4 Production possibility frontiers

SL/HL 1.1
A1 and AS1 Opportunity cost
4.1.1.5, AS 3.1.1.5
A and AS Production possibility frontiers
AS Opportunity cost

Key points

1. The production possibility frontier (PPF) shows the maximum potential output of an economy.
2. Growth in the economy will shift the PPF outwards whilst a shift inwards of the PPF shows that the productive potential of an economy has declined.
3. Consuming more in the present at the expense of producing capital goods can lead to lower growth of the potential output of an economy in the future.
4. Production at a point inside the PPF indicates an underuse or an inefficient use of resources.
5. The PPF shows only what could be produced but not what should be produced.

Starter activity

Your Economics A level group decided to raise money for charity. It took each person a day to take part and you raised £500. You can give the money to two charities. Which two charities would you chose? How much would you give to each? If you give £100 more to one charity, how much less to do you give to the other? What would have been the likely outcome if half the group had given excuses and not taken part in the fund-raising activity? Answers to these questions illustrate opportunity cost, choice and production possibility frontiers.

The problem of scarcity

Over a period of time, resources are scarce and therefore only a finite amount can be produced. For example, an economy might have enough resources at its disposal to be able to produce 30 units of manufactured goods and 30 units of non-manufactured goods. If it were now to produce more manufactured goods, it would have to give up some of its production of non-manufactured items. This is because the production of a manufactured item has an opportunity cost - in this case the production of non-manufactured item. The more manufactured goods that are produced, the less non-manufactured goods can be produced.

This can be shown in Figure 1. The curved line is called the production possibility frontier (PPF) - other names for it include production possibility curve or boundary, and transformation curve. The PPF shows the different combinations of economic goods which an economy is able to produce if all resources in the economy are fully and efficiently employed. The economy therefore could be:

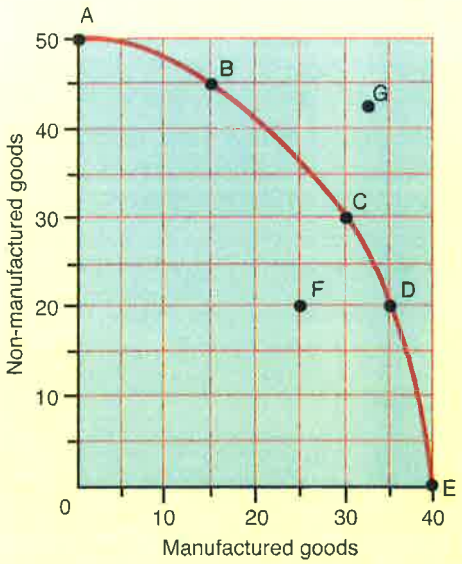
- at the point C on its PPF, producing 30 units of manufactured goods and 30 units of non-manufactured goods;
- at the point D, producing 35 units of manufactured goods and 20 units of non-manufactured goods;
- at the point A, devoting all of its resources to the production of non-manufactured goods;
- at the points B or E or anywhere else along the line.

Production cannot take place to the right of the PPF, such as at the point G. This is because the PPF shows the maximum output of the economy. It can operate within the boundary, for example at F, but the economy is producing less than its maximum.

Figure 1

The production possibility frontier

ABCDE is a production possibility frontier. It shows the different combinations of goods which can be produced if all resources are fully and efficiently utilised. The economy can produce at any point on the line. It cannot produce at G because the PPF shows the maximum that can be produced. It can produce within the PPF, such as at F, but less will be produced than the maximum possible.



Opportunity cost

The production possibility frontier illustrates clearly the principle of opportunity cost. Assume that the economy is producing at the point C in Figure 1 and it is desired to move to the point D. This means that the output of manufactured goods will increase from 30 to 35 units. However, the opportunity cost of that (i.e. what has to be given up because of that choice) is the lost output of non-manufactured goods, falling from 30 to 20 units. The opportunity cost at C of increasing manufacturing production by five units is 10 units of non-manufactured goods.

Another way of expressing this is to use the concept of the margin. In economics, the margin is a point of possible

Question 1

The production possibility frontier of an economy is as shown in Figure 1.

(a) (i) If the economy produces 15 units of manufactured goods, what is the maximum number of non-manufactured goods it can produce? (ii) How many manufactured goods could it produce if production of non-manufactured goods was 50 units?

(b) The economy is currently operating at point C. What is the opportunity cost of increasing production of non-manufactured goods by (i) 15 units; (ii) 20 units?

(c) The economy is at D. What is the marginal cost of increasing production of non-manufactured goods to the point (i) C; (ii) B?

change. At the point C in Figure 1, the economy could produce more manufactured goods, but at the cost of giving up non-manufactured goods. For example, the marginal cost of five more units of manufactured goods would be 10 fewer units of non-manufactured goods. This is shown by the movement from C to D along the boundary.

Economic growth or decline

The economy cannot produce at any point outside its existing PPF. This is because the PPF shows the maximum potential output of an economy. In Figure 1, for example, the economy cannot produce at the point G. However, the economy might be able to move to the right of its PPF in the future if there is economic growth. An increase in the productive potential of an economy is shown by a shift outwards of the PPF. In Figure 2 economic growth pushes the PPF from PP to QQ, allowing the economy to increase its maximum level of production, say, from A to B.

Growth in the economy can happen if:

- the quantity of resources available for production increases; for instance there might be an increase in the number of workers in the economy, or new factories and offices might be built;
- there is an increase in the quality of resources; education will make workers more productive whilst technical progress will allow machines and production processes to produce more with the same amount of resources.

Production possibility frontiers can shift inwards as well as outwards. The productive potential of an economy can fall. For example, war can destroy economic infrastructure. A rapid fall in the number of workers in a population can reduce potential output. Some environmentalists predict that global warming will devastate world agriculture and this will have a knock-on effect on all production. Global warming could therefore lead to a shift inwards of the world's PPF.

Many economies experience high levels of unemployment of workers. Factories and machines may lie idle when this occurs. Production then occurs **within** the boundary and **not on** the boundary such as at the point F in Figure 1. If resources became fully employed, the economy could move from inside the boundary to a point on the boundary. In Figure 1, this would mean a move from the point F to, say, D or E.

Consumption vs investment

There is a potential conflict between consuming now and economic growth fuelled by investment. If an economy produces an extra £10 billion worth of restaurant meals for consumers, then they are better off today. If, however, that £10 billion had been spent on new factories, offices or new machinery, the productive potential of the economy is likely to increase. As a result, consumers may then be better off in the future.

Figure 2

Economic growth

An increase in the quantity or quality of the inputs to the production process means that an economy has increased its productive potential. This is shown by a shift to the right of the production possibility frontier from PP to QQ. It would enable the economy to move production, for instance, from point A to point B.

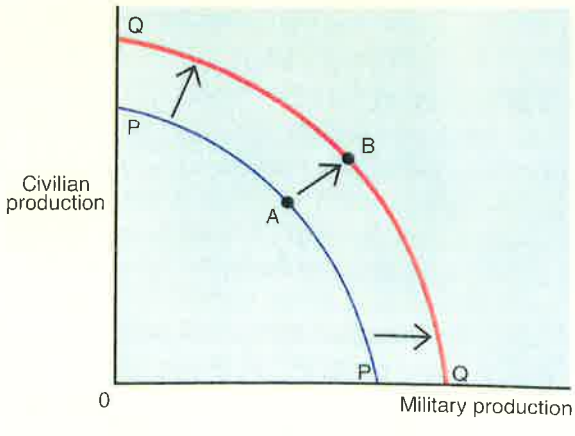
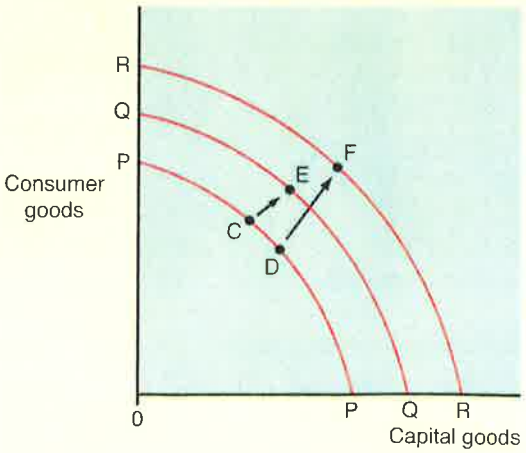


Figure 3

Consumption vs investment

Country B, which initially devotes more resources to investment (the production of capital goods) has a higher growth rate than Country A which initially produces more consumer goods. Eventually, Country B produces more capital and consumer goods than Country A because of higher growth.



This conflict can be shown in Figure 3. Consumer goods, such as food, holidays or DVDs, are shown on the vertical axis. Capital goods, such as factories, offices, roads, machines and equipment, are shown on the horizontal axis. Two economies, A and B, at the start are the same size in terms of overall production and population. However, country A produces more consumer goods and fewer capital goods than country B. So initially country A produces at the point C whilst country B produces at the point D.

Over time, both economies grow. However, because country B has invested more, devoting more of its finite resources to capital goods, it grows faster. Ten years later, growth in country A has shifted its PPF to QQ and is producing at the point E. However, the PPF of country B has shifted to RR and country B is producing at the point F. At the start of the period, consumers in country A were better off than in country B because consumption of consumer goods was higher. But at the end, consumers in country B are better off. At the point F, country B is producing more of both consumer and capital goods than country A which produces at E.

The production possibility frontiers in Figures 1 and 2 have been drawn concave to the origin (bowing outwards) rather than as straight lines or as convex lines. This is because it has been assumed that not all resources in the economy are as productive in one use compared to another.

Question 2

Draw a production possibility frontier. The vertical axis shows the production of public sector goods and the horizontal axis shows production of private sector goods. The economy is currently producing at point A on the frontier where 50 per cent of all production is devoted to public sector goods and 50 per cent to private sector goods.

(a) Mark the following points on your drawing.
  (i) Point A.
  (ii) Point B which shows production following the election of a government which increases government spending on both education and the National Health Service.
  (iii) Point C where unemployment is present in the economy.
  (iv) Point D where the government takes over production of all goods and services in the economy.

(b) Draw another diagram putting on it the original production possibility frontier you drew for (a), labelling it AA.
  (i) Draw a new production possibility frontier on the diagram, labelling it PP, which shows the position after a devastating war has hit the economy.
  (ii) Draw another PPF labelling it QQ which shows an increase in productivity in the economy such that output from the same amount of resources increases by 50 per cent in the public sector but twice that amount in the private sector.

Efficiency

The production possibility frontier shows the maximum amount that can be produced from a given number of resources. Therefore, for an economy, the boundary shows the level of output where all resources are fully and efficiently employed. In Figure 1, there is full and efficient utilisation of resources at all points along the boundary AE.

Efficiency on the boundary is of two types. There is **productive efficiency**, which means that production takes place at lowest cost. Productive efficiency occurs when a given set of resources produces the maximum number of goods. All points on the boundary are productively efficient because they show a combination of goods produced at the lowest cost for that combination.

However, not all points on the boundary are **allocatively efficient**. Allocative efficiency occurs when social welfare is maximised. Not every combination of goods produced will maximise welfare and there could be just one point which does this.

Choice

The PPF by itself gives no indication of which combination of goods will be produced in an economy. All it shows is the combination of goods which an economy could produce if output were maximised from a given fixed amount of resources. It shows a range of possibilities and much of economics is concerned with explaining why an economy, ranging from a household economy to the international economy, chooses to produce at one point either on or within its PPF rather than another.

Key Terms

Capital goods - goods that are used in the production of other goods such as factories, offices, roads, machines and equipment.
Consumer goods - goods and services that are used by people to satisfy their needs and wants.
Margin - a point of possible change.
Production possibility frontier (also known as the production possibility curve or the production possibility boundary or the transformation curve) - a curve which shows the maximum potential level of output of one good given a level of output for all others goods in the economy.

Thinking like an economist

Water shortages

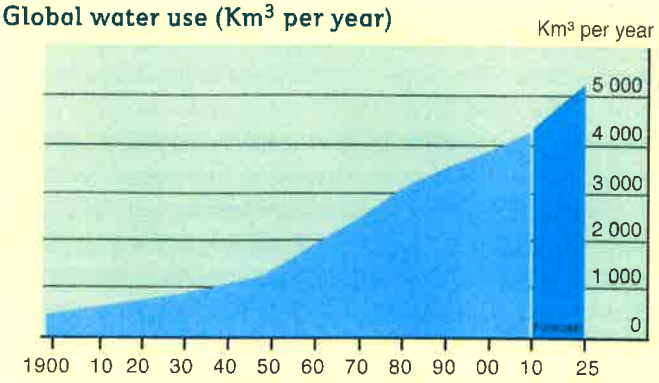
In many circumstances, water is a free good. It falls from the sky or can be collected from rivers with no opportunity cost. However, with the world's population predicted to rise to over 11 billion, water is becoming an ever scarcer resource in many countries.

Scarcity is being felt not just by consumers but also by producers. For example, the world's oil and gas supplies could be transformed by the relatively new process of fracking – forcing liquid through rocks to release oil and gas trapped in the rocks. But each US well requires on average two million gallons of water to extract all the oil or gas in the well. Many wells are in areas of relative water shortage. Hence, Antero Resources, a US shale gas company, is planning to spend $525 million on a pipeline to carry water to its operations to increase reliability of supplies.

Countries and industries where water is scarce therefore face a trade-off between investing in water facilities or using the money for other purposes. If there is not enough water, there is an immediate conflict between household consumption for drinking and cleaning, and its use by industry including farming and manufacturing. If industry faces water restrictions, in the short term there will be less production forcing the production possibility frontier inwards. In the long term, if there is too little investment in water infrastructure, production will be lower than if more had been invested today. In other words, the production possibility frontier will be to the left of where it might otherwise have been.

Figure 4

Global water use (Km^3 per year)



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Data Response Question

Civil war in Syria

In 2011, protests against the government broke out in Syria. The country has been governed by the Baath party since 1963. For nearly 40 years the party had ruthlessly suppressed opponents through torture and killing to maintain power. Since 2011, the country has descended into civil war with western governments imposing bans on exports to the country. Not surprisingly, output measured by gross domestic product has fallen sharply. Millions of people have been forced to flee their homes. Most have been internally displaced but several million have become refugees in neighbouring countries. Thousands of schools have been destroyed or are being used as shelter for displaced persons. A lack of access to health care and scarcity of medications have led to catastrophic health situations in several regions in Syria. In the meantime, spending on armaments has soared.

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China

Since the mid-1970s, many indicators have suggested that China's economy has been growing dramatically. In 2014 it was growing by nearly 10 per cent per annum. This meant that output would be doubling roughly every seven years. It is not difficult to understand why the Chinese economy has been so successful. By the mid-1970s, it already had a relatively well educated workforce compared to other poor developing countries. However, some sources suggested its economy was otherwise inefficient and backward. From the mid-1970s, there was a gradual easing of Communist control of the economy that allowed ordinary Chinese people to set up their own businesses in a more free market style economy. Exports began to be encouraged. This linked China to the global economy. Finally, there was a considerable flow of investment money and technological know-how into China. Foreign investors were keen to take advantage of cheap labour and found the lure of what would soon become the world's largest economy irresistible.

Table 1 China, average annual growth in output (%), 1971-2014

					Percentage
	1971-80	1981-1990	1991-2000	2001-2011	2012-2014
Yearly average growth in output (%)	6.3	9.4	10.5	10.3	7.7

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Replacing Trident

The UK currently has four nuclear-powered submarines able to fire nuclear missiles, but they are coming to the end of their service life. It is estimated that replacing the four submarines and their nuclear missiles will cost at least £25 billion.

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1. What is a production possibility frontier for an economy?
2. Explain why a production possibility frontier might shift inwards or outwards. Illustrate you answer with examples from the data.
3. A peace group has put forward a proposal that the UK should not replace its fleet of Trident submarines. Using production possibility frontiers, evaluate the possible economic implications of this proposal.

Evaluation

Identify the alternative ways in which the resources used to build a new fleet of replacement Trident submarines could be used, including spending on alternative defence goods. Mention opportunity cost and choice. Which would be consumer goods and which would be capital goods? Which might be the best alternative uses and why?