

3 Supply

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3-1

The supply curve

Learning outcomes

By the end of this section, you should understand:

- ◆ That supply describes the behaviour of sellers
- ◆ The effect of price on quantity supplied
- ◆ How supply curves depict this relationship
- ◆ When supply curves shift

Much of the world's cocaine began as a coca plant in Columbia, and poppies in Afghanistan are the source of most of the heroin that finds its way into European countries. American and European governments keep pressurising politicians in Columbia and Afghanistan to eradicate the problem by stopping their farmers producing the raw materials for the drugs trade. From time to time the BBC and CNN show flaming hill-sides as helicopters attack peasant farmers. But the following year, the same crops are back in bloom. Why is the supply of coca and poppies so hard to stamp out?

An economist's answer is that the incentive to produce this crop is large. When poor farmers get much higher prices for one crop than for the alternative crops that they could produce instead, they will be very keen to supply. French farmers could also produce poppies, but, within the Common Agricultural Policy, they have other crops which also yield them high returns.

Frozen out of the markets of G8 countries by high external tariffs, farmers in Third World countries do not have profitable opportunities to engage in legal trade with the world's rich countries. Illegal trade is relatively more attractive to farmers. The quantity supplied is high because farmers get a high price for their crops. As international travel has become easier, transporting drugs has become easier too. In turn, this has raised the price that drug traffickers will pay poppy growers, making poppy growing even more attractive to farmers.

Moreover, in comparison with the government of Afghanistan, the French government has more incentive and greater ability to stamp out illegal crop production. It has more incentive because, as a member of the G8 and EU, it has more to lose by upsetting its partner countries. It has greater ability because it is richer and technically more sophisticated. Identifying and eradicating illegal crops is easier.

This example illustrates many of the themes of this chapter. What determines the incentive to produce and supply to the market? How sensitive is production to the price being offered? Must prices be reduced in order to diminish the incentive to supply or can supply be reduced through other means?

Supply is the quantity producers wish to offer for sale at each conceivable price.

Supply is not a particular quantity but a full description of the quantity producers would sell at each and every possible price. We can show this relationship between price and quantity demanded as a *supply curve*, *SS* in Figure 3-1.¹ The vertical distance measures the price of the good or service. The horizontal distance measures the corresponding quantity supplied. Thus, each point on *SS* indicates a price and corresponding quantity supplied at that price.

A **supply curve** shows the quantity supplied at each possible price, other things equal

When the price of poppies is zero, nobody will bother to grow them for sale. As the price of poppies rises, the quantity supplied rises, other things equal. In Figure 3-1 this corresponds to moving *along* the line *SS* – rightwards and upwards – offering more and more poppies for sale as the price is increased, until every Afghan hillside is saturated with poppies and no more can be produced. In Figure 3-1 the maximum possible supply is Q^* , and any price above P^* has no further effect in raising the quantity supplied.

¹As with demand curves, supply curves may be a straight line or a curve, but in either case must slope upwards as we move to the right. If, unlike Figure 3-1, the supply curve was a straight line this would imply that the quantity supplied could be increased without limit provided the price was high enough.

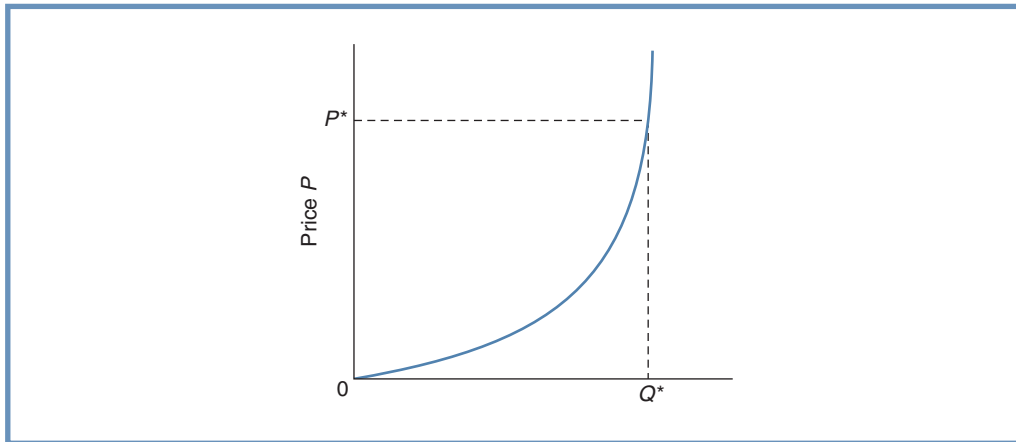


Figure 3-1 The supply of poppies

We can use a similar figure to think about the clean UK energy from wind power in the early twenty-first century. At a low price, it is not worth UK producers producing energy from wind farms (which are not very efficient and, being noisy and ugly, cause a lot of local resentment that is not worth incurring for low levels of energy production). If energy prices were to rise a lot, it would then become worth bearing these costs and producing more UK energy in wind farms. But there is only so much physical wind in the UK in any one year. Beyond some output Q^* , the UK cannot currently produce any more energy from wind no matter how high the price. The supply curve becomes vertical at that point.

Figure 3-2 shows what happened to poppy production when the advent of cheaper and faster travel made smuggling easier, raising the price that smugglers were prepared to pay for poppies. Initially, the poppy market was at point A with a price P_0 and quantity Q_0 supplied. Once smuggling became easier, the price rose to P_1 and farmers responded by raising quantity supplied to Q_1 . They moved upwards along a given supply curve, from A to B , in response to the higher price they were being offered.

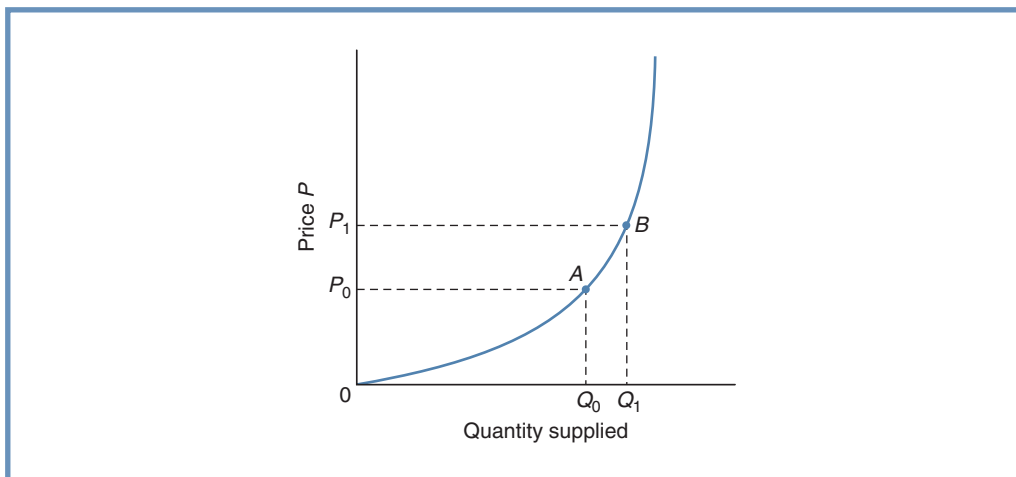


Figure 3-2 Prices and the supply of poppies

3-1 THE SUPPLY CURVE

Conversely, if Western countries adopt better surveillance techniques that eradicate smuggling, the prices being offered to Afghan poppy growers will fall: only a few flower shops will want to buy poppies. In Figure 3-2 we can imagine that we begin at point B , with a price P_1 and quantity Q_1 . The consequence of eradicating drug smuggling is to reduce the price to price P_0 and poppy farmers respond by reducing the quantity supplied to Q_0 .

If changes in prices make suppliers move *along* a given supply curve, how then do we represent more effective policing of illegal poppy production by the Afghan government?

3-2

Behind the supply curve

Learning outcomes

By the end of this section, you should understand:

- ◆ Other determinants of supply
- ◆ When supply curves shift

Recall our discussion of demand curves in Chapter 2, in which price changes moved demanders along a given demand curve but changes in the prices of related goods, changes in incomes, or changes in tastes led to shifts in the demand curve. In exactly the same way, movements in price move suppliers along a given supply curve, but changes in any of the ‘other things equal’ have to be depicted as *shifts* in the supply curve.

The three principal ‘other things’ that affect supply are technology available to producers, the cost of inputs (labour, machines, fuel, and raw materials), and government regulation. Holding these three things constant, movements *along* a particular supply curve show the effect of prices on quantity supplied. A change in any of these ‘other things equal’ shifts the supply curve, changing the amount producers want to supply at each price.

Technology

Better knowledge of fertilisers or improvements in irrigation technology make it profitable to supply more poppies than before at any particular price being offered, just as electronic or information technology have made it possible to supply more televisions and computers at any price than was the case ten years ago.

As a determinant of supply, technology must be interpreted broadly. A technological advance is any improvement in knowledge that allows more physical output from the same quantity of physical input as before. It is this productivity increase that means that producers are willing to supply more than before at any particular price. This improvement might come from better science, but it might also arise from better psychology.

When Japanese car producers first established car plants in the UK, they achieved much higher productivity levels than traditional car producers. This was due in part to workforce motivation and organisation. Rather than take lunch alone in a directors’ dining room, those running the company ate in the same cafeteria as workers, making the workers feel more valued and allowing insights from the factory floor to be fed into senior management.

Technical progress can reflect better teamwork as well as better science. Either way, a supplier gets more output from given input quantities, and hence can supply more at any particular price. The supply curve shifts to the right (because we measure quantities in the horizontal direction, a rightward shift implies a greater quantity supplied at each price). Conversely, if we ever had a collective memory lapse and forgot how to do something, the supply curve would shift to the left.

Input prices

A particular supply curve is also drawn for a given level of input prices. Lower input prices (lower wages, lower fuel costs) induce firms to supply more at each price, shifting the supply curve to the right. When world oil prices fell to \$10/barrel for several years in the late 1980s and early 1990s, the airline business was profitable and lots of new airlines sprung up supplying more airline flights than before. The supply curve for flights shifted to the right. Conversely, when oil prices rose to over \$50/barrel, the cost of running an airline increased dramatically, and the supply curve for flights shifted sharply to the left. Some airlines even went bankrupt and quit the industry entirely.

Government regulation

Given a free choice, suppliers choose the lowest-cost production method from their viewpoint. If regulations make suppliers use a different production method, this must be more costly for suppliers. It shifts the supply curve to the left, reducing the quantity supplied at each price. More stringent safety regulations prevent chocolate producers using the most productive process because it is dangerous to workers. Anti-pollution devices raise the cost of making cars. More effective prosecution of poppy growers raises the cost of supplying poppies. When regulation prevents producers (legal or illegal) from selecting the cheapest production method, regulation shifts the supply curve to the left.

Event	Supply curve for UK university places	
	Shifts right	Shifts left
1 UK top up fees abolished		
2 UK lecturers get big pay rise		
3 New law requires wheelchair access to every classroom		
4 Young people lose faith in education, volunteer instead for a lifetime of service in Africa		
5 Bill Gates donates E-learning packages to all UK universities		
6 An earthquake destroys five UK universities		

Table 3-1 Shifts in the supply curve (tick the appropriate box in each line)

(answers on page ?? but complete the table before skipping to the answers!)

3-3

Measuring supply responses

Learning outcomes

By the end of this section, you should understand:

- ◆ The price elasticity of supply
- ◆ The revenue effect of a price change

The price responsiveness of supply

When a price rise has a large effect on quantity supplied, we say that the supply of the good is *elastic*. Suppliers are very responsive to prices. When the same size of price rise has a small effect on quantity supplied, we say that supply is *inelastic*. Sellers are not very responsive to prices.

The **elasticity of supply** measures the *responsiveness* of quantity supplied to the price that suppliers receive.

When supply is elastic (inelastic), a 1 per cent price rise increases quantity by more than (less than) 1 per cent.

In the previous chapter, whether demand was elastic or inelastic affected whether revenue (price times quantity) fell or rose when the price increased. Because demand curves slope down, prices and quantities change in opposite directions, which is why it is important to know which effect dominates the other. For supply, there is no such conflict. Supply curves slope up not down. Prices and quantities always change in the same direction: high prices go with high quantities, low prices with low quantities. Hence, a price increase always raises the total revenue received by sellers (both price and quantity increase), and a price fall always reduces the revenue of sellers since both price and quantity are lower. In Figure 3-2 a price increase from P_1 to P_0 increases total revenue received by suppliers from OP_0AQ_0 to OP_1AQ_1 .

3-1 Box: What determines supply elasticities?

The elasticity of supply is determined by how profitable it is for suppliers to increase quantity supplied when they are offered higher prices for their output. In part, this reflects technology. With a mass production line, it may be relatively easy to respond to opportunities to sell at higher prices, but doubling the prize money for golf tournaments is no guarantee that another Tiger Woods will emerge.

As with demand, we need to distinguish between supply to the market as a whole and the behaviour of individual suppliers. If prices rise, a particular supplier may already be near full capacity, and have little ability or willingness to increase the quantity supplied. But higher prices may entice new suppliers into the market, thereby enlarging total supply. Total supply is then more elastic than the supply of individual producers. In the 1990s the airline boom reflected the arrival of EasyJet and Ryanair, rather than a major expansion of British Airways and Air France.

As with elasticity of demand, elasticity of supply is higher in the long run than the short run. Given more time, it is easier for producers to respond to a price change. It may take time to build new production capacity to respond to a price increase. Similarly, closing factories or laying off workers is not something producers undertake on the first day that prices fall. They wait a bit to see if the price reduction is permanent, and even then it takes time to organise a production response. Overnight, supply can be pretty inelastic. Supply curves are often steep in the short run, showing that price changes have only small effects on quantity supplied. In the longer run, supply is more elastic and supply curves become flatter, indicating that quantity supplied varies more with price changes.

3-3 MEASURING SUPPLY RESPONSES

Event	Supply curve for UK university places	
	Shifts right	Shifts left
1. UK top up fees abolished	Alters the price and moves universities along a given supply curve. No shift.	
2. UK lecturers get big pay rise		Lower quantity supplied at each level of fees
3. New law requires wheelchair access to every		Level quantity classroom supplied at each level of fees
4. Young people lose faith in education, volunteers instead for a lifetime of service in Africa	Affects demand not supply	
5. Bill Gates donates E-learning packages to all UK	Makes supplying easier universities	and cheaper; hence entire supply curve shifts right
6. An earthquake destroys five UK universities	Lower capacity to supply, so supply curve shifts left	

Answers to Table 3-1 (page ???) Shifts in the supply curve

3-4

Introducing the theory of supply

Learning outcomes

By the end of this section, you should understand:

- ◆ Revenue, economic cost, and economic profit
- ◆ Stocks and flows
- ◆ Whether profit maximization is plausible
- ◆ How a firm chooses the output to supply

So far, we have described supplied behaviour, but in order to develop a better simulation model that allows us to predict how suppliers respond in hypothetical situations, we need to develop an explicit theory of supply. For each possible output level, a firm compares what this output costs to make and what revenue it earned from sales. Profits are the excess of revenue over costs. Our theory of supply assumes each firm chooses the output level that maximizes its profit. This is the key to our theory of supply.

A firm's accounts

Although illegal poppy growers may not bother to keep accounts, legitimate businesses are required to keep and submit accounts. Moreover, once a business attains any level of sophistication, those running it will want to know all the details of how it is operating, in order to take the best decisions possible.

In modern economies, 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 over a period of time.

The water flowing out of a tap is different per second and per minute. The measurement requires a time interval to make sense. The stock of water in the basin at any instant is a number of litres, and requires no time dimension. 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, as they are for the basin of water. The inflow from the tap is what changes the stock of water over time, even though the latter is only measured in litres at each point in time.

Flow accounts (profit and loss)

A firm's **revenue** is income from sales during the period, its **costs** are expenses incurred in production and sales during the period, and its **profits** are the excess of revenue over costs.

This sounds very easy, but there are a few tricky complications. Economists and accountants adopt different definitions because they are interested in different things. Accountants have to certify that nobody is stealing cash from the business. They care about cash flow.

Cash flow is the net amount of money received by a firm during a given period.

Economists care about what, how and for whom goods are produced. Accountants keep track of actual cash spent. Economists focus on opportunity cost.

Opportunity cost is the amount lost by not using resources in their best alternative use.

You quit a job as a teacher of IT and start an internet business, paying out £5000 in the first year as you camp in an internet café, whose facilities are used as your office. An accountant treats your costs as £5000. An economist stresses that your time was not free – you could have earned £20 000 a year teaching IT. It only makes sense to switch your labour resources into the Internet job if you can earn at least £25 000. For an economist, interested in incentives to allocate resources, a revenue of £25 000 is merely break-even; for an accountant it is £20 000 profit after paying the Internet cafe.

Normal profit is the accounting profit to break-even after all economic costs are paid. **Economic (supernormal) profits** in excess of normal profit are a signal to switch resources into the industry. **Economic losses** mean that the resources could earn more elsewhere.

Here is a second case in which economists and accounting definitions are different. The Internet start-up also requires the IT lecturer to use £2000 of her savings to cover everyday expenses. The accountant treats this personal financial injection by the owner as free, but an economist recognizes the opportunity cost. If the money could have earned £100 in interest during the year, that is another economic cost to deduct in calculating economic profit.

Suppose the internet startup company does so well that it buys its own office.

Physical capital is any input to production not used up within the production period. Examples include machinery, equipment, and buildings. *Investment* is additions to physical capital.

This capital is a stock and not a flow, but we cannot exclude it entirely from the firm's flow accounts. The capital becomes less valuable during the period for which flow accounts are drawn up. This depreciation is a proper charge on the flow accounts.

Depreciation is the cost of using capital during the period.

It reflects both wear and tear, and gradual obsolescence. Capital has a second economic cost in flow accounts: the money tied up when the capital was bought. The interest this could have earned is an economic cost to in the flow accounts of the firm.

Stock accounts (balance sheet)

The balance sheet shows at a point in time the assets and liabilities that the firm has built up as a result of flows in all preceding periods.

Assets are what the firm owns. **Liabilities** are what is owes. **Net worth** is assets minus liabilities.

Assets include cash in the bank, money owed by customers, inventories, and physical capital such as plant and machinery. Liabilities are debts the firm still has to repay to suppliers and its bankers. Net worth includes not just these tangible assets minus liabilities, but should also include an estimate for the value of its reputation, customer loyalty, and a host of intangible assets that economists call *goodwill*.

3-2 Box: The value of a good name

Goodwill affects the ability of the firm to make money in the future and is just as valuable an asset as physical assets cumulated from past behaviour. The consultancy Interbrand tries to calculate goodwill by comparing the stock market value of companies with the identifiable physical and financial assets they own. US giants such as Coca Cola top the worldwide list. Microsoft, Nokia and Yahoo! are well up the list. So are Nike and Adidas. Interestingly, the big banks perform poorly in this rating.

3-2 Box: *Continued*

Rank	Company	Industry	Brand value (\$bn)
1	Coca-Cola	Drinks	71
2	Microsoft	Software	65
3	IBM	Computers	52
5	Intel	Computers	31
6	Nokia	Mobile phones	29
7	Disney	Entertainment	28
10	Mercedes	Cars	21
20	Sony	Electronics	13
33	Nike	Sports goods	8
43	Ikea	Furniture	7
67	Adidas	Sports goods	4

Source: www.interbrand.com.

You are considering switching resources between uses. Should you study the flow accounts for the year, or the stock accounts at the time of your decision? The former shows recent behaviour, the latter shows the long-run position. If you can afford to take a long-run view, you may be more interested in the stock accounts. If you have to worry about short-term considerations, the flow accounts may be more informative.

Do firms really maximize profits?

Economists assume that firms make supply decisions to maximize profits. Some business executives, and even some economists, question this assumption. A sole owner is accountable only to herself and may have other aims (nice location, popularity with the local community, doing good). However, most business is done by large companies.

Companies are not run directly by their owners. Company directors have day-to-day discretion and only account formally to shareholders at the annual shareholders' meeting. In practice, shareholders rarely dismiss the directors, who have inside information about the true prospects of the firm. It is hard for shareholders to be sure that new directors could do better.

Given this separation of ownership and control, shareholders want maximum profits but directors have some scope to pursue their own agenda. This may include executive perks, such as nice cars and a company jet. If status depends on size, directors may pursue size rather than profits, advertising too much or holding prices lower than is ideal for profits and shareholders' interests.

Even so, profit maximization is a good place to start in developing a theory of supply. First, even if shareholders are kept partly in the dark, other firms in the industry are better

informed. Companies not pursuing profits have low profits, and hence low share prices. A takeover raider can buy the company cheaply, change the policy, make extra profits, and cash up as the share price soars. Fear of takeovers may force the directors to pursue profit maximization.

Second, shareholders provide incentive for managers to do what shareholders want. They offer directors profit-related bonuses and share options. The total value of these is small relative to company profits but big relative to what directors earn in salary alone. Directors then maximise profits, as the shareholders want.

3-2 Box: Fat-cat bosses

Many empire-building managers now indulge in takeovers in spite of, rather than because of, pressure from shareholders. *The Economist* (5/5/01)

The article cited considerable empirical evidence that shareholders in the company doing the taking over usually lose out in the process, and concluded

The takeover threat has become like a nuclear option: so disruptive that it can be used only as a last resort.

Company bosses have used this greater security to vote themselves fat-cat pay rises and ensure huge golden handshakes even if they are leaving the company because it is doing poorly. How can shareholders fight back?

Big institutional shareholders – the pension funds and insurance companies whose assets are shares held in other companies – are being more active in monitoring the companies in which they invest, using a louder voice at companies' annual general meetings. Sackings of unsuccessful bosses are at an all-time high.

3-5

An overview of the supply decision

Learning outcomes

By the end of this section, you should understand:

- ◆ Total revenue and marginal revenue
- ◆ Total cost and marginal cost
- ◆ The output level that maximizes supplier profits

We begin with production costs. Each output level can be made in several ways. A field of wheat can be farmed by lots of workers with few tools, or by one worker with a lot of machinery.

Given the price of each input and the different production techniques available, the firm calculates the lowest cost way to make each possible output level. This may entail different techniques at different outputs.

The **total cost curve** shows the lowest cost way to make each output level. Total cost rises as output rises.

Table 3-2 shows different outputs and the corresponding total cost. At any output, the firm has a fixed cost of 10, perhaps the cost of paying interest on old debts. As output rises from 1 to 4, total cost rises from 18 to 54. Extra output incurs extra costs. The third column shows marginal cost.

Output Q	Total cost TC	Marginal cost MC	Total revenue TR	Marginal revenue MR	Economics Profits	MR – MC
0	10	–	0	–	–10	
1	18	8	20	20	2	12
2	28	10	31	11	3	1
3	40	12	36	5	–4	–7
4	54	14	35	–1	–19	–15

Table 3-2 The supply decision

Source: World Bank, *World Development Report 2003*

Marginal cost is the change in total cost as a result of producing the last unit.

The marginal cost of the first unit of production is 8, the rise in total cost from 10 to 18. Similarly, the marginal cost of producing the fourth unit of output is 14, the rise in total cost from 40 to 54. Having considered cost, now think about revenue. Column 4 shows total revenue from selling the output produced. With no output the firm gets no revenue. One unit of output can be sold at a price of 20, giving a total revenue of 20. This is also the marginal revenue of going from zero to one unit of output sold.

Total revenue is the output price times the quantity made and sold. **Marginal revenue** is the change in total revenue as a result of making and selling the last unit.

As output and sales rise, column 4 shows that revenue rises for a bit but eventually gets smaller as sales increase. To sell more and more output, the firm has to cut prices to induce buyers to demand this output. Since all output is sold for the same price, cutting the price to sell new units reduces the revenue earned on previous units. This second effect eventually outweighs the first. Beyond three units, extra sales actually cut revenue. Column 5 does the sums for you, showing the marginal revenue from the last unit sold, which takes into account the effect on total revenue of bidding down the price that previous units have been sold for. By the bottom row of Table 3-2, marginal revenue is actually negative.

Armed with the first five columns of Table 3-2, you advise the firm what output to make and sell. One method is simply to subtract total cost from total revenue to obtain

3-5 AN OVERVIEW OF THE SUPPLY DECISION

economic or supernormal profits. Column 6 shows that that profit-maximizing output is 2, at which profits are 3. This is similar to the method used by a mountaineer who checks the top has been reached by making sure he can look down on all surrounding sides.

There is another way to check you are at the top. Work out the slope you are standing on. If it not flat, take the upwards direction. At the very top, the slope is zero. There is no direction you can move in order to get any higher. This is the marginal principle.

The **marginal principle** says that, if the slope is not zero, moving in one direction must make things better, moving the other way makes things worse. Only at a maximum (or a minimum) is the slope temporarily zero.

Economists use the marginal principle a lot. Profit is maximized at the output at which marginal profit is zero. Otherwise, a different output can add to profit. Marginal profit is simply marginal revenue minus marginal cost. Column 7 uses this decision rule. If marginal revenue exceeds marginal cost, the firm made a marginal profit on the last unit, and should make even more. If marginal revenue is less than marginal cost, the firm made a marginal loss on the last unit, and already made too much. With a marginal profit of 1 it was a good idea to make as much as 2 units. However, with a marginal loss of 7 from making a third unit, it is best to stop at 2 units. This, of course, is the same answer we got by calculating total profit from total revenue and total cost. Sometimes it is an easier method to implement.

Plotting *MC* and *MR* curves

Table 3-2 is an artificial example. Output does not have to be a whole number. Dairies can make 1284.8 litres of milk if this is the best output level. Figure 3-3 plots continuous curves for marginal cost *MC* and marginal revenue *MR*. The *MR* curve steadily falls as output rises: price cuts are needed to get customers to buy more. For most of its range, the *MC* curve rises: making the last unit gets harder and harder. For example, a coal mine has to go ever deeper to find more coal.

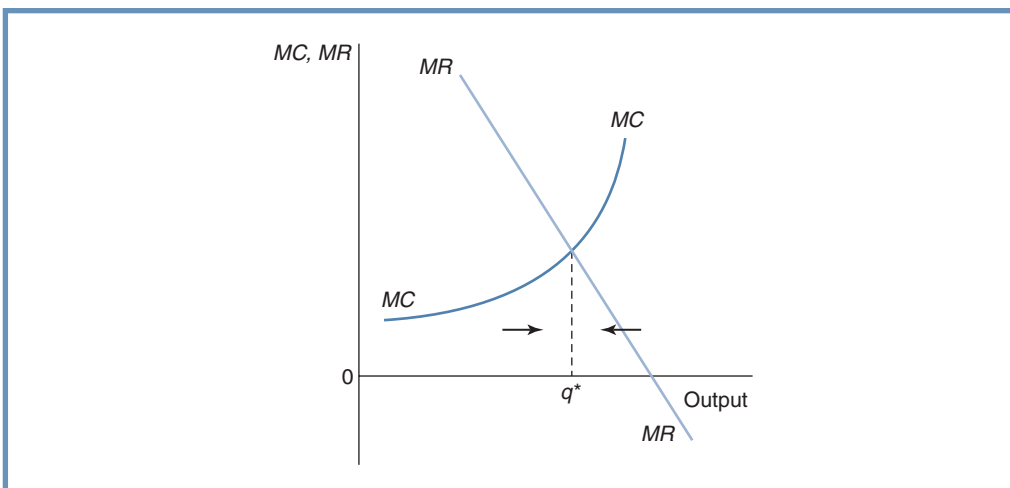


Figure 3-3 A firm's supply decision

A profit-maximizing firm chooses to supply the output q^* , at which marginal profit is zero. Marginal revenue exactly equals marginal cost. At any lower output, MR exceeds MC and the firm adds to profits by expanding. At any output above q^* , MC exceeds MR and the firm adds to profits by contracting output.

We can also use Figure 3-3 to examine changes in costs or revenue curves. Anything that shifts the MC curve up (such as wage increase, or tougher pollution controls) means that MC crosses MR at a lower output. This makes perfect sense: when costs rise, the firm supplies less. Conversely, a change in demand behaviour that shifts the MR curve up increases the output that the firm supplies: with better revenue opportunities, the firm chooses to supply more output.

You probably thought you knew that already. However, Figure 3-3 is also making a point that is less obvious. What induces a profit-maximizing firm to reduce output is an increase in *marginal* cost. If you ask your friends who are not studying economics, they might reply that it is higher average costs or higher total costs that make firms wish to cut back production. Actually, neither of these assertions need be correct.² But if the marginal revenue curve MR is unaltered, you now know that an upward shift in marginal cost curve MC always makes firms wish to supply less.

Do firms know their MC and MR curves?

There are two ways in which to maximize profits. The first is by having a highly professional management with access to excellent management information. Marginal cost and marginal revenue are what they are trying to discover. Alternatively, a firm may simply be run by an intuitive genius who gets things right without going through all the laborious steps above.

Competition means that most surviving bosses are good at such decisions. If they get things right, they are maximizing profit, which ensures that MC must equal MR whether anyone in the firm knows it or not. Using the marginal principle is how mere mortals keep track of what proven business leaders do instinctively.

So we've mastered the supply decision?

We have found the principle from which all else follows. There are still some details to fill in. First, both revenue and costs may differ in the short run and in the longer run. A firm may have to react to a marginal revenue schedule that changes over time. Even more important, a firm's cost curves change over time. We also have to aggregate individual supplies to get the market supply curve. This depends on how many suppliers there are, and how they react to one another. The ensuing chapters explain different forms of market structure and what this means for the supply decision.

²If you wish to show off your new economic understanding, here is a simple example. To help finance disaster relief, the government imposes a tax of £50 000 on every firm, whatever output they produce. At all positive output levels, the cost and benefit of raising output are unaffected by this tax, and hence MC and MR are unaffected. The firm will not cut back output despite the fact that average and total costs have risen. It might as well get the biggest surplus possible from production and sale, whether or not it then has to pay a disaster levy to the government.

3-6

Combining supply and demand

Learning outcomes

By the end of this section, you should understand:

- ◆ How prices reconcile demand and supply
- ◆ Equilibrium in a market
- ◆ The effect of shifts in demand or supply curves

Now that we have developed the theories of demand and supply, and understand how to reflect behaviour in demand and supply curves, we can provide a deeper analysis of the role of markets that we introduced in Chapter 1. Prices adjust to equate the quantity people wish to buy and the quantity people wish to sell. In so doing, these prices influence what goods are produced, how they are produced, and for whom they are produced. The upward sloping curve SS in Figure 3-4 shows how much sellers wish to sell at each price. The downward sloping curve DD shows how much consumers wish to purchase at each price. The market is in equilibrium at point E where the two curves intersect. The equilibrium price is P^* at which a quantity Q^* is supplied and demanded. The **equilibrium price** clears the market. At this price, the quantity supplied equals the quantity demanded.

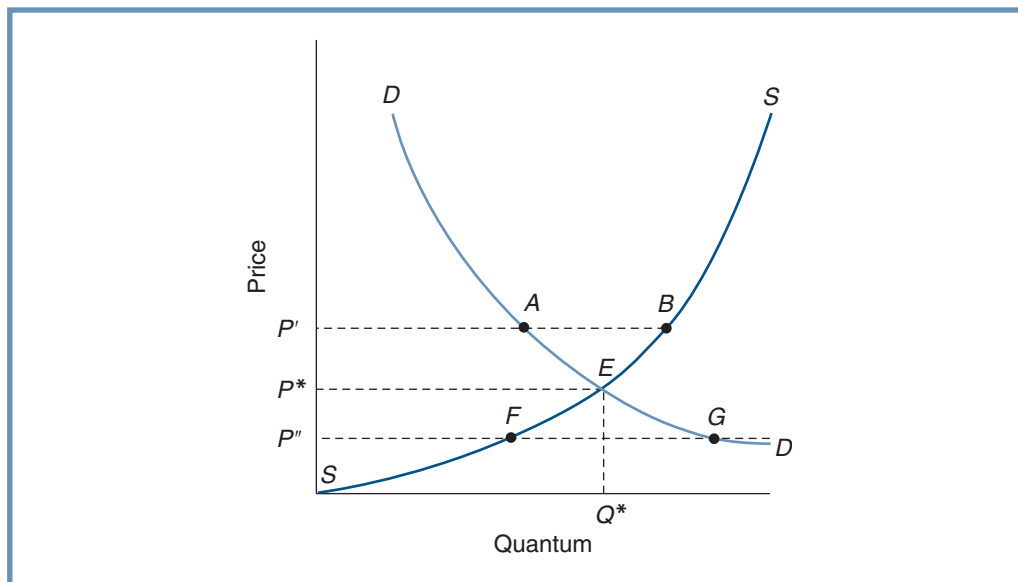


Figure 3-4 Market equilibrium

At any price P' above P^* (a higher vertical distance in the price direction in Figure 3-4), the quantity supplied exceeds the quantity demanded. There is excess supply at this price and suppliers have unsold stock. To sell this unsold stock, suppliers have to reduce the price. This keeps happening until the market returns to equilibrium at point E .

Conversely, at any price P'' below P^* (a lower vertical distance in the price direction in Figure 3-4), the quantity demanded now exceeds the quantity supplied. There is excess demand at this price, and buyers cannot find all the goods they would like to purchase. Buyers offer to pay more than suppliers are asking for, and the price is steadily bid upwards until the equilibrium is restored at point E .

3-1 Case Study: The Green Revolution in third world agriculture

Rich countries have spent years accumulating physical capital, such as factories and buildings, and human capital, the stock of knowledge and skills that makes the workforce productive. In rich countries, few people still farm the land. There are more profitable things to do. Box 1-1 in Chapter 1 showed that agriculture is now less than 2 per cent of national output in countries such as Japan, France, and the UK.

Poor countries are poor precisely because they have accumulated less physical and human capital. They have to make do with their labour and the land available to them. Agriculture is a much larger share of their national output. Fifty years ago many people thought that the best way to help poor countries was to provide aid and technical assistance to improve their agricultural productivity. Since this was such a large share of their output, it offered the best opportunity to increase people's living standards.

Some countries, such as Sudan, have remained ravaged by civil war and little progress has been made. But in many countries – India is a good example – there has been a Green Revolution. With better fertiliser, better irrigation, and, importantly, better varieties of crops that are faster growing and more disease resistant, agricultural output has soared. However, this has not led to the increase in national income that was expected.

The table below what has happened to the real (inflation-adjusted) price of the crops in the last 50 years. Prices are now only about a third of what they were five years ago. World markets have been flooded by extra supply, both because G8 farmers have become more productive and export to world markets, and because Third World producers have also become much more productive than they used to be.

	1955	1975	2003
Average real price of 28 crops	186	287	67
(1995 price = 100)			

However, the additional supply alone is not the whole story. It is also the fact that Third World producers are having to sell their extra supply in poor markets that have a limited capacity to absorb the extra quantity being supplied. Demand in these markets is quite inelastic. There is a limit to how much extra poor people wish to buy, no matter how much the price is reduced. If Third World producers had access to G8 markets, they would find demand was much more elastic. The two figures below illustrate the same increase in world food supply, and hence the same rightward shift in the two supply curves. However, in the left-hand figure, demand is inelastic and the demand curve is steep. Producer revenue (price times quantity) actually falls when supply increases. In the right-hand figure, demand is elastic and the demand curve is much flatter. The same increase in supply bids down the price much less in the right-hand diagram, and the rightward shift in the supply curve now increases producer revenue (price times quantity).

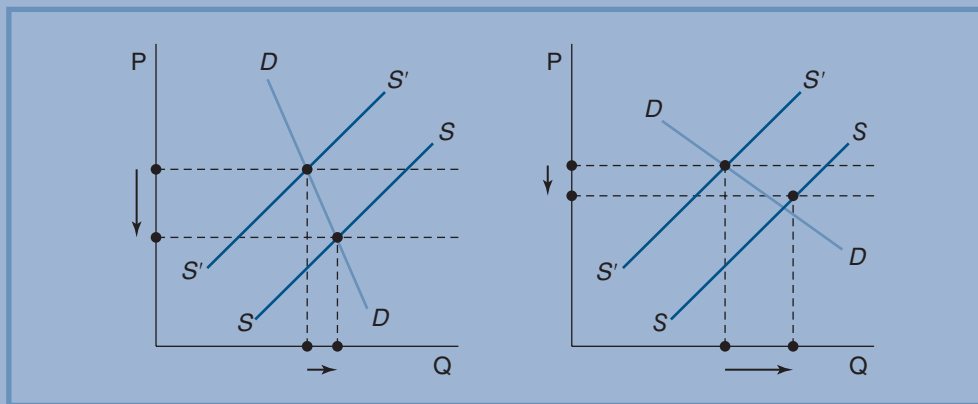


Rice fields
© Robert Essel NYC/CORBIS

3-1 Case Study: *Continued*

Notice finally the difference between saying that the G8 is rich and that its demand for food is more elastic than food demand of poor countries. Access to the rich markets of the G8, where demand is high because people are wealthy, would imply that the *level* of food prices is high. If poor producers could access these markets, they would get a higher price for their produce than if they have to sell in poor markets where demand curves are much lower in position.

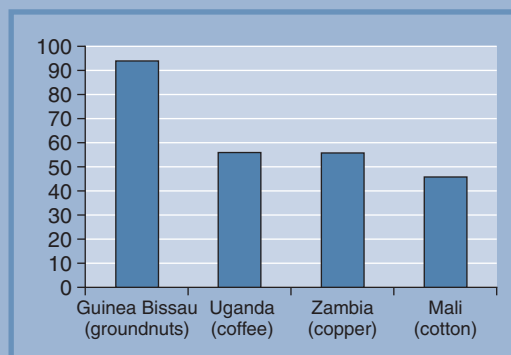
However, this case study has been making a second point, not about levels of prices but about changes in prices in response to increases in supply. For a given rightward shift in the supply curve, the induced *change* in prices in the two diagrams below depends not on the height of the demand curves but on their *slope*. It is because the demand curve is flatter in the right-hand diagram that the same shift in supply induces a smaller fall in price (and therefore has to be reflected in a larger change in equilibrium quantity).



Single crop as percentage of export revenue

Source: IMF

We can also consider shifts in demand rather than supply. Some countries, especially in subSaharan Africa, are very dependent on a single crop which, once harvested, has to be sold for whatever price it will fetch. Such countries have a very inelastic supply curve in the short run. The diagram below shows the consequence of shifts in demand. With a near-vertical supply curve, the effect of demand fluctuations is to cause large fluctuations in the equilibrium price. When demand is DD , equilibrium occurs at E with a price P and a quantity Q . When demand shifts to $D'D'$, the new equilibrium at E' entails a price P' and quantity Q' . With quantity supplied unresponsive to price, these large price fluctuations also induce large fluctuations in farmers' incomes.



Source: IMF

Recap

- Supply describes how much producers wish to sell at each possible price.
- A supply curve plots quantity supplied against price, other things equal. Changes in price move suppliers along a given supply curve.
- The principal other things equal are technology, input price, and the extent of regulation. Technical progress makes inputs more productive and allows producers to produce more at each possible output price. The supply curve shifts to the right. Lower input prices have a similar effect. Tougher regulation makes life harder for producers and the supply curve shifts to the left.
- An increase in supply shifts supply curves to the right, which also implies downwards. This is because quantity is measured in the horizontal direction, and supply curves slope upwards. We can interpret an increase in supply either as a rightward shift (more quantity at each price) or a downward shift (do not require such a high price to produce any particular quantity). It is the same thing.
- Supply is elastic if quantity supplied is very responsive to price, inelastic if quantity supplied is not very responsive to price. Provided the supply curve remains given, revenue of suppliers always changes in the same direction as price, since price and quantity change in the same direction as we move along a given supply curve.
- Flows are measured over time, stocks at a point in time. Profit is the difference between the flow of revenue and cost.
- Economic costs include all opportunity costs. Normal profit is the accounting profit that just covers all economic costs. Supernormal profits are any profits above this level.
- Firms are assumed to maximize profits even if shareholders cannot directly observe the behaviour of directors. Maximizing profits automatically entails marginal cost equals marginal revenue.
- Marginal cost is the extra total cost entailed in producing an extra output unit. Marginal revenue is the corresponding change in revenue from selling that extra unit of output.
- An upward shift in the *MR* schedule, or downward shift in the *MC* schedule, raises the output supplied. Lower marginal revenue or higher marginal cost schedules have the opposite effect
- The equilibrium price equates the quantity demanded and supplied. It is the point at which supply and demand curves intersect.
- Above this price, there is excess supply, which puts downward pressure on prices to restore equilibrium. Below this price, there is excess demand, which puts upward pressure on prices to restore equilibrium.
- The more inelastic the supply curve, the more a shift in demand will lead to changes in price rather than quantity. The more inelastic the demand curve, the more a shift if supply will lead to changes in price rather than quantity.

Review questions

- Which of the following represent an increase in supply by supermarkets:
 - the invention of the Internet, that makes it possible for supermarkets to sell online and reduces their costs of distribution?
 - a reduction in the wages of supermarket workers because their trade union becomes less powerful?
 - deregulation of supermarkets that ends the ban on opening on Sundays?
 - higher prices for supermarket goods because families are stocking up for their annual parties?
- Unit-elastic demand implies that prices changes have no effect on the spending of buyers and revenue of sellers. Is there a corresponding interpretation of unit-elastic supply? Why or why not?
- You are a sheep farmer in the Welsh hills. Give three examples of a change that would reduce your supply. Was one of your answers a change in the price of wool? Why or why not?
- The table below shows two demand curves DD and $D'D'$ and two supply curves SS and $S'S'$. Each row shows a price, and the quantities supplied or demanded at that price on each of the different curves.
 - What are the equilibrium price and quantity when demand is DD and supply SS ?
 - What if demand is DD and supply $S'S'$?
 - Which of the two supply curves is more inelastic? What is the reason for your answer?
 - Now suppose demand increases by 3 units at each price so that DD becomes $D'D'$. Repeat your answers to (a) and (b)
 - Which of the two supply curves will be associated with smaller price fluctuations for any given shift in demand?

	DD	$D'D'$	SS	$S'S'$
Price	Quantity demanded	Quantity demanded	Quantity supplied	Quantity supplied
1	7	10	4	5.5
2	6	9	6	6
3	5	8	8	6.5
4	4	7	10	7
5	3	6	12	7.5

- Why might firms, such as accountants and lawyers, where the trust of the customer is important, choose to be partnerships with unlimited liability?
- At the very top of a hill, what is the slope? Suppose on your walk you always move in the upward direction: will you eventually find the top of the hill? Now think of the hill as a representation of a firm's profit. Marginal profit on the next unit of output, the slope of the profit hill at this level of production, is simply marginal revenue MR minus marginal cost MC . What is marginal profit when the firm is maximising profits? What does this tell you about MR in comparison with MC at that point?

3-6 COMBINING SUPPLY AND DEMAND

- 7 A firm's consultants report that, at the current level of operations, marginal cost exceeds marginal revenue. What output decision should the firm take? What should it do if marginal cost is less than marginal revenue?
- 8 Which of the following are flows and which are stocks: (a) income (b) output (c) a factory building (d) labour input?
- 9 Why are these statements wrong? (a) Firms with an accounting profit must be thriving. (b) Firms don't know their marginal costs. A theory of supply can't assume that firms set marginal revenue equal to marginal cost. (c) The biggest profit comes from the largest sales.
- 10 Examine the following table and deduce what is the profit-maximizing level of output

Output (units)	1	2	3	4	5	6
MC	4	5	6	7	8	9
MR	8	7	6	5	4	3

- 11 To check your answer to Question 10, complete the table below. Assume that it costs 5 to be in business at all, even if you produce no output, but that you get zero revenue if you produce zero output. [Hint: to get total cost of making 1 unit, take the TC of 0 units and add the marginal cost of the first unit. The TC of 2 units is simply the TC of 1 unit plus the marginal cost of the second unit, and so on]. What output maximizes total profits? Is this what you got in Question 10?

Output (units)	0	1	2	3	4	5	6
Total cost TC	5						
Total revenue TR	0						
Total profits = TR - TC							

Answers on pages 000–000

