Credit Spreads, Banking Crises and Financial Policy

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Federal Reserve Bank of New York and Federal Reserve Board

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The views expressed in this presentation are our own and do not necessarily reflect those of the Federal Reserve Bank of New York or the Board of Governors of the Federal Reserve System.
Motivation

- Recent wave of financial crises has put financial stability at the forefront of policy discussions.

- “Macroprudential” policy has been used as first line of defense for systemic financial instability risks.

- Need for models that can account for financial crises, and that can be used to analyze the desirability of macroprudential policies.
Financial Crises: Some Facts

- Infrequent events associated with severe disruption in financial intermediation.
  - Large spikes in credit spreads, sharp losses in financial sector equity.
  - Financial sector vulnerabilities ex-ante.
  - Importance of nonlinearities.
Data

- Countries: **Italy, Spain, France, Germany, UK, US.**

- **Corporate Credit Spreads** for non-financial firms.
  - The average spreads on the yield of private sector bonds in each country relative to the yield on German/UK/US government securities of matched maturities.

- **Bank Equity** (S&P500 Financial Index for the US and its equivalent for other countries) and **macroeconomic variables**.


Financial Crises: Some Facts

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  - Large spikes in credit spreads, sharp losses in financial sector equity.
  - Financial sector vulnerabilities ex-ante.
  - Importance of nonlinearities.
Crises Event Study

Credit Spread

Bank Equity

GDP

Investment

quarters

quarters

quarters

quarters

ppt, annual

log deviation from HP trend

log deviation from HP trend

log deviation from HP trend

log deviation from HP trend
Financial Crises: Some Facts

- Infrequent events associated with severe disruption in financial intermediation.
  - Large spikes in credit spreads, sharp losses in financial sector equity.
  - Financial sector vulnerabilities ex-ante.
  - Importance of nonlinearities.
Positive Skewness in Distribution of Spreads
Asymmetry in Relation between Spreads and Economic Activity

- **All Spread Deviations**
  - Correlation: $\text{Corr} = -0.34$

- **Negative Spread Deviations**
  - Correlation: $\text{Corr} = -0.14$

- **Positive Spread Deviations**
  - Correlation: $\text{Corr} = -0.33$
Goal of This Paper

- Develop a small open economy DSGE model with frictions in financial intermediation that can account for the facts.

- Use the model for analysis of financial stability policies.
Main Modeling Features

- A macroeconomic model with banks, as in Gertler and Karadi (2009).

- Banks’ incentive constraint occasionally binding
  - occasional severe financial distress.
  - nonlinearity in relation between financial distress and activity.

- Banks can issue (inside) equity as well as short-term debt
  - precautionary behavior.

- Banking sector integrated into an otherwise standard real business cycle model of a small open economy.
Related Literature

- Nonlinear Dynamic Stochastic General Equilibrium models:
    - exogenous collateral constraint.
    - no banking sector.
Related Literature

Nonlinear Dynamic Stochastic General Equilibrium models:

  → exogenous collateral constraint.
  → no banking sector.

Dynamic Stochastic General Equilibrium models with banking sector:

  → constraint always binds.
  → no precautionary behavior by banks.
Related Literature

- **Nonlinear Dynamic Stochastic General Equilibrium models:**
    - exogenous collateral constraint.
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- **Dynamic Stochastic General Equilibrium models with banking sector:**
    - constraint always binds.
    - no precautionary behavior by banks.

- **Other related models with and without banking sector:**
Model

Foreign Banks

Agency problem

Banks

Nonfinancial Firms

Domestic Households
Households

- Within each household, $1 - f$ “workers” and $f$ “bankers”.

- Workers supply labor to firms and return wages to the household.

- Each banker manages a financial intermediary and also transfers earnings back to the household.

- Perfect consumption insurance within the family.

- Bankers have finite survival probability $\sigma$ (average survival time $\frac{1}{1-\sigma}$).
Households: Objective

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\left( C_t - \chi \frac{L_t^{1+\epsilon}}{1+\epsilon} \right)^{1-\gamma} - 1}{1-\gamma}$$

subject to

$$C_t + B_t \leq W_t L_t + R_{t-1} B_{t-1} + \Pi_t$$

where

- $B_t$: short term bonds (intermediary deposits)
- $\Pi_t$: payouts to the household from firm ownership net transfers to its bankers
Banks: Period-\(t\) Timeline

\[
n_{t+1} = R_{K,t+1} Q_t s_t - R_t d_t + e_t
\]

Beginning-of-period net worth \(n_t\)
\(Q_t s_t \leq n_t + d_t\)

- \((\theta Q_t s_t \text{ (\& exit)})\)
- \((\text{divert})\)
- \((\text{honor})\)
- \((\text{exit shock realized})\)
- \((\text{exit (prob. } 1 - \sigma))\)
- \((\text{survive (prob. } \sigma))\)
- \((\text{Raise equity } e_t)\)
- \((\text{Pay cost } C(e_t, Q_t s_t))\)
- \((\text{Pay household } R_{K,t+1} Q_t s_t - R_t d_t)\)
Banks: Balance Sheet and Net Worth

- **Balance Sheet**

\[ Q_t s_t \leq n_t + d_t \]

where

\[ d_t = b_t + b^*_t \]

- **Evolution of Net worth**

  ▶ Surviving Banks: \( n_t = R_{K,t} Q_{t-1} s_{t-1} - R_{t-1} d_{t-1} + e_{t-1} \)

- Banks can issue new equity \( e_t \) at cost \( C(e_t, Q_t s_t) \)

  ▶ \( C(e_t, Q_t s_t) \) captures agency and other costs of raising equity

  → Alternative interpretation: costs of lowering dividends
Banks: Agency Problem

- After the banker/intermediary borrows funds at the end of period $t$, it may divert a fraction $\theta$ of assets back to its family.

- If the bank does not honor its debt, creditors can liquidate it and obtain the remaining of assets they initially funded.

- Banks’ incentive constraint: $V_t \geq \theta Q_t s_t$.

- When the constraint binds $\rightarrow$ systemic financial crisis.
Banks: Objective

\[ V_t(n_t) = \max_{s_t, d_t, e_t} \ (1 - \sigma) \mathbb{E}_t (\Lambda_{t, t+1} \bar{n}_{t+1}) + \sigma \{ \mathbb{E}_t \Lambda_{t, t+1} [V_{t+1}(n_{t+1}) - e_t] - C(e_t, Q_s t) \} \]

subject to

\[ Q_s t \leq n_t + d_t \]
\[ n_{t+1} = R_{K, t+1} Q_s t - R_t d_t + e_t \]
\[ V_t(n_t) \geq \theta Q_s t \quad (IC) \]

where \( \Lambda_{t, \tau} \equiv \) household’s stochastic discount factor

and \( \bar{n}_t = R_{K,t} Q_{t-1} s_{t-1} - R_{t-1} d_{t-1} \)
Banks: Value Function

\[ V_t(n_t) = \max_{s_t, e_t} \underbrace{\mu_{K,t} Q_t s_t + v_t n_t + \sigma [v_{e,t} e_t - C(e_t, Q_t s_t)]}_{\alpha_t n_t} \]

s.t. (IC)

with

\[
\begin{align*}
\mu_{K,t} &= \mathbb{E}_t [\Lambda_{t,t+1} (1 - \sigma + \sigma \alpha_{t+1}) (R_{K,t+1} - R_t)] \\
v_t &= \mathbb{E}_t [\Lambda_{t,t+1} (1 - \sigma + \sigma \alpha_{t+1})] R_t \\
v_{e,t} &= \mathbb{E}_t [\Lambda_{t,t+1} (\alpha_{t+1} - 1)]
\end{align*}
\]

where \( \alpha_t \) is the marginal value of bank wealth:

\[ \alpha_t = V_t'(n_t) \]
Banks: Credit Spreads

- Assume $C(e_t, Q_t s_t) = c(x_t) Q_t s_t$, where $x_t \equiv \frac{e_t}{Q_t s_t}$

- After imposing the optimality condition for new equity, $\nu_{e,t} = c'(x_t)$, the problem becomes

$$V_t(n_t) = \max_{s_t} \mu_t Q_t s_t + \nu_t n_t$$

subject to

$$\mu_t Q_t s_t + \nu_t n_t \geq \theta Q_t s_t$$

where $\mu_t \equiv \mu_{K,t} + \sigma \frac{K}{2} x_t^2$ is the “total” excess return on assets.

- When the constraint does not bind:
  $$\mu_t = 0 \text{ and } V_t(n_t) = \nu_t n_t$$

- When the constraint binds:
  $$\mu_t > 0 \text{ and } V_t(n_t) = (\nu_t + \mu_t \bar{\phi}_t) n_t$$
Banks: Binding Incentive Constraint

- Re-writing Incentive Constraint:
  \[ \mu_t Q_t s_t + \nu_t n_t = \theta Q_t s_t \]

- Endogenous Leverage Constraint:
  \[ Q_t s_t = \phi_t n_t \]
  with \[ \phi_t \equiv \frac{\nu_t}{\theta - \mu_t} \]

- \( \phi_t \) = Maximum Leverage Ratio
Banks: Optimality Condition for New Equity

- Optimality condition for new equity issuance:

\[
\mathbb{E}_t \left[ \Lambda_{t,t+1} \left( \alpha_{t+1} = V_{t+1}'(n_{t+1}) \right) \right] = c'(x_t)
\]

\[
\Lambda_{t,t+1} = \left( v_{t+1} + \phi_{t+1} \mu_{t+1} - 1 \right)
\]

expected net value of an extra unit of bank equity in \( t+1 \)
Banks: Optimality Condition for New Equity

- Optimality condition for new equity issuance:

\[
E_t \left[ \Lambda_{t,t+1} \left( \alpha_{t+1} = V'_{t+1}(n_{t+1}) \right) \right] = c'(x_t)
\]

expected net value of an extra unit of bank equity in \( t+1 \)

- \( \mu_{t+i} = 0 \) for all \( i \geq 1 \) \( \rightarrow V_{t+i} = \alpha_{t+i} = 1 \): No equity issuance

- \( \mu_{t+i} > 0 \) for any \( i \geq 1 \) \( \rightarrow V'_{t+i}(n_{t+i}) > 1 \): Positive value of equity issuance
Banks: Optimality Condition for New Equity

- Optimality condition for new equity issuance:

\[
E_t \left[ \Lambda_{t,t+1} \left( \alpha_{t+1} = V_{t+1}'(n_{t+1}) \right) \right] = c'(x_t)
\]

\( \Lambda_{t,t+1} \left( V_{t+1} + \phi_{t+1} \mu_{t+1} - 1 \right) \)

expected net value of an extra unit of bank equity in \( t + 1 \)

- \( \mu_{t+i} = 0 \) for all \( i \geq 1 \) \( \rightarrow \) \( \nu_{t+i} = \alpha_{t+i} = 1 \): No equity issuance

- \( \mu_{t+i} > 0 \) for any \( i \geq 1 \) \( \rightarrow \) \( V_{t+i}'(n_{t+i}) > 1 \): Positive value of equity issuance

\( \rightarrow \) banks have an incentive to issue equity to the extent that they expect to be constrained by their net worth in the future.
Banks: Normal Times vs. Financial Crises

In normal times:

- Banks are unconstrained
- $\mathbb{E}_t (R_{K,t+1} - R_t)$ small
- Precautionary equity issuance
- Behavior of the economy is similar to frictionless model
Banks: Normal Times vs. Financial Crises

- In normal times:
  - Banks are unconstrained
  - $E_t (R_{K,t+1} - R_t) \text{ small}$
  - Precautionary equity issuance
  - Behavior of the economy is similar to frictionless model

- In a financial crisis:
  - Banks’ Incentive Constraints bind
  - $E_t (R_{K,t+1} - R_t) \uparrow\uparrow$
  - Nonlinear financial accelerator effect: with constraint binding, $\downarrow N \rightarrow \downarrow I$ and $Q \rightarrow \downarrow N$
Nonfinancial Firms

**Capital firms**

- Purchase capital goods from capital producers (price $Q_t$) and rent it to final goods firms.

\[ R_{K,t} = e^{\psi_t} \frac{\alpha \frac{Y_t}{e^{\psi_t} K_{t-1}} + (1 - \delta) Q_t}{Q_{t-1}} \]

where $\psi_t \sim N(0, \sigma_{\psi})$ is a capital quality shock.

**Final goods firms**

- Production function:

\[ Y_t = (e^{\psi_t} K_{t-1})^\eta L_t^{1-\eta} \]

- Optimality Condition for labor

\[ (1 - \alpha) \frac{Y_t}{L_t} = W_t \]
Capital Producers

- Capital producers make new capital using input of final output and are subject to adjustment costs. They sell new capital to firms at the price $Q_t$.

- The price of capital goods is equal to the marginal cost of investment goods production:

$$Q_t = 1 + \psi \left( \frac{l_t}{e^{\psi t} K_{t-1}} - \delta \right)$$
SOE pays a small debt-elastic interest rate premium, following SGU (2003).

\[ R_t = \frac{1}{\beta} + \varphi \left( e^{\frac{\bar{B}_t}{\bar{Y}} - b} - 1 \right) + e^{R_t^* - 1} - 1 \]

where \( R_t^* \) is a shock to the country interest rate such that:

\[ \log(R_t^*) = \rho_R \log(R_{t-1}^*) + \varepsilon_{R,t} \]
\[ \varepsilon_{R,t} \sim N(0, \sigma_R) \]
Resource Constraint and Market Clearing

- **Resource constraint:**

\[
Y_t = C_t + \left[ \frac{l_t}{e^{\psi_t K_{t-1}}} + \frac{\psi_I}{2} \left( \frac{l_t}{e^{\psi_t K_{t-1}}} - \delta \right)^2 \right] e^{\psi_t K_{t-1}} + \frac{\kappa}{2} x_t^2 Q_t K_t + NX_t
\]

- **Balance of payments:**

\[
R_{t-1} B^*_t - B^*_t = NX_t
\]
Computation

- Solve the model using the Parameterized Expectations Algorithm.
  - To take into account the precautionary savings behavior of risk averse banks.
  - To take into account the strong nonlinearities.

- Method relies on approximating the expectations as a function of the state vector.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Source/Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor</td>
<td>$\beta$</td>
<td>0.985</td>
<td>Interest rate (6%, ann.)</td>
</tr>
<tr>
<td>Risk aversion</td>
<td>$\gamma$</td>
<td>2</td>
<td>Standard RBC value</td>
</tr>
<tr>
<td>Inverse Frisch elast.</td>
<td>$\varepsilon$</td>
<td>1/3</td>
<td>Frisch lab. sup. elast. (inv)</td>
</tr>
<tr>
<td>Labor disutility</td>
<td>$\chi$</td>
<td>2.8125</td>
<td>Steady state labor (30%)</td>
</tr>
<tr>
<td>Capital share</td>
<td>$\eta$</td>
<td>0.33</td>
<td>Standard RBC value</td>
</tr>
<tr>
<td>Capital depreciation</td>
<td>$\delta$</td>
<td>0.025</td>
<td></td>
</tr>
<tr>
<td>Investment adj. cost</td>
<td>$\psi_I$</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Debt elast. of interest rate</td>
<td>$\varphi$</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Reference debt/output ratio</td>
<td>$\overline{b}$</td>
<td>0.6</td>
<td>Steady state $B/Y$ of 60%</td>
</tr>
</tbody>
</table>

**Financial Intermediaries**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Source/Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival rate</td>
<td>$\sigma$</td>
<td>0.95</td>
<td>Expected horizon of 5 yrs</td>
</tr>
<tr>
<td>Fraction divertable</td>
<td>$\theta$</td>
<td>0.26</td>
<td>Frequency of crises (2%)</td>
</tr>
<tr>
<td>Transfer rate</td>
<td>$\xi$</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>Cost of raising equity</td>
<td>$\kappa$</td>
<td>5</td>
<td>Leverage of 4 in det. SS</td>
</tr>
</tbody>
</table>

**Shock Processes**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistence of interest rate</td>
<td>$\rho_R$</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>SD of interest rate innov.</td>
<td>$\sigma_R$</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>SD of capital quality</td>
<td>$\sigma_\psi$</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>
Results
The model can be cast in terms of 4 aggregate state variables:

- $\overline{K}_t \equiv e^{\psi_t} K_{t-1}$

- $\overline{\mathcal{N}}_{t-1} \equiv \sigma [x_{t-1} Q_{t-1} K_{t-1} - R_{t-1} D_{t-1}] + (1 - \sigma) \xi Q_{t-1} K_{t-1}$

- $\overline{B}_{t-1} \equiv R_{t-1} B_{t-1}$

- $R^*_t$
Figure: Model Policy Functions
<table>
<thead>
<tr>
<th>Variables</th>
<th>Symbol</th>
<th>No Policy</th>
<th>$\tau^S = 0.03$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>$Y_t$</td>
<td>0.8379</td>
<td>0.8395</td>
</tr>
<tr>
<td>Net worth</td>
<td>$N_t$</td>
<td>1.9162</td>
<td>2.0239</td>
</tr>
<tr>
<td>New equity issuance rate</td>
<td>$x_t$</td>
<td>0.0095</td>
<td>0.0104</td>
</tr>
<tr>
<td>Leverage ratio</td>
<td>$QK/N$</td>
<td>3.55</td>
<td>3.37</td>
</tr>
<tr>
<td>Maximum leverage</td>
<td>$\phi$</td>
<td>4.02</td>
<td>3.93</td>
</tr>
<tr>
<td>Spread (annualized, %)</td>
<td>$E(R_K) - R$</td>
<td>0.52</td>
<td>0.47</td>
</tr>
<tr>
<td>Debt-to-GDP ratio</td>
<td>$B/Y$</td>
<td>0.58</td>
<td>0.58</td>
</tr>
<tr>
<td>Utility</td>
<td>$U(C, L)$</td>
<td>-3.1966</td>
<td>-3.1973</td>
</tr>
</tbody>
</table>

### Moments (%)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tr>
<td>Time at the constr.</td>
<td></td>
<td>1.98</td>
<td>0.97</td>
</tr>
<tr>
<td>2-qtr-ahead crisis prob.</td>
<td></td>
<td>1.15</td>
<td>0.27</td>
</tr>
<tr>
<td>1-yr-ahead crisis prob.</td>
<td></td>
<td>5.77</td>
<td>2.92</td>
</tr>
<tr>
<td>SD(annual $g_Y$)</td>
<td></td>
<td>1.82</td>
<td>1.79</td>
</tr>
<tr>
<td>SD($Y$/E($Y$))</td>
<td></td>
<td>6.06</td>
<td>6.04</td>
</tr>
<tr>
<td>SD($C$/E($C$))</td>
<td></td>
<td>5.89</td>
<td>5.88</td>
</tr>
<tr>
<td>SD($I$/E($I$))</td>
<td></td>
<td>23.30</td>
<td>22.66</td>
</tr>
<tr>
<td>SD($NX/Y$)</td>
<td></td>
<td>4.88</td>
<td>4.77</td>
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<tr>
<td><strong>Welfare Gain (%)</strong></td>
<td></td>
<td>0.02</td>
<td></td>
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Figure: Impulse Responses to Capital Quality Shocks

- Output
- Investment
- Foreign Debt, B
- Net Worth, N
- Total Credit, $Q \times K$
- $\psi$ (shock)

$\psi$ shock, 3%
$\psi$ shock, 3% and High Initial Debt

Quarters
Financial Crisis Events

- Simulate the economy for 150,000 quarters
- Identify all financial crisis events, defined as any instance when banks’ constraint binds for one or more consecutive periods
- Consider 16-quarter window around event
- Compute averages across events, normalizing spread peak to $t = 0$
Figure: Average Financial Crisis

Output

Investment

Foreign Debt, B

Net Worth, N

Total Credit Q × K

E(R_{t^*})−R

\(\psi\) (shock)

\(R^*\) (shock)

\(\log\)
Quantitative Application: Model vs. Data

- Consider augmented version of the model, including
  - Working capital loans by banks.
  - Shocks to Total Factor Productivity (TFP).

- Calibrate model parameters and shock processes to the data – Italy, Spain, Germany, France, UK, US.
  - TFP and country interest rate parameters obtained by fitting AR(1) processes to data.
  - Volatility of capital quality shock $\psi_t$ (iid) set to match volatility of financial sector equity in the data.

- Systemic banking crisis dates for each country taken from Laeven and Valencia (2013).
### Table: Quantitative Analysis: Calibration

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<td>$\bar{b}$</td>
<td>1</td>
<td>Steady state $B/Y \approx 100%$</td>
</tr>
<tr>
<td>Working capital</td>
<td>$\omega$</td>
<td>1</td>
<td>Paid in full</td>
</tr>
</tbody>
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**Financial Intermediaries**

| Survival rate                      | $\sigma$| 0.95    | Expected horizon of 5 yrs                         |
| Fraction divertable                | $\theta$| 0.26    | Frequency of crises $\approx 4\%$                 |
| Cost of raising equity             | $\kappa$| 28      | Bank leverage $\approx 7$                         |
| Transfer rate                      | $\xi$| 0.0001  |                                                   |

**Shock Processes**

| Persistence of interest rate       | $\rho_R$| 0.87    |                                                   |
| SD of interest rate innov.         | $\sigma_R$| 0.14/100|                                                   |
| Persistence of TFP                 | $\rho_A$| 0.92    |                                                   |
| SD of TFP innov.                   | $\sigma_A$| 0.375/100|                                                  |
| SD of capital quality              | $\sigma_\psi$| 0.575/100|                                                   |
## Model vs. Data: Moments

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</table>
Figure: Model: Histogram of Credit Spreads
Model: Spreads and Economic Activity

All Spread Deviations

Negative Spread Deviations

Positive Spread Deviations

Corr = -0.13

Corr = -0.46

Corr = -0.47

Ozge Akinci and Albert Queralto

Credit Spreads, Banking Crises and Financial Policy
Figure: Financial Crisis Events: Model and Data
Policy

- Literature suggests desirability of ex-ante policies to prevent overborrowing in the presence of pecuniary externalities.
  

- In our framework, banks may undervalue equity when the constraint binds → role for policy to encourage equity issuance in normal times.

Experiment:

Government sets a subsidy $\tau_s$ per unit of equity issued, financed by a tax $\tau_t$ on bank assets such that $\tau_t = \sigma \tau_s x_t$ (balanced budget).

Bank's first order condition for equity issuance becomes $\nu_e, t + \tau_s = c'(x_t) \rightarrow$ policy leads banks to issue more equity.

Balance sheet constraint is now $(1 + \tau_t) Q_t s_t \leq n_t + d_t$.
Policy

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- Bank’s first order condition for equity issuance becomes

$$\nu_{e,t} + \tau^s = c'(x_t)$$

→ policy leads banks to issue more equity.

- Balance sheet constraint is now

$$(1 + \tau_t)Q_t s_t \leq n_t + d_t$$
Figure: Effects of Macroprudential Policy on Crisis Probabilities and Welfare

Crisis Probabilities

- 2 Quarters Ahead
- 1 Year Ahead

Welfare Gains

\( \tau^s \)
### Table: Stochastic Steady State

<table>
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<th>Variables</th>
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<td>Debt-to-GDP ratio</td>
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<td>Utility</td>
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<td><strong>Welfare Gain (%)</strong></td>
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Conclusions

- This paper develops a NDSGE model of a small open economy with frictions in the banking sector, which can account for occasional financial crises and for banks’ precautionary behavior.

- The model provides a framework for the analysis of financial policy.
  - In the model, macroprudential policies such as capital requirements are effective in reducing the likelihood of future crises, and can improve welfare.

- Next steps:
  - Normative analysis: Social planner / Ramsey.
  - Monetary version → financial stability analysis of monetary policy.
EXTRAS
Figure: Indicators of Bank Stress

Graph 1

Indicators of bank stress

Three-month Libor-OIS spreads

Basis points

Banking sector stock indices relative to broad indices

1 July 2007 = 100

1 Simple average across major banks; for the United States, Bank of America, Citigroup, JPMorgan Chase, Goldman Sachs, Morgan Stanley; for euro area, Banco Santander, BNP Paribas, Crédit Agricole, Deutsche Bank, ING Group, Société Générale, UniCredit SpA; for the United Kingdom, Barclays, Lloyds, HSBC, RBS; for Japan, Mitsubishi UFJ, Mizuho, Sumitomo Mitsui.

Sources: Bloomberg; Datastream; authors’ calculations.
Figure: Model Policy Functions

\[
\begin{align*}
K & \quad (0, 0.1) \\
\bar{N} & \quad (0, 0.05) \\
\bar{B} & \quad (0, 0.05) \\
R^* & \quad (0, 0.05)
\end{align*}
\]
Figure: Euler Residuals
Figure: Histogram of Euler Residuals
Figure: Hedge Fund and Finance Sector Leverage: Ang, Gorovyy, and Van-Inwegen (2011)
Figure: Bank Market to Book Ratios: Miao and Wang (2014)
Figure: Domestic Macroprudential Policy

Evolution of Macroprudential Policy Use, 2000-2013

Note: Tools included in the index are capital requirements, dynamic loan loss provisioning, and caps on LTV and DTI limits on loans.
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Notes: The empirical moments are taken from Aguiar and Gopinath (2006).
Figure: Macroeconomic Dynamics around Banking Crises: Korea

Back to main3