

Government revenues and expenditures in the EU ex-communist countries: a bootstrap panel Granger causality approach

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Abstract:

The aim of this paper is to investigate the causality between government revenues and government spending in the case of 10 EU ex-communist countries, for the period 1995-2012, by following the bootstrap panel Granger causality approach proposed by Kónya (2006).

The main results show that unidirectional causality from public expenditure to revenues is registered only in the case of Bulgaria, while for Czech Republic, Hungary and Slovenia the government revenues Granger cause expenditures. A two-way causality is observed only for Slovak Republic. No Granger causality is found for the rest of the sample (i.e. Estonia, Latvia, Lithuania, Poland and Romania).

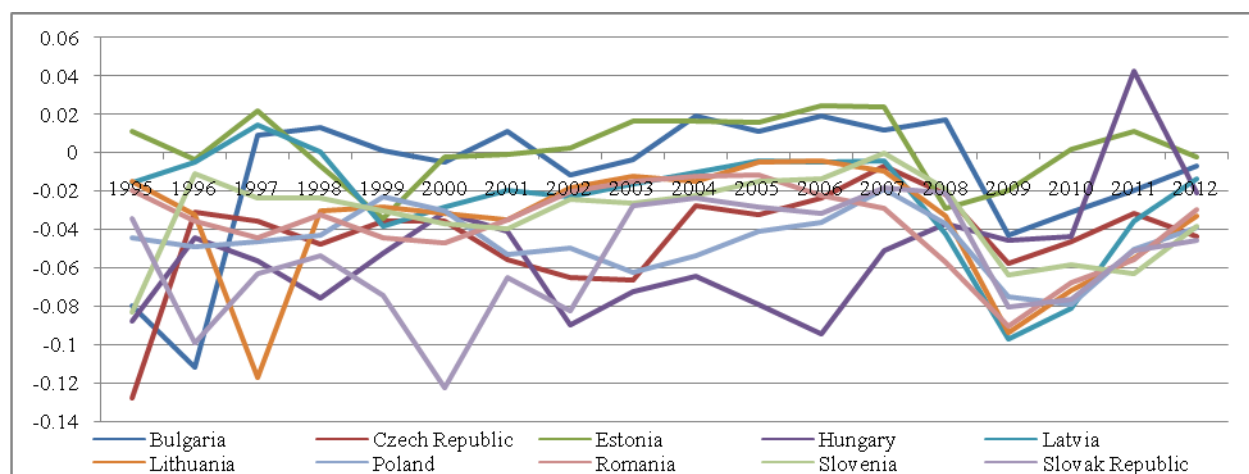
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1. Introduction

The relationship between government revenues and expenditures has been intensively investigated in the last decades, given its implications on fiscal deficit and public debt, with direct impact on economic growth. This connection becomes crucial for policymakers, especially under recent economic disturbances, which negatively affected almost all world economies. Many researchers started to revisit this connection and causality direction between government inputs and outputs, for various countries and periods, by following different methodological tools.

On this ground, the aim of the paper is to explore the government revenues-expenditures nexus, in the case of European Union (EU) ex-communist countries, by using a bootstrap panel Granger causality approach, for the period 1995-2012. The targeted area includes Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia and Slovak Republic. This group of EU countries presents a special interest for the literature, registering fundamental transformations since 1989/1990. They left the planned economy for competitive market, changed the authoritarian political system to a pluralist democracy, and followed the characteristics of a civil society. As Farkas (2011, p.15) emphasizes, Central and Eastern European countries also have several particular common elements: “the lack of capital, weak civil society and the impact of the European Union and other international organisations influencing the new member states.” On the other hand, all these countries registered in the considered period (Figure 1) a sinusoidal tendency, with strong shocks in the years 2007-2008 and converging trend to budgetary equilibrium after 2009.



Source of data: Government Finance Statistics, Eurostat online database (2015, January)

Figure 1. Budgetary deficit/surplus in EU ex-communist countries (percentage of GDP), in the period 1995-2012

Until 2008, four of these countries (i.e. Czech Republic, Hungary, Poland and Slovak Republic) exhibited significant deficits, in many cases exceeding the level of 10% of Gross Domestic Product (GDP). The rest of them followed a smooth tendency on whole 1995-2008 period, Bulgaria and Estonia registering budgetary surpluses for several years.

The paper extends the literature in the field in three main directions. Firstly, it offers for the first time a Granger causality analysis in the case of EU ex-communist countries. Secondly, also as novelty, the investigation follows the bootstrap panel Granger causality developed by Kónya (2006), which takes account of cross-sectional dependence and cross-country heterogeneity. This paper is the second one in the literature which uses such methodology. Thirdly, the outputs are an important support for the fiscal policy makers in the EU ex-communist countries, helping them to manage, on long-run, the gap between public revenues and spending.

The rest of the paper it is as follows: Section 2 highlights the literature review, Section 3 presents the data and methodology, Section 4 shows the empirical results, while Section 5 concludes.

2. Literature review

The literature which investigates the connection between government revenues and government expenditures is prolific and offers different findings. There are four main hypotheses which derive from literature review: (i) tax-spent hypothesis, (ii) spent-tax hypothesis, (iii) fiscal synchronization hypothesis, and (iv) fiscal independence or institutional separation hypothesis.

The tax-spent hypothesis states that the taxes leads government expenditures as one-way causality direction, from taxes to spending. One of the first contributions in this topic belongs to Friedman (1978), who emphasizes that the taxes positively cause spending. He argues that the tax raising is not the right way to reduce the budget deficit because such adjustment will put pressure on spending. On the contrary, the best solution in this case is the tax cutting, which will reduce the level of government expenditures. Another view of tax-spent hypothesis offer Buchanan and Wagner (1977). They stress that tax leads spending, but with a negative correlation, as result of taxpayer fiscal illusion. When the government cuts the taxes, the perceiving price of public goods and services becomes lower, which increases the demand for public programs, stimulating the government spending. All these will accentuate the budget deficit. In order to attenuate such high deficit, Buchanan and Wagner (1977) recommend as remedy the reducing of public expenditures, by limiting the government control on deficit financing.

The second hypothesis is the spend-tax hypothesis and belongs to Peacock and Wiseman (1961, 1979). They show that the government spending drives taxes. The government will start to determine the level of expenditures, which will be followed by adjustments of taxes. Roberts (1978), and Peacock and Wiseman (1979) justify the need for such a mechanism in the context of crisis situations (i.e. wars, natural disasters, recessions), which puts pressure on public expenditures, raising the level of taxes. Considering spending as exogenous variable, Barro (1974, 1979) claims that an increase of the government outputs will generates additional taxes. The author rejects the fiscal illusion and expects that the taxpayers fully capitalize the future tax liability. In the same note, von Furstenberg et al. (1992) offer an interesting point of view, revealing that spending precedes taxes when the political majority tried to preserve its governance by increasing the expenditures in the pre-electoral period. This spending will be financing by additional taxes in the post-electoral period.

Fiscal synchronization hypothesis is formulated by Musgrave (1966), and Meltzer and Richard (1981) and consists in a bidirectional causality between tax and spending (i.e. two-way causality). According to this hypothesis, there is a biunivoque connection between government inputs and outputs. It covers both previous hypotheses and means that policymakers take simultaneous decision in respect to government tax and spending. Under this assumption, in order to decide for

appropriate level of taxes and spending, the voters will evaluate the costs and benefits of the public programs.

Finally, the last hypothesis is the fiscal independence or institutional separation hypothesis. The seminal research in this topic performs Wildavsky (1988), followed by Baghestani and McNown (1994). They suppose that there is no relationship between government revenues and government expenditures. In this fiscal neutral assumption, each component is given by long-run economic growth, the decisions regarding tax and spending being taken independently.

The literature in the field offers also many empirical studies which investigate the causality between government revenues and spending. By using different methodological tools, some contributions have as target only one country, while other analyses include two or more countries. In the case of second set of investigations, which considers more than two countries, as in our case, the results are different, depending by sample and methodological tools (Table 1).

Table 1. The main studies which investigate the connection between government revenues and expenditures with more than two countries

Author/s	Period	Countries	Methods	Outputs
Owoye (1995)	1961-1990	G7 Countries	ECM	E \leftrightarrow R : US, Germany, UK, France, Canada. R \rightarrow E : Japan, Italy.
Payne (1998)	1942-1992	US States	Engle-Granger ECM	R \rightarrow E: 24 states. E \rightarrow R: 8 states. R \leftrightarrow E: 11 states.
Chang et al. (2002)	1951-1996	10 Industrialized Countries	Granger Causality	R \rightarrow E: Japan, S. Korea, Taiwan, UK, US. E \rightarrow R: Australia and S. Africa. R \leftrightarrow E: Canada. R \leftrightarrow E: New Zealand, Thailand.
Narayan and Narayan (2006)	1950-2000	12 Developing Countries	Granger Causality	R \rightarrow E: Mauritius, El Salvador, Haiti, Chile Venezuela. E \rightarrow R: Haiti. R \leftrightarrow E: Peru, South Africa, Guatemala, Uruguay, Ecuador.
Konukcu-Önal and Tosun (2008)	1999:01 \approx 2007:04	Belarus, Kazakhstan, the Kyrgyz Republic and the	Granger Causality	R \rightarrow E: Belarus, the Russian Federation. R \leftrightarrow E: Kazakhstan, the Kyrgyz Republic.

		Russian Federation		
Afonso and Rault (2009)	1960-2006	EU-25	Panel Causality	E→R: Italy, France, Spain, Greece, and Portugal. R→E: Germany, Belgium, Austria, Finland, UK.
Chang and Chang (2009)	1992-2006	15 OECD Countries	Granger Causality	R↔E
Westerlund et al. (2011)	1963-1997	50 US state-local governments	Cointegration	R→E
Mehrara and Elyasi (2011)	1995-2008	40 Asian countries	Cointegration	R↔E
Paleologou (2013)	1965-2009	Greece, Sweden, Germany	TAR, MTAR	R→E: Greece. R↔E: Sweden, Germany.
Bolat (2014)	1980-2013	10 EU countries	Bootstrap panel Granger causality	R→E: Germany, Italy, and Netherlands. E→R: France and Portugal. R↔E: Austria, Belgium, Denmark, Finland, and UK.

Note: R reveals government revenue, E illustrates government expenditure, → denotes unidirectional causality, ↔ indicates bidirectional causality, while ⇔ means no causality between R and E.

Source: Bolat (2014, p.6), with personal additional adjustments.

Based on these multitudes of empirical contributions, we investigate the causality between government revenues and government expenditures in the case of EU ex-communist countries. We also highlight there is only one study (Bolat, 2014) which uses the bootstrap panel Granger causality proposed by Kónya (2006), in order to analyze the tax-spending connection, by focusing on more than two countries. In this context, our investigation is the second one in the literature in the field which follows such a methodology.

3. Data and methodology

In order to investigate the tax-spending nexus, we consider a panel with 10 cross-sections (countries) and 18 years, by following the bootstrap panel Granger causality proposed by Kónya (2006). This approach offers several advantages. Firstly, it does not require testing the variables for unit root and cointegration (i.e. the variables are used in their levels, without any stationarity conditions). Secondly, due to contemporaneous correlations across countries, some additional panel information can also be obtained (i.e. the equations represent a SUR system). Thirdly, no

other pre-tests are need, excepting the specification of the lag structure. Finally, the procedure allows us to identify, for each country, if there is one-way, two-way or no Granger causality between considered variables.

The variables are the government revenues (R) and government expenditures (E), being expressed as percentage of Gross Domestic Product (GDP). The source of data is the Eurostat Government Finance Statistics online database (2015). The targeted countries are Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia and Slovak Republic, for the period 1995-2012 (data availability). Croatia is not included in the sample, as this country jointed the EU zone at 1st July 2013.

Before applying the bootstrap panel Granger causality, it is crucial to test the panel for cross-section dependence and cross-country heterogeneity. The existence of cross-sectional dependency among the countries and country-specific heterogeneity are two main assumptions in the bootstrap panel Granger causality proposed by Kónya (2006).

3.1. Cross-section dependence tests

Testing the cross-sectional dependence means to identify the cross-section dependence in panel data (i.e. the presence of common shocks and unobserved components). We considers a set of three tests which permits to put in evidence 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 Lagrange Multiplier (LM) test proposed by Breusch and Pagan (1980) is performed taken into account the sum of squared coefficients of correlation among cross-section residuals, obtained based on ordinary least squares (OLS). Under null hypothesis of LM test statistics, there are no cross-sectional correlations. Requiring a large T (period), the test statistics is as follows:

$$LM = T \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij}^2 \right) \quad (1)$$

where $\hat{\rho}_{ij}^2$ represents the sample estimation of pair-wise correlation coefficients based on OLS (ordinary least squares) residuals estimation for each cross-sections i. Here $i=1,2,\dots,N$, while N represents the cross-section dimension. The LM test is recommended for panels with small N and large T.

For large N and small T, Pesaran (2004) suggests the CD test, which under the null hypothesis has standard normal asymptotic distribution ($T \rightarrow \infty$ and $N \rightarrow \infty$). The CD test has this form:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \right) \quad (2)$$

The author shows that the CD test has a mean zero for fixed T and N, whereas in the case of multiple breaks in slope coefficients and error variances, it is robust for heterogeneous dynamic estimations.

As the CD test has low power when the population pair-wise correlations are zero, Pesaran et al. (2008) propose the bias-adjusted test (LM_{adj}), which is an adjusted version of classical LM test. The test is as follows:

$$LM_{adj} = \sqrt{\frac{2}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{v_{Tij}} \right) \quad (3)$$

where k denotes the number of regressors, while μ_{Tij} and v_{Tij} are the mean and standard deviation of $(T-k)\hat{\rho}_{ij}^2$. Under the null hypothesis, LM_{adj} is asymptotically distributed as a $N(0,1)$, with $T \rightarrow \infty$ and $N \rightarrow \infty$.

3.2. Slope Homogeneity Tests

The second step in the bootstrap panel causality is to test the slope homogeneity. The Wald test principle is a good choice to be followed in such situation, being valid for small N and large T panels. In this case, the independent variables are strictly exogenous, while the error variances are homoscedastic. Based on this ground, Swamy (1970) proposes a slope homogeneity test in order to identify the cross-sectional heteroscedasticity, with this form:

$$\tilde{S} = \sum_{i=1}^N \left(\hat{\beta}_i - \tilde{\beta}_{WFE} \right)' \frac{x_i' M_{\tau} x_i}{\hat{\sigma}_i^2} \left(\hat{\beta}_i - \tilde{\beta}_{WFE} \right) \quad (4)$$

where $\hat{\beta}_i$ represents the estimator of pooled OLS, $\tilde{\beta}_{WFE}$ shows the estimator derived from the weighted fixed-effect pooled estimation, M_{τ} is an identity matrix, while $\hat{\sigma}_i^2$ illustrates the estimator of the variance of the error term.

Pesaran and Yamagata (2008) develop a standardized version of \tilde{S} test, which does not have any restrictions on relative expansion as long as the errors are normally distributed. The test is as follows:

$$\tilde{\Delta} = \sqrt{N} \left(\frac{N^{-1} \tilde{S} - k}{\sqrt{2k}} \right) \quad (5)$$

An improved version of $\tilde{\Delta}$ test, under normally distributed errors, can be performed, becoming:

$$\tilde{\Delta}_{adj} = \sqrt{N} \left(\frac{N^{-1} \tilde{S} - E(\hat{z}_{iT})}{\sqrt{\text{var}(\hat{z}_{iT})}} \right) \quad (6)$$

where $E(\hat{z}_{iT}) = k$, and the variance represents $2k(T-k-1)/T+1$.

3.3. Bootstrap panel Granger causality

The classical Granger (1969) causality approach reveals how that past values (lags) of one variable help to predict another one. When we deal with a multiple-country time-series, this thing seems to be more complex. In such a situation, two points of discussion are required. The first one is the cross-sectional dependence issue, which means that a shock in one variable generates effects on others, as in our investigation (i.e. all considered countries are influenced by globalization and have common economic characteristics, as former members of Council for Mutual Economic Assistance and current members of EU). The second point which needs discussion is the cross-country heteroskedasticity. The assumption is that a significant economic connection in one country does not necessarily be registered in the others.

The bootstrap panel Granger causality proposed by Kónya (2006) manages both cross-sectional dependence and country-specific heterogeneity. This technique is relied on the estimation of Seemingly Unrelated Regressions (SUR) systems and the calculation of Wald tests with country specific bootstrap critical values. Notable is that all variables are considered in the levels and the procedure allow us to obtain causality output for each country.

Two sets of equations give content of the SUR system:

$$\begin{aligned}
 E_{1,t} &= \alpha_{1,1} + \sum_{l=1}^{mE_1} \lambda_{1,1,l} E_{1,t-l} + \sum_{l=1}^{mR_1} \delta_{1,1,l} R_{1,t-l} + \varepsilon_{1,1,t} \\
 E_{2,t} &= \alpha_{1,2} + \sum_{l=1}^{mE_1} \lambda_{1,2,l} E_{2,t-l} + \sum_{l=1}^{mR_1} \delta_{1,2,l} R_{2,t-l} + \varepsilon_{1,2,t} \\
 &\dots\dots\dots \\
 E_{N,t} &= \alpha_{1,N} + \sum_{l=1}^{mE_1} \lambda_{1,N,l} E_{N,t-l} + \sum_{l=1}^{mR_1} \delta_{1,N,l} R_{N,t-l} + \varepsilon_{1,N,t}
 \end{aligned} \tag{7}$$

and

$$\begin{aligned}
 R_{1,t} &= \alpha_{2,1} + \sum_{l=1}^{mE_2} \lambda_{2,1,l} E_{1,t-l} + \sum_{l=1}^{mR_2} \delta_{2,1,l} R_{1,t-l} + \varepsilon_{2,1,t} \\
 R_{2,t} &= \alpha_{2,2} + \sum_{l=1}^{mE_2} \lambda_{2,2,l} E_{2,t-l} + \sum_{l=1}^{mR_2} \delta_{2,2,l} R_{2,t-l} + \varepsilon_{2,2,t} \\
 &\dots\dots\dots \\
 R_{N,t} &= \alpha_{2,N} + \sum_{l=1}^{mE_2} \lambda_{2,N,l} E_{N,t-l} + \sum_{l=1}^{mR_2} \delta_{2,N,l} R_{N,t-l} + \varepsilon_{2,N,t}
 \end{aligned} \tag{8}$$

where R and E denote government revenues (% of GDP) and government expenditures (as % of GDP), respectively. N represents the cross-section dimension (in our case, N=10), t is the time period (in our analysis, t =18), and l is the lag length. Furthermore, α is the common coefficient, λ and δ reveal the slopes, while ε is the disturbance.

For each system there are maximal lags for R and E, where are the same across equations. The optimal lag combination is the lag for which the Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC) are minimal.

Related to SUR system and adapting to 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).

4. Results

In order to follow the bootstrap panel Granger causality between government revenues and government expenditures, in the case of 10 EU ex-communist countries, for the period 1995-2012, it is crucial to test the cross-section dependence and slop homogeneity. Table 2 reveals the results for three tests of cross-section dependence (LM test, CD test and LM_{adj} test) and also the outputs for slop homogeneity test ($\tilde{\Delta}$ test and $\tilde{\Delta}_{adj}$ test).

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

Method	Test statistics	p-value
<i>Cross-sectional dependence tests</i>		
LM test	87.52***	0.0002
CD test	2.464**	0.0137
LM_{adj} test	9.764***	0.0000
<i>Slop homogeneity tests</i>		
$\tilde{\Delta}$ test	2.466***	0.007
$\tilde{\Delta}_{adj}$ test	2.687***	0.004

Note:

(1) *, ** and *** denote the significance for at 0.1, 0.05 and 0.01 levels;

(2) LM test, CD test and LM_{adj} test are 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 are the slop homogeneity tests proposed by Pesaran and Yamagata (2008).

The first set of output clearly indicates that the null hypothesis of no cross-section dependence is rejected for all tests and at quasi-all significance levels. With other words, the tests indicate that in the case of 10 EU ex-communist countries, for considered period, there is a cross-sectional dependence. Thus, we can note that the SUR system estimation is more appropriate than country-by-country pooled OLS estimator. More precisely, the findings stand for transmission shocks from one EU ex-communist country to another one.

The second set of results show that the null hypothesis of slop homogeneity is rejected for both two tests and at all significance levels. This means that a significant economic relationship in one EU ex-communist country is not registered in others.

Both cross-section dependence and slope heterogeneity stand the suitability of the bootstrap panel Granger causality approach. The main outputs of this technique are illustrated in Table 3¹.

Table 3. 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
Bulgaria	9.156***	0.002	0.952	0.329
Czech Republic	0.647	0.421	7.633***	0.005
Estonia	0.729	0.392	0.574	0.448
Hungary	0.443	0.946	3.093*	0.078
Latvia	1.385	0.239	0.322	0.857
Lithuania	0.115	0.734	0.205	0.651
Poland	0.361	0.548	0.296	0.863
Romania	1.084	0.297	2.216	0.136
Slovak Republic	23.588***	0.000	22.708***	0.000
Slovenia	2.071	0.151	16.653***	0.000

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

The findings show that in four cases there is a one-way causality, whereas in only one situation there is a two-way causality between government revenues and expenditure. The rest of results clearly reveal there is not any causality between government inputs and outputs.

We find unidirectional causality from public expenditure to revenues only in the case of Bulgaria, while for Czech Republic, Hungary and Slovenia the government revenues Granger cause expenditures. A two-way causality is observed only for Slovak Republic. No Granger causality is found for the rest of the sample (i.e. Estonia, Latvia, Lithuania, Poland and Romania).

5. Conclusions

The main outputs show that in the case of 10 EU ex-communist countries there are both cross-sectional dependence and slope homogeneity, reinforced the idea that in this EU zone all considered countries are influenced by globalization and have common economic characteristics, as former members of Council for Mutual Economic Assistance and current members of EU.

Aside of this, any significant economic relationships in one country is not necessarily transmitted in the others.

The spent-tax hypothesis is supported in the case of Bulgaria, where the public expenditures precede the taxes. For Czech Republic, Hungary and Slovenia, the tax-spent hypothesis is more appropriate. In these countries, the taxes drive the government expenditures as a one-way causality direction. Fiscal synchronization hypothesis is found only for Slovak Republic, where the government inputs and outputs are determined simultaneously. The fiscal independence hypothesis is valid for Estonia, Latvia, Lithuania, Poland and Romania.

Regarding the policy implications, it is clear that, for Bulgaria, the government firstly should start to determine the public expenditures, and after that to adjust the level of taxes. For the governments of Czech Republic, Hungary and Slovenia it is recommended, as first step, to

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

determine the public inputs, followed by adjustments in the level of public spending. The fiscal policy in Slovak Republic should be made taking simultaneous decisions in respect to government tax and spending. For the rest of the countries (i.e. Estonia, Latvia, Lithuania, Poland and Romania), their policymakers should follow the long-run economic growth, the fiscal policy decisions regarding public revenues and spending being taken independently.

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