Intermediate Microeconomics

Uncertainty and Information

Agribusiness Teaching Center

Easter Term 2015

Tacit Collusion

Cartels

Fact

In order to make extra-normal (half monopoly level) profit, the producers may collude on price.

Example

	Honour Agreement		Cheat	
Honour Agreement	£1000	£1000	£ 200	£1200
Cheat	£1200	£ 200	£ 500	£ 500

- Simultaneous game
- Sequential game

Mixed strategy

Matching pennies

		Player 2: Heads	Player 2: Tails
Player 1	Heads	1,-1	-1,1
	Tails	-1,1	1,-1

There is no (pure strategy) Nash equilibrium in this game. If we play this game, we should be "unpredictable." That is, we should randomise (or mix) between strategies so that we do not get exploited.

Mixed Equilibrium and Dominated Strategies

		Player 2		
		l	m	r
Player 1	U	3,2	2,1	1,3
	M	2,1	1,5	0,3
	D	1,3	4,2	2,2

		Player 2	
		l	r
Player 1	U	3,2	1,3
	D	1,3	2,2

Expected Utility

Outcome	Prob	Utiliy
X	p	$U(X)$
Y	$1 - p$	$U(Y)$

Expected Utility

$$EU = p \bullet U(X) + (1\text{-}p) \bullet U(Y)$$

Lotteries

- Suppose you had to choose between two lotteries:
  - L_1:
    - win \$1 million for sure
  - L_2:
    - win \$5 million w.p. 0.1
    - win \$1 million w.p. 0.89
    - win \$0 w.p. 0.01
- Which one would you choose?
- Which one *should* you choose?

Lotteries

- Suppose you had to choose between two lotteries:
  - L_1:
    - win \$1 million for sure
  - L_2:
    - win \$5 million w.p. 0.1
    - win \$1 million w.p. 0.89
    - lose \$1 million w.p. 0.01
- Which one would you choose?
- Which one *should* you choose?

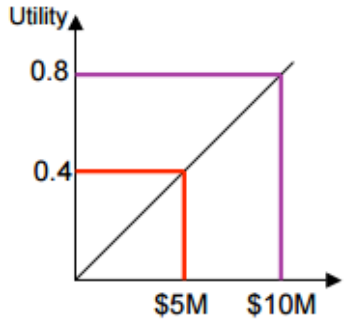
Lotteries

- Suppose you had to choose between two lotteries:
  - L_1:
    - \$5 million w.p. 0.1
    - \$0 w.p. 0.9
  - L_2:
    - \$1 million w.p. 0.3
    - \$0 w.p. 0.7
- Which one would you choose?
- Which one *should* you choose?

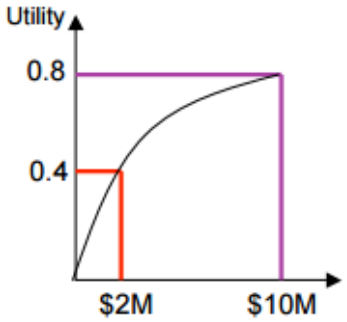
Risk and Preferences

- Capture preferences towards rewards and resource consumption
- Capture risk attitudes

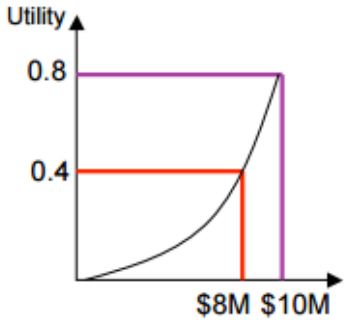
  E.g. if one is risk-neutral, getting $5 million has exactly half the utility of getting $ 10 million
- People are generally *risk-averse* when it comes to money



Risk Neutral
(= Expected reward)

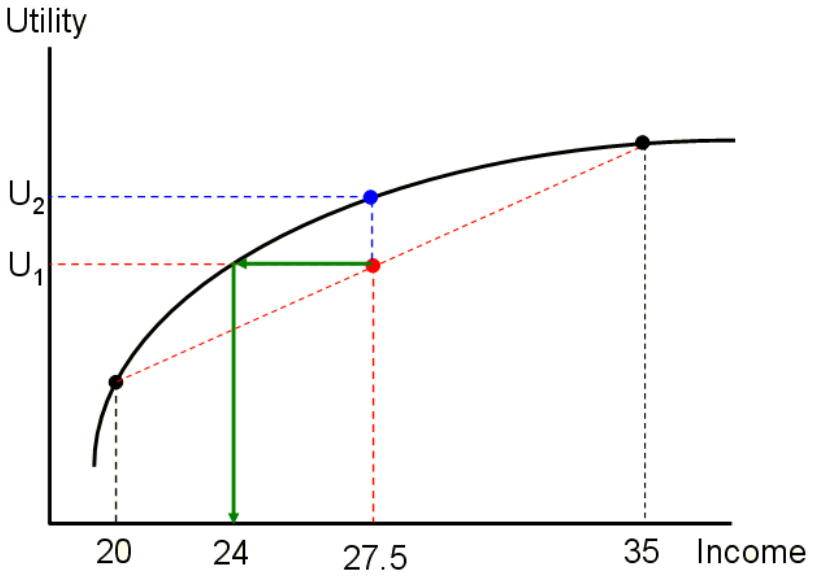


Risk Averse



Risk Seeking

Expected Utility and Risk

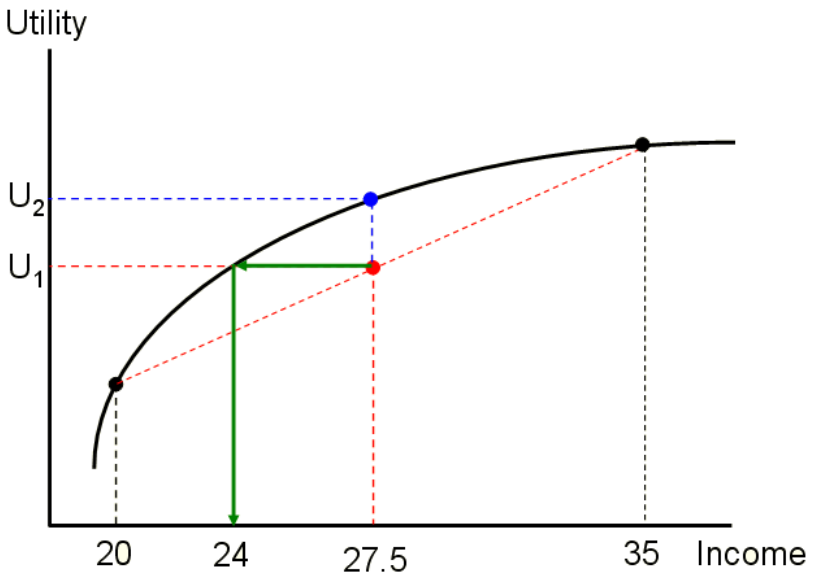


- Either 35 or 20 income
- Equal probabilities

- Expected utility
- Risk neutral, averse, or loving

- Fair gamble
- Actuarially fair insurance

Risk and Insurance



- Actuarially fair insurance
- Willingness to pay
- Adverse selection
- Moral Hazard

Value of Information

Often people pay for information they ask for:

- Investment Advice
- Management Consultants
- Market Investigation
- Palm Reading

This information is used to make a decision in future:

- Whether to invest in a particular stock
- Whether to restructure the organisation of their company
- Whether to introduce a product
- Whether they should marry

Value of information

VI is the difference between the expected value of best action given the information and the expected value of best action without the information

- Two blocks A and B, exactly one has oil, worth k
- Prior probabilities 0.5 each, mutually exclusive
- Current price of each block is k/2
- Consultant offers accurate survey of A
- What is a fair price for the survey?

Survey may say “oil in A” or “no oil in A”, with probability 0.5 each, so the value of the information is: [0.5× value of “buy A” given “oil in A”+ 0.5× value of “buy B” given “no oil in A”] − 0 = (0.5 × k/2) + (0.5 × k/2) − 0 = k/2

Internal Organisation

Contract Theory

Fact (Moral Hazard)

Unmonitored workers of a firm tend to shirk their duties.

Definition

Moral Hazard is opportunism characterised by an informed person's taking advantage of a less-informed person through an *unobserved action*.

Fact

An architect working for 'percentage' of the deal will overdecorate.

Fact

A lawer working for 'percentage' will do his best to assure the best deal for the contractor.

Internal Organisation

Problem

Worker's utility:

$$u(w, e) = w - \delta(e)$$

where w *is the wage and* $\delta(e)$ *is the disutility of working with an effort level* e.

The probability of being caught while shirking: p.

Shirks if

$$E\mathbb{U}(e = e_{shirk}) > E\mathbb{U}\left(e = e^*\right)$$

Wage while caught shirking is w_- *and otherwise is* w^*

Internal Organisation

Problem

Worker's utility: $u(w, e) = w - \delta(e)$

- *Expected utility while not shirking:*

$$E\mathbb{U}\left(e = e^*\right) = w^* - \delta\left(e^*\right)$$

- *Expected utility while shirking:*

$$E\mathbb{U}\left(e = e_{shirk}\right) = p \cdot w^- + (1 - p) \cdot w^* - \delta\left(e_{shirk}\right)$$

Assume $\delta\left(e_{shirk}\right) = 0$

Internal Organisation

Problem

Shirks if

$$\begin{aligned} E\mathbb{U}(e_{shirk}) &> E\mathbb{U}(e = e^*) \\ p \cdot w^- + (1-p) \cdot w^* &> w^* - \delta(e^*) \end{aligned}$$

Non-shirking condition is

$$w^- - w^* > \frac{\delta(e^*)}{p}$$

Efficient Risk-sharing

Principal - Agent Problem

Definition

Efficient contract is an agreement with provision that ensure that no party can be made better off without harming the other party.

Fact

Any contract should:

- *be Incentive Compatible (so that the agent wants to perform the assigned task rather than engage in opportunistic bahaviour,*
- *satisfy Participation Constraint (so that the agent would want to sign the contract).*

Principal - Agent Problem
Perfectly observable Action

Problem (of the Agent)

Utility:

$$u(e, w) = w(e) - \delta(e)$$

Levels of effort:

$$e = \{e_H, e_L\}$$

Principal - Agent Problem
Perfectly observable Action

Problem (of the Principal)

Profit: $\pi(e) = R(e) - w(e)$

Revenue probability matrix (conditional on effort level):

	e_H	e_L
R^+	p^h	p^l
R^-	$1-p^h$	$1-p^l$

Expected Revenue:

$$\begin{aligned} ER(e_H) &= p^h \cdot R^+ + \left(1-p^h\right) \cdot R^- \\ ER(e_L) &= p^l \cdot R^+ + \left(1-p^l\right) \cdot R^- \end{aligned}$$

Principal - Agent Problem
Perfectly observable Action

Problem (Stage 1)

$$\min w\left(e_H\right)$$

subject to

$$\begin{array}{ll} w\left(e_H\right) - \delta\left(e_H\right) \geqslant \bar{w} & \textit{Participation Constraint} \\ w\left(e_H\right) - \delta\left(e_H\right) \geqslant w\left(e_L\right) - \delta\left(e_L\right) & \textit{Incentive Compatibility} \end{array}$$

Problem (Stage 2)

Compare expected profits:

$$E\pi\left(e_H\right) \text{ and } E\pi\left(e_L\right)$$

Principal - Agent Problem
Unobservable Action

W hat if the actions are not observable?

Principal - Agent Problem
Unobservable Action

- Wages are conditional on the outcome:

$$w = \begin{array}{ll} w^G & \textit{if revenue is } R^+ \\ w^B & \textit{if revenue is } R^- \end{array}$$

Fact

In case the actions of Agent are observable, all of the risk is taken by the Principal.
In case of unobservable actions, the risk is shared between the Principal and the Agent.

Principal - Agent Problem
Unobservable Action

Problem (Stage 1: Motivating for high effort)

$$\min p^h w^G + \left(1 - p^h\right) w^B$$

subject to

$$p^h w^G + \left(1 - p^h\right) w^B - \delta\left(e_H\right) \geqslant \bar{w} \qquad PC$$
$$p^h w^G + \left(1 - p^h\right) w^B - \delta\left(e_H\right) \geqslant p^l w^G + \left(1 - p^l\right) w^B - \delta\left(e_L\right) \qquad IC$$

Problem (Stage 2)

Compare expected profits:

$$E\pi\left(e_H\right) \text{ and } E\pi\left(e_L\right)$$