Integrating Banking and Banking Crises in Macroeconomic Analysis

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Overview

• Adapt macro models to account for financial crises (like recent one)
  – Emphasis on banking since most major crises feature banking distress

• Provide policy insight for response to crises:
  – Ex post: (lender of last resort)
  – Ex ante: (macroprudential)
• Aggregate spending varies inversely with cost of capital $\mathbb{E}_t \{ R^k_{t+1} \}$ (ceteris par.

• Arbitrage with riskless real rate $R_{t+1}$

\[
\mathbb{E}_t \{ m_{t+1}(R^k_{t+1} - R_{t+1}) \} = 0
\]

• To first order

\[
\mathbb{E}_t \{ R^k_{t+1} \} \approx R_{t+1}
\]

• Financial structure irrelevant
Modeling Financial Crises: Basic Idea

- Generate fluctuations in $\mathbb{E}_t\{R_{t+1}^k\}$ due to changing financial conditions

- Introduce limits to arbitrage (LTA) →

$$\mathbb{E}_t\{m_{t+1}(R_{t+1}^k - R_{t+1})\} \geq 0$$

- Financial crisis: sharp tightening of LTA → sharp increase in $\mathbb{E}_t\{R_{t+1}^k - R_{t+1}\}$
  - Rise in $\mathbb{E}_t\{R_{t+1}^k\}$ → contraction in real activity
Adding Banks and Banking Crises

\( R_{t+1}^b \equiv \) banks’ marginal cost of funds

- LTA →

\[
\mathbb{E}_t \{ m_{t+1} R_{t+1}^k \} \geq \mathbb{E}_t \{ m_{t+1} R_{t+1}^b \} \geq \mathbb{E}_t \{ m_{t+1} R_{t+1} \}
\]

- Banking crisis:
  - Sharp rise in \( \mathbb{E}_t \{ R_{t+1}^k - R_{t+1} \} \) due to rise in \( \mathbb{E}_t \{ R_{t+1}^b - R_{t+1} \} \)

- Recent crisis fits this pattern for excess returns (with credit spreads as proxies)
EBP: rate of return on corporate bonds minus that on similar maturity government debt, with default premium removed
What we mean by banks:

- Hold imperfectly liquid assets
- Highly leveraged with short term debt

Focus on banks reliant on uninsured deposits (shadow, large commercial)

- Most susceptible to systemic financial distress that affects real sector
(Macro) Modeling of Banking Crises: A Sketch

\( \phi_t \equiv \) leverage (assets/net worth); \( \bar{\phi}_t \equiv \) endogenous max. of \( \phi_t \) (“leverage cap”)

Bank balance sheet:

\[ Q_t K^b_t = N_t + D_t \]

Leverage constraint:

\[ Q_t K^b_t \leq \bar{\phi}_t N_t \]

- Financial crisis: sharp contraction in either \( N_t \) or \( \bar{\phi}_t \) → constraint tightens

\( N_t \downarrow \): Bernanke/Gertler, BGG, Kiyotaki/Moore, Holmstrom/Tirole, Shleifer/Vishny

\( \bar{\phi}_t \downarrow \): Geanakoplos, Adrian/Shin, Brunnermeier/Sannikov, Christiano et, al
$$Q_t K^b_t \leq \bar{\phi}_t N_t$$

$N_t$ dynamics:

$$N_t = [(R^k_t - R_t)\phi_{t-1} + R_t]N_{t-1} - \text{Div}_t$$

- Crisis: Sharp negative bank portfolio return: $R^k_t = \frac{Z_t + Q_t}{Q_{t-1}} \downarrow \to N_t \downarrow$
  
  $\rightarrow$ constraint tightens $\rightarrow \mathbb{E}_t\{R^k_{t+1} - R_{t+1}\} \uparrow \rightarrow$ economy weakens

- Mechanism strength increasing in leverage $\phi_{t-1}$

- Uncertainty $\uparrow$ may enhance crisis by reducing $\bar{\phi}_t$
Distinguishing Mechanisms via Leverage Cyclicality?

\[ Q_t K_t^b \leq \bar{\phi}_t N_t \]

1. \( \bar{\phi}_t \downarrow \rightarrow \) procyclical leverage (e.g., Adrian/Shin)

2. \( N_t \downarrow \rightarrow \mathbb{E}_t \{ R^k_{t+1} - R_{t+1} \} \uparrow \rightarrow \bar{\phi}_t \uparrow \rightarrow \) countercyclical leverage (e.g., He/Krish.)

Market value measures of leverage \((Q_t K_t^b / N_t)\):

- Procyclical for hedge funds (Ang et. al.)

- Countercyclical for commercial and investment banks (Ang et. al., He et. al.)
  - Consistent with bank balance sheet channel (with \( N_t \) variation)
Primary dealers include the largest U.S. commercial and investment banks.

Dealer leverage from He, Kelly, and Manela (JFE 2017)
Panel Evidence on Banking Distress Transmission

Huge lit. (e.g. Bernanke/Lown, Peek/Rosen, Chowdorow-Reich)

Approach: Isolate variation in bank net worth $N_t \perp$ borrowers’ economic prospects

- Estimate impact on borrowing and real activity

Recent example: Huber (2018)

- “Orthogonal” variation in $N_t$ of Commerzbank, large German bank
  - Source: losses from U.S. mortgage-backed securities during 2008
  - Independent of Commerzbank borrower prospects: No German real estate crisis

- Finds large significant effects of $N_t$ contraction lending and on employment
Capturing Nonlinear Dimension of Crisis

- Heart of crisis featured nonlinear dynamics:
  - Unusually sharp increase in credit spreads and contraction in real activity
  - No observable large standard business cycle shocks

- Active effort to model nonlinear collapse:
  - Brunnermeier/Sannikov, Chari et. al., Dang et. al., He/Krishnamurthy

- Gertler/Kiyotaki/Prestipino: banking collapse due to rollover panic (RP)
  - Motivated by popular descriptions of crisis (Bernanke, Gorton)
GDP Growth, Credit Spreads, and Broker Liabilities

Real GDP growth and the excess bond premium

Broker-Dealer Liabilities

Excess bond premium (pct)

Real GDP growth (pct)

Total Liabilities ($ Trillion)
Integrating Rollover Panics

- To model just described, add possible firesales of bank assets
  - Add “non-experts” with limited capacity to absorb securities banks hold (e.g., Shleifer/Vishny, Brunnermeier/Pedersen, Stein).
  - Security prices decrease as assets these agents absorb increase

- Rollover panic: “sunspot” failure of lenders to roll over short term debt
  - Banks liquidate at firesale prices and lenders split proceeds proportionately
  - Like Diamond/Dybvig, but details closer to Calvo, Cole/Kehoe
Rollover Panic Equilibrium (RPE): Existence and Nonlinearity

- RPE exists if lender believes if all others do not roll over, the lender will lose money by rolling over.

- Requires firesale value of bank assets < obligation to lenders

- Nonlinearity: RPE more likely to exist if:
  - (i) Leverage ratios high and (ii) market “illiquid”, (firesale prices “low”)
  - (i) and (ii) more likely in recessions
Potential Equilibria

NO BANK RUN EQUILIBRIUM

BANKS

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>LIABILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_t^b K_t^b$</td>
<td>$D_t$</td>
</tr>
<tr>
<td>$N_t$</td>
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DIRECT CAPITAL HOLDINGS

CAPITAL ($K_t$)

BANK RUN EQUILIBRIUM

CAPITAL ($K_t$) $Q_t^b K_t^b$

NON-EXPERTS

$P$
Numerical Crisis Simulation

- Add banks with possible rollover panics (RP) to simple New Keynesian DSGE

- Simulate financial collapse during 2008Q4
  - Pre-recession: economy in “safe zone” where RP not possible
  - As recession proceeds, economy moves to crisis zone, where RP possible
  - Sunspot RP in 2008Q4 → financial and real sector collapse
Financial Crisis: Model vs. Data

1. Investment

2. GDP

3. S&P 500 Financial Index and Bank Net Worth

4. Excess Bond Premium (Gilchrist-Zakrjsek)*

* Excess bond premium = GZ Spread with default premium removed.
Lender of Last Resort (LoLR) Policies

\[ \mathbb{E}_t \{ R^k_{t+1} \} = R_{t+1} + \mathbb{E}_t \{ R^k_{t+1} - R_{t+1} \} \]

- Perspective from the theory: LoLR policies involve reducing \( \mathbb{E}_t \{ R^k_{t+1} - R_{t+1} \} \)

- Example: Large Scale Purchases of AMBS Securities (QE1)
  - Central bank intermediation to offset contraction of private intermediation
  - Fed advantage: Not balanced-sheet constrained
    * Can fund AMBS purchases by issuing interest-bearing reserves elastically
  - Evidence suggests policy led to reduction in mortgage spreads
QE1 and Mortgage Spreads

Agency MBS and Agency Debt Holdings by Sector

Mortgage Spreads

- Central Bank and Government
- Nontraditional and Shadow intermediaries
- Institutional investors

- 30Y Mortgage - 10Y Treasury
- QE1 Announced
MacroPrudential Policies

- Models provide rationale for regulation (capital / liquidity requirements, etc.)
  - Due to externalities, underinsuration by banks under laissez-faire.

Two types of externalities:

1. Crisis depends on risk exposure of entire system; individual banks don’t internalize (Lorenzoni, Farhi/Werning, GKP)

2. Ex post bailout possibility encourages bank risk-taking (Chari/Kehoe, Fahri/Tirole, and Schneider/Tornell)

- What macro literature adds: quantitative assessment

- Long term goal: Use models to find robust macroprudential policies
  - Much like the search for robust monetary policy rules
Concluding Remarks

- Considerable progress incorporating banks in macroeconomic analysis

- Some areas ripe for more work
  - Buildup of vulnerabilities
    - Beliefs
    - Regulatory arbitrage and financial innovation in shadow banking (GKP)
  - Better understanding of costs of bank equity issuance
THANK YOU!