

EE211

PRINCIPLES OF MICROECONOMICS

Topic 7.1:

Production and Costs in the Short Run

Topics

- Firm, Production Function and Cost of Production
- Production Function in the Short Run
 - Total product, average product, and marginal product
 - Law of diminishing returns
- Cost in the Short Run
 - Total cost, average cost, and marginal cost
 - Short-run costs: TFC, TVC, TC, AFC, AVC, ATC, MC
- Relationship between production and cost in the short run

Introduction

- Firm's objective is to maximize its profit, and the profit is defined by: **Profit = Total Revenue – Total Cost**

$$\pi = TR - TC = PQ - C$$

- The components of profits are:
 - Price → depends on the market structure
 - **Output**
 - **Cost**
- Hence, in this lecture, we will discuss:
 - How the firm decides to use inputs to **maximize the output**;
 - How the firm decides to use inputs to **minimize the cost**.

Economic Costs vs. Accounting Costs

- **Accounting costs** (or **explicit costs**) – costs that actually involve a purchase of goods and services by the firm
 - e.g. wage paid to workers, rent, costs of purchasing intermediate inputs
- **Accounting profit = Revenues – Explicit costs**
- **Economic costs** – all costs incurred in the production, including both explicit and implicit costs.
 - Implicit costs are the opportunity costs of items for which there is no market transaction (e.g. costs of the owner's time)
- **Economic profit = Revenues – (Explicit costs + Implicit costs)**

Production Function

- **Production function** illustrates the relationship between inputs and outputs for given a technology level, when the inputs are used efficiently.
- In general, a production function can be written as:

$$Q = f(inputs)$$

$$Q = f(x_1, x_2, \dots, x_n)$$

- Simplified version:

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

where Q = output, L = labor, K = capital

Short-Run vs. Long-Run Production

- The **short run** is the length of time over which **some of the firm's factors of production are fixed**.
- The **long run** is the length of time over which **all of the firm's factors of production can be varied**, but its technology is fixed.

Example:

- Long-run production: $Q = f(L, K)$
- Suppose capital is held constant at K_0 . Short-run production can be written as:

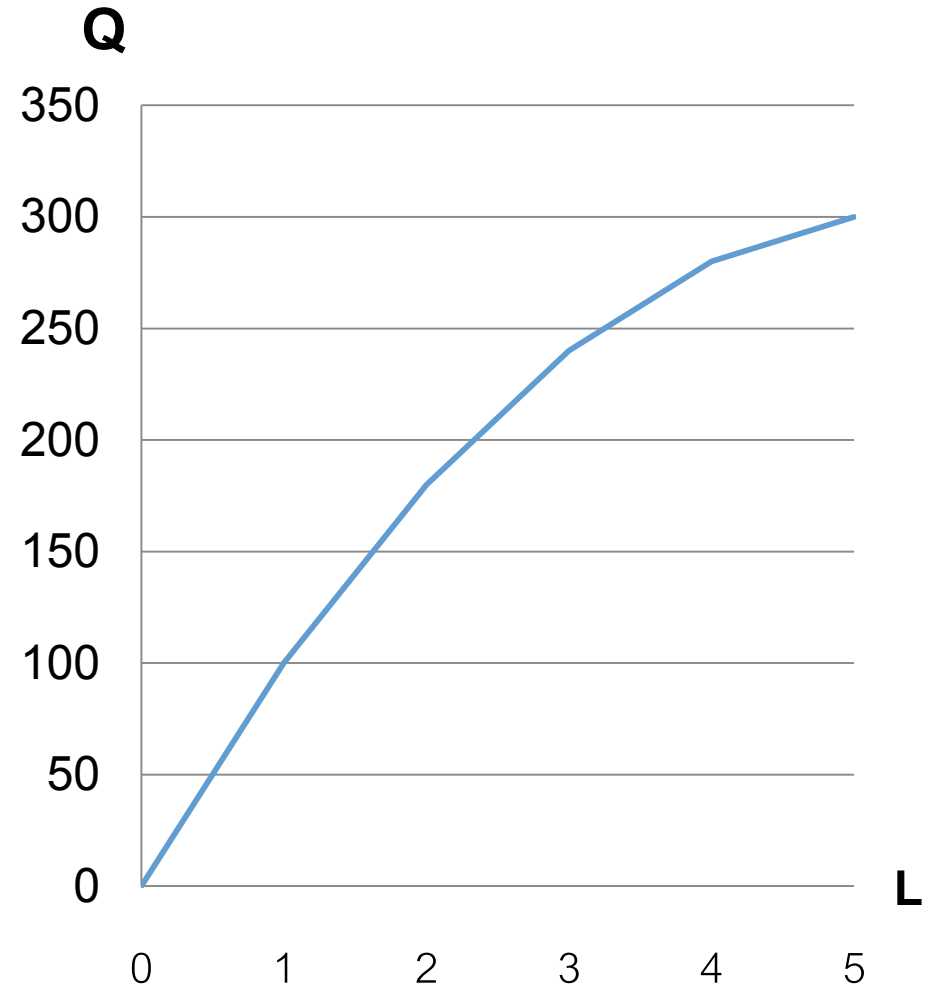
$$Q = f(L, K_0) = TP_{K_0}(L)$$

Graph: Long-Run Production

Graph: Short-Run Production

Example: Production Function in the Short Run

L	Q
0	0
1	100
2	180
3	240
4	280
5	300



PRODUCTION FUNCTION IN THE SHORT RUN

Production Function in the Short Run

- **Total product (TP):**

$$TP = Q = f(L)$$

- **Average Product (AP)** is the output per unit of input.

$$AP = \frac{TP}{L} = \frac{Q}{L}$$

- **Marginal Product (MP)** is the increase in output arising from an additional unit of that input, holding all other inputs constant.

$$MP = \frac{\Delta TP}{\Delta L} = \frac{\Delta Q}{\Delta L}$$

Example 1

L	TP	AP	MP
0	0		
1	100		
2	180		
3	240		
4	280		
5	300		

Diminishing Marginal Productivity

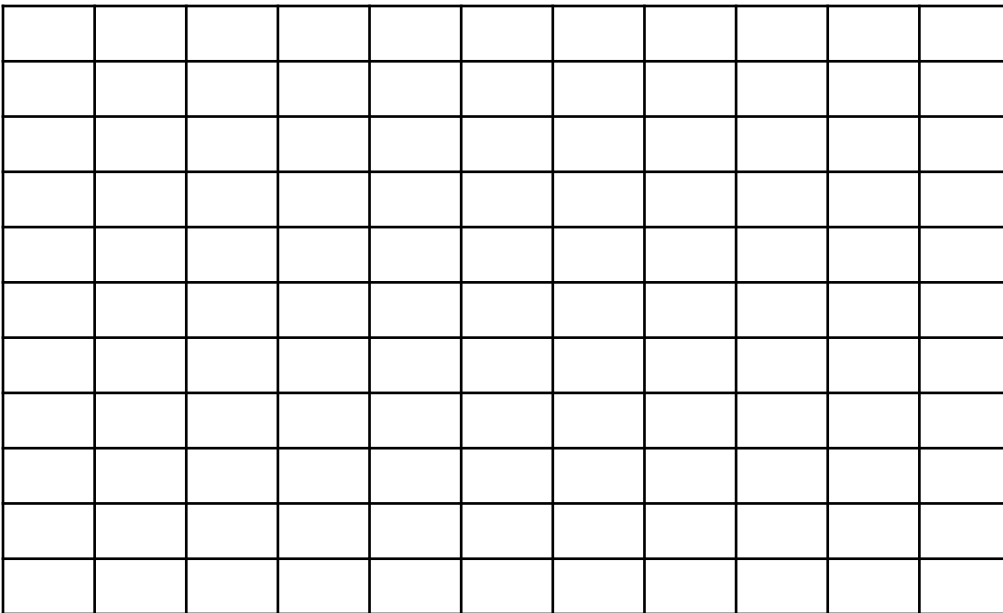
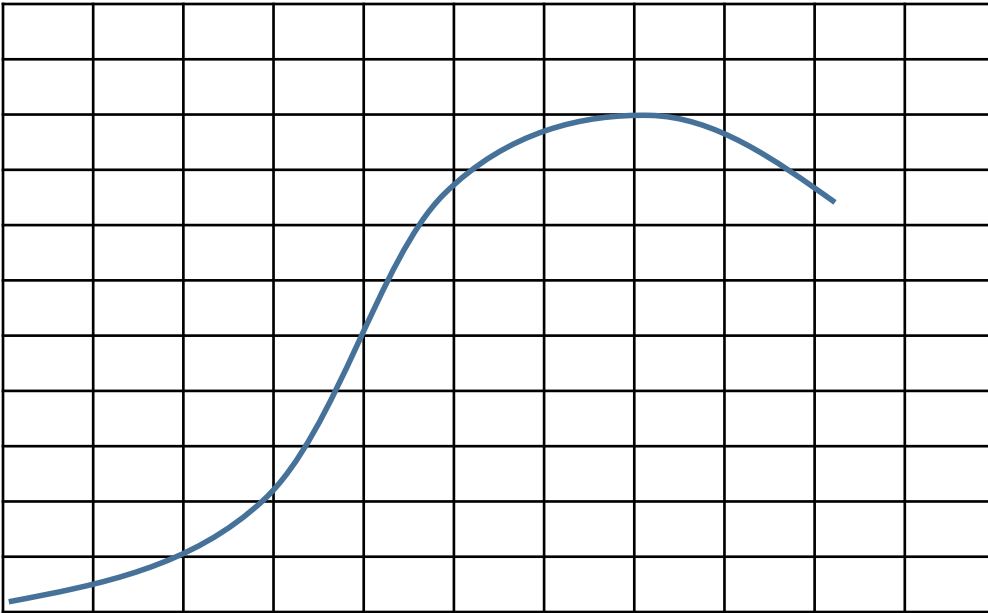
- **Law of diminishing marginal return**

If increasing quantities of a variable factor are applied to a given quantity of fixed factors, the marginal product of the variable factor will eventually decrease.

- Example: From previous slide, the output rises by a smaller and smaller amount for each additional worker.

Why?

TP, AP, and MP Curves



Example 2 (Exercise for Own Practice!)

L	TP	AP	MP
0	0		
1	3		
2	7		
3	13		
4	22		
5	35		
6	55		
7	80		
8	98		
9	107		
10	113		
11	117		
12	119		
13	120		

Graph

(Plot TP, AP, MP from the previous table using excel)

COST IN THE SHORT RUN

TC, TFC, and TVC

- **Total costs (TC)** - the sums of all costs that the firm incurs to produce a given level of output.

$$TC = TFC + TVC$$

- **Total fixed cost (TFC)** – all costs of production that do not vary with the level of output
- **Total variable cost (TVC)** – total costs of production that vary directly with the level of output

ATC, AFC, AVC, and MC

- **Average total cost (ATC)** – Total costs per unit of output

$$ATC = \frac{TC}{Q} = AFC + AVC$$

- **Average fixed cost (AFC)** – Total fixed costs divided by the number of units of output

$$AFC = TFC / Q$$

- **Average variable cost (AVC)** – Total variable costs divided by the number of units of output

$$AVC = TVC / Q$$

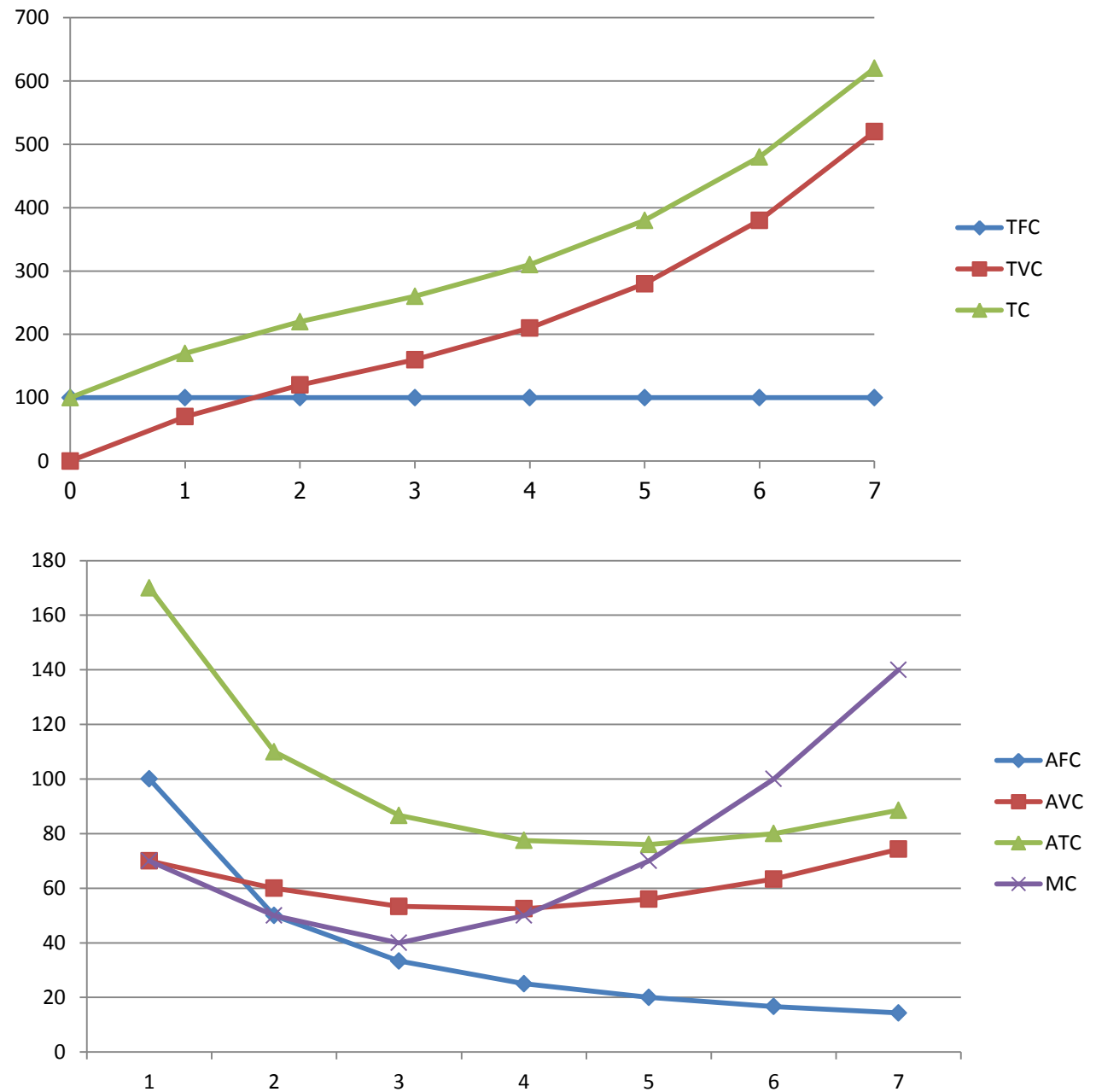
- **Marginal cost (MC)** – The increase in total cost resulting from increasing output by one unit

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

Example 3 – AFC, AVC, ATC, MC

Q	TFC	TVC	TC	AFC	AVC	ATC	MC
0	100	0	100				
1	100	70	170				
2	100	120	220				
3	100	160	260				
4	100	210	310				
5	100	280	380				
6	100	380	480				
7	100	520	620				

Example 3: Graph



Example 4 (For Own Practice)

Q	TFC	TVC	TC	AFC	AVC	ATC	MC
0	100	0					
3	100	20					
7	100	40					
13	100	60					
22	100	80					
35	100	100					
55	100	120					
80	100	140					
98	100	160					
107	100	180					
113	100	200					
117	100	220					
119	100	240					
120	100	260					

Example 4: Graph

Relationship between Production and Cost in the Short Run