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# Testing Wagner's law for Turkey, 1960–2000

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This paper presents an empirical analysis of Wagner's law in the case of Turkey over the period 1960–2000. The paper uses modern time-series econometric techniques to test the law's proposition that in the course of economic development, government expenditures increase. The results of this study do not support the empirical validity of Wagner's law for Turkey for the period 1960–2000. However, the paper finds statistical evidence for an augmented version of Wagner's law.

Keywords: Wagner's law; co-integration; causality

JEL Classifications: E6; H5; Q4

## 1. Introduction

In 1893, Adolph Wagner put forward his well-known proposition that there is a positive relationship between economic activities and government expenditure (Henrekson, 1993). Wagner's proposition further states that the causal arrow runs from economic development to government expenditure. Wagner's proposition, also known as Wagner's law or Wagner's hypothesis, has attracted a great deal of interest in the public finance literature, especially since the 1960s. Sztyber (2001) states that the validity of Wagner's law for developed countries holds for more than 100 years.

In addition, Wagner's hypothesis has been tested for many countries using both time-series and cross-sectional data sets. The empirical results, apart from a few exceptions provide strong support for it. Such studies include Peacock and Wiseman (1961), Musgrave (1969), Michas (1975), Mann (1980) and Ram (1986, 1987). These studies, however, have assumed that the time-series data are stationary and, therefore, have used inappropriate estimation techniques. The modern time-series econometric techniques developed in the last two decades have cast doubt on the validity of Wagner's law. For example, Henrekson (1993) has tested the law using two-stage co-integration (Engle and Granger, 1987) and has found no support for it in the case of Sweden. Similarly, Hondroyiannis and Papapetrou (1995) have implemented the Johansen (1988) co-integration method to test a long run relationship between government spending and national income for Greece. They have failed to find a support for the law, unlike Courakis *et al.* (1993). It is clear that as

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the previous empirical studies on Wagner's hypothesis are being updated using modern econometric techniques, the validity of the law becomes less certain (see also, for example, Thornton (1999) and Burney (2002)). The spirit of the law is based on a bivariate relationship between some form of public expenditure and economic growth, which causes some problems in implementing the modern econometric methods, such as the Johansen multivariate co-integration technique. However, this issue has been ignored in almost all the previous empirical studies concerning the law, except by Murthy (1994). Murthy (1994) has augmented the functional form of the law to include two explanatory variables finding empirical evidence for such an augmented Wagner's law.

Wagner's law has been tested empirically in time-series and cross-sectional frameworks and, with few exceptions, the law has received strong support. In empirical analyses, country-specific studies are frequently used: for example, Henrekson (1993) for Sweden, Ashworth (1995) for the UK, Hondroyiannis and Papapetrou (1995) for Greece, Nomura (1995) for Japan and Park (1996) for South Korea. Cross-country studies have also become quite popular. Thus, Ram (1987) includes 115 countries, Bohl (1996) investigates the G-7 countries and Anwar *et al.* (1996) analyze 88 countries. In addition to aggregate analyses, disaggregation of data is also noted in empirical studies of Wagner's law. See, for example, Bairam (1995), Asseery *et al.* (1999) and Burney (2002).

The previous empirical studies relating to Turkey did not use modern time-series econometric techniques (Kyzyzanick, 1974; Ram, 1987) or have failed to find empirical evidence for the law (Anwar *et al.*, 1996).

The paper proceeds as follows: first, using annual data for Turkey for the period of 1960–2000, the time-series properties of the data and order of integration via the Augmented Dickey–Fuller test are investigated (Dickey and Fuller 1979, 1981). Second, the methodology of co-integration analysis, as formulated by Johansen and Juselius (1990, 1992), to test Wagner's hypothesis using one of the traditional functional forms as suggested by various researchers, is applied. The adopted traditional functional form of Wagner's hypothesis is expanded with a view to finding a meaningful long-run relationship between economic growth and government expenditure by adding another explanatory variable. Finally, the direction of flows between the variables will be established using the Granger causality tests.

The remainder of this paper is, thus, organized as follows. Section 2 briefly introduces and reviews the functional forms of Wagner's law, along with empirical findings of the relationship between government expenditure and national income. Section 3 presents an overview of the econometric methodology used in the paper. Section 4 deals with the empirical findings from the traditional functional form and augmented version of Wagner's hypothesis and section 5 presents the concluding remarks.

## 2. Versions of Wagner's law

Wagner's law appears to be based on a simple positive correlation between total economic activity and government involvement. The interpretation of Wagner's law in functional forms, however, seems to be more controversial in a way that several versions of the law have been introduced and tested empirically since the 1960s.

According to Henrekson (1993), Wagner saw three main reasons for increased government involvement. First, industrialization and modernization would lead to a substitution of public for private activity. Second, the growth in real income would facilitate the relative expansion of the income elastic 'cultural and welfare' expenditures, where collective producers were more efficient than private ones. Finally, developments and changes in technology require governments to take over the management of natural monopolies in order to enhance economic efficiency. Henrekson (1993) also asserted that Wagner's law should be interpreted as predicting an increased share for the public sector in the total economy as per real income growth, as opposed to Musgrave's (1969) version, which interprets the law either as an increase in the share of government in national income or the absolute level of government.

Since there has been no consistent view on the functional form describing Wagner's law, the most common functional forms of the law cited in the literature are as follows:

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

$$GCE = f(GDP) \tag{2}$$

$$GE/GDP = f(GDP) \tag{3}$$

$$GE = f(GDP/N) \tag{4}$$

$$GE/N = f(GDP/N) \tag{5}$$

$$GE/GDP = f(GDP/N) \tag{6}$$

where $GE$ is the total government expenditure, $GDP$ is the gross domestic product, $GCE$ is the government consumption expenditure and $N$ is the population.

Functional form 1 is referred to as the Peacock–Wiseman (1961) version as they established a graphical relation between public spending and income and this was also utilized in Musgrave (1969) and Goffman and Mahar (1971). The second formulation was initially used by Pryor (1968). Functional form 3 represents the modified version of Peacock-Wiseman (1961) and was also adopted by Mann (1980). Functional form 4 is linked to Goffman (1968). Functional form 5 represents Gupta's (1967) version and was also adopted by Michas (1975). The final functional form is a Musgrave (1969) version, which was also adopted by Ram (1986), Murthy (1993), Henrekson (1993) and Hsieh and Lai (1994). Of the several versions of Wagner's law, the last formulation is often used and is considered to be most appropriate one. Thus, this paper will adopt it too. In general, functional forms of the law are converted into the double logarithmic linear forms and real aggregate data are used in estimations. To support Wagner's law, the elasticity between $GE/GDP$ and $GDP/N$ should exceed zero.

## 3. Econometric methodology

To investigate the relationship between government expenditure and economic activity, this paper adopts functional form 6 of Wagner's law as outlined earlier. Functional form 6 investigates the relationship between the share of government expenditure in GDP and real per capita income and can be written in linear natural logarithmic regression form as follows:

$$gey_t = a_0 + a_1 py_t + \varepsilon_t \tag{7}$$

where $a_0$ is the constant term, $gey_t$ is the share of government expenditure in GDP, $py_t$ is real per capita income and $\varepsilon_t$ is the classical regression error. For Wagner's law to hold, $a_1$ is expected to be greater than zero. Unlike traditional econometric methodology, time-series econometrics methodology requires an analysis of the time-series properties of the economic variables in a regression equation before any estimation, in order to avoid any spurious relationship between them. If the time-series properties of the variables are fulfilled, then a possible long-run relationship—co-integration—between them can be investigated. As suggested by Engle and Granger (1987), a possible long-run relationship between the economic variables can be examined by identifying their time-series paths. The long-run relationship between the economic variables exists if the variables are stationary in their level or differenced forms. The economic variables in question should be integrated in the same order—should be stationary in their level or in their first differences denoted as $I(0)$ and $I(1)$, respectively. If two variables are $I(1)$ and co-integrated then either uni-directional or bi-directional Granger causality must exist in, at least, the between $I(0)$ variables. To test the stationarity of the data, a general form of the ADF regression equation is formed as follows:

$$\Delta X_t = \beta_1 + \beta_2 T + \beta_3 X_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta X_{t-i} + \varepsilon_t \tag{8}$$

where $\Delta X_t$ is the first differenced series of $X$, $T$ is a time trend, $\varepsilon_t$ is a white noise residual.

The hypothesis that a series contains a unit root—non-stationary—is tested by setting the null hypothesis as $H_0$: $\beta_2 = \beta_3 = 0$. This setting also implies non-stationarity with a deterministic trend rather than a stochastic trend. Once the series is found to be stationary, then a co-integration test can be performed.

There are basically two approaches to test the co-integration between the stationary time-series: Engle–Granger (1987) two-stage and Johansen (1988) and Johansen and Juselius (1990, 1992) maximum likelihood. The latter approach, as suggested by Gonzalo (1994), is considered to be more robust and has more advantages over the first one. The Johansen–Juselius estimation method is based on the error correction representation of the Vector Auto Regression (VAR) model with Gaussian errors. Sims (1980) proposed VAR modelling. The VAR method is also related closely to co-integration.

A general VAR model with the lag length, $p$, can be expressed in vector format as follows:

$$\Delta X_t = \Pi_0 + \Pi_1 \Delta X_{t-1} + \Pi_2 \Delta X_{t-2} + \cdots + \Pi_{p-1} \Delta X_{t-p+1} + \pi X_{t-p} + BZ_t + v_t \tag{9}$$

where $X_t$ represents $m \times 1$ vector of $I(1)$ variables, $Z_t$ stands for $s \times 1$ vector of $I(0)$ variables, $\Pi$s are unknown parameters and $v_t$ is the error term. The hypothesis that $\pi$ has a reduced rank $r < m$ is tested using the trace and the maximum eigenvalues test statistics.

If the co-integration is found to exist between the variables, then either uni-directional or bi-directional causality must exist in the variables. Granger's (1969) causality test is originally designed for stationary variables and has been extended into the co-integration models by Engle–Granger (1987) and Granger (1988).

In the bivariate VAR model case, testing for Granger causality is straightforward. The normal tests for restrictions, such as the Wald F and LR, can be used. The Granger causality test is based on the following regression equation:

$$X_{1t} = \alpha + \sum_{i=1}^{n} \beta_1 X_{1t-i} + \sum_{i=1}^{n} \gamma_i X_{2t-i} + u_t \tag{10}$$

The two variables in equation (10) are normally assumed to be stationary. The restrictions imposed $\gamma_1 = \gamma_2 = \ldots = \gamma_n = 0$ are tested using one of the several restriction tests. Of these tests, Wald F or LR statistics appear to be quite appropriate. If there are more than two variables, the block Granger causality test (sometimes also referred as the block exogeneity test) is used. The lag selection process is based on Akaike information criterion (AIC) and Schwarz Bayes criterion (SBC).

## 4. Empirical results

The ADF unit root test results for the time-series in equations (7) and (11) are presented in table 1 in terms of logarithmic level and logarithmic first differences. According to the unit root test results, all the time-series appear to be stationary in their first differences rather than in their levels, i.e., they are both $I(1)$.

On implementing the Johansen maximum likelihood co-integration approach, the lag structure of the VAR system is selected on the basis of AIC and SBC values which are reported in table 2. According to table 2, a short lag is optimal for the system.

The Johansen co-integration test is performed with a constant term but without a linear time trend. The summary results of the test are presented in table 3.

Table 3 reveals that Wagner's law is not supported, since the normalized coefficient of *py* is negative. The next step is a search for the flow of a direction between the time-series, which is implemented using Granger's causality test, and the result of this test is summarized in panel A of table 4. It should be noted that Granger's test lag selection is also based on the AIC and SBC values which have suggested a short lag structure, too. Therefore, panel A of table 2 is again used in this context.

**Table 1. Unit root tests.**

| | ADF test statistic | | | |
|---|---|---|---|---|
| Variable | Levels (1966–2000) | $p$ | Differences (1967–2000) | $p$ |
| *gey* | −0.55 | 1 | −3.97* | 1 |
| *py* | −1.94 | 1 | −3.51* | 1 |
| *bdr* | −2.85 | 2 | −5.25* | 2 |

*Rejection of unit root hypothesis, according to McKinnon's critical value, at 5%.
The test equation includes an intercept and a time trend and a 1 to 5 lagged difference variable. Lag selections are based on AIC and SBC criteria but are not reported here for space considerations.

**Table 2. The order of the VAR model.**

| Variables: | Panel A *gey*, *py* | | Panel B *gey*, *py*, *bdr* | |
|---|---|---|---|---|
| $p$ | AIC | SBC | AIC | SBC |
| 4 | 126.25 | 111.75 | 222.37 | 190.96 |
| 3 | 127.53 | 116.26 | 217.97 | 193.78 |
| 2 | 130.57 | 122.51 | 219.92 | 203.01 |
| 1 | 133.24 | 128.41 | 223.75 | 214.08 |
| 0 | 23.41 | 21.80 | 116.12 | 114.20 |

Other lag length selection criteria are not reported although they reveal the same results.

**Table 3. Johansen and Juselius co-integration tests and results.**

Panel A: the results of λ-max and trace tests
Variables: *gp*, *yp*

| Null | Alternative | λ-max statistic | 95% critical value | Trace statistic | 95% critical value |
|---|---|---|---|---|---|
| $r=0$ | $r=1$ | 38.97 | 15.87 | 42.0 | 20.18 |
| $r\leq 1$ | $r=2$ | 3.02 | 9.16 | 3.02 | 9.16 |

Panel B: estimate of co-integrating vector
normalized coefficients

| *gey* | constant | *py* |
|---|---|---|
| −1.000 | 2.242 | −0.050 |

$r=$ number of co-integrating vectors.

According to table 4, both the Wald F and LR test statistics indicate that the causality direction is not just from economic activity to government expenditure but the flows of causality are bi-directional. Hence Wagner's law does not hold.

**Table 4. Non-causality tests.**

| Panel A: test statistics | | Panel B: test statistics | |
|---|---|---|---|
| Variables: *gey*, *py* | $p=1$ | Variables: *gey*, *py*, *bdr* | $p=1$ |
| Wald F statistic (1, 37) | 2.20 [0.146] | Wald F statistic (2, 36) | 4.50 [0.105] |
| LR statistic $\chi^2(1)$ | 2.31 [0.128] | LR statistic $\chi^2(2)$ | 2.14 [0.132] |
| Variables: *py*, *gey* | | Variables: *py*, *gey*, *bdr* | |
| Wald F statistic (1, 37) | 0.10 [0.748] | Wald F statistic (2, 36) | 0.13 [0.935] |
| LR statistic $\chi^2(1)$ | 0.11 [0.736] | LR statistic $\chi^2(2)$ | 0.60 [0.942] |
| | | Variables: *bdr*, *py*, *gey* | |
| | | Wald F statistic (2, 36) | 3.94 [0.113] |
| | | LR statistic $\chi^2(2)$ | 2.70 [0.108] |

The values within square brackets represent the probabilities of rejecting the null hypotheses and the values in front of them denote the test statistics.

The empirical results in this study obtained so far contradict the previous studies relating to Wagner's law for Turkey (Kyzyzanick, 1974; Ram, 1987; Anwar *et al*., 1996).

### 4.1. *Augmented version of Wagner's law*

In order to find a meaningful long-run relationship between government expenditure and economic development in the case of Turkey, this paper considers an augmented version of Wagner's law, as suggested by Murthy (1994). Murthy (1994) suggested a broad interpretation of the law to allow for the addition of more explanatory variables related to economic development and government expenditure, such as the degree of urbanization, budget deficits, etc into Wagner's functional forms, which would also reduce the omitted variable bias and mis-specification in econometric estimations. In regard to the Johansen co-integration approach, the presence of missing variables would be more sensitive in the econometric estimations. With this view, Murthy (1994) extended functional form 6 by adding another explanatory variable (i.e. the degree of urbanization) and found support for such formulation in Mexico. This study also adopts a similar approach and expands equation (7) by adding another explanatory variable (the ratio of budget deficit to GDP) as follows:

$$gey_t = a_0 + a_1 py_t + a_2 bdr_t + \varepsilon_t \tag{11}$$

where $bdr_t$ is the natural logarithm of the ratio of budget deficit to GDP and $a_2 < 0$. The inclusion of the last explanatory variable into equation (11) is justified because it does not contradict the spirit of the law. It is normally expected that as economic development progresses, the budget deficit ratio would increase in the case of developing countries since government revenue increases less in proportion to the expenditure. This problem would be further alleviated if developing countries were adopting financial and economic liberalization policies. Turkey, as a developing country, has been facing an ever-increasing level of budget deficits since the mid-1980s. The causes of such deficits are the extensive liberalization of the capital account, mis-management and inefficiency in its giant state economic enterprises (SEEs) and

**Table 5. Johansen and Juselius co-integration tests and results.**

Panel A: the results of λ-max and trace tests
Variables: *gey*, *py*, *bdr*

| Null | Alternative | λ-max statistic | 95% critical value | Trace statistic | 95% critical value |
|---|---|---|---|---|---|
| $r=0$ | $r=1$ | 41.27 | 22.04 | 64.27 | 34.87 |
| $r\leq 1$ | $r=2$ | 20.15 | 15.87 | 22.99 | 20.18 |
| $r\leq 2$ | $r=3$ | 2.84 | 9.16 | 2.84 | 9.16 |

Panel B: estimate of co-integrating vectors

| | *gey* | constant | *py* | *bdr* |
|---|---|---|---|---|
| Vector 1: normalized coefficients | −1.000 | −1.712 | 0.426 | −3.750 |
| Vector 2: normalized coefficients | −1.000 | 0.50 | −0.009 | −1.918 |

$r$ = number of co-integrating vectors.

external shocks, such as crude oil prices and financial crises in Russia and the far east. The causes and consequences of such budget deficits in Turkey since 1980 are analyzed extensively in Ertugrul and Selcuk (2001). The time-series properties of the new explanatory variable have been investigated and the results are reported in table 1, along with the other variables. Having identified the last variable as $I(1)$, the augmented version of equation (7) has been estimated in the same sequences of the bivariate relationship. The summary results relating to the order of the VAR, the block Granger causality tests, and co-integration tests, normalized coefficients, are reported in panel B of tables 2 and 4, and table 5, respectively. Panel B of table 2 also indicates the length of the VAR in the case of the augmented equation as 1. The subsequent implementation of the Johansen co-integration tests indicate that there exist two possible long-run relationships between the variables, as reported in table 5.

As can be seen from the estimated co-integrating vectors in panel B of table 5, the sign of *py* in vector 1 is in line with our expectations, which provides a support for the law. In regard to the block Granger causality tests (panel B of table 4), there is no support for the law but there exist trivate directional flows between the variables. It should also be noted that rejection of the validity on the basis of the block Granger causality test is borderline and, therefore, should be treated with caution. It is clear that the empirical analyses concerning the augmented version of the law have provided mixed results.

## 5. Concluding remarks

This paper has attempted to test the validity of Wagner's law for Turkey by using modern time-series econometric techniques. As a stylized fact in public finance, Wagner's law has drawn substantial interest from researchers. The empirical estimations of Wagner's law are, in general, based on the different interpretations of what Wagner really meant. There are at least six well-known versions of the law, all of which assume that they represent the spirit of the law. The previous empirical researches based on classical econometric techniques from the 1960s to the early 1980s provided evidence for the law, almost without exception. The developments in time-series econometric techniques in the 1980s and 1990s, however, have made those results dubious or simply spurious. The re-estimations of the functional forms of the law using modern time-series econometric techniques in the last two decades have started revealing mixed results for the validity of the law. The source of this contradiction might be explained tentatively as follows: (a) either the modern time-series econometric techniques are very sensitive for the time span being used in estimations, because they require considerably longer observations in regard to the classical regression methods; or (b) the interpretation of the law, hence, the functional form of it, is not suitable to perform the modern time-series econometric techniques. With regard to the empirical evidence provided for Turkey in this paper using the modern time-series econometric techniques, it is clear that Wagner's law does not hold in the case of the adopted traditional form, since neither co-integration nor causality tests were in line with the proposed implications of the law. On interpreting Wagner's law in broad terms and augmenting the adopted functional form accordingly, a positive long-run relationship has been found between the share of government in GDP and real per capita income growth, which supports the law. However, further analysis on the basis of the block Granger causality test has revealed that the law does not hold for Turkey or at least the direction of flows has been rejected.

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## Appendix A

### A.1. *Data discussions*

The econometric estimation period is selected as 1960–2000 due to data compatibility between the Turkish data set used in this study and the internationally available longest data sets that could be obtained from OECD, IMF and World Bank. Although the Turkish data set span for some variables is stretched to far before 1960, they are not consistent with other international data sets. This study also considers only the variables in aggregate terms since disaggregated data are not available for the whole selected estimation period.

### A.2. *Data definitions and sources*

*bdr* (see figure A1) is the budget deficit ratio to *GDP* and is calculated as (*GR*–*GE*/*GDP*), where *GR* is the total government revenue, *GE* is the government expenditure including the total government expenditure (central and local government) and the transfer payments, *GDP* is the gross domestic product, all measured in millions of Turkish lira at 1990 market prices (figure A1). Nominal values of *GR*, *GE* and *GDP* are deflated by the consumer prices index of 1990 = 100, which is derived from my own construction of the chain consumer price index of 1938 = 100. Sources: *Main Economic and Social Indicators of Turkey*, *1923–1998* and subsequent *Annual Statistics* published by the State Institute of Statistics of Turkey, Ankara.

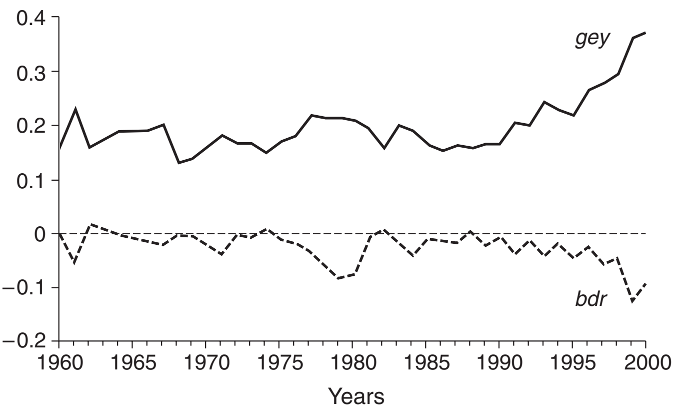


**Figure A1. The ratio of real total government expenditures in *GDP* (*gey*) and budget deficit to *GDP* (*bdr*) in Turkey 1960–2000.**

*gey* (see figure A1) is the share of the total government expenditures in *GDP*. The data transformation and source are as above.

*py* is per capita income, measured in millions of Turkish lira at 1990 market prices. The data transformation and source are as above.

*N* is the total population in millions. The data source is as above.

The econometric estimations are implemented by using Microfit 4.0 interactive econometric software developed by Pesaran and Pesaran (1997).