Mapping the UK interbank system

Given at Zurich, 14/09/12

Sam Langfield, (1) Zijun Liu (2) and Tomohiro Ota (3)

(1) UK Financial Services Authority and European Systemic Risk Board Secretariat. Email: sam.langfield@gmail.com
(2) UK Financial Services Authority. Email: zijun.liu@fsa.gov.uk
(3) Bank of England. Email: tomohiro.ota@bankofengland.co.uk
What the UK interbank system looks like

Why it looks like this
‘focus on the wood, not the trees’
9,700,000 elements in the cross-section
163 variables:

- prime lending (unsecured, secured)
- equity
- fixed income
- CDS (bought, sold)
- SFT, incl repo
- derivatives (by underlying)
- et al

by maturity (O/N, <3m, <1y, 1-5y, 5y+)
Panel A: Exposures Network: Breakdown by Instrument

- Derivatives: 44%
- Unsecured: 24%
- Secured: 5%
- Marketable: 16%
- SFT: 11%
- CDS: 18%

Total exposures: £264bn

Panel B: Funding Network: Breakdown by Instrument

- Repo: 66%
- Secured: 5%
- Unsecured: 29%

Total funding: £192bn
Exposure Network by Bank Type

Panel B: Funding Network: Breakdown by Instrument

Investment Banks
- Derivative (51%)
  - Derivative (37%)
  - Mkt securities (19%)

Large UK Banks
- Derivative (65%)

Overseas Banks
- Derivative (46%)
  - SFT (35%)

UK Commercial Banks

Building Societies

Investment Banks

Non-reporting

Note: Some small links are not shown in the graph.
Note: Some small links are not shown in the graph.
Figure 9

Degree: Exposures vs Funding Network

Markers' area are proportional to within-quintile mean of banks' total global liabilities
Sample: all 490 banks
Figure 10
Market Share: Exposures vs Funding Network

Markers' area are proportional to within-quintile mean of banks' total global liabilities
Sample: all 490 banks
Structure (1): Interbank Exposures

Generated using Financial Network Analytics
Structure (2): Hub-spoke / Core-periphery

also see:
Craig and von Peter (2010)
Structure (3): Core-periphery fitness

Panel A: Exposures networks

- No. of banks in core (LHS)
- Fitness of core-periphery model (RHS)

Panel B: Funding networks
Broad Conclusion: Interbank system is incomplete and highly concentrated

Similar findings:

• Belgium (Degryse and Nguyen, 2010) Market-makers absorbing demand-supply gaps
• Germany (Sacks, 2010; Craig and von Peter, 2010)
• Italy (Fricke and Lux, 2012)
• Mistrulli (2011)
• Degryse and Nguyen (2010)
Interpretation: Why do we have core-periphery?

- A specialist collecting info on behalf of others (Diamond-Dybvig monitoring)
- Market-makers and search costs (Duffie et al., 2005)
- Star-shape is the efficient way to be connected (Jackson and Wolinsky, 1996)
One final thought

Unsecured interbank loans / Total assets (UK banks)

Source: BoE MFI stats
Appendix
Interpretation (3):

Resilience: conflicting ideas

- Complete vs incomplete network: which is risky?
- Is core-periphery network risky?
  - Resilient because core bank becomes a fire-stop
  - Peripherals become more vulnerable against core
  - Depends on size, depends on the number of links

- Identifying weakest links (Cont et al, 2011):
  - 173 Contagious Links which can “kill” exposed bank
  - 65 (out of 176) banks are exposed to contagious link
Structure (4):
Core composition

Red: UK banks
Blue: Investment banks
Yellow: Overseas banks

No. markets bank is in core

Individual banks
Testing Maximum Entropy

- Q: How reliable is the algorithm to populate incomplete matrices?
Maximum Entropy Algorithm: How reliable is the method?

- Now we have an answer: the dataset is nearly complete

Generate several incomplete matrices by eliminating exposures smaller than $x\%$ of capitals

1. Populate the matrices by ME and RAS algorithms
2. Calculating Pearson correlations with the original
3. F test to check the Null hypothesis that ME method does not improve the estimation
   - populating the incomplete matrices by random numbers for 1000 times to generate a distribution to compare
   - Applying RAS for the randomly assigned matrices
Why does ME work well?

- Hypothesis: ME is prone to expect core-periphery structure (even when it isn’t in fact)?

<table>
<thead>
<tr>
<th>Actual matrix</th>
<th>ME’s estimate from total exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bank 1</strong></td>
<td>bk 1</td>
</tr>
<tr>
<td>bank 1</td>
<td>0</td>
</tr>
<tr>
<td>bank 2</td>
<td>0</td>
</tr>
<tr>
<td>bank 3</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
</tr>
</tbody>
</table>