC, BIC, adjusted R2 and Ramsey's RESET test results, the model in Equation (10) was decided on. The model does not contain a zero lag on differenced GDP which implies that there is no short-run relationship between G and GDP/n. The decision to

[5] Although it took a number of years for government cut-backs to fully take effect.

exclude the short-term effect might be dubious if based on the selection criteria reported in Table 6 alone. However, a perusal of the regression coefficients for the two alternatives (Table 10) will show that the coefficient on the short term variable is insignificant and no alarming changes are reported following its omission. As per Lamartina and Zaghini (2011), real variables are tested using the same model specification. Here however, we have ignored the fact that BIC marginally advises us to drop the differenced real GDP per capita and also the lagged differenced real G.

$$\Delta G_t = \beta_0 + \Sigma\, \beta_1 \Delta G_{t-1} + \delta_1 G_{t-1} + \delta_2 GDP/n_{t-1} + \varepsilon_t \tag{10}$$

Table 6: *Comparison of Model Selection Criteria in Model With (Model 1) or Without (Model 2) D.GDP/n*

Selection Criteria	*Model 1*	*Model 2*
R^2	.724	.711
Adj. R^2	.693	.699
BIC	–276.6	–278.4
AIC	–3.242	–3.246
RESET p-val.	.6386	.3752

Table 7: *Comparison of Coefficients in Model With or Without D.GDP/n*

Variables	*Model 1*	*Model 2*
LD.logg	0.446 ***	0.470 ***
	(0.117)	(0.117)
D.loggdpn	0.212	
	(0.166)	
L.logg	–0.148 ***	–0.177 ***
	(0.0535)	(0.0490)
L.loggdpn	0.139 **	0.160 ***
	(0.0532)	(0.0508)
Constant	2.235 ***	2.720 ***
	(0.785)	(0.694)
Observations	41	41
R-squared	0.724	0.711

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

5.3 *Diagnostics*

As the models in question are AR(1) there is no requirement as such to test the further dynamic stability of the specification. We must however, have sufficiently white residuals. This appears to be the case. Figure 7 plots the residuals from both nominal and real models against residual lags. No significant pattern is discernible. A Portmanteau test for white noise fails to reject the null for both real and nominal variables and a Breusch-Godfrey test for serial correlation shows no significant correlations up to 12 lags (see Table 8). The null of normality cannot be rejected by a skewness-kurtosis test. Examination of the histograms in Figure 8 corroborates this. We may therefore proceed with the test proper.

Figure 8: *Diagnostic Plots of the Residuals*

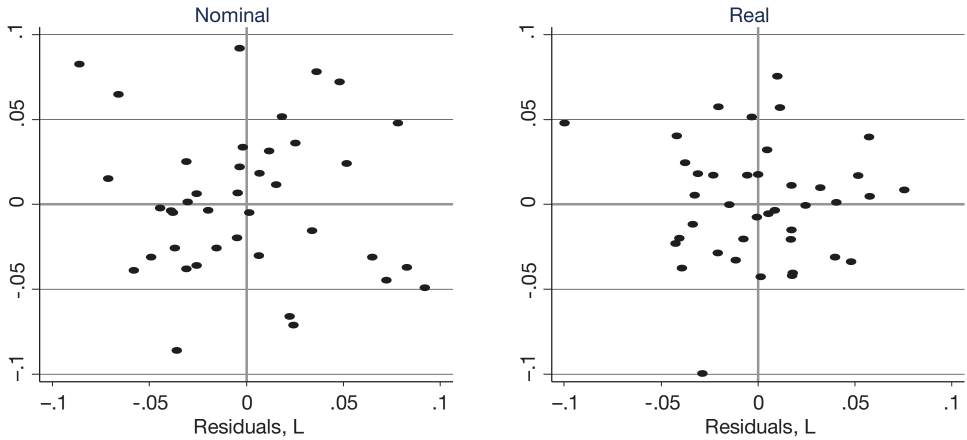


Figure 9: *Diagnostic Histograms of the Residuals*

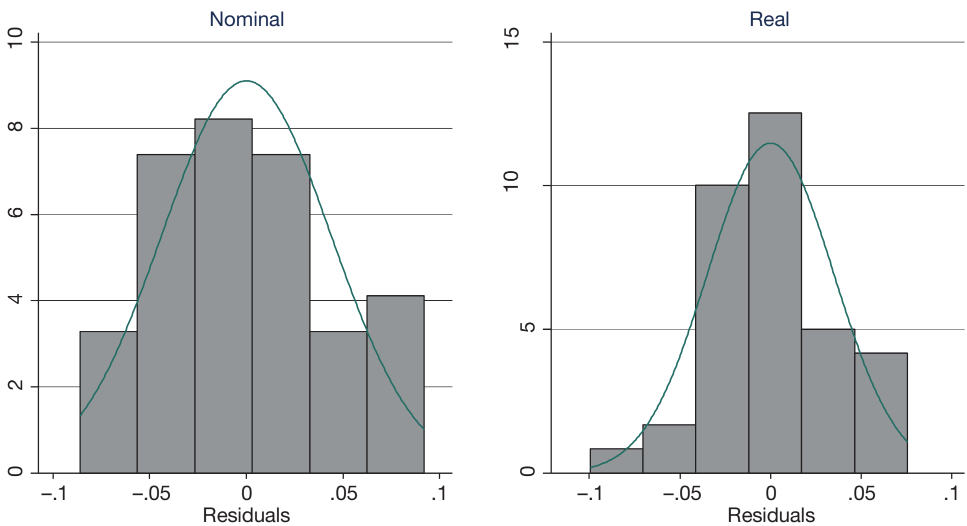


Table 8: *Diagnostic Results*

	Nominal		*Real*	
	Stat.	*p-val.*	*Stat.*	*p-val*
Portmanteau White Noise	15.16	0.65	14.49	0.70
SK Test for normality	1.02	0.60	1.08	0.58
Breusch-Godfrey – lags(1)	0.74	0.39	0.99	0.32

5.4 *The Bounds Test*

The crux of the bounds testing procedure of course is whether or not we can observe a long-term relationship in our two series – and in this instance we can, but not enough to provide evidence for WL2. This is demonstrated by the significant and non-zero coefficients on the lagged G and GDP per capita variables in real and nominal terms (Table 9). The figure for the nominal long-run multiplier is approximately 90 per cent (Equation 11). As this is less than unity it counts against the more strict interpretation of Wagner's Law. A Wald test on the joint significance of the two nominal variables gives an F statistic of 10.10, significant at the 1 per cent level given the critical values from Pesaran *et al.* (2001) (6.84 and 7.84). If we fit the standard ECM (Equation 12), we obtain the results in Table 10. Here we can see that the correction to long run equilibrium is 13.9 per cent per year.

Table 9: *Coefficients from the Conditional ECM*

Variables	*Nominal*	*Real*
LD.logg	0.470***	
	(0.117)	
L.logg	–0.177***	
	(0.0490)	
L.loggdpn	0.160***	
	(0.0508)	
LD.logrealg		0.0439
		(0.142)
L.logrealg		–0.188***
		(0.0466)
L.logrealgdpn		0.134***
		(0.0366)
Constant	2.720***	3.273***
	(0.694)	(0.802)
Observations	41	41
R-squared	0.711	0.337

Standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

For real variables evidence for WL2 is even more scant. Equation (13) shows the calculation of the long-run multiplier which hovers around 71 per cent. The Wald test statistic in this case is 8.23 which is again significant at the 1 per cent level (6.84 7.84). The error correction, given by the standard ECM, is 18.4 per cent (Table 13); the annual adjustment to disequilibrium.

$$\text{Nominal: } -\left(\frac{\delta_2}{\delta_1}\right) = -\left(\frac{.1604018}{-.17694177}\right) = .90652314 \quad (11)$$

$$\Delta G_t = \beta_0 + \beta_i \Delta G_{t-1} + \delta_0 z_{t-1} + e_t \quad (12)$$

$$\text{Real: } -\left(\frac{\delta_2}{\delta_1}\right) = -\left(\frac{.1342715}{-.1882706}\right) = .71318346 \quad (13)$$

Table 10: *Coefficients from the traditional ECM*

Variables	*Nominal*	*Real*
LD.logg	0.721***	
	(0.103)	
L.ehat1	–0.139**	
	(0.0541)	
LD.logrealg		0.0513
		(0.141)
L.ehat2		–0.184***
		(0.0461)
Constant	0.0261*	0.0297***
	(0.0137)	(0.00729)
Observations	41	41
R-squared	0.620	0.325

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

VI CONCLUSION

This paper finds that Ireland shows a long-run elasticity of government spending with respect to national product which is less than unity and, as such, aligns itself with the substantial body of empirical evidence arguing against Wagner's Law. The result is found to hold whether real or nominal variables are considered, and the inclusion of real variables is seen to significantly depress the long-run multiplier. Furthermore, the result is robust not only to specifications of the law distinct from the Goffman (1968) version used here,[6] but also to the erratic changes in government spending owing to the recent crisis.

Of course, there are possible confounding factors related to uncertainty over the order of integration, and regression in the presence of structural breaks. Furthermore, the simple descriptive statistic that both real and nominal G have kept pace with, or bettered, growth in GDP per capita over the period cannot be ignored (Tables 4 and 5). After all, it is both an undeniable fact that G has grown on average more than GDP per capita over the last forty or more years, and that this is also a metric that Wagner himself might have used to support his own thesis. However, this result is not borne out by more complex econometric analysis.

Scholars have expressed uncertainty as to the value of pursuing proof of the "Law", labelling it a "futile quest" (Durevall and Henrekson, 2011), or opining "[t]hat the myth of Wagner's Law persists is a wonder left to the historians of science" (Borcherding, 1977, p. 50). All the more so when Wagner himself expected that any power his "Law" had to describe a socio-economic climate would dissipate with the passing of his own era (Peacock and Wiseman, 1961).

However, the failure to find consensus, despite reams of econometric heavy lifting, is surely instructive in itself and may lead to further profitable inquiry. What is the significance, for example, that the bounds testing procedure (Pesaran, *et al.*, 2001) in a one-country sample fails to replicate the positive evidence found by the Pooled Mean Group (Pesaran and Shin, 1999b) procedure in a multi-country panel (Lamartina and Zaghini, 2011)?[7]

There are more prosaic considerations in terms of public policy.

> Once the crisis phase is over, a new fiscal debate will be required concerning the optimal level of long-term public spending in the economy. The main fiscal lesson from this horrendous boom-bust cycle is that the long-term component of public spending must be matched by long-term sources of tax revenue, since fiscal imprudence during the bubble years has been an unavoidable amplifying mechanism that has magnified the scale of the crisis (Lane, 2009, p. 6).

Written in the depths of the Irish fiscal crisis, the above quotation highlights the need for policymakers to look beyond the annual budget or the next election. As the Irish economy returns to significant economic growth in

[6] Results on the other five models are confined to Appendix 3.
[7] Lamartina and Zaghini covered 1970-2006 but the changes in coefficients are immaterial; see Appendix 2.

2015, it is now time for the "debate" that Philip Lane says is required. Any discussion of "the optimal level of long-term public spending" will also need to take cognisance of the drivers of the level of public expenditure. There is thus a need for a clear understanding of the long-run relationship between national income and public expenditure. This paper goes some way to providing evidence for long-run trends in Irish government spending in the context of the theoretical foundation of most theories of government expenditure – Wagner's Law.

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APPENDIX 1
LITERATURE REVIEW SUMMARY TABLES

Table A1.1: *Support for Wagner's Law*

Year	*Researcher(s)*	*Country and Period*	*Method*
1962	(Hook)	Sweden (1913-1958)	Descriptive Statistics
1967	(Gupta)	UK, Canada, Sweden US OLS and Germany	
1971	(Bird)	UK, Japan, Sweden and Germany (1790-1961) (various periods)	Descriptive Statistics
1971	(Goffman and Maher)	6 Caribbean Nations (1940-1965)	Descriptive Statistics
1974	(Henning and Tussing)	US (1900-1971)	OLS
1979	(Ganti and Kolluri)	US (1929-1971)	MLM
1980	(Mann)	Mexico (1925-1976)	OLS
1983	(Gould)	13 OECD (1960-1979)	Descriptive Statistics
1985	(Beck)	US (1960-1980)	Descriptive Statistics
1986	(Vatter and Walker)	US (1929-1979)	Descriptive Statistics
1988	(Neck and Schneider)	Austria (1955-1985)	OLS
1988	(Paldam and Zeuthen)	Denmark (1948-1985)	OLS
1992	(Yousefi and Abizadeh)	30 US States (1931-1955)	OLS
1993	(Hackl *et al.*)	Australia (1860-1986)	OLS
1994	(Oxley)	Britain (1870-1913)	Granger Causality test
1995	(Peters)	US (1948-1995), Barbados (1952-1995), Thailand (1952-1995) and Haiti (1965-1995)	Johansen-Juselius cointegration test
2000	(Kolluri *et al.*)	G7 (1960-1993)	Engle and Granger
2001	(Islam)	US (1929-1996)	Johansen-Juselius cointegration test
2006	(Aregbeyen)	Nigeria (1970-2003)	Johansen and Granger Causality test
2008	(Mohammadi and Murat Cak)	Turkey (1950-2005)	Bounds Test
2008	(Narayan *et al.*)	Fiji (1970-2002)	Johansen cointegration test

Table A1.1: *Support for Wagner's Law (contd.)*

Year	*Researcher(s)*	*Country and Period*	*Method*
2009	(Samudram *et al.*)	Malaysia (1970-2004)	ARDL bound test
2009	(Ghorbani and Zarea)	Iran (1960-2000)	Engle and Granger ECM
2009	(Kalam and Aziz)	Bangladesh (1976-2007)	Johansen and Granger Causality test
2011	(Lamartina & Zaghini)	23 OECD (1970-2006)	Pooled Mean Group regression
2011	(Pahlavani *et al.*)	Iran (1960-2008)	Bounds Test and Granger Causality Test
2011	(Torun and Arica)	17 Inflation targeting countries (1995-2007)	Johansen-Fisher
2012	(Kumar *et al.*)	New Zealand (1960-2007)	Bounds Test among others
2012	(Menyah and Wolde-Rufael)	South Africa (1950-2007)	Bounds Test
2012	(Richter *et al.*)	UK (1850-2010)	Johansen and Engle and Granger
2012	(Richter and Paparas)	Greece (1833-2010)	Engle and Granger and Granger Causality
2013	(Ageli)	Saudi Arabia (1970-2012)	Johansen and Engle and Granger
2013	(Menyah and Wolde-Rufael)	Ethiopia (1950-2007)	Bounds Test and Granger Causality

Table A1.2: *No Support for Wagner's Law*

Year	*Researcher(s)*	*Country*	*Method*
1979	(Chrystal and Alt)	UK (1900-1976)	TSLS
1981	(Pluta)	20 Developing Countries (1960-1970's)	Descriptive Statistics
1986	(Ram)	63 Countries (1950-1980)	OLS and Granger Causality test
1990	(Gemmell)	117 Countries (1960-1985)	OLS
1991	(Craigwell)	Barbados (1954-1986)	OLS
1993	(Henrekson)	Sweden (1861-1990)	OLS
1995	(Hondroyiannis and Papapetrou)	Greece (1951-1992)	MLM
2003	(Halicioglu)	Turkey (1960-2000)	Johansen-Juselius and Granger Causality test
2004	(Bağdigen and Çetintaş)	Turkey (1965-2000)	Engle and Granger and Granger Causality
2006	(Huang)	China and Taiwan (1979-2002)	Bounds Test and UECM
2006	(Dluhosch and Zimmermann)	*Theoretical*	
2007	(Pradhan)	India (1970-2004)	Engle and Granger and ECM
2007	(Sinha)	Thailand (1950-2003)	ARDL and Toda-Yamamoto
2010	(Ighodaro and Oriakhi)	Nigeria (1961-2007)	Johansen and Granger Causality test
2011	(Babatunde)	Nigeria (1970-2006)	Bounds Test and Granger Causality
2011	(Bröthaler and Getzner)	Austria (1955-2007)	ML, ARCH and GARCH
2011	(Durevall and Henrekson)	Sweden (1800-2006)	UK (1830-2006) Engle and Granger and Hansen
2012	(Kesavarajah)	Sri Lanka (1960-2010)	Engle and Granger and ECM
2012	(Kirchner)	Australia (1901-2009)	Bounds Test

Table A1.3: *Mixed Support for Wagner's Law*

Year	*Researcher(s)*	*Country*	*Method*
1971	(Gandhi)	25 African Countries (1965)	OLS
1977	(Wagner and Weber)	34 Countries (1950-1972)	OLS
1980	(Mann)	Mexico (1925-1976)	OLS
1983	(Lowery and Berry)	US (1948-1979)	OLS
1985	(Abizadeh and Gray)	53 Diverse Countries (1963-1979)	OLS
1986	(Lybeck)	12 OECD (1960-1982)	OLS and TSLS
1987	(Ram)	115 Countries (1950-1980)	OLS
1988	(Delorme, *et al.*)	US, Britain and Germany	OLS and Granger Causality test
1998	(Dollery and Singh)	Literature Review	
2004	(Chang, *et al.*)	10 Countries (1951-1996)	Johansen and Juselius and Granger Causality
2005	(Loizides and Vamvoukas)	Greece, Ireland and the UK	Error Correction Model and Granger Causality
2008	(Narayan, *et al.*)	Chinese Provinces	Panel Cointegration and Granger Causality test
2008	(Tang)	Malaysia (1960-2006)	Recursive Regression with Granger Causality
2010	(Afzal and Abbas)	Pakistan (1961-2007)	Johansen and Granger Causality test
2011	(Govindaraju, *et al.*)	Malaysia (1970-2006)	ARDL and Granger Causality
2011	(Karagianni, *et al.*)	EU 15 (1949-1998)	Engle and Granger, Johansen and Granger Causality
2012	(Kuckuck)	United Kingdom, Denmark, Sweden, Finland and Italy	Johansen and Juselius with structural breaks
2012	(Magazzino)	EU 27 (1970-2009)	Engle and Granger, Johansen and Juselius and Granger Causality
2013	(Dada and Adewale)	Nigeria (1961-2011)	Johansen and VECM
2013	(Oktayer and Oktayer)	Turkey (1950-2010)	Bounds Test

APPENDIX 2
COEFFICIENTS FOR THE SUB-SAMPLE 1970-2006 (REPLICATING LAMARTINA AND ZAGHINI (2011))

Table A2.1 *Coefficients for the Sub-period 1970-2006*

Variables	*Nominal*	*Real*
LD.logg	0.503***	
	(0.131)	
L.logg	–0.178***	
	(0.0595)	
L.loggdpn	0.160**	
	(0.0606)	
LD.logrealg		–0.0150
		(0.157)
L.logrealg		–0.175***
		(0.0524)
L.logrealgdpn		0.121***
		(0.0377)
Constant	2.732***	3.087***
	(0.846)	(0.941)
Observations	35	35
R-squared	0.651	0.277

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

APPENDIX 3
RESULTS FROM ALTERNATIVE FORMULATIONS OF WAGNER'S LAW

Table A3.1: *Alternative Formulations of Wagner's Law*

Variables	*Version 1* $G = f(GDP)$	*Version 2* $C = f(GDP)$	*Version 4* $G = f(^{GDP}/_{N})$	*Version 5* $^{G}/_{N} = f(^{GDP}/_{N})$	*Version 6* $^{G}/_{GDP} = f(GDP)$
LD.G	0.409***				
	(0.114)				
D.GDP	0.315*	0.409***			0.380**
	(0.158)	(0.122)			(0.146)
L.G	–0.165***				
	(0.0587)				
L.GDP	0.146**	0.164***			0.115**
	(0.0542)	(0.0536)			(0.0486)
LD.C		0.467***			
		(0.0934)			
L.C		–0.177***			
		(0.0574)			
LD.Govt_Share			0.0678		
			(0.147)		
D.RGDP_pc			–1.61e-05***		
			(3.58e-06)		
L.Govt_Share			–0.264***		
			(0.0654)		
L.RGDP_pc			–5.35e-07		
			(3.23e-07)		
LD.G_pc				0.418***	0.343***
				(0.122)	(0.120)
L.G_pc				–0.188***	–0.145**
				(0.0548)	(0.0567)
L.GDP_pc				0.153***	
				(0.0520)	
Constant	0.339	0.0415	0.132***	0.205**	–1.567**
	(0.224)	(0.158)	(0.0328)	(0.0818)	(0.720)
Observations	41	41	41	41	41
R-squared	0.748	0.854	0.503	0.700	0.741
Bounds F Stat.	4.10	4.78	16.34	10.34	3.76
Bounds p-val.	0.0250	0.0144	0.0003	0.0003	0.0329
Long Run Multiplier	0.86	0.92	–2.025e-06	0.81	0.79

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1