Microeconomics
Class 5

The welfare analysis of competitive markets
(Chapter 9)

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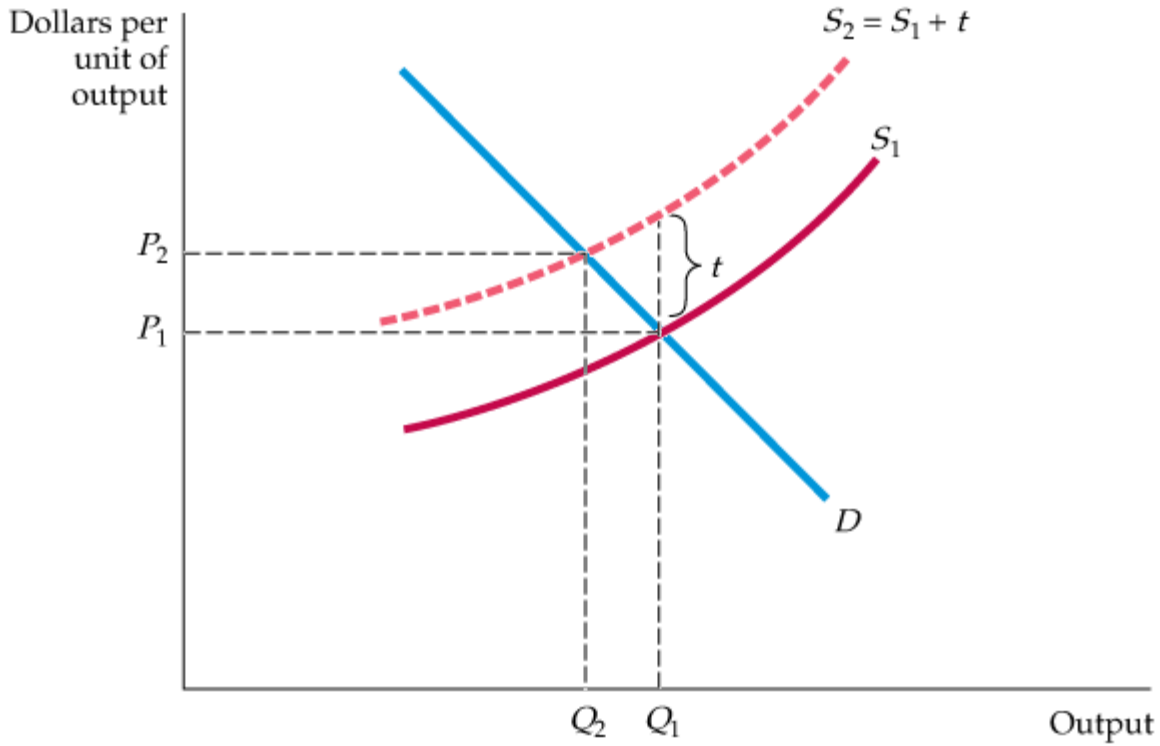
Consider a government that wants to build a road

To pay for the road, the government has to collect taxes

8.8 The Effects of a Tax on supply



Suppose an output tax is placed on all firms in a competitive market. This pushes the supply curve for the industry **upward** by the amount of the tax.

This shift *raises the price* and *lowers the quantity* traded in equilibrium.

Questions: Does it make a difference whether the tax is paid directly by the producer, or paid directly by the consumer?

Who *really* pays for the tax, in the sense of suffering the greatest decrease to their surplus?

How much *economic inefficiency* is created by the tax? Is it justified by the government's increase in revenue?

These questions are the starting point of the *welfare analysis* of markets…

Welfare analysis of markets

•Any government interference in a market (e.g. a tax, subsidy, price control, quota, etc.) will change the **price** and **quantity** of trades in that market in equilibrium.

•These changes will **benefit** some agents but **cost** other agents. The interference is justifiable if, overall, the benefits outweigh the costs.

•The **welfare analysis** of economic policy is performed by adding up all the costs and benefits of that policy, to determine if it is justifiable.

• Formally, the **welfare change** caused by a policy is a sum of (at least) five terms:

1. The change in **consumer surplus;**
2. The change in **producer surplus;**
3. The change in the **expenses/revenues** incurred by **government** (and hence, ultimately, by taxpayers);
4. The correction of **market failures** (e.g. due to externalities); and
5. The **nonpecuniary effects** (e.g. on quality of life, social cohesion, economic inequality, social justice, etc.)

•We will ignore #5, because it is beyond the scope of this course (and indeed outside the scope of traditional microeconomic analysis).

•We will only briefly discuss #4 (market failures).

•We will focus mainly on #1, #2, and #3 (economic efficiency effects).

Market failure

Market failure describes a situation where an unregulated competitive market fails to produce a socially efficient outcome. This can happen for (at least) two reasons:

1.Externalities (positive or negative);

2.Information asymmetries.

Externalities. For a market to be efficient, the price of a good must reflect *all* of the social costs and benefits which are involved in producing and consuming that good. This includes not only the resources and labour required for production, but also any other direct or indirect effects, either positive or negative.

Social costs/benefits which are *not* incorporated into the market price are called ***externalities.*** These can be either positive or negative.

Negative externalities include: pollution, noise, traffic congestion, contagion.

Positive externalities include: "spill-overs" from innovation and education, herd immunity from vaccines, economies of agglomeration (e.g. in urban areas and commercial districts), production synergies (e.g. beekeepers and orchards).

Government policy tries to "internalize" externalities into prices using mechanisms like ***Pigouvian taxation.***

Market failure

Information asymmetries. For a market to be efficient, all agents must have the *same information* about the quality of the goods and services being offered.

If agent **A** has more information than agent **B**, then **A** can mislead or exploit **B**. Knowing this, **B** will *distrust* **A**.

Result: **A** and **B** may fail to agree on what could be a mutually beneficial trade. This will create an *inefficiency*. Two examples of such inefficiencies:

1.Lemon markets: In a market for used goods (e.g. used cars), the seller knows more than the buyer about the true quality of the good. The buyer will distrust the seller. *Result*: Used goods will sell for an inefficiently low price. High-quality used goods will be "priced out of the market".

2.Principal-agent problems: When one person (the "principal") hires another person (the "agent") to act on her behalf, she cannot trust that the agent will always act in her best interests. Agents may sometimes mislead their principals. This can lead to inefficient contractual arrangements.

Imperfect competition

It may also be the case that a market fails to be perfectly competitive. The market might be dominated by a small number of producers (an ***oligopoly***), so that the "price taker" assumption is violated. Indeed, in some cases, the market might naturally tend towards a *monopoly*, because the biggest firm has an
advantage over its competitors and drives them out of business.

Also, there may be heterogeneity of the quality and characteristics of goods in the market. If the goods produced by different firms are *not* perfect substitutes, then each firm has a sort of "quasi-monopoly" over its product (this is called ***monopolistic competition***).

Consumers might not be perfectly informed about the products.

There may be *barriers to entry*, which prevent new firms from entering the market and driving down the price.

All these phenomena can cause the market to deviate from the ideal of *perfect competition.*

Measuring welfare in money units

We will *ignore* market failures. We will assume markets are *perfectly efficient*. We will also assume that they are *perfectly competitive* (no monopolies, oligopolies, collusion, etc.) Our welfare analysis of any market (or intervention) will be based on the following sum:

(Consumer surplus) + (Producer surplus) + (Government expense/revenue)

- All three terms will be measured in **money units**. It makes sense to measure *producer surplus* in money units, because producers (i.e. firms) seek to maximize profit, so they measure their own surplus in money.

- *However*, it does *not* always make sense to measure *consumer surplus* in money units. By doing this, we assume that one euro has *exactly the same value to all people, under all circumstances*. In particular, it assumes that one euro has the same value to a rich person as it does to a poor person. Thus, measuring consumer surplus in money units ignores issues of *economic inequality*.

- Likewise, while it makes sense to measure government expense/revenue in euros, the *welfare effects* of government expense/revenue might *not* be measurable in euros. The government might provide certain economic goods *more efficiently* (or *less* efficiently!) than the private sector. In particular, the government can provide **public goods**, which simply *cannot* be provided by the private sector.
- Thus, the above sum basically "adds apples to oranges". Nevertheless, we will use this approach throughout this chapter, despite its shortcomings…..

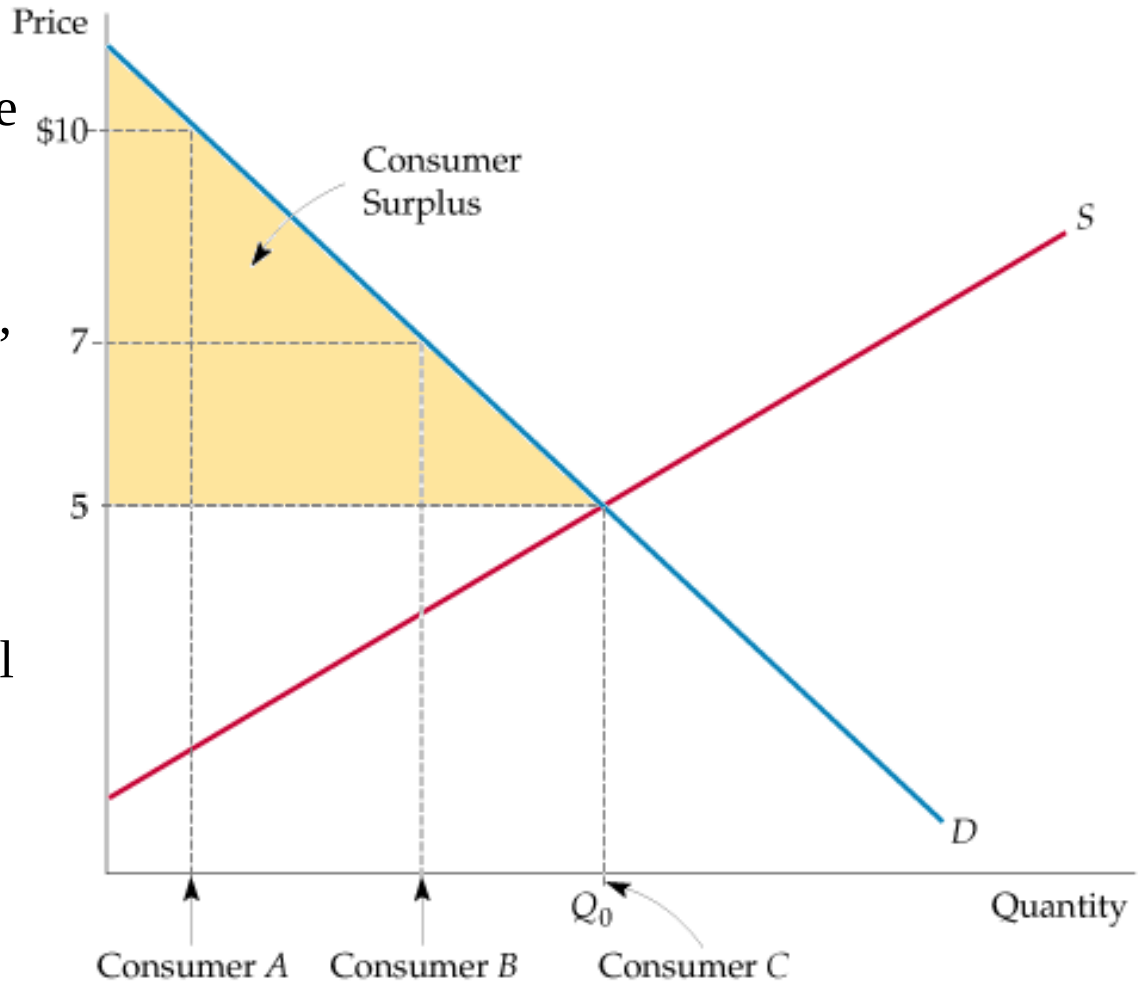
9.1 Review of Consumer and Producer Surplus

Suppose the equilibrium price is $5. Consumer *A* would pay $10 for a good whose market price is $5. She 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.

By adding up the total benefit to all consumers, we deduce that the **consumer surplus** is the **yellow-shaded area** between the demand curve and the market price.

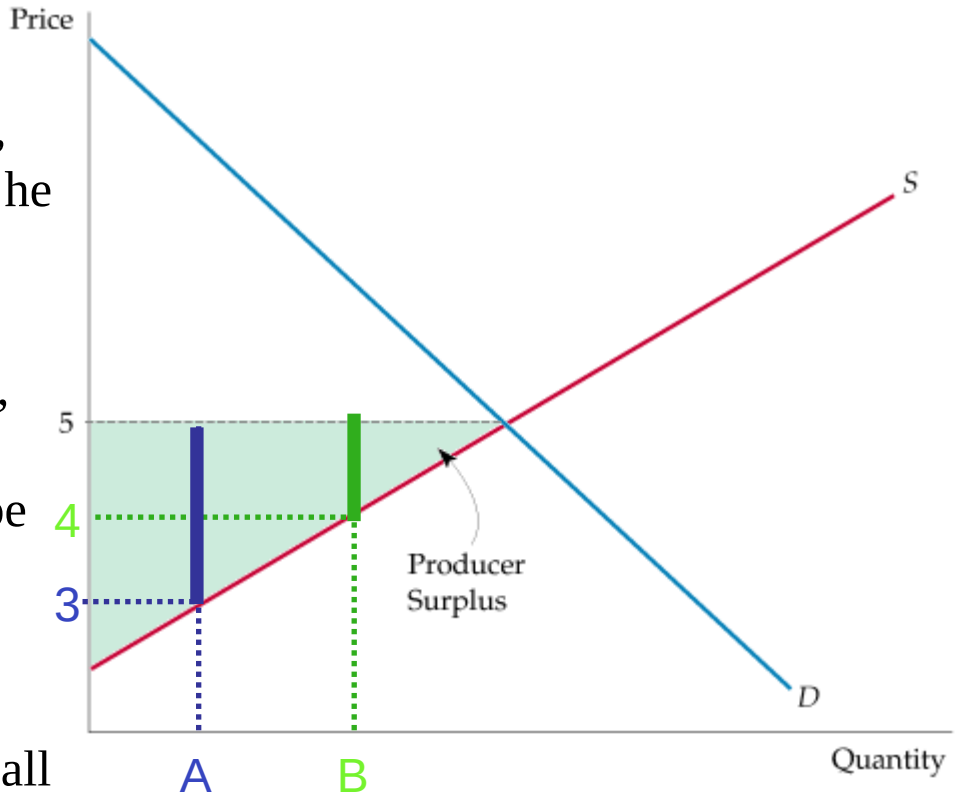
Figure 9.1



9.1 Review of Producer Surplus

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

Figure 9.1



Suppose the market price is $5. Producer A is able to produce for $3, so he makes a $2 profit on each unit he sells

Producer B is able to produce for $4, so she makes a $1 profit in each unit she sells. (Note that A and B might be the same firm, operating at different production levels.)

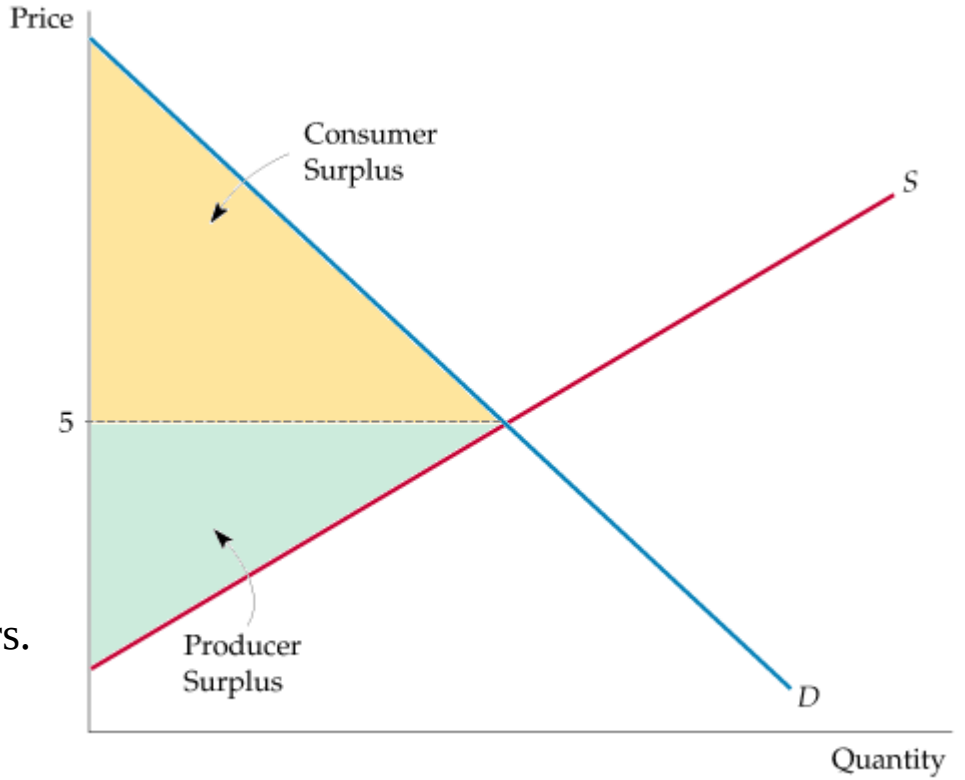
By summing together the surplus of all producers, we conclude that the total **producer surplus** is the **green-shaded area** between the supply curve and the market price.

9.1 Review of Consumer and Producer Surplus

Suppose there are no government expenditures or revenues (e.g. no taxes, no subsidies, etc.)

Then the sum of *consumer surplus* and *producer surplus* measures the *total welfare benefit* of a competitive market.

The picture shows how the equilibrium in a perfectly competitive market is ***economically efficient:*** it realizes every *mutually beneficial exchange* between the producers and the consumers. (An exchange is ***mutually beneficial*** if the cost of producing the good is less than the price the consumer is willing to pay for it).



Thus, the ***total surplus*** of consumers and producers is *maximized*.

As we will see, a*ny government intervention will reduce economic efficiency*. (However, such intervention may be justifiable on other grounds….)

9.1 The welfare effect of a price ceiling

Suppose the government imposes a ***price ceiling*** P_{max}, which is *below* the market-clearing price P_0.

This *reduces* the quantity produced from Q_0 to Q_1.

Since consumers can now buy Q_1 units at price $P_{max} < P_0$, they gain $Q_1 \times (P_0 - P_{max})$ = area(**A**).

However, *some* consumers suffer: those who previously would have bought the missing $(Q_0 - Q_1)$ units. *Their* welfare loss is the area of the triangle **B**.

Thus, the *total welfare gain* to consumers is the *difference* between rectangle **A** and triangle **B**.

Meanwhile, the *producers* of the first Q_1 units get less profit. Their welfare loss is $Q_1 \times (P_0 - P_{max})$ = area(**A**).

Furthermore, *some* producers, whose production costs were between P_{max} and P_0, will now stop producing altogether, and suffer lost profits. Their welfare loss is the area of triangle **C**.

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

Thus, the *net welfare change* for society is **(A-B) -(A+C) = -B - C.** This is a *net welfare loss.*

The area of triangles **B** and **C** together measure the ***deadweight loss*** caused by the price ceiling.

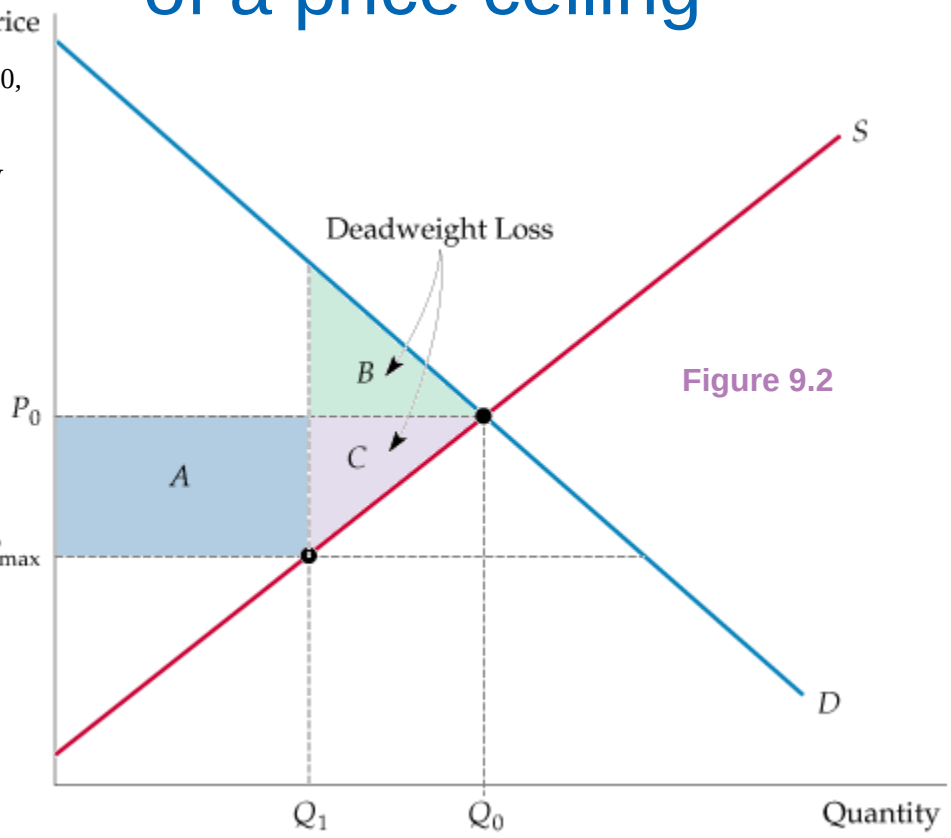


Figure 9.2

9.1 The welfare effect of a price ceiling

The area of triangles **B** and **C** together measure the ***deadweight loss*** caused by the price ceiling.

In fact, this *underestimates* the inefficiency caused by the price ceiling. We have assumed that the first Q_1 goods go to the consumers who wanted them *most* (hence maximizing their welfare effect). But these goods might be allocated *randomly* (so that the goods that "should have" gone to consumer *X* instead go to consumer *Y*). This will create *further* welfare losses among the consumers.

Furthermore, the low price will create a *demand* of Q_2. The gap between Q_1 and Q_2 is a ***shortage***. This will result in long lineups to obtain the good (creating further *opportunity costs*) and possibly even antisocial behaviour as consumers compete for the scarce good.

Finally there is an ***enforcement cost***: the government must spend resources to monitor and enforce the price ceiling.

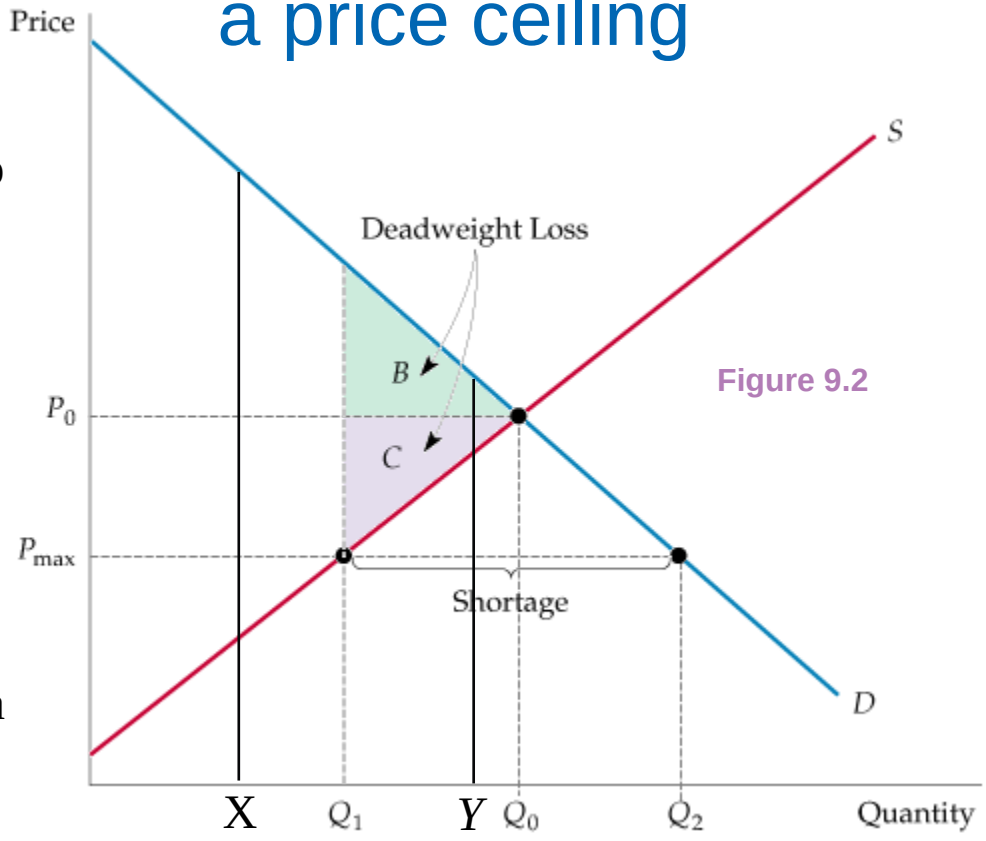


Figure 9.2

9.1 The welfare effect of a price ceiling when demand is inelastic

As we have seen, price ceilings typically benefit consumers at the expense of producers.

Thus, price ceilings (e.g. on food and other necessities) are often imposed "to protect the consumers".

However, if demand is sufficiently inelastic, then triangle *B* can be *larger* than rectangle *A*.

In this case, ironically, *consumers suffer a net loss* from the price ceiling.

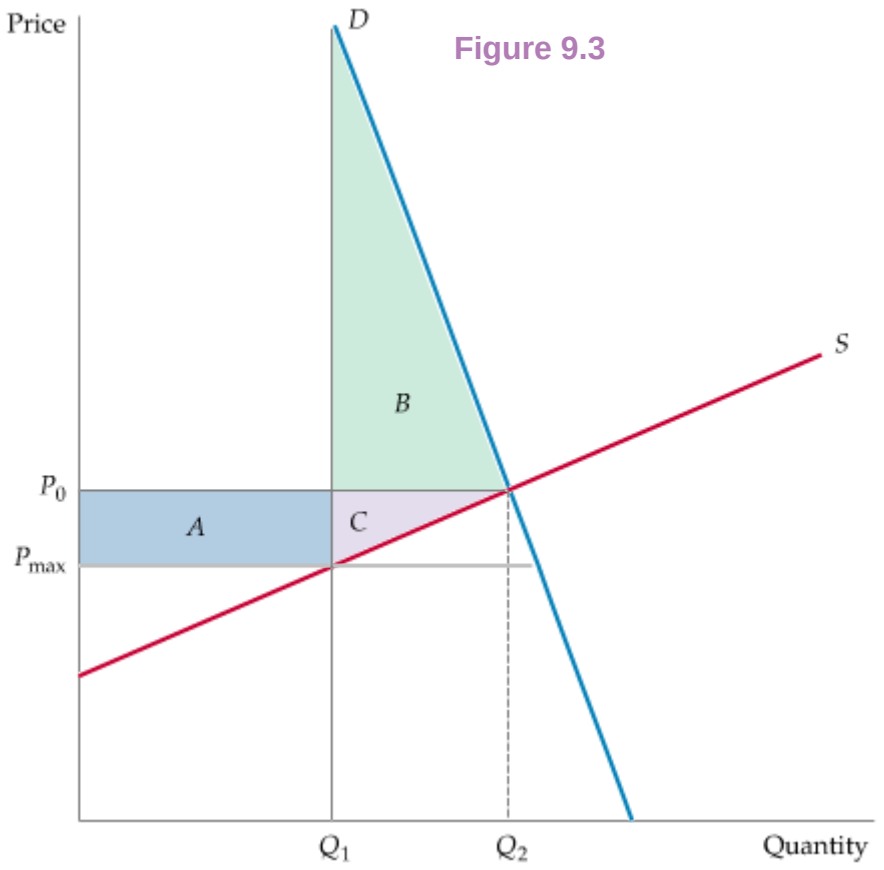


Figure 9.3

9.3 The welfare effect of a price floor

Suppose the government imposes a ***price floor*** P_2, which is *above* the market-clearing price P_0.

This reduces the *demand* from Q_0 to Q_3.

Since producers can now sell Q_3 units at a price $P_2 > P_0$, they gain $Q_3 \times (P_2 - P_0)$ = area(**A**) in profit.

However, *some* producers suffer: those who previously would have sold the missing $(Q_0 - Q_3)$ units. *Their* welfare loss is the area of the triangle **C**.

Thus, the *total welfare gain* to producers is the *difference* between rectangle **A** and triangle **C**.

Meanwhile, the *consumers* of the first Q_1 units get less welfare. Their welfare loss is $Q_3 \times (P_2 - P_0)$ = area(**A**).

Furthermore, *some* consumers, whose reservation prices were between P_2 and P_0, will now stop buying altogether. Their welfare loss is the area of triangle **B**.

The *total welfare loss* to consumers is the sum of rectangle **A** and triangle **B**.

Thus, the *net welfare change* for society is **(A-C) -(A+B) = -B - C.** This is a *net welfare loss.*

The area of triangles **B** and **C** together measure the ***deadweight loss*** caused by the price floor.

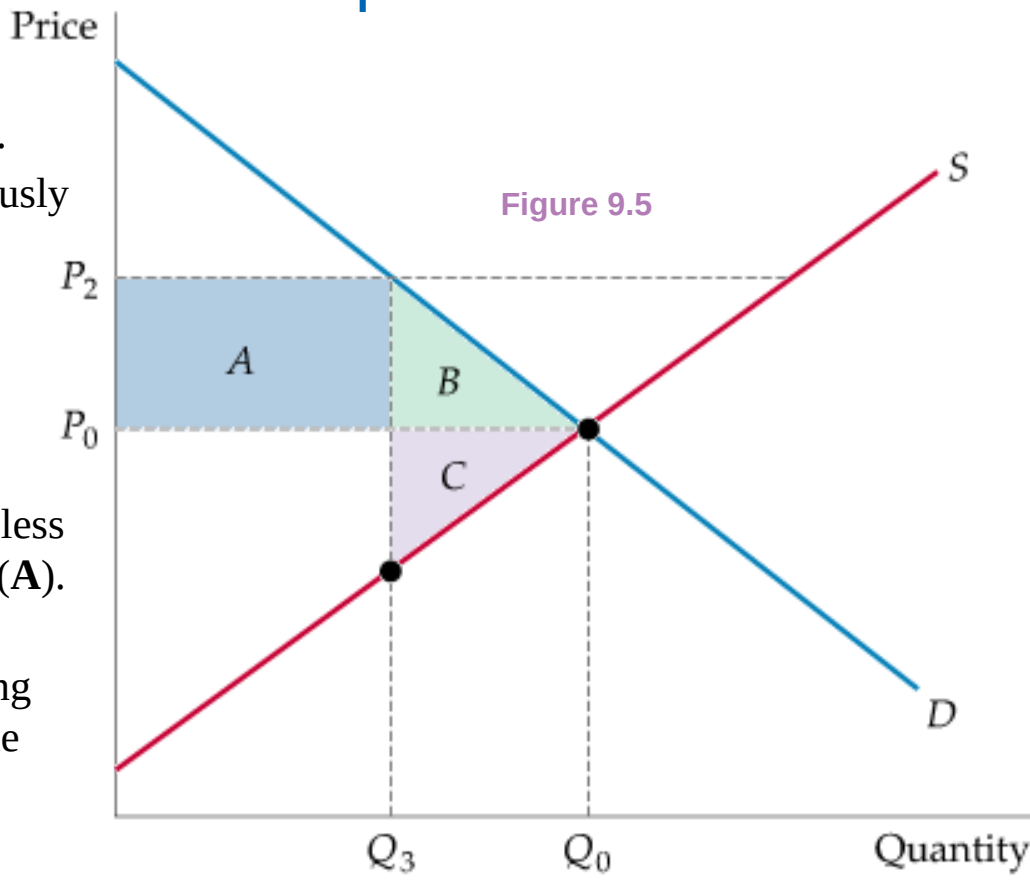


Figure 9.5

9.3 The welfare effect of a price floor

Actually, the welfare effects of a price floor can be even *worse* than this.….

Suppose we impose price floor $P_{min} > P_0$.

The higher price may induce producers to supply $Q_2 > Q_0$.

But consumers will buy only $Q_3 < Q_0$.

If producers do *not* anticipate consumer behaviour, and *indeed* produce Q_2, then $(Q_2 - Q_3)$ units will go unsold (and hence, will be *wasted*).

The total cost of producing these unsold units was the area of the trapezoid **D**.

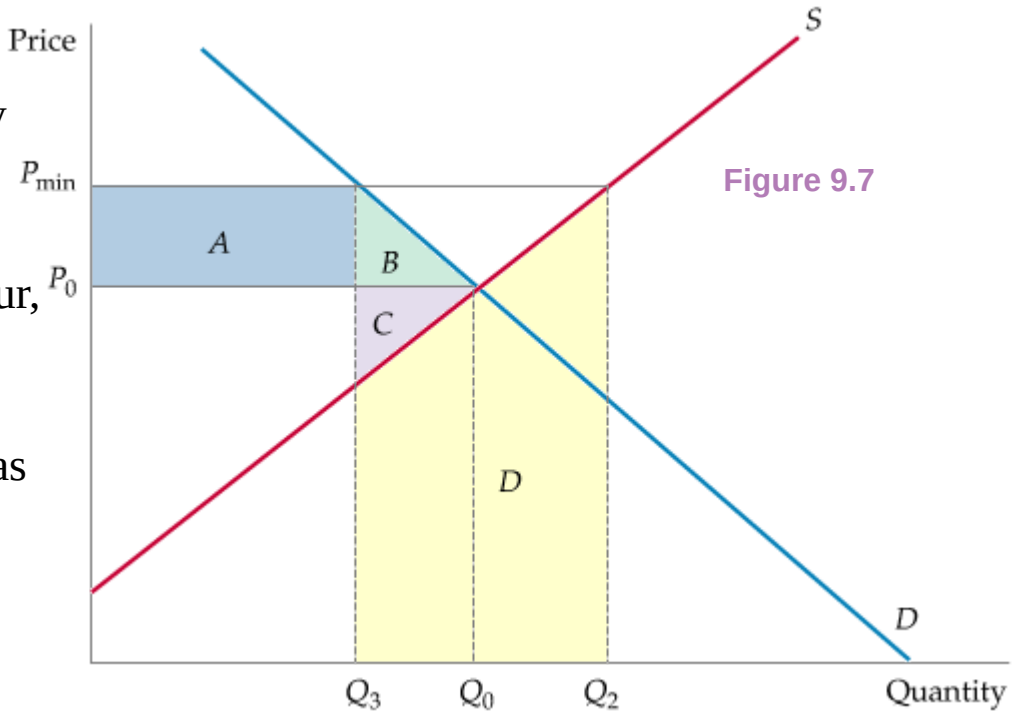


Figure 9.7

Thus, the *total* welfare loss *could* be as much as

B+C+D.

In particular, the change in producer surplus will be **A** − **C** − **D**. In this case, ironically, producers as a group may be *worse off*, even though the price floor was presumably intended to "help" them.

9.3 **Example:** The welfare effects of minimum wage

Suppose the market-clearing wage is w_0.

However, firms are not allowed to pay workers less than the **minimum wage** w_{min}.

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

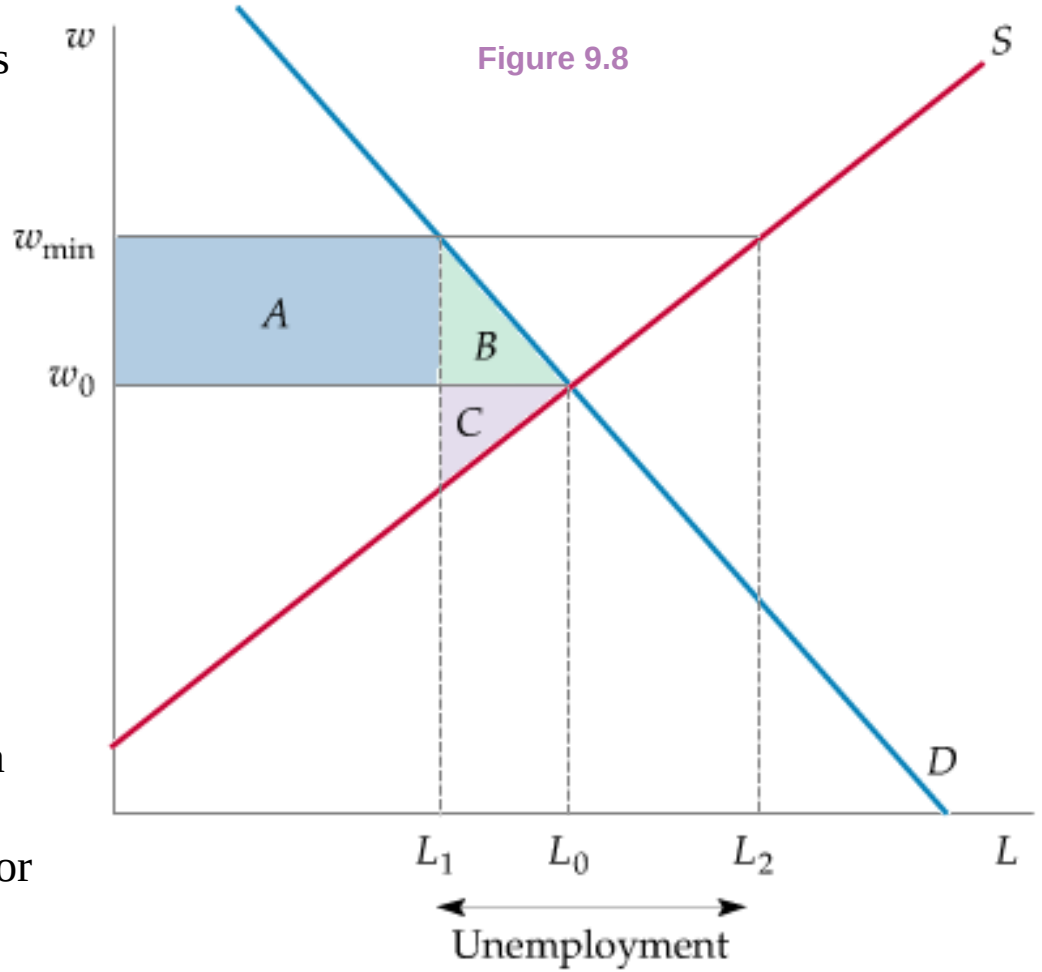
This creates a ***deadweight loss*** given by triangles *B* and *C*.

Minimum wage is supposed to improve the welfare of labourers.

The *welfare change* for labourers is **A - C.**

However, suppose the supply of labour is very *inelastic* relative to the demand. Then the area of triangle **C** may be *larger* than the area of rectangle **A**. In this case, the welfare change for labourers may be *negative*.

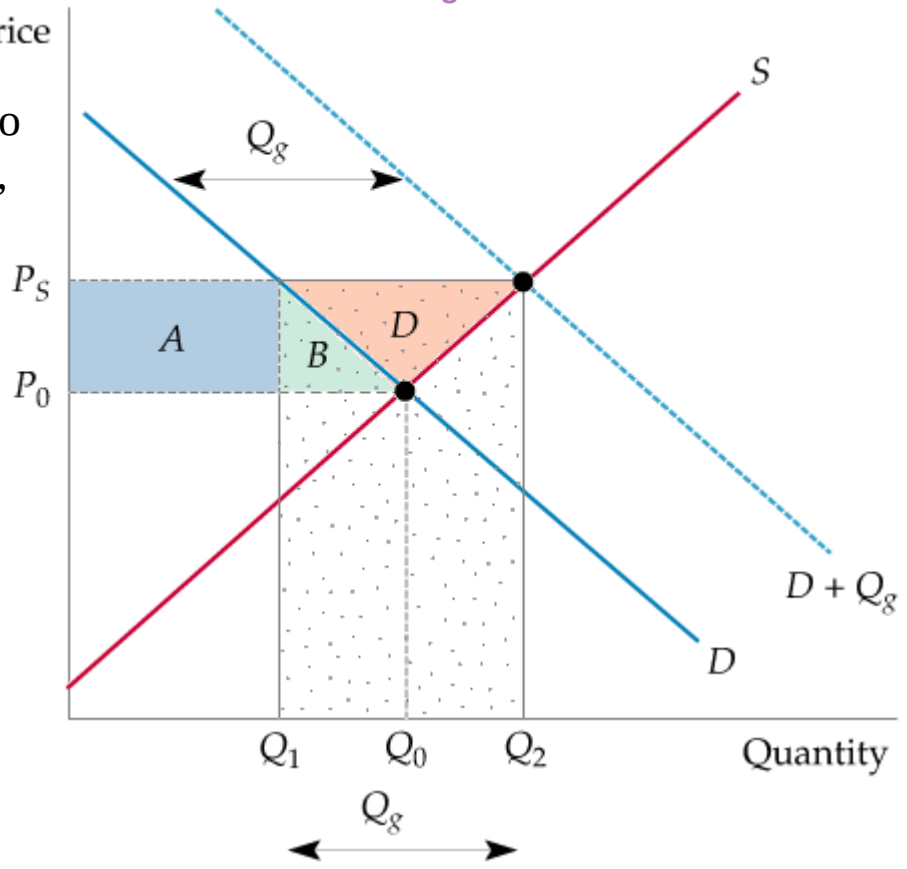
Ironically, labourers may suffer a *net welfare loss* from a policy which was supposed to "help" them.



9.4 The welfare effect of price supports

A ***price support*** is a price set by government above the market equilibrium price, and maintained by governmental purchases of excess supply.

Figure 9.10



Suppose the government buys a quantity Q_g, in order to maintain a price P_s above the market-clearing price P_0, Thus, producers can now sell Q_2 units at price P_s (instead of Q_0 units at price P_0). Thus, the gain to producers is $\Delta PS := \mathbf{A + B + D}$.

Meanwhile, consumers now only buy Q_1 units at price P_s (instead of Q_0 units at price P_0). The loss to consumers is $\Delta CS := -\mathbf{A - B}$.

Finally, the government must buy $Q_g=(Q_2 - Q_1)$ units at price P_s. (We assume these units are wasted.) The **cost** to the government is $P_s \times Q_g$, which is the area of the speckled rectangle.

Total change in welfare: $\Delta PS + \Delta CS - \text{Cost to Govt.} = \mathbf{D} - Q_g P_s$

9.4 The welfare effect of a production quota

To maintain a price P_s above the market-clearing price P_0, the government can instead restrict supply to Q_1 by imposing a ***production quota***.

This is sometimes done by requiring producers to purchase "licenses" to enter the market (e.g. fishing licences, taxicab medallions) and then restricting the supply of these licences.

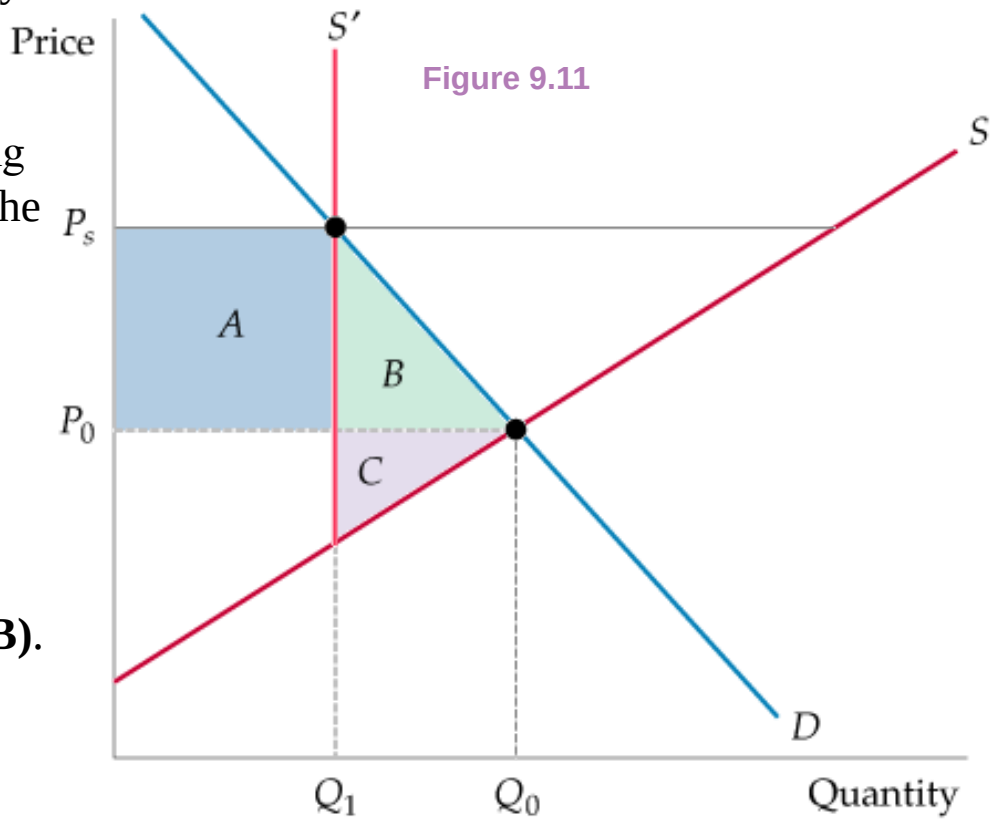


Figure 9.11

The welfare effect is similar to a price floor.

The welfare change for producers is ΔPS = **A-C**.

The welfare change for consumers is ΔCS = **-(A+B)**.

The net welfare change for society is

(**A-C**)-(**A+B**) = -(**B+C**) (***deadweight loss***).

But unlike price floors and price supports, there is no *additional* welfare loss due to wasted overproduction. (**Note**: Any government revenue from the sale of the licenses is just a *transfer* from the producers to the government. So this doesn't add to total welfare.)

9.4 The welfare effect of a production quota with incentives

To induce producers to restrict production to Q_1, the government may give them 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 $B + C + D$.

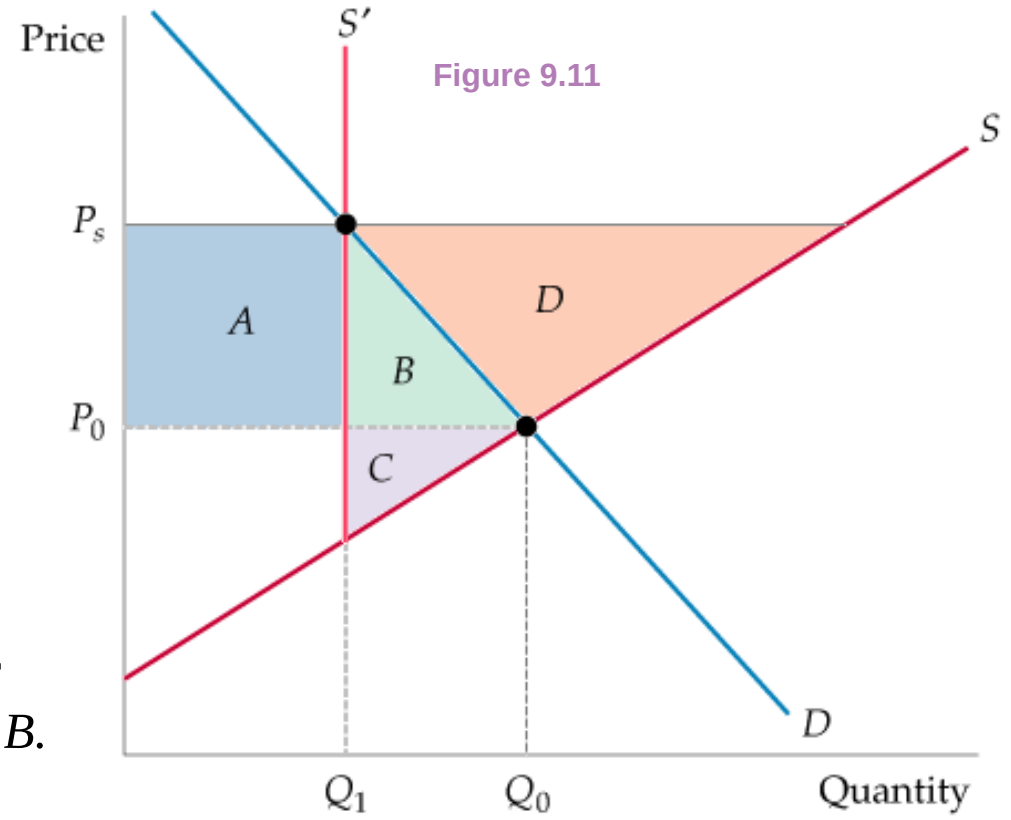


Figure 9.11

Change in consumer surplus (due to higher price and reduced supply) : $\Delta CS = -A - B$.

Government expense: $-(B+C+D)$ (the payment for not producing)

Change in producer surplus: $\Delta PS = (A - C) + (B+C+D) = A+B+D$.

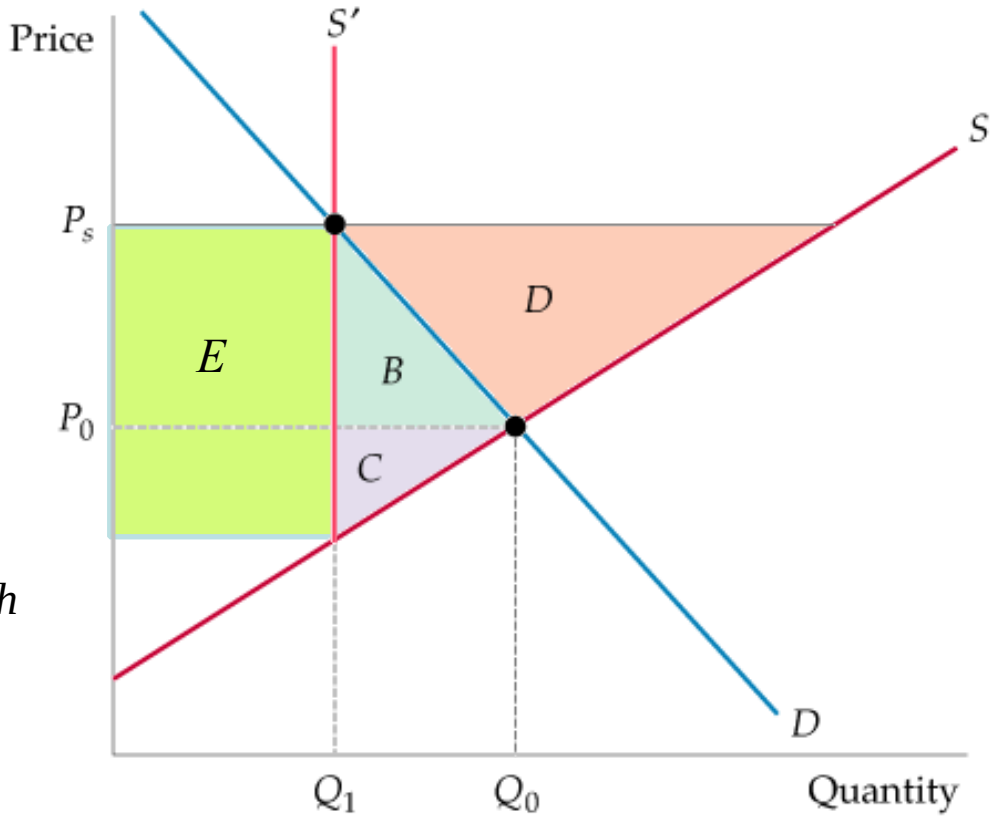
$\Delta Welfare = (-A - B) + (A + B + D) - (B + C + D) = -B - C$ (***deadweight loss***)

9.4 The wealth transfer effects of production quotas

We have just seen two ways to implement a quota:

(1)The government sells a limited number of "licenses" (e.g.taxi medallions) to producers.

(2)The government offers financial incentives to producers to limit their production.



Both policies yield the same deadweight loss of (**B**+**C**) to society.

The difference is that policy (1) involves a *wealth transfer* of area **E** from the producers to the government (payment for the licenses).

In contrast, policy (2) is a wealth transfer of area **B + C + D** from the government to the producers (the incentive payments).

Which policy is "better" depends on whether the goal of the policy is financially support the producers.

But *either* policy is more socially efficient than a price floor or a price support (because those policies can induce wasteful overproduction).

9.5 The welfare effect of an import ban

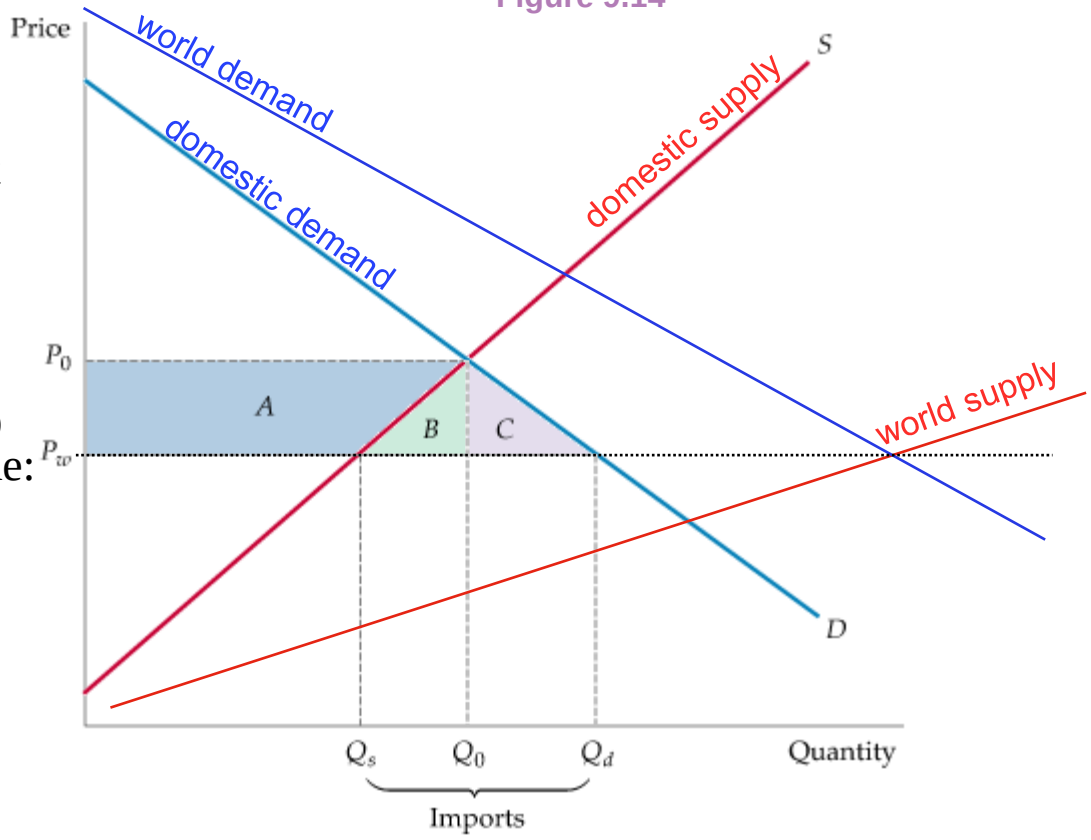
In a free market with no trade barriers, the domestic price equals the world price P_w.
A total Q_d is consumed, of which Q_s is supplied domestically and the rest imported.

Suppose the imports are eliminated by an import ban. The price is increased to P_0.
Now domestic producers can sell Q_0 units at price P_0 (instead of Q_s units at price P_w).
Thus, the gain to producers is trapezoid **A**.

However, consumers must now pay price P_0 rather than P_w for the Q_0 units they consume: a loss of $Q_0 (P_0 - P_w)$ = area(**A**)+area(**B**).
Also, they lose the welfare in triangle **C** (goods which are no longer purchased)
The loss to consumers is **A + B + C.**

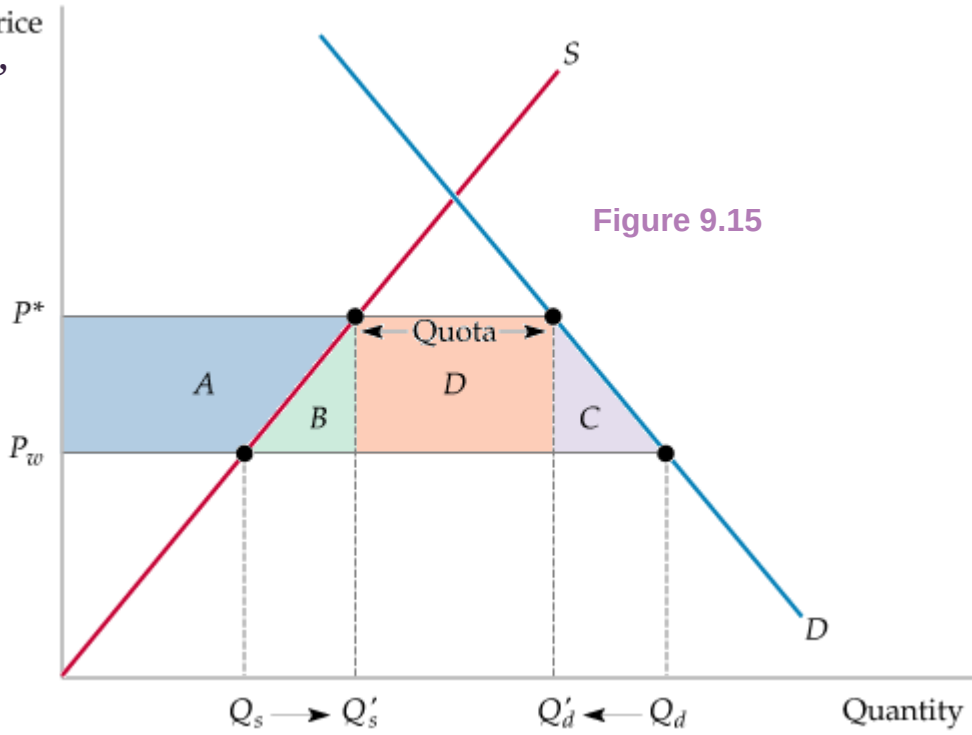
The ***deadweight loss*** to society is ***B + C***.

Figure 9.14



9.5 The welfare effect of an import quota

In general, imports are not completely *eliminated*—they are just *reduced* by an ***import quota*:** that is, a limit on the quantity of a good that can be imported. This raises the price to P^*.



Now domestic producers can sell Q'_s units at price P^* (instead of Q_s units at price P_w).

Thus, the gain to producers is trapezoid **A**.

Meanwhile, consumers will only buy Q'_d units at price P^* (instead of Q_d units at price P_w).

Thus, the consumers lose area(**A + B + D**) due to the higher price of the goods they *do* consume.

They also lose area(**C**) for the goods they will *no longer* consume.

The total loss to consumers is **A + B + C + D**.

Thus, the *total domestic welfare loss* is

(A + B + C + D) - A = B + C + D.

(Note that *foreign* producers also gain welfare area(**D**) for the increased price of the goods they sell into the domestic market.)

9.5 The welfare effect of an import tariff

Instead of a quota, the government can reduce imports through a **tariff** —that is a tax *T* on imported goods.

This increases domestic price from P_w to P^* = $P_w + T$.

Once again, trapezoid **A** is the gain to domestic producers, while the loss to consumers is **A + B + C + D**.

However, if a tariff is used, the government also gains **D**, the revenue from the tariff.

Thus, the net domestic loss is **B + C** (instead of **B+C+D**, the loss from a quota).

Upshot: Tariffs are a better policy than quotas for supporting domestic producers.

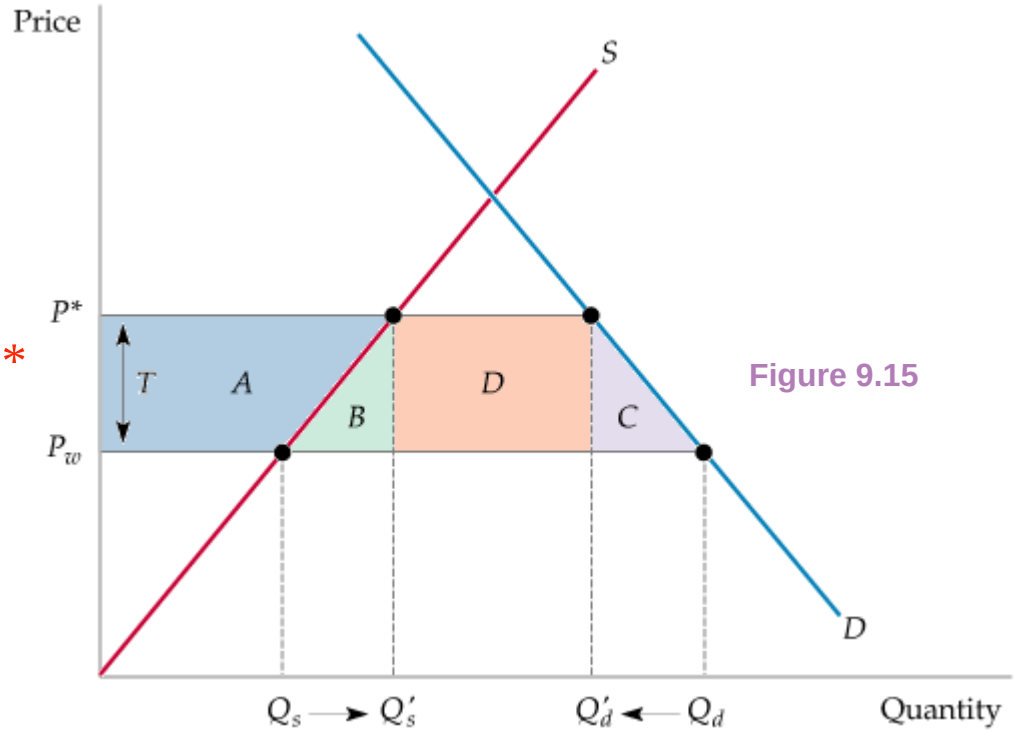


Figure 9.15

9.6 The welfare impact of a specific tax

A **specific tax** is a tax of a certain amount of money per unit sold.

A specific tax of t shifts the supply curve *perceived by the consumers* up by the amount t. (However, sellers still perceive the original supply curve.)

P_b is the price (including the tax) paid by buyers.

P_s is the price that sellers receive, after the tax.

Q_1 is the quantity traded in the new equilibrium.

Consumer welfare loss is area(**A**) + area(**B**).

Producer welfare loss is area(**D**) + area(**C**).

The *government revenue* is

$t \times Q_1 = (P_b - P_s) \times Q_1 =$ area(**A**) +area(**D**).

The ***deadweight loss*** is

(**A**+**B**)+(**D**+**C**)-(**A**+**D**) = **B**+**C**.

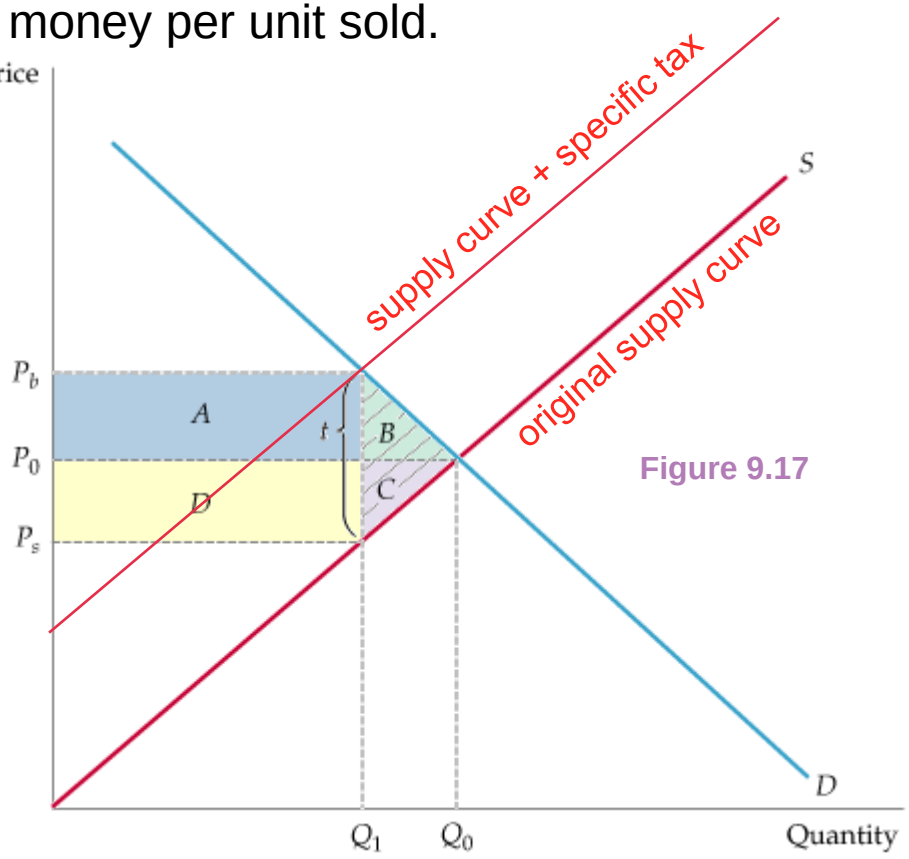


Figure 9.17

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

$Q^D = Q^D(P_b)$ **(9.1a)**

$Q^S = Q^S(P_s)$ **(9.1b)**

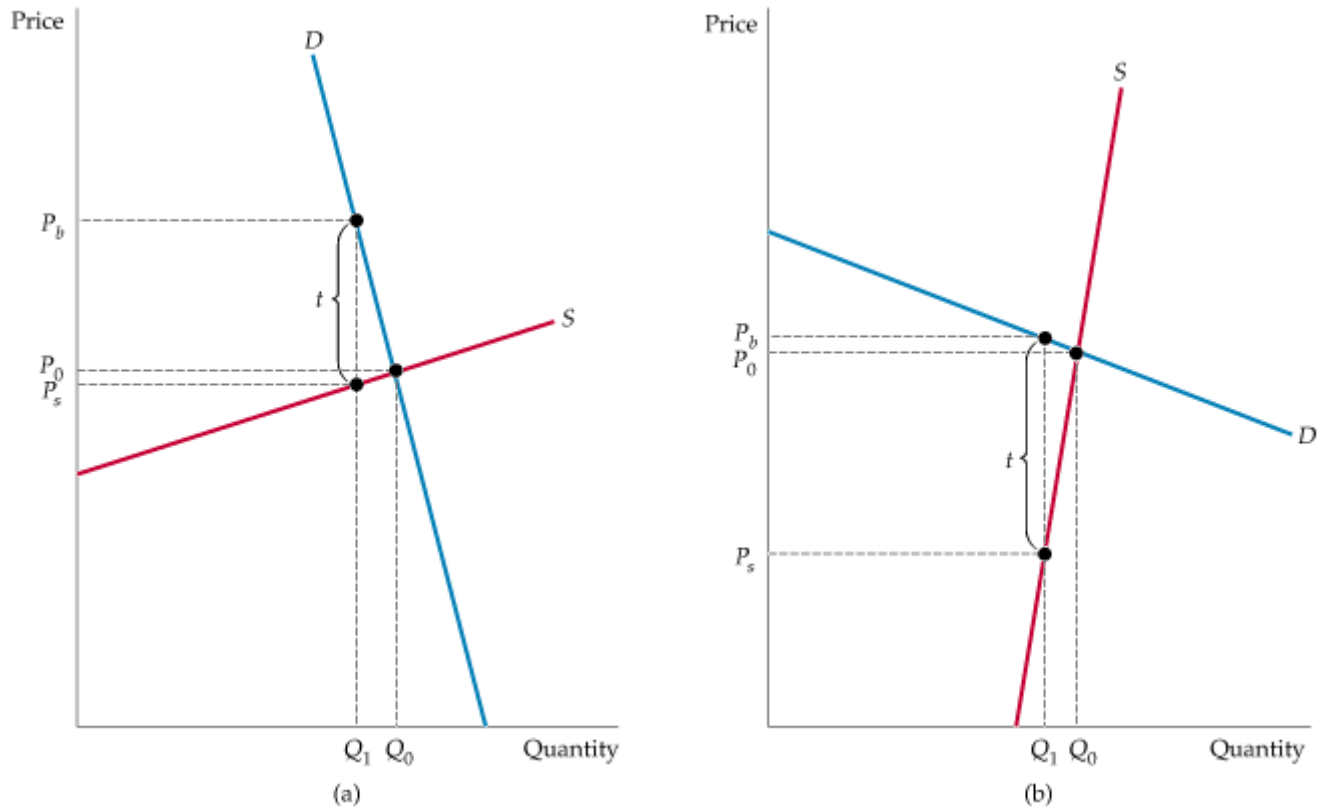
$Q^D = Q^S$ **(9.1c)**

$P_b - P_s = t$ **(9.1d)**

9.6 The welfare impact of a specific tax

Figure 9.18

Impact of a Tax Depends on Elasticities of Supply and Demand



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

(In particular, this will be true in the *very long term* in a *constant cost* industry.)

(b) If demand is very *elastic* relative to supply, then the burden of the tax falls mostly on sellers.

(In particular, this will be true in the *long term* if consumers can adapt their consumption patterns towards lower-cost substitutes.)

9.6 The welfare impact of a specific tax

Impact of a Tax Depends on Elasticities of Supply and Demand

- The ratio of tax the tax burden falling on producers and consumers depends on the elasticities of supply and demand E_S and E_D.
- The burden on producers is

$$ratio\ producer = \frac{E_D}{E_S - E_D}$$

- The burden on consumers is

$$ratio\ consumer = \frac{E_S}{E_S - E_D}$$

(a)If demand is very *inelastic* relative to supply (e.g. E_D close to 0), then the burden of the tax falls mostly on buyers.

$$ratio\ producer = \frac{E_D}{E_S - E_D} \approx 0$$

$$ratio\ consumer = \frac{E_S}{E_S - E_D} \approx 1$$

(In particular, this will be true in the *very long term* in a *constant cost* industry.)

(b) If demand is very *elastic* relative to supply (e.g. E_D close to infinity), then the burden of the tax falls mostly on sellers.

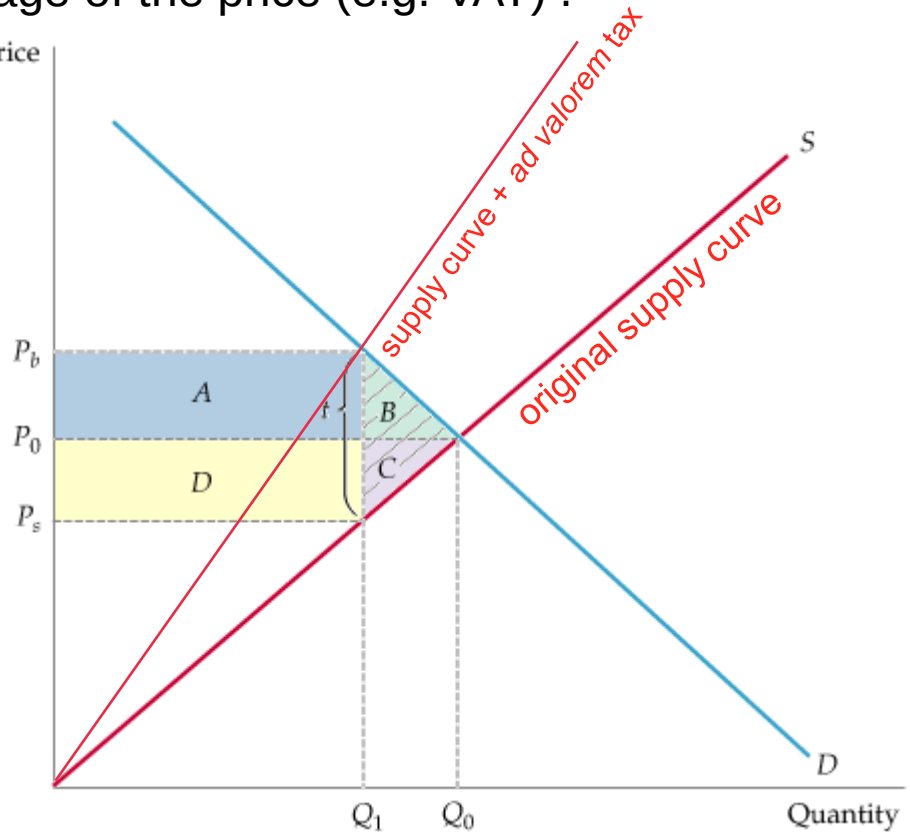
$$ratio\ producer = \frac{E_D}{E_S - E_D} \approx 1$$

$$ratio\ consumer = \frac{E_S}{E_S - E_D} \approx 0$$

(In particular, this will be true in the *long term* if consumers can adapt their consumption patterns towards lower-cost substitutes.)

9.6 The welfare impact of an *ad valorem* tax

An ***ad valorem* tax** is computed as a percentage of the price (e.g. VAT) .



An *ad valorem* tax of R % increases the slope of the supply curve *as perceived by the consumers* by a factor of $(1+r)$, where $r = R/100$. (But sellers still perceive the original supply curve.)

The analysis is similar to a specific tax…

$P_b = (1+r)\,P_s$ is the price (including the tax) paid by the buyers.

P_s is the price that sellers receive, after the tax.

Q_1 is the quantity traded in the new equilibrium.

Consumer welfare loss is area(**A**) + area(**B**).

Producer welfare loss is area(**D**) + area(**C**).

The *government revenue* is

$(P_b - P_s) \times Q_1 = r\,P_s \times Q_1$ = area(**A**) +area(**D**),

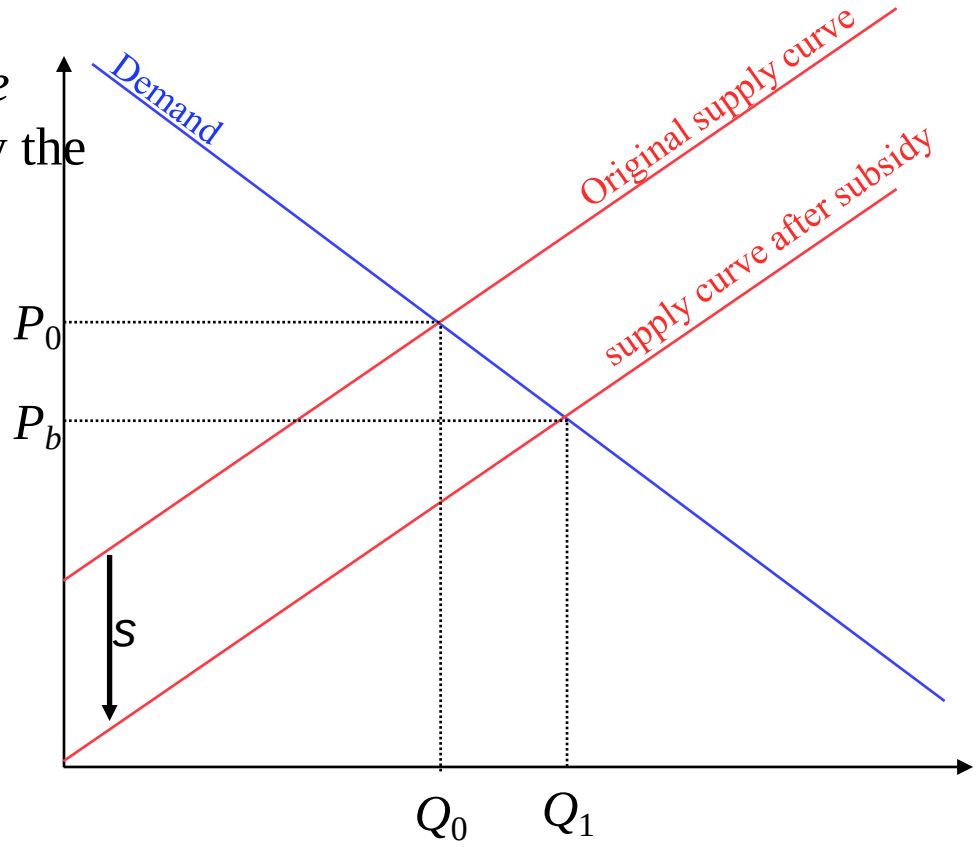
where $r\,P_s$ is the tax added to the sale price P_s.

The ***deadweight loss*** is

(A+B)+(D+C)-(A+D) = B+C.

9.6 The welfare impact of a subsidy

A *subsidy* can be thought of as a *negative tax*. It shifts the supply curve (as seen by the consumers) *down* by the amount *s*.



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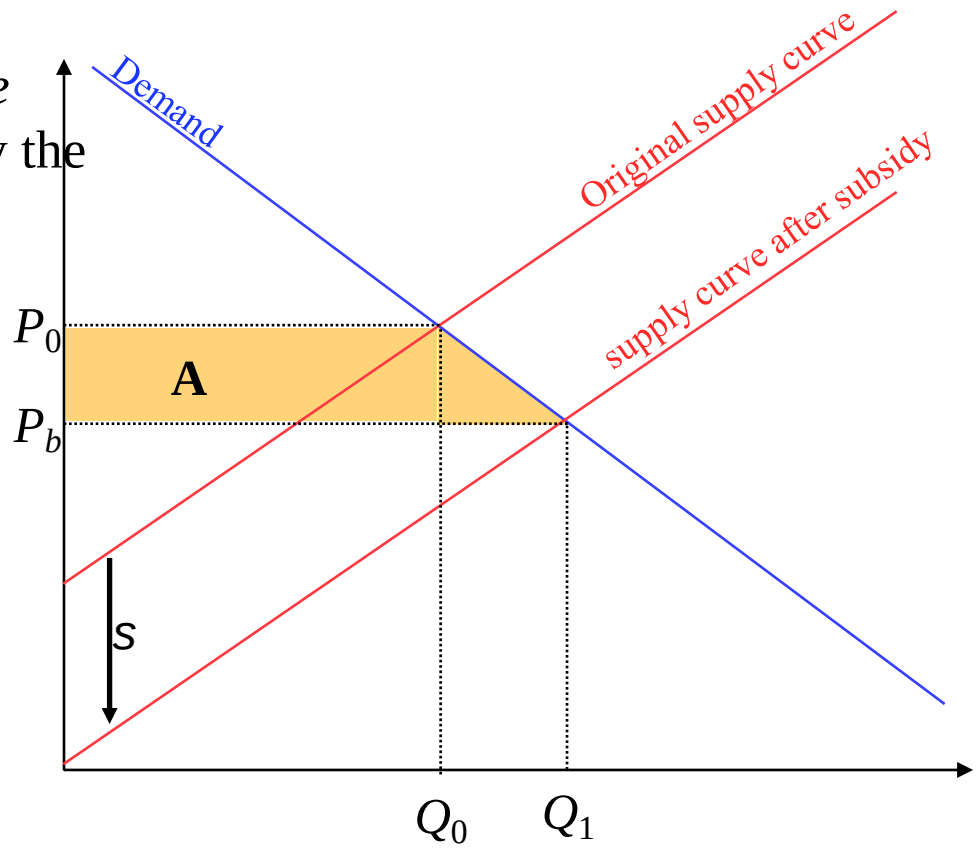
Consumers can now purchase quantity Q_1 at price P_b (instead of Q_0 at price P_0). So their **gain** in welfare is area(**A**)**.**



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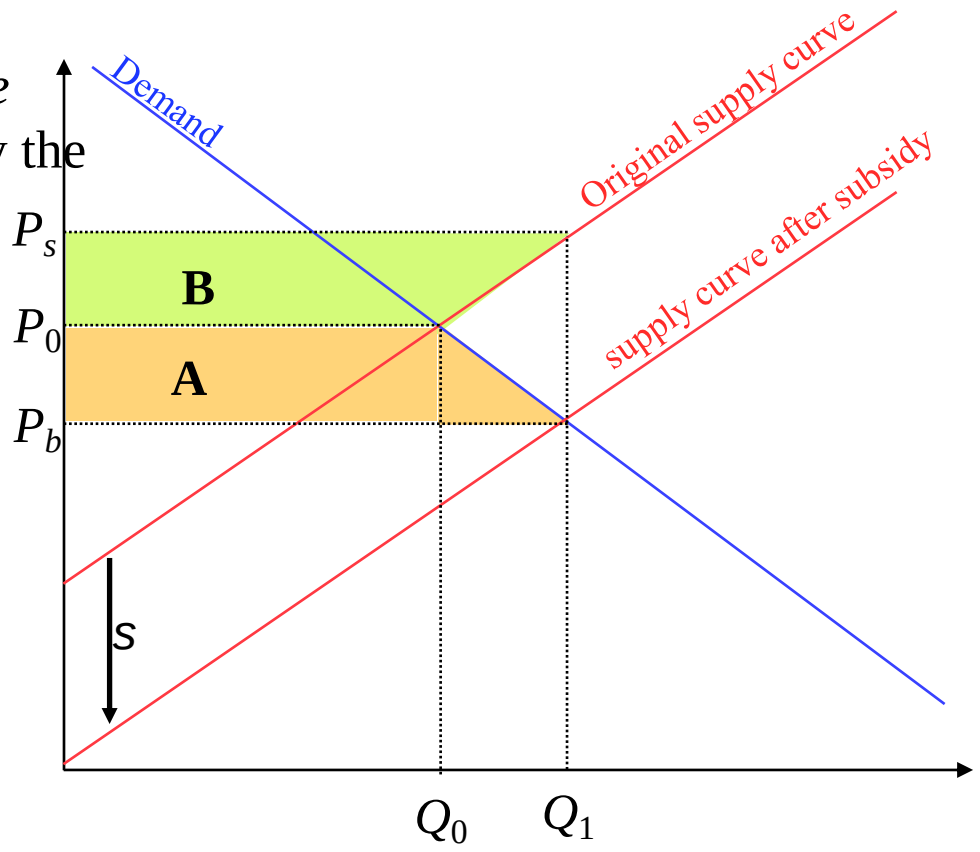
Meanwhile, producers can now sell quantity Q_1 at a *perceived* price of P_s (instead of selling Q_0 at price P_0). So their **gain** in welfare is area(**B).**



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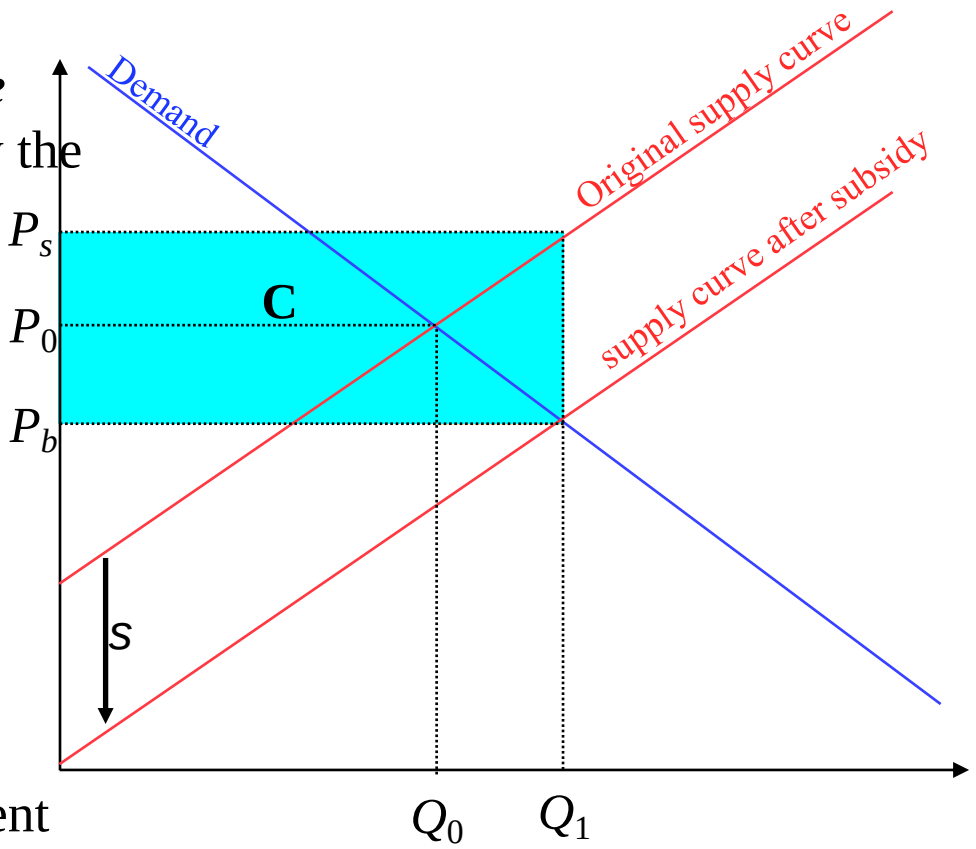

However, the subsidy costs the government

$s \times Q_1 = (P_s - P_b) \times Q_1$ = area(**C**)

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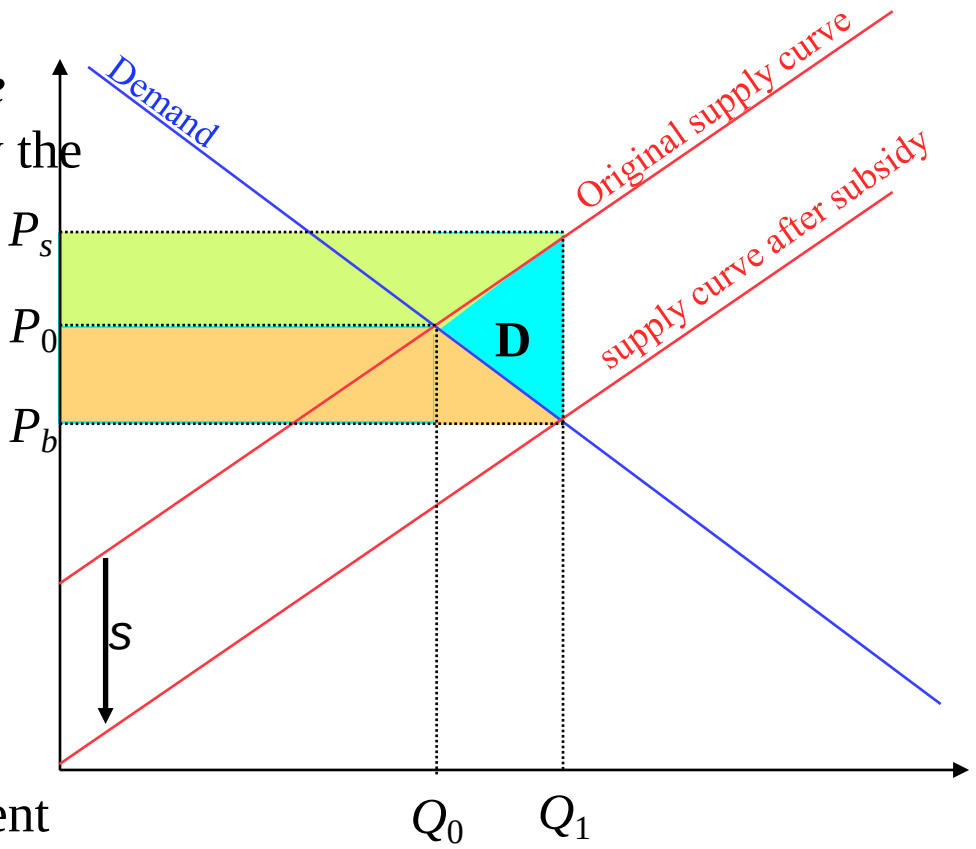

However, the subsidy costs the government

$s \times Q_1 = (P_s - P_b) \times Q_1$ = area(**C**).

Thus, the net change in social welfare is

area(**A**) + area(**B**) - area(**C**) = - area(**D**)

In other words, the area of triangle **D** represents the ***deadweight loss*** of the subsidy.

9.6 The welfare impact of taxes and subsidies

This analysis suggests that *taxes and subsidies are always bad.*

But this is not the case, for at least two reasons.

1. This welfare analysis measures all costs and benefits in *money units*. But the *social* value of some subsidies (e.g. food for poor people) might exceed its *monetary* value. Likewise, the *social* value of a government's activities (funded through taxation) may exceed the *monetary* value of the inefficiency costs imposed on the producers and consumers who pay these taxes.

2. An agent's production/consumption activities can have *negative externalities* (e.g. pollution, congestion). We can use ***Pigouvian taxes*** to make her to "internalize" the costs of these externalities, so that she produces/consumes the "socially efficient" amount. (*Example*: gasoline taxes internalize the negative externalities due to pollution, traffic congestion, and the negative health consequences of sedentary lifestyles.)

Likewise, her activities could have *positive externalities*. We can use ***Pigouvian subsidies*** to help her "internalize" the benefits of these externalities, so that she produces/consumes the "socially efficient" amount. (*Example*: medical and education subsidies internalize the positive social externalities of a healthy and educated population.)

Summary

Our analysis shows that taxes, subsidies, and other interference in the free market creates a *net loss* of economic efficiency (a *deadweight loss*).

This does not mean interference is always bad —it may have other ("nonmonetary") benefits. However, it means that government interference in the market should be *presumed* to create a net social welfare loss, *unless* you have good reason to believe that the "nonmonetary" benefits outweigh the deadweight loss.

Also, our analysis shows that different ways to achieve the same objective (e.g. a price floor vs. a price support vs. a production quota, or an import quota vs. a tariff) can have *very different* welfare costs. Some are clearly superior to others.

Finally, our analysis shows that these welfare costs are *not always equally distributed* amongst producers and consumers. In general….

- Costs are born more heavily by consumers if demand is less elastic than supply.
- Costs are born more heavily by producers if supply is less elastic than demand.

In some cases, this means that an intervention designed to help a certain group can actually impose a net welfare *loss* on that group.