

UWTSD MBA (Nov 2018 intake)

(6-1)

Economics of Information

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17 February 2019; 10:00 am to 1:30 pm

Lecture Agenda :

- Some Preliminaries
- Information Differences among Economic Actors
- Utility Maximization under Uncertainty
- Uncertainty Faced by Market Participants
- Information and Economic Efficiency
- Information Structures of Auctions

Some Preliminaries

Van Zandt, T. (2008) *Introduction to the Economics of Uncertainty and Information*. Oxford.

<https://faculty.insead.edu/vanzandt/327files/EconInfo-Book.pdf>

Introduction

- Economics of information is a branch of microeconomic theory that studies how information and information systems affect an economy and economic decisions.
- Information has special characteristics:
 - It is easy to create but hard to trust.
 - It is easy to spread but hard to control.
 - It influences many decisions.
 - These special characteristics complicate many standard economic theories.
- There are several subfields of information economics.
 - Information as signal has been described as a kind of negative measure of uncertainty.
 - It includes complete and scientific knowledge as special cases.
 - The first insights in information economics related to the economics of information goods.

- In recent decades, there have been influential advances in the study of information asymmetries and their implications for contract theory, including market failure as a possibility.
- Information economics is formally related to game theory as two different types of games that may apply, including games with perfect information, complete information, and incomplete information.
- Experimental and game-theory methods have been developed to model and test theories of information economics, including potential public-policy applications.
- Hayek is the real father of information economics, something widely accepted by many parties and the main basis for his receipt of the Nobel Prize, with his 1945 paper on information (Hayek, 1945)

Mean and Variance

- An **average** is a measure of the central tendency a set of numbers.
- An average is hardly fully representative of a set of observations unless we know the dispersion. The smaller the dispersion, the more the representative is the average for all the items in the data set.
- **Variance** is the average of squared deviation from the mean.
- **Standard Deviation** is the square root of the variance.
- Standard Deviation is a measure of risk.
- High standard deviations are associated with higher degrees of risk.
- The formula to calculate the mean value of a random variable X:

$$E(x) = \sum X P(X)$$

- The formula to calculate the variance of a random variable X:

$$V(X) = \sum X^2 P(X) - [E(X)]^2$$

- The formula to calculate the Standard Deviation of a random variable X

$$SD = \sqrt{V(X)} = \sqrt{\sum X^2 P(X) - [E(X)]^2}$$

Example

The table for computing the summation values

Economic Condition	Probability	Annual Return per 1000		$X \times P(E)$	$Y \times P(E)$	$X^2 \times P(E)$	$Y^2 \times P(E)$	$XY \times P(E)$
		CB Fund (X)	CS Fund (Y)					
Recession	P(E1) = 0.10	-20	-100	-2	-10	40	1000	200
Stagnation	P(E2) = 0.15	70	-50	10.5	-7.5	735	375	-525
Slow Growth	P(E3) = 0.35	80	140	28	49	2240	6860	3920
Moderate Growth	P(E4) = 0.30	110	200	33	60	3630	12000	6600
High growth	P(E5) = 0.10	120	250	12	25	1440	6250	3000
Total	1	- -	- -	81.5	116.5	8085	26485	13195

$$E(X) = \sum X \cdot P(E) = 81.5$$

$$E(Y) = \sum Y \cdot P(E) = 116.5$$

$$\sigma_X = \sqrt{\sum X^2 \cdot P(E) - [E(X)]^2} = 37.984$$

$$\sigma_Y = \sqrt{\sum Y^2 \cdot P(E) - [E(Y)]^2} = 113.634$$

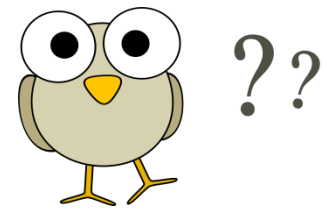
$$\begin{aligned} \sigma_{XY} &= E(XY) - E(X) \cdot E(Y) = \sum XY \cdot P(XY) - [\sum X \cdot P(X)] \cdot [\sum Y \cdot P(Y)] \\ &= 13195 - (81.5)(116.5) = 3700.25 \end{aligned}$$

Suppose that we have an investment portfolio of 1000 (in HK\$ million), and that one third is in CB fund (X) and two thirds is in CS fund. What is the expected portfolio return $E(p)$ and what is the portfolio risk σ_p ?

$$W_X = \frac{1}{3} \qquad W_Y = \frac{2}{3}$$

$$\begin{aligned} E(P) &= W_X E(X) + W_Y E(Y) \\ &= \left(\frac{1}{3}\right)(81.5) + \left(\frac{2}{3}\right)(116.5) = 104.833 \end{aligned}$$

$$\begin{aligned} \sigma_P &= \sqrt{W_X^2 \sigma_X^2 + 2W_X W_Y \sigma_{XY} + W_Y^2 \sigma_Y^2} \\ &= \sqrt{\left(\frac{1}{3}\right)^2 (37.984)^2 + 2\left(\frac{1}{3}\right)\left(\frac{2}{3}\right)(3700.25) + \left(\frac{2}{3}\right)^2 (113.634)^2} \\ &= 86.85541 \end{aligned}$$



What does the expected portfolio return $E(p) = \text{HK\$}104.833\text{M}$ mean?

What does the portfolio risk $\sigma_p = \text{HK\$}86.85541\text{M}$ mean?

The coefficient of variation (CV) is defined as the ratio of the standard deviation. It shows the extent of variability in relation to the mean of the population (when the sample size is large, we can treat the sample as the population).

$$CV = \frac{\sigma_P}{E(P)} = \frac{86.85541}{104.8333} (100\%) = 82.851\%$$

Uncertainty and Consumer Behavior

Consumer's
attitude towards
risk

Risk Averse: An individual who prefers a sure amount of \$M to a risky prospect with an expected value of \$M.

Risk Loving: An individual who prefers a risky prospect with an expected value of \$M to a sure amount of \$M.

Risk Neutral: An individual who is indifferent between a risky prospect where $E[x] = \$M$ and a sure amount of \$M.

- A risk averse consumer prefer a sure thing to an uncertain prospect of equal expected value, and thus he or she will not purchase a new product if it works just as well as the old product.
- How would your firm induce risk-averse consumers to try a new product?
 - Informative advertising to make them think that the expected quality of the new is higher than the certain quality of the old product.
 - Free samples—Lower the price to compensate for the risk.

Examples of How Risk Aversion Influences Decisions

- Product quality:
 - A risk averse consumer will not purchase a new product if it works just as well as the old product. They prefer a sure thing to an uncertain prospect of equal expected value.
 - How would your firm induce risk-averse consumers to try a new product?
 - a) Informative advertising to make them think that the expected quality of the new is higher than the certain quality of the old product.
 - b) Free samples- Lower the price to compensate for the risk
- Chain stores
 - Risk aversion explains why it may be in a firm's interest to become part of a chain store instead of remaining independent. National hamburger chain vs. local diner. Retail outlets, transmission shops etc.
- Insurance
 - Fact that consumers are risk averse implies they are willing to pay to avoid risk. Precisely why you decide to buy insurance on your home, extended warranties on purchases etc.

Information Differences among Economic Actors

Nature

- People also have differing preferences about buying information.
 - Some people care greatly about getting the best buy while the preferences of others might be to buy the first model available.
- Having information levels differ among people raises a number of difficult problems on how markets operate.

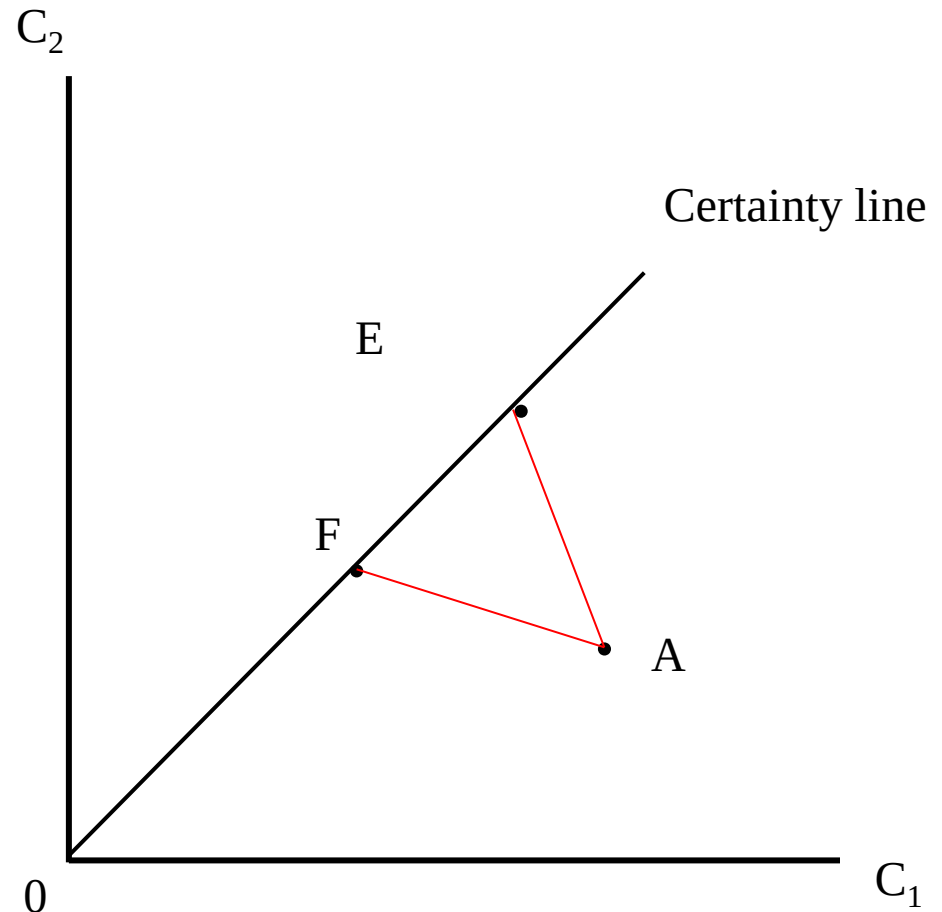
Application: Safe Driver Insurance Policies

- Since actuarially fair insurance can increase the utility of risk-adverse individuals, persons who face very different probabilities of loss should pay different insurance premiums.
- But insurers must be able to correctly estimate the individuals probability of loss so that insurance can be properly priced.

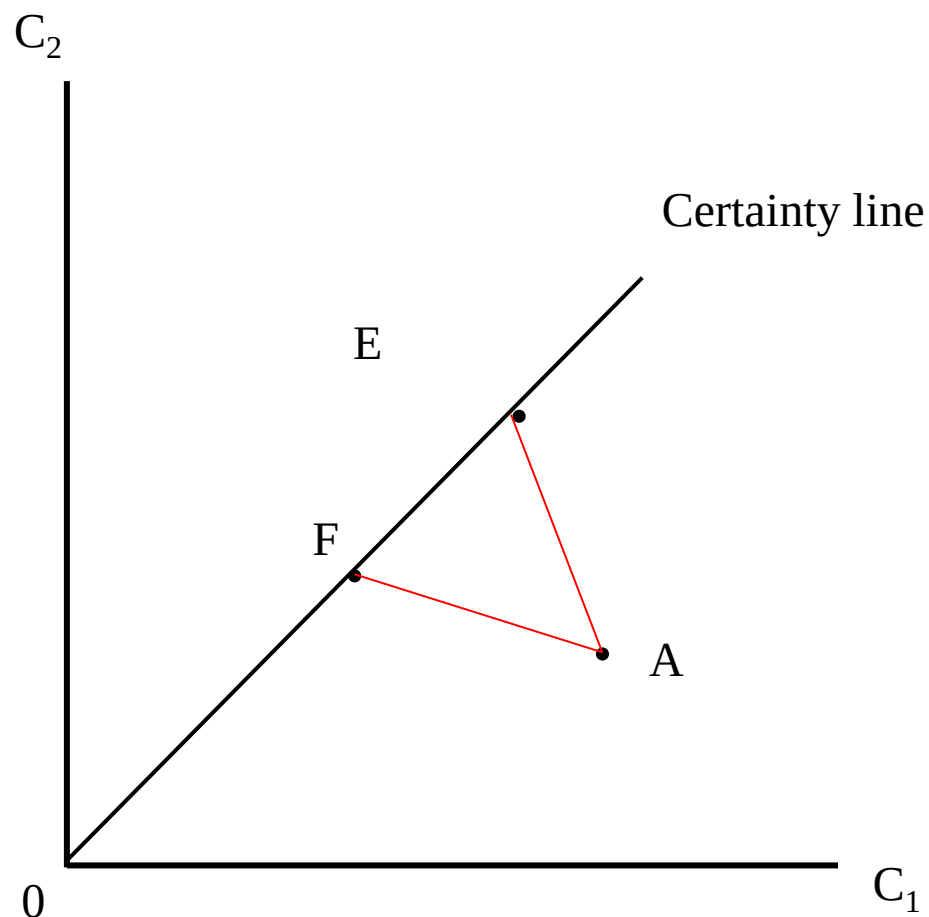
Application : A Theoretical Model

When insurers possess less information than do insurance buyers, adverse selection may undermine the entire insurance market.

- In the Figure 1, person 1 has a relatively low risk of incurring state 2, so fair insurance is represented by budget constraint AE and point E is possible.
- For person 2, losses are more likely so fair insurance is represented by the line AF.



- However, if the insurance company can not tell how risking a particular customer is, this twin solution is not feasible.
 - Person 2 will buy the policy intended for 1 and the additional losses will cause the insurer to lose money on policy AE.
 - The insurer will have to increase the price, reducing person 1's utility which may result in that person choosing to be uninsured.



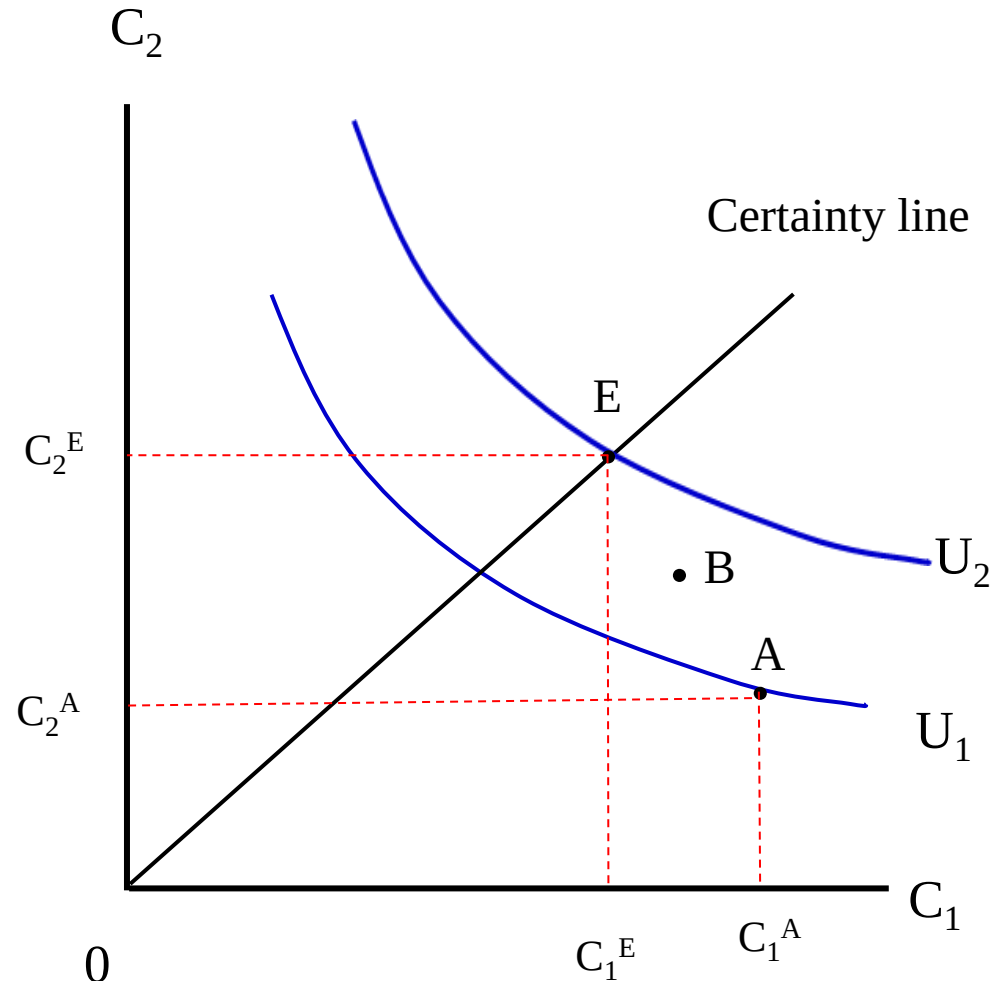
Application: Safe Driver Policies

- Traditionally insurers have used accident data to assign higher premium costs to high risk groups such as young male drivers.
- Recently measures, such as a 1989 ballot initiative in California, have tried to limit this use of rating factors.
 - High risk groups would benefit at the cost of historically safer drivers.

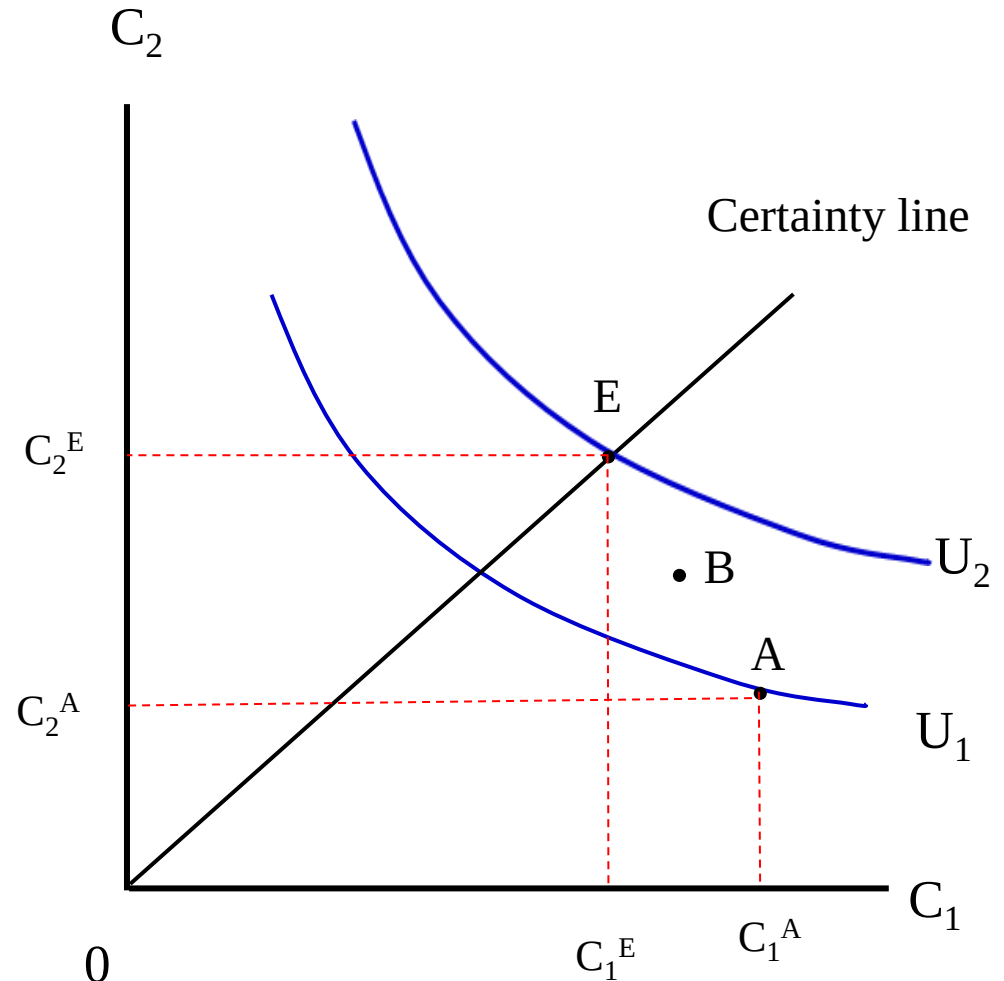
Utility Maximization under Uncertainty

Utility Maximization under Uncertainty

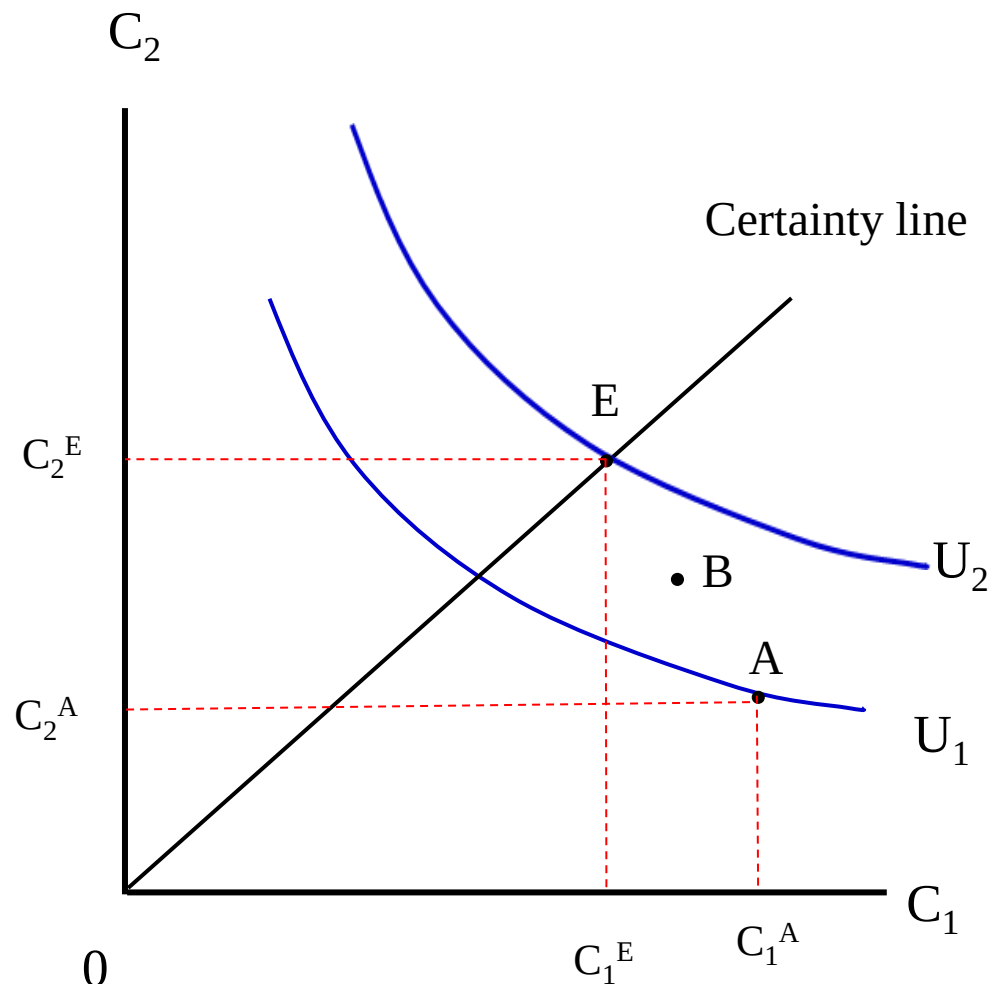
- The basic model is shown in the Figure where an individual is assumed to face two possible outcomes (sometimes called states of the world), but he or she does not know what outcome will occur.
- The person's consumption in the two states is denoted C_1 and C_2 , and possible values are recorded in the axes.



- At point A, the individual has considerably more consumption in state 1 than in state 2.
 - This person might be willing to give up some consumption in state 1 to consume more in state 2.
 - This might be accomplished by paying an insurance premium in state 1 in order to increase consumption in state 2 (when things go wrong).

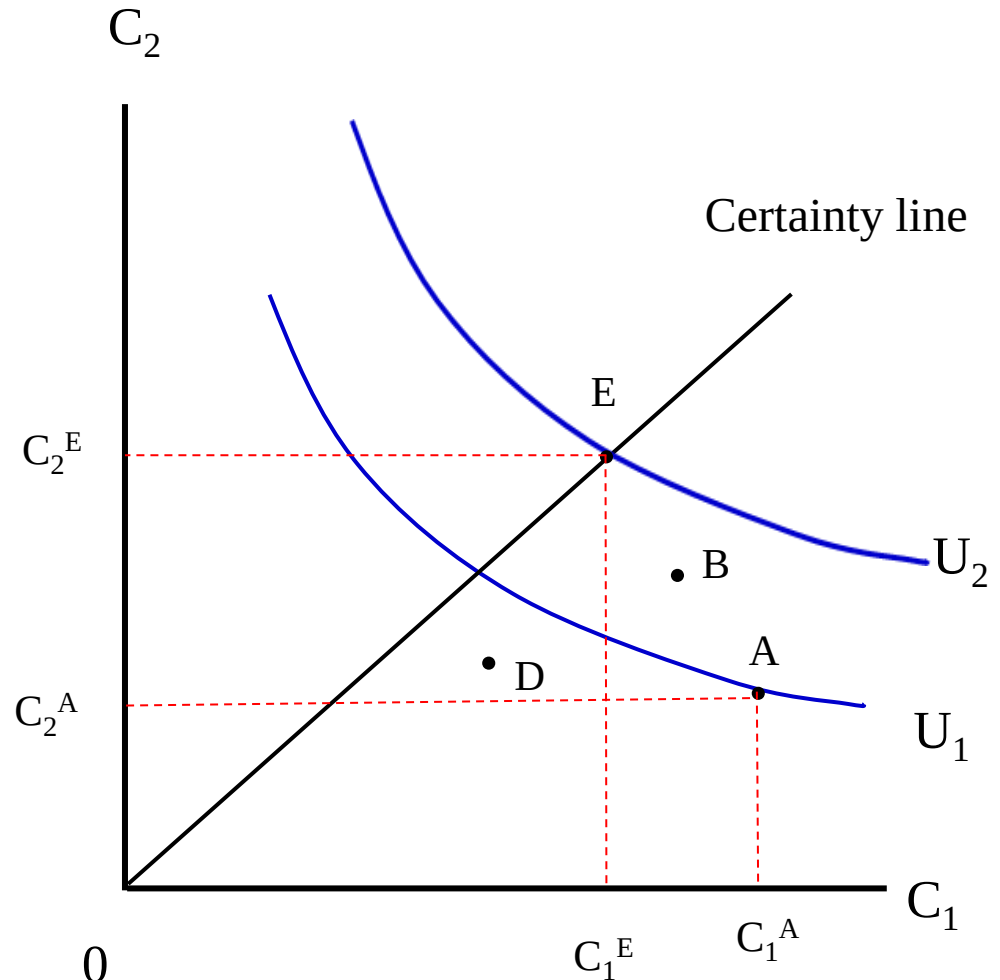


- For example, if the terms at which insurance can be bought are reflected in the slope of the line AE, this person could increase utility from U_1 to U_2 by purchasing complete insurance and moving to point E.
 - Buying complete insurance has allowed this person to obtain CE1 (which equals CE2) with certainty.



Balancing the Gains and Costs of Information

- Another way to improve his or her situation would be to gather additional information.
 - Consumption will decrease in the good outcome but increase in the bad outcome.
 - The issue is whether acquiring information will raise utility above U_1 .
 - Point B, for example, represents a utility-improving investment, but point D is a poor investment in information.



Uncertainty Faced by Market Participants

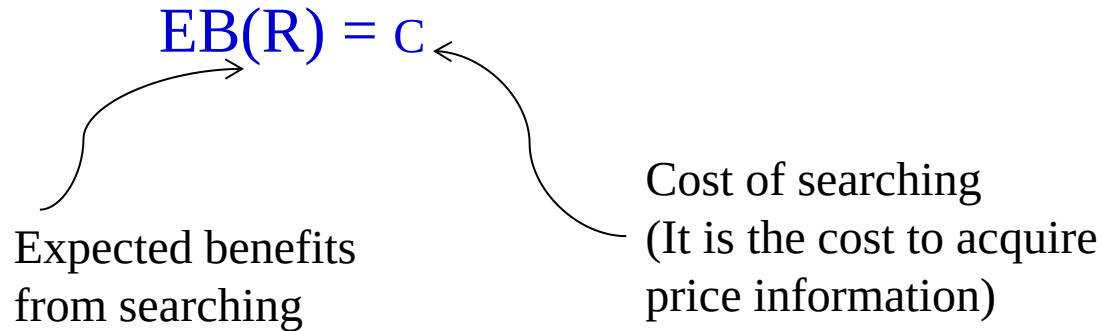
Price Uncertainty and Consumer Search

- Suppose consumers face numerous stores selling identical products, but charge different prices.
- The consumer wants to purchase the product at the lowest possible price, but also incurs a cost (C) to acquire price information.
- There is free recall and with replacement. (Free recall means a consumer can return to any previously visited store.)
- The consumer's reservation price, the price at which the consumer is indifferent between purchasing and continue to search, is R .

When should a consumer cease searching for price information?

Consumer Search Rule

- Consumer will search until



- Therefore, a consumer will continue to search for a lower price when the observed price is greater than **R** and stop searching when the observed price is less than **R**.

The consumer's
reservation price

Uncertainty and the Firm

- Risk Aversion
 - Are managers risk averse or risk neutral?
- Diversification
 - Don't put all your eggs in one basket.
- Profit Maximization
 - When demand is uncertain, expected profits are maximized at the point where expected marginal revenue equals marginal cost:

$$E[MR] = MC$$

Example: Profit-Maximization in Uncertain Environments

Suppose that economists predict that there is a 20 percent chance that the price in a competitive wheat market will be \$5.62 per bushel and an 80 percent chance that the competitive price of wheat will be \$2.98 per bushel.

If a farmer can produce wheat at cost $C(Q) = 0.5Q^2$, how many bushels of wheat should he produce? What are his expected profits?

Answer:

$$E[\text{Price}] = 0.2 \times \$5.62 + 0.8 \times \$2.98 = \$3.508$$

$E(MR) = E(AR) = E(\text{Price})$

In a competitive market firms produce where $E[\text{Price}] = MC$.

$$MC = \frac{d}{dQ} (0.005Q^2) = (0.005)(2)Q^{2-1} = 0.01Q$$

$3.508 = 0.01Q$. Thus, $Q = 350.8$ bushels.

$$\text{Expected profits} = (3.508 \times 350.8) - [1000 + 0.01(350.8)] = \$227.10$$

Uncertainty and the Market

Uncertainty can profoundly impact market's abilities to efficiently allocate resources.

- What are some problems created in the market when there is uncertainty?
- How do managers and other market participants overcome some of these problems?

Information and Economic Efficiency

Asymmetric Information

- Situation that exists when some people have better information than others. The people with least information may choose not to participate in a market.
- Suppose someone offers to sell you a box full of money. You do not know how much money is in the box but she does. Should you choose to buy the box? Another example: Insider trading

- Asymmetric Information between consumers and firms can affect firm's profit.
 - Firms invest in a new product that it knows it is superior to existing products on market.
 - Consumers do not know if product is truly superior or firm is falsely claiming superiority.
 - If degree of asymmetric information is severe, consumers may refuse to buy product.
 - Reason: They do not know the product is superior
- Asymmetric Information may affect managerial decisions like hiring workers and issuing credit to customers.
- Job applicants have much better information about their own capabilities than the manager hiring new workers.
- That's why firms spend tons of money designing tests to evaluate job applicants, background checks etc.

Two Types of Asymmetric Information

- Hidden actions
 - Actions taken by one party in a relationship that cannot be observed by the other party.
 - For example, a worker knows more than her manager about how much effort she put into her work.
- Hidden characteristics
 - Things one party to a transaction knows about itself, but which are unknown by the other party.
 - For example, used car seller knows more about the condition of the car than the buyer

Moral Hazard

- Hidden Actions generally lead to Moral Hazard.
- Situation where one party to a contract takes a hidden action (action that she knows another the other person cannot observe) that benefits him or her at the expense of another party.

Hidden Actions and Moral Hazard

- The tendency of a person who is imperfectly monitored to engage in dishonest or otherwise undesirable behavior.
 - **Agent** performs a task on behalf of the principal.
 - **Principal** cannot monitor agent perfectly.
 - **Agent** expends less effort at task than principal considers appropriate.
- Principal tries several methods to encourage agent to act more appropriately.
- Example: Worker/Manager
 - Better monitoring: hidden videos by managers for workers and by parents for babysitters. Aim is to catch irresponsible behaviours.
 - Offering higher than equilibrium wages: If worker plays on the job and is caught and fired, they might be able to get another high-paying job.
 - Delayed Payment: keeping part of compensation so if worker is caught shirking she loses a lot. E.g. year end bonuses or paying workers more later in their lives. Income increase as you age on the job.

Other examples of moral hazard

- Someone whose property is insured may not try as hard to protect it from theft/damage.
- Insurance companies attempt to reduce moral hazards by requiring a deductible on insurance claims. Person buying insurance must pay something in the event of a loss and thus has an incentive to take action to reduce the likelihood of a loss.
- Corporate Management :
 - Fixed salary contracts with hidden action of the manager results in moral hazard.
 - Owner can monitor the manager (taking away the hidden action) or by making manager's pay contingent on firm's profits (taking away manager's insurance against economic loss)

Hidden Characteristics and Adverse Selection

- Adverse selection arises from hidden characteristics.
- Refers to a situation where a selection process results in a pool of individuals with economically undesirable characteristics.
 - Can be used to explain why a car only a few weeks old sells for significantly less than a new car of the same type²⁸

Examples of Adverse Selection

- Your firm allows 5 days of paid sick leave. You decided to increase it to 10.
- If workers have hidden characteristics (that is the firm cannot distinguish between healthy and unhealthy workers), firm will attract frequently ill workers or those who value sick leave the most.
- Policy results in adverse selection.

Use hidden characteristics and adverse selection to explain why people with poor driving records find it difficult to buy automobile insurance. Assume there are two types of people with bad driving records

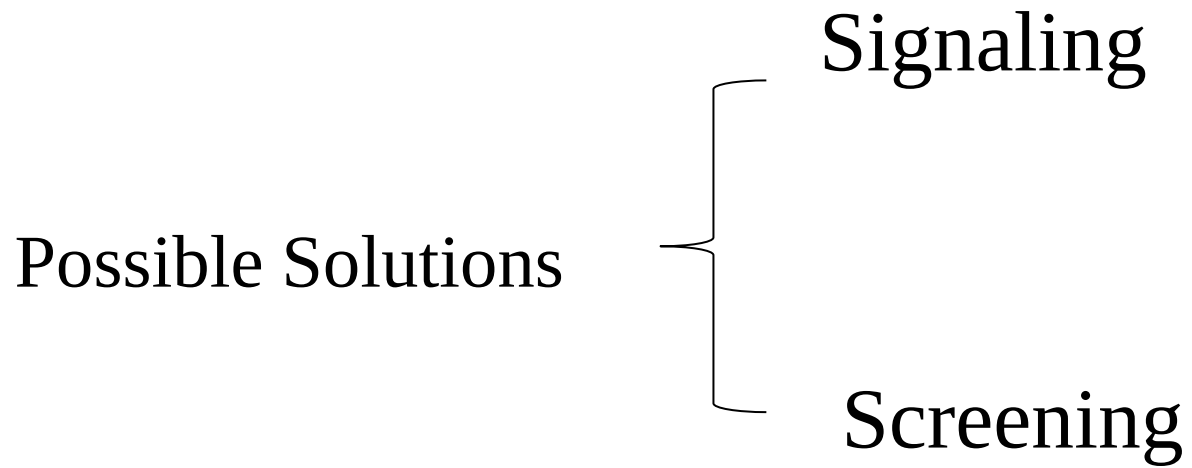
- a) those that are poor drivers and frequently have accidents;
and
- b) those that are good drivers, but due purely to bad luck, have been involved in numerous accidents

Example: Adverse Selection and the Used Car Market

- The seller knows more than the buyer about the quality of the car being sold.
- Owners of “lemons” more likely to put their vehicles up for sale.
- Owners of good used cars less likely to get a fair price, so may not bother trying to sell.
- Buyers are afraid of getting a ‘lemon’.
- Many people avoid buying used cars.
- Buyer of a used car may conclude that seller knows something about the car that is why they are trying to get rid of it.
- Subsequently, they’d want to pay a low price for it

Examples: Hidden Characteristics and Adverse Selection

- Example : Insurance
 - Buyers of health insurance know more about their health than health insurance companies.
 - People with hidden health problems have more incentive to buy insurance policies.
 - So, prices of policies reflect the costs of a sicker-than-average person.
 - These prices discourage healthy people from buying insurance.
- In both examples, the information asymmetry prevents some mutually beneficial trades.



Market Responses (Possible Solutions) to Asymmetric Information

- Signaling: action taken by an informed party to reveal private information to an uninformed party.
 - Attempt by an informed party to send an observable indicator of his or her hidden characteristics to an uninformed party.
 - To work, the signal must not be easily mimicked by other types
- What does it take for an action to be an effective signal?
 - If signaling is free, everyone would use it and it'd convey no information.
 - The signal must be less costly or more beneficial to the person with the high-quality product otherwise everyone will have the same incentive to use the signal and the signal would reveal nothing.

Examples

- Companies with a good product pay for signaling (advertising) and customers use the signal as a piece of information about the product's quality.
- Companies expect customers who use the product to be repeat customers (beneficial to company) A talented person can get through college more easily than a less talented person.
- So it is rational for a talented person to pay for the cost of the education (signal) and it is rational for employers to use that signal as information about the talent of the person.
- “As seen on TV” ads in Magazines is intended to convey to customers the company's willingness to pay for an expensive signal (spot on TV) in the hope that customers will infer that its product is of high quality.
- Same reasoning explains why graduates of elite schools always make sure that it is known to employers.

Dealership provides warranties on used cars: Signaling

- Individual selling a good used car provides all receipts for work done on car,
- Dealership provides warranties on used cars.
- Firms spend huge sums on advertising to signal product quality to buyers.
- Highly competent workers get college degree to signal their quality to employers

Gifts as signals

- Giver has private information that receiver would like to know (Asymmetric information).
- Characteristic of the gift is a signal.
- Has to be costly (takes time) and its cost depends on the private information.

For example, cash gift for a girlfriend vs. cash from parents to their college kids

2nd Possible Solution: Screening

- Attempt by an uninformed party to sort individuals according to their characteristics.
- Often accomplished through a self-selection device. A mechanism in which informed parties are presented with a set of options, and the options they choose reveals their hidden characteristics to an uninformed party.
- Action taken by an uninformed party to induce informed party to reveal private information.
 - Health insurance company requires physical exam before selling policy.
 - Buyer of a used car requires inspection by a mechanic. If seller refuses, then buyer knows it's a lemon.
 - Auto insurance company charges lower premiums to drivers willing to accept a larger deductible (they are most likely the safer drivers).
 - Offering different policies induces drivers to separate themselves

Information Structures of Auctions

Some basics

- Important for managers to understand because in many situations firms participate either as the auctioneer or the bidder
- Characteristics can affect bidding behavior and price collected by auctioneer
- Important to consider the information players have about their valuations of the items being auctioned.
- One possibility: perfect information (Each bidder knows exactly the items worth).
- Very rare situation in an auction
- Usually, bidder has information about her value estimate that is unknown to other bidders (Asymmetric Information)

Independent private values

Consider an antique auction for personal use. Bidders valuations are determined by individual tastes. While a bidder knows her own tastes, she does not know the preferences of the other bidders (Asymmetric Information).

- Bidders know their own valuation of the item, but not other bidders' valuations.
- Bidders' valuations do not depend on those of other bidders.

Affiliated (or correlated) value estimates

- Bidders do not know their own valuation of the item or the valuations of others.
- Bidders use their own information to form a value estimate.
- Value estimates are affiliated: the higher a bidder's estimate, the more likely it is that other bidders also have high value estimates.
- Common values is the special case in which the true (but unknown) value of the item is the same for all bidders.

Optimal Bidding Strategy

- In an English Auction: with independent private valuations, the optimal strategy is to remain active until the price exceeds your own valuation of the object
- In a Second-Price Sealed-Bid Auction: with independent private valuations, the optimal strategy is to bid your own valuation of the item. This is a dominant strategy.
 - You don't pay your own bid, so bidding less than your value only increases the chance that you don't win.
 - If you bid more than your valuation, you risk buying the item for more than it is worth to you.
- In a First-Price, Sealed-Bid Auction:
 - If there are n bidders who all perceive independent and private valuations to be evenly (or uniformly) distributed between a lowest possible valuation of L and a highest possible valuation of H , then the optimal bid for a risk neutral player whose own valuation is v is
 - $B = v - [(v-L)/n]$.
 - Strategically, same as a Dutch Auction

Example

Consider an auction where bidders have independent private values. Each bidder perceives that valuations are evenly distributed between \$1 and \$10. D'Castro knows her own valuation is \$2. Determine D'Castro's optimal bidding strategy in

- (a) a first price sealed-bid auction with 2 bidders.
- (b) a Dutch auction with 3 bidders.
- (c) a second-price, sealed bid with 200 bidders.

Optimal Bidding Strategies with Correlated Value Estimates

Difficult to describe because:

- Bidders do not know their own valuations of the item, let alone the valuations others.
- The auction process itself may reveal information about how much the other bidders value the object.

Optimal bidding requires that players use any information gained during the auction to update their own value estimates

The Winner's Curse

- In a common-values auction, the winner is the bidder who is the most optimistic about the true value of the item.
- To avoid the winner's curse, a bidder should revise downward his or her private estimate of the value to account for this fact.
- The winner's curse is most pronounced in sealed-bid auctions.

Expected Revenues in Auctions with Risk Neutral Bidders

- Independent Private Values

English = Second Price = First Price = Dutch.

- Affiliated Value Estimates

English > Second Price > First Price = Dutch.

- Bids are more closely linked to other players.
- Information, which mitigates players' concerns about the winner's curse.

Conclusion

- Information plays an important role in how economic agents make decisions.
- When information is costly to acquire, consumers will continue to search for price information as long as the observed price is greater than the consumer's reservation price.
- When there is uncertainty surrounding the price a firm can charge, a firm maximizes profit at the point where the expected marginal revenue equals marginal cost.
- Many items are sold via auctions.

Thank you
for
your Attention