

Sovereign Credit Risk Co-movements in the Eurozone: Simple Interdependence or Contagion?

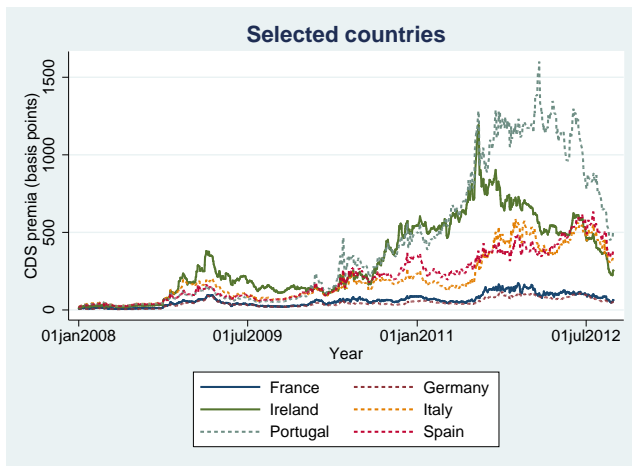
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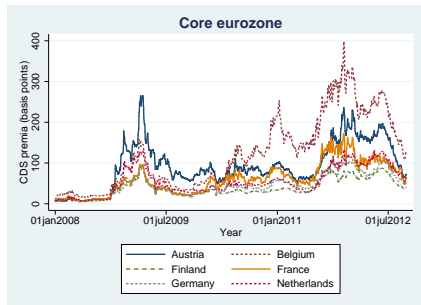
INET Workshop 2013 “Interlinkages and Systemic Risk”
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Sovereign credit risk - diverging with the debt crisis?

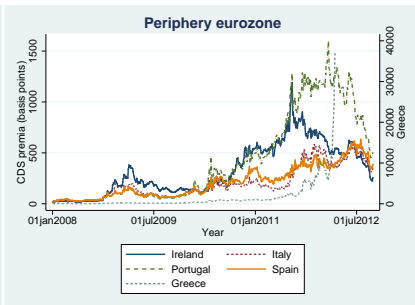


5-year sovereign CDS spreads

Sovereign credit risk - or rather co-moving?



5-year sovereign CDS spreads



5-year sovereign CDS spreads

This paper

- Explain why - despite well-known **divergence** in sovereign credit risk across countries - there are stronger **co-movements** within certain country groups.
 - ▶ Are these patterns due to simple **interdependence** arising from usual cross-country linkages? Or, is it the outcome of **contagion**?
 - ▶ And if so, which are the **channels** causing contagion?
- Answer these questions using a **three-step approach**:
 - ▶ **Correlation analysis**: obtain time-varying co-movements in sovereign credit risk.
 - ▶ **Measurement of contagion**: detect significant increases in these time-varying co-movements (= contagion) .
 - ▶ **“Gravity-type” model**: once contagion is detected, disentangle factors that cause simple interdependence from contagion channels.

Contribution to the literature

- Determinants of sovereign bond yield spreads/CDS spreads.
Attinasi et al. 2009, Haugh et al. 2009, De Grauwe and Ji 2012...
⇒ Our paper: focus on **bilateral co-movements** and not on individual countries' risk spreads.
- Two-way feedback between the banking sector and the sovereign.
Acharya et al. 2011, Bolton and Jeanne 2011, Dieckmann and Plank 2011, Alter and Schüler 2012...
⇒ Our paper: evaluate the role of **cross-border banking exposures** for sovereign credit risk co-movements.
- Measurement of contagion across countries and markets focusing on tail events and excess correlations.
Forbes and Rigobon 2002, Bae et al. 2003, Forbes 2012, Caporin et al. 2013...
⇒ Our paper: **separate** interdependence due to e.g. usual cross-country links from contagion on a country pair basis **and** explain reasons behind.

Contagion

Contagion: Definition

- *Controversial points*: Do global shocks qualify as contagion? Does the transmission of shocks due to fundamental links in trade and finance constitute contagion? Or is contagion only related to non-fundamentals reflected by panics or (ir)rational herding behavior?
- *Our definition*: Significant increase in (volatility-adjusted) cross-country correlations (Forbes and Rigobon 2002).
- *Advantages*: Separate co-movements existing in all states of the world from significant increase in correlations, i.e. interdependence from contagion.
 - ▶ Like this, we do not limit our analysis to extreme events or...
 - ▶ ...impose ex ante restrictions on possible contagion channels.

Contagion channels

Common (macroeconomic) shocks or similarities in economic fundamentals.

- similarities in fundamentals relevant for pricing of sovereign risk might impact co-movements (public debt, banking sector) – “wake-up call” contagion.
- shocks affecting all countries at the same time might affect the pattern of co-movements (volatility index, interest rate spreads).

Direct linkages causing interdependence and fundamentals based contagion.

- direct links existing in all states of the world cause simple interdependence (cross-border interbank markets, trade, banks' holdings of foreign sovereign debt).
- contagion can arise due to changes in the **strength**, e.g. portfolio reallocations, or in the **nature** of direct links, e.g. risk-sharing to channeling contagion.

Indirect linkages leading to non-fundamentals based contagion.

- e.g. think of herding behavior or irrational market sentiments.
- variables are not observable but there exist proxies (policy uncertainty index, economic sentiment indicators).

Empirical Approach

Data and Sample

- Daily data on 5-year sovereign CDS spreads
- Sample period: Jan 2008 to Aug 2012
- 17 countries (of which 11 eurozone (EZ) countries)
- $17 \times 16/2 = 136$ country pairs
- Classification into country groups:

Core EZ	Periphery EZ	EU, non EZ	Non EU
Austria	Greece	Denmark	Japan
Belgium	Ireland	Sweden	Norway
Finland	Italy	United Kingdom	United States
France	Portugal		
Germany	Spain		
Netherlands			

Empirical approach

Step I: Dynamic conditional correlations (DCCs) for *daily* CDS spreads (Engle 2002).

- Use DCCs to get volatility adjusted time-varying credit risk co-movements

Step II: Measurement of contagion based on *weekly* averaged co-movements.

- Detect episodes with significant increase in weekly averaged co-movements.
- Construct contagion indicator varying across time and country pairs
⇒ analyze *WHEN* contagion takes place.

Step III: Gravity-type model for *monthly* averaged DCCs.

- Analyze drivers behind simple interdependence in contrast to contagion.
- Exploit contagion indicator to learn more about the transmission channels:
⇒ analyze *WHY* and *THROUGH WHICH CHANNELS* contagion takes place.

Step I: Correlation analysis

- DCC Model (Engle, 2002) based on multivariate GARCH processes
- allows estimating time-varying credit risk co-movements measures $\rho_{ij,t}$ DCC
- Advantage: The DCCs are time-varying, based on the full sample period and adjusted for the underlying volatility.
- Hence, we can interpret a significant increase in the DCCs as **contagion** (Forbes and Rigobon 2002, Chiang et al. 2007).

Step II: Measurement of contagion

- Now: Measure contagion defined as significant increase in volatility-adjusted correlations, i.e. significant increase in DCCs.
- To do so, we aggregate the DCCs to weekly frequency ρ_{ijw} and run sequential time-series regressions for each country pair ij as follows:

$$\rho_{ijw} = d_0 + \sum_{k=1}^K d_k \rho_{ijw-k} + q_w \text{dummy}_w + \epsilon_{ijw}$$

- with dummy_w being an indicator variable taking a value of one for a given week w and zero otherwise.
- Contagion indicator (CI_{ijw}):

$$CI_{ijw} = \begin{cases} 1 & \text{if } q_w \geq 0 \text{ and } p\text{-value}_{q_w} \leq 0.1, \\ 0 & \text{otherwise.} \end{cases}$$

Gravity-type model

- Now: What are the *determinants* of co-movements in general and the *channels* behind contagion in particular?
- To answer this, we aggregate the DCCs to monthly frequency ρ_{ijm} and use them as dependent variable...

- ▶ ...to analyze the determinants of co-movements:

$$\rho_{ijm} = \mathbf{x}'_{ijm} \boldsymbol{\beta} + u_{ijm}$$

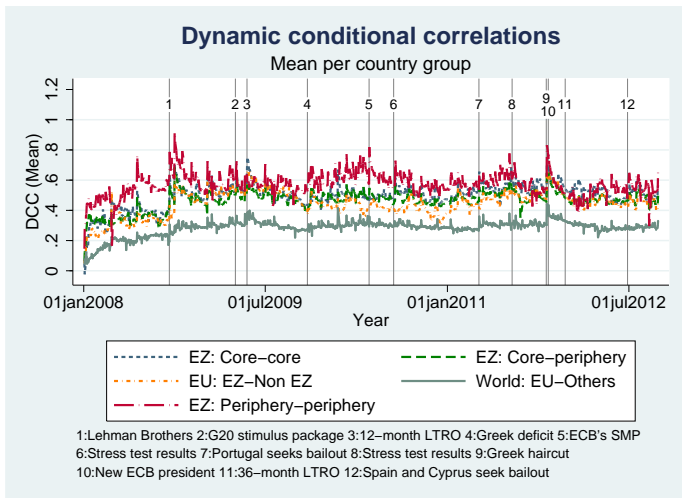
- ▶ ...to identify the channels behind contagion:

$$\rho_{ijm} = \mathbf{x}'_{ijm} \boldsymbol{\beta} + \mathbf{x}'_{ijm} \boldsymbol{\delta} * CI_{ijm} + u_{ijm}$$

- Robust SE, clustered by country pair, augmented by ij and m fixed effects.
- Contagious episode: The contagion indicator CI_{ijm} takes a value of one if at least one weekly dummy in month m is positive and significant.

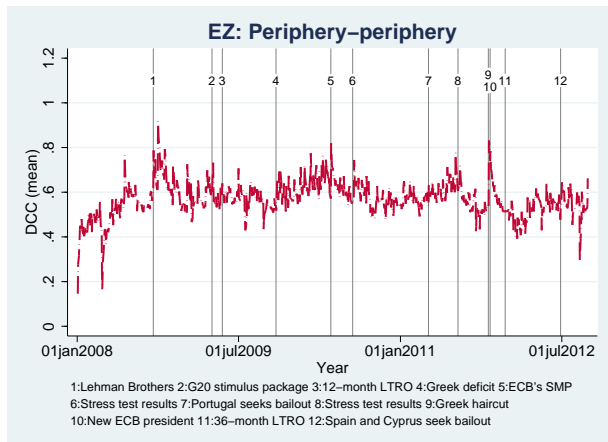
Results

Results: Correlation analysis



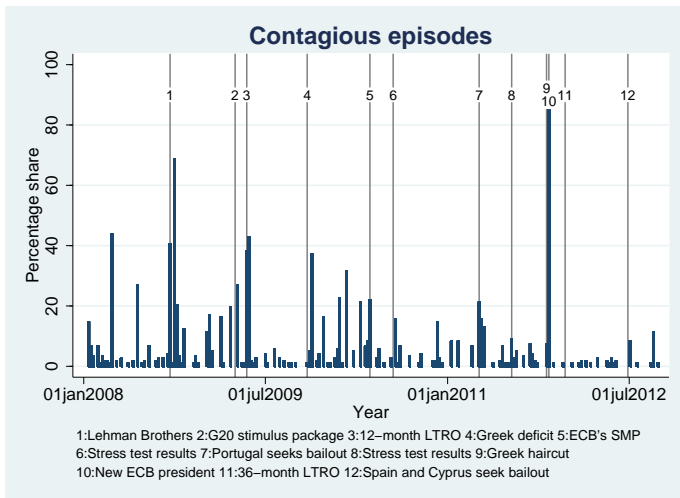
- DCC $\rho_{ij,t}$ show increase after Sept 2008; peaks correspond to key events.
- Divergence with sovereign crisis: eurozone effect; high DCCs in EZ periphery.

Crisis events and DCCs



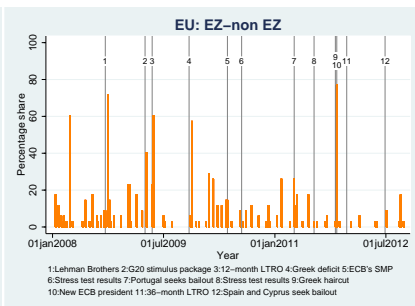
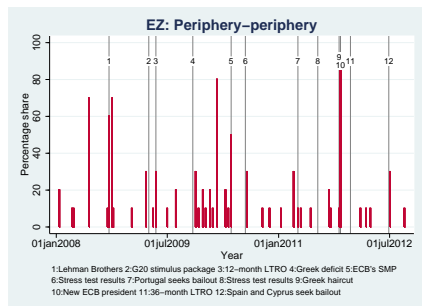
- 4: Increase after announcement of Greek deficit (Nov 2009).
- 5: Decline due to rescue packages (May 2010).
- 9: Sharp peak due to failure of Dexia and PSI rumors (Oct 2011).
- 10: Lower level since ECB interventions (Nov 2011).

Results: Measurement of contagion



- Graph shows share of country pairs with contagious episode, i.e. $CI_{ijw} = 1$.
- Sovereign debt markets experienced various contagious episodes.

Similarities *and* discrepancies across country groups



- Graph shows share of country pairs with contagious episode per country group.
- Variation of contagion indicator not only across *time* but also across *groups*.
- Specifying arbitrary cut-off points held constant across countries would miss this!

Concluding remarks

- Sovereign debt crisis characterized by sharp widening in sovereign credit risk spreads. Yet, EZ countries co-move despite diverging fundamentals. Why?
- *Our results suggest:*
 - ▶ Sovereign debt markets in the eurozone are tied together during the sovereign debt crisis (monetary union effect) with co-movements highest for periphery countries.
 - ▶ Contagion is not attributable to one moment in time or country pair.