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Contagion in Eurozone sovereign bond markets? The good, the bad and the ugly[☆]

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HIGHLIGHTS

- We test for contagion between Eurozone bond markets during the sovereign debt crisis.
- We identify two distinct phases of the crisis.
- Contagion plays a limited role in propagating shocks.
- Contagion is more important during the more intense phase of the crisis.
- In the majority of cases, market comovements are due to interdependencies.

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ABSTRACT

We test for contagion between Eurozone bond markets during the sovereign debt crisis. Using a three-regime Markov-switching VAR, we identify two distinct crisis phases (the bad and the ugly) with differing patterns of shock transmission. Evidence of contagion is scant.

1. Introduction

Eurozone sovereign bond markets have experienced considerable and persistent turmoil in recent times. Most sovereigns have suffered downgrades to their credit ratings since 2010. Bailout programmes were required in Greece, Ireland, and Portugal and the European Central Bank (ECB) intervened in the market to purchase the bonds of larger countries like Spain and Italy. We analyse the stability of Eurozone sovereign bond cross-market linkages over the period 2003–2014, and empirically test for contagion among member states. Contagion is defined as the excessive co-movement between bond spreads following a shock in one market, while normal levels of comovement constitute 'interdependencies'. It is important to distinguish between these two shock propagation mechanisms as they require different policy responses to curb the spread of the crisis. Beirne and Fratzscher (2013), Blatt et al. (2015), Claeys and Vašíček (2014) and Metiu (2012) among others have addressed this issue but results differ across studies. We shed new light on the topic by analysing cross-market relationships in a three-regime Markov-switching model. This allows us to identify two distinct phases of the 'crisis' and provides a more subtle understanding of shock transmission during the different phases.

We employ a Markov-switching VAR (MS-VAR) model to date the phases of the crisis and then apply a multivariate test for contagion introduced by Dungey et al. (2005). The crisis is best captured by two distinct regimes and both exhibit different

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patterns of shock transmission. Contagion plays a limited role in propagating shocks but is relatively more important during the highest volatility regime. In the vast majority of cases, market comovements are due to interdependencies.

Section 2 presents our methodological framework and data. Empirical results are discussed in Section 3, while Section 4 contains our conclusions.

2. Data and methodological framework

We analyse daily 10-year sovereign bond spreads over Germany for ten Eurozone countries (Austria (AT), Belgium (BE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Netherlands (NL), Portugal (PT)) and the US. We include the US to control for external events and thereby disentangle global from country-specific shocks. All data are sourced from Datastream. Our sample covers the period from January 1, 2003 to December 31, 2014. We begin in 2003 to avoid contamination from earlier bond crises in Russia and Latin America. Unit root tests indicate that the spreads are I(1) processes so we choose to work with first differences.

The empirical analysis requires a testable definition of contagion and a method of dating the crisis. Following Forbes and Rigobon (2002), we define contagion as a significant increase in market dependence between normal and crisis periods. We estimate a fixed transition probability (FTP) MS-VAR and use the estimated smoothed probabilities to endogenously date the crisis.[1] Many studies of contagion focus on 'normal' versus 'crisis' periods but we find that a three-regime specification better characterises the evolution of bond market conditions over the sample with the crisis exhibiting two distinct phases.

The model is specified as follows:

$$y_{i,t} = \alpha(s_t) + \sum_{k=1}^{K} \beta_k(s_t) y_{i,t-k} + \epsilon_{i,t}^{st}, \tag{1}$$

$$s_t \in \{1, 2, 3\}, \tag{2}$$

$$\epsilon_{i,t}^{st} \sim \text{i.i.d.} N(0, \sigma_s^2), \tag{3}$$

in which $y_{i,t}$ is an n-dimensional time series vector of dependent variables, α is a matrix of state dependent intercepts, $\beta_1 \cdots \beta_k$ are matrices of the state dependent autoregressive coefficients and $\epsilon_{i,t}^{st}$ is a state dependent noise vector, which has a zero mean and constant variance within each regime. As s_t is unobserved, we assume that it follows a first-order Markov process, which determines the regime path.

We then proceed to test for contagion between each pair of markets by implementing the multivariate test of Dungey et al. (2005). This involves estimating a system of equations with the following form.

$$\frac{y_{i,t}}{\sigma_{i,N}} = \mu_i + \mu_i * \delta_{1,t} + \mu_i * \delta_{2,t} + \gamma_{i,j} * \frac{y_{j,t}}{\sigma_{j,N}} + \theta_{i,j} * \frac{y_{j,t}}{\sigma_{j,N}} * \delta_{1,t} + \psi_{i,j} * \frac{y_{j,t}}{\sigma_{j,N}} * \delta_{2,t} + \zeta_{i,t}, \quad \forall j \neq i \tag{4}$$

where the dependent variable is the first-differenced spread over Germany for country i divided by its standard deviation in the 'good' regime. $\delta_{1,t}$ and $\delta_{2,t}$ are dummies which take the value of 1 when we are in the 'bad' and 'ugly' regimes respectively and zero otherwise. During the former (latter), contagion from country j to i is detected by the statistical significance of the $\theta_{i,j}$ ($\psi_{i,j}$) parameter. The system of eleven equations is estimated by seemingly unrelated regressions (SUR) technique to account for contemporaneous shocks and we further control for autocorrelation and heteroskedasticity in the errors.

[1] Mandilaras and Bird (2010) use a similar approach.

Table 1
Ratio of standard deviations between regimes.

Country	Bad regime: good regime	Ugly regime: good regime
Austria	7.17	24.17
Belgium	7.79	30.99
Finland	5.08	13.30
France	6.90	23.87
Greece	27.22	183.34
Ireland	17.02	68.03
Italy	9.89	33.63
Netherlands	6.40	15.50
Portugal	19.56	76.15
Spain	16.24	50.59
US	1.27	1.25

Notes: This table presents the ratio of the standard deviations, between crisis and good regimes, generated from our estimated FTP-MS-VAR model.

3. Discussion of results

Fig. 1 presents the smoothed probabilities of each regime extracted from the estimated FTP-MS-VAR model.

Regimes are identified using the estimated asset volatilities. We observe three distinct regimes over the sample. The first is the 'good' period from 2003 to mid-2007, characterised by benign economic and financial environments (top panel, Fig. 1). Spreads were low and stable and yields fell in many countries as investors expected convergence towards German rates (Arghyrou and Kontonikas, 2012). Mid-2007 marks a transition to a crisis (bad) regime triggered by uncertainty in the US financial system (middle panel). Spreads widened and volatilities increased. This persists until late 2010 and re-establishes itself from 2013 to the end of the sample. This phase of the crisis book-ends the 'ugly' regime, i.e. the most pronounced period of bond market turmoil: late-2010 to early 2013 (bottom panel). Spreads widened further, accompanied by intense volatility coinciding with the emergence of the Greek crisis and bailout programmes for Ireland and Portugal.

These phases of the crisis, nevertheless, had differential impacts across countries. Table 1 reports the ratios of our estimated standard deviations between the crisis regimes and normal market conditions.

There is a striking difference between the volatility increases experienced by the peripheral countries; Greece, Ireland, Portugal, and Spain (the PIGS), and core countries like Finland and the Netherlands. The US is markedly different from the Eurozone countries. There is little increase in volatility (at least relative to the European states) and there is hardly any difference between the 'bad' and the 'ugly' states.

Having identified the regimes, we test for contagion between each pair of markets using the Dungey et al. (2005) test described in Eq. (4). Panels A and B of Table 2 present the results for the 'bad' and the 'ugly' phases of the crisis respectively.

A striking feature of our results is that there are relatively few examples of contagion among the member states. Market interdependencies appear to have been the main shock propagation mechanism during the turmoil. However, when contagion is detected, it occurs more often in the 'ugly' rather than the 'bad' regime. This highlights the importance of differentiating between the two phases of the crisis and not treating it as one homogeneous event. Among the 110 bilateral relationships analysed, we only reject the null hypothesis of 'No contagion' at a 5% (10%) significance level in 9 (15) cases during the 'bad' regime and 11 (24) cases during the 'ugly' regime.

The peripheral states of Greece, Ireland and Portugal transmit contagion to other members in some limited instances but the presence of contagion from these countries is not pervasive. There is little evidence of contagion from Spain, suggesting the bond-buying programmes of the ECB were successful in curbing the international transmission of Spanish shocks. The lack of

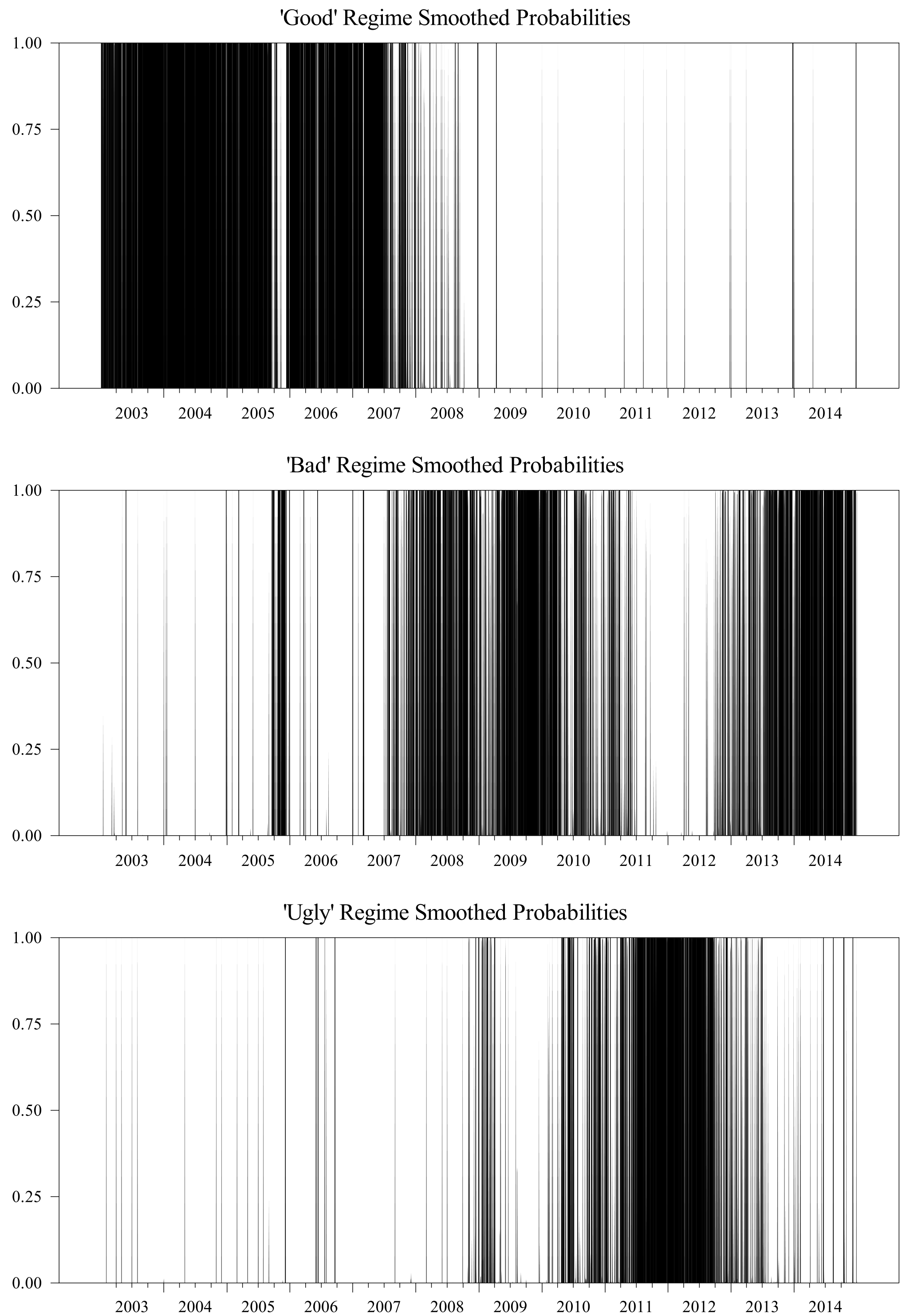

Fig. 1. Smoothed probabilities.

widespread evidence of contagion from Greece is noteworthy and contrasts with Arghyrou and Kontonikas (2012) and Metiu (2012). Our results are more consistent with Beirne and Fratzscher (2013), Blatt et al. (2015) and Mink and de Haan (2013). Blatt et al. (2015) presents evidence that it was the dynamics of the relationship between the Greek bond market and its Eurozone neighbours that changed and not the contemporaneous reaction, as measured here and in most studies of contagion.

Interestingly, contagion does not exclusively spread from the PIGS. There is at least as much evidence of contagion stemming from 'core' countries. This is consistent with Kaminsky and Reinhart (2003) who explain how larger markets process information more efficiently and transmit the 'news' to their more peripheral counterparts. For example, adverse shocks in the Austrian financial sector appear to have generated more contagion within the Eurozone than larger disturbances in the PIGS.

There is also some limited evidence of contagion to and from the US but this is predominantly with the 'core' Eurozone countries. Finland, for example, suffers contagion from the US in the first

Table 2
Testing for contagion.

Contagion from: To:	AT	BE	FI	FR	GR	IE	IT	NL	PT	ES	US
Panel A: Contagion during the 'Bad' regime											
AT	–	0.215	0.293	0.371	0.694	0.690	0.321	0.124	0.119	0.116	0.010
BE	0.344	–	0.044**	0.360	0.108	0.858	0.783	0.143	0.224	0.854	0.946
FI	0.614	0.043**	–	0.855	0.069*	0.822	0.342	0.498	0.369	0.497	0.011**
FR	0.463	0.328	0.568	–	0.096*	0.789	0.567	0.933	0.018**	0.169	0.166
GR	0.911	0.207	0.016**	0.176	–	0.013**	0.554	0.599	0.951	0.399	0.140
IE	0.667	0.658	0.734	0.622	0.004***	–	0.472	0.832	0.116	0.178	0.560
IT	0.268	0.985	0.155	0.473	0.312	0.507	–	0.938	0.079*	0.367	0.452
NL	0.007***	0.134	0.209	0.323	0.473	0.741	0.673	–	0.682	0.932	0.217
PT	0.315	0.289	0.589	0.030**	0.358	0.112	0.098*	0.597	–	0.350	0.954
ES	0.318	0.990	0.288	0.440	0.225	0.288	0.258	0.632	0.216	–	0.479
US	0.063*	0.363	0.196	0.254	0.501	0.608	0.416	0.092*	0.977	0.479	–
Panel B: Contagion during the 'Ugly' regime											
AT	–	0.766	0.087*	0.034**	0.291	0.033**	0.612	0.811	0.080*	0.812	0.640
BE	0.936	–	0.107	0.853	0.735	0.322	0.004***	0.492	0.162	0.700	0.761
FI	0.212	0.131	–	0.213	0.040**	0.053*	0.373	0.661	0.956	0.323	0.444
FR	0.065*	0.994	0.680	–	0.129	0.576	0.482	0.778	0.049**	0.997	0.379
GR	0.522	0.977	0.187	0.193	–	0.095*	0.289	0.712	0.313	0.547	0.076*
IE	0.034**	0.915	0.145	0.889	0.012**	–	0.282	0.542	0.801	0.114	0.274
IT	0.764	0.386	0.450	0.570	0.957	0.226	–	0.241	0.246	0.702	0.694
NL	0.752	0.038**	0.945	0.464	0.284	0.341	0.321	–	0.535	0.184	0.063*
PT	0.051*	0.632	0.524	0.068*	0.004***	0.252	0.413	0.632	–	0.076*	0.253
ES	0.751	0.501	0.919	0.664	0.615	0.411	0.459	0.072*	0.084*	–	0.722
US	0.060*	0.020**	0.624	0.293	0.559	0.487	0.747	0.037**	0.551	0.292	–

Notes: This table reports the p-values for the test of the null hypothesis of 'No Contagion' as described in Eq. (4). Contagion is defined as a statistically significant change in bond yield spread relationships between the low-volatility 'good' regime and the two high-volatility (the bad and the ugly) regimes.

[*] Denotes significance at the 10% level.
[**] Denotes significance at the 5% level.
[***] Denotes significance at the 1% level.

phase, while the US imports contagion from Belgium and the Netherlands during the more intense crisis period.

4. Conclusion

We investigate the role of contagion in propagating shocks across countries during the Eurozone sovereign debt crisis. We show that the crisis was not a single homogeneous event but is better modelled as two distinct regimes. The regimes exhibit different patterns of shock transmission. Overall, the evidence of contagion is limited but is relatively stronger during the more intense, 'ugly' phase of the crisis. Transmitting contagion is not exclusively a phenomenon associated with the PIGS and it also spreads from the core group of countries. However, the vast majority of pairwise relationships remained stable over the sample period and, consequently, market comovements are more often due to interdependencies rather than to contagion.

References

Arghyrou, M., Kontonikas, G., 2012. The EMU-sovereign debt crisis: Fundamentals, expectations and contagion. J. Int. Financ. Mark. 22 (4), 658–677.

Beirne, J., Fratzscher, M., 2013. The pricing of sovereign risk and contagion during the European sovereign debt crisis. J. Int. Money Finance 34, 60–82.

Blatt, D., Candelon, B., Manner, H., 2015. Detecting contagion in a multivariate time series system: An application to sovereign bond markets in Europe. J. Bank. Financ. 59, 1–13.

Claeys, P., Vašíček, B., 2014. Measuring bilateral spillover and testing contagion on sovereign bond markets in Europe. J. Bank. Financ. 46, 151–165.

Dungey, M., Fry, R., Gonzalez-Hermosillo, B., Martin, V., 2005. Empirical modelling of contagion: A review of methodologies. Quant. Finance 5, 9–24.

Forbes, K., Rigobon, R., 2002. No contagion, only interdependence: Measuring stock market co-movement. J. Financ. 57, 2223–2261.

Kaminsky, G., Reinhart, C., 2003. The center and the periphery: The globalization of financial turmoil, NBER Working Paper 9479. Cambridge, MA.

Mandilaras, A., Bird, G., 2010. A Markov switching analysis of contagion in the EMS. J. Int. Money Finance 29 (6), 1062–1075.

Metiu, N., 2012. Sovereign risk contagion in the Eurozone. Econom. Lett. 117, 35–38.

Mink, M., de Haan, J., 2013. Contagion during the Greek sovereign debt crisis. J. Int. Money Finance 34, 102–113.