E C O N O M I C S B U L L E T I N

Should we care for structural breaks when assessing fiscal sustainability?

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Abstract

We apply recent panel cointegration methods to a structural equation between government expenditure and revenue. Allowing for multiple endogenous breaks and after computing appropriate bootstrap critical values, we conclude for fiscal sustainability in the overall EU15 panel.We apply recent panel cointegration methods to a structural equation between government expenditure and revenue. Allowing for multiple endogenous breaks and after computing appropriate bootstrap critical values, we conclude for fiscal sustainability in the overall EU15 panel.

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1. Introduction

Within a panel framework we study fiscal sustainability in the EU15,[1] assessing cointegration between general government expenditure and revenue, stemming from the intertemporal government budget constraint.[2] Fiscal sustainability analysis either based on unit root or cointegration tests have been mostly performed for individual countries posing the problem of relatively short time series. A few exceptions provide panel unit root and panel cointegration analysis in this context for the EU, notably Prohl and Schneider (2006), while Westerlund and Prohl (2006) study OECD countries, allowing for cross-country dependence.

We use Banerjee and Carrion-i-Silvestre (2006) cointegration technique that generalizes the approach in Pedroni (2004) to accommodate cross-sectional dependence[3], the bootstrap panel cointegration test proposed by Westerlund and Edgerton (2007), as well as the test from Westerlund (2006) allowing for multiple endogenous structural breaks, which can differ among series. This last test generalizes Im et al. (2005) and assumes that the individual series are not cross-correlated. However, given that this is an overly restrictive assumption in macroeconomics, we draw our empirical conclusions using bootstrap-based critical values. The paper is organised as follows: Section Two presents the analytical framework; Section Three reports the empirical results and Section Four concludes.

[1] Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Sweden and the UK.
[2] See, for instance, Hakkio and Rush (1991), Quintos (1995), Haug (1991), Ahmed and Rogers (1995) and Afonso (2005).
[3] These tests do not provide a uniform solution, and it is not possible to test for cointegration while entertaining the possibility of both cross-sectional dependence and heterogeneous breaks. Therefore, we only use this test as a benchmark for testing for cointegration in the absence of breaks.

2. Analytical framework

The starting point for the analysis, the so-called present value borrowing constraint, can be written for a given country as

$$B_{t-1} = \sum_{s=0}^{\infty} \frac{1}{(1+r)^{s+1}} (R_{t+s} - E_{t+s}) + \lim_{s \to \infty} \frac{B_{t+s}}{(1+r)^{s+1}} . \qquad (1)$$

where $E_t = G_t + (r_t - r)B_{t-1}$, with G - primary government expenditure R - government revenue, B - government debt, r - real interest rate, assumed to be stationary with mean r. A sustainable fiscal policy needs to ensure that the present value of the stock of public debt goes to zero in infinity.

Using GDP ratios, with the GDP real growth rate, y, also assumed constant, we have

$$b_{t-1} = \sum_{s=0}^{\infty} \left(\frac{1+y}{1+r} \right)^{(s+1)} [\rho_{t+s} - e_{t+s}] + \lim_{s \to \infty} b_{t+s} \left(\frac{1+y}{1+r} \right)^{(s+1)} , \qquad (2)$$

with $b_t = B_t/Y_t$, $e_t = E_t/Y_t$ and $\rho_t = R_t/Y_t$. When $r > y$, the solvency condition $\lim_{s \to \infty} b_{t+s} \left(\frac{1+y}{1+r} \right)^{(s+1)} = 0$ is needed to bound public debt growth.

From (1), and defining $GG_t = G_t + r_t B_{t-1}$, we have

$$GG_t - R_t = \sum_{s=0}^{\infty} \frac{1}{(1+r)^{s-1}} (\Delta R_{t+s} - \Delta E_{t+s}) + \lim_{s \to \infty} \frac{B_{t+s}}{(1+r)^{s+1}} . \qquad (3)$$

With the no-Ponzi game condition, GG_t and R_t must be cointegrated of order one for their first differences to be stationary. If R and E are non-stationary, and the first differences are stationary, then R and E in levels are I(1). Thus, for (3) to hold, its left-hand side will also have to be stationary, which is possible if GG and R are integrated of

order one, with cointegration vector (1,-1). Therefore, assessing fiscal sustainability involves testing the cointegration regression:

$$R_t = a + bGG_t + u_t . \qquad (4)$$

3. Estimation results

We first test the stationarity of the fiscal series using panel data unit root tests of the first and second generation. The first generation tests (including Hadri, 2000; Im, Pesaran and Shin, 2003), were developed on the assumption of the cross-sectional independence among panel units (except for common time effects), and may be at odds with economic theory and empirical results. On the other hand, second generation tests (for instance, Choi, 2006; Moon and Perron, 2004) relax the assumption of cross-sectional independence, allowing for a variety of dependence across the different units. All tests mentioned above were implemented for the general government expenditure and the general government revenue taken as a percentage of GDP.[4] The results, not reported to save space but available upon request, confirm that for the EU15 panel, government expenditure and revenue ratios are non-stationary at the five percent level.

As a second step we test whether expenditure and revenue ratios are cointegrated in line with equation (4), comparing the situation that assumes the existence of no breaks with that accounting for the possibility of multiple heterogeneous and endogenous structural breaks. Definitely, if no account is taken of changes in the parameters of the model, inference concerning the presence of cointegration can be affected by misspecification

[4] Annual data are from the European Commission AMECO database (updated on 04/05/2007), covering the period 1970-2006 (general government total expenditure, % of GDP, 1.0.319.0.UUTGE; 1.0.319.0.UUTGF; general government total revenue, % of GDP, 1.0.319.0.URTG; 1.0.319.0.URTGF).

errors, which can bias conclusions towards accepting the null hypothesis of no cointegration (see Campos, Ericsson and Hendry, 1996).

To investigate cointegration without breaks, we used Banerjee and Carrion-i-Silvestre (2006) methodology as a benchmark, which tests the null hypothesis of no cointegration and accommodates possible cross-sectional dependence. We also implemented the very powerful bootstrap panel cointegration test proposed by Westerlund and Edgerton (2007), whose null hypothesis is cointegration and that permits to accommodate correlation both within and between the individual cross-sectional units.[5]

Finally, the case of cointegration with structural breaks is considered with the use of the recent Lagrange multiplier (LM) test developed by Westerlund (2006) for the null hypothesis of cointegration, which shows small size distortions and reasonable power. This test allows for multiple structural breaks in both the level and trend of a cointegrated panel regression, being general enough to allow for endogenous regressors, serial correlation and an unknown number of breaks, which may differ among units.

The results are reported in Tables 1 and 2 along with the bootstrap computations. Firstly, in Table 1 (the no-break case), accommodating cross-sectional dependence using bootstrap is a crucial issue. Indeed, using the standard normal asymptotic critical values, results would have been mixed and not conclusive since we reject the null of no cointegration between government revenue and expenditure ratios at any conventional level (Banerjee and Carrion-I-Silvestre, 2006), and reject the null of cointegration (Westerlund and Edgerton, 2007). On the contrary, using bootstrap-based critical values

[5] We thank A. Banerjee and J. Carrion-i-Silvestre and J. Westerlund for providing us the GAUSS codes.

the two tests provide evidence supporting the hypothesis of cointegration between government revenues and expenditures ratios in the no-break case, at the one percent level of significance.

Table 1 – Panel cointegration between government revenue and expenditure ratios, model with constant term, no structural break

Test	ADF-stat	LM-stat	Asymptotic p-value	Bootstrap distribution 1%	5%	10%	Bootstrap p-value
Banerjee and Carrion-i-Silvestre (2006)[a]	-4.38	-	0.00	-4.88	-4.01	-3.52	-
Westerlund and Edgerton (2007)[b]	-	-3.19	0.00		-		0.02

Note: bootstrap based on 2000 replications.
a - one-sided test, a computed statistic smaller than the critical value implies the rejection of the null hypothesis of no cointegration.
b - the null hypothesis is cointegration.

Secondly, allowing for multiple possible breaks (Table 2) the Westerlund (2006) test is able to detect 41 breaks in the panel and up to 5 significant breaks for Italy and Luxembourg. The asymptotic and bootstrap p-values for the null hypothesis of cointegration are respectively of 0.01 and 0.15, indicating rejection of the null at five and ten percent levels of significance, according to asymptotic p-values. By contrast, the null hypothesis cannot be rejected based on the bootstrap p-values at all conventional level of significance. Hence we conclude for the existence of strong evidence that revenue and expenditure ratios are cointegrated once multiple structural and endogenous breaks are accommodated, and once suitable generated bootstrap values take cross-sectional dependence into account.

Table 2 – Estimated structural breaks (Westerlund, 2006)

Country	Number of breaks	Years				
Austria	2	1977	1996			
Belgium	3	1974	1983	1995		
Denmark	1	1984				
Finland	2	1974	1984			
France	4	1978	1991	1996	2001	
Germany	2	1995	2001			
Greece	3	1980	1990	1995		
Ireland	4	1974	1982	1997	2000	
Italy	5	1979	1986	1991	1996	2001
Luxembourg	5	1974	1982	1990	1996	2001
Netherlands	0					
Portugal	3	1981	1987	1995		
Spain	3	1974	1986	1998		
Sweden	4	1975	1981	1990	2000	
United Kingdom	0					

Note: The breaks are estimated using the Bai and Perron (2003) procedure with a maximum number of five breaks for each country. The minimum length of each break regime is set to $0.1T$.

We also computed the confidence interval for the panel cointegration coefficient of the general government expenditure-to-GDP ratios in the cointegrating regression, where revenue ratios are the dependent variable. This confidence interval at the 5 percent level of significance is [1.028; 1.145], showing that the value of the coefficient is likely to be above unity. Therefore, there is a more than proportional raise in the revenue ratios vis-à-vis increases in the expenditure ratios, implying fiscal sustainability in the panel set.

4. Conclusion

Allowing for multiple endogenous breaks and computing appropriate bootstrap values to accommodate cross-sectional dependence, we conclude that fiscal policy has been sustainable for the EU15 panel over the period 1970-2006. Therefore, existing country specific non-sustainability results with short time spans need to be read with care, a relevant issue for policy makers.

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