


經濟學原理 (上)

Unit 13: THE COSTS OF PRODUCTION


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 【本著作除另有註明外，採取創用CC「姓名標示—非商業性—相同方式分享」臺灣3.0版授權釋出】

本課程指定教材為N. Gregory Mankiw, Principles of Economics (2012), 6th edition.
參考教材為吳曉敏，「經濟學原理」，雙葉書廊。
本講義僅引用部分內容，請讀者自行準備。

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 臺大開放式課程

0

13 THE COSTS OF PRODUCTION


PRINCIPLES OF ECONOMICS
SIXTH EDITION

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1

The theory of firms

- ▶ Firms are every where: large, small. Labor intensive, capital intensive....
- ▶ Firm is the other half of the market.
 - Firms are willing to produce and sell a greater quantity of a good when the price of the good is high.
 - This results in a supply curve that slopes upward.
 - To determine how much should it produces at a given price, firms needs to make some optimization, too!(Just like consumers)
 - We assume that the firm's goal is to maximize profit. (極大化利潤)

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2

Total Revenue, Total Cost, Profit

$$\text{Profit(利潤)} = \text{Total revenue (總收入)} - \text{Total cost(總成本)}$$

the amount a firm receives from the sale of its output


the market value of the inputs a firm uses in production

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3

Costs: Explicit (外顯) vs. Implicit (隱藏)

- ▶ **Explicit costs** – require an outlay of money, e.g. paying wages to workers
- ▶ **Implicit costs** – do not require a cash outlay, e.g. the opportunity cost of the owner's time
- ▶ Remember one of the Ten Principles:
The cost of something is what you give up to get it.
- ▶ This is true whether the costs are implicit or explicit. Both matter for firms' decisions.

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4

Explicit vs. Implicit Costs: An Example

You need \$100,000 to start your business. The interest rate is 5%.

- ▶ Case 1: borrow \$100,000
 - explicit cost = \$5000 interest on loan
- ▶ Case 2: use \$40,000 of your savings, borrow the other \$60,000
 - explicit cost = \$3000 (5%) interest on the loan
 - implicit cost = \$2000 (5%) *foregone* interest you could have earned on your \$40,000.

In both cases, total (exp + imp) costs are \$5000.

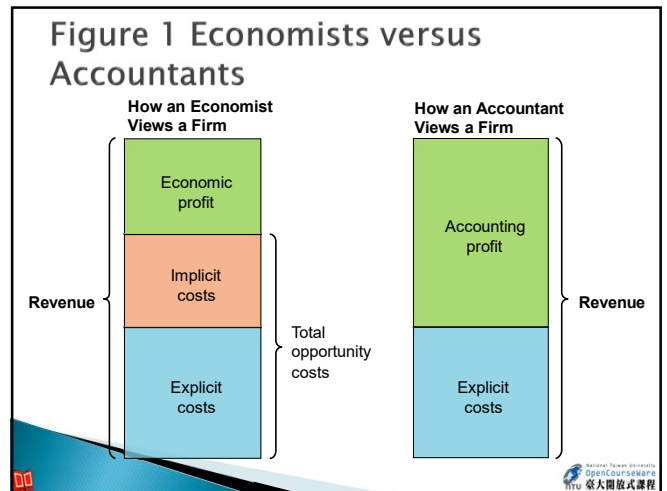
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5

Economic Profit (經濟利潤) vs. Accounting Profit(會計利潤)

- ▶ **Accounting profit**
= total revenue minus total explicit costs
- ▶ **Economic profit**
= total revenue minus total costs (including explicit and implicit costs)
- ▶ Accounting profit ignores implicit costs, so it's higher than economic profit.

6



7

PRODUCTION AND COSTS

要計算成本，我們需要知道 (1)投入和產出之間的關係 (2) 成本和產出之間的關係

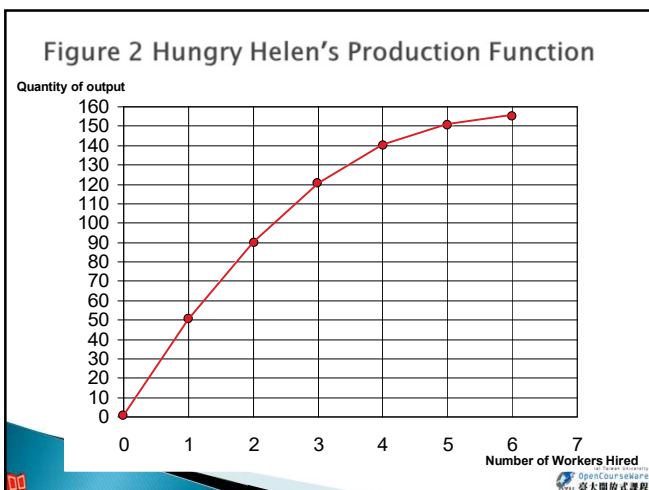
- ▶ (1) 就是 Production Function
 - The *production function*(生產函數) shows the relationship between **quantity of inputs** used to make a good and the **quantity of output** of that good.
 - $Q=F(L, K, \dots)$

8

Table 1 A Production Function and Total Cost: Hungry Helen's Cookie Factory

Number of Workers	Output (quantity of cookies produced per hour)	Marginal Product of Labor	Cost of Factory	Cost of Workers	Total Cost of Inputs (cost of factory + cost of workers)
0	0		\$30	\$0	\$30
1	50	50	30	10	40
2	90	40	30	20	50
3	120	30	30	30	60
4	140	20	30	40	70
5	150	10	30	50	80
6	155	5	30	60	90

9



10

Marginal Product

- ▶ The **marginal product** of any input is the increase in output arising from an additional unit of that input, holding all other inputs constant.
- ▶ *E.g.*, if Farmer Jack hires one more worker, his output rises by the marginal product of labor.
- ▶ Notation:
 Δ (delta) = "change in..."
- Examples:
 ΔQ = change in output, ΔL = change in labor
- ▶ Marginal product of labor (MPL) = $\Delta Q / \Delta L$

11

The Production Function

- ▶ Diminishing Marginal Product
 - The slope of the production function measures the marginal product of an input, such as a worker.
 - When the marginal product declines, the production function becomes flatter.

12

Why MPL Is Important

- ▶ Recall one of the Ten Principles:
Rational people think at the margin.
- ▶ When Helen hires an extra worker,
 - her costs rise by the wage he pays the worker
 - her output rises by *MPL*
- ▶ Comparing them helps Helen decide whether he would benefit from hiring the worker. (You need one more information: price of the product)

13

The Production Function

- ▶ *Diminishing marginal product* (邊際產量遞減)
- ▶ is the property whereby the marginal product of an input declines as the quantity of the input increases (other things being equal).
 - Example: As more and more workers are hired at a firm, each additional worker contributes less and less to production because the firm has a limited amount of equipment (congestion).
 - In general, *MPL* diminishes as *L* rises whether the fixed input is land or capital (equipment, machines, etc.)

14

From the Production Function to the Total-Cost Curve

- ▶ Production : $Q=f(L, K)$,
- ▶ Given P_L , P_K , and production function, we can calculate the cost of producing a certain amount of the good
- ▶ The total-cost curve shows this relationship graphically.

15

THE VARIOUS MEASURES OF COST

- ▶ Costs of production may be divided into *fixed costs* and *variable costs*.
 - **Fixed costs** (固定成本) are those costs that *do not vary* with the quantity of output produced.
 - **Variable costs** (變動成本) are those costs that *do vary* with the quantity of output produced.
 - $TC = TFC$ (總固定成本) + TVC (總變動成本)

16

Fixed and Variable Costs


- ▶ Average Costs(平均成本)
 - Average costs can be determined by dividing the firm's costs by the quantity of output it produces.
 - The average cost is the cost of each typical unit of product.

17

Average and Marginal Costs

- *Average Fixed Costs* (AFC) (平均固定成本)
- *Average Variable Costs* (AVC) (平均變動成本)
- *Average Total Costs* (ATC) (平均總成本)
- $ATC = AFC + AVC$ ($TC = TFC + TVC$, divided by Q)


$$AFC = \frac{\text{Fixed cost}}{\text{Quantity}} = \frac{FC}{Q}$$

$$AVC = \frac{\text{Variable cost}}{\text{Quantity}} = \frac{VC}{Q} \quad ATC = \frac{\text{Total cost}}{\text{Quantity}} = \frac{TC}{Q}$$


18

Average and Marginal Costs


- ▶ **Marginal Cost** (邊際成本)
 - *Marginal cost* (MC) measures the increase in total cost that arises from an extra unit of production.
 - Marginal cost helps answer the following question:
 - How much does it cost to produce an additional unit of output?



19

Average and Marginal Cost


$$MC = \frac{(\text{change in total cost})}{(\text{change in quantity})}$$

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


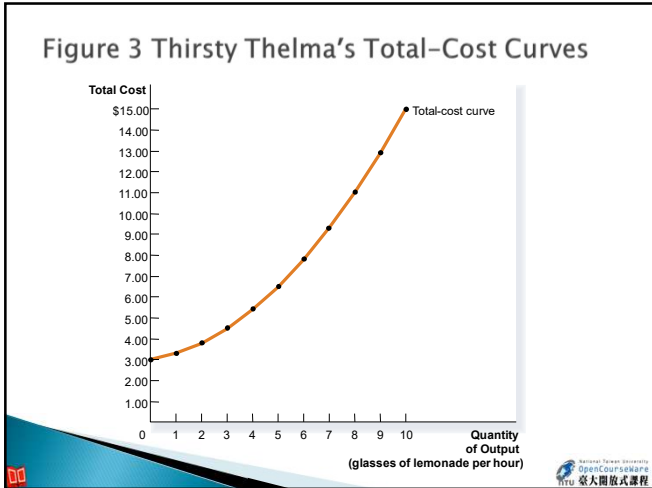
20

Table 2 The Various Measures of Cost: Thirsty Thelma's Lemonade Stand

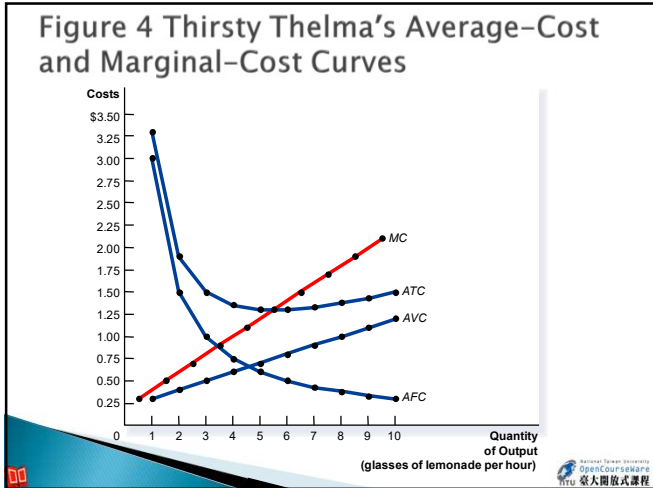
Quantity of Lemonade (Glasses per hour)	Total Cost	Fixed Cost	Variable Cost	Average Fixed Cost	Average Variable Cost	Average Total Cost	Marginal Cost
0	\$ 3.00	\$3.00	\$ 0.00	—	—	—	\$0.30
1	3.30	3.00	0.30	\$3.00	\$0.30	\$3.30	0.50
2	3.80	3.00	0.80	1.50	0.40	1.90	0.70
3	4.50	3.00	1.50	1.00	0.50	1.50	0.90
4	5.40	3.00	2.40	0.75	0.60	1.35	1.10
5	6.50	3.00	3.50	0.60	0.70	1.30	1.30
6	7.80	3.00	4.80	0.50	0.80	1.30	1.50
7	9.30	3.00	6.30	0.43	0.90	1.33	1.70
8	11.00	3.00	8.00	0.38	1.00	1.38	1.90
9	12.90	3.00	9.90	0.33	1.10	1.43	2.10
10	15.00	3.00	12.00	0.30	1.20	1.50	



21



22



23

Cost Curves and Their Shapes

- ▶ Marginal cost rises with the amount of output produced.
 - This reflects the property of diminishing marginal product.

24

Cost Curves and Their Shapes

- ▶ The average total-cost curve is U-shaped.
- ▶ At very low levels of output average total cost is high because fixed cost is spread over only a few units.
- ▶ Average total cost declines as output increases.
- ▶ Average total cost starts rising because average variable cost rises substantially.

25

Cost Curves and Their Shapes

- ▶ The bottom of the U-shaped ATC curve occurs at the quantity that minimizes average total cost. This quantity is sometimes called the efficient scale of the firm.

26

Cost Curves and Their Shapes

- ▶ Relationship between Marginal Cost and Average Total Cost
 - Whenever marginal cost is less than average total cost, average total cost is falling.
 - Whenever marginal cost is greater than average total cost, average total cost is rising.

27

Cost Curves and Their Shapes

- ▶ Relationship between Marginal Cost and Average Total Cost
 - The marginal-cost curve crosses the average-total-cost curve at the efficient scale.
 - *Efficient scale* is the quantity that minimizes average total cost.

28

Typical Cost Curves

- ▶ Three Important Properties of Cost Curves
 - Marginal cost eventually rises with the quantity of output.
 - The average-total-cost curve is U-shaped.
 - The marginal-cost curve crosses the average-total-cost curve at the minimum of average total cost.

29

COSTS IN THE SHORT RUN AND IN THE LONG RUN

- ▶ For many firms, the division of total costs between fixed and variable costs depends on the time horizon being considered.
 - In the short run, some costs are fixed.
 - In the long run, *all* fixed costs become variable costs.
- ▶ Because many costs are fixed in the short run but variable in the long run, a firm's long-run cost curves differ from its short-run cost curves.

30

Economies and Diseconomies of Scale

- ▶ *Economies of scale* (規模經濟) refer to the property whereby long-run average total cost falls as the quantity of output increases.
- ▶ *Diseconomies of scale* (規模不經濟) refer to the property whereby long-run average total cost rises as the quantity of output increases.
- ▶ *Constant returns to scale* (規模報酬不變) refers to the property whereby long-run average total cost stays the same as the quantity of output increases.

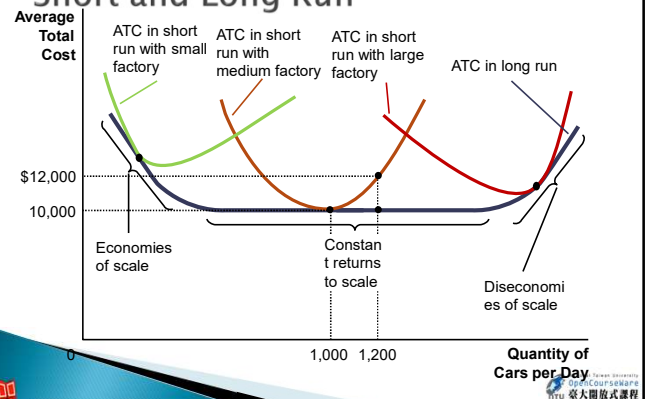
31

Long Run v.s. Short run

- ▶ Long run AC is a much flatter U shape than the short run,
- ▶ All SR AC lies above LR AC
- ▶ b/c in the long run, the firm is much flexible:
- ▶ The firm gets to choose which SR AC it wants to used,
- ▶ But in the SR, the firm was stuck to one particular AV

32

Figure 6 Average Total Cost in the Short and Long Run



33

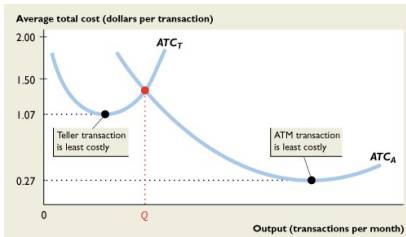
The ATM and the Cost of Getting Cash

The average total cost curve for transactions with a human teller is ATC_T .

The lowest average total cost for a human teller transaction is \$1.07.

The average total cost curve for transactions with an ATM is ATC_A .

The lowest average total cost curve for an ATM transaction is 27 cents.



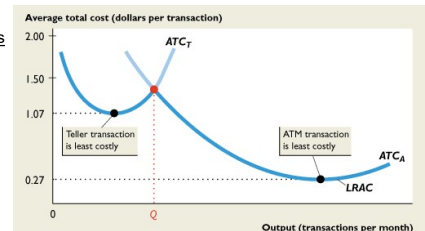
34

The ATM and the Cost of Getting Cash

The long-run average cost curve is $LRAC$. At Q transactions per month, both methods have the same average total cost.

For a credit union that does fewer than Q transactions per month, its least-cost method is the teller.

For a bank that does more than Q transactions per month, the least-cost method is the ATM.



35