

>> Consumer and Producer Surplus

Section 1: Consumer Surplus and the Demand Curve

The market in used textbooks is not a big business in terms of dollars and cents. But it is a convenient starting point for developing the concepts of consumer and producer surplus.

So let's look at the market for used textbooks, starting with the buyers. The key point, as we'll see in a minute, is that the demand curve is derived from their preferences—and that those same preferences also determine how much they gain from the opportunity to buy used books.

Willingness to Pay and the Demand Curve

A used book is not as good as a new book—it will be battered and coffee-stained, may include someone else's highlighting, and may not be completely up to date. How much this bothers you depends on your own preferences. Some potential buyers would prefer to buy the used book if it is only slightly cheaper, while others would buy the used book only if it is considerably cheaper than a new book. Let's define a potential buyer's **willingness to pay** as the maximum price at which he or she would



A consumer's **willingness to pay** for a good is the maximum price at which he or she would buy that good.

buy a good, in this case a used textbook. An individual won't buy the book if it costs more than this amount but is eager to do so if it costs less. If the price is just equal to an individual's willingness to pay, he or she is indifferent between buying and not buying.

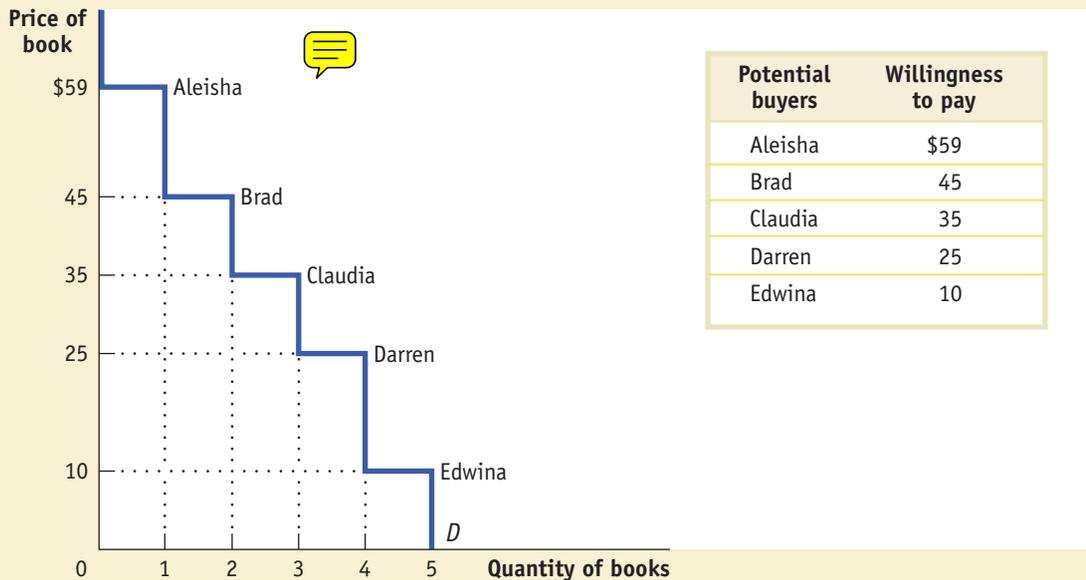
The table in Figure 6-1 shows five potential buyers of a used book that costs \$100 new, listed in order of their willingness to pay. At one extreme is Aleisha, who will buy a second-hand book even if the price is as high as \$59. Brad is less willing to have a used book and will buy one only if the price is \$45 or less. Claudia is willing to pay only \$35, Darren only \$25. And Edwina, who really doesn't like the idea of a used book, will buy one only if it costs no more than \$10.

How many of these five students will actually buy a used book? It depends on the price. If the price of a used book is \$55, only Aleisha buys one; if the price is \$40, Aleisha and Brad both buy used books, and so on. So the information in the table on willingness to pay also defines the *demand schedule* for used textbooks.



As we saw in Chapter 3, we can use this demand schedule to derive the market demand curve shown in Figure 6-1. Because we are considering only a small number of consumers, this curve doesn't look like the smooth demand curves of earlier chapters, where markets contained hundreds or thousands of consumers. This demand curve is step-shaped, with alternating horizontal and vertical segments. Each horizontal segment—each step—corresponds to one potential buyer's willingness to pay. However, we'll see shortly that for the analysis of consumer surplus it doesn't matter whether the demand curve is stepped, as in this figure, or whether there are many consumers, making the curve smooth.

Figure 6-1 The Demand Curve for Used Textbooks



With only five potential consumers in this market, the demand curve is step-shaped. Each step represents one consumer, and its height indicates that consumer's willingness to pay, the maximum price at which each student will buy a used textbook, as indicated in the table. Aleisha has the highest willingness to pay at

\$59, Brad has the next highest at \$45, and so on down to Edwina with the lowest at \$10. At a price of \$59 the quantity demanded is one (Aleisha); at a price of \$45 the quantity demanded is two (Aleisha and Brad), and so on until you reach a price of \$10 at which all five students are willing to purchase a book.

Individual consumer surplus is the net gain to an individual buyer from the purchase of a good. It is equal to the difference between the buyer's willingness to pay and the price paid.

Willingness to Pay and Consumer Surplus

Suppose that the campus bookstore makes used textbooks available at a price of \$30. In that case Aleisha, Brad, and Claudia will buy books. Do they gain from their purchases, and if so, how much?

The answer, shown in Table 6-1, is that each student who purchases a book does achieve a net gain but that the amount of the gain differs among students.

Aleisha would have been willing to pay \$59, so her net gain is $\$59 - \$30 = \$29$. Brad would have been willing to pay \$45, so his net gain is $\$45 - \$30 = \$15$. Claudia would have been willing to pay \$35, so her net gain is $\$35 - \$30 = \$5$. Darren and Edwina, however, won't be willing to buy a used book at a price of \$30, so they neither gain nor lose.

The net gain that a buyer achieves from the purchase of a good is called that buyer's **individual consumer surplus**. What we learn from this example is that every buyer of a good achieves some individual consumer surplus.

TABLE 6-1

Consumer Surplus When the Price of a Used Textbook Is \$30

Potential buyer	Willingness to pay	Price paid	Individual consumer surplus = willingness to pay – price paid
Aleisha	\$59	\$30	\$29
Brad	45	30	15
Claudia	35	30	5
Darren	25	—	—
Edwina	10	—	—
Total consumer surplus: \$49			

Total consumer surplus is the sum of the individual consumer surpluses of all the buyers of a good.

The term **consumer surplus** is often used to refer to both individual and to total consumer surplus.



The sum of the individual consumer surpluses achieved by all the buyers of a good is known as the **total consumer surplus** achieved in the market. In Table 6-1, the total consumer surplus is the sum of the individual consumer surpluses achieved by Aleisha, Brad, and Claudia: $\$29 + \$15 + \$5 = \49 .

Economists often use the term **consumer surplus** to refer to both individual and total consumer surplus. We will follow this practice; it will always be clear in context whether we are referring to the consumer surplus achieved by an individual or by all buyers.

Total consumer surplus can be represented graphically. Figure 6-2 reproduces the demand curve from Figure 6-1. Each step in that demand curve is one book wide and represents one consumer. For example, the height of Aleisha's step is \$59, her willingness to pay. This step forms the top of a rectangle, with \$30—the price she actually pays for a book—forming the bottom. The area of Aleisha's rectangle, $(\$59 - \$30) \times 1 = \$29$, is her consumer surplus from purchasing a book at \$30. So the individual consumer surplus Aleisha gains is the *area of the dark blue rectangle* shown in Figure 6-2.

In addition to Aleisha, Brad and Claudia will also buy books when the price is \$30. Like Aleisha, they benefit from their purchases, though not as much, because they each have a lower willingness to pay. Figure 6-2 also shows the consumer surplus gained by Brad and Claudia; again, this can be measured by the areas of the appropriate rectangles. Darren and Edwina, because they do not buy books at a price of \$30, receive no consumer surplus.

The total consumer surplus achieved in this market is just the sum of the individual consumer surpluses received by Aleisha, Brad, and Claudia. So total consumer surplus is equal to the combined area of the three rectangles—the entire shaded area in Figure 6-2. Another way to say this is that total consumer surplus is equal to the area that is under the demand curve but above the price.

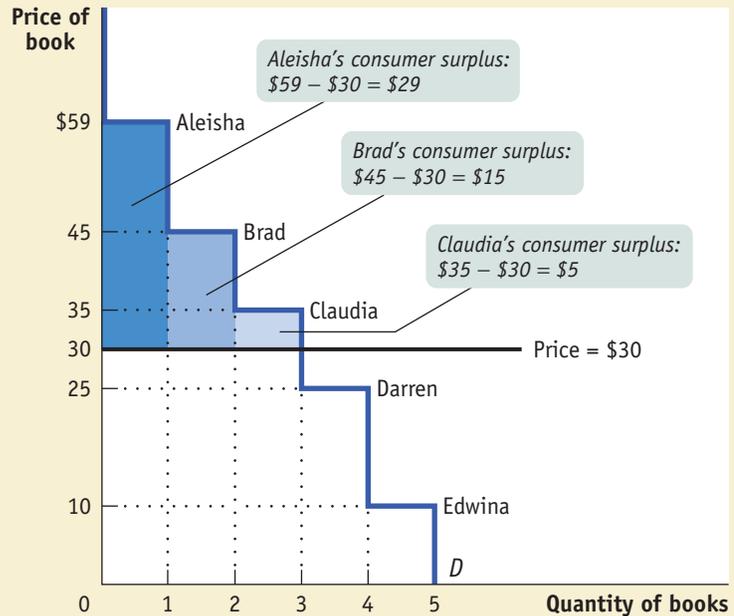
This illustrates the following general principle: *The total consumer surplus generated by purchases of a good at a given price is equal to the area below the demand curve but above that price.* The same principle applies regardless of the number of consumers.

When we consider large markets, this graphical representation becomes extremely helpful. Consider, for example, the sales of personal computers to millions of potential buyers. Each potential buyer has a maximum price that he or she is willing to pay. With so many potential buyers, the demand curve will be smooth, like the one shown in Figure 6-3.

Figure 6-2

Consumer Surplus in the Used-Textbook Market

At a market price of \$30, Aleisha, Brad, and Claudia each buy a book but Darren and Edwina do not. Aleisha, Brad, and Claudia get individual consumer surpluses equal to the difference between their willingness to pay and the market price, illustrated by the areas of the shaded rectangles. Both Darren and Edwina have a willingness to pay less than \$30, so they are unwilling to buy a book in this market; they receive zero consumer surplus. The total consumer surplus is given by the entire shaded area—the sum of the individual consumer surpluses of Aleisha, Brad, and Claudia—equal to $\$29 + \$15 + \$5 = \49 .

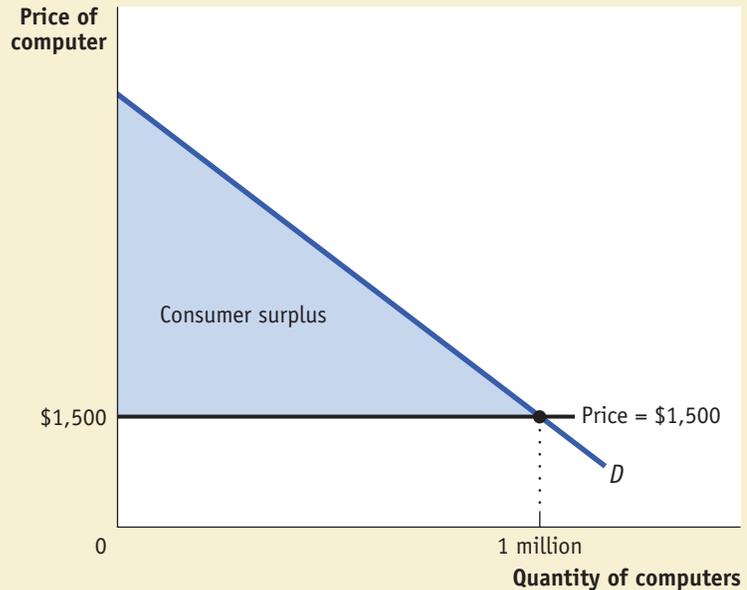


Suppose that at a price of \$1,500, a total of 1 million computers are purchased. How much do consumers gain from being able to buy those 1 million computers? We could answer that question by calculating the consumer surplus of each individual buyer and then adding these numbers up to arrive at a total. But it is much easier just to look at Figure 6-3 and use the fact that the total consumer surplus is equal to the

Figure 6-3

Consumer Surplus

The demand curve for computers is smooth because there are many potential buyers of computers. At a price of \$1,500, 1 million computers are demanded. The consumer surplus at this price is equal to the shaded area: the area below the demand curve but above the price. This is the total gain to consumers generated from consuming computers when the price is \$1,500.





shaded area. As in our original example, consumer surplus is equal to the area below the demand curve but above the price.

How Changing Prices Affect Consumer Surplus

It is often important to know how much consumer surplus *changes* when the price changes. For example, we may want to know how much consumers are hurt if a frost in Florida drives up orange prices or how much consumers gain if the introduction of fish farming makes salmon less expensive. The same approach we have used to derive consumer surplus can be used to answer questions about how changes in prices affect consumers.

Let's return to the example of the market for used textbooks. Suppose that the bookstore decided to sell used textbooks for \$20 instead of \$30. How much would this increase consumer surplus?

The answer is illustrated in Figure 6-4. As shown in the figure, there are two parts to the increase in consumer surplus. The first part, shaded dark blue, is the gain of those who would have bought books even at the higher price. Each of the students who would have bought books at \$30—Aleisha, Brad, and Claudia—pays \$10 less, and therefore each gains \$10 in consumer surplus from the fall in price to \$20. So the dark blue area represents the \$30 increase in consumer surplus to those three buyers. The second part, shaded light blue, is the gain of those who would not have bought a book at \$30 but are willing to pay more than \$20. In this case that means Darren, who would not have bought a book at \$30 but does buy one at \$20. He gains \$5—the difference between the new price of \$20 and his willingness to pay, \$25. So the light blue area represents a further \$5 gain in consumer surplus. The total increase in consumer surplus is the sum of the shaded areas, \$35. Likewise, a rise in market price from \$20 to \$30 would decrease consumer surplus by an amount equal to the sum of the shaded areas.

Figure 6-4

Consumer Surplus and a Fall in the Market Price of Used Textbooks

There are two parts to the increase in consumer surplus generated by a fall in market price from \$30 to \$20. The first is given by the dark blue rectangle: each person who would have bought at the original price of \$30—Aleisha, Brad, and Claudia—receives an increase in consumer surplus equal to the total fall in price, \$10. So the area of the dark blue rectangle corresponds to an amount equal to $3 \times \$10 = \30 . The second part is given by the light blue rectangle: the increase in consumer surplus for those who would *not* have bought at the original price of \$30 but who buy at the new price of \$20—namely, Darren. Darren's willingness to pay is \$25, so he now receives a consumer surplus of \$5. The total increase in consumer surplus is $3 \times \$10 + \$5 = \$35$, represented by the sum of the shaded areas. Likewise, a rise in market price from \$20 to \$30 would decrease consumer surplus by an amount equal to the sum of the shaded areas.

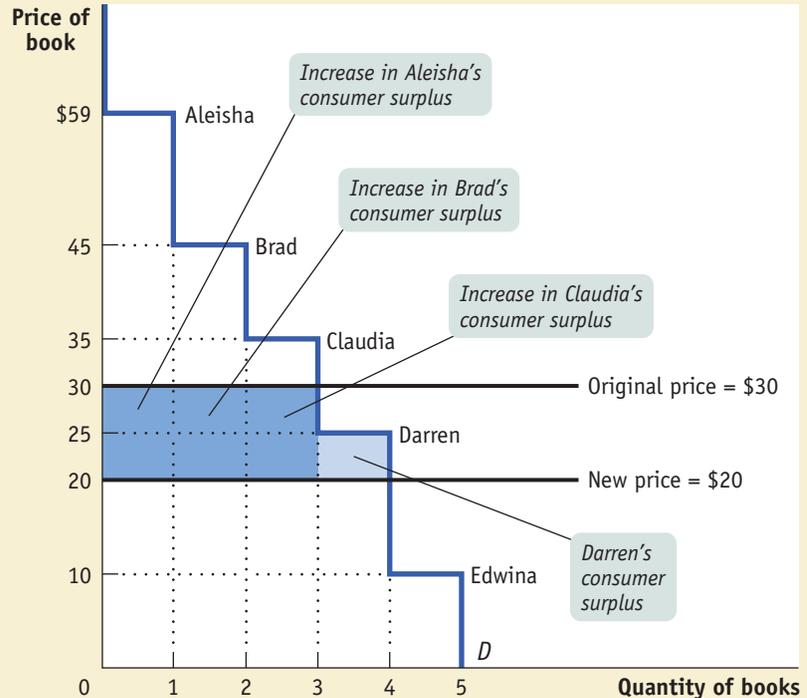


Figure 6-4 illustrates that when the price of a good falls, the area under the demand curve but above the price—which we have seen is equal to the total consumer surplus—increases. Figure 6-5 shows the same result for the case of a smooth demand curve, the demand for personal computers. Here we assume that the price of computers falls from \$5,000 to \$1,500, leading to an increase in the quantity demanded from 200,000 to 1 million units. As in the used-textbook example, we divide the gain in consumer surplus into two parts. The dark blue rectangle in Figure 6-5 corresponds to the dark blue area in Figure 6-4: it is the gain to the 200,000 people who would have bought computers even at the higher price of \$5,000. As a result of the price fall, each receives additional surplus of \$3,500. The light blue triangle in Figure 6-5 corresponds to the light blue area in Figure 6-4: it is the gain to people who would not have bought the good at the higher price but are willing to do so at a price of \$1,500. For example, the light blue triangle includes the gain to someone who would have been willing to pay \$2,000 for a computer and therefore gains \$500 in consumer surplus when he or she is able to buy a computer for only \$1,500. As before, the total gain in consumer surplus is the sum of the shaded areas, the increase in the area under the demand curve but above the market price.



What would happen if the price of a good were to rise instead of fall? We would do the same analysis in reverse. Suppose, for example, that for some reason the price of computers rises from \$1,500 to \$5,000. This would lead to a fall in consumer surplus, equal to the shaded area in Figure 6-5. This loss consists of two parts. The dark blue rectangle represents the losses to consumers who would still buy a computer, even at a price of \$5,000. The light blue triangle represents the loss to consumers who decide not to buy a computer at the higher price.

Figure 6-5

A Fall in the Market Price Increases Consumer Surplus

A fall in the market price of a computer from \$5,000 to \$1,500 leads to an increase in the quantity demanded and an increase in consumer surplus. The change in the total consumer surplus is given by the sum of the shaded areas: the total area below the demand curve but between the old and new prices. Here, the dark blue area represents the increase in consumer surplus for the 200,000 consumers who would have bought a computer at the original price of \$5,000; they each receive an increase in consumer surplus of \$3,500. The light blue area represents the increase in consumer surplus for those willing to buy at a price equal to or greater than \$1,500 but less than \$5,000. Similarly, a rise in the market price of a computer from \$1,500 to \$5,000 generates a decrease in consumer surplus equal to the sum of the two shaded areas.

