Title	MODELING THE RELATIONSHIP BETWEEN OUTPUT AND GOVERNMENT EXPENDITURES IN CANADA
Sub Title	
Author	AFXENTIOU, Panes C. SERLETIS, Apostolos
Publisher	Keio Economic Society, Keio University
Publication year	1992
Jtitle	Keio economic studies Vol.29, No.1 (1992.) ,p.17- 43
JaLC DOI	
Abstract	Following a brief examination of the main theories of government growth Wagner's law emerged as the dominant theory and tested in the Canadian context, where both exhaustive and transfer outlays and their major subcategories were covered. Based on the statistical properties of the series the tests were carried out in terms of growth rates. Limited support for Wagner's law in four of its major versions for the insignificant category of transfers to business, and in two versions for exhaustive expenditures alone and in combination with total transfers, was restricted to 1926-1988. No support was established for 1947-1988, the period of real government growth. This absence of statistical robustness undermines confidence even in these cases where some support for this hypothesis was found.
Notes	
Genre	Journal Article
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=AA00260492-19920001-0017

MODELING THE RELATIONSHIP BETWEEN OUTPUT AND GOVERNMENT EXPENDITURES IN CANADA*

Panos C. AFXENTIOU and Apostolos SERLETIS*

Abstract: Following a brief examination of the main theories of government growth Wagner's law emerged as the dominant theory and tested in the Canadian context, where both exhaustive and transfer outlays and their major subcategories were covered. Based on the statistical properties of the series the tests were carried out in terms of growth rates. Limited support for Wagner's law in four of its major versions for the insignificant category of transfers to business, and in two versions for exhaustive expenditures alone and in combination with total transfers, was restricted to 1926–1988. No support was established for 1947–1988, the period of real government growth. This absence of statistical robustness undermines confidence even in these cases where some support for this hypothesis was found.

1. INTRODUCTION

The enormous worldwide growth of government, especially after World War II, could not have been anticipated by the classical economists. Associated with this relative growth of the public sector was an assortment of extra government responsibilities which clearly extended beyond the general classical vision of services from which all people benefit equally and indiscriminately. Irrespective of the important issue of efficiency with which government discharges these responsibilities, the fact remains that an explanation was needed as to why they are undertaken and as to whether there are patterns in public expenditure that systematically tie them with trends in national income. In response to such a challenge for a public expenditure framework, a variety of ideas, with varying degrees of theoretical soundness, have been proposed. Variety, which usually commands a high value in such fields as aesthetics, art and culture, is viewed less highly in science, where it commonly demonstrates a precariousness in knowledge and a rather limited understanding of a phenomenological domain. As a result of this variety it can therefore be stated that we are still far away from a comprehensive theory of government expenditure, and instead we have partial or incomplete theoretical interpretations of the bahavior of the public sector.

Earlier studies on the growth of government did not differentiate between real and nominal terms. While such differentiation is inconsequential under conditions

* We would like to thank an anonymous referee for comments on an earlier version of the paper.

of long term price stability, it becomes crucial in periods of universal inflation which often affects unevenly the cost of the various government activities. Notwithstanding the insights gained from studies conducted in current prices,[1] the emphasis gradually and definitely shifted toward studies in real terms.[2] In addition to this shift, a distinction is made in these studies between exhaustive expenditures, which mainly represent government consumption expenditures, and transfers, which crudely represent the ethical standards of society with regard to income distribution and welfare. Based on this distinction, Beck [1979] found that the size of the public sector in thirteen developed countries over the period 1950–1977 expanded because of transfer outlays, not because of collective consumption, which in most countries exhibited an income elasticity that was smaller than one.[3]

Our study which covers the Canadian experience from 1926 to 1988 is carried out in real terms, and distinguishes between exhaustive and transfers outlays. In this classification of expenditure, it must always be kept in mind that by its very nature government is a wealth-redistributing entity, and that an indeterminate proportion of exhaustive expenditure represents real transfers, as in the case of education. If the difficulties in developing a true production function for the public sector, due to its service orientation, are duly recognized, and a significant economic ineffciency in public service admitted, then inefficiency, however measured, is translated into labour subsidy and automatically becomes a transfer. These issues, however, fall outside our perspective and to a large extent lose their importance when all government spending is examined in aggregate form. When the analysis pursued is applied to disaggregate expenditures, their classification is taken directly from the national accounts and the CANSIM database published by Statistics Canada.

The analysis differs from previous work in two important ways. First, we evaluate empirically (using Dickey-Fuller unit-root tests) the time series properties of the variables involved. Nelson and Plosser (1982) argue that most macroeconomic time series have a unit root (a stochastic trend) and described this property as one of being "difference stationary" (DS) so that the first difference of a time series is stationary. An alternative "trend stationary" (TS) model, where a stationary component is added to a deterministic trend term, has generally been found to be less appropriate. Second, we test Wagner's law in disaggregated data

[1] An examination of the relative size of government in current prices is not necessarily without merit. As argued by Goule [1983] such an examination focusses on the fact that it is the level of expenditures in current prices that has to be financed and which through the government's budget constract has possible repercussions on government borrowing, interest rates, investment, growth, monetary expansion and inflation.

[2] These studies, though more meaningful than studied in current prices, as a rule fail to deal satisfactorily with changes in quality and the introduction of new government services.

[3] The observed expansions of transfers in the industrial countries has led Peltzaman [1980] to the development of a theory of government growth that relies on maximizing bahaviour which emanates from the various "incentives to redistribute wealth politically..." [p. 221].

of government expenditure using autoregressive causality models. Tests are coducted using four different, ad hoc, lag lengths—4, 3, 2, and 1 years—as well as a statistically determined—using Schwarz's (1978) criterion—lag structure.

Before proceeding with the statistical investigation of government spending, it is necessary to evaluate briefly in the next section the principal models of government growth and choose the most prominent among them for our tests. In the third section, the statistical properties of the time series are examined in order to determine the appropriate form of the tests; based on the findings of this section, Granger causality is pursued in the fourth section in which the results obtained are portrayed. The last section is reserved as usually for the conclusions of the paper.

2. THE PRINCIPAL MODELS OF GOVERNMENT GROWTH

In much earlier times when government budgets were balanced it made no difference whether either government revenue or expenditure as a GDP ratio was used in measuring the size of the public sector. The trend toward large budget deficits however has dictated that expenditure ratios be used exclusively for this purpose, and the hypotheses in the literature have either anticipated this trend or tend to reflect this development.[4] In this regard there are four main theories of government spending: (a) Wagner's law; (b) the displacement-concentration hypothesis; (c) the productivity lag theory; and (d) the theory of bureaucracy.

More than a century passed since Adolph Wagner [1883, 1893] advanced the proposition that the evolving complexities of industrialization inexorably lead to an expansion of state activity, and still his thesis continues to occupy the center stage of present-day statistical research. In his grand philosophical framework, a progressive state has its own preferences, but is also systemically connected with the changes in society and promptly adjusts to the requirements of its environment. The rich diversity, which accompanies the increasingly higher forms of social and economic organization, inevitably dictates according to Wagner an expansion of the administrative and protective functions of government so that it be able to cope with increased population density and urbanization growth. Expansion of other activities is also called for so that govenments (i) countervail the power of emerging monopolies; (ii) invest in projects which technologically command large capital outlays; (iii) offer a variety of cultural and welfare services; and (iv) bear the high cost of the international arms race and invest in the highly capital-intensive defense industry.[5]

[4] Keynesianism is generally a theory of economic stabilization, not a theory of government growth. It does not suggest that government in fighting economic fluctuations would necessarily increase or decrease its relative size. While budget imbalances, dictated by fiscal activism, are acceptable on a yearly basis, a Keynesian premise is that over a number of years the budget would be balanced.

[5] A detailed enumeration of the areas of government expansion, as anticipated by A. Wagner, is given by Bird [1971] and Tarchys [1975].

Because deficit financing was not practiced at that time, Wagner foresaw a short term lag between the emerging need for govenment services and their implementation. He was aware that tax revenue constraints might hold back the financing of these services temporarily, but was confident that "in the long run the desire for development of a progressive people will always overcome these financial difficulties."[6] It is clear then that Wagner was basically following the classical tradition whereby taxes are commensurate with the benefits accruing to people from govenment spending, yet he furthered the notion of equilibrium in the public sector in a dynamic way to account for an inevitable expansion of services that was dictated by the process of economic development. Apparently his ideas were rather broad, if not somewhat imprecise, rendering themselves to different interpretations. Nevertheless despite their generality, they are methodologically appealing because they represent government expenditure as dependent on only one variable, namely *GDP* or *GDP* per capita, with an elasticity larger than unity. In this simplicity they cut through the maze of the sociosphere to claim, in the context of this paper, that *GDP* growth is the cause of the growth of the public sector.

The displacement-concentration hypothesis as originally proposed by Peacock and Wiseman [1961] represents a historical examination of the stepwise upward movement in the government/*GDP* ratio, attributing it to major social upheavals which lead to a national crisis—war, in the specific case at hand. There is a close affinity between this hypothesis and Wagner's law as both consider national income to be the strategic explanatory force of government expenditure. Structurally the two hypotheses are different as exemplified by their different conception ragarding the public sector equilibrium and the mechanism which sustains the growth of government. Whereas in Wagner's law the public sector is generally at equilibrium, in the displacement-concentration hypothesis disequilibrium forces are paramount waiting for an opportunity to displace upward government spending; whereas in Wagner's law tax revenue may only temporarily act as a constraint on government spending, tax revenue and tax tolerance are crucial in the displacement effect; and whereas in Wagner's law the relative growth of government is perceived to be rather smooth, the time profile of government spending in the displacement-concentration hypothesis is discontinuous being the result of specific events. The upward displacement produced by these events is not later completely offset, first, because the expanded bureaucracy is better able to assert its interests, and second, because the social upheaval concentrates power at the national level. This concentration of power limits the restaint on taxes provided by competition among localities. Thus a mechanism of government expansion is rooted in a high and increasing centralization of government.

The inherent differences between Wagner's law and the displacement-concentration hypothesis were responsible for two developments, one that led to

[6] Quoted in Musgrave and Peacock [1958, p. 8].

quite distinct methods of testing them, and the other that tended to bring the two hypotheses closely together. More concretely, the testing of Wagner's law proceeds as a straightforward relation between *GDP* or *GDP* per capita and one of the various ways used in measuring government size, whereas the early crude geometric representation of displacement by a sudden shift of government expenditure that coincided with war was later replaced by more sophisticated techniques which were designed to capture statistically the essence of structural breaks [Diamond, 1977]. The trend toward closer affinity between the two hypotheses began with the task of defining what constitutes a major social upheaval, and advanced along with the tendency of researchers to gradually adopt whatever definition suited their purpose. Thus Gupta [1967] used the two World Wars as such upheavals, Nagarajan [1979] considered a "non-global" event as satisfying the requirements of displacement, Bonin et al. [1969] included the great depression among the legitimate upheavals, while Musgrave [1969] and Mann [1975] used displacement in a broader perspective to stand correspondingly for anything that affects people's attitudes toward the public sector or toward ecconomic development. Upheavals act as catalysts which through the inspection effect enable the citizens to realize that their benefits form government spending are in balance with their tax sacrifices. Although the inspection effect effectively thrusts the displacement-concentration hypothesis in the domain of the theories of public choice whereas Wagner's law is built on the premise of a largely organic state which basically determines government spending in line with its evolving needs, it cannot be claimed that the inspection effect is absent from Wagner's law. On the contrary it can be argued that it is ever-present in Wagner's law, compared to its reaching a high intensity during major social upheavals under the displacement-concentration hypothesis. This presence renders the latter hypothesis as an offshoot of the former that may be characterized as a lagged Wagner's hypothesis owing to the time needed for the inspection effect to become operative. The scientific superiority of Wagner's law, enhanced by its simplicity and comprehensive nature, is juxtaposition further amplified by the failure of scholars to agree on the definition of a major social upheaval, a fact which by itself is sufficient to erode irreparably confidence in the displacement-concentration hypothesis.

The productivity lag theory bases its explanation of the relative growth of government on three premises: (1) that for the most part government activities are labour-intensive; (2) that technological improvements have little, if any, impact on the labour-input of public services; and (3) that, in the absence of competitive market pressures, government agencies have little incentive to improve efficiency or productivity. As long as productivity increases significantly faster in the production of material goods, and as long as wage rates are set uniformly economy-wide by the productivity of the private sector, the cost per unit of government output will outpace the per unit cost of the private sector, and as a consequence the same government output can only be produced at an increasing relative cost. Ultimately then, the growth of the public setor is determined by productivity differentials, which have been extensively used in the transmission mechanism of cost increases in models of inflation. The impact of these differentials on the size of the public sector have been emphasized by Martin and Lewis [1956] as well as by Williamson [1961], although it was Baumol [1967] who synthesized in a theoretical framework the analysis of this phenomenon. Traces of the impact of differences in productivity on the size of the public sector are also spotted in Wagner's reference to the high capital intensity of the defense industry, but more than that what transpires from Wagner's reference to defense is the broader inference that changes in the structural composition of government output have important real cost repercussions which impact significantly on the size of government. This inference is more profound than the message of the productivity lag theory which is generally valid only when the size of the public sector is measured in nominal terms. When, however, the measurement is done in real terms, which is what Wagner was really concerned with, the message is invalidated and the theory itself loses its purported relevance.

As for the theory of bureaucracy, it hardly offers a comprehensive explanation of the growth of government spending and even if such a claim is made on its behalf, it would be difficult to substantiate it empirically. According to this theory, the bureaucrats, who are in charge of the administration of the state, employ the monopoly power they enjoy for self-advancement by maximizing the size of their departments [Niskanen, 1971]. In this model, the bureaucrats who value larger budgets always have some power to extract budget dollars from a legislature that values bureaucratic output. The ability to extract unproductive budget dollars is conditioned by the intensity of competition among bureaucrats and among jurisdictions, as well as by the relationship between politicians and bureaucrats. Institutional developments that weaken competition, such as centratlization of governmental functions and the consolidation of governmental functions into fewer bureaus, tend to increase budgets. Similarly the degree of ignorance of legislators, and the direct benefits of politicians from bureaucratic budgets are seen as contributing to government growth.[7] What is rather unconvincing about this theory is its tenet that the promotion of self-interest and prestige of bureaucrats is the primary factor, rather than one of the various factors, responsible for the growth of government. What is missing from it is the realization that in the absence of certain objective conditions that favour government growth the empire-building by bureaucrats is not possible. At best the bureaucrats should be seen as simply taking some advantage of the potential for expansion of the public sector rather than creating the potential itself upon which, in the final analysis, the government size depends. And for bureaucrats to make a difference in the continuous growth of government their influence on government spending should not remain constant but must increase constanly over time. For these reasons the scope of the theory

[7] In view of the public's intolerance for higher taxes needed to finance the expansion of bureaucracy, and the politician's unlikely admission of ignorance in matters of government, it is unrealistic to attribute much significance to the government growth capability of these factors.

of bureaucracy, contrary to its advocates, is rather limited and its real objective sought in accounting for the residual which such conventional demand increasing factors as the size of income, population growth, urbanization and education fail to explain [Borcherding, 1977].

A careful evaluation of the four main theories of government spending suggests the superiority of Wagner's law by virtue of its methodological simplicity and in view of certain major shortcoming that characterize the other three competing theories. More specifically, because (i) the arbitrary definitions of upheavals reduce the displacement-concentration hypothesis into a variation of Wagner's law, (ii) the productivity lag theory is really an explanation of government growth in nominal, not in real terms, and (iii) the rather untestable theory of bureaucracy complements at best other explanations of government growth, Wagner's law emerges as the dominant hypothesis and is used in our statistical tests.

3. UNIVARIATE TESTS FOR UNIT ROOTS

In order to establish the appropriate form in which the tests will be carried out the time series properties of the series are examined in this section. The data under examination consist of gross domestic product (*GDP*), government consumption expenditure (*GCE*) covering all levels of government (i.e., federal, provincial and local), government investment expenditure (*GIE*), total government exhaustive expenditure (*GTE*), which are the summation of the previous two categories, total government transfers (*GTT*), which are divided between government transfers to persons (*GTP*) and government transfers to business (*GTB*)[8]; (*GCE*+*GTP*) are examined also as a group owing to the preponderance of consumption in transfers to persons, in the same way that (*GIE*+*GTB*) are added together due to the investment orientation of government transfers to business; to obtain total government spending the exhaustive and transfer outleys are added giving (*GTE*+*GTT*). In addition to their above from, the data are also examined in per capita terms, dividing through by population (*N*), and the different catagories of government expenditure used in the form of *GDP* ratios as required by the various formulations of Wagner's law.

It is imperative in investigating empirical relationships between variables to determine the order of integration (the number of unit roots) of the individual time series. Several tests for the presence of unit roots in time series data have appeared in the literature (see, for example, Dickey and Fuller [1981], and Phillips and Perron [1988]). In what follows, we test the null hypothesis of a unit root using the simplest Dickey-Fuller test (see Fuller [1976]). Tables 1–3 present the results form estimation (by OLS) the following augmented Dickey-Fuller type regression.

[8] Transfers from one level of government to another do not appear in our analysis because they offset each other; their inclusion would constitute double counting.

TABLE 1. DICKEY-FULLER TESTS FOR AUTOREGRESSIVE UNIT ROOTS

$$Y_t = \hat{\mu} + \hat{\beta}_t + \hat{\alpha} Y_{t-1} + \sum_{i=1}^{k} \hat{c}_i \Delta Y_{t-i} + \hat{\varepsilon}_t$$

Series	$\hat{\mu}$	$t(\hat{\mu})$	$\hat{\beta}$	$t(\hat{\beta})$	$\hat{\alpha}$	$t(\hat{\alpha})$	$S(\hat{e})$
log(*GDP*)	3.138	3.937	0.014	3.919	0.691	−3.911*	0.034
log(*GCE*)	1.829	2.754	0.008	2.444	0.792	−2.690	0.132
log(*GIE*)	0.916	2.595	0.009	2.652	0.850	−2.603	0.146
log(*GTE*)	2.028	2.803	0.009	2.546	0.771	−2.752	0.129
log(*GTP*)	0.833	4.656	0.037	4.048	0.496	−4.200**	0.134
log(*GTB*)	−0.154	−0.855	0.027	2.569	0.683	−2.962	0.415
log(*GTT*)	0.914	4.821	0.037	4.113	0.501	−4.301**	0.109
log(*GCE*+*GTP*)	1.825	2.751	0.008	2.442	0.792	−2.694	0.131
log(*GIE*+*GTB*)	0.918	2.599	0.009	2.657	0.850	−2.604	0.144
log(*GTE*+*GTT*)	2.026	2.804	0.009	2.549	0.772	−1.781	0.128

Note: $t(\hat{\alpha})$ is significant at the **1%, *5% and +10% level. Under the null hypothesis that $\hat{\alpha}=1$, the 1%, 5% and 10% critical values of $t(\hat{\alpha})$ are −4.15, −3.80 and −3.18 for 50 observations—see Fuller [1976, Table 8.5.2].

TABLE 2. DICKEY-FULLER TESTS FOR AUTOREGRESSIVE UNIT ROOTS

$$Y_t = \hat{\mu} + \hat{\beta}_t + \hat{\alpha} Y_{t-1} + \sum_{i=1}^{k} \hat{c}_i \Delta Y_{t-i} + \hat{\varepsilon}_t$$

Series	$\hat{\mu}$	$t(\hat{\mu})$	$\hat{\beta}$	$t(\hat{\beta})$	$\hat{\alpha}$	$t(\hat{\alpha})$	$S(\hat{e})$
log(*GDP*/*N*)	0.304	3.802	0.007	3.682	0.717	−3.670+	0.036
log(*GCE*/*N*)	−0.053	−1.005	0.004	2.071	0.813	−2.597	0.133
log(*GIE*/*N*)	−0.512	−2.670	0.007	2.726	0.829	−2.714	0.144
log(*GTE*/*N*)	−0.043	−0.885	0.005	2.248	0.792	−2.666	0.130
log(*GTP*/*N*)	−3.964	−4.365	0.030	4.288	0.466	−4.487**	0.132
log(*GTB*/*N*)	−2.853	−2.707	0.020	2.390	0.702	−2.893	0.417
log(*GTT*/*N*)	−3.047	−3.898	0.024	3.816	0.577	−4.067*	0.111
log[(*GCE*+*GTP*)/*N*]	−0.053	−1.002	0.004	2.072	0.813	−2.597	0.133
log[(*GIE*+*GTB*)/*N*]	−0.513	−2.676	0.007	2.737	0.829	−2.709	0.142
log[(*GTE*+*GTT*)/*N*]	−0.043	−0.884	0.005	2.250	0.792	−2.670	0.129

Note: $t(\hat{\alpha})$ is significant at the **1%, *5% and +10% level. Under the null hypothesis that $\hat{\alpha}=1$, the 1%, 5% and 10% critical values of $t(\hat{\alpha})$ are −4.15, −3.80 and −3.18 for 50 observations—see Fuller [1976, Table 8.5.2].

$$Y_t = \hat{\mu} + \hat{\beta} t + \hat{\alpha} Y_{t-1} + \sum_{i=1}^{k} \hat{c}_i \Delta Y_{t-i} + \hat{\varepsilon}_t \tag{1}$$

where y is the logarithm of the series.

In practice, the appropriate order of the autoregression, k, is not known. One approach would be to use a model selection procedure based on some information criterion. However, Said and Dickey [1984] showed that the unit root test is valid

TABLE 3. DICKEY-FULLER TESTS FOR AUTOREGRESSIVE UNIT ROOTS

$$Y_t=\hat{\mu}+\hat{\beta}_t+\hat{\alpha}Y_{t-1}+\sum_{i=1}^{k}\hat{c}_i\Delta Y_{t-i}+\hat{\varepsilon}_t$$

Series	$\hat{\mu}$	$t(\hat{\mu})$	$\hat{\beta}$	$t(\hat{\beta})$	$\hat{\alpha}$	$t(\hat{\alpha})$	$S(\hat{e})$
$\log(GCE/GDP)$	−0.294	−2.451	−0.000	−0.999	0.788	−2.787	0.121
$\log(GIE/GDP)$	−0.633	−2.672	0.002	1.704	0.847	−2.628	0.143
$\log(GTE/GDP)$	−0.306	−2.545	−0.000	−0.821	0.765	−2.834	0.115
$\log(GTP/GDP)$	−4.612	−5.013	0.015	4.517	0.456	−5.132**	0.140
$\log(GTB/GDP)$	−3.451	−2.893	0.012	2.093	0.675	−3.066	0.409
$\log(GTT/GDP)$	−4.776	−5.376	0.016	4.886	0.426	−5.519**	0.116
$\log[(GCE+GTP)/GDP]$	−0.293	−2.449	−0.000	−0.983	0.788	−2.778	0.120
$\log[(GIE+GTB)/GDP]$	−0.633	−2.672	0.002	1.723	0.847	−2.624	0.142
$\log[(GTE+GTT)/GDP]$	−0.306	−2.544	−0.000	−0.798	0.765	−2.834	0.115

Note: $t(\hat{\alpha})$ is significant at the **1%, *5% and +10% level. Under the null hypothesis that $\hat{\alpha}=1$, the 1%, 5% and 10% critical values of $t(\hat{\alpha})$ are −4.15, −3.80 and −3.18 for 50 observations—see Fuller [1976, Table 8.5.2].

asymptotically if k is increased with sample size (T) at a controlled rate ($T^{1/3}$). For our sample size, this translates into $k=4$.

Turning to the results, and using the critical values tabulated by Fuller [1976], the null hypothesis that $\hat{\alpha}=1$ cannot be rejected except perhaps for GTP and GTT. Thus, we can conclude that the variables are integrated of order one (i.e., they have a stochastic trend). Following this finding we proceed in the next section to examine the rationale of Granger causality, which is suited to testing Wagner's law, and to clarify the reason why the given specification satisfies the requirements for the application of asymptotic distribution theory.

4. GRANGER CAUSALITY TESTS

In this section we report the results of applying several standard tests of the Granger causality relation between the above variables in the context of Wagner's law. In the Granger sense (see Granger [1969]) a variable Y causes another variable X with respect to a given information set that includes X and Y, if X is better predicted by adding the past Y time series to the past X time series than by using the past X series alone.

Consider the following specification (with $I(0)$ variables):

$$\Delta \log X_t=\alpha_0+\sum_{i=1}^{r}\alpha_i\,\Delta \log X_{t-i}+\sum_{j=1}^{s}\beta_j\,\Delta \log Y_{t-j}+u_t \tag{2}$$

The parameters in the specification are α_0, α_i and β_j. Causal relationships would appear to enter this model in a very natural way. For example, if $\beta_j=0$ for all $j=1,\cdots,s$, then Δ log Y_i does not cause Δ log X_t. Thus, one could determine the causal relationships between the variables of interest by simply carrying out standard F-tests. The distrubance term u_t, however, in the above equation, must be white noise to make the said test statistic an asymptotic F distribution. This requirement is satisfied here since the growth rates of the variables are used (in view of the finding in the previous section that the variables are integrated of order 1).

The main difficulty in fitting model (2) is determining the appropriate lag lengths. In the literature r and s are frequently chosen to have the same value, and lag lengths of 1, 2, 3 and 4 are often used. However, such arbitrary lag specifications can produce misleading results as they may imply misspecification of the order of the autoregressive process. For example if either r or s (or both) is too large, the estimates will be unbiased, but inefficient. If either r or s (or both) is too small, the estimates will be biased but will have a smaller variance.

Here, we tried four different commonly chosen lag lengths—1, 2, 3 and 4 lags. In addition, we used the data to determine the "optimum" lag structure. In particular, the optimal r and s in equation (2) was determined using Schwarz's (SC) criterion—ser Schwarz [1978]. The SC criterion is defined as

$$SC(r, s) = T \log(SSR/T) + (r + s + 1) \log T$$

where T is the number of observations and SSR is the sum of squared residuals.

The results, presented in Tables 4–13, relate to the different interpretations that emanated naturally from the general, if not vague, manner in which Wagner presented his ideas. According to Gandhi [1971] and Mann [1980] these interpretations of Wagner's law appear as six different versions, given below, along with the name of the corresponding chief advocate.

(a)	$GTE = f(GDP)$	Peacock-Wiseman [1961]
(b)	$GCE = f(GDP)$	Pryor [1968]
(c)	$GTE = f(GDP/N)$	Goffman [1968]
(d)	$GTE/GDP = f(GDP/N)$	Musgrave [1969]
(e)	$GTE/N = f(GDP/N)$	Gupta [1967] and Michas [1975]
(f)	$GTE/GDP = f(GDP)$	Mann's [1980] "modified" Peacock-Wiseman version

In our tests, based on Wagner's reasoning, causality is hypothesized to run from GDP or GDP/N to the dependent variable, which takes four different froms. For a complete examination of the issue, the principal dependent variable (i.e., government spending) was allowed to stand separately for all exhaustive and transfer outlays, for their sum, as well as for each of their main consituent parts. Whether transfers should be included or not in the public sector is still debated in public finance. For some, like Bird [1970, p. 18] and Musgrave and Musgrave [1984, p. 134], their inclusion overstates the size of government expenditure, which

TABLE 4. GRANGER CAUSALITY TESTS BASED ON THE PEACOCK-WISEMAN AND PRYOR FORMULATIONS—TIME PERIOD 1926–1988

Variable		*F*-ratio				*SC* lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta \log(GTE)$	$\Delta \log(GDP)$	3.532 [.065]	1.606 [.192]	1.015 [.393]	1.042 [.395]	(1, 0) NL
$\Delta \log(GCE)$	$\Delta \log(GDP)$	2.925 [.092]	1.487 [.234]	0.920 [.437]	0.882 [.481]	(1, 0) NL
$\Delta \log(GIE)$	$\Delta \log(GDP)$	0.921 [.341]	1.001 [.374]	0.506 [.679]	0.643 [.634]	(1, 0) NL
$\Delta \log(GTP)$	$\Delta \log(GDP)$	2.719 [.104]	3.691* [.031]	2.662 [.057]	2.331 [.068]	(1, 0) NL
$\Delta \log(GTB)$	$\Delta \log(GDP)$	7.636* [.007]	3.542* [.035]	3.424* [.023]	2.618* [.046]	(1, 1) 7.636* [.007]
$\Delta \log(GTT)$	$\Delta \log(GDP)$	0.004 [.949]	0.882 [.419]	2.033 [.120]	1.122 [.356]	(1, 0) NL
$\Delta \log(GCE+GTP)$	$\Delta \log(GDP)$	2.929 [.092]	1.487 [.234]	0.920 [.437]	0.882 [.481]	(1, 0) NL
$\Delta \log(GIE+GTB)$	$\Delta \log(GDP)$	1.020 [.316]	1.050 [.356]	0.513 [.675]	0.649 [.630]	(1, 0) NL
$\Delta \log(GTE+GTT)$	$\Delta \log(GDP)$	3.526 [.065]	1.693 [.193]	1.009 [.396]	1.039 [.396]	(1, 0) NL

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate autoregressive processes. ii) NL = no lag chosen. iii) p-values of the F-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the F distribution under the null are (1, 58), (2, 55), (3, 52) and (4, 49) for the 1, 2, 3 and 4 lag cases, respectively.

TABLE 5. Granger Causality Tests Based on the Peacock-Wiseman and Pryor Formulations—Time Period 1947–1988

Variable		F-ratio				SC lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta\log(GTE)$	$\Delta\log(GDP)$	0.241 [.626]	1.558 [.224]	1.611 [.206]	0.991 [.428]	(4, 0) NL
$\Delta\log(GCE)$	$\Delta\log(GDP)$	0.056 [.814]	1.322 [.279]	1.467 [.242]	0.585 [.676]	(4, 0) NL
$\Delta\log(GIE)$	$\Delta\log(GDP)$	1.893 [.176]	1.214 [.309]	0.856 [.473]	0.469 [.757]	(1, 0) NL
$\Delta\log(GTP)$	$\Delta\log(GDP)$	0.064 [.801]	2.880 [.069]	2.504 [.076]	1.786 [.158]	(1, 0) NL
$\Delta\log(GTB)$	$\Delta\log(GDP)$	0.333 [.567]	1.182 [.318]	0.928 [.438]	1.009 [.418]	(1, 0) NL
$\Delta\log(GTT)$	$\Delta\log(GDP)$	0.000 [.986]	2.646 [.085]	2.399 [.086]	1.734 [.169]	(1, 0) NL
$\Delta\log(GCE+GTP)$	$\Delta\log(GDP)$	0.064 [.801]	1.353 [.271]	1.495 [.234]	0.572 [.685]	(4, 0) NL
$\Delta\log(GIE+GTB)$	$\Delta\log(GDP)$	1.881 [.178]	1.216 [.308]	0.855 [.474]	0.471 [.756]	(1, 0) NL
$\Delta\log(GIE+GTB)$	$\Delta\log(GDP)$	1.881 [.178]	1.216 [.308]	0.855 [.474]	0.471 [.756]	(1, 0) NL
$\Delta\log(GTE+GTT)$	$\Delta\log(GDP)$	0.240 [.627]	1.587 [.218]	1.627 [.202]	1.040 [.403]	(4, 0) NL

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate processes. ii) NL = no lag chosen. iii) p-values of the F-ratios are in brackes. iv) *indicates significance at the 5% level. iv) *indicates significance at the 5% level. v) The degrees of freedom of the F distribution under the null are (1, 38), (2, 35), (3, 32) and (4, 29) for the 1, 2, 3 and 4 lag cases, respectively.

Table 6. Granger Causality Tests Based on Goffman's (1968) Formulation—Time Period 1926–1988

Variable		F-ratio				SC lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta\log(GTE)$	$\Delta\log(GDP/N)$	3.416 [.069]	1.635 [.204]	1.085 [.363]	1.159 [.340]	(1, 0) NL
$\Delta\log(GCE)$	$\Delta\log(GDP/N)$	2.879 [.095]	1.461 [.240]	1.029 [.387]	1.020 [.406]	(1, 0) NL
$\Delta\log(GIE)$	$\Delta\log(GDP/N)$	0.603 [.440]	0.890 [.416]	0.411 [.745]	0.583 [.676]	(1, 0) NL
$\Delta\log(GTP)$	$\Delta\log(GDP/N)$	2.572 [.114]	3.419* [.039]	2.376 [.080]	2.252 [.076]	(1, 0) NL
$\Delta\log(GTB)$	$\Delta\log(GDP/N)$	8.324* [.005]	3.959* [.024]	3.643* [.018]	2.750* [.038]	(1, 1) 8.324* [.005]
$\Delta\log(GTT)$	$\Delta\log(GDP/N)$	0.000 [.982]	0.760 [.472]	1.714 [.175]	0.991 [.421]	(1, 0) NL
$\Delta\log(GCE+GTP)$	$\Delta\log(GDP/N)$	2.883 [.094]	1.462 [.240]	1.029 [.387]	1.021 [.405]	(1, 0) NL
$\Delta\log(GIE+GTB)$	$\Delta\log(GDP/N)$	0.682 [.412]	0.933 [.399]	0.414 [.743]	0.586 [.674]	(1, 0) NL
$\Delta\log(GTE+GTT)$	$\Delta\log(GDP/N)$	3.413 [.069]	1.633 [.204]	1.081 [.365]	1.555 [.201]	(1, 0) NL

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate autoregressive processes. ii) NL = no lag chosen. iii) p-values of the F-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the F distribution nuder the unll are (1, 58), (2, 55), (3, 52) and (4, 49) for the 1, 2, 3 and 4 lag cases, respectively.

Table 7. Granger Causality Tests Based on Goffman's (1968) Formulations—Time Period 1947–1988

Variable		*F*-ratio				*SC* lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta \log(GTE)$	$\Delta \log(GDP/N)$	0.186 [.668]	0.630 [.538]	1.604 [.207]	0.830 [.517]	(1, 0) NL
$\Delta \log(GCE)$	$\Delta \log(GDP/N)$	0.076 [.784]	0.558 [.577]	1.319 [.285]	0.477 [.752]	(1, 0) NL
$\Delta \log(GIE)$	$\Delta \log(GDP/N)$	0.966 [.331]	0.371 [.692]	0.908 [.448]	0.642 [.636]	(1, 0) NL
$\Delta \log(GTP)$	$\Delta \log(GDP/N)$	0.154 [.696]	3.620* [.037]	2.554 [.072]	1.771 [.161]	(1, 0) NL
$\Delta \log(GTB)$	$\Delta \log(GDP/N)$	0.497 [.485]	1.834 [.174]	1.469 [.241]	1.772 [.343]	(1, 0) NL
$\Delta \log(GTT)$	$\Delta \log(GDP/N)$	0.006 [.938]	3.004 [.062]	2.169 [.110]	1.628 [.193]	(1, 0) NL
$\Delta \log(GCE+GTP)$	$\Delta \log(GDP/N)$	0.083 [.774]	0.577 [.566]	1.339 [.279]	0.459 [.765]	(1, 0) NL
$\Delta \log(GIE+GTB)$	$\Delta \log(GDP/N)$	0.951 [.335]	0.370 [.693]	0.895 [.454]	0.636 [.640]	(1, 0) NL
$\Delta \log(GTE+GTT)$	$\Delta \log(GDP/N)$	0.186 [.668]	0.649 [.528]	1.619 [.204]	0.874 [.491]	(1, 0) NL

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate processes. ii) NL = no lag chosen. iii) p-values of the F-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the F distribution under the null are (1, 38), (2, 35), (3, 32) and (4, 29) for the 1, 2, 3 and 4 lag cases, respectively.

Table 8. GRANGER CAUSALITY TESTS BASED ON MUSGRAVE'S (1969) FORMULATION—TIME PERIOD 1926–1988

Variable		*F*-ratio				*SC* lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta \log(GTE/GDP)$	$\Delta \log(GDP/N)$	3.833 [.055]	1.906 [.158]	1.380 [.259]	1.381 [.254]	(1, 1) 3.833 [.055]
$\Delta \log(GCE/GDP)$	$\Delta \log(GDP/N)$	3.351 [.072]	1.730 [.186]	1.377 [.260]	1.274 [.292]	(1. 0) NL
$\Delta \log(GIE/GDP)$	$\Delta \log(GDP/N)$	0.004 [.949]	0.303 [.739]	0.135 [.938]	0.311 [.869]	(1, 0) NL
$\Delta \log(GTP/GDP)$	$\Delta \log(GDP/N)$	2.517 [.118]	2.689 [.076]	2.114 [.109]	2.136 [.090]	(1, 0) NL
$\Delta \log(GTB/GDP)$	$\Delta \log(GDP/N)$	4.756* [.033]	2.281 [.111]	2.809* [.048]	2.178 [.085]	(1, 1) 2.517 [.118]
$\Delta \log(GTT/GDP)$	$\Delta \log(GDP/N)$	0.053 [.818]	0.579 [.563]	1.669 [.185]	0.920 [.459]	(1, 0) NL
$\Delta \log[(GCE+GTP)/GDP]$	$\Delta \log(GDP/N)$	3.346 [.072]	1.727 [.187]	1.376 [.260]	1.274 [.292]	(1, 0) NL
$\Delta \log[(GIE+GTB)/GDP]$	$\Delta \log(GDP/N)$	0.010 [.920]	0.334 [.717]	0.133 [.939]	0.309 [.870]	(1, 0) NL
$\Delta \log[(GTE+GTT)/GDP]$	$\Delta \log(GDP/N)$	3.834 [.055]	1.907 [.158]	1.381 [.258]	1.382 [.253]	(1, 1) 3.834 [.055]

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate autoregressive processes. ii) NL = no lag chosen. iii) *p*-values of the *F*-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the *F* distribution under the null are (1, 58), (2, 55), (3, 52) and (4, 49) for the 1, 2, 3 and 4 lag cases, respectibely.

Table 9. GRANGER CAUSALITY TESTS BASED ON MUSGRAVE'S (1969) FORMULATION—TIME PERIOD 1947–1988

Variable		*F*-ratio				*SC* lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta\log(GTE/GDP)$	$\Delta\log(GDP/N)$	0.782 [.382]	1.156 [.326]	1.875 [.153]	0.954 [.447]	(1, 1) 0.728 [.382]
$\Delta\log(GCE/GDP)$	$\Delta\log(GDP/N)$	0.765 [.387]	1.116 [.338]	1.789 [.169]	0.720 [.585]	(1, 1) 0.765 [.387]
$\Delta\log(GIE/GDP)$	$\Delta\log(GDP/N)$	2.126 [.153]	0.648 [.529]	1.075 [.373]	0.710 [.591]	(1, 1) 2.126 [.153]
$\Delta\log(GTP/GDP)$	$\Delta\log(GDP/N)$	0.016 [.900]	4.285* [.021]	2.964* [.046]	1.864 [.143]	(1, 1) 0.016 [.900]
$\Delta\log(GTB/GDP)$	$\Delta\log(GDP/N)$	0.634 [.430]	1.488 [.239]	1.189 [.329]	1.012 [.417]	(1, 1) 0.634 [.430]
$\Delta\log(GTT/GDP)$	$\Delta\log(GDP/N)$	0.243 [.624]	3.631* [.036]	2.562 [.072]	1.703 [.176]	(1, 1) 0.243 [.624]
$\Delta\log[(GCE+GTP)/GDP]$	$\Delta\log(GDP/N)$	0.765 [.387]	1.123 [.336]	1.793 [.168]	0.731 [.578]	(1, 1) 0.765 [.387]
$\Delta\log[(GIE+GTB)/GDP]$	$\Delta\log(GDP/N)$	2.092 [.156]	0.647 [.529]	1.059 [.380]	1.700 [.598]	(1, 1) 2.092 [.156]
$\Delta\log[(GTE+GTT)/GDP]$	$\Delta\log(GDP/N)$	0.779 [.382]	1.158 [.325]	1.878 [.153]	0.954 [.447]	(1, 1) 0.779 [.382]

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate processes. ii) NL = no lag chosen. iii) p-values of the F-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the F distribution under the null are (1, 38), (2, 35), (3, 32) and (4, 29) for the 1, 2, 3 and 4 lag cases, respectively.

Table 10. GRANGER CAUSALITY TESTS BASED ON GUPTA'S (1967) AND MICHAS'S (1975) FORMULATION—TIME PERIOD 1928—1988

Variable		F-ratio				SC lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta \log(GTE/N)$	$\Delta \log(GDP/N)$	3.361 [.071]	1.618 [.207]	1.101 [.357]	1.159 [.340]	(1, 0) NL
$\Delta \log(GCE/N)$	$\Delta \log(GDP/N)$	2.815 [.098]	1.450 [.243]	1.053 [.377]	1.022 [.405]	(1, 0) NL
$\Delta \log(GIE/N)$	$\Delta \log(GDP/N)$	0.659 [.420]	0.915 [.406]	0.446 [.721]	0.629 [.644]	(1, 0) NL
$\Delta \log(GTP/N)$	$\Delta \log(GDP/N)$	2.460 [1.22]	3.276* [.045]	2.318 [.086]	2.176 [.085]	(1, 0) NL
$\Delta \log(GTB/N)$	$\Delta \log(GDP/N)$	8.346* [.005]	4.001* [.023]	3.674* [.017]	2.774* [.037]	(1, 1) 8.346* [.005]
$\Delta \log(GTT/N)$	$\Delta \log(GDP/N)$	0.002 [.964]	0.699 [.501]	1.674 [.183]	0.985 [.424]	(1, 0) NL
$\Delta \log[(GCE+GTP)/N]$	$\Delta \log(GDP/N)$	2.809 [.099]	1.446 [.244]	1.050 [.378]	1.020 [.406]	(1, 0) NL
$\Delta \log[(GIE+GTB)/N]$	$\Delta \log(GDP/N)$	0.744 [.391]	0.960 [.389]	0.448 [.719]	0.632 [.642]	(1, 0) NL
$\Delta \log[(GTE+GTT)/N]$	$\Delta \log(GDP/N)$	3.360 [.071]	1.618 [.207]	1.100 [.357]	1.158 [.340]	(1, 0) NL

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate autoregressive processes. ii) NL = no lag chosen. iii) p-values of the F-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the F distribution under the null are (1, 58), (2, 55), (3, 52) and (4, 49) for the 1, 2, 3 and 4 lag cases, respectively.

Table 11. GRANGER CAUSALITY TESTS BASED ON GUPTA'S (1967) AND MICHAS'S (1975) FORMULATION—TIME PERIOD 1947–1988

Variable		F-ratio				SC lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta\log(GTE/N)$	$\Delta\log(GDP/N)$	0.270 [.606]	0.684 [.511]	1.447 [.247]	0.797 [.536]	(1, 1) 0.270 [.606]
$\Delta\log(GCE/N)$	$\Delta\log(GDP/N)$	0.114 [.737]	0.566 [.572]	1.172 [.335]	0.541 [.706]	(1, 1) 0.114 [.737]
$\Delta\log(GIE/N)$	$\Delta\log(GDP/N)$	0.961 [.333]	0.274 [.761]	0.848 [.477]	0.647 [.633]	(1, 1) 0.961 [.333]
$\Delta\log(GTP/N)$	$\Delta\log(GDP/N)$	0.105 [.747]	3.595* [.038]	2.607 [.068]	1.773 [.161]	(1, 1) 0.105 [.747]
$\Delta\log(GTB/N)$	$\Delta\log(GDP/N)$	0.507 [.480]	1.910 [.163]	1.505 [.231]	1.193 [.334]	(1, 1) 0.507 [.480]
$\Delta\log(GTT/N)$	$\Delta\log(GDP/N)$	0.001 [.974]	2.902 [.068]	2.198 [.167]	1.162 [.347]	(1, 1) 0.001 [.974]
$\Delta\log[(GCE/GTP)/N]$	$\Delta\log(GDP/N)$	0.114 [.737]	0.571 [.570]	1.175 [.334]	0.547 [.702]	(1, 1) 0.114 [.737]
$\Delta\log[(GIE/GTB)/N]$	$\Delta\log(GDP/N)$	0.952 [.335]	0.273 [.762]	0.832 [.486]	0.638 [.639]	(1, 1) 0.952 [.335]
$\Delta\log[(GTE/GTT)/N]$	$\Delta\log(GDP/N)$	0.268 [.607]	0.689 [.508]	1.448 [.247]	0.797 [.536]	(1, 1) 0.268 [.607]

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate processes. ii) NL = no lag chosen. iii) p-values of the F-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the F distribution under the null are (1, 38), (2, 35), (3, 32) and (4, 29) for the 1, 2, 3 and 4 lag cases, respectively.

Table 12. GRANGER CAUSALITY TESTS BASED ON MANN'S (1980) "MODIFIED" VERSION OF THE PEACOCK-WISEMAN FORMULATION—TIME PERIOD 1926–1988

Variable		*F*-ratio				*SC* lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta \log(GTE/GDP)$	$\Delta \log(GDP)$	3.937 [.051]	1.976 [.148]	1.290 [.287]	1.255 [.300]	(1, 1) 3.937 [.051]
$\Delta \log(GCE/GDP)$	$\Delta \log(GDP)$	3.393 [.070]	1.769 [.180]	1.246 [.302]	1.125 [.355]	(1, 0) NL
$\Delta \log(GIE/GDP)$	$\Delta \log(GDP)$	0.049 [.825]	0.335 [.716]	0.143 [.933]	0.288 [.884]	(1, 0) NL
$\Delta \log(GTP/GDP)$	$\Delta \log(GDP)$	2.696 [.106]	2.988 [.058]	2.424 [.076]	2.274 [.073]	(1, 0) NL
$\Delta \log(GTB/GDP)$	$\Delta \log(GDP)$	4.208* [.044]	1.930 [.154]	2.618 [.060]	2.066 [.099]	(1, 1) 4.208* [.044]
$\Delta \log(GTT/GDP)$	$\Delta \log(GDP)$	0.085 [.771]	0.754 [.475]	1.985 [.127]	1.047 [.392]	(1, 0) NL
$\Delta \log[(GCE+GTP)/GDP]$	$\Delta \log(GDP)$	3.386 [.070]	1.766 [.180]	1.245 [.302]	1.125 [.355]	(1, 0) NL
$\Delta \log[(GIE+GTB)/GDP]$	$\Delta \log(GDP)$	0.068 [.795]	0.369 [.693]	0.143 [.933]	0.288 [.884]	(1, 0) NL
$\Delta \log[(GTE+GTT)/GDP]$	$\Delta \log(GDP)$	3.937 [.051]	1.977 [.148]	1.290 [.287]	1.255 [.300]	(1, 1) 3.937 [.051]

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate autoregressive processes. ii) NL = no lag chosen. iii) p-values of the F-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the F distribution under the null are (1, 58), (2, 55), (3, 52) and (4, 49) for the 1, 2, 3 and 4 lag cases, respectively.

Table 13. GRANGER CAUSALITY TESTS BASED ON MANN'S (1980) "MODIFIED" VERSION OF THE PEACOCK-WISEMAN FORMULATION—TIME PERIOD 1947–1988

Variable		*F*-ratio				*SC* lags
Effect	Cause	1 lag	2 lags	3 lags	4 lags	
$\Delta \log(GTE/GDP)$	$\Delta \log(GDP)$	0.731 [.397]	1.959 [.156]	2.273 [.098]	1.181 [.339]	(1, 1) 0.731 [.397]
$\Delta \log(GCE/GDP)$	$\Delta \log(GDP)$	0.550 [.462]	1.708 [.195]	2.262 [.100]	0.869 [.494]	(1, 1) 0.550 [.462]
$\Delta \log(GIE/GDP)$	$\Delta \log(GDP)$	2.943 [.094]	1.545 [.227]	1.103 [.362]	0.662 [.623]	(1, 1) 2.943 [.094]
$\Delta \log(GTP/GDP)$	$\Delta \log(GDP)$	0.009 [.924]	3.540* [.039]	2.551 [.072]	1.643 [.190]	(1, 1) 0.009 [.924]
$\Delta \log(GTB/GDP)$	$\Delta \log(GDP)$	0.405 [.528]	0.903 [.414]	0.651 [.588]	0.834 [.514]	(1, 1) 0.405 [.528]
$\Delta \log(GTT/GDP)$	$\Delta \log(GDP)$	0.204 [.654]	3.269* [.049]	2.411 [.085]	1.578 [.206]	(1, 1) 0.204 [.654]
$\Delta \log[(GCE+GTP)/GDP]$	$\Delta \log(GDP)$	0.549 [.463]	1.718 [.194]	2.270 [.099]	0.881 [.487]	(1, 1) 0.549 [.463]
$\Delta \log[(GIE+GTB)/GDP]$	$\Delta \log(GDP)$	2.912 [.096]	1.546 [.227]	1.095 [.365]	0.659 [.625]	(1, 1) 2.912 [.096]
$\Delta \log[(GTE+GTT)/GDP]$	$\Delta \log(GDP)$	0.726 [.399]	1.966 [.155]	2.282 [.097]	1.185 [.338]	(1, 1) 0.726 [.399]

Notes: i) Numbers in parentheses indicate the optimal lag order of the bivariate processes. ii) NL = no lag chosen. iii) *p*-values of the *F*-ratios are in brackets. iv) *indicates significance at the 5% level. v) The degrees of freedom of the *F* distribution under the null are (1, 38), (2, 35), (3, 32) and (4, 29) for the 1, 2, 3 and 4 lag cases, respectively.

for others, like Buchanan and Flowers [1987, p. 63] who see no useful purpose served by the distinction between productive expenditures and transfers, their incorporation into the public sector appears self-evident. It is true that Wagner made reference to an expected growth of welfare expenditures, but their significance in his system was minor in comparison to the envisaged growth of the other classes of government spending. It is therefore reasonable to argue, along with Ram [1987], that in Wagner's spirit the public sector should be measured by exhaustive expenditure alone. Understandably Wagner could not conceivably perceive in his time the contemporary dimensions of transfers, which express the concerns of modern society for more equality in income distribution. Yet their impact on the overall government system, at least on administrative costs, cannot be overlooked without distorting the size of government.[9] For this reason, and because in causality terms transfers are expected to depend on *GDP* probably more directly than exhaustive expenditure, they are covered in this paper without any need for further justification.

The functional from $GTE = f(GDP)$ is representative of Peacock-Wiseman who relied on the visual charting of the relationship between public spending and income. In our causality examination the tests were extended to all other subcategories of spending and the transfers, which whenever appropriate were added to the different dependent variables. Because government consumption expenditure (*GCE*) as the largest component of all public spending is seen by Pryor to exemplify Wagner's spirit, the results of Tables 4 and 5 apply similtaneously to our first two versions of Wagner's law. It is clear that in the aggregate formulations there is no corroboration of causality for either the Peacock-Wiseman or for the Pryor versions during 1926–1988 or the post World War II period. *GDP* growth is not found to Granger cause either *GTE* or *GCE* growth individually or when respectively their growth is measured after total transfers (*GTT*) and transfers to persons (*GTP*) are added to them. Causality is established from *GDP* growth to the growth of transfers to persons with two lags and from *GDP* growth to the growth of transfers to business with all lags tested over the period 1926–1988. The fact that these causality relations were not validated for 1947–1988 suggests that their importance was mainly restricted to the pre-war years when the dollar amounts of transfers were very minor in comparison to the post-war period when the levelling spirit was in full swing.

Tables 6 and 7 show the results from the application of Goffman's version not only to aggregates but also to subcategories of government experiditure whose absolute real dollar values are functionally dependent on per capita *GDP*. There is little difference in these causality results from those based on the previous two versions. While the causality results for 1926–1988 are parallel with those under

[9] There is an inevitable administrative interconnectedness between exhaustive and transfer outlays. Though it is difficult to estimate the magnitude of this interconnectedness, a valid argument can be made that in the extreme case of zero transfers the level of exhaustive expenditures would be ceteris paribus lower.

the Peacock-Wiseman and Pryor versions, there is also causality from *GDP/N* growth to the growth of transfers to persons with two lags for the postwar years. The statistical significance of transfers to persons in the post-war period is repeated under Musgrave's formulation, with two and three lags (see Table 9), but in the formulation, in which all expenditures are expressed as *GDP* ratios, causality is also found for the growth of total transfers with two lags. However the evidence of the importance of transfers during 1947–1988 in Musgrave's version of Wagner's law weakens during the period 1926–1988 (see Table 8) when causality is only found between the rate of *GDP/N* and the rate of growth of the rather insignificant category of transfers to business.

The Gupta and Michas formulation, which is structurally similar to the Peacock-Wiseman version except for employing the variables in per capita terms, gives also similar results for the period 1926–1988 (Table 10), i.e., finding causality from *GDP/N* growth to *GTB/N* growth for all lags tested and from *GDP/N* growth to *GTP/N* growth with two lags; the main difference in the results between these two formulations arises from the growth of transfers to persons, which were found not to be causally related to *GDP* growth under the Peacock-Wiseman version in the 1947–1988 period, but are shown in Table 11 to be causally related with two lags when per capita growth rates of the variables are used. In Mann's "modified" version of the Peacock-Wiseman formulation, we see in Table 12 evidence of causality from *GDP* growth to the growth of the *GDP* ratio to business transfers with one lag for the period 1926–1988. Moreover we also see in Table 13 that in the post-war years the growth of *GDP* contributed positively to the growth of the *GDP* ratios of total transfers and transfers to persons, in both cases with two lags.

All statistical results cited above suggest that causality is not pervasive but rather limited, and when not rejected it is in cases not involving the relatively important expenditure aggregates, but the rather smaller subcategories of government spending. Furthermore, even in these cases the reliability of these results must be seen as somewhat tempered by the fact that in testing for causality we followed a procedure in which the lags were decided in advance. Even though this procedure is commonly followed in empirical work, this predetermined lag structure involves an undesirable degree of arbitrariness that should be avoided. For this reason in selecting the appropriate lag structure we also empolyed in our tests the Schwarz criterion, which compared to other available statistical criteria, usually reaches a well-defined global minimum with a fairly parsimonious parameterization and has the advantage that its asymptotic probability of overestimating the true size of a model is often zero [see Yi and Judge, 1988].

Based on this criterion, we found that at the 5 per cent level the null hypothesis of no causality could be rejected only with respect to the growth of business transfers for the period 1926–1988 in four out of six versions, namely, in Peacock-Wiscman, Goffman, Gupta and Michas, and the modified Peacock-Wiseman version by Mann. No evidence of causality between the growth of business transfers and the growth of *GDP* in the different forms suggested by each version was found in the postwar years. Besides business transfers, which represent a small proportion of total government spending, particularly in the pre-war years, we found that the null hypothesis of no causality could not be rejected at the 5 per cent level with respect to the growth of government exhaustive expenditures alone and when increased by total transfers for 1926–1988 in two versions, namely, in Musgrave's and in Mann's modified Peacock-Wiseman formulation of Wagner's law; again there was no causality evidence for these two broad classes of government expenditures in the post-war period 1947–1988. Beyond these cases no other causality evidence was established from the application of the Schwarz criterion to our data.[10]

How do our results compare with other tests of Wagner's law in Canada? A meaningful comparison presupposes some degree of uniformity in the methods employed by the various researchers. A look at the work of Gupta [1967], Bird [1970], Beck [1981], Sahni and Singh [1984], and Ram [1986] shows that there is no common-method denominator that unifies these investigations of the Canadian government expenditure and *GDP* relationship. These studies come out in support of Wagner's law, yet excepting Sahni and Singh [1984] and Ram [1986] who employed causality tests, the others either used simple regression techniques or considered the application of sophisticated techniques unfruitful in the face of the enormous complications surrounding the issues of government spending that actually prevent any clear-cut isolation of the influences which ultimately determine the size of the public sector [see Bird, 1970]. Even the results of Sahni and Singh are not comparable to ours because their data were taken from different sources, being gross for some years and net for other years, while their model specification was different from ours in that it accounted for displacements during the depression and World War II; their results cannot thus be regarded as a real test of Wagner's law. We are therefore justified in claiming a certain uniqueness for our results, which cover a much wider range of issues and time than our comparable study [Afxentiou and Serletis, 1991] which was confined totally to aggregate exhaustive expenditure during the period 1947–1986.

[10] A glance at some figures will convey to the reader the dimensions of some of the variables involved. For example, transfers to business amounted to 0.79 of one per cent of *GDP*, and 14.19 per cent of total transfers over the period 1929—1988; from 1926 to 1946 they never exceeded 0.4 of one per cent of *GDP* in any year; their level increased after 1980 averaging 3.4 per cent of *GDP* from 1980 to 1988, but for the post-war years their growth was found not to be causally related to *GDP* growth. The largest proportion of transfers went to persons; over the period 1926—1988 they represented 85.8 per cent of total transfers; these transfers represented 3.6 per cent of *GDP*. However as in the case of transfers to business, these transfers which were 0.7 of one per cent in 1945, and 1.5 per cent of *GDP* in 1946, they increased steadily over time until they reached 15.9 per cent of *GDP* in 1988. Transfers to both business and persons did not exceed one per cent of *GDP* prior to 1945, were less than 10 per cent of *GDP* up to 1979, and exceeded marginally 19 per cent of *GDP* in 1987 and 1988. But in the post-war years, transfer growth was found not to be causally related to *GDP* growth.

5. CONCLUSIONS

Among the four principal theories of government growth, Wagner's hypothesis has been chosen for testing the Canadian experience over the period 1926–1988 and the post-war 1947–1988 years. Our choice was determined firstly by the positive attributes of the hypothesis itself, namely its scientific simplicity, and its all-embracing long run characteristics that were perceived by Wagner to manifest themselves during the industrialization process, and secondly by the serious methodological defects of the other three competing theories, namely the existing disagreement over what constitutes a major upheaval in the displacement-concentration hypothesis, the irrelevance of the productivity lag theory in studies of the public sector in real terms like this one, and the non-testability of the theory of bureaucracy.[11]

After the long run properties of the time series dictated that the empirical work should be carried out in terms of growth rates, we tested Wagner's law following two approaches. In the first approach we arbitrarily fixed in advance the lag structure and proceeded to test for Granger causality, obtaining results which are more indicative than definitive in nature. According to these low-confidence results the most often encountered causality relation was between the growth of *GDP* and the growth of transfers to business, followed by those between the growth of *GDP*, on the one hand, and the growth of transfers to persons and total transfers, on the other. These relations were more often visible for 1926–1988, but not for 1947–1988, the period of rapid expansion of transfers in Canada. It is significant to note that in this approach, in contradiction to Wagner's hypothesis, neither the growth of aggregate exhaustive expenditure by itself nor when combined with total transfers were found to be causally related with *GDP* growth.

In the second econometrically sound approach the optimal lag structure when determined in accordance with the Schwarz criterion showed even less support for Wagner's law. Whatever limited support for causality was found, it was entirely restricted to the period 1926–1988. No evidence whatsoever was found between the growth of *GDP* and the growth of the different variables tested in the post-war years, which represent the time when historically the ratio of government spending to *GDP* reached its highest levels and the industrial expansion and diversification of the Canadian economy occurred. Again causality was supported between *GDP* growth and the growth of business transfers, in four out of six versions of Wagner's law, but further to this relation, which must be judged unimportant in view of the small proportion of business transfers in the overall scheme of government

[11] This superiority of Wagner's law must be kept in proper perspective. As a hypothesis, which claims that government spending exhibits a *GDP* elasticity larger than unity, it leads inescapably to a total socialization of all resources, excepting the trivial case of an asymptote. Therefore, its validity should be viewed as limited to a certain unspecified period of industrialization. If in the course of advanced development the hypothesis is rejected, an easy escape is to conveniently consider the countries covered as having entered the postindustrialization stage. For an appraisal of the principal theories of public expenditure see Afxentiou [1982].

spending, there was causality support for *GDP* growth and the growth of the ratios of both exhaustive expenditures in isolation and in combination with total transfers according to Musgrave's version of Wagner's law and Mann's reformulation of the Peacock-Wiseman version.

It should be emphasized that in only two of the possible six Wagner versions was evidence found for these expenditure aggregates, and most probably this suport is due to the explosion of military expenditures during World War II. Such expenditures can hardly be claimed to be representative of Wagner's grant philosophical design which was expected to unfold gradually during the normal industrial transformation of economies under peaceful conditions. For this reason we are reluctant to state that any reliable evidence for Wagner's law emerged from our statistical analysis.

Where does our rejection of Wagner's law leave us in terms of an expenditure theory of govenment? When the most encompassing hypothesis is rejected, the quest for a new theory should go on unabated as science always commands. Such a search would most assuredly benefit from a future determination of the legitimate areas of government responsibilities. Without this determination, and with government presently meddling at will in every conceivable aspect of social and economic life, it is reasonable to expect that the development of a theory of government growth will not be an easy undertaking. It may not be even in the cards. As long as government behaviour is characterized by ad hoc rather than by systematic precesses, government spending will be more associated with an art rather than a science of government.

The University of Calgary

REFERENCES

Afxentiou, P. C. and Serletis, A. (1991), "A Time Series Analysis of the Relationship Between Govenment Expenditure and GDP in Canada," *Public Finance Quarterly*, 19/3 (July 1991), 316–333.

Afxentiou, P. C. (1982), "Economic Development and the Public Sector: An Evaluation," *Atlantic Economic Journal*, 10/4, 32–38.

Baumol, William J. (1967), "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis," *American Economic Review*, **57**, 415–429.

Beck, Morris (1979), "Public Sector Growth: A Real Perspective, "*Public Finance/Finances Publiques*, 34/2, 313–355.

Beck, Morris (1981), *Government Spending: Trends and Issues* (New York: Praeger).

Bird, Richard M. (1970), *The Growth of Government Spending in Canada* (Toronto: Canadian Tax Foundation).

Bird, Richard M. (1971), "Wagner's 'Law' of Expanding State Activity," *Public Finance/Finances Publiques*, 26/1, 1–26.

Bonin, J. M., Finch, B. N. and Waters, J. B. (1969), "Alternative Test of the 'Displacement Effect' Hypothesis," *Public Finace/Finances Publiques*, 24/3, 441–452.

Borcherding, Thomas E. (ed.) (1977), *Budgets and Bureaucrats: The Sources of Government Growth* (Durham: Duke University Press).

Buchanan, J. M. and Flowers, M. R. (1987), *The Public Finances: An Introductory Textbook*, 6th Edition (Homewood: Irwin).

Diamond, J. (1977), "Econometric Testing of the 'Displacement Effect': A Reconsideration," *Finanzarchiv*, 35/3, 384–404.

Dickey, David A. and Fuller, Wayne A. (1981), "Likelihood Ratio Statistics for Autoregressive Time Series With a Unit Root," *Econometrica*, 49, 1057–1072.

Fuller, Wayne A. (1976), *Introduction to Statistical Time Series* (New York: John Wiley & Sons).

Gandhi, Ved P. (1971), "Wagner's 'Law' of Public Expenditure: Do Recent Cross Section Studies Confirm It?," *Public Finance/Finances Publiques*, 26/1, 44–55.

Goffman, I. J. (1968), "On the Empirical Testing of Wagner's Law: A Technical Note," *Public Finance/Finances Publiques*, 23/3, 359–364.

Gould, F. (1983), "The Development of Public Expenditures in Western, Industrialized Countries: A Comparative Analysis," *Public Finance/Finances Publiques*, 38/1, 38–69.

Granger, C. W. J. (1969), "Inverstigating Causal Relations by Econometric Models and Gross-Sepectral Methods," *Econometrica*, 37, 424–438.

Gupta, S. P. (1967), "Public Expenditure and Economic Growth: A Time-Series Analysis," *Public Finance/Finances Publiques*, 22/4, 423–466.

Mann, Arthur J. (1975), Public Expenditure Patterns in the Dominican Republic and Puerto Rico, 1930–70," *Social and Economic Studies*, 24/1, 60–72.

Mann, Arthur J. (1980), "Wagner's Law: An Econometric Test for Mexico, 1925—1976," *National Tax Journal*, 33/2, 189–201.

Martin, A. M. and Lewis, W. Arthur (1956), "Patterns of Public Revenue and Expenditure," *The Manchester School*, 24/3, 203–232.

Michas, Nicholas A. (1975), "Wagner's Law of Public Expenditures: What is the Appropriate Measurement for a Valid Test?," *Public Finance/Finances Publiques*, 30/1, 77–84.

Musgrave, R. A. and Musgrave, P. B. (1984), *Public Finance in Theory and Practice* (New York: McGraw-Hill).

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

Musgrave, R. A. and Peacock, A. R. (eds.) (1958), *Classics in the Theory of Public Finance* (London: Macmillan and Co. Ltd.).

Nagarajan, P. (1979), "Econometric Testing of the 'Displacement Effect' Associated With a 'Non-Global' Social Distrubance in India," *Public Finance/Finance Publiques*, 34/1, 100–113.

Nelson, Charles R. and Plosser, Charles I. (1982), "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications," *Journal of Monetary Economics*, 10, 139–162.

Niskanen, William A. (1971), *Bureaucracy and Representative Government* (Chicago, Aldine).

Peacock, A. T. and Wiseman, J. (1961), *The Growth of Government Expenditure in the United Kingdom* (Princeton: Princeton University Press).

Peltzman, S. (1980), "The Growth of Government," *Journal of Law and Economics*, 23/2, 209—287.

Phillips, Peter C. B. and Perron, Pierre (1988), 'Testing for a Unit Root in Time Series Regression," *Biometrica*, 75, 335–346.

Pryor, Frederic L. (1968), *Public Expenditures in Communist and Capitalist Nations* (London: Gaorge Allen and Unwin).

Ram, Rati (1987), "Wagner's Hypothesis in Time-Series and Cross-Section Perspetives: Evidence from 'Real' Data for 115 Countries," *Review of Economics and Statistics*, 69/2, 194–204.

Ram, Rati (1986), "Causality Between Income and Government Expenditure: A Broad International Perspective," *Public Finance/Finances Publiques*, 31/3, 393–413.

Sahni, B. S. and Singh B. (1984), "On the Causal Directions Between National Income and Government Expenditure in Canada," *Public Finance/Finances Publiques*, 39/3, 359–393.

Said, S. E. and Dickey, D. A. (1984), "Testing for Unit Roots in Autoregressive Moving Average Models of Unknown Order," *Biometrica*, 71, 599–607.

Schwarz, G. (1978), "Estimating the dimension of a model, "*The Annals of Statistics*, 6, 461–464.

Tarchys, Daniel (1975), "The Growth of Public Expenditures: Nine Models of Explanation," *Scandinavian Political Studies*, **10**, 9–31.

Wagner, Adolph (1883), *Finanzwissenshaft* (Leipzig: C. F. Winer).
Wagner, Adolph (1892), *Grudlagen der Politishen Ökonomi*, 3rd Edition (Leipzig: C. F. Winter).
Williamson, J. G. (1961), "Public Expernditure and Revenue; An International Comparison," The Manchester School, 29/1, 43–56.
Yi, G. Jugde, G. (1988). "*Statistical Model Selection Criteria*," *Economic Letters*, **28**, 47–51.