Externalities, Public Goods, and Internal Organisation

Economics II: Microeconomics

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Microeconomics

- Consumers: $\longleftarrow$ `Now`
    - People.
    - Households.
- Firms: $\longleftarrow$ `Now`
    - Industrial organisation
    - Internal organisation
- `Equilibrium` $\longleftarrow$ `Now`

Conditions

- Efficiency in Consumption
- Efficiency in Production
- Efficiency in Production Mix

Definition

There is a **consumption externality** if one consumer cares directly about another agent's production or consumption.

Definition

There is a **prodcution externality** if the production possibilities of one firm are influenced by the choices of another firm.

Definition

External economy in production (consumption) or positive production (consumption) externality is an increase in production possibilities (utility) form others' production or consumption.

Definition

External dis-economy in production (consumption) or negative production (consumption) externality is a decrease in production possibilities (utility) form others' production or consumption.

- Producing firm:

$$\max_{s,x} p_s s - c_s\left(s,x\right)$$

- Conditions:

$$\begin{aligned} \frac{\partial c_s}{\partial x} &< 0 \\ . \\ p_s &= \frac{\partial c_s\left(s^*,x^*\right)}{\partial s} \\ 0 &= \frac{\partial c_s\left(s^*,x^*\right)}{\partial x} \end{aligned}$$

- Consuming firm:

$$\max_{f} p_f f - c_f\left(f,x\right)$$

- Conditions:

$$\begin{aligned} \frac{\partial c_f}{\partial x} &> 0 \\ \frac{\partial c_i}{\partial i} &> 0 \\ . \\ p_f &= \frac{\partial c_f\left(f^*,x^*\right)}{\partial f} \end{aligned}$$

External dis-economy in production

Social costs: Too much x, too high costs

$$p_s = \frac{\partial c_s\left(s^*, x^*\right)}{\partial s}$$

$$0 = \frac{\partial c_s\left(s^*, x^*\right)}{\partial x}$$

$$p_f = \frac{\partial c_f\left(f^*, x^*\right)}{\partial f}$$

Joint production:

$$\max_{s,f,x} p_s s + p_f f - c_s(s, x) - c_f(f, x)$$

- Optimality conditions:

$$\begin{aligned} p_s &= \frac{\partial c_s(\bar{s}, \bar{x})}{\partial s} \\ p_f &= \frac{\partial c_f(\bar{f}, \bar{x})}{\partial f} \\ 0 &= \frac{\partial c_s(\bar{f}, \bar{x})}{\partial x} + \frac{\partial c_f(\bar{f}, \bar{x})}{\partial x} \end{aligned}$$

External dis-economy in production

Socially optimal production: Internalising

Internal

$$
\begin{aligned}
p_s &= \frac{\partial c_s(\bar{s},\bar{x})}{\partial s} \\
p_f &= \frac{\partial c_f(\bar{f},\bar{x})}{\partial f} \\
0 &= \frac{\partial c_s(\bar{f},\bar{x})}{\partial x} + \frac{\partial c_f(\bar{f},\bar{x})}{\partial x}
\end{aligned}
$$

External

$$
\begin{aligned}
p_s &= \frac{\partial c_s(s^*,x^*)}{\partial s} \\
p_f &= \frac{\partial c_f(f^*,x^*)}{\partial f} \\
0 &= \frac{\partial c_s(s^*,x^*)}{\partial x}
\end{aligned}
$$

External (dis-)economy in production

'Solutions'

Generally, 3 ways of eliminating externalities

- Internalising
- Pigouvian Tax
- Redefining Property Rights

Pigouvian Tax:

$$\max_{s,x} p_s s - c_s(s,x) - tx$$

- Optimality conditions:

$$\begin{aligned} p_s - \frac{\partial c_s(s,x)}{\partial s} &= 0 \\ -t - \frac{\partial c_s(s,x)}{\partial x} &= 0 \end{aligned}$$

$$\texttt{Assume: } t = \frac{\partial c_f(f,x)}{\partial x}$$

Internalisation

$$p_s = \frac{\partial c_s(\bar{s}, \bar{x})}{\partial s}$$
$$p_f = \frac{\partial c_f(\bar{f}, \bar{x})}{\partial f}$$
$$0 = \frac{\partial c_s(\bar{f}, \bar{x})}{\partial x} + \frac{\partial c_f(\bar{f}, \bar{x})}{\partial x}$$

Pigouvian tax

$$p_s = \frac{\partial c_s(s, x)}{\partial s}$$
$$p_f = \frac{\partial c_f(f, x)}{\partial f}$$
$$-t = \frac{\partial c_s(s,x)}{\partial x}$$
$$t = \frac{\partial c_f(f,x)}{\partial x}$$

- Producing firm:

$$\max_{s,x} p_s s - c_s\left(s,x\right) - qx$$

- Conditions:

$$\begin{aligned} p_s &= \frac{\partial c_s\left(s^*,x^*\right)}{\partial s} \\ q &= -\frac{\partial c_s\left(s^*,x^*\right)}{\partial x} \end{aligned}$$

- Consuming firm:

$$\max_{f,x} p_f f - c_f\left(f,x\right) + qx$$

- Conditions:

$$\begin{aligned} p_f &= \frac{\partial c_f\left(f^*,x^*\right)}{\partial f} \\ q &= \frac{\partial c_f\left(f^*,x^*\right)}{\partial x} \end{aligned}$$

- Producing firm:

$$\max_{s,x} p_s s - c_s\left(s,x\right) - q\left(\bar{x}-x\right)$$

- Conditions:

$$\begin{aligned} p_s &= \frac{\partial c_s\left(s^*,x^*\right)}{\partial s} \\ q &= -\frac{\partial c_s\left(s^*,x^*\right)}{\partial x} \end{aligned}$$

- Consuming firm:

$$\max_{f,x} p_f f - c_f\left(f,x\right) + q\left(\bar{x}-x\right)$$

- Conditions:

$$\begin{aligned} p_f &= \frac{\partial c_f\left(f^*,x^*\right)}{\partial f} \\ q &= \frac{\partial c_f\left(f^*,x^*\right)}{\partial x} \end{aligned}$$

Definition

Property is any physical or intangible entity that is **owned** by a person or jointly by a group of persons.

- Property rights and income redistribution
- Efficiency and property
- Jungle equilibrium (Ariel Rubinstein)

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Tragedy of The Commons, or ...
One More Reason for Communism to Collapse?
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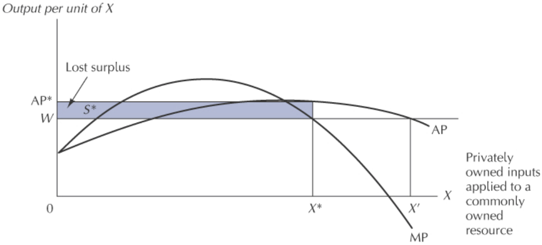
- Ingredients:
    - common property (graze field or fishing pond)
    - diminishing returns to scale production
    - many people
    - social vs. personal optimisation

`Tragedy of The Commons, or ...`
`One More Reason for Communism to Collapse?`



$$\max f(c) - ac$$

$$\max \left\{ \frac{f(c+1)}{c+1} > a \right\}$$

$$f'(c) = a$$

$$\frac{f(c)}{c} = a$$

Theorem

When the parties affected by externalities can negotiate costlessly with one another, an efficient outcome results no matter how the law assigns responsibility for damages.

Nuclear example
Austria *vs*. Czechoslovakia
No NPP = Free electricity
Schüssel vs. Čalfa

Microeconomics

- Consumers:
  - People.
  - Households.
- Firms:
  - Monopoly.
  - Oligopoly
  - Perfect Competition
  - `Internal organisation` $\longleftarrow$ `Now`
- Equilibrium:
  - Holds.
  - Does not hold.

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.

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^*

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

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

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

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).*

Problem (of the Agent)

Utility:

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

Levels of effort:

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

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:

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

Problem (Stage 1)

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

subject to

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

Problem (Stage 2)

Compare expected profits:

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

Principal-Agent Problem

Unobservable Actions

- Wages are conditional on the outcome:

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

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.

Problem (Stage 1: Motivating for high effort)

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

subject to

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

Problem (Stage 2)

Compare expected profits:

$$E\pi\left(e_H\right) \;\; and \; E\pi\left(e_L\right)$$

Thank you!