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A bootstrap panel Granger causality analysis of government revenues and expenditures in the PIIGS countries

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Abstract

The paper investigates the government revenues-expenditures nexus in the case of Portugal, Ireland, Italy, Greece and Spain (PIIGS). The analysis covers the period 1988-2014 and follows the bootstrap panel Granger causality proposed by Kónya (2006). The findings show that there is a one-way causality in case of Greece and Italy, from government revenues to spending. The same unidirectional causality is also registered for Portugal, but it runs from public expenditure to revenues. There is no Granger causality for Ireland and Spain.

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1. Introduction

Over the last decades, the connection between government revenues and expenditures has been deeply explored by many researchers, having important implications on fiscal deficit and public debt. The recent economic crisis shows that this relationship becomes crucial for policymakers in their effort to ensure macroeconomic stability and restart the economic growth.

The paper investigates the government revenues-expenditures nexus in the case of Portugal, Ireland, Italy, Greece and Spain (PIIGS). This group of countries arouse a special interest in the last years, given their substantial economic instability and high public debt. The analysis covers the period 1988-2014 and follows the bootstrap panel Granger causality proposed by Kónya (2006).

The literature in the field is prolific, offering four main statements: (i) tax-spent hypothesis, (ii) spent-tax hypothesis, (iii) fiscal synchronization hypothesis, and (iv) fiscal independence or institutional separation hypothesis. Tax-spent hypothesis reveals that the government inputs drive spending, as unidirectional causality from taxes to spending (Friedman, 1978; Buchanan and Wagner, 1977). The spend-tax hypothesis is formulated by Peacock and Wiseman (1961, 1979) and claims that the government expenditures lead taxes in on-way direction. A mixed view offer Musgrave (1966), and Meltzer and Richard (1981). Their fiscal synchronization hypothesis highlights bidirectional causality between taxes and spending. The last hypothesis, the fiscal independence or institutional separation, has origins in the contributions of Wildavsky (1988), followed by Baghestani and McNown (1994). The authors emphasise that there is no any connection between government revenues and government expenditures.

This is the first study in the literature which explores the causality between government revenues and government expenditures in the case of PIIGS countries and the second one, after Bolat (2014), which follows the bootstrap panel Granger causality tool in the fiscal area.

The rest of the paper is it as follows: Section 2 highlights the data and methodology, Section 3 illustrates the empirical results, while Section 4 concludes.

2. Data and methodology

The analysis follows the bootstrap panel Granger causality proposed by Kónya (2006) and uses a panel with 5 cross-sections (five countries) and 27 years (the period 1988-2014). There are several advantages of Kónya's (2006) proposal. First of all, the methodology does not require testing the variables for unit root and cointegration, in this case the variables being used in their levels. Secondly, the tool considers the existence of contemporaneous correlations across countries and offers additional panel information (the equations composes a SUR system). Not at least, the procedure enforces for each country one-way, two-way or no Granger causality between variables.

The variables considered are the government revenues (R) and government expenditures (E). Both are expressed as percentage of Gross Domestic Product (GDP). The source of data is International Monetary Fund, World Economic Outlook Database (April, 2014).

The bootstrap panel Granger causality requires two main assumptions: cross-sectional dependence and cross-country heterogeneity.

A battery of three tests is selected to check the cross-sectional dependence: the Breusch and Pagan (1980) LM test, the Pesaran (2004) CD test, and the Pesaran et al. (2008) bias-adjusted LM test. The cross-country heterogeneity is tested by using the standardized version of Swamy's

(1970) test for slope homogeneity proposed by Pesaran and Yamagata (2008) and its improved version.

Managing the cross-sectional dependence and country-specific heterogeneity, the Kónya's (2006) procedure has its ground in the Seemingly Unrelated Regressions (SUR) systems and the Wald tests with country specific bootstrap critical values.

For our investigation, the SUR system comprises two sets of equations:

$$\mathrm{E}_{1,\mathrm{t}} = \alpha_{1,1} + \sum_{l=1}^{mlE_1} \lambda_{1,1,l} E_{1,t-1} + \sum_{l=1}^{mlR_1} \delta_{1,1,l} R_{1,t-1} + \varepsilon_{1,1,t} \quad (1)$$

$$\mathrm{E}_{2,\mathrm{t}} = \alpha_{1,2} + \sum_{l=1}^{mlE_1} \lambda_{1,2,l} E_{2,t-1} + \sum_{l=1}^{mlR_1} \delta_{1,2,l} xR_{2,t-1} + \varepsilon_{1,2,t}$$

.....

$$\mathrm{E}_{\mathrm{N},\mathrm{t}} = \alpha_{1,\mathrm{N}} + \sum_{l=1}^{mlE_1} \lambda_{1,N,l} E_{2Nt-1} + \sum_{l=1}^{mlR_1} \delta_{1,N,l} xR_{N,t-1} + \varepsilon_{1,N,t}$$

and

$$\mathrm{R}_{1,\mathrm{t}} = \alpha_{2,1} + \sum_{l=1}^{mlE_2} \lambda_{2,1,l} E_{1,t-1} + \sum_{l=1}^{mlR_2} \delta_{2,1,l} R_{1,t-1} + \varepsilon_{2,1,t} \quad (2)$$

$$\mathrm{R}_{2,\mathrm{t}} = \alpha_{2,2} + \sum_{l=1}^{mlE_2} \lambda_{2,2,l} E_{2,t-1} + \sum_{l=1}^{mlR_2} \delta_{2,2,l} R_{2,t-1} + \varepsilon_{2,2,t}$$

.....

$$\mathrm{R}_{\mathrm{N},\mathrm{t}} = \alpha_{2,\mathrm{N}} + \sum_{l=1}^{mlE_2} \lambda_{2,N,l} E_{2Nt-1} + \sum_{l=1}^{mlR_2} \delta_{2,N,l} R_{N,t-1} + \varepsilon_{2,N,t}$$

where R is the government revenues (% of GDP), E represents the government expenditures (as % of GDP), N denotes the cross-section dimension (in our case, N=5), t is the time period (in our analysis, t =27), and l is the lag length. The common coefficient is captured by α, λ and δ show the slopes, while ε represents the disturbance. There are maximal lags for R and E, for each system, which are the same across equations. The optimal lag combination the lag for which the Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC) are minimal represents the optimal lag combination. Given the SUR system, based on our notations, for any i country, "(i) there is one-way Granger-causality from R to E if not all $\delta_{1,i}$ are zero, but all $\lambda_{2,i}$ are zero, (ii) there is one-way Granger causality running from E to R if all $\delta_{1,i}$ are zero, but not all $\lambda_{2,i}$ are zero, (iii) there is two-way Granger causality between E and R if neither $\delta_{1,i}$ nor $\lambda_{2,i}$ are zero, and (iv) there is no Granger causality between E and R if all $\delta_{1,i}$ and $\lambda_{2,i}$ are zero" (Kónya, 2006, p.981).

3. Results

The outputs of tests for cross-sectional dependence (LM test, CD test and LM_{adj} test) and slop homogeneity ($\tilde{\Delta}$ test and $\tilde{\Delta}_{adj}$ test) are presented in Table 2.

Table 2: Cross-sectional dependence and slop homogeneity test results

Method	Test statistics	p-value
Cross-sectional dependence tests		
LM test	34.61***	0.0001
CD test	1.559	0.1191
LM_{adj} test	15.62***	0.0000
Slop homogeneity tests		
$\tilde{\Delta}$ test	4.755***	0.0000
$\tilde{\Delta}_{adj}$ test	5.032***	0.0000

Note:
(1) *, ** and *** are the significance for at 0.1, 0.05 and 0.01 levels;
(2) LM test, CD test and LM_{adj} test represent the cross-sectional dependence tests of Breusch and Pagan (1980), Pesaran (2004), and Pesaran et al. (2008), respectively;
(3) $\tilde{\Delta}$ test and $\tilde{\Delta}_{adj}$ test denote the slop homogeneity tests proposed by Pesaran and Yamagata (2008).

The first set of results shows that the null hypothesis of no cross-section dependence is rejected by two out of three tests. This means that in the PIIGS group there is a cross-sectional dependence, any shock in one country being transmitted to another one. We also note that SUR system estimation is more appropriate than country-by-country pooled OLS estimator.
The second outputs reveal that the null hypothesis of slop homogeneity is strongly rejected by both tests. This suggests that, in the PIIGS area, a significant economic relationship in one country is not replicated in others.
As the conditions of cross-section dependence and cross-country heterogeneity are validated, the bootstrap panel Granger causality approach can be followed. The results are presented in Table 2[1].

Table 2. The bootstrap panel Granger causality results

Country	H_0: E does not Granger causes R		H_0: R does not Granger causes E	
	Wald test	P-value	Wald test	P-value
Greece	1.986	0.158	3.101*	0.078
Ireland	0.601	0.981	0.396	0.529
Italy	0.978	0.322	10.04***	0.001
Portugal	6.429**	0.011	0.151	0.901
Spain	1.585	0.207	0.691	0.405

Note: *, ** and *** denote the significance for at 0.1, 0.05 and 0.01 levels.

The findings show that there is a one-way causality in case of Greece and Italy, from government revenues to spending. The same unidirectional causality is also registered for Portugal, but it runs from public expenditure to revenues. There is no Granger causality for Ireland and Spain.

[1] The TSP codes used in the bootstrap panel Granger causality approach is offered by the courtesy of Laszlo Kónya.

4. Conclusions

The analysis of the connection between government revenues - spending in the PIIGS countries, by following the bootstrap panel Granger causality, offers interesting outputs. This group of countries is strongly influenced by globalization and have common economic characteristics, as part of European Union. Moreover, any significant economic relationships in one country are not necessarily replicated by the others.

Tax-spend hypothesis is validated for Greece and Italy, taxes driving the level of government expenditures. Conversely, the spent-tax hypothesis is highlighted in the case of Portugal. In this country, the government expenditures lead taxes. Finally, the fiscal independence hypothesis characterises Ireland and Spain.

Regarding the policy implications, the Greece and Italy's policymakers should firstly determine the government revenues and after that the level of spending. In the case of Portugal, it is recommended that the estimations of government expenditures to be followed by tax adjustments. The fiscal policy decisions regarding public revenues and spending should be taken independently in Ireland and Spain, their policymakers being focused on the long-run economic growth.

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