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 \( ((x_1^1, x_1^1), (x_1^2, x_2^2)) \) there exists some endowment \((\omega_1, \omega_2)\) such that \( ((x_1^1, x_1^1), (x_1^2, x_2^2)) \) is a Walrasian Equilibrium for endowment \((\omega_1, \omega_2)\).

• 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 $\rightarrow$ Infeasible in large companies

• Agent chooses effort $e$ (unobserved)
  
  – Induces output $y = e + \varepsilon$, where $\varepsilon$ 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 \( \varepsilon \sim N (0, \sigma^2) \)

• Can solve explicitly for \( EU (w) \):

\[ EU (w) = -\frac{1}{\sqrt{2\pi}} \int e^{-\gamma w e^{-\frac{1}{2} \frac{w - \mu w}{\sigma^2 w}}} dw = \mu_w - \frac{\gamma}{2} \sigma^2 w \]
• Expected utility of agent is $EU(w) = \mu_w - \frac{\gamma}{2} \sigma_w^2$

• Note: $\mu_w$ is average salary and $\sigma_w^2$ is variance of salary
  
  – Agent likes high mean salary $\mu_w$
  
  – Agent dislikes variance in salary $\sigma_w^2$
  
  – Dislike for variance is higher the higher is $\gamma$

• 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:

\[ \max e a + b e - \frac{\gamma}{2} b^2 \sigma^2 - c(e) \]

• Solution:

\[ c'(e) = b \]

• If assume \( c(e) = ce^2/2 \) \( \Rightarrow e^* = b/c \)

• 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:

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

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

• Finally, the owner maximizes expected profits

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

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

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

\[ = e + c'(e)e - \frac{\gamma}{2} \left(c'(e)\right)^2 \sigma^2 - c(e^*) - c'(e)e \]

\[ = e - \frac{\gamma}{2} \left(c'(e)\right)^2 \sigma^2 - c(e^*) \]

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