ECN 532

Microeconomics II

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ADVERSE SELECTION

Lecture's Objectives

- We saw how hidden action or moral hazard can affect transactions
- The "remedy" is the proper design of incentive schemes
- Another fundamental information friction is that of hidden information, which is also called adverse selection
  - Pervasive problem that affects markets and organizations
- After discussing some real-world examples, we analyze the effects of adverse selection in markets, including the possibility of complete market failure
- Then we will discuss some remedies such as signaling and screening

Adverse Selection: Definition and Examples

Definition and Historical Remarks

- Let us define what the problem of adverse selection or hidden information is:
  - There is adverse selection when one party to a transaction knows something that is payoff-relevant but unknown to the other party
- In earlier general equilibrium literature, this problem received little attention
- Adam Smith (1776) mentioned problem of interest rates and bad borrowers
- Hayek (1945) puts information at the heart of markets vs. planning debate
- Mirrlees (1971) analyzes optimal taxation with hidden information
- Fundamental contributions:
  - Akerlof (1970): adverse selection effects in market settings
  - Spence (1973): signaling can mitigate adverse selection
  - Rothschild and Stiglitz (1976): screening can mitigate adverse selection
  - Stiglitz (1977), Mussa and Rosen (1978), Maskin and Riley (1984), principal-agent with adverse selection, and Myerson (1981) for auctions

Real-World Examples

- Hidden information or adverse selection is pervasive in economic interactions
- Any time one party has private information that the other party would benefit from knowing it, there is a problem of hidden information
- But there is a large class of hidden information problems (which are the ones that should properly be called adverse selection problems) that are particularly problematic and subtle
- This class is the so called "selection markets"
- Roughly speaking, those customers with a higher willingness to pay for a good are also those more costly to serve
    - This applies in particular to insurance markets in general, but it has many more applications of economic interest
- We are going to begin with a series of examples to get a flavor of the problem we will analyze in detail below

Real-World Examples

- American Airlines AAirpass
  - In 1981, for $250,000 one could buy a mileage pass with unlimited first-class travel for life
  - Generated big losses from the start
  - Problem: only those who traveled a lot bought the pass
  - Those are the most costly customers for AA
  - By 1990, AAirpass cost $600,000, and made the problem worse
  - Only those extreme frequent flyers bought it, leading to losses for AA
  - The price increase to $1,000,000 and losses were worse
  - Program was canceled in 1994

Real-World Examples

- Health insurance in West Hollywood
  - In the 80s, it became impossible for young men to get health insurance in West Hollywood
  - Market in that area disappeared, while in East Hollywood things were fine
  - Issue: West Hollywood had a large concentration of gay men at risk of AIDS, which was extremely costly to treat at the time and thus very costly to insure
  - Those with a higher willingness to get insured were the most costly customers
- SafetyNet, IncomeAssure, and layoff insurance
  - Provided as much as $9,000 to cope with unemployment upon being laid off
  - Problem: only those who knew it was very likely that they would be let go bought the insurance policy
  - Again, these are the most costly customers to insure
  - These insurance products stopped being offered

Real-World Examples

- SafeGuard Guaranty and divorce insurance
  - Provided insurance that covered legal costs upon divorce
  - Came with 48 months waiting period
  - Only couples who put a high probability of divorce bought the product
  - Premium was so high that demand was low; product canceled within two years
- Petplan and pet insurance
  - This type of insurance was almost inexistent a few years ago
  - Now it exists but it is quite expensive, especially for older dogs
  - For a fifteen year old dachshund, it costs \$650 per month, 70% reimbursement, and \$15,000 cap, no coverage for routine care
  - For younger ones it is cheaper but still capped at \$15,000
  - Again, those who demand the product more are most costly to insure

Real-World Examples

- Bidding and the winner's curse
  - This is a variation on the adverse selection problem
  - Suppose you bid for a large contract and there are four other bidders
  - You estimate how much it will cost you to complete the project and submit a bid based on that estimate and your conjecture about how the others will bid
  - Suppose your bid is the lowest one and you will the contract. You may suffer from a winner's curse
  - Why? Your bid was the lowest one, which means that you are the most optimistic among all bidders regarding the completion cost of the contract
  - It is called a winner's curse since if you are an unsophisticated bidder and bid just based on your own estimate, you may end up with losses as the real cost is likely to be higher than your estimate
  - Savvy bidders take this into account as follows: the bid is based not just on your own estimate but also on the information that will be revealed if you win the contract (that is, your cost estimate was the lowest)

Adverse Selection and Competitive Markets

A Market for Used Cars

- Competitive market for used cars, with a large number of buyers and sellers
  - N sellers (N very large) and even larger number of buyers
- Each seller has a used car, and only seller knows car quality
- Quality of a car is $\theta \in [\underline{\theta}, \bar{\theta}]$, $\underline{\theta} \geq 0$, uniformly distributed over this interval
  - This means that there is an equal number of cars of each quality level
  - If $\theta \in (\underline{\theta}, \bar{\theta})$, then the number of cars of quality at most θ is $\frac{\theta - \underline{\theta}}{\bar{\theta} - \underline{\theta}} N$, and the number of cars with quality above θ is $\frac{\bar{\theta} - \theta}{\bar{\theta} - \underline{\theta}} N$
- If seller keeps the car, her payoff is θ, so she sells if and only if $p \geq \theta$
- A buyer's utility for a car of quality θ is $v(\theta)$, where $v(\theta) \geq \theta$ for all θ, and v is strictly increasing and continuous
- Buyer's utility if he buys a car of quality θ and pays p is $v(\theta) - p$
- For concreteness, let us assume $v(\theta) = \alpha + \beta\theta$, $\alpha \geq 0$ and $\beta \geq 0$

Observable Quality Case

- As a benchmark, consider the case in which buyers can observe θ
- Then in this case the competitive market will work efficiently:
  - Separate market for each quality θ and an equilibrium price $\hat{p}(\theta)$ for each θ
  - More buyers than sellers in each market, and thus $\hat{p}(\theta) = \alpha + \beta\theta$ for all θ
  - All cars would be traded; allocation is efficient
- When θ is private information, things are more interesting
  - There will be a single price p^* for used cars (since buyers cannot distinguish quality), so all cars traded are traded at that price

A Market for Used Cars

- Let us derive the supply and demand for cars and the market equilibrium
- Supply of cars $x_s(\cdot)$: at each p, a seller with type θ sells iff $p \geq \theta$, and so the quantity of cars that will be offered in the market at price p is

$$x_s(p) = \begin{cases} 1 & \text{if } p \geq \overline{\theta} \\ \frac{p-\underline{\theta}}{\overline{\theta}-\underline{\theta}} N & \text{if } \underline{\theta} < p < \overline{\theta} \\ 0 & \text{if } p \leq \underline{\theta} \end{cases}$$

- The demand for cars is much more subtle, since buyers must infer from the price p they observe what are the cars being offered in the market
  - This way they can determine their willingness to pay for a used car

A Market for Used Cars

- How do we calculate the demand for cars at a price p?
  - Note that at p, buyers understand that only sellers with cars whose quality $\theta \leq p$ are willing to sell their car (those with $\theta > p$ prefer to keep it)
  - Thus, they infer than only qualities between $\underline{\theta}$ and p are offered in the market
  - Since they cannot observe the quality of any given car they buy, they calculate the expected (average) quality of the car
  - Since the distribution of qualities is uniform, the average is $\frac{\underline{\theta}+p}{2}$ (check)
  - But since the utility that a buyer obtains from buying a car of quality θ is $v(\theta) = \alpha + \beta\theta$, it follows that the expected utility they obtain from buying one of the cars available for sale at p is (check)

$$\alpha + \beta\left(\frac{\underline{\theta}+p}{2}\right)$$

A Market for Used Cars

- It follows that a buyer will be willing to buy a car if and only if (why?)

$$\alpha + \beta \left(\frac{\underline{\theta} + p}{2} \right) \geq p$$

- But then, the market demand for cars at price p is given by (check)

$$x_d(p) = \begin{cases} 0 & \text{if } p > \alpha + \beta \left(\frac{\underline{\theta}+p}{2} \right) \\ [0, \infty) & \text{if } p = \alpha + \beta \left(\frac{\underline{\theta}+p}{2} \right) \\ \infty & \text{if } p < \alpha + \beta \left(\frac{\underline{\theta}+p}{2} \right) \end{cases}$$

- There is no demand at p above the expected utility of the average car offered in the market at p, infinite demand at p strictly below that value (recall there are lots of buyers), and any quantity at p exactly equal to that value

A Market for Used Cars

- An equilibrium is a price p^* such that $x_s(p^*) = x_d(p^*)$
- But we know buyers are willing to buy if and only if $p^* \leq \alpha + \beta\left(\frac{\underline{\theta}+p^*}{2}\right)$
  - Since there are more buyers than sellers, price will settle at the highest value consistent with this inequality
- Thus, any p^* such that $p^* = \alpha + \beta\left(\frac{\underline{\theta}+p^*}{2}\right)$ is an equilibrium price
- This is one equation in one unknown, p^*, and so the equilibrium price is

$$p^* = \frac{2\alpha + \beta\underline{\theta}}{2 - \beta}$$

- What is the equilibrium quantity of cars offered in the market?

$$q^* = x_s(p^*) = \frac{p^* - \underline{\theta}}{\bar{\theta} - \underline{\theta}} N$$

A Market for Used Cars

- Remarks:
  - Above we have implicitly assumed that $\beta < 2$, and that $p^* \leq \bar{\theta}$
  - This is indeed the most interesting case
  - What if $\beta \geq 2$? Then $p^* \geq \bar{\theta}$ and all the cars are sold
  - What if $\beta < 2$ but α large enough that $p^* > \bar{\theta}$? Then equilibrium price is again $p^* \geq \bar{\theta}$ and all the cars are sold
  - Note that in this case since all the cars are sold, the average quality of any given car for a buyer is $\frac{\underline{\theta}+\bar{\theta}}{2}$
  - Thus, any buyer is willing to pay up to $\alpha + \beta \frac{\underline{\theta}+\bar{\theta}}{2}$
  - What is the equilibrium price in this case? Since there are more buyers than sellers, it follows that $p^* = \alpha + \beta \frac{\underline{\theta}+\bar{\theta}}{2}$

A Market for Used Cars

- Compared to the observable θ case, equilibrium is inefficient when $p^* \in [\underline{\theta}, \overline{\theta})$ since some cars are not traded despite the existence of gains to trade
  - The fraction $\frac{\bar{\theta}-p^*}{\bar{\theta}-\underline{\theta}}$ of the N cars will not be sold
  - Recall $v(\theta) = \alpha + \beta\theta > \theta$ for all $\theta > \underline{\theta}$, so there are gains to trade each θ
  - Thus, if buyers could observe the quality of any given car, there would be trade at some price for each quality level
- Economic intuition is that buyers understand that, given p, only an adverse selection of cars in terms of quality is available in the market
- As with externalities or imperfect competition, adverse selection is another problem that can preclude the efficiency of competitive markets

A Market for Used Cars

- Example: Market breakdown
  - Adverse selection can be so extreme that market might shut down
  - Assume that $\alpha = 0$, $\beta \in (1, 2)$, and $\theta \in [0, 2]$ uniformly distributed
  - Then the equilibrium price solves

$$p^* = \alpha + \beta \left(\frac{\underline{\theta} + p^*}{2} \right) = \frac{\beta}{2} p^*$$

  - But, since $\frac{\beta}{2} p < p$ for all $p > 0$, and the only equilibrium price is $p^* = 0$
  - Hence, essentially no car is traded in the market

Signaling and Screening

Some Remedies

- Adverse selection can be a severe problem for transactions
- A few (partial) remedies: information disclosure, signaling, and screening
- Information disclosure:
  - Example: sellers might be legally mandated to disclose problems with the car they sell; or they may voluntarily disclose that information if in equilibrium everyone truthfully discloses the information they have
- Signaling:
  - Example: seller of a high quality car could signal quality by allowing buyer to inspect car or by offering a warranty
- Screening:
  - Example: buyer could design two contracts, one for a seller with a high quality car that has a high price but also a generous warranty, and one for a seller with a low quality car that has a low price but also a very limited warranty

Signaling

- Informed party of "high quality" takes an action (signal) that would be too costly for someone who is of "low quality"
- Many examples of this sort:
  - Seller of a high quality used car can signal quality by letting buyer having their own mechanic inspect the car, or by offering a warranty
  - An entrepreneur with a high quality project might signal quality by keeping a significant stake in the project
  - Education (say university degree) can also serve as a signal of ability of worker
- In all this cases, a party with a low quality good or with low ability would find it too costly to signal in this way
- The uninformed party can infer quality, ability, etc., by observing the signal (in some cases signal perfectly reveals quality, in other cases could be noisy)

Screening

- Uninformed party designs a menu of contracts with different terms that are tailored to each individual quality, in a way that each individual takes the contract designed to that individual's private information
- Many examples of this sort:
  - Buyer of a used car may approach a seller with a menu of contracts that a seller can choose from, and by doing so reveal their information
  - An investor may approach an entrepreneur with a deal that they will buy a stake in their project at a given price so long as the entrepreneur is willing to keep a certain fraction of the project
  - Insurance companies (car, health, life, etc.) offer a menu of policies consisting of premium and coverage so that individuals of different risk categories self-select into the one design for their risk category
  - Companies like ATT, verizon, etc., design different plans for different customers' willingness to pay, and customers self-select