

CDSs in the Analysis of Sovereign Debt Crisis: the Case of the PIIGS and the UK

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Outline

- Stylized Facts about the Eurozone Crisis
- Aim and Methods
- Why CDSs?
- Techniques and Results
- Data Requirement for ABM
- Initial Network of Sovereigns
- Concluding Remarks

Eurozone Crisis



- GFC of 2007-2009 → demise of global banks
- States “sponsored” the crisis → insolvencies passed on to sovereigns → sovereign debt crisis
- SDC – not new to international finance (Russia, Mexico, Asia, Argentina)
- Europe is the weakest link → biggest challenge for decades

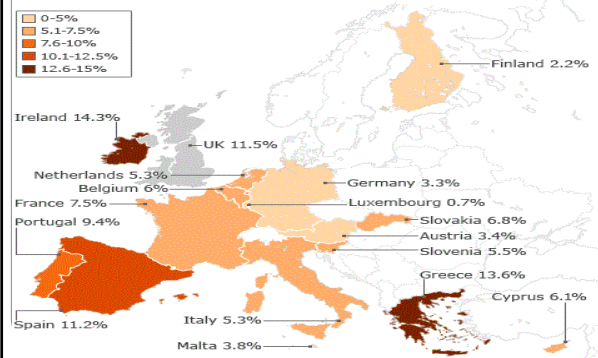


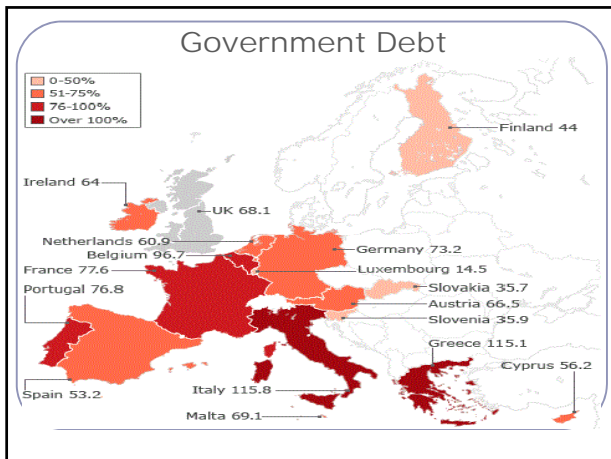
Paul Mason: VIX is higher now than when Lehman Brothers collapsed

Eurozone Crisis

- PIIGS – Portugal, Ireland, Italy, Greece, Spain
- Not outliers – government balance sheets in other countries swell (assistance to banks)
- Deterioration in the country risks of the PIIGS → sovereign systemic crisis for the Eurozone → first major test since its 1999 launch
- GFC hit Europe but did not originate there
- Reason – breached their own rules (debt 60%, deficit 3 %) → except Luxemburg and Finland

Government Deficit



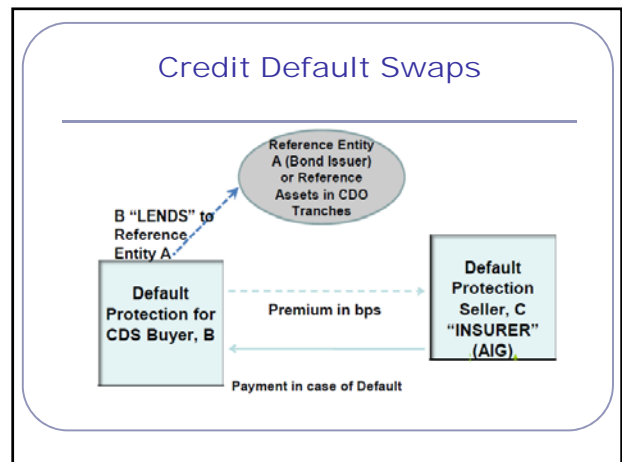


This Paper

- Examines sovereign risks intensifying in Europe and the possibilities of contagion for the PIIGS and the UK
- Questions: whether several healthier and larger economies share the burden of a Greek bailout, and if so, whether contagion can be stopped
- Greek bailout does not make the risk disappear but transfers it to governments of Northern Europe
- I.e. all the system and systemic risk should be considered along with interconnections b/w market players

Aim and Methods

- First standard econometric analysis - EWMA and Granger-causality – and find contagion, besides, Greece and Italy – highest role, while Ireland – the lowest role
- Final aim: to create an ABM among sovereigns (in the process of development)
- ABM allows to study in-depth interrelations; research on such models is in its preliminary stage without any standard setup



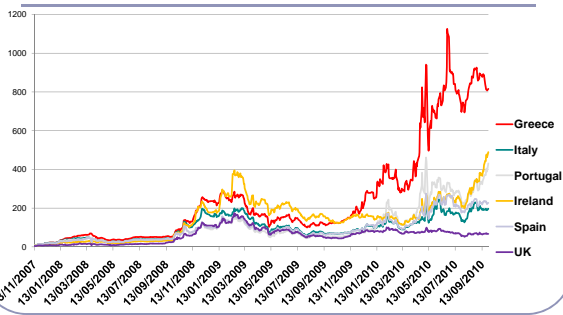
Why to Focus on CDSs?

- CDSs play a central role in the credit market:
 - banks use CDSs for hedging purposes;
 - express market views on the expected loss in case of default
 - represent credit worthiness of the RE and probability of default;
- Increasing harmonization of CDS contracts allows for a more direct comparison of cross country default risk
- CDSs are not subject to distortions inherent to bond markets, ex. early call features
- BUT, strong self-reflexive properties → can accelerate the default event

CDS Data

- **DataStream data** on CDS spreads in basis points on 5 years government bonds
- Jan 2004 – Sept 2010, UK – Nov 2007
- ABM in steps, first to check whether there is any relevant information nested in the DataStream data on CDS spreads

CDS Spreads since Nov 2007



Technical Specifications

- Ambiguity concerning the precise definition of contagion and how we should measure it
- No theoretical or empirical definition on which researchers agree
- Broadly: cross-country transmission of shocks or general cross-country spillover effects
- To capture the phenomenon quantitatively – very restrictive definition of the WB: cross country correlations increase during 'crisis times' relative to correlations during 'tranquil times' – **Statistical Contagion**
- We use log first differences of CDS spreads:

$$x_t^i = \log(s_t^i) - \log(s_{t-1}^i)$$

Technical Specifications

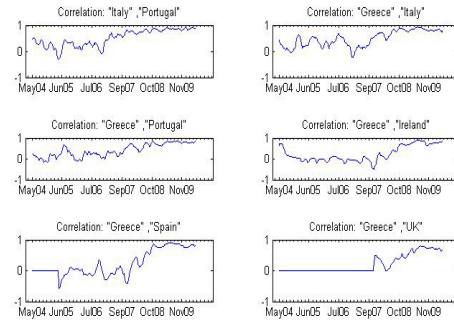
- Gex and Coudert (2008). EWMA idea: calculate moving average by weighting components with an exponential factor:

$$p_t \approx (1 - \lambda) \frac{x_{1,t-1} x_{2,t-1}}{\sigma_{1,t-1} \sigma_{2,t-1}} + \lambda p_{t-1}$$

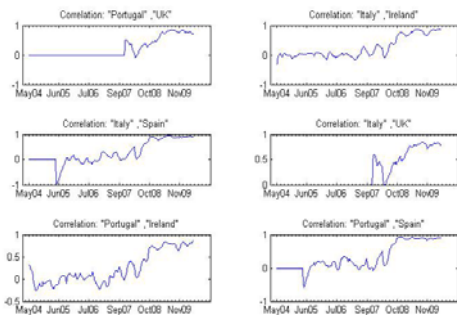
$$\sigma_{k,t} = \sqrt{(1 - \lambda) x_{k,t-1}^2 + \lambda \sigma_{k,t-1}^2}$$

- λ should be such as to minimize the root mean square errors of forecasts. In our case $\lambda = 0.939$ (Risk Metrics, JPMorgan)

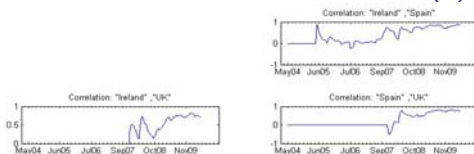
EWMA Correlations Charts (1)



EWMA Correlations Charts (2)



EWMA Correlations Charts (3)



- Most of them increased already after the "credit crunch" in August 2007 but ECB saved
- After the LB collapse clearly spiked again (long-term elevation up to 0.93)
- Remained high since Oct 2009

Technical Specifications

- To verify the hypothesis whether correlations increased significantly during the crisis regression:

$$p_t = \beta_0 + \beta_1 p_{t-1} + \beta_2 D_t + \varepsilon_t$$

$D_t^1 = 1$ after 13.11.2007; $D_t^1 = 0$ elsewhere

$D_t^2 = 1$ after 12.09.2008; $D_t^2 = 0$ elsewhere

$D_t^3 = 1$ after 01.10.2009; $D_t^3 = 0$ elsewhere

Experiment	D_1	D_2	D_3
Greece - Ireland			
coefficient	0.005***	0.0009	-0.0004
t-statistics	4.272	0.497	-0.28
p-value	2.0492e-005	0.619	0.779
Greece - Spain			
coefficient	0.007***	0.0016	-0.0017
t-statistics	6.146	0.936	-1.306
p-value	9.9568e-010	0.349	0.192
Greece - UK			
coefficient	0.0006	0.001	-0.002*
t-statistics	0.673	1.287	-1.934
p-value	0.501	0.198	0.053
Italy - Ireland			
coefficient	0.003***	0.003***	0.0001
t-statistics	4.457	2.639	0.162
p-value	8.8743e-006	0.0084	0.871
Italy - Spain			
coefficient	0.006***	0.002	-0.0003
t-statistics	2.769	0.805	-0.131
p-value	0.005	0.421	0.896
Portugal - Ireland			
coefficient	0.003***	0.002	4.4174e-005
t-statistics	4.403	1.544	0.052

Technical Specifications

- Drawback of EWMA:** difficult to investigate the direction of causality
- Want to know how contagion spreads and who is "infecting" who - **Granger-causality test** to see the probable direction of contagion
- Idea:** if one variable causes the other, it should help to predict it. An autoregressive model with lag p :

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \dots + \alpha_p x_{t-p} + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \dots + \beta_p y_{t-p} + \varepsilon_t$$

Technical Specifications

- F-test of the null hypothesis:

$$H_0 : \beta_1 = \beta_2 = \dots = \beta_p = 0$$

- If coefficients are not significant $\rightarrow y$ is not Granger-causing x
- Optimal lag length – tests of models with longer lags versus shorter lag lengths
- In our case optimal lag is 5 since the LR tests reject lag 4 as significantly degrading the fit of the model at 0.01 level

Granger-Causality Probabilities

Variable	Greece	Italy	Portugal	Ireland	Spain	The UK
Greece	0.00	0.02	0.00	NaN	NaN	0.02
Italy	0.00	0.00	0.08	NaN	NaN	0.00
Portugal	0.00	0.01	0.00	NaN	NaN	NaN
Ireland	NaN	NaN	NaN	0.00	NaN	NaN
Spain	0.00	0.00	NaN	0.07	0.00	NaN
The UK	NaN	0.00	NaN	NaN	NaN	0.00

Problems with Granger-Causality Test

- Results are hard to interpret, ex. does not answer the question who will be the next weakest link if some country defaults (ex. Greece)
- This test is designed to handle pairs of variables and may produce misleading results when the true relationship involves three or more variables
- EX. no variable Granger-causes the other (Ire)
- OR each of the two variables Granger-causes the second (Greece and Italy cause Spain) \Rightarrow

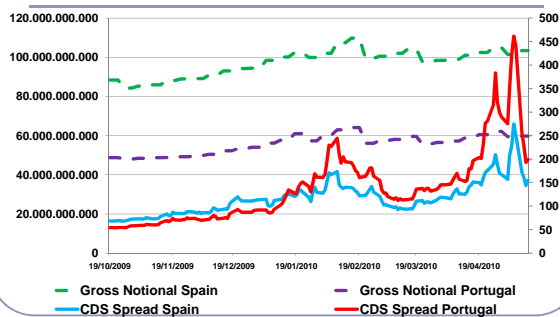
ACE Approach to Modeling Financial Contagion

- ACE model for more accurate results on the probability of contagion. **Structural contagion** - models based on default causality of chain reactions governed by the network connections of the financial entities
- Successfully used in biology, sociology, zoology, epidemiology and chemistry
- Bottom-up approach to modeling (agents with own properties and internal dynamics and rules of interaction between them)
- Different from traditional modeling and help to study fiercely interconnected monetary and financial system

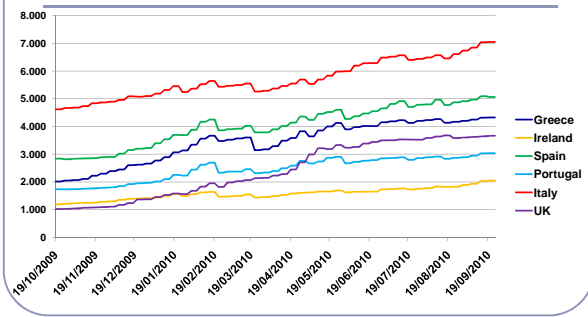
Data Requirement

- IMF GFSR (2009): research is in preliminary phase
- Data on CDSs issued on bonds of six sovereigns: PIIGS and the UK
- Data sources to be used:
 - **DTCC data** including outstanding GN and NN values and the number of CDS contracts for sovereigns to see if there is any pressure from the market on CDS spreads. Spans from Oct 2009

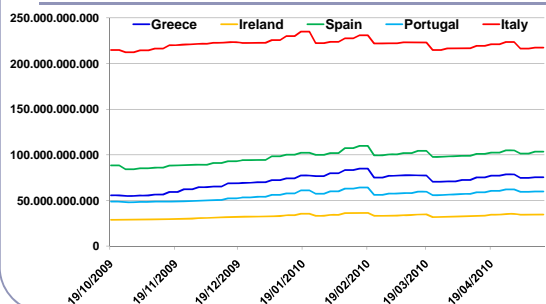
CDS Spread and GNV on Spain and Portugal



Number of CDS Contracts for PIIGS and the UK

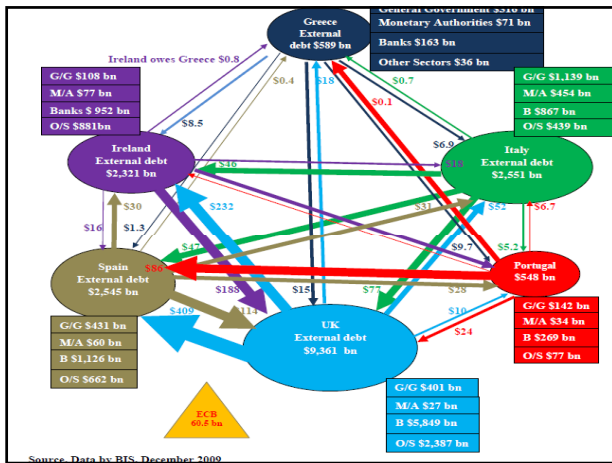


Gross Notional Value of CDS for PIIGS and the UK



Financial Network of Sovereigns

- Initial network is based on **BIS data** on consolidated foreign claims of banks in individual countries, and their assets and liabilities (network of sovereigns)
- Nodes are sovereigns which are interconnected according to their debt relationships
- The amounts of debt are calculated for each country
- Arrow width proportional to debt amounts



Concluding Remarks

- Most of the EU countries are highly indebted and have high budget deficits
- PIIGS and the UK are the most problematic
- The biggest concern is the risk of contagion
- The GFC of 2007-2009 did not originate in Europe but triggered sovereign default risk
- Greece and Italy exert the highest impact
- Spain, UK, and Portugal play a smaller role
- Ireland seems to be “disregarded”
- Analysis did not answer the question who will be the next weakest link in case of default – ACE model

Thank you!