Advanced Macroeconomics I

ECON 525a - Fall 2009

Yale University

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Week 7 - Reputation and Risk Taking
Motivation

"A sound banker, alas, is not one who foresees danger and avoids it, but one who, when he is ruined, is ruined in a conventional way along with his fellows, so that no one can really blame him"

J. M. Keynes, 1931
Motivation

- Reputation concerns may deter opportunistic behavior.
  - Short-term opportunistic benefits vs. long-term reputational costs.
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- Reputation has limits.
Motivation

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- Reputation has limits.

- In lending markets, borrowers whose actions are non-observable may take excessive risk...and reputation imposes self-discipline...with certain limits.
Question

Aggregates effects of reputation incentives?
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    - Conditions determine the temptation to take excessive risk.
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  - Effects of changes in aggregate conditions on aggregate behavior?
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    - Conditions determine the temptation to take excessive risk.
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- Why is this relevant?
  - Reputation is at the core of lending relations, based on confidence.
  - Reputation affects cost and availability of credit.
Answer

- Reputation is effective, but fragile
  - Borrowers with intermediate and high reputation change risk-taking behavior under similar aggregate conditions.
  - Small aggregate shocks may lead to clustering in risk-taking and confidence crises.
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- Current crisis
  - Confidence crisis on the reliability of ratings.
Road Map

- Model of reputation and risk-taking in lending markets.
  - Diamond (89) and Mailath and Samuelson (01)
  - Introduction of aggregate shocks.
  - Selection of a unique equilibrium.

- Fragility of reputation and clustering in risk-taking.

- Sudden collapses in otherwise well-functioning lending markets.
Main Problem

- Firms borrow at a given interest rate to run a project.
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- They decide to take safe or risky unobservable actions.
- Typical moral hazard → Short-term opportunistic benefits.
- Reputation concerns → Long-term reputational cost.
- How far reputation can go in reducing excessive risk-taking?
Example - Efficiency

- If actions of firms are observable.

\[
\begin{align*}
\text{Loan}=1, \quad \bar{R} = 1, \quad R_s &= \frac{1}{0.9}, \quad R_r = \frac{1}{0.7} \\
\end{align*}
\]

<table>
<thead>
<tr>
<th>Action</th>
<th>Prob</th>
<th>Payoff</th>
<th>Payoff to lenders</th>
<th>Payoff to firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe</td>
<td>0.9</td>
<td>1.5 + 2</td>
<td>3.15</td>
<td>3.15 – 1</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risky</td>
<td>0.7</td>
<td>2.2 + 2</td>
<td>2.95</td>
<td>2.95 – 1</td>
</tr>
<tr>
<td></td>
<td>0.3</td>
<td>0</td>
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Differential gains Safe \(0.2 > 0\)

- Safe is efficient.
Example - Moral Hazard

- If actions of firms are non-observable.

\[
\text{Loan} = 1, \quad \bar{R} = 1, \quad R \in \left[ \frac{1}{0.9}, \frac{1}{0.7} \right]
\]

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<td>0.9R</td>
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Differential gains Safe 0.2 − 0.2R

- Risky is preferred when \( R > 1 \) (Always)
Example - Reputation

- **Two unobservable types**, Strategic (choose) and Risky.
- **Reputation** $\phi$ is the probability the firm is strategic.
- **Signals correlated to actions.**

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<td>2.2 + 2.5</td>
<td>0.6 2.2 + 1.5</td>
<td>2.9 0.7$R$</td>
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- **Differential gains Safe** $0.5 - 0.2R$

- **Safe is preferred when** $R < 2.5$ (Always)
A simplified two period model

Timing

- Loan of 1 at \( R(\phi) > 1 \) (decreasing in \( \phi \)).
- Fundamentals \( \theta \sim \mathcal{N}(\mu, \frac{1}{\alpha}) \) are realized.
- Strategic firms decide safe (s) or risky (r) actions.
- Firm continues or die: \( (p_s > p_r) \)
  - Dies          Gets 0. Defaults.
  - Continues:    Gets \( \Pi_s \) if s or \( \Pi_r = \Pi_s - \theta \) if r.
    Repayment. No asset accumulation.

- Lenders update reputation based on continuation from \( \phi \) to \( \phi' \).
- Fixed payment \( V(\phi') \) (increasing in \( \phi' \)).
\( \Delta - \text{Differential gains from safe actions} \)

\[
V_s(\phi, \theta) = p_s(\Pi_s - R(\phi) + V(\phi')) \\
V_r(\phi, \theta) = p_r(\Pi_s - \theta - R(\phi) + V(\phi'))
\]

\[
\Delta(\phi, \theta) = (p_s - p_r)\Pi_s + p_r\theta + (p_s - p_r)V(\phi) - (p_s - p_r)R(\phi) + (p_s - p_r)[V(\phi') - V(\phi)]
\]

*Short term* \[\text{Continuation}\] \[\text{Moral Hazard}\]

*Reputation Formation*
Δ decreases with beliefs of risk taking \( \hat{x} \)

Define \( \hat{x}(\phi) \) the probability assigned by lenders to firms \( \phi \) taking risk

\[
\Delta(\phi, \theta|\hat{x}) = (p_s - p_r)\Pi_s + p_r\theta + (p_s - p_r)V(\phi) - (p_s - p_r)R(\phi) + (p_s - p_r)[V(\phi') - V(\phi)]
\]
$\Delta$ decreases with beliefs of risk taking $\hat{x}$

$$\Delta(\phi, \theta | \hat{x}) = (p_s - p_r)\Pi_s + p_r\theta + (p_s - p_r)V(\phi) - (p_s - p_r)R(\phi)$$

$$+ (p_s - p_r)[V(\phi' | \hat{x}) - V(\phi)]$$
$\Delta$ increases with fundamentals $\theta$

$$\Delta(\phi, \theta|\hat{x}) = (p_s - p_r)\Pi_s + p_r\theta + (p_s - p_r)V(\phi) - (p_s - p_r)R(\phi)$$

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$$+ (p_s - p_r)[V(\phi' | \hat{x}) - V(\phi)]$$
Cutoff Strategies

\[ a(\phi, \theta) = \begin{cases} 
  s & \text{if } \theta > k(\phi) \\
  r & \text{if } \theta < k(\phi) 
\end{cases} \]

\[ \hat{x}(\phi, \theta, k(\phi)) = \begin{cases} 
  0 & \text{if } \theta > k(\phi) \\
  1 & \text{if } \theta < k(\phi) 
\end{cases} \]
Multiple solutions when $\theta$ is observed
Uniqueness when $\theta$ is not perfectly observed

- New assumption about the information structure.
  - Before production, all firms $i$ observes a signal $z_i = \theta + \epsilon_i$ where $\epsilon_i \sim \mathcal{N}(0, \frac{1}{\beta})$ identically and independently distributed across $i$.
  - After production, lenders $j$ observes a signal $z_j = \theta + \epsilon_j$ where $\epsilon_j \sim \mathcal{N}(0, \frac{1}{\beta})$ identically and independently distributed across $j$.
  - **Alternative assumption:** Lenders observe aggregate default rate by firms with reputation $\phi$.

- Equilibrium strategies are redefined over signals.

\[
   a^*(\phi, z) = \begin{cases} 
   s & \text{if } z > z^*(\phi) \\
   r & \text{if } z < z^*(\phi) 
\end{cases}
\]
Uniqueness when $\theta$ is not perfectly observed

\[ \hat{\theta}_i = E(\theta|x_i) = \frac{\alpha \mu + \beta x_i}{\alpha + \beta} \]

\[ x_j|\hat{\theta}_i \sim \mathcal{N}\left(\hat{\theta}_i, \frac{1}{\alpha + \beta} + \frac{1}{\beta}\right) \]

\[ \hat{x}(z_i) = Pr\left(\hat{\theta}_j < \hat{\theta}_i|\hat{\theta}_i\right) = \Phi\left[\sqrt{\gamma}(\hat{\theta}_i - \mu)\right] \]

where

\[ \gamma = \frac{\alpha^2(\alpha + \beta)}{\beta(\alpha + 2\beta)} \]
Uniqueness as $\beta \rightarrow \infty$
Uniqueness as $\beta \to \infty$

\[ E_\theta (\Delta(\phi, \theta|\hat{x})|z^*) = 0 \]

As $\beta \to \infty$, $E(\theta|x_i^*) \to z^*$ and $\hat{x} \to 0.5$ for all $z_i$

\[ (p_s - p_r) (\Pi_s - R(\phi) + V(\phi'|\hat{x} = 0.5)) + p_r E(\theta|z^*) = 0 \]

\[ z^* = -\frac{p_s - p_r}{p_r} (\Pi_s - R(\phi) + V(\phi'|\hat{x} = 0.5)) \]
Uniqueness as $\beta \to \infty$
Properties of Reputation

**Proposition**

- **Ex-ante probabilities of risk taking decrease with reputation**
  \[
  \frac{d\Phi(z^*(\phi))}{d\phi} < 0 \text{ for all } \phi \in [0, 1]
  \]

- **Interest rates decrease with reputation**
  \[
  \frac{dR(\phi)}{d\phi} < 0 \text{ for all } \phi \in [0, 1]
  \]

- **Continuation values increase with reputation**
  \[
  \frac{dV(\phi)}{d\phi} > 0 \text{ for all } \phi \in [0, 1]
  \]

- **Reputation concerns convexify the schedule of cutoffs** \(z^*(\phi)\). 
  \[
  \frac{\partial^2 z^*(\phi)}{\partial \phi^2} > 0 \text{ for all } \phi \in [0, 1]
  \]
Risk Taking WITHOUT reputation formation

\[ \Delta(\phi, \theta) = (p_s - p_r)(\prod_s(\theta) + V(\phi) - R(\phi) + p_r\theta) \]
Reputation formation incentives

\[ \Delta(\phi, \theta) = (p_s - p_r) (\Pi_s + V(\phi) - R(\phi) + [V(\phi') - V(\phi)]) + p_r \theta \]
Risk Taking WITH reputation formation

\[
\begin{align*}
\phi & \\
1 & \\
\phi_M & \\
0 & \\

\text{Risky actions} & \\
\text{Safe actions} & \\
\end{align*}
\]
Fragility of Reputation

**Proposition**

- **Selection:** *For* $\beta \to \infty$, small changes in $\theta$ around $z^*(\phi)$ induce sudden changes in risk-taking behavior among firms with the same $\phi$.

- **Learning:** *For* $\beta \to \infty$, as fundamentals decrease, an increasingly wider range of reputation levels $\phi$ decide to take risk.
Clustering in Risk Taking

The diagram shows a graphical representation of risky and safe actions based on certain parameters. The areas are defined by the parameters $\phi$, $\theta_1$, $\theta_0$, and $z^*(\phi)$. The blue area represents risky actions, while the yellow area represents safe actions. The boundaries are marked by the values of $\phi$, $\theta_1$, and $\theta_0$.
Clustering in Risk Taking

\[ \phi \]

\[ 1 \]

\[ 0 \]

\[ \theta_1 \]

\[ \theta_0 \]

\[ z^*(\phi) \]

Risky actions

Safe actions
Simulations - Example

- Value function iteration. Finite and large grid $\phi$
- Assume $\Pi_s > 0$, $\Pi_r = \Pi_s + K - \psi \theta$, where $\psi > 0$ and $\theta \sim \mathcal{N}(0, 1)$
- Parameters: $\beta = 0.95$, $\bar{R} = 1$, $\Pi_s = 1.5$, $K = 0.4$, $\psi = 0.2$,
  $p_s = 0.9$, $p_r = 0.7$, $\alpha_s = 0.8$ and $\alpha_r = 0.4$. 
Simulations - Limits to Reputation

- Fundamentals below which firms take risk: WITHOUT reputation formation
- Distribution of fundamentals (Standard Normal)

Fundamentals below which it is efficient to take risk

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Simulations - Default Probabilities

![Graph showing aggregate default probability over periods with and without reputation formation]

- **Fundamentals**: Aggregate Default Probability
- **Efficiency Cutoff with Full Information**: Default Probability WITH reputation formation
- **Default Probability WITHOUT reputation formation**

**Periods**: 0 10 20 30 40 50 60 70 80 90 100
Simulations - Net Returns to Lenders
Clustering in Corporate Default Rates

- Corporate default cluster in recessions. Duffie et al. (2007).
Clustering in Risk Taking Behavior

Conclusions

- Natural use of global games to select a unique equilibrium in reputational games.

- Fragility of reputation.
  - Large change in aggregate risk-taking in response to small and non-obvious changes in aggregate fundamentals.

- Financial crises.
  - Sudden raise in moral hazard vs. sudden weakening of reputation.

- Policy implications. Extensions.
  - Basel II banking regulations.
  - Credit bureaus.
  - Reputation or Regulation?
Reputation or Regulation?

- Ben Bernanke, NY Times, Dec. 18, 2007
  ”..market discipline has in some cases broken down and the incentives to follow prudent lending procedures have, at times, eroded”.

- Paul Krugman, NY Times, Dec. 21, 2007
  ”Mr. Greenspan dismissed as a ”collectivist” myth the idea that businessmen, left to their own devices, ”would attempt to sell unsafe food and drugs, fraudulent securities, and shoddy buildings.” On the contrary, he declared, ”it is in the self-interest of every businessman to have a reputation for honest dealings and a quality product... Protection of the consumer by regulation is thus illusory, the only reliable protection the consumer has is competition for reputation”.

- Charles Goodhart, FT, Jan. 31, 2008
  ”Capital adequacy requirement on mortgage lending should be linked to the rise in both mortgage lending and housing prices.”
Even more recent quotes

- **NY Times, Oct. 3, 2008 (Stephen Labaton)**
  - About a 2004 rule change by the SEC that removed regulation of investment bank debt ratios, only for the largest firms: "We’ve said these are the big guys...We foolishly believed firms had a strong culture of self-preservation and responsibility and would have the self-discipline not to be excessively borrowing”.
  - "A similar laissez-faire philosophy has driven a push for deregulation throughout the government, from the CPSC and the EPA to worker safety and transportation agencies”.

- **NY Times, Oct. 2, 2008 (Joe Nocera)**
  - "This is what a credit crises looks like...It’s a loss of confidence in seemingly healthy institutions".