Economics 101A
(Lecture 26)

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Outline

1. Existence of Equilibrium and Welfare Theorems

2. Asymmetric Information: Introduction

3. Hidden Action (Moral Hazard)

1 Existence and Welfare Theorems

- Does Walrasian Equilibrium always exist? In general, yes, as long as preference convex

- Is Walrasian Equilibrium always unique? Not necessarily

- Is Walrasian Equilibrium efficient? Yes.

- **First Fundamental Welfare Theorem.** All Walrasian Equilibria are on Contract Curve (and therefore are Pareto Efficient).

- Figure

- **Second Fundamental Welfare theorem.** Given convex preferences, for every Pareto efficient allocation $\left((x_1^1, x_1^1), (x_1^2, x_2^2)\right)$ there exists some endowment (ω_1, ω_2) such that $\left((x_1^1, x_1^1), (x_1^2, x_2^2)\right)$ is a Walrasian Equilibrium for endowment (ω_1, ω_2).

- Figure

- Significance of these results:
  - First Theorem: Smithian Invisible Hand. Market leads to an allocation that is Pareto Efficient.
  - BUT: problems with externalities and public good
  - BUT: what about distribution?
  - Second Theorem: Can redistribute endowments to achieve any efficient outcome as a WE.
  - But redistribution is hard to implement, and distortive.

2 Asymmetric Information: Introduction

- Nicholson, Ch. 18, pp. 627-632 [*NOT* in 9th Ed.]
- Common economic relationship
- Contract between two parties:
  - Principal
  - Agent
- Two parties have asymmetric information
  - Principal offers a contract to the agent
  - Agent chooses an action
  - Action of agent (or his type) is not observed by principle

- Example 1: *Manager and worker*
  - Manager employs worker and offers wage
  - Worker exerts effort (not observed)
  - Manager pays worker as function of output
- Example 2: *Car Insurance*
  - Car insurance company offers insurance contract
  - Driver chooses quality of driving (not observed)
  - Insurance company pays for accidents
- Example 3: *Shareholders and CEO*
  - Shareholders choose compensation for CEO
  - CEO puts effort
  - CEO paid as function of stock price

- In all of these cases (and many more!), common structure
  - Principal would like to observe effort (of worker, of CEO, of driver)
  - Unfortunately, this is not observable
  - Only a related, noisy proxy is observable: output, accident, success
  - Contract offered by principal is function of this proxy
- This means that occasionally an agent that put a lot of effort but has bad luck is 'punished'
- Also, agents that shirked may instead be compensated
- These principle-agent problems are called *hidden action* or *moral hazard*

- Second category (next lecture): *hidden type* or *adverse selection*

- Example 1: *Manager and worker*
  - Manager employs worker and offers wage
  - Worker can be hard-working or lazy

- Example 2: *Car Insurance*
  - Car insurance company offers insurance contract
  - Drivers ex ante can be careful or careless

- Example 3: *Shareholders and CEO*
  - Shareholders choose compensation for CEO
  - CEO is high-quality or thief

- Problem is similar (action is not observed), but with a twist
  - *Hidden action*: principal can convince agent to exert high effort with the appropriate incentives
  - *Hidden type*: agent's behavior is not affected by incentives, but by her type
- Different task for principal:
  - *Hidden action*: Principal wants to incentivize agent to work hard
  - *Hidden type*: Principal wants to make sure to recruit 'good' agent, not 'bad' one
- Two look similar, but analysis is different
- Start from *Hidden Action*

3 Hidden Action (Moral Hazard)

- Nicholson, Ch. 18, pp. 632-637 [*NOT* in 9th Ed.]

- Example 3: *Shareholders and CEO*
  - Division of ownership and control

- Shareholders (owners of firm):
  - Have capital, but do not have time to run company themselves
  - Want firm run so as to maximize profits

- CEO (manager)
  - Has time and managerial skill
  - Does not have capital to own the firm

- If CEO owns the company (private enterprises), problem is solved –> Infeasible in large companies

- Agent chooses effort e (unobserved)
  - Induces output $y = e + \varepsilon$, where ε is a noise term, with $E(\varepsilon) = 0$
  - Example: Despite putting effort, investment project did not succeed

- Principal pays a salary w to the agent
  - Salary is a function of y: $w = w(y)$
  - Remember: Salary cannot be function of e

- Principal maximizes expected profits

$$E[\pi] = E[y - w(y)] = e - E[w(y)]$$

- Agent is risk averse and maximizes

$$E[U(w(e + \varepsilon))] - c(e)$$

  - $c(s)$ is cost of effort: assume $c'(s) > 0$ and $c''(s) > 0$ for all s
  - Utility function U satisfies $U' > 0$ and $U'' < 0$
  - Notice: Agent is risk-averse, Principal is risk-neutral

- Assume $U(w) = -e^{-\gamma w}$ and $\varepsilon \sim N\left(0, \sigma^2\right)$

- Can solve explicitly for $EU(w)$:

$$EU(w) = -\frac{1}{\sqrt{2\pi}} \int e^{-\gamma w} e^{-\frac{1}{2}\frac{w-\mu_w}{\sigma_w^2}} dw = \mu_w - \frac{\gamma}{2}\sigma_w^2$$

- Expected utility of agent is $EU(w) = \mu_w - \frac{\gamma}{2}\sigma_w^2$

- Note: μ_w is average salary and σ_w^2 is variance of salary
  - Agent likes high mean salary μ_w
  - Agent dislikes variance in salary σ_w^2
  - Dislike for variance is higher the higher is γ

- Assume that contract is linear: $w = a + by = a + be + b\varepsilon$
  - Compute $\mu_w = E(w) = E[a + be + b\varepsilon] = a + be + bE[\varepsilon] = a + be$
  - Compute $\sigma_w^2 = Var[a + be + b\varepsilon] = b^2\sigma^2$

- Rewrite expected utility as $EU(w) = a + be - \frac{\gamma}{2}b^2\sigma^2$

- Solve problem from last stage (backward induction)

- 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

  – With respect to c

- Next condition: Agent needs to be willing to work for principal

- Individual rationality condition:

$$EU\left(w\left(e^{*}\right)\right)-c\left(e^{*}\right)\geq 0$$

- Substitute in the solution for e^{*} and obtain

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

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

- Finally, the owner maximizes expected profits

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

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

- Obtain

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

- Maximization of principal yields f.o.c.

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

and hence

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

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

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

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

- Compare this to case in which effort is observable
  - Principal offers a flat wage $w = a$ as long as agent works e^*
  - Agent accepts job if

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

  - Substitute (with equality) into profit of principal

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

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

$$e^* = 1/c$$

- Notice: With observable effort agent works harder

4 Next lecture

- Asymmetric Information: Adverse Selection
- Then: Empirical Economics
- Some examples of Empirical Economics
  - House insurance
  - Save More Tomorrow
  - Fox News