

Short-Run Cost & Production

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- (3) Short-Run Quantity and Cost of Production
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1. Meaning of Production

1.1 Producer, Factor of Production and Production

4.1

Definition – Firm or Producer

Firm of producer is an institution that gathers all the factors to conduct production of a good or service for a society.

Definition – Factors of Production

4.2

Factors of production are resource, material or people gathered to produce a good or service.

Land – rent

Capital – interest

Labor – wage

Entrepreneur – profit

Definition – Production

4.3

Production is a process of transforming all the factors of production into a good or service serving people's need.

Some of the economists are not interested in the production.

1. Meaning of Production

1.1 Producer, Factor of Production and Production

Firm	Factors of Production	Product
Consider these productions		
• <u>iPhone Xs</u> - good Apple Inc.	Land: Foxconn Labor: Chinese (child) labor Capital: Machine Entrepreneurs: Tim Cook	• iPhone Xs
• Starbucks coffee	Land: Labor: Capital: Entrepreneurs:	
• <u>Recruiting company</u> - service 6-12 months salary Exxon Mobil ↳ Recruiting Agency ↳ Graduates	Land: Rent an office Labor: Recruiters Capital: Office supplies Entrepreneurs: Manager	• Recruiting people

1. Meaning of Production

1.2 Producer's Incentive and Production Function

Monopolist - Geymon

4.4

Definition – Profit Maximization *eg. Predatory Pricing*

If a firm or producer is a rational decision maker, its objective is to maximize profit.

4.5

Definition – Production Function

Production function is a mechanism that transform factors of production into a good or service. *quantity of product*

$$Q = f(\text{land, labor, capital, entrepreneur})$$

But for the sake of simplicity

implicit function

$$Q = f(\text{labor, capital}) = f(K, L)$$

1. Meaning of Production

1.2 Producer's Incentive and Production Function

Das Kapital

Cobb-Douglas Production Function

$$Q = AK^\alpha L^\beta \quad (\text{explicit function})$$

Q : Quantity of product

A : Level of technological advancement

K : Amount of capital

L : Amount of labor

α, β : the elasticity of capital and labor respectively.

$$Q = (10)(30)(50)^1$$

$$= 15,000$$

$$= 10$$

$$= 30$$

$$= 50$$

$$= (1, 1)$$

Marginal Product of Labor is quantity of product resulted from the incremental labor.

$$\frac{\partial Q}{\partial L} = \beta \cdot AK^\alpha L^{\beta-1} = MP_L$$

$$MP_K = \frac{\partial Q}{\partial K} = \alpha \cdot AK^{\alpha-1} L^\beta$$

1. Meaning of Production

1.3 Short-Run and Long-Run Production

Definition – Short-Run Production

4.6

Short-run production is when there are

- (1) Fixed factor of production – or a factor that cannot be increased or decreased
- (2) Variable factor of production – or a factor that can be increased or decreased

$$Q = f(\bar{K}, L)$$

$\bar{K}$ $\rightarrow$ constant

Definition – Long-Run Production

4.7

Long-run production is when all the factors can be variable.

$$Q = f(\underline{K}, L)$$

2. Short-Run Production, Factor and Quantity

2.1 Types of output

Short-run production

Short-run production is a study between **a factor of production and output**, given that capital (K) is a fixed factor and labor (L) is a variable factor.

$$\underline{Q} = f(\bar{K}, \underline{L})$$

Capital is kept constant throughout the production. Therefore, this is an example of relationship between labor and output.

2. Short-Run Production, Factor and Quantity

2.1 Types of output

Definition – Total Product (TP, Q)

4.8

Total product is the amount of total output from adding all the factors of production into the production process.

Definition – Average Product (AP)

4.9

Average product is the amount of product per variable factor.

$$AP_L = \frac{TP}{L}$$

Definition – Marginal Product (MP)

4.10

Marginal product is the amount of additional product from marginal labor added into production.

$$MP_L = \frac{\Delta TP}{\Delta L} = \frac{dTP}{dL}$$

2. Short-Run Production, Factor and Quantity

2.1 Types of output

$$Q = f(K, L)$$

Table of output

(1) Labor	(2) Total product	(3) Average product	(4) Marginal product
<u>0</u>	0	—	$MP_L = \frac{\Delta TP}{\Delta L} = 1$
1	3	$\frac{3}{1} = 3$	$\frac{3-0}{1-0} = 3$
2	8	$\frac{8}{2} = 4$	$\frac{8-3}{2-1} = 5$
3	12	$\frac{12}{3} = 4$	4
4	14	$\frac{14}{4} = 3.5$	2
5	14	$\frac{14}{5} = 2.8$	0
6	12	$\frac{12}{6} = 2$	-2

2. Short-Run Production, Factor and Quantity

2.2 Law of Diminishing Marginal Product

4.11

Definition – Law of Diminishing Marginal Product

Law of diminishing marginal product states that, in the short-run production, when variable factor is added incrementally into the production, marginal product will be increasing at first, then decreasing and become negative eventually.

Consider these examples

- TU T-shirt #72

Factory $\swarrow$ $\searrow$ $\begin{matrix} \text{Sewing machine} : K \\ \text{Labor} : L \end{matrix}$

- iPhone Xs production

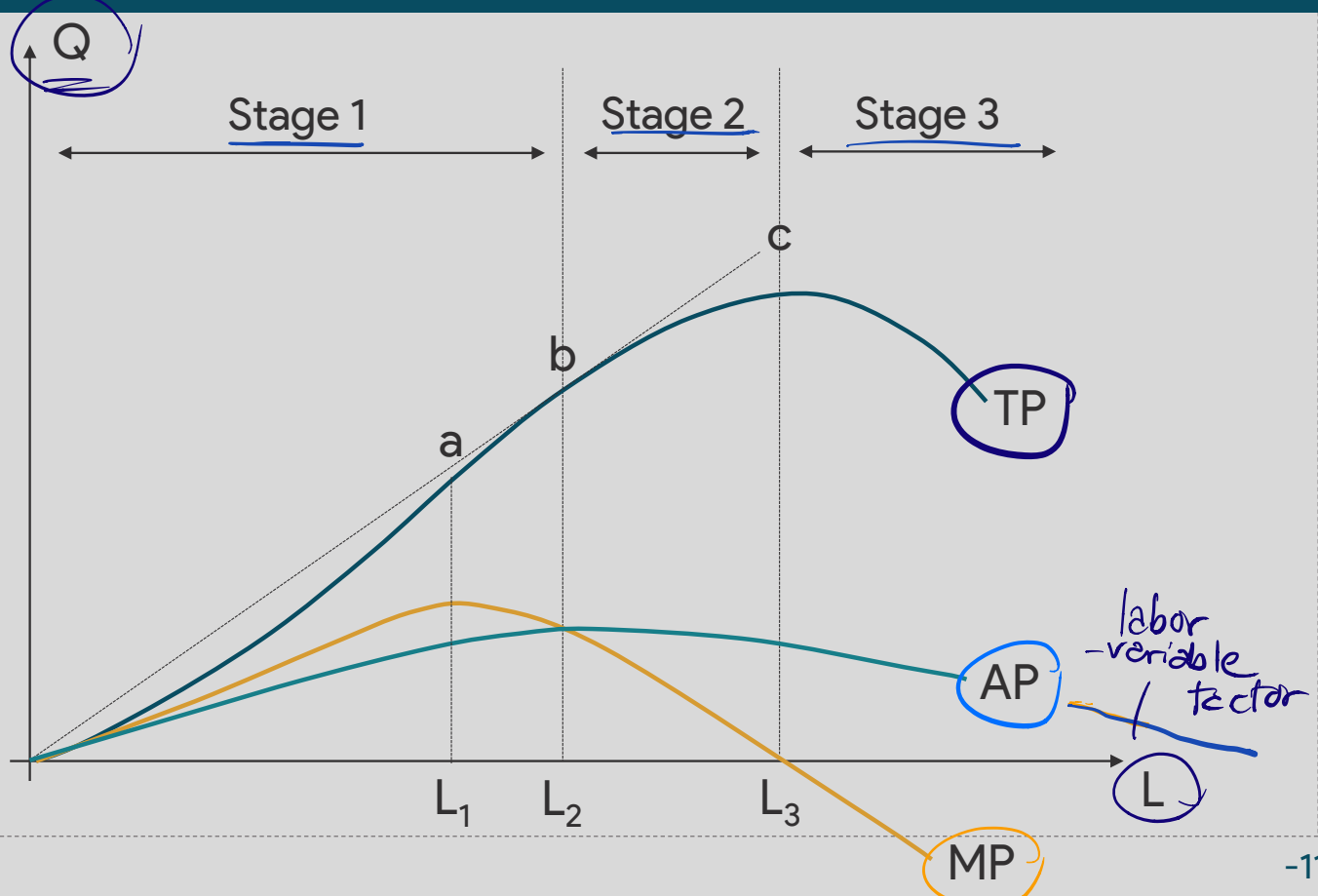
Cause?

Disproportioned
factors of production

2. Short-Run Production, Factor and Quantity

2.3 Stages of production

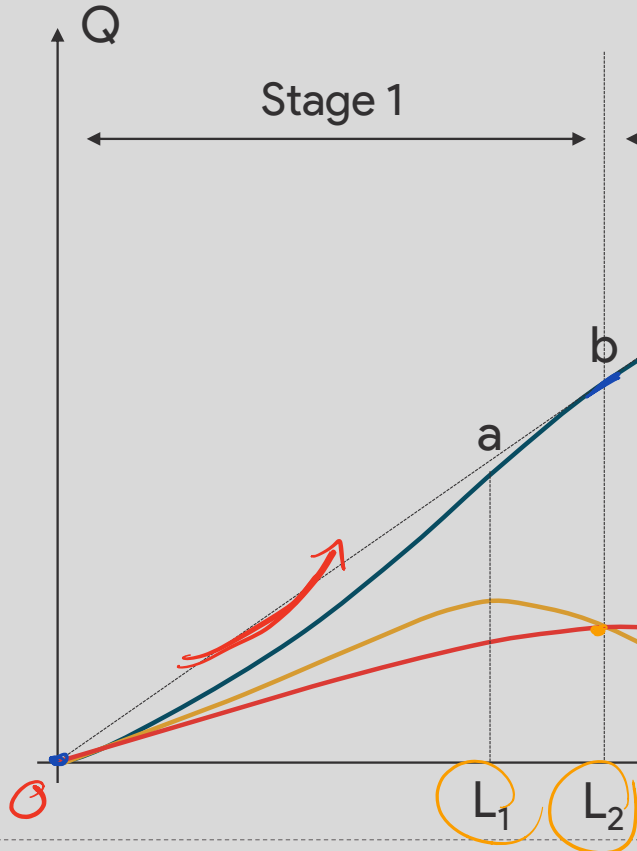
Product curves



2. Short-Run Production, Factor and Quantity

2.3 Stages of production

Product curves



Stage 1

- **TP**
 - Increasing at increasing rate until point a.
 - After point a, still increasing at decreasing rate.
 - At point b, a tangent line can be drawn from the origin.
- ~~MP~~ ~~MP~~ **MP**
 - Increasing until point a.
 - Decreasing after point a.
 - Intersect with **AP** at point b.
- ~~AP~~ **AP**
 - Increasing until point b
 - Intersect with **MP** at point b.

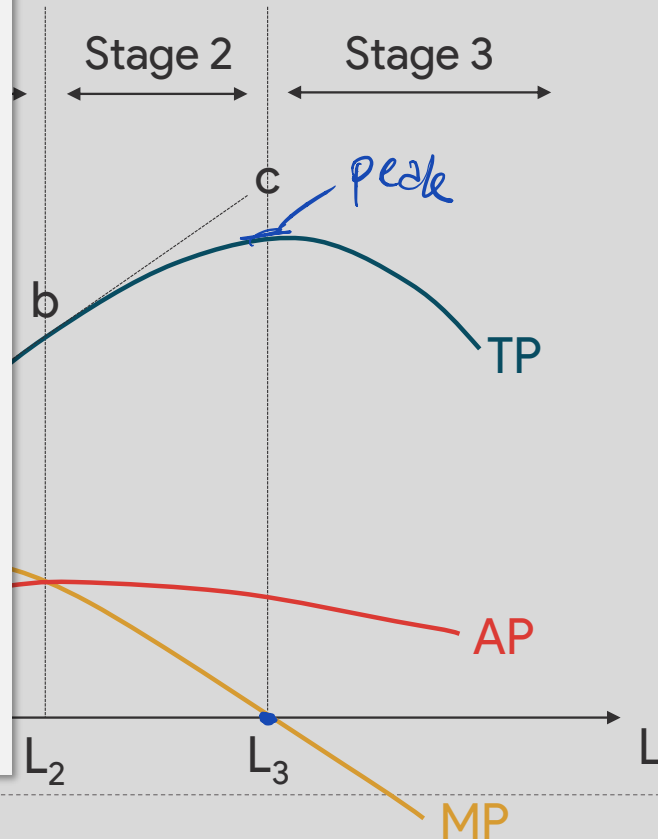
2. Short-Run Production, Factor and Quantity

2.3 Stages of production

Product curves

Stage 2

- **TP**
 - Increasing and reaches its peak at point c.
- **MP**
 - Decreasing and hits 0 at point c.
- **AP**
 - Decreasing.



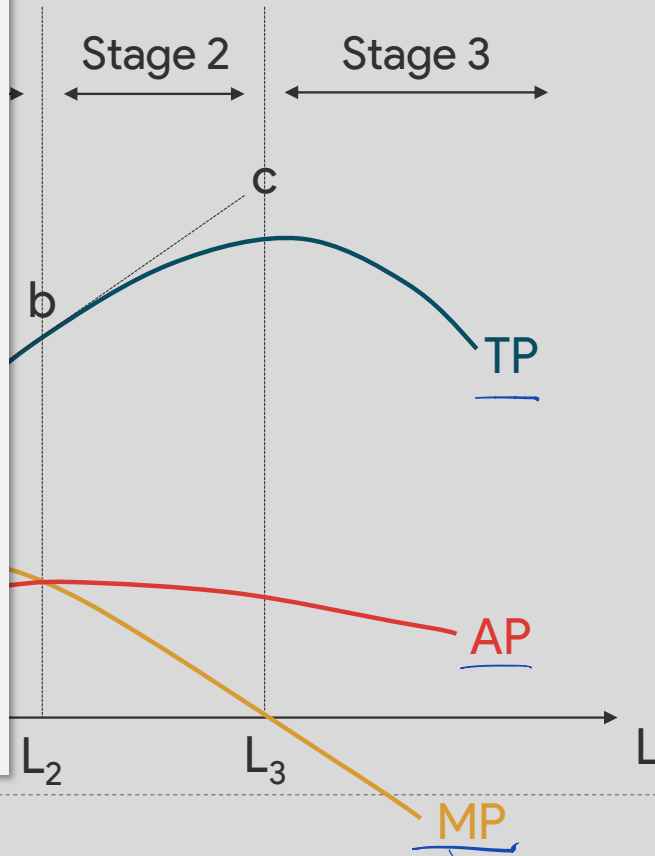
2. Short-Run Production, Factor and Quantity

2.3 Stages of production

Product curves

Stage 3

- **TP**
- Keep decreasing.
- **MP**
- Decreasing and becomes negative.
- **AP**
- Decreasing.



3. Short-Run Quantity and Cost of Production

3.1 Meaning of cost $(Q \rightarrow C)$

Definition – Cost of Production

4.12

Cost of production is opportunity cost or reward of factors of production.

• Types of cost

(1) Economic cost

vs

(2) Accounting cost

10000

(3) Private cost

vs.

(4) Social cost

10000
↓
10000
↓
10000

ine. opportunity cost

exc. —

Land

Labor

Capital

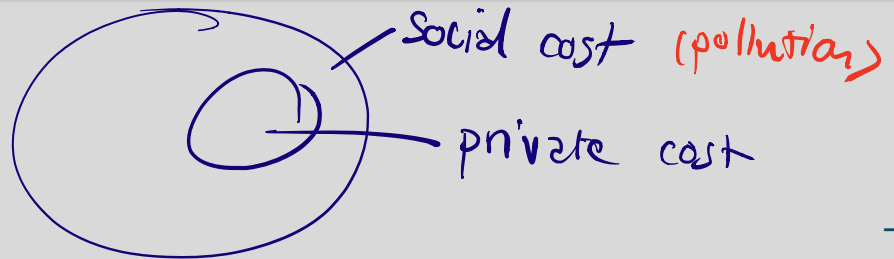
Entrepreneur

— Rent

— Wage

— Interest

— Profit



3. Short-Run Quantity and Cost of Production

3.2 Types of short-run cost (fixed/variable factors)

4.13

Definition – Total Fixed Cost (TFC)

Total fixed cost is the total amount of cost for fixed factor of production.

4.14

Definition – Total Variable Cost (TVC)

Total variable cost is the total amount of cost for variable factor of production.

4.15

Definition – Total Cost (TC)

Total cost is the combined amount of fixed cost and variable cost.

$$\underline{TC = TFC + TVC}$$

3. Short-Run Quantity and Cost of Production

3.2 Types of short-run cost

4.16

Definition – Average Fixed Cost (AFC)

Average fixed cost is the total fixed cost per output.

$$AFC = \frac{TFC}{Q}$$

4.17

Definition – Average Variable Cost (AVC)

Average variable cost is the variable cost per output.

$$AVC = \frac{TVC}{Q}$$

4.18

Definition – Average Cost (AC)

Average cost is the total cost per output.

$$\underline{AC} = AFC + AVC = \frac{TC}{Q} = \frac{TFC}{Q} + \frac{TVC}{Q}$$

3. Short-Run Quantity and Cost of Production

3.2 Types of short-run cost

Definition – Marginal Cost (MC)

4.19

Marginal cost is the incremental amount of cost when a unit of output is produced.

$$MC = \frac{\Delta TC}{\Delta Q}$$

$$\underline{MC} = \frac{\Delta TC}{\Delta Q} = \frac{\cancel{\Delta TFC}}{\Delta Q} + \frac{\Delta TVC}{\Delta Q} = \frac{\Delta TVC}{\Delta Q} = \frac{dTVC}{dQ}$$

discrete (continuous)

$$\sum_{i=1}^N MC_n = TVC = \int_1^n MC dx$$

3. Short-Run Quantity and Cost of Production

3.2 Types of short-run cost

Table of cost

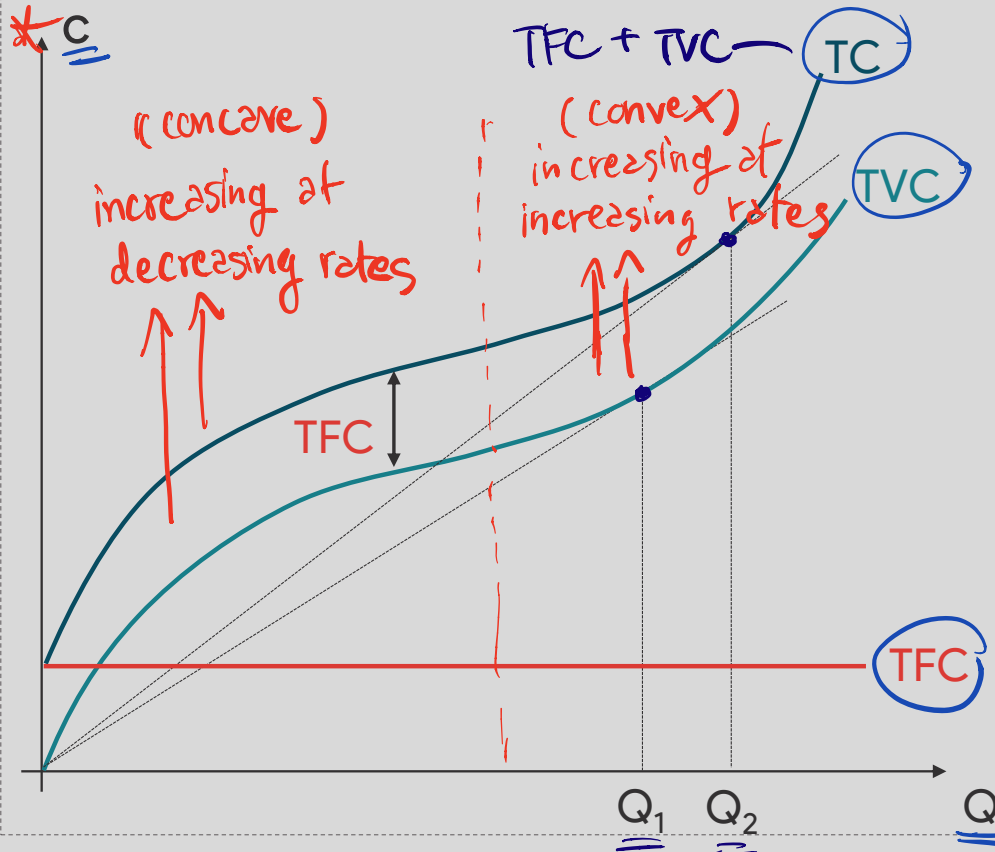
1. Total product (TP,Q)	2. Total fixed cost (TFC)	3. Total variable cost (TVC)	4. Total cost (TC)	5. Average fixed cost (AFC)	6. Average variable cost (AVC)	7. Average cost (AC)	8. Marginal cost (MC)
*			$TFC + TVC$	TFC/Q (2)/(1)	TVC/Q (3)/(1)	TC/Q (4)/(1)	$\Delta TC / \Delta Q$ $TC_n - TC_{n-1}$
* 0	25	0	25	—	—	—	—
1		12	37	25	12	37	12
2		18	43	12.5	9	21.5	6
3	25	20	45	8.33	6.33	15	2
4		24	49	6.25	6	12.25	4
5		35	60	5	7	12	11

smaller → but ≠ 0

3. Short-Run Quantity and Cost of Production

3.3 Short-run cost curves

Cost curves

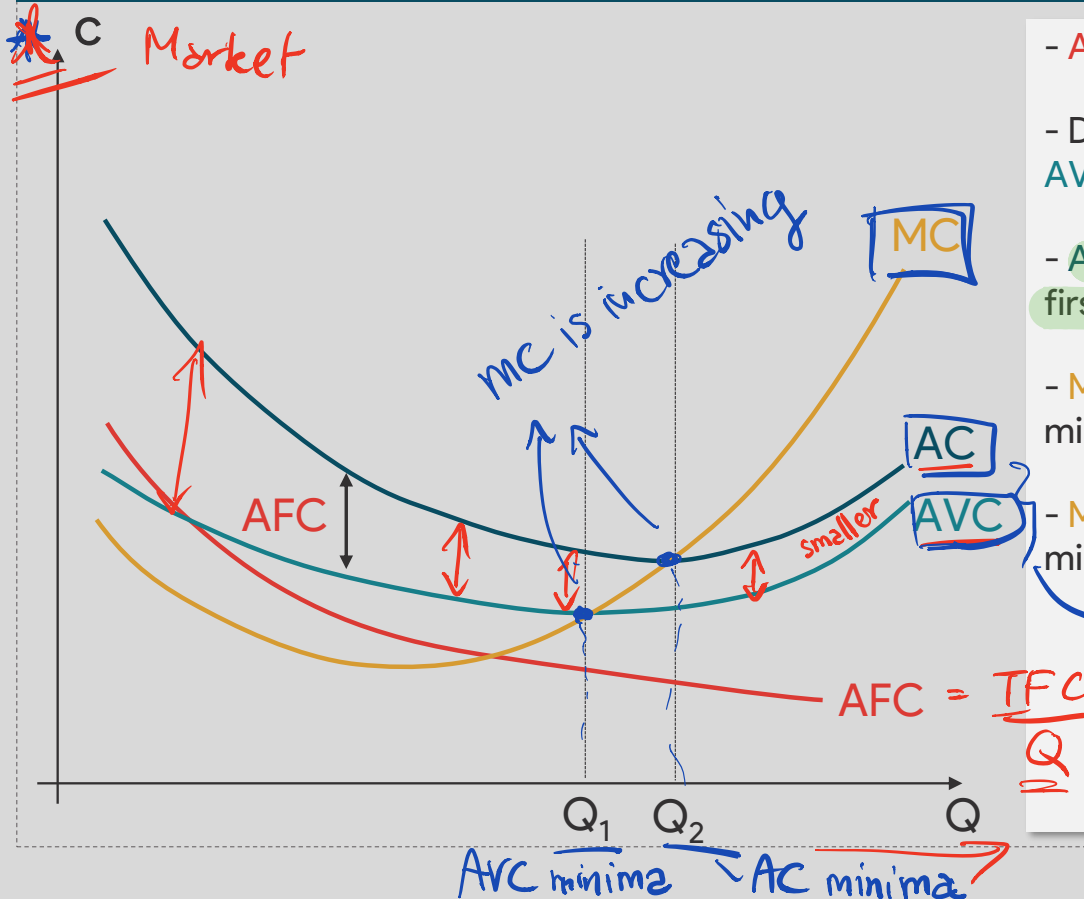


- TFC is constant.
- Distance between TC and TVC is TFC.
- TC and TVC increase at decreasing rate at first, then increasing rate eventually.
- A tangent line can be drawn from the origin and touches with TVC at Q_1 .
- A tangent line can be drawn from the origin and touches with TC at Q_2 .

3. Short-Run Quantity and Cost of Production

3.3 Short-run cost curves

Cost curves

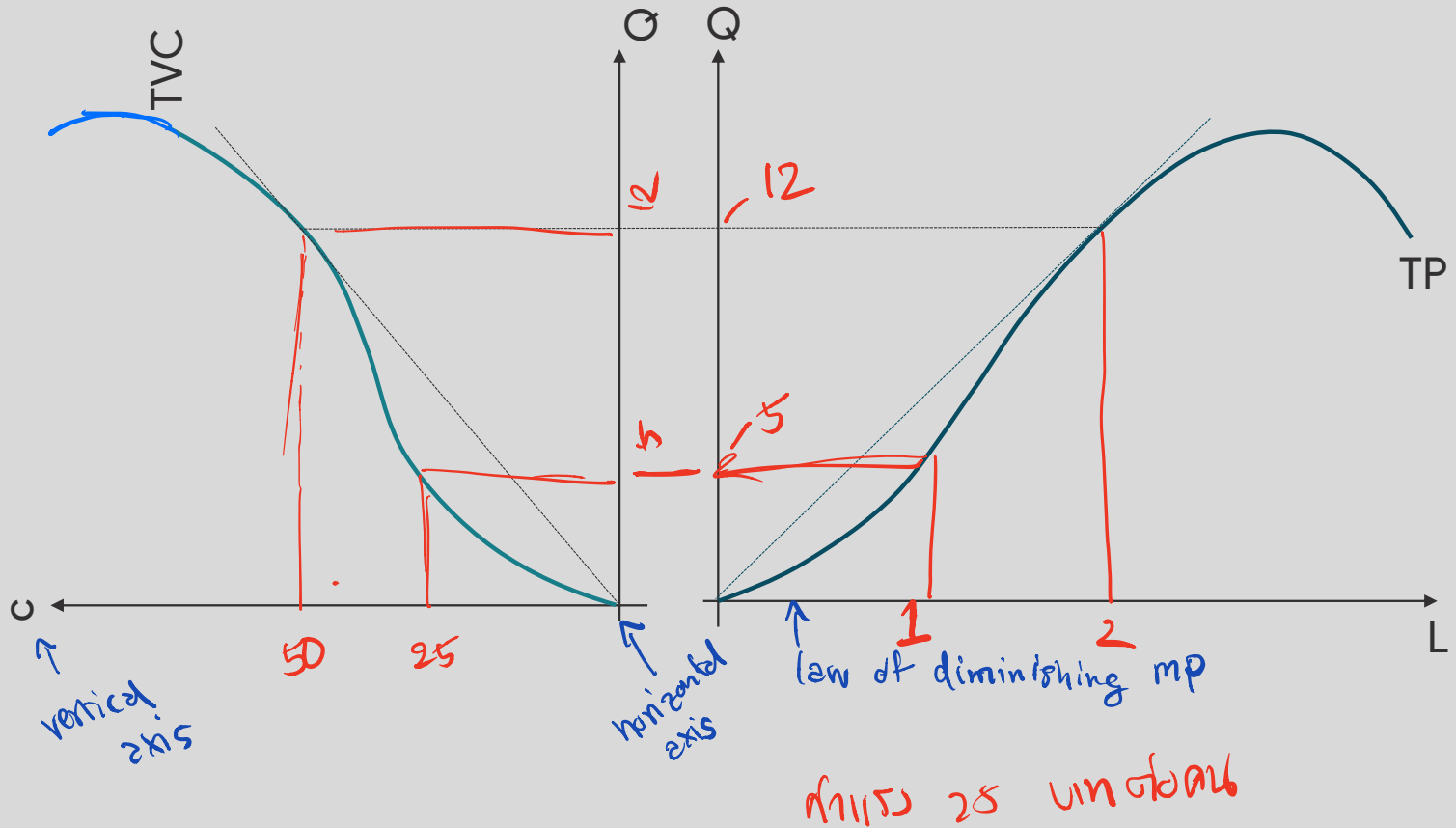


- AFC keeps decreasing.
- Distance between AC and AVC is AFC.
- AC and AVC decrease at first, then increase eventually.
- MC intersects with AVC at its minimum or Q₁.
- MC intersects with AC at its minimum or Q₂.

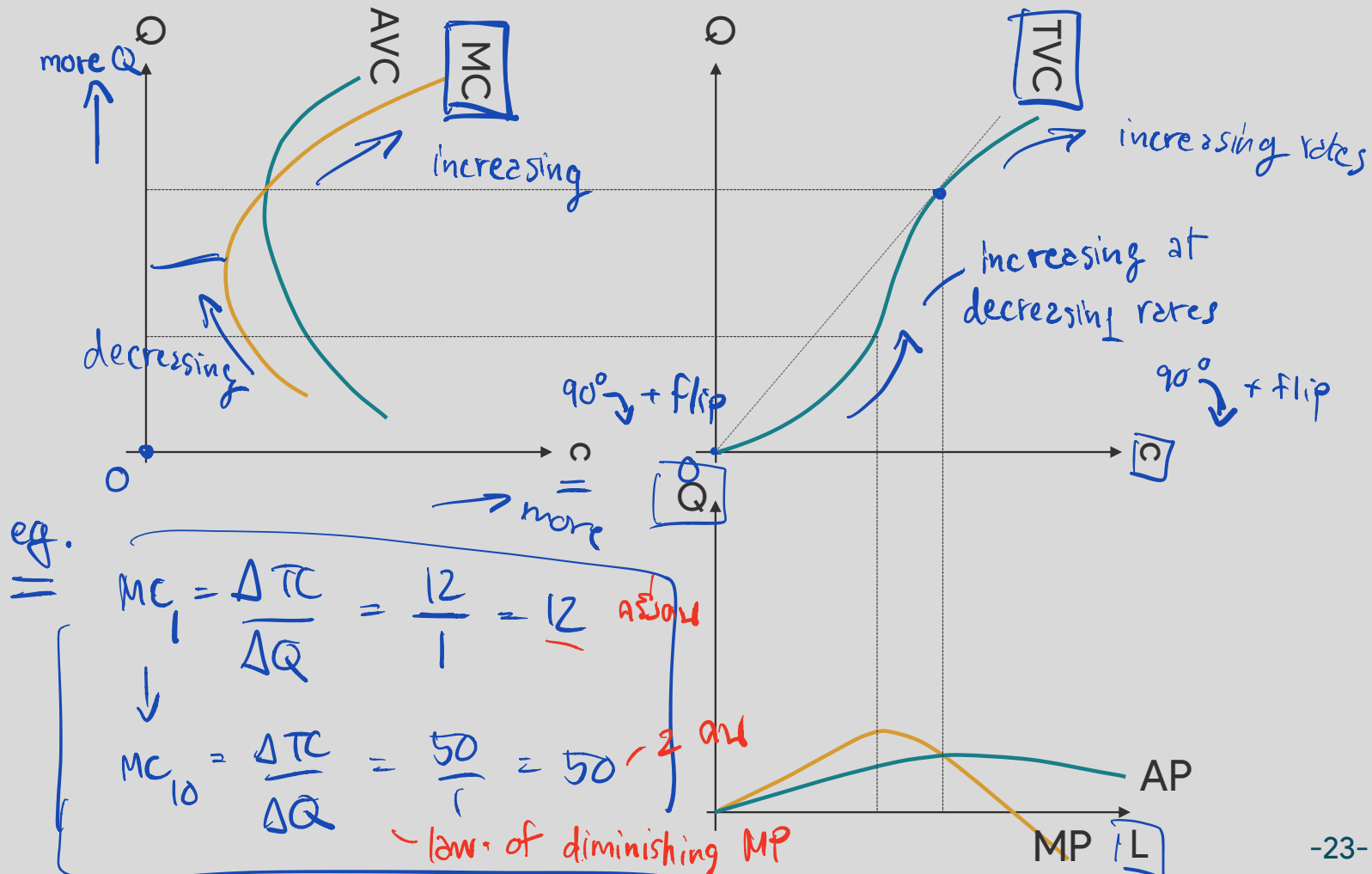
U-shape

4. Relationship of Cost and Factor of Production

factor $\rightarrow$ output $\rightarrow$ cost



4. Relationship of Cost and Factor of Production



4. Relationship of Cost and Factor of Production

Proposition – Short-run cost and Production

4.1

- Short-run production includes fixed factor. If variable factor is incrementally added, law of diminishing marginal product will kick in.
- Average fixed cost keeps reducing as the production goes on.
- Diminishing product causes marginal cost to rise, also total variable cost at increasing rate.