

Annex 1.10. Euro Zone Sovereign Spreads: Global Risk Aversion, Spillovers or Fundamentals?¹

This annex explores what was driving the large movements in euro zone sovereign spreads over the course of the crisis. In particular, how much of these changes reflected shifts in global risk aversion or country-specific risks, both directly from worsening fundamentals and indirectly from spillovers originating in other sovereigns? The analysis shows that earlier in the crisis, the surge in global risk aversion was a significant factor influencing swap spreads, while more recently country-specific factors have started to dominate.

To measure euro zone sovereign spreads as spreads to a common numeraire, we use the yield on a 10-year euro swap, in other words the yield at which one party is willing to pay a fixed rate in order to receive a floating rate from a given counterparty. The credit risk of exposure of these swaps should reflect that of the better quality banks across the euro zone. Therefore, the swap spread should in part reflect the risk differential between individual sovereigns and the euro zone banking system as a whole. Typically, the yield on an AAA-rated government bond would trade below the swap yield. In contrast, yields on lower-rated bonds might be above the swap yield as investors demand a higher premium on these riskier assets. The crisis and the following interventions of the sovereigns to support financial institutions have significantly altered these relationships.

In order to address the question of what is driving euro area sovereign spreads, we introduce a simple model where each of these spreads is regressed over a number of factors including:

- (i) *Global Risk Aversion*. The price of an asset reflects both market expectations of the asset's returns and the price of risk; i.e., the price that investors are willing to pay for receiving income in "distressed" states of nature. The Index of Global Risk Aversion typifies the market price of risk; thus, it allows us to extract from asset prices the effects of price of risk; henceforth, to compute the market's expectation of the probability of distress (Espinoza and Segoviano, 2010).
- (ii) *Fundamentals*, identified by each country's stock of public debt and budget deficit.
- (iii) *Spillovers*, as captured by a measure of distress dependence, which characterizes the probability of distress of a country conditional on another country becoming distressed. This indicator embeds distress dependence across sovereign CDS and their changes throughout the economic cycle, reflecting the fact that dependence increases in periods of distress. This measure of distress dependence is appropriately weighed by the probability of each of these events to occur (Segoviano and Goodhart, 2009).

The constructed data set spans from mid-2005, well ahead of the start of the crisis, through early 2010, for a total of over 1,000 daily observations, encompassing ten euro zone sovereign markets.

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The Estimation Model

The model used in this analysis is described by the following General Autoregressive Conditional Heteroskedasticity (GARCH(1,1)) specification:

$$Y_t = \alpha Y_{t-1} + \beta'X_t + \varepsilon_t \quad [1]$$

$$\sigma_t^2 = \omega + \theta \varepsilon_{t-1}^2 + \gamma \sigma_{t-1}^2 \quad [2]$$

where [1] is the mean equation for the swap spreads Y_t as a function of the explanatory variables stacked in the vector X_t (which include a constant term) and an error term ε_t , with conditional variance σ_t^2 . This conditional variance is given by equation [2] as function of the lag of the squared residual from the mean equation ε_{t-1}^2 and last period's variance σ_{t-1}^2 .

The explanatory variables include an index of Global Risk Aversion, a measure of distress dependence captured by the sum of joint probabilities of default and two country specific fundamental variables, namely the overall fiscal balance as percent of GDP and the debt-to-GDP ratio. The lagged dependent variable is included in the model to capture the high persistence inherent in the swap spread time series².

Estimation Results

The results from the estimation of the model described by equations [1] and [2] are presented in Table 1.³ These results were obtained using daily data from 2005Q2 to 2009Q3⁴

² The presence of the lag dependent variable mitigates the autocorrelation that would otherwise be observed in the residuals from estimating equation [1] without the lag dependent variable.

³ The estimation was carried out in EViews via Maximum likelihood estimation, using the Marquardt optimization algorithm.

⁴ The daily series for the fundamental variables were obtained by using a linear interpolation on the underlying quarterly data. This is based on the assumption that these variables tend to explain the low frequency movements on the swap spreads, with almost no impact on high frequency (daily) variations in these spreads.

Table 1.22. GAR Estimation Results

Country	GER	FRA	ITA	SPA	NET	BEL	AUT	GRE	IRE	POR
<i>Mean equation:</i>										
Constant	-0.247*** -0.068	-0.162** -0.073	-0.196** -0.09	-0.160*** -0.024	-0.211*** -0.028	-0.068** -0.028	-0.158*** -0.034	-0.402*** 0.057	-0.276*** -0.065	-0.107*** -0.038
Lagged dependent	0.902*** -0.01	0.939*** -0.009	0.930*** -0.01	0.896*** -0.013	0.891*** -0.013	0.864*** -0.015	0.918*** -0.008	0.918*** -0.007	0.947*** -0.007	0.915*** -0.008
Global Risk Aversion	-0.251*** -0.063	-0.327*** -0.052	0.005 -0.063	-0.200*** -0.05	-0.355*** -0.056	-0.215*** -0.052	-0.254*** -0.045	-0.012 -0.06	-0.203*** -0.055	-0.319*** -0.053
Spillover	0.185** -0.101	0.470*** -0.07	0.649*** -0.101	0.694*** -0.073	0.734*** -0.081	1.188*** -0.116	0.933*** -0.081	1.662*** -0.159	0.988*** -0.1	1.453*** -0.11
Fiscal Balance	-0.005*** -0.001	-0.004* -0.002	-0.005*** -0.001	-0.003*** -0.001	-0.006*** -0.002	-0.006*** -0.001	-0.003*** -0.001	-0.001* -0.001	-0.002*** -0.001	-0.002** -0.001
Debt/GDP ratio	0.002* -0.001	0 -0.001	0.002** -0.001	0.001*** 0	0.001** 0	-0.001 0	0 0	0.004*** -0.001	0.002*** -0.001	-0.001* 0
<i>Variance equation:</i>										
Constant	0.000*** 0	0.000*** 0	0.000*** 0	0.000*** 0	0.000*** 0	0.000*** 0	0.000*** 0	0.000*** 0	0.000*** 0	0.000*** 0
ARCH term	0.227*** -0.024	0.256*** -0.031	0.119*** -0.014	0.321*** -0.036	0.220*** -0.026	0.220*** -0.028	0.242*** -0.028	0.135*** -0.017	0.183*** -0.021	0.232*** -0.029
GARCH term	0.784*** -0.02	0.751*** -0.026	0.882*** -0.012	0.691*** -0.026	0.780*** -0.022	0.780*** -0.025	0.765*** -0.024	0.918*** -0.012	0.834*** -0.016	0.755*** -0.023
R-squared	0.952	0.956	0.988	0.983	0.967	0.978	0.984	0.996	0.997	0.987
No. of observations	995	1061	1061	1061	1061	995	1061	995	1061	1061

Source: IMF staff estimates

* significant at 10 percent level. ** significant at 5 percent level. *** significant at 1 percent level.

Distress Dependence Matrices

Spillovers could be further broken down across sources of distress. In other words, for a given probability of distress in a specific sovereign, we can assess which countries are the most significant sources of spillovers during the four phases we previously identified. The percentage contributions to a country's probability of distress can be read along the rows of table 2. As noted in the text, the pattern of distress dependence has varied through the crisis, with those countries with most pressing fiscal concerns (Greece, Portugal and Spain) becoming the largest contributors to sovereign risk spillover in the euro zone.

Main Results

The regression analysis shows that:

(i) During the phase which we call financial crisis build-up, between July 2007 and September 2008, securities from Germany and, to some extent, other core euro area sovereigns, benefited from flight-to-quality flows, whereas bonds from peripheral countries saw their yields rising versus swap yields as global risk aversion was weighing adversely on these lower-rated issuers. In general, fundamentals were supportive of sovereign bonds, as both the deficit and the debt were still improving at this stage.

(ii) During the systemic outbreak, between October 2008 and March 2009, as sovereigns stepped in and supported financial institutions, government bond yields rose relative to swap yields across the board, on spillovers from countries more directly involved in the financial crisis and fundamentals, which had started deteriorating. Global risk aversion was not playing such a favorable role any longer as crisis-related interventions and fiscal stimulus packages had started diluting the perception of sovereigns as a riskless asset class.

(iii) During the systemic response phase, between April 2009 and September 2009, all government bond yields fell back towards swaps, as lower probability of distress in some countries was favorably affecting others. The correction was larger among those bonds such as Italy and Greece which had underperformed during the systemic outbreak as weaker spillovers was offsetting further deterioration in fundamentals.

(iv) Finally, in the sovereign risk phase, since October 2009, swap spreads have started to be driven by country-specific developments. They have been broadly unchanged for most countries, but tightening substantially for Greece and Portugal where bond yields have surged well above swap yields on further weakening in fundamentals and intense risk of spillovers.

A closer look at distress dependence matrices for each period in the crisis shows that earlier in the crisis the sources of spillovers could be found among those countries hit hard by the financial crisis, such as Austria, the Netherlands, and Ireland, whereas more recently the countries putting pressure on Euro area sovereign bonds were primarily Greece, Portugal, and Spain, as the emphasis shifted towards short-term refinancing risk and long-term fiscal sustainability.

Table 1.23. Distress Dependence Matrices

Jul 07_Sep 08	GER	FRA	ITA	SPA	NET	BEL	AUT	GRE	IRE	POR	
GER		19.4	16.5	20.2	13.0	9.7	4.6	4.2	3.9	8.5	100.0
FRA	5.7		21.0	26.0	19.3	10.8	3.0	3.2	3.5	7.6	100.0
ITA	4.2	17.3		29.6	13.9	9.4	4.6	5.6	4.9	10.6	100.0
SPA	5.0	18.4	26.9		12.8	9.7	4.4	5.3	5.5	12.1	100.0
NET	4.7	22.1	19.8	20.3		13.7	3.9	3.5	4.5	7.5	100.0
BEL	5.1	14.4	17.3	17.0	14.7		6.6	7.0	7.2	10.7	100.0
AUT	4.5	10.2	17.7	15.4	10.0	11.3		8.5	8.0	14.4	100.0
GRE	4.3	9.8	19.2	16.2	8.3	10.5	8.2		8.8	14.8	100.0
IRE	4.7	10.5	17.8	16.3	9.6	10.7	8.4	9.9		11.9	100.0
POR	4.4	12.0	19.8	21.9	9.5	10.0	7.4	8.6	6.3		100.0
	4.2	14.1	18.1	19.7	11.8	9.2	4.4	4.9	4.7	9.0	100.0

Oct 08_Mar 09	GER	FRA	ITA	SPA	NET	BEL	AUT	GRE	IRE	POR	TOT
GER		9.9	12.0	11.1	13.7	9.4	15.8	8.4	11.1	8.7	100.0
FRA	7.7		11.8	9.7	17.4	8.9	18.0	7.8	11.4	7.3	100.0
ITA	6.3	8.6		10.8	14.7	8.9	19.2	9.9	13.9	7.8	100.0
SPA	6.5	8.6	13.3		14.3	8.5	18.6	9.0	14.1	7.1	100.0
NET	6.9	10.1	13.3	11.5		10.6	17.3	8.9	12.3	9.0	100.0
BEL	6.1	8.1	11.3	9.2	14.8		19.0	9.4	14.5	7.5	100.0
AUT	5.7	7.9	14.1	12.6	11.4	10.6		11.8	14.4	11.5	100.0
GRE	5.3	7.0	12.8	10.5	11.0	9.5	18.4		16.1	9.3	100.0
IRE	5.4	7.2	13.3	11.6	11.7	10.5	18.2	12.5		9.6	100.0
POR	5.8	7.6	11.6	9.0	12.8	8.4	21.0	9.8	13.8		100.0
TOT	5.6	7.4	11.4	9.6	12.2	8.5	16.7	8.8	12.3	7.7	100.0

Apr 09_Sep 09	GER	FRA	ITA	SPA	NET	BEL	AUT	GRE	IRE	POR	TOT
GER		9.5	12.6	11.0	11.0	10.6	13.1	9.9	12.9	9.3	100.0
FRA	8.0		12.8	12.3	10.7	10.7	12.3	10.3	12.8	10.1	100.0
ITA	6.9	7.7		11.3	10.8	10.9	15.2	11.8	15.6	9.8	100.0
SPA	7.4	8.9	12.8		10.9	10.9	13.7	11.2	14.3	10.0	100.0
NET	7.1	8.7	13.6	11.6		11.3	13.6	10.6	13.9	9.6	100.0
BEL	6.8	8.3	13.0	10.8	11.2		14.5	11.0	14.9	9.4	100.0
AUT	6.5	7.3	14.0	10.7	10.4	11.2		12.7	17.3	9.9	100.0
GRE	6.4	7.4	13.1	10.0	10.2	10.9	15.9		16.6	9.5	100.0
IRE	6.5	7.2	13.8	10.4	10.5	11.5	17.3	13.2		9.6	100.0
POR	6.9	8.4	12.9	10.9	10.4	10.6	14.1	11.4	14.4		100.0
TOT	6.2	7.2	11.9	9.8	9.5	9.9	13.1	10.3	13.4	8.7	100.0

Oct 09_Feb 10	GER	FRA	ITA	SPA	NET	BEL	AUT	GRE	IRE	POR	
GER		12.0	11.1	13.4	4.8	7.4	6.9	19.8	6.2	18.3	100.0
FRA	5.6		13.4	14.8	6.0	8.1	7.7	18.2	8.0	18.3	100.0
ITA	4.0	10.4		16.4	3.3	6.8	7.2	24.2	7.2	20.5	100.0
SPA	4.3	10.2	14.4		3.3	7.0	7.4	23.9	8.4	21.1	100.0
NET	4.5	13.2	10.2	12.2		8.0	5.3	22.1	3.3	21.2	100.0
BEL	4.3	10.3	10.9	12.9	4.6		7.6	22.6	8.1	18.8	100.0
AUT	3.7	8.7	10.8	12.5	3.0	7.0		26.5	6.0	21.8	100.0
GRE	4.1	7.5	14.2	15.7	4.2	7.8	10.5		15.7	20.3	100.0
IRE	3.1	7.7	9.9	12.8	2.0	6.8	5.9	31.3		20.6	100.0
POR	4.2	8.5	13.7	15.7	4.6	7.4	10.0	23.6	12.3		100.0
	3.7	8.3	11.0	12.7	3.4	6.5	7.0	21.4	8.1	18.0	100.0

Source: IMF staff estimates.