Introducing supply decisions

Microeconomics

Types of firms

- There are three main types of firms: self-employed sole traders, partnerships, and companies.
- Sole traders are the most numerous but are often very small. The large firms are companies. Companies are owned by their shareholders but run by the board of directors.
- Shareholders of a company have limited liability. The most they can lose is the money they spent buying shares. Partners and sole traders have unlimited liability: they can be forced to sell their personal possessions if the business goes bust.

Supply decisions

- No matter how small or large a firm is, we will assume that their main goal is to maximize their profits:

  $\pi(q) = TR(q) - TC(q)$

- Profits are the excess of revenues (TR) over costs (TC).
- In order to maximize their profits, firms have to make several important decisions. These include determining the optimal (profit-maximizing)
  - Quantity produced (Q) ← 'theory of supply'
  - (Output) price (P) → Aim: maximize TR(q) if q is given (The optimal price can be determined according to the demand curve facing the firm).
  - Technology and factors of production → Aim: minimize TC(q) if q is given (can be calculated from a production function and the rental/wage rates)

Determinants of profits

- For each possible output level a firm needs to calculate what it *costs* to make this output and how much *revenue* is earned by selling it.
- At each output, production costs depend on technology; which determines the inputs needed; and on the input prices that the firm faces.
- Sales revenue depends on the demand curve faced by the firm. The demand curve determines the price for which any output quantity can be sold and thus the revenue the firm earns.

Economic costs and profits

- Economists and accountants take different views of cost and profit.
- An accountant is interested in tracking the actual receipts and payments of a company.
- Economists identify the cost of using a resource not as the payment actually made but as its opportunity cost.
- Opportunity cost is the amount lost by not using a resource (labour, capital) in its best alternative use.

Examples of opportunity costs

- Opportunity costs include the cost of the owner's time and effort in running a business.
- For example, if you could have earned $25,000 a year working for someone else, and the accounting profit of a firm you run is $20,000, being self-employed is losing you at least $5000.
- Accounting profits also ignore the use of owned (as opposed to borrowed) financial capital. The money you put up to start a business could have been deposited in an interest-bearing bank account or used to buy shares in other firms.

Economic costs and supernormal profits

- These opportunity costs are part of the economic costs of the business but not its accounting costs.
- If, after deducting opportunity costs, the business still makes a profit, economists call this ‘supernormal profit’. Supernormal profit is the pure profit accruing to the owners after allowing for all economic costs.
- Supernormal profits are the true indicator of how well a firm is doing by tying up the owner’s time and funds in the business.

The firm's supply decision

- Suppose a firm makes spoons. The firm knows different techniques for making spoons, and the cost of hiring inputs – the wage rate for workers and rental for leasing a machine.
- The firm also knows its demand curve, and hence its revenue from selling different quantities of spoons at different prices.
- To maximize profits the firm chooses the best level of output. Chaning output affects both the costs of production and the revenue from sales.
- Costs and demand conditions jointly determine the output choice of a profit-maximizing firm.

Cost minimization

- The firm certainly wants to make its chosen output level at the least possible cost.
- Otherwise, by producing the same output at lower cost it could increase profits.
- Thus a profit maximizing firm must produce its chosen output as cheaply as possible.

Cost and production functions

The total cost curve

- Knowing the available production methods and the cost of hiring workers and machines, the firm calculates the least cost at which each output can be made.*
- To make a few spoons it is not worth using many machines; to make more spoons, it makes sense to use more machines.

*TC(Q) is the minimum cost (w*L + r*K) needed to produce a given quantity (Q).
(K – physical capital, r – avg. rental rate, L – hours employed, w – avg. hourly wage)

Cost, revenue, profit (weekly)

(1) Output	(2) Total cost	(3) Price	(4) Total revenue	(5) Profit
	(€)	(€)	(1) × (3) (€)	(4) − (2) (€)
0	10	–	0	−10
1	25	21	21	−4
2	36	20	40	4
3	44	19	57	13
4	51	18	72	21
5	59	17	85	26
6	69	16	96	27
7	81	15	105	24
8	95	14	112	17
9	111	13	117	6
10	129	12	120	−9

Quantity and costs

- The table on the previous slide shows various outputs in column (1).
- Column (2) shows the minimum cost at which each output can be made.
- The firm incurs a cost of €10 even when output is zero. This is the cost of being in business at all – running an office, renting a telephone etc.
- Thereafter, costs rise with output. Costs include the opportunity costs of all resources used in production. At high levels of output, cost rises sharply as output increases: the firm has to pay the workers overtime to work weekends and nights.

Total revenue

- The revenue from an output depends on price and hence demand.
- Column (3) of the table shows the demand curve, the price at which each output can be sold.
- Column (4) calculates sales revenue, price times quantity. At a price of €21 the firm sells only one spoon. The lower the price, the more it sells: its demand curve slopes down.

Profit

- The last column shows profit, the difference between revenue and cost. At low output, profit is negative. At the highest output of 10, profit is again negative. At intermediate outputs, the firm makes positive profit.
- The highest profit is €27 a week, at an output of 6 spoons. At €16 each, total revenue is €96. Production costs, properly calculated, is €69, leaving a profit of €27 a week. This chosen output, or supply decision, is the highlighted row in the table.

Profits and revenue

- Maximizing profit is not the same as maximizing revenue.
- By selling 10 spoons a week the firm could earn €120, but it would cost €129.
- Making the last few spoons is expensive and brings in little extra revenue. It is more profitable to make less.

A different angle

- We could also ask at each output level, whether the firm should increase output still further.
- Suppose the firm makes 3 spoons and considers making 4 spoons.
- Our table shows this raises total cost from €44 to €51. a €7 increase in total cost.
- Revenue rises from €57 to €72, a rise of €15.
- Raising output from 3 to 4 spoons adds more to revenue than cost. Profit rises by €8 (€15 more revenue, minus €7 more cost).

Marginal cost and revenue

- This approach – examining how one more unit of output affects profit – focuses on the marginal cost and marginal revenue of producing one more unit.
- Marginal cost (MC) is the rise in total cost when output rises one unit.
- Marginal revenue (MR) is the rise in total revenue when output rises one unit.

The firm's supply decision (2)

- If marginal revenue exceeds marginal cost, the firm should raise output. Producing and selling an extra unit adds more to total revenue than to total cost, raising total profit.
- If marginal cost exceeds marginal revenue, the extra unit of output reduces total profit.
- Thus we can use MC and MR to calculate the output that maximizes π. So long as MR exceeds MC, keep increasing output. As soon as MR falls short of MC, stop increasing output.

Total and marginal cost

Output	Total cost (€)	Marginal cost (€)
0	10	
1	25	15
2	36	11
3	44	8
4	51	7
5	59	8
6	69	10
7	81	12
8	95	14
9	111	16
10	129	18

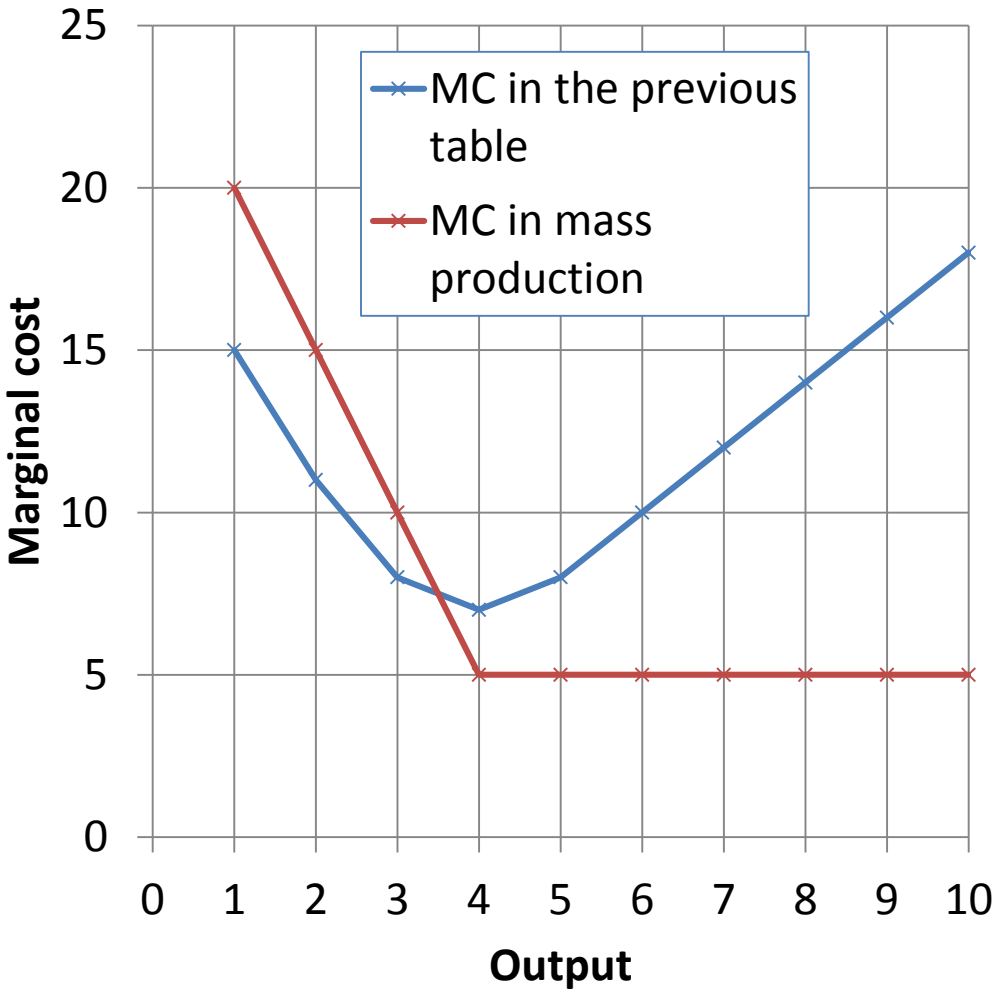
$$MC(q) = \frac{\partial TC(Q)}{\partial q}$$

The table to the left uses the data from our previous table to calculate the marginal cost of producing each extra unit of output. Increasing output from 0 to 1 raises total cost from €10 to €25. The marginal cost of the first unit is €15. This table shows the marginal cost of each output level, the extra total cost of raising output by the last unit.

Marginal cost is large when output is low but also when output is high. Marginal cost is lowest when making the fourth unit, which adds only €7 to total costs.

As output increases, why do marginal costs start high, then fall, then rise again? The answer reflects different production techniques. At low output, the firm uses simple techniques. As output rises, more sophisticated machines are used, making extra output quite cheaply. As output rises still further, the difficulties of managing a large firm emerge. Raising output gets hard and marginal costs rise.

Marginal costs



The figure to the left plots the relation between output and marginal cost, which varies from firm to firm. In a coal mine that is nearly worked out, marginal cost rises steeply with extra output. In mass production industries, as output increases marginal cost may decline and then become constant.

Price, total revenue, and marginal revenue (€)

Q	P	Total revenue	Marginal revenue
0	–	0	
1	21	21	21
2	20	40	19
3	19	57	17
4	18	72	15
5	17	85	13
6	16	96	11
7	15	105	9
8	14	112	7
9	13	117	5
10	12	120	3

Still based on our first table, the table to the left shows marginal revenue, the extra total revenue when an extra unit of output is made and sold. Raising output from 0 to 1 raises revenue from €0 to €21. The marginal revenue of the first unit is €21. Raising output from 7 to 8 units raises revenue from €105 to €112 so marginal revenue is €7. Total revenue and marginal revenue depend on the demand curve for the firm's product.

Marginal revenue falls steadily as output rises and can be negative at high output levels. To sell 11 spoons the price must be cut to €10 each. Total revenue is €110. Since 10 spoons earn €120, the marginal revenue from 10 to 11 spoons is €110 − €120, and thus −€10.

Decomposing marginal revenue

- To understand how marginal revenue changes with output, we keep track of two separate effects:
- Marginal revenue = extra revenue from making and selling 1 more unit
  = [price for which last unit sold]
  – [revenue lost by selling existing units at a lower price]

$$TR(q) = p(q) \times q \qquad MR = \frac{\partial TR}{\partial q}$$

$$MR(q) = p(q) + q\frac{\partial p(q)}{\partial q} =$$

$$= p(q)\left(1 + \frac{q}{p}\frac{\partial p(q)}{\partial q}\right) = p\left(1 + \frac{1}{\varepsilon}\right)$$

Where ε is the price elasticity of demand; since it is (almost always) negative, MR ≤ p

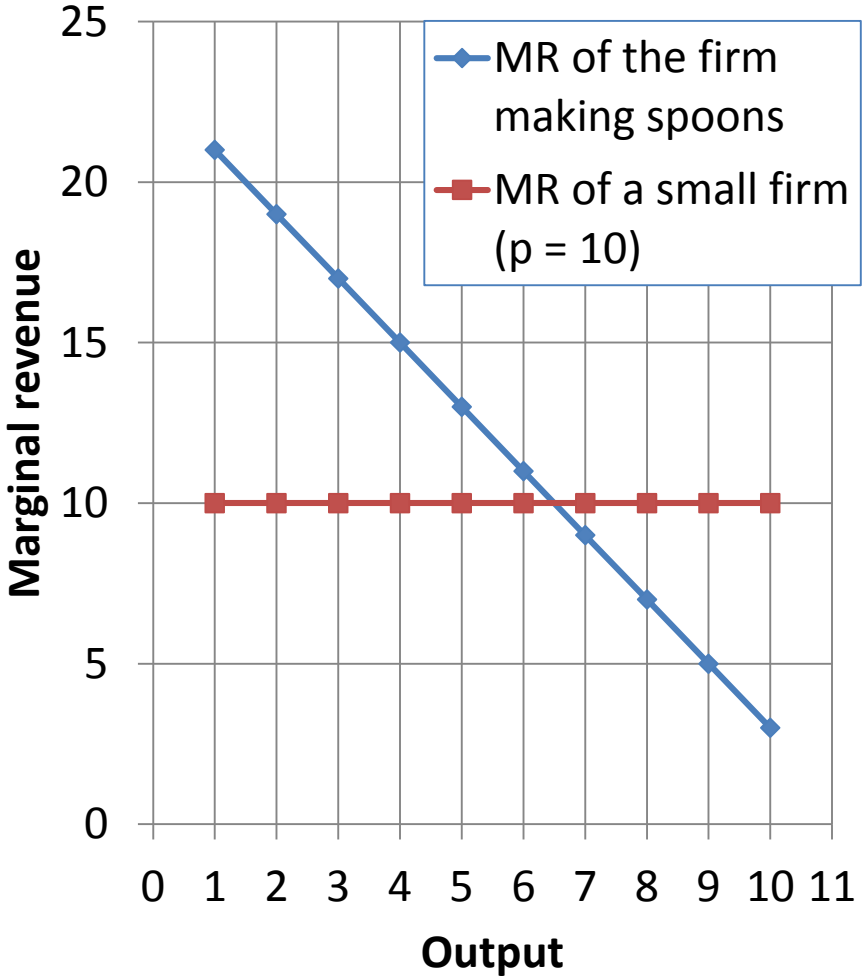
Demand and revenue

- Demand curves (almost always) slope down. To sell more output, the price must be cut.
- Selling an extra unit of output at this lower price is the first component of marginal revenue.
- However, to sell that extra unit the firm has to cut the price for which all previous units of output can be sold. This effect reduces the marginal revenue obtained from selling an extra unit of output.

Output and MR

- Marginal revenue falls steadily for two reasons:
  - First, because demand curves slope down, the extra unit must be sold at a lower price.
  - Second, successive price reductions reduce the revenue earned from existing levels of output, and at larger output, there are more existing units on which revenue is lost when prices fall further.

The shape of the MR curve



- The shape of the marginal revenue curve reflects the shape of the demand curve.
- A small firm in a huge market sells as much output as it wants without affecting the market price.
- That firm's demand curve is horizontal at the going price. In this special case, the price is the marginal revenue. No revenue is lost on existing output when more output is sold.

Using MR and MC to choose output

(1) Q	(2) MR (€)	(3) MC (€)	(4) Mπ (€) = MR−MC	Output decision
1	21	15	6	Raise
2	19	11	8	Raise
3	17	8	9	Raise
4	15	7	8	Raise
5	13	8	5	Raise
6	11	10	1	
7	9	12	−3	Lower
8	7	14	−7	Lower
9	5	16	−11	Lower
10	3	18	−15	Lower

We seek a q that maximizes $\pi = \mathrm{TR} - \mathrm{TC}$

$$\mathrm{M}\pi = \frac{\partial \mathrm{TR}}{\partial \mathrm{q}} - \frac{\partial \mathrm{TC}}{\partial \mathrm{q}} = \mathrm{MR} - \mathrm{MC} = 0$$

- Combining MC and MR, the table to the left examines the output that maximizes the firm's profits.
- If MR exceeds MC, a 1-unit increase in output will increase profits. The last column shows that this reasoning leads the firm to make at least 6 units of output.
- The firm now considers increasing output from 6 to 7 units. Marginal revenue is €9 and marginal cost €12. Profits fall by €3. Output should not be expanded to 7 units, or to any level above this. The firm should expand up to 6 units of output but no further. This output maximizes profits, as we know already from our previous table.

TC and TR versus MC and MR

- Our first table, based on TC and TR, and the last table, based on MC and MR, are different ways to study the same problem.
- Economists frequently use marginal analysis.
- ‘Is there a small change that could make the firm better off?’
- If so, the current position cannot be the best possible one and changes should be made.

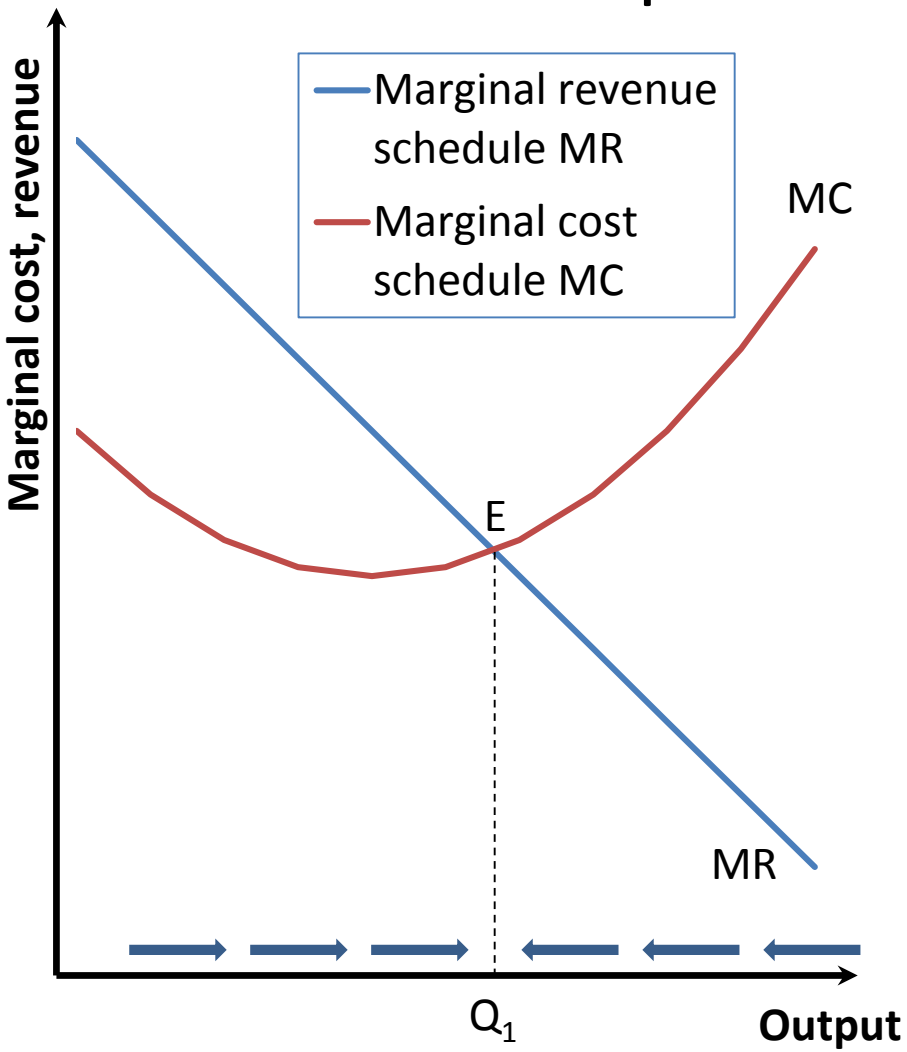
Negative profits

- Marginal analysis should be subjected to one very important check. It may miss an all-or-nothing choice.
- For example, suppose that MR exceeds MC up to an output level of 6 units but thereafter MR is less than MC. 6 units seems to be the best possible output level.
- However, if profits are negative at this output, the firm should close down if this reduces losses.

Output levels are not always integers

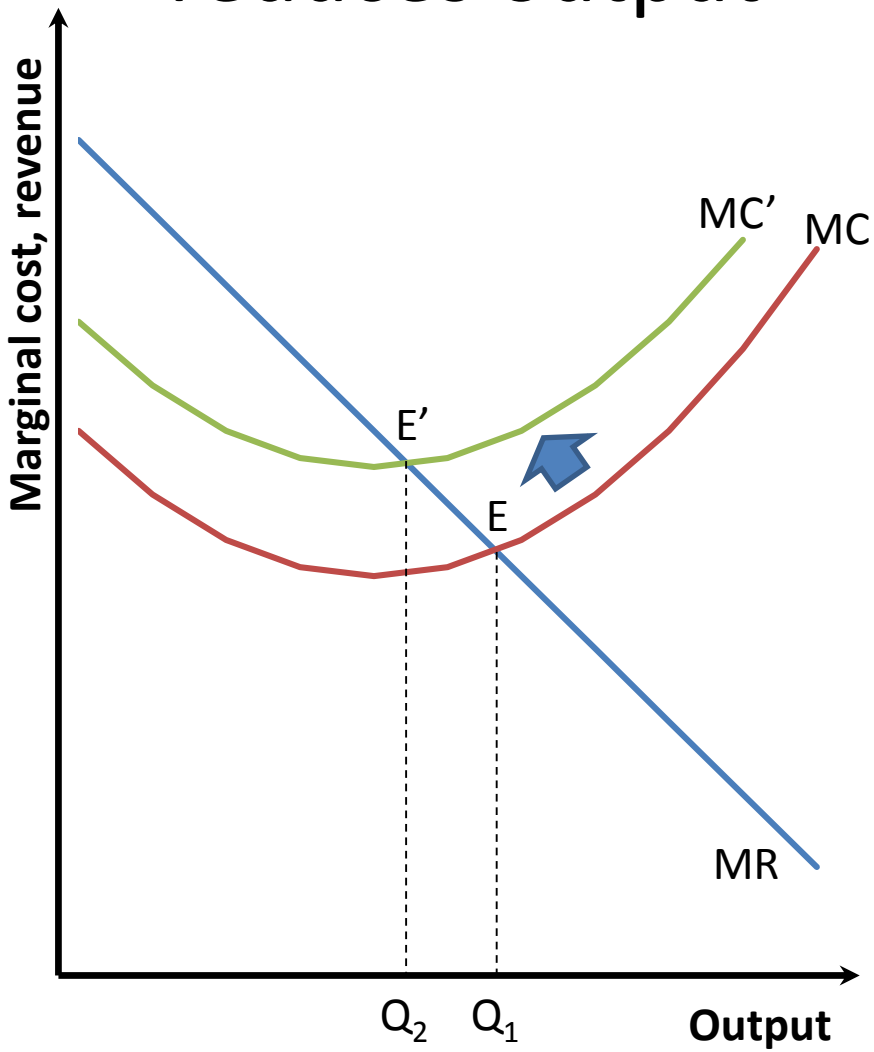
- Thus far we have assumed the firm produces an integer number of goods. Such as 0, 1, or 6, rather than a quantity such as 1.5 or 6.7.
- Output is not usually confined to integer levels. For goods such as wheat or milk, the firm can sell in fractional amounts (e.g. 1.5 litres of milk).
- Even for goods such as cars, sold in whole units, the firm may be selling 75 cars every four weeks, or 18.75 cars a week. It is convenient to imagine that firms can vary output and sales levels continuously.
- We can then draw smooth schedules for marginal cost (MC) and marginal revenue (MR).

MC and MR determine the firm's output



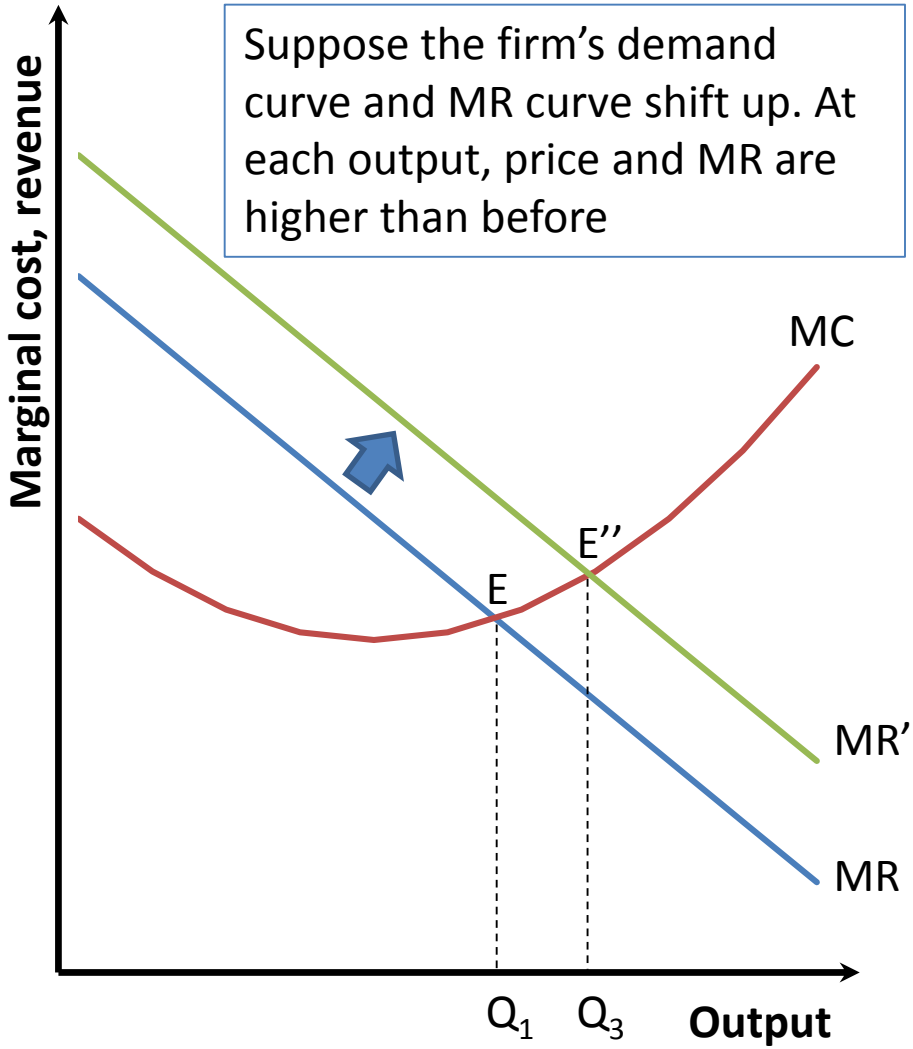
- The MC and MR schedules are shown changing smoothly. The firm's optimal output is Q_1, at which MR is equal to MC.
- Anywhere to the left of Q_1, MR is larger than MC and the firm should increase output, as shown by the arrows.
- Where output is greater than Q_1, MR is less than MC and profits are increased by reducing output.
- If the firm is losing money at Q_1 it has to check whether it might be better not to produce at all than to produce Q_1.

An increase in MC reduces output



- The marginal cost curve shifts from MC to MC' as a result of an increase in the costs of using a factor of production: for instance, the wage may have risen.
- This upward shift moves the intersection of MC and MR curves from E to E'. Output falls from Q_1 to Q_2.
- Thus, when the firm's costs rise, it decides to produce less.

An upward shift in MR increases output



- When the MR curve shifts upward from MR to MR', the intersection point between the marginal revenue and cost curves shifts from E to E''.
- The firm's optimal level of output increases from Q_1 to Q_3.
- The upward shift in the marginal revenue curve could result, for instance, from an increase in the number of customers in the firm's market.

Do firms know their marginal cost and revenue curves?

- Do firms in the real world know their marginal cost and marginal revenue curves, let alone go through some sophisticated calculations to make sure output is chosen to equate the two?
- Such thought experiments by firms are not necessary for the relevance of our model of supply. If, by luck, hunch, or judgement, a firm succeeds in maximizing profits, marginal cost and marginal revenue must be equal.
- Our formal analysis merely tracks the hunches of smart managers who get things right and survive in a tough business world.

Appendix: A firm's accounts

- Firms report two sets of accounts, one for stocks and one for flows. **Stocks** are measured at a point in time, **flows** are corresponding measures during a period of time.
- A firm reports profit-and-loss accounts per year (flow accounts) and a balance sheet showing assets and liabilities at a point in time (stock accounts).
- The two are related: the profits and losses change assets and liabilities over time.

Flow accounts: income statement and cash flow

- An **income statement** lists revenues and costs. Revenue is what the firm earns from selling goods or services in a given period, cost (for an accountant) is the expense incurred in production in that period and profit is revenue minus cost.
- A firm's **cash flow** is the net amount of money actually received during the period (≠ profits).
- Actual receipts and payments may differ from economic revenue and cost. Profitable firms may still have a poor cash flow, for example when customers are slow to pay.

Stock accounts: the balance sheet

- The balance sheet lists the **assets** the firm owns and the **liabilities** for which it is responsible at a point in time.
- A firm's **net worth** is the assets it owns minus the liabilities it owes.
- A firm's assets are its cash and deposits, money owed by its customers, inventories in its warehouses, its factory, machinery etc.
- Its liabilities are bills it has yet to pay, the mortgage on its factory, bank loans etc.