Economics 101A
(Lecture 25)

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Outline

1. Hidden Action (Moral Hazard) II
2. The Takeover Game
3. Hidden Type (Adverse Selection)
4. Evidence of Hidden Type and Hidden Action

1 Hidden Action (Moral Hazard) II

- Back to Principal-Agent problem

- Solve problem in three Steps, starting from last stage (backward induction)

  - **Step 1** *(Effort Decision)*. Given contract $w(y)$, what effort e^* is agent going to put in?

  - **Step 2.** *(Individual Rationality)* Given contract $w(y)$ and anticipating to put in effort e^*, does agent accept the contract?

  - **Step 3.** *(Profit Maximization)* Anticipating that the effort of the agent e^* (and the acceptance of the contract) will depend on the contract, what contract $w(y)$ does principal choose to maximize profits?

- **Step 1.** Solve effort maximization of agent:

$$Max_e a + be - \frac{\gamma}{2} b^2 \sigma^2 - c(e)$$

- Solution:

$$c'(e) = b$$

- If assume $c(e) = ce^2/2$ –> $e^* = b/c$

- Check comparative statics

  – With respect to b –> What happens with more pay-for-performance?

  – With respect to c –> What happens with higher cost of effort?

- **Step 2.** Agent needs to be willing to work for principal

- *Individual rationality* condition:

$$EU(w(e^*)) - c(e^*) \geq 0$$

- Substitute in the solution for e^* and obtain

$$a + be^* - \frac{\gamma}{2}b^2\sigma^2 - c(e^*) \geq 0$$

- Will be satisfied with equality: $a^* = -be^* + \frac{\gamma}{2}b^2\sigma^2 + c(e^*)$

- **Step 3**: Owner maximizes expected profits

$$\max_{a,b} E[\pi] = e - E[w(y)] = e - a - be$$

- Substitute in the two constraints: $c'(e) = b$ (Step 1) and $a^* = -be^* + \frac{\gamma}{2}b^2\sigma^2 + c(e^*)$ (Step 2)

- Obtain

$$\begin{aligned} E[\pi] &= e - \left(-be + \frac{\gamma}{2}b^2\sigma^2 + c(e)\right) - c'(e)e \\ &= e + be - \frac{\gamma}{2}b^2\sigma^2 - c(e^*) - c'(e)e \\ &= e + c'(e)e - \frac{\gamma}{2}\left(c'(e)\right)^2\sigma^2 - c(e^*) - c'(e)e \\ &= e - \frac{\gamma}{2}\left(c'(e)\right)^2\sigma^2 - c(e^*) \end{aligned}$$

- Profit maximization yields f.o.c.

$$1 - \gamma c'(e)\sigma^2 c''(e) - c'(e) = 0$$

and hence

$$c'(e^*) = \frac{1}{1 + \gamma\sigma^2 c''(e^*)}$$

- Notice: This implies $c'(e^*) < 1$

- Substitute $c(e) = ce^2/2$ to get

$$e^* = \frac{1}{c}\frac{1}{1 + \gamma\sigma^2 c}$$

- Comparative Statics:

  – Higher risk aversion γ –>...

  – Higher variance of output σ –>...

  – Higher effort cost c –>...

- Also, remember $b^* = c'(e^*) = ce^*$ and hence

$$b^* = ce^* = c\frac{1}{c}\frac{1}{1+\gamma\sigma^2 c} = \frac{1}{1+\gamma\sigma^2 c}$$

- Notice $0 < b^* < 1$:
  - Agent gets paid increasing function of output to incentivize
  - Does not get paid one-on-one ($b = 1$) because that would pass on too much risk to agent
  - (Remember $w^* = a^* + b^* y = a^* + b^* e + b^* \varepsilon$)
  - Comparative Statics: what happens to b^* if $\gamma = 0$ or $\sigma = 0$? Interpret

- Consider solution when effort is observable

- This is so-called **first best** since it eliminates the uncertainty involved in connecting pay to performance (as opposed to effort)

  - Principal offers a flat wage $w = a$ as long as agent works e^*

  - Agent accepts job if

  $$a - c(e^*) \geq 0$$

  - Principal wants to pay minimal necessary and hence sets $a^* = c(e^*)$

  - Substitute into profit of principal

  $$\max_{a,b} E[\pi] = e - E[w(y)] = e - a^* = e - c(e)$$

  - Solution for e^*: $c'(e^*) = 1$ or

  $$e^*_{FB} = 1/c$$

- Compare e^* above and e^*_{FB} in first best

- –$>$ With observable effort (first best) agent works harder

- Summary of hidden-action solution with risk-averse agent:

- **Risk-incentive trade-off:**
  - Agent needs to be incentivized ($b^* > 0$) or will not put in effort e
  - Cannot give too much incentive (b^* too high) because of risk-aversion
  - Trade-off solved if
    * Action e observable OR
    * No risk aversion ($\gamma = 0$) OR
    * No noise in outcome ($\sigma^2 = 0$)
  - Otherwise, effort e^* in equilibrium is sub-optimal

- Same trade-off applies to other cases

- Example 2: *Insurance* (Not fully solved)
  - Two states of the world: Loss and No Loss
  - Probability of Loss is $\pi(e)$, with $\pi'(e) < 0$
    * Example: Careful driving (Car Insurance)
    * Example: Maintaining your house better (House insurance)
    * Agent chooses quantity of insurance α purchased
  - Agent risk averse: $U(c)$ with $U' > 0$ and $U'' < 0$

- Qualitative solution:
  - No hidden action –> Full insurance: $\alpha^* = L$
  - Hidden action –>
    - Trade-off risk-incentives –> Only Partial insurance $0 < \alpha^* < L$
    - Need to make agent partially responsible for accident to incentivize
    - Do not want to make too responsible because of risk-aversion

2 Takeover Game

- "The Takeover Game" (Samuelson and Bazerman, 1985)

- See hand-out

3 Hidden Type (Adverse Selection)

- Nicholson, Ch. 18, pp. 671-672.

- Solution of Take-over game
  - When does seller sell? If bid profitable ($b \geq V$)
  - Profit of buyer? $1.5V - b$ –> BUT: Must take into account strategic behavior of seller

- Solution:

$$
\begin{aligned}
E[profit(b)] &= (E[1.5V|V \leq b] - b) \cdot \Pr(V \leq b) \\
&= \left(1.5\frac{b}{2} - b\right) \Pr(V \leq b) \\
&= -.25b \Pr(V \leq b)
\end{aligned}
$$

- Derive First order condition
  - Solution: $b^* = 0$!

- No market for take-overs, despite clear benefits. Why?

- First type of asymmetric information problems: Hidden Action (Moral Hazard)
  - Manager can shirk when she is supposed to work hard.
- Second type of asymmetric information problems: Hidden Type (Adverse Selection)
  - Informational problem: one party knows more than the other party.
  - Example 1: wisdom teeth extraction (Doctors are very prone to recommend extraction. Is it necessary? Or do they just want to make money. Likely too many wisdom teeth extracted.)
  - Example 2: finding a good mechanic. (Most people don't have any idea if they are being told the truth. People can shop around, but this has considerable cost. Because of this, mechanics can sometimes inflate prices)

- **Lemons Problem**

- Classic asymmetric information situation is called "Lemons Problem"
  - (Akerlof, 1970) on used car market
  - Idea: "If you're so anxious so sell to me do I really want to buy this?"

- Simple model:
  - The market for cars has two types, regular cars (probability q) and lemons (probability $1-q$).
    - To seller, regular cars are worth \$1000, lemons are worth \$500.
    - To potential buyer, regular cars are worth \$1500 and lemons worth \$750.

- Which cars should be sold (from efficiency perspective)?
  - All cars should be sold since more valuable to buyer.
  - BUT: buyers **do not know** type of car, sellers **do know**

- Solve in two stages (backward induction):
  - Stage 2: Determine buyers willingness to pay
  - Stage 1: Determine selling strategy of sellers

- Stage 2. What are buyers' WTP?
  - Expected car value $= \mu 1500 + (1 - \mu)750 = 750 + \mu 750$
  - Notice: μ is expected probability that car sold is regular (can differ from p)

- Buyer willing to pay up to $p = 750 + \mu 750$

- Stage 1. Seller has to decide which car to sell
  - Sell lemon if $500 \leq p = 750 + \mu 750$ YES for all μ
  - Sell regular car if $1000 \leq p = 750 + \mu 750 \Leftrightarrow \mu \geq 1/3$

- Two equilibria
  1. If $q \geq 1/3$: *Sell both types of cars* $->$ $\mu = q \geq 1/3$ $->$ $p^* = 750 + \mu 750$
  2. If $q < 1/3$: *Sell only lemons* $->$ $\mu = 0$ $->$ $p^* = 750$

- Market for cars can degenerate: Only lemons sold

- *Conclusion*: the existence of undetectable lemons may collapse the market for good used cars

- *Basic message*: If sellers know more than buyers, buyers must account for what a seller's willingness to trade at a price tells them about hidden information

- Same issues apply to:

  - *Car Insurance.* If offer full insurance, only bad drivers take it

  - *Salary.* If offer no salary incentives, only low-quality workers apply

4 Evidence of Hidden Type and Hidden Action

- Consider asymmetric information in lending market (Karlan-Zinman, 2007)

- Lenders offer different borrowing rates

  - High interest rates –> *Adverse selection:* Tend to select bad borrowers

  - *Moral Hazard:* Borrowers have incentive to default on loan

- Both forms of asymmetric information lead to defaults

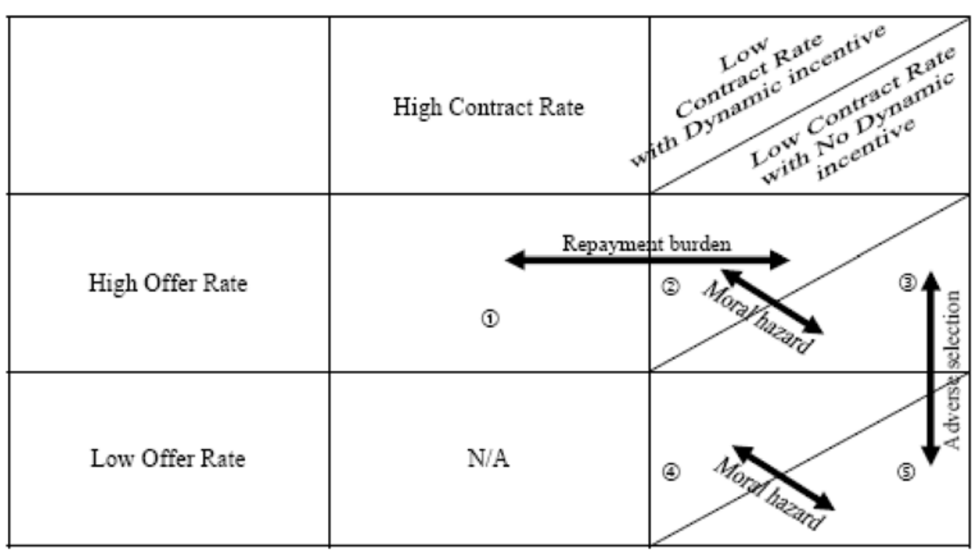
- Separate the two:

– Randomize high and low credit offer

– To some (randomized) high-offer consumers, lower rate ex-post

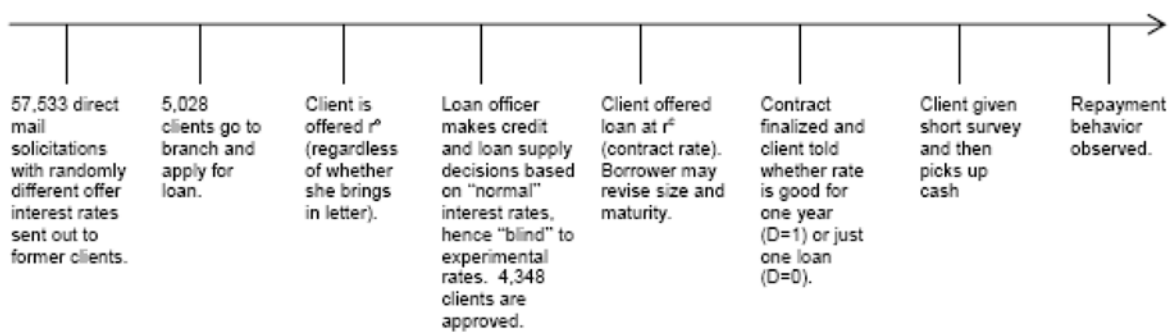
– To some (randomized) high-offer consumers, offer incentives to keep good credit (can keep loan ex post if repay in time

Figure 1. Basic Intuition Behind the Experimental Design



- Timing:

Figure 2: Operational Steps of Experiment



- Results:

Table 3. Identifying Adverse Selection, Repayment Burden, and Moral Hazard: Comparison of Means

	Selection Effects			Repayment Burden Effects		
	High Offer, Low Contract	Low Offer, Low Contract	t-stat: diff≠0	High Offer, High Contract	High Offer, Low Contract	t-stat: diff≠0
Full Sample	(1)	(2)	(3)	(4)	(5)	(6)
Average Monthly Proportion Past Due	0.102	0.082	1.90*	0.105	0.102	0.23
	(0.009)	(0.004)		(0.006)	(0.009)	
Proportion of Months in Arrears	0.211	0.202	0.72	0.244	0.211	2.38**
	(0.011)	(0.006)		(0.008)	(0.011)	
Account in Collection Status	0.123	0.101	1.50	0.139	0.123	0.99
	(0.013)	(0.007)		(0.009)	(0.013)	
# of observations	625	2087		1636	625	

Moral Hazard Effects		
No Dynamic Incentive, Low Contract	Dynamic Incentive, Low Contract	t-stat: diff≠0
(7)	(8)	(9)
0.094	0.079	1.94**
(0.006)	(0.005)	
0.217	0.188	2.70***
(0.008)	(0.008)	
0.118	0.092	2.16**
(0.008)	(0.008)	
1458	1254	

- Substantial effect of incentives to keep good credit (moral hazard)

- Some effect of adverse selection

- Importance of field experiment: Can do controlled test of theory

Summary of how to separate moral hazard and adverse selection in credit card borrowing

- *Adverse Selection.* Compare two groups
  - Offered rate r_{HI} and gets r_{LO}
  - Offered rate r_{LO} and gets r_{LO}
  - This holds constant final offer (r_{LO}) and varies initial offer –> Adverse Selection

- *Moral Hazard.* Compare two groups
  - Offered rate r_{HI} and gets r_{LO}
  - Offered rate r_{HI} and gets r_{HI}
  - This holds constant initial offer (r_{HI}) and varies final offer –> Moral hazard