Credit Booms and Macroprudential Policies in LICs

Joseba Martinez, Pau Rabanal, D. Filiz Unsal

AEA Meetings 2016

January 5, 2016

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

- Arena, Bouza, Dabla-Norris, Gerlin, Njie (2015)
  - *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)

Literature

- Asymmetric information in credit markets: Stiglitz and Weiss (1981), Myers and Majluf (1984), De Meza and Webb (1987), Bernanke and Gertler (1990)
- Search and matching in credit markets: Dell'Ariccia and Garibaldi (1998), Wasmer and Weil (2004), Boualam (2015)
- Credit standards, bank competition, business cycle: Ruckes (2004), Dell'Ariccia and Marquez (2006)
- Entrepreneurial choice: Banerjee and Newman (1993), DeMeza and Webb (2000), Ghatak, Morelli, Sjöström (2007), Takalo and Toivanen (2012), Inci (2013)
- Good and bad booms: Mendoza and Terrones (2008), Gorton and Ordoñez (2015)
- Micro empirics: Beaman, Karlan, Thuysbaert, Udry (2015)
- Macro empirics: Arena, Bouza, Dabla-Norris, Gerlin, Njie (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

Model: Entrepreneurs

- 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 θ of good entrepreneurs and $1 - \theta$ bad
  - Entrepreneurs can store wealth at rate ρ^e

Model: Bankers

- Banks:
  - Mass B of bankers
  - Each banker can originate one loan per period
  - Bankers' *opportunity cost of funds*: ρ^b
- Baseline model:
  - $B < \theta$ - there are fewer loans available than good projects
  - Bankers endowed with liquidity L at cost ρ^e
  - Liquidity not lent out stored at ρ^b

Model: Alternative Interpretations

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

Model: Loan Contract

- Loan contract is a pair (r, y), where y is entrepreneurs contribution to project (equity)
- $l = k - y$; $\underline{w} \leq y \leq w$
- 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 => bank payoff:

$$\min(r(k-y), R^i), \ i \in \{s, f\}$$

- Expected profit from a loan (r, y)

$$\pi^b = p^j r(k-y) + (1-p^j)R^f + \rho^b(L-(k-y))$$

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

$$\pi^b \geq \rho^b L$$

- Banks' surplus:

$$S^{b,j}(r, y) = \pi^b - \rho^b L = p^j r(k-y) + (1-p^j)R^f - \rho^b(k-y)$$

Model: Credit Markets

- Credit market is a sequential game
- First stage: entrepreneurs decide whether to apply for loans or not
  - Applying for a loan costs ϵ (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

Equilibrium: Efficiency

- 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 $\forall y$
- $\rho^b > \rho^e \Rightarrow$ joint surplus maximized at $y = w$
- $\rho^b < \rho^e \Rightarrow y = 0$

Equilibrium: Interest Rate

- Max and min interest rates as function of y implied by participation constraints
- $S^{e,i} = 0, \ i \in \{b, g\}$:

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

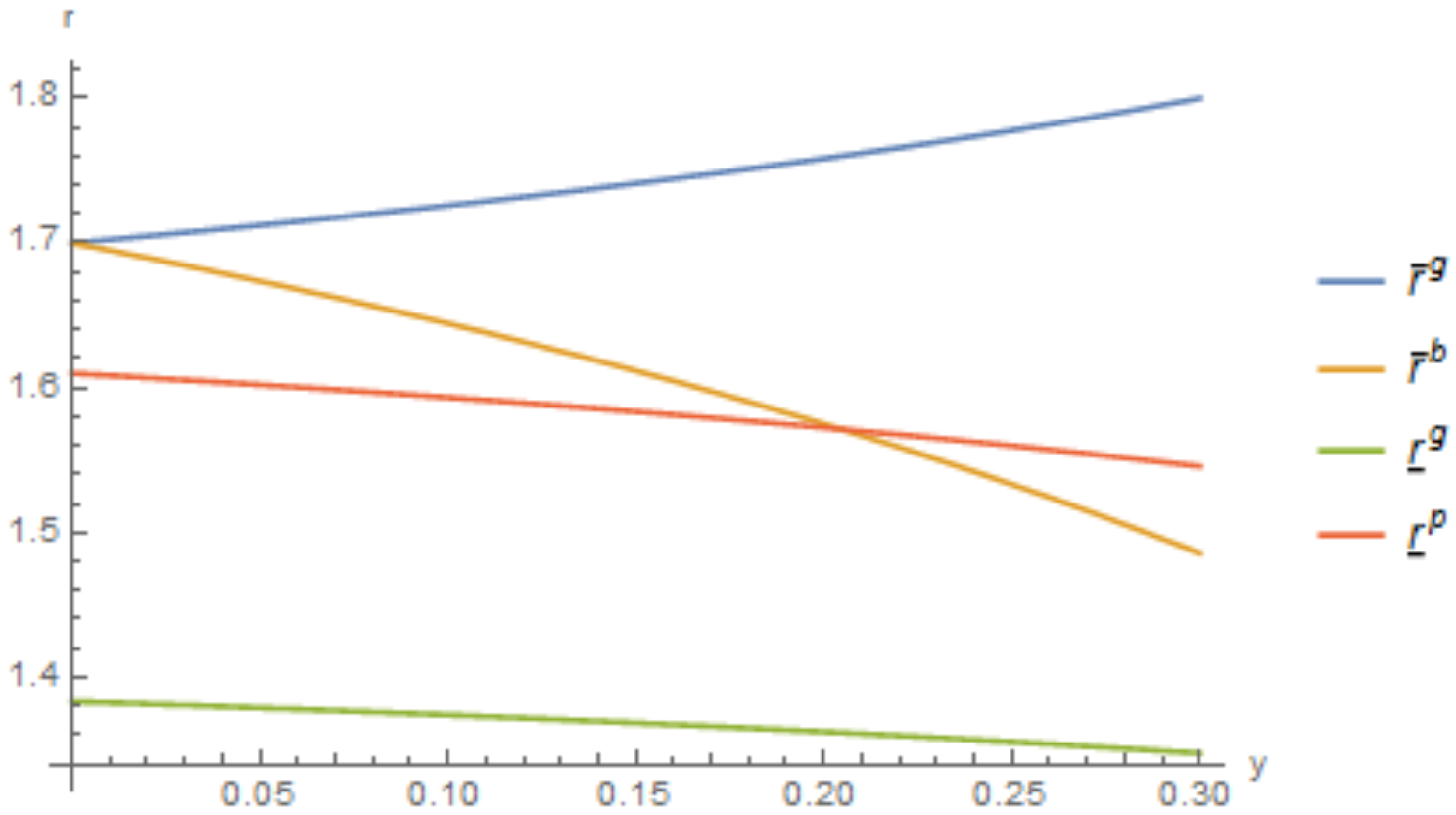
- $S^{b,j} = 0, \ j \in \{g, p\}$:

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

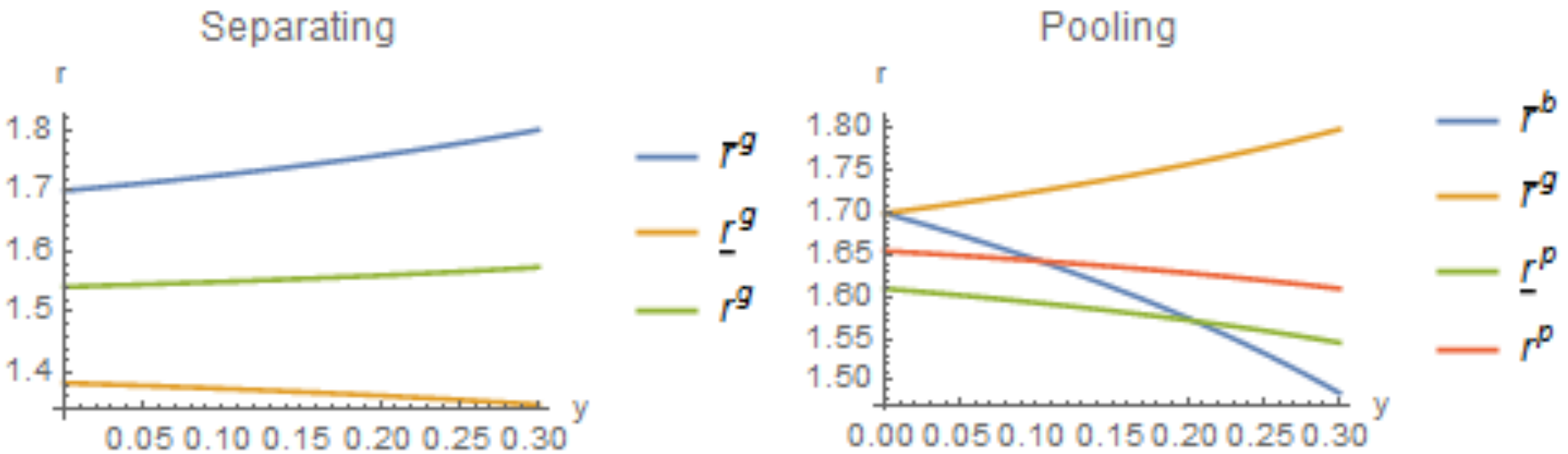
- Equilibrium interest rate:

$$r^j(y, \eta) = (1-\eta)\underline{r}^j(y) + \eta\bar{r}^j(y)$$

Equilibrium: Interest Rate



Equilibrium: Interest Rate



Equilibria of Credit Market Game

- 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:

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

(Good Applies, Bad Applies)	(r^s, y^s)	(r^p, y^p)
(Yes,No)	✓	×
(Yes,Yes)	×	✓
(No,No)	✓	✓
(No,Yes)	×	×

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 $=>$ if borrower is bad, banker stores and earns zero surplus
  - If all apply, matched entrepreneur is good w.p. θ
  - 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

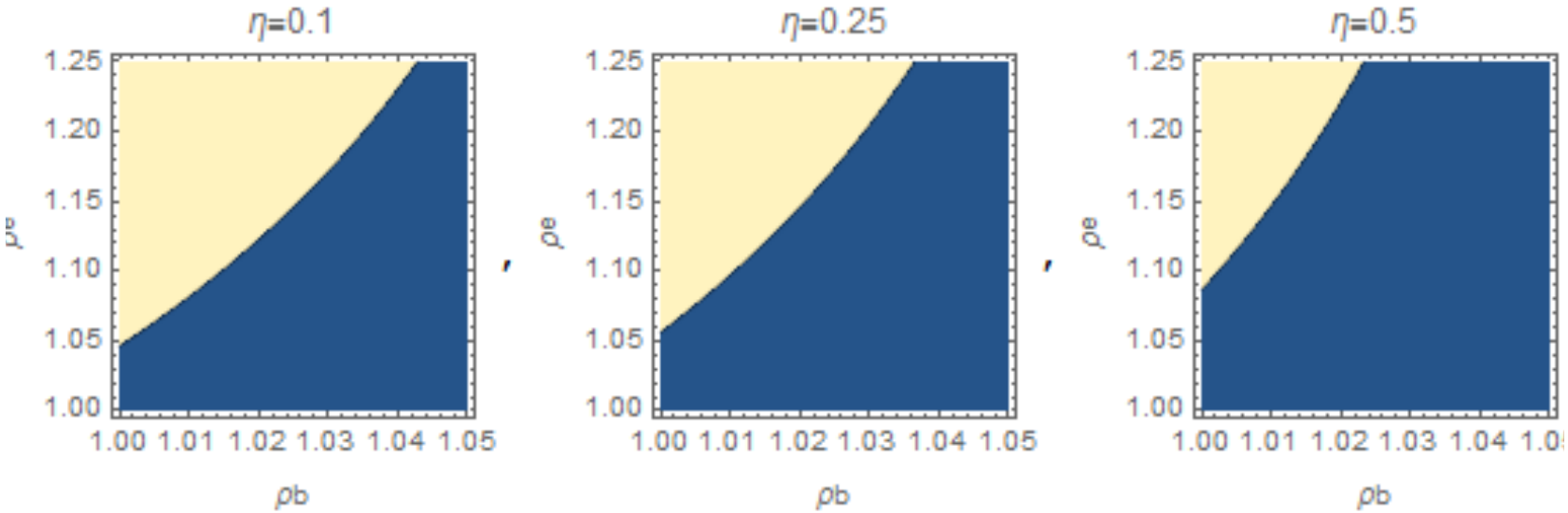
Results

1. No credit equilibrium:

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

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. η increases
   2. ρ^e decreases
   3. w increases
   4. ρ^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 η
  - 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