Sources of economic uncertainty in the European Union countries

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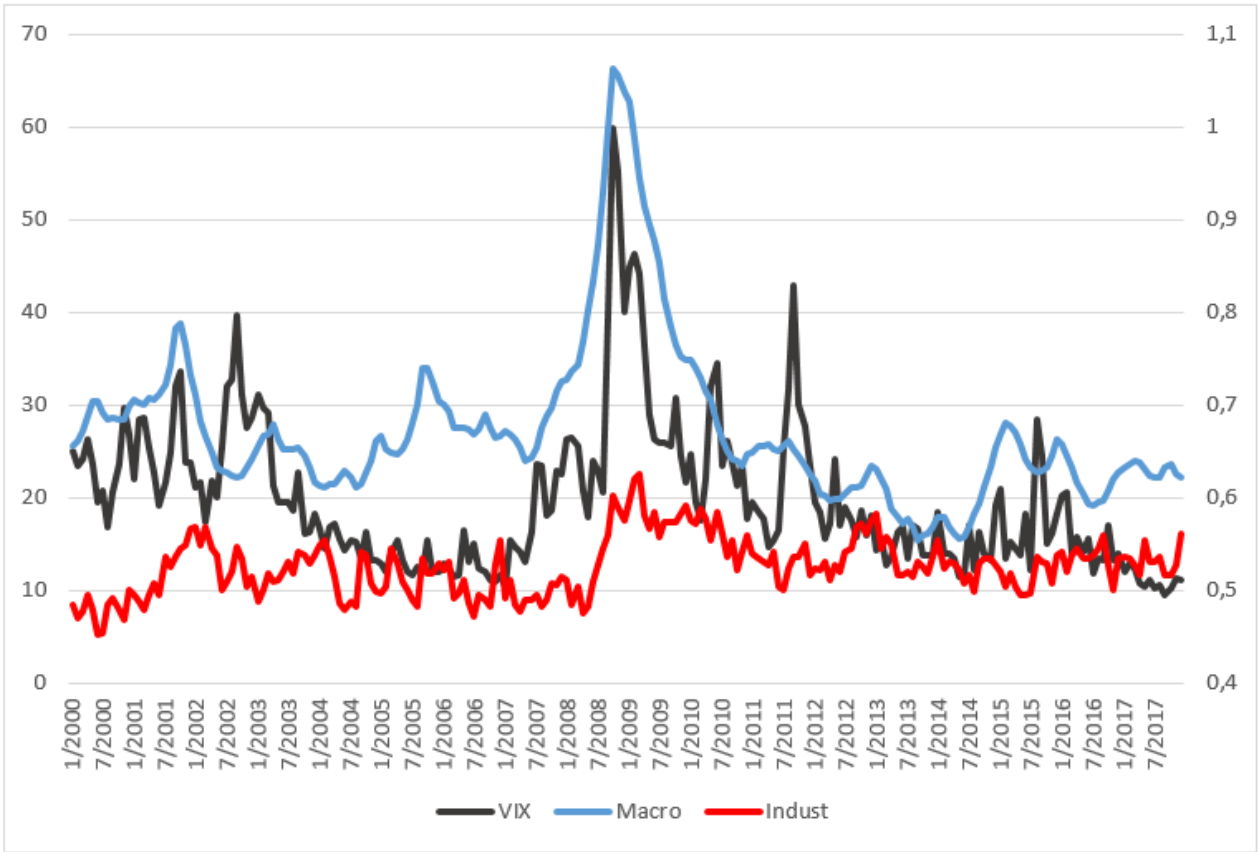
Outline

1. Motivation and research objective
2. Empirical strategy and data
3. Empirical results
4. Conclusions

Motivation: uncertainty measures

Financial, macroeconomic and industrial uncertainty in 2000-2017



Brief literature review: uncertainty shocks and advanced economies

Advanced economies:

- Bloom (2009): uncertainty generates a rapid drop, rebound, and overshoot in employment, output, and productivity growth (different from the more persistent slowdown that occurs in response to demand shock) (US economy);
- Bachmann et al. (2012): innovations in uncertainty reduce production and employment (Germany and the US); quick rebound effect in Germany, but not in the US;
- Jurado et al. (2015): uncertainty innovations lead to a sizable and persistent decline in real activity (production, hours, employment) (US economy);
- Kang et al. (2016): uncertainty is associated with a decline in industrial production (rebound effect), inflation, interest rates (15 largest economies);
- Baker et al. (2016): EPU foreshadows declines in gross investment, industrial production, employment (the US, panel of 12 economies for which EPU is calculated);
- Girardi and Reuter (2017): shocks to uncertainty lead to a temporary reduction in real activity without any overshooting (Euro Area).

Brief literature review: uncertainty shocks and emerging market economies

Emerging market economies:

- Fernández-Villaverde et al. (2011): an increase in real interest rate volatility triggers a fall in output, consumption, investment, and hours worked, and a notable change in the current account (four Latin American countries).
- Matsumoto (2011): adverse global liquidity shocks result in higher interest rates, depreciation, lower output and equity returns (four Latin American countries).
- Carrière-Swallow and Céspedes (2013): much more severe falls in investment and private consumption following an exogenous uncertainty shock, take significantly longer to recover, and do not experience a subsequent overshoot in activity (20 EMEs, incl. five CEE countries);
- Choi (2018): US financial uncertainty shocks have an adverse impact on the output of EMEs (credit channel) (18 EMEs, incl. three CEE countries);

Research objective and research questions

Research objective is to gain a better understanding of uncertainty measures in EU countries:

- to construct uncertainty measures for UE countries
- to compare different type of uncertainty measures
- to examine the relationship between uncertainty measures obtained for different types of uncertainty and different countries

Specific questions:

- are different type of uncertainty measures universal or country specific?
- are different type of uncertainty measures independent of one another?

Alternative approaches to measuring uncertainty impact on a macroeconomy

Approaches based on an extraneous measure of uncertainty:

- uncertainty as stock market volatility (e.g. Chicago Board of Options Exchange VXO index, VIX index, EuroVIX index, common coponent of stock market volatility) – see, e.g., Bloom (2009), Kang et al. (2016);
- uncertainty as an aggregate of unforecastable component of the future value of a series – see, e.g., Jurado et al. (2015), Meinen and Röhe (2017);
- uncertainty as disagreement in production expectations revealed in business survey data – see, e.g., Bachmann et al. (2013), Girardi and Reuter, (2017);
- other related studies: Caggiano et al. (2014), Fernandez-Villaverde et al. (2011), Grier et al. (2004).

Approaches based on simultaneous estimation of uncertainty and its macroeconomic effects:

- uncertainty modeled as a latent variable – see, e.g., Crespo Cuaresma et al. (2017);
- other related studies: Hauzenberger et al. (2018), Shin and Zhon (2016), Mumtaz and Theodoridis (2016), Mumtaz et al. (2016), Carriero et al. (2016).

Empirical strategy

1. Construction of different uncertainty measures:
   - Industrial uncertainty index: INDU_country;
   - Consumer uncertainty index: C_country,
   - Financial uncertainty index: S_country.
2. Comparative analysis of uncertainty measures:
   - comparison of time series of uncertainty measures for each EU country - time series clustering
   - transmission of uncertainty: Diebold-Yilmaz (2012) approach:
     * Estimation of VAR(2) model (156 months, lasso estimation).
     * Calculation of connectedness matrix
     * Decomposition of a connectedness matrix into a symmetric and a skew-symmetric matrix.
     * Clustering uncertainty regarding similarity of transmission patterns
     * Distinguishing of net uncertainty transmitters and receivers - analysis of the skew-symmetric part of the connectedness matrix.

Industrial uncertainty index – INDU_country

- It is constructed on the responses to the forward-looking question in the European Commission Business and Consumer Surveys.
- Question 5: *How do you expect your production to develop over the next 3 months?*
- Respondents **(managers)** answer: (+ increase; = remain unchanged; - decrease).
- Following Bachmann et al. (2013), industrial uncertainty index is measured as:

$$Indu\_country_t = \sqrt{Frac_t^+ + Frac_t^- - (Frac_t^+ + Frac_t^-)^2},$$

$Frac_t^+$ - the weighted fraction of firms with "increase" responses at time t ;
$Frac_t^-$ - the weighted fraction of firms with "decrease" responses at time t.

Consumer uncertainty index – C_country

- It is constructed on the responses to the forward-looking question in the European Commission Business and Consumer Surveys.
- Question 2: *How do you expect the financial position of your household to change over the next 12 months?*
- Respondents **(consumers)** answer: (++ get a lot better; + get a little better; = stay the same; - get a little worse; - - get a lot worse; N don't know).
- Following Balta et al. (2013), consumer uncertainty index is measured using Theil's entropy formula as:

$$C\_country_t = -\frac{1}{n}\sum_{i=1}^{n} a_{i,t}\log\left(a_{i,t}\right),$$

$a_{i,t}$ - the share of respondents choosing each type of response at time t;
n - the number of response categories for each of the forward-looking questions.

Financial uncertainty index – S_country

- Following Bloom (2009), Bachmann et al. (2013), Choi and Loungani (2015) and Choi et al. (2017), financial uncertainty index is measured by the realized volatility of stock market returns using formula as:

$$S\_country_t = 100\sqrt{T\sum_{s=1}^{T} r_s^2},$$

r_s - daily returns of the stock market from each trading day s;
T - the stock market's number of trading days in a month.

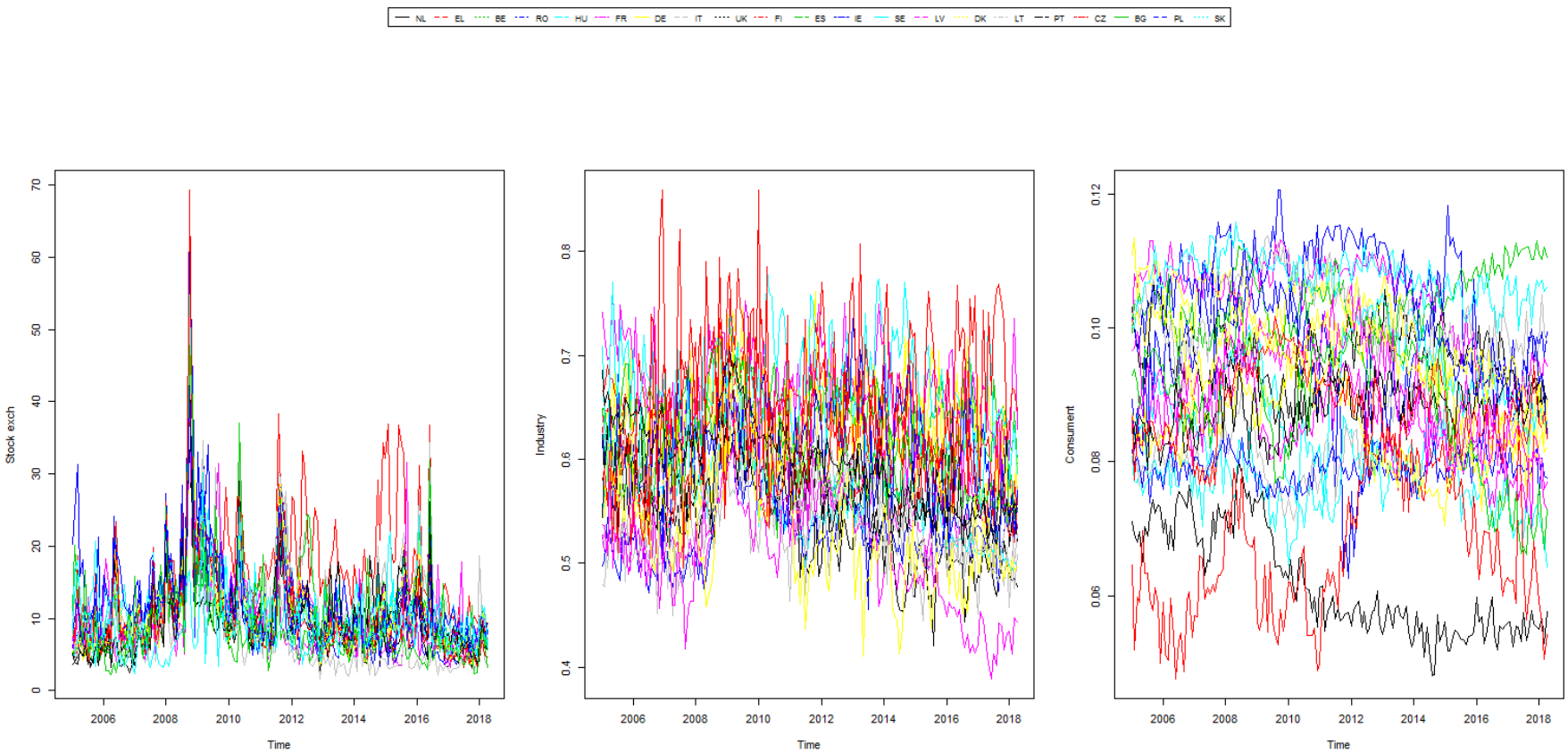
Data - country-specific uncertainty indicies

21 EU countries: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden, United Kingdom

Monthly data: January 2005 to December 2017

- INDU_country
- C_country
- S_country = realized volatility of stock market returns

2. Comparative analysis of uncertainty measures:



How to find common patterns in a sets of time series?

- To analyze distribution of different uncertainty types in subsequent moments (boxplot for moments)
- To find typical paths for particular types of uncertainty measures (centroids)
- To find clusters of uncertainty series (distance matrix determined by means of Dynamic Time Warping)

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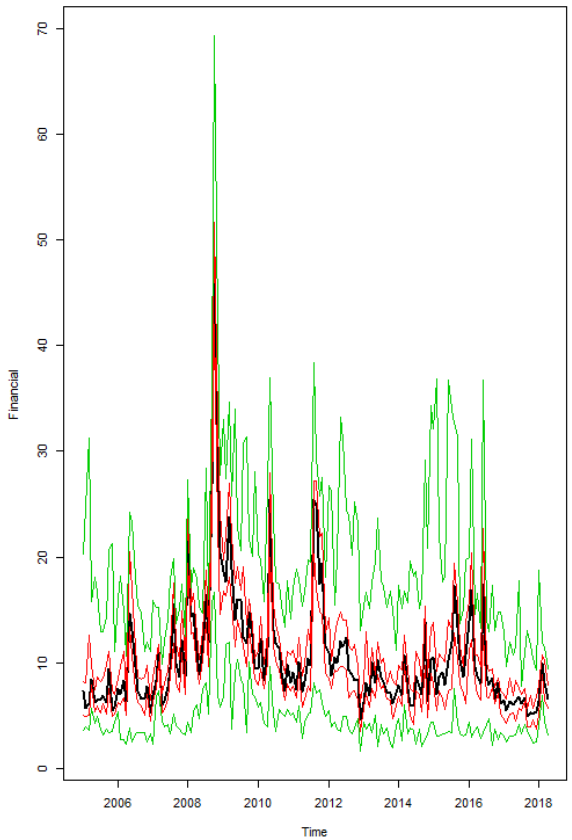

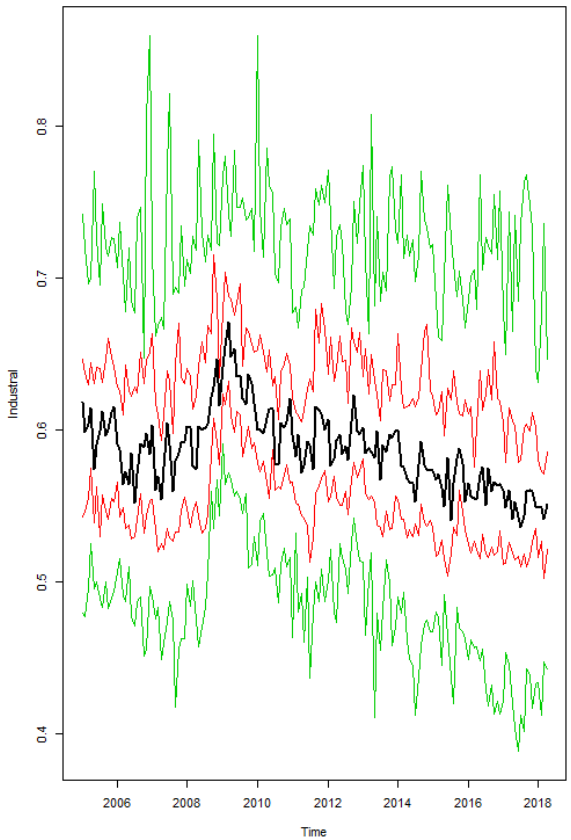

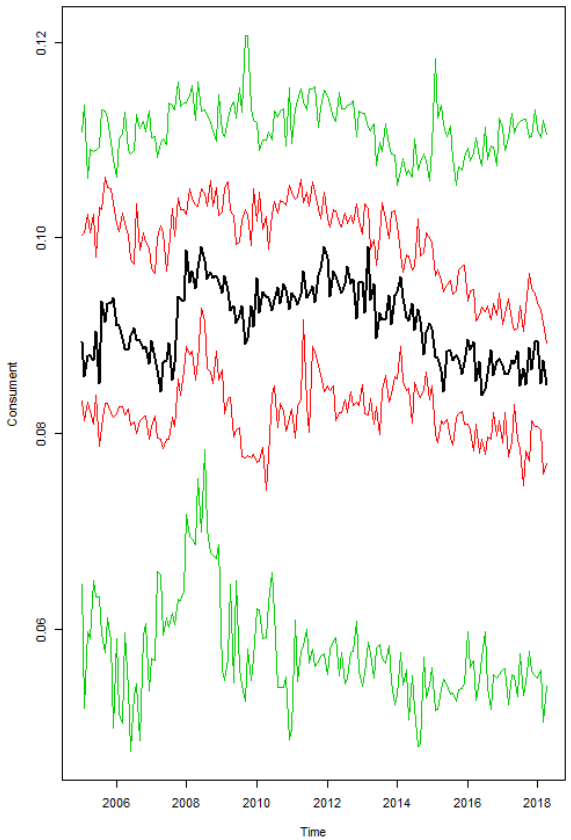

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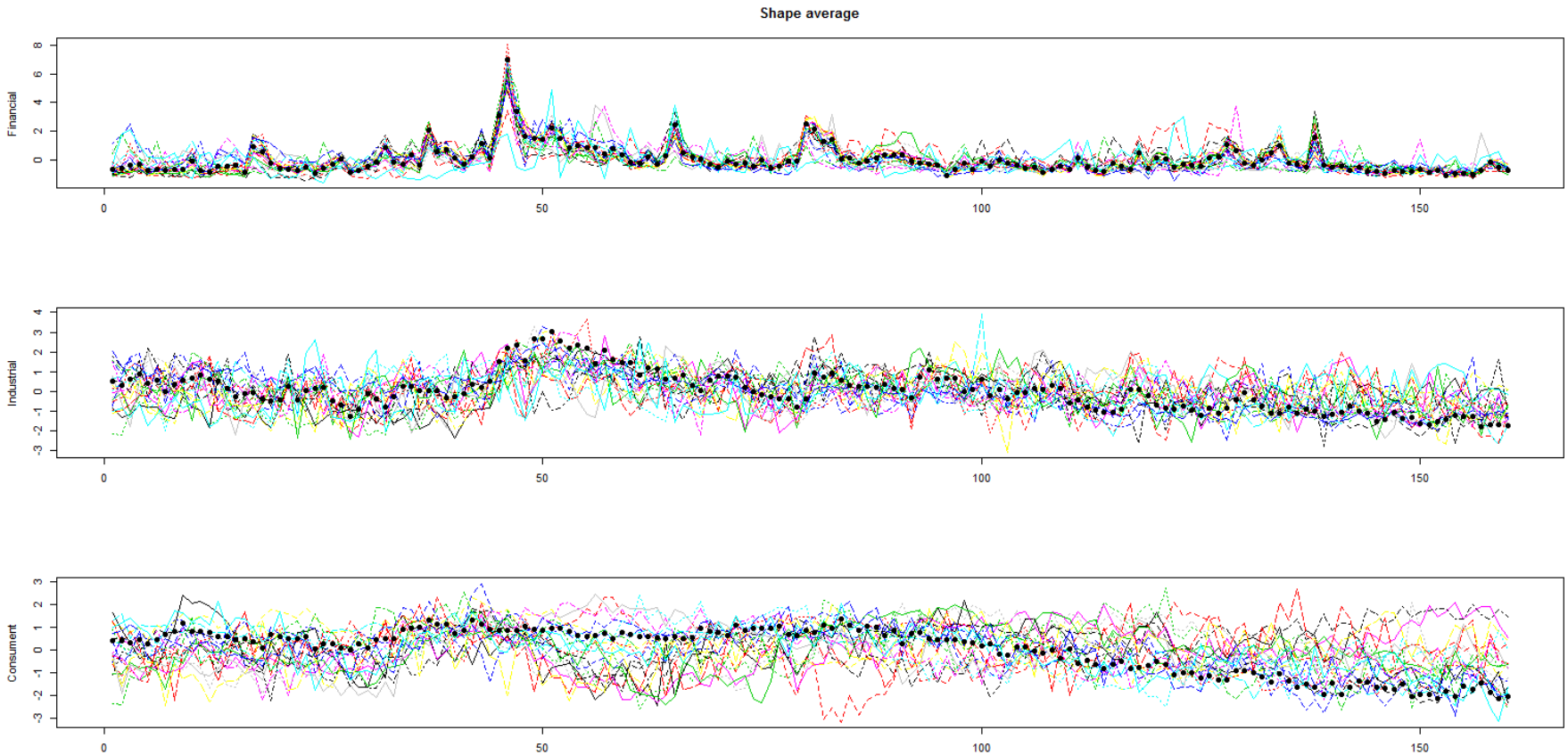

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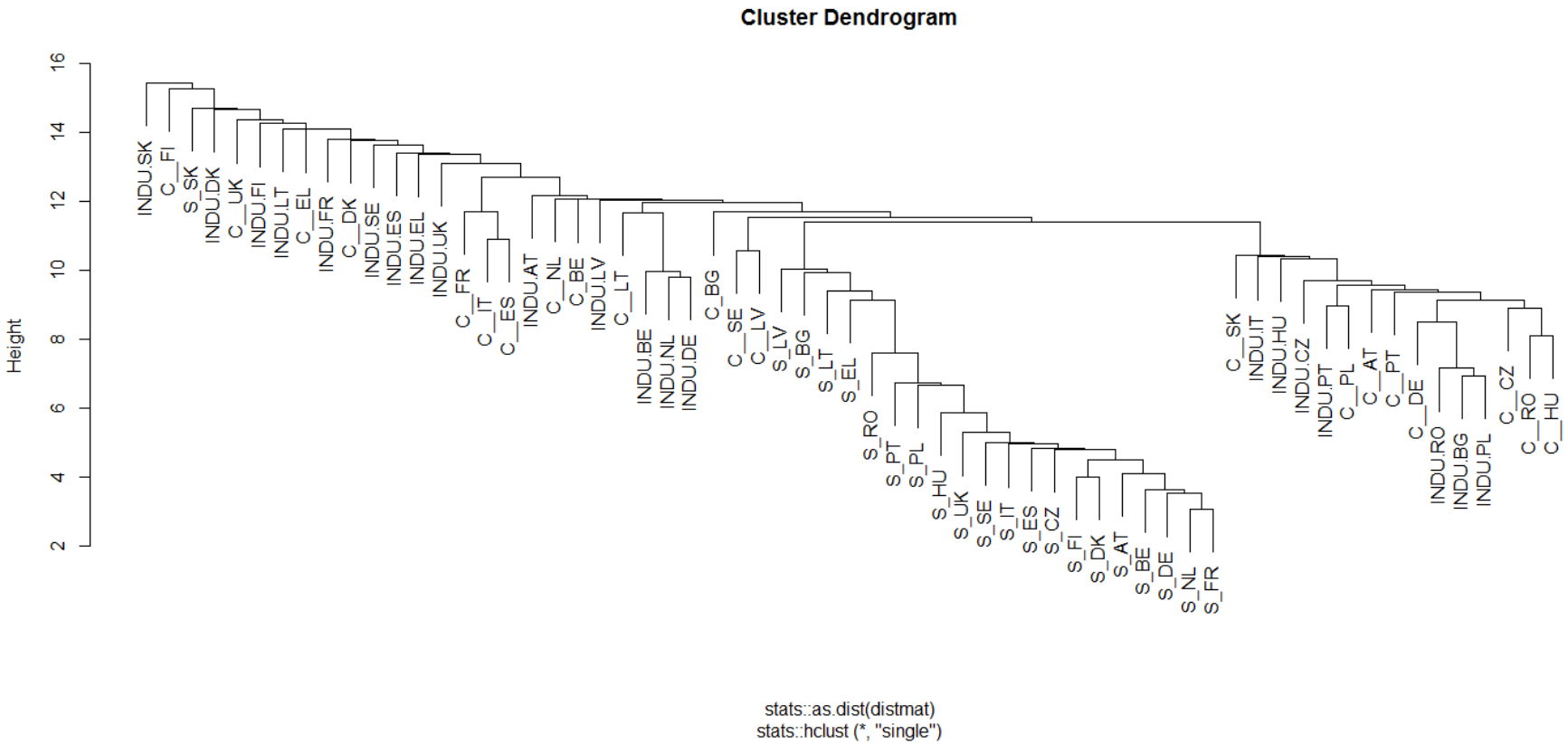

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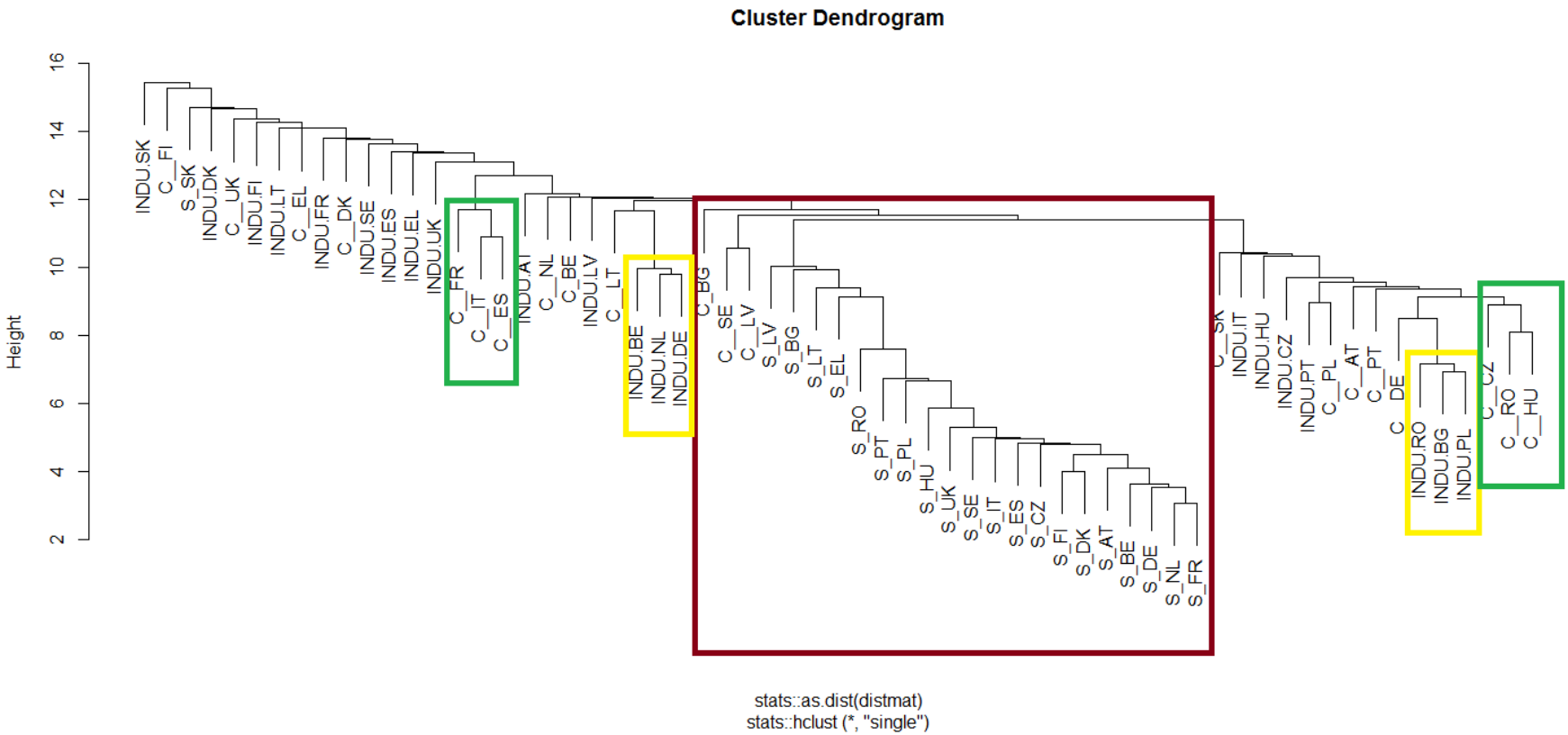

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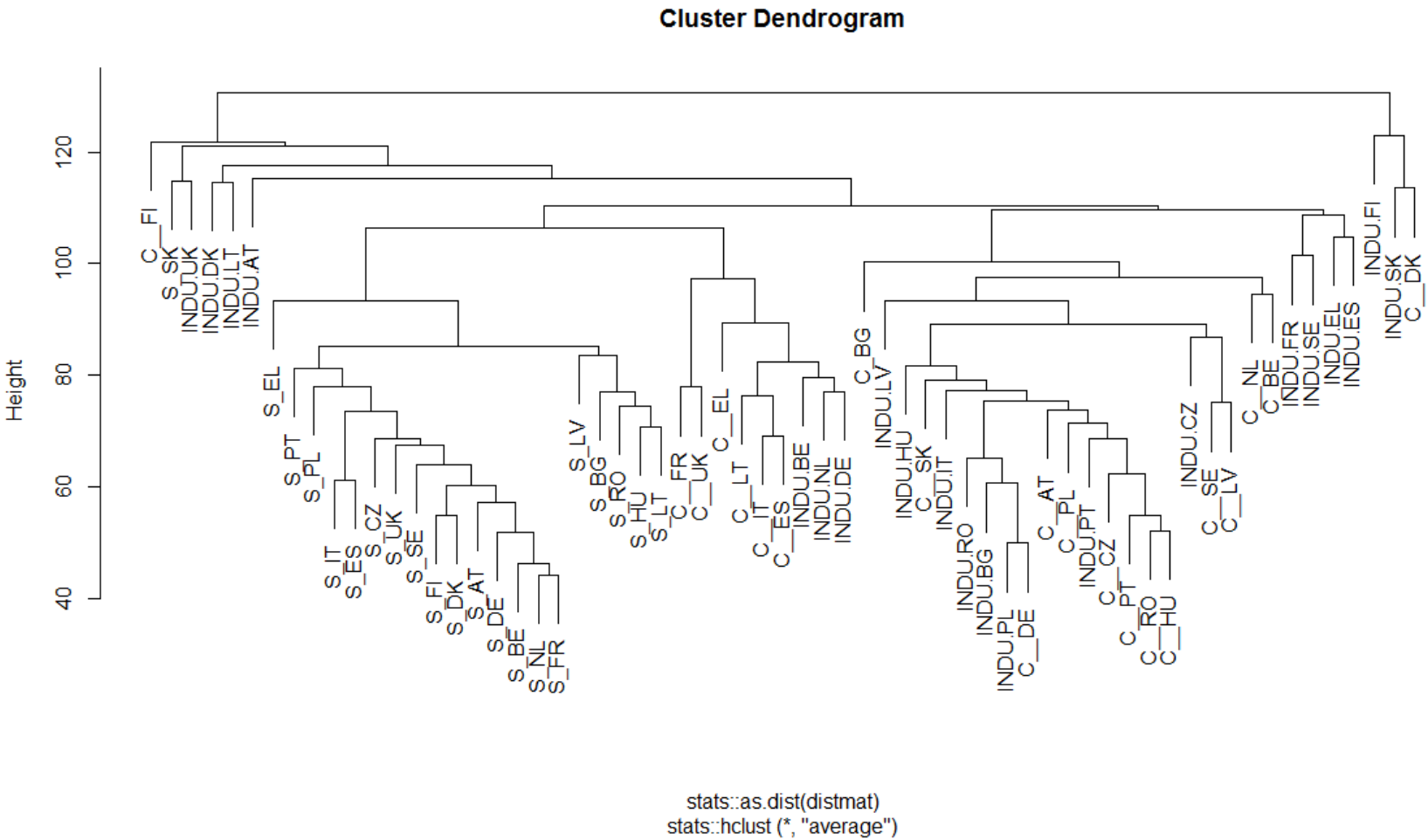

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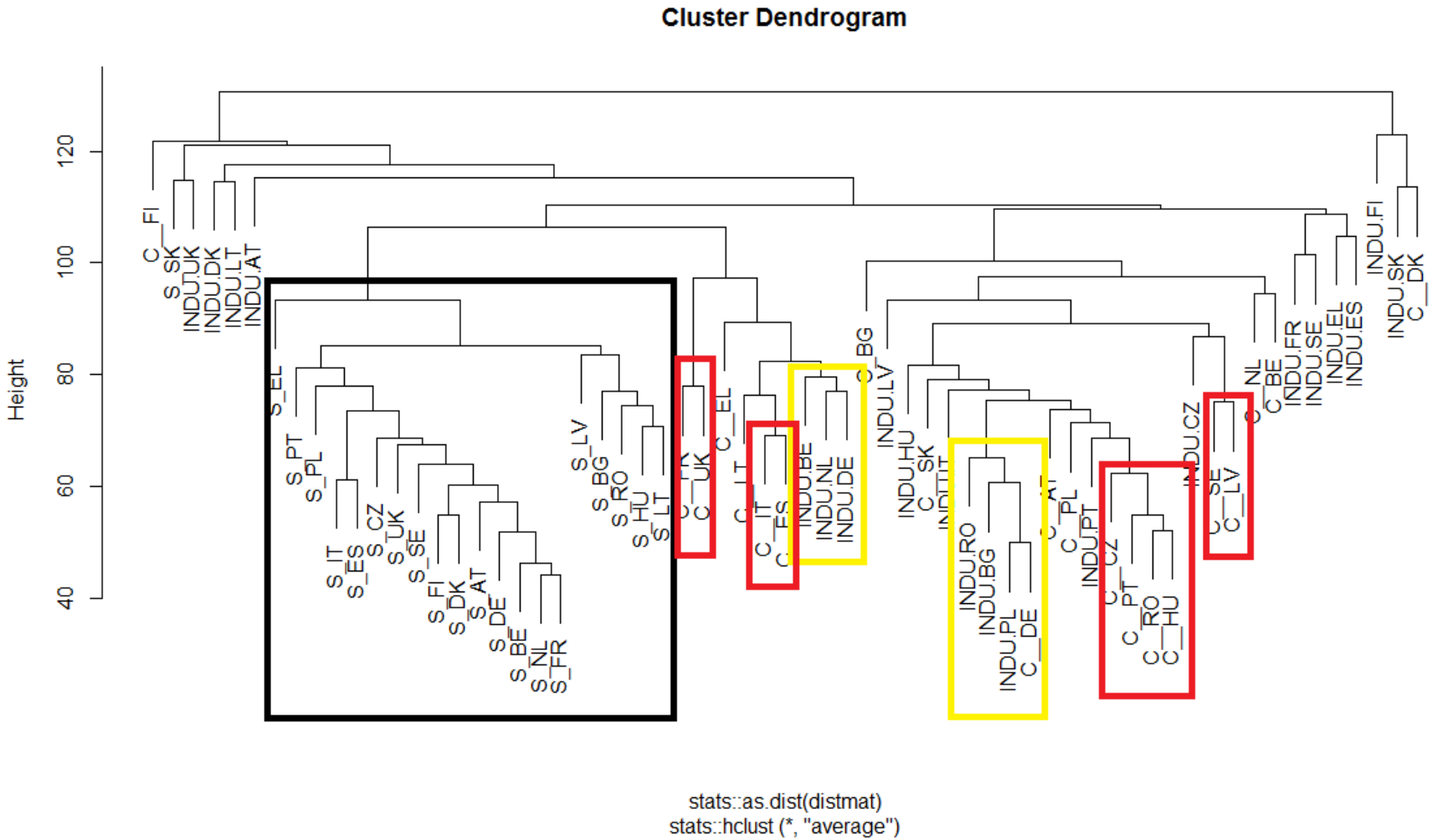


2. Comparative analysis of uncertainty measures:

- Analysis of Diebold Yilmaz (2012) connectedness table (forecast error variance decomposition matrix),
- 63 dimensional VAR(2) model estimated with lasso
- Decomposition of connectedness table into symmetric and skew-symmetric components $Q = S + A$,
- Symmetric component S is transformed into distance matrix, provides clustering and multidimensional scaling,
- Skew-symmetric component A shows pairwise net uncertainty spillover.

Decomposition of asymmetric matrix

- The decomposition into symmetric and skew-symmetric components is given as:

$$Q = S + A$$

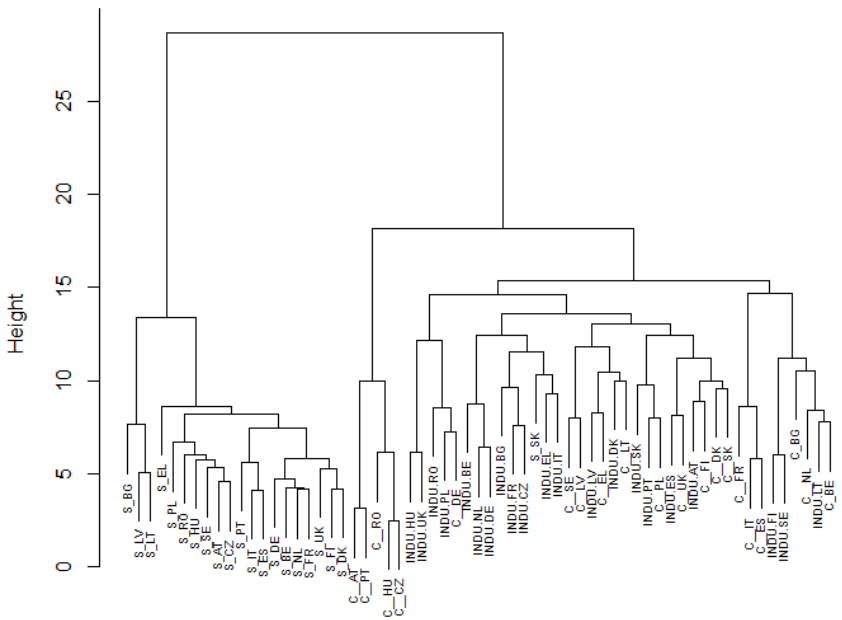
where S is a symmetric matrix with averages: $(q_{ij} + q_{ji})/2$ and A is a skew-symmetric matrix with elements: $(q_{ij} - q_{ji})/2$

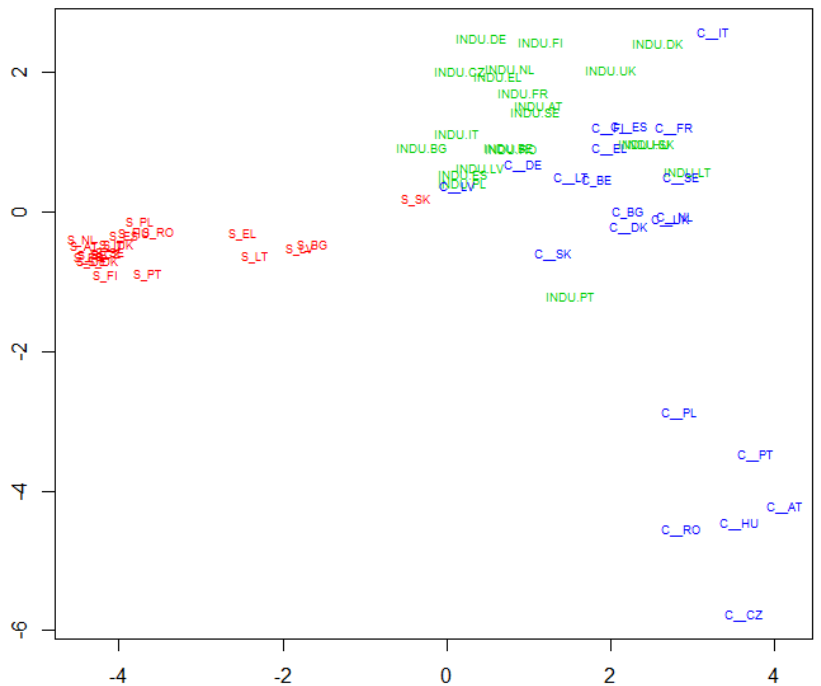
- A square matrix is skew-symmetric if $A^T = -A$.
- The decomposition is additive, and, as the two components S and A are orthogonal, the decomposition of the sum of squares of the two matrices is also additive.
- The sum of squares consists of two components:

$$\sum_{i=1}^{n}\sum_{j=1}^{n} q_{ij}^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} s_{ij}^2 + \sum_{i=1}^{n}\sum_{j=1}^{n} a_{ij}^2$$

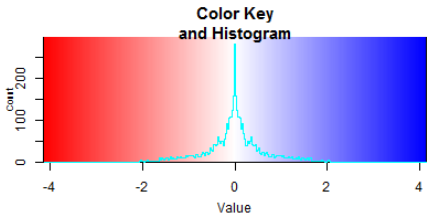
which provides a justification for analyzing the two components independently.

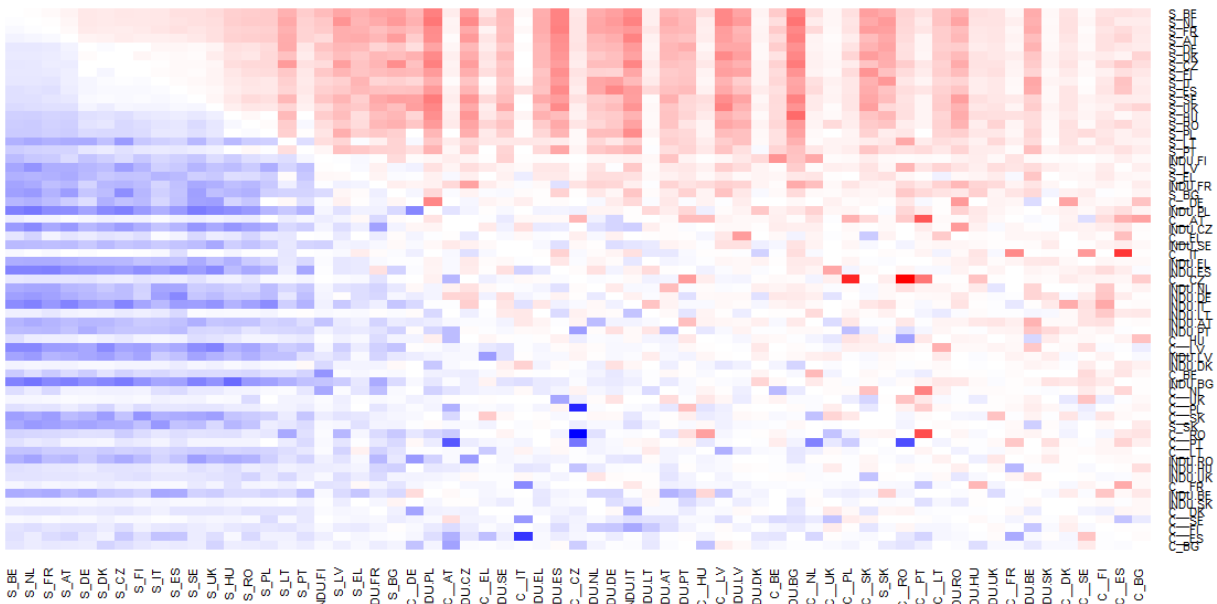
Symmetric part of connectedness table





Skewsymmetric part of connectedness table





Conclusions

Main findings:

- Alternative measures of uncertainty are to large extend independent,
- Type of uncertainty measures are different when homogeneity is taken into account,
- The most homogeneous are financial uncertainty; the consumer uncertainty are the least homogeneous,
- Time series clustering show a homogeneous group of financial uncertainty measures and clusters of uncertainty measures for countries that are related,
- When transmission between uncertainty measures is taken into account: similar patterns are observed for financial uncertainty measures; the remaining measures are heterogeneous
- Financial uncertainty is transmitted to industrial and consumer uncertainty.

Thank you for your attention