Bank Competition, Information Choice and Inefficient Lending Booms

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- these reforms have increased banking competition and are thought to have increased availability of credit
- but is it possible that competition has prompted *too much* lending?
  - U.S. Senior Loan Officer Survey hints at a competition channel behind the 2003-2006 boom in residential mortgage lending

Can more banking competition foster inefficient lending booms?

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2. more competition reduces lenders' incentives to screen their borrowers thoroughly

Both effects are procyclical.

Together, they match the stylized facts about lending booms quite well.

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- "poison the well" by making bad loans to prevent customer poaching
- approval of bad loans implies poor use of information from screening $\Longrightarrow$ choose less precise screening ex-ante

With more competition, these distortions become more pronounced.

Related Literature

Literature on Competition and Credit Screening

- Broecker (1990), Riordan (1993), Gehrig (1998), Ruckes (2004), Ogura (2006), Direr (2008)

Adverse Selection to Deter Entry

- Dell'Ariccia et al. (1999)

Competition in Banking and Information Choice

- Hauswald and Marquez (2003), Hauswald and Marquez (2006)

Theories of Lending Booms

- Rajan (1994), Dell'Ariccia and Marquez (2006), Lorenzoni (2008)

Empirical Literature on Lending Procyclicality and Booms

- Gourinchas et al. (2001), Borio and Lowe (2002), Bordo and Jeanne (2002)
- Berger and Udell (2005), Lown and Morgan (2006)

Outline

Outline:

The Model

Model (I)

Heterogeneous Entrepreneurs:

- two islands $j \in \{1, 2\}$
- each island has a continuum of mass 1 of wealthless entrepreneurs, indexed by $i \in [0, 1]$
- option to run risky project: invest one unit at time t, obtain in $t + 1$ a payoff

$$X_i = \begin{cases} R & \textit{with probability } p_i \\ \\ r & \textit{with probability } 1 - p_i \end{cases} \quad (1)$$

- $p_i \sim U(\bar{p} - \frac{\varepsilon}{2}, \bar{p} + \frac{\varepsilon}{2})$, private knowledge
- no signaling or self-selection mechanisms available

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- bank uses costless *credit-worthiness test* to assess borrower quality
- precision of the test is given by the bank's *screening precision* $\lambda \in [0, 1)$:
    - test yields the true type p_i with probability λ, otherwise random noise that is drawn from prior distribution
    - the bank does not know whether signal is informative or just noise, uses Bayesian updating of beliefs

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- screening works only for entrepreneurs on the same island

Model: Timing

Timing:

1. Each bank
   - chooses its screening precision λ^j (observable to everyone),
   - pays screening cost $c(\lambda^j)$ and
   - observes private signal $\sigma_{i,\lambda}$ for every project $i \in [0, 1]$
2. both banks choose their domestic *loan portfolio* comprising of
   - a set $\mathcal{P}_j$ of projects to be offered a loan, and
   - state-contingent repayment terms (D_i, d_i) for every project $i \in \mathcal{P}_j$.
3. each bank observes the domestic loan offers made on the other island and chooses whether and under which terms $(O_i^{j'}, o_i^{j'})$ to offer outside credit to loan-approved entrepreneurs
   $\Rightarrow$ informational spillover
4. entrepreneurs choose loan offer with lowest expected repayment rate; if indifferent, they stay with the domestic bank.

Benchmark: The Planner's Solution

Planner's Solution

Planner's Problem:

1. choose screening precision λ, pay $c(\lambda)$
2. observe signals, update beliefs, and
3. determine projects to be financed such that surplus is maximized.

Solution: by backward induction.

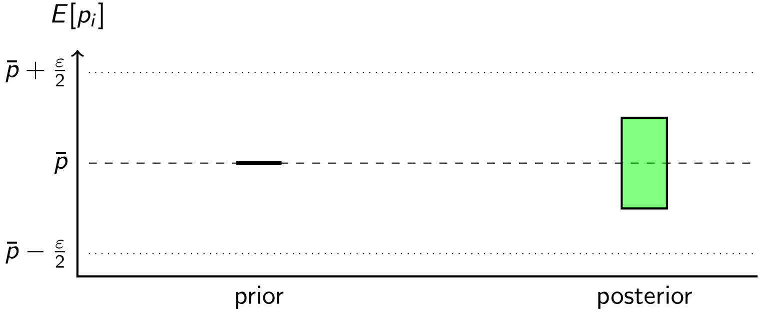
1. given posterior beliefs after observing the signal, find welfare-maximizing portfolio of projects to finance
2. choose screening precision λ^* as to maximize total welfare

Dispersion of Posterior Beliefs

Posterior beliefs:
Bayesian updating of beliefs conditional on observing a signal realization s_i yields

$$E[p_i|\sigma_i = s_i] = \lambda s_i + (1 - \lambda)\bar{p}$$

More screening precision generates more dispersion in posterior expectations (see Ganuza and Penalva, 2010):



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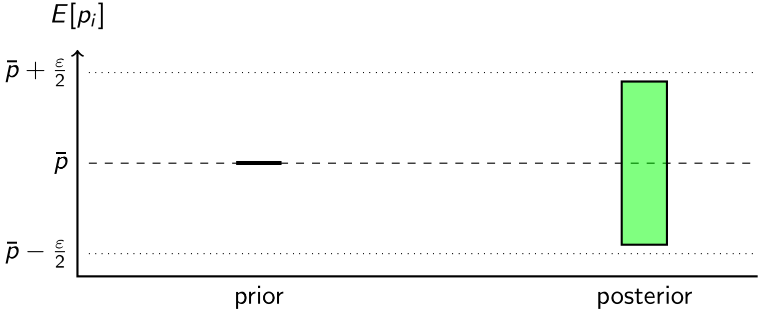


Planner's Optimal Portfolio Choice

Finding the marginal project:

$$\begin{aligned} \pi(q) &= qR + (1-q)r - \rho \overset{!}{=} 0 \\ \Leftrightarrow q &= \frac{\rho - r}{R - r} \end{aligned}$$

Reminder:

R	payoff upon project success
r	payoff upon project failure (liquidation)
ρ	Bank refinancing rate

q is **high** in recession, **low** in boom.

Remark

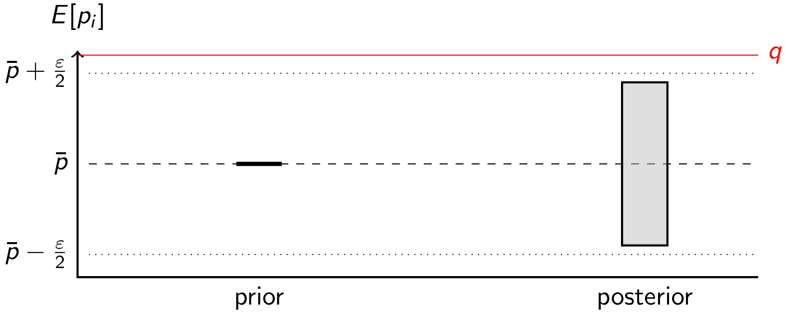
The planner's optimal portfolio choice is to finance all projects for which

$$E[p_i|s_i] > q$$

Planner's Optimal Portfolio Choice (II)

Credit Mass: Size of the second-best portfolio is

$$m_\lambda^{SB} = \begin{cases} 0 & \text{if } q - \bar{p} \geq +\frac{\lambda\varepsilon}{2} \\ & \end{cases}$$



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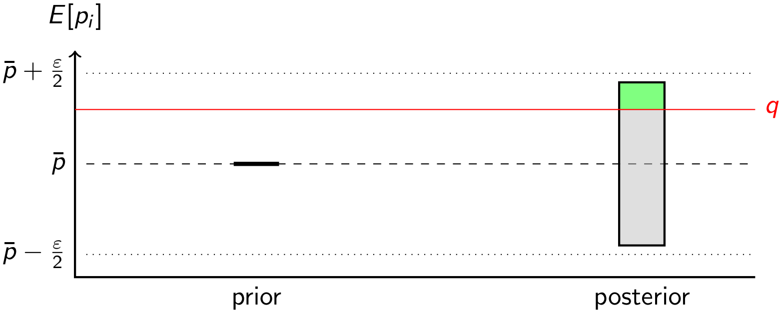

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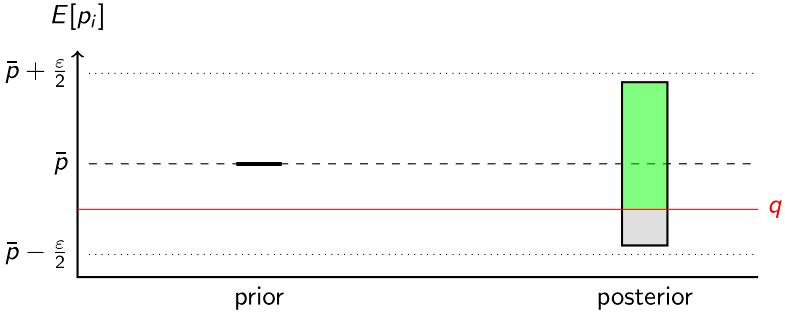

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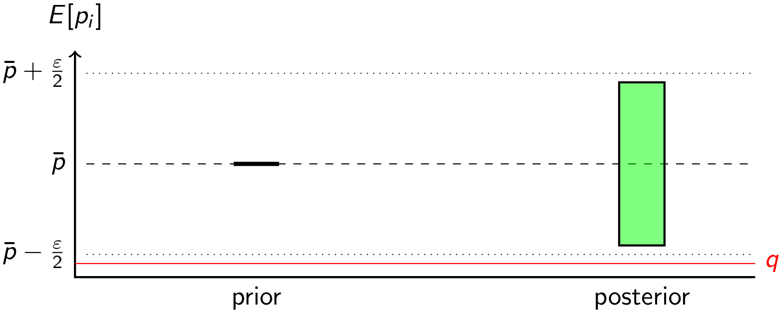

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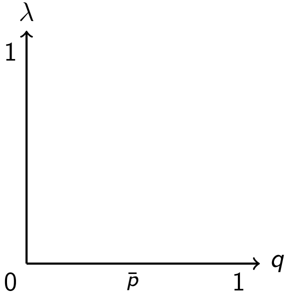

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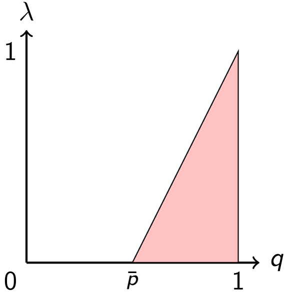

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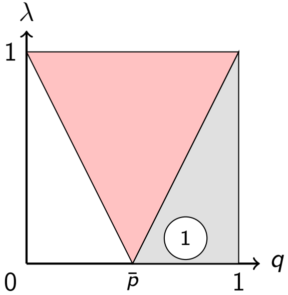

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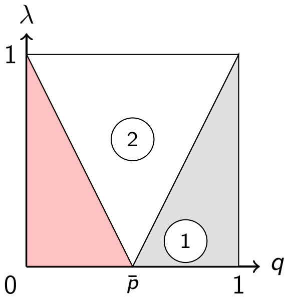

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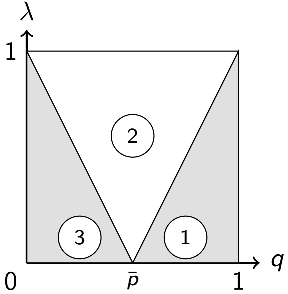


The Planner's Information Choice (I)

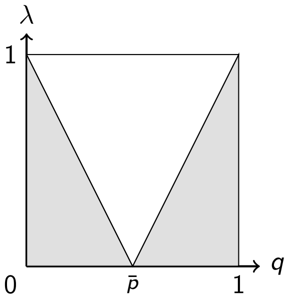
Optimal choice of screening precision:

$$\max_{\lambda} \quad \Pi_{\lambda}^{SB} - c(\lambda)$$
$$\text{s.t.} \quad \lambda \geq 0$$

Which cost function? Use $c(\lambda) = c_0 \frac{\lambda}{1-\lambda}$ which gives closed-form solutions.

▸ Show

Optimal screening precision $\lambda_{SB}^*(q)$ as function of economic state q:



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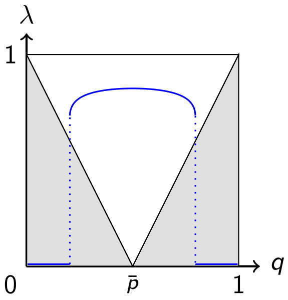

Equilibrium under Competition:

Two Results

Solving for Equilibrium under Competition

Again, I solve the problem by backward induction:

1. for given screening precision λ, I find the optimal portfolio as a function of competition.

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2. I find the profit-maximizing screening precision λ_E^*

Equilibrium (I): $\gamma \geq \frac{(R-r)\varepsilon}{2}$

Monopolist's Problem

- for $\gamma \geq \frac{(R-r)\varepsilon}{2}$, each bank is always a monopolist on its island
- due to fixed project size, monopolist can extract entire project surplus (R, r)
- thus, maximization problem coincides with the planner's problem
- monopolistic allocation is constrained *Pareto optimal* in this model!
- caution: with endogenous project size this would not be true

Equilibrium (II): $\gamma < \frac{(R-r)\varepsilon}{2}$

Competition

- if $\gamma < \frac{(R-r)\varepsilon}{2}$, for *some* values of (q, λ) competition will matter.
- when is the incumbent safe from entry of competitors?

Definition

Let $\mathcal{P}$ be a loan portfolio, and denote the volume of loans in the portfolio as $|\mathcal{P}|$. Then, $\mathcal{P}$ is **noncontestable** if its gross surplus per loan is at most γ: $\Pi[\mathcal{P}] \leq \gamma|\mathcal{P}|$

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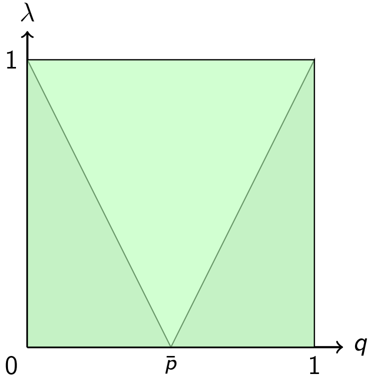
- if portfolio is *noncontestable* **and** all repayment terms are equal, there is no threat of entry
- for which (q, λ) combinations is the monopolistic portfolio noncontestable?

Noncontestability: Intuition

Graphical Representation:

- let's draw the set of all (q, λ) for which the *monopolistic* portfolio is noncontestable: $\left\{(q, \lambda) \in [0,1] \times [0,1] : \frac{\Pi_\lambda^M(q)}{m_\lambda^M(q)} \leq \gamma\right\}$



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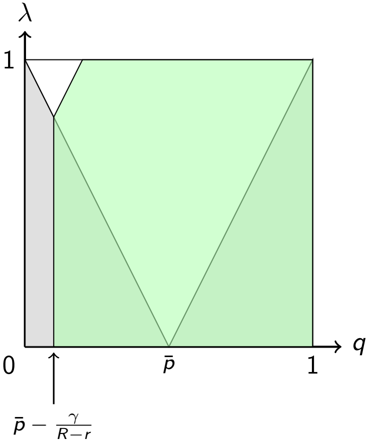

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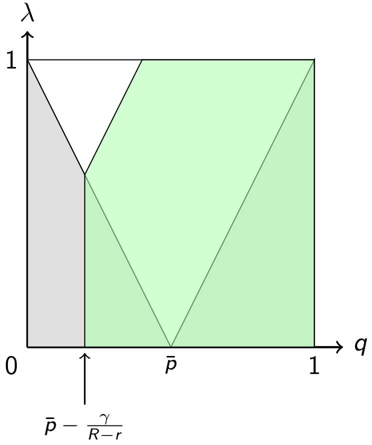

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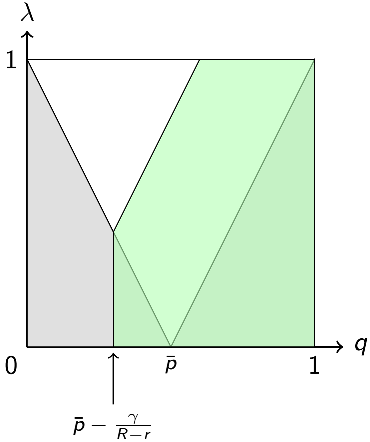

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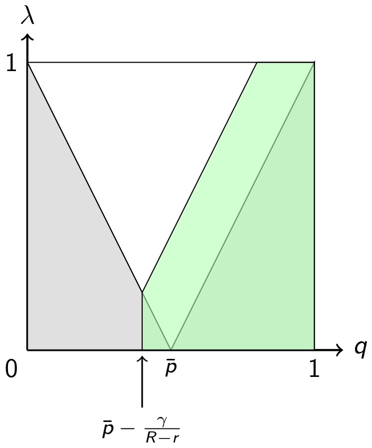

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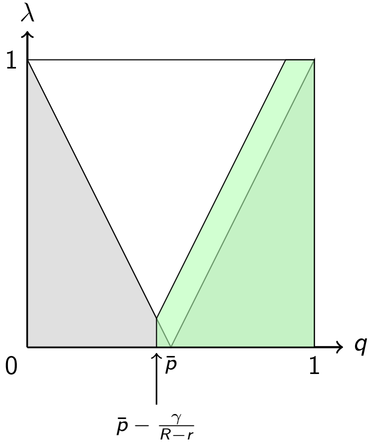

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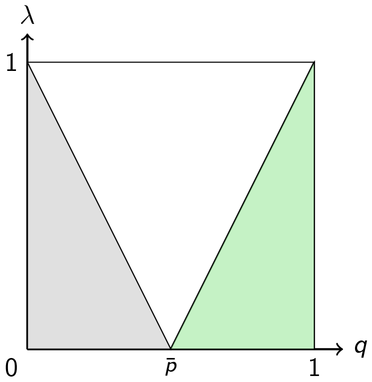

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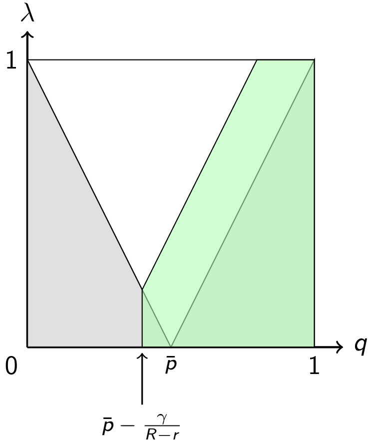

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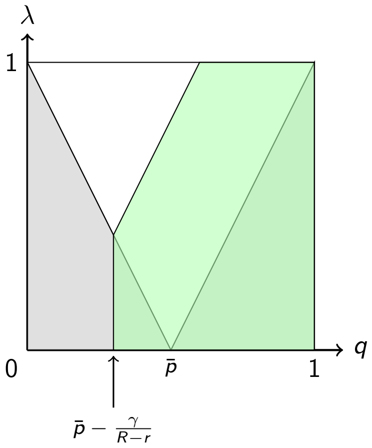

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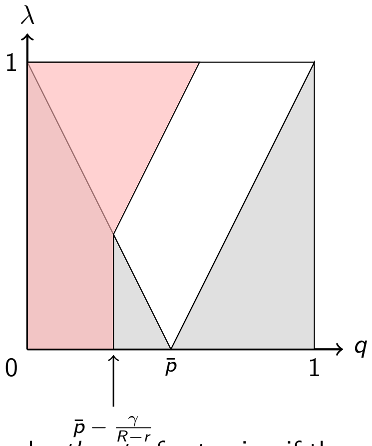

- what happens under *threat of entry*, i.e. if the monopolistic portfolio is contestable?

Threat of Entry

What if the incumbent chooses some contestable portfolio?

- the outside lender can profitably undercut
- it poaches all loan-approved customers
- incumbent earns zero

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Two ways to make a portfolio noncontestable:

1. reduce repayment rates
2. change composition

Making a portfolio noncontestable

Assume $\mathcal{P}$ is a contestable portfolio of size m: $\Pi[\mathcal{P}] > \gamma m$.
How can we make it noncontestable?

Via prices (repayment rates):

- construct portfolio $\mathcal{P}'$ with same projects but reduced repayments

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Note $\tilde{m}\gamma > m\gamma$
$\Rightarrow$ second strategy is more profitable

Equilibrium under Competition

When is a noncontestable portfolio an equilibrium of the game?

In the paper I show:

Any portfolio $\mathcal{Q}^*$ that maximizes surplus subject to noncontestability,

$$\max_{\mathcal{Q}=(\mathcal{S},(D,d))} \quad \Pi[\mathcal{Q}]$$
$$\text{s.t.} \quad \Pi[\mathcal{Q}] \quad \leq \gamma|\mathcal{Q}|$$

and has the same repayment terms (D, d) for all entrepreneurs is an equilibrium.

▸ Proof

Equilibrium under Competition (II)

The equilibrium has three cases:

1. competition does not matter
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   $\Rightarrow$ cross-subsidized excessive lending, repayment terms (R, r).

3. there is threat of entry, and even by financing all projects at terms (R, r) the incumbent does not regain noncontestability
   $\Rightarrow$ finance everyone, and reduce repayment terms such that $\Pi = \gamma$.

Equilibrium Credit Mass

$$m^E_\lambda(q,\gamma) = \begin{cases} 1 & \text{if } 0 \leq \lambda \leq \frac{2(\bar{p}-q)}{\varepsilon} \text{ and } \bar{p} - \frac{\gamma}{R-r} < q < \bar{p} \\ 0 & \text{if } 0 \leq \lambda \leq \frac{2(q-\bar{p})}{\varepsilon} \\ \frac{1}{2} - \frac{q-\bar{p}}{\lambda\varepsilon} & \text{if } \frac{2|q-\bar{p}|}{\varepsilon} < \lambda \leq \frac{2(q-\bar{p})}{\varepsilon} + \frac{4\gamma}{\varepsilon(R-r)} \end{cases}$$

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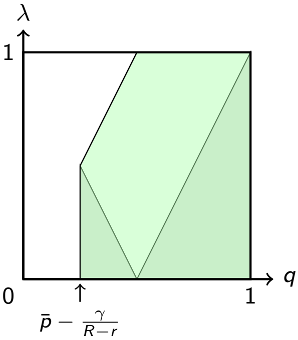

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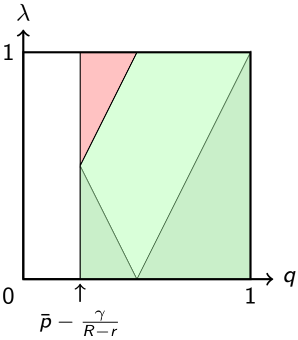

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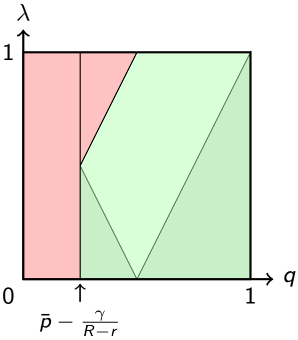


The First Key Result

Finding 1:

Under threat of entry, equilibrium credit mass is inefficiently large.

Its excessiveness increases with bank competition.

Further Comparative Statics

Threat of entry makes credit more volatile:

- the sensitivity $\frac{\partial m_E}{\partial q}$ of credit to changes in q is twice as high under threat of competition than under monopoly.
- the average default rate $\mathcal{D}_\lambda(q)$ decreases in q: the best loans are made in recessions, the worst in booms
- the sensitivity $\frac{\partial \mathcal{D}_\lambda}{\partial q}$ is independent of λ, but is twice as large under threat of competition than under monopoly.

Endogenous Screening Choice

Gross Profit Function:
$\Pi_\lambda^E = \gamma \cdot m_\lambda^E$ wherever competition is relevant, unchanged otherwise

Optimal Screening Precision λ_E^*:

$$\max_\lambda \quad \Pi_\lambda^E - c(\lambda)$$
$$\text{s.t.} \quad \lambda \geq 0$$

The Second Key Result

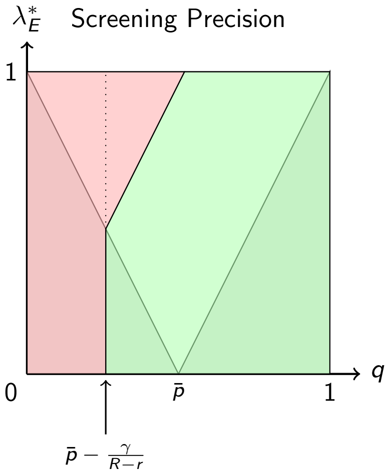
Finding 2:

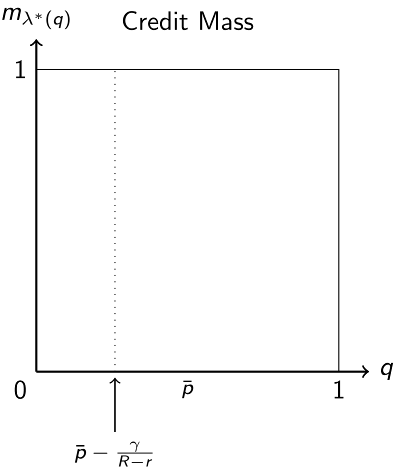
Screening precision λ_E^* is chosen inefficiently low when there is threat of entry.

Marginal returns to screening

- are strictly lower under threat of entry, and
- are zero for $q < \bar{p} - \frac{\gamma}{R-r}$

Equilibrium Allocations





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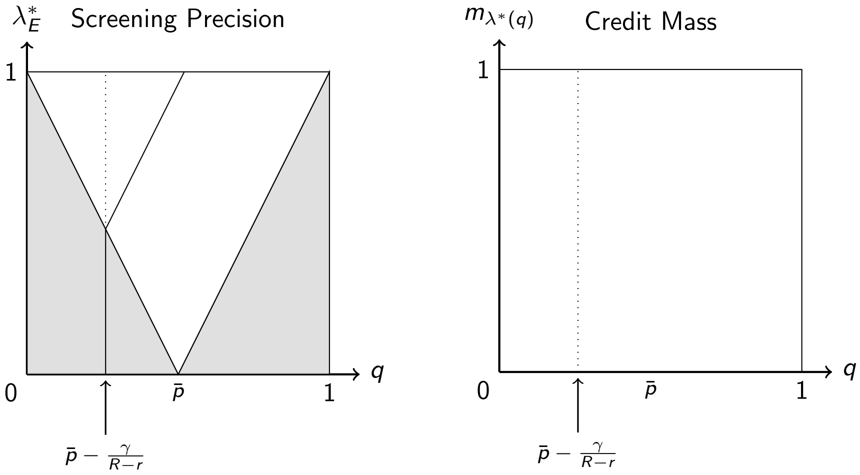

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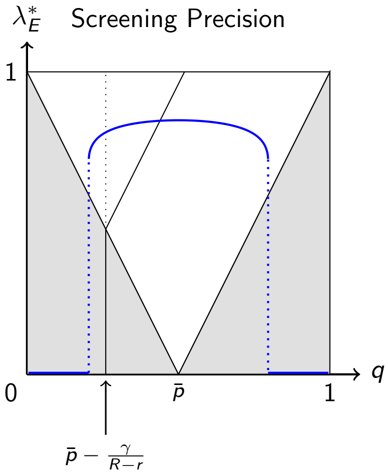

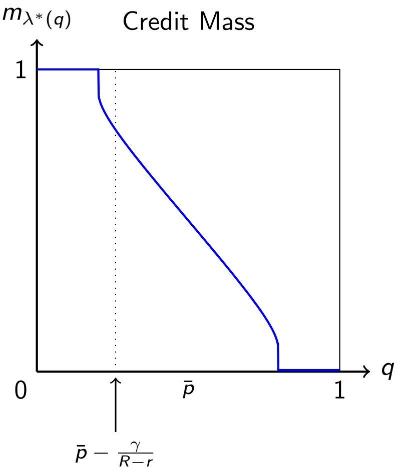

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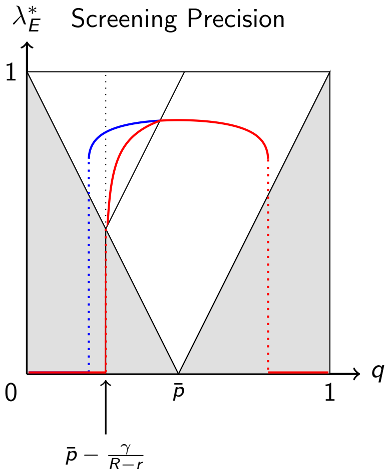

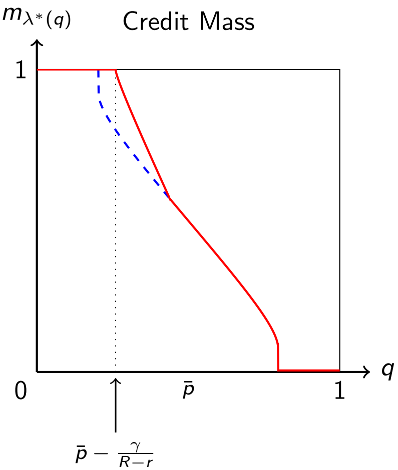

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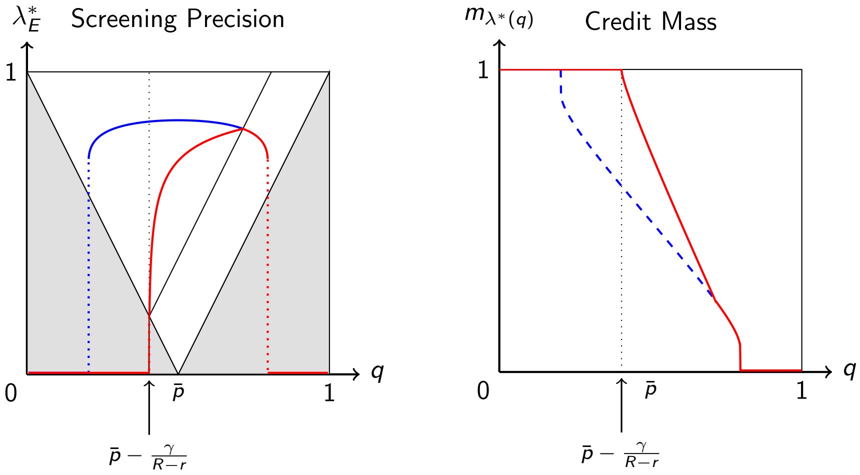


Lending Cycles

A Simple Theory of Lending Cycles

Let's play a simple dynamic version of the model:

- play a sequence of one-shot games: periods $\{t, t+1, \dots\}$
- aggregate state q_{t+1} unknown ex-ante
- $\bar{\lambda}^*_{t+1}$ is chosen *before* knowing the actual realization of q_{t+1}:

$$\begin{aligned} \max_{\bar{\lambda}} \quad & \int \Pi^E_{\bar{\lambda}}(q, \gamma) - c(\bar{\lambda}) \, \mathrm{d}\mathcal{U}(q) \\ \text{s.t.} \quad & \bar{\lambda} \geq 0 \end{aligned}$$

Lending Cycles (cont.)

Dynamic Model (cont.):

- I use the following stylized specification:

$$q_{t+1} = \begin{cases} q_t & \text{with probability } \phi \\ \sim U(\bar{p} - \frac{\varepsilon}{2}, \bar{p} + \frac{\varepsilon}{2}) & \text{with probability } 1 - \phi \end{cases}$$

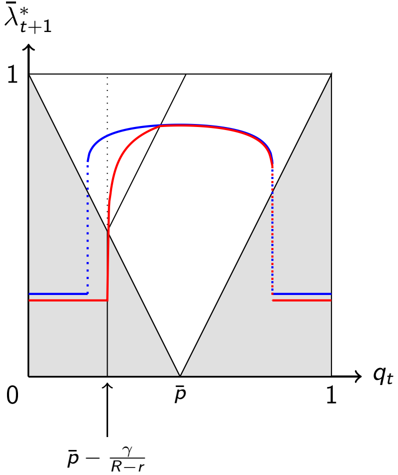
- special case $\phi \to 1$ restores the baseline model
- Let's think of ϕ as large but not quite 1, i.e. $\phi = 0.8$
- the optimal screening precision choice problem becomes

$$\max_{\bar{\lambda}_{t+1}} \left[\phi \, \Pi^E_{\bar{\lambda}_{t+1}}(q_t, \gamma) + (1 - \phi) \int_{\bar{p}-\frac{\varepsilon}{2}}^{\bar{p}+\frac{\varepsilon}{2}} \Pi^E_{\bar{\lambda}_{t+1}}(q_{t+1}, \gamma) \, \varepsilon^{-1} \mathrm{d}q_{t+1} \right] - c(\bar{\lambda}_{t+1})$$

$$\text{s.t.} \quad \bar{\lambda}_{t+1} \geq 0$$

Dynamic Screening Choice

Ex-ante Optimal Screening Choice $\bar{\lambda}^*_{E,t+1}$



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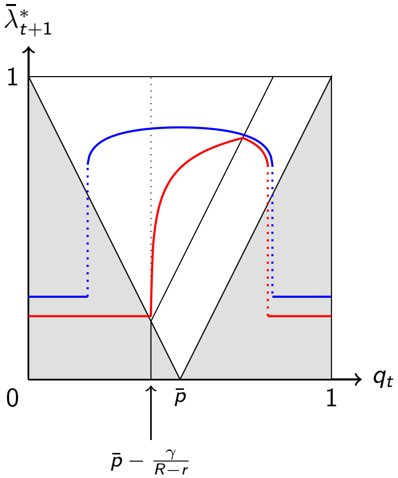

Flight to Quality

Credit Contractions and Flight to Quality

- during boom, $\bar{\lambda}^*_{E,t+1}$ is chosen low because good conditions are expected to persist and threat of competition depresses information acquisition incentives
- if actual realization q_{t+1} takes some high value (i.e., boom is over), competition would ex-post not have been the problem
- but inefficiently low $\bar{\lambda}^*_{E,t+1}$ now results in credit contraction
- due to impaired screening precision, only outstanding projects can be identified as credit-worthy $\Rightarrow$ *flight to quality*

Relation with Empirical Findings

Related Empirical Findings:

- Berger and Udell (2004) “institutional memory hypothesis”

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- Foos et al. (2009): rapid loan growth but low average interest income, loan loss provisions spike three years ahead

Conclusions

Conclusions

- informational spillovers can change the effect of competition on lending substantially
- excessive lending booms occur due to a combination of low screening and cross-subsidized lending
- the model also explains credit contractions and flight-to-quality in recessions
- suitable for integration in general equilibrium model to perform macroprudential analyses
- directions of future research:
  - empirical: screening choice under competition, lending standards
  - theory: international lending booms and capital flows

Thank you!

Appendix: Closed Form Solutions (I)

Monopolistic case:

$$\begin{aligned}
\frac{c_0}{(\lambda-1)^2} &= b - \frac{a}{\lambda^2} \\
a &= \frac{(R-r)(\bar{p}-q)^2}{2\varepsilon} \\
b &= \frac{(R-r)\varepsilon}{8} \\
\gamma &= a - b - c_0 \\
\phi &= 108a^2b - 108ab^2 - 108ab\gamma - 2\gamma^3 \\
\beta &= \frac{\sqrt[3]{2}\gamma^2}{3a\left(\phi+\sqrt{\phi^2-4\gamma^6}\right)^{1/3}} + \frac{\left(\phi+\sqrt{\phi^2-4\gamma^6}\right)^{1/3}}{3\sqrt[3]{2}a} \\
\lambda_1^* &= \frac{1}{2}\sqrt{2+\beta-\frac{4\gamma}{3a}-\frac{2(a-2b-\gamma)}{a\sqrt{1-\beta-\frac{2\gamma}{3a}}}} - \frac{1}{2}\sqrt{1-\beta-\frac{2\gamma}{3a}} + \frac{1}{2} \\
\lambda_2^* &= \frac{1}{2}\sqrt{2+\beta-\frac{4\gamma}{3a}+\frac{2(a-2b-\gamma)}{a\sqrt{1-\beta-\frac{2\gamma}{3a}}}} + \frac{1}{2}\sqrt{1-\beta-\frac{2\gamma}{3a}} + \frac{1}{2}
\end{aligned}$$

whereby the correct solution is the root that lies in the $[0,1]$ interval. Back...

Appendix: Closed Form Solutions (II)

Competitive case:

$$\lambda_C^*(q,\gamma) = \frac{1}{1+\sqrt{\frac{c_0}{\delta}}} \qquad (2)$$

where $\delta = 2\gamma\varepsilon^{-1}(q - \bar{p} + \frac{\gamma}{R-r})$

Appendix: Proof of equilibrium property (sketch)

Maximization subject to noncontestability constraint yields an equilibrium:

1. if portfolio $\mathcal{P}$ is noncontestable, and portfolio $\mathcal{Q}$ is noncontestable and symmetric, and its surplus is weakly higher, i.e. $\Pi[\mathcal{P}] \leq \Pi[\mathcal{Q}]$ then the incumbent can generate same or higher payoff for himself by choosing $\mathcal{Q}$ over $\mathcal{P}$.
2. for any noncontestable portfolio $\mathcal{P}$ there always exists a symmetric noncontestable portfolio $\mathcal{Q}$ that yields weakly higher surplus
3. so, search within the class of symmetric noncontestable portfolios yields an element for which payoff is maximal among all noncontestable portfolios $\Rightarrow$ equilibrium.

Back...