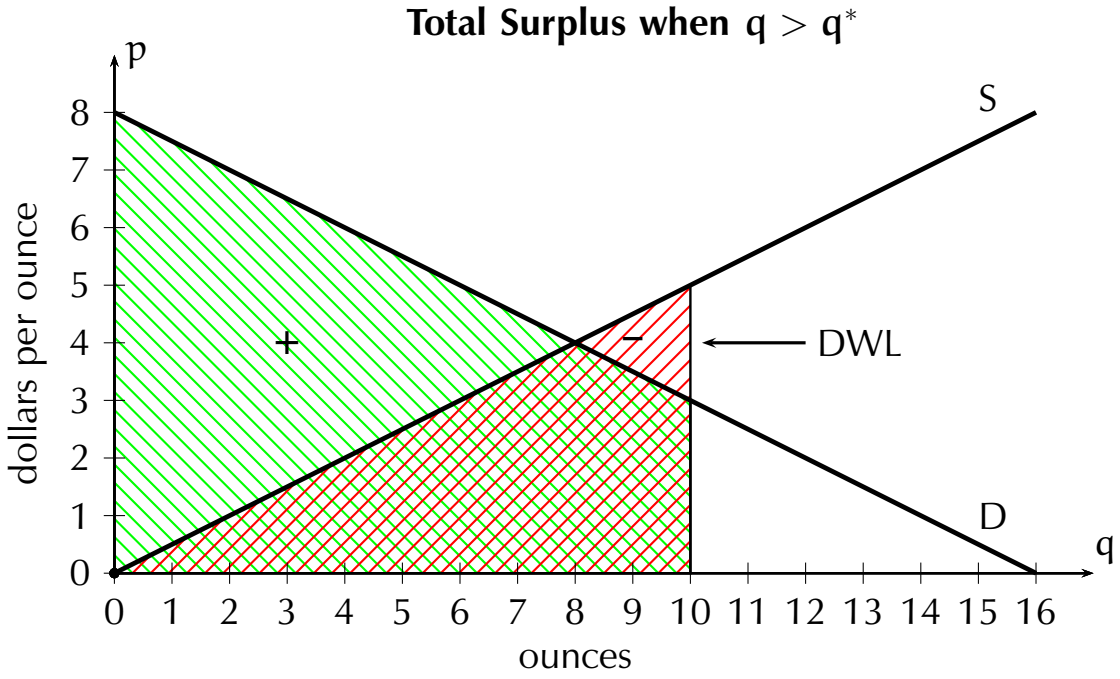
Intermediate Microeconomics — Week 3

Professor Boyd **Sept. 6 & 8, 2022**

3.4.4 Maximizing Total Surplus II

09/06/22

Now let's try trading a quantity greater then q^*. What happens to total surplus? Since $q^* = 8$, let's try $q = 10$.



The benefits here are \$32 ($\frac{1}{2} \times 8 \times 8$) and the uncancelled costs are \$2 ($\frac{1}{2} \times 2 \times 2$) for a total surplus of \$30, less than we got with the equilibrium quantity.

Recall that at the market quantity of 8 and price of 4, consumer's surplus is $\frac{1}{2}(8-4) \times 8 = 16$ and producer's surplus is $\frac{1}{2}(4-0) \times 8 = 16$, for a total surplus of \$32.

The deadweight loss is the reduction in surplus, \$2.

Putting the two cases together shows that the market equilibrium quantity is the efficient quantity, the quantity that maximizes total surplus.

3.4.5 The Meaning of Deadweight Loss

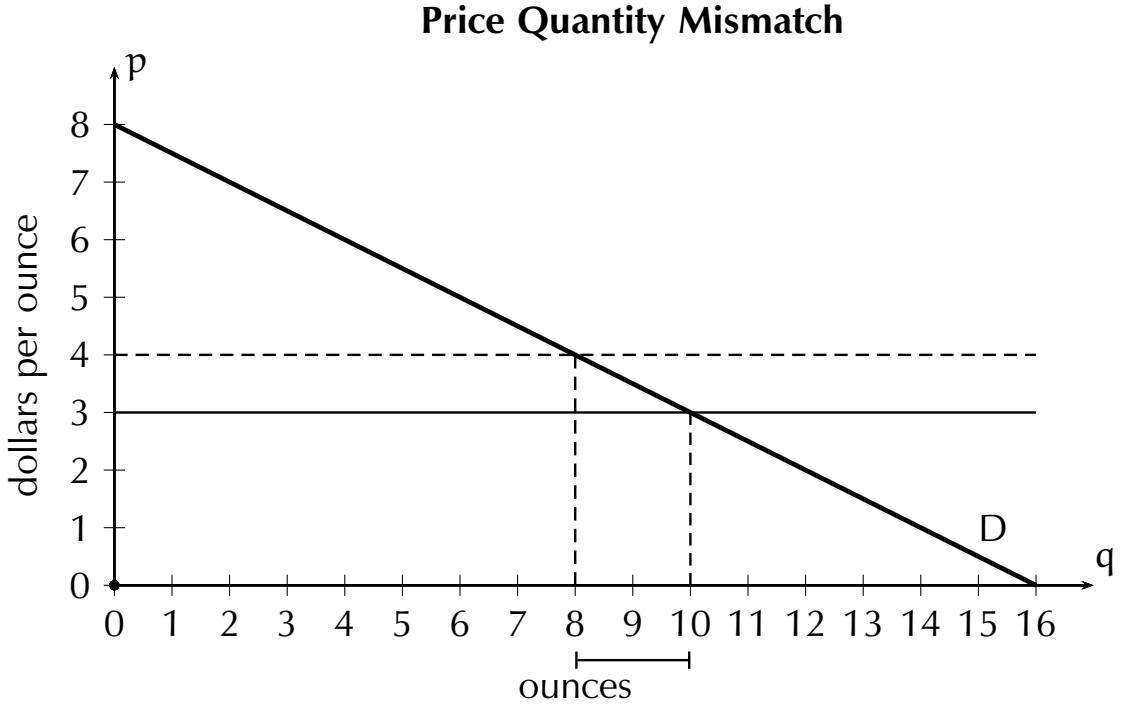
The **deadweight loss** measures the gap (in dollars) between the the largest possible surplus and the surplus we actually get.

There are two main ways to generate deadweight loss.

1. Beneficial Trades Not Made. Whenever there are buyers willing to buy for a price higher than some sellers are willing to accept, there is a deadweight loss.
2. Trades Made that are Too Costly. If some buyers who obtain the good value it at less than the sellers, there is a deadweight loss.

3.4.6 What if Price and Quantity Don't Match?

Let's consider the same demand and supply curves, together with the equilibrium quantity traded, $q^* = 8$, but where consumer's face a price different from $p^* = 4$. So suppose they face $p_d = 3$, in which case the quantity demanded is 10 while quantity supplied remains at 8.



Because there are only 8 ounces available at a price of \$4 per ounce, some consumers who want to buy, cannot buy. There is an excess demand, a shortage, of 2 ounces.

What determines who gets to buy? Is it first come first serve? Or perhaps a question of who knows those distributing the good? Or is there some arbitrary rule, such as allowing those whose surnames start with A–M, have priority? None of these methods ensure that those who value this product the most end up buying it. It is **likely** that some who value it at less than \$4 per ounce will buy it. In that case, the surplus is **less than calculated** from the diagram.

3.4.7 What if the Price is Too High?

If instead the price is 5, there will be excess supply, some of the sellers won't be able to sell. We would have to force people to buy the product, as was tried with Obamacare. Again, there is no way to make sure those who value the product the most (but at less than $5) are those forced to buy it. Again, the surplus is **less than calculated** from the diagram.

The upshot of all this is that unless we get **both** the price and quantity right, there will be inefficiency. The gains from trade will not be the maximum possible.

In the situations analyzed later, we will often have either buyers or sellers with price-quantity combination that is off the demand curve (maybe both!). We should recall that the actual surplus will less than than the calculated surplus because of these issues.

Besides measuring the gains from trade, surplus measures can also be used to identify winners and losers from various government policies.

3.5 Effects of Price Controls

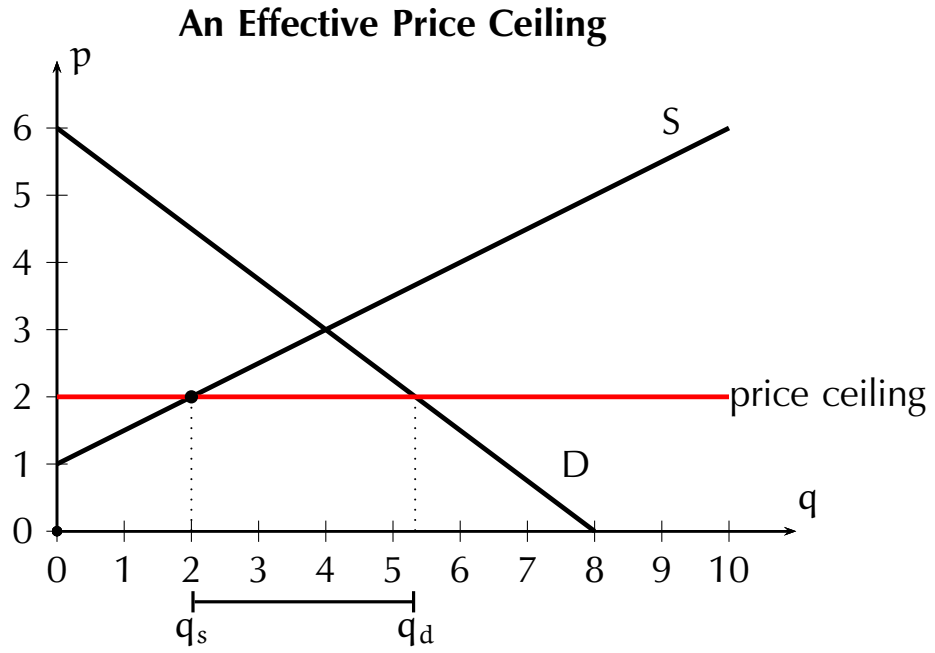
Price controls are legal limitations on prices. There are two main forms: price ceilings and price floors. A **price ceiling** is an upper limit on the price that can legally be charged or paid. A **price floor** is a lower limit of the price that can be changed or paid.

Federal price ceilings were widely used during World War II, and also for a period during the Nixon administration, beginning Aug 15, 1971. Rent controls are one of the most common forms at present, but laws banning "price gouging" can have a similar effect during crises such as hurricanes. Minimum wage laws are a widely price floor in the US.

3.5.1 Effects of Price Ceilings

A price ceiling is **effective** if the ceiling price is below the market equilibrium price. If the ceiling price is above the market equilibrium it will not have an effect on the market unless economic conditions change and raise the price above the ceiling.

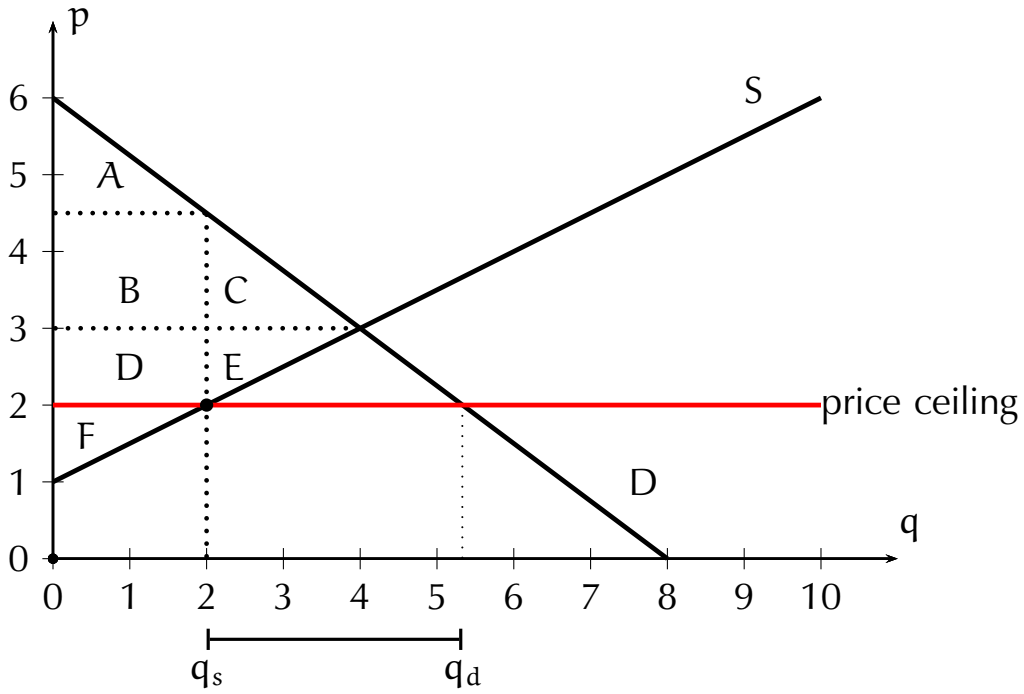
Effective price ceilings cause excess demand, shortages. In the diagram below, the equilibrium price is $p^* = \$3$ and the ceiling price is \$2. Although the excess demand puts pressure on the price to rise above \$2, legal constraints prevent that, causing a persistent shortage.



3.5.2 Dividing the Diagram for a Price Ceiling

Since the buyers can't buy more than is supplied for sale, the short side of the market (the sellers) determines the quantity, $q_s = 2$. The equilibrium with the price ceiling is at $(2, 2)$. To compute and compare the surpluses with the equilibrium surpluses, we designate a number of regions.

Subdividing the Surplus

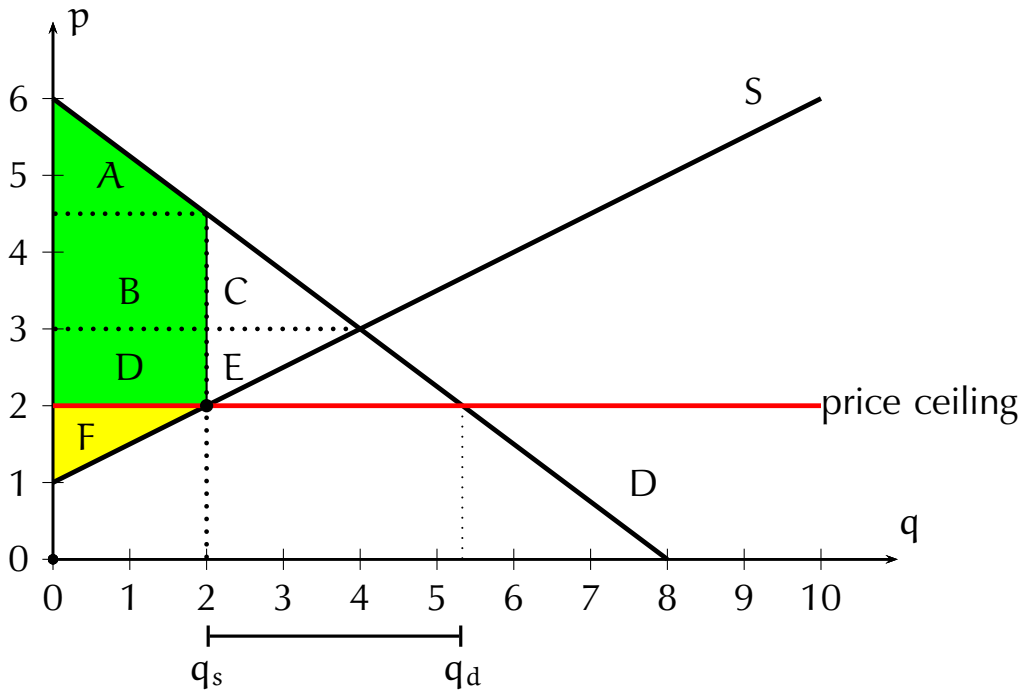


When we started examining the effects of price ceilings. We found effective price ceilings lead to persistent excess demand, persistent shortages. We started a welfare analysis of price ceilings to examine its effects on consumer's and producer's surplus. The next two slides reprise the beginning of that analysis.

3.5.3 Surpluses with a Price Ceiling

The consumer's surplus is the area below the demand curve and above the price ceiling. I've shaded it in green. It is areas A + B + D. Now triangle A has area \$1.50 and rectangle B+D has area \$5, so CS = \$6.50. The producer's surplus is the yellow triangular area below the price ceiling and above the supply curve. PS = F = \$1. Total surplus is \$7.50.

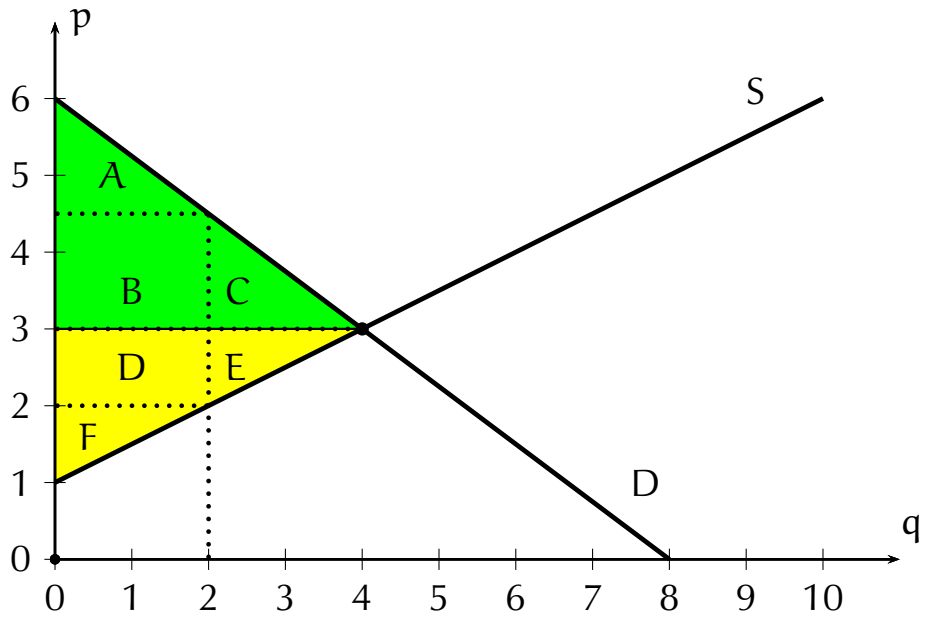
CS and PS with a Price Ceiling



3.5.4 Surplus without a Price Ceiling

The consumer's surplus is shown in green, and consists of the triangular area A + B + C, so CS = \$6. The producer's surplus is in yellow. It is the triangular area D + E + F, so PS = \$4. Total surplus is \$10, the maximum possible. Comparing with the price ceiling case, we see that the price ceiling causes a deadweight loss of \$10 − \$7.50 = \$2.50.

CS and PS without a Price Ceiling



As is often the case in welfare problems, the surplus that is lost represents trades not made due to the intervention—the price ceiling. Only 2 units of X are with the ceiling, 4 units without. They generate a total surplus of C + E = \$2.50, no one gets that surplus if there is a price ceiling. It is the deadweight loss due to the price ceiling.

3.5.5 Welfare Analysis of Price Ceilings

We now carry out a basic welfare analysis, examining the gains or losses of buyers and sellers.

	With Ceiling	Without Ceiling	Difference
CS	\$6.50	\$ 6.00	+\$0.50
PS	\$1.00	\$ 4.00	−\$3.00
TS	\$7.50	\$10.00	−\$2.50

As you can see, the price ceiling increased consumer's surplus, but decreased producer's surplus. Overall, the ceiling decreased economic welfare, meaning that total surplus was decreased.

You should be careful here. The consumer's surplus with the ceiling is only an upper bound because we are **off the demand curve**. It may actually be less. This is not a problem for supply, as the modified market equilibrium remains on the supply curve.

3.5.6 Long-run Effects of Price Ceilings

The above welfare analysis shows the short-run effect of a price ceiling. That is not the end of the story, as there are also longer run effects.

Price ceilings lead to a reduction in price, which tends to drive firms out of the market. This reduces supply in the long-run. The effects can be substantial. Diamond et al. studied this issue in the San Francisco area.[1]

Here's the abstract of their paper: "Using a 1994 law change, we exploit quasi-experimental variation in the assignment of rent control in San Francisco to study its impacts on tenants and landlords. Leveraging new data tracking individuals' migration, we find rent control limits renters' mobility by 20 percent and lowers displacement from San Francisco. Landlords treated by rent control reduce rental housing supplies by 15 percent by selling to owner-occupants and redeveloping buildings. Thus, while rent control prevents displacement of incumbent renters in the short run, the lost rental housing supply likely drove up market rents in the long run, ultimately undermining the goals of the law."

Their analysis points to one of the additional costs to renters in the long-run. One is that it decreases their ability to move, both because they would give up the benefit of lower rent, and partly because of difficulties finding rental housing in a possible new location if it is also rent-controlled. This sometimes means turning down promising job opportunities, leading to permanently lower wages.

[1] Rebecca Diamond, Tim McQuade, and Franklin Qian (2019) Landlords, and Inequality: Evidence from San Francisco, American Economic Review **109**: 3365–3394.

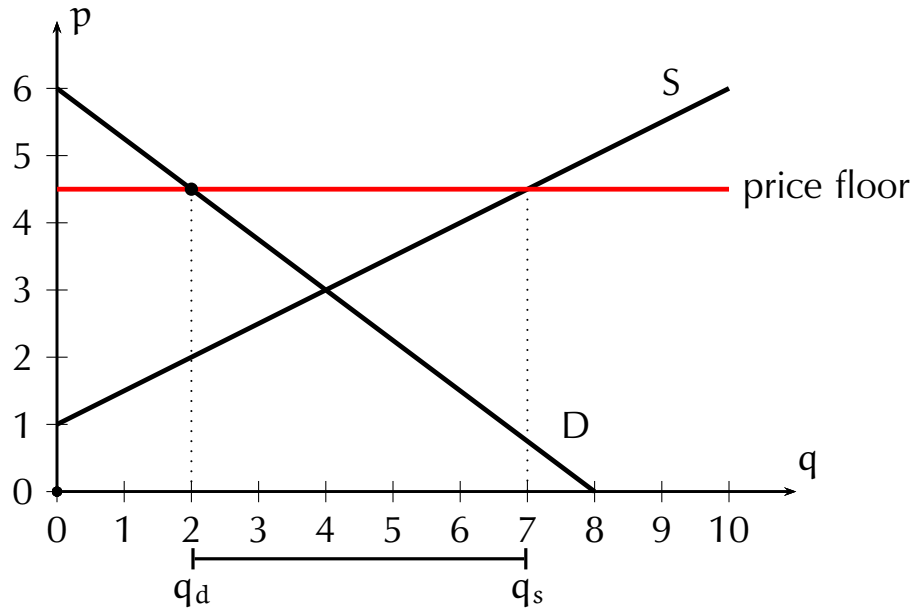
3.5.7 Effect of Price Floors

A price floor is **effective** if the floor price is above the market equilibrium price. If the floor price is below the market equilibrium it will not have an effect on the market unless economic conditions change and raise the price to be above the floor.

Effective price floors cause excess supply, surpluses. In the diagram below, the equilibrium price is $p^* = \$3$ and the floor price is \$4.50. Although the excess supply puts pressure on the price to fall below \$4.50, legal constraints prevent that, causing a persistent excess supply—a persistent surplus.

Again, the short side of the market determines the quantity. Here demand is the short side and the quantity is 2. The quantity supplied is 7, so the excess supply is $7 - 2 = 5$.

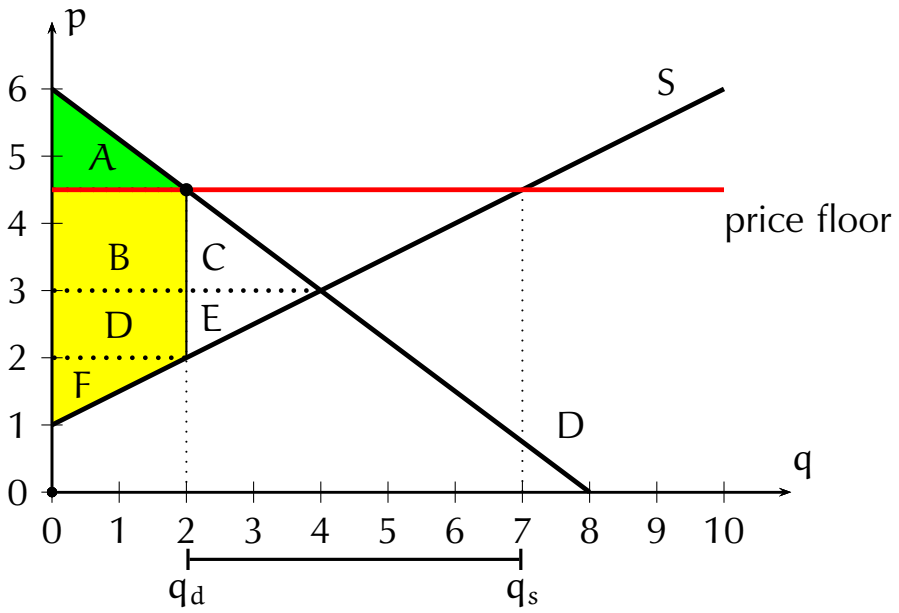
Effect of a Price Floor



3.5.8 Surpluses with a Price Floor

The consumer's surplus is the area below the demand curve and above the price ceiling. I've shaded it in green. It is the triangular area AD. Now triangle A has area CS = \$1.50. The producer's surplus is the yellow area below the price ceiling and above the supply curve. PS = B + D + F. The rectangle B + D has area \$5 and the triangle F has area \$1, yielding a producer's surplus of \$6. This means that total surplus is \$7.50.

Price Floor: Finding the Surpluses



3.5.9 Total Surplus Unaffected by Price, Again

Here total surplus is the same as in the price ceiling example because we have the same demand and supply curves, and the quantity traded is the same.

The change in price does not affect the surplus under the optimistic assumptions that only those who demand the product most actually buy it (for ceilings) and that the lowest cost producers actually sell it (for floors).

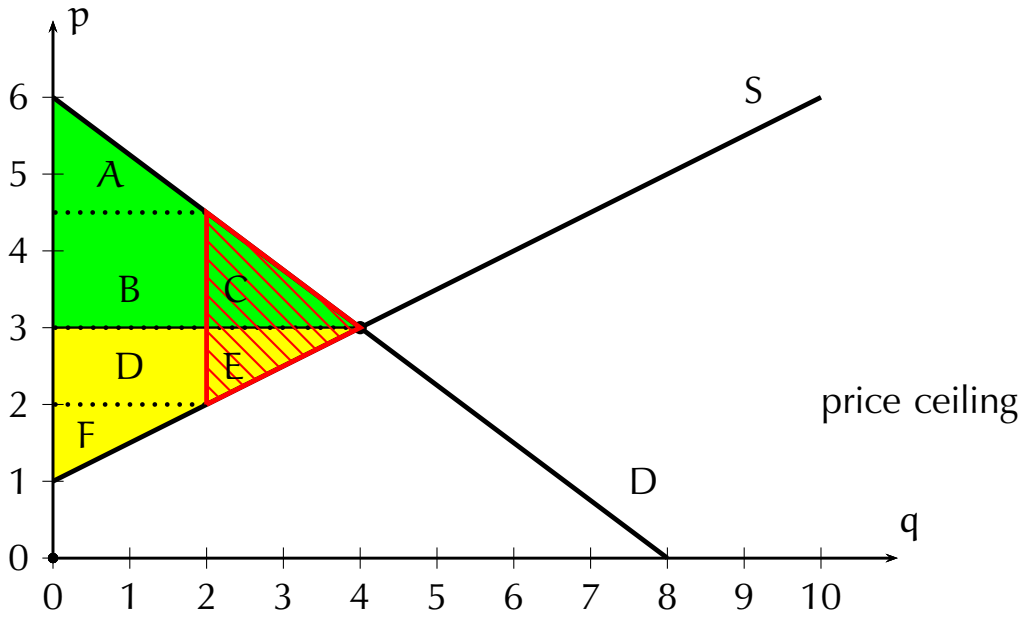
Under more realistic assumptions, the actual surpluses will differ for the side of the market that is not on their supply or demand curve. In the price ceiling case it is unlikely that the consumers who buy are all the ones who value the product most highly. Some of those with high valuations will miss out and the actual consumer's surplus will be lower.

In the price floor case, some of the higher cost producers will end up selling and some lower cost producers will not sell. This lowers the actual producer's surplus below $6.

3.5.10 Deadweight Loss from a Price Floor

As before, the deadweight loss is the difference between the maximum possible surplus of \$10, as seen on page 9 (aka section 3.5.4) and the total surplus with the price floor \$7.50. This is illustrated on the diagram, where the deadweight loss is the red hatched triangle C + E. Either way you calculate it, we find DWL = \$2.50.

Price Floor: Deadweight Loss



3.5.11 Welfare Analysis of Price Floors

We now carry out a basic welfare analysis, examining the gains or losses of buyers and sellers.

	With Floor	Without Floor	Difference
CS	\$1.50	\$ 6.00	−\$4.50
PS	\$6.00	\$ 4.00	+\$2.00
TS	\$7.50	\$10.00	−\$2.50

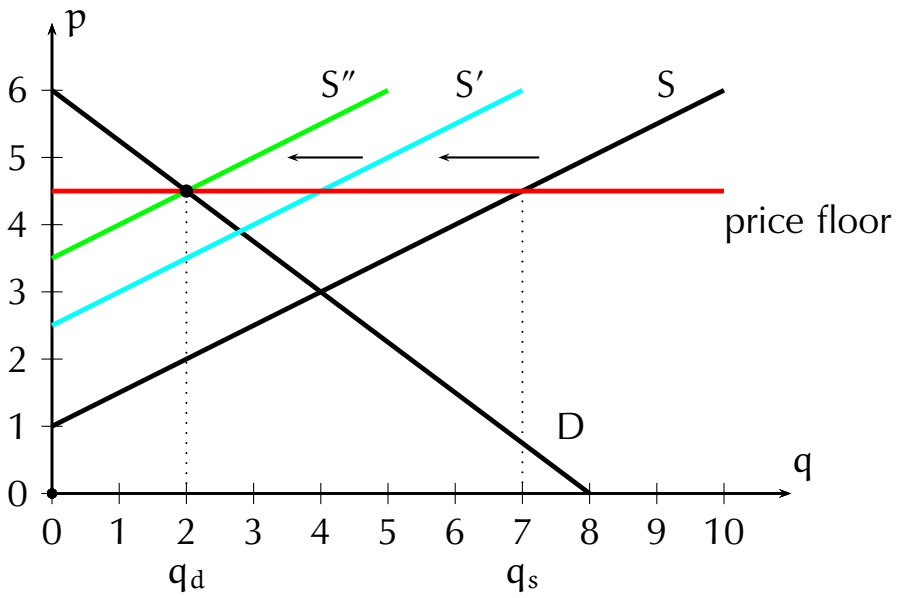
As you can see, the price floor decreased consumer's surplus, but increased producer's surplus. Compared with price ceilings, the pattern has reversed. Suppliers gain, buyers lose. Overall, the price floor decreased economic welfare, meaning that total surplus was decreased.

You should be careful here. The producer's surplus with the floor is only an upper bound because we are off the supply curve. It may actually be less. This is not a problem for demand, as the market is still on the demand curve.

3.5.12 Long-run Effects of Price Floors

Firms will not stay in markets if they can't sell their product. In most markets price floors like those above will cause firms to lose money because of a lack of customers. They respond by leaving the market. This reduces supply, and starts moving the market toward equilibrium. This is illustrated in the diagram below as S shifts to S' and S''.

Price Floor: Long Run



As a result, removing the floor may not significantly lower the price.

3.5.13 Minimum Wages as a Price Floor 09/08/22

We usually think of firms as the suppliers and individuals as the buyers. That is not the case in labor markets. There individuals offer their labor services for sale, and firms do much of the buying. Sometimes, individuals are on both sides of the market, as when homeowners buy cleaning or maintenance services from self-employed workers.

Either way, the supply of labor here comes from individuals who often need money to support themselves and their families. They don't necessarily stay in the market when it is difficult to find work, but they often do. The minimum wage can cause involuntary unemployment as it serves as a price floor.

Although there are federal, state, and even local minimum wages, they are not a cause of large-scale unemployment because they cover only a small part of the labor force.

3.5.14 Minimum Wages in the US

The US Bureau of Labor Statistics releases an annual report describing minimum wage workers in the US. The most recent report is *Characteristics of minimum wage workers, 2021*.

The current **federal** minimum wage is $7.25 per hour, although many states and localities have higher minimum wages. It is $10.00 per hour in **Florida**. It will be $11.00 per hour starting at the end of September. Inflation of 8.5% over the last year means the real increase over last year will be small, around 1.4%.

The federal minimum wage covers most hourly employees that are 16 and older. Salaried employees are mostly exempt. In 2021, roughly 76.1 million workers were paid hourly wages, and represented 55.8 % of wage and salary workers. The total labor force was about 136 million.

Of those hourly workers, approximately 778,000 were paid the federal minimum wage or less (there are some exemptions to the minimum wage, e.g., if you earn tips). These were about 0.6% of the total labor force.

In an increasing number of states and even cities, local minimum wages are higher than the federal minimum wage. Unfortunately, the Bureau of Labor Statistics' Current Population Survey (CPS) does not collect information on local minimum wages.

3.5.15 Minimum Wage Workers in the US

Minimum wage workers are often young. While about 20% of hourly workers are under 25, 48% of minimum wage workers are under 25, and are even more disproportionately under 20. Over 5% of such workers earn the minimum wage or less.

Many minimum wage workers are less educated than other workers. Some of this is due to their relative youth.

Minimum wage workers are also more often female, black, or hispanic. They are concentrated in service occupations, primarily restaurants, bars, and other food services.

For more information, see:

https://www.bls.gov/opub/reports/minimum-wage/2021/home.htm

3.5.16 Price Controls and Inflation

Some people suggest price controls (ceilings) as a way to control inflation. This was tried during the Nixon administration. While it may reduce **reported** inflation, the effects remain with us. Indeed, if the price ceilings are effective, they create **additional deadweight loss**, which means that the economy is producing less value. Wage and price controls disrupt economic activity, which merely adds to the damage.

In the case of the Nixon administration, inflation continued to rise in spite of the wage and price controls, which are generally regarded as a failure.

We don't have general ways to correct economic statistics for deadweight losses. As a result, figures on real economic growth in and immediately after World War II, and in roughly 1971-1974 (Nixon's wage and price controls), are artificially high.

3.6 Taxes and Subsidies

We will look at effects of excise taxes (taxes on sellers) and sales taxes (taxes on buyers) as well as subsidies to buyers and sellers.

We'll do taxes first. The same principles apply to subsidies. However, some of the subsidy policies are more complex.

3.6.1 Excise and Sales Taxes

An **excise tax** is a tax levied on the sellers of a good. For example, Florida charges an excise tax of $0.04 per gallon on gasoline. It's included in the pump price, and the seller pays the tax. There's also a federal excise tax on gasoline of $0.184 per gallon.

A **sales tax** is a tax levied on the buyers of a good. One of the most obvious is the 6% general sales tax levied by the state of Florida. There is also a county sales tax in Miami-Dade of an additional 1%. So in Miami-Dade, we face a 7% sales tax.

Fortunately, we are not taxed on the tax! If we were, the total tax would be slightly higher,

$$1.06 \times 1.01 = 1.0706$$

meaning the total tax would be 7.06% if we were taxed on the tax.

3.6.2 The Tax Wedge: Sales Taxes

One useful way to analyze the effects of sales and excise taxes is to think of them in terms of putting a wedge between what the buyer pays (after-tax) and what the seller keeps (after-tax).

If we have a sales tax of $\$t$ per gallon, the buyers pay the posted price p plus the tax of t. The seller collects the tax for the government, and must pass it on. The seller keeps $p = p_s$. This means

$$p_d = p + t = p_s + t \tag{3.6.1}$$

3.6.3 The Tax Wedge: Excise Taxes

If there is an excise tax of t, the buyer pays the posted price $p = p_d$ and the seller must pay the tax of t, leaving them with $p - t = p_s$ after tax. Then

$$p_d = p = p_s + t \tag{3.6.2}$$

3.6.4 The Tax Equilibrium

Equations (3.6.1) and (3.6.2) both tell us the same thing.

$$p_d = p_s + t$$

In other words, the tax t puts a wedge between buyer's price p_d and seller's price p_t. The buyer's price p_d will be higher than the seller's price p_s by the amount of the tax.

At the market clearing quantity q^*, the demand and supply prices must be separated by the tax wedge. We have three equations to solve.

$$\begin{aligned} p_d^* &= p_d(q^*) && \text{Demand Price} \\ p_s^* &= p_s(q^*) && \text{Supply Price} \\ p_d^* &= p_s^* + t && \text{Tax Wedge} \end{aligned}$$

3.6.5 Solving for the Tax Equilibrium I

Suppose there is a tax (sales or excise, or a combo) of $t = \$3$ per gallon. In the equilibrium, inverse demand and supply must obey

$$p_d^* = p_d(q^*) = 8 - \frac{1}{2}q^*$$
$$p_s^* = p_s(q^*) = 2 + \frac{1}{4}q^*.$$

Now in equilibrium $p_d^* = p_s^* + 3$. We substitute this in the first equation to obtain

$$p_s^* + 3 = 8 - \frac{1}{2}q^*$$
$$p_s^* = 2 + \frac{1}{4}q^*.$$

3.6.6 Solving for the Tax Equilibrium II

We then simplify the first equation to get two expressions for p_s^*.

$$p_s^* = 5 - \frac{1}{2}q^*$$
$$p_s^* = 2 + \frac{1}{4}q^*.$$

Since both right-hand sides are equal to p_s^*, we may equate them. Than

$$5 - \frac{1}{2}q^* = 2 + \frac{1}{4}q^*$$

so that

$$3 = \frac{3}{4}q^*.$$

The equilibrium quantity is then

$$q^* = 4.$$

3.6.7 Solving for the Tax Equilibrium II

Going back to supply and demand, we find the equilibrium prices (both of them!)

$$p_s^* = 2 + \frac{1}{4}(4) = 3$$
$$p_d^* = p_s^* + 3 = 6.$$

Of course, we can check our work using the demand equation

$$p_d(q^*) = 8 - \frac{1}{2}(4) = 6.$$

Finally, we check that the price gap is the tax rate.

$$p_d(q^*) - p_s(q^*) = 6 - 3 = t,$$

which it is.

3.6.8 The Equilibrium without Taxes

For an equilibrium without taxes, $t = 0$ and $p_d^* = p_s^*$. The equilibrium equations are then

$$p^* = 8 - \frac{1}{2}q^*$$
$$p^* = 2 + \frac{1}{4}q^*.$$

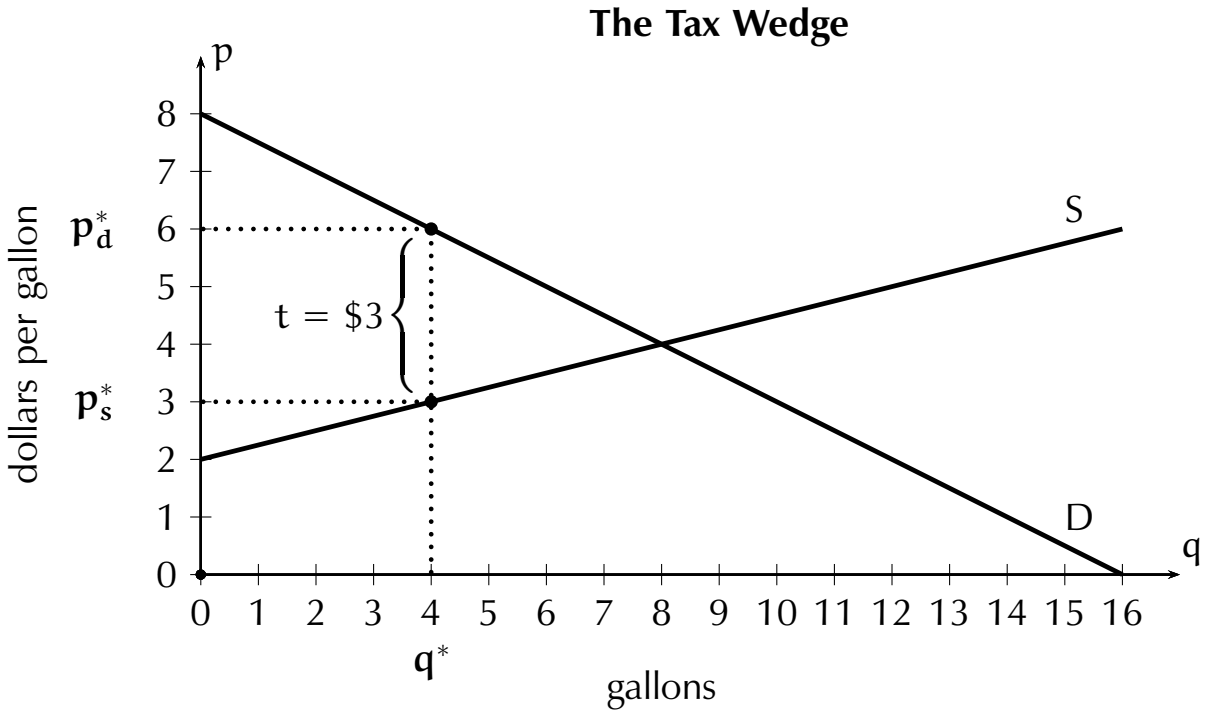
Equating the right-hand sides, we get

$$8 - \frac{1}{2}q^* = 2 + \frac{1}{4}q^*,$$

which simplifies to $6 = \frac{3}{4}q^*$, so $q^* = 8$ and $p^* = 8 - \frac{1}{2}(8) = 4$.

3.6.9 The Tax Wedge in a Diagram

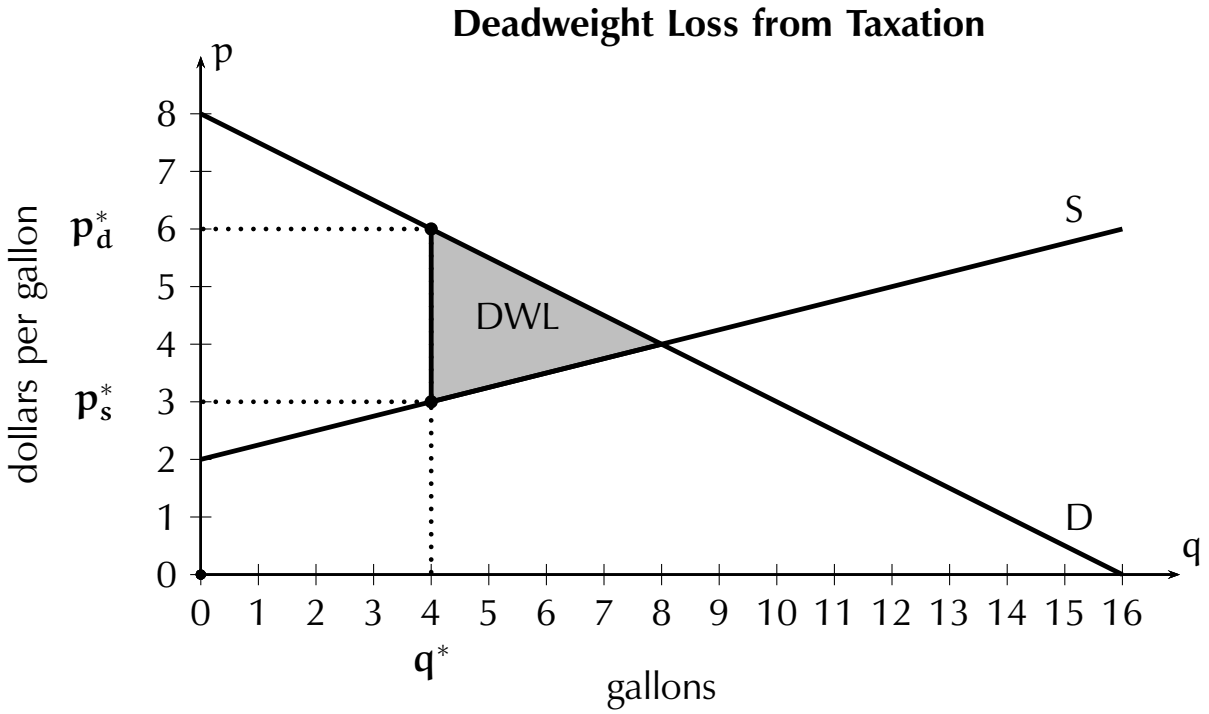
Here's the same problem, showing how to illustrate a $3 per gallon tax wedge in a diagram.



One way to think about this is that we take the $3 tax wedge, and jam it in the left side of the supply and demand diagram until it fits.

3.6.10 Taxes Create a Deadweight Loss

Sales and excess taxes both reduce the quantity sold. This creates a deadweight loss, as we can see on our diagram.

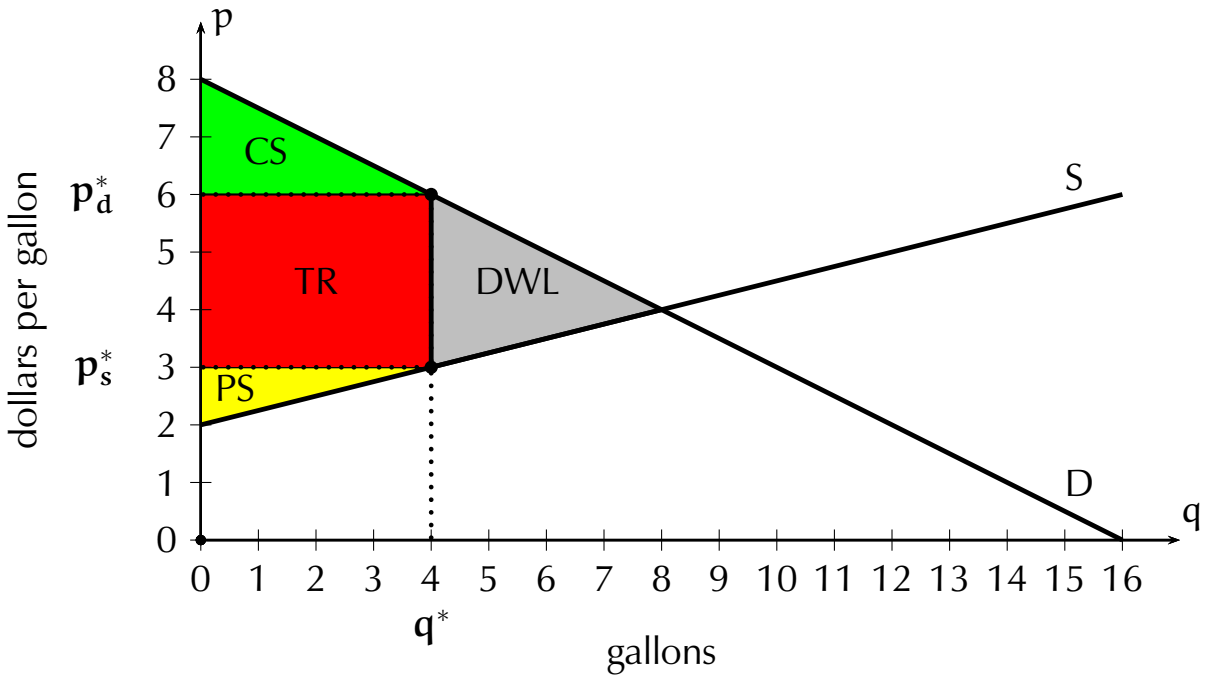


The deadweight loss measures the value of the transactions that are not made because of the tax.

3.6.11 Three Sides to the Transaction

The welfare analysis becomes more complicated as there are now three sides to our market transaction: buyers, sellers, and the government. The government collects tax revenue, the buyers and sellers get their surpluses. The tax revenue is $t \times q^*$, which we can conveniently locate in the diagram between the consumer's and producer's surpluses.

Gains to Consumers, Producers, and the Government



3.6.12 Welfare Analysis of Taxation

We now carry out a basic welfare analysis, examining the gains or losses of buyers and sellers under sales or excise taxes.

	With Taxes	Without Taxes	Difference
CS	\$4.00	\$ 16.00	−\$12.00
PS	\$2.00	\$ 8.00	−\$ 6.00
TR	\$12.00	\$ 0.00	+\$12.00
TS	\$18.00	\$24.00	−\$ 6.00

The tax has decreased both consumer's and producer's surplus. That shouldn't be a surprise. A tax is being collected from both of them, and it hurts both. The government gains the tax revenue. The is sometimes called the **direct burden** of the tax. There is also an **excess burden**, the deadweight loss.

The tax shown here causes a fair amount of waste. The total burden on the economy is the sum of the direct and indirect burdens. Here it's \$6. That increases the total tax burden by 50%.

September 9, 2022