Chapter 4

Elasticity

After studying this chapter you will be able to:

- **Define, calculate and explain the factors that influence the price elasticity of demand**
- **Define, calculate and explain the factors that influence the cross elasticity of demand and the income elasticity of demand**
- **Define, calculate and explain the factors that influence the elasticity of supply**

Squeezing Out Revenue

A new juice bar opens and offers low-price smoothies that attract lots of customers. But is that a smart decision? Could the firm generate more revenue with higher prices and fewer customers? If a cafe opens next door, by how much will the price of a smoothie have to fall to avoid losing customers to the new rival? This chapter introduces tools that help to answer questions like these. And *Reading Between the Lines* at the end of the chapter shows you how the French government is using these same tools to combat cigarette smoking.

Price Elasticity of Demand

Andy operates a juice bar. He knows that if the supply of smoothies increases the price of a smoothie will fall. But will the price fall by a large amount and the quantity increase by a little? Or will the price barely fall and the quantity increase by a large amount? To answer this question, Andy needs to know how the quantity demanded responds to a change in price.

Figure 4.1 shows two possible scenarios in Andy's local smoothie market. Figure 4.1(a) shows one scenario, and Figure 4.1(b) shows the other.

In both cases, supply is initially S_0. In part (a), the demand for smoothies is shown by the demand curve D_A. In part (b), the demand for smoothies is shown by the demand curve D_B. Initially, in both cases, the price is £3 a smoothie and the quantity of smoothie produced and consumed is 10 smoothies an hour.

Now three new juice bars open and the supply of smoothies increases. The supply curve shifts rightward to S_1. In case (a), the price falls by £2 to £1 a smoothie, and the quantity increases by only 5 to 15 smoothies an hour. In contrast, in case (b), the price falls by only £1 to £2 a smoothie and the quantity doubles to 20 smoothies an hour.

The different outcomes arise from differing degrees of responsiveness of the quantity demanded to a change in price. But what do we mean by responsiveness? One answer is slope. The slope of demand curve D_A is steeper than the slope of demand curve D_B.

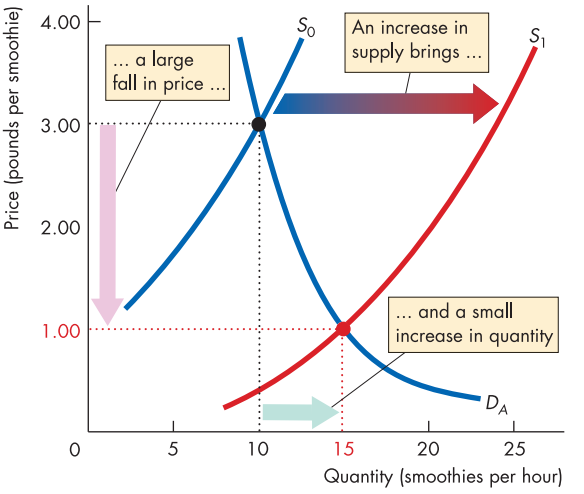
In this example, we can compare the slopes of the two demand curves. But we can't always do so. The reason is that the slope of a demand curve depends on the units in which we measure the price and quantity. And we often must compare the demand curves for different goods and services that are measured in unrelated units. For example, a juice bar operator might want to compare the demand for smoothies with the demand for sandwiches. Which quantity demanded is more responsive to a price change?

This question can't be answered by comparing the slopes of two demand curves. The units of measurement of smoothies and sandwiches are unrelated. But the question *can* be answered with a measure of responsiveness that is independent of units of measurement. Elasticity is such a measure.

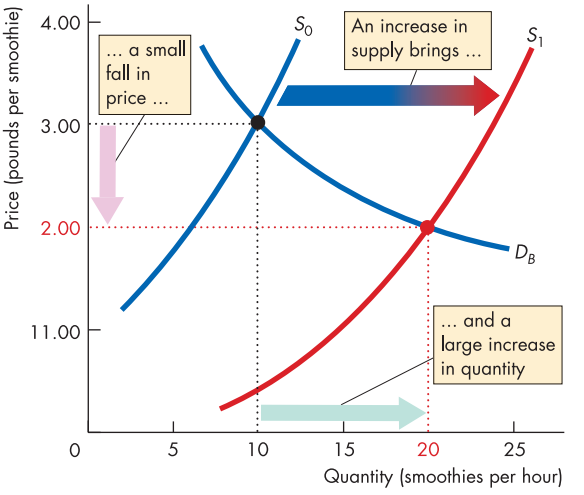
The **price elasticity of demand** is a units-free measure of the responsiveness of the quantity demanded of a good to a change in its price, when all other influences on buyers' plans remain the same.

Figure 4.1

How a Change in Supply Changes Price and Quantity



(a) Large price change and small quantity change



(b) Small price change and large quantity change

Initially, the price is £3 a smoothie and the quantity sold is 10 smoothies an hour. Then supply increases from S_0 to S_1. In part (a), the price falls by £2 to £1 a smoothie, and the quantity increases by 5 to 15 smoothies an hour.

In part (b), the price falls by only £1 to £2 a smoothie, and the quantity increases by 10 to 20 smoothies an hour. The price change is smaller and the quantity change is larger in case (b) than in case (a). The quantity demanded is more responsive to price in case (b) than in case (a).

Calculating Price Elasticity of Demand

We calculate the price elasticity of demand with the same data that we use to construct a demand curve – data on the quantity demanded at different prices when all other influences on buying plans remain the same. We use these numbers in the formula:

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

Let's calculate the elasticity of demand for smoothies using the demand curve in Figure 4.2. This figure zooms in on the demand curve for smoothies and shows how the quantity demanded responds to a small change in price. Initially, the price is £3.10 a smoothie and 9 smoothies an hour are sold – the original point in the figure. The price then falls to £2.90 a smoothie, and the quantity demanded increases to 11 smoothies an hour – the new point in the figure. When the price falls by 20 pence a smoothie, the quantity demanded increases by 2 smoothies an hour.

To calculate the price elasticity of demand, we express the changes in price and quantity as percentages of the *average price* and *average quantity*. By using the average price and average quantity, we calculate the elasticity at a point on the demand curve midway between the original point and the new point.

The original price is £3.10 and the new price is £2.90, so the average price is £3. The 20 pence price decrease is 6.67 per cent of the average price. That is:

$$\Delta P/P_{AVE} = (£0.20/£3.00) \times 100 = 6.67\%$$

The original quantity demanded is 9 smoothies and the new quantity demanded is 11 smoothies, so the average quantity demanded is 10 smoothies. The increase in the quantity demanded of 2 smoothies is 20 per cent of the average quantity. That is:

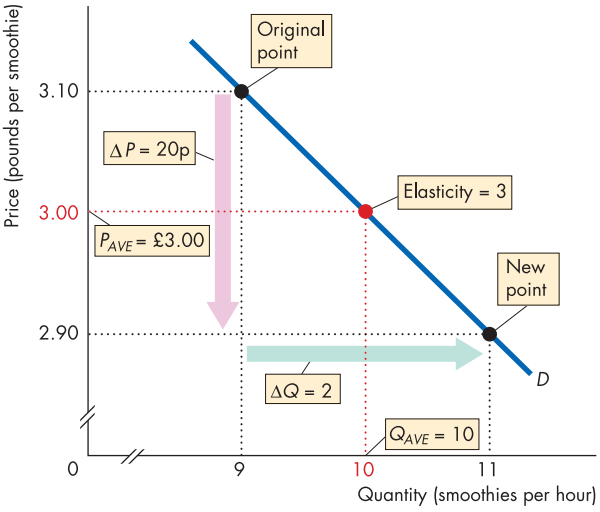
$$\Delta Q/Q_{AVE} = (2/10) \times 100 = 20\%$$

So the price elasticity of demand, which is the percentage change in the quantity demanded (20 per cent) divided by the percentage change in price (6.67 per cent) is 3. That is:

$$\text{Price elasticity of demand} = \frac{\%\Delta Q}{\%\Delta P} = \frac{20\%}{6.67\%} = 3$$

Figure 4.2

Calculating the Elasticity of Demand



The elasticity of demand is calculated by using the formula:*

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}} = \frac{\%\Delta Q}{\%\Delta P} = \frac{\Delta Q/Q_{AVE}}{\Delta P/P_{AVE}} = \frac{2/10}{0.20/3.00} = 3$$

This calculation measures the elasticity at an average price of £3.00 a smoothie and an average quantity of 10 smoothies an hour.

* In the formula, the Greek letter delta (Δ) stands for "change in" and %Δ stands for "percentage change in".

Average Price and Quantity

We use the *average* price and *average* quantity because it gives the most precise measurement of elasticity – midway between the original and new point. If the price falls from £3.10 to £2.90, the 20 pence price change is 6.45 per cent of £3.10. The 2 smoothies change in quantity is 22.2 per cent of 9 smoothies, the original quantity. So if we use these numbers, the price elasticity of demand is 22.2 divided by 6.45, which equals 3.44. If the price *rises* from £2.90 to £3.10, the 20 pence price change is 6.9 per cent of £2.90. The 2 smoothies change in quantity is 18.2 per cent of 11 smoothies, the original

quantity. If we use these numbers, the price elasticity of demand is 18.2 divided by 6.9, which equals 2.64.

By using percentages of the *average* price and *average* quantity, we get the same value for the elasticity regardless of whether the price falls from £3.10 to £2.90 or rises from £2.90 to £3.10.

Percentages and Proportions

When we divide the percentage change in quantity by the percentage change in price, the 100s cancel. A percentage change is a *proportionate* change multiplied by 100. The proportionate change in price is $\Delta P/P_{AVE}$, and the proportionate change in quantity demanded is $\Delta Q/Q_{AVE}$. So if we divide $\Delta Q/Q_{AVE}$ by $\Delta P/P_{AVE}$, we get the same answer as we get by using percentage changes.

A Units-free Measure

Elasticity is a *units-free measure* because the percentage change in each variable is independent of the units in which the variable is measured. And the ratio of the two percentages is a number without units.

Minus Sign and Elasticity

When the price of a good *rises*, the quantity demanded *decreases* along the demand curve. Because a *positive* change in price brings a *negative* change in the quantity demanded, the price elasticity of demand is a negative number. But it is the magnitude, or *absolute value*, of the price elasticity of demand that tells us how responsive – how elastic – demand is. To compare price elasticities of demand, we use the magnitude of the elasticity and ignore the minus sign.

Inelastic and Elastic Demand

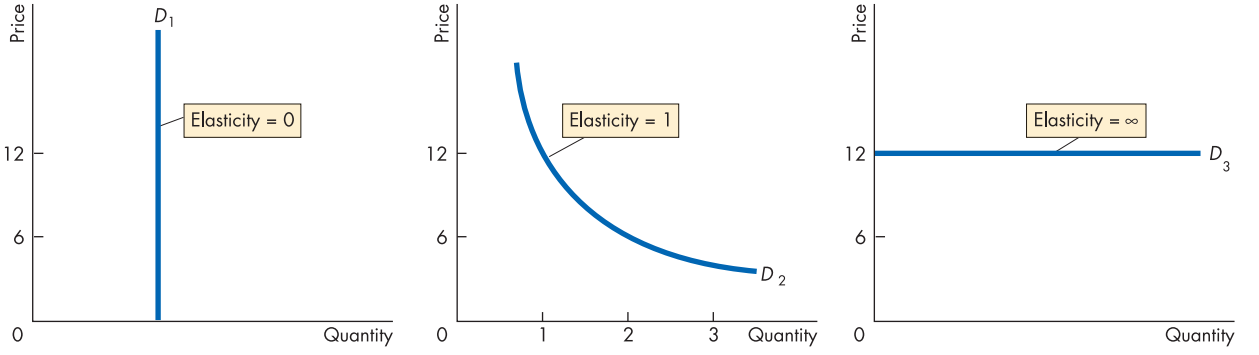
Figure 4.3 shows three demand curves that cover the entire range of possible elasticities of demand. In Figure 4.3(a), the quantity demanded is constant regardless of the price. If the quantity demanded remains constant when the price changes, then the price elasticity of demand is zero and the good is said to have a **perfectly inelastic demand**. One good that has a very low price elasticity of demand (perhaps zero over some price range) is insulin. Insulin is of such importance to some diabetics that if the price rises or falls, they do not change the quantity they buy.

If the percentage change in the quantity demanded equals the percentage change in price, then the price elasticity equals 1 and the good is said to have a **unit elastic demand**. The demand in Figure 4.3(b) is an example of unit elastic demand.

Between the cases shown in Figure 4.3(a) and Figure 4.3(b) is the general case in which the percentage change in the quantity demanded is less than the percentage change in price. In this case, the price elasticity of demand is between zero and 1 and the

Figure 4.3

Inelastic and Elastic Demand



(a) Perfectly inelastic demand **(b) Unit elastic demand** **(c) Perfectly elastic demand**

Each demand illustrated here has a constant elasticity. The demand curve in part (a) illustrates the demand for a good that has a zero elasticity of demand. The demand curve in part (b) illustrates the demand for a good with a unit elasticity of demand. And the demand curve in part (c) illustrates the demand for a good with an infinite elasticity of demand.

good is said to have an **inelastic demand**. Food and housing are examples of goods with inelastic demand.

If the quantity demanded changes by an infinitely large percentage in response to a tiny price change, then the price elasticity of demand is infinity and the good is said to have a **perfectly elastic demand**. Figure 4.3(c) shows a perfectly elastic demand. An example of a good that has a very high elasticity of demand (almost infinite) is a salad from two campus machines located side by side. If the two machines offer the same salads for the same price, some people buy from one machine and some from the other. But if one machine's price is higher than the other's, by even a small amount, no one will buy from the machine with the higher price. Salads from the two machines are perfect substitutes.

Between the cases in Figure 4.3(b) and Figure 4.3(c) is the general case in which the percentage change in the quantity demanded exceeds the percentage change in price. In this case, the price elasticity of demand is greater than 1 and the good is said to have an **elastic demand**. Cars and furniture are examples of goods that have elastic demand.

Elasticity Along a Linear Demand Curve

Elasticity and slope are not the same, but they are related. To understand how they are related, let's look at elasticity along a straight-line demand curve – a demand curve that has a constant slope.

Figure 4.4 illustrates the calculation of elasticity along a straight-line demand curve. First, suppose the price falls from £5 to £3 a smoothie. The quantity demanded increases from zero to 10 smoothies an hour. The average price is £4 a smoothie, and the average quantity is 5 smoothies. So:

$$\text{Price elasticity of demand} = \frac{\Delta Q/Q_{AVE}}{\Delta P/P_{AVE}}$$
$$= \frac{10/5}{2/4}$$
$$= 4$$

That is, the price elasticity of demand at an average price of £4 a smoothie is 4.

Next, suppose that the price falls from £3 to £2 a smoothie. The quantity demanded increases from 10 to 15 smoothies an hour. The average price is now £2.50 a smoothie, and the average quantity is 12.5 smoothies an hour. So:

$$\text{Price elasticity of demand} = \frac{5/12.5}{1/2.5}$$
$$= 1$$

That is, the price elasticity of demand at an average price of £2.50 a smoothie is 1.

Finally, suppose that the price falls from £2 to zero. The quantity demanded increases from 15 to 25 smoothies an hour. The average price is now £1 and the average quantity is 20 smoothies an hour. So:

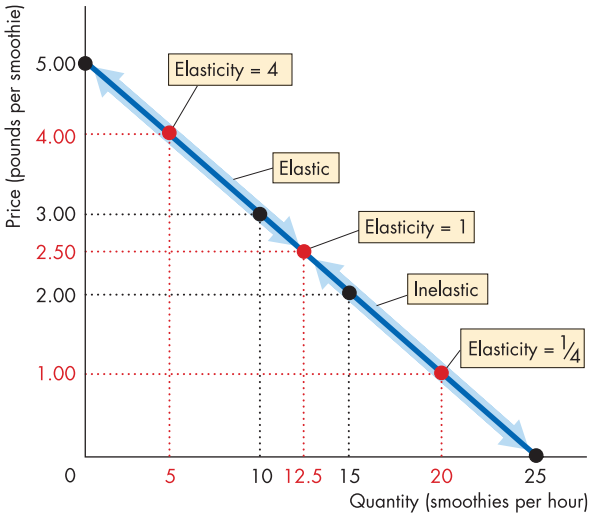
$$\text{Price elasticity of demand} = \frac{10/20}{2/1}$$
$$= 1/4$$

That is, the price elasticity of demand at an average price of £1 a smoothie is 1/4.

You've now seen how elasticity changes along a straight-line demand curve. At the mid-point of the curve, demand is unit elastic. At prices above the mid-point, demand is elastic. At prices below the mid-point, demand is inelastic.

Figure 4.4

Elasticity Along a Linear Demand Curve



On a linear demand curve, elasticity decreases as the price falls and the quantity demanded increases. Demand is unit elastic at the mid-point of the demand curve (elasticity is 1). At prices above the mid-point, demand is elastic; at prices below the mid-point, demand is inelastic.

Total Revenue and Elasticity

The **total revenue** from the sale of a good equals the price of the good multiplied by the quantity sold. When a price changes, total revenue might or might not change. And a rise in price does not always increase total revenue.

The change in total revenue depends on the elasticity of demand in the following way:

1 If demand is elastic, a 1 per cent price cut increases the quantity sold by more than 1 per cent and total revenue increases.

2 If demand is inelastic, a 1 per cent price cut increases the quantity sold by less than 1 per cent and total revenue decreases.

3 If demand is unit elastic, a 1 per cent price cut increases the quantity sold by 1 per cent and so total revenue does not change.

Figure 4.5 shows how we can use this relationship between elasticity and total revenue to estimate elasticity using the total revenue test. The **total revenue test** is a method of estimating the price elasticity of demand by observing the change in total revenue that results from a change in the price, when all other influences on the quantity sold remain the same.

1 If a price cut increases total revenue, demand is elastic.

2 If a price cut decreases total revenue, demand is inelastic.

3 If a price cut leaves total revenue unchanged, demand is unit elastic.

In Figure 4.5(a), over the price range from £5 to £2.50, demand is elastic. Over the price range from £2.50 to zero, demand is inelastic. At a price of £2.50, demand is unit elastic.

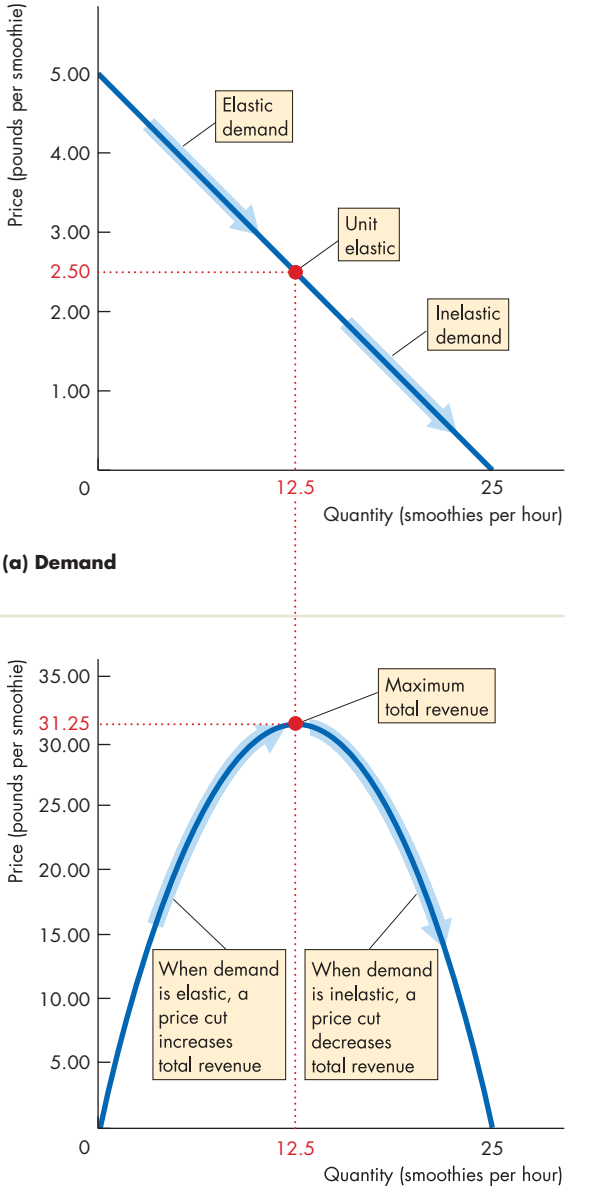
Figure 4.5(b) shows total revenue. At a price of £5, the quantity sold is zero (part a), so total revenue is zero (part b). At a price of zero, the quantity demanded is 25 smoothies an hour and total revenue is again zero.

A price cut in the elastic range brings an increase in total revenue – the percentage increase in the quantity demanded is greater than the percentage decrease in price.

A price cut in the inelastic range brings a decrease in total revenue – the percentage increase in the quantity demanded is less than the percentage decrease in price. At unit elasticity, total revenue is at a maximum.

Figure 4.5

Elasticity and Total Revenue



When demand is elastic, in the price range from £5 to £2.50, a decrease in price in part (a) brings an increase in total revenue in part (b). When demand is inelastic, in the price range from £2.50 to zero, a decrease in price in part (a) brings a decrease in total revenue in part (b). When demand is unit elastic, at a price of £2.50 in part (a), total revenue is at a maximum in part (b).

Your Expenditure and Your Elasticity

When a price changes, the change in your expenditure on the good depends on *your* elasticity of demand.

1 If your demand is elastic, a 1 per cent price cut increases the quantity you buy by more than 1 per cent and your expenditure on the item increases.

2 If your demand is inelastic, a 1 per cent price cut increases the quantity you buy by less than 1 per cent and your expenditure on the item decreases.

3 If your demand is unit elastic, a 1 per cent price cut increases the quantity you buy by 1 per cent and your expenditure on the item does not change.

So if you spend more on an item when its price falls, your demand for that item is elastic; if you spend the same amount, your demand is unit elastic; and if you spend less, your demand is inelastic.

The Factors That Influence the Elasticity of Demand

What makes the demand for some goods elastic and the demand for others inelastic? The magnitude of the elasticity of demand depends on:

- The closeness of substitutes
- The proportion of income spent on the good
- The time elapsed since a price change

Closeness of Substitutes

The closer the substitutes for a good or service, the more elastic is the demand for it. For example, oil from which we make petrol has substitutes but none that are currently very close (imagine a steam-driven, coal-fuelled car). So the demand for oil is inelastic. Plastics are close substitutes for metals, so the demand for metals is elastic.

The degree of substitutability between two goods also depends on how narrowly (or broadly) we define them. For example, the elasticity of demand for meat is low, but the elasticity of demand for beef or pork is high. The elasticity of demand for personal computers is low, but the elasticity of demand for a Gateway, Dell, or IBM computer is high.

In everyday language we call some goods, such as food and housing, *necessities* and other goods, such as exotic vacations, *luxuries*. A necessity is a good that has poor substitutes and that is crucial for our well-being. So generally, a necessity has an inelastic demand. In the table in Box 4.1, food and oil might be classified as necessities.

A luxury is a good that usually has many substitutes, one of which is not buying it. So a luxury generally has an elastic demand. In the table in Box 4.1, furniture and motor vehicles might be classified as luxuries.

Box 4.1
Some Real World Price Elasticities of Demand

The table below shows some estimates of price elasticities of demand in the United Kingdom. These values range from 1.4 for fresh meat, the most elastic in the table, to zero for bread, the least elastic in the table.

You can see that the items with an elastic demand include luxuries (wine and spirits) while items with an inelastic demand include necessities (bread and green vegetables). You can also see that luxuries that are habit forming (tobacco and beer) also have an inelastic demand.

Services, with unit elasticity, is such a broad category that it almost certainly hides wide variations in elasticity across the different services.

Table 1

UK Price Elasticities of Demand

Good or service	Elasticity
Elastic demand	
Fresh meat	1.4
Spirits	1.3
Wine	1.2
Unit elasticity	
Services	1.0
Cereals	1.0
Inelastic demand	
Durable goods	0.9
Fruit juice	0.8
Green vegetables	0.6
Tobacco	0.5
Beer	0.5
Bread	0.0

Sources: Ministry of Agriculture, Food and Fisheries, *Household Food Consumption and Expenditure*, 1992, London, HMSO. C. Godfrey, 'Modelling Demand', *Preventing Alcohol and Tobacco Problems*, Vol. 1, (A. Maynard and P. Tether, eds), Avebury, 1990. J. Muellbauer, 'Testing the Barten Model of Household Composition Effects and the Cost of Children', *Economic Journal*, (September 1977).

Proportion of Income Spent on the Good

Other things remaining the same, the greater the proportion of income spent on a good, the more elastic is the demand for it.

Think about your own elasticity of demand for toothpaste and housing. If the price of toothpaste doubles, you consume almost as much as before. Your demand for toothpaste is inelastic. If flat rents double, you shriek and look for more students to share accommodation with you. Your demand for housing is more elastic than your demand for toothpaste. Why the difference? Housing takes a large proportion of your budget, and toothpaste takes only a tiny proportion. You don't like either price increase, but you hardly notice the higher price of toothpaste, while the higher rent puts your budget under severe strain.

Time Elapsed Since Price Change

The longer the time that has elapsed since a price change, the more elastic is demand. When the price of oil increased by 400 per cent during the 1970s, people barely changed the quantity of oil and petrol they bought. But gradually, as more efficient auto and airplane engines were developed, the quantity used decreased. The demand for oil has become more elastic as more time has elapsed since the huge price hike. Similarly, when the price of a PC fell, the quantity of PCs demanded increased only slightly at first. But as more people have become better informed about the variety of ways of using a PC, the quantity of PCs bought has increased sharply. The demand for PCs has become more elastic.

Review Quiz

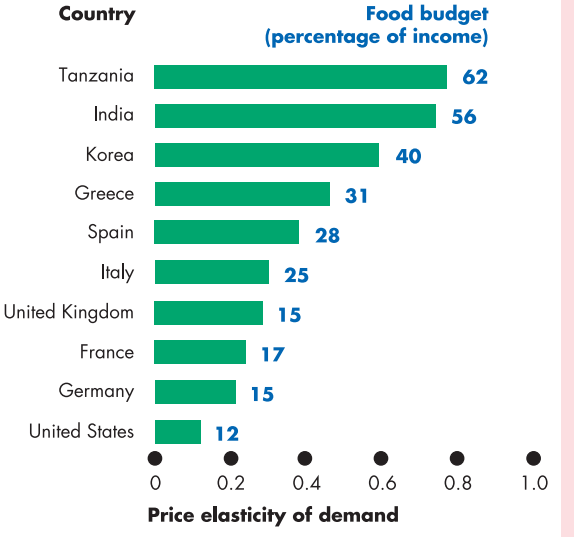
1 Why do we need a units-free measure of the responsiveness of the quantity demanded of a good or service to a change in its price?
2 Can you define and calculate the price elasticity of demand?
3 Why, when we calculate the price elasticity of demand, do we express the change in price as a percentage of the *average* price and the change in quantity as a percentage of the *average* quantity?
4 What is the total revenue test and why does it work?
5 What are the main influences on the elasticity of demand that make the demand for some goods elastic and the demand for other goods inelastic?
6 Why is the demand for a luxury generally more elastic than the demand for a necessity?

Box 4.2
Price Elasticity of Demand for Food

You can see the proportion of income spent on food and the price elasticity of demand for food in 10 countries in the figure below. In general, the larger the proportion of income spent on food, the more price elastic is the demand for food. In a very poor country like Tanzania, where 62 per cent of income is spent on food, the price elasticity of demand for food is 0.77. In contrast, in Germany where 15 per cent of income is spent on food, the elasticity of demand for food is just 0.23. These figures make sense. In a country that spends a large proportion of its income on food, an increase in the price of food forces people to make a bigger adjustment to the quantity of food they buy than in a country in which only a small proportion of income is spent on food.

Figure 1

The Price Elasticity of Demand for Food in Ten Countries



As income increases and the proportion of income spent on food decreases, the demand for food becomes less elastic.

Source: Henri Theil, Ching-Fan Chung and James L. Seale Jr, *Advances in Econometrics, Supplement 1, International Evidence on Consumption Patterns*. Greenwich, Connecticut, JAI Press Inc. 1989.

You've now completed your study of the *price* elasticity of demand. Two other elasticity concepts tell us about the effects of other influences on demand. Let's look at these other elasticities of demand.

More Elasticities of Demand

Back at the juice bar, Andy is trying to work out how a cut in the price of soft drinks at the cafe next door will affect the demand for his smoothies. He knows that smoothies and soft drinks are substitutes. And he knows that when the price of a substitute for smoothie falls, the demand for smoothies will decrease. But by how much? He also knows that smoothies and salads are complements. And he knows that if the price of a complement of smoothies falls, the demand for smoothies will increases. So he wonders whether he might keep his customers by cutting the price he charges for salads. But again, by how much?

To answer these questions, Andy needs to calculate some cross elasticities of demand. Let's examine this elasticity measure.

Cross Elasticity of Demand

We measure the influence of a change in the price of a substitute or complement by using the concept of the cross elasticity of demand. The **cross elasticity of demand** is a measure of the responsiveness of the demand for a good to a change in the price of a substitute or complement, other things remaining the same. We calculate the *cross elasticity of demand* by using the formula:

$$\text{Cross elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price of substitute or complement}}$$

The cross elasticity of demand can be positive or negative. It is *positive* for a *substitute* and *negative* for a *complement*.

Substitutes

Suppose that the price of smoothie is constant and 11 smoothies an hour are sold. Then the price of a soft drink falls from 50p to 30p. No other influence on buying plans changes and the quantity of smoothies sold decreases to 9 an hour.

The change in the quantity demanded is –2 smoothies – the new quantity, 9 smoothies, minus the original quantity, 11 smoothies. The average quantity is 10 smoothies. So the quantity of smoothies demanded changes by –20 per cent. That is:

$$\Delta Q/Q_{AVE} = (-2/10) \times 100 = -20\%$$

The change in the price of a soft drink, a substitute for smoothie, is –20p – the new price, 30p, minus the original price, 50p. The average price is 40p a soft drink. So the price of a soft drink falls by 50 per cent (–50). That is:

$$\Delta P/P_{AVE} = (-20/40) \times 100 = -50\%$$

So the cross elasticity of demand for smoothies with respect to the price of a soft drink is:

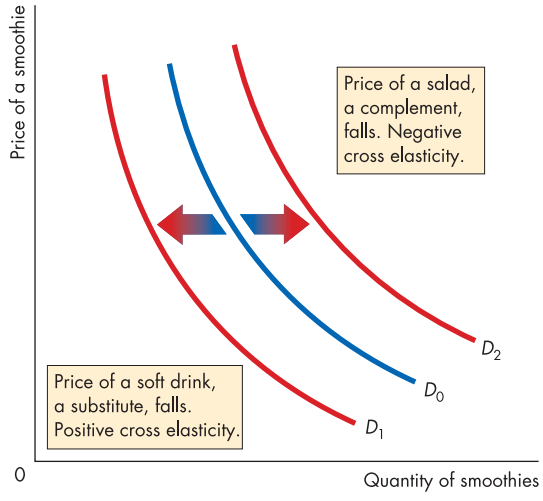
$$\frac{-20\%}{-50\%} = 0.4$$

Figure 4.6 illustrates the cross elasticity of demand. Smoothies and soft drinks are substitutes. Because they are substitutes, when the price of a soft drink *falls*, the demand for smoothies *decreases*. The demand curve for smoothie shifts leftward from D_0 to D_1.

Because a *fall* in the price of a soft drink brings a *decrease* in the demand for smoothies, the cross elasticity of demand for smoothies with respect to the price of a soft drink is *positive*. Both the price and the quantity change in the same direction.

Figure 4.6

Cross Elasticity of Demand



A soft drink is a substitute for a smoothie. When the price of a soft drink falls, the demand for smoothies decreases and the demand curve for smoothie shifts leftward from D_0 to D_1. The cross elasticity of the demand is positive.

A salad is a complement of a smoothie. When the price of a salad falls, the demand for smoothies increases and the demand curve for smoothies shifts rightward from D_0 to D_2. The cross elasticity of the demand is negative.

Complements

Now suppose that the price of smoothie is constant and 9 smoothies an hour are sold. Then the price of a salad falls from £2.50 to £1.50. No other influence on buying plans changes and the quantity of smoothies sold increases to 11 an hour.

The change in the quantity demanded is the opposite of what we've just calculated: The quantity of smoothies demanded increases by 20 per cent (+20).

The change in the price of a salad, a complement of smoothie, is the same as the percentage change in the price of a soft drink that we've just calculated: The price of a salad rises by 50 per cent (+50). So the cross elasticity of demand for smoothies with respect to the price of a salad is:

$$\frac{+20\%}{-50\%} = -0.4$$

Because smoothies and salads are complements, when the price of a salad *falls*, the demand for smoothies *increases*. The demand curve for smoothie shifts rightward from D_0 to D_2. Because a *fall* in the price of a salad brings an *increase* in the demand for smoothies, the cross elasticity of demand for smoothies with respect to the price of a salad is *negative*. The price and quantity change in *opposite* directions.

The magnitude of the cross elasticity of demand determines how far the demand curve shifts. The larger the cross elasticity (absolute value), the greater is the change in demand and the larger is the shift in the demand curve.

If two items are very close substitutes, such as two brands of spring water, the cross elasticity is large. If two items are close complements, such as fish and chips, the cross elasticity is large.

If two items are somewhat unrelated to each other, such as a newspaper and a smoothie, the cross elasticity is small – perhaps even zero.

Income Elasticity of Demand

The economy is expanding and people are enjoying rising incomes. This prosperity is bringing an increase in the demand for most types of goods and services. But by how much will the demand for smoothies increase? The answer depends on the **income elasticity of demand**, which is a measure of the responsiveness of the demand for a good or service to a change in income, other things remaining the same.

The income elasticity of demand is calculated by using the formula:

$$\text{Income elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

Income elasticities of demand can be positive or negative and fall into three interesting ranges:

- Greater than 1 (*normal* good, income elastic)
- Positive and less than 1 (*normal* good, income inelastic)
- Negative (*inferior* good)

Income Elastic Demand

Suppose that the price of smoothie is constant and 9 smoothies an hour are sold. Then incomes rise from £475 to £525 a week. No other influence on buying plans changes and the quantity of smoothies sold increases to 11 an hour.

The change in the quantity demanded is 2 smoothies. The average quantity is 10 smoothies, so the quantity demanded increases by 20 per cent. The change in income is £50 and the average income is £500, so incomes increase by 10 per cent. The income elasticity of demand for smoothies is:

$$\frac{20\%}{10\%} = 2$$

As income increases, the quantity of smoothies demanded increases faster than income. The demand for smoothies is income elastic. Other goods in this category include ocean cruises, international travel, jewellery and works of art.

Income Inelastic Demand

If the percentage increase in the quantity demanded is less than the percentage increase in income, the income elasticity of demand is positive and less than 1. In this case, the quantity demanded increases as income increases, but income increases faster than the quantity demanded. The demand for the good is income inelastic. Goods in this category include food, clothing, newspapers, and magazines.

Inferior Goods

If the quantity demanded of a good decreases when income increases, the income elasticity of demand is negative. Goods in this category include small motorcycles, potatoes, and rice. Low-income consumers buy most of these goods.

Box 4.3
Real-world Income Elasticities of Demand

Table 1 shows some estimates of the income elasticities of demand in the United Kingdom. Basic food items such as fresh meat are income inelastic, while luxury goods such as wines and spirits are income elastic. Some goods such as tobacco and bread have income elasticities that are negative, so they are defined as inferior goods. However, their elasticity values are very close to zero.

The demand for food is income inelastic – elasticity less than 1. But income elasticity varies with income. The figure shows the effect of the *level* of income on the income elasticity of demand for food in 10 countries. In a country with low incomes, such as Tanzania, the income inelasticity of demand for food is around 0.75, while in the high-income countries of Europe and North America, the income elasticity of demand for food is much lower. These numbers tell us that a 10 per cent increase in income leads to a 7.5 per cent increase in the demand for food of in India, a 3 per cent increase in France, and a less than 2 per cent increase in the United States.

Table 1

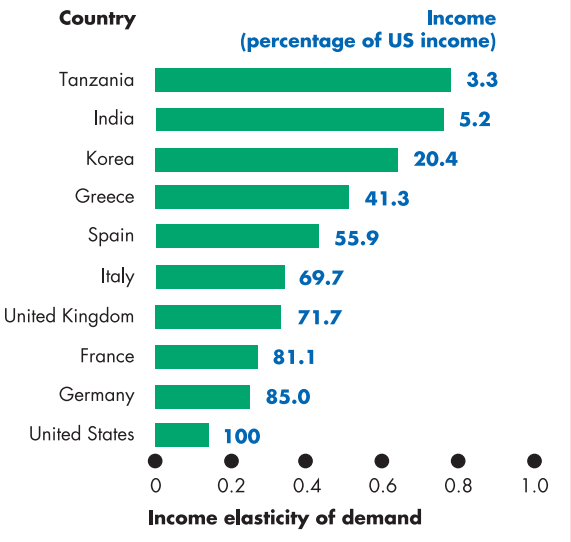
Some UK Income Elasticities of Demand

Good or service	Elasticity
Normal elastic demand	
Wine	2.6
Services	1.8
Spirits	1.7
Durable goods	1.5
Normal inelastic demand	
Fruit juice	0.9
Beer	0.6
Green vegetables	0.1
Fresh meat	0.0
Cereals	0.0
Inferior	
Tobacco	−0.1
Bread	−0.3

Sources: Ministry of Agriculture, Food and Fisheries, *Household Food Consumption and Expenditure*, 1992, London, HMSO. C. Godfrey, Modelling Demand. In *Preventing Alcohol and Tobacco Problems*, Vol. 1, (A. Maynard and P. Tether, eds), Avebury, 1990. J. Muellbauer 'Testing the Barten Model of Household Composition Effects and the Cost of Children', *Economic Journal*, (September 1977).

Figure 1

Income Elasticities in 10 Countries



As income increases, the income elasticity of demand for food decreases. Low-income consumers spend a larger percentage of any increase in income on food than do high-income consumers.

Source: Henri Theil, Ching-Fan Chung and James L. Seale Jr, *Advances in Econometrics, Supplement 1, International Evidence on Consumption Patterns*. Greenwich, Connecticut, JAI Press Inc. 1989.

Review Quiz

1 What does the cross elasticity of demand measure?
2 What does the sign (positive versus negative) of the cross elasticity of demand tell us about the relationship between two goods?
3 What does the income elasticity of demand measure?
4 What does the sign (positive versus negative) of the income elasticity of demand tell us about a good?
5 Why does the level of income influence the magnitude of the income elasticity of demand?

You've now completed your study of the *price* elasticity of demand, the *cross elasticity* of demand and the *income elasticity* of demand.

We're now going to look at the other side of a market and examine the elasticity of supply.

Elasticity of Supply

When demand increases, the equilibrium price rises and the equilibrium quantity increases. But does the price rise by a large amount and the quantity increase by a little? Or does the price barely rise and the quantity increase by a large amount?

The answer depends on the responsiveness of the quantity supplied to a change in price. You can see why by studying Figure 4.7, which shows two possible scenarios in a local smoothie market. Figure 4.7(a) shows one scenario, and Figure 4.7(b) shows the other.

In both cases, demand is initially D_0. In part (a), the supply of smoothie is shown by the supply curve S_A. In part (b), the supply of smoothie is shown by the supply curve S_B. Initially, in both cases, the price is £3 a smoothie and the quantity produced and consumed is 10 smoothies an hour.

Now increases in incomes and population increase the demand for smoothies. The demand curve shifts rightward to D_1. In case (a), the price rises by £2 to £5 a smoothie and the quantity increases by only 5 to 15 an hour. In contrast, in case (b), the price rises by only 20p to £3.20 a smoothie and the quantity increases by 10 to 20 smoothies an hour.

The different outcomes arise from differing degrees of responsiveness of the quantity supplied to a change in price. We measure the degree of responsiveness by using the concept of the elasticity of supply.

Calculating the Elasticity of Supply

The **elasticity of supply** measures the responsiveness of the quantity supplied to a change in the price of a good when all other influences on selling plans remain the same. It is calculated by using the formula:

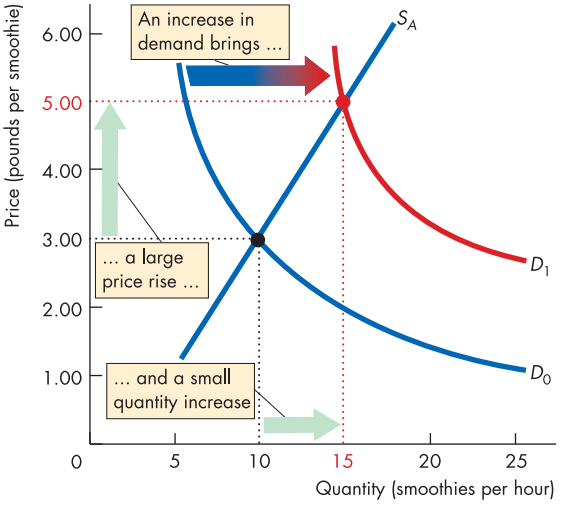
$$\text{Price elasticity of supply} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

We use the same method that you learned when you studied the elasticity of demand. (Refer back to p. 79 to check this method.) Let's calculate the elasticity of supply along the supply curves in Figure 4.7.

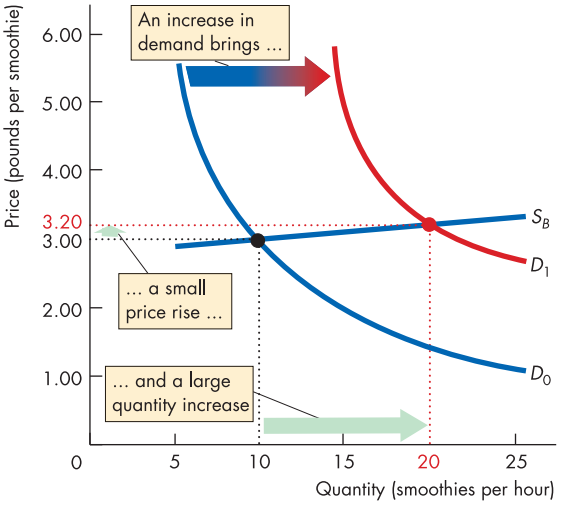
In Figure 4.7(a), when the price rises from £3 to £5, the price rise is £2 and the average price is £4, so the price rises by 50 per cent of the average price.

Figure 4.7

How a Change in Demand Changes Price and Quantity



(a) Large price change and small quantity change



(b) Small price change and large quantity change

Initially, the price is £3 a smoothie and the quantity sold is 10 smoothies an hour. Then increases in incomes and population increase the demand for smoothies. The demand curve shifts rightward to D_1. In part (a) the price rises by £2 to £5 a smoothie, and the quantity increases by 5 to 14 smoothies an hour. In part (b), the price rises by only 25p to £3.25 a smoothie and the quantity increases by 10 to 20 smoothies an hour. The price change is smaller and the quantity change is larger in case (b) than in case (a). The quantity supplied is more responsive to price in case (b) than in case (a).

The quantity increases from 10 to 15 smoothies an hour, so the increase is 5 smoothies, the average quantity is 12.5 smoothies an hour, and the quantity increases by 40 per cent.

The elasticity of supply is equal to 40 per cent divided by 50 per cent, which equals 0.8.

In Figure 4.7(b), when the price rises from £3 to £3.20, the price rise is 20p and the average price is £3.10, so the price rises by 6.45 per cent of the average price. The quantity increases from 10 to 20 smoothies an hour, so the increase is 10 smoothies, the average quantity is 15 smoothies, and the quantity increases by 66.67 per cent. The elasticity of supply equals 66.67 per cent divided by 6.45 per cent, which equals 10.34.

Figure 4.8 shows the range of elasticities of supply. If the quantity supplied is fixed regardless of the price, the supply curve is vertical and the elasticity of supply is zero. Supply is perfectly inelastic. This case is shown in Figure 4.8(a). A special intermediate case is when the percentage change in price equals the percentage change in quantity. Supply is then unit elastic. This case is shown in Figure 4.8(b). No matter how steep the supply curve is, if it is linear and passes through the origin, supply is unit elastic. If there is a price at which sellers are willing to offer any quantity for sale, the supply curve is horizontal and the elasticity of supply is infinite. Supply is perfectly elastic. This case is shown in Figure 4.8(c).

The Factors That Influence the Elasticity of Supply

The magnitude of the elasticity of supply depends on:

- Resource substitution possibilities
- Time frame for the supply decision

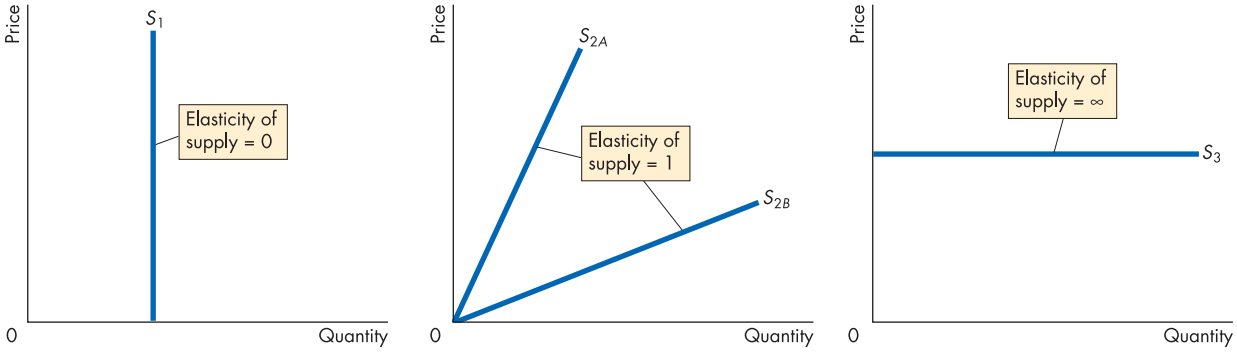
Resource Substitution Possibilities

Some goods and services can be produced only by using unique or rare productive resources. These items have a low, even perhaps a zero, elasticity of supply. Other goods and services can be produced by using commonly available resources that could be allocated to a wide variety of alternative tasks. Such items have a high elasticity of supply.

A Van Gogh painting is an example of a good with a vertical supply curve and a zero elasticity of supply. At the other extreme, wheat can be grown on land that is almost equally good for growing corn. So it is just as easy to grow wheat as corn, and the opportunity cost of wheat in terms of forgone corn is almost constant. As a result, the supply curve of wheat is almost horizontal and its elasticity of supply is very large. Similarly, when a good is produced in many different countries (for example, wheat, sugar and beef), the supply of the good is highly elastic.

Figure 4.8

Inelastic and Elastic Supply



(a) Perfectly inelastic supply **(b) Unit elastic supply** **(c) Perfectly elastic supply**

Each supply illustrated here has a constant elasticity. The supply curve in part (a) illustrates the supply of a good that has a zero elasticity of supply. The supply curve in part (b) illustrates the supply of a good with a unit elasticity of supply. All linear supply curves that pass through the origin illustrate supplies that are unit elastic. The supply curve in part (c) illustrates the supply of a good with an infinite elasticity of supply.

The supply of most goods and services lies between these two extremes. The quantity produced can be increased but only by incurring a higher cost. If a higher price is offered, the quantity supplied increases. Such goods and services have an elasticity of supply between zero and infinity.

Time Frame for Supply Decisions

To study the influence of the length of time elapsed since a price change we distinguish three time frames of supply:

1 Momentary supply
2 Long-run supply
3 Short-run supply

When the price of a good rises or falls, the *momentary supply curve* shows the response of the quantity supplied immediately following a price change.

Some goods, such as fruits and vegetables, have a perfectly inelastic momentary supply – a vertical supply curve. The quantities supplied depend on crop planting decisions made earlier. In the case of oranges, for example, planting decisions have to be made many years in advance of the crop being available.

The momentary supply curve is vertical because, on a given day, no matter what the price of oranges, producers cannot change their output. They have picked, packed and shipped their crop to market, and the quantity available for that day is fixed.

In contrast, some goods have a perfectly elastic momentary supply. Long-distance phone calls are an example. When many people simultaneously make a call, there is a big surge in the demand for telephone cables, computer switching and satellite time, and the quantity bought increases. But the price remains constant. Long-distance carriers monitor fluctuations in demand and reroute calls to ensure that the quantity supplied equals the quantity demanded without changing the price.

The *long-run supply curve* shows the response of the quantity supplied to a change in price after all the technologically possible ways of adjusting supply have been exploited. In the case of oranges, the long run is the time it takes new plantings to grow to full maturity – about 15 years. In some cases, the long-run adjustment occurs only after a completely new production plant has been built and workers have been trained to operate it – typically a process that might take several years.

The *short-run supply curve* shows how the quantity supplied responds to a price change when only *some* of the technologically possible adjustments to production have been made. The short-run response to a price change is a sequence of adjustments. The first adjustment that is usually made is in the amount of labour employed. To increase output in the short run, firms work their labour force overtime and perhaps hire additional workers. To decrease their output in the short run, firms either lay off workers or reduce their hours of work. With the passage of time, firms can make additional adjustments, perhaps training additional workers or buying additional tools and other equipment.

The short-run supply curve slopes upward because producers can take actions quite quickly to change the quantity supplied in response to a price change. For example, if the price of oranges falls, growers can stop picking and leave oranges to rot on the trees. Or if the price rises, they can use more fertilizer and improved irrigation to increase the yields of their existing trees. In the long run, they can plant more trees and increase the quantity supplied even more in response to a given price rise.

Review Quiz

1 Why do we need to measure the responsiveness of the quantity supplied of a good or service to a change in its price?
2 Can you define and calculate the elasticity of supply?
3 What are the main influences on the elasticity of supply that make the supply of some goods elastic and the supply of other goods inelastic?
4 Can you provide examples of goods or services whose elasticities of supply are (a) zero, (b) greater than zero but less than infinity and (c), infinity?
5 How does the time frame over which a supply decision is made influence the elasticity of supply?

You have now learned about the elasticities of demand and supply. Table 4.1 summarizes all the elasticities that you've met in this chapter.

In the next chapter, we study the efficiency of competitive markets. But before leaving elasticity, *Reading Between the Lines* on pp. 92–93 puts the elasticity of demand to work looking at the effects of a rise in a tax on the price, quantity, and tax revenue raised.

Table 4.1

A Compact Glossary of Elasticities of Demand

A relationship is described as	When its magnitude is	Which means that
Price Elasticity of Demand		
Perfectly elastic or infinitely elastic	Infinity	The smallest possible increase in price causes an infinitely elastic large decrease in the quantity demanded*
Elastic	Less than infinity but greater than 1	The percentage decrease in the quantity demanded exceeds the percentage increase in price
Unit elastic	1	The percentage decrease in the quantity demanded equals the percentage increase in price
Inelastic	Greater than zero but less than 1	The percentage decrease in the quantity demanded is less than the percentage increase in price
Perfectly inelastic or completely inelastic	Zero	The quantity demanded is the same at all prices
Cross Elasticity of Demand		
Perfect substitutes	Infinity	The smallest possible increase in the price of one good causes an infinitely large increase in the quantity demanded of the other good
Substitutes	Positive, less than infinity	If the price of one good increases the quantity demanded of the other good also increases
Independent	Zero	The quantity demanded of one good remains constant regardless of the price of the other good
Complements	Less than zero	The quantity demanded of one good decreases when the price of the other good increases
Income Elasticity of Demand		
Income elastic (normal good)	Greater than 1	The percentage increase in the quantity demanded is greater than the percentage increase in income
Income inelastic (normal good)	Less than 1 but greater than zero	The percentage increase in the quantity demanded is less than the percentage increase in income
Negative income elastic (inferior good)	Less than zero	When income increases, quantity demanded decreases
Price Elasticity of Supply		
Perfectly elastic	Infinity	The smallest possible increase in price causes an infinitely large increase in the quantity supplied
Elastic	Less than infinity but greater than 1	The percentage increase in the quantity supplied exceeds the percentage increase in the price
Inelastic	Greater than zero but less than 1	The percentage increase in the quantity supplied is less than the percentage increase in the price
Perfectly inelastic	Zero	The quantity supplied is the same at all prices

* In each description, the directions of change may be reversed. For example, in this case: the smallest possible *decrease* in the price causes an infinitely large *increase* in the quantity demanded.

Reading Between the Lines

Elasticity: French Taxes Cut Smoking

FT

The Financial Times, 6 January, 2004

French health move: Tobacconists fuming after new rise in cigarette tax

Jo Johnson

Yesterday, . . . the (French) government braved the wrath of tobacconists with the third tax increase in 12 months . . . Mr Jacques Chirac . . . has every chance of being able to fulfil his pledge to cut smoking by 30 per cent among young people and by 20 per cent among adults within five years.

To the delight of campaigners, cigarette sales in France are estimated to have fallen by 12–13% in 2003, following a 3.5 per cent fall in 2002. The cumulative impact of tax rises – 8.6 per cent in 2002, 11 per cent in January 2003, 20 per cent in October and now yesterday's 8–10 per cent – is starting to bite. Studies consistently show that taxation and pregnancy are the two most effective ways of stopping smoking.

'It is unprecedented', says Gerard Dubois, chairman of the French Alliance Versus Tobacco, an umbrella organisation for 29 anti-smoking groups, 'Calls to quit-smoking helplines have risen seven-fold in the past year.' He says sales of nicotine gum and patches, made by pharmaceutical giants such as GSK and Pfizer, have increased 89 per cent in the year to September, while turnover of Zyban, an anti-depressant taken by many people giving up smoking, is up 20 per cent.

Campaigners regret, however, that the government is not pressing its advantage further. The political clout of France's 32,000 tobacconists, furious that French cigarettes are now the most expensive in the EU after those sold in the UK, has prompted Jean-Pierre Raffarin, prime minister, to promise a four year freeze on duties. This is expected to apply from this year. . . .

Yesterday's 8–10 per cent increase in cigarette taxes means that the average pack of 20 costs around €5 (£3.50) compared with just €2.50 in neighbouring Spain and €2.90 in Luxembourg . . .

The Essence of the Story

- The French government has raised taxes on cigarettes 4 times in the past 2 years as part of a health policy to cut smoking.
- It is estimated that sales of cigarettes in France fell 3.5 per cent in 2002 and 12 to 13 per cent in 2003.
- Cigarette taxes in France were increased by 8.6 per cent in 2002, 31 per cent overall in 2003, and 8 to 10 per cent in January 2004.
- Higher taxes on cigarettes help stop people smoking.
- French cigarettes at €5 a pack are now among the most expensive in the European Union.

Economic Analysis

- The price elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in price, using the *average* quantity and *average* price.
- The news article does not give details of all the price and quantity changes in France at the time but these can be found in other sources as detailed in Table 1.
- Table 1 shows cigarette tax and the price and quantity of cigarettes bought in France in 2002 and 2003.
- Table 1 also shows the changes in price and quantity and the average price and quantity as well as the calculation of the price elasticity of demand for cigarettes in France.
- Based on these numbers, as the tax and price of cigarettes increased, the quantity of cigarettes bought decreased, and the elasticity of demand for cigarettes in France is 0.3.
- Figure 1 illustrates the calculation of the price elasticity of demand for cigarettes in France in 2002–2003.
- The price increased from €3.46 to €3.89 per pack, an increase of €0.43. The average price was €3.68.
- The quantity of cigarettes demanded decreased from 180 billion packs to 173.7 billion packs, a decrease of 6.3 billion packs. The average quantity was 176.9 billion packs.
- Price elasticity of demand $= \dfrac{6.3/176.9}{0.43/3.68} = 0.3.$
- Because the demand for cigarettes is inelastic, a large price rise is needed to achieve only a modest decrease in the quantity of cigarettes smoked.

Table 1

Cigarette Tax, Price and Quantity in France

Year	Tax (percentage of price)	Price (euros per pack)	Quantity (billions of packs)
2002	72.5	3.46	180.0
2003	76.0	3.89	173.7
Changes	–	+0.43	–6.3
Averages	–	3.68	176.9

Source: Tobacco Manufacturers Association and Eurostat.

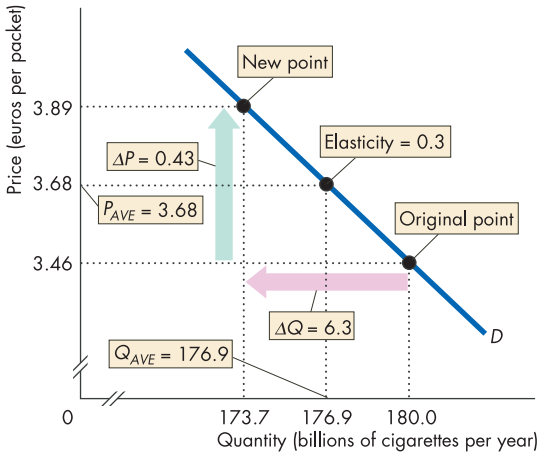


Figure 1 Price elasticity of demand

Summary

Key Points

Price Elasticity of Demand (pp. 78–84)

- Elasticity is a measure of the responsiveness of the quantity demanded of a good to a change in its price.
- Price elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in price.
- The larger the magnitude of the price elasticity of demand, the greater is the responsiveness of the quantity demanded to a given change in price.
- Price elasticity of demand depends on how easily one good serves as a substitute for another, the proportion of income spent on the good and the length of time elapsed since the price change.
- If demand is elastic, a decrease in price leads to an increase in total revenue. If demand is unit elastic, a decrease in price leaves total revenue unchanged. And if demand is inelastic, a decrease in price leads to a decrease in total revenue.

More Elasticities of Demand (pp. 85–87)

- Cross elasticity of demand measures the responsiveness of demand for one good to a change in the price of a substitute or a complement.
- The cross elasticity of demand with respect to the price of a substitute is positive. The cross elasticity of demand with respect to the price of a complement is negative.
- Income elasticity of demand measures the responsiveness of demand to a change in income. For a normal good, the income elasticity of demand is positive. For an inferior good, the income elasticity of demand is negative.
- When the income elasticity of demand is greater than 1, the percentage of income spent on the good increases as income increases.
- When the income elasticity of demand is less than 1 but greater than zero, the percentage of income spent on the good decreases as income increases.

Elasticity of Supply (pp. 88–91)

- Elasticity of supply measures the responsiveness of the quantity supplied of a good to a change in its price.
- The elasticity of supply is usually positive and ranges between zero (vertical supply curve) and infinity (horizontal supply curve).
- Supply decisions have three time frames: momentary, long run and short run.
- Momentary supply refers to the response of sellers to a price change at the instant that the price changes.
- Long-run supply refers to the response of sellers to a price change when all the technologically feasible adjustments in production have been made.
- Short-run supply refers to the response of sellers to a price change after some of the technologically feasible adjustments in production have been made.

Key Figures and Table

Key Terms

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Problems

*1 Rain spoils the strawberry crop. As a result, the price rises from £2 to £3 a box and the quantity demanded decreases from 1,000 to 600 boxes a week. Over this price range,

a What is the price elasticity of demand?

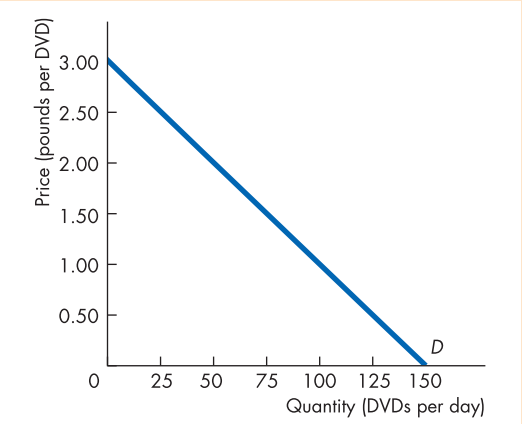
b Describe the demand for strawberries.

2 Good weather brings a bumper tomato crop. The price falls from £7 to £5 a load, and the quantity demanded increases from 300 to 500 loads a day. Over this price range,

a What is the price elasticity of demand?

b Describe the demand for tomatoes.

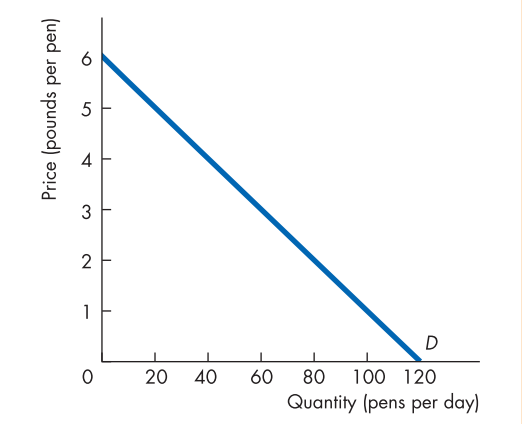
*3 The figure shows the demand for DVD rentals.



a Calculate the elasticity of demand for a rise in rental price from £3 to £5.

b At what price is the elasticity of demand equal to 1?

4 The figure shows the demand for pens.



a Calculate the elasticity of demand for a rise in price from £6 to £10.

b At what prices is the elasticity of demand equal to 1, greater than 1, and less than 1?

*Solutions to odd-numbered problems are available on *Parkin Interactive*.

*5 If the quantity of dental services demanded increases by 10 per cent when the price of dental services falls by 10 per cent, is the demand for dental service inelastic, elastic, or unit elastic?

6 If the quantity of haircuts demanded decreases by 10 per cent when the price of a haircut rises by 5 per cent, is the demand for haircuts elastic, inelastic, or unit elastic? Explain your answer.

*7 The demand schedule for computer chips is

Price (euros per chip)	Quantity demanded (millions of chips per year)
200	50
250	45
300	40
350	35
400	30
450	25
500	20

a What happens to total revenue if the price falls from €400 to €350 a chip?

b What happens to total revenue if the price falls from €350 to €300 a chip?

c At what price is total revenue at a maximum? Use the total revenue test to answer this question.

d At an average price of €350, is the demand for chips elastic or inelastic? Use the total revenue test to answer this question.

8 The demand schedule for sugar is

Price (euros per pound)	Quantity demanded (millions of pounds per year)
5	35
10	30
15	25
20	20
25	15
30	10
35	5

a What happens to total revenue if the price of sugar rises from €5 to €15 per pound?

b What happens to total revenue if the price rises from €15 to €25 per pound?

c At what price is total revenue at a maximum? Use the total revenue test to answer this question.

d At an average price of €20 a pound, is the demand for sugar elastic or inelastic? Use the total revenue test to answer this question.

*9 In problem 7, at €250 a chip, is the demand for chips elastic or inelastic? Use the total revenue test to answer this question.

10 In problem 8, at €10 a pound, is the demand for sugar elastic or inelastic? Use the total revenue test to answer this question.

***11** If a 12 per cent rise in the price of an orange smoothie decreases the quantity of orange smoothies demanded by 22 per cent and increases the quantity of apple smoothies demanded by 14 per cent, calculate the cross elasticity of demand between orange smoothies and apple smoothies.

12 If a 5 per cent fall in the price of chicken decreases the quantity of beef demanded by 20 per cent and increases the quantity of chicken demanded by 15 per cent, calculate the cross elasticity of demand between chicken and beef.

***13** Alex's income has increased from £3,000 to £5,000. Alex increased his consumption of bagels from 4 to 8 a month and decreased his consumption of doughnuts from 12 to 6 a month. Calculate Alex's income elasticity of demand for (a) bagels and (b) doughnuts.

14 Judy's income has increased from £13,000 to £17,000. Judy increased her demand for concert tickets by 15 per cent and decreased her demand for bus rides by 10 per cent. Calculate Judy's income elasticity of demand for (a) concert tickets and (b) bus rides.

***15** The table gives the supply schedule for long-distance phone calls.

Price (cents per minute)	Quantity supplied (millions of minutes per day)
10	200
20	400
30	600
40	800
50	900

Calculate the elasticity of supply when

a The price falls from 40 cents to 30 cents a minute.

b The average price is 20 cents a minute.

16 The table gives the supply schedule for jeans.

Price (dollars per pair)	Quantity supplied (millions of pairs per year)
120	2,400
125	2,800
130	3,200
135	3,600

Calculate the elasticity of supply when

a The price rises from £125 to £135 a pair.

b The average price is £125 a pair.

Critical Thinking

1 Read the news article in *Reading Between the Lines* on p. 92 about the French cigarette taxes and then:

a Using the numbers in the table below, calculate the price elasticity of demand for cigarettes in France for the years 2003 to 2004. Use the method shown on p. 79.

b Explain what your calculated value for price elasticity from part a above means.

c Do you think the revenue collected from the tobacco tax in France during 2004 will rise or fall compared to 2003? Explain your answer.

d What will happen to French cigarette tax revenue if many people go to Spain or Luxembourg to buy their cigarettes in 2004?

e Why did tobacconists in France complain about the increase in cigarette tax?

Year	Tax (percentage of price)	Price (euros per pack)	Quantity (billions of packs)
2003	76.0	3.89	173.7
2004	79.0	5.00	155.5

Web Exercises

Use the links on *Parkin Interactive* to work the following exercises.

1 Obtain information on the price of petrol during the recent past and then:

a Use demand, supply and elasticity to explain the recent changes in the price of petrol.

b Find the latest price of crude oil.

c Use demand, supply and elasticity to explain the recent changes in the price of crude oil.

2 Use the information you obtained in web exercise 1 and find the information you need to answer:

a What are the costs that make up the total cost of a gallon of petrol?

b If the price of crude oil falls by 10 per cent, by what percentage would you expect the price of petrol to change, other things remaining the same?

c In light of your answer to part (b), which elasticity of demand is greater: for crude oil or for petrol.