Bank Capital Regulation, Lending Channel and Business Cycles

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Motivation

More to Come: FDIC, August, 2009 "416 Banks on endangered list."
Motivation

Figure 3.4. Average Statistics for Recessions and Recoveries

The severity of most recessions is closely related to their duration. Recessions following financial crises are longer than average. Recessions following oil shocks are relatively severe but not very long. The bounce-back from financial crises is weaker than average. The time for output to recover to the level of the previous peak is longer.

Source: IMF staff calculations.

Recessions associated with financial crises tend to be unusually severe and their recoveries typically slow.

IMF, WEO(2009), "Recessions associated with financial crises tend to be unusually severe and their recoveries typically slow."

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Motivation

Macroeconomic Questions:

- How are the effects of macroeconomic shocks amplified and propagated through the financial system when the financial system itself is not stable?

- What are the macroeconomic costs of banking instability?
Selective Literature Review

What has been done...

- Credit Demand (Financial accelerator): Bernanke, Gertler and Gilchrist (1999), Carlstrom and Fuerst (1997) 
  *linkage between borrowing cost of firms and their net worth*

  linkage between the bank's lending decision and its capital structure

What is missing...

- No instability in the banking sector. No uncertainty in bank's loan default rate and portfolio return.
- No variation of bank capital ratio.
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- **Credit Supply (Bank Capital Channel):** Markovic (2006), Aguiar and Drumond (2007), Meh and Moran (2007)  
  *linkage between the bank’s lending decision and its capital structure*

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Contribution

- Financial contract that pins down the optimal capital structure of firms and banks in a realistic setting: namely full deposit insurance and bank capital regulation.

- Endogenously derive uncertainty in bank’s loan portfolio.

- Introduce bank capital position as an additional state variable that amplifies and propagates business cycles.
Structure of Economy

Households
  ⤷ Deposit → Bank
  ⤷ Equity → Bank

Labor

Consumption

Bank
  ⤷ Loan → Entrepreneur
  ⤷ Loan+Net Worth → Entrepreneur

Entrepreneur
  ⤷ Wholesale goods → Retail
  ⤷ Capital → Capital Producer

Retail
  ⤷ Investment → Capital Producer

Capital Producer
A continuum of entrepreneurs and banks, both risk-neutral
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Asymmetric information:
Idiosyncratic productivity shock $\omega_i$ is private information to entrepreneur, banks have to pay monitoring cost (a fixed portion of realized return) to observe the outcome.
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Optimal contract: Risky debt. (Gale and Hellwig (1985))
$\omega_i > \bar{\omega}$, entrepreneur pay $R^L$
$\omega_i < \bar{\omega}$, entrepreneur default on loan, bank monitors the project outcome and take what is left.
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Entrepreneurs maximize their profit subject to the participation constraint of banks, $\bar{\omega}$ is pinned down.
Credit demand derived from optimal contract

\[ E_t R^k_{t+1} = S \left( \frac{q_t K_{t+1}}{N_{t+1}} \right) R^f_{t+1} \]

- Cost of bank fund \( R^f_{t+1} \):
  - In BGG, risk free rate.
  - In Bank Capital Channel literature, linear combination of cost of bank equity and deposit.

\[ R^f_{t+1} = \Delta_t R^e_{t+1} + (1 - \Delta_t) R^d_{t+1} \]

\( \Delta_t \) is bank capital ratio.
Major difference compared to BGG contract:

- BGG (1999): state-contingent contract. entrepreneurs undertake all the aggregate risk. (All the aggregate shocks are absorbed by firm’s net worth) Bank has safe loan portfolio.

- In this model, entrepreneurs and banks share aggregate risk. Contract has fixed loan rate. Ex-post default rate may deviate from ex-ante default rate, banks face uncertainty in loan portfolio. (Aggregate shocks hit both the firm and bank’s balance sheet)

\[ \overline{\omega^b} = \frac{\overline{\omega^a E_t R^k_{t+1}}}{R^k_{t+1}} \]

- \( \overline{\omega^a} \) - ex-ante default
- \( \overline{\omega^b} \) - ex-post default
State variables

- Evolution of Bank capital:

\[ e_{t+1} = (1 - \Phi_t) e_t + R^L_{t+1} L_{t+1} (F(\omega^a) - F(\omega^b)) + (1 - \mu) \int_{0}^{\omega^b} \omega R^k_{t+1} q_t K_{t+1} f(\omega) d\omega - (1 - \mu) \int_{0}^{\omega^a} \omega E_t R^k_{t+1} q_t K_{t+1} f(\omega) d\omega + w^e_t \]

- Evolution of Entrepreneur net worth:

\[ N_{t+1} = \gamma V_t + w^e_t \]

\[ V_t = \int_{\omega^b}^{\infty} \omega R^k_{t+1} q_t K_{t+1} f(\omega) d\omega - (1 - F(\omega^b)) R^L_{t+1} L_{t+1} - \int_{0}^{\omega^b} \mu \omega R^k_{t+1} q_t K_{t+1} f(\omega) d\omega \]
Intuition

Credit Demand Curve: Contingent on Firm Net Worth

Credit Supply Curve: Contingent on Bank Capital

Position Credit Spreads

Credit Volume $L^*$

Credit Spreads $RP^*$
Banking regulation

- Basel Accord: Risk adjusted capital to asset ratio minimum 8 percent.

\[ \Phi_t = cdf(\Delta_t, \sigma) \]

- \( \Delta_{i,t} \) is lognormal distributed with mode of \( \Delta_t \), standard deviation of \( \sigma \).


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Household:

$$\max E_t \sum_{k=0}^{\infty} \beta^k [\ln(c_{t+k}) + \frac{d_{t+k}^{1+\varphi}}{1+\varphi} + \rho \ln(1 - l_{t+k})]$$

subject to

$$d_{t+1} + e_{t+1} + c_t = w_t l_t + R_{t+1}^d d_t + R_{t+1}^e (1 - \Phi_{t+1}) e_t + \Pi_t$$

$\Phi_t$ is bank default rate.

Aggregate production function:

$$Y_t = A_t K_t^{\alpha_k} h_t^{\alpha_h} (h_t^e)^{\alpha_e} (h_t^b)^{\alpha_b}$$

Capital supply curve:

$$q_t = 1 + \chi \left( \frac{i_t}{k_t} - \delta \right)$$
Retail Sector (Monopolistic Competition and Calvo Pricing)

\[ \beta E_t \pi_{t+1} = \pi_t - (1 - \beta \theta) \frac{1 - \theta}{\theta} \hat{m} c_t \]

Monetary Policy

\[ r^m_t = \rho r^m_{t-1} + \rho \pi \pi_{t-1} + \epsilon_t \]
Calibration

Parameters are calibrated to match following steady states:

- Leverage ratio 50 percent
- Bankruptcy rate of entrepreneur 2.6 percent
- External finance premium 180bp
- Bank capital ratio 10 percent
- Bank default rate 1 percent
- Bank equity premium 480bp
- Mark-up 20 percent

Other parameters important for dynamics:

- Calvo probability 0.75
- Capital adjustment parameter 2 (King and Wolman (1996), Chirinko (1993))
Impulse Responses to Monetary Policy Shock

- **Aggregate Lending**
- **Bank Capital**
- **Bank Default Rate**
- **Cost of Bank Capital**
- **Expected Loan Default Rate**
- **Realized Loan Default Rate**

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Empirical Evidence

Christiano, Eichenbaum and Evans (JPE, 2005) ’Following a contractionary monetary shock, net funds raised by the business sector increase for roughly a year, after which it falls.’
Short Run Effect of Bank Capital Channel: Monetary Shock

![Graphs showing the effect of bank capital channel on various economic indicators.]

- **Output**: Comparison of Zhang, BGG, and No financial friction models.
- **Investment**: Similar models compared.
- **Asset price**: Same models compared.
- **Risk Premium**: Comparison of models.
- **Inflation**: Comparison of models.
- **Consumption**: Comparison of models.

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Intuition

Old Credit supply curve
Old Credit demand curve
New Credit demand Curve
Credit Spreads
Credit Volume
Demand Friction

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Intuition

Old Credit supply curve
New credit supply curve
Old Credit demand curve
New Credit demand Curve
Credit Spreads
Credit Volume
Supply Friction
Demand Friction

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Financial Shock: Sudden decline in Bank Capital

- Output
- Inflation
- Investment
- Asset Price
- Firm Net Worth
- Credit Spreads
- Realized Loan Default Rate
- Aggregate Lending
- Bank Default Rate

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Long Run Effect of Bank Capital Channel

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<th></th>
<th>ZHANG</th>
<th>BGG</th>
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<tr>
<td>Capital</td>
<td>7.1621</td>
<td>7.4116</td>
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<tr>
<td>Investment</td>
<td>0.17905</td>
<td>0.1853</td>
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<tr>
<td>Output</td>
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<td>0.875</td>
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<tr>
<td>Consumption</td>
<td>0.68604</td>
<td>0.68964</td>
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Compared to BGG, additional banking capital channel leads to lower level of investment and output in the long run.
Banking instability amplifies and propagates business cycles to a large extent in the short run.

Banking instability leads to lower investment and output in the long run.

Extend the model to consider consumer loan and to open economy.

Use the model to give policy suggestions on banking regulation.