COSTS OF PRODUCTION

Instructor: Ghislain Nono Gueye

AUBURN UNIVERSITY

Introduction

- People create firms because they want to make money.
- Whether they deal in goods (e.g. Walmart, GM, Sony, …) or in services (e.g. Barber shops, car cleaning, medical clinics…), all firms aim at *making profit*.
- However, making profit by creating a firm does not come free of charge.
- There are costs attached to this endeavor (e.g. cost of capital, administrative costs, various setup costs…)

What are costs?

- Generally speaking, a cost is what you have to give up in order to acquire something you want.
- In production, a cost is the necessary initial investment needed to initiate the production process.
- For instance, the cost of making and selling hotdogs is the money invested in bread, sausages, mayonnaise, mustard and a grill.
- These are prerequisites if one wants to produce and sell hotdogs for profit.

The two main categories of costs

- The production of certain goods requires very many costs.
- For example, opening a business in the car manufacturing industry comes with hundreds of costs.
- However, whatever the cost, it falls within one of two main categories of costs:

- Explicit costs
- Implicit costs

Explicit costs

- Within the category of explicit costs, there are:

- Variable costs

These are costs that change with the level of production/output.

They increase as output increases and they decreases as output decreases.

- Fixed costs

Fixed costs do not immediately change with the level of output.

They only change when the output significantly increases.

Explicit costs: illustrated

- Carmen wants to open a firm to sell cookies.
- She buys *flour, sugar, chocolate chips…*
- She also buys an *oven*.
- Now she is good to go!!!

Explicit costs: illustrated (2)

- Variable costs are costs that change with the level of production/output.
- Carmen's variable costs are flour, sugar and chocolate chips.
- If she wants to increase/increase her production of cookies, she has to buy more/less of them.

Explicit costs: illustrated (3)

- Fixed costs are costs that do not easily change with the level of production/output.
- Carmen's fixed cost is the oven.
- Producing more cookies does not immediately require the purchase of another oven.
- But at some higher levels of production, Carmen will need to purchase a new oven.

Implicit costs

- There are many kinds of implicit costs in a firm.
- They can all be grouped under the concept of opportunity costs.
- For example, the owner of a business may run an errand for the firm using his own car.
- He will not necessarily take money from the business for his labor or for the use of his car.
- He would have earned money if he had run that errand for another business.
- This is an implicit cost.

Production periods

- There are two main production periods in the life cycle of any firm:
- The short-run
- The long-run

- These two production periods are determined by whether the firm has fixed costs or not.
- Let’s illustrate…

Production periods: the short run

- Reminder: Carmen's variable costs are flour, sugar and chocolate chips.
- Her fixed cost is the oven.
- Let's assume that Carmen can only make 50 cookies per day with one oven.
- So long as the quantity demanded for her cookies is 50 or lower, she is just fine with one oven.
- The entire time period within which she only needs one oven (i.e. the fixed cost) is called the short run.

Production periods: the long run

- Now Carmen has become very popular on Auburn campus.
- The demand for her cookies has now exceeded 50 cookies per day.
- Therefore, she needs to buy a second oven.
- At this point, there is no more fixed cost.
- The oven has now become a variable cost.
- Carmen's firm has now entered the long run. This is the production period in which the previous fixed costs are not fixed anymore.

How to calculate profit (loss)?

- One of the most important objectives of any firm is to make profit.
- Firms make profit according to this formula

Total Profit/Loss = Total Revenue – Total (Explicit) Cost

Total Profit/Loss = (P * Q) – (TFC + TVC)

Total Revenue = Price * Quantity sold

Total Cost = Total Fixed Costs + Total Variable Costs

Accounting profit vs Economic profit

- The profit computed as seen on the previous slide is called accounting profit.
- The economic profit is computed by including opportunity costs to the equation.

Total Profit = Total Revenue – Total Cost

Total Profit = (P * Q) – (TFC + TVC + OC)

Total Revenue = Price * Quantity sold

Total Cost = Total Fixed Costs + Total Variable Costs + Opportunity Costs

The production function

- In the production process, inputs are used to make outputs.
- The costs incurred by the firm are very closely linked to the level of inputs used in the production process.
- In the example of the cookie selling firm owned by Carmen, the inputs are: sugar, flour, chocolate chips and the oven.
- Now, let's assume that the firm's sole inputs are the number of hired workers.
- The relationship between the inputs the firm uses and the output it creates is shown by the production function.
- Following is a hypothetical production function:

The production function (2)

Number of workers (Variable Inputs)	Total Product (TP) (Number of cookies produced per day)	Marginal Product of labor (MP)
0	0	-
1	5	5
2	15	10
3	30	15
4	42	12
5	52	10
6	60	8
7	65	5
8	67	2
9	63	-4
10	55	-8

The production function (3)

- The marginal product of labor is the additional output (i.e. the extra number of cookies) produced when one more worker is hired in the firm.
- When the firm has only 1 worker, 5 cookies are produced every day.
- When the firm hires a second worker, the production of cookies per day increases to 15.
- Therefore, the marginal product of hiring a second worker in the firm is 10.

The production function (4)

- From 0 to 3 workers:

- Total output rises at an increasing rate. It rises rapidly!
- Marginal product is positive and is rising.

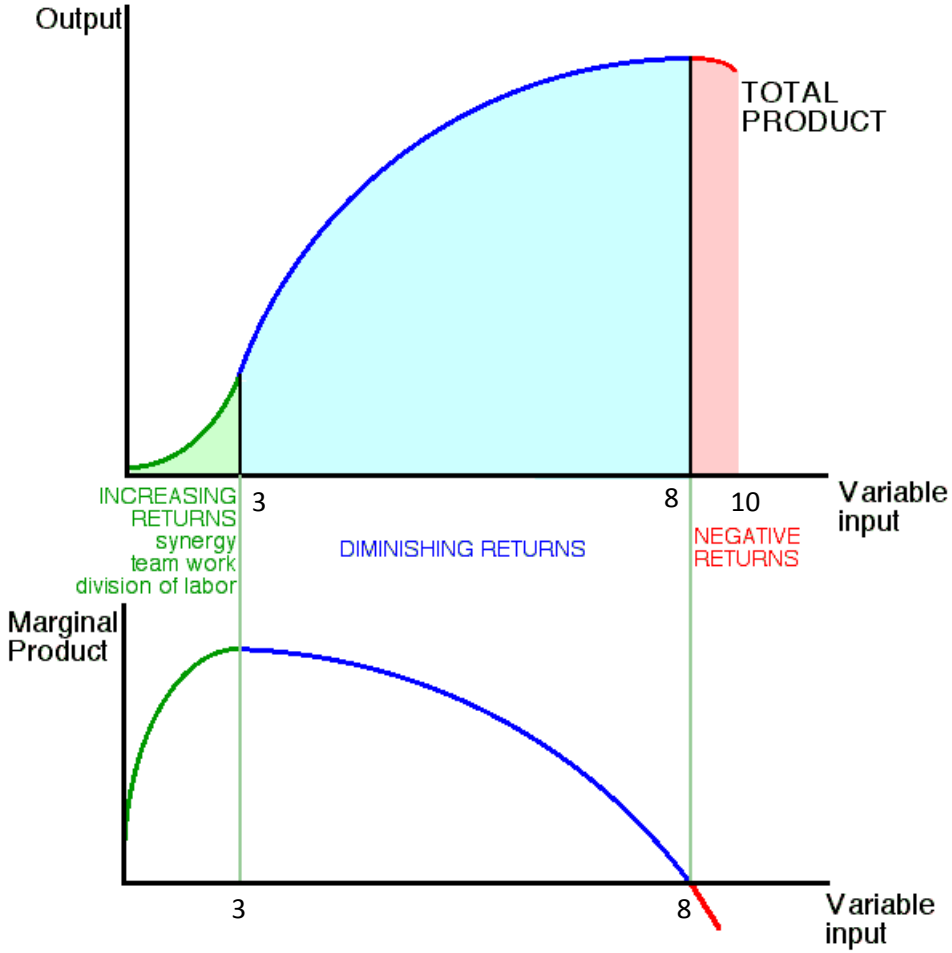
- From 4 to 8 workers:

- Total output rises at a decreasing rate. It rises slowly!
- Marginal product is positive and is declining.

- From 9 to 10 workers:

- Total output declines.
- Marginal product is negative.

The production function (5)



*Variable input = number of workers

The production function (6)

- The total output (i) increases, (ii) reaches a maximum point and then (iii) decreases.
- The marginal production (i) increases, (ii) decreases and (iii) further decreases below zero.
- The total output curve is convex when the marginal product curve increases.
- The total output curve is convex when the marginal product curve decreases.
- The total output curve slopes downward when the marginal product curve is below zero.

The 3 production phases

- Here, we identify three (3) main production phases.

(i) The first phase (0 to 3 workers) with increasing marginal product (increasing returns)

(ii) The second phase (4 to 8 workers) with diminishing marginal product (decreasing returns)

(iii) The third phase (9 to 10 workers) with negative marginal product (negative returns)

The 3 production phases (2)

(i) The production phase of increasing returns

In this production phase, increases in variable inputs (i.e. number of workers) lead to an increase in the total output (i.e. number of cookies produced per day) Here, the total output increases rapidly.

(ii) The production phase of diminishing returns

In this production phase, increases in variable inputs (i.e. number of workers) lead to an increase in the total output (i.e. number of cookies produced per day). Here, the total output increases slowly.

The 3 production phases (3)

(iii) The production phase of negative returns

In this production phase, increases in variable inputs (i.e. number of workers) lead to a decrease in the total output (i.e. number of cookies produced per day).

Decision-making in the firm

- The production function of the firm gives us all the information we need about how inputs and output are related.
- So, it is useful in the decision-making process. For instance:
- If the firm wants to be the most profitable, how much output should be produced every day?
- Questions about the level of production such as this one are very important for firms.
- However, another very important aspect to take into consideration is cost.
- Therefore, production and cost are the main factors when making decisions in a firm.

Short-run costs

- Production and cost considerations are different depending on the production period.
- Following is a hypothetical *short-run* cost schedule.

Total Product	Total Variable Cost ($)	Total Fixed Cost ($)	Total Cost ($)	Average Variable Cost ($)	Average Fixed Cost ($)	Average Total Cost ($)	Marginal Cost ($)
Q	TVC	TFC	TC	AVC	AFC	ATC	MC
0	0	100	100	-	-	-	-
1	30	100	130	30	100.0	130	30
2	50	100	150	25	50.0	75	20
3	65	100	165	21.7	33.3	55	15
4	77	100	177	19.3	25.0	44.3	12
5	87	100	187	17.4	20.0	37.4	10
6	100	100	200	16.7	16.7	33.4	13
7	120	100	220	17.1	14.3	31.4	20
8	160	100	260	20	12.5	32.5	40
9	220	100	320	24.4	11.1	35.5	60
10	300	100	400	30	10.0	40	80

Formulas

- TC = TFC + TVC
- ATC = AFC + AVC

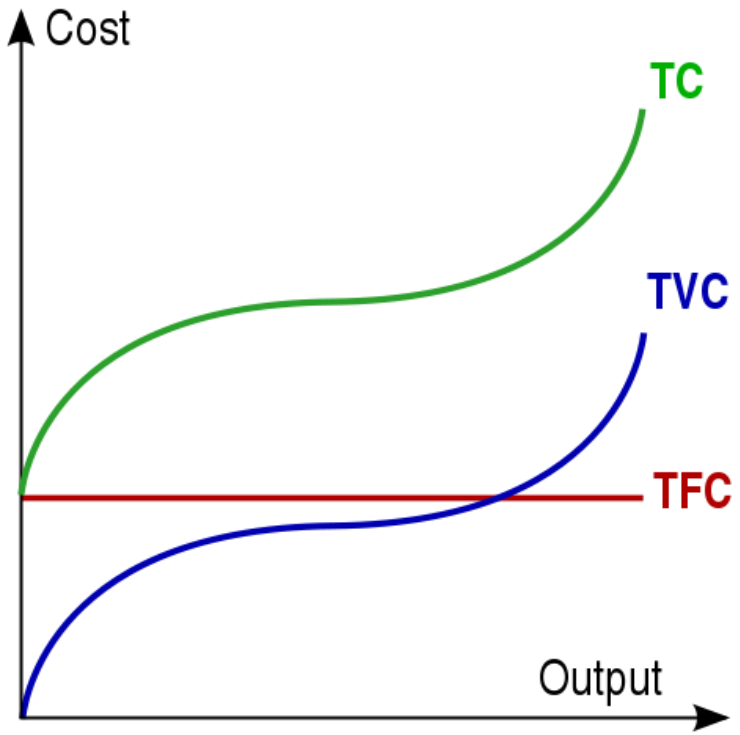
- ATC = TC/Q
- AFC = TFC/Q
- AVC = TVC/Q

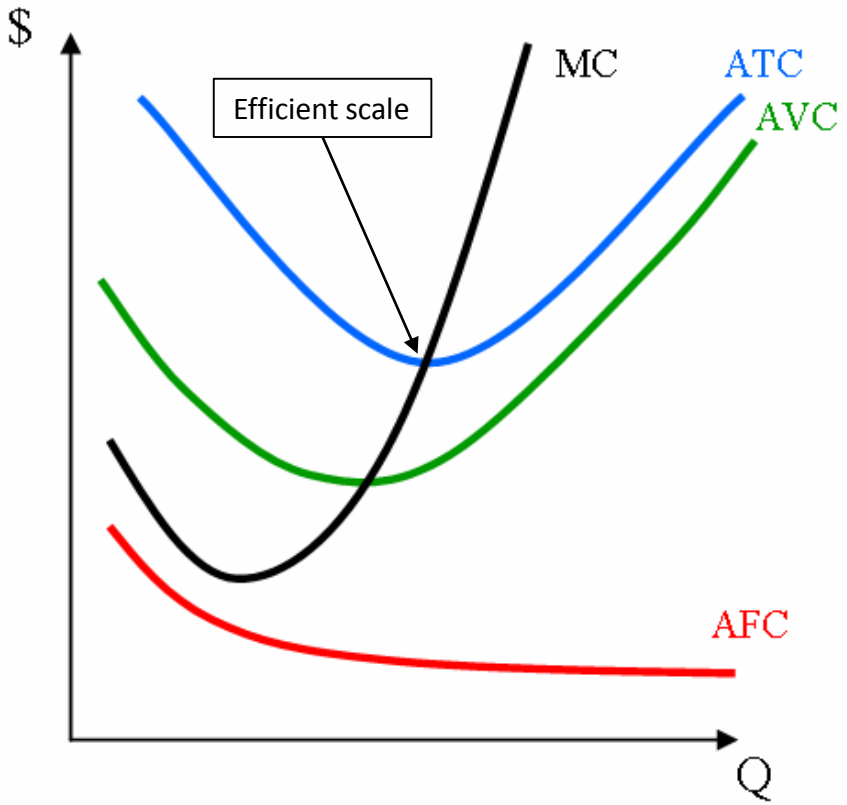
- MC = ΔTVC / ΔQ = ΔTC / ΔQ (because TFC does not change. It is fixed)

What is marginal cost?

- Marginal cost in the additional cost incurred by the company as a result of producing one more unit of output.
- In other words…
- It is how much it costs the company to produce one more unit of output.

Short-run cost curves





Short-run cost curves (2)

- The TC and TVC curves have the same shape. The vertical distance between them is the value of the TFC.
- The MC, AVC and ATC curves are all U-shaped.
- The ATC curve lies above the AVC curve. The vertical distance between them in the value of the AFC.
- The AFC curve is L-shaped.
- The MC curve (in its upward sloping part) cuts the AVC and the ATC curves at their lowest points.
- The lowest point on the ATC curve is called the efficient scale.

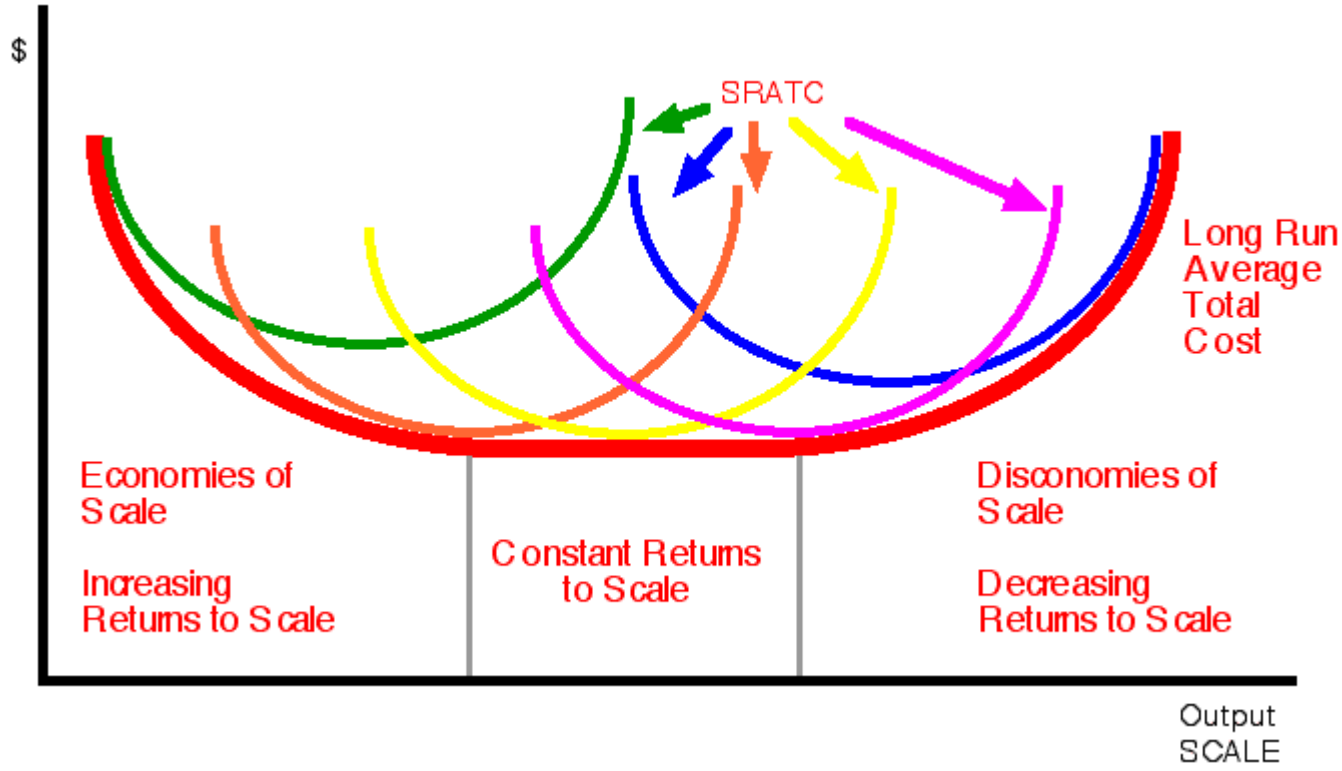
Long-run costs

- In the short run, there are fixed costs.
- In the long run, all costs are variable.
- In the short run, the only decisions that are made are related to the *level of production*.
- In our earlier example, Carmen could decide to increase her production from 7 cookies to 8 cookies per day.
- In the short run, the change in the level of production is not very significant.

Long-run costs (2)

- In the long-run, the decisions are made with respect to *the scale of the firm's activities*.
- When Carmen buys a second oven or even rents a second spot on campus to sell her cookies, her level of production changes significantly.
- The cost structure of her company will be affected.
- *Let's talk about how the average total cost of the company changes in the long run*.

The long-run average total cost curve



SRATC: Short Run Average Total Cost

The long-run average total cost curve

- There are three main phases in the long-run average total cost curve.
- The first phase, where the average total cost falls
- The second phase, where the average total cost remains constant
- The last phase, where the average total cost rises
- The changes in the average total cost are respectively due to:
- Economies of scale (or increasing returns to scale)
- Constant returns to scale
- Diseconomies of scale (or decreasing returns to scale)

Economies of scale

- Economies of scales are factors that cause the average total cost of a firm to fall as the output scale of the firm rises.
- Hence it may cost a firm $1000 to produce 10 units of a good and $1500 to produce 20 units of a good.
- Examples of economies of scale are:

- Cheaper inputs
- Specialization
- Improved efficiency (i.e. Research and Development)
- …

Diseconomies of scale

- Diseconomies of scale are factors that cause the average total cost of a firm to increase as the firm's output scale increases.
- An example may be a firm which incurs a cost of $1000 to produce 10 units of a good and $2500 to produce 20 units of a good.
- Examples of diseconomies of scale:

- Over-hiring
- Inefficient managerial/labor policies
- Underemployment of capacity
- …

You should now be able to…

- Define costs and identify the main categories of costs
- Identify the two kinds of explicit costs
- Give examples of implicit costs
- Identify the two production periods and the main difference between them
- Calculate the accounting and the economic profit/loss
- Explain what a production function is

You should now be able to… (2)

- Explain the relationship between changes in output and changes in the marginal product
- Identify and comment on the 3 production phases
- Identify the different types of short-run costs and how to calculate them
- Draw the short-run cost curves
- Draw the long-run average total cost curve
- Identify the factors that define its shape
- Define (dis-)economies of scale and give examples

THANK YOU