Statistical standard, methodology and application in data management and usage

Network Topology of Economic Sectors

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Presentation Flow

• Focus of Research
• Highlights
• Research Methodology
• Results and Discussion
• Conclusions and Future Research
Focus of Research

Approaches

• Multivariate time series (MVTS) representation of economic sector.

• Minimal spanning tree (MST) to filter the information presented in a vector correlation matrix.
Highlights

• In the current practice, stock is represented by univariate time series (UVTS) of its closing price.

• According to the literatures (e.g., Duellmann et al., 2006; Fasnacht and Louberge, 2007; Ferreira and Gama, 2010; Roy and Sakar, 2013), it is important to analyze economic sectors for investment decisions and portfolio management.
Highlights

• The existing method (e.g.: Zhang et al., 2011 and Cheong et al., 2012) is by representing sector by UVTS of its index related to closing price and not by MVTS of $p$ components each of which is a UVTS of stock’s closing price.

• The problem is how to measure the similarity among sectors (MVTS) which might have different number of stocks (number of components in MVTS).
Economic Sectors Network Construction

- Current practice
Economic Sectors Network Construction

- Research scenario
Economic Sectors Network Construction

- Escoufier vector coefficient (EVC) \((\text{Escoufier, 1973})\) between economic sectors \(E_k\) and \(E_l\) is,

\[
RV_{kl} = \frac{Tr(S_{kl}S_{lk})}{\sqrt{Tr(S_{kk}^2)Tr(S_{ll}^2)}}
\]
Economic Sectors Network Construction

- Distance between economic sectors $E_k$ and $E_l$ is,

$$\delta_{kl} = \sqrt{2(1-RV_{kl})}$$
Results and Discussion

Illustrative example:
New York Stock Exchange (NYSE)

1515 stocks → 63 SICs (Standard Industrial Classification)
Dec 16, 2004 – Nov 21, 2014
# Results and Discussion

<table>
<thead>
<tr>
<th>No.</th>
<th>Industry Sector</th>
<th>Color</th>
<th>Number of SICs</th>
<th>Number of Stocks</th>
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<tbody>
<tr>
<td>1</td>
<td>Mining</td>
<td>Red</td>
<td>4</td>
<td>115</td>
</tr>
<tr>
<td>2</td>
<td>Construction</td>
<td>Cyan</td>
<td>3</td>
<td>28</td>
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<td>3</td>
<td>Manufacturing</td>
<td>Yellow</td>
<td>20</td>
<td>469</td>
</tr>
<tr>
<td>4</td>
<td>Transportation, Communication, Electric, Gas &amp; Sanitary Services</td>
<td>Green</td>
<td>8</td>
<td>187</td>
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<tr>
<td>5</td>
<td>Wholesale Trade</td>
<td>Magenta</td>
<td>2</td>
<td>33</td>
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<tr>
<td>6</td>
<td>Retail Trade</td>
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<td>78</td>
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<tr>
<td>7</td>
<td>Finance, Insurance &amp; Real Estate</td>
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<td>490</td>
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<td>Services</td>
<td>Orange</td>
<td>10</td>
<td>110</td>
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<td>9</td>
<td>Public Administration</td>
<td>Blue</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

**TOTAL** 1515
Results and Discussion

The most important SICs:

(i) SIC 35 (Industrial and Commercial Machinery and Computer Equipment),
(ii) SIC 37 (Transportation Equipment),
(iii) SIC 36 (Electronic and other Electrical Equipment and Components except Computer Equipment), and
(iv) SIC 28 (Chemicals and Allied Products).

Figure 1. Minimal spanning tree of 63 SICs
Results and Discussion

- **Figure 2.** Topological structure of inter and intra SICs
Results and Discussion

The closest pair of stocks between

• SIC 35 and SIC 37 are ITW (Illinois Tool Works Inc.) and HON (Honeywell International Inc.).
• SIC 35 and SIC 36 are ITW and EMR (Emerson Electric Company).
• SIC 35 and SIC 28 are DOV (Dover Corporation) and PPG (PPG Industries Inc.).

ITW, EMR, DOV and PPG are the constituents of S&P500 dividend aristocrats index in 2015.
Conclusions

• MVTS representation of economic sector.

• Economic sectors network
  - topological structure of economic sectors
  - topological structure of individual stocks within each sector
  - particular important stocks.
Future Research

• To generalize the similarity between two economic sectors: \( p \) and \( q \) stocks, respectively; each stock is represented by its OHLC prices.