Credit Booms and Macroprudential Policies in LICs

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Motivation and Goals

- Financial deepening and inclusion much needed in LICs
- Periods of credit expansion often (but not always) end in crisis
  - Why do ‘bad booms’ happen?
  - Recognize a bad boom as it is happening?
  - Turn a bad boom into a good boom?
  - => Role for macroprudential (or micro-) policy?

- Our focus is exclusively on private, intermediated credit
- LICs face larger obstacles to policy implementation:
  - Informational requirements
  - Institutional hurdles
- Goal: build a model that is tailored to analysis of LIC credit markets and macroprudential policy
- Think about implementability of macroprudential policy in LIC context
Motivation: Credit Markets in LICs

- One size does NOT fit all
- Pathologies are not unique to LICs - but more severe
- Some common features:
  - Information scarce and asymmetrically distributed
  - Uncompetitive funding and loan markets
  - Large exogenous shocks
    - Real economy
    - Liquidity/financial shocks
  - Limited enforcement of contracts
  - Frictional spot markets, limited price discovery
  - Low proportion of economy’s wealth held in liquid form
  - Limited lending capacity
  - Dollarization
  - Role of foreign banks
Motivation: Empirics of Credit Booms in LICs

  - Surges in capital inflows are associated with credit booms
  - Domestic and external factors play a role in driving credit booms
- Gorton and Ordoñez (2015)
  - Booms start with an increase of total factor productivity (TFP) and labor productivity (LP), such growth falls much faster subsequently for bad booms
- Credit standards: countercyclical (IMF staff reports)


Credit standards, bank competition, business cycle: Ruckes (2004), Dell’Ariccia and Marquez (2006)


Good and bad booms: Mendoza and Terrones (2008), Gorton and Ordoñez (2015)

Micro empirics: Beaman, Karlan, Thuysbaert, Udry (2015)

The Model

- A simple static model of frictional financial intermediation
- *Extensive margin* of credit - new projects/plants/firms
- Profit maximizing entrepreneurs and bankers

**Entrepreneurs:**
- Have idea and wealth - but not enough to start project
- Can choose to apply for loans and if successful, start a firm
- Alternatively, invest their wealth in best possible alternative
- Some are intrinsically better (ideas have higher expected NPV), but they all look the same
- Entrepreneurs know which type they are

**Bankers:**
- Hold wealth in liquid form
- Have lending technology

**Contracts:**
- Bankers make loans (size, rate) to entrepreneurs
- Borrower fails to pay: banker seizes firm
- No recourse to entrepreneurs outside wealth
Entrepreneurs:

- Endowed with wealth $w$
- Technology: invest $k > w$ to yield $R^s$ w.p. $p^i$, $R^f$ w.p. $1 - p^i$
- $i \in \{b, g\}; p^g > p^b$
- $p^g R^s + (1 - p^g) R^f > \rho^b k > p^b R^s + (1 - p^b) R^f$
- Mass $\theta$ of good entrepreneurs and $1 - \theta$ bad
- Entrepreneurs can store wealth at rate $\rho^e$
Banks:
- Mass $B$ of bankers
- Each banker can originate one loan per period
- Bankers’ opportunity cost of funds: $\rho^b$

Baseline model:
- $B < \theta$ - there are fewer loans available than good projects
- Bankers endowed with liquidity $L$ at cost $\rho^e$
- Liquidity not lent out stored at $\rho^b$
Model: Alternative Interpretations

- Setup accommodates range of macro contexts
- $\rho^b (\rho^e)$ is bankers’ (entrepreneurs’) opportunity cost of funds
  1. Bank has $L$ units of domestic currency liquidity. Entrepreneurs earn $\rho^e$ on bank deposits, government bonds yield $\rho^b$.
  2. $L$ is in USD, $\rho^e$ is onshore USD depo rate and $\rho^b$ is offshore USD depo rate
  3. Dollarized economy, bank can borrow abroad at $\rho^b$
  4. Parent bank funds domestic subsidiary at $\rho^b$
Model: Loan Contract

- Loan contract is a pair \((r, y)\), where \(y\) is entrepreneurs contribution to project (equity)
- \(l = k - y; \ w \leq y \leq w\)
- Limited liability for entrepreneurs:

\[
\max(R^i - r(k - y), 0), \ i \in \{s, f\}
\]

With \(R^f < r(k - w)\), entrepreneur expected profit:

\[
\pi^{e,i} = p^i(R^s - r(k - y)) + \rho^e(w - y)), \ i \in \{b, g\}
\]

- Participation constraint:

\[
\pi^{e,i} \geq \rho^e w
\]

- Entrepreneurs’ surplus:

\[
S^{e,i}(r, y) = \pi^{e,i} - \rho^e w = p^i(R^s - r(k - y)) - \rho^e y
\]
Model: Loan Contract

- Limited liability for entrepreneurs $\implies$ bank payoff:
  \[ \min(r(k - y), R^i), \quad i \in \{s, f\} \]

- Expected profit from a loan $(r, y)$
  \[ \pi^b = p^j r(k - y) + (1 - p^j) R^f + \rho^b(L - (k - y)) \]

- $j \in \{b, g, p\}; \quad p^p = \theta p^g + (1 - \theta) p^b$

- Participation constraint:
  \[ \pi^b \geq \rho^b L \]

- Banks’ surplus:
  \[ S^{b,j}(r, y) = \pi^b - \rho^b L = p^j r(k - y) + (1 - p^j) R^f - \rho^b(k - y) \]
Credit market is a sequential game

First stage: entrepreneurs decide whether to apply for loans or not
- Applying for a loan costs $\epsilon$ (non-pecuniary cost)

Second stage: bankers are randomly matched with applicants
- Bank offers a contract $(r, y)$ to its potential borrower

Third stage: entrepreneurs accept or reject contract
- If reject, entrepreneur (bank) stores her wealth (liquidity)
- If accept, project is activated, entrepreneur stores $w - y$ and bank stores $L - (k - y)$
Model: Surplus sharing

- How is \((r, y)\) determined in a match?
- Interested in studying effect that surplus distribution has on equilibrium
- Intuitively: more competitive credit market, lower share of surplus bankers keep
- Surplus sharing rule: banker sets \(r\) such that it gets \(\eta \in (0, 1)\) of expected surplus from a match
- In equilibrium, \(y\) will be set to either maximize match surplus or screen bad entrepreneurs
Three possible equilibria (from best to worst):

1. Only good projects funded ("good" boom - separating)
2. Both types of projects funded on same terms ("bad" boom - pooling)
3. No credit

Bad projects are negative NPV so no separating equilibrium where both types borrow
Equilibrium: Joint Surplus

- Surplus at a screening equilibrium:
  \[ S^g(y) \equiv S^{b,g} + S^{e,g} = p^g R^s + (1 - p^g) R^f - \rho^b k + (\rho^b - \rho^e) y \]

- Surplus at a pooling equilibrium:
  \[ S^p(y) \equiv S^{b,p} + \theta S^{e,g} + (1 - \theta) S^{b,g} = p^p R^s + (1 - p^p) R^f - \rho^b k + (\rho^b - \rho^e) y \]

- Assume:
  \[ p^p R^s + (1 - p^p) R^f > \rho^b k \]

- \( p^p < p^g \) so surplus at pooling is lower than at separating \( \forall y \)

- \( \rho^b > \rho^e \implies \) joint surplus maximized at \( y = w \)

- \( \rho^b < \rho^e \implies y = 0 \)
Max and min interest rates as function of $y$ implied by participation constraints

$S^{e,i} = 0, \ i \in \{b, g\}$:

$$\bar{r}^i(y) = \frac{R^s}{k - y} - \frac{\rho^e y}{p^i(k - y)}$$

$S^{b,j} = 0, \ j \in \{g, p\}$:

$$r^j(y) = \frac{\rho^b}{p^j} - \frac{1 - p^j}{p^j} \frac{R^f}{k - y}$$

Equilibrium interest rate:

$$r^j(y, \eta) = (1 - \eta)r^j(y) + \eta \bar{r}^j(y)$$
Equilibrium: Interest Rate

Graph showing the relationship between interest rates and a variable y.
Equilibrium: Interest Rate

Separating

Pooling

$r^g$

$r^p$

$r^b$

$r^g$

$r^g$

$r^p$

$r^p$

$r^p$

$r^p$
Solve the credit market game by backward induction

Look for symmetric, pure strategy Bayesian Nash equilibria

Final stage is straightforward: entrepreneur type $i$ accepts $(r, y)$ if it satisfies participation constraint:

$$p^i(R^s - r(k - y)) - \rho^e y \geq 0$$

<table>
<thead>
<tr>
<th>(Good Applies, Bad Applies)</th>
<th>$(r^s, y^s)$</th>
<th>$(r^p, y^p)$</th>
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Equilibrium: Contracting Stage

- Assume that both a screening and pooling equilibrium are feasible (necessary conditions hold)
- If both types apply for loan, when do bankers offer pooling contract?
  - Bad entrepreneur rejects the screening contract by definition \( \Rightarrow \) if borrower is bad, banker stores and earns zero surplus
  - If all apply, matched entrepreneur is good w.p. \( \theta \)
  - If both apply, pooling contract \((r^p, y^p)\) offered if:
    \[
    S^{b,p}(r^p, y^p) > \theta S^{b,g}(r^s, y^s)
    \]
- If the condition is satisfied, both types apply and \((r^p, y^p)\) is equilibrium contract
- If violated, only good apply and \((r^s, y^s)\) is equilibrium contract
- Why? Applying is costly, so bad only apply if probability of getting a loan is \( > 0 \)
Results

1. No credit equilibrium:

\[ r^g(y) \geq \bar{r}^g(y) \quad \forall \quad y \in [\underline{w}, \overline{w}] \iff NPV^G < 0 \quad \text{and} \quad w < \underline{w} \]

2. If \( \rho^b > \rho^e \), equilibrium is always separating with \( y = w \)

3. \( y = \underline{w} \) at all pooling equilibria

4. If \( \rho^b < \rho^e \), equilibrium may be pooling or separating.

5. Pooling less likely as:
   1. \( \eta \) increases
   2. \( \rho^e \) decreases
   3. \( w \) increases
   4. \( \rho^b \) ambiguous
Results

- Bad booms in the yellow area, good booms in the blue
- From left to right: bankers keep more of the surplus
- Finding: lower competition lowers the probability of a bad boom
Macroprudential Policy

- Relationship between opportunity cost of funds for bankers and entrepreneurs determines existence of inefficient credit boom
- How do these vary with:
  - The business cycle
  - Global financial cycles
  - Domestic liquidity conditions
  - Monetary policy
- Exact answers will depend on macro context in which micro model is embedded
Macroprudential Policy: General Findings

- **Micro-prudential:**
  - Loan-level leverage limits very effective in turning a bad boom into a good boom
  - High informational requirement for implementation?

- **Capital requirements:**
  - Capital requirements work similarly to increasing $\eta$
  - Higher capital requirements can reduce probability of bad booms

- **Limits on loan growth (caps on banking licenses or loans)**
  - Will prevent bad booms - but at the cost of any credit growth

- **Monetary policy**
  - Interest rate targets dominate quantity targets from financial stability perspective
  - Control over opportunity cost of funds to banking sector effective tool for financial stability
  - Comes at cost of reducing volume of loans