Multivariate Time Series Similarity-Based Complex Network in Stocks Market Analysis: Case of NYSE during Global Crisis 2008

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SYNOPSIS:
3 problems (mathematical, computational & analysis)

• Mathematical problem: Understanding stocks market as a complex system
  Approach: 1. Random Matrix Theoretical approach
    2. Graph Theoretical approach
  Main Tool: Similarity among stocks
    (Univariate/Multivariate Time Series setting)

• Computational: Visualization of stocks network

• Network Analysis: The properties of stocks network topology
SYNOPSIS:

In mathematical terms:
• 1. How to measure the similarity among stocks
• 2. How to define the appropriate complex network of stocks market
• 3. How to filter the information contained in the complex network

In terms of computation:
• How to construct & visualize the filtered stocks network

In terms of analysis/economic properties:
• How to derive the network topological properties of stock market
SYNOPSIS:

This talk is about the theory and method of stocks market analysis developed at:

Laboratory of Computational Statistics and Operations Research
Institute for Mathematical Research (INSPEM)
Universiti Putra Malaysia
43400 UPM Serdang, Selangor DE
CASE STUDY:
NYSE 100 Most Capitalized Stocks 2007 – 2009
* Consists of 10 Economic Sectors
* Stock is represented by its OHLC Prices

Data Source:
http://www.nyse.com/about/listed/nyid_components.shtml
## Legend of Economic Sector in MST

<table>
<thead>
<tr>
<th>Colour</th>
<th>Economic sector</th>
<th># of Stocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>Financials</td>
<td>18</td>
</tr>
<tr>
<td>Light-Orange</td>
<td>Health Care</td>
<td>12</td>
</tr>
<tr>
<td>Pine-Green</td>
<td>Consumer Goods</td>
<td>11</td>
</tr>
<tr>
<td>Grey</td>
<td>Industrials</td>
<td>16</td>
</tr>
<tr>
<td>Thistle</td>
<td>Oil &amp; Gas</td>
<td>12</td>
</tr>
<tr>
<td>Red</td>
<td>Consumer Services</td>
<td>11</td>
</tr>
<tr>
<td>Pink</td>
<td>Utilities</td>
<td>4</td>
</tr>
<tr>
<td>Blue</td>
<td>Basic Materials</td>
<td>6</td>
</tr>
<tr>
<td>Green-Yellow</td>
<td>Technology</td>
<td>4</td>
</tr>
<tr>
<td>Cyan</td>
<td>Telecommunications</td>
<td>2</td>
</tr>
</tbody>
</table>
DYNAMICS OF NETWORK TOPOLOGY
(Minimal Spanning Tree)
IN HALF-YEARLY-BASIS
MST in Jan-Jun 2007
MST in Jul-Dec 2007
MST in Jan-Jun 2008
MST in Jul-Dec 2008
MST in Jan-Jun 2009
MST in Jul-Dec 2009
At a glance,

- 1 year before global crisis the hub of NYSE is dominated by Financials (Yellow).
- It was not so anymore during the crisis. In this period all colours are distributed more randomly. Industry (Grey) came as an emergency exit of US economy in the first half year 2008.
- The situation becomes severe in the second half of 2008 where Financials moved to the periphery and the less important sectors such as Consumer Services (Red) and Telecommunications (Cyan) came into the hub.
- When the crisis was over, Financials sector strengthened again. But, in the second half of 2009 it worsened again. This is perhaps due to the Greek debt crisis.
DEGREE DYNAMICS OF EACH SECTOR
Legend of Economic Sector’s in Degree & Diameter Dynamics

- Financials
- Health care
- Consumer goods
- Industrials
- Oil & Gas
- Consumer services
- Utilities
- Basic materials
- Technology
- Telecommunications
Aid of Interpretation:

• Degree of a stock refers to Market Index of that stock
• Degree of an economic sector is the average of its stocks’ degrees
• Diameter within sector measures how long (at most) the influence of a stock will propagate to other stock in the same sector
• Diameter between sectors measures how long (at most) the influence of a stock in a given sector will propagate to another stock in different sectors
RANK OF SECTOR’S DEGREE

- Technology
- Telecommunications
- Basic Materials
- Consumer services
- Industrials
- Health care
- Oil & Gas
- Consumer Goods
- Utilities
- Financials

RANK OF RELATIVE DIAMETER WITHIN SECTOR

Telecommunications
Technology
Health care
Consumer services
Basic Materials
Consumer Goods
Industrials
Utilities
Oil & Gas
Financials
RANK OF RELATIVE DIAMETER BETWEEN SECTOR

Telecommunications 10
Basic Materials 9
Utilities 8
Technology 7
Consumer services 6
Health care 5
Consumer Goods 4
Oil & Gas 3
Industrials 2
Financials 1

FUTURE RESEARCH

• 1515 stocks traded at NYSE from 2005 – 2014.
• Data from www.nasdaq.com.
• This period is chosen to cover some important events such as:
  + sub-prime mortgage crisis in 2007,
  + global financial crisis in 2008,
  + Greek debt crisis in 2009,
  + European sovereign debt crisis in 2010, and
FUTURE RESEARCH:

How to convert this network of NYSE 1515 stocks into economic information?

How to define measurements?
FUTURE RESEARCH

ARE YOU INTERESTED?

YOU ARE INVITED TO JOIN US
MORE IDEAS IS BETTER
FURTHER INQUIRIES:

Please visit INSPEM

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TERIMA KASIH/THANK YOU

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