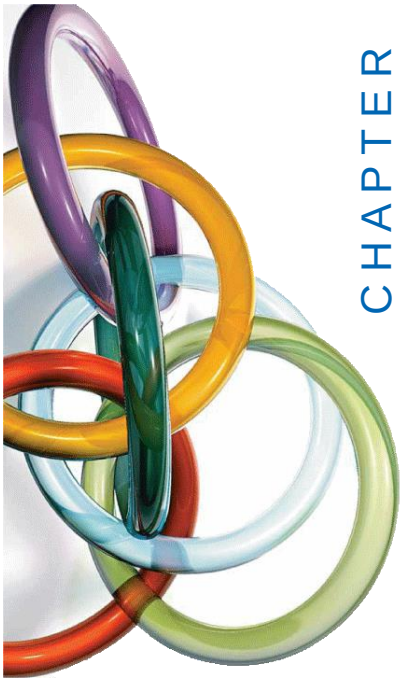


CHAPTER 9

The Analysis of Competitive Markets

CHAPTER 9 OUTLINE

9.1 Evaluating the Gains and Losses from Government Policies—Consumer and Producer Surplus

9.2 The Efficiency of a Competitive Market

9.3 Minimum Prices

9.4 Price Supports and Production Quotas

9.5 Import Quotas and Tariffs

9.6 The Impact of a Tax or Subsidy

9.1 EVALUATING THE GAINS AND LOSSES FROM GOVERNMENT POLICIES—CONSUMER AND PRODUCER SURPLUS

Review of Consumer and Producer Surplus

Figure 9.1

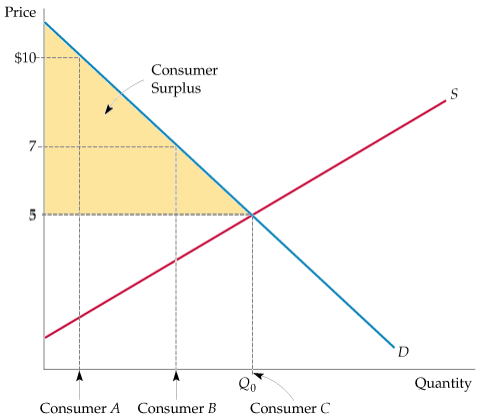
Consumer and Producer Surplus

Consumer *A* would pay $10 for a good whose market price is $5 and therefore enjoys a benefit of $5.

Consumer *B* enjoys a benefit of $2,

and Consumer *C*, who values the good at exactly the market price, enjoys no benefit.

Consumer surplus, which measures the total benefit to all consumers, is the yellow-shaded area between the demand curve and the market price.



9.1 EVALUATING THE GAINS AND LOSSES FROM GOVERNMENT POLICIES—CONSUMER AND PRODUCER SURPLUS

Review of Consumer and Producer Surplus

Chapter 9: The Analysis of Competitive Markets

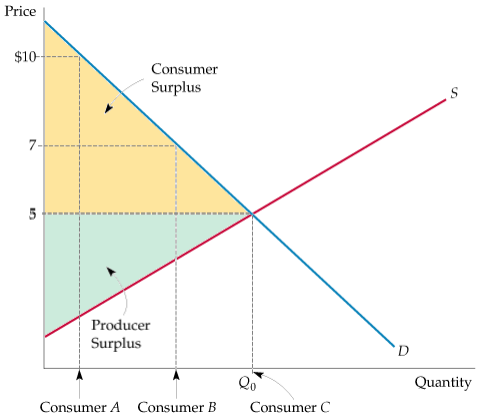
Figure 9.1

Consumer and Producer Surplus (continued)

Producer surplus measures the total profits of producers, plus rents to factor inputs.

It is the green-shaded area between the supply curve and the market price.

Together, consumer and producer surplus measure the welfare benefit of a competitive market.



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Consumer surplus

Suppose the representative consumer has preferences on a good X and money m that can be represented by the utility function:

$$U(x,m) = f(x) + m$$

where $f'(x) > 0, f"(x) < 0 \ \ and \ f(0) = 0$

Suppose that he has an endowment of money B.

He has to decide the quantity of good x to buy (at a given price p) and the quantity of money to keep

His problem is:

$$\max f(x) + B - px$$

Note that $B - px$ is the quantity of money he decide to keep (budget B minus the cost of x)

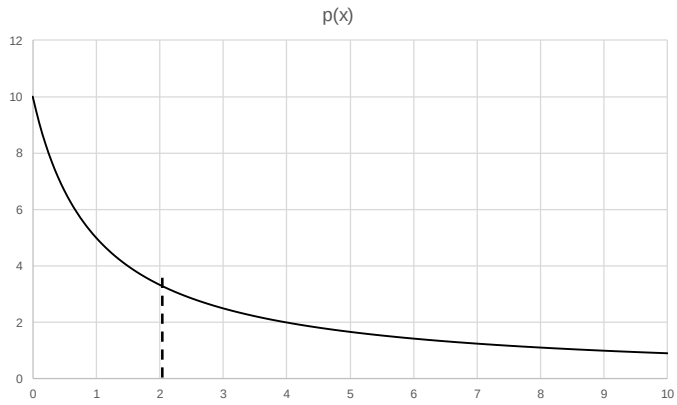
The solution of this problem is (FOC):

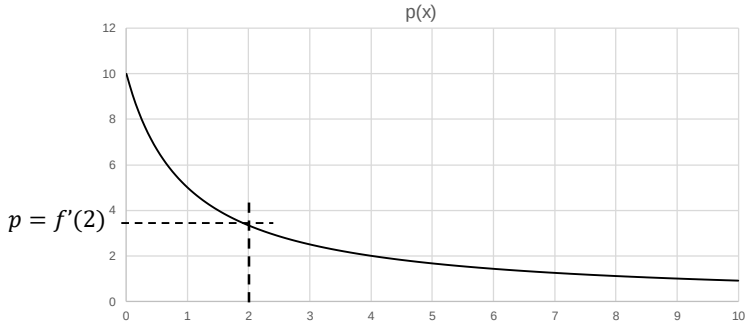
$$f'(x) - p = 0$$

That rewritten is

$$p = f'(x)$$

Note that this is the (inverse) demand function





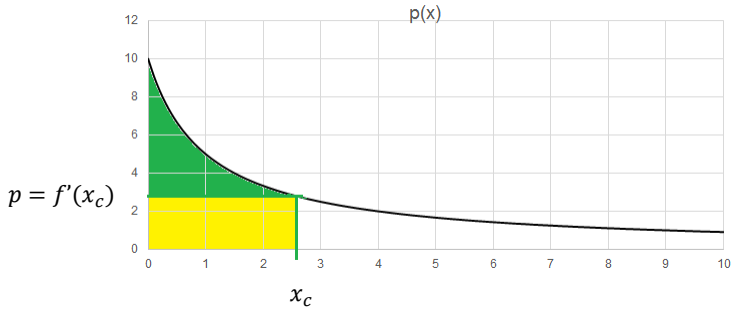
The area below the curve, between 0 and 2 represents the gross utility of x=2, f(2)

This is given by

$\int_0^2 f'(x)dx = f(2) - f(0) = f(2)$

Then net utility $(f(x) - px)$ is given by:

$$\int_0^2 f'(x)dx - px$$



Gross utility

$\int_0^{x_c} f'(x)dx = f(x_c) - f(0) = f(x_c)$

Net utility

$\int_0^{x_c} f'(x)dx - px$

Firm profit

Suppose the representative firm has a profit function:

$$\pi = p\,x - c(x)$$

where $c'(x) > 0, c"(x) > 0 \;\; and \; c(0) = 0$

Its problem is:

$$\max px - c(x)$$

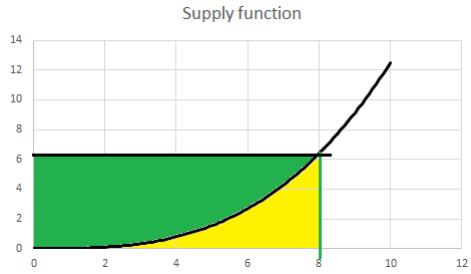
The solution of this problem is (FOC):

$$c'(x) - p = 0$$

That rewritten is

$$p = c'(x)$$

Note that this is the supply function



The area in yellow represents the cost to produce quantity 8, i.e. $\int_0^8 c'(x)dx = c(8) - c(0) = c(8)$

In general to produce x_1 the cost is:

$\int_0^{x_1} c'(x)dx = c(x_1) - c(0) = c(x_1)$

So profits are given by revenue minus cost, i.e. :

$$px - \int_0^{x_1} c'(x)dx$$

9.1 EVALUATING THE GAINS AND LOSSES FROM GOVERNMENT POLICIES—CONSUMER AND PRODUCER SURPLUS

Application of Consumer and Producer Surplus

- **welfare effects** Gains and losses to consumers and producers.

Figure 9.2

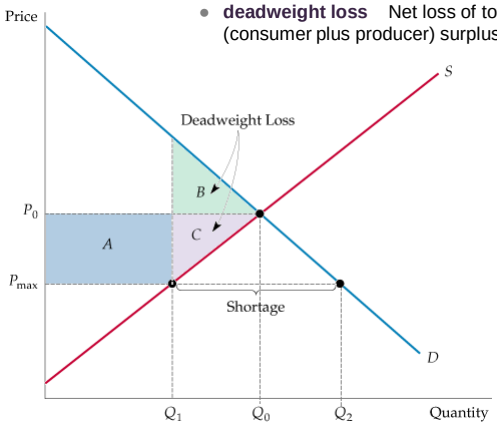
Change in Consumer and Producer Surplus from Price Controls

The price of a good has been regulated to be no higher than P_{max}, which is below the market-clearing price P_0.

The gain to consumers is the difference between rectangle *A* and triangle *B*.

The loss to producers is the sum of rectangle *A* and triangle *C*.

Triangles *B* and *C* together measure the deadweight loss from price controls.



- **deadweight loss** Net loss of total (consumer plus producer) surplus.

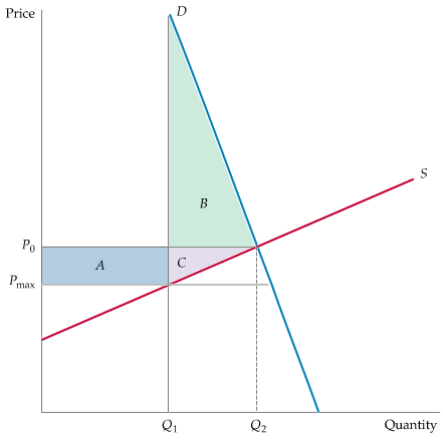
9.1 EVALUATING THE GAINS AND LOSSES FROM GOVERNMENT POLICIES—CONSUMER AND PRODUCER SURPLUS

Application of Consumer and Producer Surplus

Figure 9.3

Effect of Price Controls When Demand Is Inelastic

If demand is sufficiently inelastic, triangle *B* can be larger than rectangle *A*. In this case, consumers suffer a net loss from price controls.



9.1 EVALUATING THE GAINS AND LOSSES FROM GOVERNMENT POLICIES—CONSUMER AND PRODUCER SURPLUS

EXAMPLE 9.1 Price Controls and Natural Gas Shortages

Supply: $Q^S = 15.90 + 0.72P_G + 0.05P_O$

Demand: $Q^D = 0.02 - 0.18P_G + 0.69P_O$

Figure 9.4

Effects of Natural Gas Price Controls

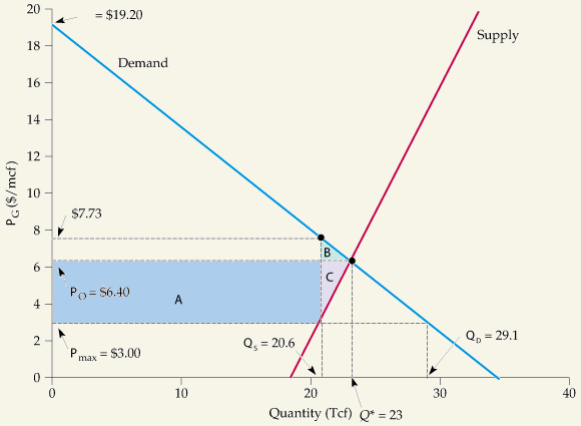
The market-clearing price of natural gas is $6.40 per mcf, and the (hypothetical) maximum allowable price is $3.00.

A shortage of 29.1 − 20.6 = 8.5 Tcf results.

The gain to consumers is rectangle *A* minus triangle *B*,

and the loss to producers is rectangle *A* plus triangle *C*.

The deadweight loss is the sum of triangles *B* plus *C*.



9.2 THE EFFICIENCY OF A COMPETITIVE MARKET

- **economic efficiency** Maximization of aggregate consumer and producer surplus.

Market Failure

- **market failure** Situation in which an unregulated competitive market is inefficient because prices fail to provide proper signals to consumers and producers.

There are two important instances in which market failure can occur:

1. Externalities
2. Lack of Information

- **externality** Action taken by either a producer or a consumer which affects other producers or consumers but is not accounted for by the market price.

9.2 THE EFFICIENCY OF A COMPETITIVE MARKET

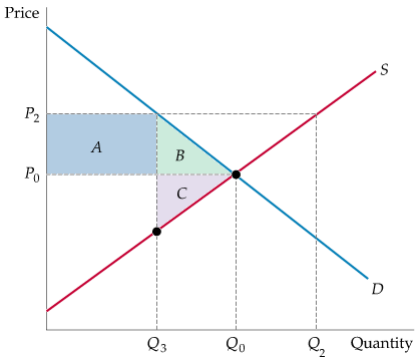
Figure 9.5

Welfare Loss When Price is Held Above Market-Clearing Level

When price is regulated to be no lower than P_2, only Q_3 will be demanded.

If Q_3 is produced, the deadweight loss is given by triangles *B* and *C*.

At price P_2, producers would like to produce more than Q_3. If they do, the deadweight loss will be even larger.



9.2 THE EFFICIENCY OF A COMPETITIVE MARKET

EXAMPLE 9.2 The Market for Human Kidneys

Figure 9.6

The Market for Kidneys and the Effect of the National Organ Transplantation Act

The market-clearing price is $20,000; at this price, about 24,000 kidneys per year would be supplied.

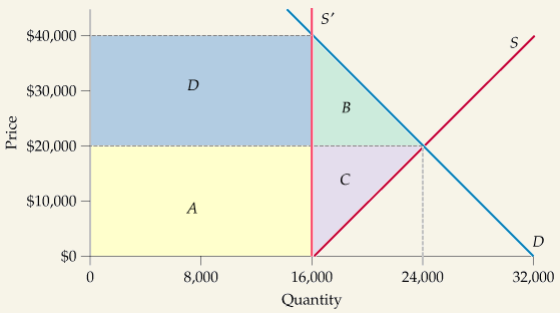
The law effectively makes the price zero. About 16,000 kidneys per year are still donated; this constrained supply is shown as *S'*.

The loss to suppliers is given by rectangle *A* and triangle *C*.

If consumers received kidneys at no cost, their gain would be given by rectangle *A* less triangle *B*.

Supply: $Q^S = 16{,}000 + 0.4P$

Demand: $Q^D = 32{,}000 - 0.4P$



9.2 THE EFFICIENCY OF A COMPETITIVE MARKET

EXAMPLE 9.2 The Market for Human Kidneys (continued)

Figure 9.6

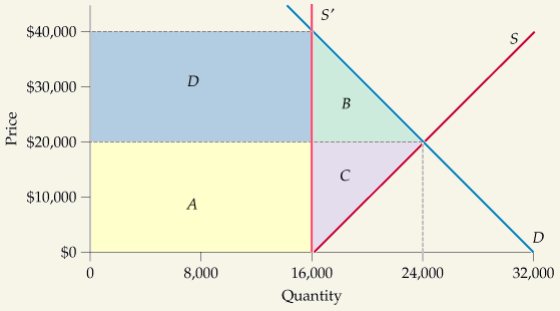
The Market for Kidneys and the Effect of the National Organ Transplantation Act (continued)

In practice, kidneys are often rationed on the basis of willingness to pay, and many recipients pay most or all of the $40,000 price that clears the market when supply is constrained.

Rectangles *A* and *D* measure the total value of kidneys when supply is constrained.

Supply: $Q^S = 16{,}000 + 0.4P$

Demand: $Q^D = 32{,}000 - 0.4P$



9.3 MINIMUM PRICES

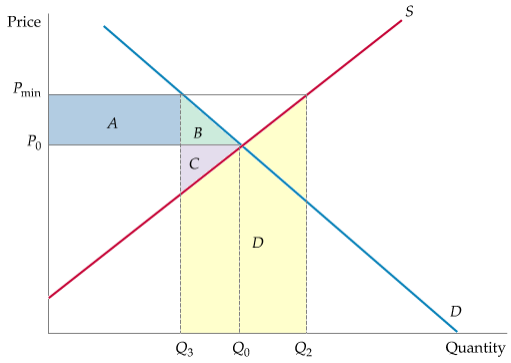
Figure 9.7

Price Minimum

Price is regulated to be no lower than P_{min}.

Producers would like to supply Q_2, but consumers will buy only Q_3.

If producers indeed produce Q_2, the amount $Q_2 - Q_3$ will go unsold and the change in producer surplus will be $A - C - D$. In this case, producers as a group may be worse off.



9.3 MINIMUM PRICES

Figure 9.8

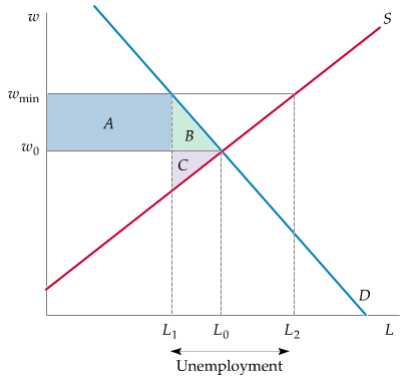
The Minimum Wage

Although the market-clearing wage is w_0,

firms are not allowed to pay less than w_{min}.

This results in unemployment of an amount $L_2 - L_1$

and a deadweight loss given by triangles *B* and *C*.



9.3 MINIMUM PRICES

EXAMPLE 9.3 Airline Regulation

Figure 9.9

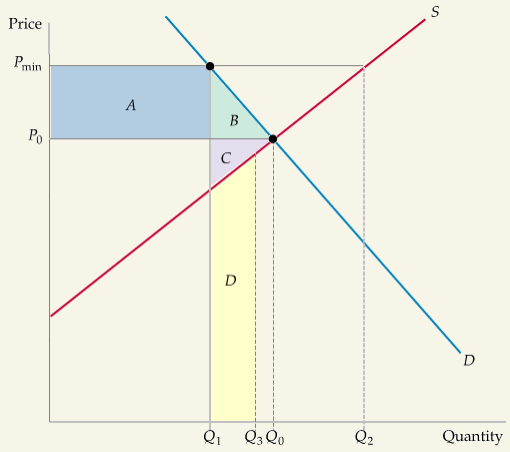
Effect of Airline Regulation by the Civil Aeronautics Board

At price P_{min}, airlines would like to supply Q_2, well above the quantity Q_1 that consumers will buy.

Here they supply Q_3. Trapezoid *D* is the cost of unsold output.

Airline profits may have been lower as a result of regulation because triangle *C* and trapezoid *D* can together exceed rectangle *A*.

In addition, consumers lose *A* + *B*.



9.3 MINIMUM PRICES

EXAMPLE 9.3 Airline Regulation (continued)

TABLE 9.1 Airline Industry Data

	1975	1980	1985	1990	1995	2000	2005
Number of Carriers	36	63	102	70	96	94	80
Passenger Load Factor (%)	54	58	61	62	67	72	78
Passenger Mile Rate (Constant 1995 dollars)	.218	.210	.165	.150	.129	.118	.092
Real Cost Index (1995 = 100)	101	122	111	109	100	101	93
Real Fuel Cost Index (1995 = 100)	249	300	204	163	100	125	237
Real Cost Index Corrected for Fuel Cost Changes	71	73	88	95	100	96	67

By 1981, the airline industry had been completely deregulated. Since that time, many new airlines have begun service, others have gone out of business, and price competition has become much more intense. Because airlines have no control over oil prices, it is more informative to examine a "corrected" real cost index which removes the effects of changing fuel costs.

9.4 PRICE SUPPORTS AND PRODUCTION QUOTAS

Price Supports

- **price support** Price set by government above free-market level and maintained by governmental purchases of excess supply.

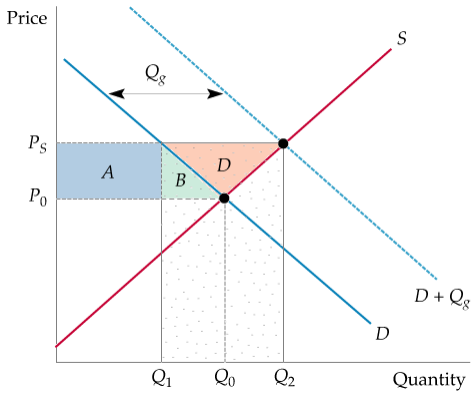
Figure 9.10

Price Supports

To maintain a price P_s above the market-clearing price P_0, the government buys a quantity Q_g.

The gain to producers is $A + B + D$. The loss to consumers is $A + B$.

The cost to the government is the speckled rectangle, the area of which is $P_s(Q_2 - Q_1)$.



Total change in welfare: $\Delta CS + \Delta PS - \text{Cost to Govt.} = D - (Q_2 - Q_1)P_s$

9.4 PRICE SUPPORTS AND PRODUCTION QUOTAS

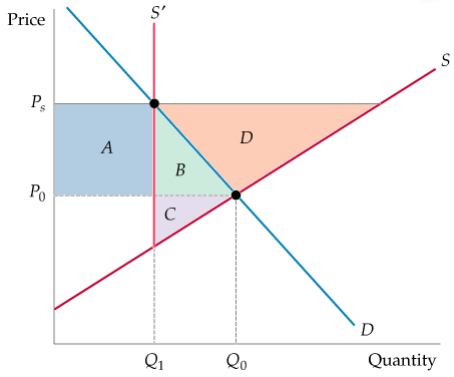
Production Quotas

Figure 9.11

Supply Restrictions

To maintain a price P_s above the market-clearing price P_0, the government can restrict supply to Q_1, either by imposing production quotas (as with taxicab medallions) or by giving producers a financial incentive to reduce output (as with acreage limitations in agriculture).

For an incentive to work, it must be at least as large as $B + C + D$, which would be the additional profit earned by planting, given the higher price P_s. The cost to the government is therefore at least $B + C + D$.



$\Delta CS = -A - B$

$\Delta PS = A - C +$ Payments for not producing

$\Delta Welfare = -A - B + A + B + D - B - C - D = -B - C$

9.4 PRICE SUPPORTS AND PRODUCTION QUOTAS

EXAMPLE 9.4

Supporting the Price of Wheat

Figure 9.12

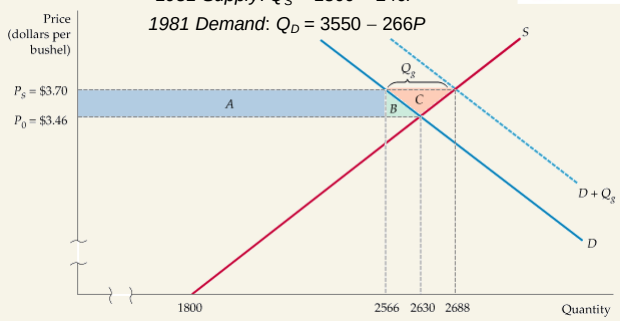
The Wheat Market in 1981

To increase the price to $3.70, the government must buy a quantity of wheat Q_g.

By buying 122 million bushels of wheat, the government increased the market-clearing price from $3.46 per bushel to $3.70.

1981 Supply: $Q_S = 1800 + 240P$

1981 Demand: $Q_D = 3550 - 266P$



1981 Total demand: $Q_{DT} = 3550 - 266P + Q_g$

$Q_g = 506P - 1750$

$Q_g = (506)(3.70) - 1750 = 122$ million bushels

Loss to consumers = $A + B$ = $624 million

Cost to the government = $3.70 x 122 million = $451.4 million

Total cost of the program = $624 million + $451.4 million = $1075 million

Gain to producers = $A + B + C$ = $638 million

9.4 PRICE SUPPORTS AND PRODUCTION QUOTAS

EXAMPLE 9.4 Supporting the Price of Wheat (continued)

Figure 9.13

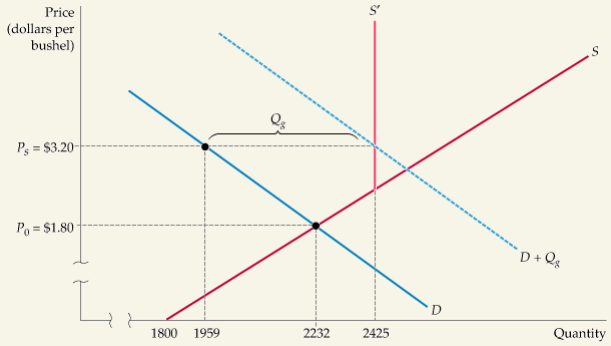
The Wheat Market in 1985

In 1985, the demand for wheat was much lower than in 1981, because the market-clearing price was only $1.80.

To increase the price to $3.20, the government bought 466 million bushels and also imposed a production quota of 2425 million bushels.

1985 Supply: $Q_S = 1800 + 240P$

1985 Demand: $Q_D = 2580 - 194P$



$2425 = 2580 - 194P + Q_g$

$Q_g = -155 + 194P$

$Q_g = -155 + 194(\$3.20) = 466$ million bushels

Cost to the government = ($3.20)(466) = $1491 million

9.5 IMPORT QUOTAS AND TARIFFS

- **import quota** Limit on the quantity of a good that can be imported.
- **tariff** Tax on an imported good.

Figure 9.14

Import Tariff or Quota That Eliminates Imports

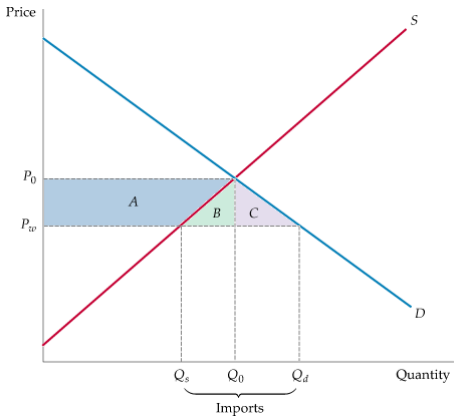
In a free market, the domestic price equals the world price P_w.

A total Q_d is consumed, of which Q_s is supplied domestically and the rest imported.

When imports are eliminated, the price is increased to P_0.

The gain to producers is trapezoid *A*.

The loss to consumers is *A* + *B* + *C*, so the deadweight loss is *B* + *C*.



9.5 IMPORT QUOTAS AND TARIFFS

Figure 9.15

Import Tariff or Quota (General Case)

When imports are reduced, the domestic price is increased from P_w to P^*.

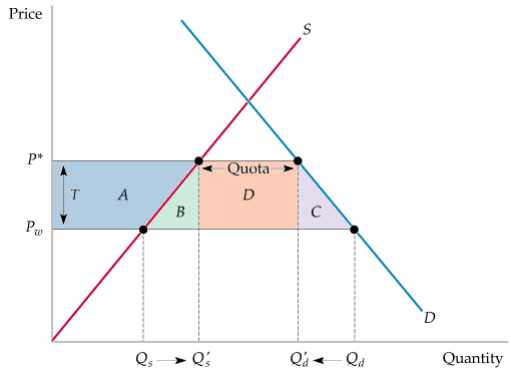
This can be achieved by a quota, or by a tariff $T = P^* - P_w$.

Trapezoid A is again the gain to domestic producers.

The loss to consumers is $A + B + C + D$.

If a tariff is used, the government gains D, the revenue from the tariff. The net domestic loss is $B + C$.

If a quota is used instead, rectangle D becomes part of the profits of foreign producers, and the net domestic loss is $B + C + D$.



9.5 IMPORT QUOTAS AND TARIFFS

EXAMPLE 9.5 The Sugar Quota

U.S. supply: $Q_S = -7.48 + 0.84P$

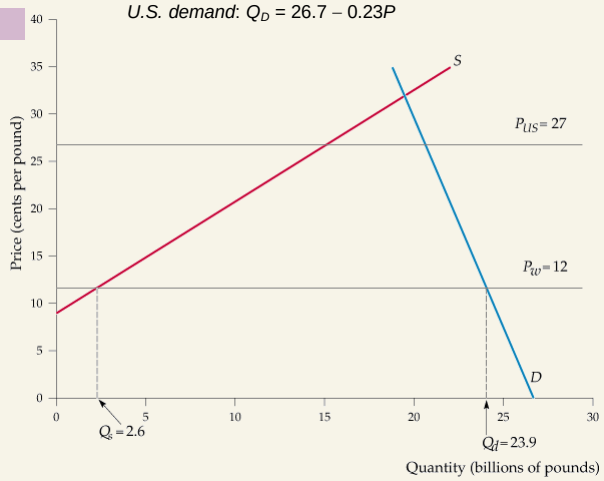
U.S. demand: $Q_D = 26.7 - 0.23P$

Figure 9.16

Sugar Quota in 2005

At the world price of 12 cents per pound, about 23.9 billion pounds of sugar would have been consumed in the United States in 2005, of which all but 2.6 billion pounds would have been imported.

Restricting imports to 5.3 billion pounds caused the U.S. price to go up by 15 cents.



9.5 IMPORT QUOTAS AND TARIFFS

EXAMPLE 9.5 The Sugar Quota (continued)

Figure 9.16

Sugar Quota in 2005 (continued)

The gain to domestic producers was trapezoid *A*, about $1.3 billion.

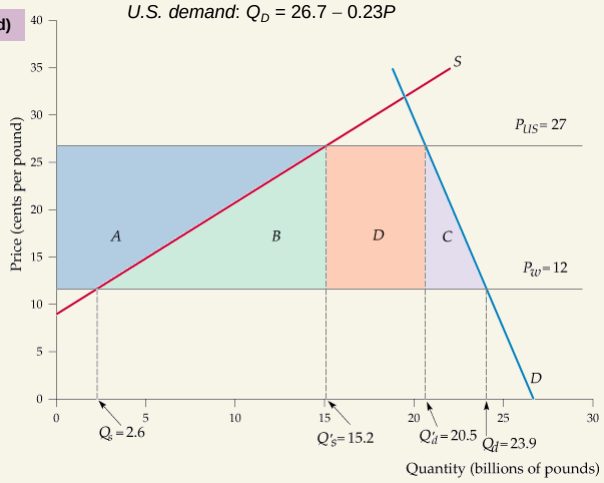
Rectangle *D*, $795 million, was a gain to those foreign producers who obtained quota allotments.

Triangles *B* and *C* represent the deadweight loss of about $1.2 billion.

The cost to consumers, *A* + *B* + *C* + *D*, was about $3.3 billion.

U.S. supply: $Q_S = -7.48 + 0.84P$

U.S. demand: $Q_D = 26.7 - 0.23P$



9.6 THE IMPACT OF A TAX OR SUBSIDY

- **specific tax** Tax of a certain amount of money per unit sold.

Figure 9.17

Incidence of a Tax

P_b is the price (including the tax) paid by buyers. P_s is the price that sellers receive, less the tax.

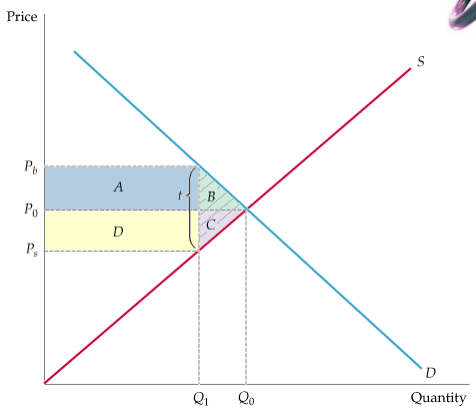
Here the burden of the tax is split evenly between buyers and sellers.

Buyers lose *A* + *B*.

Sellers lose *D* + *C*.

The government earns *A* + *D* in revenue.

The deadweight loss is *B* + *C*.



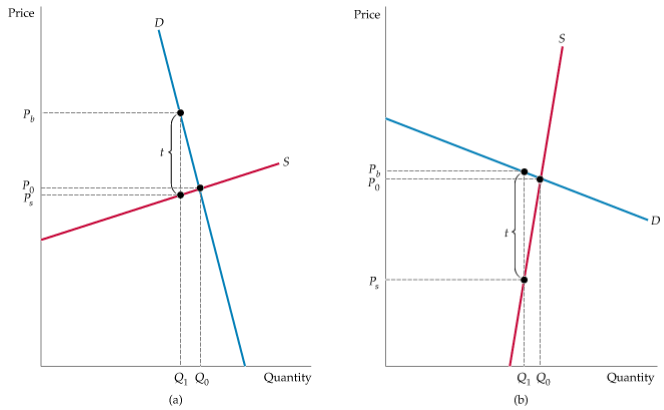
Market clearing requires *four conditions* to be satisfied after the tax is in place:

$$Q^D = Q^D(P_b) \quad \textbf{(9.1a)}$$
$$Q^S = Q^S(P_s) \quad \textbf{(9.1b)}$$
$$Q^D = Q^S \quad \textbf{(9.1c)}$$
$$P_b - P_s = t \quad \textbf{(9.1d)}$$

9.6 THE IMPACT OF A TAX OR SUBSIDY

Figure 9.18

Impact of a Tax Depends on Elasticities of Supply and Demand



(a) If demand is very inelastic relative to supply, the burden of the tax falls mostly on buyers.

(b) If demand is very elastic relative to supply, it falls mostly on sellers.

9.6 THE IMPACT OF A TAX OR SUBSIDY

The Effects of a Subsidy

- **subsidy** Payment reducing the buyer's price below the seller's price; i.e., a negative tax.

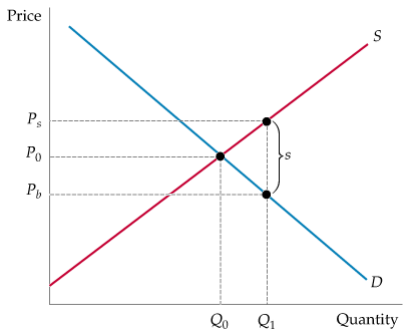
Conditions needed for the market to clear with a subsidy:

$$Q^D = Q^D(P_b) \quad \textbf{(9.2a)}$$
$$Q^S = Q^S(P_s) \quad \textbf{(9.2b)}$$
$$Q^D = Q^S \quad \textbf{(9.2c)}$$
$$P_s - P_b = s \quad \textbf{(9.2d)}$$

Figure 9.19

Subsidy

A subsidy can be thought of as a negative tax. Like a tax, the benefit of a subsidy is split between buyers and sellers, depending on the relative elasticities of supply and demand.



9.6 THE IMPACT OF A TAX OR SUBSIDY

EXAMPLE 9.6 A Tax on Gasoline

Effect of a $1-per-gallon tax:

$Q^D = 150 - 25P_b$ (Demand)
$Q^S = 60 + 20P_s$ (Supply)
$Q^D = Q^S$ (Supply must equal demand)
$P_b - P_s = 1.00$ (Government must receive $1.00/gallon)

$150 - 25P_b = 60 + 20Ps$
$P_b = P_s + 1.00$
$150 - 25(P_s + 1) = 60 + 20P_s$
$20P_s + 25P_s = 150 - 25 - 60$
$45P_s = 65$, or $P_s = 1.44$
Q = 150 – (25)(2.44) = 150 – 61, or Q = 89 bg/yr

Annual revenue from the tax tQ = (1.00)(89) = $89 billion per year

Deadweight loss: (1/2) x ($1.00/gallon) x (11 billion gallons/year = $5.5 billion per year

9.6 THE IMPACT OF A TAX OR SUBSIDY

EXAMPLE 9.6 A Tax on Gasoline (continued)

Gasoline demand: $Q^D = 150 - 25P$
Gasoline supply: $Q^S = 60 + 20P$

Figure 9.20
Impact of $1 Gasoline Tax

The price of gasoline at the pump increases from $2.00 per gallon to $2.44, and the quantity sold falls from 100 to 89 bg/yr.

Annual revenue from the tax is (1.00)(89) = $89 billion (areas *A* + *D*).

The two triangles show the deadweight loss of $5.5 billion per year.