CB2400 Microeconomics

1. Fundamental Economic Issues

- **Economics**: the study of how human beings allocate scarce resources to satisfy their unlimited wants.
- **Microeconomics**: the study of how households (consumers) and firms (producers) make decisions and how they interact in **markets**.
- **Macroeconomics**: the study of the economy as a whole, including topics such as inflation, unemployment, and economic growth.

Choice, Opportunity Cost, and Sunk Cost

- **Scarcity**: the quantity of resources is insufficient to satisfy all human wants.
- **Choice**: the act of choosing among alternatives. Scarcity forces us to make choices.
- **Opportunity cost**: the benefit of the best alternative foregone (not chosen).
- **Sunk cost**: a cost that has already been incurred and cannot be recovered.

Example: You paid $10 to see a movie, but you don't like it.

- Choices are: stay or leave. Leave is the best choice. However, you cannot see the unwatched part (= benefit of stay = benefit of best alternative foregone), which is the opportunity cost.
- The $10 is a sunk cost.

Production Possibilities Curve (PPC)

PPC is a C-K curve.

C = Consumption goods & services (e.g. food, clothing, entertainment, etc.)

K = Capital goods & services (e.g. factories, machines, roads, etc.)

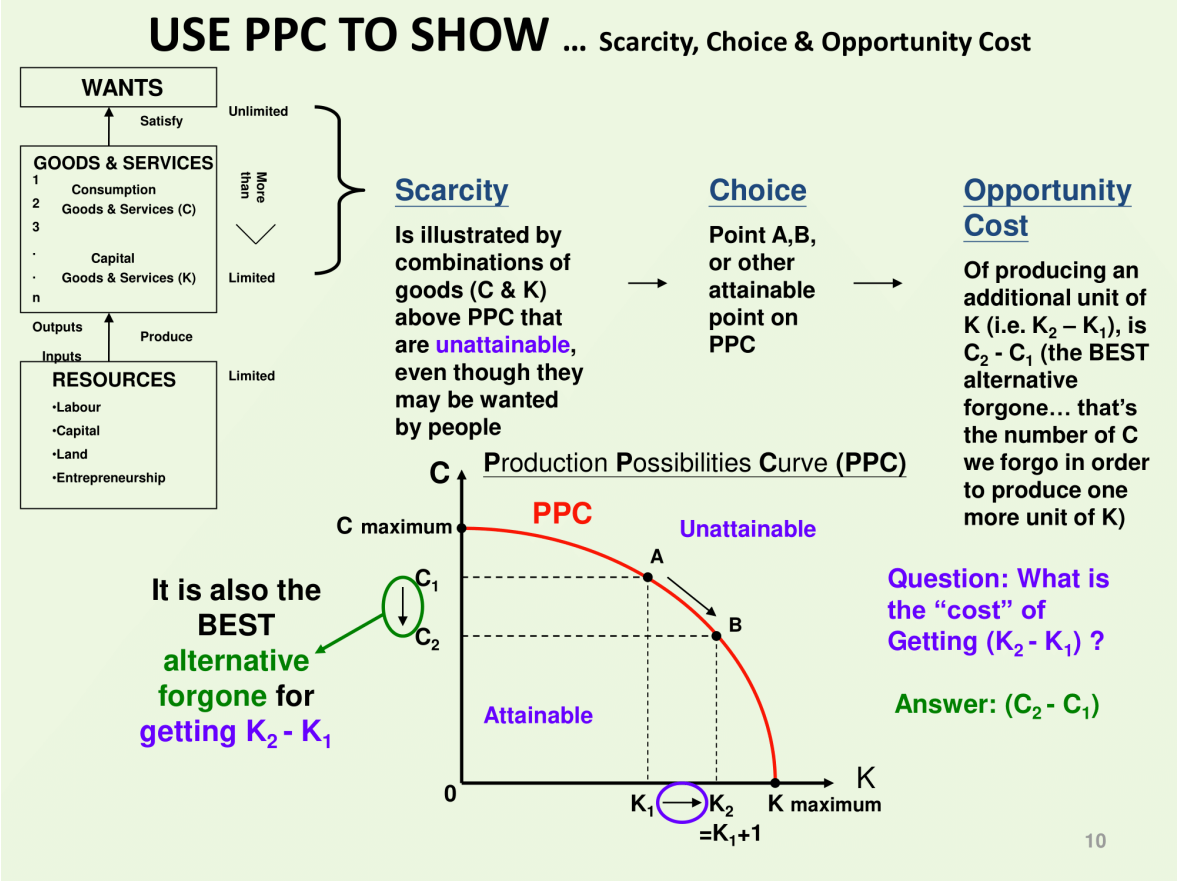
PPC depicts **all maximum combinations of C and K that can be produced with given resources and technology**.

- Points on the curve: efficient
- Points outside the curve: unattainable
- Points inside the curve: inefficient

Slope of PPC: $k = \frac{\Delta K}{\Delta C}$

The opportunity cost of producing one more unit of K is $\frac{\Delta C}{\Delta K} = k^{-1}$.

PPC is concave to the origin because of **increasing opportunity cost**. It grows steeply as we move from left to right.



Shifts in PPC

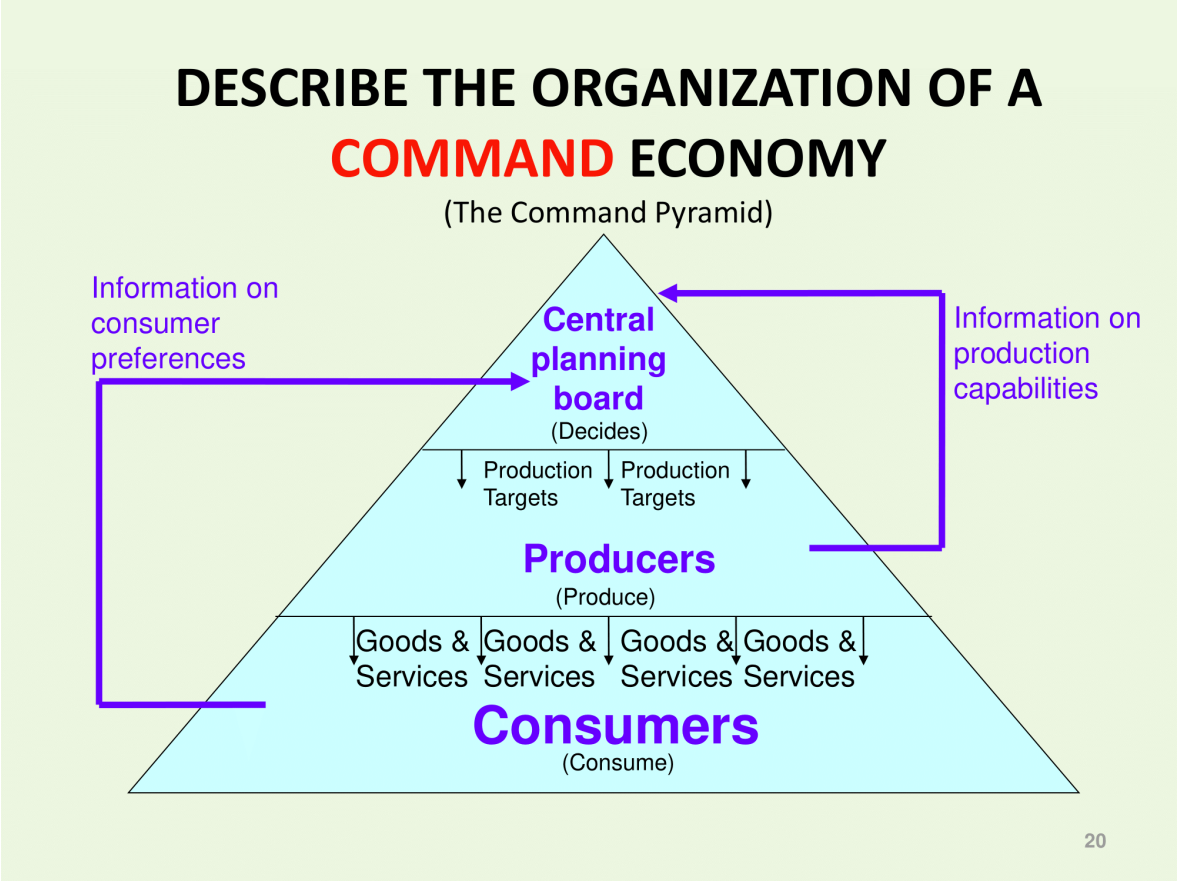
1. **Technology progress**: PPC shifts outward (↗️).
2. **Input increase**: PPC shifts outward (↗️).

Economic System

- **Economic system**: a set of institutions and mechanisms that resolve the what, how, and for whom questions.
  - **What** goods and services are produced?
  - **How** to combine inputs to produce output?
  - **For whom** to produce?
- **Market economy**: an economy in which individual consumers and producers coordinate production and consumption decisions through market.
- **Command economy**: an economy in which the Central Planning Authority (CPA) determines the allocation of resources.

Today, most countries are mixed economies.

Command economy - The Command Pyramid:



Market economy:

- **Goods and services market**: Firms sell goods and services to households.
- **Factor market**: Households sell factors of production to firms.
- Resources = Factors = Labor + Capital + Land + Entrepreneurship

2. Demand and Supply

Demand

Demand: the maximum quantity of a good (or service) that consumers are willing and able to purchase at various prices

Demand function: $Q_d = f(P_X, Y_2, Y_3, \cdots)$

- Q_d: quantity demanded
- P_X: price of the good
- Y: other factors

Demand curve is a relationship between quantity demanded Q_d of a good and its price P_X, with **Ceseteris Paribus** assumption (= **all other factors being constant**).

Law of Demand: if the price of a good rises, the quantity demanded of the good falls, and vice versa. (i.e. Demand curve is **downward-sloping**)

- This can be explained by the **substitution effect** and the **income effect**.

Demand Determinants

(1) **Price of related goods**

- When the price of a **substitue** good Y rises, the demand for good X rises (shifts right).
- When the price of a **complement** good Y rises, the demand for good X falls (shifts left).

(2) **Income**

- For a **normal** good X, when income rises, the demand for good X rises (shifts right).

- For an **inferior** good X, when income rises, the demand for good X falls (shifts left).

(3) **Expectation of future prices**

If the price of good X is expected to rise in the future, the demand for good X rises today (shifts right).

More determinants: taste, population, etc.

Market Demand

The market demand curve is the **horizontal summation** of individual demand curves.

$$Q_d = Q_{d1} + Q_{d2} + \cdots + Q_{dn}$$

Remarks

Distinguish **Demand function** and **Demand curve**:

- Demand function can be represented by a **3D graph**, with (P_X, Y) on the plane and Q_d on the vertical axis.
- Demand curve is a **2D graph**, with P_X on the vertical axis and Q_d on the horizontal axis.

Distinguish **Movement along the demand curve** and **Shift in the demand curve**:

- Movement is caused by change in the price of the good P_X.
- Shift is caused by change in other factors Y.

Distinguish **Change in demand** and **Change in quantity demanded**:

- Change in demand results from a change in **non-own-price** determinants of demand. (results in a **shift** in the demand curve)
- Change in quantity demanded results from a change in **own price**. (results in a **movement** along the demand curve)

Supply

Supply: the maximum quantity of a good (or service) that producers are willing and able to offer for sale at various prices.

Supply function: $Q_s = f(P_X, \overline{Y_2}, \overline{Y_3}, \cdots)$

Supply curve is a relationship between quantity supplied Q_s of a good and its price P_X, with **Ceseteris Paribus** assumption.

Law of Supply: if the price of a good rises, the quantity supplied of the good rises, and vice versa. (i.e. Supply curve is **upward-sloping**)

Supply Determinants

(1) **Input prices**

When the price of input rises, the supply of good X falls (shifts left).

(2) **Technology**

When technology progresses, the supply of good X rises (shifts right).

(3) **Expectation of future prices**

If the price of good X is expected to rise in the future, the supply of good X falls today (shifts left).

More determinants: number of firms, government policy, etc.

Market Supply

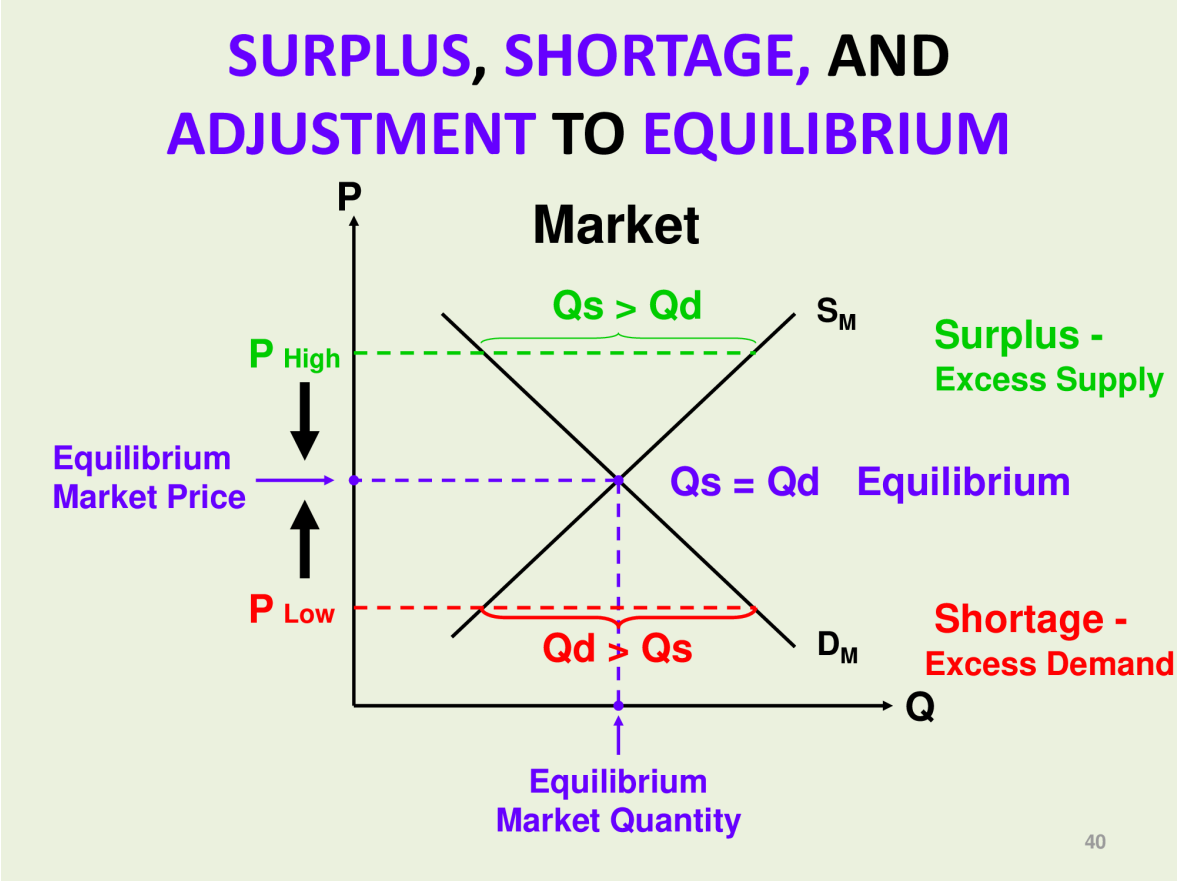
The market supply curve is the **horizontal summation** of individual supply curves.

$$Q_s = Q_{s1} + Q_{s2} + \cdots + Q_{sn}$$

Market Equilibrium

- Simple supply and demand model: An arrangement where SELLERS and BUYERS interact to determine the PRICE and QUANTITY of goods and services.
- **Equilibrium**: a state that will continue indefinitely, if exogenous factors remain unchanged.
- **Market equilibrium**: the intersecting point of the market demand and supply curves.

Surplus and Shortage



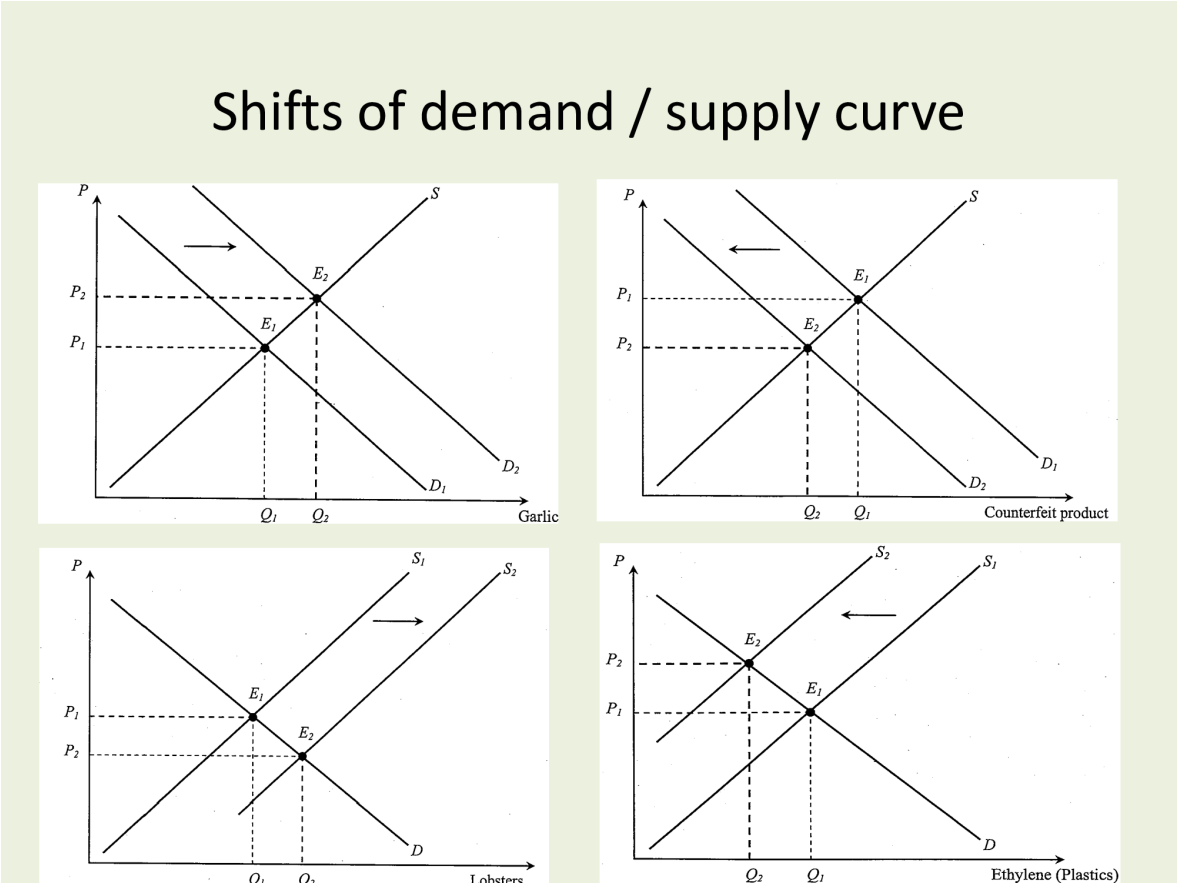
Denote Q^* as the equilibrium quantity and P^* as the equilibrium price.

- If $P > P^*$, $Q_s > Q_d$, which results in a **surplus**.
- If $P < P^*$, $Q_s < Q_d$, which results in a **shortage**.

Price Controls

- **Price ceiling**: a maximum price set by the government, below the equilibrium price.
  - Since $P_c < P^*$, $Q_s < Q_d$, which results in a shortage.
  - Example: rent control
- **Price floor**: a minimum price set by the government, above the equilibrium price.
  - Since $P_f > P^*$, $Q_s > Q_d$, which results in a surplus.
  - Example: minimum wage

Examples



Example 1: Garlic

Since demand increases, the demand curve shifts right. $P^* \uparrow, Q^* \uparrow$.

Possible reasons: health benefits

Example 2: Counterfeit product

Since demand decreases, the demand curve shifts left. $P^* \downarrow, Q^* \downarrow$.

Possible reasons:

- A drop in the price of complement goods (i.e. genuine products)
- An increase in residents' income (counterfeit products are inferior goods)

Example 3: Lobster

Since supply increases, the supply curve shifts right. $P^* \downarrow, Q^* \uparrow$.

Possible reasons:

- The season of lobster catching
- The technology of lobster catching has improved

Example 4: Ethylene (Plastic)

Since supply decreases, the supply curve shifts left. $P^* \uparrow, Q^* \downarrow$.

Possible reasons:

- The price of input (e.g. crude oil) has increased
- Government policy (e.g. environmental protection)

3. Elasticity

Basic supply and demand model emphasizes on **qualitative** (directional) relationships, namely the shift and movement of the curves.

Elasticity measure the **quantitative magnitude** from a change in price or income.

Elasticity of Demand

Price Elasticity of Demand

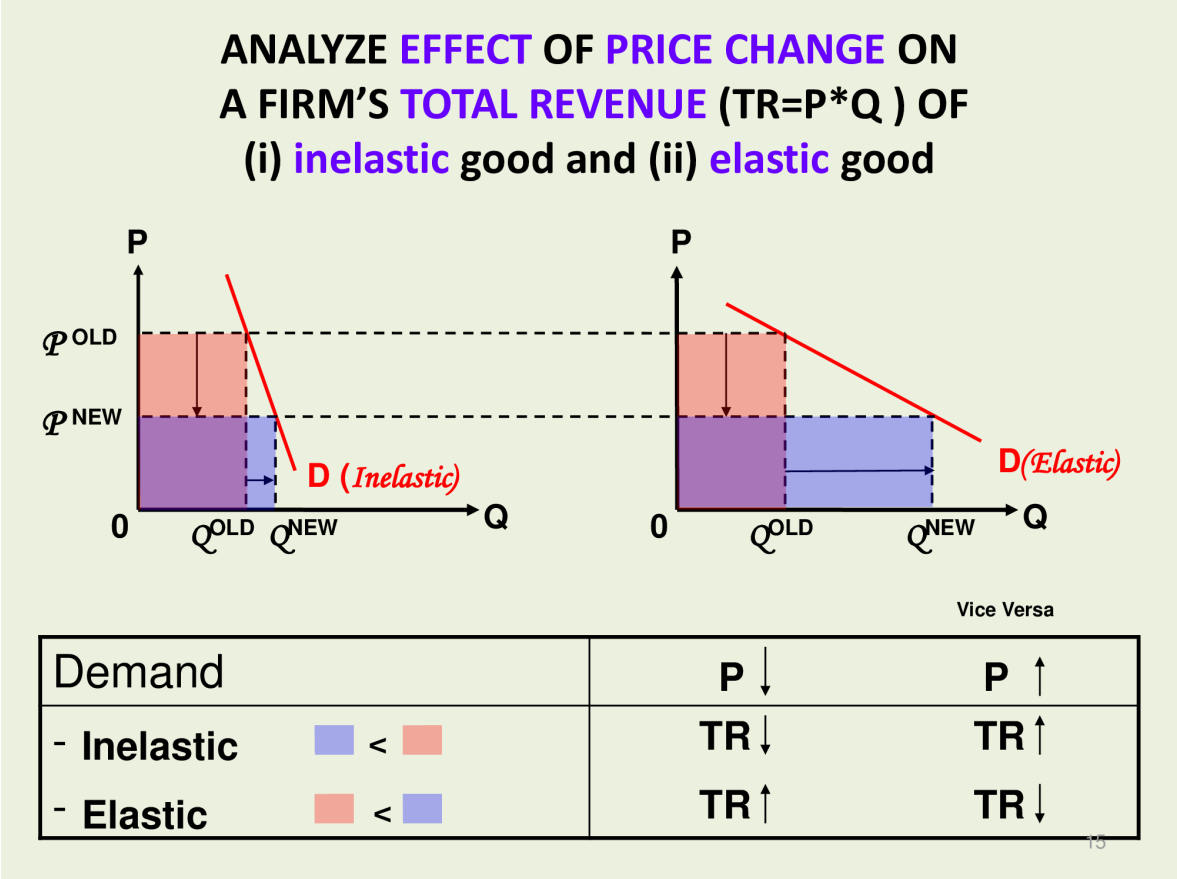
Given $Q_d = f(P_X, \cdots)$, the price elasticity of demand (PED) is defined as:

$$E_{P_X} = \frac{\%\text{ change in quantity demanded}(Q_d)}{\%\text{ change in price}(P_X)} = \frac{\Delta Q_d / Q_d}{\Delta P_X / P_X}$$

Based on the Law of Demand, the price elasticity of demand is **always negative**.

3 types of PED:

- $E_{P_X} > 1$: **elastic** (the demand is sensitive to price changes)
- $E_{P_X} = 1$: **unitary elastic**
- $E_{P_X} < 1$: **inelastic** (the demand is insensitive to price changes)



Judging from the demand curve:

Total revenue = $P_X \times Q_d$ (TR = P × Q)

In the above example, revenue is divided into 3 rectangles:

- orange: revenue loss from the price decrease ($P \downarrow$)
- purple: revenue remains unchanged
- blue: revenue gain from the quantity increase ($Q \uparrow$)

Elasticity	Figure	$P \downarrow$	$P \uparrow$
Inelastic	Orange > Blue	$TR \downarrow$	$TR \uparrow$
Elastic	Blue > Orange	$TR \uparrow$	$TR \downarrow$

Determinants of PED

(1) Necessary vs. luxury goods

- Necessity: inelastic
- Luxury: elastic

(2) Availability of substitutes

- No or few substitutes: inelastic
- Many substitutes: elastic

(3) Proportion of income spent on the good

- Small proportion: inelastic
- Large proportion: elastic

Perfectly Elastic and Inelastic Demand

- **Perfectly elastic demand**: $E_{P_X} = -\infty$
  - The demand curve is horizontal.
  - You either win the market by setting the lowest price, or lose the market by setting any higher price.
- **Perfectly inelastic demand**: $E_{P_X} = 0$
  - The demand curve is vertical.
  - The quantity demanded remains the same, regardless of the price.

Income Elasticity of Demand

Given $Q_d = f(P_X, Y)$, where Y denotes income, the income elasticity of demand is defined as:

$$E_Y = \frac{\%\text{ change in quantity demanded}(Q_d)}{\%\text{ change in income}(Y)} = \frac{\Delta Q_d / Q_d}{\Delta Y / Y}$$

3 types of E_Y:

- $E_Y > 1$: **luxuries** (elastic to income changes)
- $0 < E_Y < 1$: **necessities** (inelastic to income changes)
- $E_Y < 0$: **inferior goods** (demand falls as income rises)

Cross-Price Elasticity of Demand

Given $Q_d = f(P_X, P_Y)$, where P_Y denotes the price of good Y, the cross-price elasticity of demand is defined as:

$$E_{P_Y} = \frac{\%\text{ change in quantity demanded of good X}(Q_d)}{\%\text{ change in price of good Y}(P_Y)} = \frac{\Delta Q_d / Q_d}{\Delta P_Y / P_Y}$$

2 types of E_{P_Y}:

- $E_{P_Y} > 0$: **substitutes** (the demand for good X rises as the price of good Y rises)
- $E_{P_Y} < 0$: **complements** (the demand for good X falls as the price of good Y rises)

Elasticity of Supply

Price elasticity of supply (PES) is defined as:

$$E_{P_X} = \frac{\%\text{ change in quantity supplied}(Q_s)}{\%\text{ change in price}(P_X)} = \frac{\Delta Q_s / Q_s}{\Delta P_X / P_X}$$

Based on the Law of Supply, the price elasticity of supply is **always positive**.

3 types of PES:

- $E_{P_X} > 1$: **elastic**
- $E_{P_X} = 1$: **unitary elastic**
- $E_{P_X} < 1$: **inelastic**

Midpoint Formula

The above formulas are based on the initial and final values.

$E = \frac{\Delta Q/Q}{\Delta \alpha/\alpha} = \frac{Q_2 - Q_1}{Q_1} \div \frac{\alpha_2 - \alpha_1}{\alpha_1}$

where α denotes the study variable (e.g. price, income, etc.).

If the initial states and final states are exchanged, the result is different (since only initial values are used to compute relative changes).

Midpoint formula is used to solve this problem:

$E = \frac{\Delta Q/Q}{\Delta \alpha/\alpha} = \frac{Q_2 - Q_1}{(Q_1+Q_2)/2} \div \frac{\alpha_2 - \alpha_1}{(\alpha_1+\alpha_2)/2}$

4. Theory of Consumer

Utility

Consumer Preferences: the ranking of all possible combinations of goods and services.

Assumptions:

- **Completeness**: all combinations are ranked.
- **Transitivity**: if A is preferred to B and B is preferred to C, then A is preferred to C.
- **Non-satiation**: more is preferred to less.

Utility: a numerical representation (quantification) of consumer preferences.

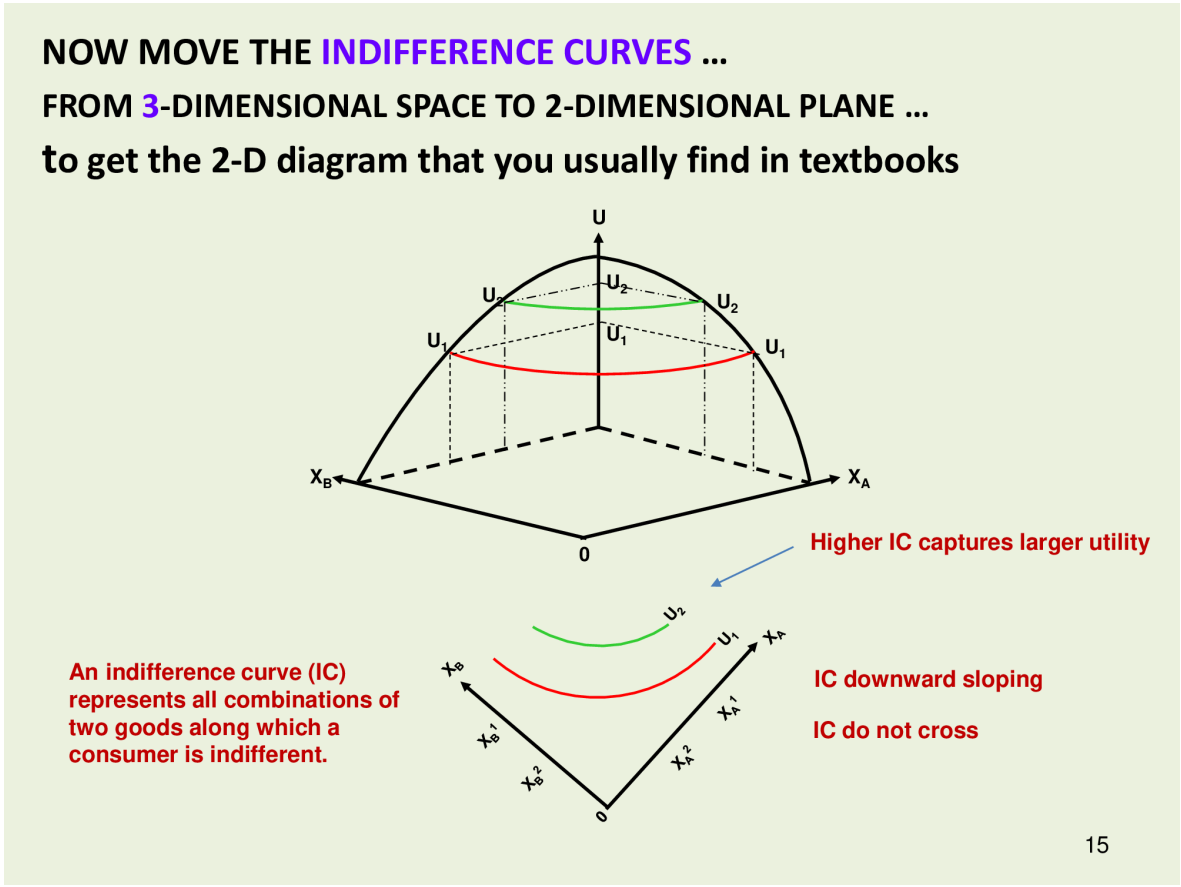
Utility function: $U = f(X_1, X_2, \cdots)$

- U: utility
- X_i: quantity of good/service i

Simple utility function: $U = f(X_1, X_2) = X_1^\alpha \times X_2^\beta$

It can be drawn in a (X_1, X_2) plane, with U on the vertical axis. The shape is a sphere-like convex surface.

Indifference Curve



Slicing the utility function at a certain height (level of U) yields an **indifference curve**.

Formally, an indifference curve (IC) is a curve that shows **all combinations of goods and services that yield the same level of utility**.

Properties of IC:

- Higher IC is preferred to lower IC. (non-satiation)
  - Therefore, IC with higher level of U is further from the origin.
- IC is **downward-sloping**. (the more of one good, the less of the other)
- IC is **convex to the origin**. (diminishing marginal rate of substitution)
- IC do not intersect. (transitivity)
- There is one IC for every combination. (completeness)

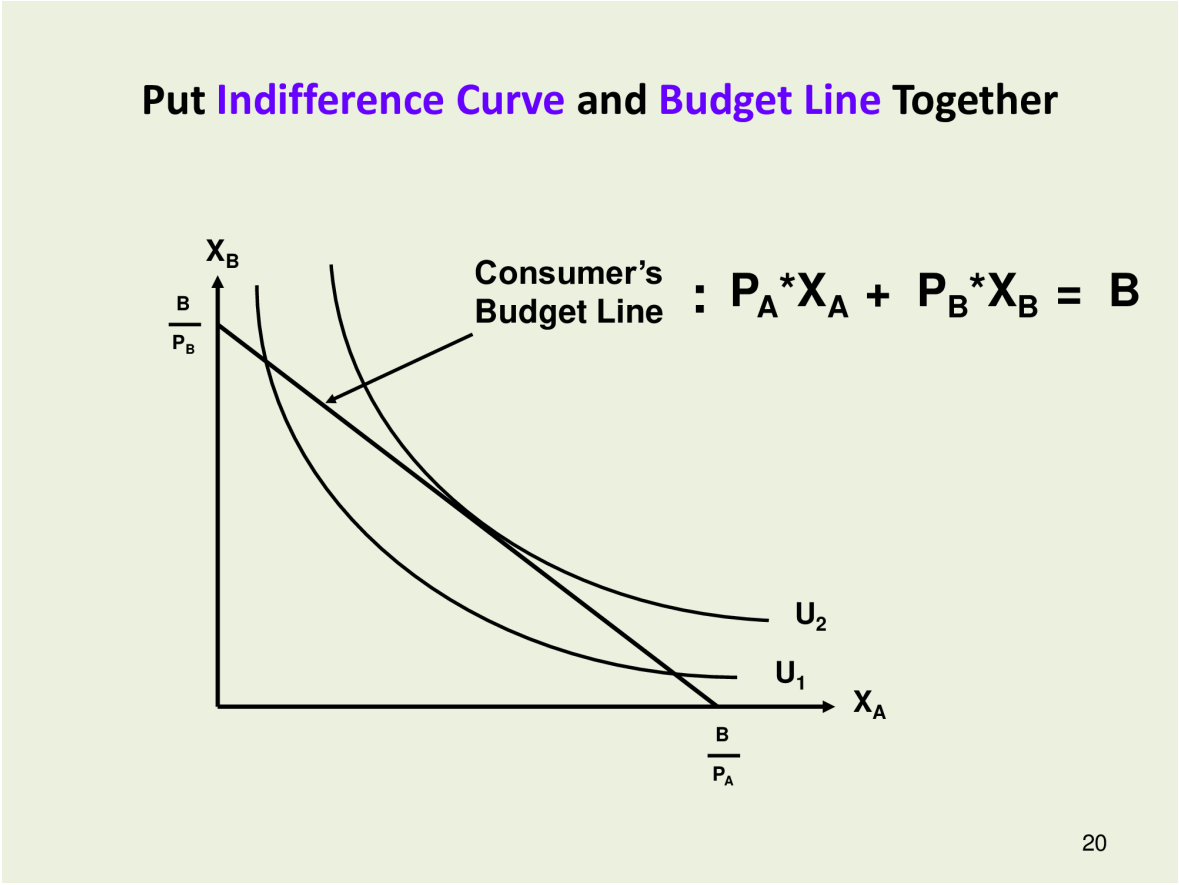
Budget Line

A **budget line** is a line that shows all combinations of goods and services that **can be purchased with a given income**.

- Function: $P_1 \times X_1 + P_2 \times X_2 = B$ (B = budget)
- Intersects with x-axis at $(B/P_1, 0)$ and with y-axis at $(0, B/P_2)$

Slope of budget line: $k = -\frac{P_1}{P_2}$.

Consumer Equilibrium



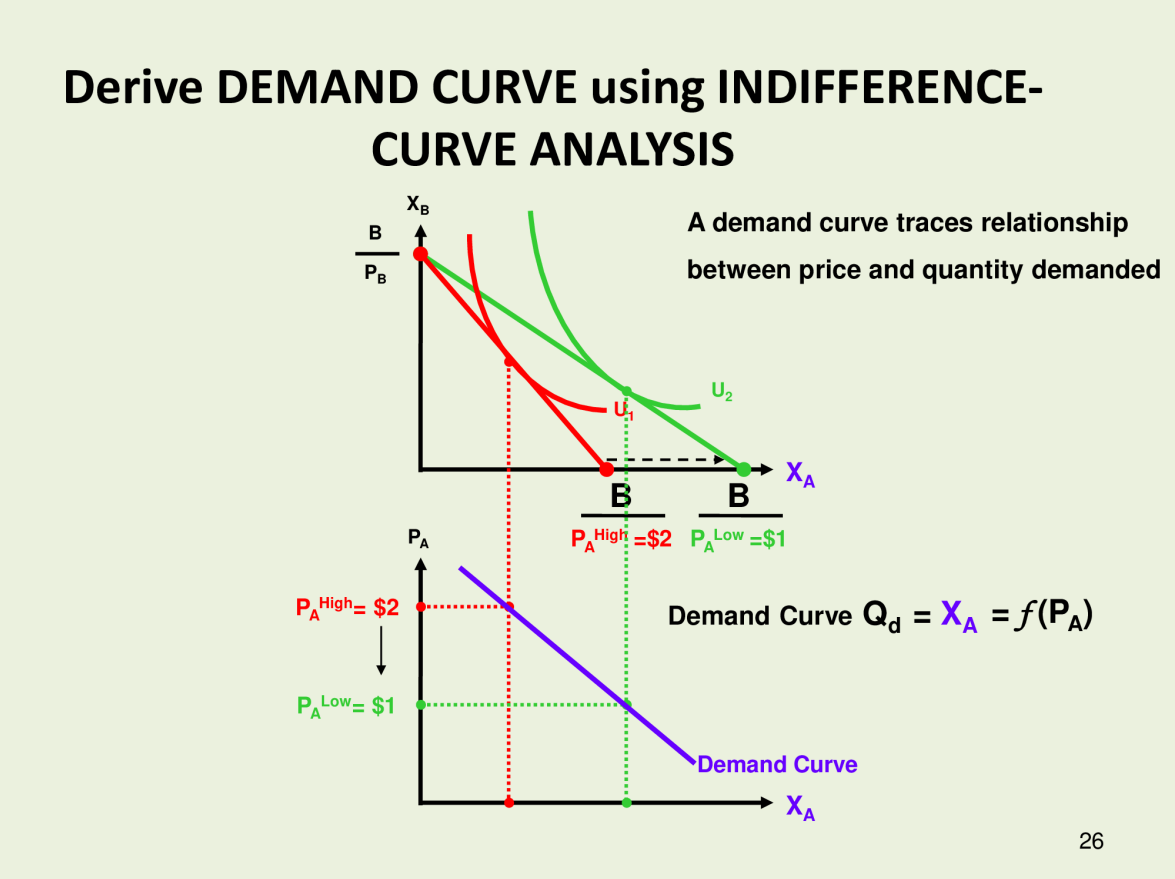
When budget line $X_2 = \frac{B}{P_2} - \frac{P_1}{P_2} \times X_1$ is tangent to an indifference curve, the consumer is in equilibrium, and **maximizes utility**.

The slope of the indifference curve is the **marginal rate of substitution** (MRS):

$MRS_{X_1} = -\frac{\Delta X_2}{\Delta X_1}$ (i.e. for 1 more unit of X_1, $|MRS_{X_1}|$ units of X_2 are given up)

When MRS = slope of budget line, $\frac{\Delta X_2}{\Delta X_1} = \frac{P_1}{P_2}$, the utility is maximized.

Deriving Demand Curve using Indifference Curve Analysis:



Consider Good A and Good B. The price of A changes from $\$1$ to $\$2$.

The consumer will give up some units of A and buy more units of B. The demand curve is the locus of all equilibrium points.

Therefore, the demand quantity of A decreases as the price of A increases.

MRS of A is the amount of B that the consumer is willing to give up for one more unit of A.
$MRS_{X_A} = -\frac{\Delta X_B}{\Delta X_A}$

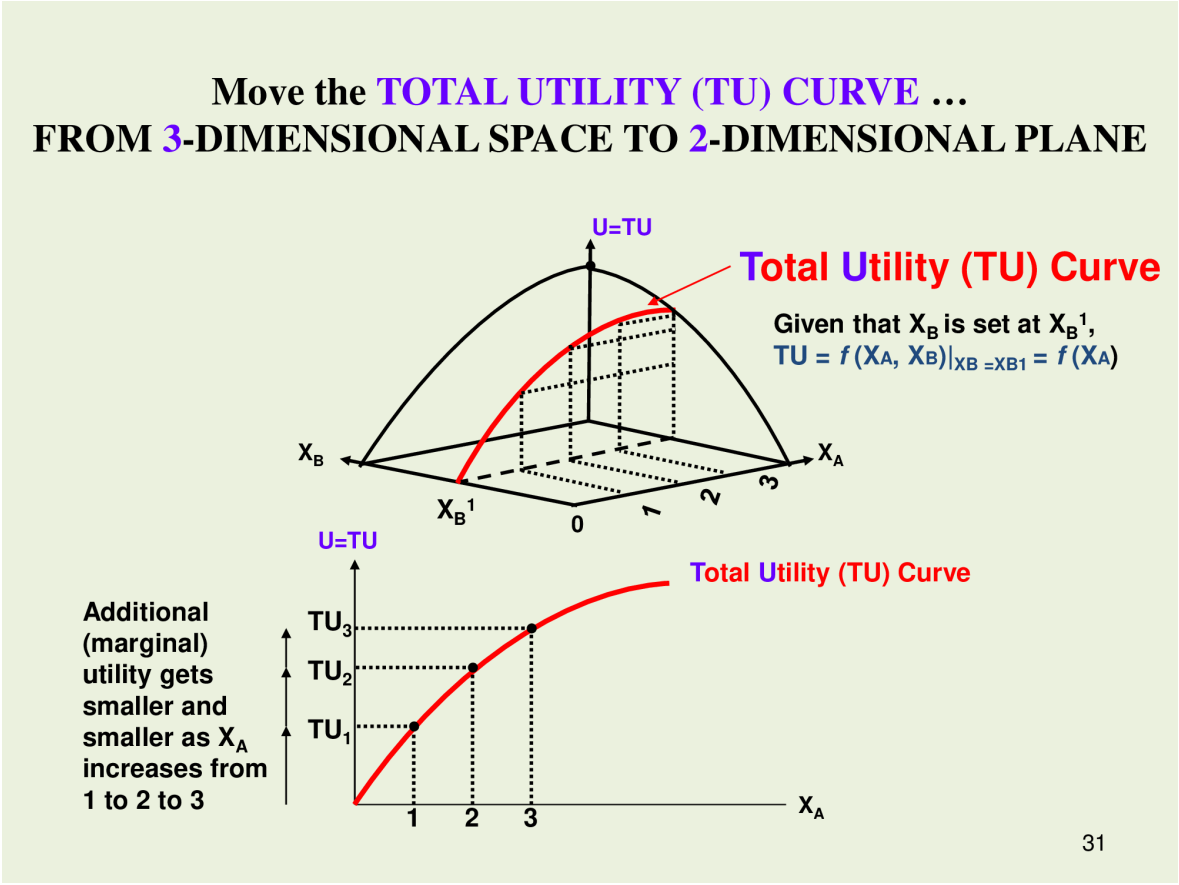
Since, to gain 1 more unit of utility, the consumer can choose to have $\frac{1}{MU_A}$ units of A or $\frac{1}{MU_B}$ units of B, $MRS_{X_A} = \frac{\frac{1}{MU_B}}{\frac{1}{MU_A}} = \frac{MU_A}{MU_B}$.

The budget line is $P_A \times X_A + P_B \times X_B = I$, with a slope of $-\frac{P_A}{P_B}$.

Therefore,

- When $|MRS_{X_A}| = \frac{MU_A}{MU_B} = \frac{P_A}{P_B}$, the consumer is in equilibrium.
- When $|MRS_{X_A}| > \frac{P_A}{P_B}$, or $\frac{MU_A}{P_A} > \frac{MU_B}{P_B}$, the marginal utility per dollar of A is greater than that of B, and the consumer will buy more A and less B.
- When $|MRS_{X_A}| < \frac{P_A}{P_B}$, or $\frac{MU_A}{P_A} < \frac{MU_B}{P_B}$, the marginal utility per dollar of A is less than that of B, and the consumer will buy less A and more B.

Total Utility



Slicing the utility function at a certain quantity of X_2 yields a **total utility curve** for X_1.

Marginal utility (MU) is the change in total utility from consuming one more unit of a good.

$$MU = \frac{\Delta U}{\Delta X}, MU_{X_1} = \frac{\Delta TU}{\Delta X_1}$$

Diminishing marginal utility: as the quantity of a good consumed increases, the marginal utility of the good decreases.

Properties of Utility Function:

- Total utility increases as the quantity of a good increases.
- Marginal utility decreases as the quantity of a good increases. (the curve is downward-sloping)

5. Theory of Producer

Production function: $Q = f(L, K)$ is a relationship between

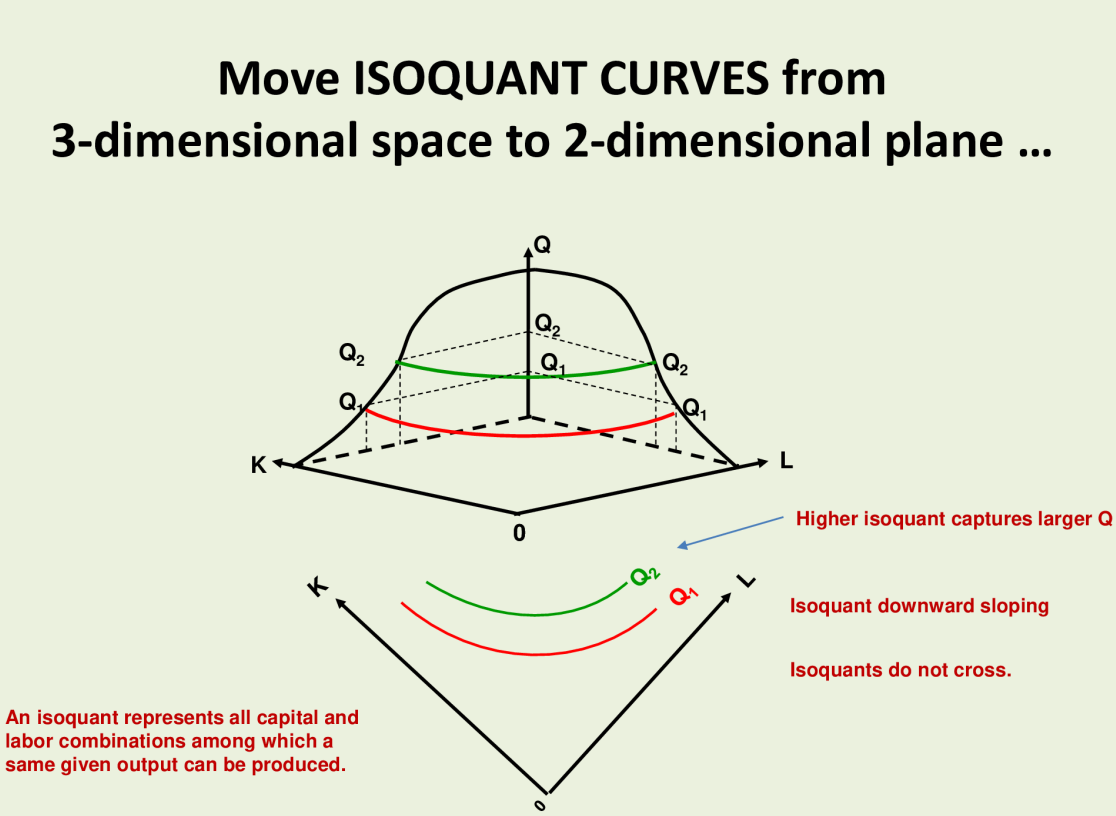
- inputs (factors of production) L (labor) and K (capital), and
- output Q of a firm.

$Q = f(L, K)$ is a 3D graph, with L and K on the plane and Q on the vertical axis.

Isoquant Curve

Slicing the production function at a certain level of Q yields an **isoquant curve**.

An isoquant curve is a curve that shows all combinations of labor and capital that yield the same level of output.



Properties of Isoquant Curve:

- **Downward-sloping**: the more of one input, the less of the other.
- **Convex to the origin**: diminishing marginal rate of technical substitution (MRTS).

Marginal rate of technical substitution (MRTS) is the rate at which L can be substituted for K, while keeping output constant.

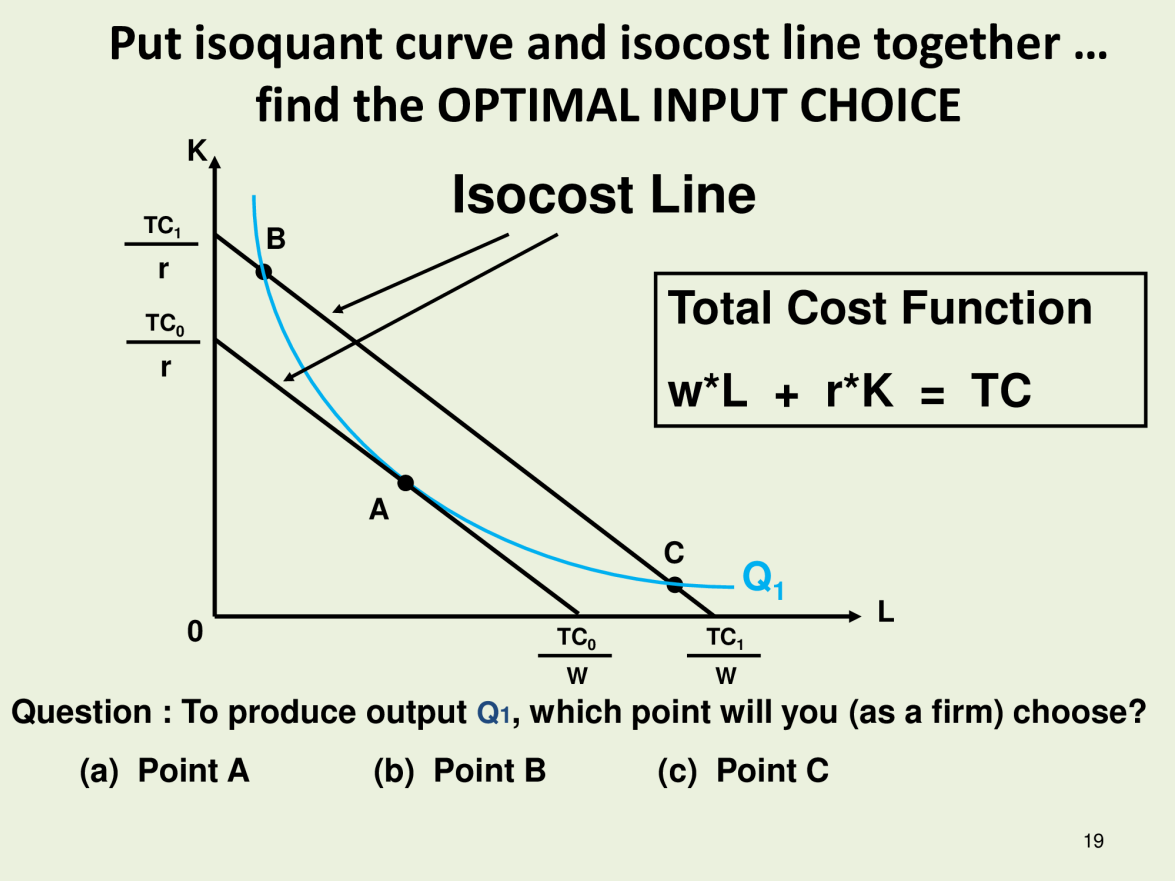
In other words, for each additional labor employed, MRTS is the amount of capital that can be saved.

$MRTS = -\frac{\Delta K}{\Delta L}$

Isocost Line

Isocost line is a line that shows all combinations of labor and capital that can be purchased with a given cost.

- Function: $w \times L + r \times K = TC$
- Intersects with L-axis at $(TC/w, 0)$ and with K-axis at $(0, TC/r)$



When Isoquant curve is tangent to an isocost line, **producer equilibrium** and **cost minimization** are achieved.

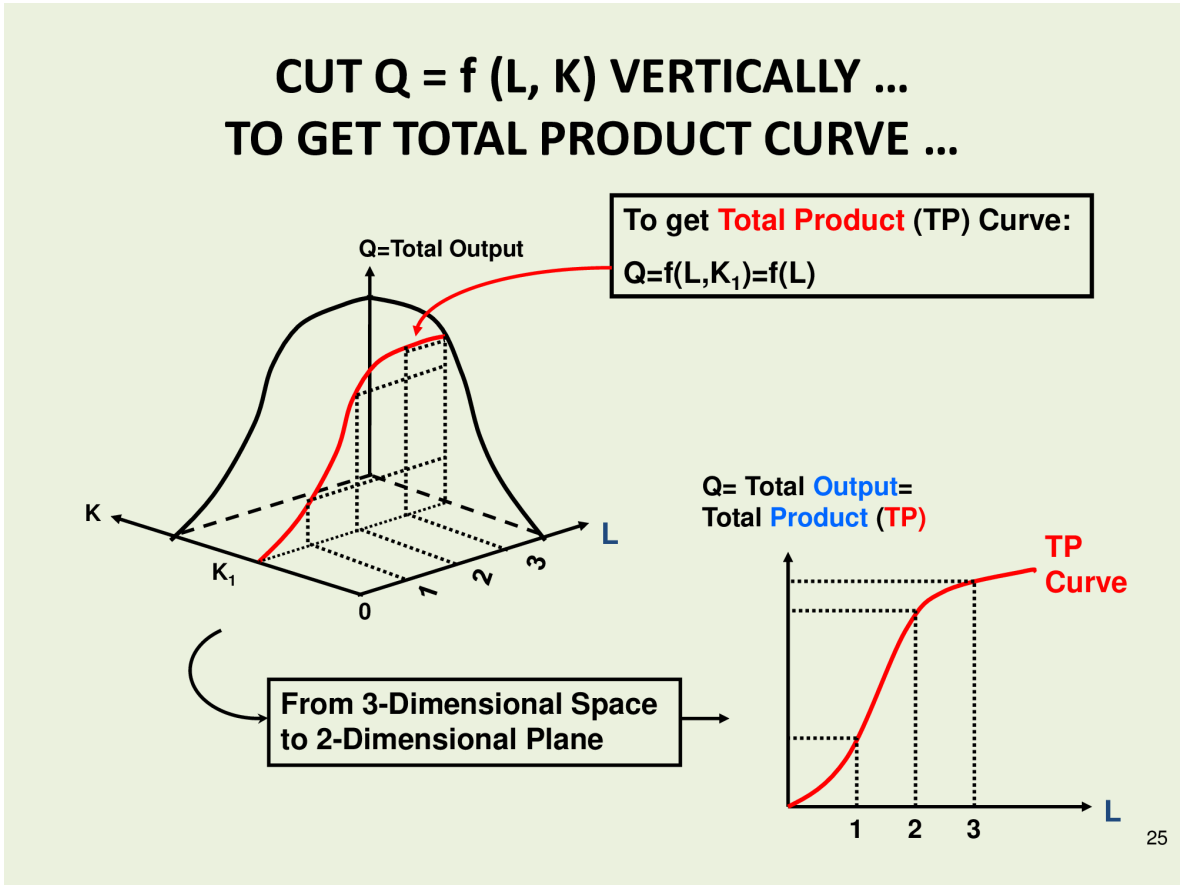
$$|MRTS| = \frac{\Delta K}{\Delta L} = \frac{w}{r}$$

Total Product Curve

Analysis of the two factors of production:

	Short run	Long run
Labor	Variable	Variable
Capital	Fixed	Variable

Therefore, to derive the total product curve for short-run decisions, we fix the capital and vary the labor.

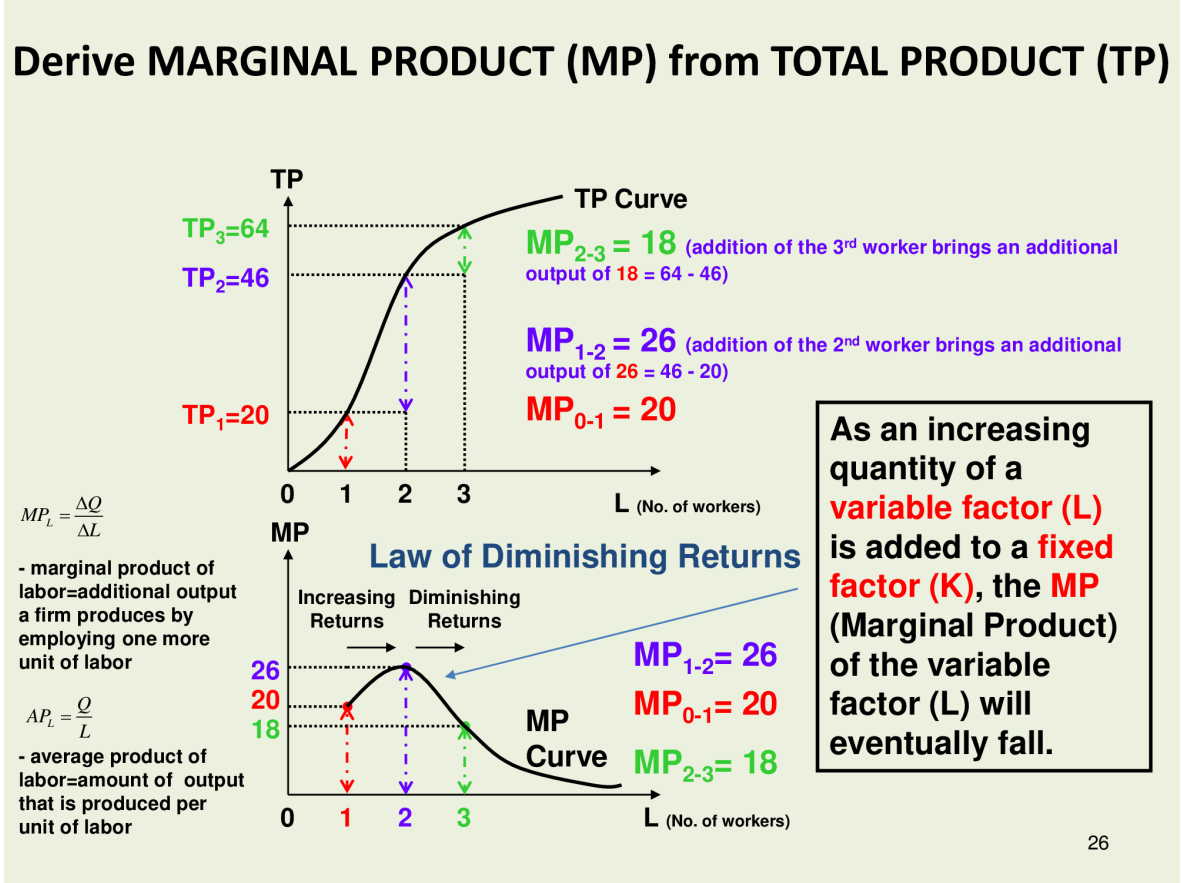


Slicing the production function at a certain level of K yields a **total product curve** for L, $TP = f(L)$.

Differentiating the total product curve yields the **marginal product** (MP) curve, $MP = \frac{\Delta TP}{\Delta L}$.

Average product (AP) is the total product per unit of labor, $AP = \frac{TP}{L}$.

Law of Diminishing Returns



When K is fixed, the marginal product of L changes as L increases:

- **Increasing marginal returns**: When L is small, the marginal product of L increases.
- **Decreasing marginal returns**: When L exceeds a threshold, the marginal product of L decreases.
- The MP-L curve and AP-L curve are both inverted U-shaped.

MP and AP are related:

- When MP > AP, AP is increasing.
- When MP < AP, AP is decreasing.
- When MP = AP, AP is at its maximum.

MP starts to decrease before AP reaches its maximum.

6. Theory of Cost

Types of Costs

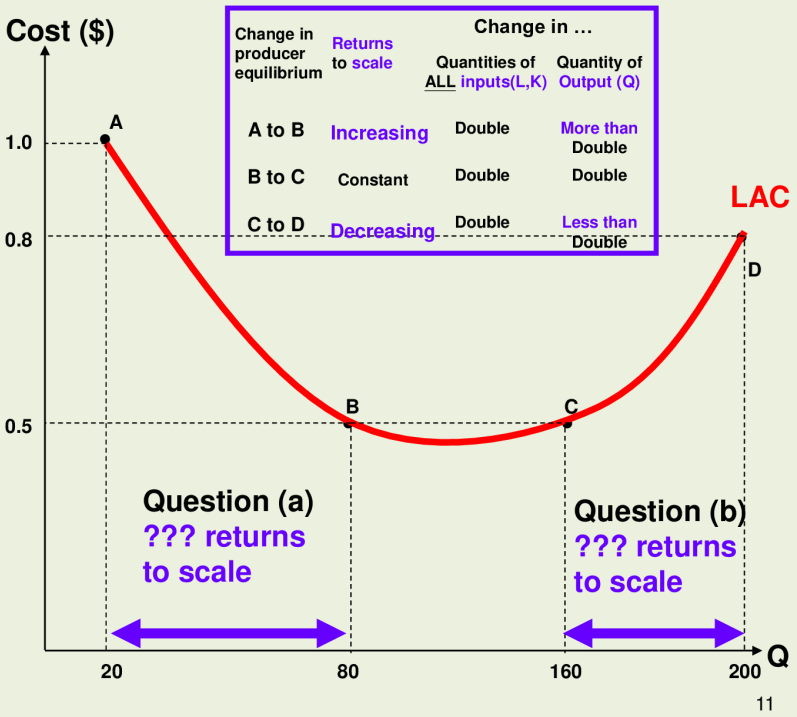
- Short-run costs: at least one factor (usually K) is fixed.
  - **Total cost** (TC) = FC + VC
  - **Fixed cost** (FC): cost of fixed inputs (capital)
  - **Variable cost** (VC): cost of variable inputs (labor)
  - **Average total cost** (ATC) = AFC + AVC
  - **Average fixed cost** (AFC) = FC / Q
  - **Average variable cost** (AVC) = VC / Q
  - **Marginal cost** (MC) = $\frac{\Delta TC}{\Delta Q}$
- Long-run costs: all factors are variable.
  - **Long-run total cost** (LTC)
  - **Long-run average cost** (LAC) = LTC / Q
  - **Long-run marginal cost** (LMC) = $\frac{\Delta LTC}{\Delta Q}$

Long-run Costs

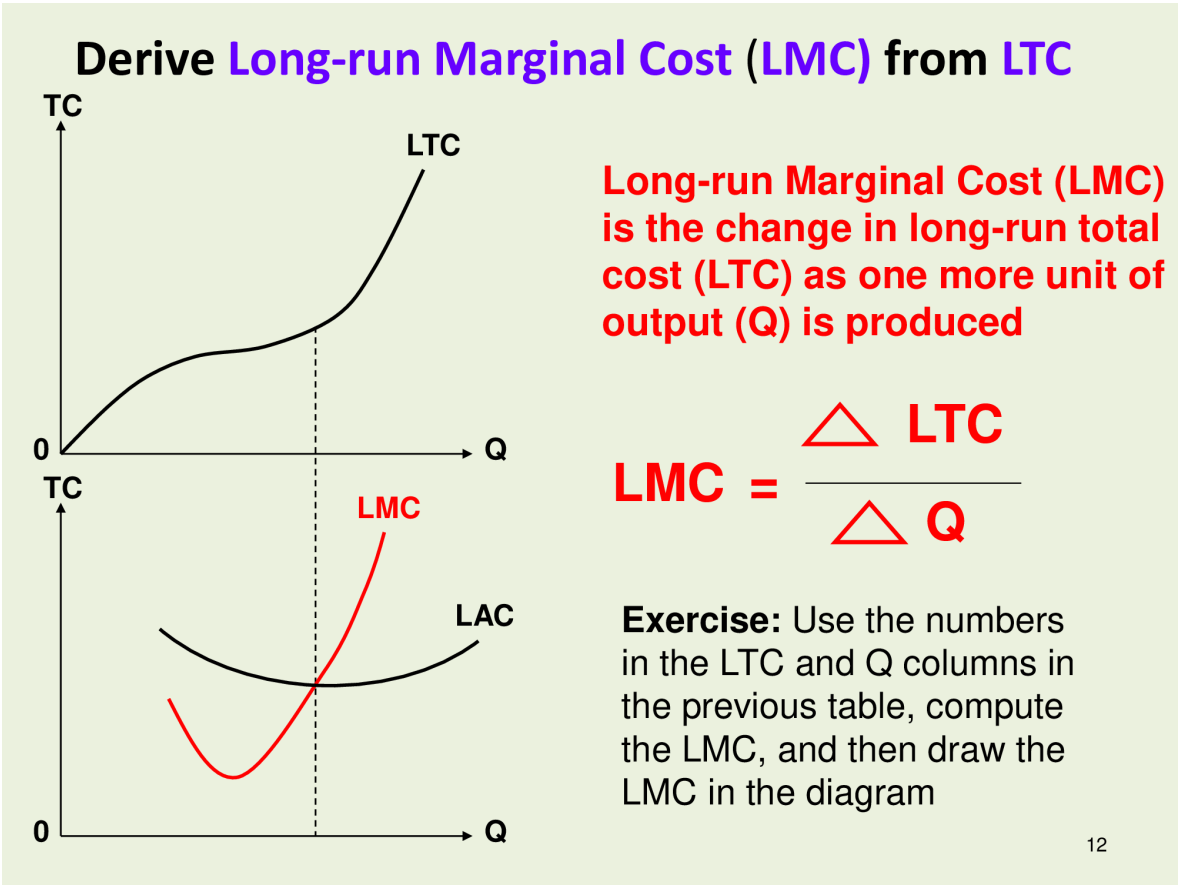
In the context of long-run costs, suppose a firm increases all inputs by x times:

- if output increases by more than x times, the production exhibits **increasing returns to scale**.
- if output increases by exactly x times, the production exhibits **constant returns to scale**.
- if output increases by less than x times, the production exhibits **decreasing returns to scale**.

Answers to Questions (a) & (b):

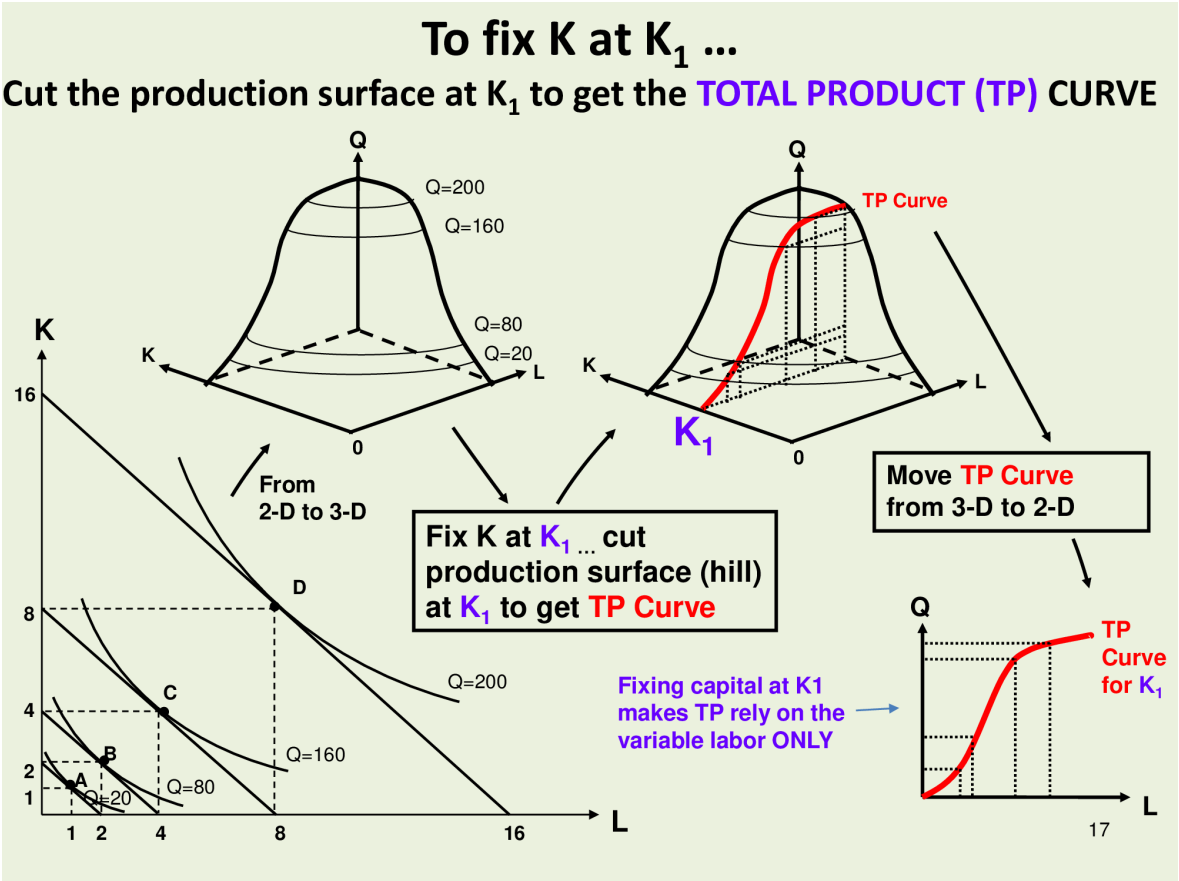


- Drawing the LTC curve: Q on x-axis, LTC on y-axis.
- Deriving the LAC curve: $LAC = \frac{LTC}{Q}$.
  - LAC is U-shaped, decreasing at first and then increasing.
- Deriving the LMC curve: $LMC = \frac{\Delta LTC}{\Delta Q}$.
  - LMC is U-shaped, decreasing at first and then increasing.
  - LMC intersects the LAC at its minimum point. i.e. LMC starts increasing before LAC starts increasing.



Short-run Costs

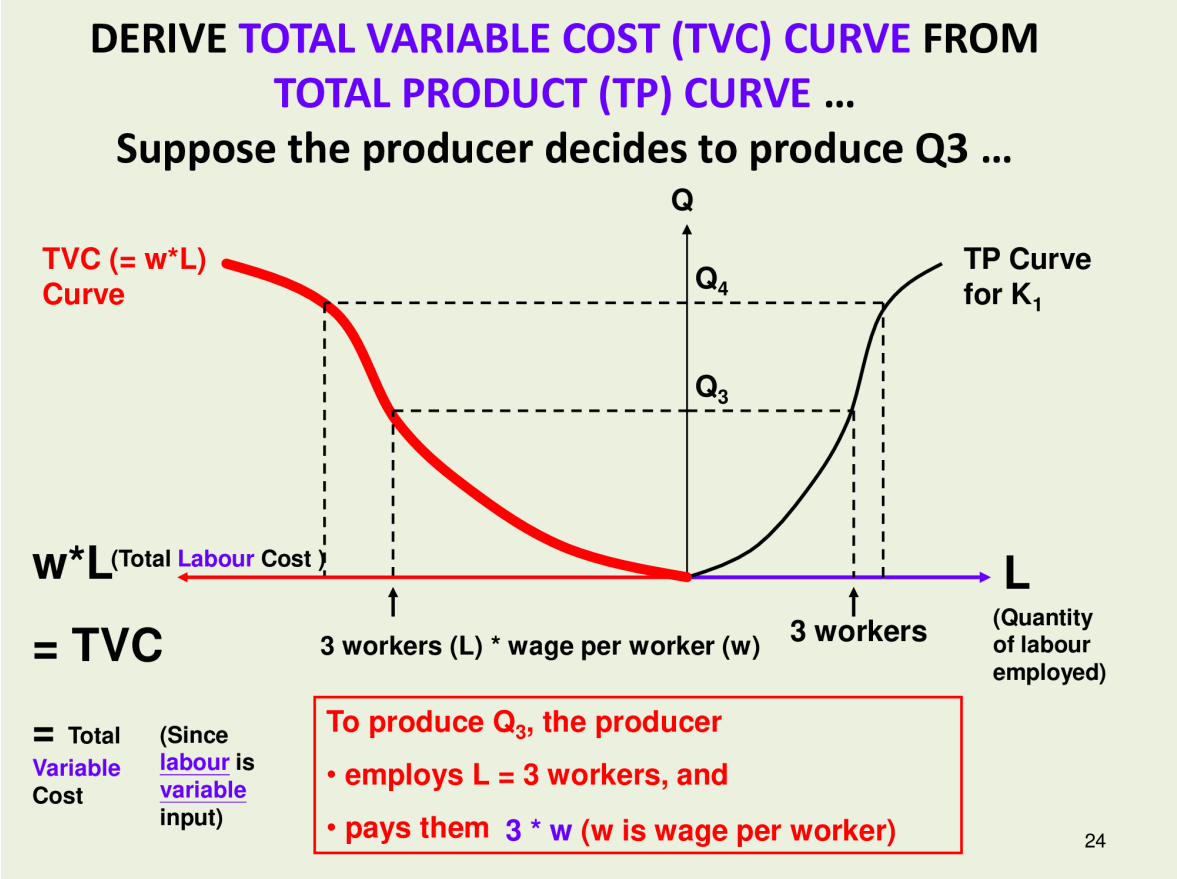
All costs functions are $C = f(Q)$ with other factors being constant.



Deriving the VC curve:

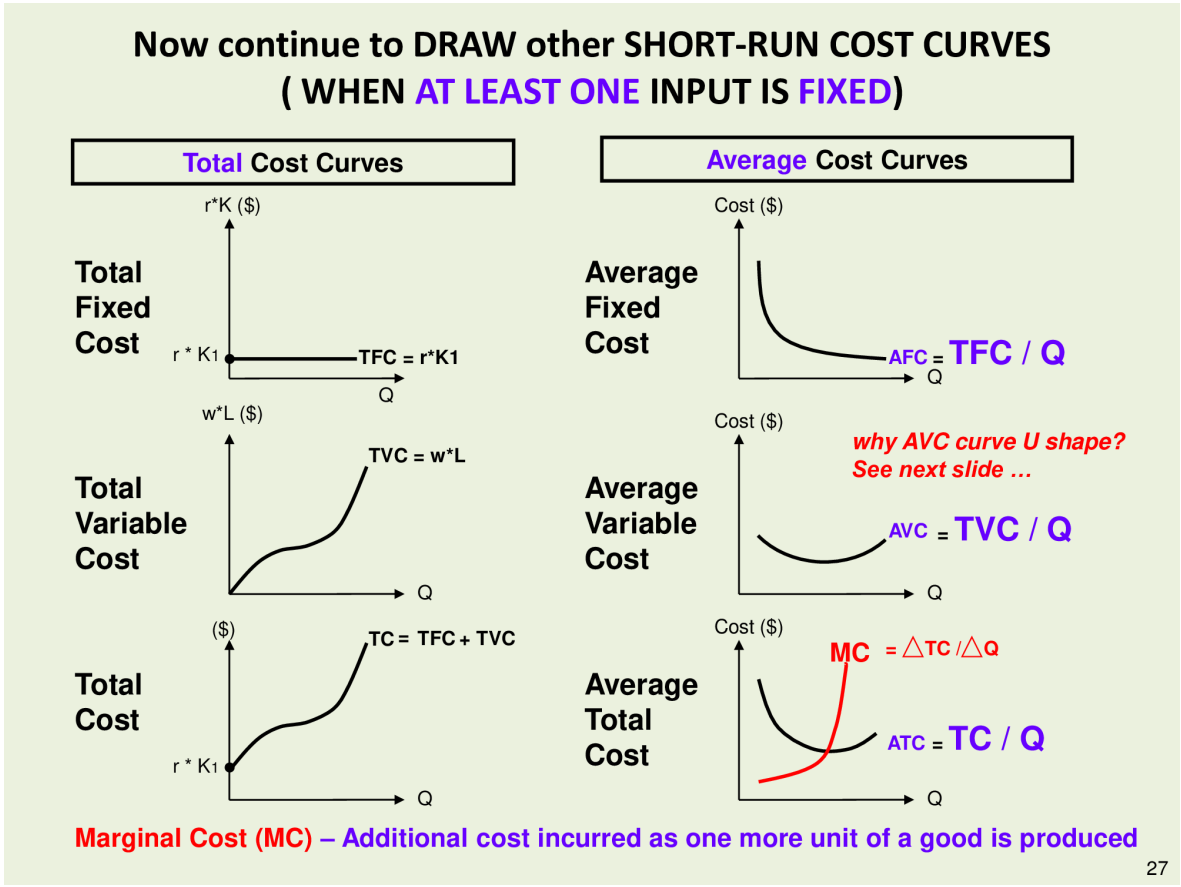
- Use a 3D $Q = f(L, K)$ graph.
- Cut the graph at a certain (constant) level of K, which produces a 2D $Q = f(L)$ graph.

- After that, use $rK + wL = C$ to calculate C based on L, which yields the VC curve.



Deriving all other curves:

- FC: a fixed line
- AFC: $AFC = \frac{FC}{Q}$ -> decreasing
- AVC: $AVC = \frac{VC}{Q}$ -> U-shaped
- TC: $TC = FC + VC$ -> shape of VC but offset by FC
- ATC: $ATC = \frac{TC}{Q}$ -> U-shaped
- MC: $MC = \frac{\Delta TC}{\Delta Q}$ -> U-shaped
    - MC intersects AVC at its minimum point



$AVC = \frac{VC}{Q} = \frac{wL}{Q} = \frac{w}{\frac{Q}{L}} = \frac{w}{AP_L}$

Remember that AP_L (average product of labor) has an inverted U-shape.

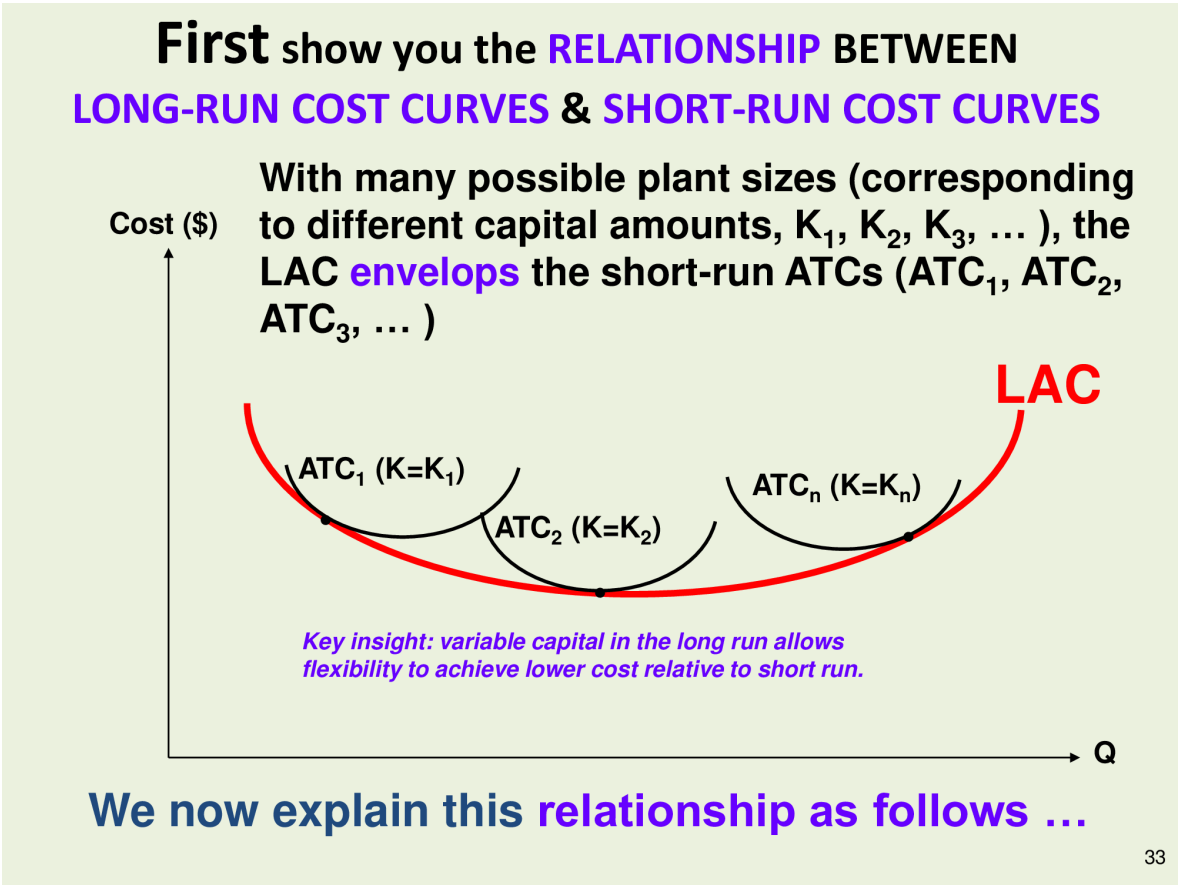
$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta VC}{\Delta Q} = \frac{w\Delta L}{\Delta Q} = \frac{w}{\frac{\Delta Q}{\Delta L}} = \frac{w}{MP_L}$

MP_L (marginal product of labor) has an inverted U-shape.

Connection between Short-run and Long-run Costs

In the long run, all costs are variable. Therefore, the long-run cost curve is the envelope of all short-run cost curves.

Denote short run ATC at a fixed capital K_i as ATC_i. The long-run ATC is the lowest point of all ATC_i.



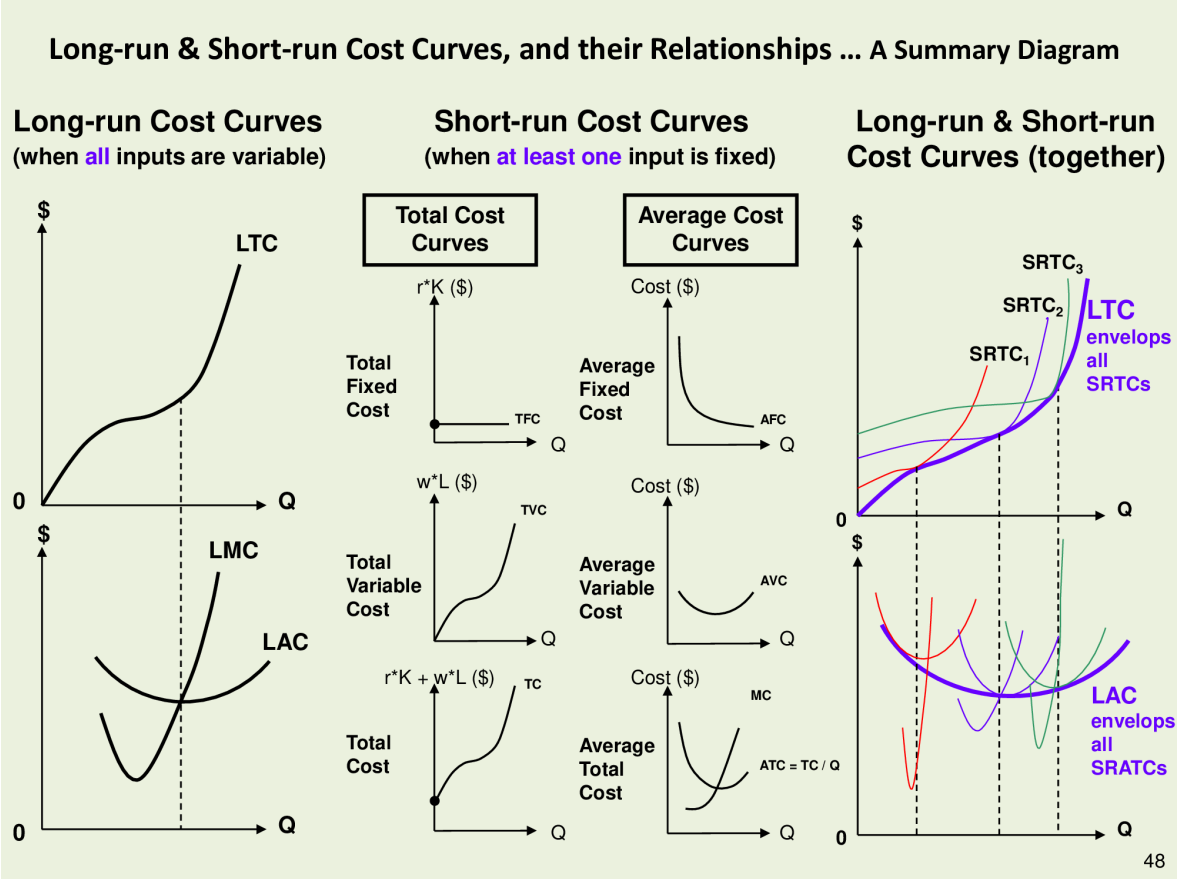
When capital K increases, SRTC shifts **UP and RIGHT**.

Further, LTC envelops all SRTC curves, and is tangent to the lowest point of all SRTC curves.

- **Economies of scale**: when output increases, the long-run average cost decreases.
- **Constant economies of scale**: when output increases, the long-run average cost remains constant.
- **Diseconomies of scale**: when output increases, the long-run average cost increases.

Compare with increasing, constant, and decreasing returns to scale, which focus on the input-output relationship.

In the range of Economies of scale, the slope of the LRAC curve is negative. Further, since the ATC curve is tangent to the LRAC curve, the slope of the ATC curve is also negative.

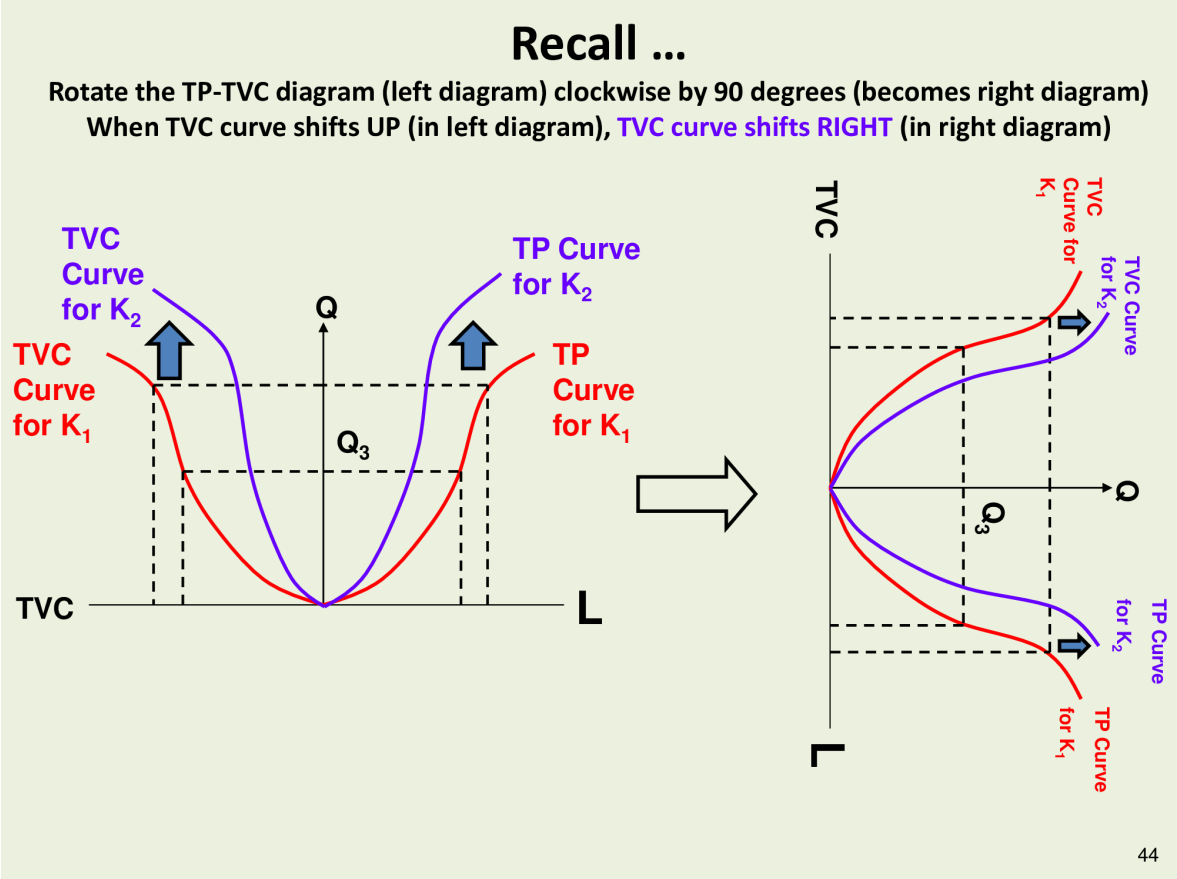


Detailed explanation:

Now we only consider the first two SRTC curves $SRTC_1$ and $SRTC_2$. (SRTC = SRTFC + SRTVC)

When capital increases from K_1 to K_2,

- the fixed cost increases from rK_1 to rK_2, Therefore, SRTFC shifts UP.
- the same number of workers can produce more output, Therefore, SRTVC shifts RIGHT.
    - When you rotates the SRTP curve to obtain the SRTVC curve, the curve shifts RIGHT.



7. Perfect Competition

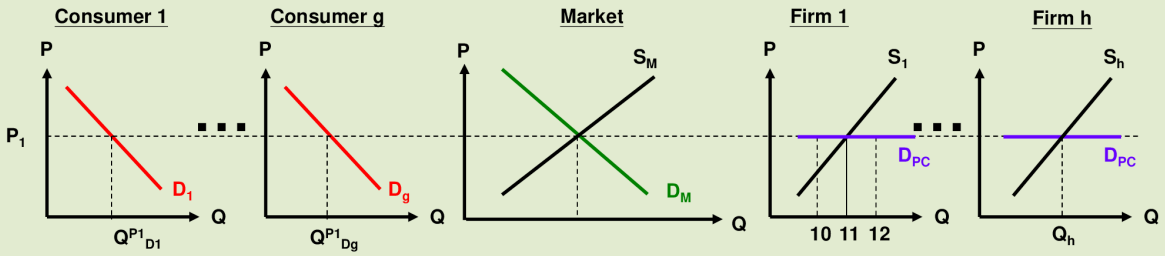
Characteristics of Perfect Competition

- **Many buyers and sellers**: no single buyer or seller can influence the market price.
- **Free entry and exit**: firms can enter or exit the market without restriction.
- **Homogeneous goods/services**: products are identical.
- **Perfect information**: buyers and sellers have perfect information about the market.

Three Demand Curves

- **Individual demand curve**: the price-quantity relationship for an individual customer.
- **Market demand curve**: horizontal summation of all individual demand curves.
- **Demand curve facing a perfectly-competitive firm**: the price-quantity relationship for a specific firm. The curve is horizontal; price elasticity of demand is negative infinity.

SUMMARIZE (and DISTINGUISH) THREE DIFFERENT DEMAND CURVES



D_1 (or D_2, … , or D_g) Individual Demand Curve:

Relationship of Price and Quantity of an INDIVIDUAL consumer (in a market) of a good/service

D_M Market Demand Curve:

Relationship of Price and Quantity of ALL consumers (in a market) for a good/service

D_{PC} Demand Curve Facing a Perfectly-Competitive Firm:

Relationship of Price and Quantity of ALL consumers (in a market) for a SPECIFIC firm's (say Firm 1's) good/service

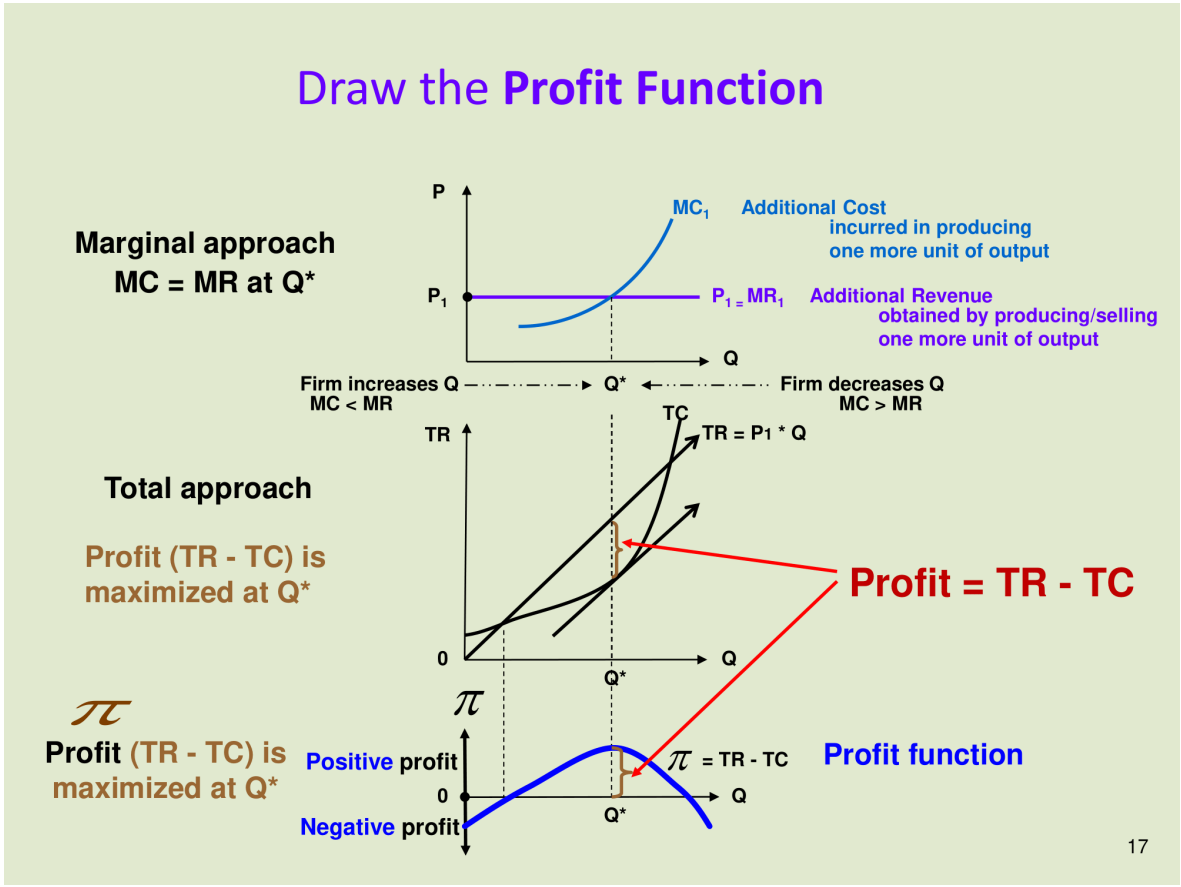
9

Revenue and Profit

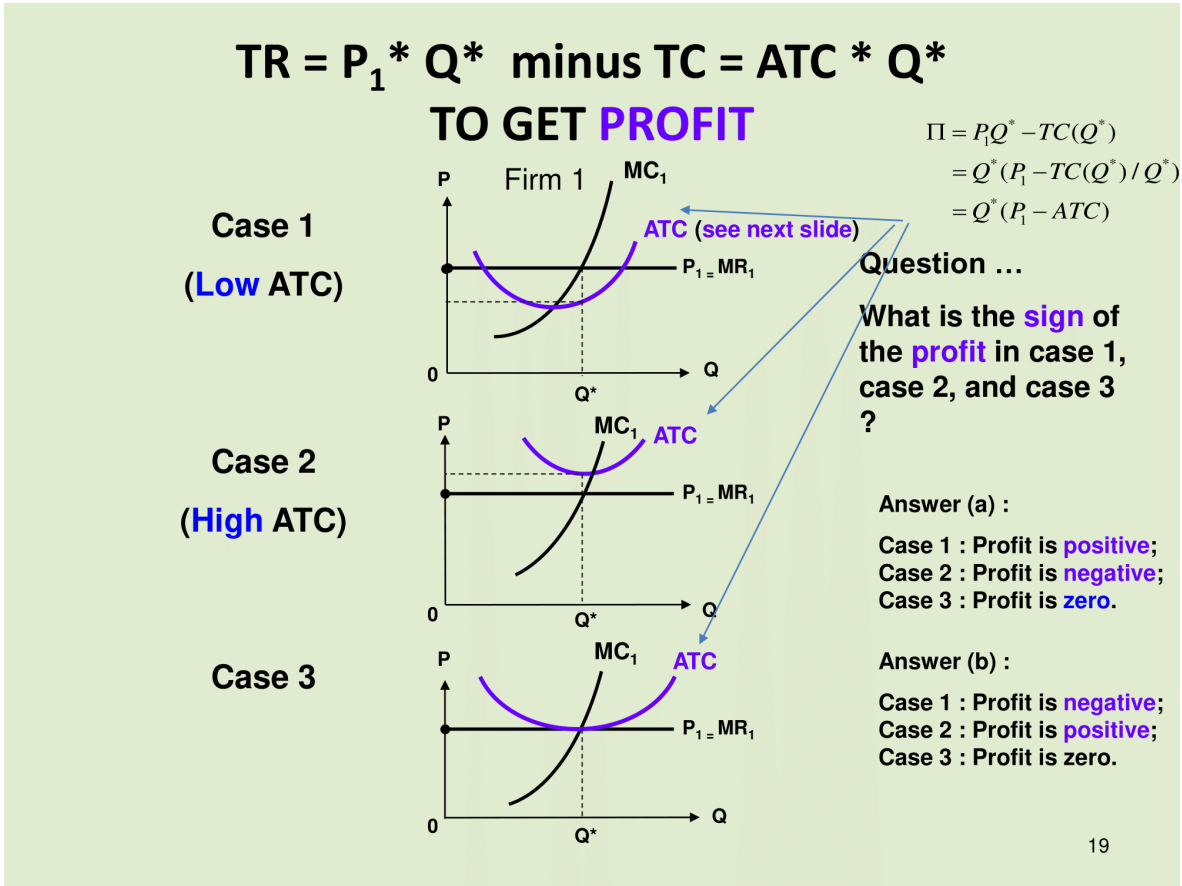
Horizontal summation of all individual demand curves yields the market demand curve.

i.e. with a given price, the market demand is the sum of all individual demands.

- **Total revenue** (TR) = $P \times Q$
- **Marginal revenue** (MR) = $\frac{\Delta TR}{\Delta Q}$
- **Total profit** (π or TP) = TR - TC



Total profit is maximized when MR = MC.



Since TP = TR - TC = $(P - ATC) \times Q$, TP is positive when $P > ATC$, zero when $P = ATC$, and negative when $P < ATC$.

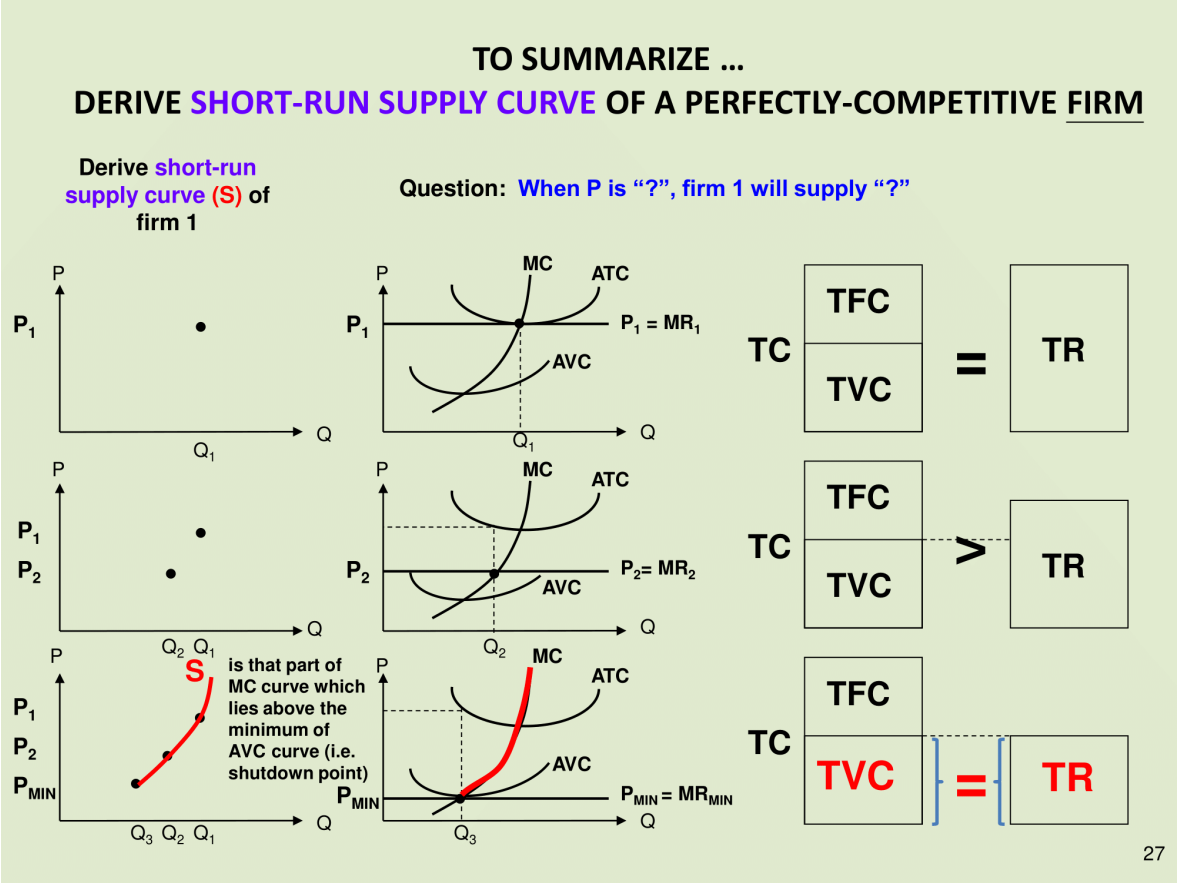
Normal and Economic Profit

- **Normal profit**: the minimum profit required to keep a firm in the market.
- **Economic profit**: the profit above normal profit. $\pi = TR - TC$

Normal profit is the **opportunity cost** of the firm's resources.

i.e. what money the entrepreneur could have earned if he/she had chosen the next best alternative instead of running the business.

Total cost = explicit cost (wages, interest, rent, etc.) + implicit cost (opportunity cost)



- When $TR \geq TFC + TVC$, the firm is making economic profit.
- When $TVC \leq TR < TFC + TVC$, the firm is making negative economic profit but positive normal profit.
- When $TR < TVC$, the firm is making negative economic profit and negative normal profit.

Shutdown point: the point where $TR = TVC$. If $TR < TVC$, the firm should shut down.

Expansion point: the point where $TR = TC$. If $TR > TC$, the firm should expand. This will increase π but normal profit remains the same.

Long-run equilibrium: the company makes zero economic profit in the long run. New companies will enter the market until the economic profit becomes zero.

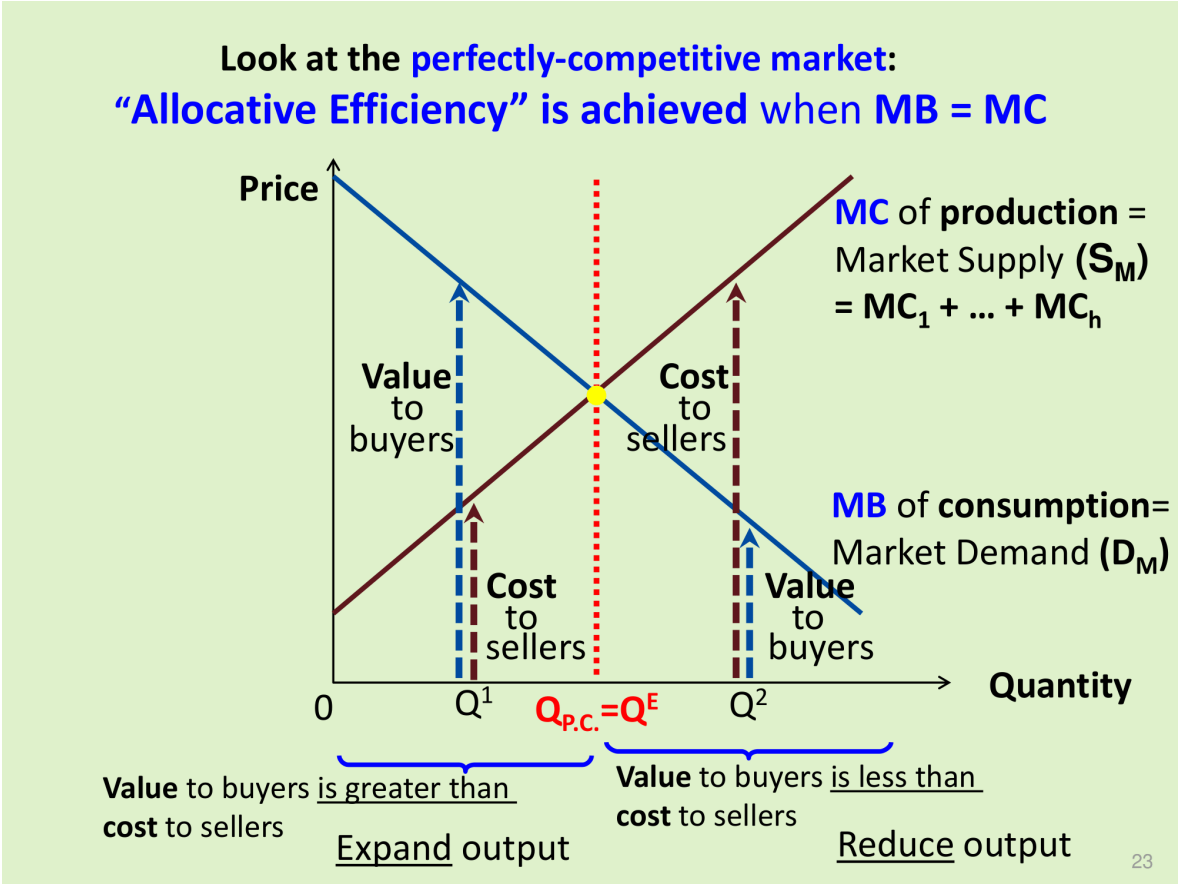
Surplus

- **Consumer Surplus** = the **Maximum amount willing to pay** - **Amount actually paid** for each unit.
- Consumer Surplus is the **net benefit** of consuming a good.
- $P = MB$ is the marginal benefit of consuming one more unit, and is equal to the maximum amount willing to pay.
- **Producer Surplus** = the **Amount actually received** - **Minimum amount willing to accept** for each unit.
- $P = MC$ is the marginal cost of producing one more unit, and is equal to the minimum amount willing to accept.

8. Perfect Competition & Allocative Efficiency

Allocative Efficiency

- Formally, **allocative efficiency** is achieved when the **value** that consumers place on a good (marginal benefit) is equal to the **cost** of resources used up in production (marginal cost).
- When $MB = MC$, the market is allocatively efficient. Denote the quantity as Q^*.
- If $Q < Q^*$, the value for buyers is greater than the cost for sellers, so the sellers will expand output.
- If $Q > Q^*$, the value for buyers is less than the cost for sellers, so the sellers will reduce output.

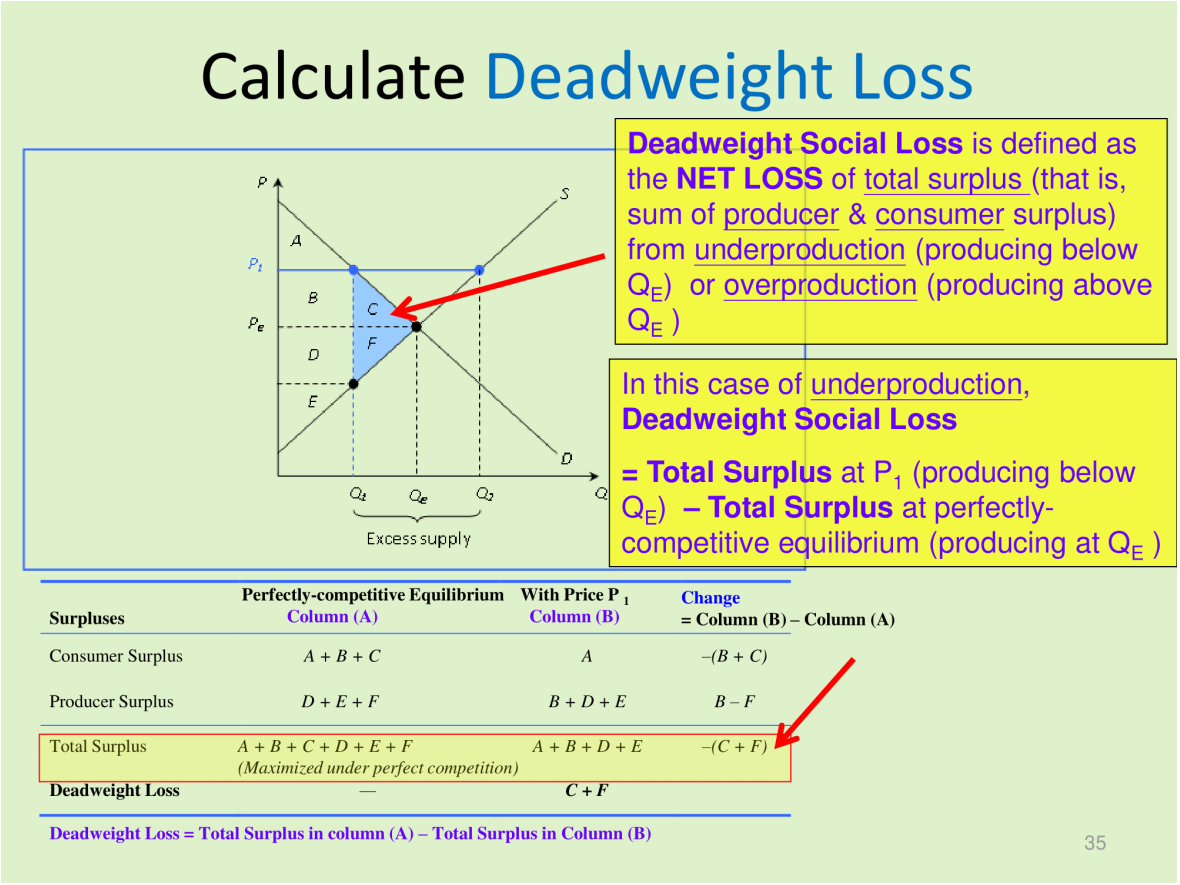


Society's Welfare

- **Society's Welfare** = **Consumer Surplus** + **Producer Surplus**
- Society's Welfare is maximized when the market is allocatively efficient.

Market Failure and Deadweight Loss

- **Market failure**: when the market produces more or less than the allocatively efficient quantity.
- **Deadweight social loss**: the loss of society's welfare due to market failure.
- DWL = theoretical maximum welfare - actual welfare



9. Monopoly

Characteristics of Monopoly

- **Single seller**
- **restricted entry**: barriers to entry prevent new firms from entering the market.
- **Unique product**: no close substitutes
- **Imperfect information**: buyers and sellers do not have perfect information.

Barriers to entry:

- **Legal barriers** to entry: government gives a monopoly legal right (e.g. license, patent, copyright) to sell a product.
  - e.g. MTR. No other companies are allowed to operate railway services in Hong Kong (after the merger of KCR and MTR).
- **Input/Resource Ownership Barriers**: the monopoly owns (or monopolizes) scarce resources.
- **Cost Barriers**: the monopoly has cost advantages over potential competitors.
  - Therefore, the monopoly can supply the whole market at a lower cost than multiple firms.
  - Natural monopolies: industries with high fixed costs and low marginal costs.

Market Power

Assumption: one firm takes over all firms in a perfectly competitive market, and becomes a monopoly. Therefore, the demand curve does not change.

The **demand curve** of a monopoly is the **market demand curve** which is downward-sloping. This means the monopoly has control over the price.

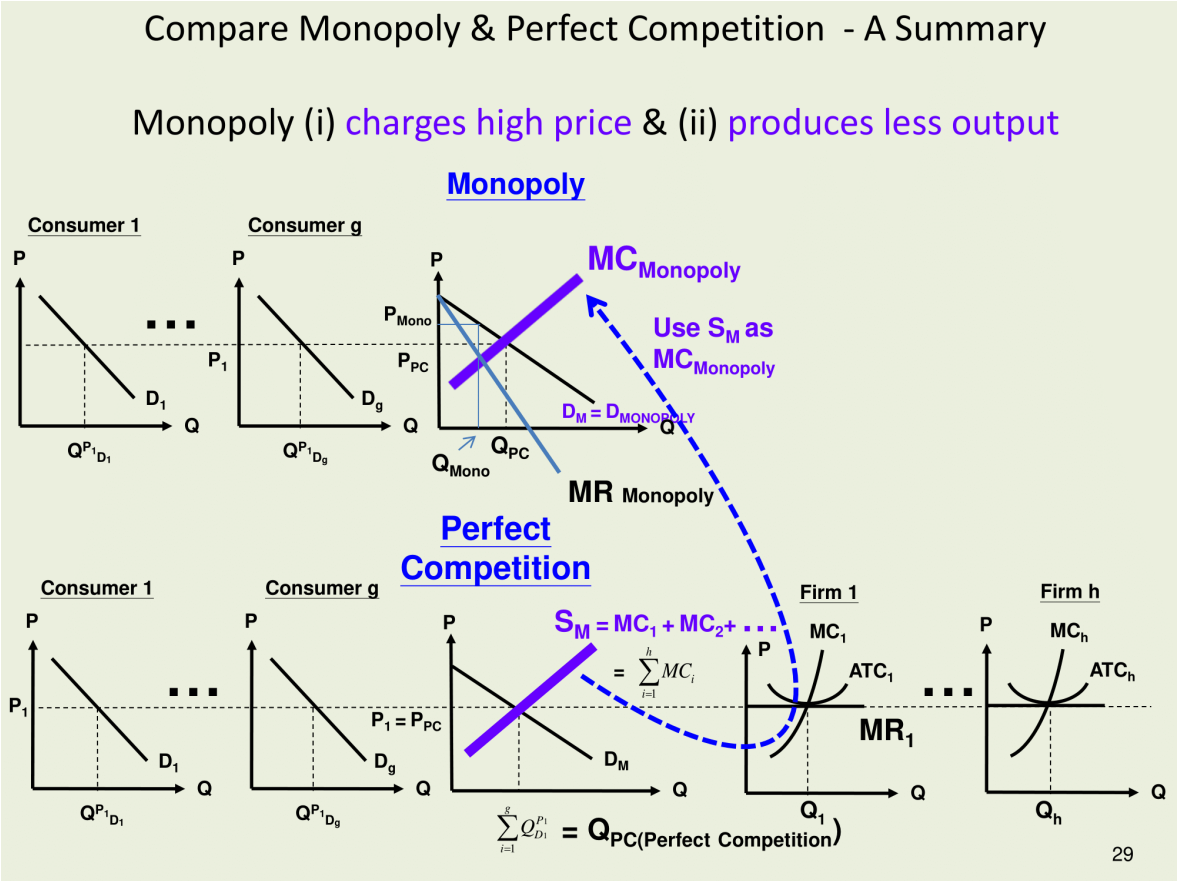
Market power: the ability of a firm to **raise its price without losing all its customers**.

- A perfectly competitive firm is a **price taker**. It has no market power.
- A monopoly is a **price maker**. It has market power.

Marginal revenue and demand curve:

- For a monopoly, **MR < P**. The MR curve is below the demand curve.
- This is because the monopoly has to lower the price to sell more units.
- e.g. the first product is sold at 90. To sell the second product, the price has to be lowered to 80. The price of the first product is also lowered to 80. Therefore, MR = 70 while P = 80, so MR < P.
- For competitive firms, MR = P. Marginal revenue does not change with quantity, and is equal to the market price.

Monopoly Equilibrium

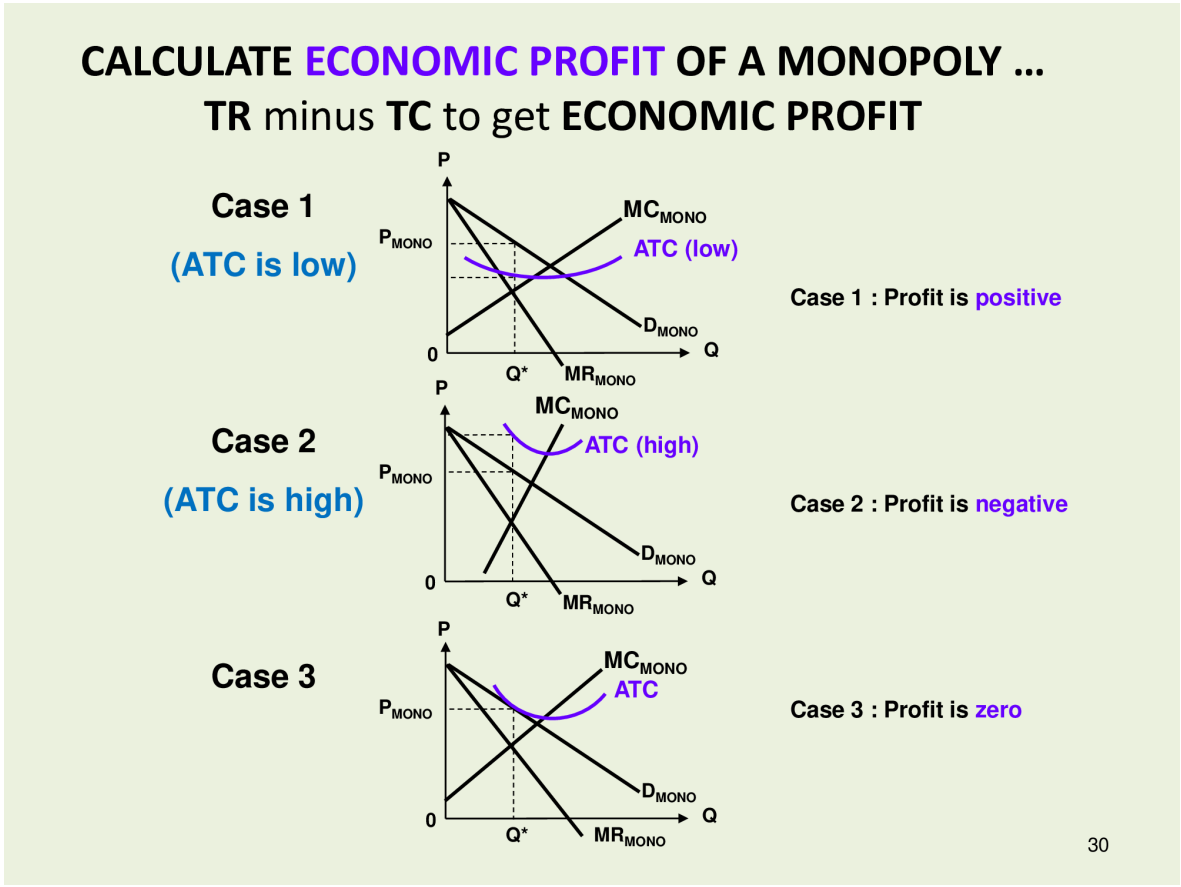


The monopoly maximizes profit when MR = MC.

Since there are only 1 firm in the market, the monopoly will choose the quantity where MR = MC, and set the price based on the demand curve.

Therefore,

- $P_{mono} > P_{PC}$ (monopoly charges a higher price)
- $Q_{mono} < Q_{PC}$ (monopoly produces less quantity)



Economic profit of a monopoly:

(Recall: economic profit = TR - TC)

Determinants of Market Power of Monopoly:

$\frac{P-MC}{P} = -\frac{1}{\epsilon}$

where ϵ is the price elasticity of demand. ($\epsilon = \frac{\%\text{ change in Q}}{\%\text{ change in P}}$)

A monopolist market is protected by **no new entrants**. But the market power is limited by the **elasticity of demand** ϵ.

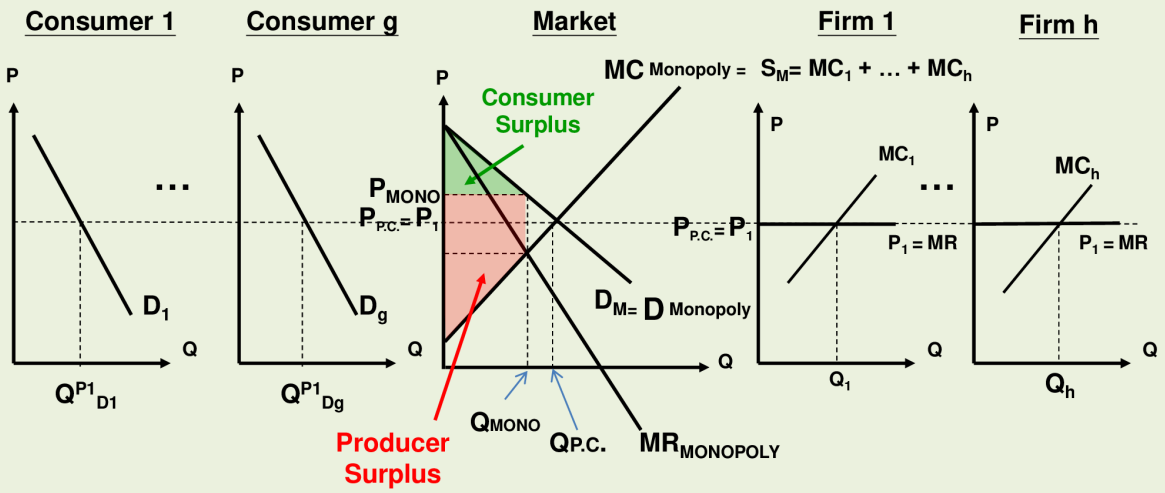
Explanation of this formula:

- $TR = P \times Q$ (total revenue = price × quantity)
- $\Delta TR = P\Delta Q + Q\Delta P$ ($TR_0 = P_0Q_0, TR_1 = P_1Q_1, TR_1 - TR_0 = P_1Q_1 - P_0Q_0 = P_0(Q_1 - Q_0) + Q_0(P_1 - P_0) = P_0\Delta Q + Q_0$)
- $\frac{\Delta TR}{\Delta Q} = P + Q\frac{\Delta P}{\Delta Q} = P + Q \times \text{MR} = P(1 + \frac{Q}{\Delta Q}\frac{\Delta P}{P}) = P(1 + \frac{1}{\epsilon})$ (MR = $\frac{\Delta TR}{\Delta Q}$)
- In monopoly, $MR = MC$, so $P(1 + \frac{1}{\epsilon}) = MC$
- Therefore $\frac{P-MC}{P} = -\frac{1}{\epsilon}$

Consumer Surplus and Producer Surplus

Producer surplus is the area between the supply curve Q = f(P) and the price line P.

FIND OUT CONSUMER SURPLUS AND PRODUCER SURPLUS IN MONOPOLY



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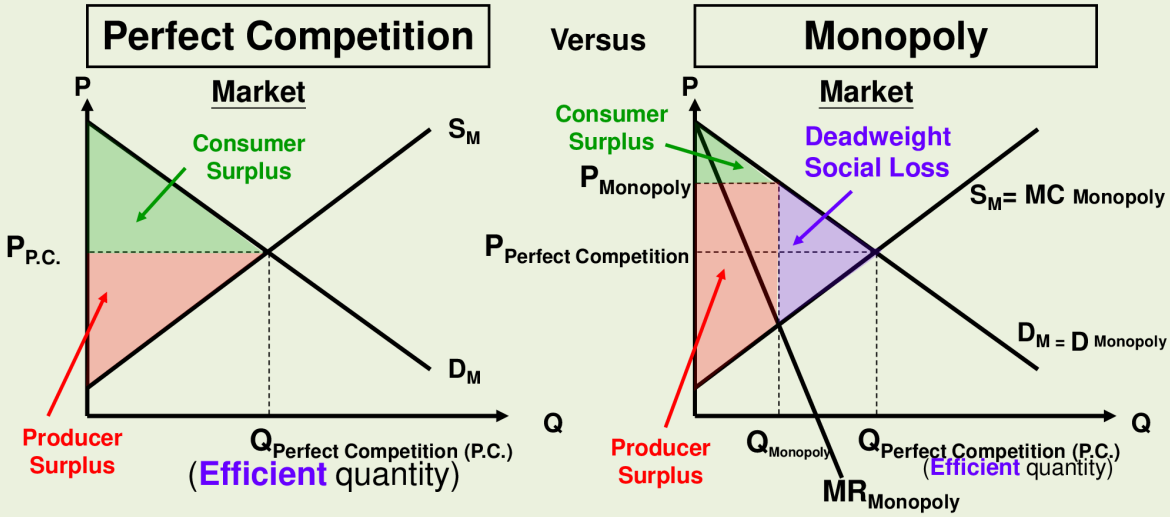
PUTTING TOGETHER PERFECT COMPETITION & MONOPOLY …



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Compared to perfect competition, monopoly results in a **transfer of surplus** from consumers to producers.

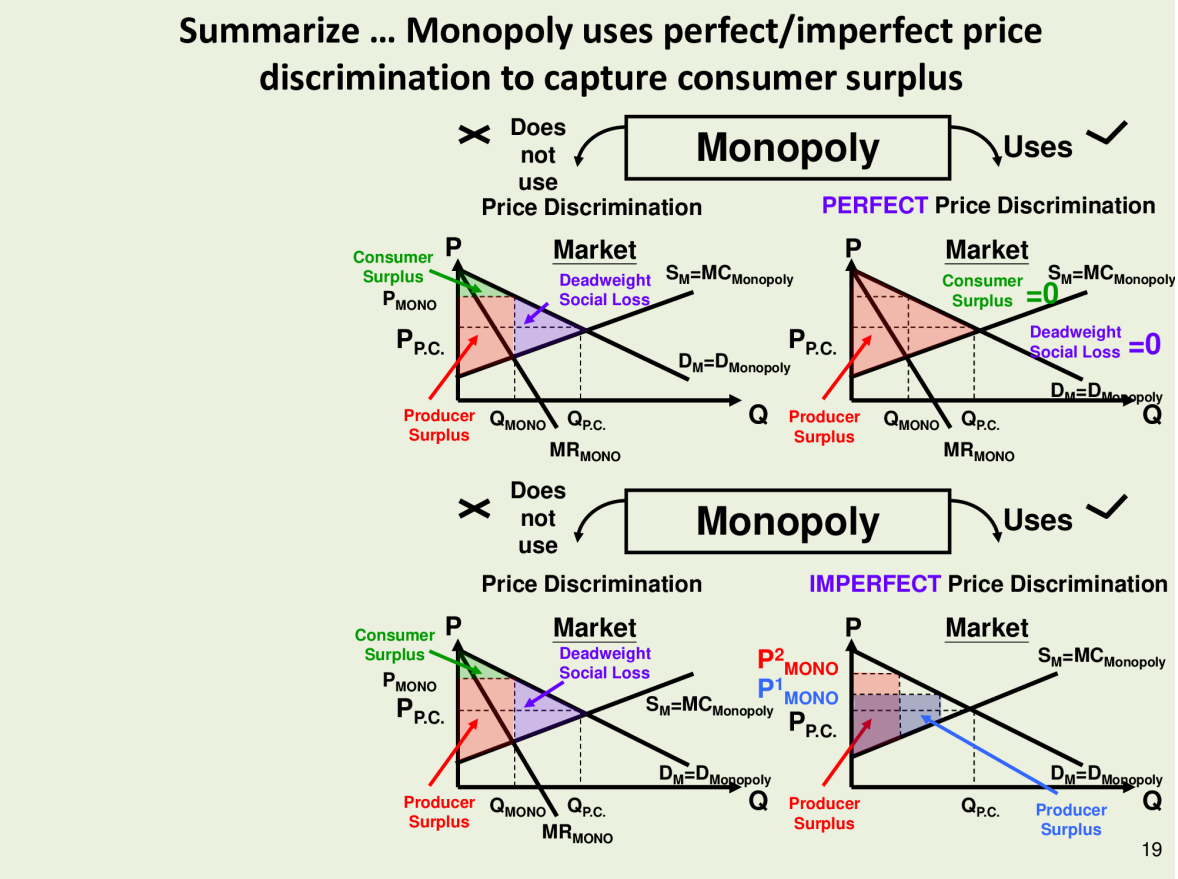
- Consumer surplus decreases.
- Producer surplus increases.
- Total social welfare decreases. Deadweight social loss is created.

Deadweight social loss is the loss of total social welfare (consumer surplus + producer surplus) due to overproduction or underproduction.

Allocative efficiency is achieved when $MB = MC$. In monopoly, $MB > MR = MC$, so the market is not allocatively efficient.

Price Discrimination

- **Price discrimination**: charging different prices to different customers for the same product, so that the firm can capture more consumer surplus. (maximize profit)
- **Perfect price discrimination**: charging each customer the maximum price they are willing to pay.
  - Consumer surplus = 0, producer surplus = total revenue - total cost, deadweight loss = 0
- **Imperfect price discrimination**: charging different prices to different groups of customers.
  - e.g. student discount, senior discount, etc.



10. Monopolistic Competition

	Perfect Competition	Monopoly	Monopolistic Competition
Number of firms	Many	One	Many
Entry and exit	Free	Restricted	Free
Goods	Homogeneous perfect substitutes	Unique no close substitutes	Differentiated close substitutes

Monopolistic competition is a market structure with many firms selling products that are similar but not identical.

Marginal Revenue and Demand Curve

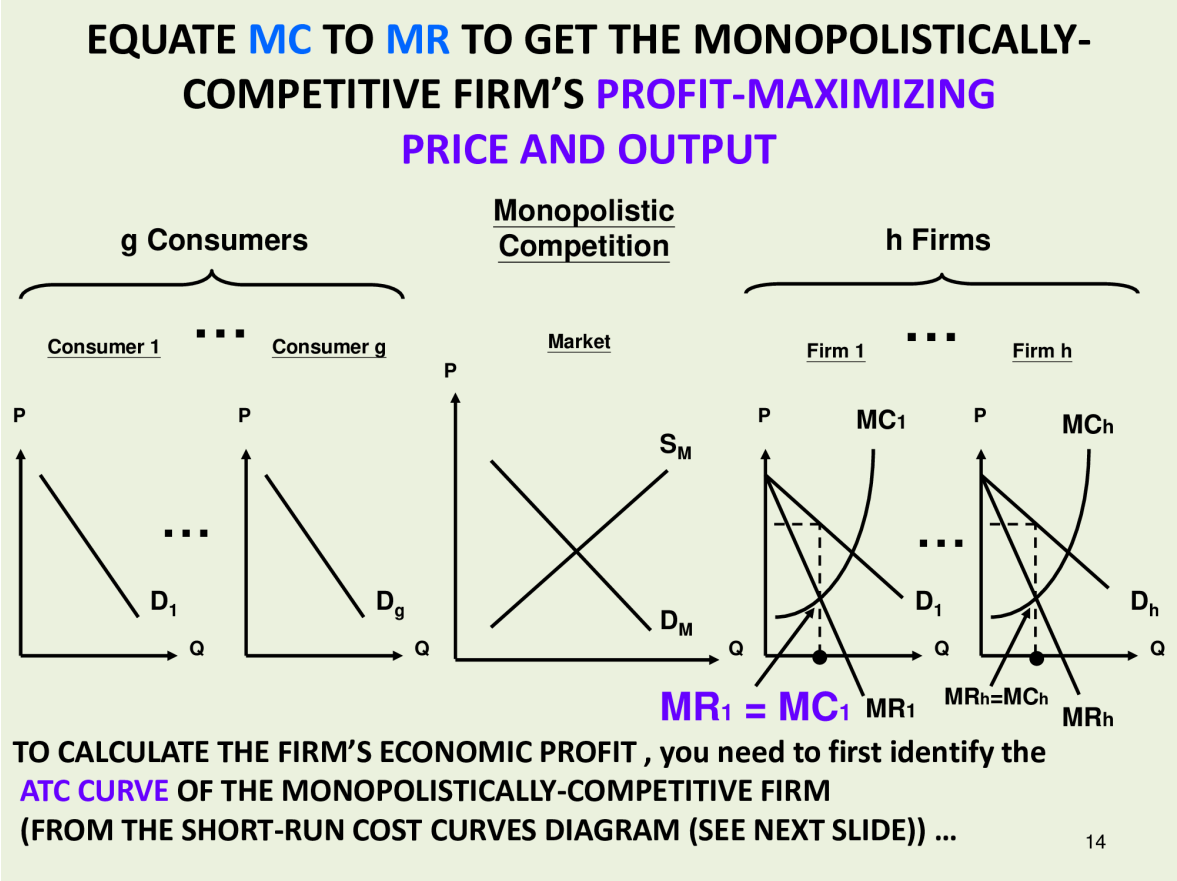
Recall:

- In perfect competition, selling more units does not change the price. Therefore, MR = P (horizontal line).
- In monopoly, selling more units lowers the price. Therefore, MR < P (downward-sloping line) and MR < MB.

In monopolistic competition, the demand curve is downward-sloping, but not as steep as a monopoly.

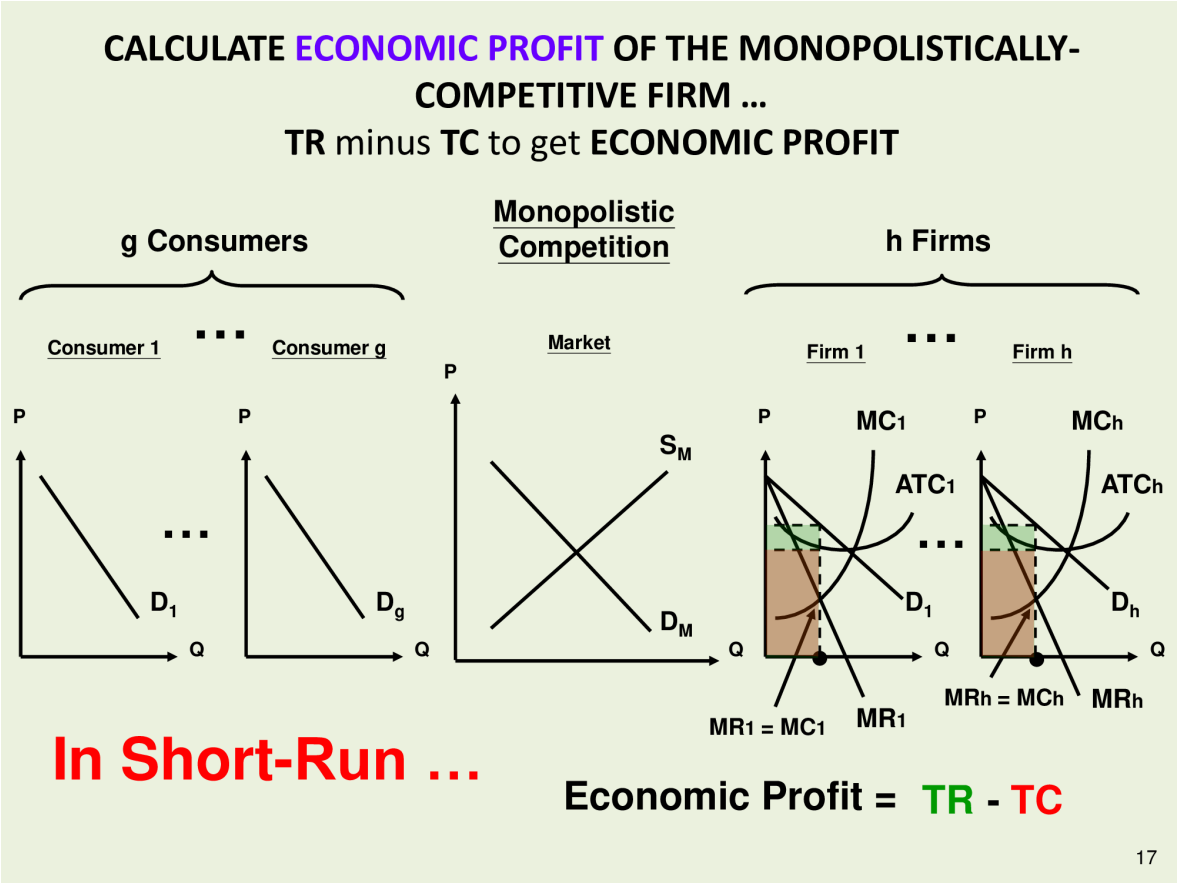
Each company has some market power, but the demand curve is more elastic than a monopoly. If the company increases the price by a little, it will not lose all its customers like in a perfect competition.

Short-run Profit Maximization

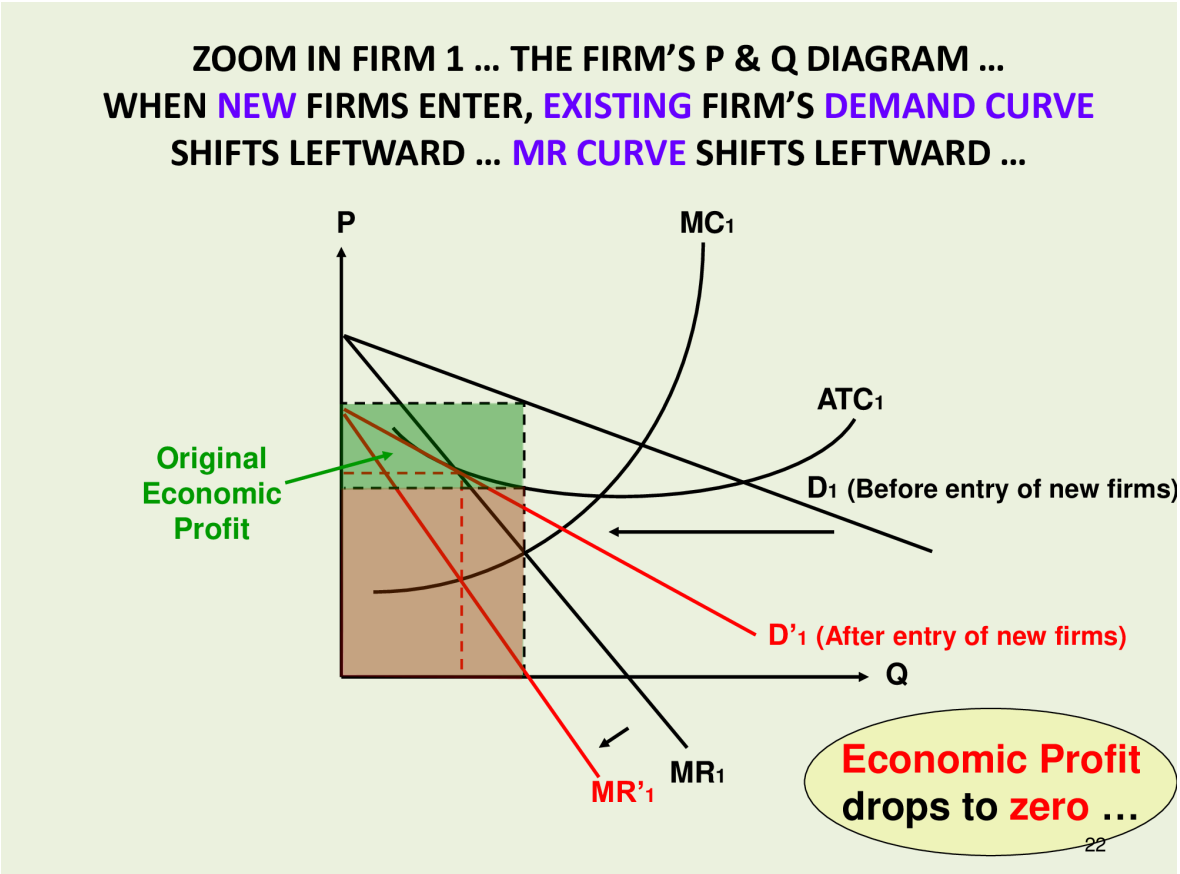


When MR = MC, the company maximizes profit. (This is the same as monopoly, and inherent in all market structures.)

Short-run economic profit: $\pi = TR - TC$



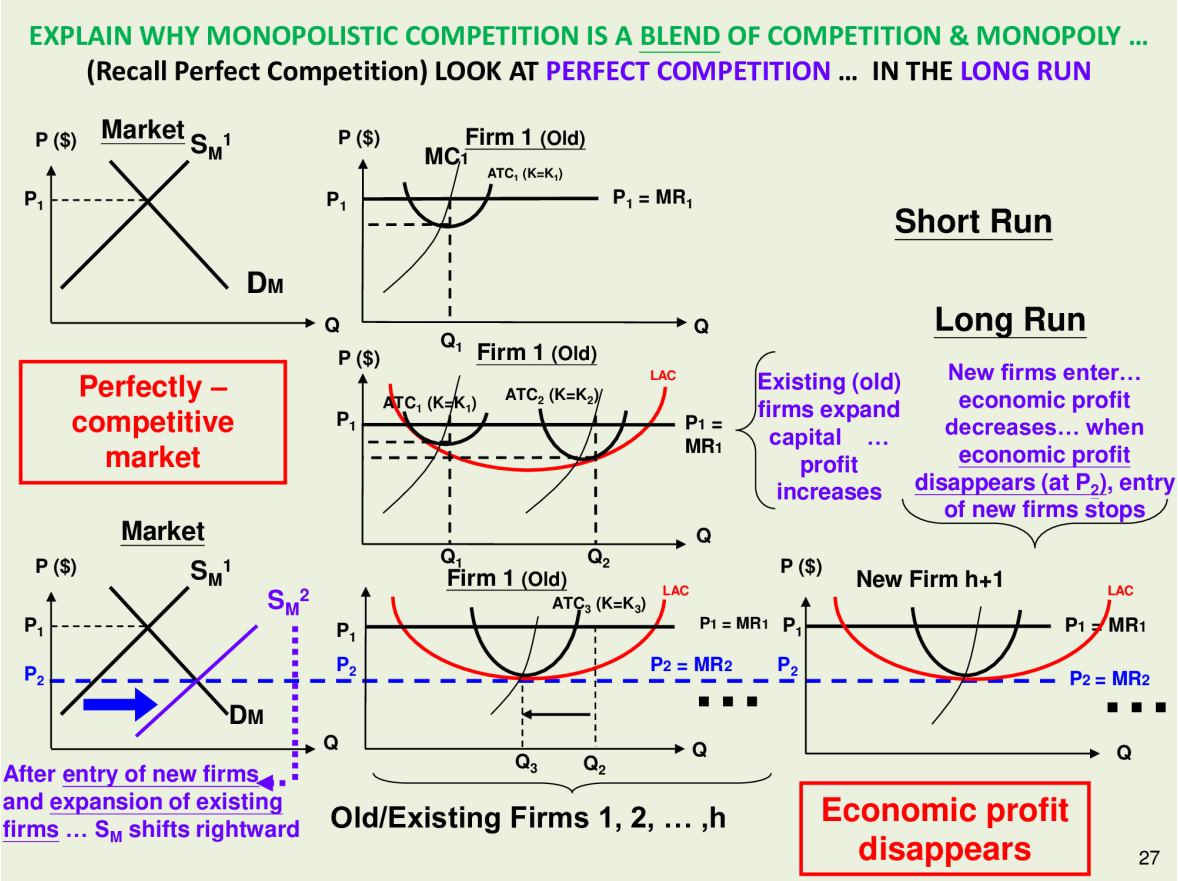
Long-run Equilibrium



Like in perfect competition, if a market is making positive economic profit, new firms will enter the market, till the economic profit becomes zero.

Different from perfect competition is that in monopolistic competition, new entrants will reduce the demand for existing firms (they attract some customers away). Therefore, the demand curve shifts left, and the economic profit decreases.

When demand curve intersects with ATC ($P = ATC$), the company is making zero economic profit.



Recall in perfect competition, when the company is making positive economic profit, new firms will enter the market, and the economic profit will decrease.

This is because, consider the market equilibrium demand = supply $MB = MC = P$. When new firms enter, **market supply** MC will shift right, which intersects demand MB at a lower price and higher quantity. Therefore all firms will make less and less profit.

Comparatively, in monopolistic competition, new firms makes existing companies' **individual demand** MB shift left.

Perfect Comp vs. Monopoly vs. Mono Comp

- In short-run, Mono Comp shares the **market power** of monopoly.
- In long-run, Mono Comp shares the **zero economic profit** of perfect competition.

Recall the determinants of market power of monopoly:

$\frac{P-MC}{P} = -\frac{1}{\epsilon}$

In Mono Comp, $\epsilon < -1$, i.e. the demand curve is highly elastic, because it is also elastic to the price changes of other firms.

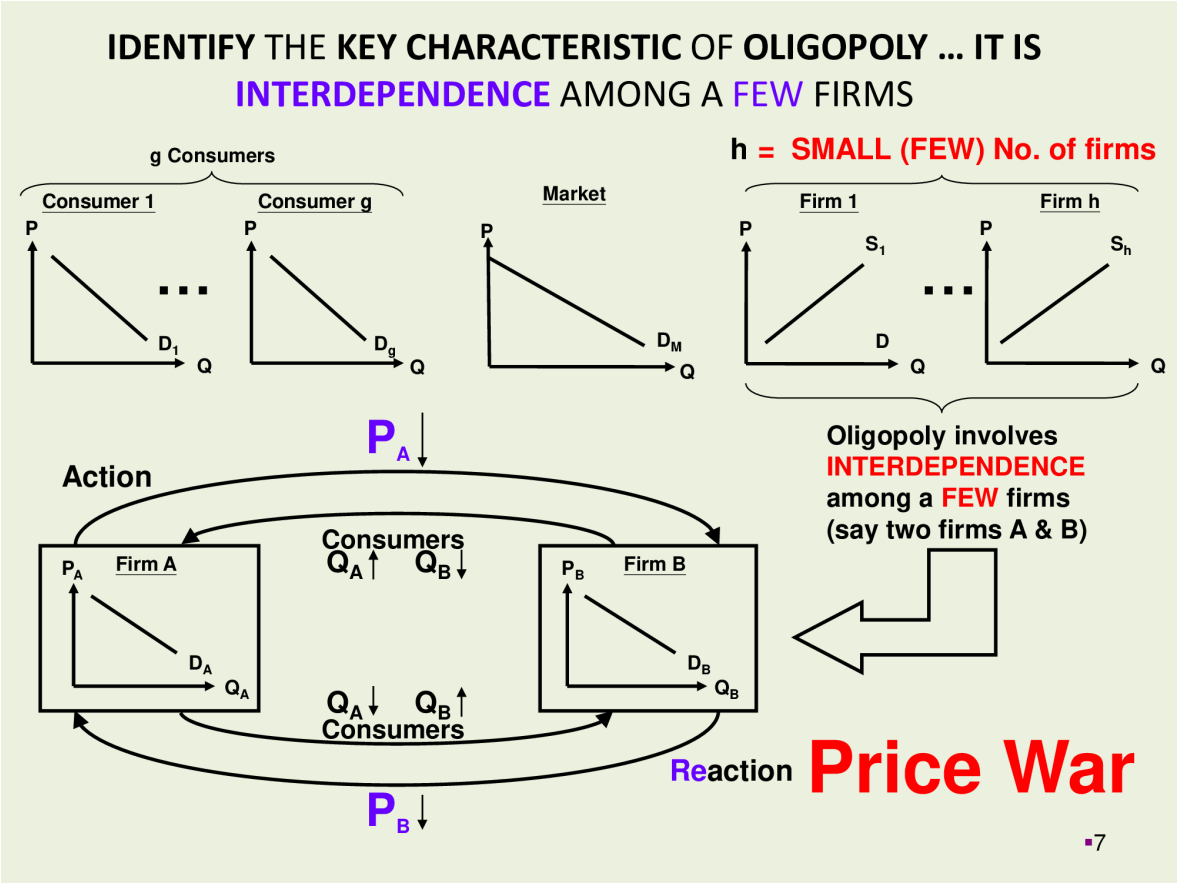
- A Mono Comp is **closer to perfect competition** than monopoly.
- A Mono Comp is **allocatively inefficient** because $MB > MC$. DWL created due to underproduction. However, this is offset by the **product differentiation**.

11. Oligopoly

	Perfect Comp	Monopoly	Mono Comp	Oligopoly
Number of firms	Many	One	Many	Few
Entry and exit	Free	Restricted	Free	Restricted

	Perfect Comp	Monopoly	Mono Comp	Oligopoly
Goods	Homogeneous	Unique	Differentiated	Homogeneous or differentiated
Market power	None	High	Some	High

Cartel



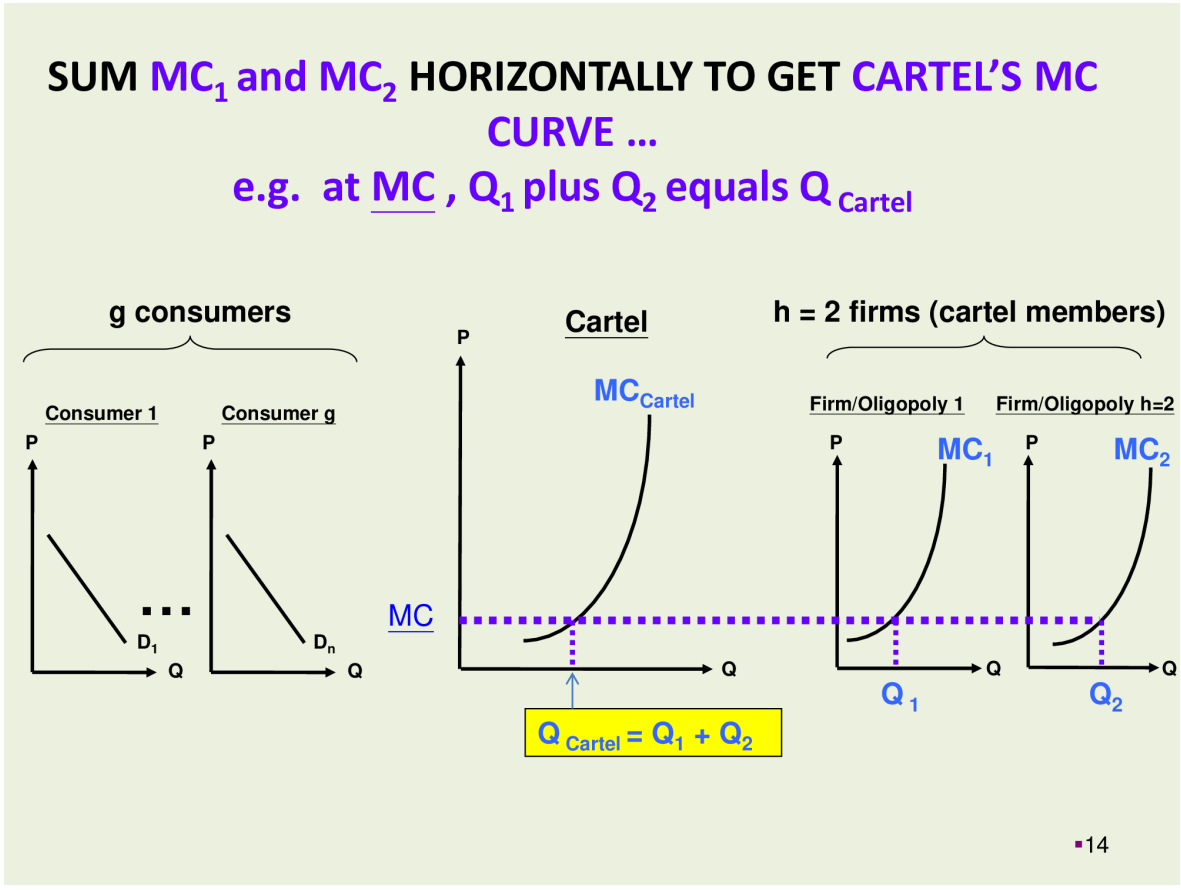
Assume two firms A and B. If A lowers the price, B will also lower the price to compete. This is a **price war**.

The price war will continue until the price is equal to the marginal cost $MR = MC$.

To avoid a price war, a few oligopoly firms can cooperate and form a **cartel**. (e.g. OPEC)

Companies in a cartel set the same price and share the market. The cartel behaves like a monopoly, in terms of price and quantity.

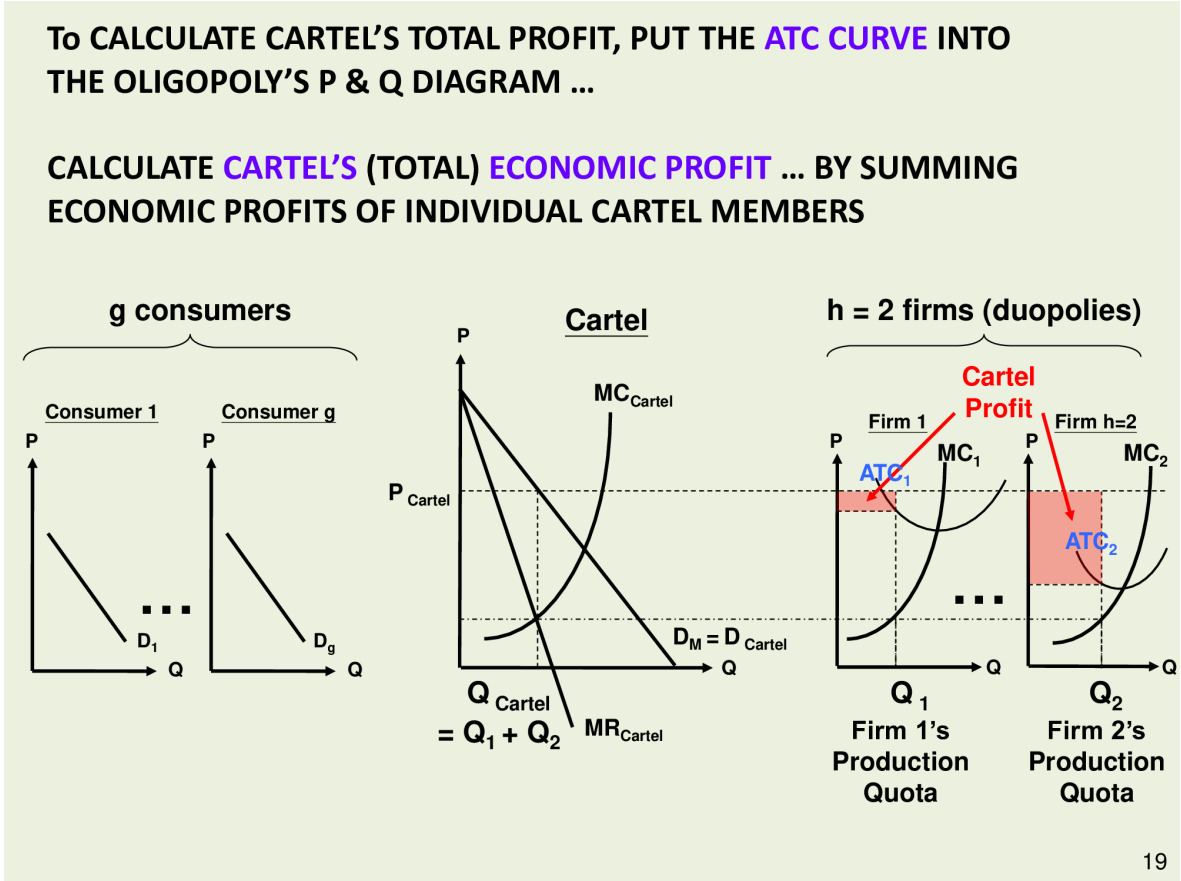
Marginal Cost and Marginal Revenue



MC of a cartel is the **horizontal summation** of all firms' MC curves.

At a given MC, the output quantity is the sum of all firms' output.

MR of a cartel is a downward-sloping line, like a monopoly.

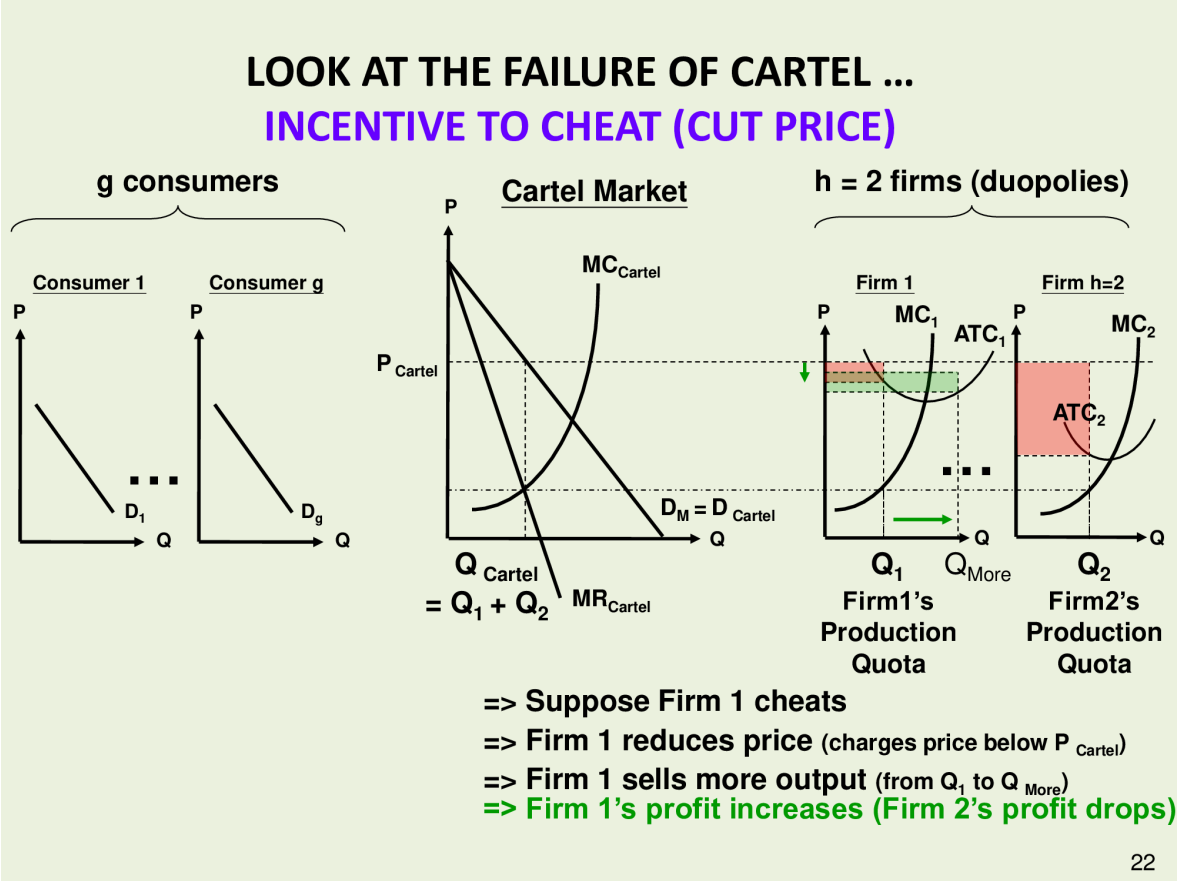


When MC intersects with MR at $P = P_0, Q = Q_{\text{cartel}}$, the cartel maximizes profit. Additionally, $P = P_{\text{cartel}}, Q = Q_{\text{cartel}}$ is on the demand curve, which determines the market price.

The cartel profit = $(P - ATC) \times Q_{\text{cartel}}$, which is different for each firm.

Failure of Cartel

- **Internal** failure: each firm has an incentive to cheat. If one firm increases output, it can sell more at the same price.
- **External** failure: new firms can enter the market and break the cartel.



Internal failure: If firm 1 reduces price and sells more, the profit of firm 1 increases, but the profit of firm 2 decreases.

External failure: new competitors reduce the profit of existing firms.

Game Theory

Game Theory is a branch of mathematics that studies the strategic interaction between rational decision-makers.

This includes strategic actions and reactions of firms in an oligopoly market.

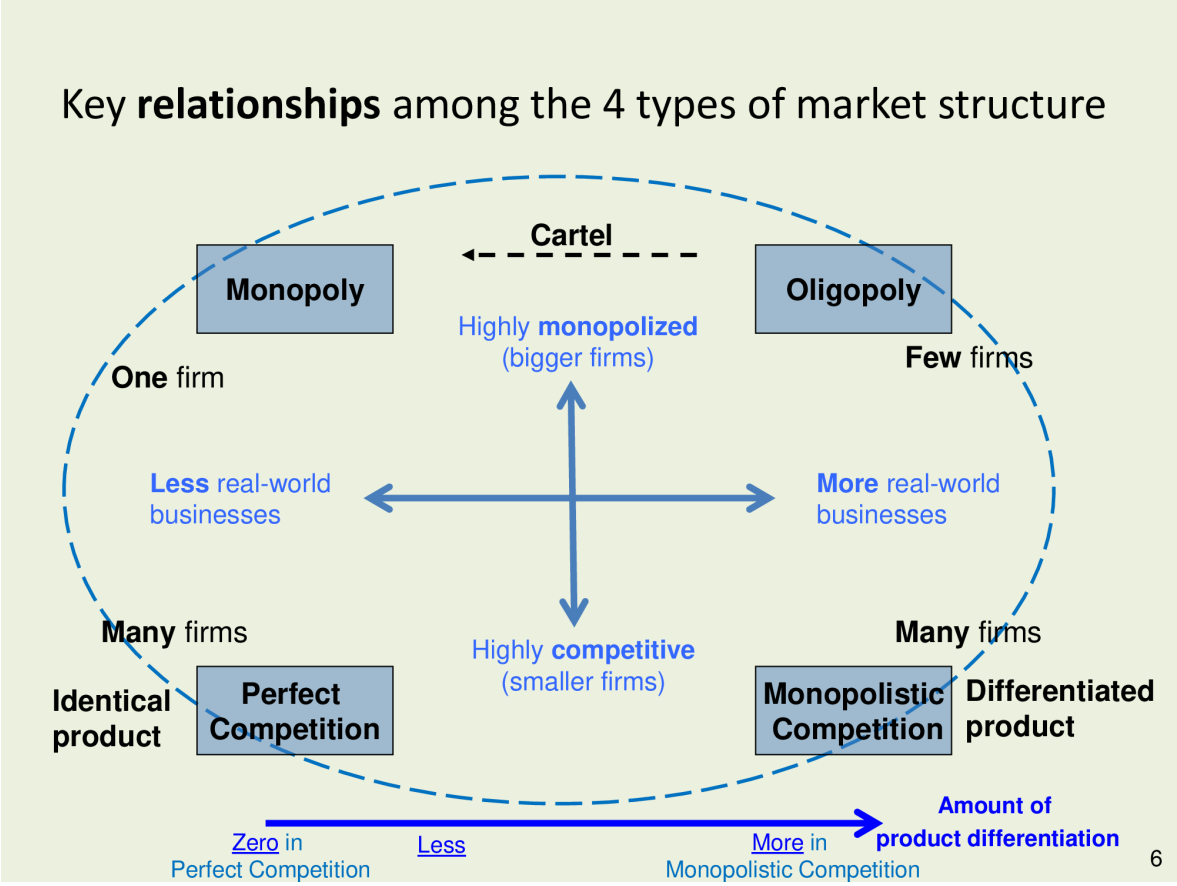
We assume there are 2 players named A and B.

- **Nash Equilibrium**: The outcome that occurs when both players choose their best strategy, given the strategy of the other player.
  - Player A chooses the best strategy given the strategy of player B.
  - Player B chooses the best strategy given the strategy of player A.
- **Dominant Strategy**: A strategy that is the best choice for a player, regardless of the strategy chosen by the other player.
  - Player A chooses the best strategy regardless of the strategy of player B.
  - If both A and B choose their dominant strategy, the outcome is a **Dominant Strategy Equilibrium**.
  - **Dominant Strategy Equilibrium MUST BE a Nash Equilibrium**.
  - **Nash Equilibrium MAY NOT BE a Dominant Strategy Equilibrium**.
- **Prisoner's Dilemma**: A game in which players have a dominant strategy that leads to a worse outcome for both players.

- Prisoner's Dilemma involves a Dominant Strategy Equilibrium that is not Pareto efficient.

- **Pareto Efficiency**: A situation in which no player can be made better off without making another player worse off.

Four Types of Market Structure



4-firm concentration ratio: the percentage of total industry sales accounted for by the 4 largest firms.

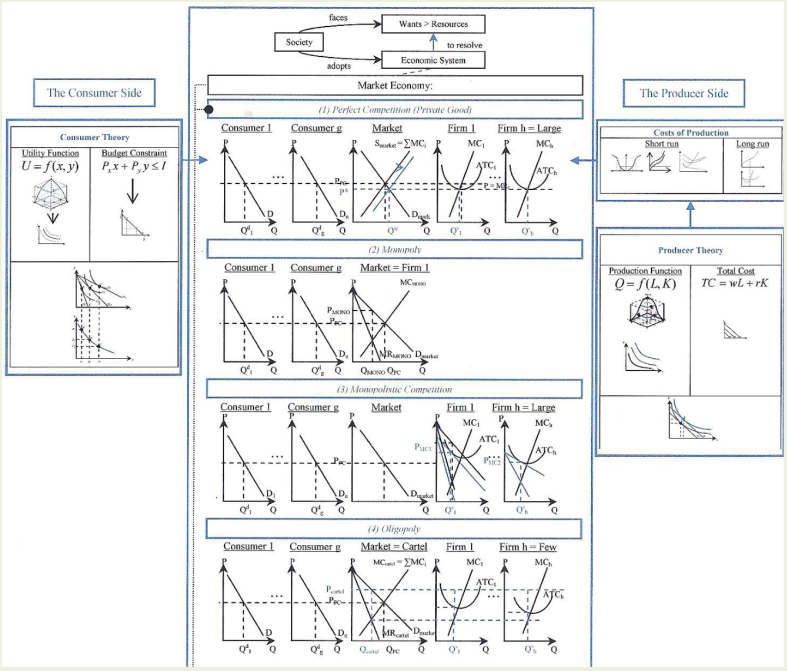
In Monopoly, the 4-firm concentration ratio is 100%.

In Oligopoly, the 4-firm concentration ratio is high, but less than 100%.

In Perfect Comp and Mono Comp, the 4-firm concentration ratio is low.

Microeconomics:

Use concept map to Link major concepts from the beginning to present



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- Demand curve $P = f(Q)$ is downward-sloping.
- Market demand curve is the horizontal summation of all individual demand curves (sum of Q at each price).

In perfect competition,

- Each firm has a MC and ATC curve. MC is increasing, ATC is U-shaped.
- When MC = ATC, the firm maximizes profit.
- Market supply curve is the horizontal summation of all individual MC curves.

Glossary

Fundamentals

- **Microeconomics**: the study of how individuals and firms make decisions and how they interact in markets.
- **Opportunity cost**: the benefit of next best (unselected) alternative.
- **Sunk cost**: a cost that has already been incurred and cannot be recovered.
- **PPC** (Production Possibility Curve): a curve that shows the maximum possible output combinations of two goods or services (K, C) that an economy can produce with its limited resources.

Theory of Consumer

- **Utility**: a numerical representation of consumer preferences.
- **Indifference Curve**: a curve that shows all combinations of A and B that yield the same level of utility U.
  - Slope: **marginal rate of substitution** (MRS) $-\frac{MU_A}{MU_B} = -\frac{\Delta X_B}{\Delta X_A}$, i.e. 1 more unit of A can yield the same utility as MRS units of B.
- **Budget Line**: a line that shows all combinations of A and B that can be purchased with a given income I. $P_A \times X_A + P_B \times X_B = I$
  - Slope: $-\frac{P_A}{P_B}$, i.e. for 1 more unit of A, $\frac{P_A}{P_B}$ units of B are given up.

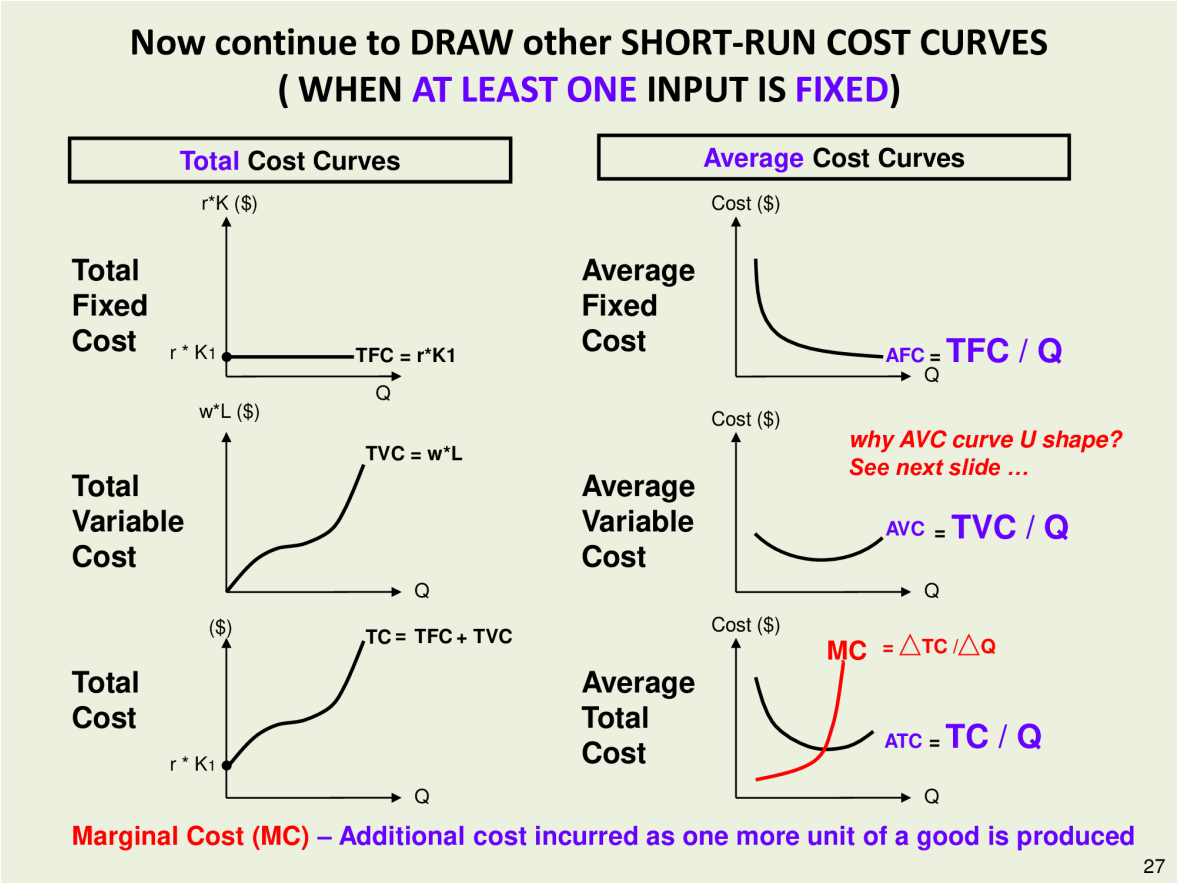
- **Utility Maximization**: when the budget line is tangent to an indifference curve, the consumer is in equilibrium and maximizes utility.
  - $|MRS| = \frac{MU_A}{MU_B} = \frac{P_A}{P_B}$ or $\frac{MU_A}{P_A} = \frac{MU_B}{P_B}$.
  - $\frac{MU_A}{P_A}$ is the marginal utility per dollar of A.
- **Total Utility** (TU) curve is upward-sloping, growing at a decreasing rate.
- **Marginal Utility** (MU) is the derivative of TU, and is downward-sloping.

Theory of Producer

- **Isoquant Curve**: a curve that shows all combinations of labor and capital that yield the same level of output.
  - Slope: **marginal rate of technical substitution** (MRTS) $-\frac{\Delta K}{\Delta L} = -\frac{MP_L}{MP_K}$, i.e. 1 more unit of L can save MRTS units of K.
- **Isocost Line**: a line that shows all combinations of labor and capital that can be purchased with a given cost. $w \times L + r \times K = TC$
  - Slope: $-\frac{w}{r}$, i.e. for 1 more unit of L, $\frac{w}{r}$ units of K are given up.
- **Cost Minimization**: when the isoquant curve is tangent to an isocost line, the producer is in equilibrium and minimizes cost.
  - $|MRTS| = \frac{w}{r}$ or $\frac{MP_L}{w} = \frac{MP_K}{r}$.
- **Total Product** (TP) curve is upward-sloping, growing slow-fast-slow.
  - For short run TP curve, K is a constant, so it is TP = f(L).
- **Marginal Product** (MP) curve is inverted U-shaped, increasing and then decreasing.
  - When MP > AP, AP is increasing. When MP < AP, AP is decreasing. When MP = AP, AP is at its maximum.

Theory of Cost

- Short-run costs: at least one factor (usually K) is fixed.
  - **Total cost** (TC) = FC + VC
    - a upward-sloping line starts at $(0, rK)$.
  - **Total fixed cost** (TFC) is a constant.
    - a horizontal line with $C = rK$.
  - **Total variable cost** (TVC) is increasing.
    - an upward-sloping line starts at $(0, 0)$.
  - **Average total cost** (ATC) = AFC + AVC
    - a downward-sloping line.
  - **Average fixed cost** (AFC) = FC / Q
    - a U-shaped curve, decreasing and then increasing.
  - **Average variable cost** (AVC) = VC / Q
    - a U-shaped curve, decreasing and then increasing.
  - **Marginal cost** (MC) = $\frac{\Delta TC}{\Delta Q}$
    - an upward-sloping line, intersecting AVC at its minimum point.



- Long-run costs: all factors are variable.
  - **Long-run total cost** (LTC) envelops all short-run total cost (SRTC) curves.
  - **Long-run average cost** (LAC) is U-shaped, decreasing at first and then increasing. It envelops all short-run average cost (SRATC) curves.

Market Structure

Common among all market structures:

- To maximize profit, MR = MC.
- Total profit $\pi = TR - TC = (R - ATC) \times Q$.

Perfect Competition

- **Total profit**: revenue minus explicit costs. $\pi = TR - TC$. Consists of 2 parts: normal profit and economic profit.
- **Economic profit**: the profit above normal profit.
- **Normal profit**: the minimum profit required to keep a firm in the market. The opportunity cost of the firm's resources. (If not continuing the business, the entrepreneur could have earned the next best alternative.)
- **Shutdown decision**: TC = TFC + TVC
  - If $TR \geq TC$, the firm is making economic profit.
  - If $TVC \leq TR < TC$, the firm is making negative economic profit but positive normal profit.
  - If $TR < TVC$, the firm is making negative normal profit. The company should shut down.
- Market supply curve is the horizontal summation of all individual MC curves. $S = MC_1 + MC_2 + \dots$
- **Long-run equilibrium**: the company makes zero economic profit in the long run. New companies will enter the market until the economic profit becomes zero.
  - New entrants increase the market supply
  - The market reaches a new equilibrium with lower price and higher quantity.
  - In the long-run, MR gradually decreases to MC = $\min(ATC)$.

- **Consumer Surplus**: the net benefit of consuming a good. The maximum amount willing to pay minus the amount actually paid.
  - Area between MB curve and price line.
- **Producer Surplus**: the amount actually received minus the minimum amount willing to accept.
  - Area between price line and MC curve.
- **Allocative Efficiency**: achieved when $MB = MC$.
  - In perfect competition, a equilibrium $Q_D = Q_S$ is allocatively efficient. (In perfect competition, $Q_D = MB, Q_S = MC$.)
  - In all other market structures, allocative efficiency is not achieved. (Except price discrimination in monopoly.)
- **Society's Welfare**: consumer surplus + producer surplus. Maximized when the market is allocatively efficient.
- **Market Failure**: **Deadweight social loss** created due to overproduction or underproduction.

Monopoly

Key difference: marginal revenue curve is lower than the market demand curve. $MR < P$. This is because selling more units lowers the price.

Market power $\frac{P-MC}{P} = -\frac{1}{\epsilon}$, where ϵ is the price elasticity of demand.