AN APPLICATION OF WAGNER'S 'LAW' OF EXPANDING STATE ACTIVITY TO TOTALLY DIVERSE COUNTRIES *

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Number of Words: 7365

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ABSTRACT

Wagner's 'law' of expanding state activity, is the proposition that there is a long run propensity for government expenditure to grow relative to national income. This paper presents a discussion of the applicability of this hypothesis to four totally diverse countries. To test the proposition, unit root pre tests and maximum likelihood estimation techniques of cointegrating vectors are employed. The paper concludes that the 'law' is more universal than Wagner himself intended it to be. The empirical evidence places this paper among the numerous studies that support Wagner's 'law'.

Key words: Cointegration, Stationarity

1. INTRODUCTION

Over one hundred years ago a German economist, Adolph Wagner in his classic book, *Grundlegung der Politischen Ökonomie* (1863) formulated a 'law' of expanding state activity. He asserted that there is a long run propensity for the scope of government to increase with higher levels of economic development.

Wagner's contribution to public expenditure theories is particularly significant when we consider that before Wagner made his observations, the prevailing view was the notion that as a country grows richer, government activities would have a tendency to decline (Henrekson, 1993). To a large extent this view is still prevalent in modern economic thought. Indeed, many conservative economists in the debate on the role of government assert that the expansion of government activity in macroeconomic affairs associated with the Keynesian revolution, is an unfortunate aberration.

Since the initial formulation of Wagner's hypothesis, a considerable amount of effort has gone into testing it. This has given rise to many debates in the Public Finance literature on a wide spectrum of issues. First, the specification of an appropriate functional form for empirical testing and a means by which the results are to be interpreted, is a serious discussion that has not abated. Second, in regression analysis, there is a choice between time series models and cross section models to adequately test the 'law'. Furthermore, the cointegration revolution in time series analysis indicates that in order for a long run relationship between government activity and economic development to exist, the two variables should cointegrate. In other words, the variables should exhibit a long-run equilibrium. Another issue of note, is whether Wagner's hypothesis is applicable to developing nations and to a lesser extent to highly mature economies.

This paper argues that Wagner's 'law' is plausible and universal. The stationarity properties of the data are examined and maximum likelihood techniques are used to test for the presence of cointegrating vectors. This study utilises data from four countries at varying stages of development, of different economic and physical size, and with different economic history and experiences of public sector expansion. These countries are, the United States; Thailand; Barbados and Haiti. Section 2 offers a detailed statement about the 'law', while Section 3 examines the formulation, testing and results of some of the major studies that have tested Wagner's hypothesis. Section 4 discusses the methodology of this study and the results are presented in section 5. Section 6 concludes the paper.

2. STATEMENT ABOUT THE 'LAW'

The size and growth of public expenditure are complex societal processes that cannot be explained exclusively by the discipline of economics. In fact, there are many causal factors behind the size and growth of public expenditure.

Wagner's 'law' is not really a theory of public expenditure growth but, rather, a generalisation concerning the secular trend of public spending (Goffman and Mahar, 1971).

Bird (1971) states that 'as per capita income rises in industrialising nations, their public sectors will grow in relative importance.'

Wagner offered three reasons in support of his hypothesis. Firstly, as nations develop they experience increased complexity of legal relationships and communications, as a result of the immense division of labour that accrues with industrialization. Because of this, Wagner envisaged an enlarged role for the state in the form of public, regulatory and protective activity. Further, increased urbanization and population density would lead to greater public expenditure on law and order, and economic regulation due to the associated risk of more conflict in densely populated urban communities. Because of the substitution of private for public activity, the administrative and protective functions of the state would expand. Thus, as nations become more advanced the number and/or magnitude of market failures would force the state to become more regulatory in nature, thereby expanding its role and this would inevitably involve higher public expenditures.

Wagner predicted the expansion of 'cultural and welfare' expenditures based on the presumption that as income rises, society would demand more education, entertainment, a more equitable distribution of wealth and income, and generally more public services. Public Services were seen as normal goods, that is, their income elasticities of demand exceeded unity. Wagner cited education and culture as areas in which collective producers were more efficient than private producers.

Wagner's final suggestion was that the dynamic nature of technology and increasing scale of investment required in many activities would bring the development of large private monopolies whose domineering effects on the market would have to be neutralised by the state or alternatively the monopolies would have to be taken over by the state in the interest of economic efficiency. For some economic activities the required scale of capital was so large that the only way these capital projects could be financed was if the state participated in the activity.

Wagner, undoubtedly, was influenced by the historical events that surrounded him. The 'law' was formulated in Germany in the late nineteenth century, a period characterised by expansion of the German empire and the fall of the Ottoman empire. At this time, incomes in Germany were rising as a result of rapid growth in technology.

Richard Bird (1971) supports this notion by postulating that the 'law' operates under the following conditions:

(i) Rising per capita incomes;

(ii) Technological and institutional change of a particular sort, and

(iii) At least implicitly, democratization (in the sense of wider political participation of the polity).

Before examining some of the underlying conditions and assumptions, that are supposed to limit the existence of the 'law' to only a few countries, we evaluate the plausibility of the 'law'.

At least on the surface Wagner's proposition appears to be plausible. Wagner simply envisioned increasing social complexity with economic development and with this he saw increased responsibilities of the state. Economic development can be defined as the process of both quantitative and qualitative improvement in the standard of living in a given country. This includes sustainable increases in the per capita income, reduction in the levels of poverty, and social, political and legal modernisation, resulting in a reduction in inequality and unemployment. It is reasonable to assume, therefore, that economic development will bring about increased labour participation, larger and more diverse markets with more players. As countries develop, they become more efficient and effective in the production of goods and services, so there is reason to believe that complexity will increase. Increased prosperity and complexity require management. The scope of the government will inevitably grow as the demands placed on government services expand.

Bird (1971) concurs with Wagner's 'law' stating that 'the activities of government are an increasing function of the changing structure of the economy.' Whether the state decides to combat or to support private sector activity such as private monopolies, with the growth of this sector, it is plausible to assume that public sector activity will increase.

We noted earlier that Wagner's hypothesis was formulated in the context of industrializing economies with rising per capita incomes. While this is so, public expenditures have been observed to rise over time in many developing countries. Is Wagner's hypothesis applicable to developing nations? The answer lies in one's conceptualisation of underdevelopment. In the late nineteenth century underdevelopment referred to a static state of nature, where the production function was unchanging. Both production and consumption in those countries were low. However, due to the improvement in technology, developing countries can no longer be considered to exist in a static state of nature. Developing countries have improved access to technology. It is reasonable to assume that developing nations today are fundamentally different now than they were in the late nineteenth century because they possess dynamic technology and many of them experience rapidly rising incomes.

Richard Musgrave (1969) stated that 'low income countries today do not operate under the same technical, political, and value conditions as prevailed in the past when now developed countries were at similar low levels of income. Attitudes toward growth, changed communication, the demonstration effect of affluence and welfare measures taken abroad, the conflict of political ideologies all make for the basic differences in the historical setting.' This means that developing nations are more likely to provide public services which approximate current levels in the developed countries than the levels provided by the currently developed nations when they were in the earlier stages of development.

Some economists argue that it is not the level of income that determines a nation's expenditure, but rather its prevailing conception of the role of the government. They note that developed countries currently spend relatively more on their public services than they had done a hundred years ago, not because they became richer and more prosperous but rather as a result of an evolving conception of the duties of the state. That the state should pay for schooling for every child, that they should pave and light the streets of every village with over a thousand inhabitants was not taken for granted a hundred years ago. They argue that these changes in ideas were not confined to the richer countries; poorer countries went through similar experiences and they too experienced increases in relative public expenditures.

Perhaps the evolution of ideas is as much a part of development as rising incomes, since the former induces the latter. Today there are many developing countries that satisfy the three conditions set out by Bird (1971). That is, in the long run per capita incomes are rising, they possess dynamic technology, and increasingly the polity has the opportunity to transmit their demands and/or preferences through a democratic system. Equally, highly mature economies that have already industrialised still satisfy the three conditions, in other words being developed is not a static equilibrium either and so there is every reason to believe that Wagner's 'law' will operate in those countries as well.

The prevailing conditions of the time have increased the scope of Wagner's 'law' and in its most abstract form, Wagner's 'law', is more universal.

3. FORMULATION AND TESTING OF WAGNER'S LAW

Wagner was inexplicit in his own formulation of the hypothesis leaving the precise formulation of the hypothesis subject to disagreement among economists. It can be argued that Wagner's 'law' cannot be adequately tested empirically because it is not a clear and concise theoretical construct; it amounts to looking at the past and trying to explain the upward trend in public spending. It is therefore inherently biased toward certain factors and their assumed role in the historical process. The assumptions are not clearly outlined, rendering it difficult to accept or reject this 'law' based on 'fact'. Moreover, the 'law' does not have an explicit empirical counterpart. Whether the relevant variables that determine public spending can be limited is debatable, as public spending is influenced by a number of socio-economic variables not all of which are quantifiable. In fact, it is not clear what variables should be used to measure both economic development and state activity. It is conventional however, to use per capita income as an index of development but this is not the only index of development nor is it the only compatible interpretation of the 'law' but it continues to be used by most economists (Michas, 1975; Bird, 1971; Goffman, 1968; Gupta, 1967; Musgrave, 1969; Pryor, 1968). Government expenditure is probably the most significant and practical measure of the state's activity.

Bird (1971) states 'essentially, this 'law' is not really a theory at all but rather a kind of philosophising about history. Any attempt to 'test' it necessarily does violence to the facts by adjusting them to preconceived theory.' He then went on to suggest that even if a narrowly defined formulation of the relevant variables was desired, the variables are probably not stable enough over time to allow testing of this evolutionary proposition.

Perhaps Wagner's 'law' does not readily lend itself to empirical testing but this does not mean it cannot be tested. In the absence of optimal solutions, economists have sought second best solutions to the problem of testing Wagner's 'law'. They have reasonable measures of economic development (national income) and state activity (government expenditure) and can, through the employment of econometric estimation, now isolate the effects of a few variables on public spending. In addition to this, the stationarity properties of the data can be assessed and the stability of the variables accounted for. The appropriate tools are available for the testing of such a hypothesis, a few appropriate variables can be defined to express the law explicitly in numerical terms, what is now left to decide upon is the exact functional form and method of testing.

There are in general six different formulations of Wagner's hypothesis. These are:

1	Peacock-Wiseman "traditional" version	$G = f\,(GDP)$
2	Pryor version	$C = f\,(GDP)$
3	Goffman version	$G = f\,(GDP/N)$
4	Musgrave version	$G/GDP = f\,(GDP_R/N)$

5 Gupta/Michas version $G/N = f\,(GDP/N)$

6 Peacock-Wiseman "share" version $G/GDP = f\,(GDP)$

where G is nominal total government expenditure, GDP is nominal Gross Domestic Product, GDP_R is real Gross Domestic Product, N is the total population size, and C is government consumption expenditure.

The first formulation was employed by Peacock and Wiseman (1961), Musgrave (1969), and Goffman and Mahar (1971). The second functional form was formulated and tested by Pryor (1968). The third formulation was suggested and formulated by Goffman (1968) and Mann (1980). The fourth was utilised by Musgrave (1969), Murthy (1993), and Ram (1987). Gupta (1967) and Michas (1975) considered the fifth formulation and the sixth formulation was suggested and tested by Mann (1980).

All of the above functional forms have been employed to test Wagner's hypothesis. According to Wagner, "cultural and welfare" expenditures were income elastic and by extension one of Wagner's major assumptions was that a large number of public goods and services are luxuries so that public outlay in national income is income elastic. This contention derived from his organic concept of the state. As such, economists expected the income elasticity of public spending to exceed unity. Bird (1971) suggested that Wagner's 'law' would be verified if the income elasticity of demand was in excess of unity. Goffman

(1968) employed similar reasoning. Michas (1975) points out that the elasticity does not have to exceed unity but rather zero, depending on the functional form. For formulations, one and three, an elasticity estimate would have to transcend unity to verify the 'law', but for functional forms six and four, the elasticity estimate would have to be in excess of zero. The elasticity for formulation four is defined as follows:

[1] $$\eta_4 = \frac{d(G/GNP)}{G/GNP} \div \frac{d(GNP/N)}{GNP/N}$$

and it is monotonically related to the elasticity of the fifth functional form (See Appendix):

[2] $$\eta_4 = \eta_5 - 1$$

[3] $$\eta_4 = \frac{d(G/GNP)}{G/GNP} \div \frac{d(GNP/N)}{GNP/N} = \frac{d(G/N)}{G/N} \div \frac{d(GNP/N)}{GNP/N} - 1$$

It has now become the general consensus that Wagner had the relative growth of the public sector in mind (Timm, 1961). In addition to this, GDP per capita is used to measure increases in income, as it is a more accurate index of income advances because it accounts for population growth. A time series framework is used because as Bird (1971) states '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 in B at a particular point in time.' He then points out that a rising ratio over time is quite different from a higher ratio at a point in time. Hence, inferences made from international cross sectional studies are irrelevant as tests of

Wagner's 'law'. Wagner's hypothesis is undoubtedly a time series phenomenon. Hence, in this study time series techniques are used to test for the 'law'.

Over time numerous economists have tested for the presence of Wagner's 'law' in both developed and developing countries. They have employed various formulations and estimation techniques and while Wagner's 'law' appears to be supported in some instances, it is negated in others, the evidence seems more to support than to controvert the 'law'.

Musgrave (1969) and Goffman and Mahar (1971) found strong support for the 'law' using ratios of percentage changes in government spending and GDP and interpreting the ratios as elasticities. Mann (1980) used six different formulations to test for the 'law'. He employed an ordinary least squares bivariate regression on a data set spanning from 1925 to 1976. From this study he found strong support for different formulations of the 'law'. Gupta (1967) tested formulation five for the United States, United Kingdom, Sweden, Canada, and Germany for different periods between the late nineteenth century and 1960. With the exception of two cases, all elasticity estimates were in excess of unity, thereby supporting the 'law'.

Ganti and Kolluri (1979) used U.S. data for the period 1929-1971, to test formulation number five. He excluded government expenditure from GDP as opposed to using total GDP per capita. The income elasticity of demand that was derived was approximately two. Abizadeh and Gray (1985) used a pooled regression for fifty-five countries for the period 1963-1974. The countries were categorised into three groups according to their levels of development. The 'law' appeared to hold for the wealthier groups, but not for the poorest group. Ram (1987) used data for the period 1959-1980 for one hundred and fifteen (115) countries finding mild support for Wagner's hypothesis.

Many studies have tested for the 'law' in specific countries. Gyles (1991) tested the 'law' for the UK. Pluta (1979) and Kyzyzaniak (1974) tested the 'law' for Taiwan and Turkey respectively. In addition to those aforementioned, Vatter and Walker (1986) tested the 'law' on US data. Nagarajan and Spears (1990) and Murthy (1990) tested for the existence of the 'law' in Mexico, the results were mixed. Apart from the aforementioned, Bird (1970), Singh and Sahni (1984), and Afxentiou and Serletis (1991) tested the 'law' in Canada. Provopoulos (1981), Courakis et al (1993), and Hondroyiannis and Papapetrou (1995), apart from those previously mentioned, tested the 'law' for Greece.

Most of the studies have found strong support for Wagner's proposition, however, most of the studies have not examined the stationary properties of the data and therefore may be inappropriate as estimation techniques. The next section will present a discussion of the methodology used in this paper.

The operation of Wagner's 'law' is explained from a demand perspective. That is, public spending is responsive to the expansionary demand for more public goods, and state regulatory and protective activity. However, there is a budget constraint that the state must observe. The state cannot and does not behave like an unconstrained economic agent but rather it must maximise some form of welfare function subject to a budget constraint. It is plausible at the same time to associate a relationship between government revenue and national income, so that as economic activity heightens or as a country becomes wealthier, tax revenues should rise as well. Rising revenues increase the government's ability to spend.

We employ the use of formulation four as it stems from the interpretation of the 'law' as predicting an increasing relative share for the public sector in the total economy as per capita income grows. It is now generally agreed that Wagner had the relative growth of the public sector in mind (Timm, 1961).

4. METHODOLOGY

Classical methods of estimation are based on the assumption that the means and variances of the variables are well-defined constants, independent of time. In other words standard estimation methods assume that the variables are stationary. The applications of unit root tests have demonstrated that these assumptions are not satisfied by many macroeconomic time series so using classical techniques such as ordinary least squares (OLS) on data with the presence of unit roots can lead to misguided inferences.

Hence, testing Wagner's 'law' on non-stationary variables as most studies hitherto have done could lead to spurious results. This implies that just observing the income elasticity of demand estimates is insufficient. Tests have been developed to determine the degree of stationarity, by Fuller (1976), Dickey and Fuller (1981), Phillips (1987) et cetera. These tests, determine whether the series are integrated of order one I(1) against the alternative that they are integrated of order zero I(0). If the two variables exhibit long run equilibria they can be said to be cointegrated.

The hypothesis that the variables are integrated of order one I(0) plus the significance of deterministic trend can be tested using the Augmented Dickey Fuller (ADF) statistic. The tests are derived from OLS estimation of the following:

[4.1] $$\Delta y_t = \mu + \psi T + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \ldots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t$$

The null hypothesis that the series contains a unit root is tested by H_0: $\gamma=0$**.** The hypothesis that the series is non-stationary with a stochastic trend rather than a deterministic time trend is tested by H_0: $\psi=\gamma=0$, the rejection of which suggests the presence of deterministic trend. The lag order was determined by the Schwartz criteria.

The unit root test proposed by Phillips (1987), Perron (1988), and Phillips and Perron (1988) is also employed. This test is an extension of the Dickey-Fuller tests that makes semi-parametric correction for autocorrelation.

The long run comovement of two variables is examined using the two step test for cointegration proposed in Engle and Granger (1987).

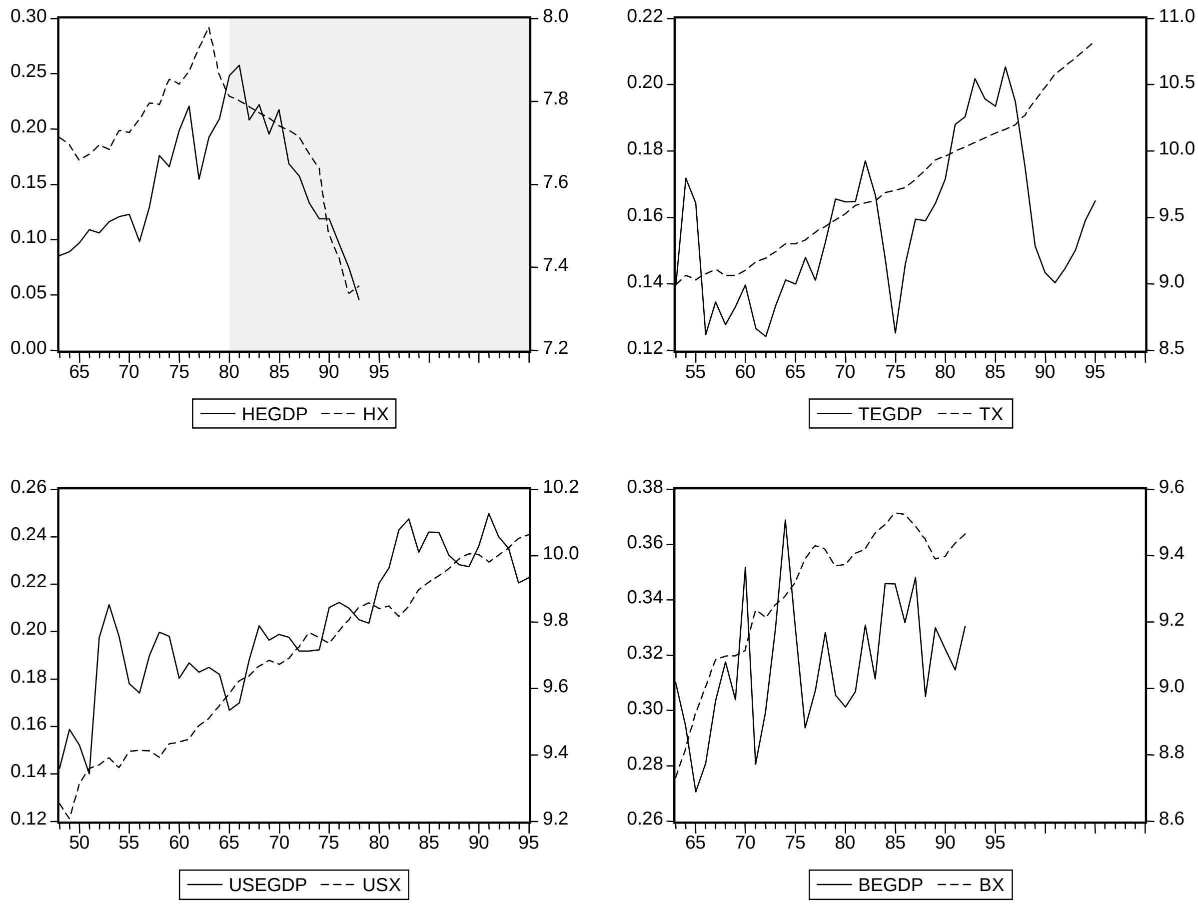
The paper then applies the Johansen maximum likelihood approach (Johansen, 1988; Johansen and Juselius, 1990 and 1992). This cointegration procedure can test hypothesis concerning the number of equilibrium relationships and it is based on the assumption that the introduction of sufficient lags will produce a well-behaved disturbance term.

Many studies using cointegration techniques have used the Engle Granger two step procedure (Murthy, 1993 and Henrekson, 1993) but as Houdroyiannis and Papapetrou (1995) point out there are several advantages that the Johansen and Juselius method has over the Engle Granger. Firstly, it tests for all the cointegrating vector variables, secondly all variables are treated as endogenous, so that the choice of dependent variable is not arbitrary.

5. EMPIRICAL RESULTS

The study examines the United States, Thailand, Barbados, and Haiti for the periods 1948-1995, 1952-1995, 1966-1995 and 1965-1995 respectively. First we present some graphs so as to get an idea of the relationship. Figure 1 depicts the log of real per capita income (X) and the ratio of government exhaustive expenditure to GDP (EGDP). The prefixes US, T, B, and H represent the United States, Thailand, Barbados, and Haiti respectively. For the United States both real per capita income and government share in economic activity have increased over the years. For Thailand and Barbados the same appears to be true though it is less apparent by just looking at the graphs. Haiti is the exception because incomes rose and then started to decline rapidly. Interestingly enough, the share of government activity in the economy moved in tandem with real per capita income. Hence the data appears to lend support to Wagner's hypothesis.

FIGURE 1
Evolution of real per capita income in logs (X) and the ratio government exhaustive expenditure to GDP (EGDP).



A slightly more objective approach to evaluating data trend would be to test for trend in the data. To do this we employ the Cox and Stuart non-parametric sign test for trend for all the variables. LCAP refers to per capita income (without logs). The results are presented in table 1.

TABLE 1

Cox and Stuart Test For Trend

Variable	n*	n	T	t	Hypotheses	Decision Rule Reject Ho If:	Result
USLCAP	34	17	17	6	H_0:P(+) ≤ P(-) H_a:P(+) > P(-)	T ≥ n-t	+ve Trend
USEGDP	33	16	16	4	H_o:P(+) ≤ P(-) H_a:P(+) > P(-)	T ≥ n-t	+ve Trend
TLCAP	33	16	16	4	H_o:P(+) ≤ P(-) H_a:P(+) > P(-)	T ≥ n-t	+ve Trend
TEGDP	33	14	11	3	H_o:P(+) ≤ P(-) H_a:P(+) > P(-)	T ≥ n-t	+ve Trend
BLCAP	26	13	13	3	H_o:P(+) ≤ P(-) H_a:(P(+) > P(-)	T ≥ n-t	+ve Trend
BEGDP	21	10	6	2	H_o:P(+) ≤ p(-) H_a:P(+) > P(-)	T ≥ n-t, T ≤ t	No Trend
HLCAP1	17	8	8	1	H_o:P(+)≥ P(-) H_a:P(+) > P(-)	T ≥ n-t	+ve Trend
HLCAP2	17	8	0	1	H_o:P(+) ≥ P(-) H_a:P(+) < P(-)	T ≤ t	-ve Trend
HEGDP1	12	6	6	0	H_o:P(+) ≤ P(-) H_a:P(+) > P(-)	T ≥ n-t	+ve Trend
HEGDP2	17	8	1	1	H_o:P(+) ≥ P(-) H_a:P(+) < P(-)	T< t	-ve Trend

n*-sample size, n=n*/2 or (n*-1)/2, T= the number of '+' signs (y>x), $t=1/2(n+w_\alpha\sqrt{n})$ P=0.5, α=0.05

The results show that at the 95 per cent confidence level, it is reasonable to conclude that for the United States and Thailand, both real per capita income and the ratio of government expenditure to GDP exhibit positive trend over their respective time periods. For the country of Barbados, although there was a strong growth trend in per capita income, the ratio of government expenditure to GDP exhibited neither upward trend nor downward trend. On the surface it appears as though government involvement in the economy is independent of the level of development (i.e. per capita income), in which case it is not so apparent that the 'law' has a presence in Barbados. Finally, Haiti poses the most interesting case because when testing the whole period for both variables the results (not shown) reveal that for both variables there is no trend. We then split the data set into two time series so as to capture the actual relationship and account for any structural breaks. Both variables increased (upward trend), peaked and then declined rapidly (downward trend). Although Wagner did not really envision negative development, there appears to be a positive relationship between per capita income and the ratio of government expenditure to GDP in Haiti.

It is not sufficient to casually observe data trend and conclude that there is a long run relationship between the two variables. Regressions in levels are misleading, as they do not take into account the stationarity properties of the data. As mentioned in the previous section, in a case where most economic time series are non-stationary, regressions on non-stationary variables will produce spurious results. It is against this background that we test for the presence of unit roots in all of the variables in levels and in first differences to determine whether the series are I(0) or I(1). To do this we employ the Augmented Dickey-Fuller test and the Phillips-Perron (PP) test, with and without the assumption of deterministic trend, so as to account for the possibility of stochastic trend in any one of the series. The prefix D refers to a variable that has been differenced and the X and Y notation refer to log per capita income and the log of government expenditure as a proportion of GDP, respectively. The results are shown in table 2 and table 3.

TABLE 2

Tests for Unit Root in levels

Variables	Augmented Dickey-Fuller Statistic		Phillips-Perron Statistic	
	With Trend	No Trend	With Trend	No Trend
USY	-4.07**	-2.31*	-3.61**	-2.62*
USX	-3.58**	-1.59	-2.92	-0.86
TY	-3.07	-2.22	-2.50	-2.23
TX	-1.44	2.90*	-0.61	3.20**
BY	-3.91**	-3.14**	-4.47**	-3.73*
BX	-2.36	-2.93*	-2.38	-4.31**
HY	1.32	-0.09	2.13	-0.45
HX	-.22	-0.01	0.08	0.33

Notes: * (**) denotes rejection of the null hypothesis at 10%(5%) significance level

TABLE 3

Tests for Unit Root in First Difference

Variables	Augmented Dickey-Fuller Statistic		Phillips-Perron Statistic	
	With Trend	No Trend	With Trend	No Trend
DUSY	-6.85**	-6.77**	-6.58**	-6.63**
DUSX	-5.50**	-5.60**	-8.01**	-7.51**
DTY	-5.15**	-5.22**	-6.09**	-6.17**
DTX	-4.36**	-3.49**	-5.87**	-4.44**
DBY	-5.64**	-5.69**	-7.21**	-7.35**
DBX	-3.37**	-3.08**	-4.02**	-3.44**
DHY	-3.70**	-2.11	-5.66**	-4.06**
DHX	-3.56**	-2.38	-4.69**	-3.79**

Notes: *(**) denotes rejection of the hypothesis at 10%(5%) significance level

Table 2 indicates that at the 90 per cent confidence level, some variables appear to reach stationarity in the level of the series. USY and BY appear to be strongly stationary in the levels for both the ADF test and the PP test, with and without trend. TX and BX also appear to be stationary. The PP test reported stationarity in many variables. The fact that it is possible to obtain stationarity in the level of the series suggests that the numerous tests of Wagner's 'law' most of which confirm its existence, should not be dismissed. The results reported in table 3 are stationarity tests performed on the first difference of the variables, and all the variables were stationary for both tests and nearly all assumptions, indicating strong stationarity. The series are therefore stationary in the first difference.

It is therefore possible to derive consistent estimates by taking the log difference of the variables and recovering the elasticities. Stock and Watson (1989) show that two I(1) series can give consistent estimates if they cointegrate. To test for cointegration we employ the Engle Granger cointegration test where $X_t=\alpha+\beta_t Y_t+\varepsilon_t$ is estimated and from this static regression the residuals are tested for stationarity. In the regression equation X refers to the log of real per capita income and Y refers to the log ratio of government expenditure to GDP. Table 4 reports the results of the stationarity test on the residuals of the static regression just referred to:

TABLE 4

Engle-Granger Co-integration Test: Testing for Unit Roots in the Residuals

Variables	Augmented Dickey-Fuller Statistic		Phillips-Perron Statistic	
	With Trend	No Trend	With Trend	No Trend
URESID	-4.04*	-3.10	-3.31**	-3.47*
TRESID	-2.23	-2.84**	-2.44	-2.48
BRESID	-3.68*	-4.46*	-6.07*	-5.88*
HRESID	-3.61*	-2.25	-1.48	-2.32

Notes: *(**) denotes rejection of the hypothesis at 10%(5%) significance level

The results show that for the United States and Barbados, the variables cointegrate, but for Haiti and Thailand the variables do not cointegrate. The implication of this is that we cannot find a long run relationship between public expenditure and per capita income for Haiti and Thailand. It must be noted that this does not necessarily mean that there is no long run relationship between the two variables since as Murthy (1994) states “ the absence of cointegration and hence any cointegrating vector might suggest the possibility that the test results are period-specific or sensitive to the implied lag structure and omitted variable bias.”

Next we report the results of the Johansen maximum likelihood cointegration technique, however a multivariate system is utilised so that we can make use of an improved model and the test is not overly subjected to the presence of missing variables. For this purpose we incorporate a degree of urbanisation variable[1], URB, to provide a more correct specification of the ‘law’.

Table 5, 6, 7, and 8 summarise the results of the cointegration analysis using the Johansen maximum likelihood procedure for all the countries. The lag order is 1 and was selected using the Schwartz criteria. Three different models are presented, model 1 assumes linear deterministic trend in the data, performing the cointegration regression equation with an intercept and no trend and testing the vector auto regression (VAR). Similarly model 2 assumes linear deterministic trend in the data, but in addition to including an intercept in the cointegration equation it also includes trend though not in the VAR and finally model 3 assumes that there is no deterministic trend in the data, it has an intercept in the cointegrating equation but not in the VAR and it also has a trend in the cointegrating equation. The results are reported in the following tables:

TABLE 5

Johansen and Juselius Cointegration Tests

Variables: USY USX LURB

Model 1				
Eigenvalue	λ	5%critical value	1% critical value	# of CE(s)
0.436223	47.48153	29.68	35.65	None**
0.335149	21.11905	15.41	20.04	At most 1**
0.049643	2.342207	3.76	6.65	At most 2
Model 2				
Eigenvalue	λ	5%critical value	1% critical value	# of CE(s)
0.457764	56.48924	42.44	48.45	None**
0.387313	28.33476	25.32	30.45	At most 1*
0.118449	5.79931	12.25	16.26	At most 2
Model 3				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.542811	72.96003	34.91	41.07	None**
0.356037	36.95775	19.96	24.6	At most 1**
0.304633	16.71251	9.24	12.97	At most 2**

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

Model 1: L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Model 2: L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Model 3: L.R. test indicates 3 cointegrating equation(s) at 5% significance level

TABLE 6

Johansen and Juselius Cointegration Tests

Variables: TY TX LTURB

Model 1				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.446337	29.93787	29.68	35.65	None*
0.124608	5.698679	15.41	20.04	At most 1
0.005892	0.242275	3.76	6.65	At most 2
Model 2				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.477225	41.82252	42.44	48.45	None
0.212099	15.22975	25.32	30.45	At most 1
0.1246	5.456056	12.25	16.26	At most 2
Model 3				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.493178	52.01032	34.91	41.07	None**
0.368109	24.1469	19.96	24.6	At most 1*
0.121826	5.326333	9.24	12.97	At most 2

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

Model 1: L.R. test indicates 1 cointegrating equation(s) at 5% significance level

Model 2: L.R. rejects any cointegrating equation(s) at 5% significance level

Model 3: L.R. test indicates 2 cointegrating equation(s) at 5% significance level

TABLE 7

Johansen and Juselius Cointegration Tests

Variables: BY BX LBURB

Model 1				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.556069	35.98469	29.68	35.65	None**
0.366869	13.24625	15.41	20.04	At most 1
0.015876	0.448081	3.76	6.65	At most 2
Model 2				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.566352	46.12704	42.44	48.45	None*
0.447625	22.7324	25.32	30.45	At most 1
0.196151	6.113633	12.25	16.26	At most 2
Model 3				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.630073	54.87147	34.91	41.07	None**
0.478159	27.02691	19.96	24.6	At most 1**
0.270104	8.815905	9.24	12.97	At most 2

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

Model 1: L.R. test indicates 1 cointegrating equation(s) at 5% significance level

Model 2: L.R. test indicates 1 cointegrating equation(s) at 5% significance level

Model 3: L.R. test indicates 2 cointegrating equation(s) at 5% significance level

TABLE 8

Johansen and Juselius Cointegration Tests

Variables: HY HX LHURB

Model 1				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.563736	38.19711	29.68	35.65	None**
0.384678	14.14139	15.41	20.04	At most 1
.002022	0.05869	3.76	6.65	At most 2
Model 2				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.60299	59.85077	42.44	48.45	None**
0.482809	33.06076	25.32	30.45	At most 1**
0.381639	13.93981	12.25	16.26	At most 2*
Model 3				
Eigenvalue	λ	5% critical value	1% critical value	# of CE(s)
0.587578	48.71727	34.91	41.07	None**
0.384679	23.03176	19.96	24.6	At most 1*
0.265517	8.949053	9.24	12.97	At most 2

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

Model 1: L.R. test indicates 1 cointegrating equation(s) at 5% significance level

Model 2: L.R. test indicates 3 cointegrating equation(s) at 5% significance level

Model 3: L.R. test indicates 2 cointegrating equation(s) at 5% significance level

For all the countries examined there is strong evidence in favour of cointegration. For the United States there are at least two cointegrating vectors, and at most three. In Haiti there is at least one cointegrating vector and at most two. Finally Thailand probably represented the weakest case, with no cointegrating equations found in model two and a maximum of two cointegrating equations in model three. Cointegrating vectors can be seen as constraints that an economic system imposes on the movement of variables in a system in the long run. It therefore follows that more cointegrating vectors ensure greater stability of the system. It is in general more desirable to have a system that is stationary in as may directions as possible. There is statistical support for the presence of a long run relationship between government expenditure and income as hypothesised by Wagner. In general, strict cointegration tests of Wagner's hypothesis require specification of a correct model with an optimal lag structure (Murthy, 1994).

6. CONCLUSION

This paper examines the plausibility of Wagner's 'law' for countries that are diverse in different ways. It presents a discussion of the applicability of the law to countries at various stages of development and with different characteristics. We use the most accepted functional form to test for the existence of the 'law'. The unit roots test show that some of the variables are integrated of order zero in levels. The Engle Granger cointegration test and the Johansen and Juselius maximum likelihood estimation technique of cointegrating vectors are employed to determine whether there is a long run relationship between government spending and income. While the Engle Granger test supports the existence of Wagner's 'law' for only United States and Barbados, the Johansen procedure with an improved model supports the existence of Wagner's 'law' for all countries under all assumptions. The paper finds empirical support for Wagner's hypothesis in four diverse countries. The 'law' may be applicable to a wider range of countries due to advancements in technology and communications.

APPENDIX

Proof that $\eta_4 = \frac{d(G/GNP)}{G/GNP} \div \frac{d(GNP/N)}{GNP/N} = \frac{d(G/N)}{G/N} \div \frac{d(GNP/N)}{GNP/N} - 1$

Let $G/GDP = G/N \times N/GDP = (G/N)/(GDP/N)$

Let $Z = G/GDP$

$X = G/N$

$Y = GDP/N$

Therefore $d \log Y = 1/Y \times dY$

$Z = X/Y$

Therefore $d \log Z = d \log X - d \log Y$

Hence: $dZ/Z = dX/X - dY/Y$

Divide through out by dY/Y:

$\Rightarrow \quad (dZ/Z = dX/X - dY/Y) \div dY/Y$

$\Rightarrow \quad dZ/Z \times Y/dY = d/X/X \times Y/dy - 1$

$\Rightarrow \quad \frac{d(G/GNP)}{G/GNP} \div \frac{d(GNP/N)}{GNP/N} = \frac{d(G/N)}{G/N} \div \frac{d(GNP/N)}{GNP/N} - 1$; *QED*

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[1] Data on the degree of urbanisation are taken from the World Tables (various issues) and for missing observations data was interpolated using a first order procedure.