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RESEARCH ARTICLE
Economy

Cointegration, Causality and Wagner's Law: A Panel Data Analysis for Eurozone *

Eşbütünleşme, Nedensellik ve Wagner Kanunu: Euro Bölgesi için bir Panel Veri Analizi

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ABSTRACT

Government spending is one of the main issues in macroeconomics. According to Keynes, economic growth can be stimulated by government spending. Before Keynes, Adolph Wagner, a German economist, revealed the relationship between government spending and economic growth. Wagner claims that as economy grows, the share of public sector in the progressive states increases. According to Wagner's Law, the relationship is from economic growth to government spending. In this study, the validity of Wagner's Law analyzed by Westerlund panel cointegration and Dumitrescu and Hurlin(2012) panel causality analysis by using 16 Eurozone countries' yearly data between 1995 and 2018. According to test results, economic growth and government spending have long run relationship and there is one way causality that from economic growth to government spending. In other words, Wagner's Law is valid for selected Eurozone countries and period subject to the study.

Keywords: Wagner's Law, Government Expenditures, Economic Growth, Panel Causality Analysis, Cointegration Analysis

ÖZET

Devlet harcamaları, Keynesyen Model'den sonra makroekonominin temel konularından biri haline gelmiştir. Keynesyen Modele göre, devlet harcamaları ekonomik büyümeyi teşvik eder. Ancak Keynes'ten önce, önde gelen bir Alman ekonomist Adolph Wagner, hükümet harcamaları ile ekonomik büyüme arasındaki ilişkiyi ortaya koydu. Wagner, ekonomi büyüdükçe gelişen devletlerde kamu sektörünün payının arttığını iddia ediyor. Wagner Yasası, ilişkinin ekonomik büyümeden kamu harcamalarına doğru olduğunu ileri sürer. Bu çalışmada, Wagner Yasasının geçerliliği Westerlund panel eşbütünleşe testi ve Dumitrescu ve Hurlin (2012) panel nedensellik testi ile Euro kullanan Avrupa Birliği üyesi ülkeler için analiz edilmiştir. Analiz, 16 Euro Bölgesi ülkesinin 1995-2018 yılları arasındaki yıllık verileri kullanılarak yapılmıştır. Test sonuçlarına göre ekonomik büyüme ile kamu harcamaları arasında uzun dönemde ilişki bulunmakta ve büyümeden kamu harcamalarına doğru bir nedensellik vardır. Başka bir deyişle, Wagner Yasası, çalışmaya konu olan seçilmiş Euro Bölgesi ülkeleri ve dönem için geçerlidir.

Anahtar Kelimeler: Wagner Kanunu, Kamu Harcamaları, Ekonomik Büyüme, Panel Nedensellik Analizi, Eşbütünleşme Analizi

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INTRODUCTION

In macroeconomics, economic growth is the main issue for all countries. From a Keynesian view, government expenditure has become one of the leading reasons for economic growth. According to Keynesian Theory, government expenditures stimulate economic growth. Therefore, Keynes shows that the relationship is from government spending to economic growth. However, before and after Keynes this relationship has been one of the main debates in the literature. Before Keynes, a famous German economist Adolph Wagner, revealed the relationship between economic growth and government spending. Wagner (1958) claims that as the economy grows, the share of public sector increases in progressive countries. The increase in government spending is needed because of three main reasons. First of all, the social functions such as retirement insurance, natural disaster aid, environmental programs of state enlarge over time. Secondly, the assignments of state into sciences, technology and various investment products increase. Lastly, government debt service expenditure rise.

Wagner's Law is also known as the law of increasing state activity, meaning that public spending increases as national income rises. This principle is closely related with industrialization. The improvement of an industrial economy comes along with an increase in public spending for a higher social welfare. Europe is known as the starting point of industrialization. The emergence of the modern industrial society in Europe brought along the welfare state understanding. After World War II, the concept of welfare state has become used within the framework of the social opportunities provided by the state. The economic growth provided by modern industrial society creates political pressure on governments for social progress. Europe is known as one of the main regions where the social state concept is widespread. This concept has increase its importance in times of global economic crisis and regional crisis in Europe.

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Studies using panel data are limited in the literature. Therefore, this study will contribute to the literature in terms of including country groups. In addition, this study will help to understand the tendencies of countries about this issue that use the same currency and therefore are interdependent in terms of monetary and fiscal policies.

LITERATURE

In the literature there are different studies that focus on the relationship between government expenditure and economic growth. The results of these empirical studies show that the relationship differs according to countries and time of period analyzed. There are studies that test the validity of Wagner's Law for countries by using time series data. Also, there are different panel data analysis to demonstrate the relationship between government expenditure and economic growth for country groups. The results show that these studies have achieved different results.

In the literature there are time series studies for different countries in testing the validity of Wagner's Law by using causality analysis. For example, Tang (2001) tested for Malaysia by using 1960-1998 period yearly data and found that causality is from gross domestic product (GDP) to Government expenditure. Also, Iniguez – Montiel (2010) for Mexico, Sideris (2007) for Greece, Kumar, Webber and Fargher (2012) for New Zealand tested and found that Wagner's Law is valid for these countries according to used yearly data and time period. Bayrakdar et al. (2015) used quarterly data including the period between 1998-2004 for Türkiye and found that Wagner's Law is valid.

Some other country specific studies found that Keynesian view is valid in testing the relationship between economic growth and public sector. Liu et al. (2008) used yearly data between 1974-2002 and found that government expenditure is a granger causal of economic growth. Also, Babatunde (2011) for Nigeria and Jiranyakul (2013) for Thailand examined the relationship and found the relationship between government expenditure and GDP that is congruous with Keynesian view. Tuna (2013) also found that Wagner's Law is not valid for Turkey but Keynesian view is valid on the contrary.

There are also other empirical studies testing Wagner's Law which show two-sided relationship between government expenditure and GDP. For example, Bojanic (2013) used yearly data of Bolivia including period 1940-2010 for testing validity of Wagner's law by cointegration and causality analysis. He found bi-directional causality between income and government expenditures. Also Ghazy et al. (2020), one of the most recent papers, examined the validity of Wagner's Law in Egypt from 1960 to 2018. They found strong evidence for long term relationship between GDP and government expenditure and the casual relationship is bi-directional. Paparas et al. (2019) analyzed UK as a developed country and found mixed relationship between two variables.

Some studies in the literature found no relationship between government spending and income. For example, Sharma and Sing (2019) found no clue for the relationship between government expenditure and national income for India including the years 1988-2017. Moreover, Bashir and Ibrahim (2019) for Sudan and Gurgul et al. (2012) for Poland found no causality between government expenditure and economic growth.

In addition to time series analysis there are also panel data analysis to test Wagner's Law for selected country groups. Demez (2021) analyzed the relationship between economic growth and public expenditure for EU transition economies by using data from 1995 to 2019. The result shows that the Wagner's Law is valid for EU transition countries for the period covering this study. Narayan et al. (2008) tested Wagner's Law for Chinese by using panel unit root, panel cointegration and panel causality testing approach. In addition to full panel of provinces they also utilized smaller panels corresponding to China's eastern, central, and western provinces. For the less developed, lower income central and western panels there is mixed support for Wagner's law. There is less support for Wagner's law for China as a whole or for the higher income eastern provinces (Narayan et al., 2008:305).

Bandres and Gadea (2019) analyzed the relationship between government spending and economic growth for 25 European countries including data between 1960 and 2017.The study used different econometric methods that include both country individual analysis and panel data models. The results show that Wagner's Law is invalid.

Another study to test Wagner's Law for 15 European countries was applied by Karagianni et al.(2002) by using data between 1949 and 1998. They applied the Engle-Granger cointegration test, the Johansen maximum likelihood method and the Granger causality test to different functional interpretations of the law. The results are very ambiguous but law is vali for the vast majority of countries according to Johansen Criterion.

Narayan et al. (2012) examined the Wagner's Law for 15 Indian states including the period 1986-2008. According to the test result granger causality is from growth to public expenditure that shows the validity of Wagner's law for these 15 Indian states. Also, the studies of Wu et al. (2010) and Afonso and Jalles (2014) which used panel data method are other exemplary works that demonstrate the validity of Wagner's Law.

MODEL AND DATA

There are several versions of Wagner's Law that appeared in the literature. According to law it is basically assumed that the public spending size is a function of economic growth. The variables used in determining the function have different measurements. GDP and per capita GDP are most common measurements for economic growth. Public spending were expressed by government expenditure or government expenditure share to GDP. Five different models mentioned in the literature are shown below. In these models, EXP stands for government expenditure, GDP stands for gross domestic product and pop stands for polulation.

Model 1: $\ln EXP=\alpha+\beta GDP$ (1)

Model 2: $\ln EXP=\alpha+\beta \ln(GDP/pop)$ (2)

Model 3: $\ln(EXP/GDP)=\alpha+\beta GDP$ (3)

Model 4: $\ln(EXP/GDP)=\alpha+\beta(GDP/pop)$ (4)

Model 5: $\ln(EXP/pop)=\alpha+\beta \ln(GDP/pop)$ (5)

Model 1 is formulated by Peacock and Wiseman (1961) as the government expenditure is a function of government spending. Fort he validity of Wagner's law, the government expenditure should increase more than GDP. Model 2 that expressed by Goffman (1968) shows that government expenditure is a function of GDP per capita. In the third model the share of government spending in the economy is used as government expenditure variable. It is a funktion of GDP which is similar to first model. In model 4, Musgrave(1969) stated that GDP per capita is a function of the share of government expenditure in economic activities. The last model, applied by Gupta(1967), shows that GDP per capita as a function of government expenditure per capita.

The study includes 16 Euro using countries depending on the availability of data. Data include countries' annual time series data covering the period from 1995 to 2018. These countries, in alphabetical order, are Austria, Belgium, Estonia, Finland, France, Germany, Greece, Greek Cyprus, Ireland, Italy, Luxemburg, Netherland, Portugal, Slovakia, Slovenia, and Spain. Yearly GDP data in real form is used as an economic growth indicator. Also, real government expenditure variables are used as public sector indicator. IMF's World Economic Outlook(WEO) databases were used as the source of countries' data. Gross Domestic Product is in constant prices (base year is 2015). General Government Total Expenditure converted to real term by deflator index (100 in 2015). Both variables are in local currency(EURO). All variables are in log form.

LRGDP= Real GDP (constant 2015) in log form

LREXP= Real Government Expenditure (constant 2015) in log form

DLRGDP= first difference of LRGDP series

DLREXP= First difference of LREXP series

METHODOLOGY AND EMPRICAL FINDINGS

In this study, Granger causality analysis is performed to determine the direction of the relationship between the variables. However, beforehand, it is important to test cross-sectional dependence between variables. Because, the results without considering the cross-sectional dependence will be biased and inconsistent. Also, we used the homogenity test to find out whether the economies of the countries that used in the analysis are similar or not. After that, according to cross section dependence test results, the second generation panel unit root test is applied. Then, to determine the existance of long run relationship between variables cointegration test is used. Finally, Dumitrescu and Hurlin (2012) panel causality test is used to test the casual relationship between the series.

Cross-Section Dependence Test

Before examining causal linkages within the panel framework, first issue is to control for cross-sectional dependEnce between countries, because a shock that affects one country may also affects others. Pesaran (2006) shows the importance of testing for cross-sectional dependence in a panel data study and he also illustrates the substantial bias and size distortions when cross-sectional dependence is ignored in the estimates (Menyahet al., 2014:289). Also, cross-section dependency testing should be performed to determine the correct unit root test and cointegration tests in panel data series.

There are different tests to measure the cross section dependence in the literature. One of them is Breusch Pagan's (1980) LM test. This test can be used in panel data analysis if T>N where T is time dimension and N is unit dimension. But it is appropriate to use Peseran's (2004) scaled LM test if N>T. Also Pesaran's (2004) CD test is feasible to use

if both N<T and T<N. All three tests mentioned can be used for both homogenus and heterogenous panels. There is also Bias corrected scaled LM test to measure the cross section dependence for only homogenous panels that developed by Baltagi, Feng and Kao (2012).

The cross section dependence test results are given in the Table-1. According to statistical outcomes for both variables, all tests results are significant at 1%. Then it can be said that series have cross section dependence.

Table 1: Cross Section Dependence Test Results

Test (for LREXP)	**Statistic**	**Prob**
Breusch-Pagan LM	2068.496	0.0000
Pesaran scaled LM	125.7749	0.0000
Bias-corrected scaled LM	125.4270	0.0000
Pesaran CD	35.18195	0.0000
Test (for LRGDP)	**Statistic**	**Prob**
Breusch-Pagan LM	2266.018	0.0000
Pesaran scaled LM	138.5248	0.0000
Bias-corrected scaled LM	138.1770	0.0000
Pesaran CD	46.60056	0.0000

Hsiao Homogeneity Test

The homogeneity test in panel data analysis, aims to understand whether other countries are affected at the same level by a change in any of the countries studied. In this context, the economic structures of countries play an important role. In general, if the economic structures of the countries discussed differ from each other, the coefficients in the model are expected to be heterogeneous. However, if their economic structures are similar, the coefficients are expected to be homogeneous (Kar et al., 2018:312).

In this study, the Hsiao (1986) test was used for the homogeneity test. The Hsiao test has three different hypotheses: H1, H2 and H3. The first hypothesis H1 states that the coefficients are homogeneous, the alternative of the hypothesis says that it is heterogeneous. The second one H2, on the other hand, is the same as the H1 hypothesis, while defending homogeneity, it states that its alternative is heterogeneous. However, the H3 hypothesis, unlike other hypotheses, assumes that its alternative is partially heterogeneous (Turgut and Uçan, 2019:10).

The Table-2 shows the result of Hsiao homogeneity test. According to the results, coefficients are heterogenous.

Table 2: Hsiao Homogenity Test Results

Hypotheses(LREXP dependent)	**F-Stat**	**P-Value**
H1	38.62318	6.35E-93
H2	18.89034	9.65E-37
H3	33.70817	8.78E-60
Hypotheses(LRGDP dependent)	F-Stat	P-Value
H1	88.39755	1.3E-144
H2	43.70081	6.28E-71
H3	48.48140	1.96E-77

Panel Unit Root Test

In the current econometrics' literature, panel unit root tests are divided into two as those that consider cross-section dependency and those that do not. First generation unit root tests are applied under cross-section independence in panel data analysis. However, if there is cross section dependence, second generation unit root tests are applied.

Most common unit root tests are developed by Moon and Perron (2004), Phillips and Sul (2003), Bai and Ng (2004), Choi (2002) and Pesaran (2007) (Tatoğlu,2012:220). In this study, since there is cross section dependency between series(countries) Pesaran's (2007) Covariate Augmented Dickey Fuller (CADF) test which is one of the second generation unit root tests was used. Pesaran (2007) CADF test is an extended version of ADF regression with cross-sectional means of first differences and lag levels of individual series. In the test, individual results of each cross-section are obtained with the CADF statistic, and results related to the overall panel are obtained with the CIPS (Cross sectionally augmented Im, Peseran and Shin) statistic, which is expanded by taking the cross-sectional averages. The CADF test gives fairly consistent results even when the cross-section (N) and time (T) dimensions are relatively small. In addition, this test can be used both in cases where $T > N$ and $N > T$ (Pesaran, 2007: 266-267).

The panel unit root test CIPS statistical results for the panel is given in the Table-3. Results show that for the whole panel, series have unit root at level but are stationary at I (1). Since the series are not stationary at level values, it was decided that the cointegration relationship between these series could be analyzed.

Table 3: Panel Unit Root Test Results

Pesaran CIPS	T-Stat	
	Constant	Constant&Trend
LRGDP	-1.72526*	-2.74327*
DLRGDP	-2.76444***	-2.94040**
LREXP	-1.79402*	-2.03133*
DLREXP	-4.01045***	-3.82602***
Note: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.		

Panel Cointegration Test

The existance of long-run relationships between the series that stationary at I(1) is determined by cointegration tests. In this study, Westerlund's (2007) error correction based second generation panel data cointegration test used, because there is cross-section dependence between the variables. Westerlund test is run, and p values (robust p-value) determined by the bootstrap method. Since coefficients are heterogenous, Gt and Ga robust p-values are considered. According to the results shown in the Table-4 the null hypothesis- that is no cointegration- can be rejected at 1% significance level with the Gt and Ga tests. Therefore, it can be said that there is cointegration between GDP and Government Expenditures.

Table 4: Panel Cointegration Test Results

Statistic	Value	Z-value	P-value	Robust P-value
Gt	-3.438	-9.465	0.000	0.000
Ga	-8.974	-4.548	0.000	0.000
Pt	-6.392	-3.726	0.000	0.090
Pa	-3.296	-3.136	0.001	0.010

Dumitrescu Hurlin Panel Causality Test

For the purpose of this study, Dumitrescu and Hurlin (2012) panel causality test was used to test the casual relationship between the series. According to Dumitrescu and Hurlin (2012) the advantages of this test are; it can take into account both the cross sectional dependence and heterogeneity between the countries forming the panel, it can be used when the time dimension(T) is larger or smaller than the cross-section size(N), and it can produce effective results in unbalanced panel data sets.

According to the results given in the Table 5 shows that the null hypothesis where GDP does not cause of EXP is rejected but the null hypothesis where EXP does not cause of GDP is not. Therefore, it can be said that GDP is grangercause of EXP but the reverse is not. This result is consistent with Wagner's Law.

Table 5: Dumitrescu Hurlin Panel Causality Tests Results

Null Hypothesis:	W-Stat	Zbar-Stat	Prob.
DLRGDP does not cause DLREXP	12.3611*	5.88887	4.E-09
DLREXP does not cause DLRGDP	5.06333	0.05067	0.9596
*Indicates that estimated parameters are significant at 1% level.			

CONCLUSION

In this study, Wagner's Law was examined for 16 eurozone countries by using Dumitrescu and Hurlin (2012) causality analysis for the 1995-2018 period. This law reveals the relationship between economic growth and government expenditure. Wagner claims that as the economy grows public spending increases. The study employed panel cointegration and panel causality tests. The cointegration analysis validates the existence of long run relationship between the variables. The result of causality analysis indicates that there is one way causality from economic growth to government expenditure which is congruent with Wagner's Law for these Euro using countries. In other words, Keynesian view that government spending is a policy to encourage economic growth is not supported for these countries for the period stated in the study.

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