

# Sovereign Debt and External Constraint in Europe : a new look to the recent crisis

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- ✓ Introduction
- ✓ Methodology
- ✓ Data and Results
- ✓ Conclusions

# Aim and background of this presentation

- Framework :
  - Eurozone crisis : from a sovereign debt perspective to a foreign constraint one
  - Size and duration of the crisis depending on (Baldwin and Giavazzi, 2016):
    - (i) the size of the initial imbalances
    - (ii) the initial shock and its amplifiers
    - (iii) how policies respond

## Aim and background of this presentation

### (i) Size of the initial imbalances

- There were large capital flows from core Eurozone countries to the periphery and a large share of them were invested in non-traded sectors. This means:
  - (a) assets have not been created to help pay-off in the investment
  - (b) increase in wages and costs in a way that harmed the competitiveness
- With the Global Financial crisis, cross border capital inflows stopped and this raised concerns about the viability of banks and even governments (Greece)

## Aim and background of this presentation

### (ii) Initial shock and its amplifiers

- A rapid loss of Eurozone investors' trust in deficit nations that was amplified by :
  - governments who got in trouble had no lender of last resort
  - the predominance of bank financing: European banks were thinly capitalized and large compared to countries' GDP, saving them imposed a 'double drowning scenario'
  - a doom-loop situation: a vicious feedback cycle between banks and their government.
    - "The sovereign debt crisis in the Eurozone has become systemic" (Tabellini 2011)
  - rigidity of factor and product markets in countries that could not restore competitiveness through a currency devaluation

## Aim and background of this presentation

### (iii) Policy responses

- the Eurozone institutional framework was not prepared for a crisis of this magnitude
- restructuring Eurozone architecture ... "whatever it takes" as asserted by the ECB President, Mario Draghi

## Aim and background of this presentation

- This presentation will particularly focus on :
  - (i) initial imbalances
  - (ii) the initial shocks and the lost of investors' confidence in deficit countries
- How are we going to do this? using which approach?

## Aim and background of this presentation

- Eurozone crisis: **from a systemic risk and sovereign debt approach** (Tabelinni, 2011)...
- Approach based on Popescu and Turcu (2014) and on Hurlin, Popescu and Turcu (2015)
  - Identify countries contribution to systemic risk and establish a ranking in order to spot the systemically important countries
    - **Systemically important countries?** Countries that need to raise an important amount of funds and/or face high bond yields when the system is already in stress.
    - This countries' **ranking** can be a useful tool for regulators => a better surveillance mechanism and penalties on countries that infringe regulation.



## Aim and background of this presentation

- ...to a **foreign constraint approach** (Sinn, 2012, 2014)
  - Insights based :
    - on the further developments of previous systemic risk papers
    - on a PSTR (Panel Smooth Transition Regression) model developed in Marakbi and Turcu (2016)

# Systemic sovereign risk

- Financial approach: the question of identifying the contribution of a financial institution to the systemic risk has already been asked (Brownlees and Engle 2011)
  - This issue can be addressed also at countries level: **this is the first attempt to do it !**
- How to evaluate the expected financing requirements of Eurozone countries during a debt crisis at EMU level?
- Which countries contribute the most to systemic sovereign risk?

# Macroeconomic approach

- Macroeconomic approach based on publicly available data
  - Countries (not firms)
  - Government bond yields (not financial returns)
  - Government bond index (not market index) using public debt (not market capitalization) weights
  - **Crisis event?** Situation where the whole area (Euro area in our case) faces a global difficulty to issue bonds (high bond rates) and to finance the global debt

# Macroeconomic approach

- Literature review
  - **Theoretical literature** on the incentives faced by sovereign debtors to repay their debt (Dooley and Svensson 1994, Cole and Kehoe 2000)
  - **Empirical work** focused on the link between sovereign credit risk and global and financial market factors (Pan and Singleton 2008, Longstaff et al 2011)
- **Our approach:** we compute complementary systemic risk measures using macroeconomic data in order to derive countries rankings that might be interesting for macroeconomic policy design

# Before starting...

- Financial returns and weighted market index (Brownlees and Engle 2011)
- Our approach:
  - Government bond yields for a 10-year maturity for each country at time  $t$
  - Government Bond Index constructed as a weighted average of these yields

$$r_{mt} = \sum_{i=1}^N w_{it} r_{it}$$

# Before starting...

- Expected Shortfall (ES) in the financial literature
  - ES at  $\alpha\%$  level is the expected return in the worst  $\alpha\%$  of the cases
  - this definition can be extended to the general case in which the returns are beyond a given threshold  $C$  (Brownlees and Engle 2011)
- Our approach:
  - **Expected Shortfall (ES):** Expected market bond yields in the cases when these bond yields exceed a certain threshold

$$ES_{t-1} = \mathbb{E}_{t-1}(r_{mt} \mid r_{mt} > C)$$

- where systemic events are situated in the right tail of the bond yield distribution
- threshold  $C$  is the historical Value-at-Risk at a 95% confidence level computed for the yields

# Before starting...

- Marginal Expected Shortfall (MES) (Brownlees and Engle 2011)
  - The expected loss an equity investor in a financial firm would experience if the overall market declined substantially
  - Marginal contribution of a financial institution to systemic risk
- Our approach:
  - the expected increase in a particular bond yield when the overall government bonds market is above a given threshold
  - marginal contribution of a country to the overall risk of the area (Eurozone) as given by the expected shortfall (ES) of the system

$$MES_{i,t-1} = \frac{\partial ES_{t-1}}{\partial w_i} = \mathbb{E}_{t-1}(r_{it} \mid r_{mt} > C)$$

- MES is the average bond yield that will be applied to country  $i$  when the system is under stress

# Component Expected Shortfall

- In a financial perspective, Component Expected Shortfall (CES) (Banulescu and Dumitrescu, 2015) is the product of MES and the weight of the financial institution.
- In our approach,  $CES\%$  represents one country's contribution to the overall risk at time  $t$

$$CES\%_{it}(C) = \frac{\partial ES_{t-1}(C)}{\partial w_{it}} \frac{w_{it}}{ES_{t-1}(C)} = \frac{w_{it}MES_{it}(C)}{\sum_i^N w_{it}MES_{it}(C)}.$$

- The larger the  $CES\%$  of a country, the more systemically important this country is.



# Expected financing requirements

- Measures the *expected financing requirements*, EFR, of a *country* in a crisis.
- Obtained from the *government budget constraint*, EFR is a function of:
  - (i) structural factors of each country (primary deficit, public debt level, inflation and growth rate) and
  - (ii) MES, the expected bond yield of a country when the overall market experiences a crisis.

# A simple theoretical idea

- Identify and measure the financing requirements of a country by using the standard government budgetary constraint.
- The evolution of the government debt-GDP ratio:

$$\frac{B_{it}}{Y_{it}} = (r_{it} - \pi_{it} - g_{it}) \frac{B_{i,t-1}}{Y_{i,t-1}} + \frac{def_{it}}{Y_{it}} + \frac{B_{i,t-1}}{Y_{i,t-1}}.$$

- The increase in the real debt stock at time t for country i:

$$B_{it} - B_{i,t-1} = [(g_{it} + 1)(1 + r_{it} - \pi_{it} - g_{it}) - 1] \times B_{i,t-1} + def_{it}$$

# A simple theoretical idea

- Expected financing requirements = the expected increase in debt of country  $i$  conditional on the emergence of a European debt crisis.

$$EFR_{i,t-1} = \mathbb{E}_{t-1} (B_{it} - B_{i,t-1} | Crisis)$$

- Thus, assuming that growth and primary deficit are predetermined, the expected financing requirements become:

$$EFR_{it} = [(1+g_{it})(1+\underbrace{\mathbb{E}_{t-1}(r_{it}|Crisis)}_{MES}) - \overbrace{\mathbb{E}_{t-1}(\pi_{it}|Crisis)}^{MES} - g_{it}) - 1]B_{i,t-1} + def_{it}$$

- Interpretation of EFR:** the capital that a country would need to raise, if the European bond market experienced a crisis.

# Some remarks

- **The crisis event:** the whole area faces a difficulty to raise funds *i.e.* high bond rates.
- **First remark** - no “market index” as Eurobonds are not yet in place → construct a virtual index
- **Second remark** - the dynamics of sovereign bond yields follow random walks:

$$r_{it} = r_{i,t-1} + z_{it} \quad \text{and} \quad r_{mt} = r_{m,t-1} + z_{mt}$$

- Thus, the crisis event:  $z_{mt} > C$ , where the threshold is the VaR (95%).

# DCC-GARCH

- A bivariate DCC is used to model the volatility and the correlations between the innovations of the bond yield index and of the yields of each country
- A two-step approach is used:
  - a univariate asymmetric Garch, namely the GJR Garch(1,1), is considered for each country and for the market index.
  - dynamic conditional correlation matrix
- Tail expectation: non parametric kernel estimation à la Scaillet (2005), with a notable difference related to the fact that the sign in the conditioning event is reversed

# Framework (1)

- Bivariate process with:

$$\begin{aligned} Z_{it} &= \sigma_{it}\varepsilon_{it} = \sigma_{it} \left( \rho_{it}\varepsilon_{mt} + \sqrt{1 - \rho_{it}^2}\xi_{it} \right) \\ Z_{mt} &= \sigma_{mt}\varepsilon_{mt} \end{aligned}$$

- Disturbances are independent and identically distributed over time:

$$\varepsilon_t = (\varepsilon_{mt}, \xi_{it}) \sim F$$

so that  $\mathbb{E}_{t-1}(\varepsilon_t) = 0$ .

- $\mathbb{E}_{t-1}(Z_t Z_t') = H_t = \begin{pmatrix} \sigma_{it}^2 & \rho_{it}\sigma_{it}\sigma_{mt} \\ \rho_{it}\sigma_{it}\sigma_{mt} & \sigma_{mt}^2 \end{pmatrix}$

# Framework (2)

$$\begin{aligned}
 E_{t-1}(r_{it} \mid \text{Crisis}) &= E_{t-1}(r_{i,t-1} + z_{it} \mid z_{mt} > C) \\
 &= r_{i,t-1} + \sigma_{it} \rho_{it} E_{t-1}(\varepsilon_{mt} \mid \varepsilon_{mt} > \frac{C}{\sigma_{mt}}) + \sigma_{it} \sqrt{1 - \rho_{it}^2} E_{t-1}(\xi_{it} \mid \varepsilon_{mt} > \frac{C}{\sigma_{mt}}).
 \end{aligned}$$

- GJR Garch(1,1) to get conditional volatilities,  $\sigma_{it}$ .
- DCC(1,1) to get conditional correlations,  $\rho_{it}$ .
- Non-parametric approach to get tail expectations.



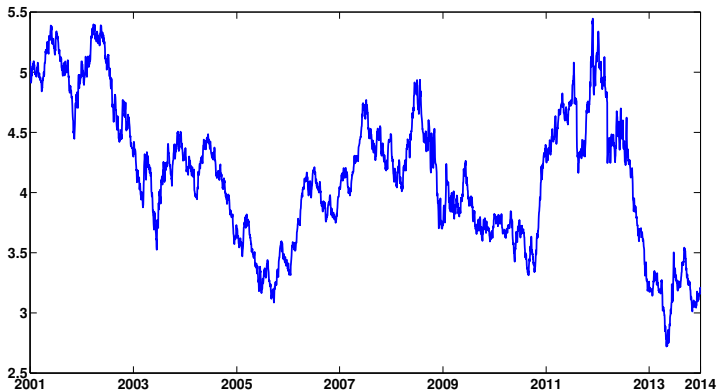
# Data

- 11 Eurozone countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain)
  - Government bonds yields for a 10-year maturity (time span: May 2000 - December 2013)
  - Quarterly country public debt
  - Monthly inflation
  - Quarterly GDP to get the growth rate
  - Quarterly primary deficit
- Data source: Datastream & Eurostat

# Country weights

Country	Belgium	Germany	Ireland	Greece	Spain	France	Italy	Netherlands	Austria	Portugal	Finland
Weight (2011)	4,40%	25,39%	2,06%	4,32%	8,95%	20,88%	23,18%	4,79%	2,65%	2,25%	1,13%

# Government Bond Yield Index



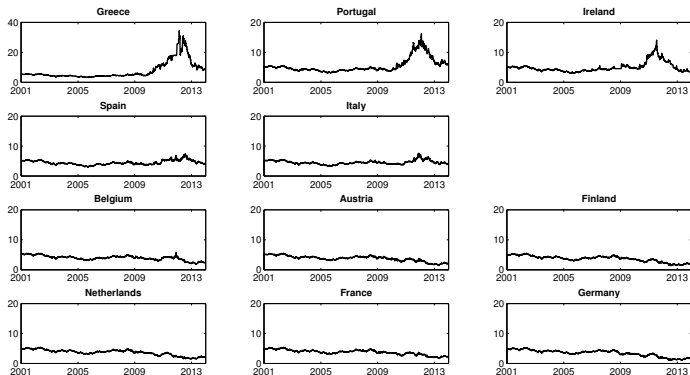
# GJR-GARCH and DCC results

**Table :** GJR-GARCH and DCC estimated parameters

Parameters	$\alpha$	$\gamma$	$\beta$	$\alpha_C$	$\beta_C$
<b>Market Index</b>	0.028***	0.012***	0.961***	-	-
<b>Belgium</b>	0.051***	0.011***	0.930***	0.046***	0.949***
<b>Germany</b>	0.038***	0.000	0.954***	0.043***	0.955***
<b>Ireland</b>	0.150***	0.134***	0.715***	0.007***	0.993***
<b>Greece</b>	0.038***	0.077***	0.923***	0.026***	0.974***
<b>Spain</b>	0.050***	0.061***	0.914***	0.062***	0.933***
<b>France</b>	0.032***	0.000	0.960***	0.016***	0.982***
<b>Italy</b>	0.036***	0.061***	0.928***	0.039***	0.960***
<b>Netherlands</b>	0.033***	0.000	0.957***	0.022***	0.975***
<b>Austria</b>	0.128***	0.000	0.819***	0.021***	0.978***
<b>Portugal</b>	0.047***	0.042***	0.931***	0.023***	0.975***
<b>Finland</b>	0.048***	0.000	0.938***	0.048***	0.947***

Note: This table presents the estimated parameters of the GJR-GARCH and DCC models.

Figure : Marginal Expected Shortfall (MES) by country



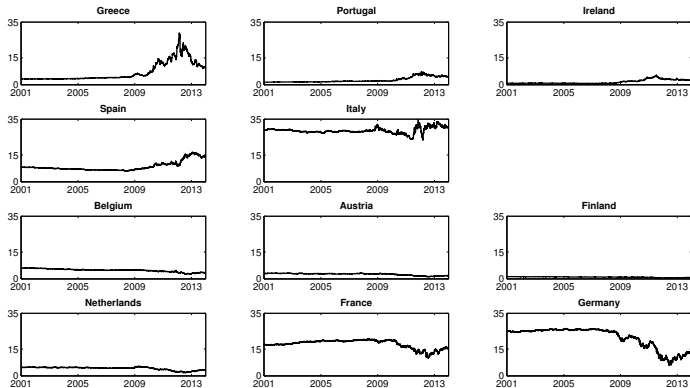
# MES ranking

Table : MES based ranking

15/06/2006		15/06/2012	
<b>Greece</b>	4.19	<b>Greece</b>	29.04
<b>Italy</b>	4.18	<b>Portugal</b>	10.62
<b>Portugal</b>	4.00	<b>Ireland</b>	7.27
<b>Finland</b>	3.92	<b>Spain</b>	6.91
<b>Austria</b>	3.92	<b>Italy</b>	6.21
<b>Belgium</b>	3.91	<b>Belgium</b>	3.34
<b>France</b>	3.91	<b>France</b>	2.69
<b>Spain</b>	3.87	<b>Austria</b>	2.36
<b>Ireland</b>	3.87	<b>Netherlands</b>	2.01
<b>Netherlands</b>	3.87	<b>Finland</b>	1.84
<b>Germany</b>	3.84	<b>Germany</b>	1.37

Note: This table provides the countries' rankings based on the MES measure at two different dates.

**Figure :** Percentage Component Expected Shortfall (CES%) by country



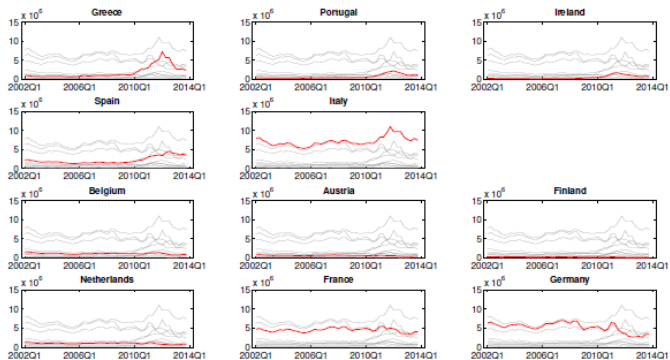
# CES Ranking

Table : CES% based ranking

15/06/2006		15/06/2012	
<b>Italy</b>	28.37	<b>Italy</b>	30.76
<b>Germany</b>	25.69	<b>Greece</b>	20.63
<b>France</b>	19.62	<b>Spain</b>	13.59
<b>Spain</b>	6.59	<b>France</b>	12.25
<b>Belgium</b>	4.95	<b>Germany</b>	7.37
<b>Netherlands</b>	4.45	<b>Portugal</b>	5.14
<b>Greece</b>	3.87	<b>Belgium</b>	3.24
<b>Austria</b>	2.83	<b>Ireland</b>	3.21
<b>Portugal</b>	1.83	<b>Netherlands</b>	2.04
<b>Finland</b>	1.03	<b>Austria</b>	1.34
<b>Ireland</b>	0.78	<b>Finland</b>	0.43

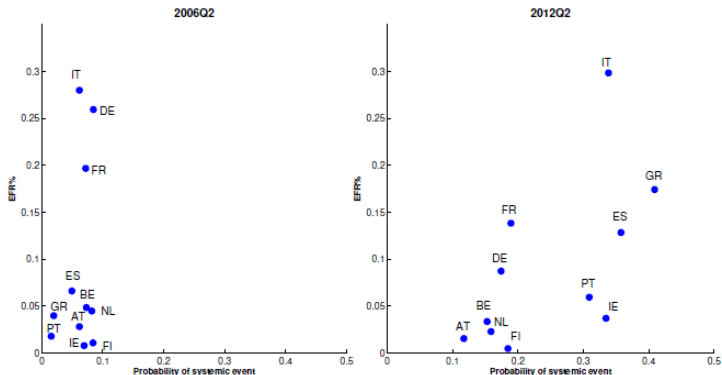


Figure : Expected Financing Requirements (EFR%) by country



Note: This figure presents the evolution of the Expected Financing Requirements of the countries in our sample. For comparison reasons, in each panel the main series is presented in red, whereas the other series are shaded. The scale is kept the same for all countries.

Figure : Expected Financing Requirements (EFR%) by country



Note: This figure presents the Expected Financing Requirements in percentage version at two dates representing a calm period (2006Q2) and a crisis period (2012Q2). On the x-axis, we represent the probabilities of countries to be confronted with a systemic event, defined as an increase in its respective bond yield. The scale on the two axes is kept the same for comparison reasons.

# Robustness

- S&P Eurozone Sovereign Bond Index 7 – 10Y
- Constant weights
- Garch(1,1)

# Conclusions and future research

- MES, CES and EFR are systemic risk measures that can successfully be applied not only to financial crises, but also to the sovereign debt crisis.
- Our findings confirm the fact that countries with deteriorated public finances, sanctioned by investors with high yields, have experienced in recent years an important increase in their (marginal) contribution to systemic risk.
- These measures give information about which countries need more monitoring and provide a ranking of systemically important countries relative to their probability of default.

# Conclusions and future research

- Further research:
  - take into account the relationship with the banking system
  - integrate openness variables and country ratings → which allows to take account of the financial constraint dimension
- All countries that ended in bail out programs had substantial and increasing current account deficits
- All countries that participated in the bail outs were net lenders
- The transition towards a current account deficit perspective of the crisis : captured through a PSTR approach linking current account deficit to public finance, quality of institutions and other controls

Thank you for your attention!