Exploiting big data for sharpening financial sector risk assessment

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Financial Network Analytics

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1 This presentation was prepared for the meeting. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.
Exploiting Big Data for Sharpening Financial Sector Risk Assessment

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www.fna.fi
Agenda: Three Examples

1. **Advanced Analytics**
   - Measuring interconnectedness of global CCPs
   - Identify Risks Concentrations

2. **Monitoring**
   - Identify Liquidity and Solvency problems from payments
   - Provide Early Warning

3. **Simulation**
   - Operational failure of an FMI member bank
   - Predict Outcomes
The **New Systemic Risk**

Three CCP failures in the past (Paris, Kuala Lumpur and Hong Kong)

Interest by regulators, CCPs and members.

Especially with tie in to Cyber, IT and other operational risks.

"They [CCPs] are not equipped, however, to test the impact of their failure on the financial system as a whole nor are they equipped to assess the potential contagion effect on other members of a given member’s failure."

Cox & Steigerwald (2018)
Comparison with BIS "Analysis of Central Clearing Interdependencies" (2017)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>CCPs</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>Jurisdictions</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Clearing Members</td>
<td>n/a</td>
<td>811</td>
</tr>
<tr>
<td>Parents Organizations</td>
<td>307</td>
<td>563</td>
</tr>
<tr>
<td>Roles</td>
<td>5 (member, settlement, LOC, ...)</td>
<td>1 (member)</td>
</tr>
</tbody>
</table>
Private vs Public Data

BIS (2017)

FNA (2018)
CCP Interconnectedness - Subsidiary Level

We see CCPs (diamonds) and their members (circles) from different regions:

- North America (blue)
- Europe (Yellow)
- Asia (green)
- Middle East (brown)
- Latin America (blue)
- Australia & Oceania (purple)

On subsidiary level, we see a tight core with peripheral CCPs and a number of completely disconnected CCPs from Latin America and Middle East.
210 Banking Groups

Largest (# of entities):

1. Citigroup (19)
2. Morgan Stanley (13)
3. Goldman Sachs (12)
4. JPMorgan Chase (12)
5. Bank of America (12)
6. HSBC (11)
7. Credit Suisse (10)
8. Deutsche Bank (10)
9. Nomura (9)
10. Banco Santander (8)
We see CCPs (diamonds) and their members (circles) from different regions:

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- Europe (Yellow)
- Asia (green)
- Middle East (brown)
- Latin America (blue)
- Australia & Oceania (purple)

On parent level we see a completely connected network dominated by a core consisting of CCPs from North America and Europe and global banks.
## CCP Interconnectedness on GSIB Level

<table>
<thead>
<tr>
<th>Bank (Parent)</th>
<th># of FMIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citigroup</td>
<td>21</td>
</tr>
<tr>
<td>DEUTSCHE BANK</td>
<td>21</td>
</tr>
<tr>
<td>JPMorgan Chase &amp; Co.</td>
<td>19</td>
</tr>
<tr>
<td>BNP PARIBAS</td>
<td>18</td>
</tr>
<tr>
<td>Bank of America</td>
<td>17</td>
</tr>
<tr>
<td>HSBC</td>
<td>17</td>
</tr>
<tr>
<td>Morgan Stanley</td>
<td>16</td>
</tr>
<tr>
<td>Societe Generale</td>
<td>16</td>
</tr>
<tr>
<td>The Goldman Sachs</td>
<td>15</td>
</tr>
<tr>
<td>Credit Suisse</td>
<td>14</td>
</tr>
</tbody>
</table>
A disruption in a CCP would affect all of that CCP’s clearing members, thereby affecting the other CCP’s to which the affected CCP’s members belong, possibly creating a cascading cycle as disruption is propagated across members and CCPs.
LCH Ltd 100 members are connected to 27 other CCPs.

The membership is mostly European with a significant US base.

The most connected CCP is LCH SA and ICE-CLEAR EUROPE.
A member disruption can be felt by up to 458 banking groups or banks (of total of 563, or 80%) that are members of the same CCP as the stricken group.

<table>
<thead>
<tr>
<th>Banking Group</th>
<th># banking groups connected via a CCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deutsche Bank</td>
<td>458</td>
</tr>
<tr>
<td>Citigroup</td>
<td>446</td>
</tr>
<tr>
<td>Morgan Stanley</td>
<td>442</td>
</tr>
<tr>
<td>BNP Paribas</td>
<td>423</td>
</tr>
<tr>
<td>Goldman Sachs</td>
<td>412</td>
</tr>
<tr>
<td>HSBC Holdings</td>
<td>402</td>
</tr>
<tr>
<td>JPMorgan Chase</td>
<td>388</td>
</tr>
<tr>
<td>Bank of America</td>
<td>382</td>
</tr>
<tr>
<td>Credit Suisse</td>
<td>348</td>
</tr>
<tr>
<td>Société Générale</td>
<td>340</td>
</tr>
</tbody>
</table>
Deutsche Bank Group participates in 21 CCPs (of 29 mapped).

458 other banking groups or banks are members of these CCPs.
Journey

Advanced Analytics
1. Understand interconnectedness, data visualization
2. Identify Risks Concentrations

Monitoring
2. Detect risks and anomalies in real-time
3. Provide Early Warning

Simulation
3. What-if analysis, failure simulations & remediation scenarios
4. Predict Outcomes
Use Case: Monitoring Liquidity and Solvency of FIs

Central Bank of Colombia identifies early warning on liquidity and solvency of financial institutions with FNA

Background
The Central Bank of Colombia has been using balance sheet and regulatory reporting data to understand the liquidity and solvency of participants in the Colombian financial system. However, the analysis is time consuming and the data comes months late.

Objective
Using network analysis of data from the interbank payment system would allow the Bank to get early warning about risks substantially faster.

Outcomes
Using the FNA Platform, the Bank is now able to monitor its banking system in near real time. Automatic alerts notify the bank of any abnormal behavior in the network. Furthermore, automated stress tests where they fail the two largest participants in the network help to understand the riskiness of the system.

Use Case: Monitoring Liquidity and Solvency of FIs
Journey

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- Identify Risks Concentrations
- Provide Early Warning
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Concept: Operational Failure of a Settlement Member

Mapping
This network shows settlement relationships between the:
- CCP (center)
- Settlement members (inner circle) and
- Clearing members (outer circle)

Note: Data is representative, not real

Size of node shows value of multilateral position

Width of lines shows value of bilateral positions

Question
What would happen if member 4 had an operational failure?
Backup Relationships

Map

Shows Clearing Members on the left, and Settlement Members on the right.

The lines denote which settlement member the clearing member can use for settlement (ie its main and its backups)
Each clearing member using Bank 4 must now effect settlement through one of its backup relationships.

**Findings**
Simulation shows that settlement flows could be concentrated on a few participants, e.g. causing operational challenges for Bank 11.

**Insight**
Bank 11 was not among the most active settlement members on a normal day, but might need to build operational capacity to cover for rare failure days.
Findings
... or clearing members might use different settlement members resulting in a much higher number (18 instead of 10) of settlement members for the day.

Insight
The CCP may need to build operational capacity to be able to complete settlement.
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