# THE VALIDITY OF WAGNER'S LAW: THE CASE OF TURKEY WITHIN THE FRAMEWORK OF THE MUSGRAVE AND MANN MODELS

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## 1. INTRODUCTION

The relationship between public expenditures, one of the most important tools of fiscal policy implemented by governments, and GDP (gross domestic product) is very important for the decisions of policymakers. In this context, this relationship has been among the subjects studied since the 19th century and has been discussed in many studies. One of the studies is Wagner's Law.

In 1883, Wagner conducted a study by addressing the countries such as North American countries, Britain, Switzerland, and Prussia and concluded that the developments in the economy led to an increase in public expenditures, and this view has been included in the literature as Wagner's Law (Ulutürk et al., 2016: 20 – 21). With this law expressed as the "Law of Increasing Public Expenditures," it was argued that there was a relationship between public expenditures and GDP and that the most important reason for the growth in the public sector was the increase in GDP. Furthermore, according to this law, the rate of increase in public expenditures is higher compared to the rate of increase in GDP, and there is a causal relationship from GDP to public expenditures.

In line with Wagner's Law, public expenditures increase due to three reasons as GDP increases. The first one of these reasons is industrialization. In other words, states increase public expenditures to eliminate the complexity caused by urbanization resulting from industrialization. The second one is the increase in demand for public services as GDP per capita increases. The third one is that technological developments are supported by

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public sector funds since private sector funds are insufficient (Atgür, 2020: 898 – 899; Demir and Balkı, 2019:13).

In case of the validity of Wagner's Law, the reason for the increase in public expenditures is the increase in GDP. In this case, it is stated that public expenditures, among the important tools of fiscal policy in terms of macroeconomic policies, will not affect real variables and that public expenditures cannot be used as a political tool.

Two of the models employed in the testing of Wagner's Law are the Musgrave (1969) and (1980) Mann models. Musgrave indicated that the increase in public expenditures was regular and continuous apart from wars in the USA for the period of 1890-1948 (Bayramoğlu and Sümer, 2019: 967). After Musgrave translated Wagner's work into English in 1958, studies on public expenditures began to increase (Şanlısoy and Sunal, 2016: 106). Mann (1980) performed OLS for Mexico for the period of 1925 - 1976 and concluded that Wagner's Law was valid.

The extent of public expenditures is very important for both economic and political stability. The failure to provide a sustainable public discipline was one of the problems that started in the eighties and continued in the later years in Turkey. Furthermore, the borrowing method started to be mostly preferred in the financing of budget deficits since 1984, and consequently, the public debt burden increased and then a crisis occurred in 1994. Then, the importance attached to the public discipline started to increase with the financial crisis in 2001 (Atgür, 2020: 897). In this context, this study's goal was to analyze the validity of Wagner's Law, which claims that the increase in real GDP, an indicator of economic growth, leads to an increase in public expenditures and which is an important topic of discussion in the national and international literature, in Turkey for the period of 1985- 2019 within the framework of the Musgrave and Mann models. To this end, an extensive literature review was first conducted in the study, and then, the validity of Wagner's Law in Turkey for the period of 1985- 2019 was investigated by Johansen cointegration, standard Granger and Toda & Yamamoto Granger causality analyses.

## 2. LITERATURE REVIEW

Many applied studies were conducted to test the validity of Wagner's Law, and cointegration analyses and causality tests were mostly used in these studies. While Wagner's Law was concluded to be valid in some of these studies, it was concluded to be invalid in some of them. The reason for this difference between the studies was due to the difference in the methods used and the periods addressed. Therefore, there is no empirical consensus on whether Wagner's Law is valid in Turkey.

The studies concluding that Wagner's Law is valid for Turkey can be listed as the studies carried out by Günaydın (2003), Arısoy (2005), Gacener (2005), Işık and Alagöz (2005), Mohammadi et al. (2008), Selen and Eryiğit (2009), Altunç (2011), Oktayer (2011), Güder et al. (2016), Şanlısoy and Sunal (2016), Cergibozan et al. (2017), Şit and Karadağ (2018), Tülümce and Yayla (2017), Tülümce and Zeren (2017), Bayramoğlu and Sümer (2019), Gövdeli (2019), Atgür (2020), Esen et al. (2020) and Zabun (2020). On the contrary, the studies concluding that Wagner's Law is invalid for Turkey can be listed as the studies performed by Demirbaş (1999), Bağdigen and Çetinbaş (2003), Çavuşoğlu (2005), Başar et al. (2009), Yüksel and Songur (2011), Tuna (2013), Ulucak and Ulucak (2014), Telek and Telek (2016) and Timur and Albayrak (2016).

# 3. ECONOMETRIC ANALYSIS

This section of the study consists of the data set, method, stationarity tests and Johansen cointegration analysis, and standard Granger and Toda & Yamamoto Granger causality analyses.

## 3.1. Data set

In the study, an analysis was performed by considering the annual time series data for the period of 1985-2019 to examine whether Wagner's Law was valid for Turkey. Furthermore, in the study, dummy variables for the 1994, 2001, and 2008 crises were included in the models. A summary of the data used in the study is presented in Table 1 below.

**Table 1. Data Set**

| Variables | Description of Variables | Source |
|---|---|---|
| ge | Ratio of Public Expenditures to GDP | WDI |
| gdp | Real GDP | WDI |
| gdppc | Real GDP Per Capita | WDI |

In the application section of the study, letters "d" and "l" at the beginning of the symbols of the variables show that the difference and logarithm of the relevant variable are taken, respectively.

## 3.2. Models

Two of the models employed in the testing of Wagner's Law are the Musgrave (1969) and (1980) Mann models. These two models were developed as an alternative to Wagner's Law. In this context, in the current research, the validity of Wagner's Law was investigated within the framework of the models developed by Musgrave (1969) and Mann (1980), which are two different versions of Wagner's Law.

Musgrave Model: $ge = \alpha + \beta lgdppc + \lambda t$ $\beta > 0$

Mann Model: $ge = \alpha + \beta lgdp + \lambda t$ $\beta > 0$

## 3.3. Method

In this study, firstly, whether the data in the Musgrave and Mann models were stationary was investigated by the Augmented Dickey-Fuller (ADF) and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) unit root tests. Then, the Johansen cointegration test was used to examine whether there was a cointegration relationship in the relevant data. Finally, whether there was a causal relationship between the variables was tested by standard Granger and Toda & Yamamoto Granger causality analyses. E-Views 10 and GAUSS 19.1 econometric analysis programs were used for these analyses.

## 3.4. Stationarity Test

The data must be stationary so that the cointegration and causality analyses performed for the variables included in the models would provide accurate results. In this context, the stationarity of the data was first examined by the ADF and KPSS tests.

**Table 2. ADF Stationarity Test Statistics**

| Fixed Model | | | |
|---|---|---|---|
| **Variable** | **t** | **p** | **Stationarity** |
| **ge** | -1.876967 | 0.3387 | Non- stationary |
| **d(ge)** | -6.093425 | 0.0000 | **Stationary** |
| **lgdp** | -0.148950 | 0.9357 | Non- stationary |
| **d(lgdp)** | -6.056931 | 0.0000 | **Stationary** |
| **lgdppc** | -0.161088 | 0.9342 | Non- stationary |
| **d(lgdppc)** | -6.092569 | 0.0000 | **Stationary** |

The analyses were performed for the fixed model. The lag values of the variables were determined using the AIC (Akaike Info Criterion), and the maximum lag length was taken as 2.

Table 2 includes the ADF stationarity test results of the variables discussed. According to the stationarity test results, ge, lgdp, and lgdppc data were stationary in the first-order difference in the fixed model.

**Table 3. KPSS Stationarity Test Statistics**

| Variables | KPSS Test Statistics | Stationarity State |
|---|---|---|
| **ge** | 0.712642** | Non- stationary |
| **d(ge)** | 0.090013 | **Stationary** |
| **lgdp** | 0.696896** | Non- stationary |
| **d(lgdp)** | 0.077908 | **Stationary** |
| **lgdppc** | 0.689208** | Non- stationary |
| **d(lgdppc)** | 0.089766 | **Stationary** |
| **Critical Values** | | |
| **10%** | **5%** | **1%** |
| 0.347000 | 0.463000 | 0.739000 |

The analyses were performed for the fixed model. (**) refers to significance at the level of = 5%. The Bartlett Kernel method as the Spectral Estimation Method and the Newey-West Bandwidth method as the bandwidth were used in the application of the KPSS stationarity test.

Table 3 includes the KPSS stationarity test results of the variables discussed. According to the stationarity test results, ge, lgdp, and lgdppc data were stationary in the first-order difference in the fixed model.

According to the findings of both the ADF and KPSS tests, the presence of a long-term relationship between the variables was analyzed by the Johansen cointegration test since all of the data were stationary in their first-order differences.

## 3.5. Johansen Cointegration Analysis

Since we have I(1) in our three variables in the two models discussed, it is necessary to examine the presence of a cointegration relationship. The lag length of the data in the models should first be determined to perform the cointegration analysis. The goodness of fit criteria values calculated based on various lag lengths are presented in Table 4 and Table 5.

**Table 4. Lag Length Selection for the Musgrave Model**

| Lag | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|
| 0 | NA | 0.019309 | 1.726178 | 2.088968 | 1.848246 |
| 1 | 73.81541* | 0.001608* | -0.765302* | -0.221117* | -0.582200* |
| 2 | 3.232748 | 0.001821 | -0.652187 | 0.073392 | -0.408052 |
| * Indicates the appropriate value for the relevant information criterion. | | | | | |

**Table 5. Lag Length Selection for the Mann Model**

| Lag | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|
| 0 | NA | 0.034330 | 2.301615 | 2.664405 | 2.423683 |
| 1 | 88.92721* | 0.001633* | -0.749561* | -0.205376* | -0.566459* |
| 2 | 3.281251 | 0.001847 | -0.638387 | 0.087193 | -0.394251 |
| * Indicates the appropriate value for the relevant information criterion. | | | | | |

The appropriate lag length was found to be 1 for both the Musgrave and Mann models according to information criteria such as LR, FPE, Akaike, Schwarz, and HQ.

In both the estimated Musgrave model and the Mann model, attention was paid to ensure that there was no autocorrelation and heteroskedasticity problem for VAR (1) and that the inverse roots of the AR polynomial would remain inside the unit circle. The results of the tests performed for this purpose are shown in Table 6, Table 7, and Figure 1.

**Table 6. Autocorrelation LM Test Results**

| Autocorrelation | | | | |
|---|---|---|---|---|
| Lag length | Musgrave Model | | Mann Model | |
| | LM Statistics Value | Probability Value (p) | LM Statistics Value | Probability Value (p) |
| 1 | 3.047114 | 0.5500 | 3.103324 | 0.5407 |
| 2 | 5.292174 | 0.2586 | 5.256969 | 0.2619 |
| 3 | 0.173415 | 0.9965 | 0.174811 | 0.9964 |
| 4 | 3.646548 | 0.4559 | 3.461519 | 0.4838 |
| 5 | 3.082255 | 0.5442 | 2.930392 | 0.5695 |
| 6 | 1.789939 | 0.7743 | 1.850043 | 0.7633 |
| 7 | 2.122592 | 0.7132 | 1.987525 | 0.7381 |
| 8 | 3.867287 | 0.4243 | 3.917455 | 0.4173 |
| 9 | 3.467530 | 0.4828 | 3.462327 | 0.4836 |
| 10 | 6.402735 | 0.1710 | 6.060458 | 0.1947 |
| 11 | 1.870253 | 0.7596 | 1.983970 | 0.7387 |
| 12 | 3.583710 | 0.4653 | 3.422825 | 0.4897 |

According to Table 6, it was observed that there was no autocorrelation problem for 12 lags in both the Musgrave and Mann models.

**Table 7. Heteroskedasticity Test**

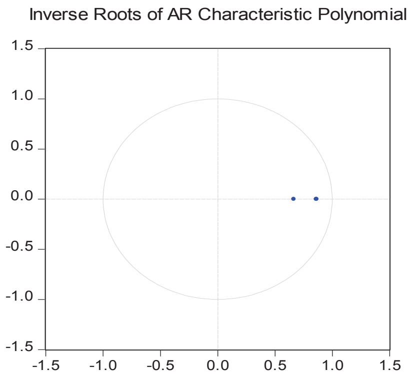
| White Heteroskedasticity Test | | | | | |
|---|---|---|---|---|---|
| Musgrave Model | | | Mann Model | | |
| Chi-square | Degree of Freedom | Prob. | Chi-square | Degree of Freedom | Prob. |
| 27.90483 | 21 | 0.1429 | 27.87071 | 21 | 0.1439 |

(**): Refers to significance at the level of 5%.

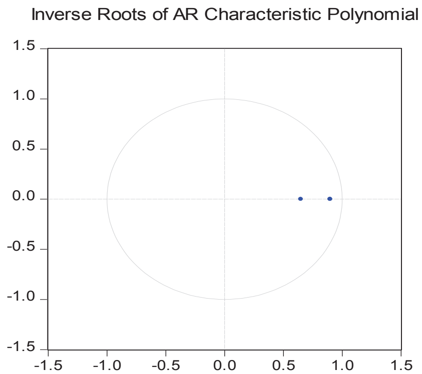
According to Table 7, it was observed that there was no heteroskedasticity problem in both the Musgrave and Mann models.

**Figure 1. Characteristic Roots for the Musgrave and Mann Models**

**Characteristic Roots for the Musgrave Model**




**Characteristic Roots for the Mann Model**




According to Figure 1, the inverse roots of the AR polynomial are inside the unit circle, and both the Musgrave and Mann models meet the stationarity condition.

**Table 8. Trace and Maximal Eigenvalue Statistics for the Musgrave Model**

| Rank (r) | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|
| | Trace Statistics | Maximal Eigenvalue Statistics | Trace Statistics | Maximal Eigenvalue Statistics | Trace Statistics | Maximal Eigenvalue Statistics |
| **None (r=0)** | 28.13047 (0.0033) $H_O$ Rejected | 21.41709 (0.0061) $H_O$ Rejected | 8.480862 (0.4155) **$H_O$ Accepted** | 8.405771 (0.3389) **$H_O$ Accepted** | 14.29607 (0.6331) $H_O$ Accepted | 8.518167 (0.7729) $H_O$ Accepted |
| **At most 1 (r=1)** | 6.713379 (0.1424) $H_O$ Accepted | 6.713379 (0.1424) $H_O$ Accepted | 0.075091 (0.7840) $H_O$ Accepted | 0.075091 (0.7840) $H_O$ Accepted | 5.777899 (0.4890) $H_O$ Accepted | 5.777899 (0.4890) $H_O$ Accepted |

The values in parentheses refer to prob. values.

According to Table 8, Trace and Maximal Eigenvalue statistics for the Pantula Principle are presented for the equation consisting of ge and lgdppc variables. According to the Pantula Principle, the appropriate definition is Model 3.

**Table 9. Trace and Maximal Eigenvalue Statistics for the Mann Model**

| Rank (r) | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|
| | Trace Statistics | Maximal Eigenvalue Statistics | Trace Statistics | Maximal Eigenvalue Statistics | Trace Statistics | Maximal Eigenvalue Statistics |
| **None (r=0)** | 41.10943 (0.0000) $H_O$ Rejected | 33.93565 (0.0000) $H_O$ Rejected | 8.764948 (0.3876) **$H_O$ Accepted** | 8.698300 (0.3121) **$H_O$ Accepted** | 15.02160 (0.5727 $H_O$ Accepted | 8.732369 (0.7516) $H_O$ Accepted |
| **At most 1 (r=1)** | 7.173782 (0.1175) $H_O$ Accepted | 7.173782 (0.1175) $H_O$ Accepted | 0.066649 (0.7963) $H_O$ Accepted | 0.066649 (0.7963) $H_O$ Accepted | 6.289229 (0.4245) $H_O$ Accepted | 6.289229 (0.4245) $H_O$ Accepted |

The values in parentheses refer to prob. values.

According to Table 9, Trace and Maximal Eigenvalue statistics for the Pantula Principle are presented for the equation consisting of ge and lgdp variables. According to the Pantula Principle, the appropriate definition is Model 3.

According to Table 10 and Table 11, the appropriate cointegration model for the Musgrave and Mann Models is Model 3.

**Table 10. Johansen Cointegration Test for the Musgrave Model**

| Musgrave Model | | | | |
|---|---|---|---|---|
| **Rank (r)** | **Trace Statistics (p-values)** | **Critical Values for Trace Statistics (5%)** | **Maximal Eigenvalue Statistics (p-values)** | **Critical Values for Maximal Eigenvalue Statistics (5%)** |
| **None (r=0)** | 8.480862 (0.4155) | 15.49471 | 8.405771 (0.3389) | 14.26460 |
| **At most 1 (r=1)** | 0.075091 (0.7840) | 3.841466 | 0.075091 (0.7840) | 3.841466 |
| **Result:** There is no cointegration. | | | | |

As seen in Table 10, according to the Trace and Maximal Eigenvalue statistical values, there is no cointegration vector directing ge and lgdppc and bringing them into balance in the long term. The absence of cointegration between the variables demonstrates that there is no long-term relationship between the relevant variables. Therefore, it can be said that there is no long-term equilibrium relationship between the variables discussed and that the variables do not affect each other in the long term.

**Table 11. Johansen Cointegration Test for the Mann Model**

| Mann Model | | | | |
|---|---|---|---|---|
| **Rank (r)** | **Trace Statistics (p-values)** | **Critical Values for Trace Statistics (5%)** | **Maximal Eigenvalue Statistics (p-values)** | **Critical Values for Maximal Eigenvalue Statistics (5%)** |
| **None (r=0)** | 8.764948 (0.3876) | 15.49471 | 8.698300 (0.3121) | 14.26460 |
| **At most 1 (r=1)** | 0.066649 (0.7963) | 3.841466 | 0.066649 (0.7963) | 3.841466 |
| **Result:** There is no cointegration. | | | | |

As seen in Table 11, according to the Trace and Maximal Eigenvalue statistical values, there is no cointegration vector directing ge and lgdp and bringing them into balance in the long term. The absence of cointegration between the variables demonstrates that there is no long-term relationship between the relevant variables. Therefore, it can be said that there is no long-term equilibrium relationship between the variables discussed and that the variables do not affect each other in the long term.

## 3.6. Standard Granger and Toda & Yamamoto Granger Causality Analysis

In the present research, standard Granger and Toda & Yamamoto Granger causality analysis was performed to reveal the causal relationship between the variables in the Musgrave and Mann models. In line with Wagner's Law, the direction of the causal relationship between the variables in the relevant models was from lgdppc to ge in the Musgrave model; however, it was from lgdp to ge in the Mann model. In this context, the results of the standard Granger and Toda & Yamamoto Granger causality tests are shown in Table 12 and Table 13.

**Table 12. Standard Granger and Toda & Yamamoto Granger Causality Test Results for the Musgrave Model**

| | Standard Granger Causality Test | | Toda & Yamamoto Granger Causality Test | |
|---|---|---|---|---|
| **Direction of Causality** | **Wald - stat** | **Bootstrap p - value** | **Wald - stat** | **Bootstrap p - value** |
| **lgdppc → ge** | 0.044 | 0.838 | 0.132 | 0.729 |

The lag values of the variables were determined using the AIC (Akaike Info Criterion), and the maximum lag length was taken as 2. Furthermore, since the number of observations in this study was less than 50, the "Bootstrap p" value was taken into account in the analyses.

According to Table 12, it was observed that there was no causal relationship from lgdppc to ge. Therefore, it was concluded that changes in real GDP per capita did not affect the ratio of public expenditures to GDP in the short term.

**Table 13. Standard Granger and Toda & Yamamoto Granger Causality Test Results for the Mann Model**

| | Standard Granger Causality Test | | Toda & Yamamoto Granger Causality Test | |
|---|---|---|---|---|
| **Direction of Causality** | **Wald - stat** | **Bootstrap p - value** | **Wald - stat** | **Bootstrap p - value** |
| **lgdp → ge** | 0.036 | 0.839 | 0.254 | 0.601 |

The lag values of the variables were determined using the AIC (Akaike Info Criterion), and the maximum lag length was taken as 2. Furthermore, since the number of observations in this study was less than 50, the "Bootstrap p" value was taken into account in the analyses.

According to Table 13, it was observed that there was no causal relationship from lgdp to ge. Therefore, it was concluded that changes in real GDP did not affect the ratio of public expenditures to GDP in the short term.

## 4. CONCLUSION

In the current research, the validity of Wagner's Law, which argues that the increase in GDP or economic growth increases public expenditures, for Turkey was investigated within the scope of the Musgrave and Mann models. In accordance with these models, while the ratio of public expenditures to GDP was considered as a dependent variable, real GDP per capita and real GDP variables were considered as independent variables. In this study in which annual data for the period of 1985 - 2019 were used for Turkey, the validity of Wagner's Law was investigated by Johansen cointegration and standard Granger and Toda & Yamamoto Granger causality analyses. As a result of the analyses, it can be said that there was no long-term equilibrium relationship between the variables in both models, that the variables did not affect each other in the long term, and that the variables did not act together. Furthermore, the causal relationship between the variables in the models discussed was investigated by standard Granger and Toda & Yamamoto Granger causality analyses. In this context, the findings of the causality analysis performed for both the Musgrave and Mann models revealed that there was no Granger causality relationship between the variables discussed, in consistentcy with the results of the cointegration analysis. Thus, according to the cointegration and causality tests, Wagner's Law indicating that "the increase in GDP increases public expenditures" was not valid for Turkey within the framework of the period, models and methods used. This result indicates that public expenditures were not affected by changes in GDP and that the rate of increase in public expenditures was not more significant than the rate of increase in GDP and reveals that public expenditures did not increase as a result of economic growth in Turkey.

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