Credit Booms, Financial Crises and Macroprudential Policy

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December 2018
What We Do

- We develop a model of banking panics in which:
  1. Banking crises are usually preceded by credit booms
  2. Credit booms often do not result in crises, i.e. good booms

- We study Macroprudential regulation in this model:
  - How does Macroprudential policy weigh the benefits of preventing a crisis against the costs of stopping a good boom?
  - What are the effects of macroprudential policy and the features of optimal regulation?
    - Unintended consequences of regulation; Countercyclical buffers
Banking Crises in the Data (Schularick and Taylor)
Framework

- Endowment economy version of GKP (2018)

- Focus on how beliefs driven fluctuations can reproduce key empirical properties of banking crises in the data:
  - Boom bust cycles in credit
  - Unpredictability of crises

- Macroprudential regulation
Model Overview

- Capital is fixed $K_t = K = 1$ (normalized to unity)

- $(K^b_t)$ intermediated by banks; $(K^h_t)$ directly held by households:
  \[
  1 = K^h_t + K^b_t
  \]

- Households direct finance entails a quadratic deadweight loss:
  \[
  \frac{\alpha}{2} \left( K^h_t \right)^2
  \]

- Resource constraint is:
  \[
  Y_t = Z_t - \frac{\alpha}{2} \left( K^h_t \right)^2 = C_t
  \]

  where $Z_t$ is an exogenous productivity shock
Marginal Rates of Return on Capital

\( Q_t \equiv \) price of capital

- Intermediated capital

\[
R_{t+1}^b = \frac{Z_{t+1} + Q_{t+1}}{Q_t}
\]

- Directly held

\[
R_{t+1}^h = \frac{1}{1 + \alpha \frac{\kappa_t^h}{Q_t}} R_{t+1}^b
\]

i.e. increasing marginal cost of direct finance
Household and Bank Intermediation

**NO BANK RUN EQUILIBRIUM**

**BANKS**

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

**DIRECT CAPITAL HOLDING**

$Q_t K_t^h$

**CAPITAL**

$K$

**HOUSEHOLDS**

**BANK RUN EQUILIBRIUM**

$Q_t^* K$

**CAPITAL**

$K$

**HOUSEHOLDS**
Bankers

- Objective

\[ V_t = E_t \Lambda_{t,t+1} \left[ (1 - \sigma) n_{t+1} + \sigma V_{t+1} \right] \]

- Net worth \( n_t \) accumulated via retained earnings - no new equity issues

\[ n_{t+1} = R_{t+1}^b Q_t k_t^b - \bar{R}_t d_t \quad \text{if no run} \]
\[ = 0 \quad \text{if run} \]

- Balance sheet

\[ Q_t k_t^b = d_t + n_t \]
Deposit Contract

\( \bar{R}_t \equiv \text{deposit rate}; \ R_{t+1} \equiv \text{return on deposits} \)

\( p_t \equiv \text{run probability}; \ x_{t+1} < 1 \equiv \text{recovery rate} \)

- Deposit contract: (One period)

\[
R_{t+1} = \begin{cases} 
\bar{R}_t \text{ with prob. } 1 - p_t \\
x_{t+1} \bar{R}_t \text{ with prob. } p_t 
\end{cases}
\]
Limits to Bank Arbitrage

- **Moral Hazard Problem:**
  - After banker borrows funds at $t$, it may divert fraction $\theta$ of assets for personal use.
  - If bank does not honor its debt, creditors can
    - recover the residual funds and
    - shut the bank down.

- \[ \Rightarrow \text{Incentive constraint (IC)} \]
  \[ \theta Q_t k^b_t \leq V_t \]
Can show $V_t = \psi_t n_t$ with $\psi_t \geq 1$ and independent of $n_t$

Combine with $IC \rightarrow$ endogenous capital requirement:

$$\kappa_t \equiv \frac{n_t}{Q_t k_b^b} \geq \frac{\theta}{\psi_t}$$

Note:

- $\psi_t$ countercyclical $\rightarrow$ market capital requirements relaxed in bad times
- $n_t \leq 0 \Rightarrow$ bank cannot operate (key for run equilibria)
Bank Runs

- Self-fulfilling "bank run" equilibrium (i.e. rollover crisis) possible if:
  - A depositor believes that if other households do not roll over their deposits, the depositor will lose money by rolling over.
  - Condition met iff banks’ net worth $n_t$ goes to zero during a run
    - $n_t = 0 \rightarrow$ banks cannot operate
Conditions for Bank Run Equilibrium (BRE)

- Run equilibrium exists at $t + 1$ if

$$
(Q_{t+1}^* + Z_{t+1}) K_t^b < D_t \bar{R}_t
$$

where $Q_{t+1}^*$ is the liquidation price:

$$
Q_t^* = E_t\{\Lambda_{t,t+1}(Z_{t+1} + Q_{t+1}) - \alpha K_t^h\}
$$

evaluated at $K_t^h = 1$

- $\iota_{t+1}$ is a sunspot variable; if $\iota_{t+1} = 1$ depositors panic when run possible

- Run occurs if (i) equation (1) is satisfied and (ii) $\iota_{t+1} = 1$
Run Probability $p_t$

- Assume sunspot occurs with probability $\kappa$.
- The time $t$ probability of a run at $t + 1$ is
  \[
p_t = \Pr_t \{ Z_{t+1} < Z^R_{t+1} \} \cdot \kappa
  \]
- $Z^R_{t+1}$ is the threshold value below which a run is possible
  \[
  Q^*_{t+1} \left( Z^{R}_{t+1} \right) + Z^R_{t+1} = \frac{D_t \bar{R}_t}{K^b_t}
  \]
- Higher leverage ratios $\frac{D_t \bar{R}_t}{K^b_t}$ increase run probability
Run Equilibrium

\[ Q_{t+1}^* \left( Z_{t+1}^R \right) + Z_{t+1}^R \]

No Run-Equilibrium Possible

Negative Productivity Shock

Run-Equilibrium Possible
Run Equilibrium

\[ Q_{t+1}^* \left( Z_{t+1}^R \right) + Z_t^R \]

No Run-Equilibrium
Possible

Higher Leverage Ratio
BA

\[ \frac{D_t \bar{R}_t}{K^b} \]

Run-Equilibrium
Possible
Run After a Negative 2 std Shock

**Productivity**

**Run Probability**

**Bank Net Worth**

**Bank Intermediation**

**Excess Return: ER^b-R^{free} (10 years)**

**Output**
Boom leading to the bust: news driven optimism

- Productivity:
  \[ Z_{t+1} = \rho Z_t + \epsilon_{t+1} \]

- Normally, \( E\{\epsilon_{t+1}\} = 0 \)

- Occasionally, bankers receive news about future productivity

- If news at \( t \), bankers learn that unusually large realization \( \epsilon_{tB} \) of size \( B > 0 \) will happen at \( t^B \in \{t + 1, \ldots, t + T\} \) with prob. \( \overline{P}_0^B < 1 \)

- \( \Pr_t\{t^B = t + i\} \) is a truncated Normal (discrete approx.)

- Agents update \( \Pr_{t+i} \) and \( \overline{P}_{t+i}^B \) by observing \( \epsilon_{t+i} \)

- Prob. at \( t + i \) of shock at \( t + i + 1 \) is \( \Pr_t\{t^B = t + i + 1\} \cdot \overline{P}_{t+i}^B \)
Beliefs Driven Credit Boom

Prior cond. prob. of shock happening at time $t$

Beliefs Evolution

Productivity

Output

Credit: $Q \cdot K^b$

Prob. of being in crisis zone: $\Pr \{ Z_{t+1} < Z_{t+1}^R \}$
Boom Leading to a bust

- **Expected Productivity**
  - Graph showing the expected productivity over 60 quarters with a peak at 10 quarters.

- **Realized Productivity**
  - Graph showing the realized productivity with two lines, one for $Z_t$ and another for $Z_{t+1}$.

- **Bank Intermediation**
  - Graph showing the percentage change in bank intermediation over 60 quarters.

- **Run Probability (if no boom)**
  - Graph showing the run probability level over 60 quarters.

- **Bank Net Worth**
  - Graph showing the percentage change in bank net worth.

- **Output**
  - Graph showing the output levels from -100 to 500 over 60 quarters.

- **Capital Ratio ($\kappa$)**
  - Graph showing the capital ratio change over 60 quarters.

- **Asset Price**
  - Graph showing the asset price level.

- **Excess Return: $ER^b - R^{free}$ (10 yrs)**
  - Graph showing the excess return over 60 quarters.
False Alarms

- **Expected Productivity**
- **Realized Productivity**
- **Bank Intermediation**
- **Run Probability (if no boom)**
- **Bank Net Worth**
- **Output**
- **Capital Ratio:**
- **Asset Price**
- **Excess Return:** $ER^b - R^{free}$ (10 yrs)

Graphs illustrating changes in various economic indicators over time, with blue lines indicating boom scenarios and red dashed lines indicating no sunspot observed.
Unpredictability of Crises: Data and Model

The diagrams illustrate the relationship between changes in credit and crises. On the left, the log of credit from trend at t-2 is plotted against the log of credit from trend at t-1. The right diagram shows the percentage change in credit from the mean at year t-2 against the percentage change in credit from the mean at year t-1. The data points are color-coded to indicate whether there was a crisis at time t or not.
Macroprudential regulator sets time varying capital requirement $\bar{\kappa}_t$

Equilibrium capital ratios are

$$\kappa_t = \max \{\bar{\kappa}_t, \kappa^m_t\}$$

where $\kappa^m_t = \frac{\theta}{\psi_t}$ are the market imposed capital ratios

We restrict policy to be determined by simple rule

$$\bar{\kappa}_t = \begin{cases} \bar{\kappa} & \text{if } N_t \geq \bar{N} \\ 0 & \text{if } N_t < \bar{N} \end{cases}$$

We look for $(\bar{\kappa}, \bar{N})$ that maximize welfare
Regulation

Capital Ratio

Unregulated Equilibrium

Bank Net Worth

0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09
Regulation

Bank Net Worth

Capital Ratio

Unregulated Equilibrium
Capital Requirement
Avoiding a Run with Regulation

**Expected Productivity**

- Regulated
- Unregulated

**Realized Productivity**

- \( Z_t \)
- \( Z_{t+1}^{R} \) (Unregulated)

**Capital Ratio**: \( \kappa \)

**Bank Intermediation**

**Run Probability**

**Output**

Quarters

% Δ from SS

% Δ from SS

% Δ from SS
Responding to False Alarms: No Sunspot Observed

- Expected Productivity
- Realized Productivity
- Capital Ratio: $\kappa$
- Bank Intermediation
- Run Probability
- Output

Graphs showing the effects of regulated vs. unregulated conditions over time.
## Effect of Regulation

<table>
<thead>
<tr>
<th></th>
<th>Unregulated Economy ((\bar{k} = 0; \bar{N} = 0))</th>
<th>Optimal Regulation ((\bar{k} = .13; \bar{N} = .85 * N_{SS}^{DE}))</th>
<th>Fixed Capital Requirements ((\bar{k} = .13; \bar{N} = 0))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run Frequency</td>
<td>.8 pct</td>
<td>.45 pct</td>
<td>.3 pct</td>
</tr>
<tr>
<td>AVG Output Cond. No Run</td>
<td>0</td>
<td>−.4 pct</td>
<td>−1.7 pct</td>
</tr>
<tr>
<td>((\Delta ) from Decentralized Economy)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVG Output</td>
<td>0</td>
<td>.1 pct</td>
<td>−.9 pct</td>
</tr>
<tr>
<td>((\Delta ) from Decentralized Economy)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welfare Gain</td>
<td>0</td>
<td>.16 pct</td>
<td>−1.16 pct</td>
</tr>
<tr>
<td>((\Delta ) Permanent Consumption)</td>
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Recovery From a Run

- Asset Price
- Net Worth
- Output

Graphs showing the recovery from a run with three scenarios:
- Regulated Fixed
- Unregulated
- Regulated Countercyclical

Plots for Asset Price, Net Worth, and Output over quarters showing the percentage change from SS values.
Conclusion

- Develop model of banking panics that captures boom-bust cycles and unpredictability of runs

- Study macroprudential policy

Future work

- Ex-post intervention
- Regulated and Unregulated Banks
- Multiple assets