

UNIVERSITÀ
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Economics

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Global Law and Transnational Legal Studies

PRODUCTION AND COSTS

HOW FIRMS USE RESOURCES AND DECIDE WHAT TO PRODUCE

Costs of Production

Costs are very important as they are a key **determinant** of the production and pricing **decisions** of the firm

Costs of Production

- We'll consider the **costs of production**, **revenues** and **profit** of the firm and
- differentiate between **economic costs** and **accountancy costs**
- We'll see that
- costs and profit have a special meaning in economics, which is different from the ordinary one
- This will allow us to study how **firms behave** in **different market structures**

What Are Costs?

We will use a Pizza place as an example of a small business.

A pizza place has to pay for:

- The ingredients used to make pizzas
- Equipment
- Workers to run his equipment
- Utilities (electricity, water, gas…)
- Rent?…

Costs

A firm's *cost of production* includes both

Explicit*, *Direct*, *Accountancy costs - costs that require a direct outlay of money by the firm

Implicit*, *Indirect*, *Opportunity costs - costs that do not require an outlay of money by the firm.

They occur anytime the firm uses resources *which could have been used differently*

Opportunity cost

Choosing one option means giving up another

The owner spends the day working in the pizzeria.

She gives up the pay from her best alternative job.

Opportunity cost = the value of the best alternative forgone

Costs as Opportunity Costs

- The working activity of the owner of the firm is a real cost of operating the firm *even if there is no real wage paid, no money flows out of the firm!*
- It is an **opportunity cost** – the wage lost for not doing an alternative job but working in the firm instead

- **It is important for decision, then it is important from an economic point of view!**

Using your own premises

No rent payment, but a valuable alternative

The owner could rent the premises to someone else for €80 a day.

Using them for the pizzeria gives up that rental income.

Implicit opportunity cost: €80 a day

Costs as Opportunity Costs

- Another example:
- The lost interest on capital invested in the firm
- It is a real, **implicit, opportunity** cost, even if it is not an accounting cost

Using your own savings

Money invested in the business also has an alternative use

The owner invests €20,000 of her savings.

An alternative investment would earn 5% a year.

The annual interest forgone is €1,000.

€20,000 × 5% = €1,000 per year

Cost of Capital as Opportunity Cost

- 1. Example: a businessman uses €**200.000** of his savings to start his firm. **It was in a savings account, paying 5% interest**.
- 2. Since the businessman could have earned €**10.000** per year on his savings, we must include this **opportunity cost**. An accountant would not!
- 3. If the businessman had instead borrowed €**100.000** from a bank and used €**100,000** from his savings, the **opportunity cost is the same** if the interest rate stayed the same at **5%** - according to the economist! (5.000+5.000)
- But the accountant would now count the €**5.000** in interest paid for the bank loan!

Explicit and implicit costs

Explicit costs

The business makes a payment.

Examples: ingredients, wages, rent.

Implicit costs

The business gives up an opportunity.

Examples: the owner's unpaid time and own premises.

Economic cost includes both

Accounting and economic profit

One day	Amount
Revenue	€800
Explicit expenses	€600
Accounting profit	€200
Implicit opportunity costs	€160
Economic profit	€40

Economic profit subtracts the opportunities forgone as well

Costs as Opportunity Costs

- This difference between implicit and explicit costs is the real **difference between accountancy and economic point of view**

Production and Costs, fixed and variable…

Time horizon

- 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 – **some factors of production cannot be changed**.
- In the **long** run, fixed costs become variable costs – **all factors of production can be changed**.

Production and Costs, fixed and variable…

- In the SHORT RUN this implies looking at the relation between the quantity of the input LABOR and the QUANTITY produced
- The SHORT RUN is too short a period for increasing the other inputs of production (capital and land)
- In the short run the dimension of the firm is fixed

Short run and long run

Short run

At least one input cannot change.

The pizzeria uses its current oven and kitchen.

Long run

The firm can change all inputs.

It can move to larger premises or change its equipment.

The distinction depends on flexibility, not a fixed number of months

The Production Function

The *production function* shows the relationship between the quantity of **inputs** used to produce a given good or service and the quantity of **output** of that good or service

The production function

How much output can a given set of inputs produce?

Input: number of workers.

Output: pizzas per hour.

For now, the oven and kitchen stay the same.

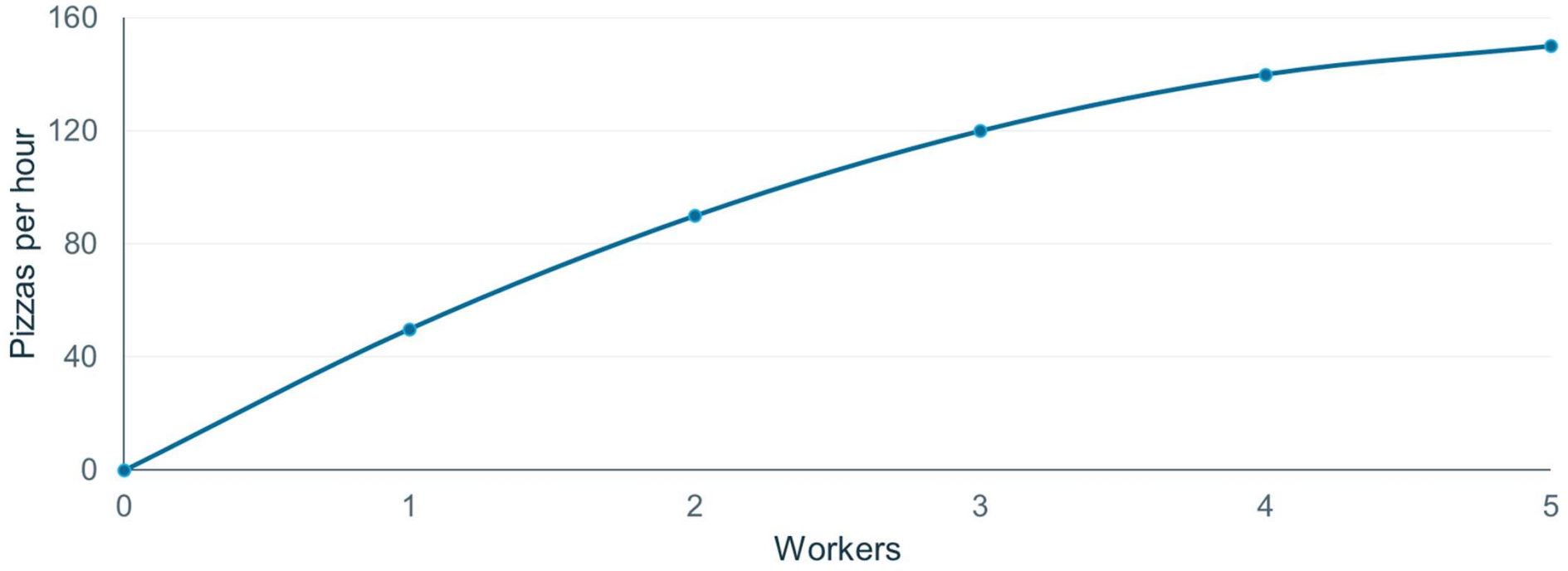
More workers share the same fixed capacity

Workers and pizzas

Workers	Pizzas per hour
0	0
1	50
2	90
3	120
4	140
5	150

Output increases, but the extra output becomes smaller

The production curve



Each extra worker adds less output than the previous worker

Let's rewrite the table

L	Q		MPL
From 0 to 1	From 0 to 50	50	
From 1 to 2	From 50 to 90	40	
From 2 to 3	From 90 to 120	30	
From 3 to 4	From 120 to 140	20	
From 4 to 5	From 140 to 150	10	

Number of workers	Output (quantity of pizzas produced per hour)
0	0
1	50
2	90
3	120
4	140
5	150

MPL = $\Delta Q/\Delta L = (\Delta Q/1)$ = **marginal product of labour**

Δ = change

What happens to MPL when L increases?

Number of workers L	Output (quantity of pizzas produced per hour)	Marginal product of labour
0	0	
1	50	50
2	90	40
3	120	30
4	140	20
5	150	10

When L increases, Q increases but at a decreasing rate…

The increase in output for an increase of 1 unit in L is smaller and smaller the more L increases

Diminishing marginal product

Extra workers share a kitchen that has not grown

The first workers have room and equipment available.

Later workers must wait or share the oven.

Total output still rises, but by smaller amounts.

This short-run result holds other inputs fixed

The diminishing marginal product of labour

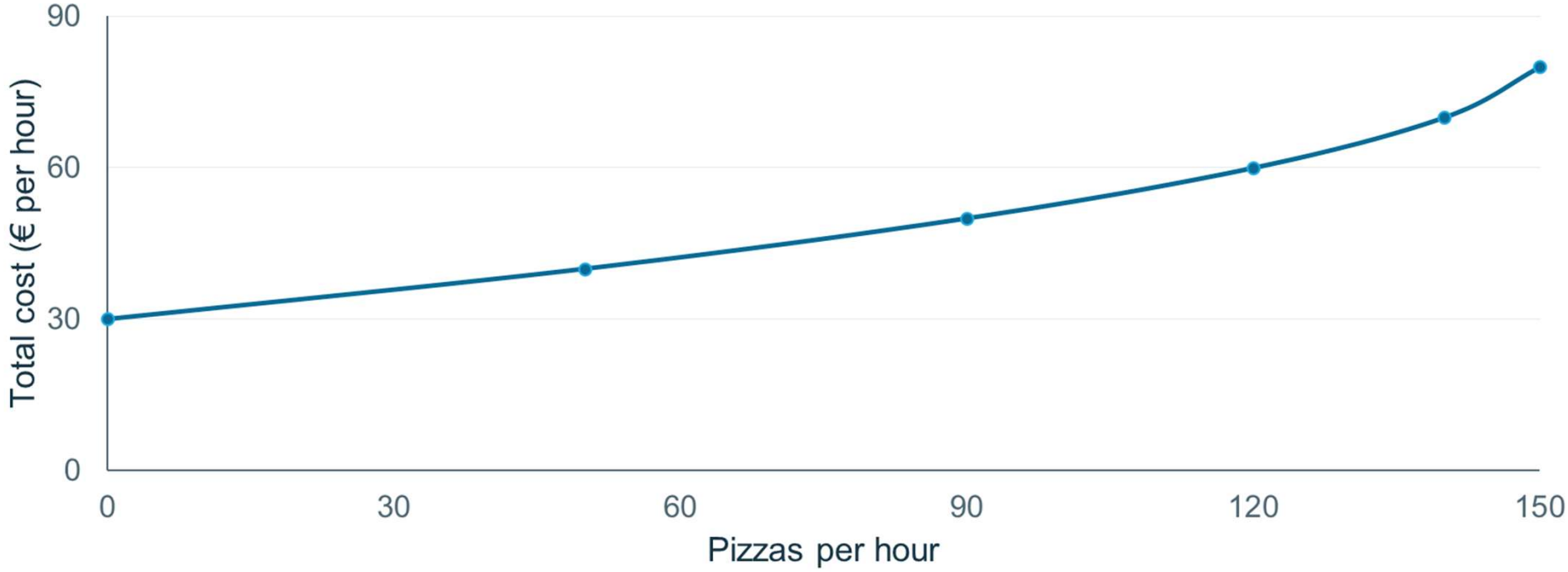
- **Note that this is true for the short run**, in when **L increasing but all other factors of production are kept fixed…**
- That is, **the dimension of the firm is fixed**

Production becomes a cost

Workers	Pizzas/hour	Total cost/hour
0	0	€30
1	50	€40
2	90	€50
3	120	€60
4	140	€70
5	150	€80

Fixed cost: €30/hour. Each worker costs €10/hour.

The total cost curve



The same €10 buys fewer extra pizzas as output grows

Fixed and variable costs

Fixed cost: FC

Does not change with output in the period considered.

Example: agreed daily rent.

Variable cost: VC

Changes as output changes.

Examples: flour and extra paid working hours.

Total cost = fixed cost + variable cost

Another example

Quantity of lemonade glasses (per hour)	Total cost	=	Fixed cost	+	Variable cost
0	€3.00		€3.00		€0.00
1	3.30		3.00		0.30
2	3.80		3.00		0.80
3	4.50		3.00		1.50
4	5.40		3.00		2.40
5	6.50		3.00		3.50
6	7.80		3.00		4.80
7	9.30		3.00		6.30
8	11.00		3.00		8.00
9	12.90		3.00		9.90
10	15.00		3.00		12.00

Total Costs

- Total Fixed Costs
  - +
- Total Variable Costs
  - =
    - Total Costs

Average Costs

Average Costs

- 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**.

Average Costs

Types of Average Cost

- Average Fixed Costs (*AFC*)
- Average Variable Costs (*AVC*)
- Average Total Costs (*ATC*)

- ***ATC = AFC + AVC***

Types of Average Costs

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

$$AVC = \frac{\text{Variable cost}}{\text{Quantity}} = \frac{VC}{Q}$$

$$ATC = \frac{\text{Total cost}}{\text{Quantity}} = \frac{TC}{Q}$$

The Average Measures of Cost

Quantity of lemonade glasses (per hour)	Total cost	Fixed cost	Variable cost	Average fixed cost
0	€3.00	€3.00	€0.00	–
1	3.30	3.00	0.30	€3.00
2	3.80	3.00	0.80	1.50
3	4.50	3.00	1.50	1.00
4	5.40	3.00	2.40	0.75
5	6.50	3.00	3.50	0.60
6	7.80	3.00	4.80	0.50
7	9.30	3.00	6.30	0.43
8	11.00	3.00	8.00	0.38
9	12.90	3.00	9.90	0.33
10	15.00	3.00	12.00	0.30

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

The Average Measures of Cost

Quantity of lemonade glasses (per hour)	Total cost	Fixed cost	Variable cost	Average fixed cost	Average variable cost
0	€3.00	€3.00	€0.00	–	–
1	3.30	3.00	0.30	€3.00	€0.30
2	3.80	3.00	0.80	1.50	0.40
3	4.50	3.00	1.50	1.00	0.50
4	5.40	3.00	2.40	0.75	0.60
5	6.50	3.00	3.50	0.60	0.70
6	7.80	3.00	4.80	0.50	0.80
7	9.30	3.00	6.30	0.43	0.90
8	11.00	3.00	8.00	0.38	1.00
9	12.90	3.00	9.90	0.33	1.10
10	15.00	3.00	12.00	0.30	1.20

$$AVC = \frac{\text{Variable cost}}{\text{Quantity}} = \frac{VC}{Q}$$

The Average Measures of Cost

Quantity of lemonade glasses (per hour)	Total cost	Fixed cost	Variable cost	Average fixed cost	Average variable cost	Average total cost
0	€3.00	€3.00	€0.00	–	–	–
1	3.30	3.00	0.30	€3.00	€0.30	€3.30
2	3.80	3.00	0.80	1.50	0.40	1.90
3	4.50	3.00	1.50	1.00	0.50	1.50
4	5.40	3.00	2.40	0.75	0.60	1.35
5	6.50	3.00	3.50	0.60	0.70	1.30
6	7.80	3.00	4.80	0.50	0.80	1.30
7	9.30	3.00	6.30	0.43	0.90	1.33
8	11.00	3.00	8.00	0.38	1.00	1.38
9	12.90	3.00	9.90	0.33	1.10	1.43
10	15.00	3.00	12.00	0.30	1.20	1.50

$$ATC = \frac{\text{Total cost}}{\text{Quantity}} = \frac{TC}{Q}$$

The Average Measures of Cost

Quantity of lemonade glasses (per hour)	Total cost	Fixed cost	Variable cost	Average fixed cost	Average variable cost	Average total cost
0	€3.00	€3.00	€0.00	–	–	–
1	3.30	3.00	0.30	€3.00	€0.30	€3.30
2	3.80	3.00	0.80	1.50	0.40	1.90
3	4.50	3.00	1.50	1.00	0.50	1.50
4	5.40	3.00	2.40	0.75	0.60	1.35
5	6.50	3.00	3.50	0.60	0.70	1.30
6	7.80	3.00	4.80	0.50	0.80	1.30
7	9.30	3.00	6.30	0.43	0.90	1.33
8	11.00	3.00	8.00	0.38	1.00	1.38
9	12.90	3.00	9.90	0.33	1.10	1.43
10	15.00	3.00	12.00	0.30	1.20	1.50

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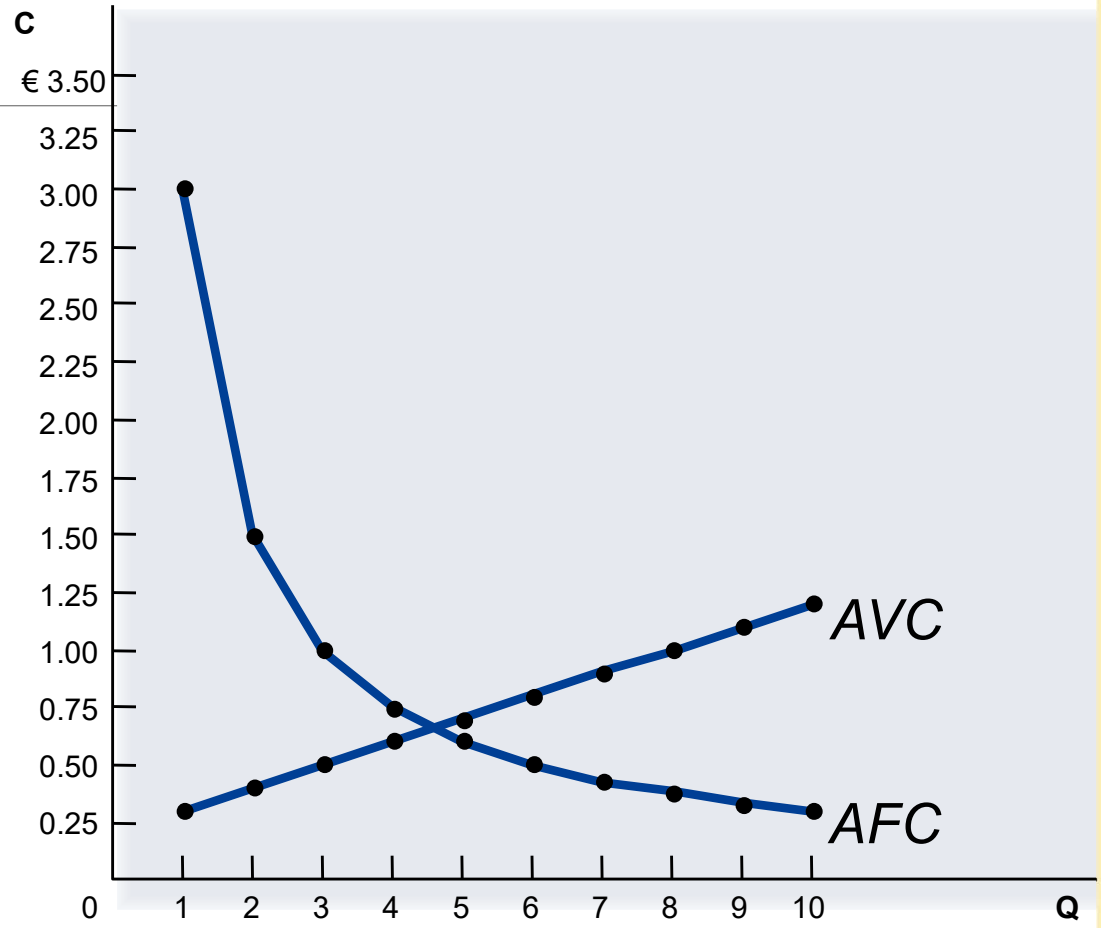
Average fixed and average variable Cost Curves



Quantity of lemonade glasses (per hour)	Average fixed cost	Average variable cost
0	–	–
1	€3.00	€0.30
2	1.50	0.40
3	1.00	0.50
4	0.75	0.60
5	0.60	0.70
6	0.50	0.80
7	0.43	0.90
8	0.38	1.00
9	0.33	1.10
10	0.30	1.20

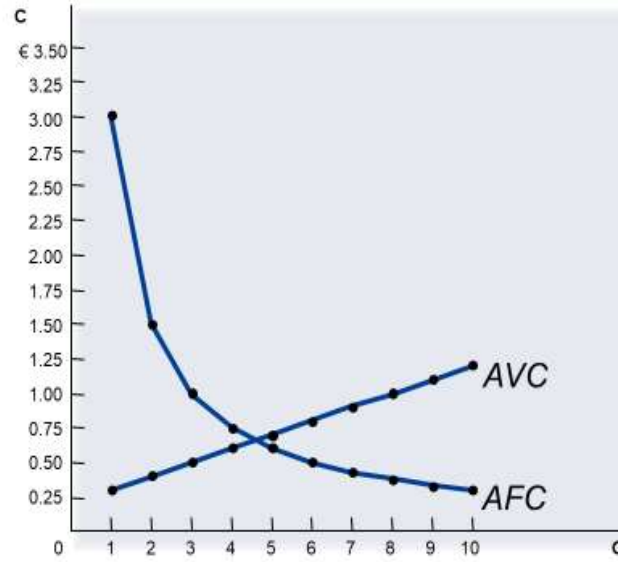
What is the shape of the Average Total Cost curve

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.



Why marginal cost can rise

Fixed capacity makes additional output harder to produce

Extra workers add fewer pizzas in the same kitchen.

Producing the next batch needs more paid time per pizza.

Diminishing marginal product can lead to rising marginal cost

Marginal cost and the average

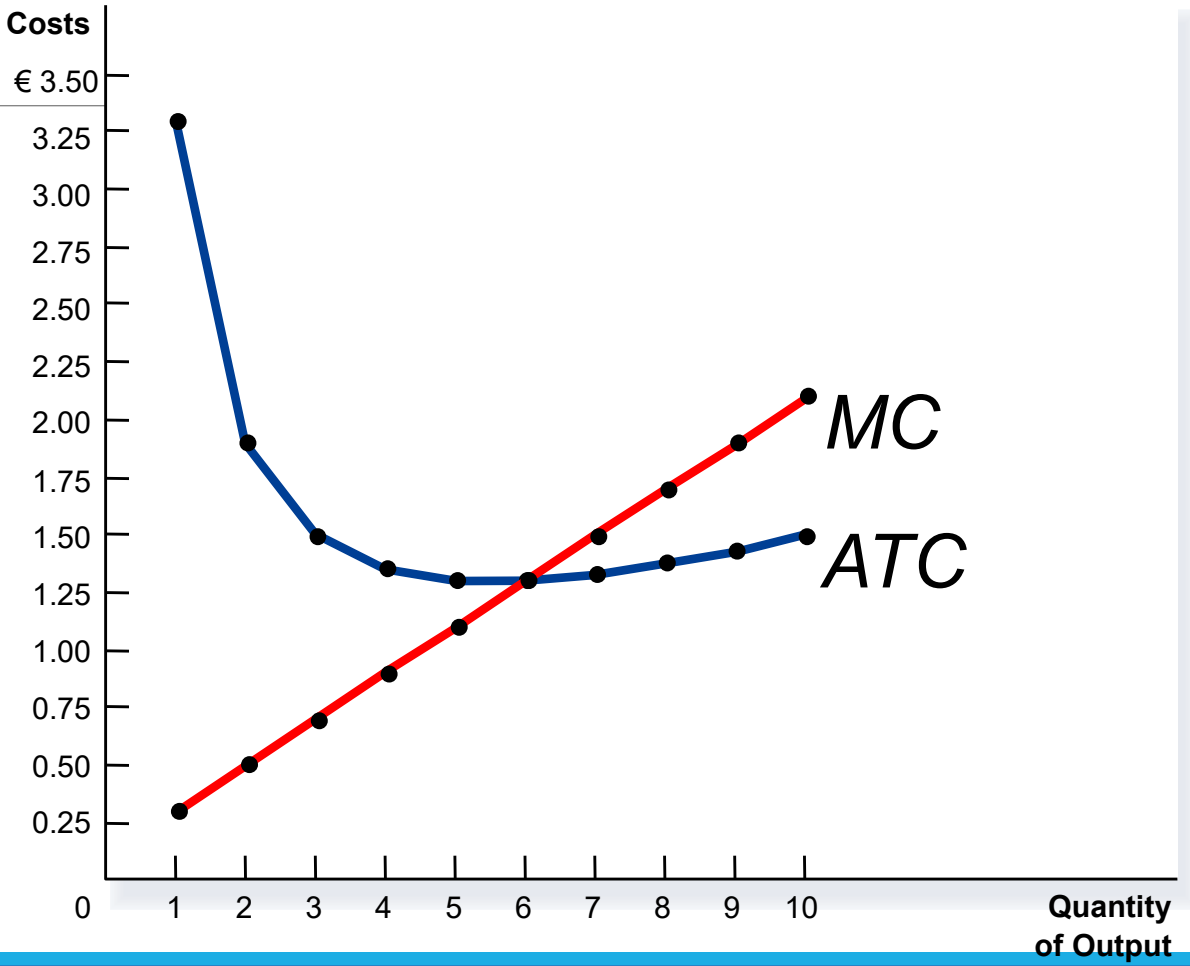
Think of adding one mark to your exam average

A new mark below the current average lowers the average.

A new mark above the current average raises it.

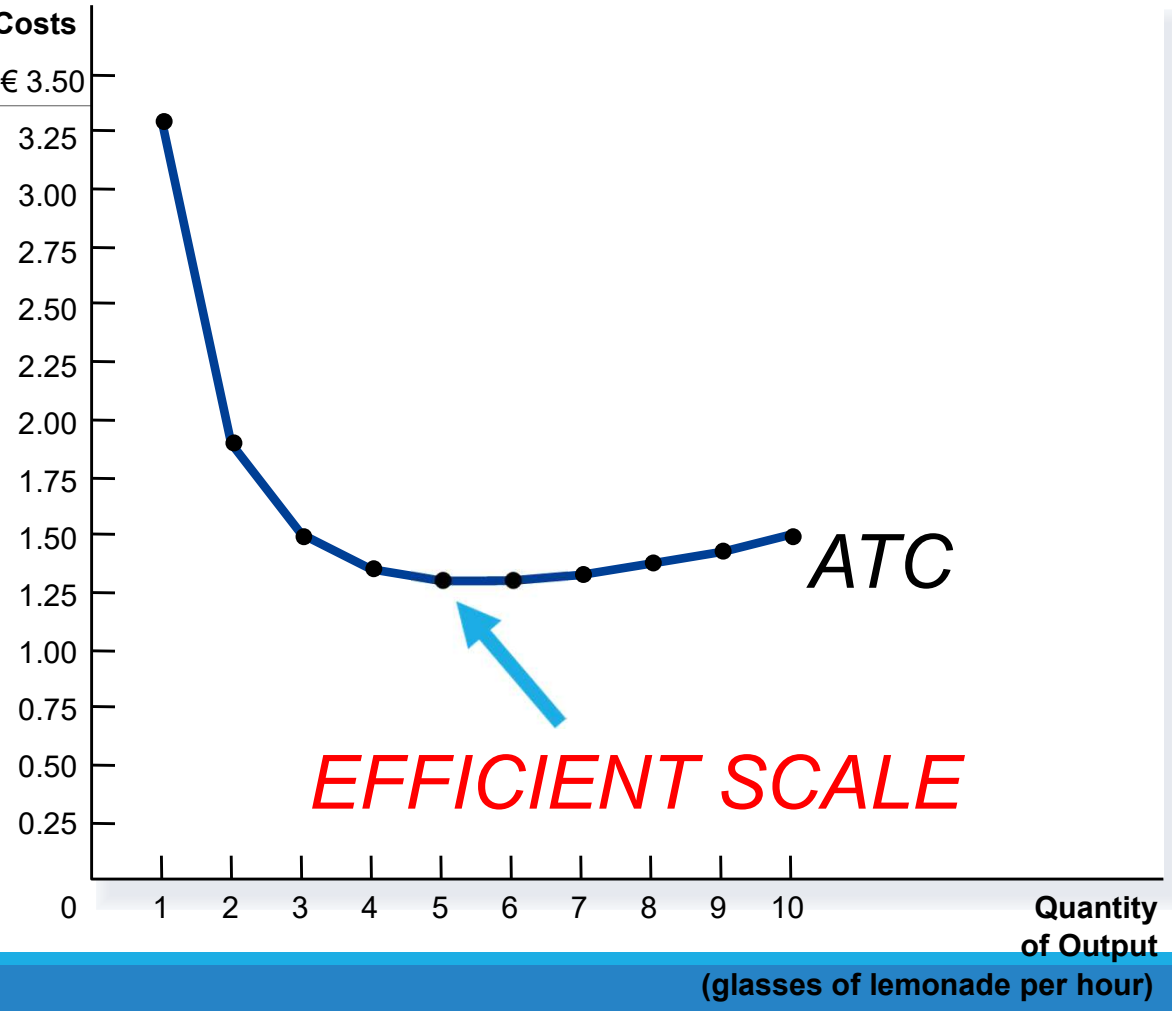
The same logic applies to the cost of an extra unit

MC meets ATC at its minimum



Average Cost total-cost curve is *U-shaped*

The bottom of the U-shaped *ATC* curve occurs at the quantity that *minimizes average total cost*



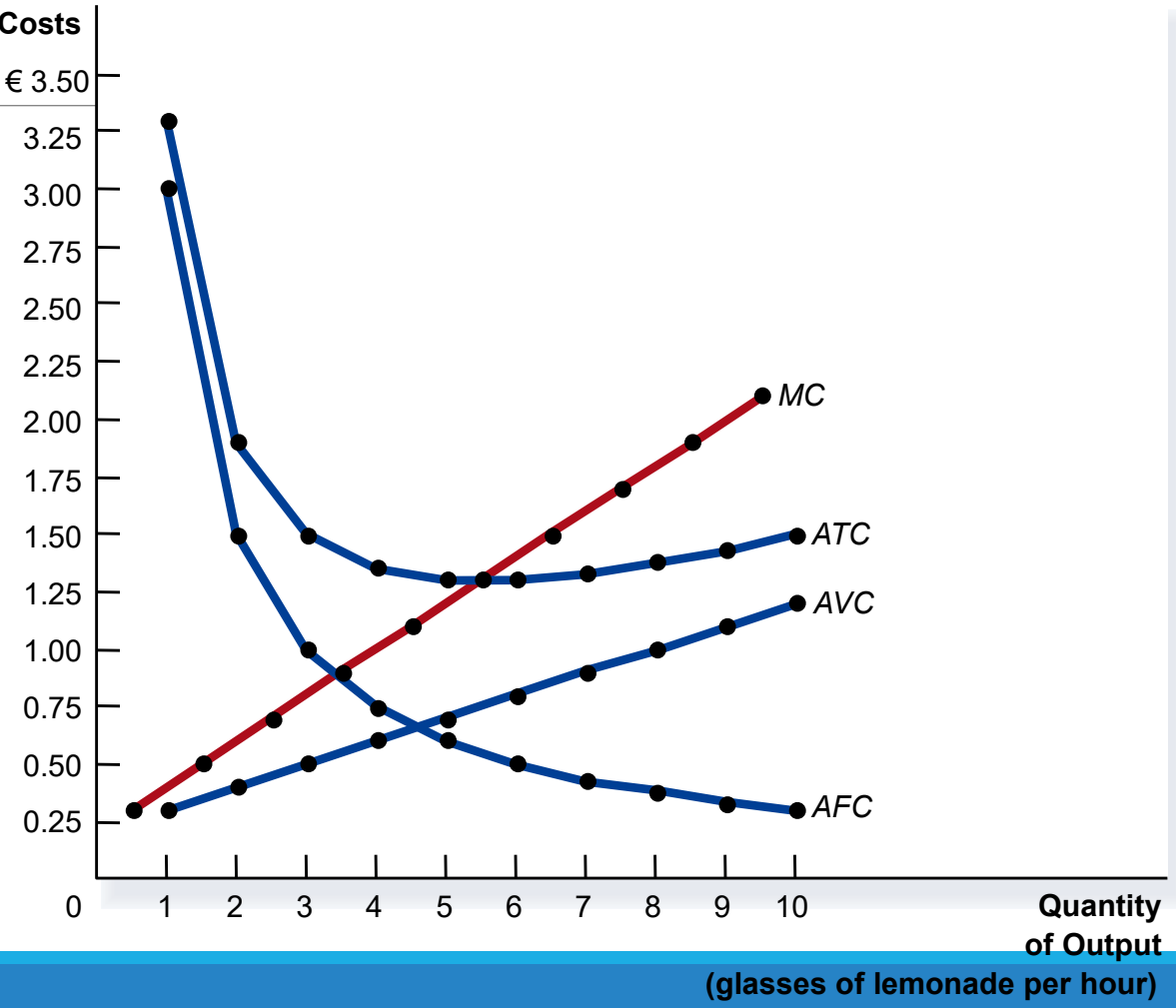
This quantity is sometimes called the *efficient scale* of the firm.

Cost measures at a glance

Measure	Question it answers	Calculation
TC	Total cost of this output?	FC + VC
AFC	Fixed cost per unit?	FC ÷ Q
AVC	Variable cost per unit?	VC ÷ Q
ATC	Total cost per unit?	TC ÷ Q
MC	Cost of additional output?	ΔTC ÷ ΔQ

Average looks at all units. Marginal looks at an addition.

Average Costs and Marginal Cost Curves



Changing the size of the business

This week

The kitchen and oven are already chosen.

The owner adjusts ingredients and working hours.

For a future expansion

The owner can choose a different kitchen.

A new scale changes the available cost options.

Long-run flexibility adds options

Choosing premises in the long run

Pizzas/day	Small premises	Medium premises	Large premises
20	€4.00	€7.00	€11.00
40	€5.00	€4.50	€7.00
60	€8.00	€5.00	€4.50

Illustrative average costs per pizza. The best size depends on output.

Economies of scale

A larger scale can lower average cost

Workers can specialise in different tasks.

Larger equipment can use resources more efficiently.

Bulk purchasing may reduce input prices.

All inputs can change in this long-run comparison

Diseconomies of scale

A larger organisation can also raise average cost

Coordination takes more time.

Communication becomes harder.

Additional management can add overheads.

Constant average cost is also possible over a range of output

Diminishing productivity and scale

Diminishing marginal product

Add workers to the same kitchen.

Other inputs stay fixed.

Economies of scale

Change workers and kitchen size together.

Compare costs across different scales.

The two ideas can apply to the same business

Exercise: one day in the pizzeria

40 pizzas. Total cost €164. Fixed cost €60.

What are variable cost and average total cost?

If each pizza sells for €10, what is accounting profit?

If implicit costs are €100, what is economic profit?

Use the information given. All figures refer to the same day.

Exercise: producing ten more pizzas

Total cost rises from €164 to €210

Output rises from 40 to 50 pizzas.

What is the extra cost per pizza over this interval?

Why is that different from average total cost at 50 pizzas?

Extra cost uses the change. Average cost uses the total.

The ideas to remember

Opportunity cost includes the best alternative forgone.

Some costs stay fixed in the short run.

Average cost describes all units. Marginal cost describes extra output.

Long-run decisions allow the firm to change its scale.

Next: how costs and revenues guide a competitive firm