Bernacer Lecture 2008
On Central Banking and Financial Stability
Markus K. Brunnermeier
Overview

- Two world views
  1. No financial frictions ... sticky price
  2. Financial sector + bubbles
- Role of the financial sector
  - Leverage
  - Maturity mismatch – maturity rat race
  - Linkage
- Monetary transmission mechanism
- Implications for monetary economics
- Implications for financial regulation
Role of Financial Institutions

- **Project/asset selection/monitoring**
  - Informational advantage (Sharpe, Rajan)

- **Create info-insensitive securities** (Gorton-Pennachi, Duffie-DeMarzo)
  - Pool and tranch in order to reduces lemon’s problem

- **Maturity transformation**
  - Why short-term (debt) funding?
    - Liquidity shock insurance (Diamond-Dybvig)
      - maturity transformation is *good*, but bank run caveat
    - Incentivize management (Calomiris-Kahn)
      - For large corporate debt holders, but for demand depositors (?)
      - Maturity mismatch is *good*
  - **Maturity rat race** (with MartinOehmke)
    - Maturity mismatch is *bad*

- Why leverage? Why maturity mismatch?
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- Why leverage? Why maturity mismatch?
Entrepreneurs

- Needs financing
- Start projects (trees with payoff $AK_t$)
- $dK = \kappa(I_t/K_t)K_t - \delta K_t + \sigma K_t dZ_t$

Financial Experts

- Monitoring
- Securitizes “trees” to expand investment

Households

- Provide financing

Optimal dynamic contract

direct lending
higher depreciation $\delta$
Entrepreneurs

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Households
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Optimal dynamic contract

Direct lending
Higher depreciation $\delta$

Entrepreneurs & Financial Experts & Households

### Brunnermeier-Sannikov (new)
Procyclicality - Liquidity Spirals

- **Loss spiral**
  - same leverage
  - mark-to-market

- **Margin/haircut spiral**
  - Margins/haircuts increase in times of crisis
  - Margin/haircut max leverage
  - delever!
    - mark-to-model

Brunnermeier-Pedersen (2009)
Some Results

1. **Procyclical leverage** due to margin/haircut spiral
   - Margin/haircut increase forces delevering process
     - Low **FUNDING LIQUIDITY** *(rollover risk)*
     - (haircut/margin/collateral value)
   - Depresses price
     - Low **MARKET LIQUIDITY**
     - Note that funding constraint need not be binding – just the threat that it might be binding can lead to delevering.

2. **Linkage between leverage and maturity mismatch**
   - Margin = f(volatility of collateral until debt expires)

3. **Fire-sale externality**
   - When levering up, institution $i$ does not take into account that its fire-sales depress price of others
   - Inefficient pecuniary externality in incomplete market setting
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- Why leverage? Why maturity mismatch?
The Maturity Rat Race (with Martin Oehmke)

- Leads to a unraveling to short-term debt
- Friction with multiple creditors with differing maturities

- Mechanism:
  - Creditors with shorter maturity can adjust face value (reduce interest rate) since they can pull out in bad states
  - Part of cost in low state is borne not by borrower but by remaining long-term creditors (long-term debt holders are diluted)
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  - Monetary transmission mechanism

- Implications for financial regulation
Monetary transmission mechanism

- Monetary Transmission
  - Target rate (short-term)
  - Effective rate (short-term)
  - Corporate lending rate
    - Long-term (term premium)
    - Credit risk

- Two roles
  - Term risk + liquidity risk
  - Credit risk

- Helps to define “liquidity policy”
Implications for monetary policy

- Tinbergen Principle

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price stability</td>
<td>Target rate (money supply)</td>
</tr>
<tr>
<td>Financial stability</td>
<td>Liquidity policy</td>
</tr>
</tbody>
</table>

- Liquidity policy

  - *Narrow*: Hold short-term rate close to target  
    - Reduce term risk premium  
  - *Broad*: financial stability  
    - to ensure monetary transmission mechanism  
    - Reduce term and credit risk premium  
    - Lean against bubbles  

Separation principle
Overturning “benign neglect bubble policy”

- Arguments brought forward
  1. Bubbles are **difficult to identify/measure**
     ... but so is inflation
  2. Bubbles are **unimpressed** by a interest rate increase
     .... but not for credit bubbles
     searching for yield based on short-term financing,
     increase $i$ by .25% and many SIVs unprofitable
  3. Interest rate is **too blunt** an instrument to prick bubble
     ... but credit bubble affected whole economy
     (housing, corporate takeovers, etc.)
A new rational for monetary aggregates

- Traditional rationale: quantity theory
  \[ M \times V(i) = P \times Y \]
  ... but
  - empirical: policy relevant horizon
  - theoretical: not in New Keynesian models without financial sector

- New rationale in models with financial frictions
  Money aggregate: measure lending activity
  (build-up of credit bubbles)
  ... but money aggregates need to be modified
    - drawn vs. extended new credit lines
    - incorporate shadow banking system

Refocusing the rationale of ECB’s second pillar
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- **Implications for monetary economics**
- **Implications for financial regulation**
Implications for financial regulation

1. Risk of each bank in isolation, e.g. Value at Risk
   - Capital requirements
   - Haircuts/margins
   - Ratings

2. Procyclical of capital requirements, haircuts, ratings
   - countercyclical regulation (break leverage cycle)

3. Focus on asset side of the balance sheet
   - incorporate funding structure

4. Shadow banking system gets little attention
   - objective criterion for regulation
1. **Externality:**
   - Measure contribution of institution to systemic risk: CoVaR contributes (non-causal)!
   - Response to current regulation “hang on to others and take positions that drag others down when you are in trouble” (maximizes bailout probability Moral Hazard)
     - become big
     - hold similar position (be in trouble when others are)
     - become interconnected

2. **Procyclicality:**
   - Impose Capital requirements/Pigouvian tax/Private insurance scheme not directly on ΔCoVaR, but on frequently observed factors, like maturity mismatch, leverage, B/M, crowdedness of trades/credit, ...
   - Lean against “credit bubbles”
     - Bubble + maturity mismatch impair financial system (vs. NASDAQ bubble)

3. **Funding:** Asset-Liability Maturity Match
## Who should be regulated?

- Based on functions – not name
- Micro-prudential: based on risk in isolation
- Macro-prudential: Classification on systemic risk contribution measure, e.g. CoVaR

<table>
<thead>
<tr>
<th>group</th>
<th>examples</th>
<th>macro-prudential</th>
<th>micro-prudential</th>
</tr>
</thead>
<tbody>
<tr>
<td>“individually systemic”</td>
<td>International banks (national champions)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>“systemic as part of a herd”</td>
<td>Leveraged hedge funds</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>non-systemic large</td>
<td>Pension funds</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>“tinies”</td>
<td>unlevered</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
CoVaR

- VaR \( q_i \) is implicitly defined as quantile
  \[
  \Pr(X^i \leq \text{VaR}^i_q) = q
  \]

- CoVaR \( q_{jl|i} \) is the VaR conditional on institute \( i \) (index) is in distress (at it’s VaR level)
  \[
  \Pr(X^j \leq \text{CoVaR}^j_{jl|i} \mid X^i = \text{VaR}^i_q) = q
  \]

- \( \Delta \text{CoVaR}^j_{jl|i} = \text{CoVaR}^j_{jl|i} - \text{VaR}^j_q \) q-prob. event

Various conditionings? (direction matters!)

Contribution \( \Delta \text{CoVaR} \)
- \( Q_1 \): Which institutions contribute (in a non-causal sense)
  - \( \text{VaR}^\text{system} \mid \text{institute } i \) in distress

Exposure \( \Delta \text{CoVaR} \)
- \( Q_2 \): Which institutions are most exposed if there is a systemic crisis?
  - \( \text{VaR}^i \mid \text{system in distress} \)

Network \( \Delta \text{CoVaR} \)
- VaR of institution \( j \) conditional on \( i \) in non-causal sense!
Network CoVaR

- conditional on origin of arrow
\(\Delta \text{CoVaR} \text{ vs. } \text{VaR}\)

- VaR and \(\Delta \text{ CoVaR}\) relationship is very weak
- Data up to 12/06
Implications for financial regulation

- **Externalities**
  - CoVaR – a measure of systemic risk contribution

- **Addressing Procyclicality**
  - **Step 1:** Time-varying CoVaRs
  - **Step 2:** Predict CoVaR using institution characteristics
    - Balance sheet variables (leverage, maturity mismatch, + interdependence, …)
    - Market variables (CDS, implied vol., …)
Step 1: Time-varying CoVaR

- Control for macro factors, $M_t$
  - VIX Level
  - 3 month yield
  - Repo – 3 month Treasury
  - Moody’s BAA – 10 year Treasury
  - 10Year – 3 month Treasury
  - Real estate index
  - Equity market risk

  **interpretation**
  - “Volatility”
  - “Flight to Liquidity”
  - “Credit indicator”
  - “Business Cycle”
  - “Housing”

Obtain Panel data of CoVaR
- Next step: Relate to institution specific (panel) data
Step 2a: Portfolios Sorted on Characteristics

- Institutional characteristics matter
- ... but individual financial institutions have changed the nature of their business over time
- Form decile portfolios, each quarter, according to previous quarter’s data:
  1. Leverage
  2. Maturity mismatch
  3. Size
  4. Book-to-Market
- Add 4 industry portfolios
  1. Banks
  2. Security broker-dealers
  3. Insurance companies
  4. Real estate companies
### Table 3A: ΔCoVaR Forecasts by Characteristics Cross-section, Portfolios, 1%

<table>
<thead>
<tr>
<th>COEFFICIENT</th>
<th>2 Years</th>
<th>1 Year</th>
<th>1 Quarter</th>
</tr>
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<tbody>
<tr>
<td>ΔCoVaR (lagged)</td>
<td>0.71***</td>
<td>0.80***</td>
<td>0.94***</td>
</tr>
<tr>
<td>VaR (lagged)</td>
<td>-1.99***</td>
<td>-2.27***</td>
<td>-0.47***</td>
</tr>
<tr>
<td>Leverage (lagged)</td>
<td>-9.43***</td>
<td>-10.73**</td>
<td>-2.53**</td>
</tr>
<tr>
<td>Maturity mismatch (lagged)</td>
<td>-0.89***</td>
<td>-0.30</td>
<td>-0.14</td>
</tr>
<tr>
<td>Relative Size (lagged)</td>
<td>-170.84***</td>
<td>-161.99***</td>
<td>-38.58***</td>
</tr>
<tr>
<td>Book-to-Market (lagged)</td>
<td>85.24***</td>
<td>87.65***</td>
<td>31.03**</td>
</tr>
<tr>
<td>Constant</td>
<td>-40.92**</td>
<td>-50.04**</td>
<td>-19.93*</td>
</tr>
<tr>
<td>Observations</td>
<td>3627</td>
<td>3805</td>
<td>3939</td>
</tr>
<tr>
<td>R²</td>
<td>0.62</td>
<td>0.69</td>
<td>0.89</td>
</tr>
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Step 2b: Forecasting with Market Variables

- CDS spread and equity implied volatility for 10 largest US commercial and investment banks (from Bloomberg)

- Betas:
  - Extract principal component from CDS spread changes/implied vol changes within each quarter from daily data
  - Regress each CDS spread change/implied vol change on first principal component
### Table 6: ΔCoVaR Forecasts by Market Variables
Cross Section, Portfolios, 1%

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<tr>
<td>VaR (lagged)</td>
<td>-1.84</td>
<td>0.05</td>
<td>-0.08</td>
</tr>
<tr>
<td><strong>CDS beta (lagged)</strong></td>
<td>-1.727**</td>
<td>787.92</td>
<td>95.37</td>
</tr>
<tr>
<td>CDS (lagged)</td>
<td>1.320</td>
<td>-2.211</td>
<td>-40.26</td>
</tr>
<tr>
<td>Implied Vol beta (lagged)</td>
<td>-8.30</td>
<td>-590.28**</td>
<td>-85.78</td>
</tr>
<tr>
<td>Implied Vol (lagged)</td>
<td>-144.60</td>
<td>111.02</td>
<td>234.56***</td>
</tr>
<tr>
<td>Constant</td>
<td>-335.30</td>
<td>-147.72</td>
<td>-114.07*</td>
</tr>
<tr>
<td>Observations</td>
<td>114</td>
<td>154</td>
<td>184</td>
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<tr>
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<td>0.57</td>
<td>0.77</td>
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*short data-span (2004-2008)!*
What type of charge?

Capital charge
- Strictly binding
- Might stifle competition

Pigouvian tax + government insurance
- Generates revenue
- In times of crisis it is cheap to issue government debt
- Very salient

Private insurance scheme
- (Kashap, Rajan & Stein, 2008 + NYU report)
- Requires lots of regulation
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Conclusion

- Institutional Macro/Finance
  - Financial institutions are not a veil
  - Moving away from representative agent models

- Monetary/Liquidity Policy
  - Role of financial institutions – why short-term funding?
  - Avoid “credit bubbles” since they impair financial system
  - Modified rationale for ECB’s second pillar

- Financial Regulation
  - Macro-prudential has to focus on measuring contribution to systemic risk
  - Countercyclical (to overcome margin/haircut spiral)