9 CHAPTER

Applying the Competitive Model

Disbelief in magic can force a poor soul into believing in government and business.
—Tom Robbins

In 2002, the World Trade Organization, which referees global trade disputes, ruled that the European Union could impose $4 billion in retaliatory tariffs on U.S. exports in compensation for illegal U.S. tax breaks that promote exports. The European Commission compiled a list of hundreds of U.S. products, particularly farm products and steel, on which it might impose tariffs unless the United States changed its tax laws. How does such a trade war affect consumers and producers? In this chapter, we show how the competitive model can answer this type of question. One of the major strengths of the competitive market model is that it can predict how trade wars, changes in government policies, global warming, and major cost-saving discoveries affect consumers and producers.

This chapter introduces the measure that economists commonly use to determine whether consumers or firms gain or lose when the equilibrium of a competitive market changes. Using such a measure, we can predict whether a policy change benefits the winners more than it harms the losers. To decide whether to adopt a particular policy, policymakers can combine these predictions with their normative views (values), such as whether they are more interested in helping the group that gains or the group that loses.

To most people, the term *welfare* refers to the government's payments to poor people. No such meaning is implied when economists employ the term. Economists use *welfare* to refer to the well-being of various groups such as consumers and producers. They call an analysis of the impact of a change on various groups' well-being a study of *welfare economics*.

In this chapter, we examine six main topics

1. **Consumer welfare:** How much consumers are helped or harmed by a change in the equilibrium price can be measured by using information from demand curves or utility functions.
2. **Producer welfare:** How much producers gain or lose from a change in the equilibrium price can be measured by using information from the marginal cost curve or by measuring the change in profits.
3. **Maximizing welfare:** Competition maximizes a measure of social welfare based on consumer and produce welfare.
4. **Policies that shift supply curves:** Government policies that limit the number of firms in competitive markets harm consumers and lower welfare.
5. **Policies that create a wedge between supply and demand:** Government policies such as taxes, price ceilings, price floors, and tariffs that create a wedge between the supply and

demand curves reduce the equilibrium quantity, raise the equilibrium price to consumers, and lower welfare.

6. **Comparing both types of policies: imports:** Policies that limit supply (such as quotas or bans on imports) or create a wedge between supply and demand (such as *tariffs*, which are taxes on imports) have different welfare effects when both polices reduce imports by equal amounts.

9.1 CONSUMER WELFARE

Economists and policymakers want to know how much consumers benefit from or are harmed by shocks that affect the equilibrium price and quantity. To what extent are consumers harmed if a local government imposes a sales tax to raise additional revenues? To answer such a question, we need some way to measure consumers' welfare. Economists use measures of welfare based on consumer theory (Chapters 4 and 5).

If we knew a consumer's utility function, we could directly answer the question of how an event affects a consumer's welfare. If the price of beef increases, the budget line facing someone who eats beef rotates inward, so the consumer is on a lower indifference curve at the new equilibrium. If we knew the levels of utility associated with the original indifference curve and the new one, we could measure the impact of the tax in terms of the change in the utility level.

This approach is not practical for a couple of reasons. First, we rarely, if ever, know individuals' utility functions. Second, even if we had utility measures for various consumers, we would have no obvious way to compare them. One person might say that he got 1,000 utils (units of utility) from the same bundle that another consumer says gives her 872 utils of pleasure. The first person is not necessarily happier—he may just be using a different scale.

As a result, *we measure consumer welfare in terms of dollars*. Instead of asking the rather silly question "How many utils would you lose if your daily commute increased by 15 minutes?" we could ask "How much would you pay to avoid having your daily commute grow a quarter of an hour longer?" or "How much would it cost you in forgone earnings if your daily commute were 15 minutes longer?" It is easier to compare dollars across people than utils.

We first present the most widely used method of measuring consumer welfare. Then we show how it can be used to measure the effect of a change in price on consumer welfare.

Measuring Consumer Welfare Using a Demand Curve

Consumer welfare from a good is the benefit a consumer gets from consuming that good minus what the consumer paid to buy the good. How much pleasure do you get from a good above and beyond its price? If you buy a good for exactly what it's worth to you, you are indifferent between making that transaction and not. Frequently, however, you buy things that are worth more to you than what they cost. Imagine that you've played tennis in the hot sun and are very thirsty. You can buy a soft drink from a vending machine for 75¢, but you'd be willing to pay much more because you are so thirsty. As a result, you're much better off making this purchase than not.

If we can measure how much more you'd be willing to pay than you did pay, we'd know how much you gained from this transaction. Luckily for us, the demand curve contains the information we need to make this measurement.

Marginal Willingness to Pay. To develop a welfare measure based on the demand curve, we need to know what information is contained in a demand curve. The demand curve reflects a consumer's *marginal willingness to pay*: the maximum amount a consumer will spend for an extra unit. The consumer's marginal willingness to pay is the *marginal value* the consumer places on the last unit of output.

David's demand curve for magazines per week, panel a of Figure 9.1, indicates his marginal willingness to buy various numbers of magazines. David places a marginal value of \$5 on the first magazine. As a result, if the price of a magazine is \$5, David buys one magazine, point *a* on the demand curve. His marginal willingness to buy a second magazine is \$4, so if the price falls to \$4, he buys two magazines, *b*. His marginal willingness to buy three magazines is \$3, so if the price of magazines is \$3, he buys three magazines, *c*.

Consumer Surplus. The monetary difference between what a consumer is willing to pay for the quantity of the good purchased and what the good actually costs is called **consumer surplus** (*CS*). Consumer surplus is a dollar-value measure of the extra pleasure the consumer receives from the transaction beyond its price.

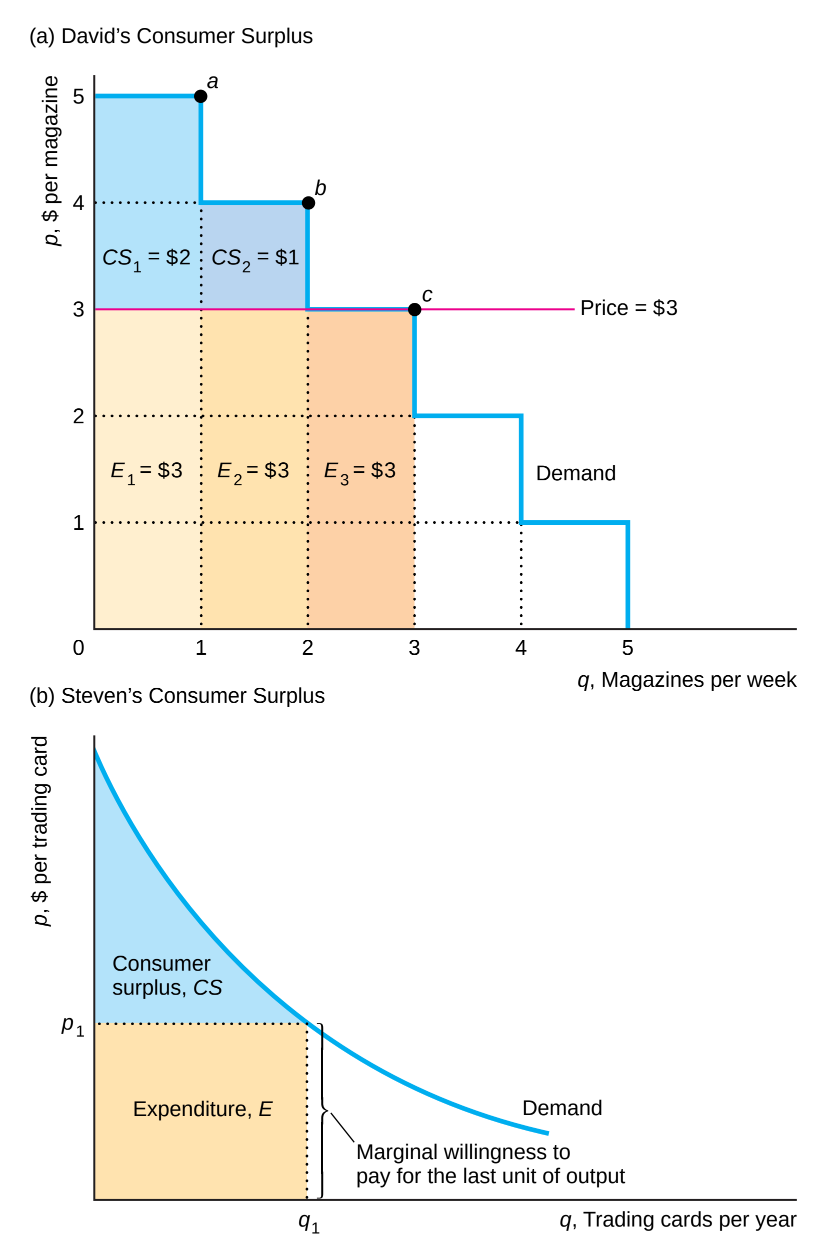
David's consumer surplus from each additional magazine is his marginal willingness to pay minus what he pays to obtain the magazine. His marginal willingness to pay for the first magazine, \$5, is area $CS_1 + E_1$. If the price is \$3, his expenditure to obtain the magazine is area $E_1 = \$3$. Thus his consumer surplus on the first magazine is area $CS_1 = (CS_1 + E_1) - E_1 = \$5 - \$3 = \$2$. Because his marginal willingness to pay for the second magazine is \$4, his consumer surplus for the second magazine is the smaller area $CS_2 = \$1$. His marginal willingness to pay for the third magazine is \$3, which equals what he must pay to obtain it, so his consumer surplus is zero, $CS_3 = \$0$. He is indifferent between buying and not buying the third magazine.

At a price of \$3, David buys three magazines. His total consumer surplus from the three magazines he buys is the sum of the consumer surplus he gets from each of these magazines: $CS_1 + CS_2 + CS_3 = \$2 + \$1 + \$0 = \$3$. This total consumer surplus of \$3 is the extra amount that David is willing to spend for the right to buy three magazines at \$3 each. Thus *an individual's consumer surplus is the area under the demand curve and above the market price up to the quantity the consumer buys*.

David is unwilling to buy a fourth magazine unless the price drops to \$2 or less. If David's mother gives him a fourth magazine as a gift, the marginal value that David puts on that fourth magazine, \$2, is less than what it cost his mother, \$3.

We can determine consumer surplus for smooth demand curves in the same way as with David's unusual stairlike demand curve. Steven has a smooth demand curve for baseball trading cards, panel b of Figure 9.1. The height of this demand curve measures his willingness to pay for one more card. This willingness varies with the number of cards he buys in a year. The total value he places on obtaining q_1 cards per year is the area under the demand curve up to q_1, the areas *CS* and *E*. Area *E* is his actual expenditure on q_1 cards. Because the price is p_1, his expenditure is p_1q_1. Steven's consumer surplus from consuming q_1 trading cards

Figure 9.1 Consumer Surplus. (a) David's demand curve for magazines has a step-like shape. When the price is \$3, he buys three magazines, point *c*. David's marginal value for the first magazine is \$5, areas $CS_1 + E_1$, and his expenditure is \$3, area E_1, so his consumer surplus is CS_1 = \$2. His consumer surplus is \$1 for the second magazine, area CS_2, and is \$0 for the third (he is indifferent between buying and not buying it). Thus his total consumer surplus is the shaded area $CS_1 + CS_2 + CS_3$ = \$3. (b) Steven's willingness to pay for trading cards is the height of his smooth demand curve. At price p_1, Steven's expenditure is E (= p_1q_1), his consumer surplus is CS, and the total value he places on consuming q_1 trading cards per year is $CS + E$.



is the value of consuming those cards, areas CS and E, minus his actual expenditures E to obtain them, or CS. Thus his consumer surplus, CS, is the area under the demand curve and above the horizontal line at the price p_1 up to the quantity he buys, q_1.

Just as we measure the consumer surplus for an individual using that individual's demand curve, we measure the consumer surplus of all consumers in a market using the market demand curve. *Market consumer surplus is the area under the market demand curve above the market price up to the quantity consumers buy.*

To summarize, consumer surplus is a practical and convenient measure of consumer welfare. There are two advantages to using consumer surplus rather than utility to discuss the welfare of consumers. First, the dollar-denominated consumer surplus of several individuals can be easily compared or combined, whereas the utility of various individuals cannot be easily compared or combined. Second, it is relatively easy to measure consumer surplus, whereas it is difficult to get a meaningful measure of utility directly. To calculate consumer surplus, all we have to do is measure the area under a demand curve.

Application

CONSUMER SURPLUS FROM TELEVISION

Do you get consumer surplus from television? Fewer than one in four (23%) Americans say that they would be willing to "give up watching absolutely all types of television" for the rest of their lives in exchange for $25,000. Almost half (46%) say that they'd refuse to give up TV for anything under $1 million. One in four Americans wouldn't give it up for $1 million. Indeed, one-quarter of those who earn under $20,000 a year wouldn't give up TV for $1 million—more than they will earn in 50 years.

Thus if you ask how much consumer surplus people receive from television, you will get many implausibly high answers. For this reason, economists typically calculate consumer surplus by using estimated demand curves, which are based on actual observed behavior, or by conducting surveys that ask consumers to choose between relatively similar bundles of goods. A more focused survey of families in Great Britain and Northern Ireland in 2000 found that they were willing to pay £10.40 per month to keep their current, limited television service (BBC1, BB2, ITV, Channel 4, and Channel 5) and received £2 ($3) per month of consumer surplus.

Effect of a Price Change on Consumer Surplus

If the supply curve shifts upward or a government imposes a new sales tax, the equilibrium price rises, reducing consumer surplus. We illustrate the effect of a price increase on market consumer surplus using estimated supply and demand curves for sweetheart and hybrid tea roses sold in the United States.[1] We then discuss which markets are likely to have the greatest loss of consumer surplus due to a price increase.

[1]I estimated this model using data from the *Statisticsal Abstract of United States*, *Floriculture Crops*, *Floriculture and Environmental Horticulture Products*, and **usda.mannlib.cornell.edu/data-sets/crops/95917/sb917.txt**. The (wholesale) prices are in real 1991 dollars.

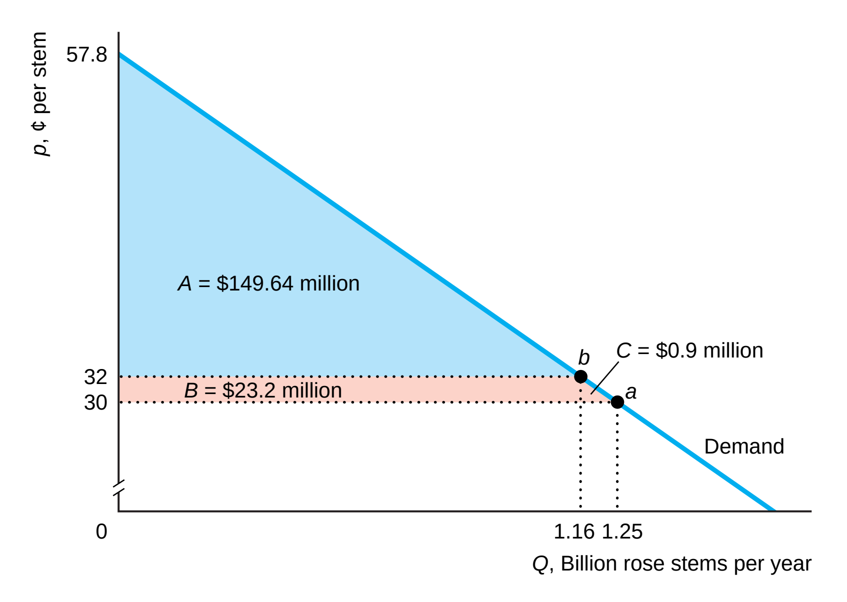


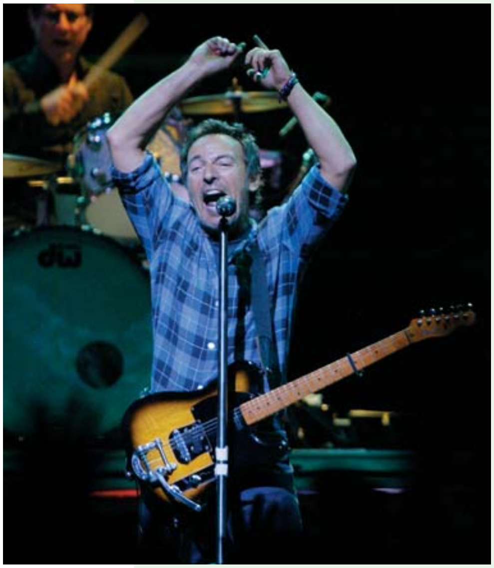
Figure 9.2 Fall in Consumer Surplus from Roses as Price Rises. As the price of roses rises 2¢ per stem from 30¢ per stem, the quantity demanded decreases from 1.25 to 1.16 billion stems per year. The loss in consumer surplus from the higher price, areas *B* and *C*, is $24.1 million per year.

Consumer Surplus Loss from a Higher Price. Suppose that the introduction of a new tax causes the (wholesale) price of roses to rise from the original equilibrium price of 30¢ to 32¢ per rose stem, a shift along the wholesale demand curve in Figure 9.2. The consumer surplus is area $A + B + C$ = \$173.74 million per year at a price of 30¢, and it is only area A = \$149.64 million at a price of 32¢.[2] Thus the loss in consumer surplus from the increase in the price is $B + C$ = \$24.1 million per year.

BRUCE SPRINGSTEEN'S GIFT TO HIS FANS

In 2002, the average rock concert ticket price was nearly $51. Nonetheless, the $75 that Bruce Springsteen and the E Street Band charged for their concerts that year was well below the market-clearing price. When the tickets

[2]The height of triangle *A* is 25.8¢ = 57.8¢ − 32¢ per stem and the base is 1.16 billion stems per year, so its area is $\frac{1}{2} \times \$0.258 \times 1.16$ billion = \$149.64 million per year. Rectangle *B* is $\$0.02 \times 1.16$ billion = \$23.2 million. Triangle *C* is $\frac{1}{2} \times \$0.02 \times 0.09$ billion = \$0.9 million.



went on sale at the Bradley Center in Milwaukee, 9,000 tickets sold in the first 10 minutes and virtually all were gone after 20 minutes.

Some tickets were available from scalpers, ticket brokers, and on the Internet at higher prices. One Web site offered tickets for the concert at the American Airlines Center in Dallas for $540 to $1,015. According to a survey, the average price of a resold ticket for the concert at the First Union Center in Philadelphia was $280. Mr. Springsteen said that he set the price relatively low to give value to his fans (in addition, he may have helped to promote his new album). Assuming that he could have sold all the tickets at $280, he gave almost $3 million of consumer surplus to his Philadelphia fans—double the ticket revenue for that concert.

Markets in Which Consumer Surplus Losses Are Large. In general, as the price increases, consumer surplus falls more (1) the greater the initial revenues spent on the good and (2) the less elastic the demand curve (Appendix 9A). More is spent on a good when its demand curve is farther to the right so that areas like A, B, and C in Figure 9.2 are larger. The larger $B + C$ is, the greater is the drop in consumer surplus from a given percentage increase in price. Similarly, the less elastic a demand curve is (the closer it is to vertical), the less willing consumers are to give up the good, so consumers do not cut their consumption much as the price increases, with the result of greater consumer surplus losses.

Higher prices cause greater consumer surplus loss in some markets than in others. Consumers would benefit if policymakers, before imposing a tax, considered in which market the tax is likely to harm consumers the most.

We can use estimates of demand curves to predict for which good a price increase causes the greatest loss of consumer surplus. Table 9.1 shows the consumer surplus loss in billions of 2002 dollars from a 10% increase in the price of various goods. The table shows that when the loss in consumer surplus is larger, the larger the initial revenue (price times quantity) that is spent on a good. A 10% increase in price causes a much greater loss of consumer surplus if it is imposed on food, $64 billion, than if it is imposed on alcohol and tobacco, $13 billion, because much more is spent on food.

At first glance, the relationship between elasticities of demand and the loss in consumer surplus in Table 9.1 looks backward: A given percent change in prices has a larger effect on consumer surplus for the relatively elastic demand curves.

Table 9.1 Effect of a 10% Increase in Price on Consumer Surplus (Revenue and Consumer Surplus in Billions of 2002 Dollars)

	Revenue	Elasticity of Demand, ε	Change in Consumer Surplus, ΔCS
Food	648	–0.245	–64
Housing	542	–0.633	–53
Medical	355	–0.604	–34
Transportation	305	–0.461	–30
Clothing	295	–0.405	–29
Utilities	156	–0.448	–15
Alcohol and tobacco	135	–0.162	–13

Source: Revenues and elasticities based on Blanciforti (1982). Appendix 9A shows how the change figures were calculated.

However, this relationship is coincidental: The large revenue goods happen to have relatively elastic demand curves. The effect of a price change depends on both revenue and the demand elasticity. In this table, the relative size of the revenues is more important than the relative elasticities.

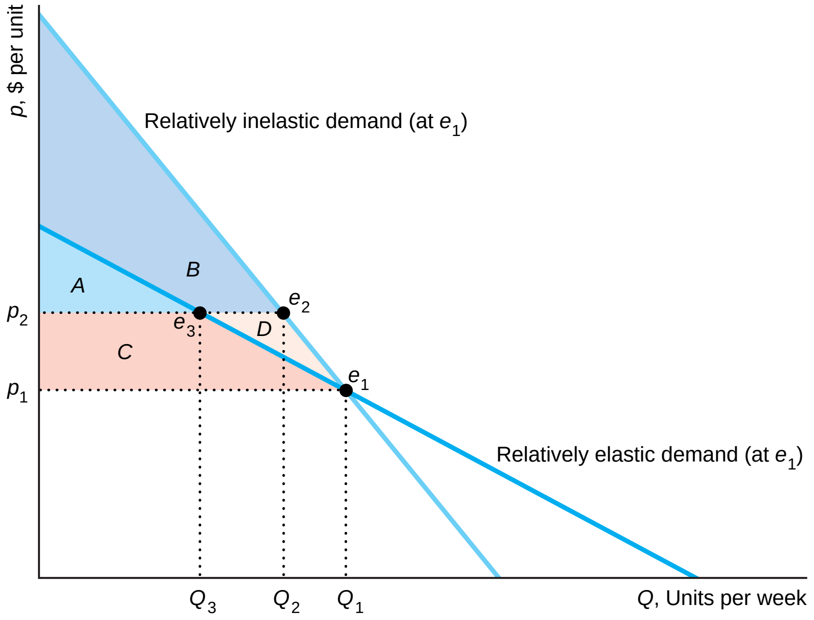
If we could hold revenue constant and vary the elasticity, we would find that consumer surplus loss from a price increase is larger as the demand curve becomes less elastic. If the demand curve for alcohol and tobacco were 10 times more elastic, –1.62, while the revenue stayed the same—the demand curve became flatter at the initial price and quantity—the consumer surplus loss from a 10% price increase would be $1 million less.

9.1 **Suppose that two linear demand curves go through the initial equilibrium, e_1. One demand curve is less elastic than the other at e_1. For which demand curve will a price increase cause the larger consumer surplus loss?**

Answer

1. *Draw the two demand curves, and indicate which one is less elastic at the initial equilibrium*: Two demand curves cross at e_1 in the diagram. The steeper demand curve is less elastic at e_1.[3]

[3]As we discussed in Chapter 3, the price elasticity of demand, $\varepsilon = (\Delta Q/\Delta p)(p/Q)$, is 1 over the slope of the demand curve, $\Delta p/\Delta Q$, times the ratio of the price to the quantity. At the point of intersection, where both demand curves have the same price, p_1, and quantity, Q_1, the steeper the demand curve, the lower the elasticity of demand.



	Relatively Elastic Demand Curve	Relatively Inelastic Demand Curve
Consumer Surplus at p_1	$A + C$	$A + B + C + D$
Consumer Surplus at p_2	A	$A + B$
Consumer Surplus Loss	$-C$	$-C - D$

2. *Illustrate that a price increase causes a larger consumer surplus loss with the less elastic demand curve*: If the price rises from p_1 to p_2, the consumer surplus falls by only $-C$ with the relatively elastic demand curve and by $-C - D$ with the relatively inelastic demand curve.

9.2 PRODUCER WELFARE

A supplier's gain from participating in the market is measured by its **producer surplus** (*PS*), which is the difference between the amount for which a good sells and the minimum amount necessary for the seller to be willing to produce the good. The minimum amount a seller must receive to be willing to produce is the firm's avoidable production cost (the shutdown rule in Chapter 8).

Measuring Producer Surplus Using a Supply Curve

To determine a competitive firm's producer surplus, we use its supply curve: its marginal cost curve above its minimum average variable cost (Chapter 8). The firm's supply curve in panel a of Figure 9.3 looks like a staircase. The marginal cost of producing the first unit is $MC_1 = \$1$, which is the area under the marginal cost curve between 0 and 1. The marginal cost of producing the second unit is $MC_2 = \$2$, and so on. The variable cost, VC, of producing four units is the sum of the marginal costs for the first four units: $VC = MC_1 + MC_2 + MC_3 + MC_4 = \$1 + \$2 + \$3 + \$4 = \$10$.

If the market price, p, is \$4, the firm's revenue from the sale of the first unit exceeds its cost by $PS_1 = p - MC_1 = \$4 - \$1 = \$3$, which is its producer surplus on the first unit. The firm's producer surplus is \$2 on the second unit and \$1 on the third unit. On the fourth unit, the price equals marginal cost, so the firm just breaks even. As a result, the firm's total producer surplus, PS, from selling four units at \$4 each is the sum of its producer surplus on these four units: $PS = PS_1 + PS_2 + PS_3 + PS_4 = \$3 + \$2 + \$1 + \$0 = \$6$. Graphically, the total producer surplus is the area

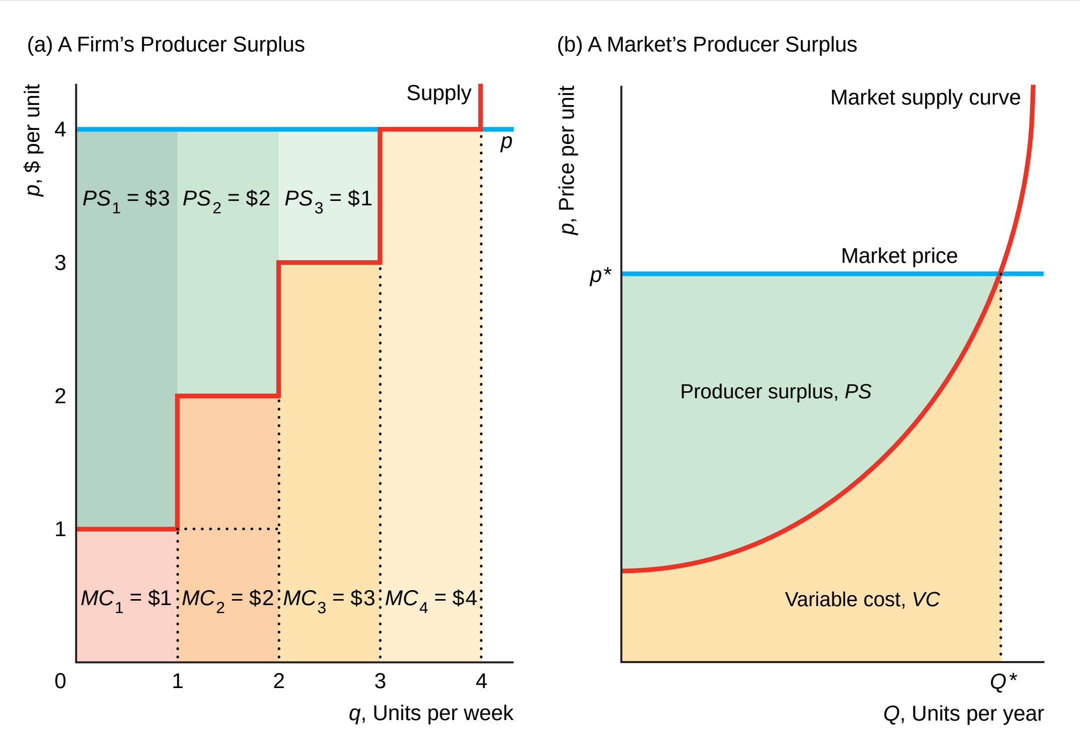


Figure 9.3 Producer Surplus. (a) The firm's producer surplus, \$6, is the area below the market price, \$4, and above the marginal cost (supply curve) up to the quantity sold, 4. The area under the marginal cost curve up to the number of units actually produced is the variable cost of production. (b) The market producer surplus is the area above the supply curve and below the line at the market price, p^*, up to the quantity produced, Q^*. The area below the supply curve and to the left of the quantity produced by the market, Q^*, is the variable cost of producing that level of output.

above the supply curve and below the market price up to the quantity actually produced. This same reasoning holds when the firm's supply curve is smooth.

The producer surplus is closely related to profit. Producer surplus is revenue, R, minus variable cost, VC:

$$PS = R - VC.$$

In panel a of Figure 9.3, revenue is $\$4 \times 4 = \$16$ and variable cost is \$10, so producer surplus is \$6.

Profit is revenue minus total cost, C, which equals variable cost plus fixed cost, F:

$$\pi = R - C = R - (VC + F).$$

Thus the difference between producer surplus and profit is fixed cost, F. If the fixed cost is zero (as often occurs in the long run), producer surplus equals profit.[4]

Another interpretation of producer surplus is as a gain to trade. In the short run, if the firm produces and sells its good—trades—it earns a profit of $R - VC - F$. If the firm shuts down—does not trade—it loses its fixed cost of $-F$. Thus producer surplus equals the profit from trade minus the profit (loss) from not trading of

$$(R - VC - F) - (-F) = R - VC = PS.$$

Using Producer Surplus

Even in the short run, we can use producer surplus to study the effects of any shock that does not affect the fixed cost of firms, such as a change in the price of a substitute or an input. Such shocks change profit by exactly the same amount as they change producer surplus because fixed costs do not change.

A major advantage of producer surplus is that we can use it to measure the effect of a shock on *all* the firms in a market without having to measure the profit of each firm in the market separately. We can calculate market producer surplus using the market supply curve in the same way as we calculate a firm's producer surplus using its supply curve. The market producer surplus in panel b of Figure 9.3 is the area above the supply curve and below the market price, p^*, line up to the quantity sold, Q^*. The market supply curve is the horizontal sum of the marginal cost curves of each of the firms (Chapter 8). As a result, the variable cost for all the firms in the market of producing Q is the area under the supply curve between 0 and the market output, Q.

9.2 **If the estimated supply curve for roses is linear, how much producer surplus is lost when the price of roses falls from 30¢ to 21¢ per stem (so that the quantity sold falls from 1.25 billion to 1.16 billion rose stems per year)?**

Answer

1. *Draw the supply curve, and show the change in producer surplus caused by the price change:* The figure shows the estimated supply curve for roses.

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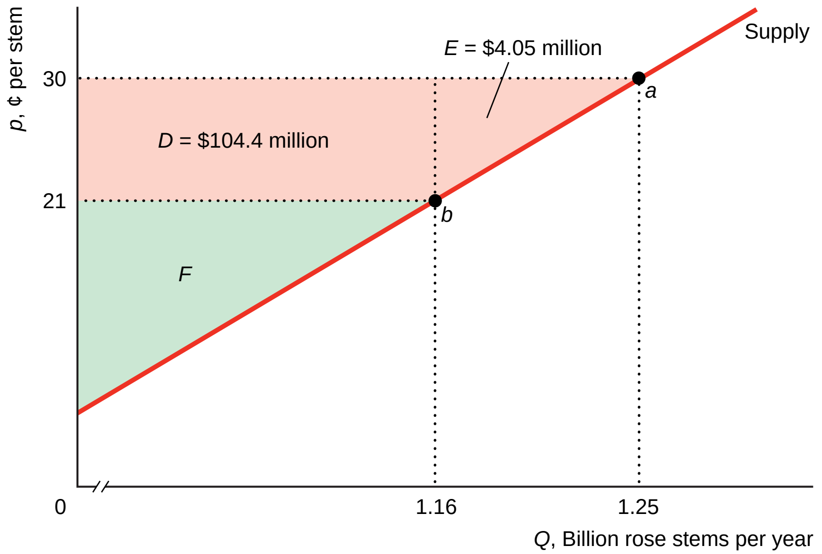
[4]Even though each competitive firm makes zero profit in the long run, owners of scarce resources used in that market may earn rents (Chapter 8). Thus owners of scarce resources may receive positive producer surplus in the long run.



	Original Price, 30¢	Lower Price, 21¢	Change ($ millions)
Producer Surplus	$D + E + F$	F	$-(D + E) = -108.45$

Point *a* indicates the quantity supplied at the original price, 30¢, and point *b* reflects the quantity supplied at the lower price, 21¢. The loss in producer surplus is the sum of rectangle D and triangle E.

2. *Calculate the lost producer surplus by adding the areas of rectangle D and triangle E:* The height of rectangle D is the difference between the original and the new price, 9¢, and its base is 1.16 billion stems per year, so the area of D (not all of which is shown in the figure because of the break in the quantity axis) is \$0.09 per stem × 1.16 billion stems per year = \$104.4 million per year. The height of triangle E is also 9¢, and its length is 0.9 billion stems per year, so its area is $\frac{1}{2}$ × \$0.09 per stem × 0.9 billion stems per year = \$4.05 million per year. Thus the loss in producer surplus from the drop in price is \$108.45 million per year.

9.3 COMPETITION MAXIMIZES WELFARE

How should we measure society's welfare? There are many reasonable answers to this question. One commonly used measure of the welfare of society, W, is the sum of consumer surplus plus producer surplus:

$$W = CS + PS.$$

This measure implicitly weights the well-being of consumers and producers equally. By using this measure, we are making a value judgment that the well-being of consumers and that of producers are equally important.

Not everyone agrees that society should try to maximize this measure of welfare. Groups of producers argue for legislation that helps them even if it hurts consumers by more than the producers gain—as though only producer surplus matters. Similarly, some consumer advocates argue that we should care only about consumers, so social welfare should include only consumer surplus.

We use the consumer surplus plus producer surplus measure of welfare in this chapter (and postpone a further discussion of other welfare concepts until the next chapter). One of the most striking results in economics is that competitive markets maximize this measure of welfare. If either less or more output than the competitive level is produced, welfare falls.

Why Producing Less than the Competitive Output Lowers Welfare

Producing less than the competitive output lowers welfare. At the competitive equilibrium in Figure 9.4, e_1, where output is Q_1 and price is p_1, consumer surplus equals areas $CS_1 = A + B + C$, producer surplus is $PS_1 = D + E$, and total welfare is $W_1 = A + B + C + D + E$. If output is reduced to Q_2 so that price rises to p_2 at e_2, consumer surplus is $CS_2 = A$, producer surplus is $PS_2 = B + D$, and welfare is $W_2 = A + B + D$.

The change in consumer surplus is

$$\Delta CS = CS_2 - CS_1 = A - (A + B + C) = -B - C.$$

Consumers lose B because they have to pay $p_2 - p_1$ more than at the competitive price for the Q_2 units they buy. Consumers lose C because they buy only Q_2 rather than Q_1 at the higher price.

The change in producer surplus is

$$\Delta PS = PS_2 - PS_1 = (B + D) - (D + E) = B - E.$$

Producers gain B because they now sell Q_2 units at p_2 rather than p_1. They lose E because they sell $Q_2 - Q_1$ fewer units.

The change in welfare, $\Delta W = W_2 - W_1$, is[5]

$$\Delta W = \Delta CS + \Delta PS = (-B - C) + (B - E) = -C - E.$$

The area B is a transfer from consumers to producers—the extra amount consumers pay for the Q_2 units goes to the sellers—so it does not affect welfare. Welfare drops because the consumer loss of C and the producer loss of E benefit no one. This drop in welfare, $\Delta W = -C - E$, is a **deadweight loss** (DWL): the net reduction in welfare from a loss of surplus by one group that is not offset by a gain to another group from an action that alters a market equilibrium.

The deadweight loss results because consumers value extra output by more than the marginal cost of producing it. At each output between Q_2 and Q_1, consumers' marginal willingness to pay for another unit—the height of the demand curve—is

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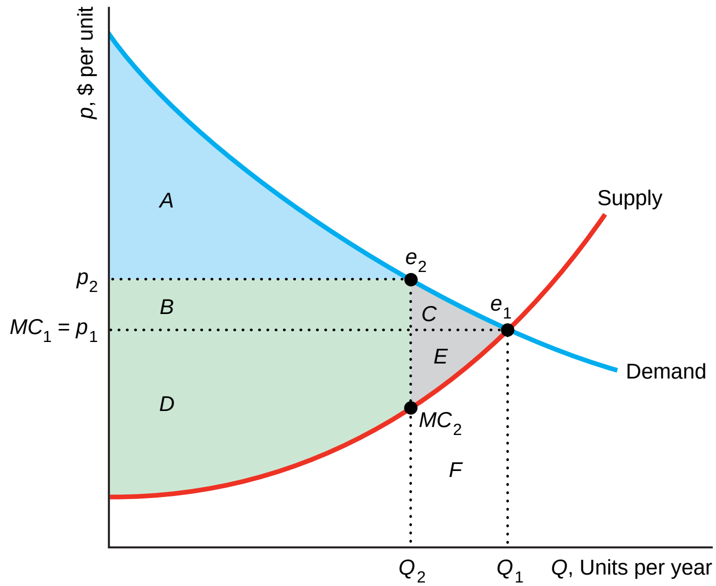
[5]The change in welfare is

$$\Delta W = W_2 - W_1 = (CS_2 + PS_2) - (CS_1 + PS_1) = (CS_2 - CS_1) + (PS_2 - PS_1) = \Delta CS + \Delta PS.$$



	Competitive Output, Q_1 (1)	Smaller Output, Q_2 (2)	Change (2) – (1)
Consumer Surplus, *CS*	$A + B + C$	A	$-B - C = \Delta CS$
Producer Surplus, *PS*	$D + E$	$B + D$	$B - E = \Delta PS$
Welfare, $W = CS + PS$	$A + B + C + D + E$	$A + B + D$	$-C - E = \Delta W = DWL$

Figure 9.4 **Why Reducing Output from the Competitive Level Lowers Welfare.** Reducing output from the competitive level, Q_1, to Q_2 causes price to increase from p_1 to p_2. Consumers suffer: Consumer surplus is now A, a fall of $\Delta CS = -B - C$. Producers may gain or lose: Producer surplus is now $B + D$, a change of $\Delta PS = B - E$. Overall, welfare falls by $\Delta W = -C - E$, which is a deadweight loss (DWL) to society.

greater than the marginal cost of producing the next unit—the height of the supply curve. For example, at e_2, consumers value the next unit of output at p_2, which is much greater than the marginal cost, MC_2, of producing it. Increasing output from Q_2 to Q_1 raises firms' variable cost by area F, the area under the marginal cost (supply) curve between Q_2 and Q_1. Consumers value this extra output by the area under the demand curve between Q_2 and Q_1, area $C + E + F$. Thus consumers value the extra output by $C + E$ more than it costs to produce it.

Society would be better off producing and consuming extra units of this good than spending this amount on other goods. In short, *the deadweight loss is the opportunity cost of giving up some of this good to buy more of another good.*

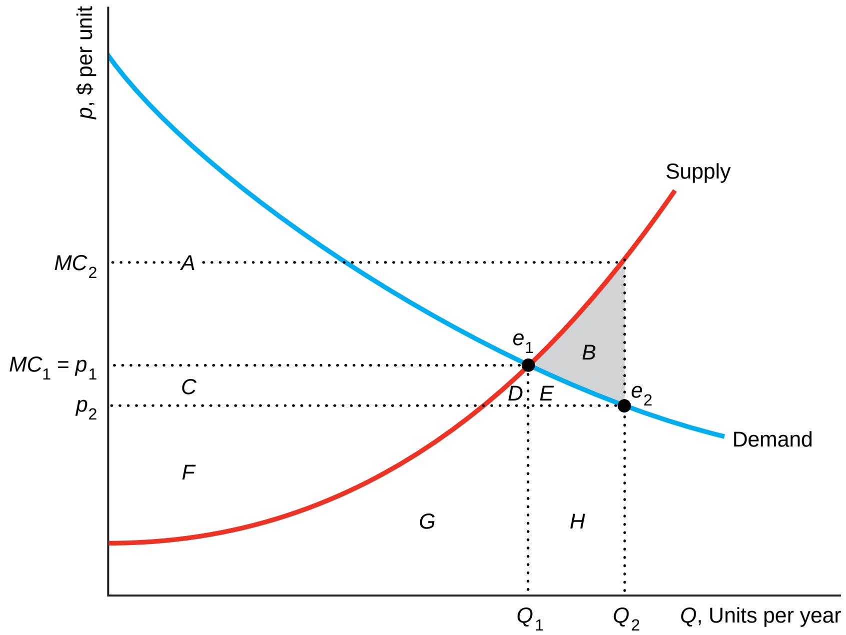
Why Producing More than the Competitive Output Lowers Welfare

Increasing output beyond the competitive level also decreases welfare because the cost of producing this extra output exceeds the value consumers place on it. Figure 9.5 shows the effect of increasing output from the competitive level Q_1 to Q_2 and letting the price fall to p_2, point e_2 on the demand curve, so consumers buy the extra output.

Because price falls from p_1 to p_2, consumer surplus rises by

$$\Delta CS = C + D + E,$$

which is the area between p_2 and p_1 to the left of the demand curve. At the original price, p_1, producer surplus was $C + F$. The cost of producing the larger output is the area under the supply curve up to Q_2, $B + D + E + G + H$. The firms sell this quan-



	Competitive Output, Q_1	Larger Output, Q_2	Change
Consumer Surplus, *CS*	A	$A + C + D + E$	$C + D + E = \Delta CS$
Producer Surplus, *PS*	$C + F$	$F - B - D - E$	$-B - C - D - E = \Delta PS$
Welfare, $W = CS + PS$	$A + C + F$	$A + C + F - B$	$-B = \Delta W = DWL$

Figure 9.5 **Why Increasing Output from the Competitive Level Lowers Welfare.** Increasing output from the competitive level, Q_1, to Q_2 lowers the price from p_1 to p_2. Consumer surplus rises by $C + D + E$, producer surplus falls by $B + C + D + E$, and welfare falls by B, which is a deadweight loss to society.

tity for only p_2Q_2, area $F + G + H$. Thus the new producer surplus is $F - B - D - E$. As a result, the increase in output causes producer surplus to fall by

$$\Delta PS = -B - C - D - E.$$

Because producers lose more than consumers gain, the deadweight loss is

$$\Delta W = \Delta CS + \Delta PS = (C + D + E) + (-B - C - D - E) = -B.$$

A net loss occurs because consumers value the $Q_2 - Q_1$ extra output by only $E + H$, which is less than the extra cost, $B + E + H$, of producing it. The new price, p_2, is less than the marginal cost, MC_2, of producing Q_2. Too much is being produced.

The reason that competition maximizes welfare is that price equals marginal cost at the competitive equilibrium. At the competitive equilibrium, demand equals supply, which ensures that price equals marginal cost. When price equals marginal cost, consumers value the last unit of output by exactly the amount that it costs to produce it. If consumers value the last unit by more than the marginal cost of production, welfare rises if more is produced. Similarly, if consumers value the last unit by less than its marginal cost, welfare is higher at a lower level of production.

A **market failure** is inefficient production or consumption, often because a price exceeds marginal cost. In the next application, we show that the surplus for the recipient of a gift is often less than the giver's cost.

DEADWEIGHT LOSS OF CHRISTMAS PRESENTS

Just how much did you enjoy the expensive woolen socks with the dancing purple teddy bears that your Aunt Fern gave you last Christmas? Often the cost of a gift exceeds the value that the recipient places on it.

Only 10% to 15% of holiday gifts are money. A gift of cash typically gives at least as much pleasure to the recipient as a gift that costs the same but can't be exchanged for cash. (So what if giving cash is tacky?) Of course, it's possible that a gift can give more pleasure to the recipient than it costs the giver—but how often does that happen to you?

An "efficient" gift is one that the recipient values as much as the gift costs the giver. The difference between the price of the gift and its value to the recipient is a deadweight loss to society. Joel Waldfogel (1993) asked Yale undergraduates just how large this deadweight loss is. He estimated that the deadweight loss is between 10% and 33% of the value of gifts. He found that gifts from friends and "significant others" are most efficient, while noncash gifts from members of the extended family are least efficient (one-third of the value is lost). Luckily, grandparents, aunts, and uncles are most likely to give cash.

Given holiday expenditures of about $40 billion per year in the United States, he concluded that a conservative estimate of the deadweight loss of Christmas, Hanukkah, and other holidays with gift-giving rituals is between a tenth and a third as large as estimates of the deadweight loss from inefficient income taxation.

The question remains why people don't give cash instead of presents. If the reason is that they get pleasure from picking the "perfect" gift, the deadweight loss that adjusts for the pleasure of the giver is lower than these calculations suggest. (Bah, humbug!)

9.4 POLICIES THAT SHIFT SUPPLY CURVES

I don't make jokes. I just watch the government and report the facts. —Will Rogers

One of the main reasons that economists developed welfare tools was to predict the impact of government policies and other events that alter a competitive equilibrium, which we consider next. We focus on government policies rather than other shocks caused by random events or other members of society because we, as part of the electorate, can influence these decisions.

Virtually all government actions affect a competitive equilibrium in one of two ways. Some government policies, such as limits on the number of firms in a market, shift the supply or demand curve. Other government actions, such as sales taxes, create a wedge between price and marginal cost so that they are not equal, as they were in the original competitive equilibrium.

These government actions move us from an unconstrained competitive equilibrium to a new, constrained competitive equilibrium. Because welfare was maximized at the initial competitive equilibrium, the following examples of government-induced changes lower welfare. In later chapters, we examine markets in which welfare was not maximized initially, so government intervention may raise welfare.

Although government policies may cause either the supply curve or the demand curve to shift, we concentrate on policies that limit supply because they are frequently used and have clear-cut effects. The two most common types of government policies that shift the supply curve are limits on the number of firms in a market and quotas or other limits on the amount of output that firms may produce. We study restrictions on entry and exit of firms in this section and examine quotas later in the chapter.

Government policies that cause a decrease in supply at each possible price (shift the supply curve to the left) lead to fewer purchases by consumers at higher prices, an outcome that lowers consumer surplus and welfare. Welfare falls when governments restrict the consumption of competitive products that we all agree are *goods*, such as food and medical services. In contrast, if most of society wants to discourage the use of certain products, such as hallucinogenic drugs and poisons, policies that restrict consumption may increase some measures of society's welfare.

Governments, other organizations, and social pressures limit the number of firms in at least three ways. The number of firms is restricted explicitly in some markets, such as the one for taxi service. In other markets, some members of society are barred from owning firms or performing certain jobs or services. In yet other markets, the number of firms is controlled indirectly by raising the cost of entry.

Restricting the Number of Firms

A limit on the number of firms causes a shift of the supply curve to the left, which raises the equilibrium price and reduces the equilibrium quantity. Consumers are harmed: They don't buy as much as they would at lower prices. Firms that are in the market when the limits are first imposed benefit from higher profits.

To illustrate these results, we examine the regulation of taxicabs. Virtually every country in the world regulates taxicabs (except Sweden, which deregulated in 1991). Many American cities limit the number of taxicabs. To operate a cab in these cities legally, you must possess a city-issued permit, which may be a piece of paper or a medallion (a coinlike metal object).

Two explanations are given for such regulation. First, using permits to limit the number of cabs raises the earnings of permit owners—usually taxi fleet owners—who lobby city officials for such restrictions. Second, some city officials contend that limiting cabs allows for better regulation of cabbies' behavior and protection of consumers. (However, it would seem possible that cities could directly regulate behavior and not restrict the number of cabs.)

Whatever the justification for such regulation, the limit on the number of cabs raises the market prices. If the city doesn't limit entry, a virtually unlimited number of potential taxi drivers with identical costs can enter freely.

Panel a of Figure 9.6 shows a typical taxi owner's marginal cost curve, MC, and average cost curve, AC^1. The MC curve slopes upward because a typical cabbie's opportunity cost of working more hours increases as the cabbie works longer hours (drives more customers). An outward shift of the demand curve is met by new firms entering, so the long-run supply curve of taxi rides, S^1 in panel b, is horizontal at the minimum of AC^1 (Chapter 8). For the market demand curve in the figure, the equilibrium is E_1, where the equilibrium price, p_1, equals the minimum of AC^1 of a typical cab. The total number of rides is $Q_1 = n_1q_1$, where n_1 is the equilibrium number of cabs and q_1 is the number of rides per month provided by a typical cab.

Consumer surplus, $A + B + C$, is the area under the market demand curve above p_1 up to Q_1. There is no producer surplus because the supply curve is horizontal at the market price, which equals marginal and average cost. Thus welfare is the same as consumer surplus.

Legislation limits the number of permits to operate cabs to $n_2 < n_1$. The market supply curve, S^2, is the horizontal sum of the marginal cost curves above minimum average cost of the n_2 firms in the market. For the market to produce more than n_2q_1 rides, the price must rise to induce the n_2 firms to supply more.

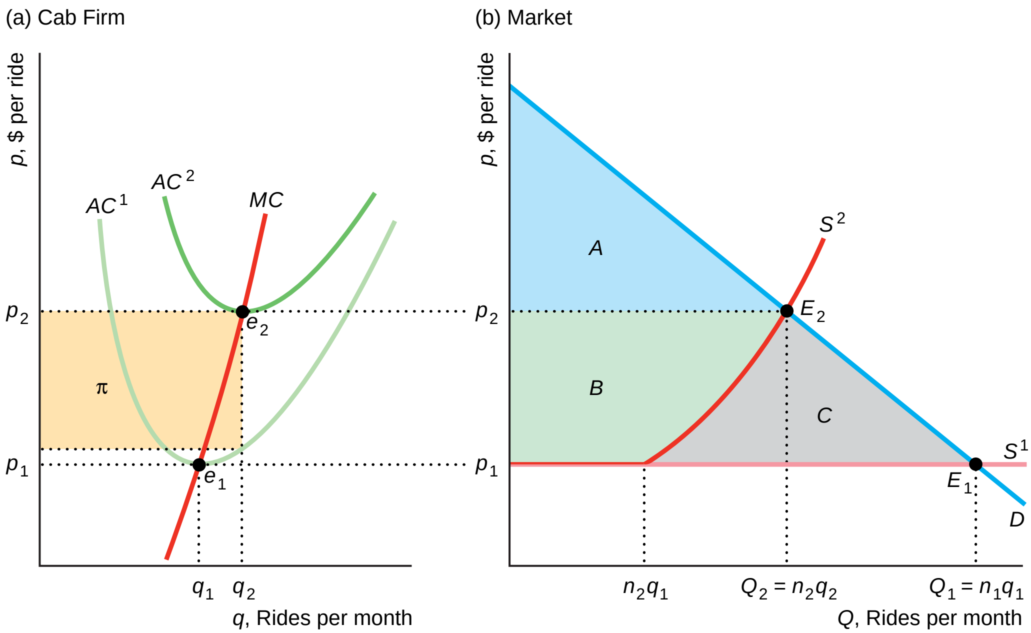
With the same demand curve as before, the equilibrium market price rises to p_2. At this higher price, each licensed cab firm produces more than before by operating longer hours, $q_2 > q_1$, but the total number of rides, $Q_2 = n_2q_2$, falls because there are fewer cabs, n_2. Consumer surplus is A, producer surplus is B, and welfare is $A + B$.

Thus because of the higher fares (prices) under a permit system, consumer surplus falls by

$$\Delta CS = -B - C.$$

The producer surplus of the lucky permit owners rises by

$$\Delta PS = B.$$



	No Restrictions	Restrictions	Change
Consumer Surplus, *CS*	$A + B + C$	A	$-B - C = \Delta CS$
Producer Surplus, *PS*	0	B	$B = \Delta PS$
Welfare, $W = CS + PS$	$A + B + C$	$A + B$	$-C = \Delta W = DWL$

Figure 9.6 Effect of a Restriction on the Number of Cabs. A restriction on the number of cabs causes the supply curve to shift from S^1 to S^2 in the short run and the equilibrium to change from E_1 to E_2. The resulting lost surplus, C, is a deadweight loss to society. In the long run, the unusual profit, π, created by the restriction becomes a rent to the owner of the license. As the license owner increases the charge for using the license, the average cost curve rises to AC^2, so the cab driver earns a zero long-run profit. That is, the producer surplus goes to the permit holder, not to the cab driver.

As a result, total welfare falls:

$$\Delta W = \Delta CS + \Delta PS = (-B - C) + B = -C,$$

which is a deadweight loss.

By preventing other potential cab firms from entering the market, limiting cab permits creates economic profit, the area labeled π in panel a, for permit owners. In many cities, these permits can be sold or rented, so the owner of the scarce resource, the permit, can capture the unusual profit, or *rent* (Chapter 8). The rent for the permit or the implicit rent paid by the owner of a permit causes the cab driver's average cost to rise to AC^2. Because the rent allows the use of the cab for a certain period of time, it is a fixed cost that is unrelated to output. As a result, it does not affect the marginal cost.

Cab drivers earn zero economic profits because the market price, p_2, equals their average cost, the minimum of AC^2. The producer surplus, B, created by the limits on entry go to the original owners of the permits rather than to the current cab drivers. Thus the permit owners are the *only* ones that benefit from the restrictions, and their gains are less than the losses to others. If the government collected the rents each year in the form of an annual license, then these rents could be distributed to all citizens instead of to just a few lucky permit owners.

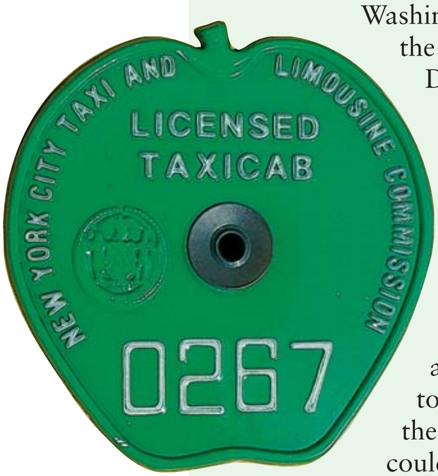
In many cities, the rents and welfare effects that result from these laws are large. The size of the loss to consumers and the benefit to permit holders depend on how severely a city limits the number of cabs.

Application

TAXICAB MEDALLIONS

Too bad the only people who know how to run the country are busy driving cabs and cutting hair. —George Burns

Limiting the number of cabs has large effects in cities around the world. Some cities regulate the number of cabs much more severely than others. Only a tenth as many cabs have permits to operate legally in San Francisco as in Washington, D.C., which has fewer people but does not restrict the number of cabs. The number of residents per cabs is 757 in Detroit, 748 in San Francisco, 538 in Dallas, 533 in Baltimore, 350 in Boston, 301 in New Orleans, and 203 in Honolulu.



These cities allow only permit holders to operate cabs. Some cities, such as San Francisco, do not allow the permits to be resold, but others, including New York City, allow resales.

In San Francisco, permit holders lease their permits for up to \$3,500 a month to taxi companies, which own only about a quarter of all permits. Thus each permit is worth up to \$42,000 a year. This rent is the extra producer surplus of the lucky permit holders that would be eliminated if anyone could supply taxi services.

In 1937, when New York City started regulating the number of cabs, all 11,787 cab owners could buy a permit, called a medallion, for \$10. Because New York City allows these medallions to be sold, medallion holders do not have to operate a cab to benefit from the restriction on the number of cabs. A holder can sell a medallion for an amount that captures the unusually high future profits from the limit on the number of cabs. Cab drivers who lease medallions certainly don't make these unusual returns: Some earn as little as \$50 a day.

Because the number of medallions has never been increased, New York City has only about a fifth as many cabs as Tokyo. As this limit has become more binding over time, the price of a medallion peaked at $277,000 in 1998 then fell to $209,000 in 2001. Taxi medallions trade for about $44,000 in Philadelphia, $60,000 in San Diego, and $17,000 in Portland Oregon.

By 2002, Medallion Financial Corp., a specialty lender that finances the purchase of taxicab medallions in 10 cities, had loaned individuals and firms more than $1 billion to buy medallions. It has never had a loss. Anyone who misses a payment can no longer operate a cab.

A 1984 study for the U.S. Department of Transportation estimated the annual extra cost to consumers from restrictions on the number of taxicabs throughout the United States at nearly $800 million. The total lost consumer surplus exceeds $800 million, because this amount does not include lost waiting time and other inconveniences associated with having fewer taxis.

Raising Entry and Exit Costs

Instead of directly restricting the number of firms that may enter a market, governments and other organizations may raise the cost of entering, thereby indirectly restricting that number. Similarly, raising the cost of exiting a market discourages some firms from entering.

Entry Barriers. If its cost will be greater than that of firms already in the market, a potential firm might not enter a market even if existing firms are making a profit. Any cost that falls only on potential entrants and not on current firms discourages entry. A long-run **barrier to entry** is an explicit restriction or a cost that applies only to potential new firms—existing firms are not subject to the restriction or do not bear the cost.

At the time they entered, incumbent firms had to pay many of the costs of entering a market that new entrants incur, such as the fixed costs of building plants, buying equipment, and advertising a new product. For example, the fixed cost to McDonald's and other fast-food chains of opening a new fast-food restaurant is about $2 million. These fixed costs are *costs of entry* but are *not* barriers to entry because they apply equally to incumbents and entrants. Costs incurred by both incumbents and entrants do not discourage potential firms from entering a market if existing firms are making money. Potential entrants know that they will do as well as existing firms once they are in business, so they are willing to enter as long as profit opportunities exist.

Large sunk costs can be barriers to entry under two conditions. First, if capital markets do not work well, so new firms have difficulty raising money, new firms may be unable to enter profitable markets. Second, if a firm must incur a large *sunk* cost, which makes the loss if it exits great, the firm may be reluctant to enter a market in which it is uncertain of success.

Exit Barriers. Some markets have barriers that make it difficult (though typically not impossible) for a firm to exit by going out of business. In the short run, exit barriers can keep the number of firms in a market relatively high. In the long run, exit barriers may limit the number of firms in a market.

Why do exit barriers limit the number of firms in a market? Suppose that you are considering starting a construction firm with no capital or other fixed factors. The firm's only input is labor. You know that there is relatively little demand for construction during business downturns and in the winter. To avoid paying workers when business is slack, you plan to shut down during those periods. If you can avoid losses by shutting down during those periods, you enter this market if your expected economic profits during good periods are zero or positive. See also **www.aw.com/perloff**, Chapter 9, "Job Termination Laws."

Now suppose that a new law requires that you give your workers six months' warning before laying them off. Because the new law prevents you from shutting down quickly, you know that you'll regularly suffer losses during business downturns because you'll have to pay your workers for up to six months during periods when you have nothing for them to do. Knowing that you'll incur these regular losses, you are less inclined to enter the market. Unless the economic profits during good periods are much higher than zero—high enough to offset your losses—you will not enter the market.

If exit barriers limit the number of firms, the same analysis that we used to examine entry barriers applies. Thus exit barriers may raise prices, lower consumer surplus, and reduce welfare.

9.5 POLICIES THAT CREATE A WEDGE BETWEEN SUPPLY AND DEMAND

The most common government policies that create a wedge between supply and demand curves are sales taxes (or subsidies) and price controls. Because these policies create a gap between marginal cost and price, either too little or too much is produced. For example, a tax causes price to exceed marginal cost—consumers value the good more than it costs to produce it—with the result that consumer surplus, producer surplus, and welfare fall.

Welfare Effects of a Sales Tax

A new sales tax causes the price consumers pay to rise (Chapter 3), resulting in a loss of consumer surplus, $\Delta CS < 0$, and a fall in the price firms receive, resulting in a drop in producer surplus, $\Delta PS < 0$. However, the new tax provides the government with new tax revenue, $\Delta T = T > 0$ (if tax revenue was zero before this new tax).

Assuming that the government does something useful with the tax revenue, we should include tax revenue in our definition of welfare:

$$W = CS + PS + T.$$

As a result, the change in welfare is

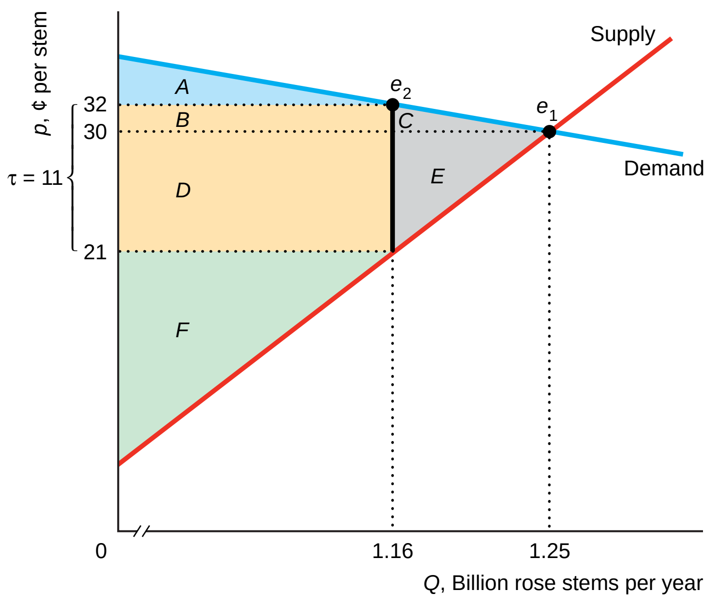
$$\Delta W = \Delta CS + \Delta PS + \Delta T.$$

Even when we include tax revenue in our welfare measure, a specific tax must lower welfare in a competitive market. We show the welfare loss from a specific tax of τ = 11¢ per rose stem in Figure 9.7.

Without the tax, the intersection of the demand curve, *D*, and the supply curve, *S*, determines the competitive equilibrium, e_1, at a price of 30¢ per stem and a quantity of 1.25 billion rose stems per year. Consumer surplus is *A* + *B* + *C*, producer surplus is *D* + *E* + *F*, tax revenue is zero, and there is no deadweight loss.

The specific tax creates an 11¢ wedge (Chapter 3) between the price consumers pay, 32¢, and the price producers receive, 32¢ − τ = 21¢. Equilibrium output falls from 1.25 to 1.16 billion stems per year.

The extra 2¢ per stem that buyers pay causes consumer surplus to fall by *B* + *C* = $24.1 million per year, as we showed earlier. Due to the 9¢ drop in the price firms receive, they lose producer surplus of *D* + *E* = $108.45 million per year (Solved



	No Tax	Specific Tax	Change ($ millions)
Consumer Surplus, *CS*	*A* + *B* + *C*	*A*	−*B* − *C* = −24.1 = Δ*CS*
Producer Surplus, *PS*	*D* + *E* + *F*	*F*	−*D* − *E* = −108.45 = Δ*PS*
Tax Revenue, *T* = τ*Q*	0	*B* + *D*	*B* + *D* = 127.6 = Δ*T*
Welfare, *W* = *CS* + *PS* + *T*	*A* + *B* + *C* + *D* + *E* + *F*	*A* + *B* + *D* + *F*	−*C* − *E* = −4.95 = *DWL*

Figure 9.7 Welfare Effects of a Specific Tax on Roses. The τ = 11¢ specific tax on roses creates an 11¢ per stem wedge between the price customers pay, 32¢, and the price producers receive, 21¢. Tax revenue is $T = \tau Q$ = $127.6 million per year. The deadweight loss to society is *C*+*E* = $4.95 million per year.

Problem 9.2). The government gains tax revenue of τQ = 11¢ per stem × 1.16 billion stems per year = \$127.6 million per year, area $B + D$.

The combined loss of consumer surplus and producer surplus is only partially offset by the government's gain in tax revenue, so that welfare drops:

$$\Delta W = \Delta CS + \Delta PS + \Delta T = -\$24.1 - \$108.45 + \$127.6 = -\$4.95 \text{ million per year.}$$

This deadweight loss is area $C + E$.

Why does society suffer a deadweight loss? The reason is that the tax lowers output from the competitive level where welfare is maximized. An equivalent explanation for this inefficiency or loss to society is that the tax puts a wedge between price and marginal cost. At the new equilibrium, buyers are willing to pay 32¢ for one more stem of roses, while the marginal cost to firms is only 21¢ (= the price minus τ). Shouldn't at least one more rose be produced if consumers are willing to pay nearly a third more than the cost of producing it? That's what our welfare study indicates.

Application

DEADWEIGHT LOSS FROM WIRELESS TAXES

Federal, state, and local government taxes and fees on cell phone and other wireless services create deadweight loss by raising costs to consumers and reducing the quantity demanded. These fees vary substantially across jurisdictions. The median state tax is 10%, and the median combined state and federal tax is 14.5%, which corresponds to a yearly payment of about \$91. California and Florida have even higher state taxes of 21%, so their combined taxes are 25.5%, or \$185 per year (and New York is nearly as high). Overall, governments raise about \$4.8 billion in wireless taxes.

The marginal cost of supplying a minute of wireless service is constant at about 5¢. Thus, a tax inflicts consumer surplus loss but not producer surplus loss (see Solved Problem 3.1). Hausman (2000) estimates the deadweight loss (efficiency cost) to the economy from taxes to be about \$2.6 billion.[6] For every \$1 raised in tax revenue, the average efficiency cost is 53¢ and the loss in high-tax states is about 70¢. Moreover, for every additional tax dollar raised, the marginal efficiency cost is 72¢ for the typical state and about 93¢ for the high-tax states.

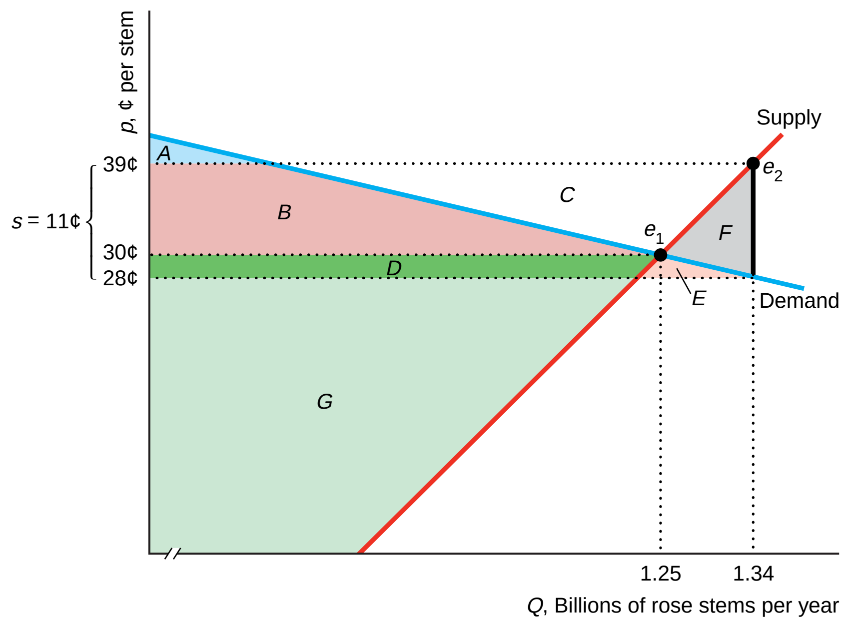
The wireless efficiency loss is large relative to that imposed by other taxes. For example, estimates of the marginal efficiency loss per dollar of income tax range from 26¢ to 41¢. One reason for the relatively large wireless efficiency losses is that the price elasticity of mobile telephones is about –0.7, which is more elastic than for other telecommunications services (see Solved Problem 9.1). In contrast, a tax on landlines creates almost no deadweight loss because the price elasticity for local landline phone service is virtually zero (–0.005).

[6] We can analyze the consumer surplus loss from taxes in both competitive and noncompetitive markets similarly. Hausman takes account of higher than competitive pretax prices in his analysis of the wireless market.

Welfare Effects of a Subsidy

Because a subsidy is a negative tax, the analysis of the welfare effect of a subsidy is similar to that for a tax. A per-unit subsidy to consumers causes the demand curve to shift to the right, or, equivalently, creates a wedge between the supply and demand curve to the right of the initial equilibrium. The subsidy causes sales to increase and both consumer surplus and producer surplus to rise. However, government expenditures more than offset these benefits, resulting in a deadweight loss.

If the government gives consumers a subsidy of s = 11¢ per rose stem, the equilibrium in the rose market shifts from e_1 to e_2 in Figure 9.8. The amount sellers receive per stem rises from 30¢ to 39¢, the amount consumers pay falls from 30¢



	No Subsidy	Subsidy	Change ($ millions)
Consumer Surplus, CS	$A + B$	$A + B + D + E$	$D + E = 116.55 = \Delta CS$
Producer Surplus, PS	$D + G$	$B + C + D + G$	$B + C = 25.9 = \Delta PS$
Government Expenses, X	0	$-B - C - D - E - F$	$-B - C - D - E - F = -147.4 = \Delta X$
Welfare, $W = CS + PS - X$	$A + B + D + G$	$A + B + D - F$	$-F = -4.95 = DWL$

Figure 9.8 Welfare Effects of a Per-Unit Subsidy on Roses. A specific subsidy of s = 11¢ per rose stem creates an 11¢ wedge between the price firms receive, 39¢, and the price consumers pay, 28¢. Consumers and producers benefit. However, taxpayers incur additional government expenses of $X = sQ$ = $147.4 million per year. The deadweight loss to society is area F, or $4.95 million per year.

to 28¢ (the 11¢ subsidy makes up the difference between what consumers pay and producers receive), and the number of rose stems sold per year jumps from 1.25 to 1.34 billion.

Consumers and producers of roses are delighted to be subsidized by other members of society. Consumer surplus rises by areas $D + E$, producer surplus increases by $B + C$. However, the change in government expenses, ΔX, are $B + C + D + E + F$, so society incurs a deadweight loss of $\Delta W = \Delta CS + \Delta PS - \Delta X = -F$. The reason for the deadweight loss is that too much is produced: The marginal cost to producers of the last unit, 39¢, exceeds the marginal benefit to consumers, 28¢.

Welfare Effects of a Price Floor

> *Farm policy, although it's complex, can be explained. What it can't be is believed. No cheating spouse, no teen with a wrecked family car, no mayor of Washington, D.C., videotaped in flagrante delicto has ever come up with anything as farfetched as U.S. farm policy.*
>
> —P. J. O'Rourke

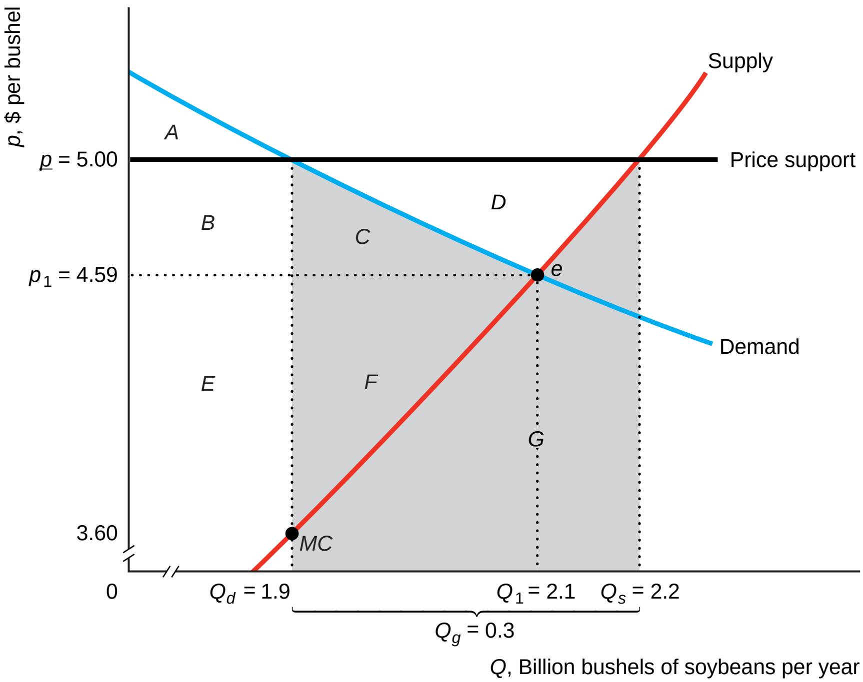
In some markets, the government sets a *price floor*, or minimum price, which is the lowest price a consumer can pay legally for the good. For example, in most countries, the government creates price floors under at least some agricultural prices to guarantee producers that they will receive at least a price of $\underline{p}$ for their good. If the market price is above $\underline{p}$, the support program is irrelevant. If the market price would be below $\underline{p}$, however, the government buys as much output as necessary to drive the price up to $\underline{p}$. Since 1929 (the start of the Great Depression), the U.S. government has used price floors or similar programs to keep prices of many agricultural products above the price that competition would determine in unregulated markets.[7]

We now show the effect of a price support using estimated supply and demand curves for the soybean market (Holt, 1992). The intersection of the market demand curve and the market supply curve in Figure 9.9 determines the competitive equilibrium, e, in the absence of a price support program, where the equilibrium price is p_1 = \$4.59 per bushel and the equilibrium quantity is Q_1 = 2.1 billion bushels per year.

With a price support on soybeans of $\underline{p}$ = \$5.00 per bushel and the government's pledge to buy as much output as farmers want to sell, quantity sold is Q_s = 2.2 billion bushels.[8] At $\underline{p}$, consumers buy less output, Q_d = 1.9 billion bushels, than the Q_1 they would have bought at the market-determined price p_1. As a result, consumer surplus falls by $B + C$ = \$864 million. The government buys $Q_g = Q_s - Q_d \approx 0.3$

[7]My favorite program is the wool and mohair subsidy. The U.S. government instituted wool price supports after the Korean War to ensure "strategic supplies" for uniforms. Congress later added the mohair subsidies, though mohair has no military use. In some years, the mohair subsidy exceeded the amount consumers paid for mohair, and the subsidies on wool and mohair reached a fifth of a billion dollars. No doubt the end of these subsidies in 1995 endangered national security. Thanks to Senator Phil Gramm and other patriots, the subsidy is back!

[8]In 1985, the period Holt studied, the price support was \$5.02. The 2002 farm bill will set the new support at \$5.80 for 2002–2007.



	No Price Support	Price Support	Change ($ millions)
Consumer Surplus, *CS*	$A + B + C$	A	$-B - C = -864 = \Delta CS$
Producer Surplus, *PS*	$E + F$	$B + C + D + E + F$	$B + C + D = 921 = \Delta PS$
Government Expense, $-X$	0	$-C - D - F - G$	$-C - D - F - G = -1{,}283 = \Delta X$
Welfare, $W = CS + PS - X$	$A + B + C + E + F$	$A + B + E - G$	$-C - F - G = -1{,}226 = \Delta W = DWL$

Figure 9.9 **Effect of Price Supports in Soybeans.** Without government price supports, the equilibrium is *e*, where p_1 = \$4.59 per bushel and Q_1 = 2.1 billion bushels of soybeans per year (based on estimates in Holt, 1992). With the price support at $\underline{p}$ = \$5.00 per bushel, output sold increases to Q_s and consumer purchases fall to Q_d, so the government must buy $Q_g = Q_s - Q_d$ at a cost of \$1.283 billion per year. The deadweight loss is $C + F + G$ = \$1.226 billion per year, not counting storage and administrative costs.

billion bushels per year, which is the excess supply, at a cost of $T = \underline{p} \times Q_g = C + D + F + G$ = \$1.283 billion.

The government cannot resell the output domestically because if it tried to do so, it would succeed only in driving down the price consumers pay. The government stores the output or sends it abroad.

Although farmers gain producer surplus of $B + C + D$ = \$921 million, this program is an inefficient way to transfer money to them. Assuming that the government's purchases have no alternative use, the change in welfare is $\Delta W = \Delta CS + \Delta PS - T = -C - F - G = -\$1.226$ billion per year.[9] This deadweight loss reflects two distortions in this market:

- **Excess production:** More output is produced than is consumed, so Q_g is stored, destroyed, or shipped abroad.
- **Inefficiency in consumption:** At the quantity they actually buy, Q_d, consumers are willing to pay \$5 for the last bushel of soybeans, which is more than the marginal cost, MC = \$3.60, of producing that bushel.

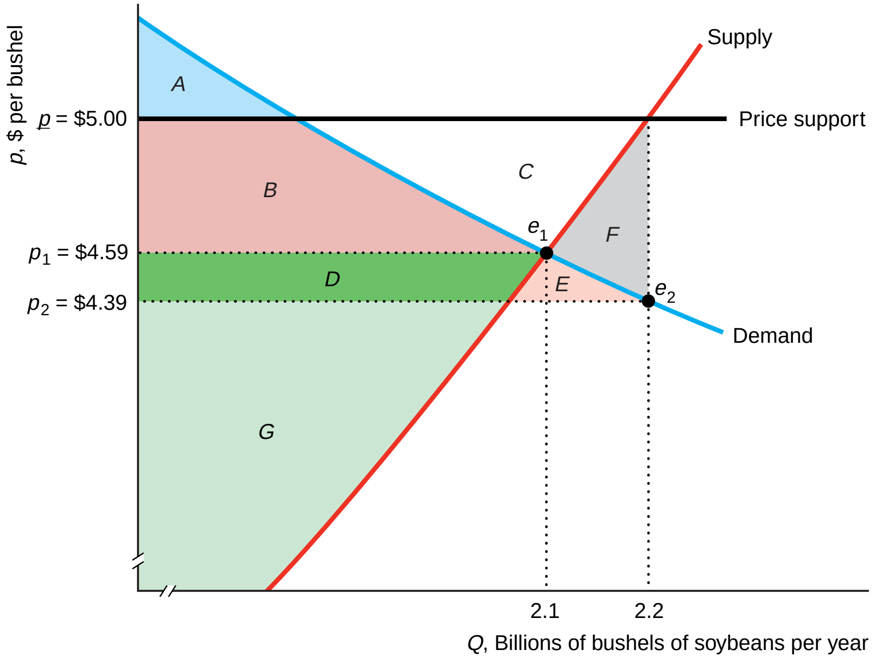
Alternative Price Support. Because of price supports, the government was buying and storing large quantities of food, much of which was allowed to spoil. As a consequence, the government started limiting the amount farmers could produce. Because there is uncertainty about how much a farmer will produce, the government set quotas or limits on the amount of land farmers could use, so as to restrict their output. See **www.aw.com/perloff**, Chapter 9, Solved Problem 2. Today, the government uses an alternative subsidy program. The government sets a support price, $\underline{p}$. Farmers decide how much to grow and sell all of their produce to consumers at the price, p, that clears the market. The government then gives the farmers a *deficiency* payment equal to the difference between the support and actual prices, $\underline{p} - p$, for every unit sold so that farmers receive the support price on their entire crop.

9.3 **What are the effects in the soybean market of a \$5-per-bushel price support using a deficiency payment on the equilibrium price and quantity, consumer surplus, producer surplus, and deadweight loss?**

Answer

1. *Describe how the program affects the equilibrium price and quantity:* Without a price support, the equilibrium is e_1 in the figure, where the price is p_1 = \$4.59 and the quantity is 2.1 billion bushels per year. With a support price of \$5 per bushel, the new equilibrium is e_2. Farmers produce at the quantity where the price support line hits their supply curve at 2.2 billion bushels. The equilibrium price is the height of the demand curve at 2.2 billion bushels, or approximately \$4.39 per bushel. Thus, the equilibrium price falls and the quantity increases.
2. *Show the welfare effects:* Because the price consumers pay drops from p_1 to p_2, consumer surplus rises by area $D+E$. Producers now receive $\underline{p}$ instead of p_1, so their producer surplus rises by $B+C$. Government payments are

[9] This measure of deadweight loss underestimates the true loss. The government also pays storage and administration costs. In 1999, the U.S. Department of Agriculture, which runs farm support programs, had 104,700 employees, or nearly one worker for every farm that received assistance (although many of these employees have other job responsibilities).



	No Price Support	1996/2002 Price Support	Change
Consumer Surplus, CS	$A + B$	$A + B + D + E$	$D + E = \Delta CS$
Producer Surplus, PS	$D + G$	$B + C + D + G$	$B + C = \Delta PS$
Government Expense, $-X$	0	$-B - C - D - E - F$	$-B - C - D - E - F = \Delta X$
Welfare, $W = CS + PS - X$	$A + B + D + G$	$A + B + D + G - F$	$-F = \Delta W = DWL$

the difference between the support price, $\underline{p}$ = \$5, and the price consumers pay, p_2 = \$4.39, times the number of units sold, 2.2 billion bushels per year, or the rectangle $B+C+D+E+F$. Because government expenditures exceed the gains to consumers and producers, welfare falls by the deadweight loss triangle F.[10]

Who Benefits. Presumably, the purpose of these programs is to help poor farmers, not to hurt consumers and taxpayers. However, the lion's share of American farm subsidies goes to large agricultural corporations, not to poor farmers. Three-quarters of

[10]Compared to the soybean price support program in Figure 9.9, the deficiency payment approach results in a smaller deadweight loss (less than a tenth of the original one) and lower government expenditures (though the expenditures need not be smaller in general).

U.S. farms have sales of less than $50,000 per year, yet these farms received only 16.1% of the total direct government payments for agriculture in 1998. In contrast, farms with over half a million dollars in annual sales are only 3.3% of all farms, yet they received 21.9% of all direct government payments. Farms with over a quarter of a million dollars in sales (top 8% of all farms) received 46.9% of the payments.

Application

INTERNATIONAL COST OF AGRICULTURAL SUBSIDIES

In some countries, government farm subsidies exceed the amount farmers receive from consumers. The Organization for Economic Cooperation and Development (OECD) collects information about such subsidies in its member nations, which include most European countries, Australia, Canada, Japan, New Zealand, and the United States. Farmers in OECD countries received $311 billion in producer support payments in 2001.

In 2001, agricultural support payments were $59 billion in Japan, $95 billion in the United States, and $106 billion in the European Union (roughly half of its budget). Switzerland's farm supports are the largest fraction, 69%, of total receipts among the OECD nations. That is, the Swiss government gives a farmer nearly $7 for every $3 that farmer earns from sales. The support shares are 67% in Norway, 59% in Iceland and Japan, 35% in the European Union, 21% in the United Sates, 17% in Canada, 4% in Australia, and 1% in New Zealand.

The cost of farmer supports to the average taxpayer is substantial. In 1998, the average person in the European Union paid $381 a year to subsidize farmers. These per-person payments were $879 in Switzerland, $656 in Iceland, $449 in Japan, $363 in the United States, $140 in Canada, $92 in Australia, $63 in Mexico, and $26 in New Zealand.

Welfare Effects of a Price Ceiling

In some markets, the government sets a *price ceiling*: the highest price that a firm can legally charge. If the government sets the ceiling below the precontrol competitive price, consumers demand more than the precontrol equilibrium quantity and firms supply less than that quantity (Chapter 2). Producer surplus must fall because firms receive a lower price and sell fewer units.

Because of the price ceiling, consumers can buy the good at a lower price but cannot buy as much of it as they'd like. Because less is sold than at the precontrol equilibrium, there is deadweight loss: Consumers value the good more than the marginal cost of producing extra units.

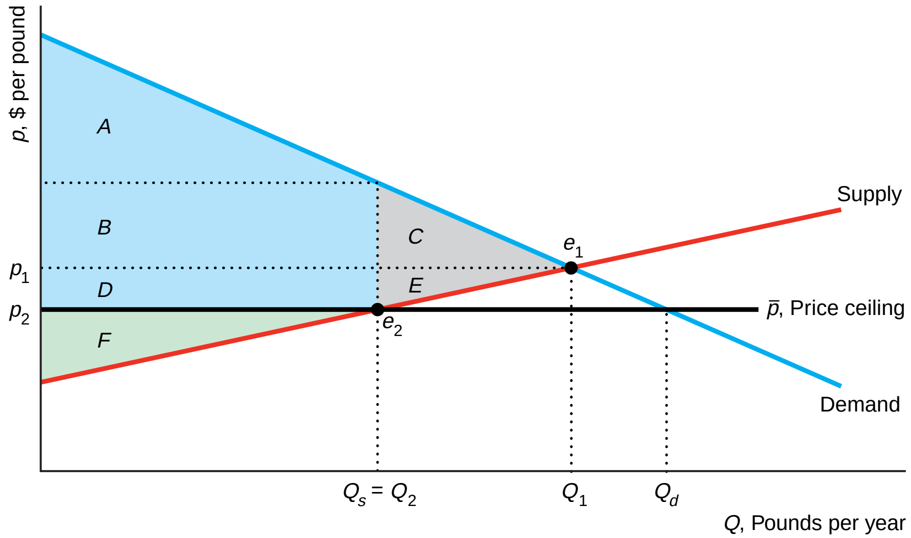
In the 1970s, the U.S. government used price controls to keep gasoline prices below the market price (Chapter 2). This policy led to long lines at gas stations and large deadweight losses. Frech and Lee (1987) estimate that the loss in consumer surplus in California in 2002 dollars was $2 billion during the December 1973 to March 1974 price controls and $1.3 billion during the May 1979 to July 1979 controls.

Solved Problem 9.4

What is the effect on the equilibrium and welfare if the government sets a price ceiling, $\bar{p}$, below the unregulated competitive equilibrium price?

Answer

1. *Show the initial unregulated equilibrium*: The intersection of the demand curve and the supply curve determines the unregulated, competitive equilibrium e_1, where the equilibrium quantity is Q_1.



	No Ceiling	Price Ceiling	Change
Consumer Surplus, CS	$A + B + C$	$A + B + D$	$D - C = \Delta CS$
Producer Surplus, PS	$D + E + F$	F	$-D - E = \Delta PS$
Welfare, $W = CS + PS$	$A + B + C + D + E + F$	$A + B + D + F$	$-C - E = \Delta W = DWL$

2. *Show how the equilibrium changes with the price ceiling*: Because the price ceiling, $\bar{p}$, is set below the equilibrium price of p_1, the ceiling binds. At this lower price, consumer demand increases to Q_d while the quantity firms are willing to supply falls to Q_s, so only $Q_s = Q_2$ units are sold at the new equilibrium, e_2. Thus the price control causes the equilibrium quantity and price to fall, but consumers have excess demand of $Q_d - Q_s$.
3. *Describe the welfare effects*: Because consumers are able to buy Q_s units at a lower price than before the controls, they gain area D. Consumers lose consumer surplus of C, however, because they can purchase only Q_s

instead of Q_1 units of output. Thus consumers gain net consumer surplus of $D - C$. Because they sell fewer units at a lower price, firms lose producer surplus $-D - E$. Part of this loss, D, is transferred to consumers because of lower prices, but the rest, E, is a loss to society. The total deadweight loss to society is $\Delta W = \Delta CS + \Delta PS = -C - E$.

9.6 COMPARING BOTH TYPES OF POLICIES: IMPORTS

Traditionally, most of Australia's imports come from overseas.

—Keppel Enderbery, former Australian cabinet minister

We've examined examples of government policies that shift supply or demand curves and policies that create a wedge between supply and demand. Governments use both types of policies to control international trade.

Allowing imports of foreign goods benefits the importing country. If a government reduces imports of a good, the domestic price rises; the profits of domestic firms that produce the good increase, but domestic consumers are hurt. Our analysis will show that the loss to consumers exceeds the gain to producers.

The government of the (potentially) importing country can use one of four import policies:

- **Allow free trade:** Any firm can sell in this country without restrictions.
- **Ban all imports:** The government sets a quota of zero on imports.
- **Set a positive quota:** The government limits imports to $\bar{Q}$.
- **Set a tariff:** The government imposes a tax called a **tariff** (or a *duty*) on only imported goods.

We compare welfare under free trade to welfare under bans and quotas, which change the supply curve, and to welfare under tariffs, which create a wedge between supply and demand.

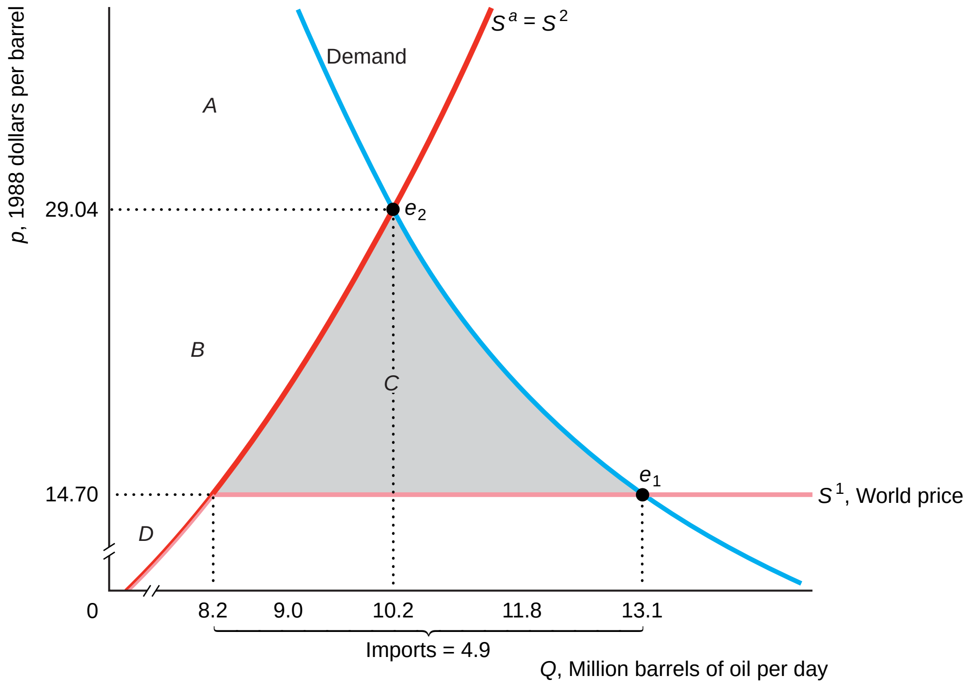
To illustrate the differences in welfare under these various policies, we examine the U.S. market for crude oil.[11] We make two assumptions for the sake of simplicity. First, we assume that transportation costs are zero. Second, we assume that the supply curve of the potentially imported good is horizontal at the world price p^*. Given these two assumptions, the importing country, the United States, can buy as much of this good as it wants at p^* per unit: It is a price taker in the world market because its demand is too small to influence the world price.

[11]We assume that the market is competitive. Our figures are based on short-run, constant-elasticity supply and demand equations for crude oil in 1988 using the short-run supply and demand elasticities reported in Anderson and Metzger (1991).

Free Trade Versus a Ban on Imports

No nation was ever ruined by trade. —Benjamin Franklin

Preventing imports into the domestic market raises the price, as we illustrated in Chapter 2 for the Japan rice market. The estimated U.S. domestic supply curve, S^a, is upward sloping, and the foreign supply curve is horizontal at the world price of \$14.70 in Figure 9.10. The total U.S. supply curve, S^1, is the horizontal sum of the domestic supply curve and the foreign supply curve. Thus S^1 is the same as the upward-sloping domestic supply curve for prices below \$14.70 and is horizontal at \$14.70. Under free trade, the United States imports crude oil if its domestic price in the absence of imports would exceed the world price, \$14.70 per barrel.



U.S.	Free Trade	U.S. Import Ban	Change (\$ millions)
Consumer Surplus, CS	$A + B + C$	A	$-B - C = -163.7 = \Delta CS$
Producer Surplus, PS	D	$B + D$	$B = 132.5 = \Delta PS$
Welfare, $W = CS + PS$	$A + B + C + D$	$A + B + D$	$-C = -31.2 = \Delta W = DWL$

Figure 9.10 Loss from Eliminating Free Trade. Because the supply curve foreigners face is horizontal at the world price of \$14.70, the total U.S. supply curve of crude oil is S_1 when there is free trade. The free-trade equilibrium is e_1. With a ban on imports, the equilibrium e_2 occurs where the domestic supply curve, $S^a = S^2$, intersects D. The ban increases producer surplus by B = \$132.5 million per day and decreases consumer surplus by $B + C$ = \$163.7 million per day, so the deadweight loss is C = \$31.2 million per day or \$11.4 billion per year.

The free-trade equilibrium, e_1, is determined by the intersection of S^1 and the demand curve, where the U.S. price equals the world price, \$14.70, and the quantity is 13.1 million barrels per day. At the equilibrium price, domestic supply is 8.2, so imports are 4.9 (= 13.1 – 8.2). U.S. consumer surplus is $A + B + C$, U.S. producer surplus is D, and U.S. welfare is $A + B + C + D$. Throughout our discussion of trade, we ignore welfare effects in other countries.

If imports are banned, the total U.S. supply curve, S^2, is the American domestic supply curve, S^a. The equilibrium is at e_2, where S^2 intersects the demand curve. The new equilibrium price is \$29.04, and the new equilibrium quantity, 10.2 million barrels per day, is produced domestically. Consumer surplus is A, producer surplus is $B + D$, and welfare is $A + B + D$.

The ban helps producers but harms consumers. Because of the higher price, domestic firms gain producer surplus of $\Delta PS = B =$ \$132.5 million per day. The change in consumers' surplus is $\Delta CS = -B - C =$ –\$163.7 million per day.

Does the ban help the United States? The change in total welfare, ΔW, is the difference between the gain to producers and the loss to consumers, $\Delta W = \Delta PS + \Delta CS =$ –\$31.2 million per day or –\$11.4 billion per year. This deadweight loss is 24% of the gain to producers. Consumers lose \$1.24 for every \$1 that producers gain from a ban.

JEFFERSON'S TRADE EMBARGO

How can we tell how much trade benefits us? An "experiment" at the beginning of the nineteenth century can help us to answer this question. In 1807 during the Napoleonic Wars, if U.S. ships did not stop in British ports, Britain seized the vessels and cargo and impressed the sailors. At President Thomas Jefferson's request, Congress responded by imposing a nearly complete (perhaps 80%) embargo on international commerce from December 1807 to March 1809.

Due to the embargo, U.S. consumers could not find good substitutes for manufactured goods from Europe, and producers could not sell farm produce and other goods for as much as in Europe. According to Irwin (2001), the welfare cost of the embargo was at least 8% of the U.S. gross national product (GNP) in 1807. Just before the embargo, exports were about 13% of GNP. In today's world, the welfare cost of an embargo may be substantially more.

Free Trade Versus a Tariff

TARIFF, n. A scale of taxes on imports, designed to protect the domestic producer against the greed of his customers. —Ambrose Bierce

There are two common types of tariffs: *specific tariffs*—τ dollars per unit—and *ad valorem tariffs*—α percent of the sales price. In recent years, tariffs have been applied throughout the world, most commonly to agricultural products.[12] American policymakers have frequently debated the optimal tariff on crude oil as a way to raise revenue or to reduce "dependence" on foreign oil.

You may be asking yourself, "Why should we study tariffs if we've already looked at taxes? Isn't a tariff just another tax?" Good point! Tariffs are just taxes. If the only goods sold were imported, the effect of a tariff in the importing country is the same as we showed for a sales tax. We study tariffs separately because a tariff is applied only to imported goods, so it affects domestic and foreign producers differently.

Because tariffs are applied to only imported goods, all else the same, they do not raise as much tax revenue or affect equilibrium quantities as much as taxes applied to all goods in a market. De Melo and Tarr (1992) find that almost five times more tax revenue would be generated by a 15% additional *ad valorem* tax on petroleum products ($34.6 billion) than by a 25% additional import tariff on oil and gas ($7.3 billion).

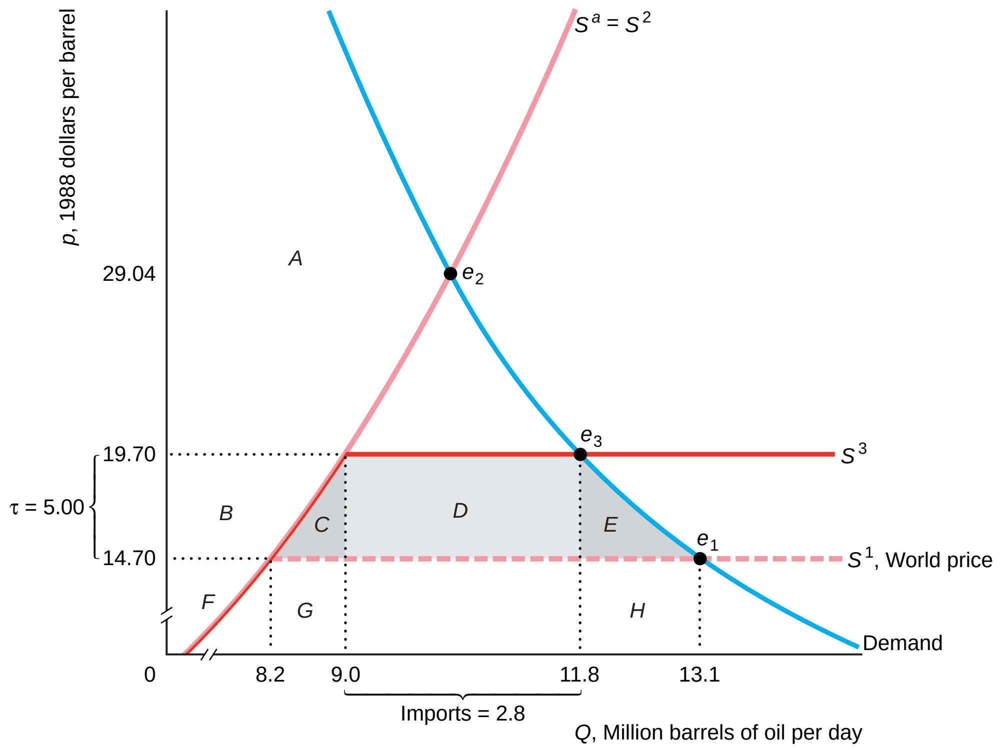
To illustrate the effect of a tariff, suppose that the government imposes a specific tariff of τ = $5 per barrel of crude oil. Given this tariff, firms will not import oil into the United States unless the U.S. price is at least $5 above the world price, $14.70. The tariff creates a wedge between the world price and the American price. This tariff causes the total supply curve to shift from S^1 to S^3 in Figure 9.11. Given that the world supply curve is horizontal at $14.70, a tariff shifts this supply curve upward so that it is horizontal at $19.70. As a result, the total U.S. supply curve with the tariff, S^3, equals the domestic supply curve for prices below $19.70 and is horizontal at $19.70.

The new equilibrium, e_3, occurs where S^3 intersects the demand curve. At this equilibrium, price is $19.70 and quantity is 11.8 million barrels of oil per day. At this higher price, domestic firms supply 9.0, so imports are 2.8 (= 11.8 – 9.0).

The tariff *protects* American producers from foreign competition. The larger the tariff, the less is imported, hence the higher the price that domestic firms can charge. (With a large enough tariff, nothing is imported, and the price rises to the no-trade level, $29.04.) With a tariff of $5, domestic firms' producer surplus increases by area B = $42.8 million per day.

Because of the rise in the price from $14.70 to $19.70, consumer surplus falls by $61.9 million per day. The government receives tariff revenues, T, equal to area D = $14 million per day, which is τ = $5 times the quantity imported, 2.8.

[12]After World War II, most trading nations signed the General Agreement on Tariffs and Trade (GATT), which limited their ability to subsidize exports or limit imports using quotas and tariffs. The rules prohibited most export subsidies and import quotas, except when imports threatened "market disruption" (the term that was, unfortunately, not defined). The GATT also required that any new tariff be offset by a reduction in other tariffs to compensate the exporting country. Modifications of the GATT and agreements negotiated by its successor, the World Trade Organization, have reduced or eliminated many tariffs.



U.S.	Free Trade	U.S. Tariff or Quota	Change ($ millions)
Consumer Surplus, *CS*	$A + B + C + D + E$	A	$-B - C - D - E = -61.9$
Producer Surplus, *PS*	F	$B + F$	$B = 42.8$
Tariff Revenues, *T*	0	D (tariff)	$D = 14.0$ (tariff)
		0 (quota)	0 (quota)
Welfare from a Tariff, $W = CS + PS + T$	$A + B + C + D + E + F$	$A + B + D + F$	$-C - E = -5.1 = DWL$
Welfare from a Quota, $W = CS + PS$	$A + B + C + D + E + F$	$A + B + F$	$-C - D - E = -19.1 = DWL$

Figure 9.11 Effect of a Tariff (or Quota). A tariff of $\tau = \$5$ per barrel of oil imported or a quota of $\bar{Q} = 2.8$ drives the U.S. price of crude oil to \$19.70, which is \$5 more than the world price. Under the tariff, the equilibrium, e_3, is determined by the intersection of the S_3 total U.S. supply curve and the *D* demand curve. Under the quota, e_3 is determined by a quantity wedge of 2.8 million barrels per day between the quantity demanded, 9.0 million barrels per day, and the quantity supplied, 11.8 million barrels per day. Compared to free trade, producers gain $B = \$42.8$ million per day and consumers lose $B + C + D + E = \$61.9$ million per day from the tariff or quota. The deadweight loss under the quota is $C + D + E = \$19.1$ million per day. With a tariff, the government's tariff revenue increases by $D = \$14$ million a day, so the deadweight loss is only $C + E = \$5.1$ million per day.

The deadweight loss is $C + E$ = \$5.1 million per day, or nearly \$1.9 billion per year.[13] This deadweight loss is almost 12% of the gain to producers. Consumers lose \$1.45 for each \$1 domestic producers gain. Because the tariff doesn't completely eliminate imports, the welfare loss is smaller than it is if all imports are banned.

We can interpret the two components of this deadweight loss. First, C is the loss from producing 9.0 million barrels per day instead of 8.2 million barrels per day. Domestic firms produce this extra output because the tariff drove up the price from \$14.70 to \$19.70. The cost of producing this extra 0.8 million barrels of oil per day domestically is $C + G$, the area under the domestic supply curve, S^a, between 8.2 and 9.0. Had Americans bought this oil at the world price, the cost would have been only G = \$11.8 million per day. Thus C is the extra cost from producing the extra 0.8 million barrels of oil per day domestically instead of importing it.

Second, E is a *consumption distortion loss* from American consumers' buying too little oil, 11.8 instead of 13.1, because the price rose from \$14.70 to \$19.70 owing to the tariff. American consumers value this extra output as $E + H$, the area under their demand curve between 11.8 and 13.1, whereas the value in international markets is only H, the area below the line at \$14.70 between 11.8 and 13.1. Thus E is the difference between the value at world prices and the value American consumers place on this extra 1.3 million barrels per day.

Free Trade Versus a Quota

The effect of a positive quota is similar to that of a tariff. If the government limits imports to $\bar{Q}$ = 2.8 million barrels per day, the quota is binding because 4.9 million barrels per day were imported under free trade. Given this binding quota, at the equilibrium price, the quantity demanded minus the quantity supplied by domestic producers equals 2.8 million barrels per day. In Figure 9.11, where the price is \$19.70, the gap between the quantity demanded, 11.8 million barrels per day, and the quantity supplied, 9.0 million barrels per day, is 2.8 million barrels per day. Thus a quota on imports of 2.8 leads to the same equilibrium, e_3, as a tariff of \$5.

The gain to domestic producers, B, and the loss to consumers, $C + E$, are the same as those with a tariff. However, unlike with the tariff, with the quota the government does not receive any revenue (unless the government sells import licenses). Area D may go to foreign exporters. As a result, the deadweight loss from the quota, \$19.1 million per day, or \$7.0 billion per year, is greater than under the tariff. This deadweight loss is nearly half (45%) of the gains to producers.

Thus the importing country fares better using a tariff than setting a quota that reduces imports by the same amount. Consumers and domestic firms do as well under the two policies, but the government gains tariff revenues, D, only when the tariff is used.

Rent Seeking

Given that tariffs and quotas hurt the importing country, why do the Japanese, U.S., and other governments impose tariffs, quotas, or other trade barriers? The reason is that domestic producers stand to make large gains from such government actions;

[13]If the foreign supply is horizontal, welfare in the importing country *must* fall. However, if the foreign supply is upward sloping, welfare in the importing country may rise.

hence it pays for them to organize and lobby the government to enact these trade policies. Although consumers as a whole suffer large losses, most individual consumers face a negligible loss. Moreover, consumers rarely organize to lobby the government about trade issues. Thus in most countries, producers are often able to convince (cajole, influence, or bribe) legislators or government officials to aid them, even though consumers suffer more-than-offsetting losses.

If domestic producers can talk the government into a tariff, quota, or other policy that reduces imports, they gain extra producer surplus (rents), such as area B in Figures 9.10 and 9.11. Economists call efforts and expenditures to gain a rent or a profit from government actions **rent seeking**. If producers or other interest groups bribe legislators to influence policy, the bribe is a transfer of income and hence does not increase deadweight loss (except to the degree that a harmful policy is chosen). However, if this rent-seeking behavior—such as hiring lobbyists and engaging in advertising to influence legislators—uses up resources, the deadweight loss from tariffs and quotas understates the true loss to society. The domestic producers may spend up to the gain in producer surplus to influence the government.[14]

Indeed, some economists argue that the government revenues from tariffs are completely offset by administrative costs and rent-seeking behavior. If so (and if the tariffs and quotas do not affect world prices), the loss to society from tariffs and quotas is all of the change in consumer surplus, such as areas $B + C$ in Figure 9.10 and areas $B + C + D + E$ in Figure 9.11.

Lopez and Pagoulatos (1994) estimate the deadweight loss and the additional losses due to rent-seeking activities in the United States in food and tobacco products. Table 9.2 summarizes their estimates for several industries in 2002 dollars.

Table 9.2 Welfare Cost of Trade Barriers (millions of 2002 dollars)

Industry	*DWL*	ΔPS	Government Revenues	ΔCS
Meat products	−29	2,400	69	−2,499
Dairy products[a]	−15,660	28,595	1,073	−41,937
Sugar confectionery[a]	−978	4,485	285	−5,745
Grain mill products	−10	1,167	10	−1,090
Fats and oils	−136	2,421	5	−2,562
Beverages	−9	1,119	150	−1,277
Tobacco	−209	3,908	97	−4,213
All food and tobacco	**−13,797**	**49,921**	**2,025**	**−65,740**

[a] Import quotas are the primary instrument of protection.

Notes: As estimated, $\Delta CS = DWL - \Delta PS -$ government revenue. Dollar amounts were adjusted using the Consumer Price Index.

Source: Lopez and Pagoulatos (1994).

[14]This argument is made in Tullock (1967) and Posner (1975). Fisher (1985) and Varian (1989) argue that the expenditure is typically less than the producer surplus.

They estimate that the deadweight loss is \$13.8 billion, which is 2.6% of the domestic consumption of these products. The largest deadweight losses were in milk products and sugar manufacturing, which primarily use import quotas to raise domestic prices. The gain in producer surplus is \$49.9 billion, or 9.5% of domestic consumption. The government obtained \$2.0 billion in tariff revenues, or 0.4% of consumption. If all of producer surplus and government revenues were expended in rent-seeking behavior and other wasteful activities, the total loss is \$65.7 billion, or 12.5% of consumption, which is 4.75 times larger than the deadweight loss alone. In other words, the loss to society is somewhere between the deadweight loss of \$13.8 billion and \$65.7 billion.

Summary

1. **Consumer welfare:** The pleasure a consumer receives from a good in excess of its cost is called *consumer surplus*. Consumer surplus equals the area under the consumer's demand curve above the market price up to the quantity that the consumer buys. How much consumers are harmed by an increase in price is measured by the change in consumer surplus.
2. **Producer welfare:** A firm's gain from trading is measured by its producer surplus. Producer surplus is the largest amount of money that could be taken from a firm's revenue and still leave the firm willing to produce. That is, the producer surplus is the amount the firm is paid minus its variable cost of production, which is profit in the long run. It is the area below the price and above the supply curve up to the quantity that the firm sells. The effect of a change in a price on a supplier is measured by the change in producer surplus.
3. **How competition maximizes welfare:** One standard measure of welfare is the sum of consumer surplus and producer surplus. The more price is above marginal cost, the lower this measure of welfare. In the competitive equilibrium, in which price equals marginal cost, welfare is maximized.
4. **Policies that shift supply curves:** Governments frequently limit the number of firms in a market directly, by licensing them, or indirectly, by raising the costs of entry to new firms or raising the cost of exiting. A reduction in the number of firms in a competitive market raises price, hurts consumers, helps producing firms, and lowers the standard measure of welfare. This reduction in welfare is a deadweight loss: The gain to producers is less than the loss to consumers.
5. **Policies that create a wedge between supply and demand:** Taxes, price ceilings, and price floors create a gap between the price consumers pay and the price firms receive. These policies force price above marginal cost, which raises the price to consumers and lowers the amount consumed. The wedge between price and marginal cost results in a deadweight loss: The loss of consumer surplus and producer surplus is not offset by increased taxes or by benefits to other groups.
6. **Comparing both types of policies: imports:** A government may use either a quantity restriction such as a quota, which shifts the supply curve, or a tariff, which creates a wedge, to reduce imports or achieve other goals. These policies may have different welfare implications. A tariff that reduces imports by the same amount as a quota has the same harms—a larger loss of consumer surplus than increased domestic producer surplus—but has a partially offsetting benefit—increased tariff revenues for the government. Rent-seeking activities are attempts by firms or individuals to influence a government to adopt a policy that favors them. By using resources, rent seeking exacerbates the welfare loss beyond the deadweight loss caused by the policy itself. In a perfectly competitive market, government policies frequently lower welfare. As we show in later chapters, however, in markets that are not perfectly competitive, government policies may increase welfare.

QUIZ

Questions

1. How would the quantitative effect of a specific tax on welfare change as demand becomes more elastic? As it becomes less elastic? (*Hint:* See Solved Problem 9.1.)

2. *Review* (Chapter 2): What were the welfare effects (who gained, who lost, what was the deadweight loss) of the gasoline price controls described in Chapter 2? Show these effects in a figure.

3. *Review* (Chapter 4): Use an indifference curve diagram (gift goods on one axis and all other goods on the other) to illustrate that one is better off receiving cash than a gift. (*Hint*: See the discussion of gifts in this chapter and the discussion of food stamps in Chapter 4.)

4. What is the long-run welfare effect of a profit tax (the government collects a specified percentage of a firm's profit) assessed on each competitive firm in a market?

5. What is the welfare effect of an *ad valorem* sales tax, α, assessed on each competitive firm in a market?

6. What are the welfare effects of a minimum wage? Use a graphical approach to show what happens if all workers are identical. Then verbally describe what is likely to happen to workers who differ by experience, education, age, gender, and race.

7. What effect does a per-unit subsidy (negative specific tax) have on equilibrium and on welfare?

8. What is the welfare effect of a lump sum tax, $\$L$, assessed on each competitive firm in a market?

9. In 2002, Los Angeles imposed a ban on new billboards. Owners of existing billboard did not oppose the ban. Why? What are the implications of the ban for producer surplus, consumer surplus, and welfare? Who are the producers and consumers in your analysis? How else does the ban affect welfare in Los Angeles?

10. The government wants to drive the price of soybeans above the equilibrium price, p_1, to p_2. It offers growers a payment of x to reduce their output from Q_1 (the equilibrium level) to Q_2, which is the quantity demanded by consumers at p_2. How large must x be for growers to reduce output to this level? What are the effects of this program on consumers, farmers, and total welfare? Compare this approach to (a) offering a price support of p_2, (b) offering a price support and a quota set at Q_1, and (c) offering a price support and a quota set at Q_2.

11. The park service wants to restrict the number of visitors to Yellowstone National Park to Q^*, which is fewer than the current volume. It considers two policies: (i) raising the price of admissions and (ii) seting a quota. Compare the effects of these two policies on consumer surplus and welfare.

12. By 1996, the world price for raw sugar, 11.75¢ per pound, was about half the domestic price, 22.5¢ per pound, because of quotas and tariffs on sugar imports. As a consequence, American-made corn sweetener, which costs 12¢ a pound to make, can be profitably sold. Archer-Daniels-Midland made an estimated profit of \$290 million in 1994 from selling corn sweetener. The U.S. Commerce Department says that the quotas and price support reduce American welfare by about \$3 billion a year. If so, each dollar of Archer-Daniels-Midland's profit costs Americans about \$10. Model the effects of a quota on sugar in both the sugar and corn sweetener markets.

13. A government is considering a quota and a tariff, both of which will reduce imports by the same amount. Which does the government prefer, and why?

14. Given that the world supply curve is horizontal at the world price for a given good, can a subsidy on imports raise welfare in the importing country? Explain your answer.

15. Canada has 20% of the world's known freshwater resources, yet many Canadians believe that the country has little or none to spare. Over the years, U.S. and Canadian firms have struck deals to export bulk shipments of water to drought-afflicted U.S. cities and towns. Provincial leaders have blocked these deals in British Columbia and Ontario. Use graphs to show the likely outcome of such barriers to exports on the price and quantity of water used in Canada and in the United States if markets for water are competitive. Show the effects on consumer and producer surplus in both countries.

16. A mayor wants to help renters in her city. She considers two policies that will benefit renters equally. One policy is a *rent control*, which places a price ceiling, $\bar{p}$, on rents. The other is a government housing subsidy of s dollars per month that lowers the amount renters pay (to $\bar{p}$). Who benefits and who loses from these policies? Compare the two policies' effects on the quantity of housing consumed, consumer surplus, producer surplus, government expenditure, and deadweight loss. Does the comparison of deadweight loss depend on the elasticities of supply and demand? (*Hint*: Consider extreme cases.) If so, how?

Problems

17. If the inverse demand function is $p = 60 - Q$, what is the consumer surplus if price is 30?
18. If the inverse demand function is $p = a - bQ$, what is the consumer surplus if price is $a/2$?
19. If the supply function is $Q = Ap^{\eta}$, what is the producer surplus if price is p^*?
20. If the inverse demand function is $p = 60 - Q$ and the supply function is $Q = p$, what is the initial equilibrium? What is the welfare effect of a specific tax of $\tau = \$2$?
21. If the inverse demand function is $p = a - bQ$ and the supply function is $Q = c + dp$, what is the initial equilibrium? What is the welfare effect of a specific tax of $\tau = \$1$?
22. The demand function for wheat is $Q = a - bp$, and the supply function is $Q = b + dp$. The government imposes a binding price support using a deficiency payment. What are the effects on output, consumer surplus, producer surplus, and deadweight loss?