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Integrating Banking and Banking Crises in Macroeconomic Analysis

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Nobel/Riksbank Symposium

- 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)

Macro Models with Frictionless Financial Markets

- Aggregate spending varies inversely with cost of capital $\mathbb{E}_t\{R_{t+1}^k\}$ (ceteris par.)
- Arbitrage with riskless real rate R_{t+1}

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

- To first order

$$\mathbb{E}_t\{R_{t+1}^k\} \approx R_{t+1}$$

- 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) \rightarrow

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

- Financial crisis: sharp tightening of LTA \rightarrow sharp increase in $\mathbb{E}_t\{R_{t+1}^k - R_{t+1}\}$
 - Rise in $\mathbb{E}_t\{R_{t+1}^k\} \rightarrow$ contraction in real activity

Adding Banks and Banking Crises

$R_{t+1}^b \equiv$ banks' marginal cost of funds

- LTA \rightarrow

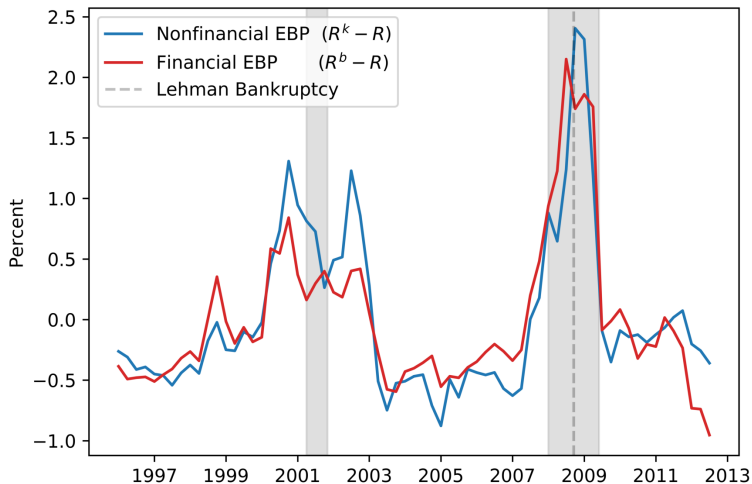
$$\mathbb{E}_t\{m_{t+1}R_{t+1}^k\} \geq \mathbb{E}_t\{m_{t+1}R_{t+1}^b\} \geq \mathbb{E}_t\{m_{t+1}R_{t+1}\}$$

- 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)

Gilchrist-Zakrasjek excess bond premium



EBP: rate of return on corporate bonds minus that on similar maturity government debt, with default premium removed

(Macro) Modeling of Banking Crises: Preliminaries

- 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 ϕ_t (“leverage cap”)

Bank balance sheet:

$$Q_t K_t^b = N_t + D_t$$

Leverage constraint:

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

- Financial crisis: sharp contraction in either N_t or $\bar{\phi}_t \rightarrow$ 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

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

N_t dynamics:

$$N_t = [(R_t^k - R_t)\phi_{t-1} + R_t]N_{t-1} - Div_t$$

- Crisis: Sharp negative bank portfolio return: $R_t^k = \frac{Z_t + Q_t}{Q_{t-1}} \downarrow \rightarrow N_t \downarrow$
 \rightarrow constraint tightens $\rightarrow \mathbb{E}_t\{R_{t+1}^k - R_{t+1}\} \uparrow \rightarrow$ economy weakens
- Mechanism strength increasing in leverage ϕ_{t-1}
- Uncertainty \uparrow may enhance crisis by reducing $\bar{\phi}_t$

Distinguishing Mechanisms via Leverage Cyclicity?

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

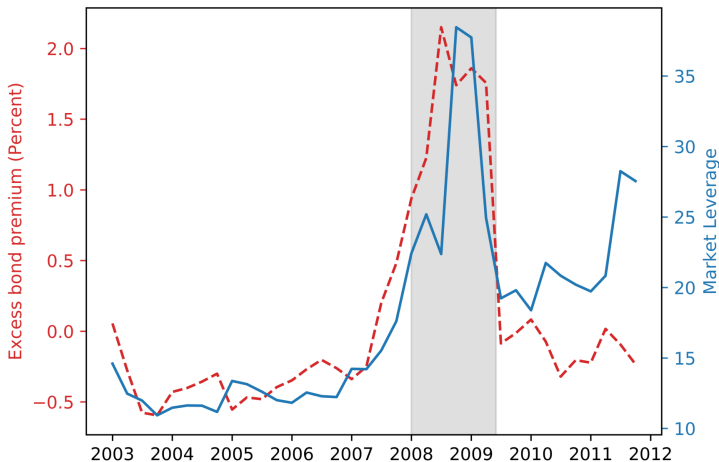
1. $\bar{\phi}_t \downarrow \rightarrow$ procyclical leverage (e.g., Adrian/Shin)
2. $N_t \downarrow \rightarrow \mathbb{E}_t\{R_{t+1}^k - R_{t+1}\} \uparrow \rightarrow \bar{\phi}_t \uparrow \rightarrow$ countercyclical leverage (e.g., He/Krish.)

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 Dealer Market Leverage and Financial EBP

red = Financial EBP, blue = Leverage



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, Chowdrow-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)

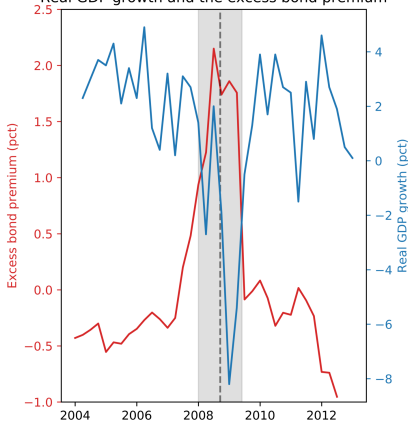
- “Orthogonal” variation in N_t of Commerzbank, large German bank
 - Source: losses from U.S. mortgage-backed securities during 2008
 - Independent of Commerzbank borrower prospects: No German real estate crisis
- Finds large significant effects of N_t contraction lending and on employment

Capturing Nonlinear Dimension of Crisis

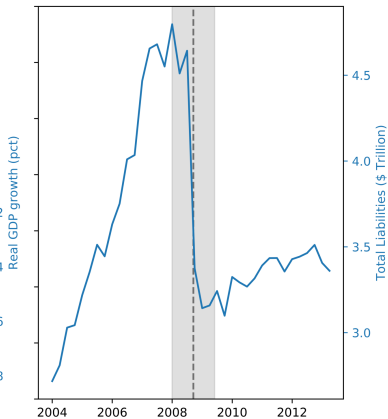
- Heart of crisis featured nonlinear dynamics:
 - Unusually sharp increase in credit spreads and contraction in real activity
 - No observable large standard business cycle shocks
- Active effort to model nonlinear collapse:
 - Brunnermeier/Sannikov, Chari et. al., Dang et. al., He/Krishnamurthy
- Gertler/Kiyotaki/Prestipino: 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



Integrating Rollover Panics

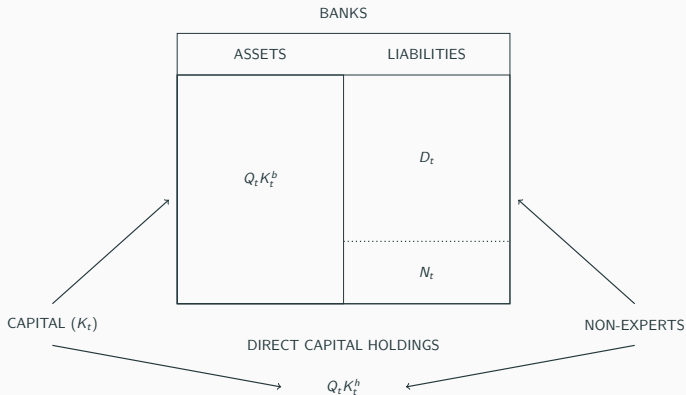
- To model just described, add possible firesales of bank assets
 - Add “non-experts” with limited capacity to absorb securities banks hold (e.g., Shleifer/Vishny, Brunnermeier/Pedersen, Stein).
 - Security prices decrease as assets these agents absorb increase
- Rollover panic: “sunspot” failure of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



BANK RUN EQUILIBRIUM



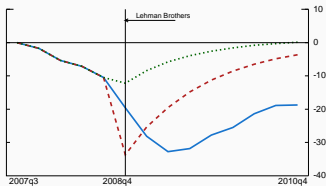
Numerical Crisis Simulation

- 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

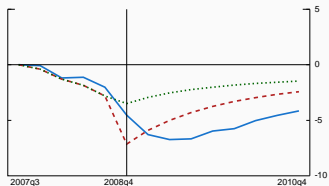
Financial Crisis: Model vs. Data

— Data - - - Model Model No Run

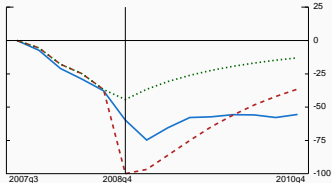
1. Investment



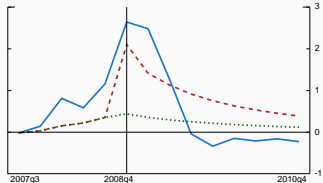
2. GDP



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



4. Excess Bond Premium (Gilchrist-Zakrajsek)*



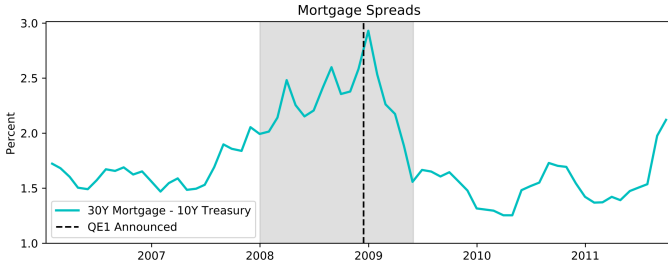
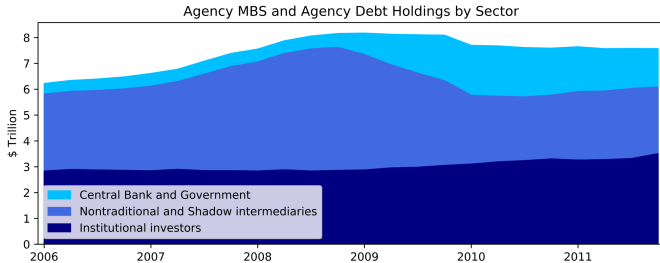
* Excess bond premium = GZ Spread with default premium removed.

Lender of Last Resort (LoLR) Policies

$$\mathbb{E}_t\{R_{t+1}^k\} = R_{t+1} + \mathbb{E}_t\{R_{t+1}^k - R_{t+1}\}$$

- Perspective from the theory: LoLR policies involve reducing $E_t\{R_{t+1}^k - R_{t+1}\}$
- 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



MacroPrudential Policies

- Models provide rationale for regulation (capital / liquidity requirements, etc.)
 - Due to externalities, underinsurance 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!