Market States and Planar Maximally Filtered Graphs

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Faculty of Physics, University of Duisburg-Essen, **Germany**

Content

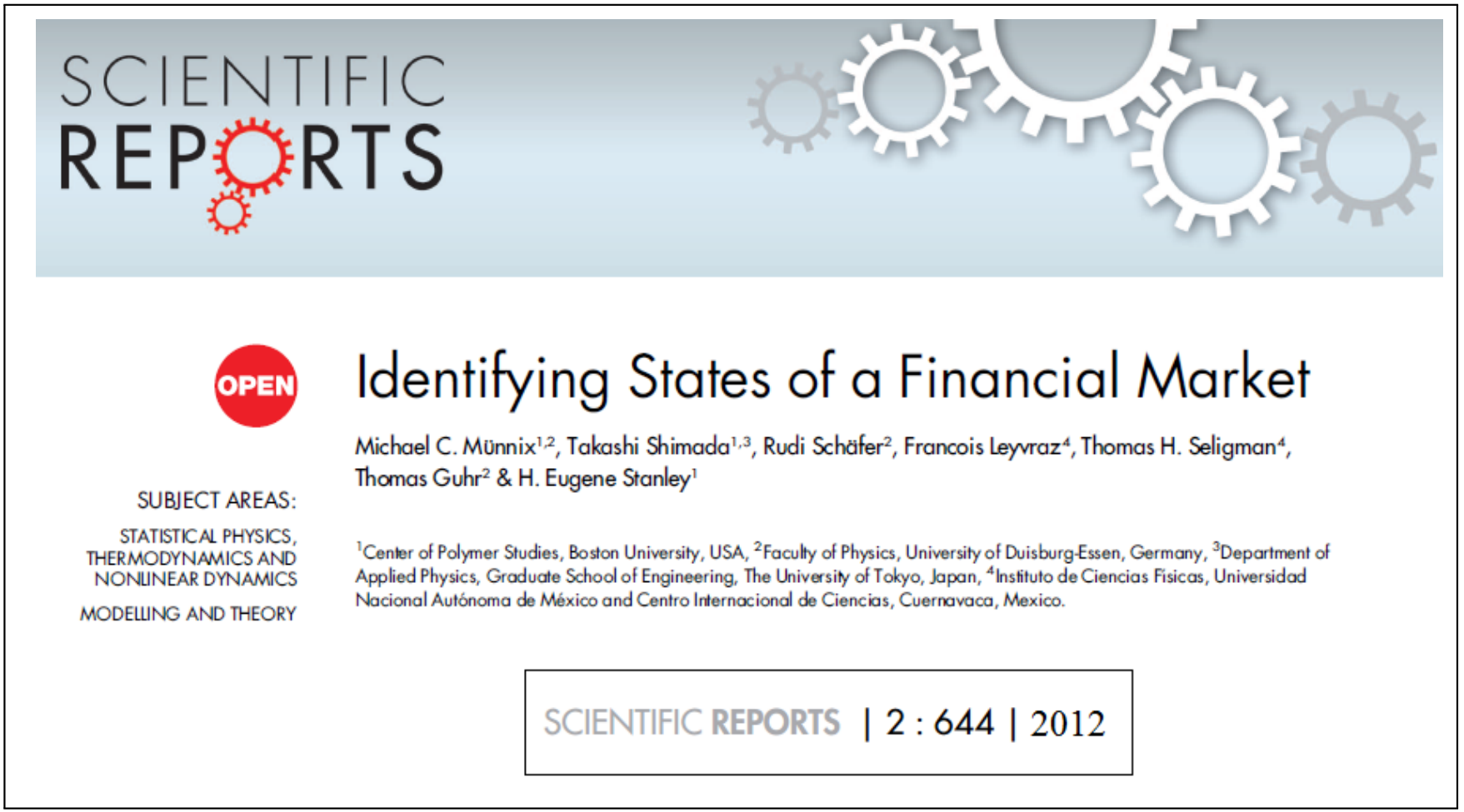
Definition of Market States

crowded ↗

↖ empty

dirty →

Definition of Market States



Münnix et al.

Definiton of Market States

- Daily data of **S&P 500** stocks in a 19 years period 1992-2010
- 1992 $\underbrace{\ldots\ldots\ldots}_{\sim 2\ months}\ t_1\ \underbrace{\ldots\ldots\ldots}_{\sim 2\ months}\ t_2\ \underbrace{\ldots\ldots\ldots}_{\sim 2\ months}\ t_3$ 2010
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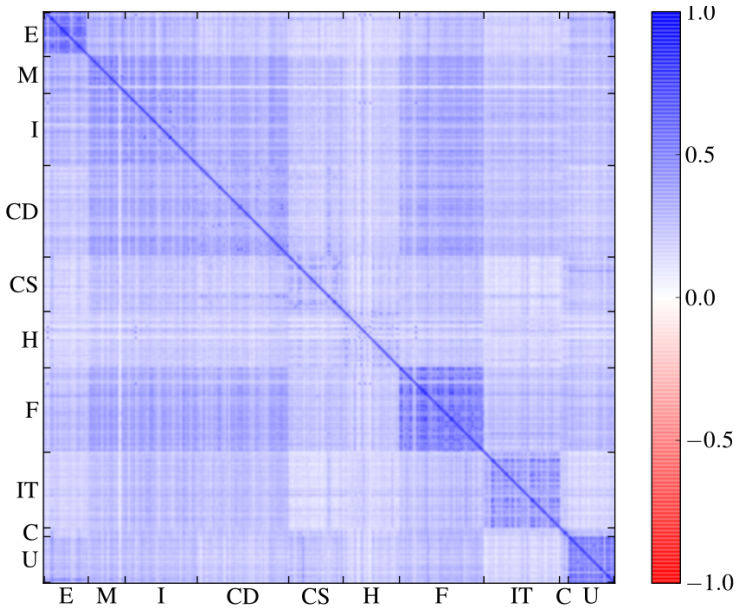

19 years average correlation matrix

Source: Münnix et al.

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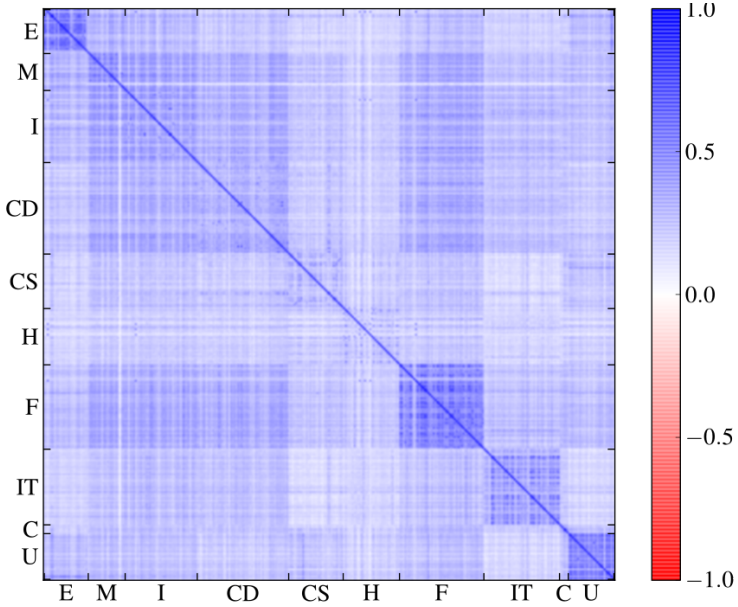

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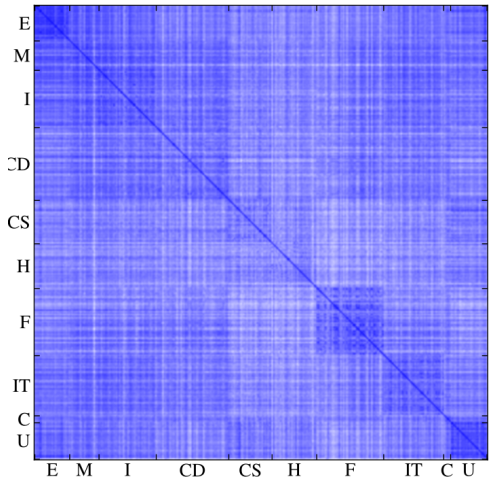

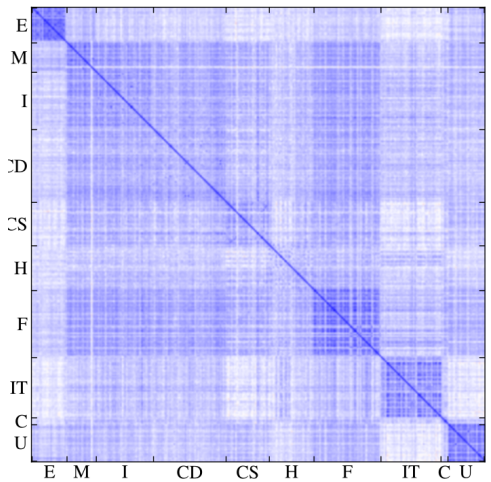

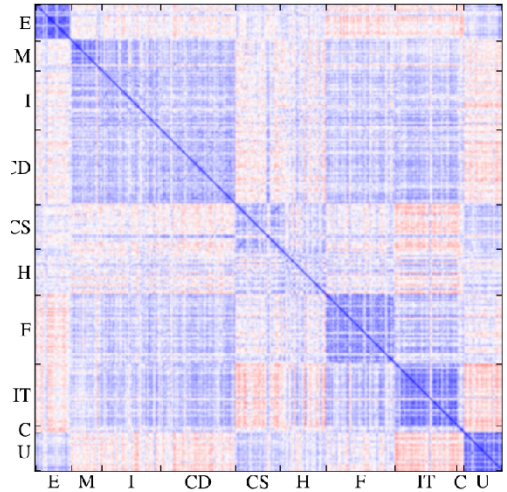

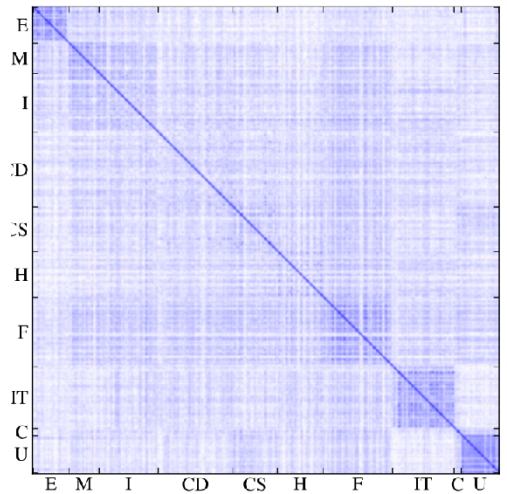

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Definiton of Market States

For $\underline{C}(t_i) \in \mathbb{R}^N$ there is a **(dis)simliarity** measure of corr. matrices

$$d_{ij} := ||\underline{C}(t_i) - \underline{C}(t_j)||$$

This gives rise to a **(dis)similarty measure of points in time**

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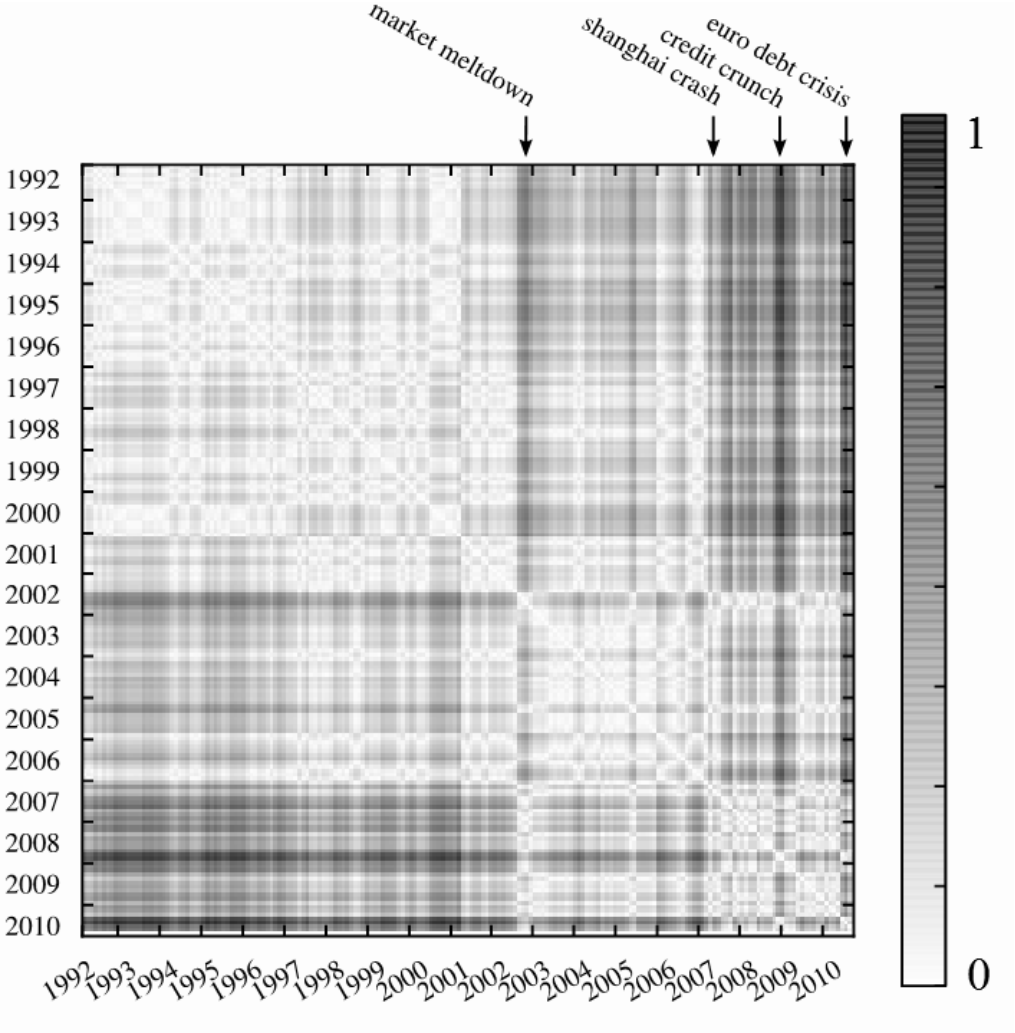

- Time points (periods) can be compared due to their similarity
- Similar time periods can be grouped into clusters
- The state in which a market is during the periods of a certain cluster are **market states**

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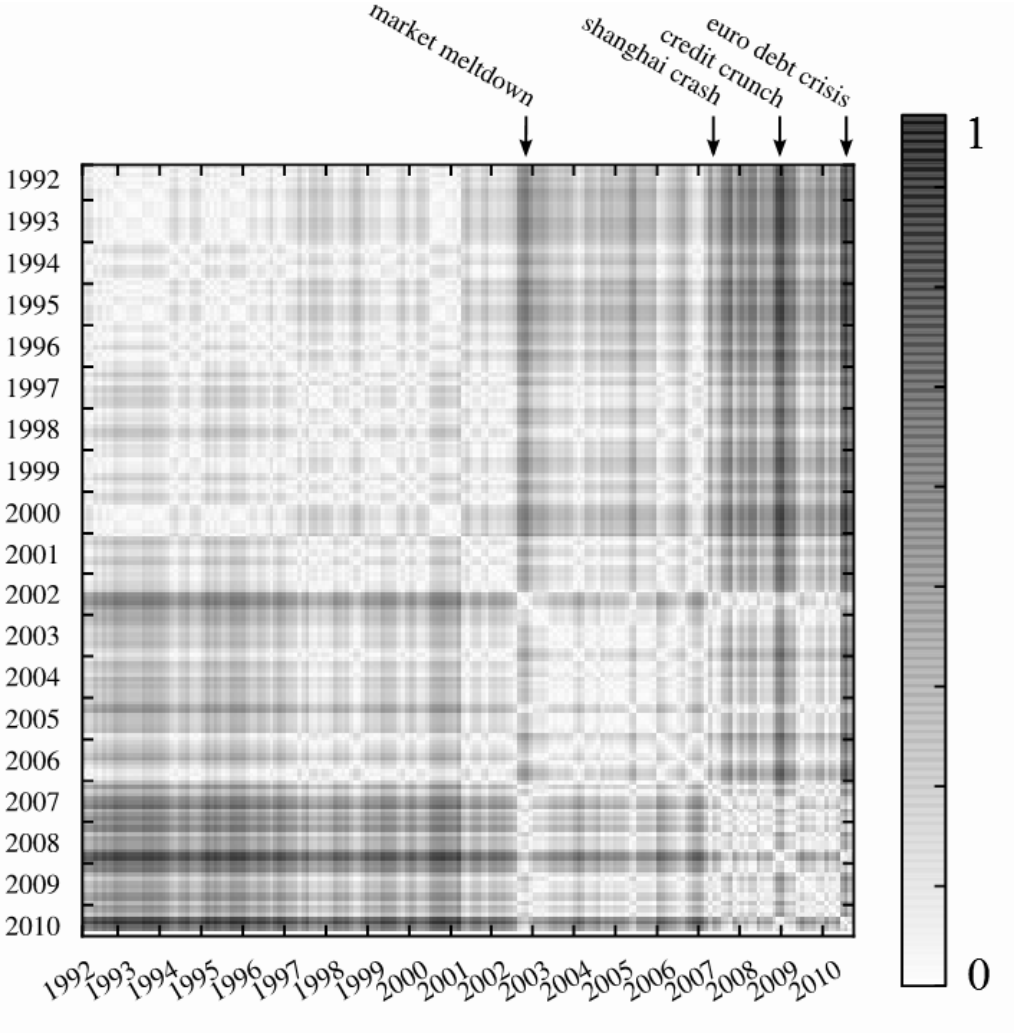

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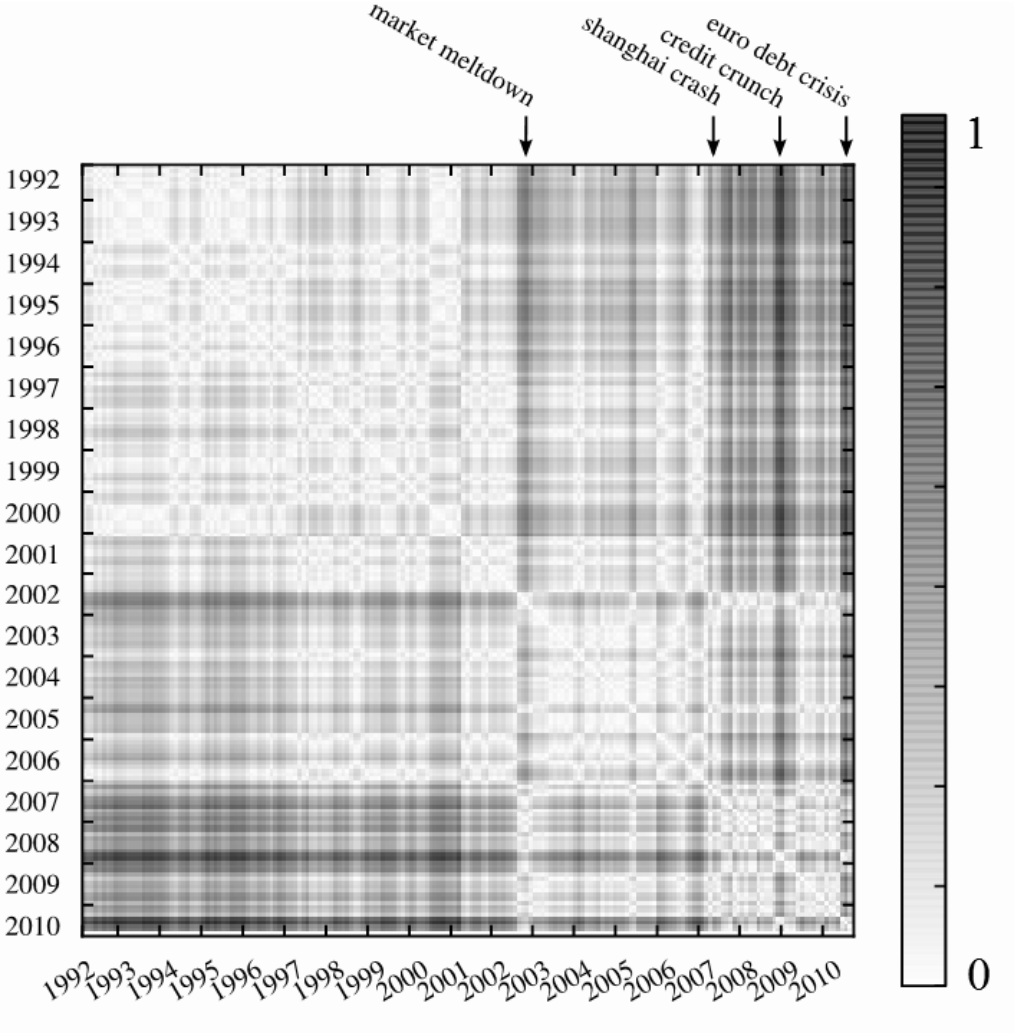

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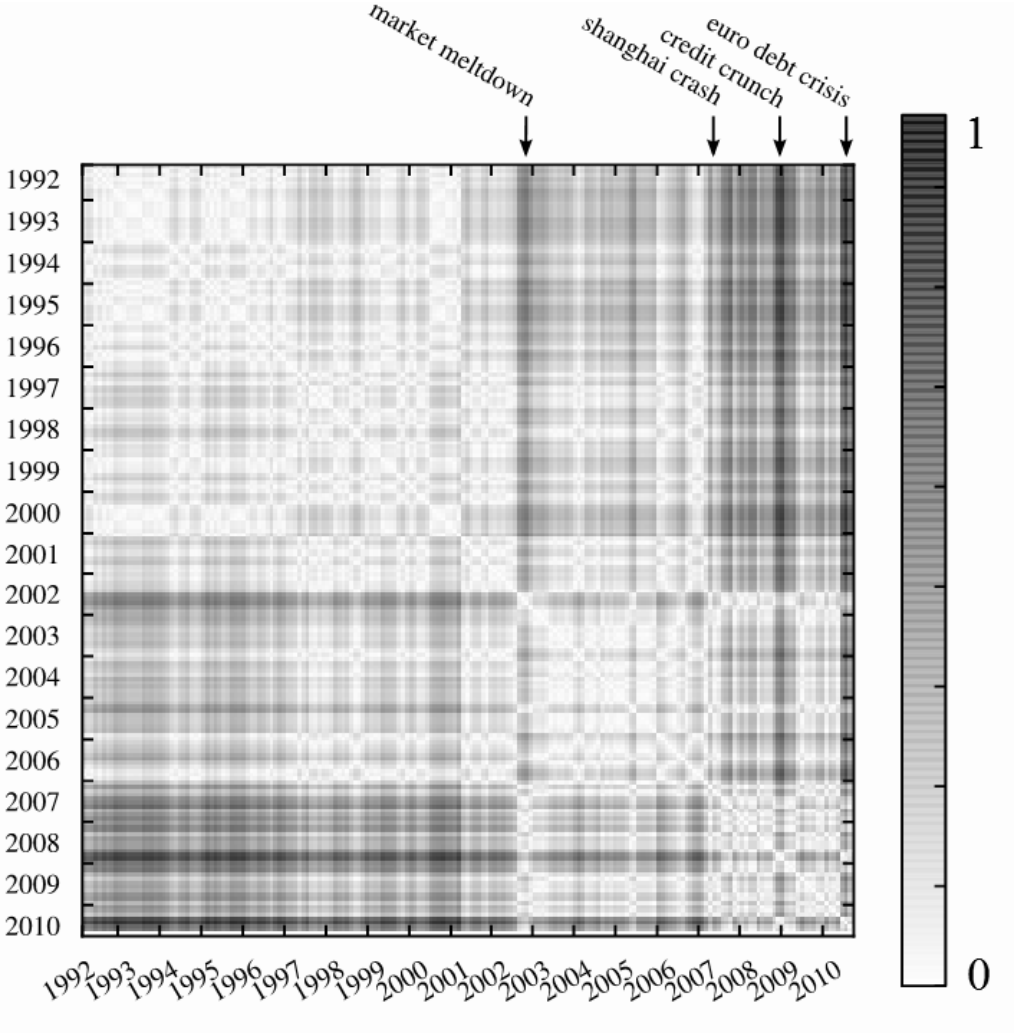

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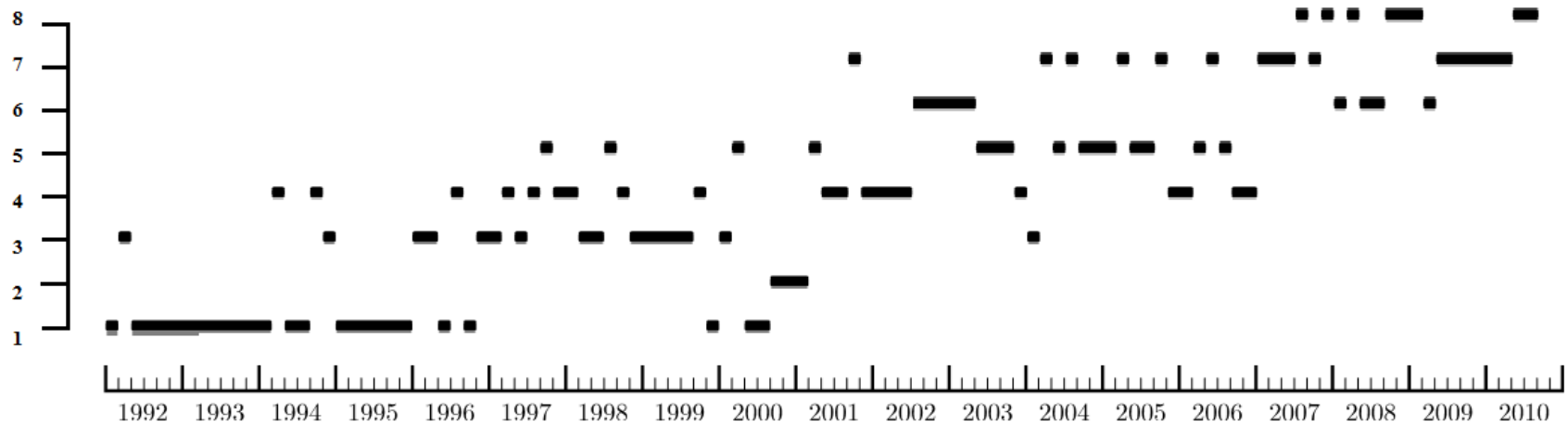
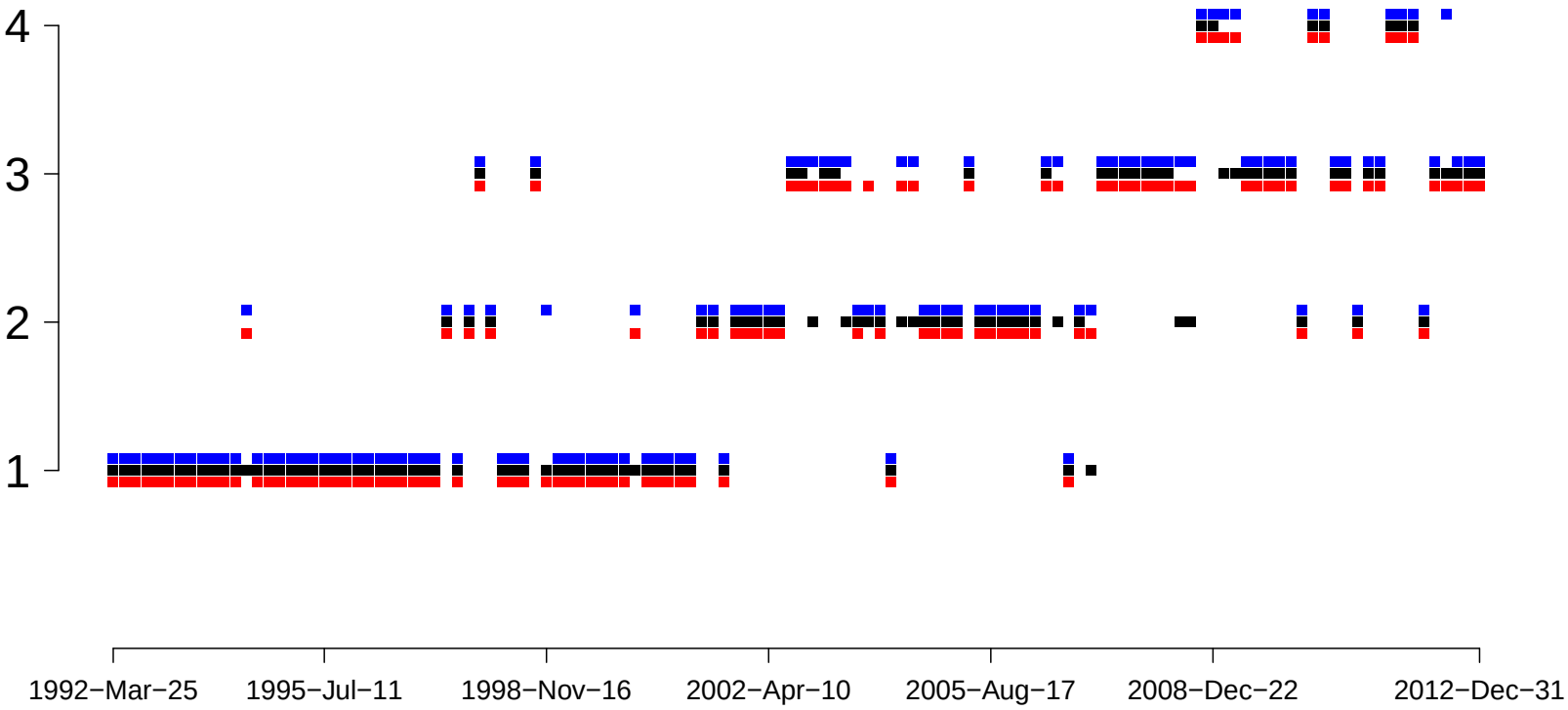


Source: Münnix et al.

Other Methods: S&P 500, 307 stocks, 1992 - 2012



Remarks

- Other methods give consistent results
- Prior information (number of clusters, a threshold value) is needed
- We want the number of states to be given by the dynamics of the market

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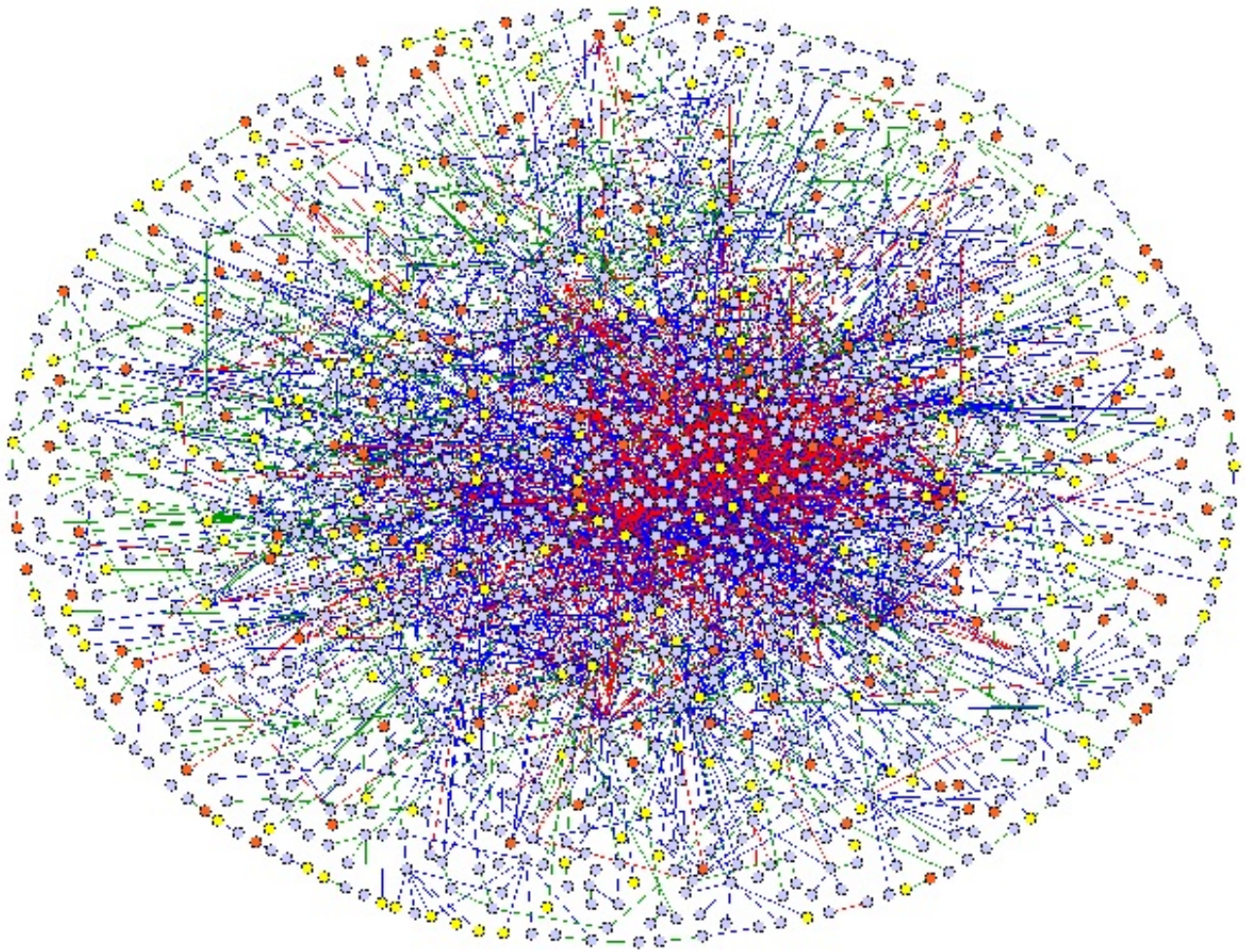
Filtered Graphs



Source: Max Delbrück Center for Molecular Medicine (MDC) Berlin-Buch
Ulrich Stelzl et al.

Filtered Graphs

Weight Matrix (e.g. Correl.)

$$\begin{pmatrix} c_{11} & c_{21} & c_{31} & \cdots & c_{n1} \\ c_{21} & c_{22} & c_{32} & \cdots & c_{n2} \\ c_{31} & c_{32} & c_{33} & \cdots & c_{n3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ c_{n1} & c_{n2} & c_{n3} & \cdots & c_{nn} \end{pmatrix}$$

(Weighted) Adjacency Matrix

$$\begin{pmatrix} 0 & c_{21} & 0 & \cdots & c_{n1} \\ c_{21} & 0 & 0 & \cdots & 0 \\ 0 & 0 & 0 & \cdots & c_{n3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ c_{n1} & 0 & c_{n3} & \cdots & 0 \end{pmatrix}$$

Filtering

Complete Graph

$\longrightarrow$

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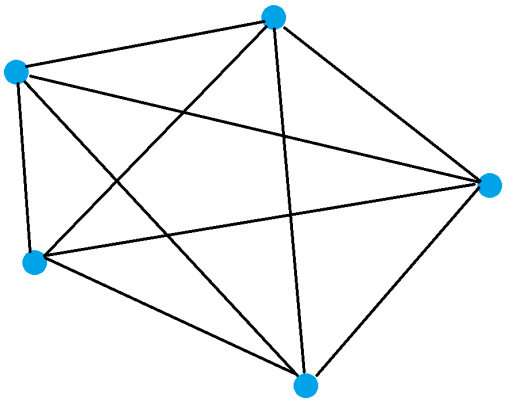
Complete Graph



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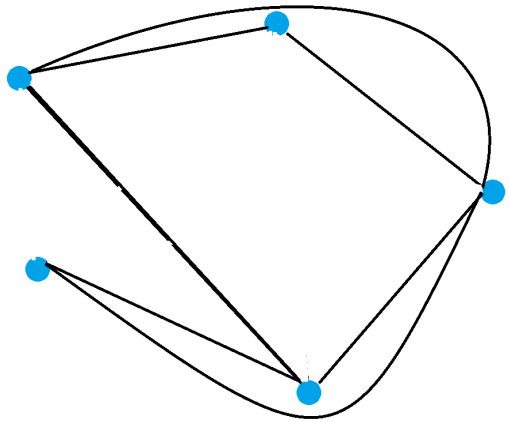
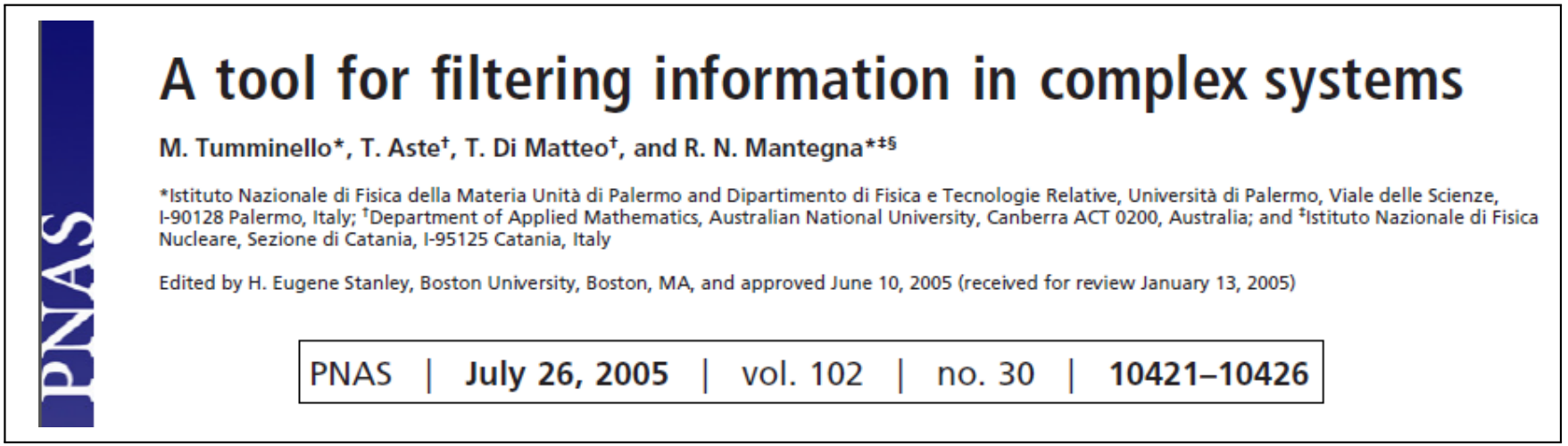


PMFG



PNAS

A tool for filtering information in complex systems

M. Tumminello*, T. Aste†, T. Di Matteo†, and R. N. Mantegna*‡§

*Istituto Nazionale di Fisica della Materia Unità di Palermo and Dipartimento di Fisica e Tecnologie Relative, Università di Palermo, Viale delle Scienze, I-90128 Palermo, Italy; †Department of Applied Mathematics, Australian National University, Canberra ACT 0200, Australia; and ‡Istituto Nazionale di Fisica Nucleare, Sezione di Catania, I-95125 Catania, Italy

Edited by H. Eugene Stanley, Boston University, Boston, MA, and approved June 10, 2005 (received for review January 13, 2005)

PNAS | July 26, 2005 | vol. 102 | no. 30 | 10421–10426

Tumminello et al.

PMFG

- A PMFG is a weighted **planar graph**
- It is an *extension* of the MST and contains more information
- Its subgraphs (cycles) have important relationship to original data

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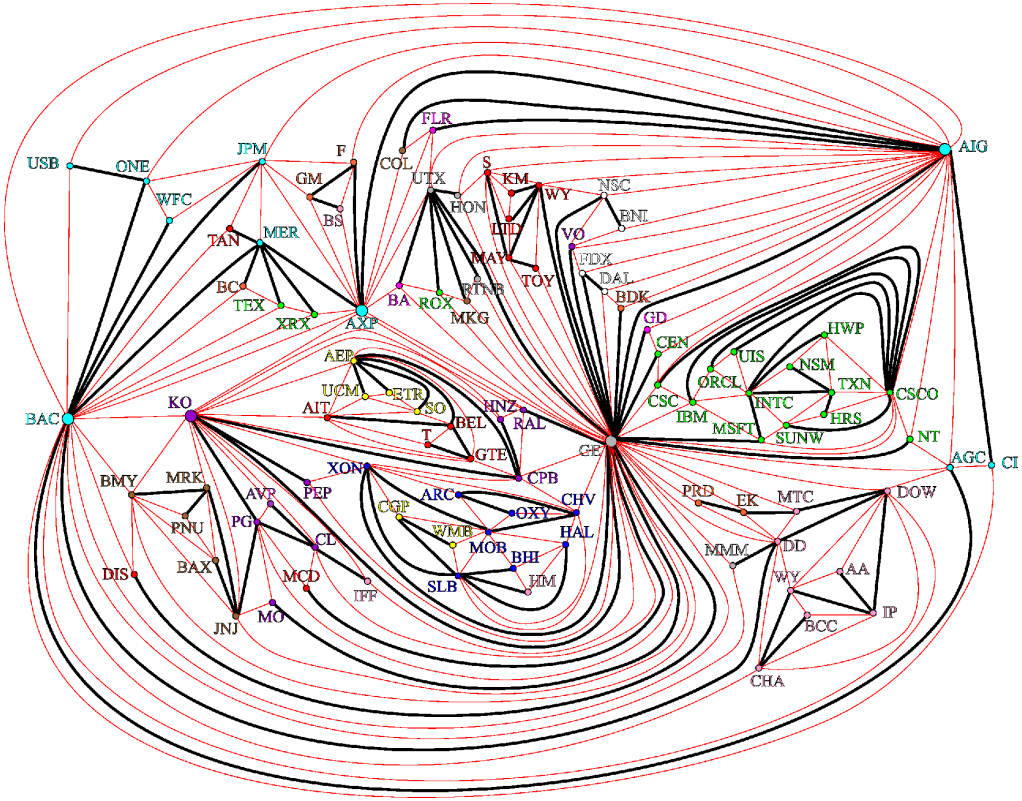
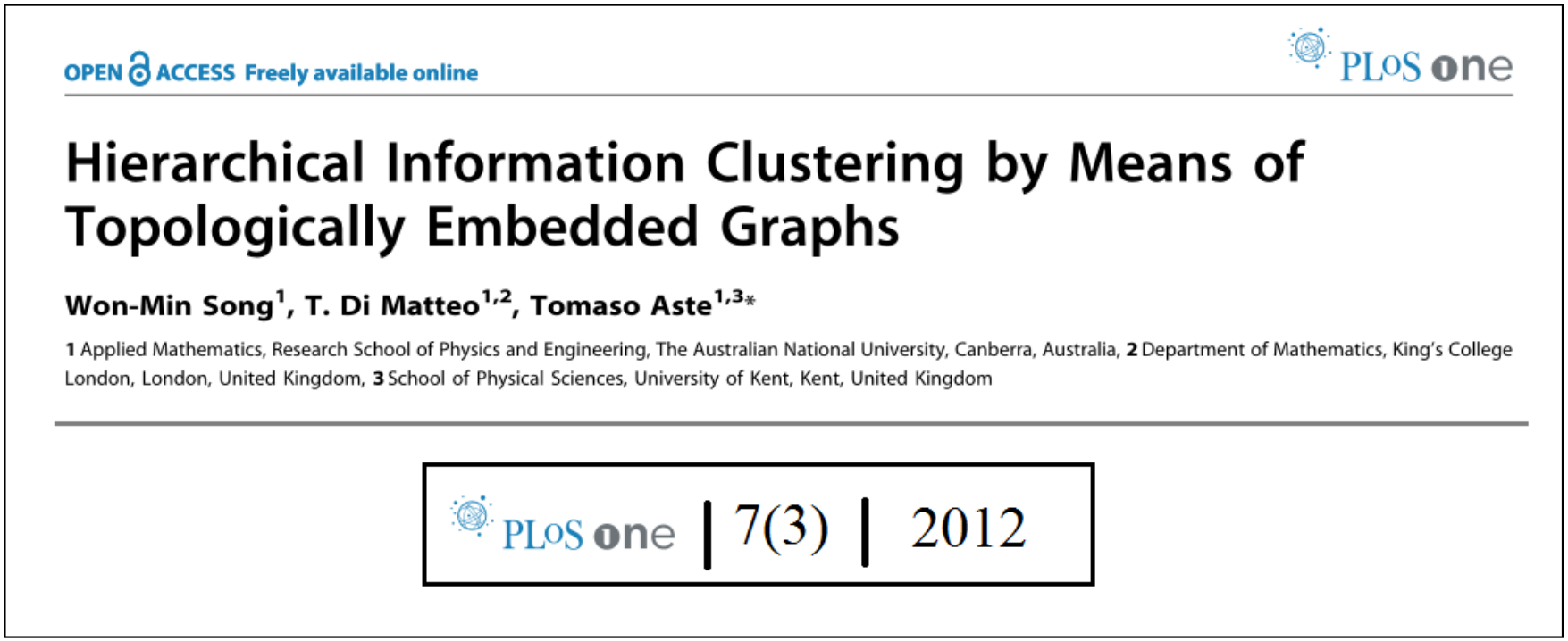


Source: Tumminello et al.

Why PMFG? DBHT Technique



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PLoS one

Hierarchical Information Clustering by Means of Topologically Embedded Graphs

Won-Min Song[1], **T. Di Matteo**[1,2], **Tomaso Aste**[1,3]*

1 Applied Mathematics, Research School of Physics and Engineering, The Australian National University, Canberra, Australia, **2** Department of Mathematics, King's College London, London, United Kingdom, **3** School of Physical Sciences, University of Kent, Kent, United Kingdom

PLoS one | 7(3) | 2012

Aste et al.

DBHT Technique

- Is applied to a PMFG with weights (similarity) and distances (dissimilarity) of nodes
- Extracts **deterministically** clusters and hierarchies out of a given PMFG
- Works **without any prior information** !!!

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Econophysics and Networks

Source: http://www.dcmarketingpro.com/

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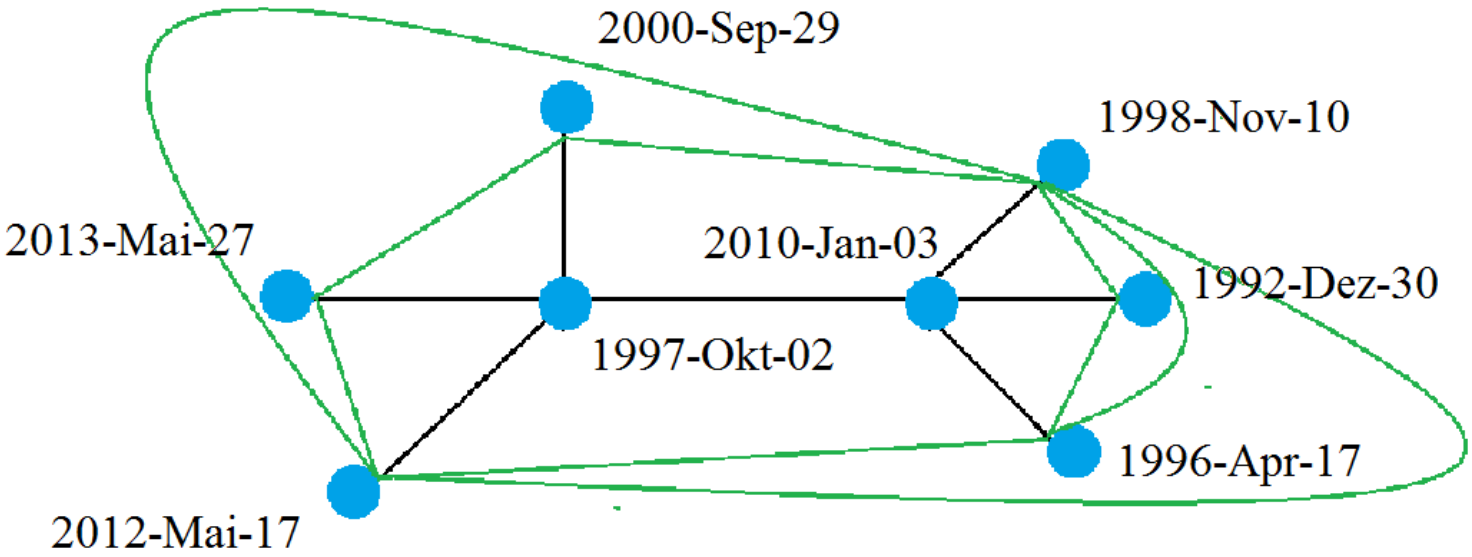

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2. State Dynamics

Topology of the PMFG of stocks for different states

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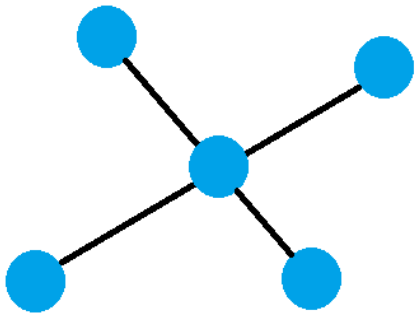
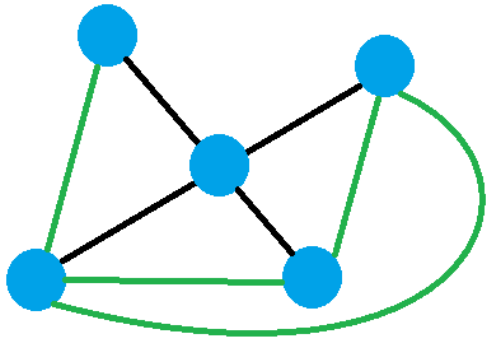
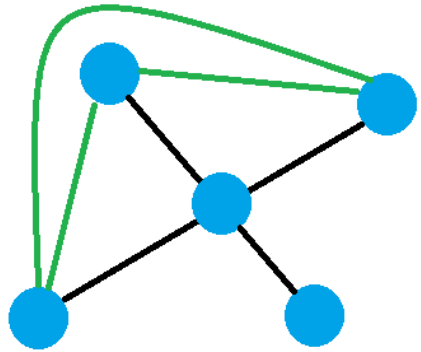


state 1



state 2



state 3

3. Collaborations are very Appreciated !!!

Source: www.mindjet.com

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