COINTEGRATION ANALYSIS-CAUSALITY TESTING AND WAGNER'S LAW: THE CASE OF TURKEY, 1950-1990

by

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Abstract

This paper investigates statistically the existence of a long-run relationship between public expenditure and GNP (Wagner's Law) using data for Turkey over the period 1950-1990. Recent advances in time series analysis have permitted the investigation of the long-run relationship between public expenditure and GNP in terms of cointegration analysis. In the case of Wagner's Law, evidence of cointegration is sufficient to establish a long-run relationship between public expenditure and income. However, to support Wagner's Law would require unidirectional causality from income to public expenditure. Therefore cointegration should be seen as a necessary condition for Wagner's Law, but not sufficient. Hence, conditional on cointegration results, it is necessary to look at the causality properties of the model(s). Using the Engle and Granger cointegration test, the Granger Causality test and Turkish time series aggregate data for the period 1950-1990, we find no empirical support for Wagner's Law.

Keywords: Wagner's Law, Public Expenditure Growth, Unit Root Test, Cointegration Analysis, Causality.

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1 Introduction

One of the main features of the contemporary world has been the continued growth in the relative size of the public sector in both developing and developed countries. In particular, after the Second World War, the phenomenon of public expenditure growth happened almost universally and regardless of the nature of either the political or economic system concerned. Thus, the growth of public expenditure as a proportion of GNP (or GDP) has received considerable attention from economists, who have mainly directed their attention to the analysis of the reasons for the permanent growth of public expenditure.

Turkey appears to follow this universally observed "rule" of permanent growth of public expenditure. During the period between 1950 and 1990, economic growth, social and political changes were accompanied by a sharp increase in government spending. For example, while the ratio of total public expenditure to GNP was 23.5 percent in 1950, this ratio doubled in just forty years, increasing to 42.0 percent in 1990.

For a long time, there was no model of the determination of public expenditures. Of course, some classical economists, e.g. Adam Smith, paid attention to tendencies in the long-term trend in public expenditures, but there was no attempt to translate such observations into a general theory (Tarschys, 1975). However, over one hundred years ago, a simple model of the determination of public expenditures was offered by Adolph Wagner, a leading German economist of the time. On the basis of his empirical findings, he "formulated a 'law' of expanding state expenditures; which pointed to the growing importance of government activity and expenditure as an inevitable feature of 'progressive state'" (Bird, 1971: 1). He was the first scholar to recognise the existence of a positive correlation between the level of economic development and the size of the public sector.

There are several models to explain public expenditure growth. The oldest and the most cited one is Wagner's Law. The aim of this paper is to investigate whether the Turkish case supports Wagner's Law or not. There are at least two reasons for investigating the validity of Wagner's Law in the Turkish case. First, we can eliminate earlier studies' methodological shortcomings in terms of Wagner's Law. Second, we attempt to reach some insights in order to develop better theories of public expenditure growth in the case of Turkey.

We will now briefly outline the structure of the paper. The paper is organised as follows: In section 2, we will briefly look at Wagner's Law. In section 3, we will very briefly mention our data. In section 4, we will discuss our methodology. That is, first, we will look at time series properties of the variables, namely, the integration level of the variables. Then, we will aapply a cointegration analysis for six version of Wagner's Law. Following this, conditional on our cointegration results, we will discuss and apply causality test for six versions of Wagner's Law. Finally, in section 5, we will provide a summary and some general conclusions.

2 Wagner's Law

Wagner (1883), writing more than one hundred years ago, offered a model of the determination of public expenditure in which public expenditure growth was a natural consequence of economic growth. Later, his views were formulated as a law and are often referred to as "Wagner's Law". His main contribution in this field was that he tried to establish generalisations about public expenditures, not from postulates about the logic of choice, but rather by direct inference from historical evidence.

After the publication of English translations of Wagner's works in 1958, Wagner's Law has become very popular in academic circles and it has been analysed and tested by many researchers, for example, Musgrave (1969), Bird (1971), Krzyzaniak (1972, 1974), Önder (1974), Mann (1980), Sahni and Singh (1984), Abizadeh and Gray (1985), Ram (1986, 1987), Yalçin (1987), Henrekson (1992), Courakis et al. (1993), Murthy (1993), Oxley (1994) Ansari et al. (1997) and Chletsos and Kollias (1997). Some of these researchers have applied traditional regression analysis, whilst some others have used causality testing, and more recently cointegration analysis has appeared in the literature. Empirical tests of Wagner's Law have yielded results that differ considerably from country to country and period to period.

Wagner's Law states that public expenditure increases at a faster rate than that of national output. In other words, "as per capita income rises in industrialising nations, their public sectors will grow in relative importance" (Bird, 1971: 2). There are at least six versions of this law (see Table 1) which have been empirically investigated. As Henrekson (1992) points out, a test of Wagner's Law should focus on the time-series behaviour of public expenditure in a country for as long a time period as possible, rather than on a cross-section of countries at different income levels. Therefore, in this paper we will examine whether there is a long-run relationship between public expenditure and GNP, along the lines suggested by Wagner's Law, for the case of Turkey. Recent advances in time series analysis have permitted the investigation of the long-run relationship between public expenditure and GNP in terms of cointegration analysis, error-correction mechanism and causality testing. As mentioned above, there are at least six version of Wagner's Law. However, there is no objective criterion to decide which of the six versions is the most appropriate and convincing test of the Law. So, we will need to consider and test all six versions of Wagner's Law in the period from 1950 to 1990. All the equations in Table 1 have been estimated in terms of constant (1968) Turkish Liras and are specified in logarithmic form, so that it will be possible to obtain measures of income elasticity directly. The symbol L, before a variable denotes its natural logarithm.

Table 1: Six Versions of Wagner's Law

	Functional form	Version
1	LE = a + bLGNP	Peacock-Wiseman [1968]
2	LC = a + bLGNP	Pryor [1969]
3	LE = a + bL(GNP/P)	Goffman [1968]
4	L(E/GNP) = a + bL(GNP/P)	Musgrave [1969]
5	L(E/P) = a + bL(GNP/P)	Gupta [1967]
6	L(E/GNP) = a + bLGNP	"Modified" version of P-W suggested by Mann [1980]

Earlier studies of the growth of public expenditure have not looked at the time series properties of the variables examined. There was an implicit assumption that the data were stationary. However, recent developments in time series analysis show that most macroeconomic time series have a unit root (a stochastic trend) and this property is described as difference stationarity, so that the first difference of a time series is stationary (Nelson and Plosser, 1982). So that, in testing Wagner's Law, the nonstationary property of the series must be considered first. If both series are I(1), it is necessary to perform cointegration tests. If a pair of I(1) variables are cointegrated, one then proceeds to build an error correction model in order to capture the short-run and long-run causal relationship between the two series. As we mentioned above, to eliminate early studies' methodological shortcomings, cointegration analysis will be applied in this study.

There have been also some empirical studies relating to Wagner's Law for Turkey. Krzyzaniak (1974) conducted a study of Turkey for the period from 1950 to 1969. After regressing public expenditure on GNP he found statistically significant estimates of the income elasticity of public expenditure with regard to GNP which appear to support Wagner's Law. Önder (1974) conducted a study of public expenditure growth in Turkey for the period 1947-1967. Using aggregate variables (in total and in per capita terms), he found the income elasticity of public expenditure with regard to GNP (or GNP per capita) to be smaller than unity. These results appear to undermine Wagner's Law (with aggregate data) for the study period. In a recent study, Yalçin (1987) also found that using aggregate data, her findings did not support the validity of Wagner's Law.

Although there are some studies of public expenditure growth in the Turkish public finance literature, as mentioned above, to best of our knowledge, none have applied modern econometric techniques. Thus, our contribution to the literature on the growth of public expenditure in terms of Wagner's Law in Turkey will be to apply recent econometric techniques which investigate time series properties of the variables, use cointegration analysis, and examine the causal relationship between national income and public expenditure.

In this paper, 1950 will be taken as the starting point. There are several reasons for the choice of this year, since it was a turning point in Turkey's politico-economic history. Firstly, there had been a single party system since 1923, but in 1950 a multi-party system was established. This new phenomenon affected not only politics but also the economy and public expenditure growth. In this new era, voters' demands were taken into account.[1] Secondly, by 1950, Turkey had recovered to a large extent from the abnormalities of the Second World War. Finally, as indicated by some researchers (e.g., Krzyzaniak (1974), and Krueger (1974)), the availability and reliability of data is poor before 1950 in the Turkish case.

3 Data

The data under examination consist of gross national product (GNP), total public expenditure (E), and public consumption expenditure (C), all in real terms. The GNP deflator has been used to obtain real values. The data are also examined in per capita terms, and some categories of public expenditure are used in the form of ratios to GNP, as required by the various formulations of Wagner's Law. The definitions of data and their sources are in Appendix.

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[1] According to Bird (1970), one of the necessary conditions for the operation of Wagner's Law is (at least implicitly) democratisation (in the sense of political participation) of the polity.

4 The Methodology: Cointegration Analysis and Causality Testing

4.1 Testing For Cointegration

4.1.1 The Concept of Cointegration

The concept of cointegration, first introduced into the literature by Granger (1981), is relevant to the problem of the determination of long-run or equilibrium 'relationships in economics. Cointegration is the statistical implication of the existence of a long-run relationship between economic variables (Thomas, 1993). In other words, from a statistical point of view, a long-term relationship means that the variables move together over time so that short-term disturbances from the long-term trend will be corrected (Manning and Andrianacos, 1993). The basic idea behind cointegration is that if, in the long-run, two or more series move closely together, even though the series themselves are trended, the difference between them is constant. It is possible to regard these series as defining a long-run equilibrium relationship, as the difference between them is stationary (Hall and Henry, 1989). A lack of cointegration suggests that such variables have no long-run relationship: in principal they can wander arbitrarily far away from each other (Dickey et.al., 1991).

In fact, many early researchers who looked at Wagner's Law ignored the stationarity requirement of the variables. However, the standard regression techniques are invalid when applied to non-stationary variables. In other words, "...static regressions among integrated series are meaningful if and only if they involve cointegrated variables" (Banerjee, et all. 1993: 204). This practice led to a substantial literature dealing with the spurious regression problem.

4.1.2 Time Series Properties of the Series: Stationarity and Unit Root Tests

The investigation of stationarity (or nonstationarity) in a time series is closely related to the tests for unit roots. Existence of unit roots in a series denotes non-stationarity. A number of alternative tests are available for testing whether a series is stationary.

Testing for the Order of Integration

In order to establish the order of integration of the variables in our data set, we employ DF and ADF tests. The ADF test for unit roots (Dickey and Fuller, 1979; 1981) indicates whether an individual series, say y_t, is stationary by running an OLS regression. All these tests are based on regression equations 1 and 2 presented below.

The general form of ADF test can be written as follows:

$$\Delta y_t = a y_{t-1} + \sum_{i=1}^{m} b_i \Delta y_{t-i} + d + gt + e_t \qquad \text{(for levels)} \qquad (1)$$

$$\Delta\Delta y_t = a \Delta y_{t-1} + \sum_{i=1}^{m} b_i \Delta\Delta y_{t-i} + d + gt + e_t \qquad \text{(for first differences)} \qquad (2)$$

where Δy are the first differences of the series, m is the number of lags and t is time. "The practical rule for establishing the value of [m] … is that it should be relatively small in order to save degrees of freedom, but large enough not to allow for the existence of autocorrelation in e_t. For example, if for [m]=2 the Durbin-Watson autocorrelation statistic is low, indicating first order autocorrelation, it would be sensible to increase m with the hope that such autocorrelation will disappear" (Charemza and Deadman, 1992:135).

In short, the DF/ADF test proceeds as follows: equations such as 1 and 2 are estimated adding as many terms of differenced variables as are necessary to achieve residuals that are non-autocorrelated. Although we have included trend in levels, but we exclude it in first differences.

Tables 2a-c present the calculated t-values from DF/ADF tests on each variable in levels and in first differences. In the case of the levels of the series, the null hypothesis of non-stationarity cannot be rejected for any of the series. Therefore, the levels of all series are non-stationary.

Table 2a ADF Unit Root Test in Levels (ADF Regression with an Intercept)

Variables	ADF (0)	ADF (1)	ADF (2)	ADF (3)
LGNP	−15853 [ASH]	−11747	-0.8178	-0.3665
LE	01102 [SH]	01522 [A]	0.4494	0.3998
LC	01627 [S]	02785 [AH]	0.6744	0.5855
L(GNP/P)	−13406 [ASH]	-0.9490	-0.5854	-0.713
L(E/P)	−00727 [SH]	00777 [A]	0.3731	0.2741
L(E/GNP)	−12207 [ASH]	-0.5429	-0.2740	-0.4646
5% CV	-2.9358	-2.9378	-2.9400	-2.9422

Notes: ADF test statistics are computed using regressions with an intercept and m lagged first-differences of the dependent variable (m=0,…,3). The superscripts, A, S and H indicate the choice of the Akaike Information, the Schwarz Bayesian and the Hannan-Quinn criteria respectively. Critical values taken from MacKinnon (1991) and reported by MFIT 4.0.

Table 2b ADF Unit Root Tests in Levels (ADF Regression with an Intercept and a Linear Trend)

Variables	ADF (0)	ADF (1)	ADF (2)	ADF (3)
LGNP	−2.0965[ASH]	−1.7185	−1.5974	−1.2817
LE	−3.2838[ASH]	−2.5815	−2.6798	−3.3552
LC	−3.4781[ASH]	−2.6133	−2.5331	−3.3006
L(GNP/P)	−2.1401[ASH]	−1.7927	−1.8116	−1.7424
L(E/P)	−3.2558[ASH]	−2.5369	−2.6885	−3.4636
L(E/GNP)	−3.3791[ASH]	−2.3392	−2.352	−2.6299
5% CV	−3.5247	−3.5279	−3.5313	−3.5348

Notes: ADF test statistics are computed using regressions with an intercept, a linear trend and m lagged first-differences of the dependent variable (m=0,...,3). The superscripts, A, S and H indicate the choice of the Akaike Information, the Schwarz Bayesian and the Hannan-Quinn criteria respectively. Critical values taken from MacKinnon (1991) and reported by MFIT 4.0.

Table 2c ADF Unit Root Test in First Differences (ADF Regression with an Intercept)

Variables	ADF (0)	ADF (1)	ADF (2)	ADF (3)
LGNP	−6.2850[ASH]	−4.3437	−4.4027	−2.6828
LE	−8.0195[ASH]	−4.9923	−3.4482	−3.1571
LC	−8.2546[ASH]	−5.5696	−3.5334	−3.0633
L(GNP/P)	−6.5086[ASH]	−4.3463	−4.3384	−2.7263
L(E/P)	−7.9994[ASH]	−4.9759	−3.3934	−3.1230
L(E/GNP)	−8.3913[ASH]	−5.2148	−3.74183	−3.0088
5% CV	−2.9378	−2.9400	−2.9422	−2.9446

Notes: ADF test statistics are computed using regressions with an intercept and m lagged first-differences of the dependent variable (m=0,...,3). The superscripts, A, S and H indicate the choice of the Akaike Information, the Schwarz Bayesian and the Hannan-Quinn criteria respectively. Critical values taken from MacKinnon (1991) and reported by MFIT 4.0.

Applying the same tests to first differences to determine the order of integration, the critical value is (are) less (in absolute terms) than the calculated values of the test statistic for all series in all cases. This shows that all of the series are integrated of order one [I(1)], and become stationary after differencing once. Since all of the series are integrated of the same order, the series may be tested for the existence of a long-run relationship between them, i.e. a cointegrating relationship.

In sum, the evidence suggests stationary series in first differences, so we can apply cointegration analysis to our data set.

4.1.3 Empirical Results of Cointegration Tests

A cointegration test can be applied to determine the existence of a long-run relationship between the variables. The Engle and Granger (1987) two step procedure for modelling the relationship between cointegrated variables has received a great deal of attention in recent years. One of the benefits of this approach is that the long-run equilibrium relationship can be modelled by a straightforward regression involving the levels of the variables (Inder, 1993). According to Holden and Thomson (1992: 26), "this approach is attractive for two reasons: First, it reduces the number of coefficients to be estimated and so, reduces the problem of multicollinearity [Of course, this is not a problem with our model(s)]. Second, the first step can be estimated by ordinary least squares."

Before testing for cointegration, that is, in order to establish the existence or otherwise of a long-run relationship between two economic time series, say x and y, it is first necessary to test whether variables are integrated to the same order. Applying DF/ADF unit root tests (Tables 2a-2c), we found that each of the variables used in all six versions of Wagner's Law is I(1). Since all series are integrated of the same order, the series can be tested for the existence of a long-run relationship between them, i.e. cointegration. The procedure used to establish the existence of a cointegrating relationship is as follows: First, the hypothesised long-run relationship(s) (e.g. $ly_t = a + blx_t + e_t$) is (are) estimated by OLS. This is called the cointegrating regression. Second, the residuals from this regression are retained and the DF/ADF test is applied to the residuals, as follows:

$$\Delta e_t = f^* e_{t-1} + \sum_{i=1}^{m} f^*{}_i \Delta e_{t-i} + v_t \qquad (3)$$

and test $H_0: f^* = 0$ against $H_1: f^* < 0$ using appropriate critical values (e.g., MacKinnon, 1990, 1991). In other words, the null hypothesis of the cointegration test is that the series formed by the residuals of each cointegrating regressions are not stationary. It is necessary to emphasise that the above equation has no intercept or time trend, since the e_ts must have a zero mean because we do not expect them to have a deterministic trend. The tests results can be seen in Table 3 below:

Table 3 Cointegration Regressions and DF/ADF Tests

Version of Wagner's L.	Dependent Variable	Constant	Coefficient of Explanatory V.	$\bar{R}^2$	CRDW	ADF (*)	Critical Values **
1	LE	-4.06	1.23	0.975	0.93	-3.44 (0)	-3.4925
2	LC	-4.70	1.27	0.966	0.93	-3.66 (0)	-3.4925
3	LE	-7.88	2.25	0.967	0.80	-3.09 (0)	-3.4925
4	L(E/GNP)	-4.74	0.41	0.556	0.91	-3.38 (0)	-3.4925
5	L(E/P)	-4.75	1.42	0.936	0.91	-3.37 (0)	-3.4925
6	L(E/GNP)	-4.06	0.23	0.573	0.92	-3.44 (0)	-3.4925

*Number of lags (in parentheses) were chosen by the Akaike Information Criterion.
** Critical values (at 5% significance level) taken from MacKinnon (1991) and reported by MFIT 3.0.

Before interpreting the cointegration results, it is necessary to emphasise that the Engle-Granger method does not prove whether the relation(s) is (are) really a long run one(s). This is an assumption and cannot be statistically verified. We need to have a strong belief in a long run equilibrium relationship between the variables that is supported by relevant economic theory where the theory suggests a suitable assumption about a long run relationship (Charemza and Deadman, 1992).

The null hypothesis of the cointegration test is that the series formed by the residuals of each of the cointegrating regressions is not stationary. To test the null hypothesis of non-stationarity of the residuals, the DF/ADF unit root tests are employed on the residuals of each of the six cointegrating regressions. Table 3 presents the results of the DF/ADF unit-root tests for the residuals series from the six cointegrating 'Wagner's Law' regressions. We cannot reject the null hypothesis of nonstationarity for five out of six versions of Wagner's Law. The 5% critical values (MacKinnon, 1991) are bigger (in absolute terms) than the calculated t-values. The null hypothesis of non-stationarity can be rejected in version 2 only (Pryor's version. If we use Charemza and Deadman's critical values which are -3.92 (lower limit) and -3.80 (upper limit), we failed to reject the null hypothesis in version 2 as well. These results show that there is no long-run relationship between public expenditure and GNP in Turkey for all six versions of Wagner's Law.

Engle and Granger (1991:14) argued that "…when testing non-cointegration of series which have a drift, one can include a time trend in the cointegrating regression which is equivalent to detrending the series first. The critical values is then even higher". Following this, we have added a time trend into cointegration regressions. However, the results did not reject the null hypothesis of non-cointegration.

The real income elasticities for non-ratio versions are all greater than unity, while for ratio versions they are greater than zero. These results imply that all versions support Wagner's Law. However, since the variables are not cointegrated in 5 out of six versions of Wagner's Law, these results should be regarded as unreliable and based on spurious regression results. Therefore, a regression specified in the levels of the variable will lead to inconsistent estimates.

Although, our findings, fail to reject the null hypothesis of no long-run relationship between the variables, we have to treat these results with caution. We need to consider the weaknesses and limitations of cointegration analysis. The findings of non-cointegration do not exclude the possibility of cointegration in some higher order system that includes more variables such as relative prices, demographic variables, dependency ratio, manufacturing ratio, agricultural ratio. In other study, we will examine some of these variables. The omission of important variables may produce the non-cointegration result. As Muscatelli and Hurn (1992:12) pointed out, "… the omission or inclusion of certain variables from the cointegration regression can dramatically affect the results obtained from cointegrating regressions."

Our inability to observe a long-run relationship between the public expenditure and GNP may be the result of a number of factors and not necessarily a rejection of the existence of a cointegrated system. The Dickey-Fuller procedure used in testing may not have sufficient power against the alternative hypothesis to allow measurement of the long-run relationship. According to Blangiewicz and Charemza (1990: 314), "…very little is known about power of cointegration tests for small samples". Therefore, static OLS cointegrating regression results may produce important bias in small samples (Banerjee et al., 1986; Perman, 1991).[2] In other words, the data period analysed may not be sufficiently long to fully capture the long-run relationship. Although our statistical procedure measures no long-run relationship we suspect that

[2] In this issue, we can also quote Kennedy's (1998:267) statement: "The power of unit root tests depends much more on the span of the data, ceteris paribus, than on the number of observations; i.e., for macroeconomic data where long business cycles are of importance, a long span of annual data would be preferred to a shorter span with, say, monthly data, even though the latter case may have more observations" (Kennedy, 1998:267).

this result should be interpreted cautiously. However, without evidence of cointegration an error correction procedure to model short-run dynamics cannot be used. However, it is possible to continue to model the short-term dynamics by applying Granger causality test to measure for possible causal relationships between variables (Ansari et al., 1997). In the following section, we will apply Granger causality test.

4.2 Causality Between Public Expenditure and National Income and Wagner's Law

As Karavitis (1987) has argued, the necessity of causality tests in the field of public expenditure growth can be considered by using Wagner's law as an example. Despite its several interpretations, the original formulation of Wagner's Law appears to imply that in the wake of economic development, government expenditure increases not merely in size but also as percentage of national income. The causality in Wagner's Law runs from national income to public expenditure. In other words, support for Wagner's Law requires unidirectional causality from GNP (and GNP/P) to public expenditure.

Singh and Sahni (1984: 630) argue that the relationship between public expenditure and national income has been treated differently in two major areas of economic analysis. While public finance studies have generally postulated that growth in public expenditure is caused by growth in national income (Wagnerian approach), most macroeconometric models have tended to take the view that income growth is determined, in part, by growth in public expenditure (Keynesian approach). These different views of the causal relation between the two variables, in turn, rest on more basic differences in assumptions. Public finance studies, following Wagner, have considered public expenditure as a behavioural variable, similar to private consumption expenditure. By contrast, macroeconometric models, essentially following Keynes, have treated public expenditure as an exogenous policy instrument designed to correct short-term cyclical fluctuations in aggregate expenditures.

The standard empirical approach used to evaluate the two different approaches has been to apply causality testing techniques in the Granger (1969) sense. Studies of the direction of causality between income and public expenditure are quite new. In the public finance literature, the casual link between public expenditure and national income was first examined by Singh and Sahni (1984) and Sahni and Singh (1984). These two pioneering studies, which applied the Granger causality test to public expenditure and national income, were each confined to one country. They conducted causality tests using annual data for Canada and India respectively covering a 30 year period from 1950 to 1980/81. Since then, causality studies of the relationship between public expenditure and national income growth have had a central place in modern public expenditure analysis. Granger causality tests have been carried out for both developed and developing countries with mixed results; in same cases, finding unidirectional causality from expenditure to income (or conversely), or finding no causal relationship or finding a bidirectional causality between two aggregate variables (e.g., Ansari et al (1997); Oxley (1994); Khan (1990); Ram (1986); Sahni and Singh (1984); Singh and Sahni (1984)).

It is clear that knowledge of the true nature of the causal process will help determine the robustness of the estimated relationships in these studies. Should the causality be Wagnerian, the estimates derived from macroeconometric models would evidently suffer from simultaneity bias. On the other hand, if the causality is Keynesian, the estimates reported in public finance studies would similarly be biased. In addition, knowledge of the precise causal process has important policy implications. For example, if the causality were Wagnerian, public expenditure is relegated to a passive role. In other words, public expenditure plays no role in economic growth, and therefore cannot be relied upon as a policy instrument. If Keynesian, it acquires the status of an important policy variable. In this case, public expenditure becomes a policy variable which can be used to influence economic growth. Relying on this Keynesian hypothesis, many developing countries, such as Turkey, have assigned to their public sector the role of promoting growth and economic development.

One of the critiques of the role of the public sector is that government is less efficient than market forces in allocating resources. Moreover, the regulatory process and, for that matter monetary and fiscal policies, can potentially distort the incentive system. As argued by Ansari et al.,

> it is not necessary that either Wagner's hypothesis, with causal ordering from national income to expenditure, or Keynes's hypothesis, with causal ordering from expenditure to national income hold true. Nor, for that matter, are the two propositions mutually exclusive. On the one hand, if government obligations call for a smoother expenditure pattern than that which is possible given the variation in national income (financed, say, through debt borrowing), the causal link from national income to expenditure will be lessened. On the other hand, government expenditure can crowd out private expenditure thus reducing the causal link from expenditure to national income. Sorting out the causal relationship between government expenditure and national income is essential if the effectiveness of public expenditure as a policy instrument for economic development is to be assessed (Ansari et al., 1997: 544).

Whether changes in national income growth help predict changes in public expenditure growth (and/or vice versa) remains an important issue of sustained interest in the empirical public finance literature. In recent years, attention has been mainly confined to two specific areas, namely, estimation of the impact of the public sector on output growth (by means of regression analysis) and causality testing. Unfortunately, the outcome of both types of analysis has been inconclusive (Ahsan et al., 1992). More recently, cointegration studies have started to appear in the literature as a new development in time series analysis.

Causality studies based on Wagner's reasoning is hypothesised to run from GNP (and/or GNP/P) to the dependent variable which takes four different forms: E, C, E/P, E/GNP. We also look at the Keynesian approach which assumes that causality is hypothesised to run from public expenditure to GNP. Wagner's Law requires that public expenditure does not cause GNP, because of that it is necessary to apply bivariate causality testing.

4.2.1 Granger Causality Test

Although there is some evidence that various measures of public expenditure and GNP (and GNP/P) are nonstationary, and noncointegrated, it is still possible to apply the Granger causality test, using I(0) series. In other words, we can use changes in GNP and public expenditure in order to apply Granger causality test.

In subsection 4.2, for each version of Wagner's Law, the ADF statistic cannot reject the null hypothesis of no cointegration and this conclusion leads us to say that a long-run equilibrium relationship between public expenditure and GNP for Turkey over the study period does not exist. In the absence of a long-run relationship between the variables, it still remains of interest to examine the short-run linkages between them (Manning and Adriacanos, 1993; Gemmell, 1990). However, without evidence of cointegration an error-correction procedure cannot be used to model short-run relationship between national income and public expenditure (Ansari et al., 1997). However, it may still be possible to model short-run behaviour of the relationship between national income and public expenditure applying the Granger causality test. That is, even though a long-run relationship between the two macro variables cannot be established for this time period, it may still be possible that the variables are causally related in the short-run.

In economics, systematic testing and determination of causal directions only became possible after an operational framework was developed by Granger (1969) and Sims (1972). Their approach is crucially based on the axiom that the past and present may cause the future but the future cannot cause the past (Granger, 1980).

In econometrics the most widely used operational definition of causality is the Granger definition of causality, which is defined as follows:

x is a Granger cause of y (denoted as $x \rightarrow y$), if present y can be predicted with better accuracy by using past values of x rather than by not doing so, other information being identical (Charemza and Deadman, 1992:190).

If event A happens after event B, it is assumed that A cannot have caused B. At the same time, if A happens before B, it does not necessarily mean that A causes B. For example, the weatherman's prediction occurs before the rain. This does not mean that the weatherman causes the rain. In practice, we observe A and B as time series and we would like to know whether A precedes B, or B precedes A.

In the literature, there are various tests for determining Granger causality in a bivariate system. Among them, Guilkey and Salemi (1982) and Geweke-Meese-Dent (1983) recommend the use of the ordinary least squares version of the Granger test, because of its ease of implementation, power, and robustness in finite samples.

There are a number of causality studies in the field of public expenditure. However, very few of them (e.g. Henrekson (1992); Afxentiou and Serletis (1992); Murthy (1993); Oxley (1994); Ansari et al. (1997)) have checked for the time series properties and especially cointegrating properties of the time series involved. As Bahmani-Oskooee and Alse (1993:536) pointed out, "Standard Granger or Sims tests are only valid if the original time series from which growth rates are generated are not cointegrated". Therefore, it is necessary to check for the cointegrating properties of the public expenditure and GNP before using the simple Granger test. Since we have applied cointegration tests earlier (see Table 3) and have found no evidence of a cointegrating relationship in any of the equations, it is now possible to apply causality testing.

If the null hypothesis of noncointegration between Y_t (public expenditure) and X_t (GNP or GNP/P) cannot be rejected, then the standard Granger causality test can be employed to examine the causal relationship between the series (using the variables in first differences) (Mahdavi et al., 1994). Following this statement we can test the hypothesis that GNP growth, labelled (ΔLX), causes public expenditure growth, labelled (ΔLY), and vice versa, by constructing the following causal models:

$$\Delta LY_t = a + \sum_{i=1}^{m} b_i \Delta LY_{t-i} + \sum_{i=1}^{n} d_i \Delta LX_{t-i} + e_t \qquad (4)$$

$$\Delta LX_t = a + \sum_{j=1}^{q} b_j \Delta LX_{t-j} + \sum_{j=1}^{r} c_j \Delta LY_{t-j} + v_t \qquad (5)$$

where et and vt are two uncorrelated white-noise series and m, n and q, r are the maximum number of lags. It is well known that the causality literature assumes stationarity of the time series being examined. In subsection 4.2, we found that the variables were are non stationary in levels, but stationary in first differences. Because of that we will apply Granger causality using the variables in first differences of the logarithms of the variables which are stationary (i.e. I(0)). One can use the standard F-test in order to determine the causal relationship between the variables. Interchanging the causal and the dependent variables in the regression equation allows a test for bi-directional causality.

Four findings are possible in a Granger causality test: (i) neither variable "Granger causes" the other. In other words, independence is suggested that when the sets of X and Y coefficients are not statistically significant in both regressions ; (ii) unidirectional causality from X to Y: That is, X causes Y, but not vice versa (in this case Wagner's Law applies); (iii) unidirectional causality from Y to X: That is, Y causes X, but not vice versa (Keynesian modelling is valid in that case); (iv) X and Y "Granger cause" each other. If (iv) is found to be true, there is a feedback effect (or bilateral causality) between two variables (Miller and Russek (1990); Gujarati (1995)). So neither the Keynesian or Wagnerian approach is valid. According to the above equations (4 and 5), the null hypothesis that X does not Granger Cause Y is rejected if the coefficients of d_is in equation 4 are jointly significant (i.e. $d_i \neq 0$), based on the standard F-test. The null hypothesis that Y does not Granger cause X is rejected if the c_js are jointly significant (i.e. $c_j \neq 0$) in equation 5. And if both some $d_i \neq 0$, and some $c_j \neq 0$ then there is feedback between Y and X.

4.2.2 Empirical Results of Granger Causality Tests

The Granger causality test results are presented in Table 4. The results include the six versions of Wagner's Law which are in presented in Table 4.

In the tests, causality is hypothesised to run from GNP (or GNP/P) to the dependent variable, which takes four different forms; E, C, E/GNP, E/P. In other words, the hypothesis that GNP causes Public expenditure requires that Public Expenditure does not cause GNP. The tests are carried out using the first differences of each series (i.e., the stationary values).

The difficulty in fitting models 4 and 5. revolves around determining the appropriate lag lengths (i.e. m, and n in equation 4; q and r in equation 5). In the literature both lags are frequently chosen to have the same value, and lag lengths of 1, 2, 3 and 4 are usually used. There are several criteria to determine "optimum" lag lengths, such as

Akaike's Information criterion, Akaike's FPE, and the Schwarz criterion. Following Afxentiou and Serletis (1992), we have chosen four different commonly chosen lag lengths - 1, 2, 3, and 4 lags.

The null hypothesis of noncausality is tested using F-statistics. The results of F-tests are presented in Table 4. The results in Table 4 indicate that there is no evidence to support either Wagner's Law in any of its versions or Keynesian hypothesis.

Table 4 The Results of Granger Causality tests on the Six Versions of Wagner's Law

Version of		F Values			
Wagner's Law	Null Hypothesis	1 Lag	2 Lag	3 Lag	4 Lag
1	Δ LGNP does not cause Δ LE	0.58		0.29	0.52
	Δ LE does not cause Δ LGNP	0.02		0.04	1.54
	Δ LGNP does not cause Δ LC	0.59	0.44	0.29	0.57
	Δ LC does not cause Δ LGNP	0.02	0.002	0.09	1.26
3	Δ Δ LE		0.37	0.26	
	Δ LE does not cause Δ L(GNP/P)	0.027	0.06	0.14	1.61
4	Δ L(GNP/P) does not cause Δ L(E/GNP)	0.09	0.13	0.23	0.31
	Δ Δ L(GNP/P)		0.05	0.13	
5	Δ L(GNP/P) does not cause Δ	0.50	0.37		0.52
	Δ L(E/P) does not cause Δ	0.02	0.05		1.60
6	Δ LGNP does not cause Δ L(E/GNP)	0.08		0.23	0.30
	Δ L(E/GNP) does not cause Δ LGNP	0.02		0.04	1.54

and 4 lag cases respectively. The related F-critical values at 5% significance level are (4.11), (3.30), (2.92) and (2.73) respectively.

As Ansari et al. (1997: 549) argued, "[m]any factors can of course lessen the causal relationship between the two macro variables, the least of which is the form of

little, but expenditure on health, education, roads, bridges and port facilities can do much to encourage growth and development in the economy. However, government

expenditure on other investments".

In testing for causality, the lags were chosen in advance, that is, arbitrarily. Even though this procedure is commonly applied in empirical studies, there are some criticisms about this way of choosing lag length. Arbitrary lag specifications can produce misleading results, and so we must treat the results with caution. That is, the Granger causality test is very sensitive to the number of lags used in the analysis. Considering this point, in order to determine the appropriate lag structure, one can use one of the appropriate lag length criteria such as Schwarz's criterion. We have looked at AIC as well. Most of the cases, one lag was chosen by AIC. However, the results were not changed at all.

The conclusion that we have reached, based on the econometric method and data set used, is that there is no evidence to support either Wagner's Law or Keynes's hypothesis.

5 Conclusion

In this paper, Wagner's Law was tested using aggregate Turkish data for the period 1950-1990. We looked at the time series properties of the data, i.e. we tested for the existence of unit roots. We found that both the public expenditure and GNP variables were nonstationary in levels, but stationary in first differences, that is, they are integrated of order one (I(1)). Since we use single equation model(s), we have applied a cointegration test (the first stage of Engle and Granger's two stage residual based approach) to six versions of Wagner's Law. According to the test results, there is no cointegrating relationship between the variables. Including time trends into cointegration regressions did not change the results either. These findings show that the support of Wagner's Law found by many early researchers may be spurious. In a test on Turkish data we cannot find any long-run positive relationship between public expenditure and GNP variables for any of the six versions of Wagner's Law listed in Table 1.

Although there is some evidence that various measures of public expenditure and GNP (and GNPPC) are nonstationary, and not cointegrated in this study, it is still possible to apply the Granger causality test, using I(0) series (i.e. first differences in our case). In the absence of a long-run relationship between variables, it still remains of interest to examine the short-run linkages between them. We have carried out Granger causality tests for the six versions of Wagner's Law. However, there is no evidence to support either Wagner's Law in any of its versions or Keynes' hypothesis.

In the light of the reported empirical results in this paper, one may tentatively suggest that the growth of public expenditure in the case of Turkey is not directly dependent on and determined by economic growth as Wagner's law states. Of course, public expenditure is the outcome of many decisions in the light of changing economic circumstances. It is shaped by decisions about how public expenditure should be distributed among competing groups, whether geographically concentrated or aggregated in organised interests (Klein, 1976). Thus, other factors, such as political processes, interest group behaviour and the nature of Turkish development may be considered as possible explanatory variables for the increase in the size of public expenditure. In this context, we should remember the importance of state economic enterprises, which we did not include in our public expenditure definition. For example, Yalçin (1987) has found evidence for Wagner's Law after including SEEs in the public expenditure definition.

In this paper, we failed to find any evidence for Wagner's Law using aggregate data. However, it is possible to examine disaggregated data to investigate public expenditure growth in Turkey in terms of Wagner's Law. In our future study, we intend to examine the role of disaggregated data in explaining public expenditure growth in Turkey.

Appendix 2: Data and Their Sources

E/GNP= the ratio of total public expenditure to GNP (Note that dependent variable is expressed as a percentage share of GNP). Total public expenditure (E) includes investment and transfers (and EBFs after 1984) are taken from Önder (1984), Öner (1993), SPO (1985) and OECD (1992; Economic Surveys); GNP is taken from SIS (1993).

C Real Public Consumption Expenditures. Pryor (1969) used this term. They cover the current expenditures for goods and services and the transfer payments by governments.

GRNPPC = the real GNP per capita (GNP per capita converted by GNP deflator (1968=100)),

P Population is taken from SIS (1993).

GNPD = deflator for GNP (1968=100) is taken from SIS (1993).

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