

Consumer Surplus and Tax Incidence

Revisiting the Market Equilibrium

- Does the equilibrium price and quantity maximize the total welfare of buyers and sellers?
 - Market equilibrium reflects the way markets allocate scarce resources.
- Whether the market allocation is desirable can be addressed by **welfare economics**.
 - **Welfare economics** is the study of how the allocation of resources affects economic well-being.
 - Buyers and sellers receive benefits from taking part in the market.
 - The equilibrium in a market maximizes the total welfare of buyers and sellers.

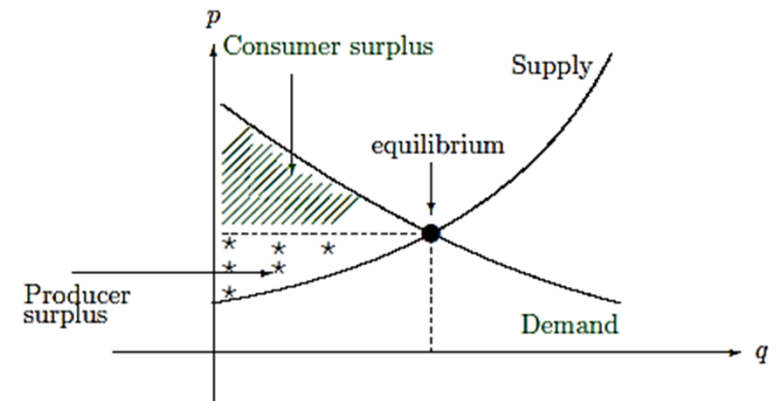
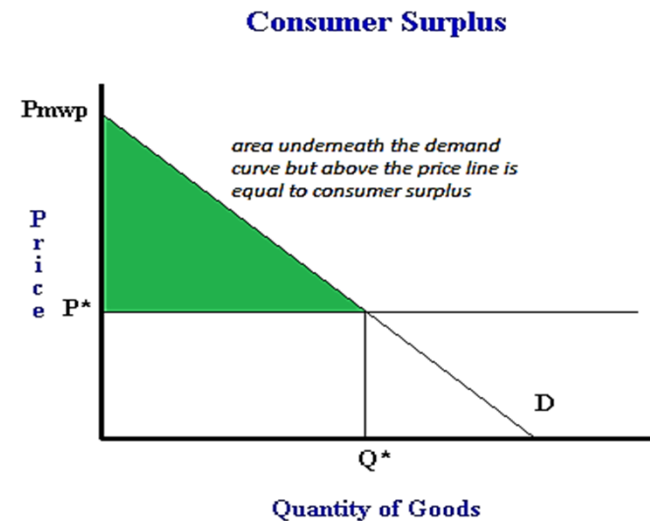
Producer and Consumer Surplus

- **Consumer surplus** is the value the consumer gets from buying a product, less its price
 - It is the area below the demand curve and above the price
 - Willingness to pay is the maximum amount that a buyer will pay for a good.
 - It measures how much the buyer values the good or service.

$$\text{Total amount paid at maximum prices} = \int_0^{q_e} D(q) dq.$$

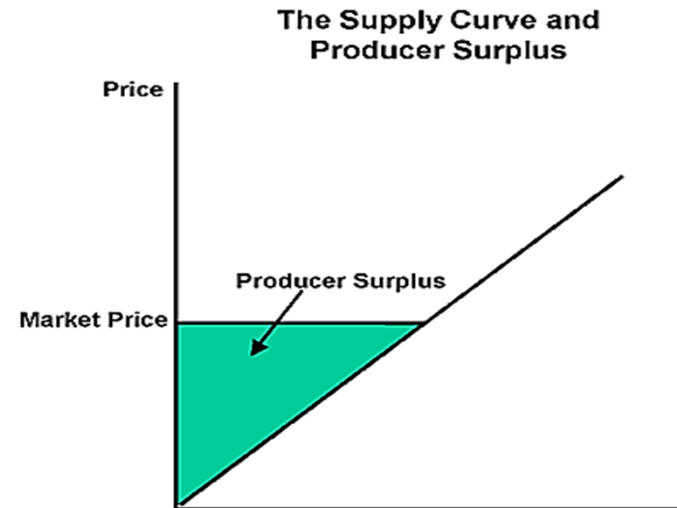
$$\text{total amount spent at equilibrium price} = p_e q_e.$$

$$\text{Consumer surplus} = \int_0^{q_e} D(q) dq - p_e q_e = \int_0^{q_e} [D(q) - p_e] dq.$$

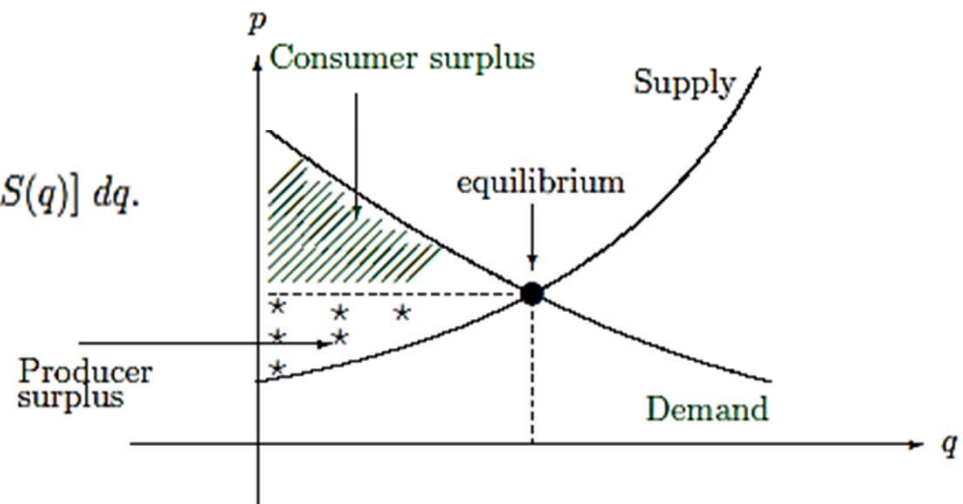


Producer and Consumer Surplus

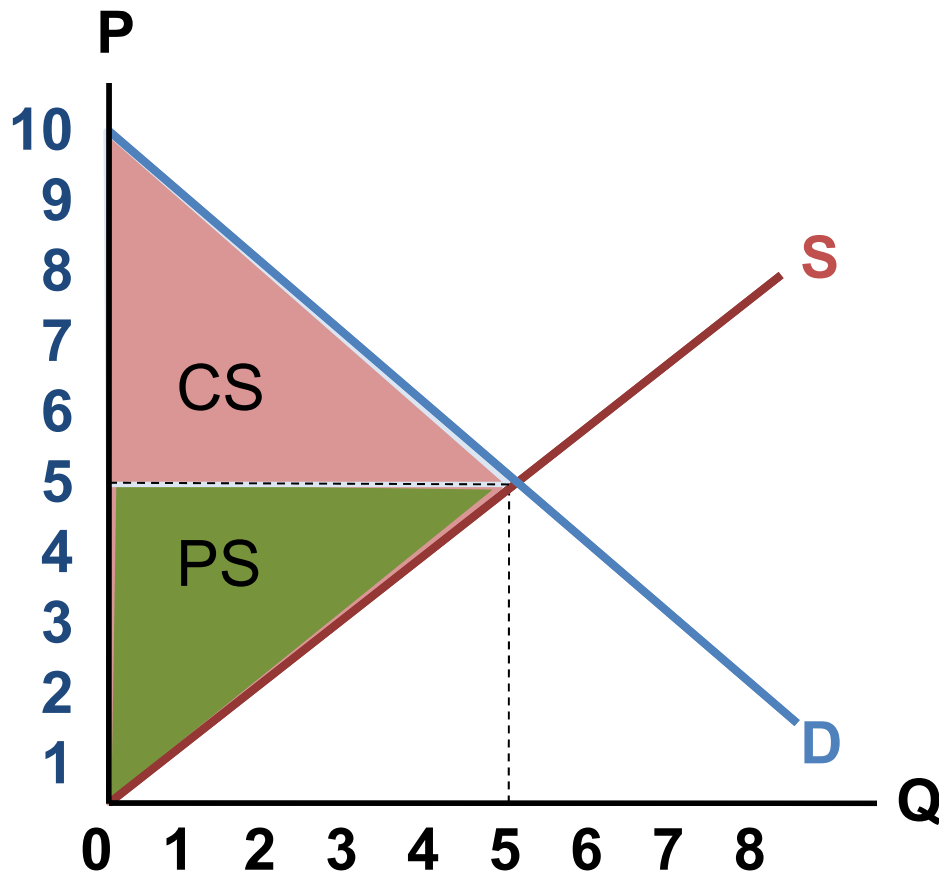
- **Producer surplus** is the value the producer sells a product for less the cost of producing it
 - It is the area above the supply curve but below the price the producer receives
 - Producer surplus is the amount a seller is paid for a good minus the seller's cost.
 - It measures the benefit to sellers participating in a market.



$$\text{Producer surplus} = p_e q_e - \int_0^{q_e} S(q) dq = \int_0^{q_e} [p_e - S(q)] dq.$$



Producer and Consumer Surplus



Consumer surplus =
area of red triangle

Producer surplus =
area of green triangle

The combination of
producer and consumer
surplus is maximized at
market equilibrium

Market Efficiency

Consumer surplus and producer surplus may be used to address the following question:

- Is the allocation of resources determined by free markets in any way desirable?

Consumer Surplus

= Value to buyers – Amount paid by buyers

Producer Surplus

= Amount received by sellers – Cost to sellers

Efficiency is the property of a resource allocation of maximizing the total surplus received by all members of society.

Government Intervention

The Role of Government in the Market Economy

Up to this point, we have examined how *free* markets work.

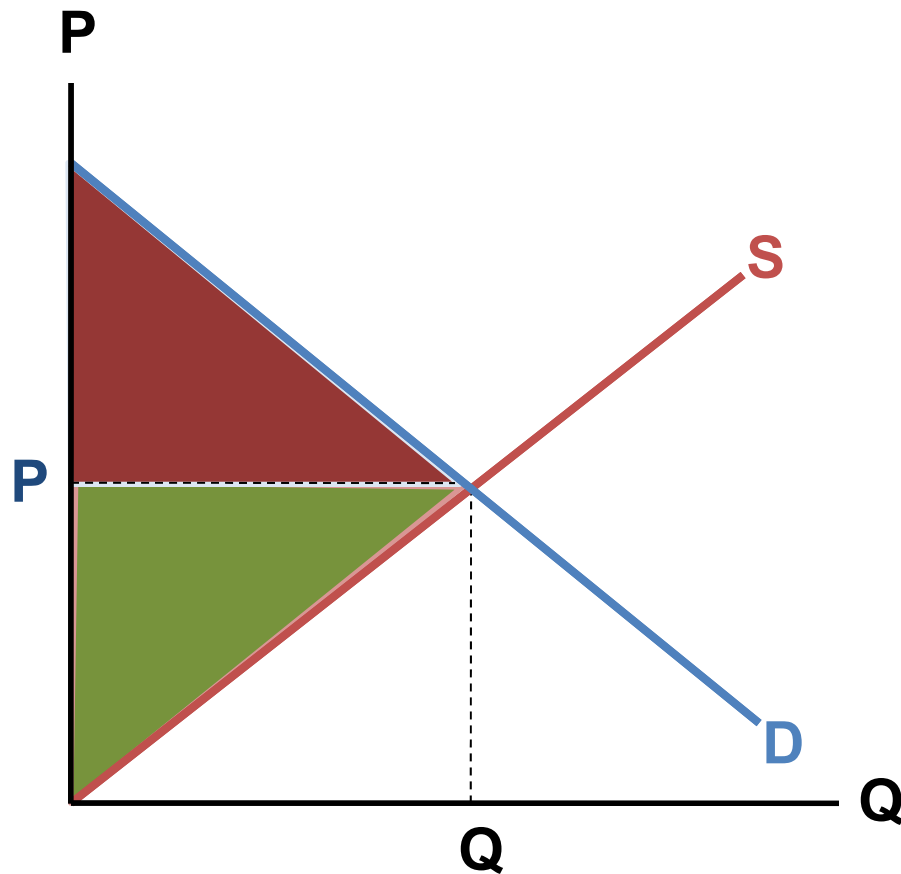
A free market is one without any government control or intervention. The price and output is determined by the interactions of buyers and sellers

However, not all markets are completely free. Governments tend to intervene often to influence several variables in markets for particular goods, such as:

- Taxing the good to discourage consumption or raise revenues: **Indirect taxes**
- Paying producers of the good to reduce costs or encourage the good's production: **Subsidies**
- Reducing the price of the good below its free market equilibrium to benefit consumers: **Price Ceilings**
- Raising the price of a good above its free market equilibrium to benefit producers: **Price Floors**

When governments intervene in the free market, the level of output and price that results is may NOT be the allocatively efficient level. In other words, government intervention may lead to a misallocation of society's resources.

A Free Market



If there is **no tax**, market equilibrium is reached and consumer and producer surplus is maximized

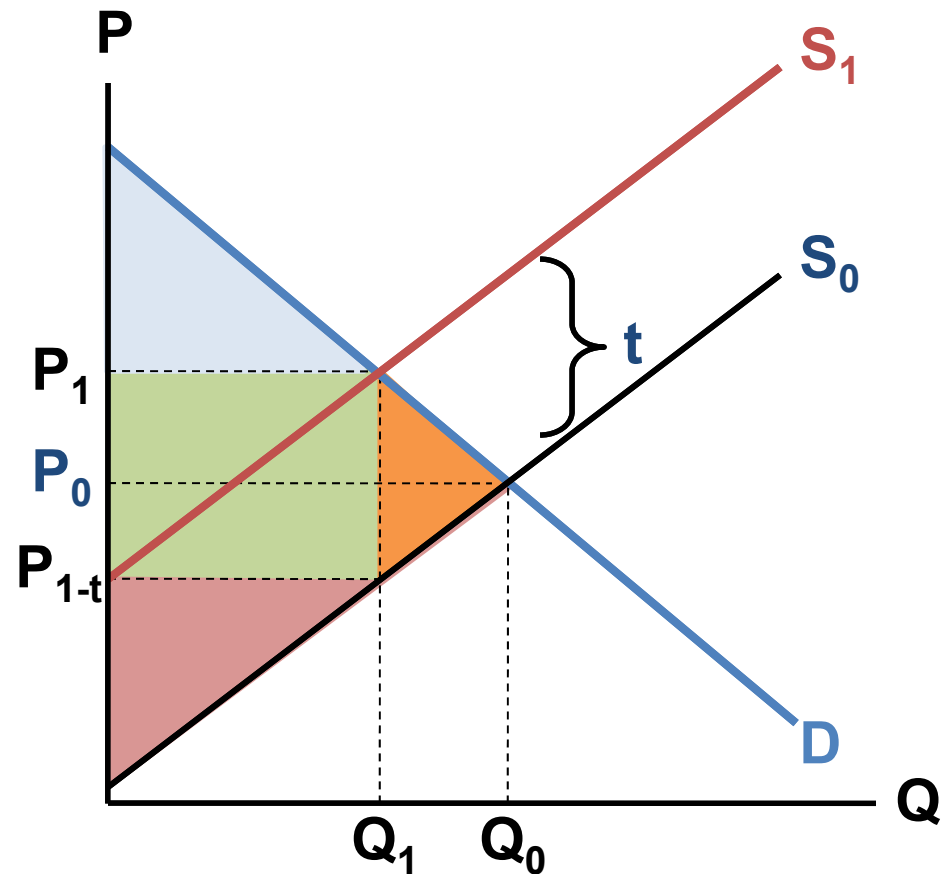
Government Intervention : Tax

A tax paid by the supplier shifts the supply curve up by the amount of the tax ($=t$)

Both producer and consumer surplus decrease

Positive government revenue

Deadweight loss exists



The Costs of Taxation

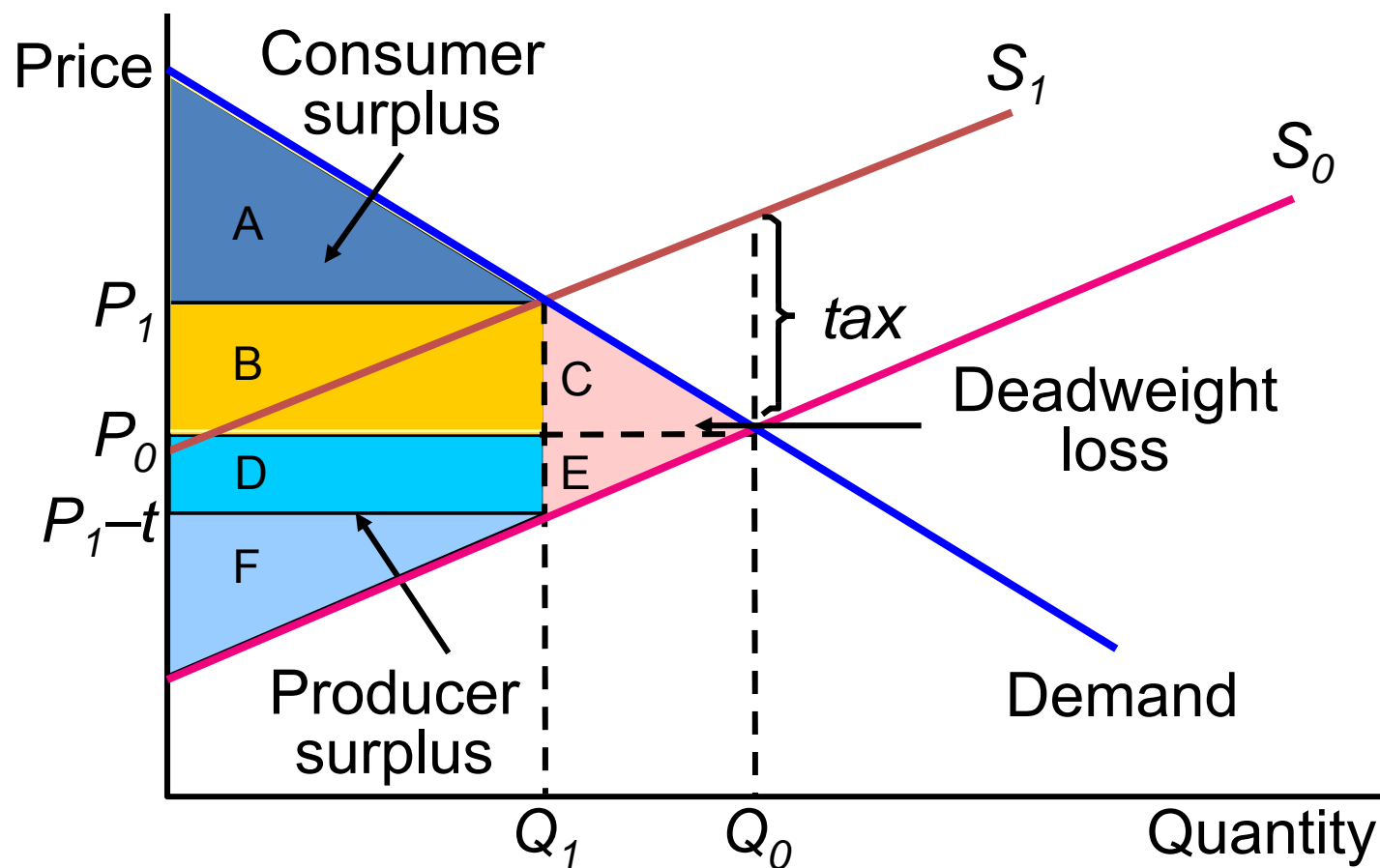
Consumer Surplus Before Tax: $A + B + C$

Consumer Surplus After Tax: A

Producer Surplus Before Tax: $D + E + F$

Producer Surplus After Tax: F

Deadweight Loss: $C + E$



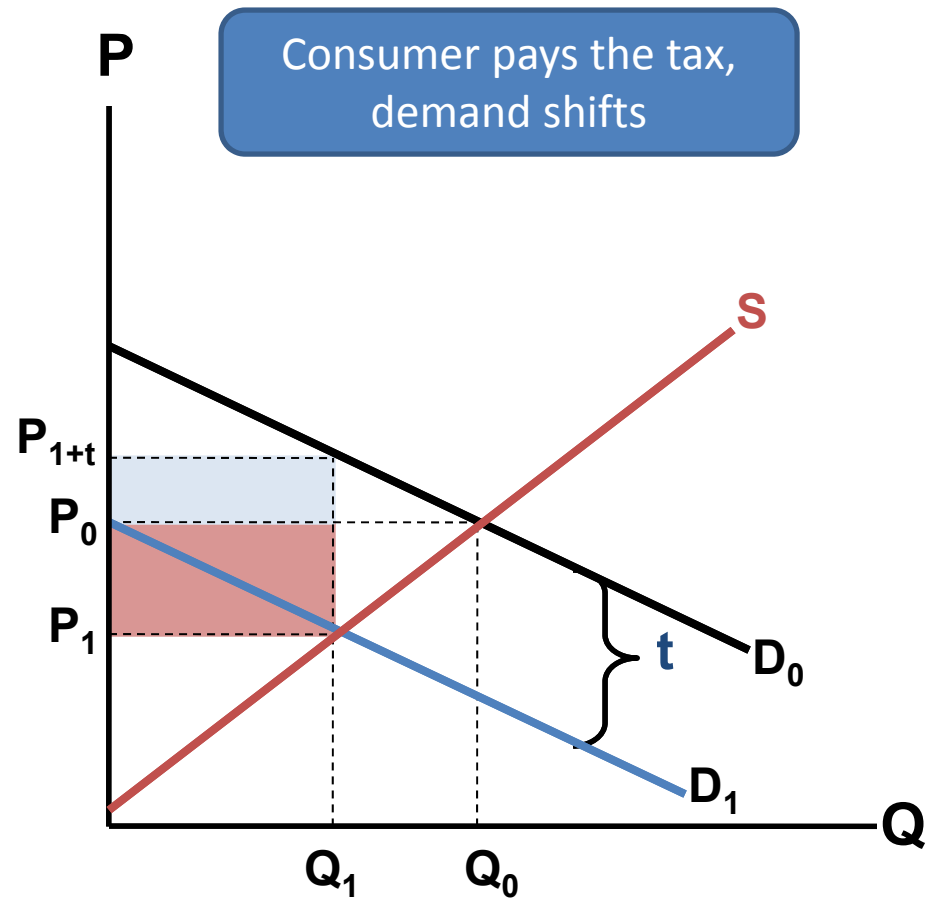
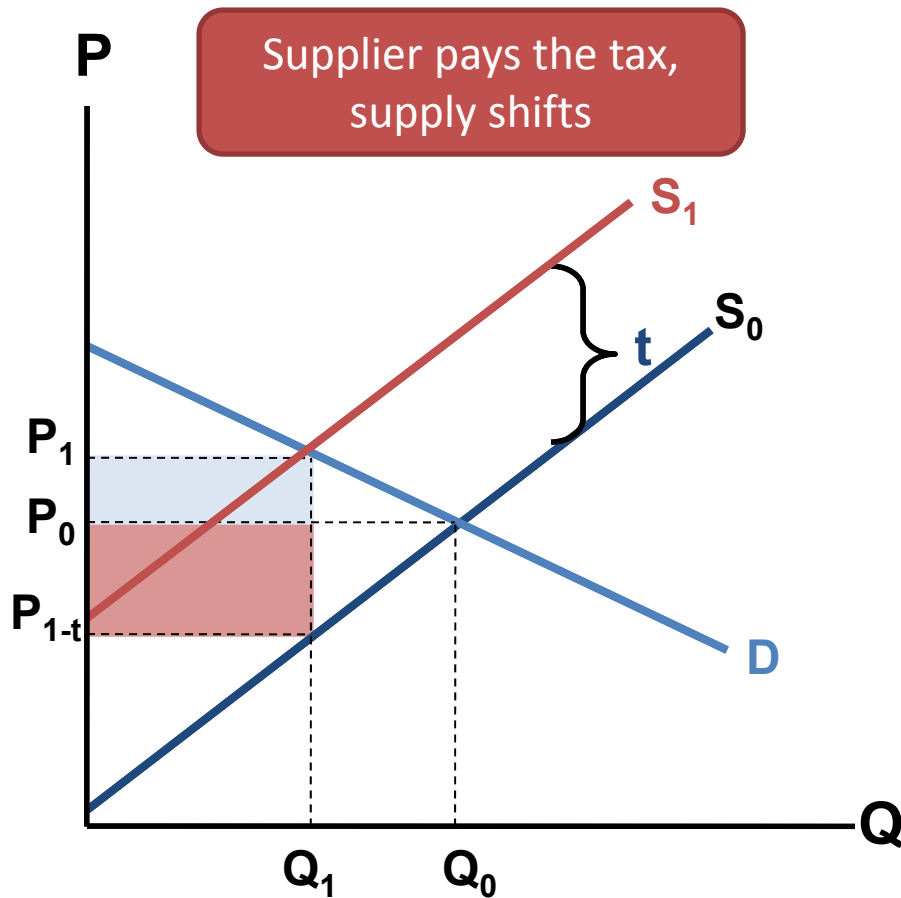
Application: The Costs of Taxation

How do taxes affect the economic well-being of market participants?

- A tax places a wedge between the price, buyers pay and the price, sellers receive.
- Because of this tax wedge, the quantity sold falls below the level that would be sold without a tax.
- The size of the market for that good shrinks.

The Burden of Taxation

The tax burden is *independent* of who pays the tax



The Burden of Taxation

Sales Tax

- Sales taxes are paid by retailers on the basis of their sales revenue
- Since sales taxes are broadly defined to include most goods and services, consumers find it hard to substitute to avoid the tax
- Demand is inelastic so consumers bear the greater burden of the tax
- As consumers increase purchases on the Internet where sales are not taxed, retail stores will bear a greater burden of the sales tax

Social Security Taxes

- Both employer and employee contribute the same percentage of before-tax wages to the Social Security fund
- Although the employer and employee contribute the same percentage, they do not share the burden equally
- On average, labor supply tends to be less elastic than labor demand, so the Social Security tax burden is primarily on employees

What Goods should be Taxed and who bears the Tax?

The Effects of an Indirect Tax and PED

Observations:

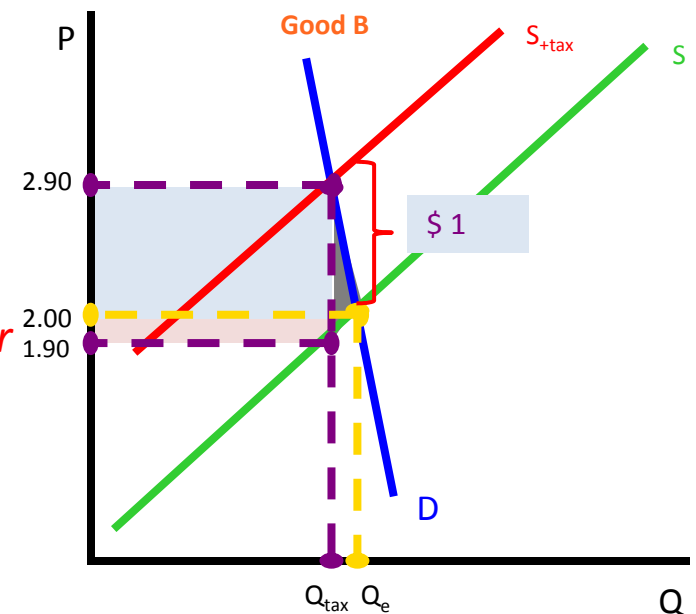
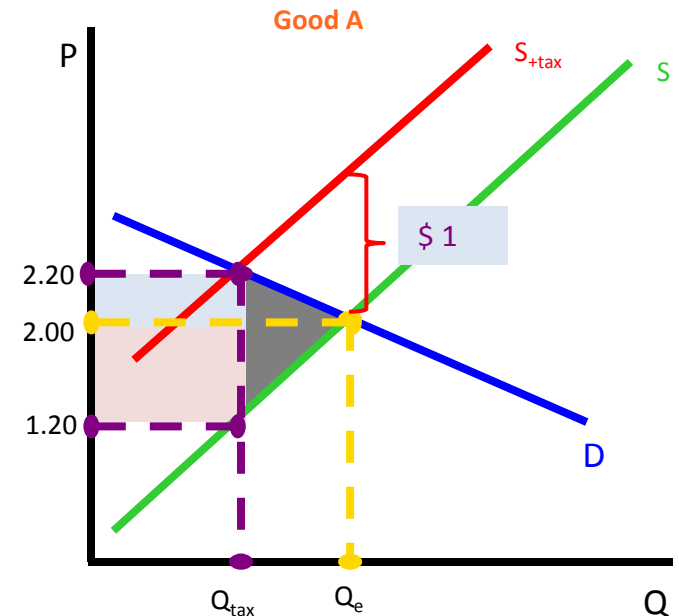
The \$ 1 tax on Good A (highly elastic demand):

- Rs 0.80 is paid by producers, and only \$ 0.20 by consumers
- Quantity falls dramatically.
- The loss of welfare (gray triangle) is large
- Revenue raised is small due to the large decrease in Q

The \$ 1 tax on Good B (highly inelastic demand):

- \$ 0.90 is paid by consumers, and only \$ 0.10 by producers
- Quantity does not fall by much
- The loss of welfare (gray triangle) is small
- Revenue raised is greater than Good A because the quantity does not fall by much

Taxing goods with relatively inelastic demand will raise more revenue and lead to a smaller loss of total welfare, while taxing goods with elastic demand will lead to a larger decrease in quantity and a greater loss of total welfare.



What Goods should be Taxed and who bears the Tax?

- **If demand is relatively elastic:** Producers will bear the larger burden of the tax. Firms will not be able to raise the price by much out of fear of losing all their customers, therefore price will not increase by much, but producers will get to keep less of what consumers pay.
- **If demand is relatively inelastic:** Consumers will bear the larger burden of the tax. Firms will be able to pass most of the tax onto consumers, who are not very responsive to the higher price, thus will continue to consume close to what they were before the tax.
- **Elasticity and government revenue:** The implication for government of the above analysis is that **if a tax is meant to raise revenue, it is better placed on an inelastic good rather than an elastic good**. Taxing elastic goods will reduce the quantity sold and thus not raise much revenue.

What Goods Should Be Taxed and who bears the Tax?

Goal of Government	Most effective when
Raise revenue, limit deadweight loss	Demand or supply is <i>inelastic</i>
Change behavior	Demand or supply is <i>elastic</i>

Elasticity	Who bears the burden?
Demand <i>inelastic</i> and supply <i>elastic</i>	Consumers
Supply <i>inelastic</i> and demand <i>elastic</i>	Producers
Both supply and demand <i>elastic</i>	Shared, but the group whose S or D is more <i>inelastic</i> pays more

Incidence of Tax

The Effects of an Indirect Tax in Linear Supply Equations

A tax is an additional cost place on producers in a market. Therefore, a tax will affect the supply curve AND the supply equation.

- One way to think about a tax is that it is a payment made by the producers to the government of a particular amount AFTER consumers have bought the good.
- Therefore, to show the effect of a tax on a supply equation, we must subtract the amount of the tax from the price consumers paid.

Consider the supply of bread in a small town: $Q_s = -200 + 150P$

Assume a \$1 tax is imposed on bread producers. This means that whatever consumers pay (P), producers will keep \$1 less. The new supply equation is therefore:

$$Q_s = -200 + 150(P - 1)$$

This can be simplified:

$$Q_s = -200 + 150P - 150$$

The new supply of bread is:

$$Q_s = -350 + 150P$$

Incidence of Tax

The Effects of an Indirect Tax in Linear Supply Equations

A \$1 tax on the production of bread cause the supply to decrease.

The new supply of bread is:

$$Q_s = -350 + 150P$$

Notice:

- The 'c' variable in the equation decreased. This is the Q-intercept of supply, which is now lower on the Q axis, meaning supply has shifted to the left by 150 units, or up by \$1.
- The 'd' variable has not changed. The tax does not change the *responsiveness* of producers to price changes. They will still supply 150 more loaves for every \$1 increase in price.

Calculating the effect of a tax on equilibrium: Assume demand for bread is: $Q_d = 600 - 50P$

- The tax has no effect on demand, only supply.

Before the tax:	$600 - 50P = -200 + 150P$ $800 = 200P$ $P = \$4$ $Q_d = 600 - 50(4)$ $Q_d = 400$	After the tax:	$600 - 50P = -350 + 150P$ $950 = 200P$ $P = \$4.75$ $Q_d = 600 - 50(4.75)$ $Q_d = 237.5$
------------------------	--	-----------------------	--

Incidence of Subsidy

The Effects of a Per-unit Subsidy in Linear Supply Equations

A subsidy is a payment to producers *for each unit produced*, therefore it reduces the costs of producing each unit of goods. Lower costs increase supply and affect the supply equation

- One way to think about a subsidy is that it is a payment to producers above and beyond the price consumers have to pay.
- Therefore, to show the effect of a subsidy on a supply equation, we must ADD the amount of the subsidy to the price consumers paid.

Consider the supply of bread in a small town: $Q_s = -200 + 150P$

Assume a \$1 subsidy is provided to bread producers. This means that whatever consumers pay (P), producers will receive \$1 more. The new supply equation is therefore:

$$Q_s = -200 + 150(P + 1)$$

This can be simplified:

$$Q_s = -200 + 150P + 150$$

The new supply of bread is:

$$Q_s = -50 + 150P$$

Incidence of Subsidy

The Effects of a Per-unit Subsidy in Linear Supply Equations

A \$1 subsidy to the producers of bread causes the supply to increase.

The new supply of bread is:

$$Q_s = -50 + 150P$$

Notice:

- The 'c' variable in the equation increased. This is the Q-intercept of supply, which is now closer to the origin on the Q axis, meaning supply has shifted to the right by 150 units
- The 'd' variable has not changed. The subsidy does not change the *responsiveness* of producers to price changes. They will still supply 150 more loaves for every \$1 price increase

Calculating the effect of a tax on equilibrium: Assume demand for bread is: $Q_d = 600 - 50P$

- The tax has no effect on demand, only supply.

Before the subsidy:	$600 - 50P = -200 + 150P$ $800 = 200P$ $P = \$4$ $Q_d = 600 - 50(4)$ $Q_d = 400$	After the subsidy:	$600 - 50P = -50 + 150P$ $650 = 200P$ $P = \$3.25$ $Q_d = 600 - 50(3.25)$ $Q_d = 437.5$
------------------------	--	-----------------------	---

The Effects of Taxes and Subsidies on Consumers and Producers

The Effects of Taxes and Subsidies on Consumers and Producers

We can determine how much of the tax burden was born by consumers and producers:

Effect of the tax

- The price increased from \$4.00 to \$4.75, meaning consumers paid \$0.75 of the \$1.00 tax.
- Producers got to keep just \$3.75, meaning they paid just \$0.25 of the \$1.00 tax

Effect of the subsidy:

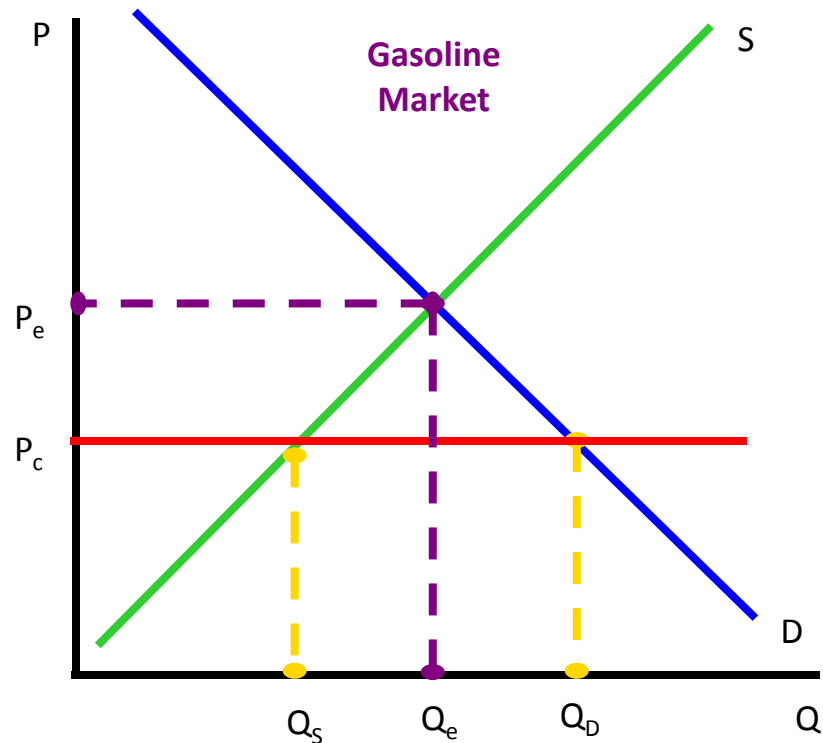
- Price went down from \$4.00 to \$3.25, meaning consumers received \$0.75 of the \$1.00 subsidy.
- Producers received \$4.25, meaning they enjoyed \$0.25 of the \$1.00 subsidy.

Before the tax and the subsidy:	$600 - 50P = -200 + 150P$ $800 = 200P$ $P = \$4$ $Qd = 600 - 50(4)$ $Qd = 400$	After the tax:	$600 - 50P = -350 + 150P$ $950 = 200P$ $P = \$4.75$ $Qd = 600 - 50(4.75)$ $Qd = 237.5$
		After the subsidy:	$600 - 50P = -50 + 150P$ $650 = 200P$ $P = \$3.25$ $Qd = 600 - 50(3.25)$ $Qd = 437.5$

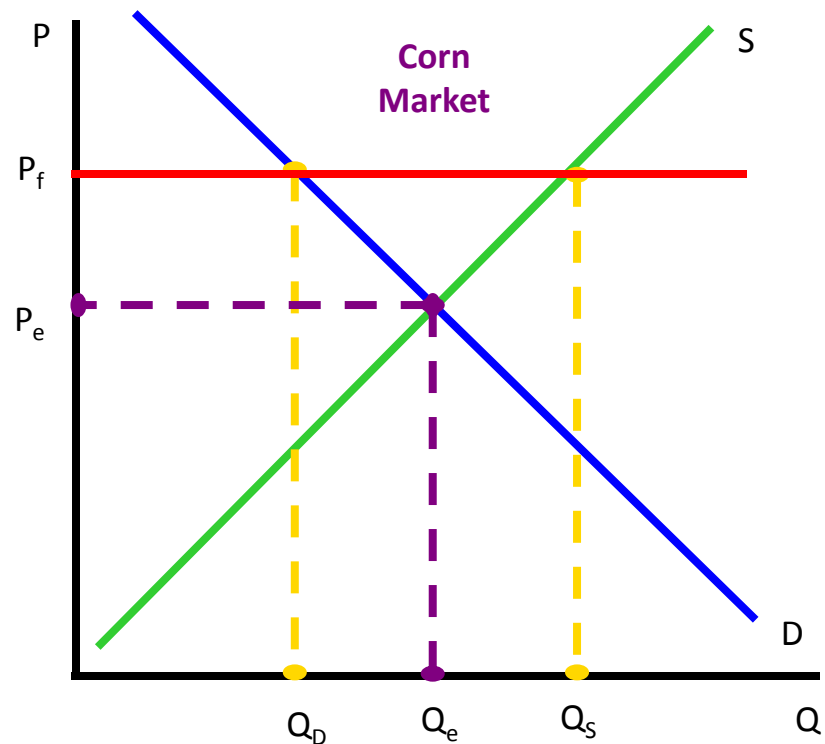
Price Controls

Price Controls: Another form government intervention might take in a market is price controls.

Price Ceiling: This is a maximum price, set below the equilibrium price, meant to help consumers of a product by keeping the price low.



Price Floor: This is a minimum price, set below the equilibrium price, meant to help producers of a product by keeping the price high.



The Effects of a Price Ceiling

When a government lowers the price of a good to help consumers, there are several effects that we can observe in the market. Assume the government has intervened in the market for gasoline to make transportation more affordable for the nation's households

On consumers:

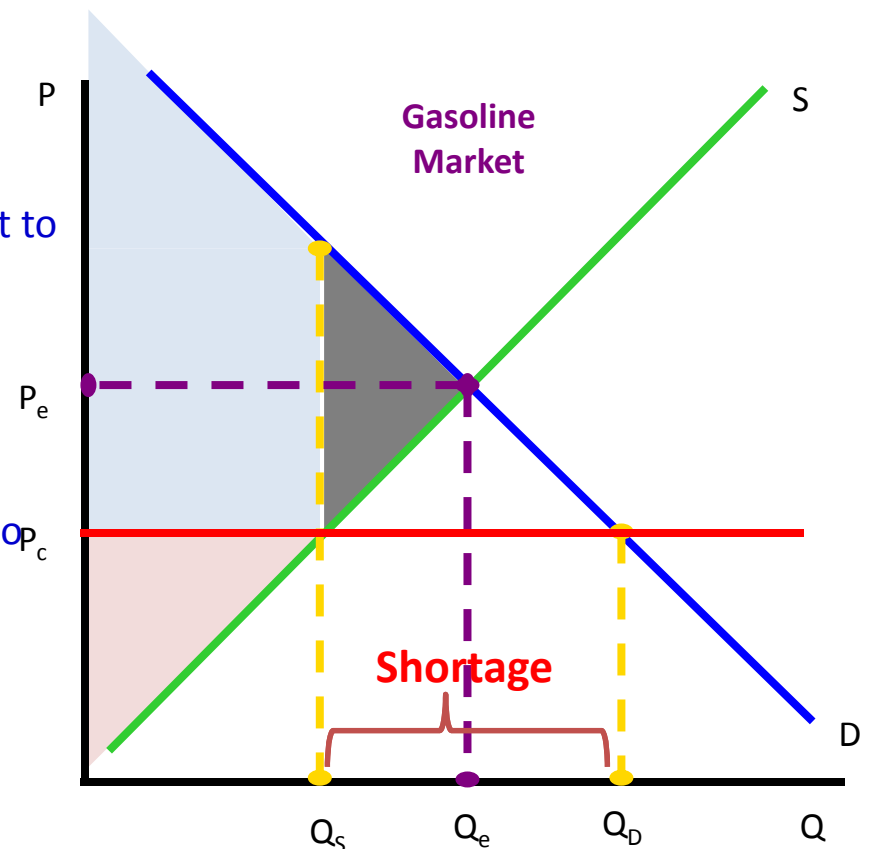
- Quantity demanded increases (Q_d)
- The lower price leads to an increase in consumer surplus, which is now the blue area
- The lower quantity means some consumers who want to will not be able to buy the good

On Producers:

- The lower price means less producer surplus (red triangle)
- The lower quantity means some producers will have to leave the market and output will decline (Q_s)

On the market:

- Overall, not enough gasoline is produced, and the market is allocatively inefficient. The gray triangle represents the loss of total welfare resulting from the price ceiling.



The Effects of a Price Ceiling

Calculating the Effects of Price Controls using Linear Equations

As with taxes and subsidies, we can use linear supply and demand equations to calculate the effects of price ceilings and price floors. Once again, assume demand and supply for bread is:

$$Q_d = 600 - 50P \text{ and } Q_s = -200 + 150P$$

As we have already shown, the current equilibrium price is \$4 and the quantity is 400 loaves.

Assume the government wishes to help households afford bread, so imposes a price ceiling of \$3 on bread. To determine the impact on the market, we must simply put \$3 into both equations.

$$\begin{aligned} Q_d &= 600 - 50(3) = 450 \text{ loaves} \\ Q_s &= -200 + 150(3) = 250 \text{ loaves} \end{aligned}$$

The \$3.00 price ceiling will create a shortage of 200 loaves of bread.

- Producers will reduce their output of bread and more consumers will wish to buy bread.
- The price ceiling took a market that was *efficient* and made it *inefficient*. *Not enough resources are allocated towards bread production as a result of the price ceiling.*

The Effects of a Price Floor

When a government raises the price of a good to help producers, there are several effects that we can observe in the market. Assume the government has intervened in the market for corn to help farmers sell their crop at a price that allows them to earn a small profit.

On consumers:

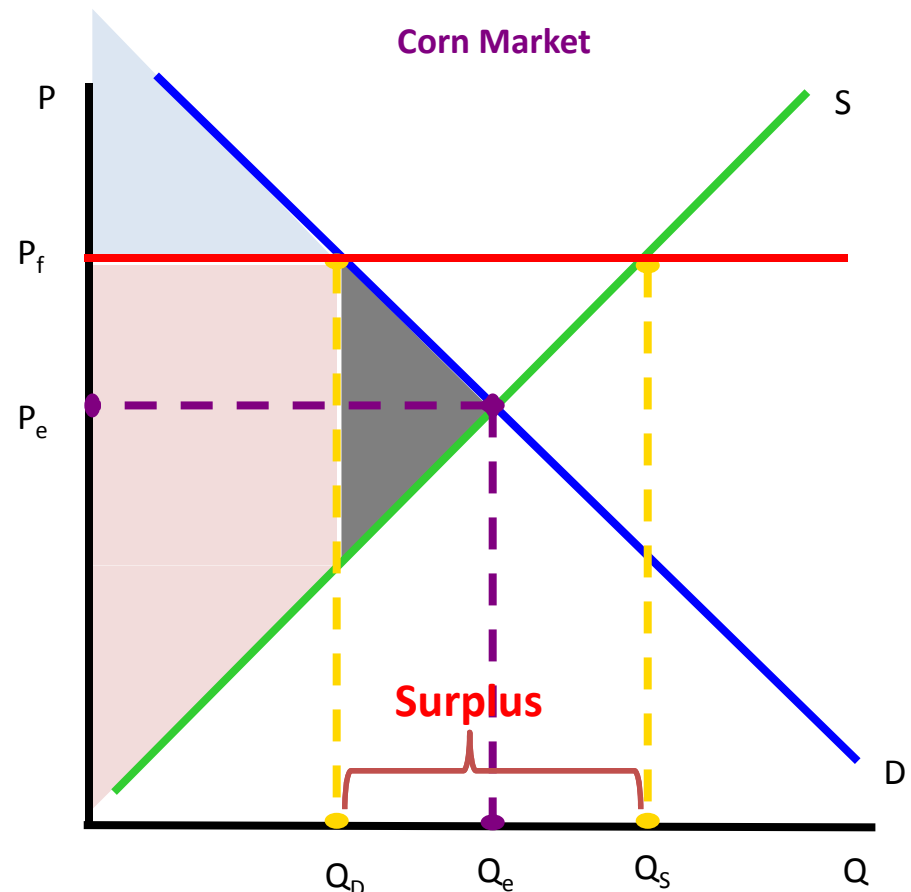
- Quantity demanded decreases (Q_d)
- The higher price means there is less consumer surplus (blue area)

On Producers:

- Quantity supplied increases (Q_s)
- The higher price means there is more producer surplus, but since consumers only demand Q_d , there is an excess supply of unsold corn ($Q_d - Q_s$)

On the market:

- Overall, the market produces too much corn and is thus allocatively inefficient. The increase in producer surplus is smaller than the decrease in consumer surplus. The total loss of welfare is represented by the gray triangle.



The Effects of a Price Floor

Calculating the Effects of Price Controls using Linear Equations

Next, assume that the government determines that \$4 is too cheap for bread, and producers need the price to be higher. The government imposes a price floor of \$5 in the market. To determine the impact on the market, we must simply put \$5 into both equations.

$$Q_d = 600 - 50(5) = 350 \text{ loaves}$$
$$Q_s = -200 + 150(5) = 550 \text{ loaves}$$

The \$5.00 price floor will create a surplus of 200 loaves of bread.

- Producers will increase their production of bread to take advantage of the now higher prices it is commanding in the market.
- Consumers will reduce the quantity of bread they demand due to the now higher price.
- The price floor took an efficient market and made it allocatively inefficient. *Too many resources are now being allocated towards bread production!*

Conclusion: Price controls rarely increase efficiency or total welfare in a market. They result in either shortages (price ceilings) or surpluses (price floors), and therefore lead to a net loss in total welfare for society. Some benefit, but many suffer.