European Government Bond Dynamics and Stability Policies: Taming Contagion Risks

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Case Study: Eurozone crisis  
Data: Daily 10Y Government Bond Yields

Financial crisis becomes Eurozone 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.**

**Duration Risk**

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

**Bond Carry**

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<td>GR</td>
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</table>
Eurozone bond correlations in yearly intervals 2004 - 2009

01-Jan-2004 - 31-Dec-2004

03-Jan-2005 - 30-Dec-2005

02-Jan-2006 - 29-Dec-2006

01-Jan-2007 - 31-Dec-2007

01-Jan-2008 - 31-Dec-2008

01-Jan-2009 - 31-Dec-2009
Eurozone bond correlations in yearly intervals 2010 - 2015

01-Jan-2010 - 31-Dec-2010

03-Jan-2011 - 30-Dec-2011

02-Jan-2012 - 31-Dec-2012

01-Jan-2013 - 31-Dec-2013

01-Jan-2014 - 31-Dec-2014

01-Jan-2015 - 28-Aug-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
Partial correlation influence

The partial correlation measure is defined as

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

The correlation influence is defined as

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

The average correlation influence is defined as

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

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 bailout
Data: Hourly 10Y Government Bond Yields

Question: as the negotiations between Greece and the Eurozone developed, did the market imply contagion risk to other Eurozone 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”
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Before Greek elections

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After Syriza won

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Tsipras’ tour across Europe

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Tsipras confirms election promises

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Nervousness before Eurogroup Brussels

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Greece commits to bailout extension; «Troika» become «Institutions»

Correlations in weekly intervals, using hourly yields
After Syriza won

Tsipras’ tour across Europe

Blue arrows: dominating positive correlations => reinforcing movements

Red arrows: dominating negative correlations => diverging movements

Tsipras confirms election promises

Nervousness before Eurogroup Brussels

Greece commits to bailout extension; «Troika» become «Institutions»
Greece commits to third bailout

Correlations in weekly intervals, using hourly yields

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

Referendum against bailout, ECB still does not raise ELA limit
Tsipras meets Putin

Many Eurogroup meetings without results

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

Referendum against bailout, ECB still does not raise ELA limit.

Greece commits to third bailout

Blue arrows: dominating positive correlations => reinforcing movements

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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 Eurozone 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 Eurozone bonds that were exposed to negative correlation influences in the previous week reduces portfolio volatility.

\[
\text{daily bond returns} \sim (\text{Duration} \times (\text{yield}(t) - \text{yield}(t-1))) + \text{yield}(t-1) \times dt
\]

Bond Carry

Duration Risk