

Lecture 9: Asymmetric Information

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Introduction

- Last time: introduction to the study of games with incomplete information.
- Generally we are interested in games where one party knows more than the other.
- Situations that exhibit this property are said to have asymmetric information.
- Asymmetric information leads to a failure of the first welfare theorem: equilibria are often not Pareto efficient.
- **Hidden Action:** one player can take an action that is unobserved by the other.
 - ▶ Example: An employee working remotely can exert more or less effort.
- **Hidden Type:** one player knows something about the game that the other does not.
 - ▶ Example: A used-car salesman knows the true condition of a car.

Table of Contents

1 Hidden Action

2 Hidden Type

Managers and Shareholders

- One manager and one representative shareholder.
- Profit is random but depends on manager effort (e): $\pi \sim N(e, \sigma^2)$
- Shareholders are risk neutral and their payoff is π minus any payments to the manager.
- The manager is risk averse with exponential utility from money (x) given by $\frac{1-e^{-\theta x}}{\theta}$. Effort has cost $c(e)$.
- Thus overall utility to the manager is:

$$U(x, e) = E \left[\frac{1 - e^{-\theta x}}{\theta} \right] - c(e)$$

- Payments are always of the form $a + b \cdot x$ where x can be effort or profit or something else.
- Game has 3 stages: shareholder proposes contract, manager accepts or rejects, manager exerts effort.

Manager and Shareholders: Asymmetric Information, Hidden Action

Before proceeding, let's take a moment to re-write utility without expectations.

- For any fixed a, b the payment to the manager is a random variable:

$$a + b\pi = a + bN(e, \sigma^2) = N(a + be, b^2\sigma^2)$$

- Remember lecture 1: exponential utility, normal RV means utility can be written as mean-variance form:

$$E[x] - \theta \text{Var}(x)/2$$

- Plug in mean and variance:

$$a + be - \theta b^2\sigma^2/2$$

- Remember to subtract the cost of effort:

$$U(e) = a + be - \theta b^2\sigma^2/2 - c(e)$$

- See handwritten notes for full solution!

Manager and Shareholders: Perfect Info, No Hidden Action

Suppose effort is perfectly observable and the shareholders can pay the manager based on it instead of based on profit.

- Then the shareholders will always pay based on effort NOT profit. (Why?)
- So the payment to the manager is of the form $a + b \cdot e$ (a bonus based on effort).
- There is no uncertainty, so we use SPNE.
- See handwritten notes for solution.

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- See handwritten notes for solution.
- Solution:

$$c'(e^*) = 1$$

Manager and Shareholders: Asymmetric Information, Hidden Action

Now suppose the shareholders only see profit not effort.

- The payment is of the form $a + b\pi$.
- Notice that if $b = 0$, $e = 0$.
- So to get effort we need positive b .
- But positive b imposes risk on a risk averse manager! So there is a tradeoff.

Manager and Shareholders: Solution

- The solution with hidden action:

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

- Note that $\theta\sigma^2 c''(e^{**}) > 0$ so $c'(e^{**}) < 1$.
- Less effort with hidden action!
- We can think of b as the “power of incentives”
- In equilibrium $b^{**} = c'(e^{**})$, so the power of incentives decrease with risk aversion and with variance.
- Main interpretation: there is a trade-off between risk and incentives.
- Higher b means more effort but also more risk.

Hidden Action Comments

- The fact that effort is under-provided in equilibrium is an example of market failure when information is asymmetric.
- When risk attitudes cause inefficient effort provision we say there is moral hazard.
- The term moral hazard has a more specific meaning in the insurance context:

Definition 1

When an economic actor inefficiently chooses not to mitigate risk because another economic actor bears the cost of that risk.

- Can you see how health or car insurance could cause this? See the problem set to see this fully worked out!
- We will discuss how this impacted Obamacare next week.

Table of Contents

1 Hidden Action

2 Hidden Type

The Market for Lemons¹

- Car quality q is uniformly distributed between $[0, 20000]$.
- One buyer who wants to buy a car but only knows the distribution of used car values (not the true value).
- Buyer utility from a car of quality q is $q + b$ less the price.
- Seller utility from selling a car is the price. Utility from not selling is q .
- Consider a sequential game: buyer sets price p . Then seller decides whether to sell.

¹Aklerlof, Nobel Prize winner.

The Market for Lemons: Full Information

- Suppose before the start of the game quality is fully observed by both buyer and seller.
- What happens?

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- All cars are sold! What is surplus?

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- Knowing this, buyer sets minimum price satisfying the inequality, so $p = q$.
- All cars are sold! What is surplus?
- Seller utility is 0. Buyer utility is the full gains from trade:

$$q - p = b$$

The Market for Lemons: Hidden Type

- Suppose now that only the seller knows the quality of the car.
- The seller only knows the distribution of quality.
- But the buyer knows the seller knows the true quality.
- See handwritten notes for solution.

The Market for Lemons: Hidden Type Solution

- The optimal price is given by:

$$p^* = b$$

- Then the cars that are sold are those with $q \in [0, b]$.
- Only the worst cars sell: there is adverse selection (more on this soon).
- As the gains from trade (b) fall the probability of a transactions shrinks to 0.

Comments on Hidden Types

- A feature of many economic situations is that the inability of someone to distinguish the type of another player leads to market failures.

Definition 2

An economic interaction exhibits **adverse selection** if one side has more information than the other side, and the informed party uses this information to selectively participate in trades in a way that reduces the utility of the other party.

- Example: Spence job-market, “Ban the Box,” can you think of others?
- This is an especially prominent issue with insurance. See the recommended problem set!

Definition 3

Adverse selection in insurance refers to the phenomenon that risky types are more likely to accept insurance policies and are also more expensive to serve.

- This was a main concern with Obamacare! (stay tuned for next lecture)