Fire-Sale Spillovers and Systemic Risk

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Introduction

Systemic risk monitoring and analysis

- Vulnerability to fire sales (externalities)
- Based on detailed balance sheet information
- Macro-prudential complement to micro-prudential stress tests
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- Build on Greenwood, Landier & Thesmar (2012)
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- **GLT**: 2011 cross-section released with European stress tests

- **We**: expand to panel analysis for US data
  - Commercial banks 2001–2013
  - Broker-dealers 2008–2013
Results

- Vulnerabilities building since early 2000s
  - Peak in 2008
  - Drop with gov’t interventions
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- “Illiquidity concentration” key driver
  - **Commercial banks**: build-up of real estate loans
  - **Broker-dealers**: rapid changes in asset liquidity
  - **Both**: Heterogeneity affects systemicness
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  - Both: Heterogeneity affects systemicness

- Granger-cause other systemic risk measures
Framework
Framework – inputs


Note: Really a “framework” and not a “model”
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  - Total size \( a_i \)
  - Portfolio shares \( m_{ik} \)
  - Leverage \( b_i = d_i/e_i \)
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- Exogenous shock to assets \( F = [f_1, \ldots, f_K] \)
Hypothetical fire-sale scenario

1. Prices decline through shock $F$
Hypothetical fire-sale scenario

1. Prices decline through shock
2. Direct portfolio losses
Hypothetical fire-sale scenario

1. Prices decline through shock
   \[ F \]
2. Direct portfolio losses
   \[ AMF \]
3. Shortfall to regain target leverage
   \[ BAMF \]

Total spillover losses:

\[ \frac{1}{2} \]
Hypothetical fire-sale scenario

1. Prices decline through shock
2. Direct portfolio losses
3. Shortfall to regain target leverage
4. Proportional asset sales

Total spillover losses: \( F_{AMF} + B_{AMF} + M'B_{AMF} \)
Hypothetical fire-sale scenario

1. Prices decline through shock
2. Direct portfolio losses
3. Shortfall to regain target leverage
4. Proportional asset sales
5. Fire-sale price impact
Hypothetical fire-sale scenario

1. Prices decline through shock
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5. Fire-sale price impact
6. Spillover portfolio losses
Hypothetical fire-sale scenario

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Total spillover losses:
Spillover indicators

- **Aggregate vulnerability:**
  Fraction of system equity capital lost due to fire-sale spillovers
Spillover indicators

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- **Systemicness of bank $i$:**
  Contribution of bank $i$’s fire sales to spillover losses
Spillover indicators

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  Fraction of system equity capital lost due to fire-sale spillovers

- **Systemicness of bank $i$:**
  Contribution of bank $i$’s fire sales to spillover losses

- **Systemicness of asset $k$:**
  Contribution of shock to asset $k$ to spillover losses
Commercial banks
Commercial banks

- Balance sheet data from regulatory form FR Y-9C
  - “Call report” for consolidated BHC
  - Quarterly from 2001q1 to 2013q1
  - Public data
Commercial banks

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- Asset liquidity:
  - Time series more important than cross-section
  - Presentation: Agnostic benchmark $\ell_k = \ell$ for all $k$
  - Paper: Several liquidity scenarios for robustness
Aggregate vulnerability and factors

\[ AV = a \times (b + 1) b \times \sum_{k'} \left[ m_k^2 \ell_k' \sum_i \left( \mu_{ik'} \alpha_i \beta_i \right) \right] \]

“illiquidity concentration”
Liquidity proportional to system size

\[ \frac{AV}{a} = (b + 1) b \times \text{leverage} \times \sum_{k'} [m_{k'}^2 \ell_{k'} \sum_i (\mu_{ik'} \alpha_i \beta_i)] \]

“illiquidity concentration”

The graph shows the relationship between AV/a, System leverage, and Illiq. Concentration from 2001q1 to 2013q1.
Most systemic banks

Top 5 spillover contributors in 2008q3
Most systemic asset classes

Top 5 spillover contributors in 2008q3

- RE loans
- C & I loans
- MBS
- Consumer loans
- ABS & debt sec.
Effect of bank heterogeneity

\[ \frac{S_{A_k}}{S_{A_k}^*} = \ldots = \frac{\sum_{k'} m_{k'}^2 l_{k'} \sum_i \left( \mu_{ik'} \alpha_i \beta_i \mu_{ik} \right)}{\sum_{k'} m_{k'}^2 l_{k'}} \]
Analysis for broker-dealers
Broker-dealers

- Data from tri-party repo market collected by NY Fed
  - Main source of funding for broker-dealers (56% of liabilities)
  - Daily from July 2008 to August 2013 (we average monthly)
  - Confidential data

### Construct collateralized sub-balance sheet

- **Assets**
  - Repo assets
  - Other assets

- **Liabilities**
  - Repo loans
  - Other debt

- **Repo haircuts**
- **Other equity**

- Captures most adjustments

### Asset liquidity

- Haircuts: Information on time-series and cross-section
Broker-dealers

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- Construct **collateralized sub-balance sheet**

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<td>Other assets</td>
<td>Other debt</td>
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- Captures most adjustments
- Main source of selling pressure
Broker-dealers

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- Captures most adjustments
- Main source of selling pressure

- Asset liquidity
  - **Haircuts**: Information on time-series and cross-section
Information on liquidity in haircuts
Size-weighted average haircuts in percent

[Graph showing liquidity in haircuts for different asset categories over time from July 2008 to July 2013.]
Aggregate vulnerability and factors

\[ AV = \underbrace{a \times (b + 1) b} \times \sum_{k'} \left[ m_{k'}^2 \ell_{k'} \sum_i \mu_{ik'} \alpha_i \beta_i \right] \]

“illiquidity concentration”
Most systemic asset classes

Top 5 spillover contributors in Nov08
Effect of broker-dealer heterogeneity

\[
\frac{SA_k}{SA^*_k} = \ldots = \frac{\sum_{k',\ell} m_{k',\ell}^2 \mu_{ik,\alpha i \beta i \mu_{ik}}}{\sum_{k'} m_{k',\ell}^2 \ell_{k'}}
\]
Comparison with other systemic risk measures

Thanks to Stefano Giglio, Bryan Kelly and Seth Pruitt!
Commercial banks
AV with three most correlated measures (std. around mean)
Broker-dealers

AV with three most correlated measures (std. around mean)
## Correlations and Granger-causality tests

<table>
<thead>
<tr>
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<th>AV $\rightarrow$ x (p-value)</th>
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<tr>
<td><strong>Comm. banks:</strong></td>
<td></td>
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<tr>
<td>Market Herfin.</td>
<td>0.736</td>
<td>0.191</td>
</tr>
<tr>
<td>TED spread</td>
<td>0.707</td>
<td>0.001***</td>
</tr>
<tr>
<td>SysRisk</td>
<td>0.455</td>
<td>0.000***</td>
</tr>
<tr>
<td>Turbulence</td>
<td>0.448</td>
<td>0.000***</td>
</tr>
<tr>
<td>Market leverage</td>
<td>0.441</td>
<td>0.000***</td>
</tr>
<tr>
<td>Dyn. Caus. Ind.</td>
<td>0.423</td>
<td>0.006***</td>
</tr>
<tr>
<td><strong>Broker dealers:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TED spread</td>
<td>0.845</td>
<td>0.106</td>
</tr>
<tr>
<td>Realized vol.</td>
<td>0.813</td>
<td>0.001***</td>
</tr>
<tr>
<td>Turbulence</td>
<td>0.723</td>
<td>0.000***</td>
</tr>
<tr>
<td>MES (SRISK)</td>
<td>0.703</td>
<td>0.003***</td>
</tr>
<tr>
<td>Amihud illiq.</td>
<td>0.696</td>
<td>0.402</td>
</tr>
<tr>
<td>SysRisk</td>
<td>0.613</td>
<td>0.000***</td>
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Conclusion

- Systemic risk measure based on fire-sale externalities
  - Macro-prudential complement to micro-prudential stress tests
- Bottom-up approach with detailed balance sheet data
  - Book-value complement to top-down market-value measures