Advanced Microeconomics III

Francisco Poggi

Information about the course

- **Lectures**: Mondays and Tuesdays, 10:15 AM.
- **Exercise session:** with Chang Liu on Tuesdays, 12:00 PM.
- **Office hours**:
  - Mondays 1:30 PM in my office (310).
  - Send me an email in advance.
- **Problem Sets**:
  - Due on Mondays.
  - Hand in via email to Chang.
  - You can work in groups of up to 3 students. Only one submission is required per group (clearly indicating group members).
- **Final exam**: June 5th.

Course material

- Slides will be hosted on my website:

  franciscopoggi.com/courses/microIII

- **Main Textbook**: “Microeconomic Theory” by Mas-Colell, Whinston, and Green, Oxford University Press, 1995 (**MWG**).
  - The course covers Ch. 13, Ch. 14, and Ch. 23 D-F.

- Also: “The Theory of Incentives: The Principal-Agent Model” by Laffont and Martimore, Princeton University Press, 2002.

Course plan

Week 1 (April 17) Adverse Selection (Akerlof)

Week 2 (April 24) Signaling (Spence)

Week 3 (May 1) Competitive Screening (Rothchild-Stiglitz)

Week 4 (May 8) Moral Hazard

Week 5 (May 15) Bayesian Implementation/Envelope Theorem

Week 6 (May 22) Auctions and efficient Mechanisms (3 lectures)

Week 7 (May 30) Revision week

Overview

Information economics

- What is "information"?
  - Informally: the ability to exclude some states of the world.
- What is "asymmetric information"?
- **Asymmetric information is present in many economic relationships**
  - Trade of used goods or novel goods
  - Labour markets
  - Financial markets
  - Provision of public goods
  - Insurance
  - Expert advise
- What is "economics of information"?
  - economics of markets with asymmetric information, i.e., welfare and distributional aspects of equilibria.

Overview

Akerlof's market for lemons

- QJE (1970).
- Around 40k citations.
- Nobel Prize (2001) with Spence and Stiglitz.

- Before QJE, the paper was rejected by 3 top journals.
  - AER: trivial.
  - JPE: wrong.
  - REStud: trivial.

Overview

Akerlof's market for lemons

- There is a continuum of sellers (measure N) and a continuum of buyers (measure larger than N).
- Each seller owns a "car" of quality $\theta \in [\underline{\theta}, \bar{\theta}]$, where $F(\theta)$ represents the proportion of sellers with quality below θ.
- Buyers and sellers have quasiliner preferences:
  - The payoff of a buyer who acquires a car of quality θ at price p:

$$\theta - p$$

  - The payoff of a seller parting with a car of quality θ at price p is:

$$p - r(\theta)$$

    - $r(\theta)$ can be thought of as an opportunity cost.

Efficient allocation

Let $\Theta \subset [\underline{\theta}, \bar{\theta}]$ be the set of car qualities that are traded.

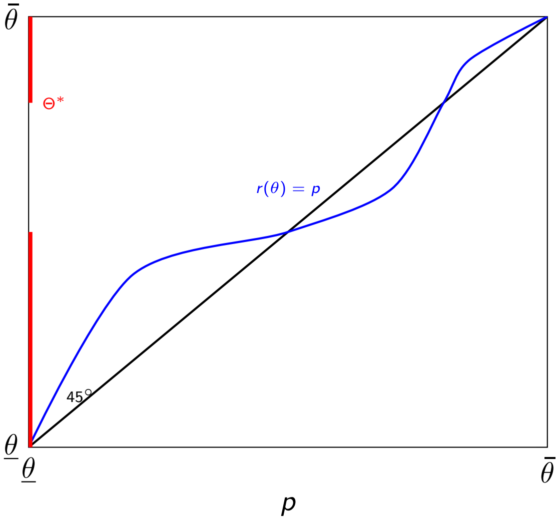
$$\text{Gains from trade} = \int_{\underline{\theta}}^{\bar{\theta}} 1_{\{\theta \in \Theta\}} \cdot [\theta - r(\theta)] \cdot N \; dF(\theta)$$

- The efficient allocation Θ^* maximizes the gains from trade.
- **Solution:**

$$\theta \in \Theta^* \qquad \Leftrightarrow \qquad \theta \geq r(\theta)$$

$$\Theta^* = \{ \; \theta \in [\underline{\theta}, \bar{\theta}] \; : \; \theta \geq r(\theta) \; \}$$

Efficient allocation



Benchmark: symmetric information

- Suppose car quality is observable. There can be different prices for different qualities of cars.
- We denote $\hat{p}(\theta)$ the price function.
- In a **Competitive equilibrium**, $\hat{p}(\theta)$ is such that quantity demanded and supplied are equal for all car qualities.

$$\text{Demand for car of quality } \theta = \begin{cases} 0 & \text{if} \quad p > \theta \\ [0, N'] & \text{if} \quad p = \theta \\ N' & \text{if} \quad p < \theta \end{cases}$$

$$\text{Supply for car of quality } \theta = \begin{cases} N & \text{if} \quad p > r(\theta) \\ [0, N] & \text{if} \quad p = r(\theta) \\ 0 & \text{if} \quad p < r(\theta) \end{cases}$$

Benchmark: symmetric information

- For qualities $\theta \in \Theta^*$:

$$\theta > r(\theta) \qquad \Rightarrow \qquad \hat{p}(\theta) = \theta \text{ and } \hat{Q}(\theta) = N$$

- For qualities $\theta \notin \Theta^*$:

$$\theta < r(\theta) \qquad \Rightarrow \qquad \hat{p}(\theta) \in (\theta, r(\theta)) \text{ and } \hat{Q}(\theta) = 0$$

Observation

With symmetric information the competitive equilibrium is efficient.

Overview

Asymmetric information: competitive equilibrium

- Since car quality is **not observable** by the buyers, all car qualities should have the same price.

- A *competitive equilibrium* is a price $\hat{p}$ and a set $\hat{\Theta} \subseteq [\underline{\theta}, \bar{\theta}]$ such that

$$\hat{p} = E[\theta | \theta \in \hat{\Theta}]$$
$$\hat{\Theta} = \{\theta : r(\theta) \leq \hat{p}\}$$

- or $\hat{\Theta} = \emptyset$ and $\hat{p} \leq \max_{\theta \in [\underline{\theta}, \bar{\theta}]} r(\theta)$.

Example

Assume $r(\theta) = \bar{r}$ and $F(\bar{r}) \in (0, 1)$.

- Note that $\Theta^* = \{\theta \in [\underline{\theta}, \bar{\theta}] : \theta \geq \bar{r}\}$.
- Constructing equilibria with $\hat{p} \geq \bar{r}$:
  - Then, by equilibrium condition 2,

$$\hat{\Theta} = \{\theta \in [\underline{\theta}, \bar{\theta}] : r(\theta) \leq \hat{p}\} = [\underline{\theta}, \bar{\theta}]$$

  - By condition 1,

$$\hat{p} = E[\theta | \theta \in \hat{\Theta}] = E[\theta]$$

  - Equilibrium candidate: $\hat{p} = E[\theta]$ and $\hat{\Theta} = [\underline{\theta}, \bar{\theta}]$.
  - Equilibrium when $E[\theta] > \bar{r}$.
  - This is inefficient.

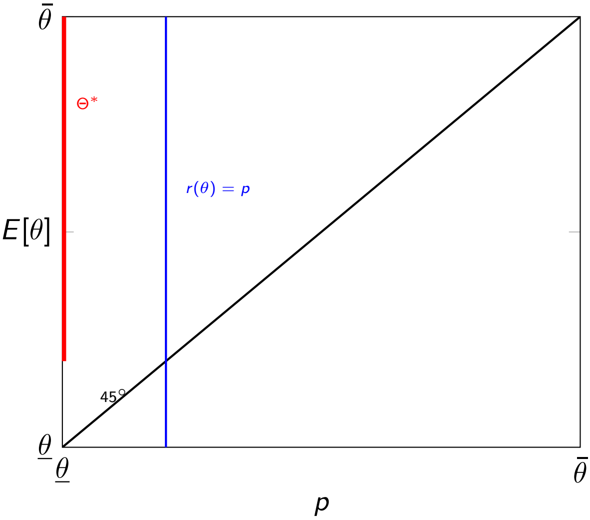
Example

- Constructing equilibria with $\hat{p} < \bar{r}$:
  - By condition 2,

$$\Theta = \emptyset$$

  - Our candidate is $\hat{p} = E[\theta]$ and $\hat{\Theta} = \emptyset$.
  - Equilibrium when $E[\theta] < \bar{r}$. This is also inefficient.

Example

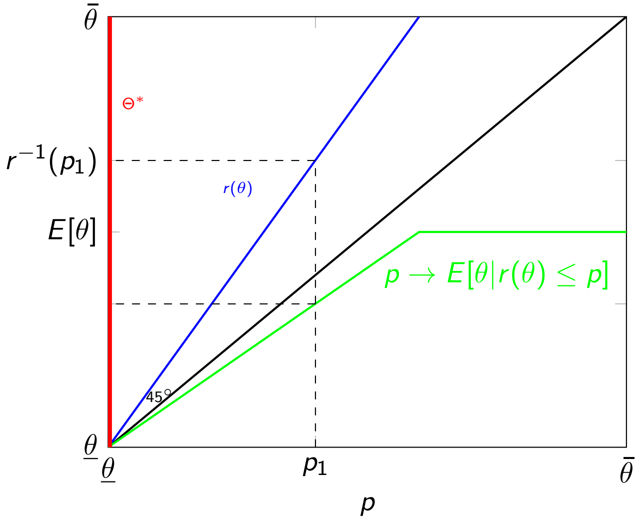

$\bar{\theta}$
Θ^*
$r(\theta) = p$
$E[\theta]$
45°
$\underline{\theta}$
$\underline{\theta}$
$\bar{\theta}$
p

Adverse selection

- In the previous example:
  - Willingness to sell r is independent of the quality.
  - Either every or no seller wants to sell.
  - But the efficient allocation depends on the quality.

- *Adverse selection* occurs when $r(\theta)$ is increasing in θ.
  - For any price, only the relatively worse cars ($\theta \leq r^{-1}(p)$) are going to be offered.
- Market may completely fail even when it is efficient that all cars are traded.

Possibility of market breakdown



Existence of CE with no market breakdown

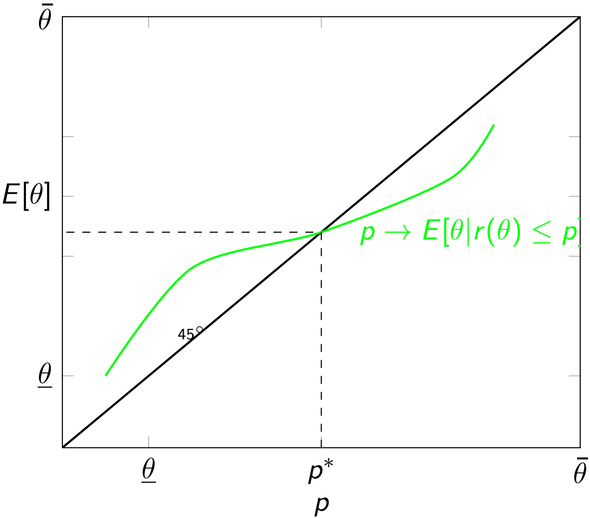
Assumptions:

1. *Negative Selection*: r is strictly increasing.
2. *No atoms*: F is continuous.
3. *No market breakdown*: There exists a price such that $E[\theta | r(\theta) \leq p] > p$.

Proposition

Assume 1-3. Then a competitive equilibrium with some trade exists.

Existence of CE with no market breakdown



Existence of CE with market breakdown

Assumptions:

3'. *Market breakdown*: $E[\theta|r(\theta) \leq p] < p$ for all p.

Proposition

Assume 1, 2 and 3'. Then a competitive equilibrium with no trade exists. Moreover, no equilibrium with a positive mass of trade exists.

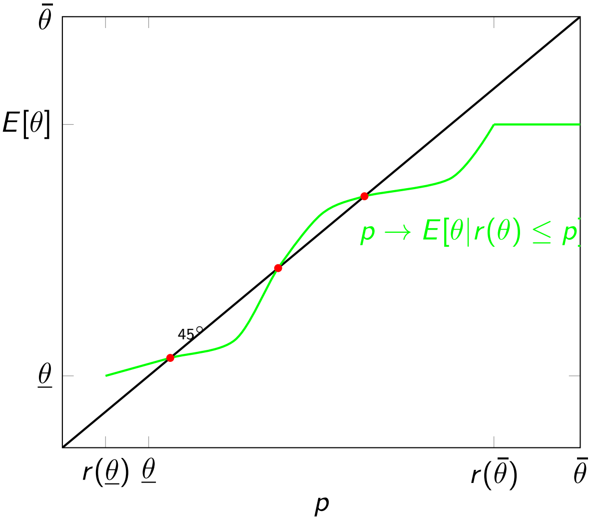
Parametric Examples

- **Example 1**: constant opportunity cost.
  - F uniform on $[0, 1]$.
  - $r(\theta) = \bar{r}$.
- For which $\bar{r}$ is the CE efficient?

- **Example 2**: linear opportunity cost.
  - F uniform on $[0, 1]$.
  - $r(\theta) = \alpha \cdot \theta$.
- For which α is the CE efficient?

Overview

Equilibrium multiplicity



Equilibrium multiplicity

- When there are multiple equilibria, these can be Pareto ranked:
  - Buyers make zero expected profits in all equilibria.
  - in 'higher' equilibria more sellers sell, and those who sell make higher profits.

- Are some of these equilibria more *likely* than others?

Overview

Game-theoretic approach

- Same underlying structure with F and $r(\cdot)$ commonly known.
  - Three players: Buyer 1, Buyer 2, Seller.

- Timing is as follows:
  - Buyers offer prices p_1, p_2 simultaneously.
  - Nature chooses car quality θ according to F.
  - Seller decides whom to trade with, if anyone.

Pure-strategy subgame-perfect Nash equilibria

- We assume negative selection, no atoms, and no market breakdown.
- Let p^* be the highest competitive equilibrium price.
- **Extra assumption**: *"genericity"*

$$\exists \epsilon > 0 : \qquad \text{for all } p \in (p^* - \epsilon, p^*) \qquad E[\theta | r(\theta) \leq p] > p$$

Proposition

Assume Negative selection, no atoms, no market breakdown and genericity. Then in any SPNE, both buyers offer the price p^*.

Pure-strategy subgame-perfect Nash equilibria

- **Seller's decision**: in any SPNE the seller
  - sells at price $\max\{p_1, p_2\}$ if greater than $r(\theta)$
  - keeps the good if $\max\{p_1, p_2\} < r(\theta)$
- Each buyer's SPNE expected payoff is zero.
  - Proof by contradiction.
- Total Payoff of buyers:

$$F(r^{-1}(p))[E[\theta | r(\theta) < p] - p] = 0$$

- Thus, p must be a CE price or below $r(\underline{\theta})$.
- If $p < p^*$ there is a profitable deviation. Which one?

Overview

1. Introduction to Information Economics

2. Akerlof's Market for Lemons
   - Setup
   - Competitive Equilibria
   - Equilibrium Multiplicity
   - A game-theoretic approach
   - Experimental Evidence
   - Information and Trade

Market with one buyer

- **Variant**: only one buyer and one seller.
  - In general, the equilibrium differs from the two-buyer case.

- However: under assumptions 'no atoms' and 'market breakdown' we have as before
  - equilibrium with no trade.
  - no equilibrium with trade.

Experimental evidence

- Ball, Bazerman, Carroll (1991): Laboratory Experiment of Akerlof's market with one buyer.
  - A firm (acquirer) is considering making an offer to buy another firm (target).
  - Acquirer is uncertain about the ultimate value of the firm.
  - Target's management has an accurate estimate of the value.
  - What final price offer should the acquirer make for the target?

Experimental evidence

- Experiment:
  - Subjects play the role of "acquirer".
  - Computer plays the role of "target".
  - Acquirer knows that, under old management, the market value of the target is uniform in $[0, 100M]$.
  - Value under new management is 50% higher than under old management.
  - Target knows its value.
  - Acquirer makes a price offer. The target accepts or rejects.
  - subjects receive the realized profit as feedback.
  - subjects play 20 rounds.
  - subjects are rewarded in proportion to profits.

- What is the SPNE?

Experimental evidence

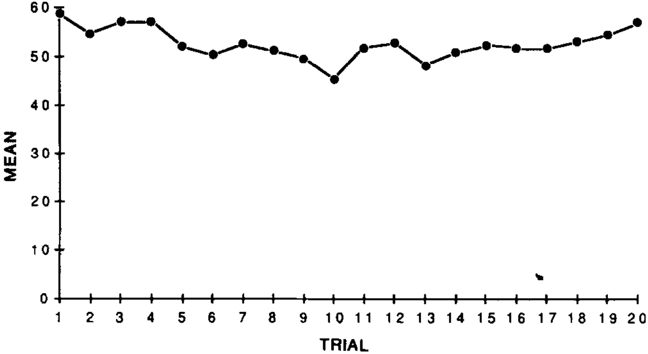


FIG. 1. Mean bids across trials for subjects in Experiment 1.

Experimental evidence

- Possible explanation: feedback too 'weak' to allow market unraveling.
    - Probability of positive profit at $p > 0$?

Overview

Relationship between information and trade

- Buyer and Seller can potentially trade a good of uncertain quality.
- Good's quality is equally likely to be of three types: $\omega \in \{L, M, H\}$.
- Buyer's valuation:

$$b(\omega) = \begin{cases} 14 & \text{if} \quad \omega = L \\ 28 & \text{if} \quad \omega = M \\ 42 & \text{if} \quad \omega = H \end{cases}$$

- Seller's valuation:

$$s(\omega) = \begin{cases} 0 & \text{if} \quad \omega = L \\ 20 & \text{if} \quad \omega = M \\ 40 & \text{if} \quad \omega = H \end{cases}$$

- Trade is always efficient.

Relationship between information and trade

- **Case 1**: Buyer and Seller are equally uninformed.

$$E[b(\omega)] = 28 > 20 = E[s(\omega)]$$

  - Trade can take place for all qualities at any price between 20 and 28.

- **Case 2**: Seller partially uninformed: {{L}, {M,H}}
  - There is no price at which L, M, H are traded.

$$E[b(\omega)] = 28 < 30 = E[s(\omega)|\omega \in \{M, H\}]$$

  - L can be traded at a price in $[0, 14]$.

Relationship between information and trade

- **Case 3**: Seller is perfectly informed.
  - L and M can be traded at a price in $[20, 21]$.

$$E[b|\omega \in \{L, M\}] = 21 > 20 = E[s|\omega = M]$$

- Example shows that the market can expand in the face of greater information asymmetry.
- Relationship between information asymmetry and trade might be nonmonotonic.