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Government debt dynamics and the global financial crisis: Has anything changed in the EA12?

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Abstract: This paper seeks to shed light on possible changes in the government debt dynamics for the first 12 euro area countries. Structural breaks are present around the global financial crisis for most countries, but not for Germany and France, the two core countries in the euro area. The properties of the government debt dynamics differ markedly across the countries receiving bailouts.

J.E.L. Classification: C2, H3
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1. Introduction

The global financial crisis that broke in 2008 had a profound impact on Europe, where governments in many countries encountered debt financing problems. The background to the financial and debt crises and the subsequent policy responses are the subjects of on-going research (van Riet, 2010; Lane, 2012).

This note analyses the dynamics of government debt from 2000 to 2013 in the 12 countries that have been part of the euro area since 2001 (EA12). The empirical analysis comprises a number of tests to ascertain whether innovations in the debt stock are persistent or are gradually reversed in the sample period. The tests examine whether there is counteracting feedback from the lagged debt stock to the fiscal stance which prevents the debt stock from growing without limit. The persistence of the government debt stock will inter alia be determined by the overall fiscal policy configuration.

Tests of the time series properties of the debt stock are sometimes interpreted as tests of "fiscal sustainability", where fiscal sustainability is defined as when the transversality condition is satisfied, i.e. the discounted value of the outstanding debt is non-positive. Stationarity of the debt stock is a sufficient condition but only with a number of assumptions, including the behaviour of the real interest rate (Hamilton and Flavin, 1986). Bohn (2008) argues for this reason that tests of the time series properties are tests of "ad-hoc sustainability" and prefers instead tests based on fiscal reaction functions where the primary balance is regressed on the lagged debt stock and various control variables. Testing of the statistical significance of the coefficient of the lagged debt stock is complicated if the debt stock exhibits a unit root and the primary balance is stationary. Other tests associate sustainability with cointegration between government revenues and spending or between the debt stock and the primary balance (Bohn 2008).

All tests of fiscal sustainability suffer, however, from two fundamental weaknesses (Bohn 1995, 2008). First, they rely on historical data, while sustainability is a forward-looking concept where the transversality condition at least conceptually imposes conditions infinitely into the future. Second, debt financing crises typically imply that real interest rates increase markedly and abruptly. It is not possible to model such fluctuations in the real interest rate within a standard model of intertemporal sustainability and the tests discussed above therefore have only very limited explanatory power vis-à-vis government financing crises.

Several studies ascertain the dynamics of government debt in European countries before the crisis (see Greiner et al., 2007, amongst many others). A few recent studies, including Cuestas and Staehr (2013) and Baldi and Staehr (2012), consider the effects of the crisis on fiscal variables, but have not considered the debt dynamics for individual countries. The contribution of the note is the application of tests for each EA12 country's debt stock separately, the endogenous determination of structural breaks and the use of tests allowing for fractional integration.

2. Method and results

The variable of interest is the government consolidated gross debt. Quarterly data spanning the sample 2000Q1-2013Q2 were downloaded from Eurostat (code: gov_q_ggdebt) on 18 December 2013. The data were seasonally adjusted using the X12 (additive) procedure.

To test for the degree of persistence of shocks we use two methodologies; Bai and Perron (2003) and Gil-Alana (2008).

Bai and Perron (2003) method allows us to test for the existence of breaks in the parameters, to determine the dates of the breaks and to estimate pre- and post-breaks parameters. In our framework, we estimate the relationship,

$$\begin{aligned}\Delta y_t &= \alpha_1 I(t < T_b) + \alpha_2 I(t \geq T_b) \\ &+ \phi_1 t I(t < T_b) + \phi_2 t I(t \geq T_b) \\ &+ \rho_1 I(t < T_b) y_{t-1} + \rho_2 I(t \geq T_b) y_{t-1} + \varepsilon_t\end{aligned} \tag{1}$$

where I(.) is the indicator function, α_1 and α_2 are the drift parameters before and after the break T_b, ϕ_1 and ϕ_2 the trend parameters before and after the break, and ρ_1 and ρ_2 the autoregressive parameters before and after the breaks. Bai and Perron (2003) suggest minimising the residual sum of squares (RSS) in equation (1).

To attain additional flexibility and robustness in the analysis, we also apply fractional integration techniques, for the possibility of non-integer orders of integration, while allowing for endogenous structural breaks. We use an approach developed by Gil-Alana (2008) under the assumption that the error term is white noise. This implies estimating the following equations,

$$(1-L)^{d_1} y_t = \alpha_1 (1-L)^{d_1} + \beta_1 (1-L)^{d_1} t + u_t, \quad t = 1,...,T_b \tag{2}$$

$$(1-L)^{d_2} y_t = \alpha_2 (1-L)^{d_2} + \beta_2 (1-L)^{d_2} t + u_t, \quad t = T_b + 1,...,T, \tag{3}$$

where d_1 and d_2 are fractional differencing parameters before and after the break. The deterministic components are multiplied by $(1-L)^{d_i}$, which is a simple reparameterisation; there is a constant and a trend in the model. The time of the break T_b is obtained by means of grid searches seeking to minimise the residual sum of squares from (2) and (3) for the full sample length (see Gil-Alana, 2008, for full details).

The results of the application of the Bai and Perron (2003) method are displayed in Table 1. We have restricted the maximum number of breaks to one to avoid estimating an excessive number of parameters; in all cases we reject the condition that there is not any break (results available upon request). The break occurs in most cases at the time of the outbreak of the global financial crisis or shortly afterwards. There are some interesting exceptions. The break came several years before the crisis in France, but approximately two years after in Germany.[1] These results are consistent with the fact that Germany and France as the core countries of the euro area were among the countries that weathered the global financial crisis best. For Greece the break is estimated to take place in 2011Q4; this is the quarter in which the debt fell markedly after a debt write-down following the second support package for Greece. Finally, the break for Portugal also occurs late; the country also started its budget consolidation rather late.

[1] If two breaks were allowed, the second break for France would actually be around the time of the global financial crisis. One break occurs in 2005Q4 and one in 2008Q2; the estimated autoregressive parameter is -0.343 in the first, -1.031 in the second and -0.229 in the last subsample.

Table 1: Unit roots with structural break

Country	Break date	1st subsample	2nd subsample
		ρ_1	ρ_2
		Constant	Constant
		Trend	Trend
Austria	2007Q4	-1.099	-0.082
		77.713	5.973
		-0.150	0.008
Belgium	2008Q2	-0.861	-0.463
		100.434	33.995
		-0.784	0.258
Finland	2008Q3	-0.209	-0.753
		10.106	-0.029
		-0.086	0.772
France	2005Q4	-0.359	-0.185
		19.140	5.920
		0.217	0.213
Germany	2010Q3	-0.163	-1.49
		9.653	114.657
		0.053	0.112
Greece	2011Q4	0.042	-1.156
		-5.767	-141.715
		0.094	6.216
Ireland	2008Q2	-0.126	-0.273
		3.881	-18.849
		-0.005	1.041
Italy	2008Q3	-0.611	-0.621
		67.535	45.274
		-0.083	0.648
Luxembourg	2008Q3	-0.141	-0.742
		0.692	1.569
		0.012	0.290
Netherlands	2008Q3	-0.247	-1.086
		13.887	30.755
		-0.061	0.864
Portugal	2011Q1	-0.049	-1.535
		2.152	-84.276
		0.0644	5.211
Spain	2007Q3	-1.244	-0.300
		77.504	-15.873
		-0.970	0.804

Note: Bai and Perron (2003) method with at most one structural break. The table reports the autoregressive parameters, the constants and the trends for the two subsamples.

We observe that the degree of persistence of shocks diminished considerably after the break for Finland, Germany, Greece, Luxembourg, the Netherlands and Portugal. These results suggest that the debt accumulation following the crisis did not have persistent effects on the debt accumulation after the break. In other countries, including Austria, Belgium, France, Ireland and Spain, the degree of persistence increased or remained high after the break. The different persistence estimates in the core countries, France and Germany, after the crisis breaks are notable. Likewise, there are large differences among the southern crisis countries; persistence has decreased in Greece and Portugal, but increased in Spain.

Table 2 shows the results of the fractional integration test when at most one break is allowed. There are many similarities with the results in Table 1, but also some differences. The most noticeable result of the fractional integration tests is that no structural break is detected for Germany and France. This is consistent with the results in Table 1, which also suggested that the global financial crisis had little effect on the debt dynamics in these core countries of the euro area. In all other cases, the break is situated around the outbreak of the global financial crisis. Another result found in both analyses is that whereas the persistence appears to have fallen in Greece, the opposite is the case in Spain. The persistence results for Portugal differ across the two methods, but this may be attributable to the different timing of the structural break.

Table 2: Fractional integration including breaks

Country	Break date	1st subsample	2nd subsample
		d_1 (95% interval)	d_2 (95% interval)
Austria	2007Q3	0.59 (0.31, 1.26)	1.43 (0.84, 2.24)
Belgium	2007Q4	**0.41 (0.20, 0.75)**	1.27 (0.96, 1.82)
Finland	2008Q2	0.99 (0.77, 1.31)	**0.61 (0.24, 0.99)**
France	---	1.49 (1.34, 1.73)	
Germany	---	1.13 (0.94, 1.40)	
Greece	2008Q2	1.07 (0.85, 1.39)	**0.44 (0.09, 0.92)**
Ireland	2007Q3	1.09 (0.79, 1.56)	0.82 (0.61, 1.11)
Italy	2008Q2	0.69 (0.41, 1.03)	1.30 (1.02, 1.59)
Luxembourg	2008Q3	0.86 (0.65, 1.21)	0.24 (-0.41, 1.08)
Netherlands	2008Q3	1.08 (0.89, 1.30)	0.94 (0.68, 1.33)
Portugal	2008Q1	1.17 (0.95, 1.44)	**0.44 (0.14, 0.98)**
Spain	2008Q1	**-0.23 (-0.57 0.46)**	1.14 (0.73, 1.77)

Note: Gil-Alana (2008) method. In bold, evidence of reversion to trend ($d_i < 1$)

3. Conclusions

This note has considered the time series properties of government debt as a percentage of GDP in the first 12 euro area members. The analyses showed that the endogenously determined structural breaks in most cases were situated around or shortly after the outbreak of the global financial crisis. The main exceptions were Germany and France where the debt dynamics appear to have been influenced little by the global financial crisis. Finally, the southern European countries that received financial support appear to have had very different debt dynamics in the period after the structural break. The results are not clear-cut for Portugal, while persistence dropped markedly in Greece but increased in Spain.

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