

Chapter 1 Cost and Benefit Analysis

$$MB(Q) = TB(Q+1) - TB(Q)$$

$$MC(Q) = TC(Q+1) - TC(Q)$$

Consume if and only if $MB(Q) \geq MC(Q)$

$$\text{MB of additional N unit} = MB(Q) \times N$$

$$\text{MC of additional N unit} = MC(Q) \times N$$

For Optimal Quantity: $MB(Q) = MC(Q)$

Opportunity cost is the highest-valued option forgone.

Opportunity cost = Explicit cost + Implicit cost

If some expenditure is made under two alternatives, it should not be considered.

Finding the best alternative as opportunity cost = $\max\{B(A1), B(A2)\}$

Sunk costs: Costs that have already been incurred → cannot be recovered → no acknowledgment as cost (beyond recovery)

1. Michelle is thinking about going to the movie tonight. A ticket costs HK\$110 and she will have to cancel her tutorial job that pays **HK\$120**. Normally, she would be unwilling to do the tutorial for less than **HK\$90**. If Michelle views the unpleasantness of the tutorial job as an offset against its salary, the cost of seeing the movie is:

$$\text{Cost} = \text{HK\$110} + \text{HK\$30 (120-90)} = \text{HK\$140}$$

\$120 = The amount she will be paid

\$90 = The minimum amount she is willing to work for (Psychic Cost)

2. John is thinking of going to a concert that will last one and a half hours. During this one and a half hours, he could have tutored a student at **\$250 per hour**. Alternatively, he could have used the same time to work as a research assistant instead and earn a total of **\$370**. He enjoys the tutoring job and research assistant job just enough that he is willing to do either job for free. If the price of the concert ticket is **\$300**, what is his cost of going to the concert?

$$\text{Cost} = \$300 \text{ (Ticket Cost)} + \$375 \text{ (Highest Alternative - tutor)} = \$675$$

3. Your family is taking a week-long summer vacation at a cabin in the mountains next to a lake. You have been able to get time off work at the job where you normally work 40-hours a week at **\$12** per hour. Your parents are paying **\$1,500** for the cabin rental and each child (including yourself) will pay **\$200** for food and other related costs. You currently have your own rented apartment with a monthly rent of **\$300** and typically pay **\$75** per week for food. The travel cost to get to the cabin and back will cost you **\$50** more than your usual weekly travel expenses. What is YOUR total opportunity cost of the summer vacation?

$$\text{Implicit cost (Work)} = \$480 (\$12 \times 40 \text{ hours}) - \$75 \text{ (food)} = \$405$$

Explicit cost (Vacation) = \$200 (food) + \$50 (additional cost) = \$250

Opportunity cost = \$405 + \$250 = \$655

4. Suppose that Paul, Ron, and Tom are the only residents of the city of Utopia. They need to determine the number of policemen Utopia should have. The marginal benefit that each person places on the additional policeman (in dollar terms) is given by the following table. Suppose that the wage of a policeman is \$20. What is the optimal number of policemen in the city?

Number of policemen	Marginal Benefit for Paul (\$)	Marginal Benefit for Ron (\$)	Marginal Benefit for Tom (\$)
1	12	15	9
2	10	13	6
3	8	11	5
4	6	5	2
5	5	4	0

Marginal Benefit (1 policeman) = 12 + 15 + 9 = \$36 (higher than the wage)

Marginal Benefit (2 policemen) = 10 + 13 + 6 = \$29 (higher than the wage)

Marginal Benefit (3 policemen) = 8 + 11 + 5 = \$24 (higher than the wage)

Marginal Benefit (4 policemen) = 6 + 5 + 2 = \$13 (Lower than the wage)

A: Therefore, the optimal number of policemen in the city is 3.

5. Which of the followings are considered as the cost for a decision?

(I) Time spent due to the decision

(II) Benefits from the best-foregone alternative

(III) The actual financial cost of the decision

(IV) The sum of all benefits from all foregone alternatives

(V) The difference between the benefits of the first and second-best choices

A: I, II, III

IV - only the benefits of the best foregone alternative is considered.

V - The addition of the first choice cost and the benefit of the second-best choice is considered.

6. Which of the following should NOT be considered in cost-benefit analysis when deciding whether to go see a movie?

(I) Non-refundable or non-transferable movie ticket purchased yesterday

(II) The entertainment value of the movie

(III) The cost of transportation

(IV) The salary from a part-time job you could have earned

A: I

I - Non-refundable costs are considered as a sunk cost (zero)

7. A manufacturing company wants to produce 5 gadgets at the lowest cost. The company has 2 machines to use. Information for the production cost of each machine is shown below:

Machine 1: Total cost of producing n units = $TC(n) = n^2$

Machine 2: Average cost of producing n units = $AC(n) = 4$

The company should use machine 1 to produce _____ units of the gadget, and machine 2 to produce _____ units of the gadget.

$$TC(n) = n^2 \rightarrow \text{by differentiation, } MC = 2n$$

$$AC = 4 \rightarrow TC = 4n \rightarrow MC = 4$$

$$2n = 4 \rightarrow n = 2 \text{ (2 units produced in 1st machine)}$$

$$5 - 2 = 3 \text{ (3 units produced in 1st machine)}$$

8. Consider Candy's choice of the number of visits to the Japan Museum. Suppose Candy's total benefit of going to Japan Museum n times in the coming year can be summarized by a function below (in HK\$)

$$B(n) = 500n - 70n^2$$

Candy has to pay an admission fee of \$100 per visit. How many visits will Candy make in the coming year?

$$MB(n = 3) = (500(3) - 70(9)) - (500(2) - 70(4)) = \$150 \text{ (higher than the MC)}$$

$$MB(n = 4) = (500(4) - 70(16)) - (500(3) - 70(9)) = \$10 \text{ (lower than the MC)}$$

Therefore, Cindy can make a maximum of 3 visits in the coming year.

Chapter 2 Basis of Exchange

Absolute Advantage

→ Person A is said to have an **absolute advantage** over person B at the production of a good if it takes fewer resources (ex. time) to produce a given amount of the good than B or if A can produce more of the good than B given a fixed amount of resources.

Comparative Advantage

→ Person A has a **comparative advantage** over person B at task if and only if A has a lower opportunity cost of performing it than B.

Term of Trade

→ The **Term of Trade** between two goods A and B is how many units of good A can be exchanged into a unit of good B.

Production possibility curves

→ A **production possibility curve** is a graph that describes the **maximum amount of one good that can be produced for every possible level of production of the other good**.

Production possibility curves (One-person Economy)

- Any combinations **within the triangle** of the curve are **attainable**
- Any combinations **outside the triangle** of the curve are **not attainable**
- Any combinations **on the straight line** are **attainable and efficient**
- Any combinations **strictly inside the triangle** of the curve are **attainable but inefficient**

Production possibility curves (n-person Economy)

→ If Person A has a comparative advantage over Person B in producing X, Person A must be the first one to produce X and vice versa (The Low-Hanging Fruit Principle - "Start from one that costs less")

1. Sam and Sara are the two agents in this economy. The following table shows the quantity produced per day for Sam and Sara regarding the two goods they produce: corn and bean.

	Bushels of Corn	Bushels of Bean
Sam	9	15
Sara	16	24

From the data, we can conclude that Sam has comparative advantage in the production of _____ and Sara has comparative advantage in the production of _____.

A: Bean, Corn

OC (Corn) = 1.66 for Sam (15/9), 1.5 for Sara (24/16) → Sara has Comparative advantage

OC (Bean) = 0.6 for Sam (9/15), 0.66 for Sara (16/24) → Sam has Comparative advantage

2. Suppose there are 3 persons in an economy, each can produce the two goods, X and Y. If they have different opportunity costs of producing 1X, then which of the following statements must be true?

- a. There is no mutually beneficial terms of trade among the 3 persons.
- b. There is mutually beneficial terms of trade among the 3 persons.
- c. If the 3 persons are to determine production level of the goods together, and then trade with another economy, then it can't be the case that all 3 persons are producing the same good.
- d. For a terms of trade that is mutually beneficial to any 2 of the 3 persons, it must also be beneficial to the remaining person.

A: d. For a terms of trade that is mutually beneficial to any 2 of the 3 persons, it must also be beneficial to the remaining person.

3. The following table shows the amount of resources (in man-hours) required to produce 1 unit of good X or 1 unit of good Y in country A and country B, respectively.

	Good X	Good Y
Country A	1	4
Country B	6	12

Which of the following can be a mutually beneficial terms of trade, i.e. both countries have strictly positive gains from trade?

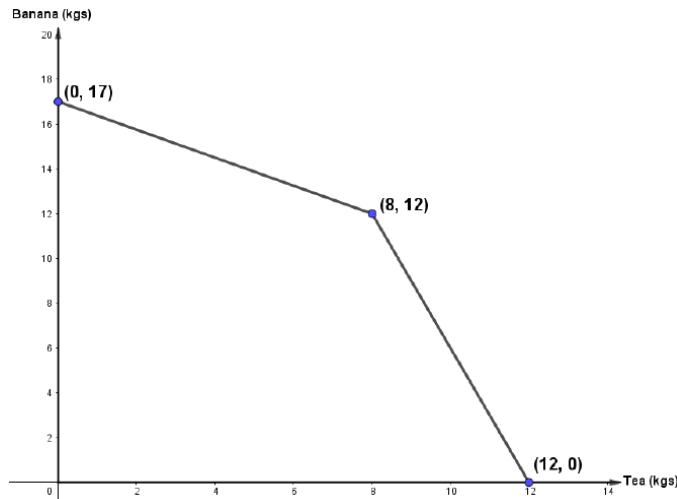
- a. $1X = 0.25Y$
- b. $1X = 2Y$
- c. $1X = 0.5Y$
- d. $1X = 1Y$
- e. $1X = 0.35Y$

A: e. $1X = 0.35Y$

OC (Good X) = 0.25 for Country A (1/4), 0.5 for Country B (1/2)

$1X = 0.25Y < ToT < 0.5Y$, therefore $1X = 0.35Y$ is correct

3. The following graph shows the Neverland's production possibilities. Neverland is a small nation. Suppose the world price of Tea is \$1 per kg and the world price of Banana is \$2 per kg, and Neverland decides to open up to the world market and trade. How many kgs of banana could they consume if they were to consume 10 kgs of tea?



A: 12 banana

First, evaluate the income at the three production combinations, under the world price.

At (8, 12), the income will be $8 \times 2 + 12 \times 3 = \52 .

Thus, we conclude they are better off producing (8,12).

Given they will have an income of 52, we can subtract their expenditure on bananas, we will get the expenditure on tea ($52 - 10 \times 3 = 22$). From this expenditure, we obtain that they will consume 11 units of tea.

4. Karis and Oni are the only farmers in Islandia, a small island nation. Karis can harvest 5 bananas or 20 pineapples per day. Oni can harvest 20 bananas or 5 pineapples per day. Islandia is currently a closed economy, i.e., no trade with the rest of the world. Islandians like to consume bananas and pineapples at 2 to 1 ratio (ratio of 2 bananas and 1 pineapple) per day. How many bananas would Karis produce?

A: 2.22

Oni: 20 bananas, 0 pineapples (specialization)

Karis: $5 \text{ bananas} - 2.22 \text{ bananas} = 2.78 \text{ bananas}$ (for production of pineapples)

$2.78 \text{ bananas} \times 4 = 11.12 \text{ pineapples}$

$(2.22 \text{ bananas} + 20 \text{ bananas}) / 11.12 \text{ pineapples} = 2$; thus, fulfills the 2 to 1 ratio.

Chapter 3 Demand, Supply and Market Equilibrium

Demand Interpretation

- **Horizontally:** How much buyers are willing and able to pay at a certain price.
- **Vertically:** The highest price buyers are willing to pay for a certain quantity.

Supply Interpretation

- **Horizontally:** How much suppliers are willing and able to sell at a certain price.
- **Vertically:** The minimum price for which suppliers are willing to sell a certain quantity.

Substitution Effect

- The **increase of the price** of good x makes good x **less attractive** if some substitute of x, say good y, is available.
- **Increase in price = reduced quantity demanded**

Income Effect:

- **Impact of price on quantity demanded through the channel of changing real income**
 - **Normal Good**
 - Quantity demanded Increases when there is an increase in income
 - Quantity demanded decreases when there is a decrease in income
 - **Inferior Good**
 - Quantity demanded decrease when there is an increase in income
 - Quantity demanded Increases when there is an decrease in income

The Law of Demand

- **The market quantity demanded of a good is inversely related to its price**
 - When there is an **increase** in the price of good x, the quantity demanded of good x will **decrease**.
 - When there is an **decrease** in the price of good x, the quantity demanded of good x will **increase**.

The Market Equilibrium

- Occurs at the price-quantity pair for which **both buyers and sellers are satisfied**.
- **Price and quantity common to both the buyers and sellers**
 - $P_s = P_d$
 - $Q_s = Q_d$

Excess Demand

- When the quantity the buyers want to buy exceeds the quantity the sellers want to sell
- Also known as shortage

Excess Supply

- When the quantity the sellers want to sell exceeds the quantity the buyers want to buy
- Also known as surplus

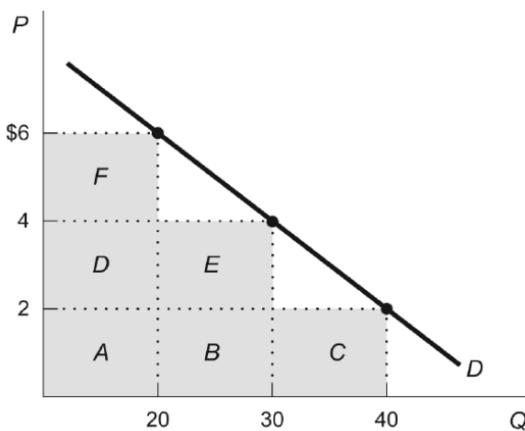
Adjustment to Equilibrium

- **More supply than demand** → Suppliers need to secure sales → Willing to lower the price → reduction of excess supply (suppliers who have higher production cost decide not to supply) → soon to reach 0 excess supply (equilibrium quantity and price)
- **More demand than supply** → Buyers willing to raise the price by a little → Buyers with lower willingness to pay leaves out from the market + some suppliers encouraged to supply in changed price → reduction of excess demand → soon to reach 0 excess demand (equilibrium quantity and price)

Economic Surplus

- $ESurplus(q) = MB(q) - MC(q)$
- The total Economic Surplus from the equilibrium is the sum of economic surpluses from the first unit up to q unit.
- **Consumer Surplus**
 - The **difference** between the **highest price a consumer will pay** at a given quantity and the **market price**
- **Producer Surplus**
 - The **difference** between the **market price** and the **minimum price at which producer would be willing to sell** a certain quantity

1. In the figure below, when the price of the product rises from \$4 to \$6, the total revenue changes by the area(s) represented by:



A: F - E - B

Total Revenue (when price is \$4) = D + E + A + B (\$4 x 30 = \$120)

Total Revenue (when price is \$6) = F + D + A (\$6 x 20 = \$120)

The change in total revenue when the price increases from \$4 to \$6 will be =

$$F + D + A - (D + E + A + B) = F - E - B$$

2. Alice is willing to pay \$30 for a piece of cheesecake and Betty is willing to pay only \$25. The price of the cheesecake is \$20. Suppose Alice manages to buy the last piece of cheesecake. However, for some reason, the restaurant decides to take the newly bought cheesecake from Alice, refund Alice the price she paid and let Betty buy the cheesecake at \$20. As a result,

A: the consumer surplus decreases.

→ $\$30 - \$20 = \$10$ (Alice), $\$30 - \$25 = \$5$ (Betty)

→ Decrease in consumer surplus by \$5

3. Suppose roses are currently selling for \$50 per dozen, but the equilibrium price of roses is \$40 per dozen. We would expect a

A: surplus to exist and the market price of roses to decrease.

→ When the current price is higher than the equilibrium price, there is an excess supply (surplus).

→ In order to decrease the excess supply (surplus), the sellers will decrease the price to get closer to the equilibrium price (to increase the quantity demanded).

4. A market can be described by the equations $Q_d = 50 - 3P$ and $Q_s = 2P$. The equilibrium price in this market is _____ and equilibrium quantity is _____ units.

A: \$10; 20

$Q_d = Q_s$ in Market Equilibrium; therefore, $50 - 3P = 2P$.

$50 - 3P = 2P \rightarrow 5P = 50 \rightarrow P = \10

$Q = 2P \rightarrow Q = 20$ units

5. Given the following supply and demand:

Demand: $P = -(2/3)Q + 60$, Supply: $P = (1/2)Q + 25$

Compute the equilibrium price and quantity, and the corresponding consumer surplus.

A: $P = 40$, $Q = 30$, Consumer surplus = 300

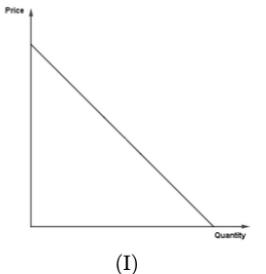
$-2/3Q + 60 = 1/2Q + 25 \rightarrow 35 = 7/6Q \rightarrow Q = 35 \times 6/7 \rightarrow Q = 30$

$P = 1/2Q + 25 \rightarrow P = 15 + 25 \rightarrow P = 40$

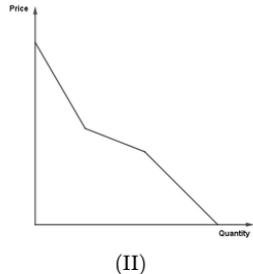
$CS = (\text{Highest price for Demand} - \text{Equilibrium price}) \times \text{Equilibrium quantity} / 2$

$CS = (60 - 40) \times 30 / 2 = \300

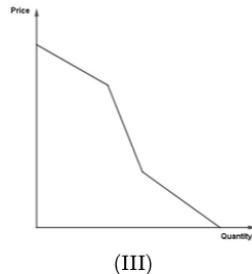
6. Which of the followings can be the market demand curve in a market consisting of three individuals each with a linear demand curve?



(I)



(II)



(III)



(IV)



(V)

A: I and V

- (I) when 3 individuals have same slope in linear demand curve
- (V), following the steeper slope to gentler slope (left to right)

7. In a college town, the demand curve for renting a two-bedroom apartment is $P = 8000 - 2Q$ and the supply curve is $P = 2Q$. In this market, the consumer surplus is _____ dollars and the producer surplus is _____ dollars.

A: 4,000,000; 4,000,000

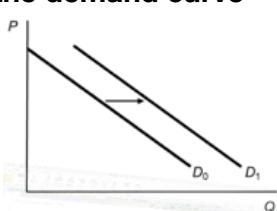
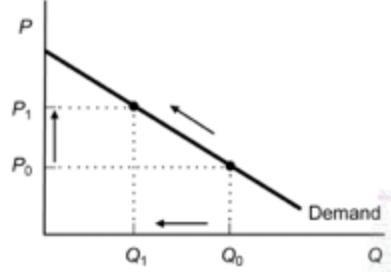
$$\rightarrow 8000 - 2Q = 2Q \rightarrow 4Q = 8000 \rightarrow Q = 2000$$

$$\rightarrow P = 2Q \rightarrow P = 4000$$

$$CS = (8000-4000) \times (2000) / 2 = \$4,000,000$$

$$PS = (4000-0) \times (2000) / 2 = \$4,000,000$$

Chapter 4 Comparative Statics of Market Equilibrium

Increase in Demand & No Change in the Supply <ul style="list-style-type: none"> → Increase in equilibrium quantity → Increase in equilibrium price 	Decrease in Demand & No change in the Supply <ul style="list-style-type: none"> → Decrease in equilibrium price → Decrease in equilibrium quantity
Increase in Supply & No Change in the Demand <ul style="list-style-type: none"> → Decrease in equilibrium price → Increase in equilibrium quantity 	Decrease in Supply & No Change in the Demand <ul style="list-style-type: none"> → Increase in equilibrium price → Decrease in equilibrium quantity
Increase in Demand & Decrease in Supply <ul style="list-style-type: none"> → Increase in equilibrium price → Uncertainty in equilibrium quantity 	Decrease in Demand & Increase in Supply <ul style="list-style-type: none"> → Decrease in equilibrium price → Uncertainty in equilibrium quantity
Increase in Supply & Increase in Demand <ul style="list-style-type: none"> → Uncertainty in equilibrium price → Increase in equilibrium quantity 	Decrease in Supply & Decrease in Demand <ul style="list-style-type: none"> → Uncertainty in equilibrium price → Decrease in equilibrium quantity
Change in Demand <ul style="list-style-type: none"> → Due to a change in factors other than the price of the good → E.g. Income, population, price of substitutes, price of complements, expectations and tastes → Shift of the demand curve 	Change in Quantity Demanded <ul style="list-style-type: none"> → Due to a change in price of the good → Movement along a demand curve 
Change in supply: <ul style="list-style-type: none"> → Due to a change in factors other than the price of the good → E.g. Technological innovations, input prices, expectations and entry or exit of producers → Shift of the supply curve 	Change in quantity supplied: <ul style="list-style-type: none"> → Due to a change in price of the good → Movement along a supply curve

<p>Demand Shifters</p> <ol style="list-style-type: none"> 1. Income <ul style="list-style-type: none"> - Income increase, normal goods demand increase & inferior goods demand decrease 2. Population <ul style="list-style-type: none"> - Population increase, demand increase 3. Price of Substitutes <ul style="list-style-type: none"> - Price of Substitute increase, demand increase 4. Price of Complements <ul style="list-style-type: none"> - Price of complements increase, demand decrease 5. Expectations of future price <ul style="list-style-type: none"> - Expect future price increase, demand increase 6. Tastes 	<p>Supply Shifters</p> <ol style="list-style-type: none"> 1. Technological Innovations <ul style="list-style-type: none"> - Lowers the cost of production 2. Input Prices (Cost of Production) <ul style="list-style-type: none"> - Input Price increase, supply decrease 3. Taxes and Subsidies 4. Expectations of future price <ul style="list-style-type: none"> - Expect future price increase, supply decrease 5. Entry or Exit of Producers <ul style="list-style-type: none"> - Entry of producers, supply increase 6. Changes in Opportunity Costs (Competitive Supply)
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Additional Notes:

- Supply has no direct effect by income and population.
- Good X and Good Y are complements if the price of Good X falls when the price of Good Y rises.
- Good X and Good Y are substitutes if the price of good X rises when the price of good Y rises.
- Increase in Demand and no change in Supply → Consumer surplus is uncertain (may increase / decrease / unchanged)
 - Depends on the shapes of demand curve
- In a free market in which equilibrium price & quantity prevails → the consumer & producer surplus are maximized
- Expectation of decrease in supply and increase in price will increase the current demand
- Increase in quantity demanded → Increase in price & Increase in quantity supplied
- Expectation on increase in supply → decrease in willingness to pay (may decrease or increase expenditure)
- Increase in cost of production → decrease in Supply (upward) and increase in price (left)
- decrease in cost of production → increase in Supply (downward) and decrease in price (right)

- **Good X and Good Y are complements if demand of X increases when demand of Y increases**
- **Good X and Good Y are substitutes if Demand of Y goes up when the price of X increases**
- **If Supply < Demand → Current price is below the equilibrium price**
- **Input availability shifts the supply curve**
- **Increase in demand never leads to a decrease in total revenue**
- **A movement along the demand curve to the right may be caused by an increase in supply.**
- **A change of the price of the good will not cause a change in demand**
- **An increase in opportunity cost (due to an increased price of other product) leads to a decrease in supply**

1. The supply of good X in any economy can be summarized by $Q_x = a + b \cdot P_x + c \cdot P_y + d \cdot INC + e \cdot POP$. In this equation, Q_x is the quantity supplied of good X, P_x is the price of good X, P_y is the price of good Y, INC is the average income of the economy, POP is the population of the economy, and a, b, c, d, e are constant coefficients. Determine whether the following statements are TRUE or FALSE for a regular supply relationship.

- (I) The coefficient b is positive.
- (II) The coefficients d and e are both zero.

A: Statement (I) is true; Statement (II) is true.

- we would assume that as the price of a good increases, the quantity supplied will increase as well; therefore the coefficient b is positive
- Income and population have no direct effect in Change of supply; therefore d and e are both zero.

2. The market for diamond rings is closely linked to the market for high-quality diamonds. If a large quantity of high-quality diamonds enters the market, then the

- a.** supply curve for diamond rings will shift right, which will create a surplus at the current price. Price will decrease, which will increase quantity demanded and decrease quantity supplied. The new market equilibrium will be at a lower price and higher quantity.
- b.** supply curve for diamond rings will shift right, which will create a shortage at the current price. Price will increase, which will decrease quantity demanded and increase quantity supplied. The new market equilibrium will be at a higher price and higher quantity.
- c.** demand curve for diamond rings will shift right, which will create a shortage at the current price. Price will increase, which will decrease quantity demanded and increase quantity supplied. The new market equilibrium will be at a higher price and higher quantity.
- d.** demand curve for diamond rings will shift right, which will create a surplus at the current price. Price will decrease, which will increase quantity demanded and decrease quantity supplied. The new market equilibrium will be at a lower price and higher quantity.

A: a. supply curve for diamond rings will shift right, which will create a surplus at the current price. Price will decrease, which will increase quantity demanded and decrease quantity supplied. The new market equilibrium will be at a lower price and higher quantity.

→ large quantity of high-quality diamonds enters the market = increase in supply
 demanded = supply curve for diamond rings will shift right
 → More supply = creation of surplus → Suppliers to decrease price to get closer to Equilibrium quantity (deduction of surplus) → increase of quantity (people who can afford increase) + less supply

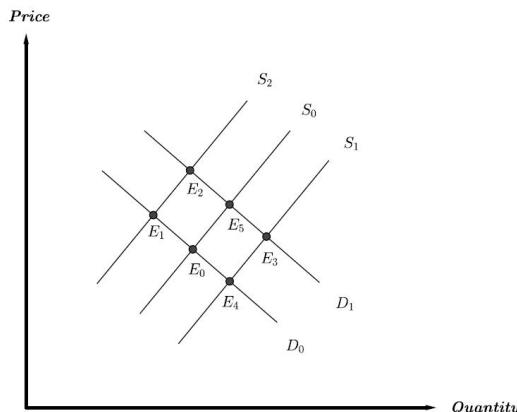
3. Suppose that a new technology substantially reduces the marginal cost of producing electric vehicles. Which of the following statements is/are INCORRECT?

- (I) This causes an increase in demand for electric vehicles.
- (II) The equilibrium price will be lowered. As a result, at equilibrium, quantity supplied is lowered than before.
- (III) The total revenue of the producers must increase.

A: all 3 statements are incorrect

→ (I): increase in quantity of demand, as price is dropped - NOT the demand; therefore false.
 → (II): Equilibrium price will be lowered, but quantity supplied will be increased; therefore false.
 → (III): If the demand is particularly inelastic, it may well happen that an increase in supply would lead to a decrease in revenues, since the percentage decrease in price will be more than the corresponding percentage increase in equilibrium quantity; therefore false.

3. Suppose farmers can only produce wheat and corn and the diagram below shows the market for whole-wheat bread in Utopia. Let E_0 denote the original equilibrium point.

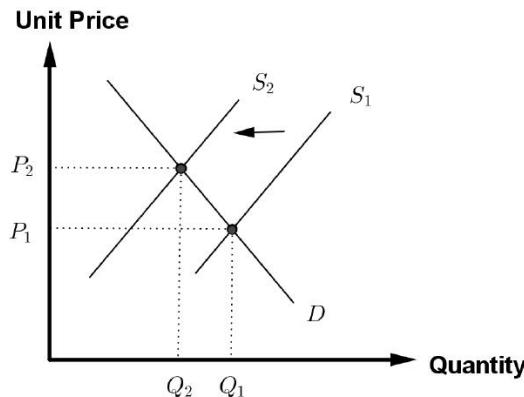


If there is an increase in the general income level and the Government decides to subsidize the production of corn in Utopia, the new equilibrium point will be

A: E₂

- Increase in income level = Increase in Demand of Wheat (curve to move upward)
- Government subsidy on corn = More profit for corn production = Decrease in Supply of wheat (curve to move left & upward)
- Increase in Demand & Decrease in Supply => equilibrium point E₂

4. Suppose the Hong Kong government imposes a toll on highway users.



The above graph shows the effect of the above toll on the market of _____ in Hong Kong.

- (I) Mass Transit Railway (MTR) services
- (II) school bus services
- (III) private motor cars

A: (II) school bus services

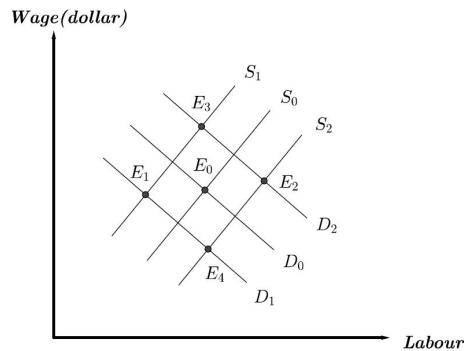
- Option (1): After there is a toll on highway users, the transport that uses the highway will become more expensive. Therefore, people will find substitutes, for example, the MTR services. In this case, the demand for MTR services will increase. As this is not a change in supply, "MTR services" cannot be a correct answer.
- Option (2): As there is a toll on highway users, the cost of production of school bus routes that pass through the highway will increase. Therefore, the supply of school bus services will in general decrease.
- Option (3): As explained above, people will tend to switch to transports that do not use the highway if a toll is charged on highway users. Therefore, the demand for private motor cars will decrease. As this is not a change in supply, "private motor cars" cannot be a correct answer.

5. The price of tea increases. At the same time, robots are developed which prove to lower the cost of production of coffee. As a result, we would expect the coffee price to _____ and the quantity of coffee to _____ in the new market equilibrium.

A: be uncertain; increase

- Price of tea (substitute) increases → More demand for coffee
- robots are developed which lower the cost of production of coffee → More supply for coffee
- More demand & more supply => uncertain in price, increase in quantity of coffee

6. The following diagram is the supply and demand curves of labour market of an economy. The initial equilibrium point is E₀.



Suppose now the economy is in recession and many firms are incurring loss. Meanwhile, the government increases the industry-specific quotas for imported workers for a few major industries in the economy. The new equilibrium point will be

A: E4

- firms are incurring loss = decrease in demand (as firms are the ones that hire the laborers)
- government to increase the industry-specific quotas for imported workers = increase in supply (more laborers wanting to be hired)

7. Corn (also known as “maize” in English English) can be used to produce bio-fuel like methane and ethanol. After a recent surge of oil (gasoline) price, we would predict that

- (I) wheat price will lower, because more farmers will grow wheat
- (II) ethanol price will rise, because gasoline and ethanol are substitutes
- (III) pork price will rise, because it costs more to raise pigs.
- (IV) corn price will lower, due to the reduction in corn consumption

A: (II) and (III)

- (II): ethanol, as a substitute of oil, will face rise in price due to a recent surge of oil price.
- (III): since more ethanol is demanded, there will be reduced supply of corn. This will lead to an increase in corn price which will also increase the cost of feeding the pork. Therefore. The pork price will rise.

7. The following equations describe the demand and supply of the market for widget A in Paradise.

$$\text{Demand : } QD = 15 + PB - 2.5PA$$

$$\text{Supply : } QS = -20 + 5PA$$

where PA and PB are the price of widget A and widget B respectively, QD and QS are quantity demanded and quantity supplied of widget A (in million) respectively. Based on the information provided, what is the relationship between the 2 widgets?

A: When the price of widget B goes up, the demand of widget A increases. Therefore, they are substitutes.

8. During lunch time, there is a long queue outside a very famous restaurant. Assume it only sells one lunch set, what can we conclude from this observation?

A: The current price is set below equilibrium price.

- Long queue implies excess demand, current price is therefore below equilibrium price.

9. Suppose the initial supply equation was $Qs = P - 2$. Now, the supply equation is changed to $Qs = P$. Which of the following is a possible cause of such change in supply?

A: An improvement in production technology.

→ Change from $Qs = P - 2$ to $Qs = P$ shows a decrease in price, which leads to increase in quantity supplied. Decrease in price must be done due to a decrease in cost of production, which is possible by an improvement in production technology.

10. Suppose the market demand is perfectly inelastic and the market supply is upward sloping, evaluate the following statements.

1. Even though there is excess supply, firms have no incentives to lower the price as that will lead to a decrease in the total revenue earned by all firms.
2. A change in market price can only be caused by a change in supply.

A: 1 is false and 2 is false.

→ Statement 1 is true only when suppliers can cooperate in price setting, but when there is competition among suppliers, they have incentives to lower the price in order to sell more units.

→ Statement 2 is false, a change in demand will also lead to price change.

11. Good X and good Y use a common input for production. As the price of X increases, we predict that in the market for Y, _____ .

A: Quantity will decrease and price will increase.

→ As price of X increases, more inputs will be allocated to the production of X. As a result, supply of Y will decrease, subsequently quantity will decrease and price will increase.

12. Demand for good A is given by $PA = 10 + 0.5PB - 2QA$. In this equation, quantity demanded of good A is denoted as QA , price of good A is denoted as PA and price of good B is denoted as PB . What can we infer about the relationship between good A and good B?

A: substitutes

→ Increase in PB leads to an increase in PA (positive changes) = A and B are substitutes

13. The table below shows the observed changes in the price of good A and the quantity demanded of good B and good C.

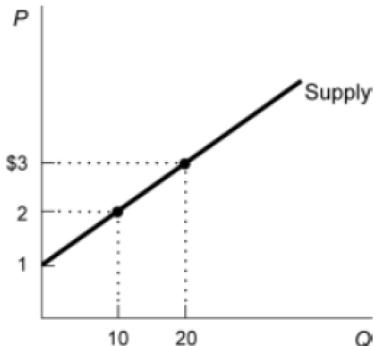
Price of A per unit	Quantity of B demanded	Quantity of C demanded
\$100	400	400
\$120	380	420

Other things being equal, the data in the table indicates that:

A: C is a substitute for A; B is a complement of A.

→ Increase in Price of A leads to a decrease of quantity demanded of B = Complement
 → Increase in Price of A leads to an increase of quantity demanded of C = Substitute

14. The graph below shows a market supply curve.



Evaluate whether the following statements are TRUE or FALSE.

- (I) The cost of producing the 20-th unit is \$3.
 (II) At the price of \$2, 10 units will be supplied to the market.

A: Statement (I) is true; Statement (II) is true.

→ (I): Vertical interpretation
 → (II): Horizontal interpretation

Chapter 5 Elasticities

Price Elasticity of Demand / Supply

→ How much quantity demanded/supplied will change in response to a change in price

$$E = \frac{\text{percentage change in quantity}}{\text{percentage change in price}}$$

→ **Elastic:** A demand / supply curve is **elastic when an increase in price changes the quantity demanded / supplied a lot**

→ **Inelastic:** A demand / supply curve is **inelastic when an increase in price changes the quantity demanded / supplied just a little**

Price Elasticity of Demand

$\eta = -\infty$	Perfectly (extremely) elastic
$-\infty < \eta < -1$	Elastic
$\eta = -1$	Unitary elastic
$-1 < \eta < 0$	Inelastic
$\eta = 0$	Perfectly (extremely) inelastic

Price elasticity of demand on a linear demand curve

y -intercept	$\eta = -\infty$	Perfectly (extremely) elastic
on the left of the mid point	$-\infty < \eta < -1$	Elastic
midpoint	$\eta = -1$	Unitary elastic
on the right of the mid point	$-1 < \eta < 0$	Inelastic
x -intercept	$\eta = 0$	Perfectly (extremely) inelastic

→ The elasticity of -0.5 tells that one percent increase in price will cause 0.5 percent decrease in quantity demanded.

→ The elasticity of -1 tells that one percent increase in price will cause one percent decrease in quantity demanded.

→ **The price elasticity of demand is always negative.**

→ **The price elasticity of demand differs across price-quantity pairs on a linear demand curve.**

→ **The price elasticity of demand for the flatter linear demand curve is more elastic than the one that is steeper.**

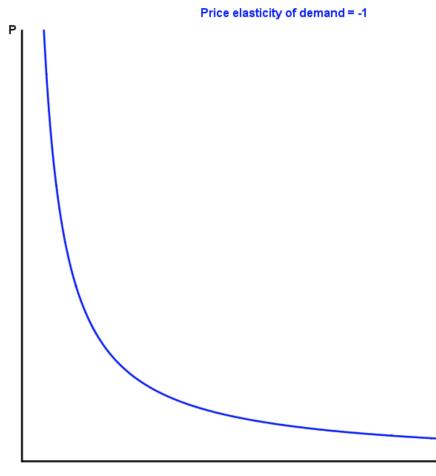
Price Elasticity of Demand and Total Expenditure

→ **The change of total revenue comes from two sources:**

- **The change of total revenue solely due to a change in price.**

- When quantity demanded is held fixed or unresponsive to the change in prices, total revenue will change by the amount of change in Price x Quantity.
 - The change of total revenue due to the change in quantity demanded
 - Quantity demanded falls as price increases
 - Total revenue falls by $P \times$ change in quantity
- When the price elasticity of demand = Elastic:
- Increase in price → relative big fall in quantity demanded
 - Hence, the change in Total Revenue will be negative
- When the price elasticity of demand = Inelastic
- Increase in price → relative small fall in quantity demanded
 - Hence, the change in Total Revenue will be positive
- The Total Revenue is maximized at the point with price elasticity of demand = -1.

Demand Curve with Constant Price Elasticity of demand



- Total revenue is equal to constant and does not change with price
 → Constant Price Elasticity of demand at -1

Price Elasticity of Supply

$\eta = \infty$	Perfectly (extremely) elastic
$1 < \eta < \infty$	Elastic
$\eta = 1$	Unitary elastic
$0 < \eta < 1$	Inelastic
$\eta = 0$	Perfectly (extremely) inelastic

Finding the elasticity using slope and point

$$\text{slope} = \frac{\Delta Y}{\Delta X} = \frac{\Delta P}{\Delta Q}$$

$$n = \left(\frac{1}{\text{slope}} \right) \left(\frac{P_0}{Q_0} \right)$$

Determinants of Elasticity of Demand

Determinant	Reason	Effect
Availability of substitutes	Difficult for consumers to switch to alternatives	More substitute, more elastic.
Time horizon	Longer time allow consumers to switch their consumptions	Longer time, more elastic
Classification of good (broad or specific)	Less specific category has less substitutes (inelastic)	More specific classification, more elastic
Nature of good (necessity or luxury)	Consumers are more sensitive to price change of luxury good	Luxury, elastic
Share of budget (purchase size)	Consumers are more sensitive when the purchase occupies much of the budget	Larger budget %, more elastic

Determinants of Elasticity of Supply

Determinant	Reason	Effect
Change in per-unit costs with increased production	The difficulty to produce additional units of product	Lower the additional cost, more elastic
Time horizon	Immediately following a price increase, producers can expand output only by using their current capacity.	Longer time, more elastic
Share for market of inputs	The price of input will be greatly altered if the producers are main players	Smaller share, more elastic
Geographic Scope (wide or narrow)	The wider the scope of the market of a good, the less elastic its supply.	Narrower scope, more elastic

Cross Price Elasticity of Demand

- Measures how sensitive the quantity of demanded of good A is to the price of good B
- **For substitutes, Cross-Price Elasticity of Demand is positive.**
 - When the price of y increases, the demand for x increases.
- **For complements, Cross-Price Elasticity of Demand is negative.**
 - When the price of y increases, the demand for x decreases.

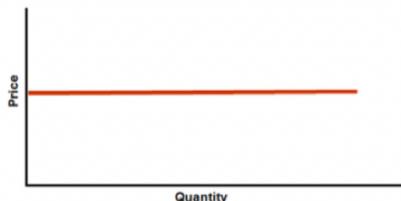
$$\frac{\% \Delta Q_{\text{demanded, } A}}{\% \Delta P_B}$$

Income Elasticity of Demand

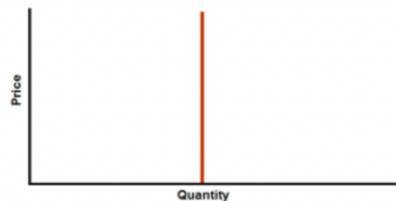
- Measures how sensitive the quantity of demanded of a good is to changes in income
- **For normal goods, Income Elasticity is positive.**
 - When income increases, demand for x increases.
- **For luxury goods, Income Elasticity is greater than one.**
 - Luxury, more elastic
- **For inferior goods, Income Elasticity is negative.**
 - When income increases, demand for x decreases.

$$\frac{\% \Delta Q_{\text{demanded}}}{\% \Delta \text{Income}}$$

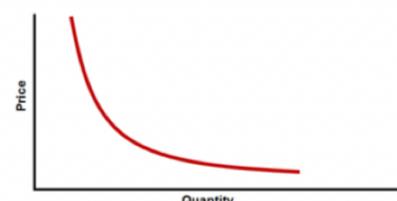
Special Cases for Elasticity



(a) Perfectly Elastic Demand



(b) Perfectly Inelastic Demand



(c) Unitary Elastic Demand

$$Ed = -\infty$$

$$Ed = 0$$

$$Ed = -1$$

Mid-point Formula

$$E_D = \frac{\frac{Q_{\text{after}} - Q_{\text{before}}}{(Q_{\text{after}} + Q_{\text{before}})/2}}{\frac{P_{\text{after}} - P_{\text{before}}}{(P_{\text{after}} + P_{\text{before}})/2}}$$

Additional Notes

- Increase in price + Increase in demand = Increase in quantity demanded
- When goods X and Y are substitutes and good X becomes less elastic, the good Y will be more price elastic (on demand).
- 2 demand curves with same slope but different size; the bigger the demand curve, the more the price elastic at a specific chosen price.
- If price is lowered & sees decrease in revenue = the company is operating at an inelastic region of demand curve
- If price is lowered & sees increase in revenue = the company is operating at an elastic region of demand curve
- In unit price elasticity of demand...
 - When the price of the good changes, the total revenue for the product does not change.
 - A percentage drop in price will lead to an equal percentage increase in quantity demanded.
 - Marginal revenue must be zero when the good is sold at the price with unit price elasticity of demand.
- A linear supply curve which is price elastic must have a positive y-intercept.
- When the supply is perfectly inelastic, a change in demand has no effect on the quantity.
- When the price elasticity of demand is constant at -1, despite any percentage of increase in supply, it will lead to the same % decrease in the price with same % increase in the quantity traded.
- For any linear supply curve with changing price elasticity along the curve, when the price is high enough, the price elasticity of supply is close to 1.
- When the supply curve is perfectly elastic, an increase in demand does not affect the equilibrium price but only increases the equilibrium quantity.
- When the demand curve is perfectly inelastic, an increase in supply does not affect the equilibrium quantity but only decreases the equilibrium price.
- linear supply curve with negative intercept has a price elasticity of supply less than 1 at any point of the supply curve.

1. In the following pairs, the supply of the first product is more price elastic than the second except for

- (I) Lemonade vs. ivory
- (II) Short-run housing supply vs. long-run housing supply
- (III) Hong Kong market for coal vs. global market for coal

A: (II) Short-run housing supply vs. long-run housing supply

- (I) Lemonade vs. ivory: Increase production of ivory is very expensive; production of lemonade can increase with little extra cost = Lemonade is more elastic.

- (II) Short-run housing supply vs. long-run housing supply: Immediately following a price increase, producers can expand output only by using their current capacity. Overtime, producers can expand their capacity = Long-run housing supply is more elastic.
- (III) Hong Kong market for coal vs. global market for coal: The wider the scope of the market of a good, the less elastic its supply. Narrower scope, more elastic = Hong Kong market for coal is more elastic.

2. Two drivers, Tom and Jerry, each drives up to a gas station. Before looking at the price, each places an order. Tom says, "I'd like 10 gallons of gas." Jerry says, "I'd like \$10 of gas." Our best guess is that Tom's price elasticity of demand is _____; Jerry's price elasticity of demand is _____.

A: 0; -1

- Tom says, "I'd like 10 gallons of gas."
- Fixed quantity demanded
 - Any price change has no effect on quantity demanded.
 - Perfectly inelastic demand
 - Tom's price elasticity of demand = 0
- Jerry says, "I'd like \$10 of gas."
- Total expenditure is fixed ($P \times Q = \text{Constant}$)
 - In other words, 1% increase (decrease) in price will lead to one percent decrease (increase) in quantity demanded.
 - Unitary elastic demand
 - Jerry's price elasticity of demand = -1

3. A decrease in the price from 55 to 45 dollars causes the quantity supplied to decrease from 105 to 95 units. The elasticity of supply (using the mid-point formula) is

A: 0.5

$$\frac{(95 - 105)/[(95 + 105)/2]}{(45 - 55)/[(45 + 55)/2]} = \frac{-10/100}{-10/50} = 0.5$$

3. The price elasticity of demand for good X is 1.2. After a decrease in supply, the equilibrium quantity drops by 30%. We expect the equilibrium price would _____ approximately by _____.

A: increase; 25%

- 30% (percentage change in quantity) / x (percentage change in price) = 1.2
- x (percentage change in price) = 30 / 1.2 = 25%
- decrease in quantity = increase in price

4. The ABC Cereal Company spends a lot of money for advertising designed to convince us that their breakfast cereal has more balanced nutrition compared to all other brands. If the ABC Company is successful, the demand for ABC cereal

A: will become less price elastic but the demand for other firms' cereal will become more price elastic.

→ **successful = people will buy same brand for nutrition purposes despite changes in price → less price elastic → substitutes to be more elastic**

5. Suppose a market has the demand function $Q = 20 - 0.5P$. Using the midpoint method, what is the price elasticity of demand between \$30 and \$40?

A: -7

$$\rightarrow Q \text{ (at \$30)} = 20 - 0.5(30) = 5$$

$$\rightarrow Q \text{ (at \$40)} = 20 - 0.5(40) = 0$$

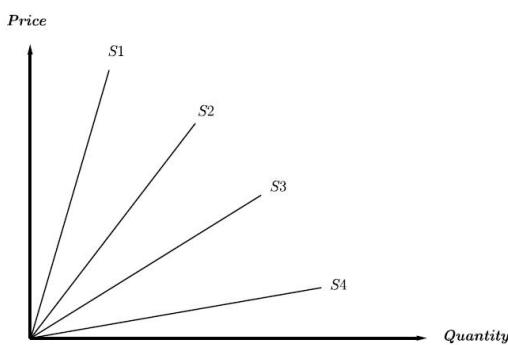
$$\rightarrow [0-5 / [(0+5)/2]] / [40-30 / [(0+5)/2]] = -7$$

6. Recently, there is an increase in the demand for paintings by Picasso and by Ah Sim. The major difference between the two artists is that Picasso is dead long time ago while Ah Sim is still alive and productive. We would expect the increase in demand for paintings by these two artists will have a _____ impact on the price of Picasso because the supply of Ah Sim's paintings is _____ than that of Picasso's.

A: bigger; more elastic

→ **increase in demand has bigger impact on price of Picasso because Picasso's painting = limited quantity = inelastic**

7. Which of following supply curve is more price elastic?



A: All four supply curves share the same elasticity.

8. The demand equation is given as $P = 20 - 2Q$. If only firm in the market wants to maximize the revenue, given the current price is set at 8, the firm should

A: raise the price.

- when $P = 8$, $8 = 20 - 2Q \rightarrow 2Q = 12 \rightarrow Q = 6$ ($P = 8$, $Q = 6$)
- slope = -2 ($P = 20 - 2Q$)
- Price Elasticity of demand (at $P = 8$, $Q = 6$) = $(1/-2) \times (8/6) = -0.67$
- In order to maximize revenue, elasticity must be -1
 - Therefore, price must be raised to reach unit elasticity (-1).

9. Suppose cheap instant noodles are inferior goods. A 2% increase in customer's income would lead to

A: a large percentage decrease in the market price when the demand is less price elastic.

→ quick prediction formula regarding the change in price when there is a change in demand/supply:

- percentage change in price = percentage change in demand / (price elasticity of supply + price elasticity of demand).
- The less price elasticity (denominator) → larger percentage change

$$\Delta P/P = \frac{\Delta D/D}{|E_D| + |E_S|}$$

10. Suppose in a market, the price elasticity of supply is constant at 2 and the price elasticity of demand is constant at -1. Following a 3% increase in supply, we expect to have _____ decrease in the price and _____ increase in the quantity traded.

A: 1% ; 1%

→ When the price elasticity of demand is constant at -1, despite any percentage of increase in supply, it will lead to 1% decrease in price and 1% increase in the quantity traded.

11. Consider a linear demand curve. Which of the following statements are correct?

- I. The price elasticity of demand always changes along the line.
- II. Every linear demand curve has a price elastic portion and a price inelastic portion.
- III. A downward sloping demand curve is price inelastic when it is steep enough.

A: None of the above statement is correct

12. As the inputs get cheaper, the equilibrium price of computers decreases by 1%, and the equilibrium quantity increases by 2%. What does this tell us about the price elasticity of demand / supply?

A: The demand is elastic

13. Utopia used to restrict import of coffee from other countries. Recently, Utopia has become a member of World Trade Organization. As a requirement of membership, Utopia has to remove its import restrictions imposed on coffee. Now, in addition to Utopian coffee, coffee around the world becomes available in the country. As a result, we would expect the price elasticity of demand for Utopian coffee in Utopia to _____, and the price elasticity of supply of Utopian coffee in Utopia to _____.

A: become more elastic; stay the same.

- More coffee available in the country = more substitute = more elastic.
- Price elasticity of supply of Utopian coffee = stay the same (no determinants)

5. Suppose in a market, the price elasticity of supply is constant at 1.7 and the price elasticity of demand is constant at -3.9. Following a 4% change in supply (parallel rightward or leftward shift), we expect to have _____ % change in the price and _____ % change in the quantity traded.

A: 0.71; 2.79

- 4% change in supply
- % change in price (denominator) = change in supply / $e_d + e_s = 4 / 5.6 = 0.71$
- % change in quantity = price elasticity of demand x % change in price = $3.9 / 0.71 =$

Chapter 6 Taxes and Subsidies

- When a \$t per unit tax is imposed on buyers, the maximum amount an individual buyer is willing to pay to the market to buy a unit is reduced by the amount of t.
- When a \$t per unit tax is imposed on sellers, the minimum amount an individual seller needs from the market to sell a unit is increased by the amount of t.
- The per unit tax imposed on buyers has an impact on all buyers, but only marginal buyers will change their decision.
- The per unit tax imposed on sellers has an impact on all sellers, but only marginal sellers will change their decision
- Who pays the tax does not depend on who writes the check to the government.

	P^s	P^d	Equil. Q	$P^s - P^*$	$P^* - P^d$
Unregulated market	10	10	500		
\$3 per unit tax imposed on buyers	9	12	400	1	2
\$3 per unit tax imposed on sellers	9	12	400	1	2

- Same reduction of equilibrium quantity & Deadweight Loss whether the tax is imposed on sellers or buyers.

	Equil. Q	CS	PS	Tax Revenue	DWL
Unregulated market	500	2500	1250	0	0
\$3 per unit tax imposed on buyers	400	1600	800	1200	150
\$3 per unit tax imposed on sellers	400	1600	800	1200	150

- For the same amount of tax per unit imposed, the more elastic the demand/supply, the more loss in quantity after tax.
 - As a result, DWL is greater when the demand/supply is more elastic.
- Finding the Q^{**} (for subsidy) = $(CS + PS + DWL) / s$
- Government expenditure = $[(CS + PS + DWL) / s] \times s$
- Tax policy = consumers to pay more & the total amount transacted to be less
- The tax burden on consumers will be smaller if the demand is relatively elastic and the supply is relatively inelastic.
- Reduction in CS and PS = Tax Revenue + Deadweight Loss
- The loss of economic surplus is also known as Deadweight Loss
- Any strictly positive subsidy results in strictly positive government expenditure.
- When the overall benefit received by consumers and producers has decreased by more than the gain to the government in tax revenue, it will result in a deadweight loss.
- Tax Revenue = change in CS + change in PS - DWL
- When the per-unit tax on a product is doubled, the tax revenue collected from this product is also doubled IF AND ONLY IF the demand is perfectly inelastic.
- Subsidies may not cause any deadweight loss, even when the government expenditure is strictly positive.

Per unit tax imposed on demand (buyers)

- Per unit tax shifts demand
 - Supply Price (P_s) = Willingness to pay to the market ($P_d - t$)
 - Find the Q^{**} (Q_s and Q_d) and P^{**} (P_s)
 - $P_d = t + P_s$
 - Find the original equilibrium point by $P_s = P_d$
 - Find the original Q and P
 - Consumer Surplus (CS) = $\frac{1}{2} \times (\text{highest } P_d - P^{**}) \times Q^{**}$
 - Tax → CS falls
 - Producer Surplus (PS) = $\frac{1}{2} \times (P^{**} - \text{lowest } P_s) \times Q^{**}$
 - Tax → PS falls
 - Tax Revenue = $t \times Q^{**}$
 - Welfare to the Society = CS + PS + Tax Revenue
 - Tax → Welfare to the Society falls (due to marginal buyers / sellers)
 - The loss is called Deadweight Loss
 - Deadweight Loss (DWL) = $\frac{1}{2} \times (P^{**} - P^*) \times (Q^* - Q^{**})$

Impact of Elasticity

- Elasticity of supply and demand affect the impact of taxes on change in equilibrium quantity, the distribution of tax burden and welfare.
- In equilibrium point, a supply curve with a flatter slope has a more elastic price elasticity of supply and vice versa.

Perfectly inelastic supply and regular downward sloping demand

- Equilibrium quantity remains unchanged
- No change in the welfare society
- Sellers receive smaller amount per unit (deduction of t)
 - Burden of tax is completely borne by the sellers (TR comes from the sellers)
- Buyers pay the same amount per unit ($P_s = P^* - t$)



Figure 6.3.5: Tax on buyers, vertical supply

Perfectly elastic supply and regular downward sloping demand

- decrease in total equilibrium quantity
- decrease in the welfare of the society
- $P_s^* = P^{**} = P^*$
- $P_d = P^* + t$
- The burden of tax is completely borne by the buyers
 - The TR completely comes from the buyers



Per unit tax imposed on supply (sellers)

- Per unit tax shifts supply
 - $P^{***} = P_d = P_{st}$
 - $Q^{***} = Q_s = Q_d$
 - Willingness to pay to consume (P^{**}) = P_s (marginal cost of production) + t (tax)
 - Find the Q^{***} and P^{***} (Equilibrium price and quantity)
 - $P_s = P^{***} - t$
 - Find the original equilibrium point by $P_s = P_d$
 - Find the original Q and P

- Consumer Surplus (CS) = $\frac{1}{2} \times (\text{highest Pd} - \text{P}^{**}) \times Q^{**}$
 - Tax → CS falls
- Producer Surplus (PS) = $\frac{1}{2} \times (\text{P}^{**} - \text{lowest Ps}) \times Q^{**}$
 - Tax → PS falls
- Tax Revenue = $t \times Q^{**}$
- Welfare to the Society = CS + PS + Tax Revenue
 - Tax → Welfare to the Society falls (due to marginal buyers / sellers)
 - The loss is called Deadweight Loss
- Deadweight Loss (DWL) = $\frac{1}{2} \times (\text{P}^{**} - \text{P}^*) \times (Q^* - Q^{**})$

Perfectly inelastic demand and regular upward sloping supply

- Equilibrium quantity remains unchanged
- No change in the welfare to the society
- burden of tax is completely borne by the buyers

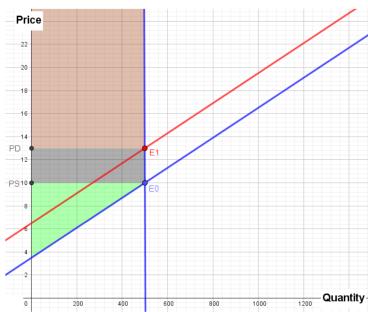
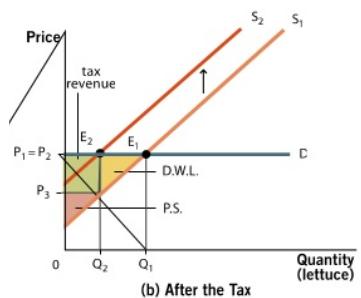


Figure 6.4.3: Tax on sellers, vertical demand

Perfectly elastic demand and regular upward sloping supply

- Equilibrium quantity decreased
- Decrease in the welfare to the society
- burden of tax is completely borne by the sellers



Wedge Approach

- Suppose that \$3 per unit tax is imposed but we are not told whom the tax was imposed.
- We know, however, that we must have $P_d - P_s = 3$ at the equilibrium Quantity.
- Wedge: $P_d - P_s = 3$
 - Ex. $P_s = 5 + 0.01Q$, $P_d = 20 - 0.02Q$, $P_d - P_s = 3$

- $20 - 0.02Q - (5 + 0.01Q) = 3 \rightarrow 12 - 0.03Q = 3$
- $0.03Q = 12 \rightarrow Q = 400$

Tax	Subsidy
Wedge $P^d - P^s = t$	Wedge $P^s - P^d = s.$

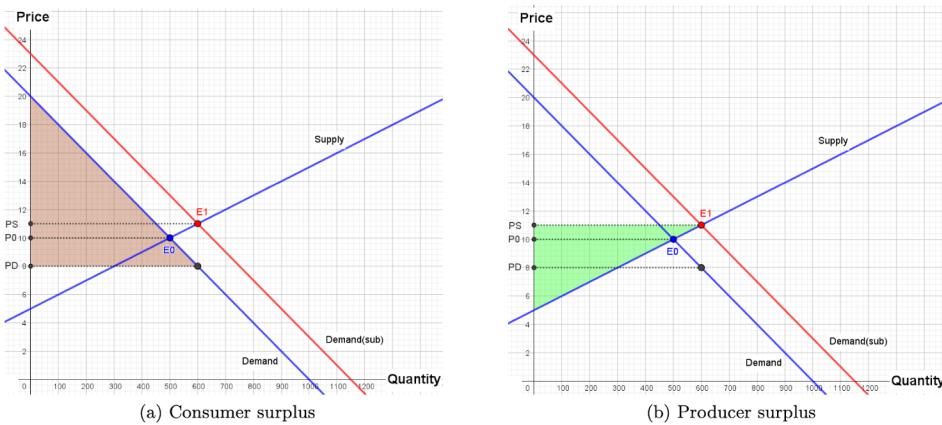


Subsidies

- Subsidy = Negative tax (apply negative t)
- When a s per unit subsidy is imposed on buyers, the minimum amount an individual seller needs from the market to sell a unit is lowered by the amount of s .
- When a s per unit subsidy is imposed on buyers, the maximum amount an individual buyer is willing to pay to the market to buy a unit is raised by the amount of s .

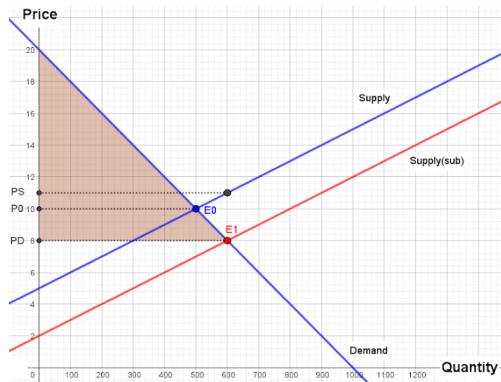
Per unit subsidy imposed on demand (buyers)

- Willingness to pay to the market (P_{ds}) = Willingness to pay to consume (P_d) + subsidy (s)
- Supply (P_s) = Willingness to pay to the market (P_{ds})
- Subsidy benefits both the buyers and sellers
 - Buyer pays a lower price per unit
 - Buyer receive a higher price per unit
- Consumer Surplus (CS) = $\frac{1}{2} \times (\text{highest } P_d^* - P^{**} - s) \times Q^{**}$
- Producer Surplus (PS) = $\frac{1}{2} \times (P^{**} - \text{lowest } P_s) \times Q^{**}$
- Subsidy Expenditure = $Q^{**} \times s$
- Welfare to the Society = CS + PS - Subsidy Expenditure
- Deadweight Loss (DWL) = $\frac{1}{2} \times (P^{**} - P^*) \times (Q^{**} - Q^*)$

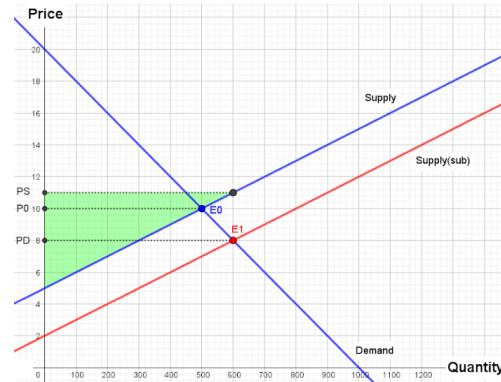


Per unit subsidy imposed on supply (sellers)

- Equilibrium price (P^{***}) = Marginal cost of production (P_s) - subsidy (s)
- $Q_s = Q_d = Q^{***}$
- Willingness to pay to consume (P_d) = Marginal cost of selling to the market (P_{ss}) = P^{***}
- Subsidy benefits both the buyers and sellers
 - Buyer pays a lower price per unit
 - Buyer receive a higher price per unit
- Consumer Surplus (CS) = $\frac{1}{2} \times (\text{highest } P_d - P^{**} - s) \times Q^{**}$
- Producer Surplus (PS) = $\frac{1}{2} \times (\text{lowest } P_s^* - P^{**}) \times Q^{**}$
- Subsidy Expenditure = $Q^{**} \times s$
- Welfare to the Society = CS + PS - Subsidy Expenditure
- Deadweight Loss (DWL) = $\frac{1}{2} \times (P^{**} - P^*) \times (Q^{**} - Q^*)$



(a) Consumer surplus



(b) Producer surplus

Figure 6.7.6: Consumer surplus and producer surplus with subsidy on sellers

1. Suppose a subsidy of \$5 per unit is provided to buyers of a good. The supply curve is a typical upward-sloping straight line and the demand curve is a typical downward-sloping straight line. The subsidy increases consumer surplus by \$10,000 and increases producer surplus by \$15,000. The deadweight loss is \$2,500. The subsidy increased the equilibrium quantity of the good from

A: 4,500 to 5,500

- finding the difference in Quantity: $2500 \times 2 / 5 = 1,000$ units
- finding the $Q^{**} = (10000 + 15000 + 2500) / 5 = 5,500$ units

2. If a government abandons the policy of giving subsidy to farm products, then the price of farm products paid by the consumers will _____ and the quantity of farm products transacted will _____.

A: increase; decrease

- price of farm paid by consumers = increase (as no subsidy is provided)

→ No subsidy = movement of supply / demand curve to make the original equilibrium point = decrease of quantity transacted

3. Suppose the market demand and supply for soda are given by the equations $Q_d = 36 - 3P$ and $Q_s = P - 2$. The government officials fear that too much soda is being consumed in the market, causing health problems of the citizens. The officials decide to impose a \$2 tax on the producers of soda. Calculate the after-tax quantity traded in the soda market.

A: 6 units

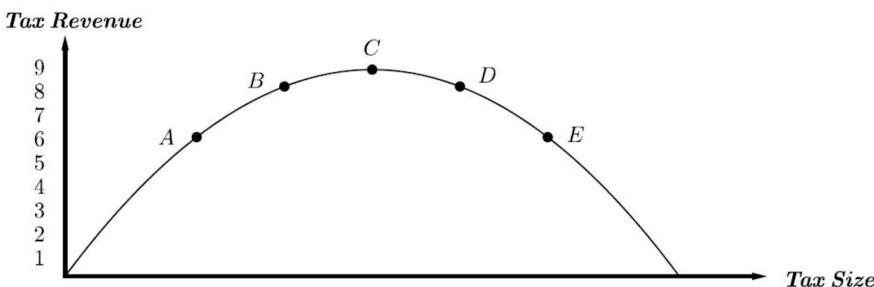
$$\rightarrow P_d = 12 - \frac{1}{3}Q$$

$$\rightarrow P_s = Q + 2$$

$$\rightarrow P^{**} = P_d = P_s + 2$$

$$\rightarrow 12 - \frac{1}{3}Q = Q + 4 \rightarrow \frac{4}{3}Q = 8 \rightarrow Q^{**} = 6$$

4. The figure represents the relationship between the size of a tax (tax rate) and the tax revenue raised by that tax



Tax revenue would

- (I) decrease if the economy began at point B and then the tax rate was decreased.
- (II) increase if the economy began at point E and then the tax rate was decreased.
- (III) decrease if the economy began at point C and then the tax rate was increased.

A: All of the above are correct.

5. Suppose both the supply and demand curves are linear. A tax of \$30 per unit is imposed on a good, and the tax causes the equilibrium quantity of the good to decrease from 500 units to 350 units. The total reduction in the consumer surplus and producer surplus equals .

A: \$12,750

$$\rightarrow \text{Reduction in CS and PS} = \text{Tax Revenue} + \text{Deadweight Loss}$$

$$\rightarrow \text{Tax revenue} = Q^{**} \times t = 350 \times 30 = 10,500$$

$$\rightarrow \text{DWL} = (Q^* - Q^{**}) \times \frac{1}{2} \times t = (500 - 350) \times \frac{1}{2} \times 30 = 2,250$$

6. Consider a market in which the demand curve is given by $P = 100 - 2Q$. The supply curve is given by $P = 20$, that is, it is horizontal. The government wants to collect some tax revenue from

this market by imposing a tax of t dollars for per unit. To maximize the total tax revenue, the government should set $t = \underline{\hspace{2cm}}$ dollars.

A: 40

→ **Total Revenue is maximized at the midpoint of equilibrium quantity (Q^{**}) & highest quantity (Q at y-intercept) demanded.**

- **Tax = $(100-20)/2 = \$40$**
- **This also means that the item must be sold \$60 (20+40) per unit, tax included in order to maximize the total tax revenue.**

7. The government wants to collect a certain amount of tax revenue by imposing commodity tax. From the perspective of efficiency, among the following suggestions, which one is the best?

- I. Tax commodities which are price elastic for both supply and demand.
- II. Tax commodities which are price inelastic for both supply and demand.
- III. Tax commodities which are price inelastic for supply and price elastic for demand.
- IV. Tax commodities which are price elastic for supply and price inelastic for demand.

A: II. Tax commodities which are price inelastic for both supply and demand.

→ **when the supply and demand are both more inelastic, the quantity decreased will be by a small amount for the increase in price.**

→ **Therefore, to achieve the same amount of tax revenue, the deadweight loss created will be minimized if the supply and demand are more inelastic.**

8. The price paid by consumers of Good X decreases by \$6 per unit after the provision of a \$10 per unit subsidy. We can conclude that in the markets, Good X has a demand or a supply.

A: less elastic; more elastic

- **If less elastic = more advantage from subsidy (2/3)**
- **If more elastic = less advantage from subsidy (1/3)**

9. The following table shows the market demand schedule and the supply schedule.

Price (dollars)	Quantity Demanded	Quantity Supplied
8	40	80
7	50	70
6	60	60
5	70	50
4	80	40

If the government provides a \$2 subsidy to the producers,

A: government expenditure equals \$140.

→ **The equilibrium point: $P^{**} = 6$, $Q^{**} = 60$**

→ \$2 subsidy = \$1 lower for buyer (\$5), \$1 higher for seller (\$7).

- The reason why subsidy is evenly distributed is because Demand and Supply Curve shows same elasticity (as the relative elasticity of supply and demand are equal)

→ At \$7, the quantity supplied increases to 70 units.

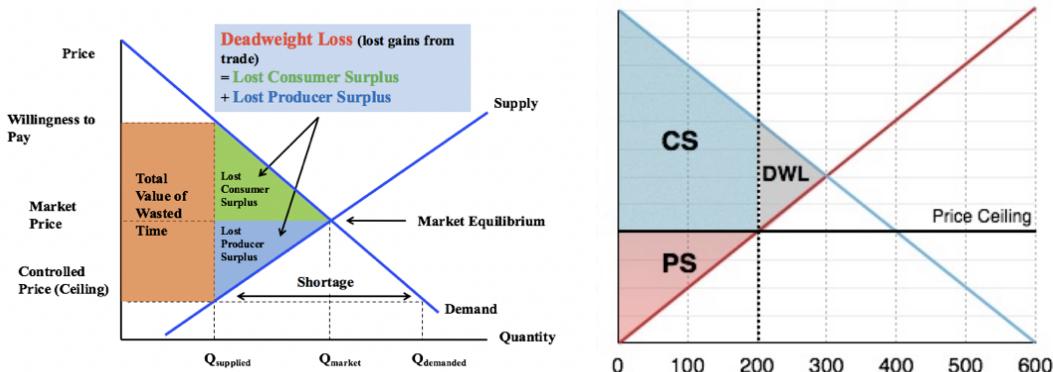
→ At \$5, the quantity demanded increases to 70 units.

→ 70 units x \$2 = \$140

Chapter 7 Price Ceilings and Floors

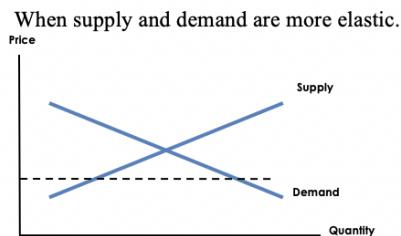
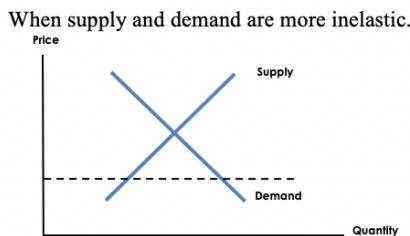
Price Ceiling (PC)

- A maximum price allowed by law
- Limit the price sellers can charge for their goods to the maximum price
- Price cannot legally go higher than the ceiling
- If Price Ceiling is set below the equilibrium price = Effective
- Example: Rent control
- Effects of price ceilings:



- Shortages ($Q_d > Q_s$)

- The difference between the quantity demanded and the quantity supplied is larger when both curves are flatter / more elastic



- The long-run supply curve is more elastic (more flexible in adjusting the plan to supply)

- Loss of Gains from Trade (creation of deadweight loss)

- Misallocation of Resources

- Price signal is distorted; no mechanism from the market to guarantee the people with the higher willingness to pay to get an allocation of goods

- Best scenario = higher CS, lower welfare loss
- Worst scenario = lower CS, higher welfare loss
- Price ceiling = in between the best & worst scenarios
 - $CS = (Q_s \text{ at PC} / Q_d \text{ at PC}) \times \frac{1}{2} \times (\text{highest demand} - \text{PC}) \times Q_d \text{ at PC}$
- Reduction in product quality
 - Response to the shortage
 - Fall in quality → More supply, lower demand → decrease in excess demand
- Wasteful Lines (when allocation is done in waiting lines)
 - Leads to a total price that is greater than the controlled price
 - Cost of consuming one unit = Ceiling price + Waiting time
 - Total waiting cost = $(P_d \text{ at PC} - P_s \text{ at PC})$
 - Additional loss of welfare (Welfare = CS + PS - waiting cost)
- Allocation by Bribery
 - Leads to a total price that is greater than the controlled price
 - Cost of consuming one unit = Ceiling price + bribe
 - A transfer of money or resources from one person to the others = NOT considered as a welfare
 - No additional loss of welfare (Welfare = CS + PS)
- Subsidy can be an alternative to price ceiling
 - Smaller welfare loss than the best scenario of price ceiling

Price Floor

→ A limit on price set by the government to prevent the market price to fall below a floor price

→ If Price Floor is set above the equilibrium price = Effective

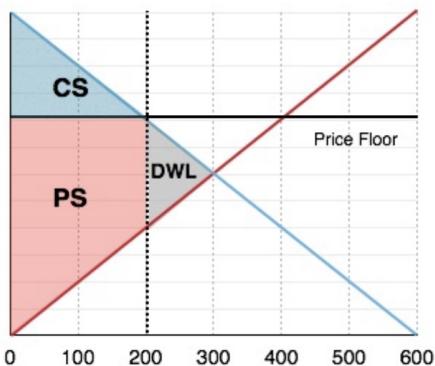
→ Example: Minimum wage

→ A binding price floor will increase the total revenue of firms in a market when demand is inelastic

→ Effective price floor increases the quantity supplied

→ an effective price floor will decrease the total revenue of firms in a market when demand is price elastic

→ Effects of price floors:



- **Surpluses ($Q_s > Q_d$)**
 - The difference between the quantity supplied and the quantity demanded is larger when both curves are flatter / more elastic
- **Loss of Gains from Trade (creation of deadweight loss)**
- **Misallocation of resources**
- **Wasteful increases in quality**
 - Response to the surplus
 - Suppliers may try to improve its product quality to attract (compete for) customers
 - increase in quality → less supply, higher demand → decrease in excess supply
- **Subsidy can be an alternative to price floor**

1. The Utopian government is not happy about the higher price of coffee than that of neighboring countries. Which of the following policies will bring down the price of coffee facing consumers in Utopia?

- (I) A price floor on coffee sold.
- (II) A subsidy on the consumption of tea, a substitute for coffee.
- (III) A subsidy on the consumption of coffee.
- (IV) A tax on the consumption of milk, a complement of coffee.

A: (II), (III) and (IV) only

- (I). Price floor = meant to protect sellers (to prevent the price falling down)**
- (II). Subsidy on the substitute → lowered price of the substitute → lowers the price of coffee**
- (III). Subsidy on coffee → lowered price of the coffee**
- (IV). tax on the complement → higher price of the complement → lowered demand of coffee → lowers the price of coffee**

2. In Farmerland tractor market, the government placed a price ceiling that is lower than the free market price in 2009. As a result, in 2009, Farmland tractor market experienced ____(1)____. The government did not lift the price ceiling until 2015. Then, in 2014, the year before the lift, ____(1)____ will be ____(2)____. (Assume that there is no change in quality of goods over time.)

A: (1): shortage of tractors; (2): larger

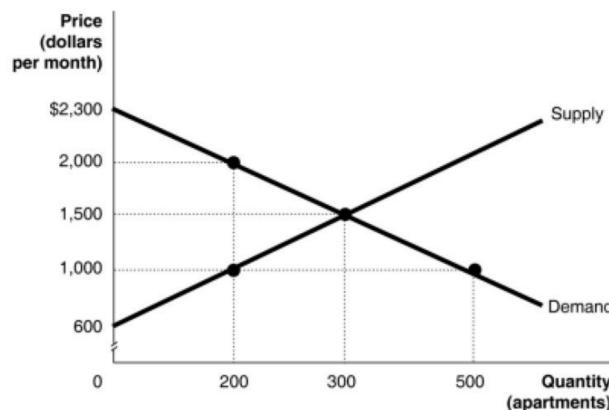
- **Effective price ceiling → shortage of the product ($Q_d > Q_s$)**
- **If the change (lifting of Price ceiling) is expected, the suppliers will produce less, and thereby increasing the shortage**

3. Suppose the supply curve of a pound of green beans is $P = 4/3 Q$. The free market equilibrium price is \$8. Government wants to impose a price ceiling at \$4. As a result of this price control, we expect producer surplus to decrease by _____.

A: 18

$$\begin{aligned}\rightarrow P &= 4/3Q \rightarrow 8 (P^*) = 4/3Q \rightarrow Q^* = 6 \\ \rightarrow P &= 4/3Q \rightarrow 4 (PC) = 4/3Q \rightarrow Q_{pc} = 3 \\ \rightarrow PS \text{ (at equilibrium)} &= 8 \times 6 \times 1/2 = \$24 \\ \rightarrow PS \text{ (at price ceiling)} &= 4 \times 3 \times 1/2 = \$6 \\ \rightarrow \$24 - \$6 &= \$18\end{aligned}$$

4. The following figure shows the market for apartments in Hoppyvalley.



The government has implemented a rent ceiling of \$2000. What is the value of the consumer surplus after the ceiling has been implemented? (Assume that the production is allocated to the lowest cost producers and the consumption is allocated to the highest valuation consumers.)

A: 120,000

$$\begin{aligned}\rightarrow \text{Rent ceiling higher than the equilibrium price} &= \text{Ineffective} = CS \& PS \text{ will not change} \\ \rightarrow CS &= (2,300 - 1,500) \times 300 \times 1/2 = 120,000\end{aligned}$$

5. The Utopian government is not happy about the high price of hamburgers. Which of the following policies will bring down the price of hamburgers facing consumers in Utopia?

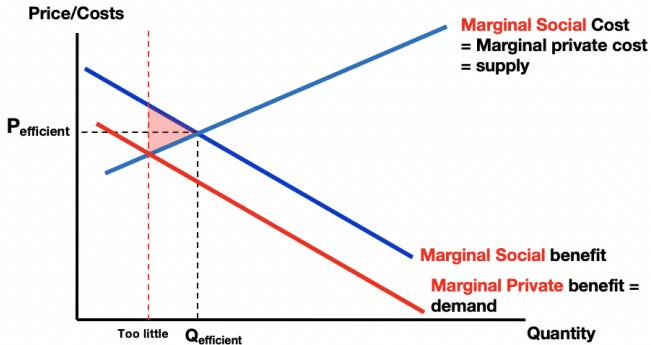
- (I) A price floor on hamburgers
- (II) A tax on the consumption of sandwiches, a substitute of hamburgers
- (III) A tax on the consumption of hamburgers
- (IV) A tax on the consumption of coca-cola, a complement of hamburgers

A: (IV) A tax on the consumption of coca-cola, a complement of hamburgers

\rightarrow Tax on the complement \rightarrow increased price \rightarrow decrease in demand \rightarrow forced to decrease price of the complement \rightarrow decrease of price of hamburgers

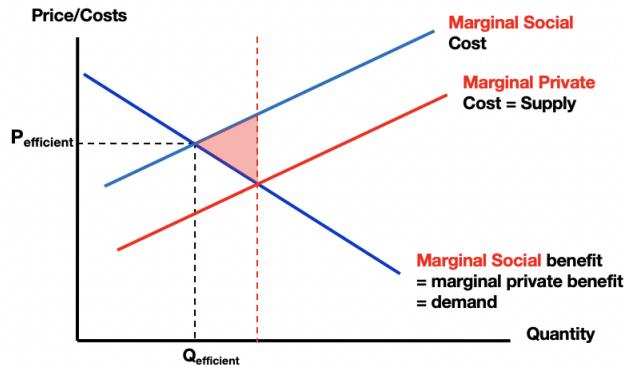
Chapter 8 Externalities and Property Rights

Positive Externalities



- When consumers and producers ignore external benefits, they base their decisions on private benefits only
- When benefits are underestimated (external benefits not taken into account), and the market quantity is lower than the socially efficient level
- The private marginal benefit curve placed lower than the social marginal benefit curve
- Positive externalities = too little activity
- socially optimal outcome = Higher equilibrium price & higher equilibrium quantity
- creation of welfare loss due to underproduction
 - $\text{DWL} = (Q_{\text{social}} - Q_{\text{private}}) \times \text{external benefit} \times \frac{1}{2}$

Negative Externalities



- When consumers and producers ignore external costs, they base their decisions on private costs only.
- When costs are underestimated (external costs not taken into account), and the market quantity is greater than the socially efficient level.
- The private marginal cost curve placed lower than the social marginal cost curve
- Negative externalities = too much activity
- socially optimal outcome = Lower equilibrium quantity & higher equilibrium price
- creation of welfare loss due to overproduction
 - $\text{DWL} = (Q_{\text{private}} - Q_{\text{social}}) \times \text{external cost} \times \frac{1}{2}$

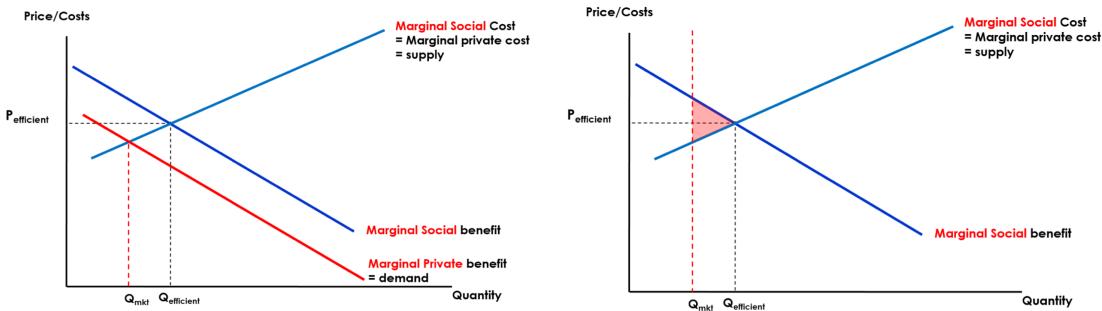
→ Social Surplus = PS + CS - External cost to the society

- External cost = $(P_{\text{private}} - P_{\text{social}}) \times Q_{\text{social}}$

Pigouvian Taxes and Subsidy

→ Positive externalities = too little activity

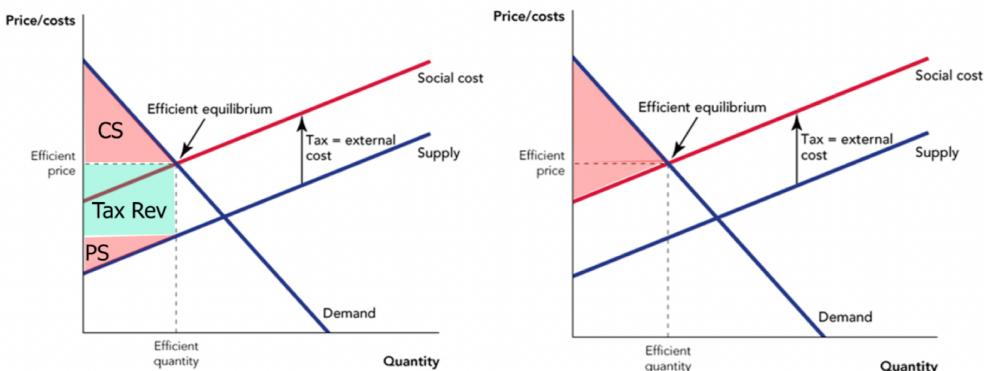
- When there is a positive externality, use a subsidy equivalent to the external benefit to help achieve the socially optimal outcome



- Impose a subsidy by the amount of marginal external benefit to encourage activity

→ Negative externalities = too much activity

- When there is a negative externality, use a tax equivalent to the external cost to help achieve the socially optimal outcome.



- Impose a tax by the amount of marginal external cost to discourage activity
- Although the tax is imposed on the producers, the tax burden is split according to the relative price elasticity of supply and demand
- Social Surplus = PS + CS

1. Suppose that the general office of Lady Ho Tung Hall provides air purifier leasing service to residents. The hourly leasing rate is HK\$15T per hour as the hall wants to punish the students who do not return the machine in time. The private marginal cost (MC) of leasing the machine (in HK\$ per hours) is given by the function

$$MC = 15T$$

where T is the total number of hours the resident lease. Olivia, a freshman who lives in room 1014 with her roommate Sirius, would love to use the air purifier for some time. Her marginal benefit (MB) function is given by

$$MB = 10 - 5T$$

Sirius, on the other hand, is not aware that Olivia tends to borrow the air purifier. She would be happy to pay HK\$10 per hour to use the air purifier in her room if informed earlier.

How many additional hours will the room 1014 pay for to use the air purifier if Sirius is informed in advance?

A: 0.5

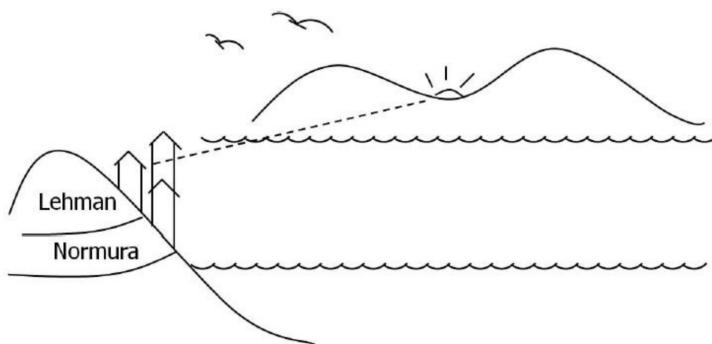
→ **Positive Externality**

$$\rightarrow \text{(socially optimum)} \quad 15T = 10 - 5T + 10 \rightarrow 15T = 20 - 5T \rightarrow T = 1$$

$$\rightarrow \text{(private)} \quad 15T = 10 - 5T \rightarrow T = 0.5$$

$$\rightarrow 1 - 0.5 = 0.5$$

2. Lehman owns a house near the peak overlooking the harbour, from which he enjoys a commanding sunset view. Now Normura purchases the property below Lehman's and is considering which of two houses to build: a one-story house that would leave Lehman's view intact; or a two-story design that would completely block Lehman's view.



Suppose the gain to Lehman from an unobstructed view is 120, the gain to Normura from having a one-story house is 220, and the gain to Normura from a two-story house is 300. It is assumed that negotiations between the two parties were costless and Normura has the right to build as tall as she can. What is the optimal private solution to the problem?

A: Normura builds a one-story house by receiving \$90 from Lehman.

→ **Benefit (two-story) - Benefit (one-story) = marginal private benefit**

→ $300 - 220 = 80 \rightarrow \text{UNLESS Normura gains more than } \$80 \text{ from Lehman, there is no reason for Normura to choose one-story}$

→ **Lehman must pay \$90 (possible since his gain from view is higher than \$90)**

3. Given that the governmental provision of education service to its citizens could lead to positive externalities, which of the following factors would determine the quantity of education service that the government should provide?

- (I) Marginal cost of education service
- (II) Consumer surplus of education service
- (III) Marginal external benefit of education service
- (IV) Elasticity of demand for education service

A: (I) and (III)

4. Consider the market of face masks. The supply and demand are summarized by the following equations.

$$\text{Demand: } P=100-0.04Q$$

$$\text{Social marginal benefit: } MSB=121-0.02Q$$

The external benefit at quantity 1616 is _____ dollars per mask.

A: 53.32

$$\rightarrow MSB(Q = 1616) = 121 - 0.02(1616) = 88.68$$

$$\rightarrow P(Q = 1616) = 100 - 0.04(1616) = 35.36$$

$$\rightarrow 88.68 - 35.36 = 53.32$$

5. Consider the market of face masks. The supply and demand are summarized by the following equations.

$$\text{Demand: } P=100-0.04Q$$

$$\text{Supply: } P=0.05+0.01Q$$

The unregulated market equilibrium quantity is 1999 masks and the equilibrium price is 20.04 dollars per mask.

While face masks provide protection of contagious disease to the persons consuming/wearing them, it also protects the persons who come into contact with us. Suppose the consumption/wearing of face masks brings to the society of an external benefit of 5.7 dollars per face mask.

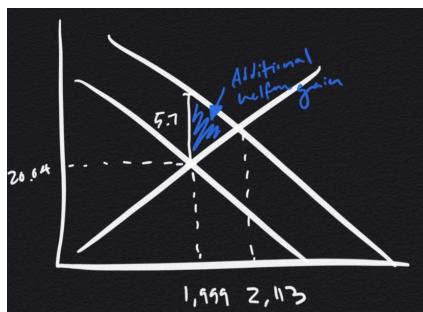
If we can achieve the socially optimal quantity using some regulatory mechanism, the welfare gain to the society (relative to the unregulated market equilibrium) is _____ dollars.

A: 324.9

$$\rightarrow 100 + 5.7 - 0.04Q = 0.05 + 0.01Q \rightarrow Q_{\text{Efficient}} = 2113$$

→ Additional welfare gain = $(Q_{\text{efficient}} - Q_{\text{private}}) \times \text{external benefit} \times \frac{1}{2}$

→ Additional welfare gain = $(2113 - 1999) \times 5.7 \times \frac{1}{2} = 324.9$



6. Consider the market of face masks. The supply and demand are summarized by the following equations.

$$\text{Demand: } P = 100 - 0.04Q$$

$$\text{Supply: } P = 0.05 + 0.01Q$$

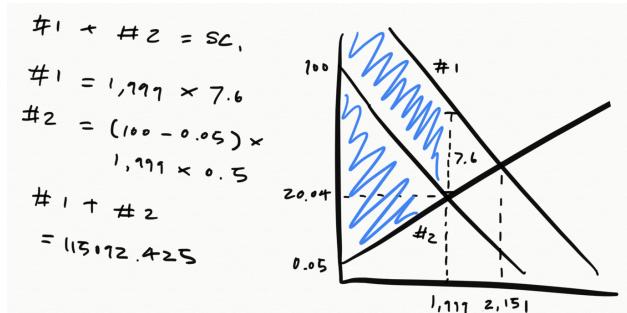
The unregulated market equilibrium quantity is 1999 masks and the equilibrium price is 20.04 dollars per mask.

While face masks provide protection of contagious disease to the persons consuming/wearing them, it also protects the persons who come into contact with us. Suppose the consumption/wearing of face masks brings to the society of an external benefit of 7.6 dollars per face mask.

The total welfare to the society at the unregulated market equilibrium is _____ dollars.

A: 115092.425

$$\rightarrow \text{Total welfare (unregulated)} = (99.95 \times 1999 \times 0.5) + (7.6 \times 1999) = 115092.425$$



Chapter 9 Public Goods and Tragedy of Commons

Classification of Goods

- Nonexcludable: A good is nonexcludable if people who don't pay cannot be easily prevented from using the good.
- Nonrival: A good is nonrival if one person's use of the good does not reduce the ability of another person to use the same good.

	Excludable	Non-excludable
Rival	Private goods	Common Resources
Non-rival	Club goods / Non-rival private goods	Public goods

- Rival & Excludable = Private Goods
 - Can be efficiently done through the market mechanism
 - Ex. Apple, jeans
- Non-Rival & Excludable = Club goods / Non-rival private goods
 - Ex. Cable TV, Wi-Fi, Netflix
- Rival & Non-excludable = Common Resources
 - Consumers cannot be excluded from consuming these goods
 - There is a strong incentive to consume these resources before others
 - The non-excludable nature causes an over-use of the resources
 - "Tragedy of commons"
 - Solution: Well-defined Property Right / Tax / Tradable Allowances
 - Ex. Tuna in the ocean, water, public roads
- Non-Rival & Non-excludable = Public goods
 - Because they are non-excludable, it is difficult to get people to pay for them voluntarily.
 - Because they are non-rival, production costs do not significantly change with additional users
 - Markets may not provide the goods efficiently
 - Provision of the goods often relies on governments
 - Ex. National Defense

→ If person decides individually how to invest (no consideration of impact of their decision on others):

- Produce until profit per product is higher or equal to the opportunity cost
- However, not socially optimal

→ Finding Socially Optimal Outcome:

- Maximization of economic benefit
- Produce until marginal benefit (MB) is higher or equal to the opportunity cost
- $MB(n) = TB(n) - TB(n-1)$

1. Each resident is willing to pay \$10 for each additional streetlight installed in the neighborhood. There are 15 residents in the neighbourhood. The cost of installing streetlights is x^2 , where x is the number of streetlights. So the marginal cost of installing another streetlight is given by $2x$. The efficient number of streetlights to be installed in this neighborhood is:

A: 75

- Marginal benefit of an additional light to the society is $(10 \times 15) = \$150$
- The marginal cost is given as $2x$
- Set marginal benefit to be equal to marginal cost ($MB = MC$) → $150 = 2x \rightarrow x = 75$ streetlights

2. A village has five residents. Each resident can choose to farm in his backyard or to fish in a nearby pond commonly owned by the villagers. The return of farming is \$14. the return of fishing depends on the weight of each fish catch, which in turn depends on the number of villagers who fish in the pond:

Number of villagers who fish	Return of fish per person
1	\$21
2	\$19
3	\$17
4	\$15
5	\$13

a) Suppose the villagers make their decision sequentially and each can observe the decision of the villagers before him. How many villagers will choose to fish?

Number of villagers who fish	Return of fish per person
1	\$21
2	\$19
3	\$17
4	\$15
5	\$13

A: 4 Villagers

- Profit at 4th villager (\$15) > Return of Farming (\$14) = Profitable
- Profit at 5th villager (\$13) < Return of Farming (\$14) = Not Profitable
- 4 Villagers will fish, 1 villager will farm
- $TB = 4 \times 15 + 1 \times 14 = \74

b) What is the socially optimal outcome for the village?

Number of villagers who fish	Return of fish per person	TB	MB
1	\$21	21	21
2	\$19	38	17
3	\$17	51	13
4	\$15	60	9
5	\$13	65	5

A: 2 Villagers

- Profit at 2th villager (\$17) > Return of Farming (\$14) = Socially optimum
- Profit at 3th villager (\$13) < Return of Farming (\$14) = Not socially optimum
- 2 Villagers will fish, 3 villagers will farm
- $TB = 2 \times 19 + 3 \times 14 = \80

3. There is a common grassland in a wealthy village. The residents of the village would like to make use of the grassland by investing in steers. The economic profit per steer depends on the number of steers which share the grassland. In particular, if n steers share the grassland, the economic profit per each of the n steers will be $10.5 - n$. Suppose there are 20 residents, each at most can send one steer to the grassland.

a) How many steers will be on the grassland in equilibrium if the residents make their decisions individually?

A: 10

- Profit per each steer = $10.5 - n$
- The villagers will expand their investment as long as $10.5 - n > 0$.
- $10.5 - n > 0 \Rightarrow n < 10.5$
- $n = 10$

b) What is the socially optimal quantity of steers, i.e., what quantity maximizes total economic profit from steers for the village?

A: 5

- Total Benefit (TB) = $n(10.5 - n)$ → $TB = 10.5n - n^2$
- Differentiation → $MB = 10.5 - 2n$
- Send additional steers as long as MB is positive
 - $10.5 - 2n > 0 \rightarrow n < 5.25$
 - $n = 5$

n	Average profit	Total profit	Marginal profit
1	9.5	9.5	9.5
2	8.5	17	7.5
3	7.5	22.5	5.5
4	6.5	26	3.5
5	5.5	27.5	1.5
6	4.5	27	-0.5
7	3.5	24.5	-2.5
8	2.5	20	-4.5
9	1.5	13.5	-6.5
10	0.5	5	-8.5

4. In the past decade, salmon have been overfished, causing the salmon population to plummet. How might the government choose to improve the overfishing situation?

- (I) Provide a subsidy to the fishermen for each ton of salmon they catch.
- (II) Issue fishing licenses and require fishermen to hold one in order to fish salmon.
- (III) Puts a quota on the number of salmon that can be caught per year.
- (IV) Impose a sales tax on salmon.
- (V) Rely on the invisible hand.

A: II, III, IV

- I. Providing a subsidy will increase the number of salmons fished, for there is an incentive.
- II. Issuing licenses will be costly, therefore will decrease the number of fishermen fishing salmon
- III. Quota on the number of Salmon puts a limit to fishing, therefore preventing the overfishing.
- IV. Sales tax on Salmon will be able to limit the fishing as there is external cost involved from tax.

5. Which of the following is a list of public goods only?

- (I) a public beach, soup kitchen meals, public roads
- (II) online video games, a public beach, national defense, a lighthouse
- (III) a public beach, a lighthouse, toll highways, public roads
- (IV) national defense, a lighthouse, smog reduction

A: IV

6. The O'Reilly Factor is a popular cable television news show. To watch the show requires a paid subscription. Therefore, which of the following is TRUE?

Select one:

- a. This show is a public good because payers and nonpayers alike are watching a rival show.
- b. This show is a nonrival private good because 1) nonpayers can be excluded and 2) when one person watches it does not diminish another person's ability to watch.
- c. This show is a common good because 1) nonpayers can be excluded and 2) when one person watches it does not diminish another person's ability to watch.
- d. This show is a public good because 1) no one can be excluded and 2) when one person watches it does not diminish another person's ability to watch.

A: b. This show is a nonrival private good because 1) nonpayers can be excluded and 2) when one person watches it does not diminish another person's ability to watch.

Chapter 10 Perfectly Competitive Supply: The cost side of the market

Competitive Market

- Market in which no individual supplier has significant influence on the market price of the product
- Characteristics:
 - Everyone is price taker (no one has the power to control over price)
 - The product is similar across sellers (Homogeneous product)
- The perfectly competitive firm's supply curve is its marginal cost curve
- Market supply curves typically have similar upward sloping shape
 - The Low-hanging Fruit Principle
 - Differences among suppliers in opportunity cost

Production

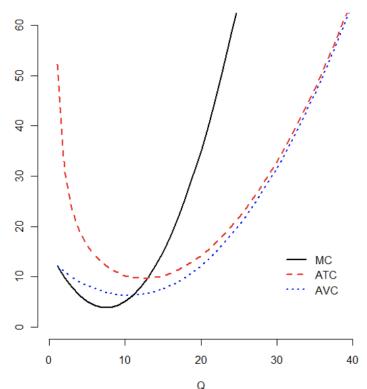
- Fixed factor of production: an input whose quantity cannot be altered in the short run
 - Usually termed Capital
 - Ex. lease of machines, land, building
- Variable factor of production: an input whose quantity can be altered in the short run
 - Usually termed Labor
 - Ex. workers' wages
- In short run, at least one factor of production is fixed in quantity and cannot be adjusted
- In long run, all factors of production can be adjusted

Economic vs. Accounting Profit

- Two types of costs:
 - Explicit cost: Cost that requires a money outlay.
 - Implicit cost: Cost that does not require an outlay of money
- Two types of profit:
 - Economic Profit: Total revenue minus total costs including implicit costs
 - Accounting Profit: Total revenue minus explicit costs

Costs

- Short Run
 - Total Cost = Fixed cost (FC) + Variable cost (VC)
 - Average Total Cost = Average Fixed Cost (AFC) + Average Variable Cost (AVC)
 - $MC = \frac{\text{change in VC}}{\text{change in Q}}$
 - FC does not vary with output the firm produces (sunk cost in output decision)
 - The FC affects the profit but not the optimal output



- The MC curve passes through the minimum point of the ATC and the AVC curves
- The curves of ATC and AVC converges as Q increases
 - The difference of ATC and AVC = Average Fixed Costs (AFC)
 - AFC = FC/Q gets lower as Q increases
- A competitive firm's short-run supply curve is the section of the marginal cost curve that is above the average variable cost.

→ Long Run

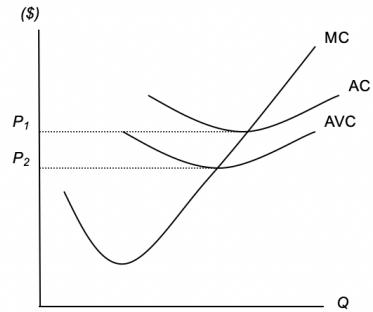
- The firm can adjust the factor input they employed
 - there is no fixed cost & every cost is variable
- MC = change in TC / change in Q
- Profit and loss = condition that determines whether a firm will produce
- Entry and exit decisions are only made in the Long Run
- Long Run Equilibrium quantity → $MC(q) = AC(q)$
 - Find equilibrium price by: P at $MC(q^*)$

Profit Maximization

- Total Revenue (TR) = Price (P) x Quantity (Q)
- Marginal Revenue (MR) = change in TR / change in Q
- The firm maximizes its profit when it produces at a quantity where:
 - $P = MR(Q) = MC(Q)$

The Short-run Shutdown Condition

- Firms will produce only if P is greater or equal to AVC
- If P is lower than the AVC at all levels of output = Shutdown
- As long as the revenue from selling the output generated exceeds the variable cost of producing it, the excess (TR - TVC) can be used to cover part of its fixed cost
 - If at zero quantity: $P/L = -FC$
 - If produced: $P/L = Q(P - AVC) - FC$
- At prices below P_1 and P_2 , the firm is covering all of its variable costs but only some of its fixed costs. In the short run it will still keep producing.
- If the price falls below P_2 then the firm is not covering its variable costs and it is better to shut down.

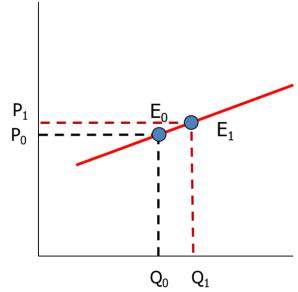


Long-run industry supply curve

- In the long run, there will be no incentive for firms to enter and exit from a market
- Entry and exit decisions = driven by profit
- In competitive markets a firm will be:
 - profitable when $P > AC$ = enter industries
 - Unprofitable when $P < AC$ = exit industries
 - At $P = AC$ → profit = 0 → no entry or exit
- Competitive firms can still earn positive accounting profits in the long run

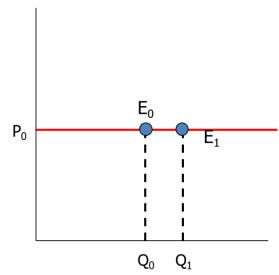
→ **Increasing cost industry**

- Upward sloping long-run industry supply curve
- Industry in which costs increase with greater output
- The entry of new firm will have impact on the cost curves
- Increasing demand → more production → positive profit → attract firms to enter the market → firms enter the market → market supply shifts right + AC and MC curves shift up (higher minimum point) → zero profit in long run



→ **Constant cost industry**

- Industry in which costs do not change with greater output
- Horizontal long-run industry supply curve
- Increasing demand → more production → positive profit → attract firms to enter the market → firms enter the market → market supply shifts right → zero profit in long run
 - No change in the cost curves and price, but change in quantity



→ **Decreasing cost industry**

- Industry in which costs decrease with greater output
- Downward sloping long-run industry supply curve

1. Assume that the two firms A and B are in two isolated markets. The total cost functions of both firms are shown below:

Firm A's total costs = \$(150 + 5Q)

Firm B's total costs = \$(100 + 5Q)

where Q is the quantity produced.

Suppose that both firms face the same demand function, that they are both pursuing a profit maximization policy, and that both firms are earning positive economic profits. Compared with firm A, firm B produce _____, and have _____ profits and _____ producer surplus.

A: the same quantity; higher; the same size of

- same slope = same VC in respect to change in quantity = production of same quantity
- lower FC with same VC = higher profit
- same VC = same quantity = same producer surplus

2. Suppose firm A has a fixed cost of \$350 per day and the daily wage of hiring a worker is \$500. The table below shows the output firm A can produce when different number of workers are hired per day.

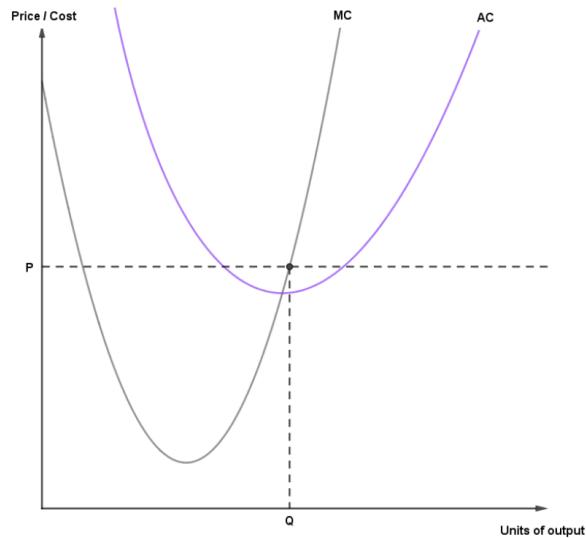
Workers per day	Output per day
0	0
1	150
2	400
3	600
4	700
5	780

How many workers should firm A hire if the price of each unit of output is \$4?

A: 3 workers

Workers per day	Output per day	Marginal benefit	Marginal cost
0	0	0	0
1	150	600	500
2	400	1000	500
3	600	800	500
4	700	400	500
5	780	320	500

3. The following shows the cost schedules of a competitive firm in a constant-cost industry and the prevailing price in the short run.



We expect, in the long run,

- (I) the marginal cost curve to shift down.
- (II) the average cost curve to shift up.
- (III) the prevailing price to decrease.
- (IV) the production of individual firm to increase.

A: (III) only

→ **In the constant cost industry, the prevailing price will decrease, as more firms enter the market & market supply shifts right. This will bring back the price to the P at the minimum point of AC.**

4. The following shows the marginal cost schedule of a competitive firm. Suppose the firm has a fixed cost of \$2 and the prevailing market price is \$4.

Output	MC
1	10
2	8
3	3
4	4
5	6

The firm should produce _____ units of output and the corresponding average variable cost will be \$_____.

A: 0; 0

→ For all 5 outputs, the AVC will be greater than the market price; therefore shutdown is the best option.

5. The following shows the average cost schedule of a competitive firm.

Output	AC
1	4
2	3
3	3
4	3.5
5	4.2

If the market price is \$5, profits of the firm will be:

A: \$6

Output	AC	TC	MC	MR	TR
1	4	4	4	5	5
2	3	6	2	5	10
3	3	9	3	5	15
4	3.5	14	5	5	20
5	4.2	21	7	5	25

$$\rightarrow P = TR(4) - TC(4)$$

$$\rightarrow P = 20 - 14 = \$6$$

6. A firm faces the following demand and total cost schedules, with all quantities listed on a per-month basis. Suppose that it is required to produce a whole number of items each month, i.e. Q is an integer. What is the price charged by the firm?

Demand	
P(\$)	Q
20	1
18	2
16	3
14	4
12	5

Total Cost	
Q	TC(\$)
1	2
2	6
3	14
4	18
5	24

A: \$14

P	Q	TC	TR	MR	MC
20	1	2	20	20	2
18	2	6	36	16	4
16	3	14	48	12	8
14	4	18	56	8	4
12	5	24	60	4	6

7. A competitive market has an unlimited number of potential suppliers producing the same output. Each supplier has an average cost function of $AC = q^2 - 4q + 6$ and a marginal cost function of $MC = 3q^2 - 8q + 6$. What is the long-run equilibrium price?

A: \$2

$$\rightarrow MC(q) = AC(q)$$

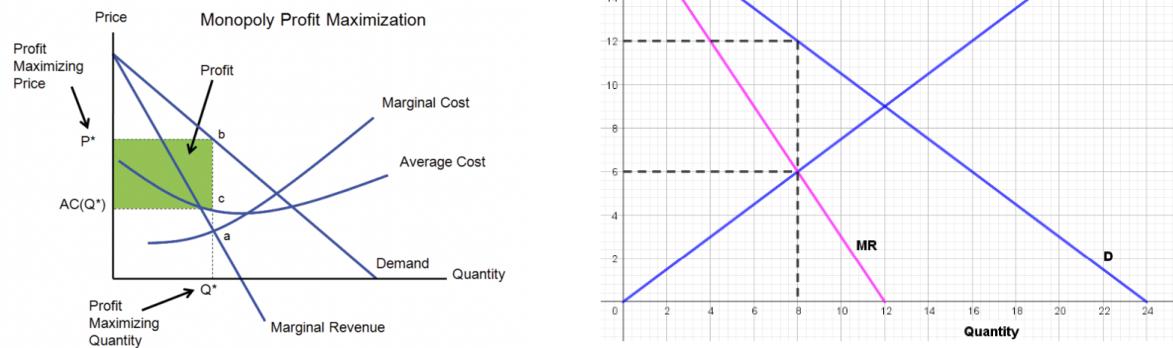
$$\rightarrow 3q^2 - 8q + 6 = q^2 - 4q + 6$$

$$\rightarrow q = 2$$

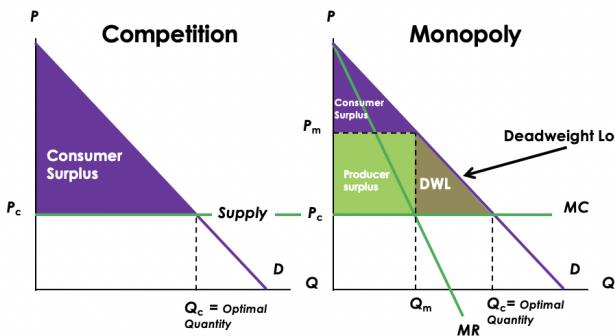
$$\rightarrow P = MC(2) = 3(2)^2 - 8(2) + 6 = \$2$$

Chapter 11 Monopoly

- Monopoly is a market with a single seller
- Monopoly firm faces a downward sloping market demand curve ($P(Q) = a - bQ$)
- Marginal curve = $MR(Q) = a - 2bQ$
 - times 2 in bQ
 - Ex. $P = 2.5 - 0.5Q \rightarrow P = 2.5 - Q$
- $TR(Q) = P(Q) \times Q$
- Optimal output → $MR(Q) = MC(Q)$
- Profit = $(P-AC)*Q$



- Markup
 - Monopolist will charge a price higher than the marginal cost
 - Markup = $-1 / (1 + e)$ (e = elasticity of demand)
 - Monopoly facing relatively more inelastic demand curve is more likely to charge a higher price
 - Monopoly facing relatively more elastic demand curve is more likely to charge a lower price
 - Markup has become a major measure of monopoly power
 - Monopoly will not produce at the quantity with inelastic price elasticity of demand
 - In fact, in a linear demand curve, the output choice can only happen in the elastic region of the demand curve
- Supply curve of Monopoly
 - If Q^* is chosen by the monopoly, we must have $MR = MC$ at Q^*
 - For monopoly there is no stable price and quantity relationship which we call a supply curve



→ Social inefficiency of monopoly

- What is optimal for the firm does not need to be optimal or efficient for the society
- Creation of deadweight loss, for monopoly chooses to produce a smaller quantity than the social efficient quantity (Q where $MR = MC$)

→ Regulating the monopoly

- Price ceiling
 - Opposite from perfectly competitive market
 - Lowers the quantity transacted because the incentive to produce is reduced
 - Straight line meeting demand curve ($P = d$)
 - Increase of quantity
 - Decrease of deadweight loss (due to reduced underproduction)
 - Effective if price ceiling has to be lower than the price without regulation
- Subsidy
 - Demand will increase, hence the marginal revenue with subsidy will increase

→ Sources of monopoly

- Exclusive control over important inputs
- Economies of Scale (Natural monopoly)
 - For some goods, the average cost of production declines as the number of units produced increases
 - The market may be dominated by a single firm
 - The firm that produces slightly higher output has a bigger cost advantage (lower average cost of production)
- Patents
 - Exclusive right granted by a country / region to an inventor for a limited period of time
 - Protection of intellectual property right → gives monopoly status = invention is encouraged
 - R&D cost can be covered by profits under monopoly status
- Government licenses or franchises
 - Government can operate some business or even grant exclusive privilege to a private individual or firm to be the sole provider of a good or service
 - Potential competitors are excluded from the market by law, regulation, or government enforcement
- Network Economies
 - Effect that one user of a good or service has on the value of that product to other people
- Trade Liberalization
 - The monopoly would like to see a trade liberalization if the world price is higher than the domestic price without trade

1. If the demand, fixed cost and marginal cost of a good are as follows:

Demand : $P = 100 - 5Q$

Fixed cost = 100

Marginal cost = 20

What is the markup for the above good if there is only 1 producer?

A: 200%

$$\rightarrow MR = a - bQ \rightarrow MR = 100 - 10Q$$

$$\rightarrow 100 - 10Q = 20 \rightarrow Q = 8$$

$$\rightarrow P = 100 - 5(8) \rightarrow P = 60$$

$$\rightarrow \text{elasticity (e)} = (1/\text{slope})(P/Q) = (1/-5)(60/8) = -1.5$$

$$\rightarrow \text{markup} = -1/(1+e) = -1/(1-1.5) = 2 (200\%)$$

2. Refer to the information below, if the monopolist is required to pay 10-dollar tax per unit sold, what is the total surplus for the market?

Demand : $P = 100 - 10Q$

Marginal cost = 10

A: 280.00

$$\rightarrow TS = PS + CS + \text{Tax Revenue}$$

$$\rightarrow \text{Due to unit-tax, new MR is set; } MC = 10 + 10 \rightarrow MC = 20$$

$$\rightarrow MR = 100 - 20Q$$

$$\rightarrow MR = MC \rightarrow 20 = 100 - 20Q \rightarrow Q^* = 4$$

$$\rightarrow P^* = 100 - 10(4) \rightarrow P^* = 60$$

$$\rightarrow TS = 40 \times 4 (\text{PS}) + 40 \times 4 \times 0.5 (\text{CS}) + 4 \times 10 (\text{TR}) = 280$$

3. If market demand is $P = 2000 - 40Q$ and a monopolist has a constant marginal cost of \$400 , then the deadweight loss resulting from monopoly is:

A: 8,000

$$\rightarrow MR = 2000 - 80Q$$

$$\rightarrow 2000 - 80Q = 20 \rightarrow Q^* = 20$$

$$\rightarrow P^* = 2000 - 40(20) \rightarrow P^* = 1,200$$

$$\rightarrow Q(\text{social}) = 2000 - 40Q = 20 \rightarrow Q(\text{social}) = 40$$

$$\rightarrow DWL = (40-20) \times (1200-400) \times \frac{1}{2} = 8,000$$

4. A monopolist has a marginal cost curve given by $MC(Q)=3Q$ and faces a demand curve given by $P=180-3Q$. What's the profit-maximizing output and price for the monopolist?

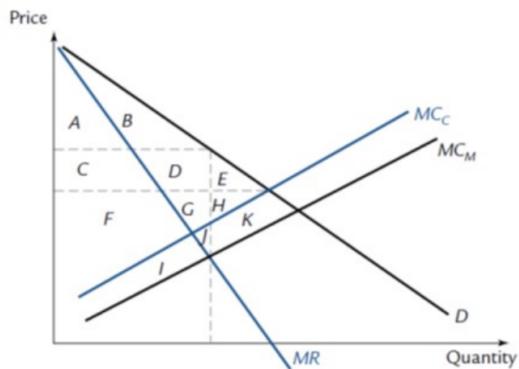
A: $Q = 20, P = 120$

$$\rightarrow MR = 180 - 6Q$$

$$\rightarrow 180 - 6Q = 3Q \rightarrow Q^* = 20$$

$$\rightarrow P^* = 180 - 3(20) \rightarrow P^* = 120$$

5. The following diagram shows the market demand for widgets and the associated marginal revenue curve. When the industry is monopolized, the marginal cost curve is MC_M . When the industry is competitive, the industry's marginal cost curve is MC_C . Suppose the industry is currently monopolized and you are a judge with the power to break up the monopoly into several competing firms. In order to exercise that power to improve economic efficiency, which four of the labelled areas would you want to measure?



A: I, J, E and H

	Consumer Surplus	Producer Surplus
Monopoly	A,B	C,D,F,G,I,J
Competitive	A,B,C,D,E	F,G,H

→ The total surplus under monopoly would be higher than the competitive solution when $(I+J) > (E+H)$

6. A monopolist has a constant marginal cost of production, and a total revenue function given by the following table.

Price (\$)	Total Revenue (\$)
18	36
17	51
16	64
15	75
14	84
13	91

It finally chooses a price of \$15. Evaluate whether the following statements are TRUE or FALSE.

(I) The marginal cost might have been \$8.5.

(II) The marginal cost might have been \$10.5.

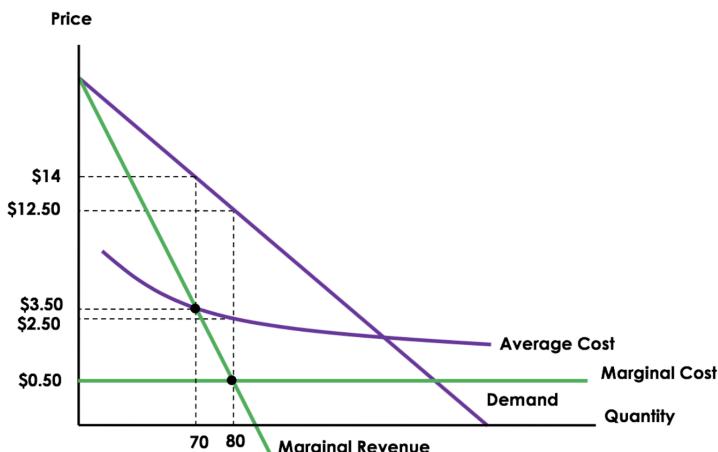
A: Statement (I) is false; statement (II) is true.

$$\rightarrow MR \text{ at } \$15 = 75 - 64 = 11$$

$$\rightarrow MR \text{ at } \$14 = 84 - 75 = 9$$

→ \$8.5 is acceptable for \$14, \$10.5 is not.

7. A monopolist faces a profit-maximizing problem given by the following graph. What's the monopolist's maximized profit?



A: \$800

- $P = (MC(Q^*) - AC(Q^*) \times Q^*$
- Q^* = optimum output (Q when $MC = MR$)
- $P = (12.50 - 2.50) \times 80 = 800$

Chapter 12 Price Discrimination

- Treating the two cities as two separate markets (and charging two different prices) yield a higher profit than treating as one market (and charging a single and common price)
- Arbitrage = buy-low-sell-high activity
 - Buying the good for profit from the low-price city will cause the price in the low-price city to rise
 - Selling the good for profit in the high-price city will cause the price in the high-city to fall
 - Consequently, the price of the two cities are forced to be the same = the monopolist cannot charge two different prices in the two cities
- The ability for the monopolist to charge different prices across cities depend on the transport cost for the consumers
 - A monopolist can treat the two cities as two separate markets only if the transport cost is higher than the prices set by the monopolist in these two markets
- Perfect price discrimination
 - The ability of the firm to charge customers their reservation price
 - For a perfectly discriminating monopolist, there is no efficiency loss
 - All buyers are served who are willing to pay a price high enough to cover marginal cost.
 - Zero consumer surplus, higher total economic surplus, higher total profit
 - Zero deadweight loss

- Marginal Revenue equals demand curve ($MR = d$)
 - Maximum social surplus (but all the surplus coming from producers)
- Using total economic surplus as welfare measure, allowing monopoly to price discriminate yields a more socially efficient outcome
- It is more profitable to set different prices in markets with different demand curves than a single price that covers all markets.
- To maximize profit = the firm should set a higher price in markets with more inelastic demand.
- Hurdle method
- Separate the market into submarkets so that the monopolist can charge consumers in different sub-market with different prices.
 - Ex. Discount coupon, Temporary sales
- Grouping products to increase profits
- Involve more than one product in carrying out the price discrimination (separating customers into groups)
 - Tying
 - Involves two goods produced by the monopoly: the base good and variable good
 - They are tied together because consumers are really interested in the services or goods generated by combining two goods
 - Firms can effectively price discriminate the users by pricing the base good below cost and the variable good above cost
 - Ex. printer and ink
 - Bundling
 - Selling more than one product as a bundle or as a package
 - Firms use bundling when they have more information on the demand for the bundle than for individual parts
 - Advantage of preventing arbitrage
 - Ex. software