

» 2

The production possibility frontier (curve): the PPF or PPC



The starting point in our economic analysis is to consider what an economy can produce. As consumers we may want many things, but there is a limit to what our economy can actually produce. This can be analysed using the production possibility frontier (PPF). In this unit we examine the factors that determine how much an economy can produce and the implications of different output decisions.

LEARNING OBJECTIVES

By the end of this unit you should be able to:

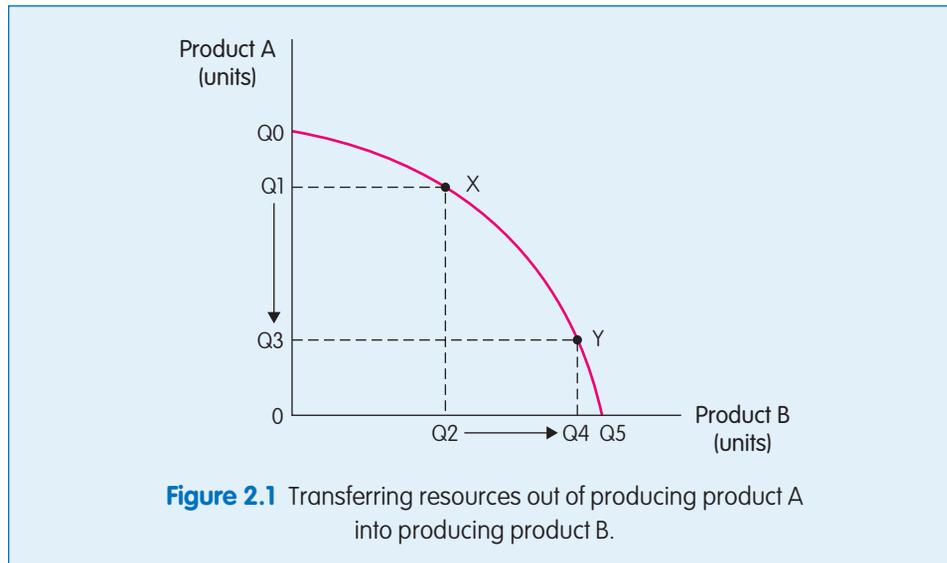
- ✓ understand what is meant by a production possibility frontier;
- ✓ analyse the shape and the position of the production possibility frontier;
- ✓ understand the concept of productive efficiency.

■ Scarcity and choice

In Unit 1 we saw how the study of economics was based around the issue of scarcity and choice. As consumers our wants are unlimited, but there is a limit to what an economy can produce because of a scarcity of resources. As consumers and voters we are, of course, interested in what an economy can produce. What an economy is capable of producing can be shown on a production possibility frontier.

■ The production possibility frontier (PPF)

The **production possibility frontier** or **curve** (PPF or PPC) shows the maximum output that can be produced in an economy at any given moment, given the resources available. If an economy is fully utilising its resources then it will be producing on the PPF. To keep



our analysis simple we consider an economy that produces only two products, A and B (see Fig. 2.1). Imagine that all of an economy's resources, such as land, labour and capital, were used in industry A. Then Q_0 of A would be produced and none of B would be made. Alternatively, if all resources were transferred to industry B then Q_5 of B would be produced and none of A would be made. If resources were divided between the two industries then a range of combinations of products is possible. For example, at point X the economy produces Q_1 of product A and Q_2 of product B; alternatively, resources could be allocated differently between the two industries and it could produce at point Y, producing Q_3 of A and Q_4 of B. All of the points on the frontier, such as X and Y, are said to be **productively efficient** because they are fully utilising the economy's resources. This is attractive because it shows that resources are being used properly and not wasted. When an economy is productively efficient it can only produce more of one product by producing less of another; resources have to be shifted from one product to another. The PPF therefore illustrates the concept of opportunity costs. As more units of product B are produced this involves shifting resources into industry B and out of industry A: this will involve sacrificing product A. Some units of A will be sacrificed to produce more of product B; the amount sacrificed is the opportunity cost. For example, the opportunity cost of producing the extra $Q_4 - Q_2$ units of B is $Q_1 - Q_3$ units of A.

18 Foundations of economics

Now you try it

Using Fig. 2.2 calculate the opportunity cost of the 5th unit of B in terms of the number of units of A sacrificed.

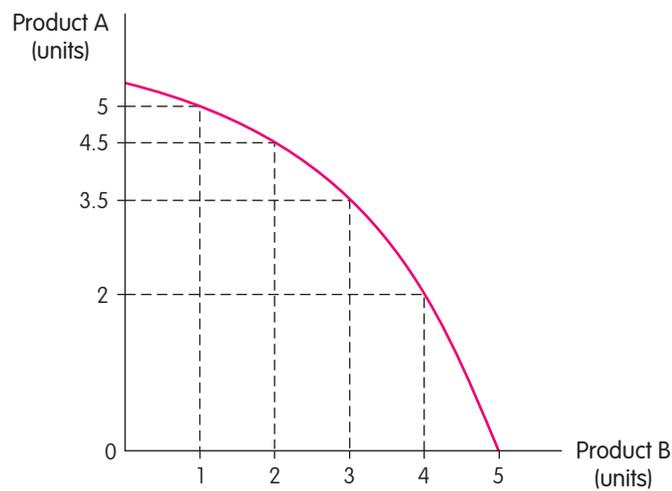


Figure 2.2 A production possibility frontier.

**Economics
in context**
The importance of opportunity cost

The concept of opportunity cost is extremely important in economics and business. It represents the opportunities foregone. Whenever a manager makes a strategic decision he/she is deciding to lead the business in one direction rather than another. Sometimes this works; for example, Nokia's decision to move out of all of its business areas apart from mobile phones was highly successful for many years. Other times it is the wrong decision, such as Marks and Spencer's move into America and Wal-Mart's move into Germany. Any decision should be judged, not just in terms of what it achieved, but also in terms of what else could have been done with those resources.

Imagine a firm is earning a return on investment of 4%. This means the profits it earns are 4% of the amount of long-term funds in the business. This is clearly better than 0%, but is not better than the rate of interest available in most UK banks. Investors might rightly question how effectively the managers are using the resources available to them.

? Question

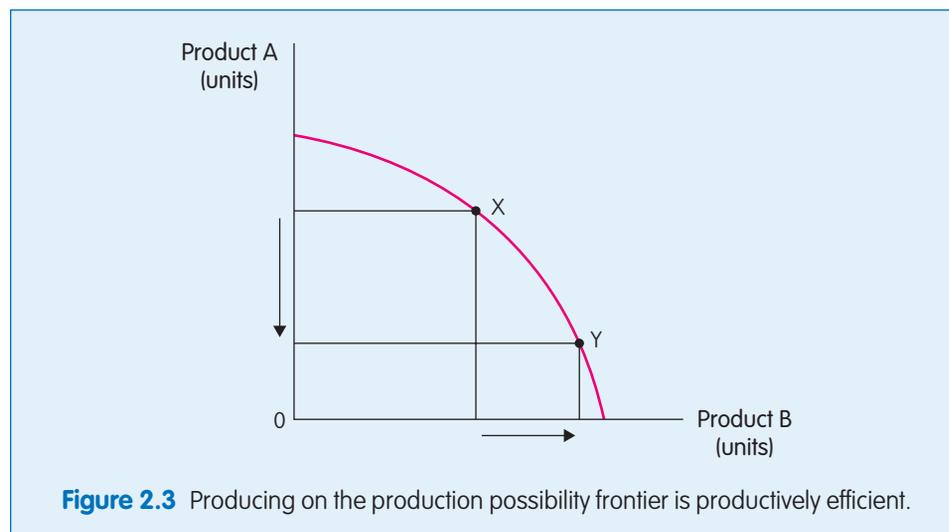
If you decide to invest money and buy a company's shares, what would the opportunity cost be?

■ Reallocation of resources

The PPF shows all the combinations of products that an economy can produce given its present resources. Any combination on the frontier is productively efficient. This shows what can be produced, but which is the right combination? What determines whether an economy should produce at X, Y, W or Z? Do we want more of product A or more of product B, for example? How do we decide?

In a free market economy this decision would be taken by the market forces of supply and demand. If there was a high level of demand for product A rather than product B then it would make this industry more attractive for producers. The greater demand for A would attract firms into this industry and out of B. The firms in industry A would need more resources, such as labour and materials, to meet the higher demand. This increased demand for resources would increase the price paid for them, attracting resources into this industry and out of industry B. Market forces triggered by an increase in demand for the product would therefore lead to a reallocation of resources from one industry to another. On the PPF shown in Fig. 2.3 this can be seen as a movement from X to Y. The demand for digital cameras, for example, has grown rapidly in recent years, whilst the demand for 'traditional' film has declined. As a result, firms such as Kodak have had to move resources out of traditional film and into digital. Similarly, the music industry has experienced a rapid growth in downloading at the expense of cassettes and CDs. Companies such as EMI have had to move their resources into these newer areas.

In a planned economy the decision about what to produce is determined by government instructions and directives. For example, the government may order that more factories and employees are used to produce product A rather than B. In this case the reallocation from, say, X to Y is not determined by demand, but by government orders. This may happen if the government does not trust market forces to produce what it regards as the right



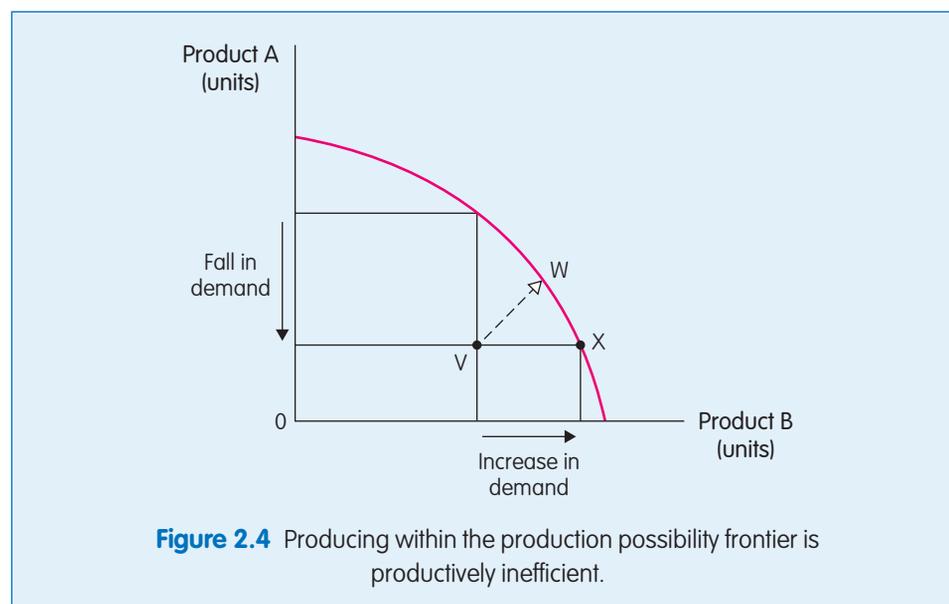
20 Foundations of economics

decision for society. For example, in a free market we may want to consume products today, but may not be very good at thinking about our health or education; the government may intervene to ensure that there is greater provision of these services.

However, what can happen is that, if the instructions given by the government do not match what people are actually demanding, then it can lead to too much of some goods being produced whilst too few of other goods are available. The government may decide that resources need to be diverted to defence or nuclear energy, for example, whereas consumers may want more houses. In democracies, political parties will set out their policies and what they intend to do if they are elected. They tell the voters what their priorities will be and then the electors can decide who they want in power.

Productive inefficiency

If the economy is producing a combination of products on the production possibility frontier then it is productively efficient. However, an economy may be operating within the frontier (e.g., at the point V in Fig. 2.4), in which case it is productively inefficient. This is because it could produce more of both products by using the existing resources effectively. Imagine you were driving around a country and noticed lots of factories that were closing down, high levels of unemployment and shops with very few customers in them; this economy would be productively inefficient. This can be illustrated using a PPF diagram; for example (see Fig. 2.4), if an economy produced at point W and not V, then it would be making more of both A and B. No economy should be operating within the PPF because it is wasting its resources. However, this can happen if resources do not reallocate effectively when conditions in an economy alter. For example, demand for product B may



increase, leading to firms wanting to move from A to B. Firms in industry A close down and, in theory, they and their employees would switch to B. However, if managers and employees lack the necessary skills or experience they may not be able to move easily. As a result the economy may get stuck at V. Hopefully, over the long term, employees will be trained and gain the skills required to take jobs. Firms will therefore be able to produce in industry B, enabling the economy to produce at a point such as X; however, in the short term at least, there is productive inefficiency. Alternatively, there could be a lack of demand in the economy, so that, although it can produce at W, customers can only afford the combination of products at V. Again, over time, demand will hopefully increase and the economy will end up on the frontier.

■ Shifting the production possibility frontier outward

Once on the production possibility frontier an economy can only produce more of both products by shifting the PPF outward, that is, increasing the amount of both products that can be produced with the economy's resources. This is what happens over time when an economy grows. Economic growth enables more goods and services to become available to consumers.

An outward shift of the frontier might be due to:

- more training of employees, enabling them to be more productive;
- greater investment in capital goods such as machines and equipment—in the short run this would mean that resources would have to be shifted from consumption goods toward capital goods, and in the long run greater investment would enable the economy to produce more products for consumption;
- an increase in the population size, for example, through immigration;
- improvements in technology providing better ways of doing things.

Most political parties put forward their policies to help an economy to grow in the future. Again, voters decide which policies they think are most likely to work. For more about economic growth see Unit 22.

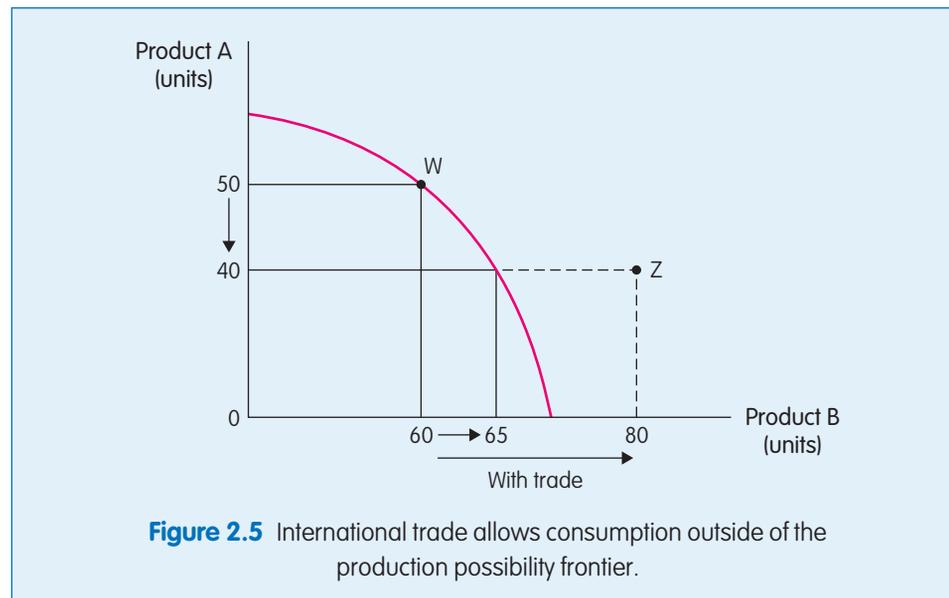
What do you think?

What actions would you take if you were in government to make the UK grow faster?

Now you try it

Imagine that technological developments enabled the production of product B to increase for any given amount of other resources, such as land, labour and machinery. The technology has no impact on the production of A. Draw the new production possibility frontier that would occur following the technological development.

22 Foundations of economics



■ Consumption outside the production possibility frontier

The PPF shows what an economy can produce given its available resources. However, it is possible to consume outside of the frontier through international trade. It may well be that another country can produce some items more efficiently than you can, and that you can produce some products more efficiently than it can; through trade both countries can benefit.

Imagine, for example, that an economy is producing at point W and then gives up 10 units of product A (see Fig. 2.5). Within its own country it could only produce 5 units of B in return. If, however, it could find a country that was less efficient at producing A then it might be able to sell these abroad at a profit. For example, it might be able to trade these 10 units of A abroad and receive more than 5 units of B in return. For example, it may be possible to sell its 10 units of A for 20 units of B; this means the economy could operate at Z. The benefits of international trade are examined in detail in Unit 31.

Now you try it

Imagine that an economy is at the point C in Fig. 2.6. Within the domestic economy what is the opportunity cost of 5 more units of B?

Assume that 2 units of A can be traded abroad for 12 units of B. Then, starting at C, if an economy gave up 2 units of A and traded overseas, how many units of B could it now have?

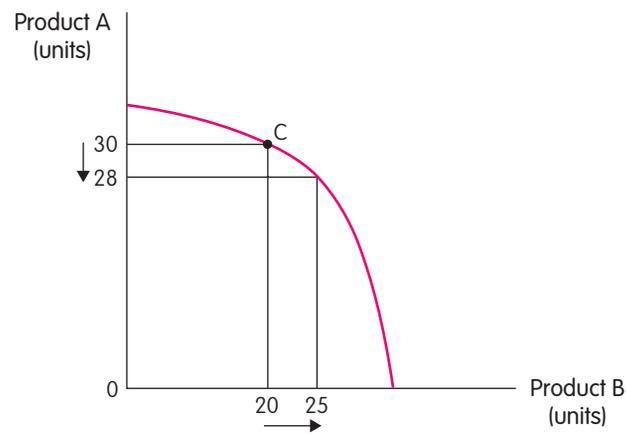


Figure 2.6 The benefits of international trade.

■ Present versus future decisions

The PPF is often used to illustrate the extent to which an economy is producing for the present or the future. Economies that focus on capital goods are investing for the long term: they are investing in machines and equipment that will allow the economy to produce more in the future. This will be shown over time by an outward shift of the PPF; when the machines are finished and being used the economy can produce more. Economies that focus more on the here and now will produce more consumer goods; this is likely to lead to a smaller outward shift in the PPF over time because the investment in the amount of machinery and technology is less.

What do you think?

Is it better for an economy to produce consumer goods, that is, focus on fulfilling peoples' demands today, or should it invest for the future?

■ The shape of the production possibility frontier

So far we have drawn the PPF as concave to the origin. This is because of the assumptions we make about what happens when resources to output are transferred from one industry to another. This depends on the returns to a factor. If there are constant returns to a factor in industries A and B then this means that every time resources are transferred from one industry to another, there is the same increase in output in B and the same decrease in

24 Foundations of economics

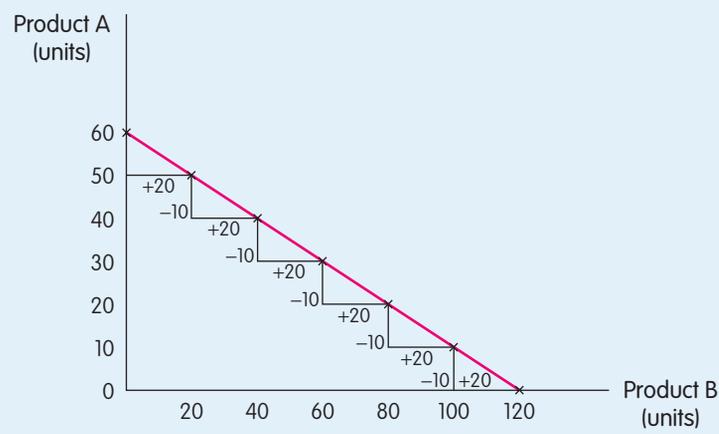


Figure 2.7 The shape of the production possibility frontier when there are constant returns.

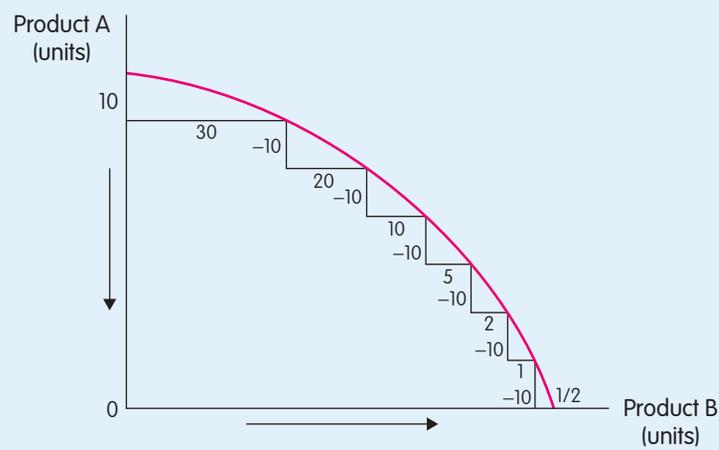


Figure 2.8 The shape of a production possibility frontier when there are diminishing returns. As resources are transferred into industry B there are diminishing returns: successively less is produced each time.

output in industry A. This would lead to a PPF that is a straight line. For example, in the economy shown in Fig. 2.7, every time a given number of resources are shifted from industry A to B, 10 units of A are given up in return for 20 units of B.

In reality, resources are unlikely to be equally productive in both industries. Some equipment may be designed specifically for some types of production rather than others. Some employees may not be able to transfer their skills easily from one sector to another.

This may lead to diminishing returns to a factor. This means that every time a given number of resources are transferred out of industry B into industry A, successively less units of A are produced (e.g., see Fig. 2.8). This means the PPF is concave to the origin. The concept of diminishing returns to a factor is examined in Unit 9.

Case Study

The success of America over the centuries has been helped enormously by immigrants into the country. However, immigration is now a very controversial issue in the US. Many of the immigrants working in the country at the moment are illegal, for example, workers who have come over the border from Mexico. These immigrants want to be recognised and allowed to work in the US officially, and on May Day 2006 over a million of them protested in rallies held in major cities across America.

According to data from the US Department of Homeland Security, 1.1 million people became legal permanent residents of the US in 2005. Mexico was the most common country that they came from, accounting for 14% of the total. However, each year, up to a million illegal immigrants also enter the country, mostly from Latin American nations. There are now more than 11.5 million of them living in the US. Over 2.5 million are based in California and over 1.4 million are in Texas.

The immigrants mainly work in particular industries. For example, around 22% of all construction jobs in the US are held by illegal workers. Other popular sectors are farming, cleaning and preparing food. Typically, these are low-skilled, low-paid jobs. Overall, immigrants account for around 5% of the workforce. Some argue that immigrants push down wages for everyone and take jobs away from Americans. Others argue that they provide a bigger workforce and help the economy. Defenders of immigration argue that the government receives tax receipts from immigrants and that the benefits paid to them are usually low; for example, most immigrants return home and do not retire in the US, and so do not receive pensions.

Questions

- How does immigration affect the production possibility frontier of an economy? Show this using a diagram.
- In what ways can immigration help an economy?
- Do you think economies should welcome immigration?

Checklist

Now you have read this unit try to answer the following questions.

- Do you understand what is meant by a production possibility frontier?
- Can you explain the shape and the position of the production possibility frontier?
- Do you understand the concept of productive efficiency?

26 Foundations of economics

End of unit questions

- 1 Can an economy produce outside the production possibility frontier? Can it consume outside?
- 2 Why might an economy be producing within the production possibility frontier?
- 3 What do you think is the best way to shift the production possibility frontier outward?
- 4 What do you think is the best point to be at on the production possibility frontier?
- 5 In what way does the production possibility frontier illustrate the concept of opportunity cost?

Key learning points

- Given the present resources of an economy there is a maximum combination of products that can be produced. This is shown by the production possibility frontier.
- If an economy is operating within the production possibility frontier then it is productively inefficient.
- Economic growth can be seen by an outward shift of the production possibility frontier.

Learn more

If you read Unit 31 you can find out more about the principle of comparative advantage. This shows how economies can benefit from free trade and consume outside of their production possibility frontier.



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