Funding Supply and Credit Quality

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What drives risk accumulation?

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Deliberate risk-taking

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Deliberate risk-taking vs **"honest mistakes"**

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- Amplification due to imperfect inference from prices

Key elements:

- inelastic savings
- opacity of bank balance sheets

Preview of the mechanism

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- Large intermediaries have better info on:
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- Smaller agents infer the productivity from asset prices
- High funding supply $\rightarrow$ high leverage $\rightarrow$ risk-shifting incentives

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  no info on funding supply → bank incentives unclear

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  - High price = risk-shifting by banks?

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$\Rightarrow$ **Amplification**: overestimate productivity when banks risk-shift

Supply and demand driven booms

Framework speaks to recent evidence:

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Framework speaks to recent evidence:

- Good credit booms - driven by TFP growth
  (Gorton & Ordonez, 2016)
- Bad credit booms - driven by credit supply
  (Krishnamurthy & Muir, 2017) (Mian et al, 2018) (Richter, et al, 2017)

Related literature

- **Evidence on credit booms and crises**
  Kaminsky and Reinhart (1999), Gourinchas et al. (2001), Mian & Sufi (2009), Jorda et al. (2010), Justinaino et al. (2015), Krishnamurthy & Muir (2016), Richter et al., (2017)
- **Erronous assessment of risk**
  empirical: Barron & Xiong (2017), Cheng at al. (2014), theoretical: Thakor (2016), Greenwood, et al. (2016), Bordalo, et al. (2016)
- **Quality of assets over the cycle**
  empirical: Madalloni & Peydro (2011), theoretical: Dell'Arriccia & Marquez (2006), Martinez-Miera and Repullo (2016), Bolton, et al. (2016)

Model set up

Basic ingredients

- Two dates: $t = 0$, $t = 1$
- Two types of agents:
  - large/global banks
  - small/local firms (later: banks)
- Two investment opportunities:
  - productive technology
  - speculative asset
- Two shocks:
  - aggregate productivity α
  - supply of bank funding s

Agents

Global banks

- Observe aggregate productivity α
- Have access to s debt funding
- Can invest in both investment opportunities (technology and asset)

Local firms

- Observe asset price p; use it to infer α
- Do not observe s or bank's investment choice
- Endowed with amount k of equity
- Can invest only in the productive technology

Investment opportunities

Depend on aggregate productivity α, drawn at $t = 0$ from $\alpha \sim U[\underline{\alpha}, \overline{\alpha}]$

Productive technology:

- $x_i \rightarrow f(x_i) = \alpha\sqrt{x_i}$

Speculative asset in fixed supply:

- $y \rightarrow \begin{cases} Ry \textit{ with prob. } q(\alpha) \\ 0 \textit{ with prob. } 1 - q(\alpha) \end{cases}$
- Speculative return increases in productivity $q'(\alpha) > 0$
- Asset price p determined endogenously

Bank funding

- At $t = 0$ global banks have access to funding supply s

$$s = \begin{cases} s^H \ \textit{with prob. } \rho \\ s^L \ \textit{with prob. } 1-\rho \end{cases}$$

- Deposit insurance $\rightarrow p_s = 1$ (can be relaxed)

Bank strategy

The investment choice

$$max_{x_i,y_i,s_i}\ q(\alpha)(\alpha\sqrt{x_i} + Ry_i - s_i) + \\ (1 - q(\alpha))\max[\alpha\sqrt{x_i} - s_i, 0]$$

subject to:

$$x_i + py_i = s_i \qquad \text{(budget constraint)}$$

$$s_i \leq s \qquad \text{(funding constraint)}$$

$$x_i \geq 0,\ \ y_i \geq 0 \qquad \text{(no short selling constraint)}$$

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Choose between:

- Solvent strategy
- Risk-shifting strategy

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- Banks may not use all available funding $s_s^* \leq s$

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  - opportunity cost is the **speculative return in the high-state**: $\frac{R}{p}$
  - $x_r^* : \; f'(x) = \frac{R}{p} \; \rightarrow \; x_r^* < x_s^*$
- Invest all the remaining funds in the speculative asset
  - $s_r^* = s$
  - $py_r^* = s - x^* > py_s^*$

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There exists a threshold asset price level $\hat{p}(\alpha, s)$ at which a global bank is indifferent between the solvent and a risk-shifting strategy.

- Banks prefer the solvent strategy if $p > \hat{p}(\alpha, s)$
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- Low price $\rightarrow$ profits from speculation high $\rightarrow$ risk-shifting

Funding supply and risk-shifting

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- Higher funding supply $\rightarrow$ risk shifting for a larger set of prices
- **Intution:** more funding $\rightarrow$ higher leverage $\rightarrow$ higher risk-shifting incentives at a given price

Solvent equilibrium

- Consider the risk-shifting threshold $\hat{p}$

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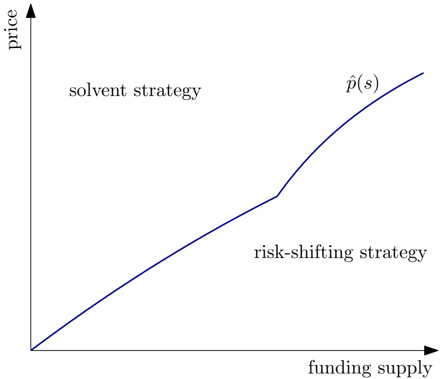

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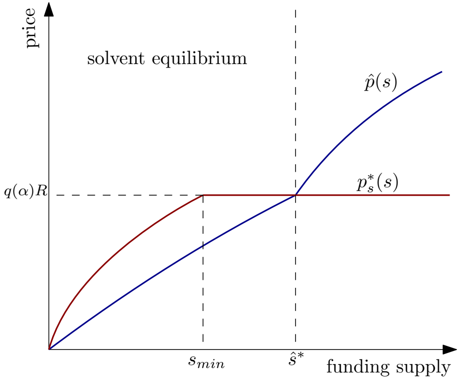

Solvent equilibrium

- Consider the risk-shifting threshold $\hat{p}$
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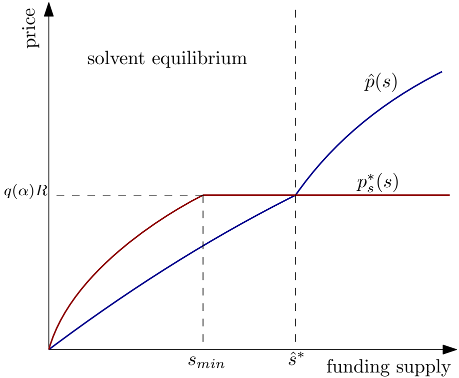
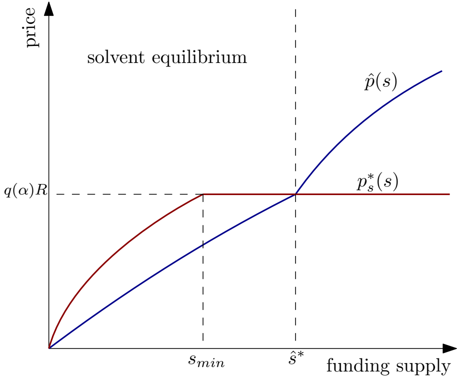
$\rightarrow$ all play solvent strategy if and only if $s \leq \hat{s}^*$



Mixed risk-shifting equilibrium

- If all banks would **risk-shift**: p_r^*



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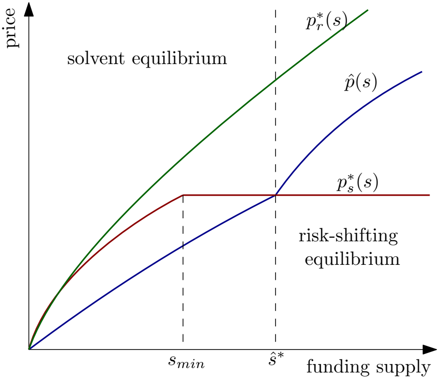

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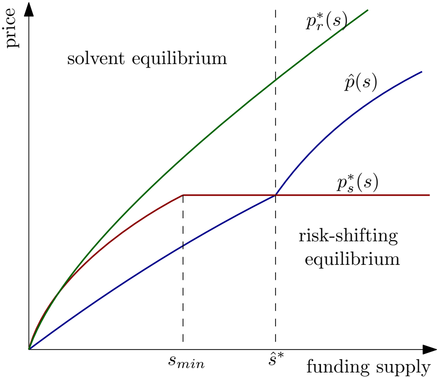

Mixed risk-shifting equilibrium

- If all banks would **risk-shift**: p_r^*
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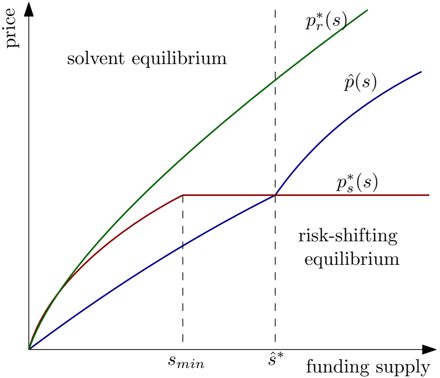
$\rightarrow$ mixed equilibrium if $s > \hat{s}^*$: some risk-shift, others solvent



Equilibrium risk-shifting thresholds

Proposition:

There exists an equilibrium risk-shifting threshold of funding supply $\hat{s}^*(\alpha)$.

- If $s \leq \hat{s}^*(\alpha)$, all banks choose the solvent strategy
- If $s > \hat{s}^*(\alpha)$, fraction ψ^* of banks risk shifts and $1 - \psi^*$ invest solvently

Equilibrium: low funding

If $s < s_{min}$, all banks invest solvently but are constrained

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- "Missed boom"

Equilibrium: moderate funding

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- Banks risk default
- "Bad boom"

Good, bad, or missed boom?

Key result: Funding supply relative to productivity determines the quality of bank lending choice

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- Low funding supply → unable to use all opportunities
- High funding supply → investment misallocated:
  - excessive in speculative asset,
  - insufficient in productive technology

	High productivity	Low productivity
High funding	Good boom	Bad boom
Low funding	Missed boom	Good boom

In what follows focus on good vs bad boom

Inference and investment by local agents

The inference problem

Assume:

- $s^H > \hat{s}(\alpha)$ for some α
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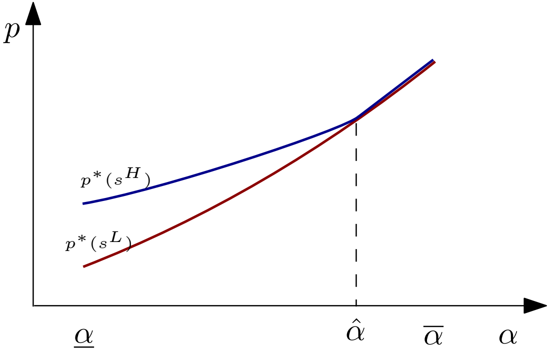

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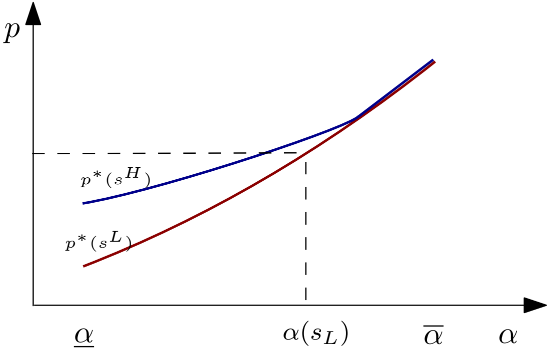

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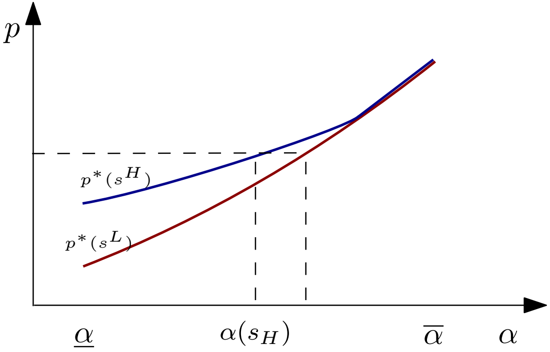

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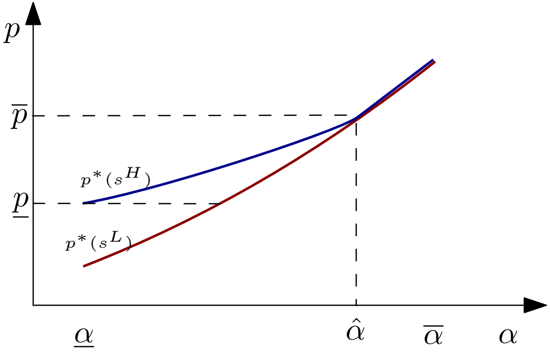

Posterior beliefs

If $p^* \in (\underline{p}, \overline{p})$ local agents form beliefs:

$$\alpha = \begin{cases} \hat{\alpha}(s^H) \text{ with prob. } \rho \\ \hat{\alpha}(s^L) \text{ with prob. } 1-\rho \end{cases}$$

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Proposition:

The inferred values are such that:

$$\hat{\alpha}(s^L) > \hat{\alpha}(s^H)$$

- Overestimate productivity when supply is high
- Underestimate productivity when supply is low

Optimal investment by local firms

$$max_{x_j} \ [\rho\hat{\alpha}(s^H) + (1-\rho)\hat{\alpha}(s^L)]\sqrt{x_j} - x_j$$
$$\text{subject to: } x_j \leq k, \ \ x_j \geq 0$$

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$\rightarrow$ **amplification**

Local bank and regulator

Local banks

- Can take up debt equal to s_k
- Deposit insurance

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$$max_{x_k}(1-\rho)[\hat{\alpha}(s^L)\sqrt{x_k}-x_k]+\rho\,\max[\hat{\alpha}(s^H)\sqrt{x_k}-x_k,0]$$
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Induced risk-shifting

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- If $s = s^L$: ex-post optimal
- If $s = s^H$: default

Local regulator

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Local regulator

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- No information on global banks funding flows
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- Tool:
  - Increase the marginal cost of lending to $1 + \tau$
  - Lump sum transfer of τx at the final date to solvent banks

Impact of the policy

$$max_{x_k}(1-\rho)[\hat{\alpha}(s^L)\sqrt{x_k} - (1+\tau)x_k + \tau x] +$$
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- Results in a lower lending (also if efficient)
- Decreases risk shifting incentives:
  - There exists $\hat{\tau}$ above which no more risk-shifting incentives

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- Optimal policy does not ensure efficiency:
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  - Rule out risk-shifting: $\tau^* = \hat{\tau}$ but allow for underinvestment

Conclusions

We study uncertainty over credit demand and supply.

- Abundant funding can lead to risk-shifting by banks
- Balance sheet opacity key to distorted inference
- Errors may result in an amplification of over-investment
- ..or worsen under-investment
- May lead to "induced risk-shifting" by local banks
- Local regulator may be unable to ensure effcient investment