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Long-run Determinants of Sovereign Yields*

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Abstract

We study sovereign bond yields in OECD countries with a dynamic panel by checking for cross-section dependence; assessing panel cointegration; and estimating panel error-correction models. The results show that markets consider budgetary and external imbalances and inflation as relevant determinants of sovereign yields.

Keywords: long-term yields, panel cointegration, bootstrap.
JEL: C23, E62, G10, H62.

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1. Introduction

The long-run relationship between fiscal variables and sovereign bond yields constitutes part of policymakers' conventional wisdom. Increases in the debt ratio or in the government deficit ratio may imply an increase in long-term interest rates, by impinging negatively on credit risk and on the quality of the outstanding debt. Under such conditions market participants perceive an additional risk stemming from the loosening of fiscal stance (Ardagna et al., 2004), while liquidity risk also plays a role notably in times of market unrest (Beber et al., 2009).[1] Moreover, fiscal developments are relevant determinants of sovereign ratings (Afonso et al., 2010).

We assess the long-run determinants of real long-term sovereign yields in the OECD employing a dynamic panel approach to test for the existence of cointegration. Furthermore, we also consider cross-country dependence (for instance, common fiscal behaviour, notably in the European Union, financial markets' integration and liberalisation, business cycle synchronization), and estimate a complete panel error-correction model to uncover the short-run parameters. Results show that budgetary and external imbalances and inflation determine sovereign yields.

2. Methodology

The specification for the real long-term sovereign yield, r, is

$$r_{it} = (i_{it} - \pi_{it}) = \alpha_i + \gamma_i X_{it} + u_{it} . \quad (1)$$

where i is the long-term nominal sovereign yield, π is the inflation rate, and X includes additional explanatory variables. i denotes the country, t indicates the period, α_i stands for the individual effects for each country i, and the disturbances u_{it} follow the standard assumptions.

An error-correction form for the real long-term interest rates is given by

$$\Delta(i_{it} - \pi_{it}) = \alpha_i + \sum_{j=1}^{k} \left[\beta_j \Delta(i_{it-j} - \pi_{it-j}) + \theta_j \Delta X_{it-j} \right] + \delta \left[(i_{it-1} - \pi_{it-1}) - \gamma_i X_{it-1} \right] + v_{it} \quad (2)$$

where the disturbances v_{it} follow the standard assumptions.

Among the several long-run factors influencing the long-term sovereign yields, we consider the budget balance ratio, the debt ratio, the current account balance ratio, and inflation.

[1] See Orr, Edey, and Kennedy (1995), Codogno et al. (2003), and Laubach (2009).

Since with high inflation governments can partially inflate away fiscal indebtedness, the need for a higher nominal and real long-term bond yields cannot be discarded. Therefore, we build a measure of inflation surprises (π^e) taking the difference between actual inflation and a 2-year moving average of past inflation.

Moreover, external imbalances are linked to fiscal imbalances, notably when private savings do not increase sufficiently to offset the effects of higher budget deficits, therefore, impinging via such channel also on long-term bond yields.

3. Analysis

For the period 1973-2008 we consider the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden, Spain, UK, Canada, Japan, and U.S.[2]

To test for cross-section dependence we use the test of Pesaran (2004) by computing the Cross section Dependence statistic, and we can reject the null of cross-section independence. Moreover, using a 2nd generation unit root test from Pesaran (2007), with the null being the unit root, results support the existence of a unit root in all series.[3]

We then apply the bootstrap panel cointegration test of Westerlund and Edgerton (2007), which accommodates correlation within and between individual cross-sections. In case of non-rejection of the null, we can assume that there is cointegration between real long-term interest rates and their determinants.

The asymptotic test results (Table 1) indicate the absence of cointegration. However, this is computed on the assumption of cross-sectional independence, not the case in our panel. Consequently, we also used bootstrap critical values. In this case we conclude that there is a long-run relationship between real long-term interest rates and their determinants, implying that over the longer run real they move together.

[2] Government Bond Yield, IFS 61.Z.F, International Financial Statistics (IFS), IMF. Consumer Price Index, IFS 64.XZF, IFS, IMF. Government debt ratio, 1.0.319.0.UDGGL, European Commission (EC) AMECO. Budget balance-to-GDP ratio, 1.0.319.0.UBLGE, EC AMECO. GDP at market prices, 1.0.0.0.UVGD, EC AMECO. Current Balance, % of GDP, CBGDPR, Balance of Payments, OECD Economic Outlook.

[3] Results are available from the authors. Trending turned out not to be very pronounced and the results are not very sensitive to the inclusion of a trend in addition to a constant in the estimated equation. We also checked using the tests of Pesaran (2007) and the bootstrap tests of Smith et al. (2004) that first differences are stationary.

Table 1 – Panel cointegration between Real Long-Term Interest Rates and determinants (with a constant)

	LM-stat	Asymptotic p-value	Bootstrap p-value #
$X_1 = (\Pi^e$, CA, DR)	7.430	0.000	0.840
$X_2 = (\Pi^e$, CA, GBR)	7.385	0.000	0.782

Notes: bootstrap based on 2000 replications.
a - null hypothesis: cointegration of Real Long-Term Interest Rates and determinant series.
Test based on Westerlund and Edgerton (2007).

Therefore, we estimate the system of long-run relationships (one by country), given by equation (1), by the Zellner approach to handle cross-sectional dependence using the SUR estimator. Results in Table 2 show that real sovereign yields are statistically and positively affected by changes in the debt ratio in 12 countries. Inflation has a statistically significant negative effect on real long-term interest rates in ten cases. Since improvements in the external balance reduce real sovereign yields in ten countries, the deterioration of current account balances may signal a widening gap between savings and investment, pushing long-term interest rates upwards. Moreover, when the budget balance ratio is used (Table 3) a better fiscal balance reduces the real sovereign yields in almost all countries

Table 2 – SUR estimation, $X_1 = (\Pi^e, CA, DR)$

Country		Coefficients	t-Statistic	Probab.	Country		Coefficients	t-Statistic	Probab.
Austria	const	7.305	11.510	0.000	Luxembourg	const	-0.935	-17.980	0.000
	Π^e	-0.717	-13.415	0.000		Π^e	0.231	6.819	0.000
	CA	-0.304	-9.177	0.000		CA	0.063	1.351	0.177
	DR	-0.029	-3.244	0.001		DR	4.256	6.416	0.000
Belgium	const	1.050	1.598	0.111	Netherlands	const	-0.521	-10.642	0.000
	Π^e	-0.576	-12.520	0.000		Π^e	-0.309	-7.084	0.000
	CA	-0.772	-17.248	0.000		CA	0.038	4.414	0.000
	DR	0.065	12.607	0.000		DR	0.005	0.003	0.998
Canada	const	1.858	1.940	0.053	Portugal	const	-0.460	-11.272	0.000
	Π^e	-0.377	-6.455	0.000		Π^e	0.386	6.071	0.000
	CA	-0.226	-4.541	0.000		CA	0.140	5.447	0.000
	DR	0.049	4.776	0.000		DR	11.491	6.876	0.000
Denmark	const	0.281	0.436	0.663	Spain	const	-0.853	-11.572	0.000
	Π^e	0.039	0.573	0.567		Π^e	0.561	7.068	0.000
	CA	-0.250	-3.375	0.001		CA	-0.033	-1.336	0.182
	DR	0.080	10.204	0.000		DR	2.351	2.558	0.011
Finland	const	11.673	14.894	0.000	Sweden	const	-0.545	-8.673	0.000
	Π^e	-1.123	-17.669	0.000		Π^e	-0.330	-4.807	0.000
	CA	-0.389	-8.224	0.000		CA	0.087	7.253	0.000
	DR	-0.068	-4.125	0.000		DR	4.899	5.235	0.000
France	const	11.197	16.550	0.000	UK	const	-0.578	-18.412	0.000
	Π^e	-0.773	-18.527	0.000		Π^e	0.305	3.717	0.000
	CA	-0.414	-6.566	0.000		CA	0.040	2.211	0.027
	DR	-0.104	-8.965	0.000		DR	7.897	18.106	0.000
Germany	const	8.093	16.096	0.000	Japan	const	-0.879	-28.964	0.000
	Π^e	-0.663	-13.594	0.000		Π^e	-0.152	-1.593	0.112
	CA	-0.064	-2.186	0.029		CA	-0.036	-9.675	0.000
	DR	-0.053	-6.574	0.000		DR	11.484	11.167	0.000
Ireland	const	0.346	0.875	0.382	U.S.	const	-0.932	-19.099	0.000
	Π^e	-0.530	-16.331	0.000		Π^e	0.331	5.057	0.000
	CA	-0.204	-5.620	0.000		CA	-0.064	-4.265	0.000
	DR	0.079	18.191	0.000		DR	-0.935	-17.980	0.000
Italy	const	-0.133	-0.063	0.950					
	Π^e	-0.383	-5.349	0.000					
	CA	0.086	0.808	0.420					
	DR	0.062	3.494	0.001					

Note: linear estimation after one-step weighting matrix. Balanced system, total observations: 612.

Table 3 – SUR estimation, X_2= (Π^e, CA, GBR)

Country	Coefficients		t-Statistic	Probab.	Country	Coefficients		t-Statistic	Probab.
Austria	const	4.815	15.391	0.000	Luxembourg	const	3.852	8.346	0.000
	Π^e	-0.488	-9.391	0.000		Π^e	-0.964	-21.013	0.000
	CA	-0.286	-6.190	0.000		CA	0.206	6.006	0.000
	GBR	-0.080	-1.233	0.218		GBR	-0.021	-0.421	0.674
Belgium	const	5.441	14.197	0.000	Netherlands	const	5.494	13.366	0.000
	Π^e	-0.844	-19.923	0.000		Π^e	-0.557	-12.082	0.000
	CA	-0.214	-3.564	0.000		CA	-0.212	-3.933	0.000
	GBR	-0.392	-12.136	0.000		GBR	-0.298	-5.395	0.000
Canada	const	5.285	17.943	0.000	Portugal	const	5.644	9.346	0.000
	Π^e	-0.561	-13.562	0.000		Π^e	-0.685	-26.644	0.000
	CA	0.027	0.422	0.673		CA	0.371	8.736	0.000
	GBR	-0.351	-8.788	0.000		GBR	-0.771	-10.086	0.000
Denmark	const	6.086	20.367	0.000	Spain	const	4.748	6.404	0.000
	Π^e	-0.361	-7.029	0.000		Π^e	-0.595	-13.076	0.000
	CA	-0.435	-6.633	0.000		CA	0.008	0.097	0.922
	GBR	-0.467	-11.140	0.000		GBR	-0.724	-6.999	0.000
Finland	const	9.304	21.059	0.000	Sweden	const	8.516	19.727	0.000
	Π^e	-1.048	-16.989	0.000		Π^e	-0.847	-17.010	0.000
	CA	-0.413	-8.572	0.000		CA	-0.476	-8.002	0.000
	GBR	0.018	0.393	0.695		GBR	-0.090	-2.871	0.004
France	const	5.152	11.254	0.000	UK	const	6.569	15.468	0.000
	Π^e	-0.548	-12.871	0.000		Π^e	-0.629	-21.870	0.000
	CA	-0.374	-5.301	0.000		CA	0.236	2.854	0.005
	GBR	-0.198	-2.404	0.017		GBR	-0.159	-3.024	0.003
Germany	const	4.700	17.069	0.000	Japan	const	7.469	14.237	0.000
	Π^e	-0.381	-8.285	0.000		Π^e	-0.919	-20.591	0.000
	CA	-0.061	-1.947	0.052		CA	-0.993	-7.246	0.000
	GBR	-0.062	-1.372	0.171		GBR	0.256	5.033	0.000
Ireland	const	5.951	17.211	0.000	U.S.	const	6.611	12.136	0.000
	Π^e	-0.775	-19.682	0.000		Π^e	-0.750	-12.057	0.000
	CA	0.017	0.408	0.683		CA	0.104	1.137	0.256
	GBR	-0.489	-13.543	0.000		GBR	0.036	0.496	0.620
Italy	const	4.209	7.338	0.000					
	Π^e	-0.682	-17.039	0.000					
	CA	0.250	2.588	0.010					
	GBR	-0.498	-8.166	0.000					

Note: linear estimation after one-step weighting matrix. Balanced system, total observations: 612.

To estimate the complete panel error-correction model given in (2) we recover from each of the cointegration relations the estimated coefficients to construct the residual quantity $\left[(i_{it} - \pi_{it}) - \gamma_i X_{it}\right]$. Afterwards, we estimate a complete VAR in first differences, with country effects, α_i, with the necessary lags of the abovementioned residual variable. The lag length structure k is chosen using the Schwarz and Hannan-Quinn selection criteria, and by carrying out a standard likelihood ratio testing-down type procedure, to examine the lag significance from a long-lag structure (started with $k=6$) to a more parsimonious one. In order to improve the statistical specification of the model, we systematically implemented Wald tests of exclusion of variables from the short-run dynamic (not reported here) to eliminate insignificant short-run estimates at the 5% level. The results of the estimations using Full Information Maximum Likelihood are reported in Table 4.

Table 4 – Error-correction estimates for Δr_{it}

X_1= (Π^e, CA, DR), short-run parameters

Δr_{it-1}	ΔCA_{it-1}	$\Delta\pi^e_{it-2}$	$\Delta\pi^e_{it-3}$	$\Delta\pi^e_{it-4}$
-0.2910	0.137722	0.229459	0.08515	0.190028
[-7.49]	[2.47]	[7.07]	[2.47]	[5.76]
Loading factor δ				
0.163733				
[3.13]				

X_2= (Π^e, CA, GBR), short-run parameters

Δr_{it-1}	$\Delta\pi^e_{it-2}$	$\Delta\pi^e_{it-3}$	$\Delta\pi^e_{it-4}$
-0.198459	0.195994	0.059376	0.138118
[-4.79]	[5.04]	[2.00]	[3.60
ΔCA_{it-1}	ΔGBR_{it-4}		
0.164672	-0.15368		
[2.87]	[-2.34]		
Loading factor δ			
0.128283			
[2.39]			

Note: total observations, 560; t-statistics in brackets.
r – real long-term interest rate; CA – current account balance; π^e – inflation surprises; DR – debt ratio; GBR – budget balance ratio.

Inflation has a significant short-run effect on real long-term sovereign yields, and a fall in inflation would imply a decline in real rates. Interestingly, the long-run effect associated with the panel results (Table 4), can in this case be computed to be around -0.4. This is in line with the long-run cointegration relationship reported for the countries in the previous SUR analysis, and implies that an increase in inflation surprises of 1 percentage point could lead to a long-run decline of around 0.4 percentage point in the real long-term interest rate. Regarding the short-run effects of the fiscal determinants, an improvement of the government budget balance also reduces the real interest rate.

4. Conclusion

We studied the long-run behaviour of sovereign yields for OECD countries, for the period 1973-2008. The use of a dynamic panel approach allowed to reflect financial and economic integration, and to increase the performance and accuracy of the tests. In this framework, cross-country dependences in the sovereign bond segment of the capital markets were also taken into account.

We rejected cross-section independence for the real long-term interest rates (and for its determinants). From an economic point of view such cross-section dependence provides evidence of capital markets integration in the OECD. After having established with 2nd generation panel unit root tests that all the series in the panel are I(1), we undertook a bootstrap panel cointegration analysis.

Finally, our analysis shows that better government budget balances mostly reduce real sovereign yields, while higher sovereign indebtedness increases them. Additionally, deteriorating current account balances, signalling a widening gap between savings and investment, push sovereign yields upwards.

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