Financial Stress Dynamics in European Economies: A Wavelet Coherence Analysis

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1. Introduction- Motivation

- Financial stress affects:
  - economic stability
  - market behavior
  - Investors decision making
  - policy decisions

- Understanding how financial stress spreads across economies is essential for assessing systemic risk and improving policy responses.

1. Introduction- Motivation

- A quantitative tool to capture systemic risk is the development of financial stress indices (FSIs) that
  - ✓incorporate the most important financial markets into a single index with continuous nature (no binary variables)
  - ✓provide a timely snapshot of the state of the markets
  - ✓is easily computable and interpretable

- Literature supportive on the value added of such metrics

1. Introduction- Motivation

- Global financial integration along with the increasing sophistication of financial products lead to market-wide turbulences (evidence of significant connectedness of global markets)

- This study uses wavelet coherence analysis to understand time-varying co-movements between financial stress indices across European markets.

- Wavelet coherence captures both time- and frequency-domain relationships, identifying lead-lag and short vs long-term dynamics.

1. Introduction- Motivation

- Our key contributions:
  - Combine a novel approach to study financial stress relationships with an information-rich metric
  - Dynamic stress transmission analysis for a crucial period (GFC and Eurozone debt crisis)
  - Cross-country coherence providing insights on lead-lag relationships within the European financial markets' spectrum
  - Market-level insights due to the use of FSIs
  - Significant policy implications, based on a rich set of empirical findings

2. Related Literature

- Stress indices show that financial and fiscal stress reduce output and inflation, with asymmetric interactions (Magkonis & Tsopanakis, 2014)

- Euro area interdependencies reveal that large economies align in stable times, while smaller ones cluster during distress (Zhang et al., 2018)

- Emerging markets and developed country stress dynamics are asymmetric and regime-dependent (Ozcelebi, 2020).

3. Methodology

- Dataset used:
  - FSIs for eleven Eurozone economies (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain)
  - Country level indices as well as market level for stock, money, banking and bond markets
  - Weekly frequency for the period 2001-2013

3. Methodology

- Dataset used:

Variables Used in FSIs	
Banking Sector	***Money Market***
Dividend Yield	TED Spread
Market Value	Inverted Team Spread
Turnover by Volume	Treasury Bill Realized Volatility
Price/Earnings ratio	Main Refinancing Rate—2 year
Bank Equities Realized Volatility	Government Bond Yield
Banking Sector Beta	Main Refinancing Rate—5 year
Bank Equities Returns	Government Bond Yield
Equity Market	***Bond Market***
Stock Returns	Sovereign Spread
Dividend Yield	Government Bond Realized Volatility
Price/Earnings ratio	Corporate Spread
Stock Realized Volatility	Government Bond Duration
Market Value	

Source: Thomson Reuters Datastream

3. Methodology

- Based on Torrence and Webster (1998):
  - If two series (x_t and y_t), with $W_{x(\tau,s)}$ and $W_{y(\tau,s)}$ wavelet transforms
  - The wavelet coherence is computed from the smoothed cross-wavelet spectrum and normalized power spectra, indicating co-movement strength and phase.

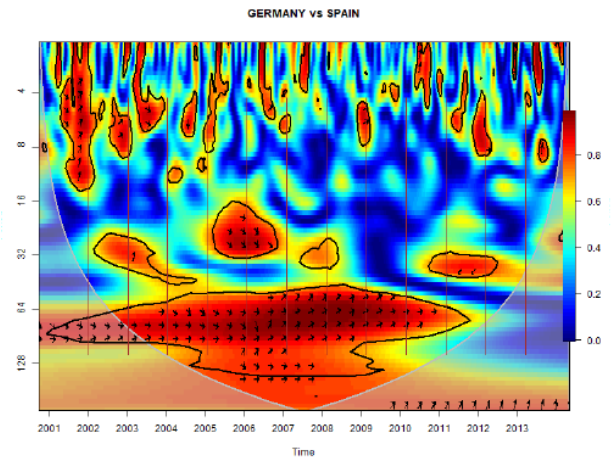
$$R^2(\tau,s) = \frac{|S(s^{-1}W_{xy}(\tau,s)|^2}{S(s^{-1}|W_x(\tau,s)|^2)\cdot S\left(s^{-1}|W_y(\tau,s)|^2\right)}$$

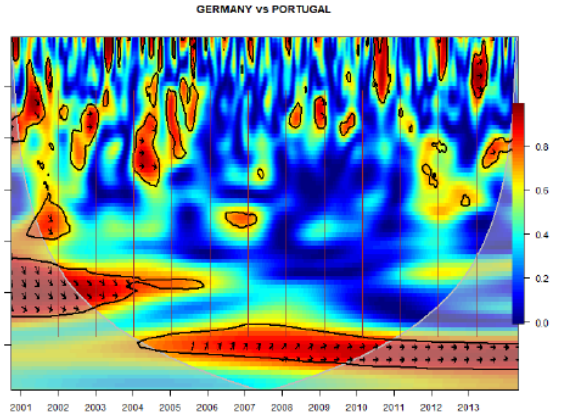
where S(.) is the smoothing operator and s is the wavelet scale.

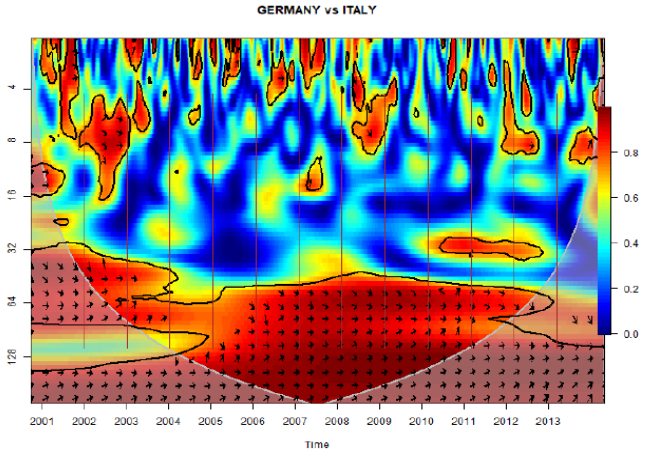
3. Methodology

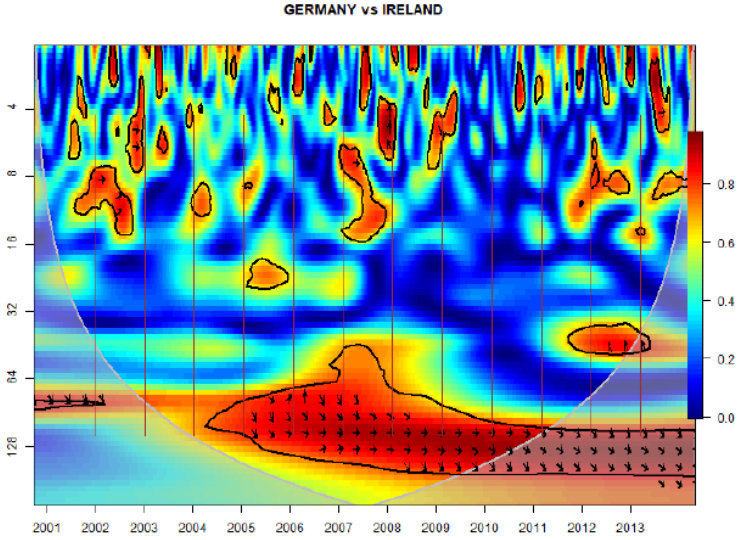
- Essentially: varying coherence is represented using heat maps, with heatmap colouring representing spectrums of blue (low coherency) up to red (high coherency).
- Y-axis represents frequencies or scale
- X- axis represents time-period studied (2011 – 2013)
- Phase differences between the two series studied in each case are indicated by arrows
- Wavelet coherence interpretation: Arrows indicate different phases; *right* = in-phase, u*p-right* = first leads, *left* = out-of-phase, *down* = lagging.

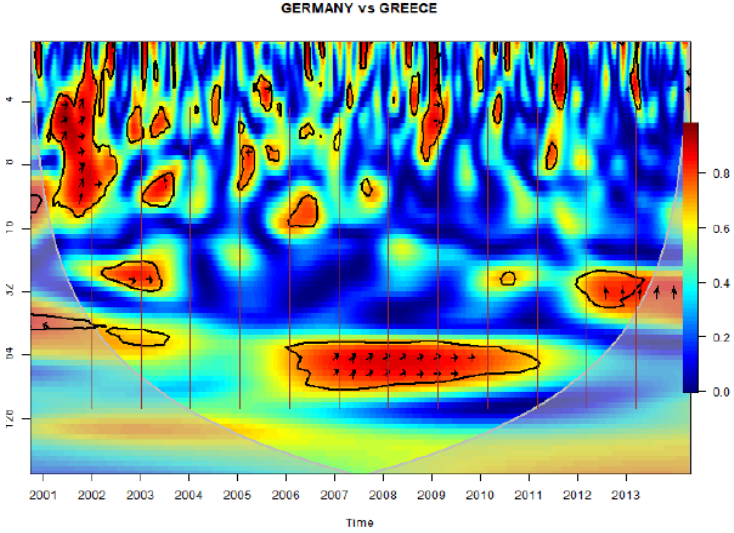
4. Empirical Results I



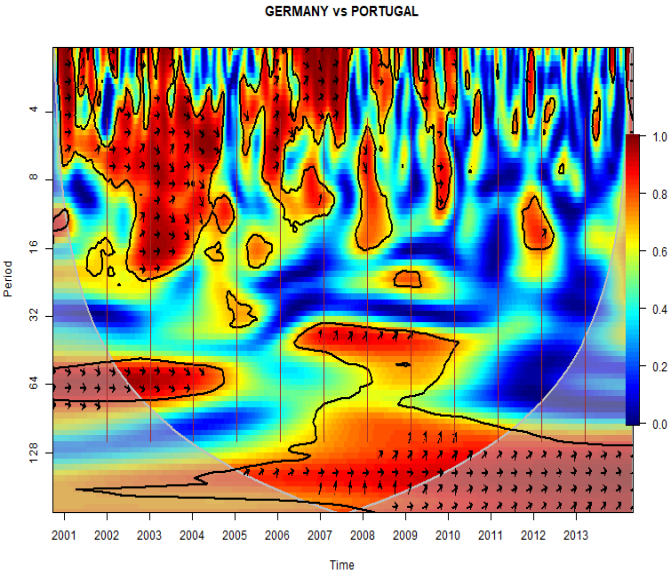


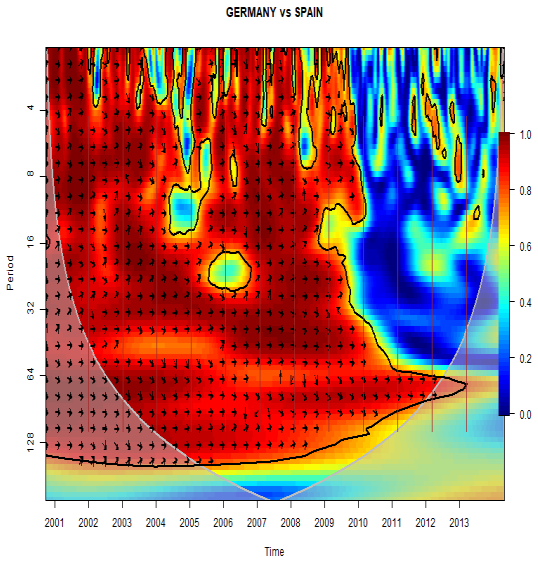


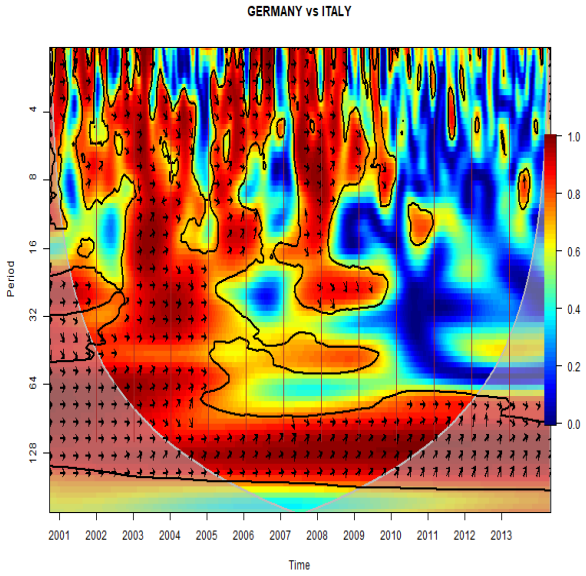


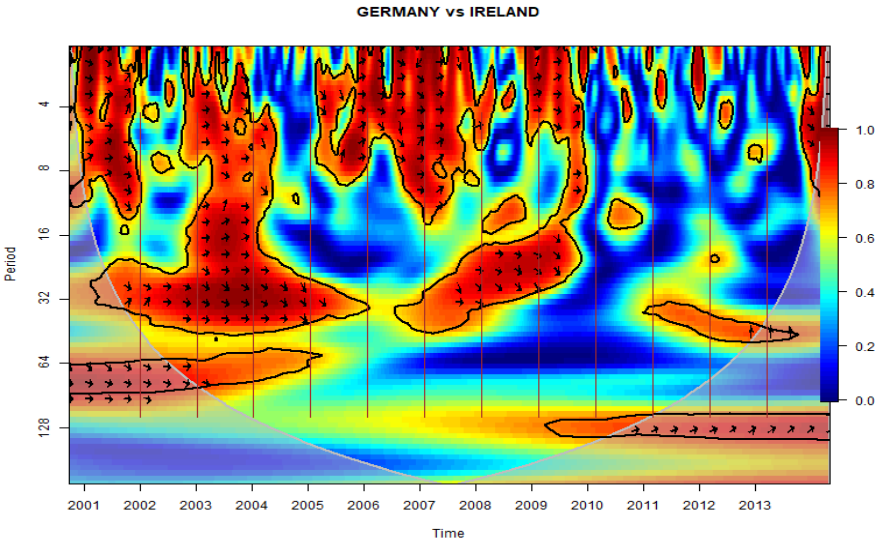


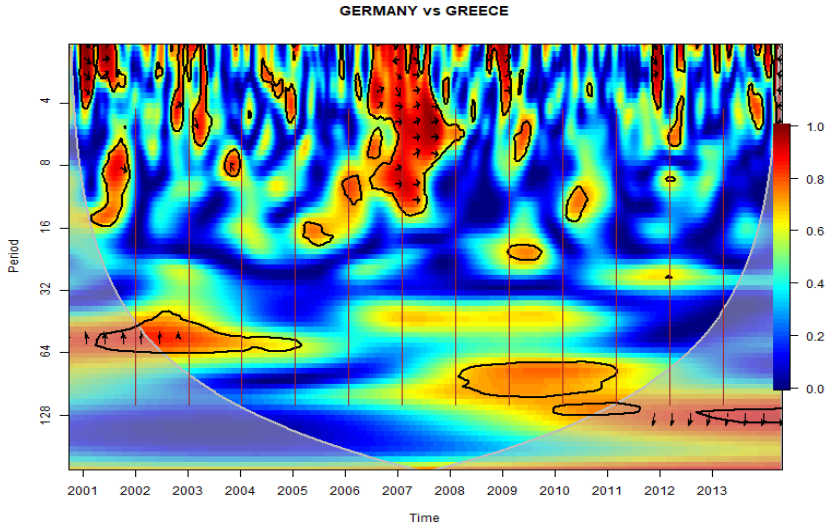
4. Empirical Results II (Money)











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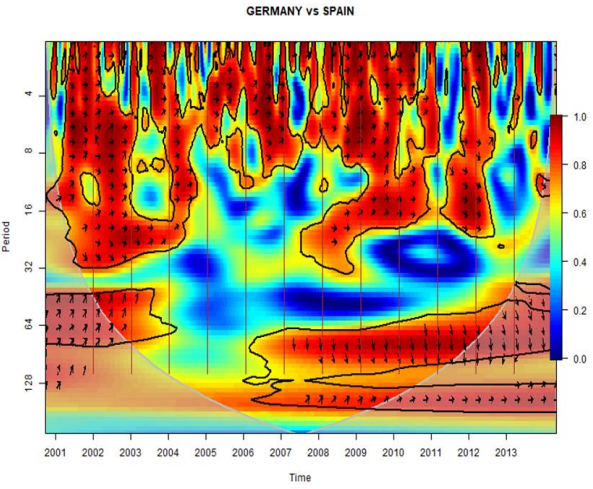
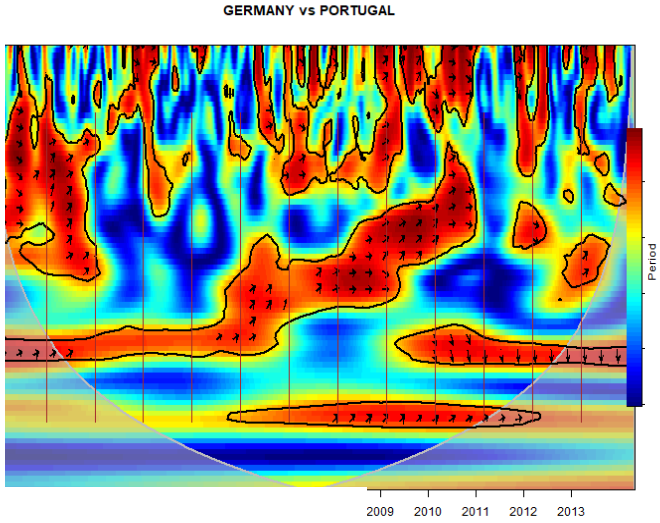
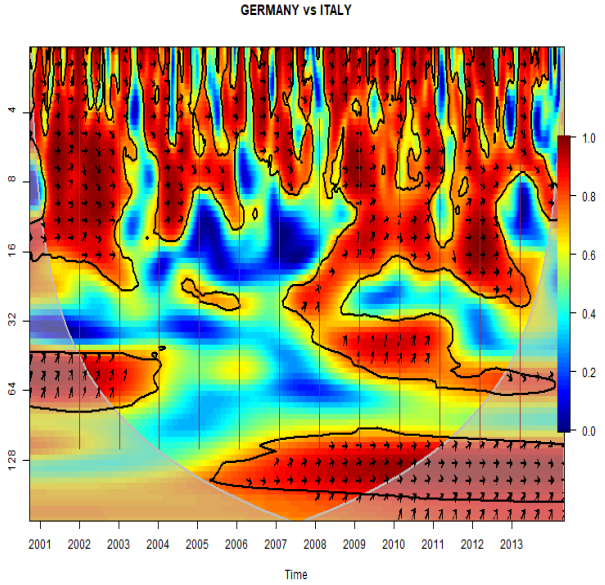
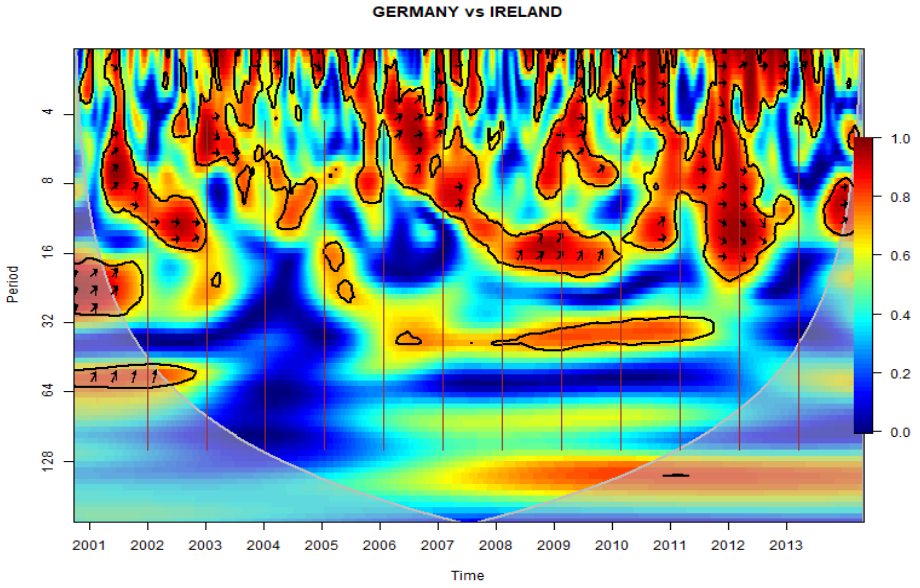
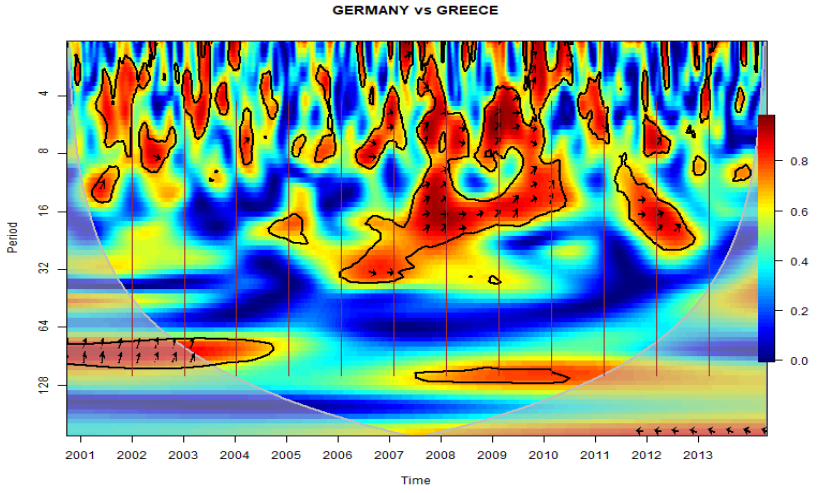


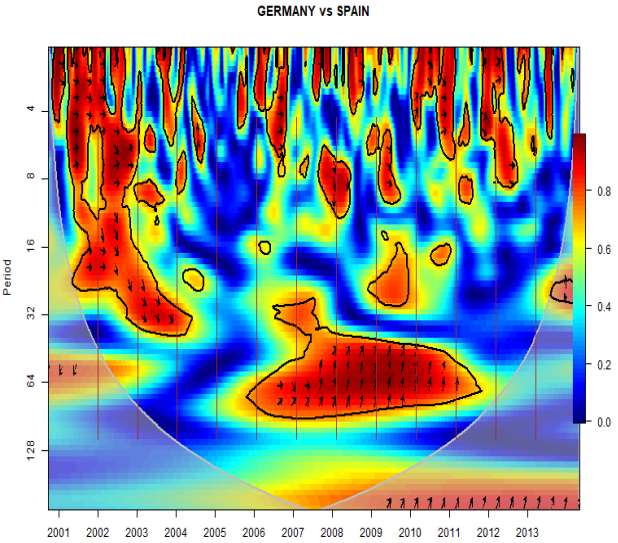


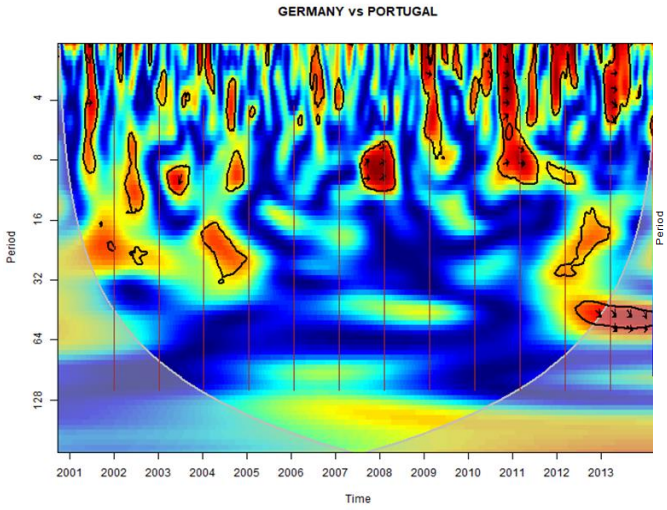


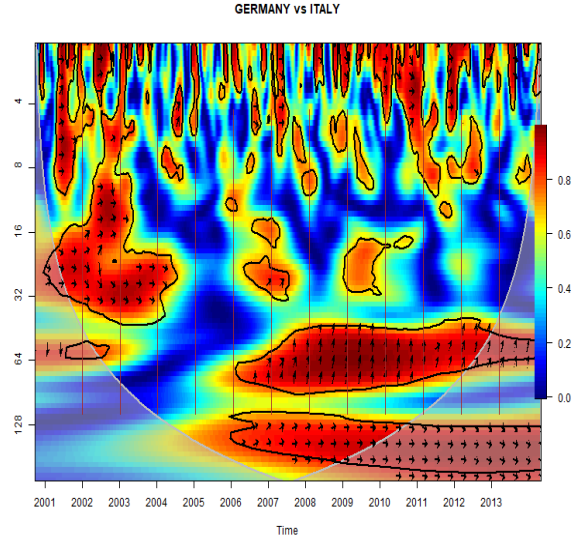


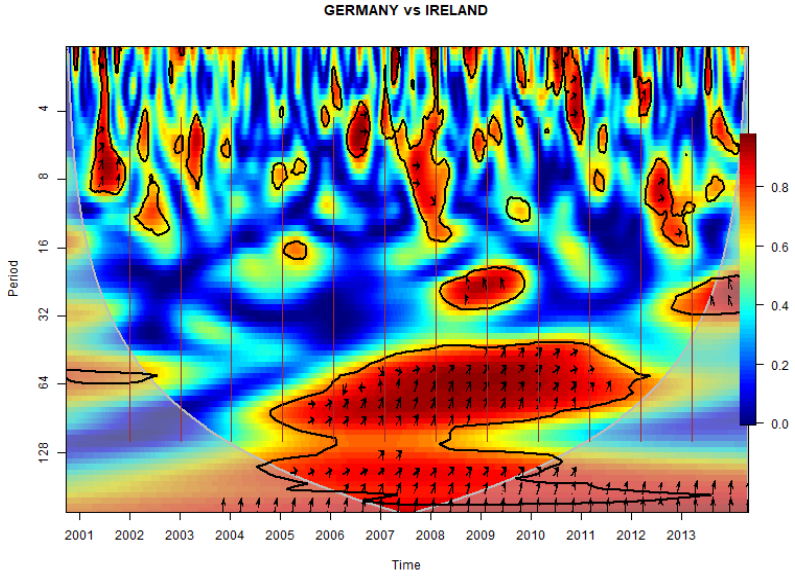


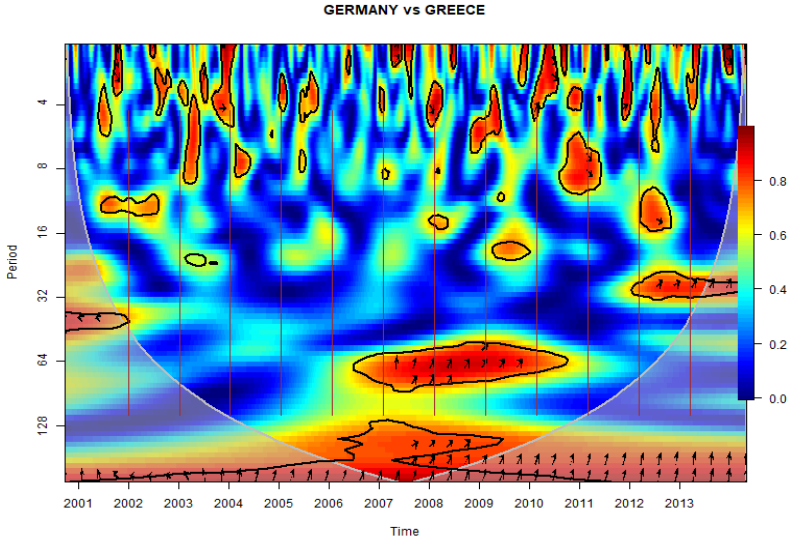
4. Empirical Results IV (Banking)











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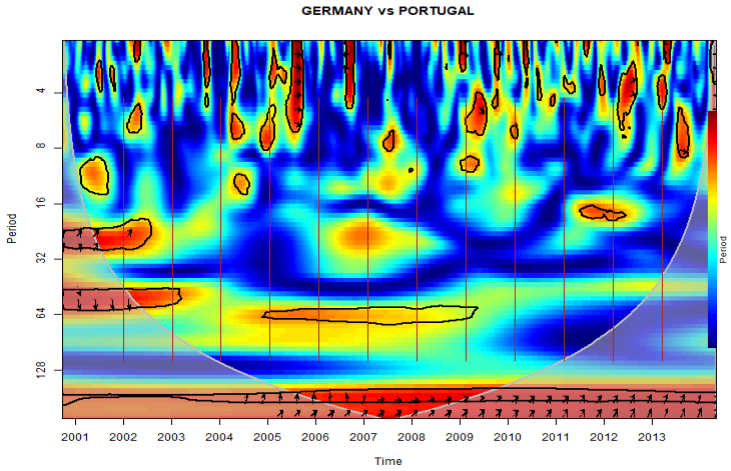

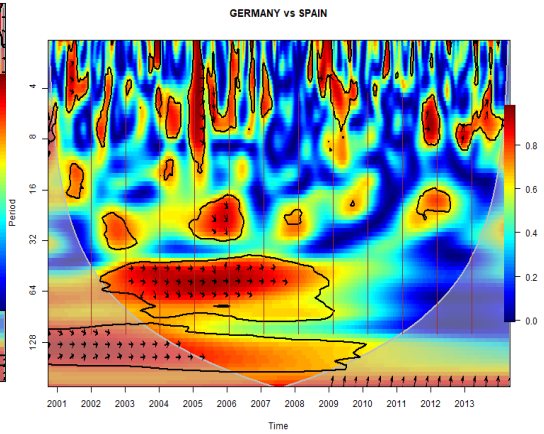

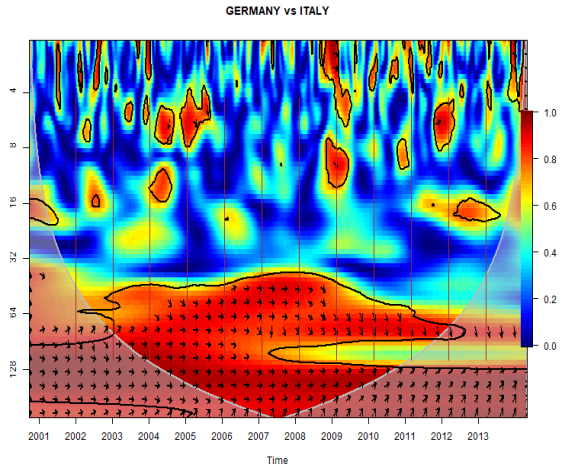

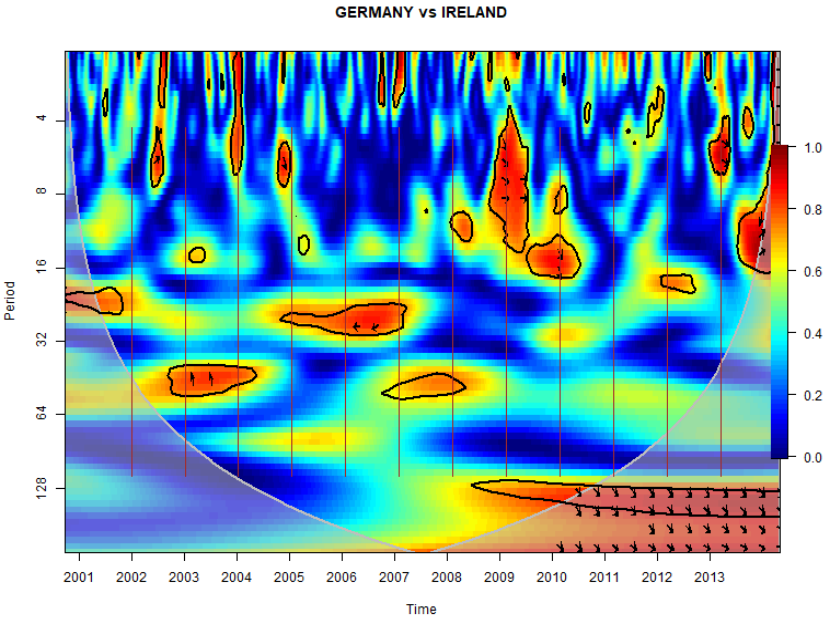

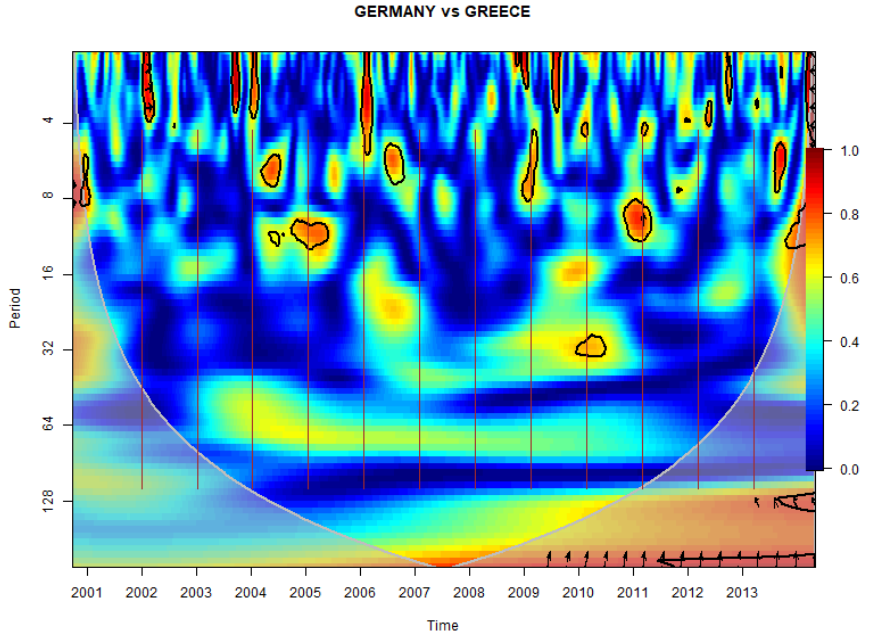

5. Summary of Results

- Money markets: Consistently high coherence across the entire period (2001–2013), especially strong during crisis years.

- Stock markets: Moderate to strong coherence in 2007–2012 period; less consistent in short-term patterns.

- Banking Stress: Strong in-phase long-term co-movements noted from 2006 to 2012; early 2000s show short-term variations.

- Bond stress: Long-term coherence dominates from 2006 to 2011; short-term patterns weaker and intermittent

5. Summary of Results

- Financial stress transmission is time-varying
- Long-term in-phase co-movements dominate
- Crisis periods amplify coherence

- Persistent long-term co-movements found across many country pairs, especially during crises, with Germany as benchmark.

6. Conclusions

- A new approach to measure the connectedness between the Eurozone economies is discussed

- Wavelet coherence is particularly useful for such financial time series, where it is important to distinct between lead-lag relationships as well as long and short -term dependencies

- Wavelet coherence reveals complex, dynamic financial stress linkages. Findings highlight importance of monitoring transmission channels across economies.