European Government Bond Dynamics and Stability Policies: Taming Contagion Risks

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Case Study: Euro area crisis  
Data: Daily 10Y Government Bond Yields

Financial crisis becomes Euro area debt crisis. Yield volatilities spike up, yield levels diverge.

Convergence before EUR introduction

ECB measures and EFSF/ESM setup

Greek 2015 elections announced

Yield / Vol tradeoff makes market timing interesting.

<table>
<thead>
<tr>
<th>Issuer</th>
<th>Current 10Y Yields</th>
<th>Yield Vol since 6/2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFSF</td>
<td>0.84</td>
<td>0.68</td>
</tr>
<tr>
<td>DE</td>
<td>0.74</td>
<td>0.76</td>
</tr>
<tr>
<td>FI</td>
<td>0.91</td>
<td>0.73</td>
</tr>
<tr>
<td>NL</td>
<td>0.94</td>
<td>0.73</td>
</tr>
<tr>
<td>AT</td>
<td>1.05</td>
<td>0.76</td>
</tr>
<tr>
<td>FR</td>
<td>1.09</td>
<td>0.76</td>
</tr>
<tr>
<td>BE</td>
<td>1.09</td>
<td>0.89</td>
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<tr>
<td>IE</td>
<td>1.40</td>
<td>1.55</td>
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<tr>
<td>ES</td>
<td>2.06</td>
<td>1.56</td>
</tr>
<tr>
<td>IT</td>
<td>1.92</td>
<td>1.50</td>
</tr>
<tr>
<td>PT</td>
<td>2.60</td>
<td>2.92</td>
</tr>
<tr>
<td>GR</td>
<td>9.19</td>
<td>11.45</td>
</tr>
</tbody>
</table>
Euro area bond correlations in yearly intervals 2004 - 2009
Euro area bond correlations in yearly intervals 2010 - 2015
Problems with yield correlations

We aim to discuss yield dynamics as close to the market as possible. Therefore, we use a model free approach, based on correlations. The Pearson Correlation coefficient is defined as:

\[
r(X, Y) = \frac{\sum_{i=1}^{n} (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n} (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^{n} (Y_i - \bar{Y})^2}}
\]

Problem with correlations: they are unstable, and hidden factors may lead to spurious correlations.
Method Overview: Filtered correlation influence networks

Bond yield time series

Correlation matrix

Filtered influence network

Bootstrap filter

01-Jan-2010 - 31-Dec-2010
EFSF  DE  FI  NL  AT  FR  BE  IE  ES  IT  PT  GR

03-Jan-2011 - 30-Dec-2011
EFSF  DE  FI  NL  AT  FR  BE  IE  ES  IT  PT  GR

02-Jan-2012 - 31-Dec-2012
EFSF  DE  FI  NL  AT  FR  BE  IE  ES  IT  PT  GR

01-Jan-2013 - 31-Dec-2013
EFSF  DE  FI  NL  AT  FR  BE  IE  ES  IT  PT  GR

01-Jan-2014 - 28-Aug-2015
EFSF  DE  FI  NL  AT  FR  BE  IE  ES  IT  PT  GR
Partial correlation influence

The partial correlation measure is defined as

$$\rho(X, Y \mid Z) := \frac{r(X, Y) - r(X, Z) \cdot r(Y, Z)}{\sqrt{1 - r(X, Z)^2} \cdot \sqrt{1 - r(Y, Z)^2}}$$

The correlation influence is defined as

$$d(X, Y \mid Z) := r(X, Y) - \rho(X, Y \mid Z)$$

The average correlation influence is defined as

$$d(X \mid Z) := \frac{1}{k} \sum_{i=1}^{k} d(X, Y_i \mid Z)$$

Small absolute value would mean „Z strongly affects correlations between X and Y“

„How much of the correlation between X and Y is explained by their correlations to Z?“

„How much does Z explain correlations between X and all other markets?“

Constructing Filtered Partial Correlation Networks

The noise in the correlation influence estimator depends heavily on the specific pair: DE->FR is very stable, but DE->GR is very volatile. We need a filtering concept.

We bootstrap average influences
• We draw $n$ times a sample (with replacement) from the data, using data blocks of length 1-10 days
• For each sample, we calc the average influence matrix and the stddev across the samples
• These standard deviations act as „blur“ indicator of the average influences

Blue arrows: dominating positive correlations => reinforcing movements

Red arrows: dominating negative correlations => diverging movements

Graphs: FNA/Firamis
Blue arrows: dominating positive correlations => reinforcing movements

Red arrows: dominating negative correlations => diverging movements
Case Study: Negotiations of third Greek programme
Data: Hourly 10Y Government Bond Yields

Question: as the negotiations between Greece and the Eurogroup developed, did the market imply contagion risk to other Euro area countries beyond Greece?

Reuters, 19 April 2015: “Greece's Varoufakis warns of Grexit contagion”

Reuters, 27 June 2015: “Euro zone prepared to guard against Greek risks – Dijsselbloem”
Tsipras' tour across Europe

Correlations in weekly intervals, using hourly yields

Tsipras confirms election promises

Nervousness before Eurogroup Brussels

Greece commits to programme extension; «Troika» become «Institutions»
After Syriza won

Tsipras’ tour across Europe

Blue arrows: dominating positive correlations => reinforcing movements

Red arrows: dominating negative correlations => diverging movements
Ongoing negotiations

Tsipras meets Putin

Many Eurogroup meetings without results

Referendum announced. ECB does not raise ELA. Capital controls.

Referendum against programme, ECB still does not raise ELA limit

Greece commits to third programme

Correlations in weekly intervals, using hourly yields
Tsipras meets Putin

Ongoing negotiations

Many Eurogroup meetings without results

Blue arrows: dominating positive correlations => reinforcing movements

Red arrows: dominating negative correlations => diverging movements

29.6.-3.7.

Referendum announced.
ECB does not raise ELA.
Capital controls.

6.7.-10.7.

Referendum against programme,
ECB still does not raise ELA limit

13.7.-17.7.

Greece commits to third programme
Conclusions

• Correlation heat maps show pronounced core / periphery block structure that maps the clusters of yield levels.

• Correlation influence networks directly show the shearing forces in the Euro area with high sensitivity. Noise filtering allows to focus on the statistically significant influences.

• No fixed separation line between core and periphery. Fluctuating correlations between the blocks.

• Increasing negative correlations from 2010-2012 imply risk of capital flights from periphery to core.

• Market believes in guarantee structure of EFSF bond issues, EFSF is part of the core.

• Since 2013, rescue mechanisms show success. Yields converge.

• Greece decoupled; during the negotiations, market implied contagion risk reappeared. Currently, Greek bonds still play an isolated role in the network.
Outlook: Use correlation influence information for dynamic hedging and market timing purposes

- Dynamically hedging Euro area bonds that were exposed to negative correlation influences in the previous week.
- Reduces portfolio volatility compared to an equally weighted portfolio.

\[
\text{Daily bond returns} \sim \left( (\cdot \text{Duration}) \times [\text{yield}(t) - \text{yield}(t-1)] \right) + \text{yield}(t-1) \times dt
\]

Bond Carry