

PCP (2nd October 2018)
Environmental Economic Theory,
No. 1
Benefits and Costs, Supply and Demand

Instructor: Eiji HOSODA

Textbook: Barry .C. Field & Martha K. Fields
(2009) *Environmental Economics - an
introduction*, McGraw-Hill, International Edition

PCP Environmental Economic Theory (Hosoda)

Homework 2

2 October 2018

1. Theme: What is externality? Explain it by means of at least two examples which are hopefully based upon the experience in your own country.
2. Language: English.
3. Volume: A4 Two pages. Single space. 12 points.
4. Submission period: 9 a.m. 8 October ~ 9a.m. 9 October 2018.
5. Submission: Submit your paper in an electric file. A file name must be “HW2.xxx.pdf” (xxx=your name). Send your file to hosoda@econ.keio.ac.jp.
6. Remark: Sources other than internet documents are recommendable. If you use internet information, check plural sources and compare them. List references you have used.

Balancing benefits and costs

- In almost all economic decisions, benefits and costs are compared.
- But, what are benefits and costs?
- How can we define benefits and costs?
- Is the definition obvious? It is not so easy as expected.
- One may think it is easy to define costs: something you sacrifice when you get something, particularly in money terms.
- Actually, you have to pay in order to obtain something, whether you might be a consumer or a producer.

An important remark on costs

- It seems easy to define costs. However, it is actually not so easy to do so as one may think. On some occasions, you are obliged to pay by someone, even though you do not obtain anything as counter provision. This type of cost is essential for discussion of environmental problems.
- Cf. External diseconomy.

How are benefits defined?

- Compared to costs, it seems a little bit hard to define benefits rigorously.
- Even if you can define benefits, it may be hard to measure them.
- How could you measure enjoyments (benefits) when you are watching a baseball game in a stadium?
- How could you measure enjoyments (benefits) when you are fishing?

Willingness to pay (1)

- Benefits can be expressed by *willingness to pay* (WTP).
- Let me define willingness to pay.
- Willingness to pay: it is the value of goods or services which someone is willing to pay for those goods or services.
- Notice that willingness to pay is realized in daily transactions of goods and services.
- When you pay some amount of money for certain goods or services, you express your willingness to pay in money terms.

Willingness to pay (2)

- One has to sacrifice something (money in many cases) to obtain goods or services.
- Individual valuation matters in willingness to pay; Each person's WTP is different.
- Basically, willingness to pay decreases as one consumes more goods or services.
- Willingness to pay also reflects *ability to pay*.

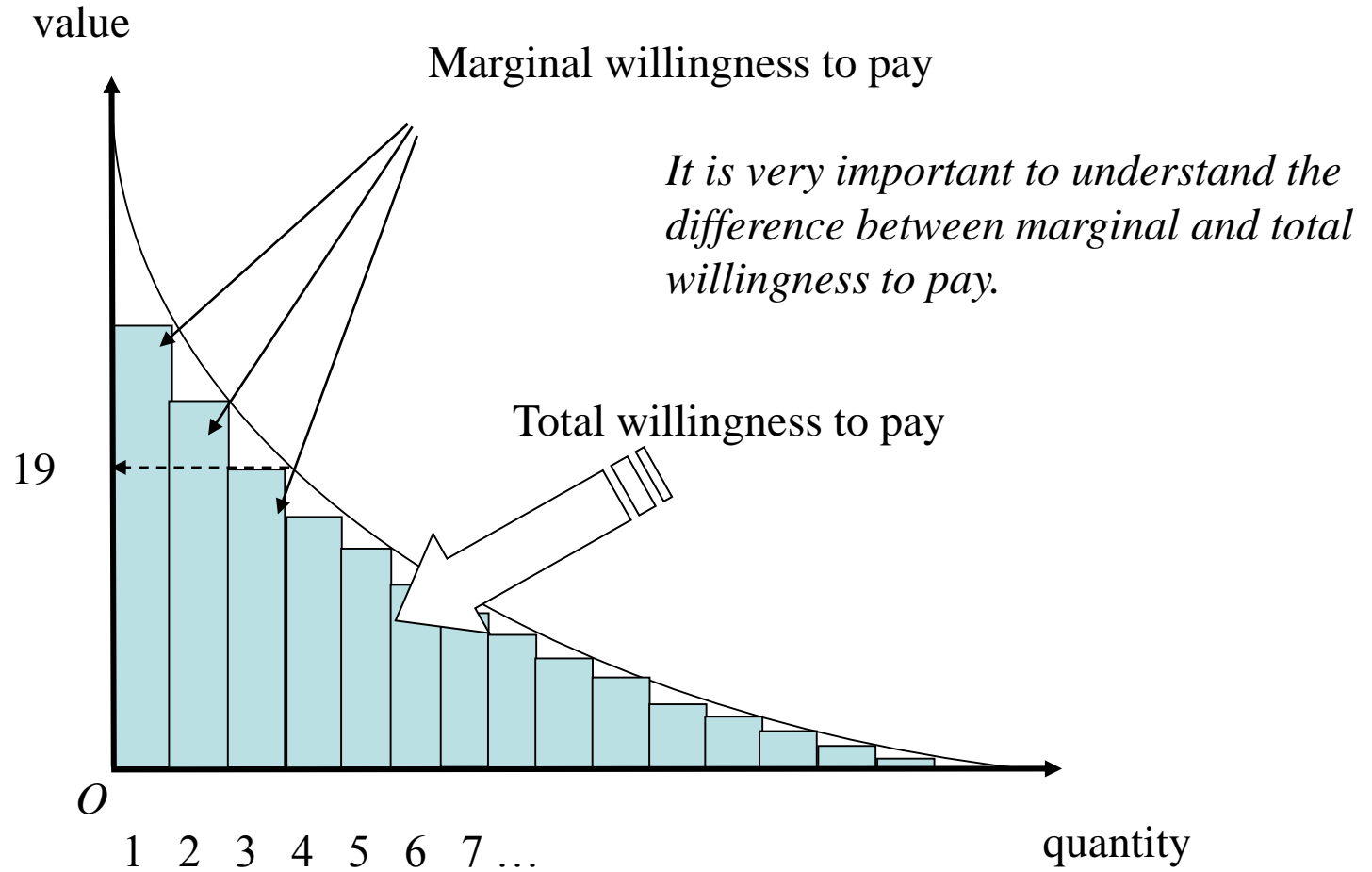
An example: a baseball game

- When you try to watch a professional baseball game (MLB), you have to pay an entrance fee.
- That shows your willingness to pay for watching a baseball game.
- Suppose that an entrance fee is **\$ 100**, it may be too high for you. Then, you don't go to the stadium.
- Then, your willingness to pay for the ball game is smaller than **\$ 100**.

An example: a baseball game (cont.)

- Suppose you went to the ball stadium, paying, say, \$ 50. Then your willingness pay is \$ 50, or larger than it.
- As you keep going to the ball stadium, your enjoyments will possibly decrease gradually.
- Of course, this is not the case if a league championship is at stake on the last game of the season!

Explanation by means of a figure



Why is “willingness to pay” important?

- Willingness to pay, say for a book, is realized and seen in a market, as I have already mentioned.
- It is, however, important that there are precious things whose willingness to pay is very high but not realized in a market.
- Thus, any market value is not given to those things, however precious they may be.
- Natural environment is such an example.
- If we are, somehow, able to measure willingness to pay for environment, we can express its value in money terms.

Demerits of willingness to pay

- Willingness to pay depends upon one's income.
- As the income level increases, one's willingness to pay also increases in most cases even if other conditions are the same as before. (See Question on the next slide.)
- This implies that willingness to pay for the same goods or services may be different between rich and poor.
- Thus, it causes some troubles when we try to measure natural environment by means of willingness to pay.

Question

- There are commodities for which one's WTP decreases as one's income increases. What type of commodities satisfy this characteristic? Why so?

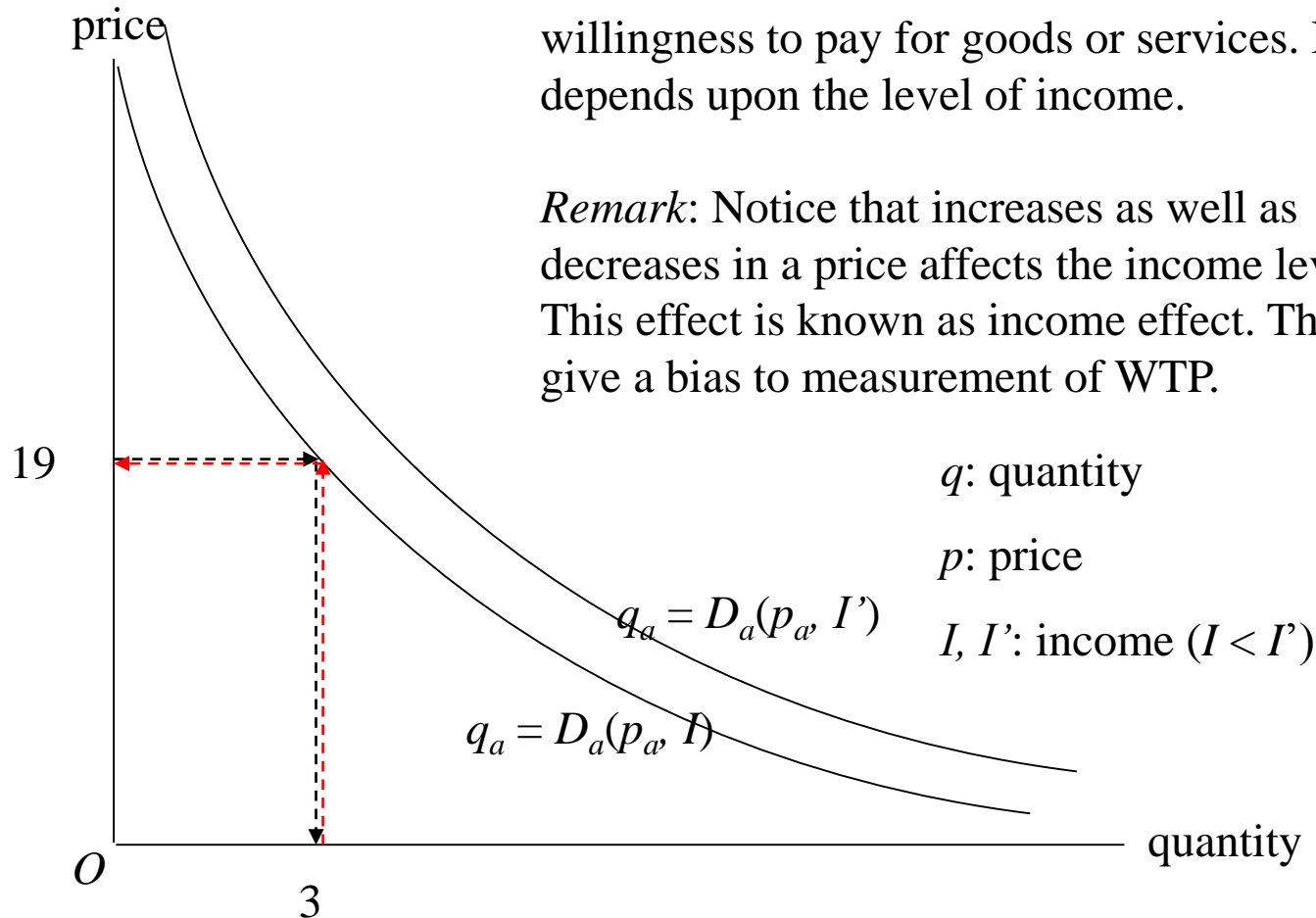
Demerits of willingness to pay (cont.)

- In poor countries, people's willingness to pay for natural environment may possibly be very small even though it is very precious for them.
- In rich countries, people's willingness to pay for natural environment tends to be larger.

Individual demand curve

An individual demand curve reflects one's willingness to pay for goods or services. It depends upon the level of income.

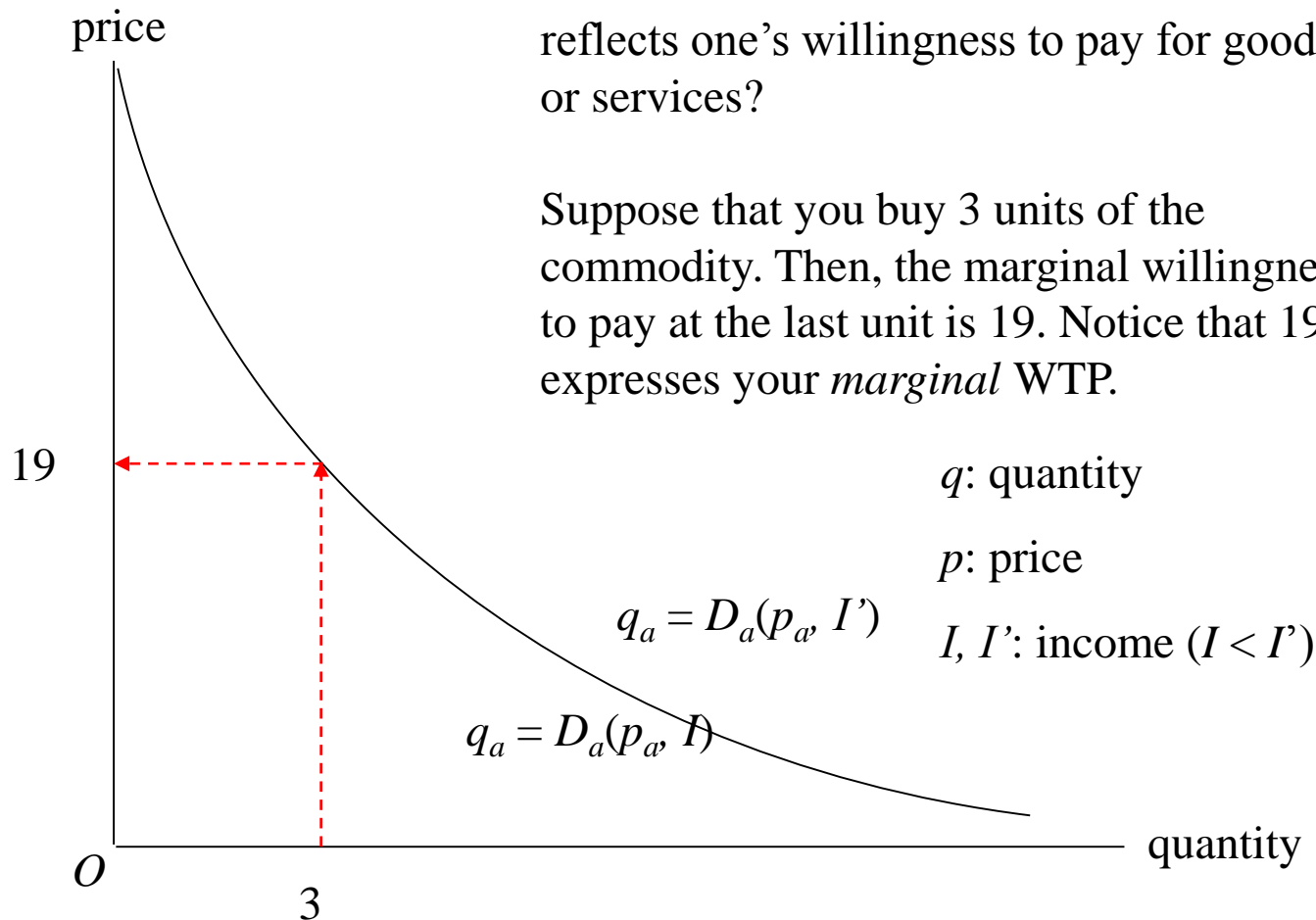
Remark: Notice that increases as well as decreases in a price affects the income level. This effect is known as income effect. This give a bias to measurement of WTP.



Individual demand curve and WTP

How does an individual demand curve reflect one's willingness to pay for goods or services?

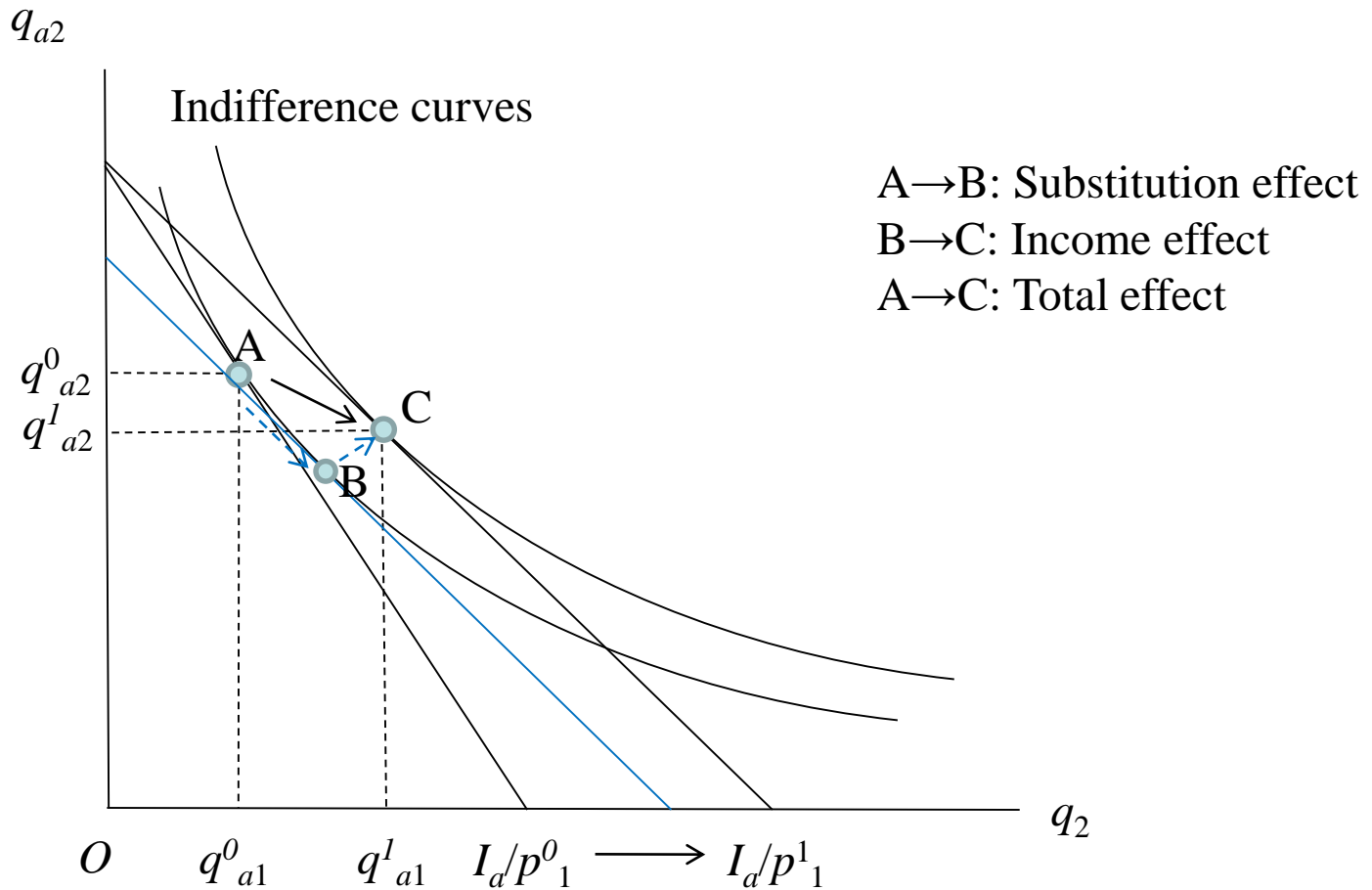
Suppose that you buy 3 units of the commodity. Then, the marginal willingness to pay at the last unit is 19. Notice that 19 expresses your *marginal* WTP.



How can an individual demand curve be deduced?

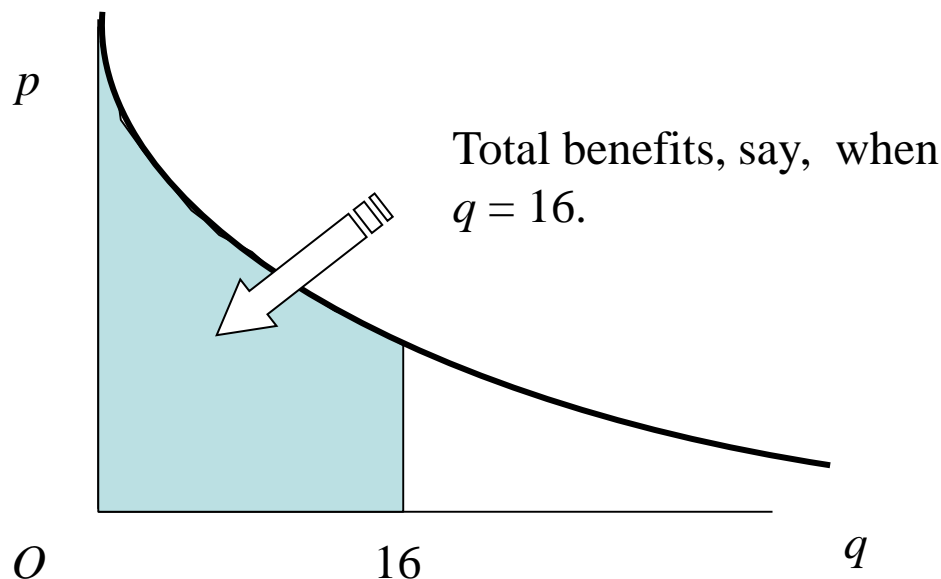
- Consider a utility function of person a :
 $u_a = u_a(q_1, q_2)$.
- Suppose he or she maximizes his/her utility subject to budget constraint $I_a = p_1 q_{a1} + p_2 q_{a2}$.
- Then, we have $q_{a1} = D_{a1}(p_1, p_2, I_a)$ and $q_{a2} = D_{a2}(p_1, p_2, I_a)$.
- If the price of the other goods is considered given, then we can express $q_{a1} = D_a(p_1, I_a)$.

Explanation by means of a figure



Aggregate demand curve and benefits

- Q : Aggregate demand (Social demand)
- $Q = q_a + q_b + q_c + \dots$
 $= D_a(p, I_a) + D_b(p, I_b) + D_c(p, I_c) + \dots$



Cost and opportunity cost

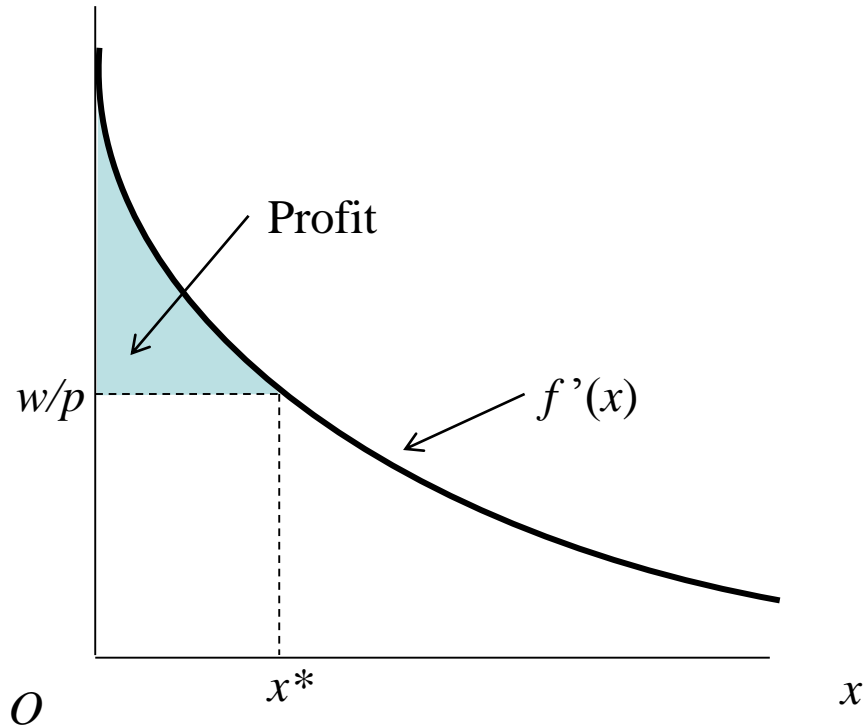
- There is no free-lunch. Someone must pay for something which give them benefits.
- When you try to get benefits or profits, you have to sacrifice something.
- When you produce something, you need many types of inputs, so that you have to buy them in markets.
- $y = f(x)$: production function, which expresses technological relationship between input (x) and output (y). Cost is expressed as wx , where w is the price of the input.

Cost and profit

- The value of sales is expressed as py where p denotes the price of output commodity.
- Hence, profit is expressed as $py - wx = pf(x) - wx$.
- From profit maximization, $pf'(x) = w$ or $f'(x) = w/p$ is obtained.
- *The marginal productivity equals the input price divided by the output price.*

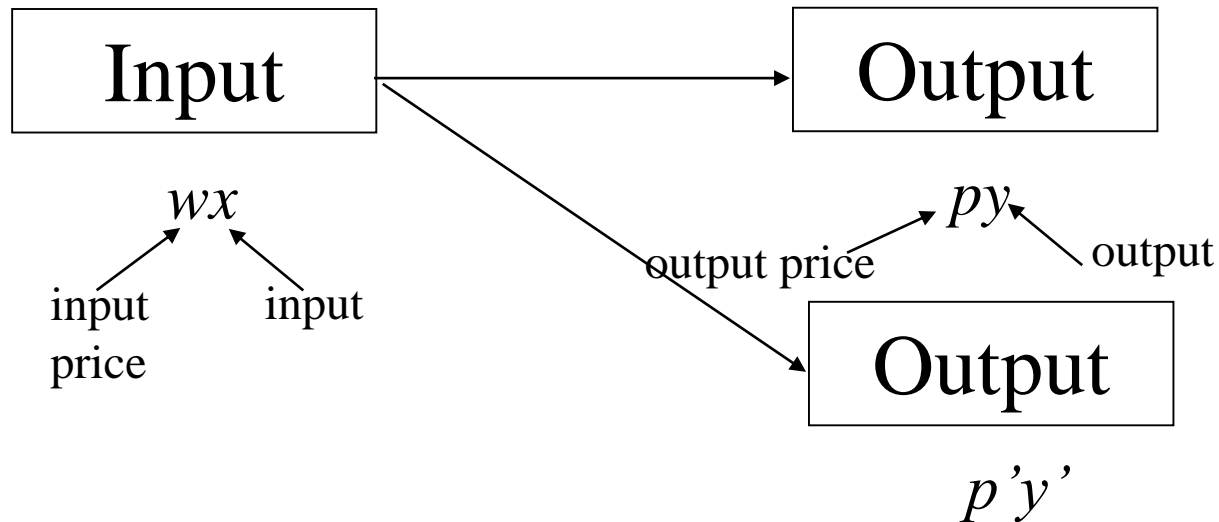
Explanation by means of a figure

Marginal productivity



Opportunity cost

- Opportunity cost is the maximum value which could have been obtained if resources had been used in a different way.
- It is hard to measure it exactly, although it is important as a concept.
- Practically, it is measured by the market value of inputs used up in production.
- Suppose you're trying to produce something, inputting some resources. If you abandon this production plan, you don't have to lose the money which equals the payment for the resources.



If alternative options of production require the same amount of expenditure for input, the production which realizes bigger value of the output is chosen.

Thus, if $py > p'y'$ holds, the first option is chosen, and its opportunity cost is practically measured as wx .

What if the second option is chosen in spite of the inequality $py > p'y'$? Then, the opportunity cost is $(py - p'y') + wx$, expressing the additional profit which could be obtained *plus* the wage payment.

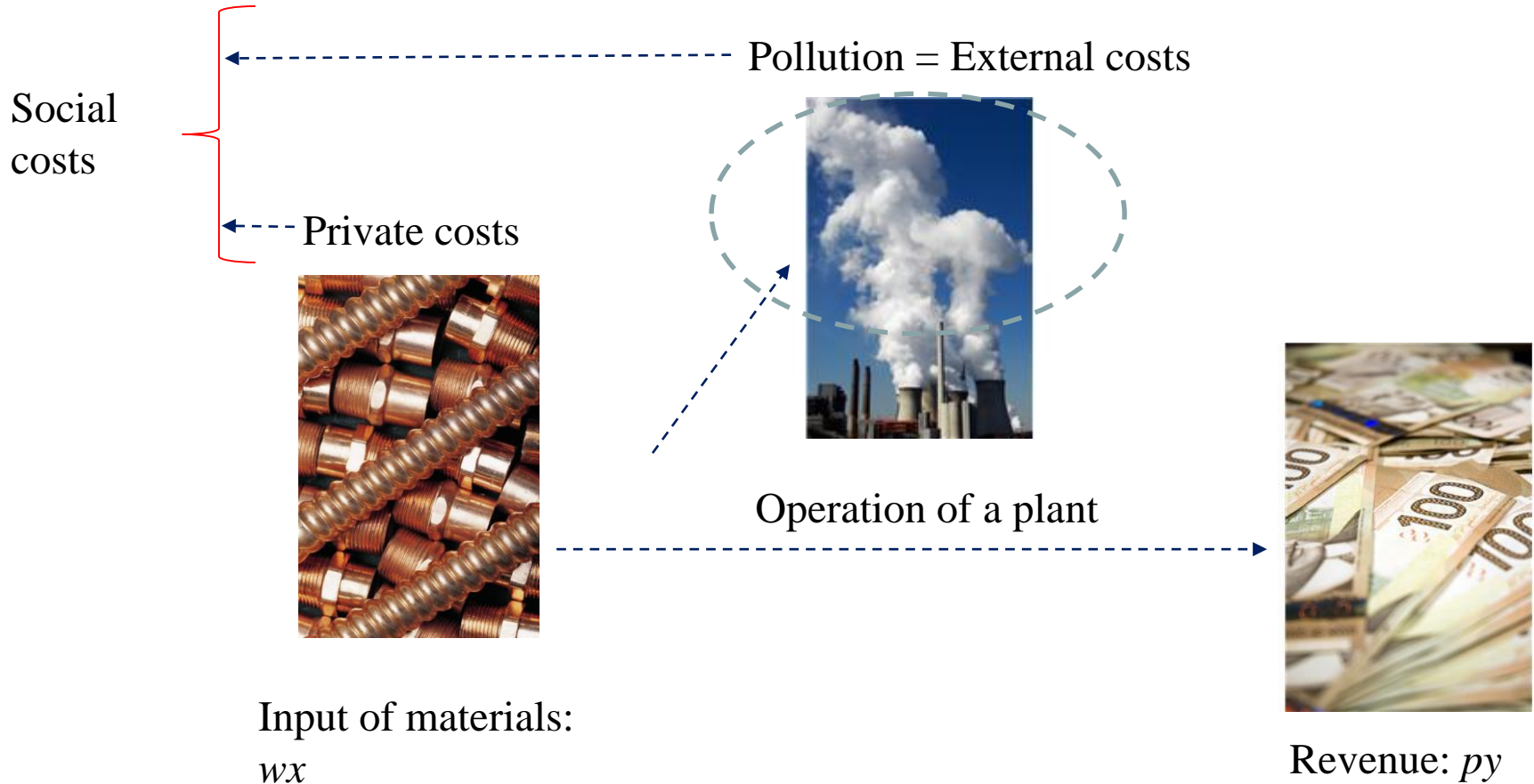
Opportunity cost of studying

- When you study at a university, you are sacrificing wages which could be obtained when you were employed somewhere.
- Suppose the expected wage rate is 20 dollars per hour.
- Then, the opportunity cost of studying is 20 dollars per hour.
- If you want to study at a university, sacrificing 20 dollars, it means that you give more value on studying at university, instead of working now.

Private and social costs

- Private costs are the costs which are experienced by an actor who makes economic decision.
- Social costs are the costs which are experienced by a whole society whoever makes economic decision.
- There is often a gap between private costs and social costs, and the amount of social costs is larger than that of private costs.
- *Example:* Pollution of waste-water from a plant.

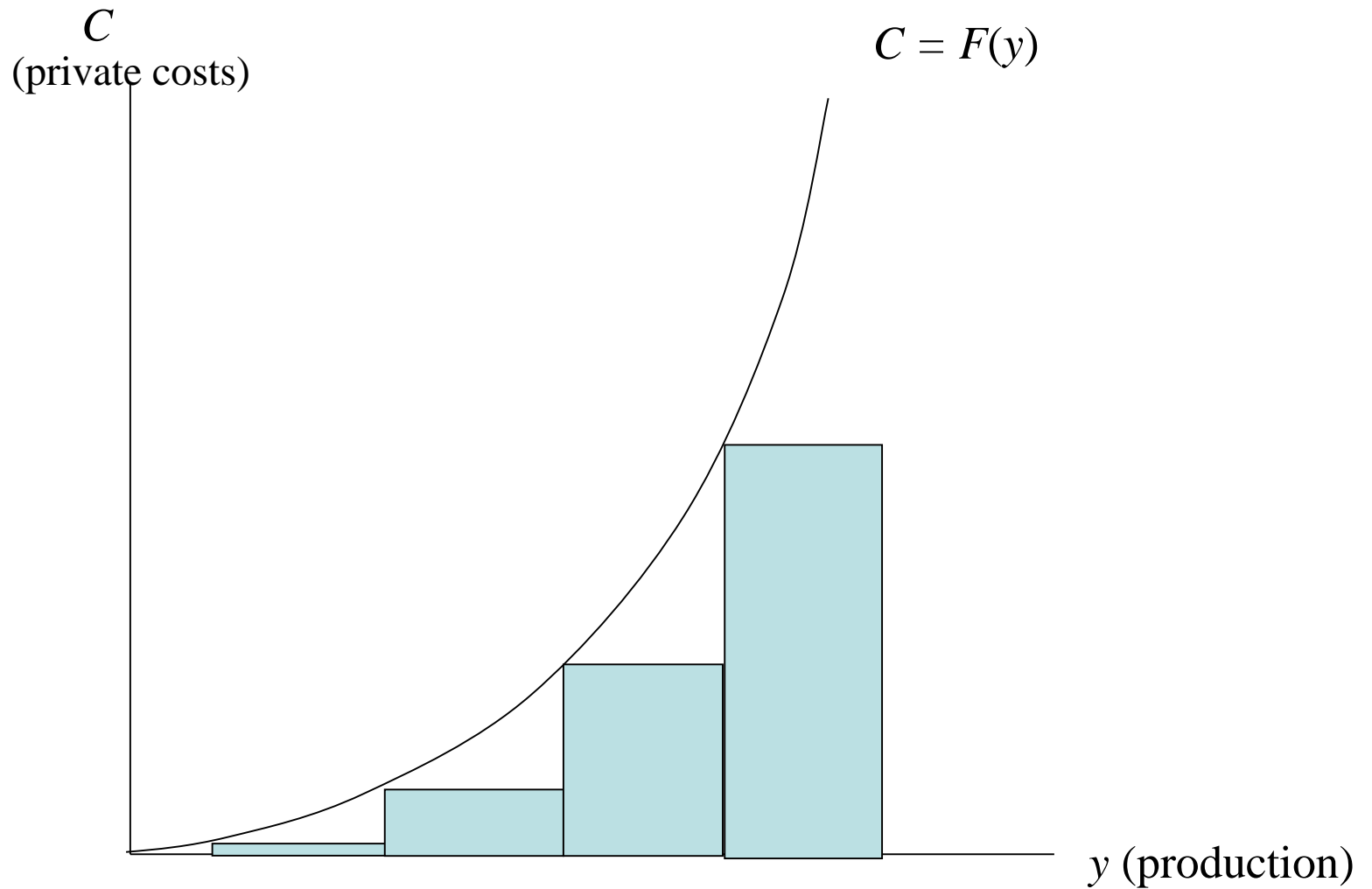
Explanation by means of a figure



A remark

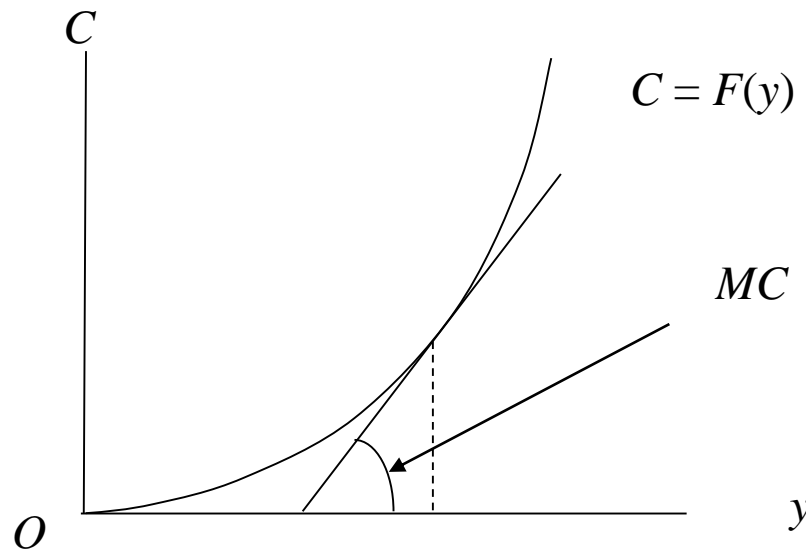
- External costs (costs due to external diseconomy) are not reflected in market prices in many cases.
- Hence, external costs give a bias to private economic decision, causing a loss to a whole economy.

Private cost curves



Total and marginal costs

- Marginal cost is expressed as $MC = dF/dy = F'(y)$: a slope of a tangent on a point of the total cost curve expressed as $C = F(y)$.



Technology: production function

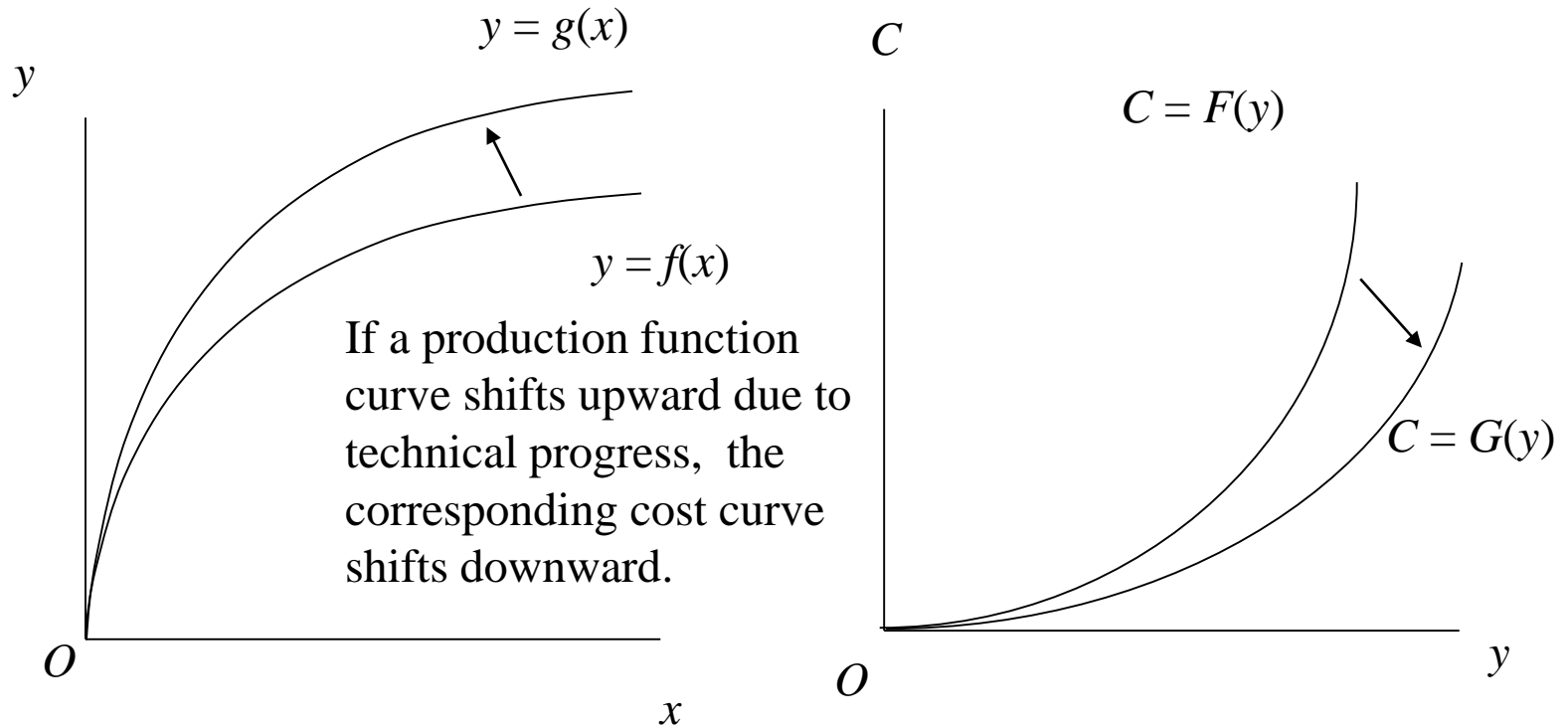
- The total and marginal cost curves are deduced from production function.
- $y = f(x)$ and $\max py - wx \Rightarrow C = F(y)$
- Confirm why so.
- Thus, technology is reflected indirectly in the total and marginal cost curves.

Deduction of a total cost function

- From the production function $y = f(x)$, x is expressed as follows: $x = f^{-1}(y)$.
- Then, the total costs are expressed as $TC(y) = wx = w f^{-1}(y)$: The total costs are expressed as a function of the output y .
- Hence, the marginal costs function is $TC'(y) = MC(y) = w \frac{d f^{-1}(y)}{dy} = w/f'$

Production possibility frontier

Technical progress changes the shapes of a production possibility curve and a cost curve.

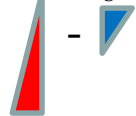


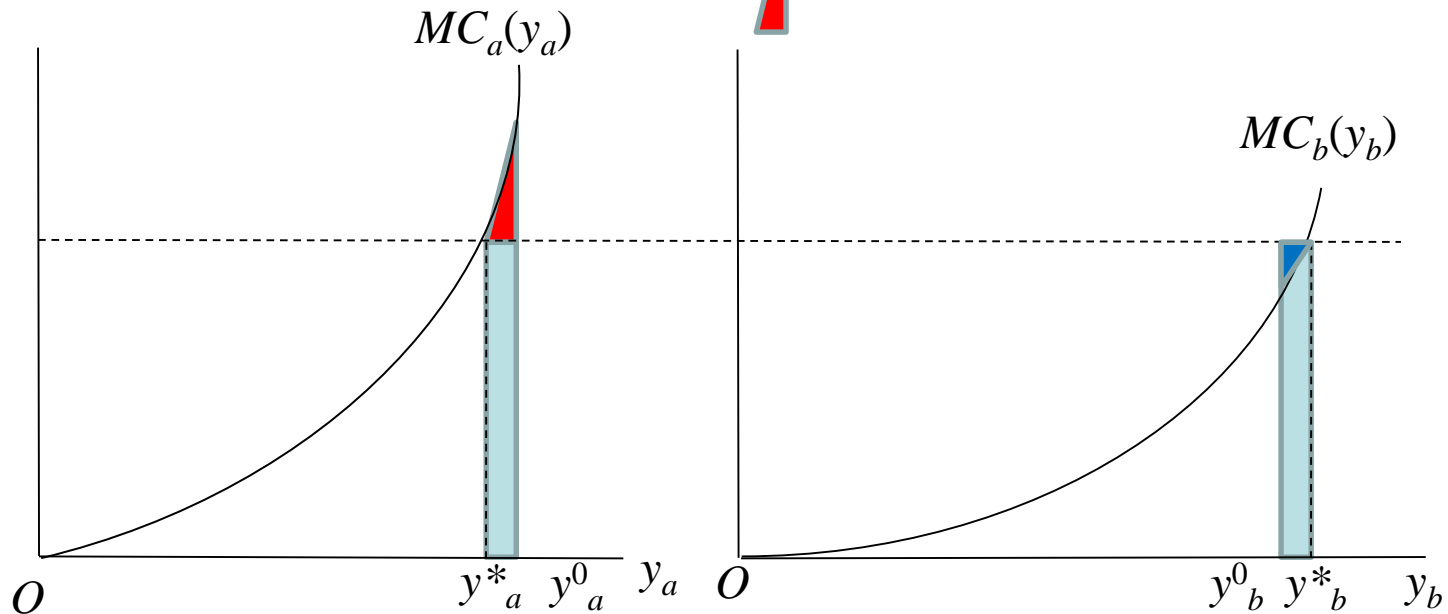
Equi-marginal principle

- Suppose that a firm has two plants whose cost functions are expressed as $C_a(y_a)$ and $C_b(y_b)$, where the amount of production at each plant is denoted by y_i ($i = a, b$).
- If the firm produces a given amount y , how does it allocate production to each plant?
- Answer: minimize $C_a(y_a) + C_b(y_b)$ subject to $y = y_a + y_b$. Then, we have $MC_a(y_a) = MC_b(y_b)$.
- The *equi-marginal* principle holds.

Explanation by means of a figure

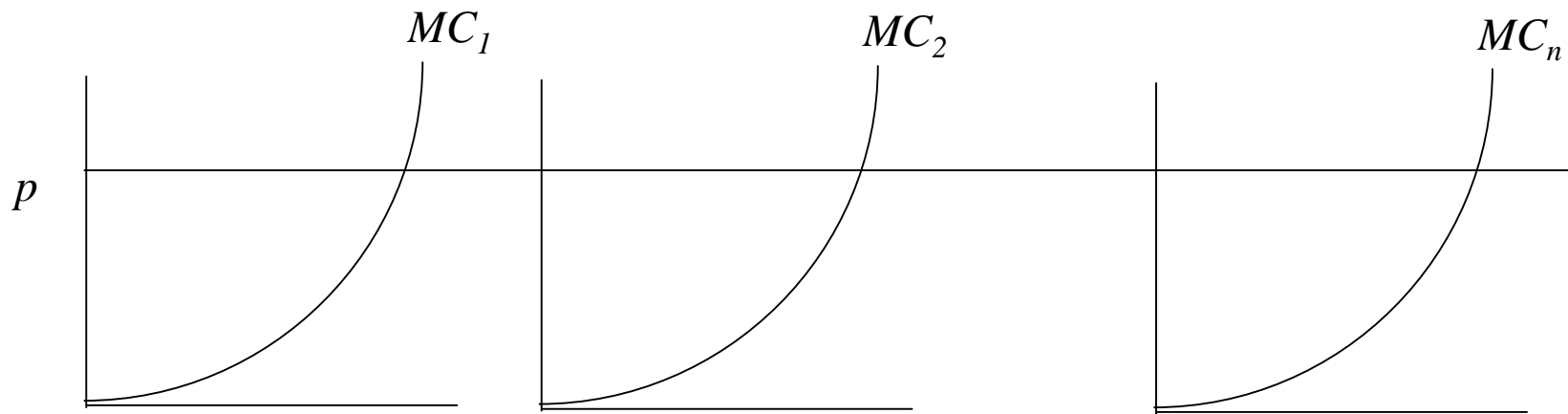
$y^*_a + y^*_b = y$: Cost is minimized.

If $y^*_a \rightarrow y^0_a$ and $y^*_b \rightarrow y^0_b$, then the cost increases by .



Profit maximization and equi-marginal principle

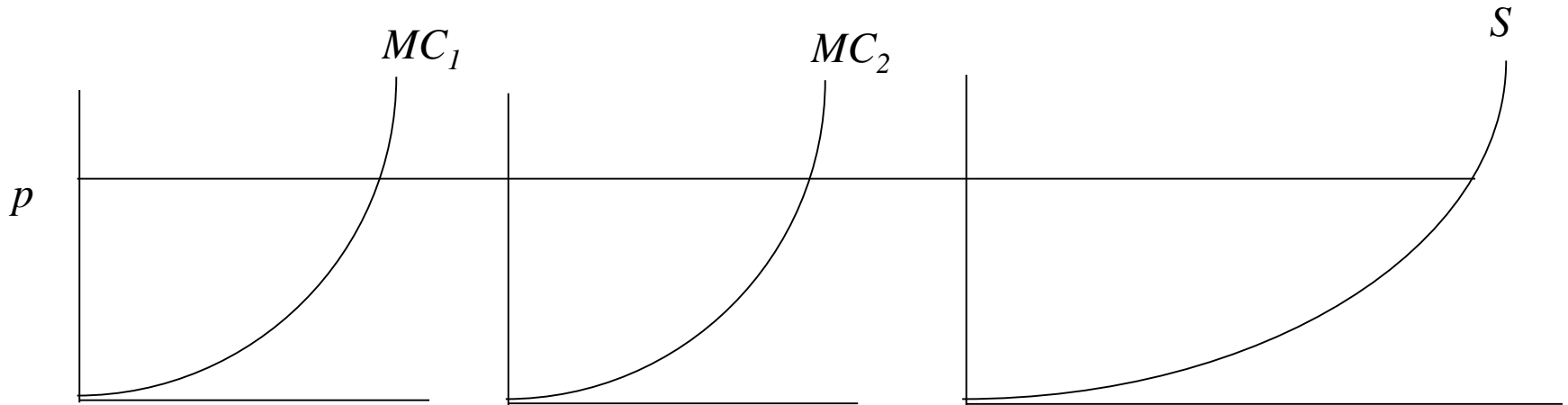
- Profit maximization for each firm is expressed as $p = MC_i (i = 1, 2, \dots, n)$
- Thus, the equimarginal principle holds.



Supply curve

- $p = MC_i (i = 1, 2, \dots, n) \Rightarrow S_i = y_i(p)$
- Aggregate supply is expressed as $S = \Sigma y_i(p)$.

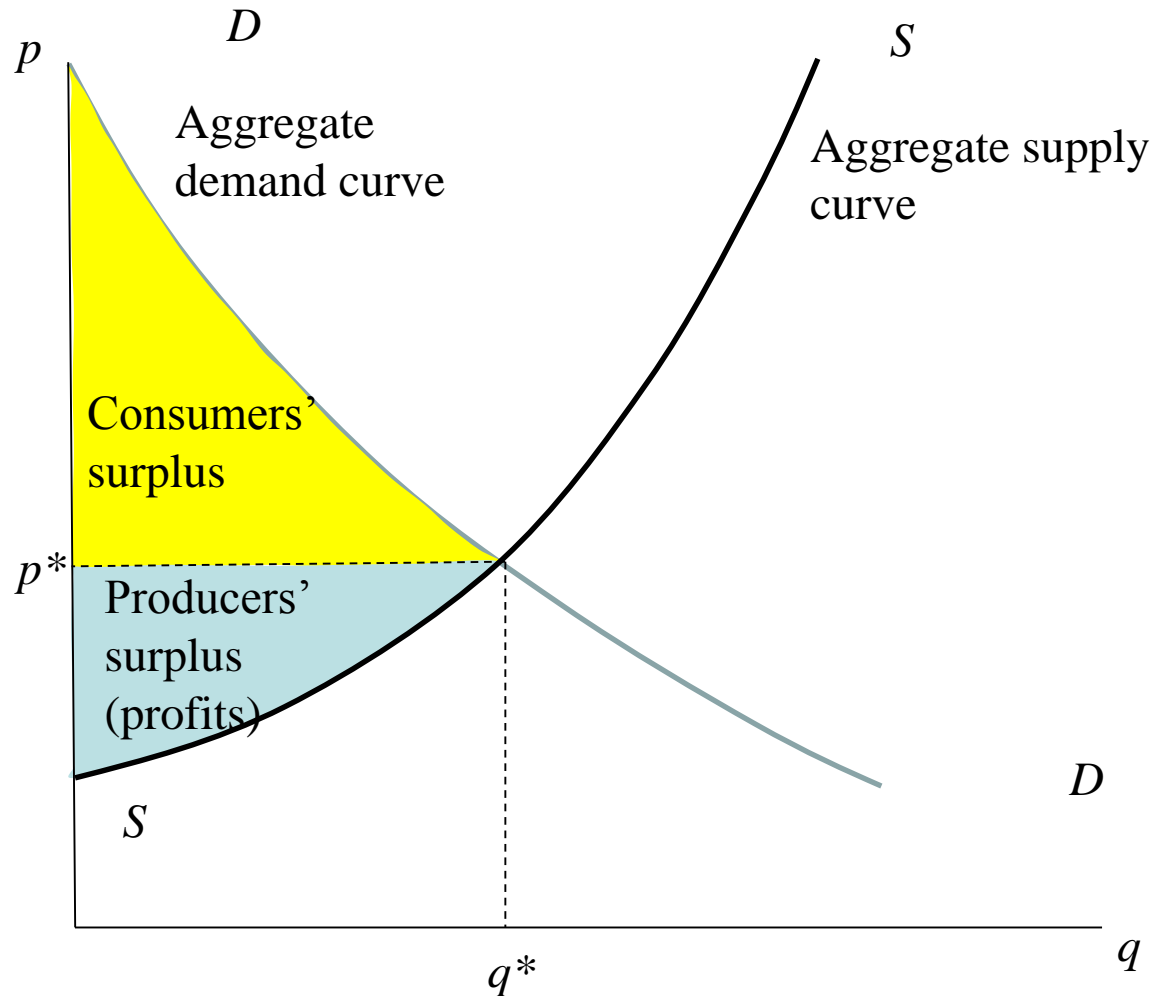
In a case of two firms



Market equilibrium

- Market equilibrium is obtained where an aggregate demand equals an aggregate supply.
- In a competitive market, price moves flexibly, so that both aggregate demand and supply are adjusted, converging to the same amount.

Explanation by means of a figure



Total surplus =
Consumers' surplus +
Producers' surplus

Equilibrium point

- At an equilibrium point, the amount of supply equals that of demand.
- Marginal WTP is equalized among consumers.
- Consumers' marginal WTP equals marginal production costs (MC), which are equalized among producers.

Remarks

- If all the costs and all the benefits (profits and willingness to pay) are reflected in the aggregate supply and demand curves respectively, the social welfare is maximized by the market mechanism.
- This is because the total WTP plus the total costs are maximized insofar as costs and benefits are reflected in those curves.

Remarks (cont.)

- However, this is not the case, as far as environment is concerned.
- Costs and/or benefits are often not reflected in supply and/or demand curves.
- There is no demand curve for Mt. Fuji revealed in a market.