Intermediate Microeconomic
Spring 2025

Part four: Competitive markets

Week 6(b): Markets and efficiency (II)

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Competitive Equilibrium: Roadmap

- Compute competitive market equilibrium

- **Properties of market equilibrium**
  - **Efficiency**
  - **Equity**

- Three examples of government interventions and their welfare implications
  - Price controls
  - Minimum wages
  - Taxation

Efficiency of competitive equilibrium

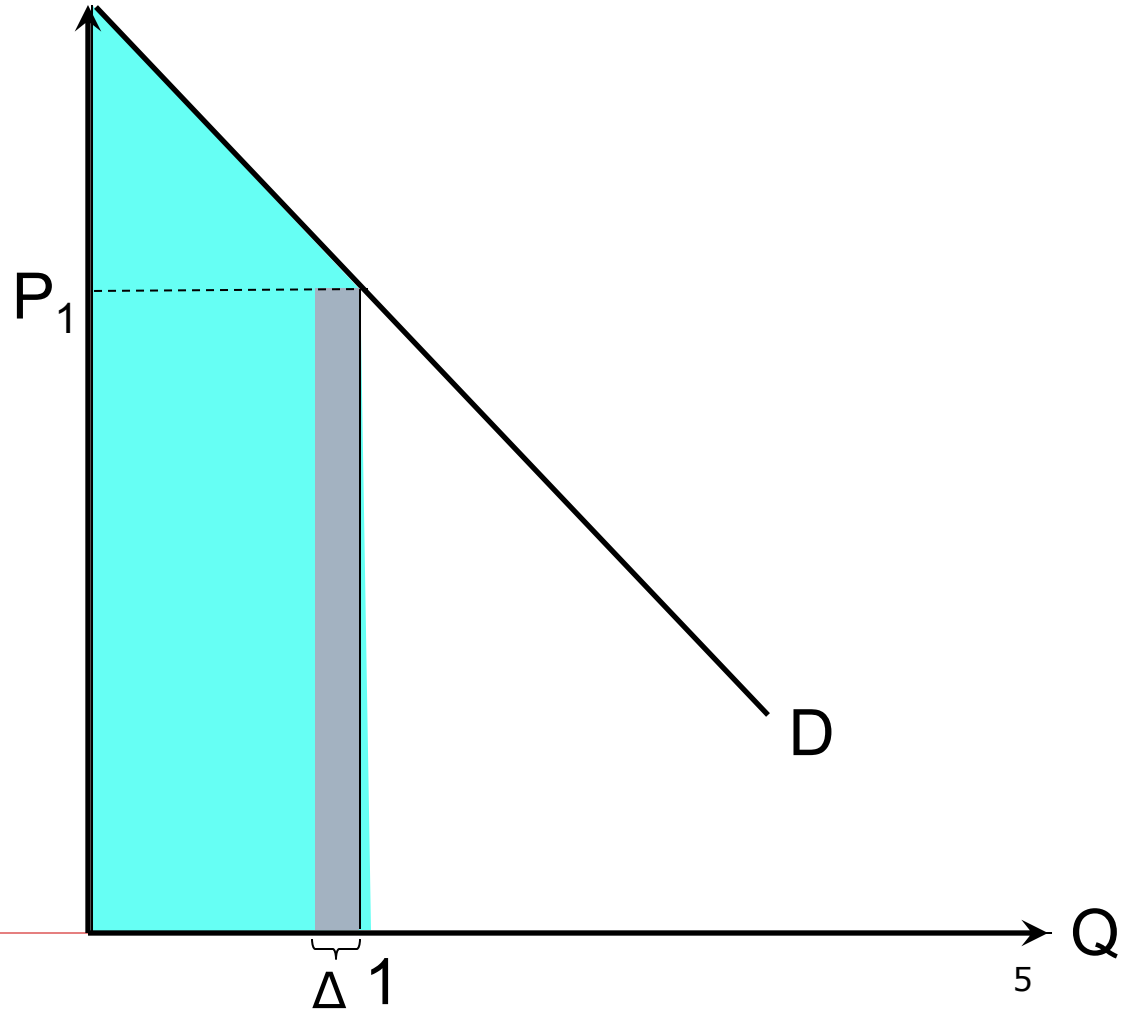
- To think about whether competitive equilibrium is “good” or “bad”, need to use two measures of how much **value** consumers and producers get from the market equilibrium
- Consumer side: **consumer surplus**
- Producer side: **producer surplus**
- Can be summarized graphically on the demand-supply chart

Willingness to pay (WTP) and consumer surplus

- At price P, a utility-maximizing consumer chooses the quantity off of his demand curve.
- That is, demand curves show how much a person is willing to buy at a given price.
- So, **a demand curve shows how much a person is "willing to pay" to consume the Q^{th} unit of output**.

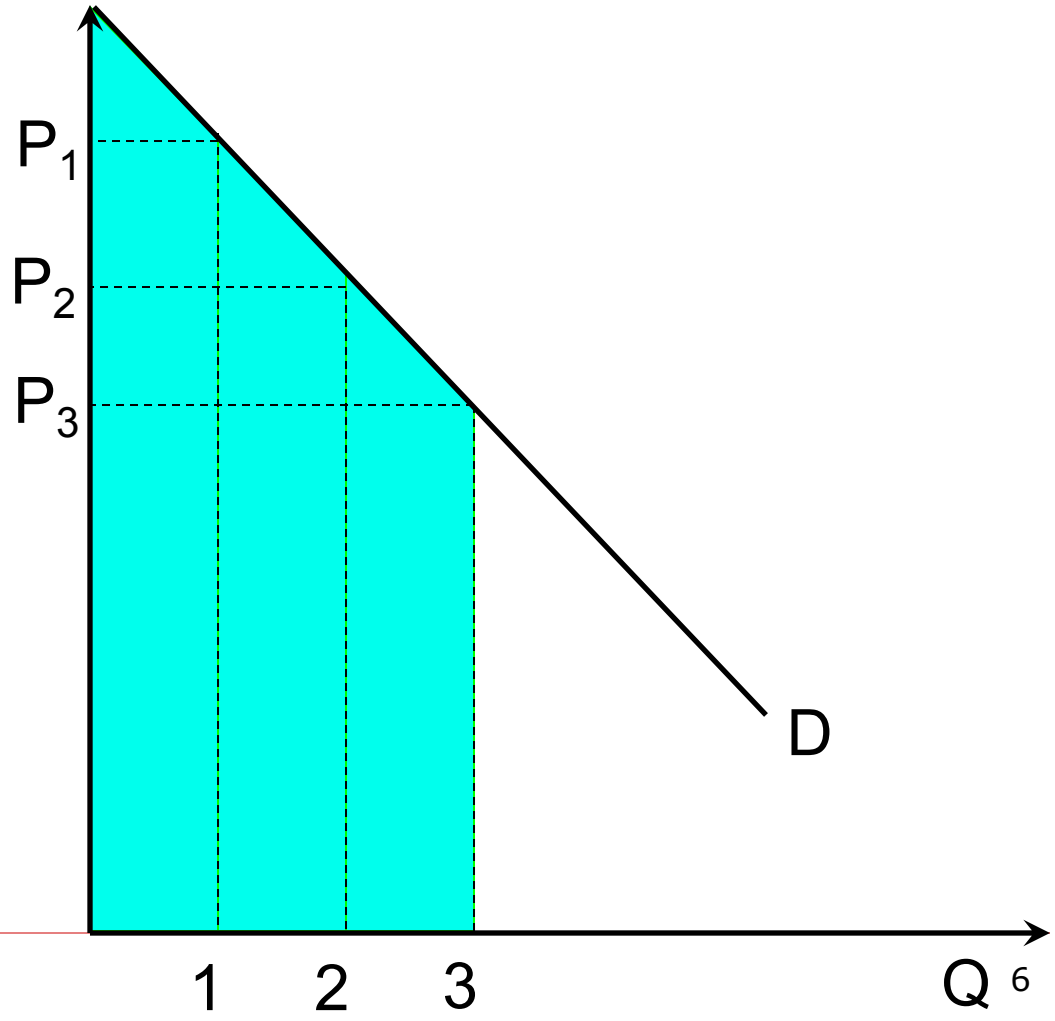
Willingness to pay for goods

- Demand curve tells you the value that the consumer places on the Qth bit of output.
- If you have 1-Δ units of output, your willingness to pay (WTP) for Δ more units is approximately P_1 * Δ.
- Height of the demand curve gives the *marginal* willingness to pay for a little bit more of the good.
- WTP for 1 unit of the good is the area under the demand curve between 0 and 1.



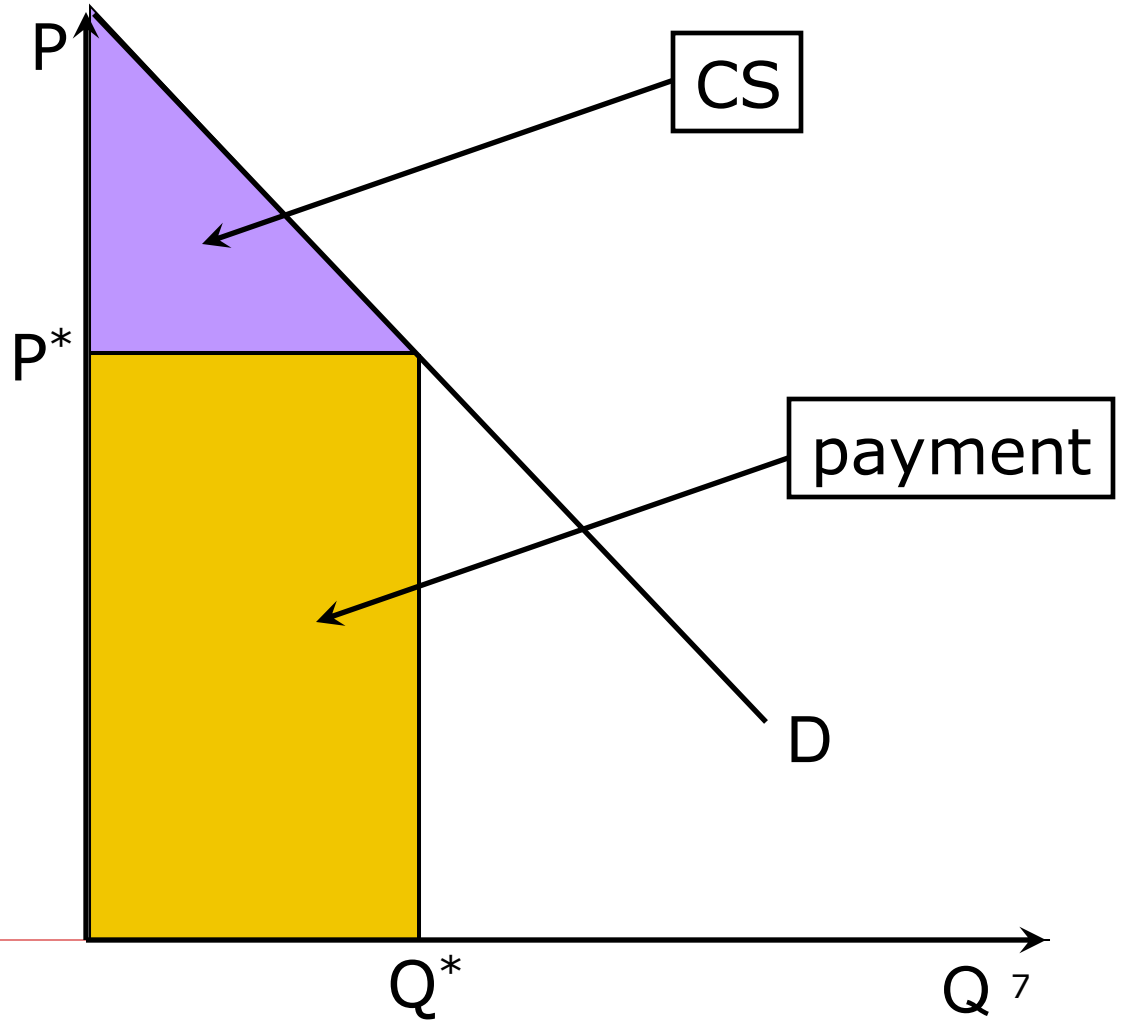
Willingness to pay for goods

- The most individual will pay for the 1st unit is:
- The most individual will pay for the 2nd unit is:
- The most individual will pay for the third unit is:
- So, **the area under the demand curve represents the total value that this consumer gets from consuming the good**.



Consumer Surplus

- To compute the net benefit, we have to subtract off what the consumer pays.
- If the market price is P^*, and the consumer buys Q^* units, the total payment is $P^* * Q^*$ (red rectangle).
- Total benefit (previous slide) minus the payment is the net benefit of paying P^* per unit for Q^* unit.
- We call the net benefit ***Consumer Surplus (CS)*** (purple triangle).



Consumer Surplus

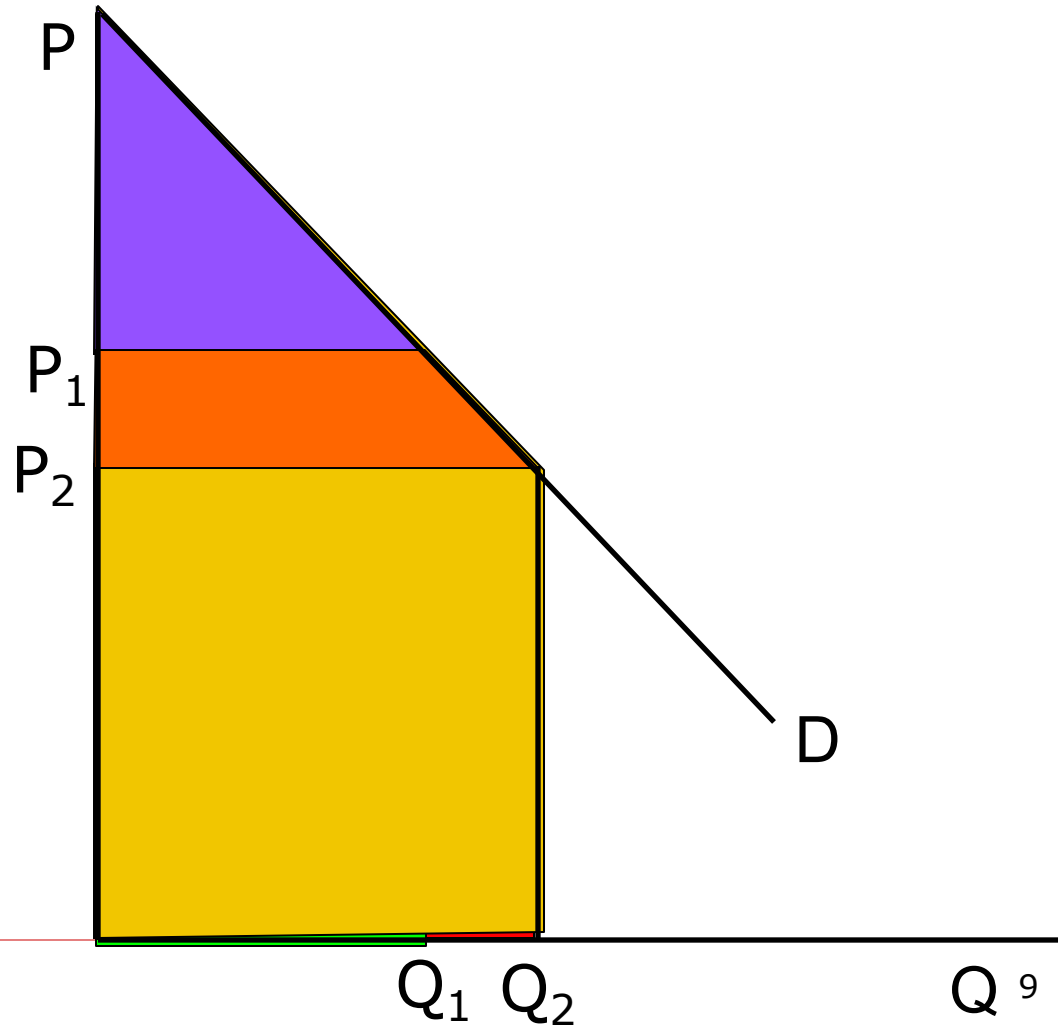
- Consumer surplus = The extra benefit that consumers receive by being able to make market transactions at the prevailing price

- In our "standard" model (consumer pays the same P* for every Q s/he consumes), consumer surplus = area under the demand curve, above P^*, left of Q^*.

- But, if producers use a more complicated pricing scheme (which we'll study later), the consumer surplus may be something else.
  - We'll worry about this in later part of the class

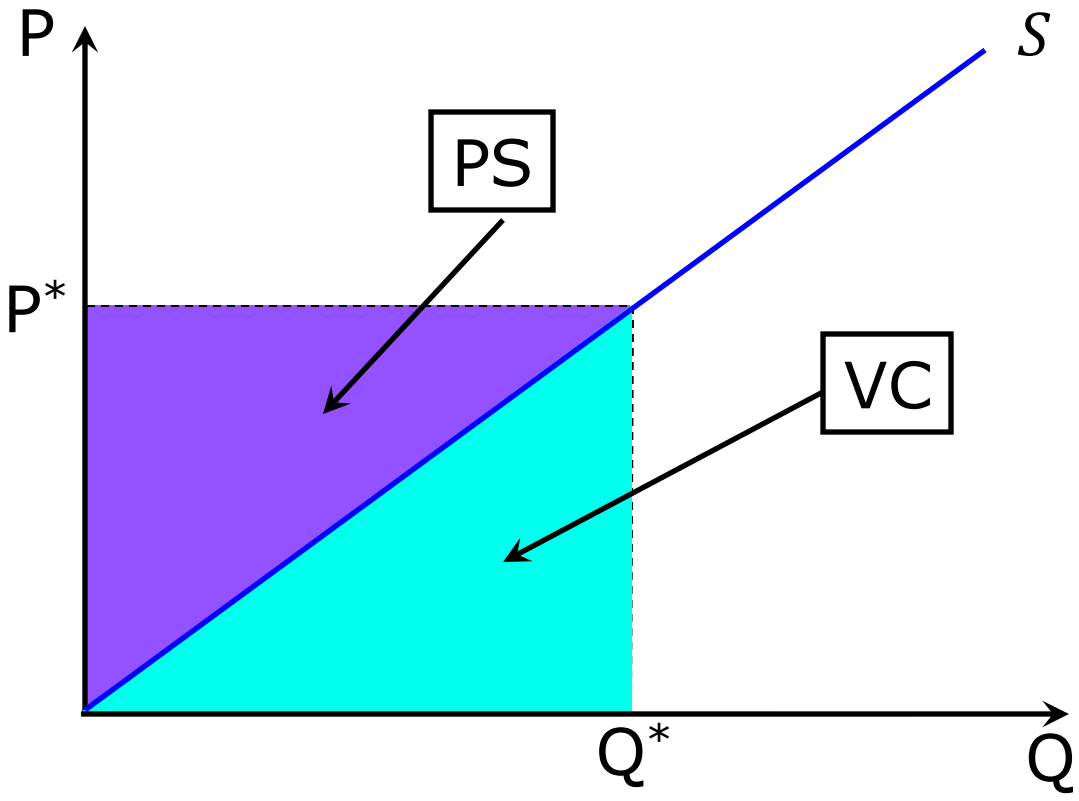
Exercise: Change in Consumer Surplus

- Suppose the price decreases from P_1 to P_2.
  - The consumer increases quantity to Q_2
  - Now, the consumer pays a lower price on more units.
- This has two effects:
  1. It changes the payment.
  2. It changes the consumers' total benefit.
- In total, CS increases by the orange trapezoid.



Producer Surplus

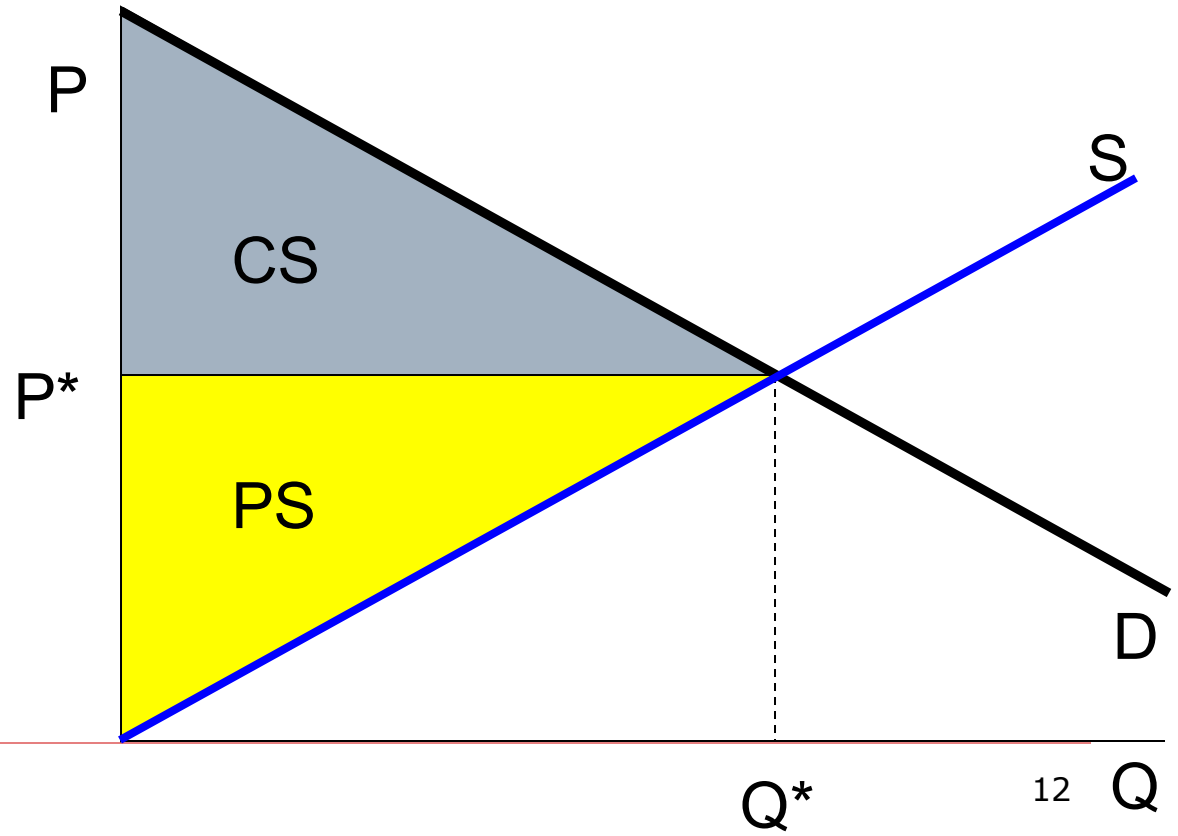
- The "height" of the supply curve equals to MC(Q)
  - Because supply curve satisfies P=MC(Q)
- So, the area under the supply curve up to the Q^{th} unit is the variable cost of producing all units up to that point.
- If the price is P^*, the firm earns revenue $P^* * Q^*$ (rectangle).
- Net value (***Producer Surplus***) is area of rectangle minus area of triangle.



= excess revenue over variable cost of producing Q^* units and selling them at P^*.

Total Societal Gains from Market

- The total surplus created when the market is in equilibrium (Q^*, P^*) is the sum of CS and PS.
- **Question:** Which Q maximizes total surplus?
- **Answer:** The Q at which supply and demand intersects, i.e. the market equilibrium quantity
- So, competitive equilibrium maximizes the total social gains, aka. Competitive equilibrium outcome is "efficient"



Efficiency of competitive equilibrium

- **"First Fundamental Theorem of Welfare Economics" (aka, First Welfare Theorem):** the competitive market equilibrium results in an efficient outcome
  - "**Efficient**:" CS+PS is maximized
  - Also known as "**Pareto Optimal**": There is no other allocation that can make one market participant better off without making another participant worse off.

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- First Welfare Theorem is one of the most powerful results in microeconomics: free interaction between self-interested market participants can result in efficient economic outcome
  - Market is "decentralized": No need for the government to know demand and supply curve
  - Can generalize to N consumer, K-commodity economy settings
  - This is essentially what people means when they talk about Adam Smith's "Invisible Hand"

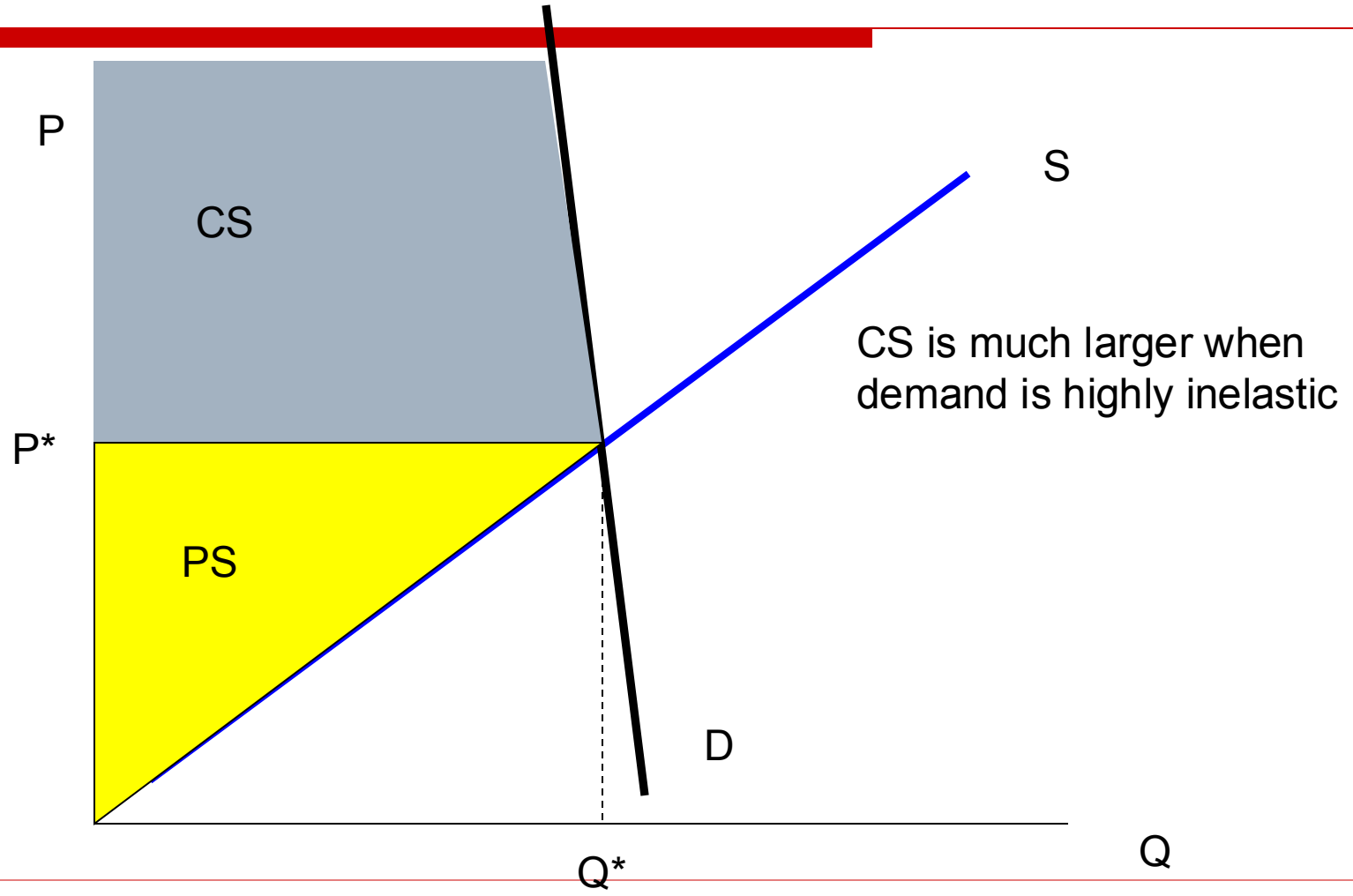
Equity of competitive equilibrium

- Pareto Optimal: There is no other allocation that can make one participant better off without making another participant worse off.
  - Example: dropping $5 on the ground and distributing the rest among you would *not* result in a Pareto Optimal distribution of the $100.

- Note, though, that Pareto Optimality says nothing about "equity"
  - Example: giving $100 to one person and $0 to everyone else is Pareto Optimal!

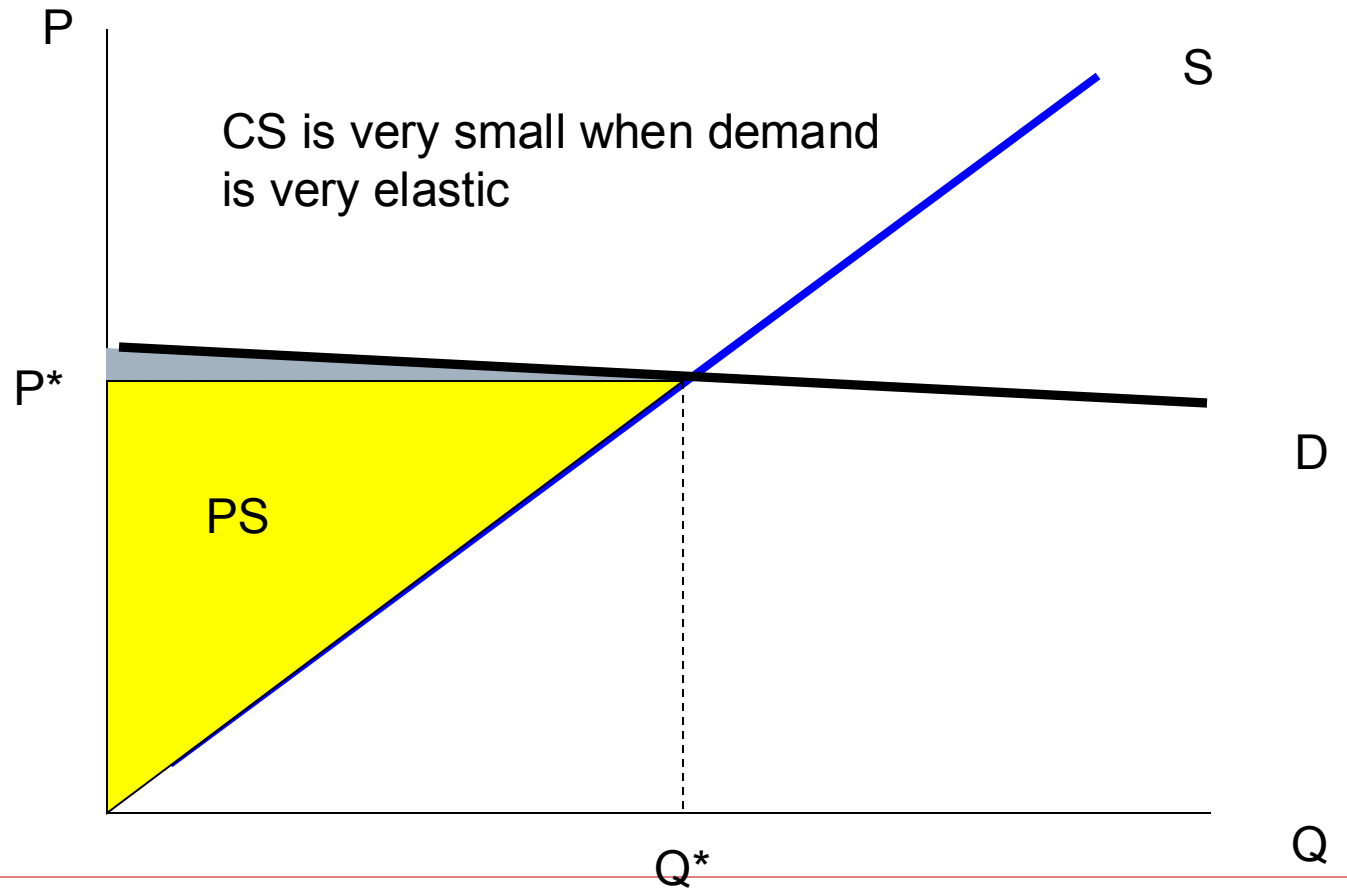
- Just because the market equilibrium is Pareto Optimal (i.e. maximizes the sum of CS and PS), that doesn't say anything about the **distribution** of surplus between producers and consumers

Elasticities and CS

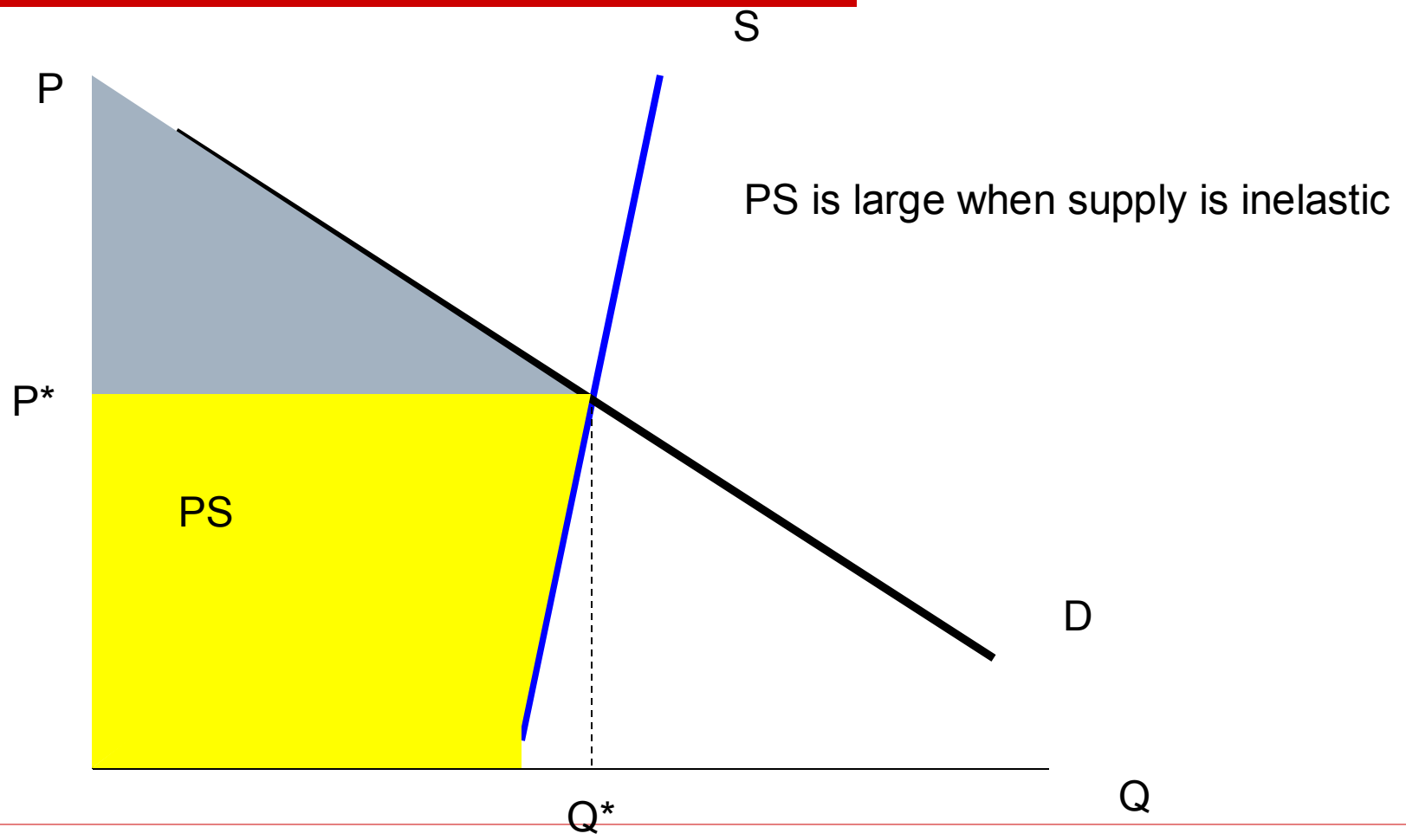


CS is much larger when demand is highly inelastic

Elasticities and CS

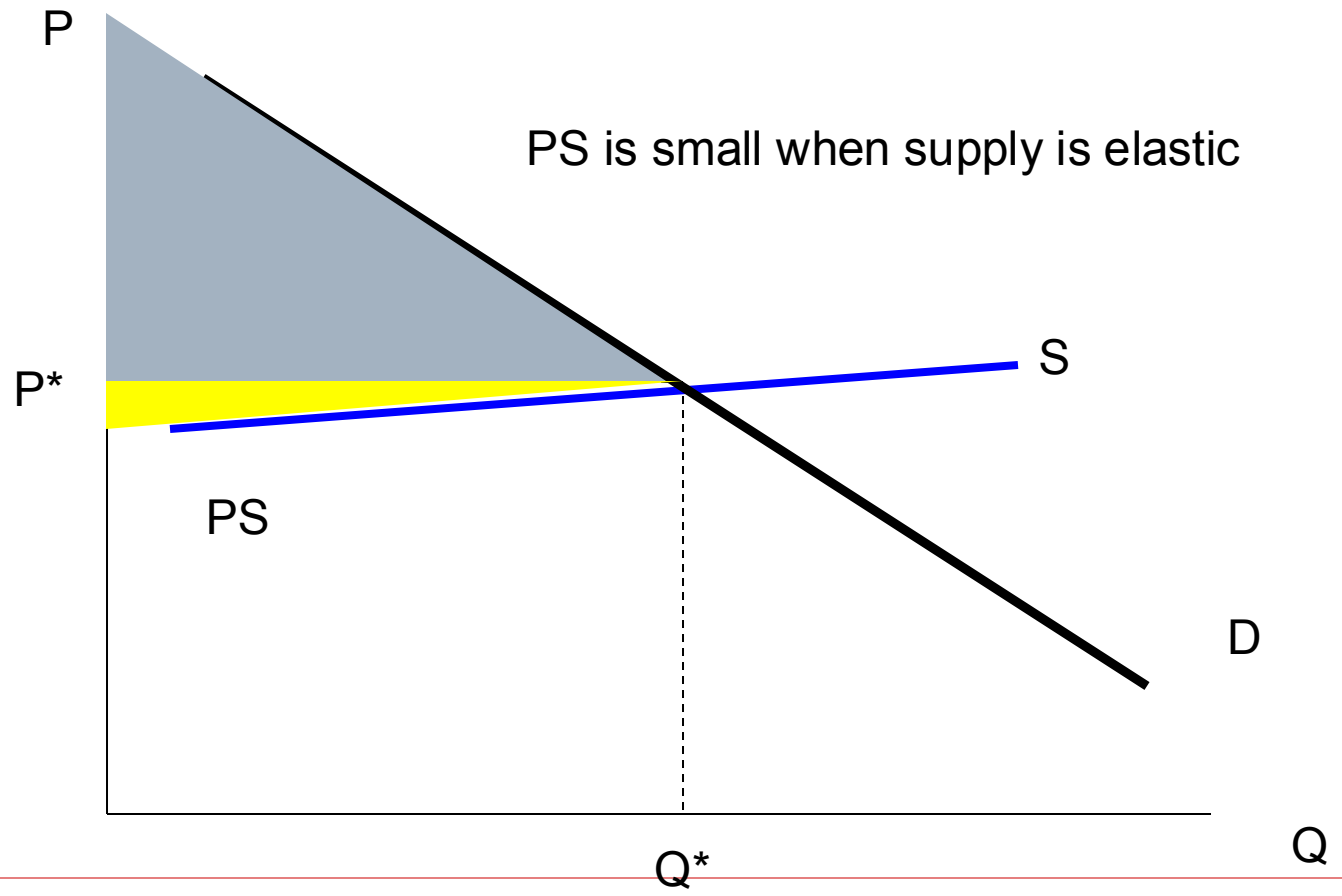


Elasticities and PS



PS is large when supply is inelastic

Elasticities and PS



Equity of competitive equilibrium

- Although competitive market results in efficient market outcome, the equity property of a competitive equilibrium is much less certain

- But as a society (or as a government), we also care about equity
  - We probably don't want markets make some people very rich and some people very poor

- For the remainder of the lecture, we'll study several ways one can depart from a purely competitive markets in order to "improve" the distribution of wealth.
  - One thing we will see, though, is that departing from competitive markets frequently means moving to an allocation that is not Pareto Optimal.

Competitive Equilibrium: Roadmap

- Compute competitive market equilibrium

- Properties of market equilibrium
  - Efficiency
  - Equity

- **Three examples of government interventions and their welfare implications**
  - **Price controls**
  - **Minimum wages**
  - **Taxation**

Government intervention

- Discuss three types of frequently used governments interventions in markets:
  - Price controls
  - Minimum wages
  - Taxation

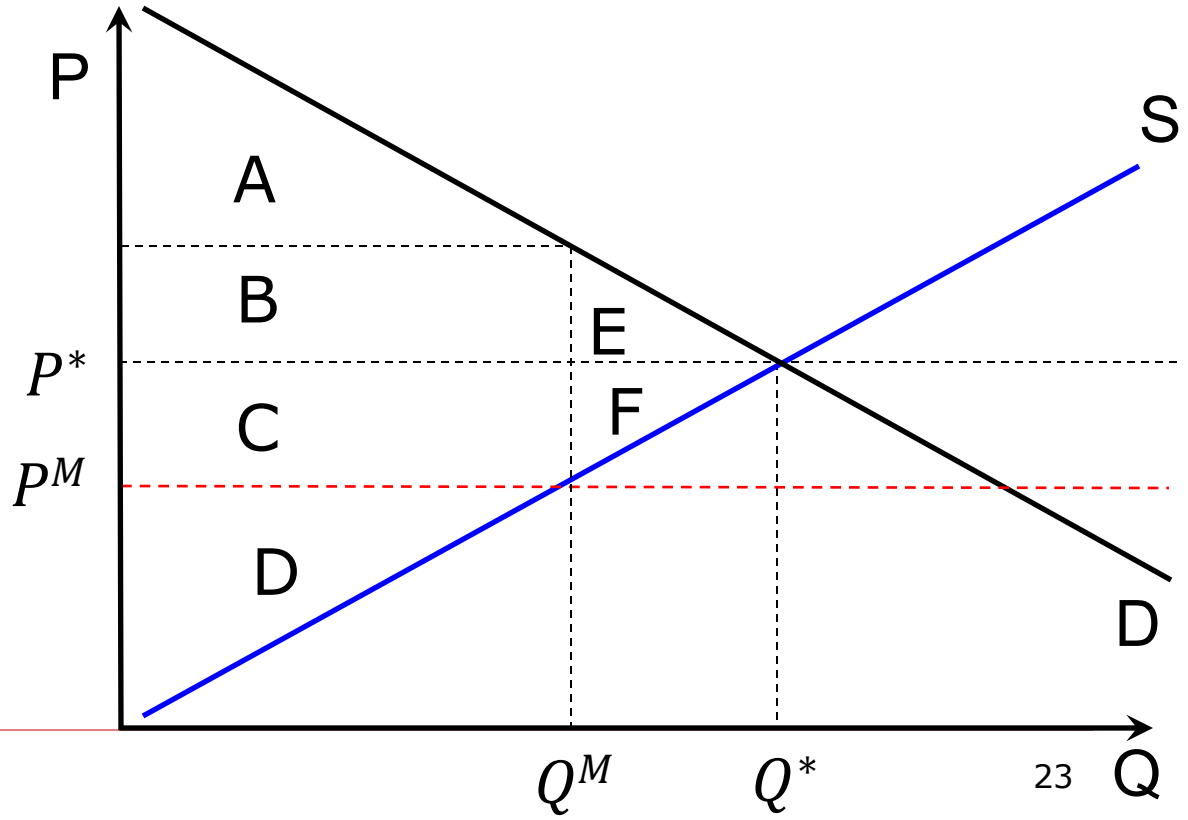
- We'll now examine the effect some of these interventions have on market equilibrium and market efficiency.

- Note: In all following slides, I will use (P*, Q*) to denote competitive market equilibrium price and quantity

1. Price Controls

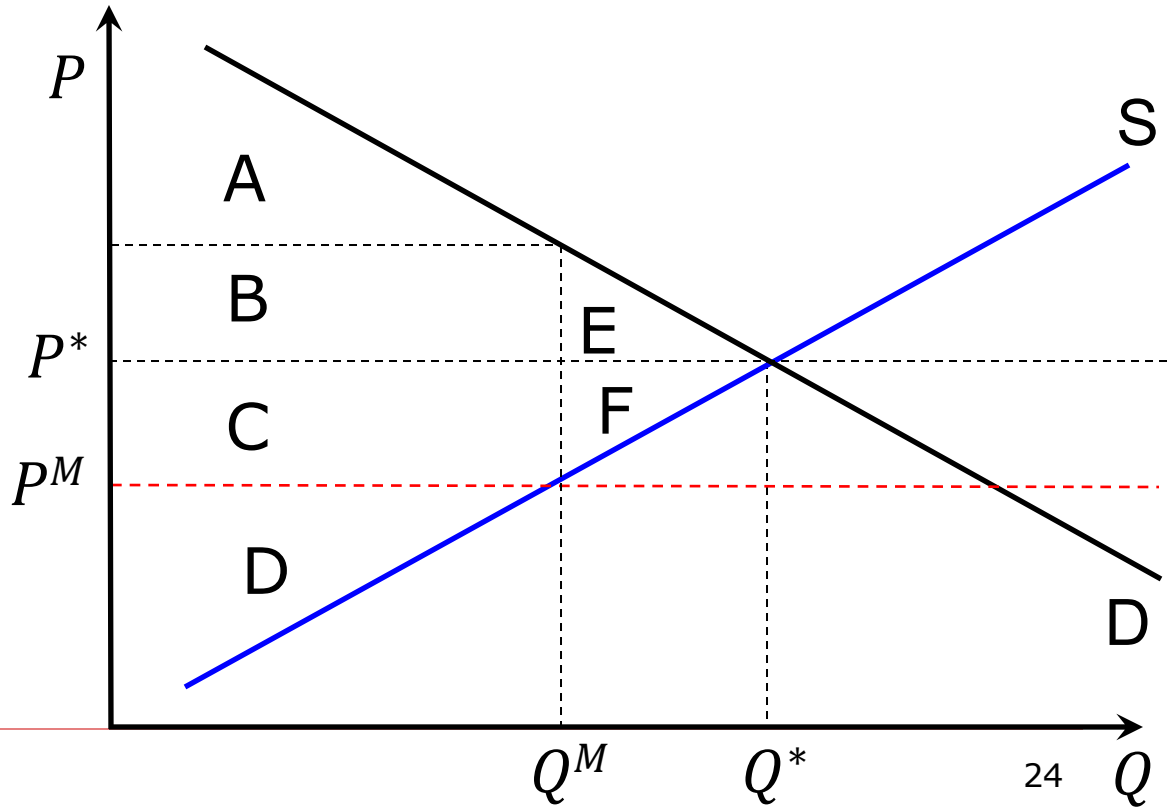
- Regulators impose a maximum price P^M on the market. Quantity drops to Q^M.

- Consumers
  - CS Before: $A + B + E$
  - CS After: $A + B + C$
  - $\Delta CS = C - E$
  - Some consumers no longer get the good ($-E$).
  - Those that still do, get it more cheaply (C).



Price Controls

- Producers:
  - PS Before: $C + D + F$
  - PS After: D
  - $\Delta PS = -C - F$
  - Some units are no longer produced and sold ($-F$).
  - Those that are still sold get a lower price ($-C$).

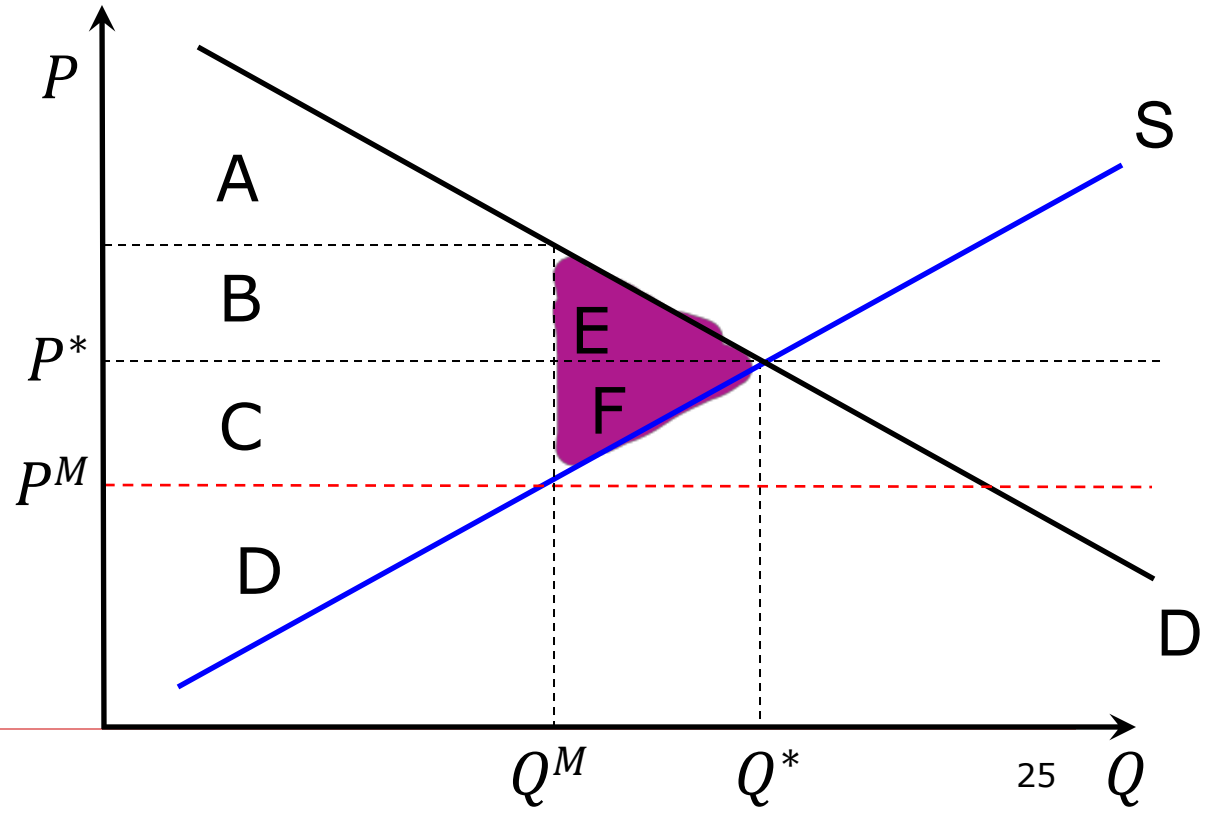


"Deadweight Loss"

Total Surplus:

- $\Delta TS = -E - F$

- Economists call $E + F$ the "deadweight loss" of the policy = reduction in overall efficiency.

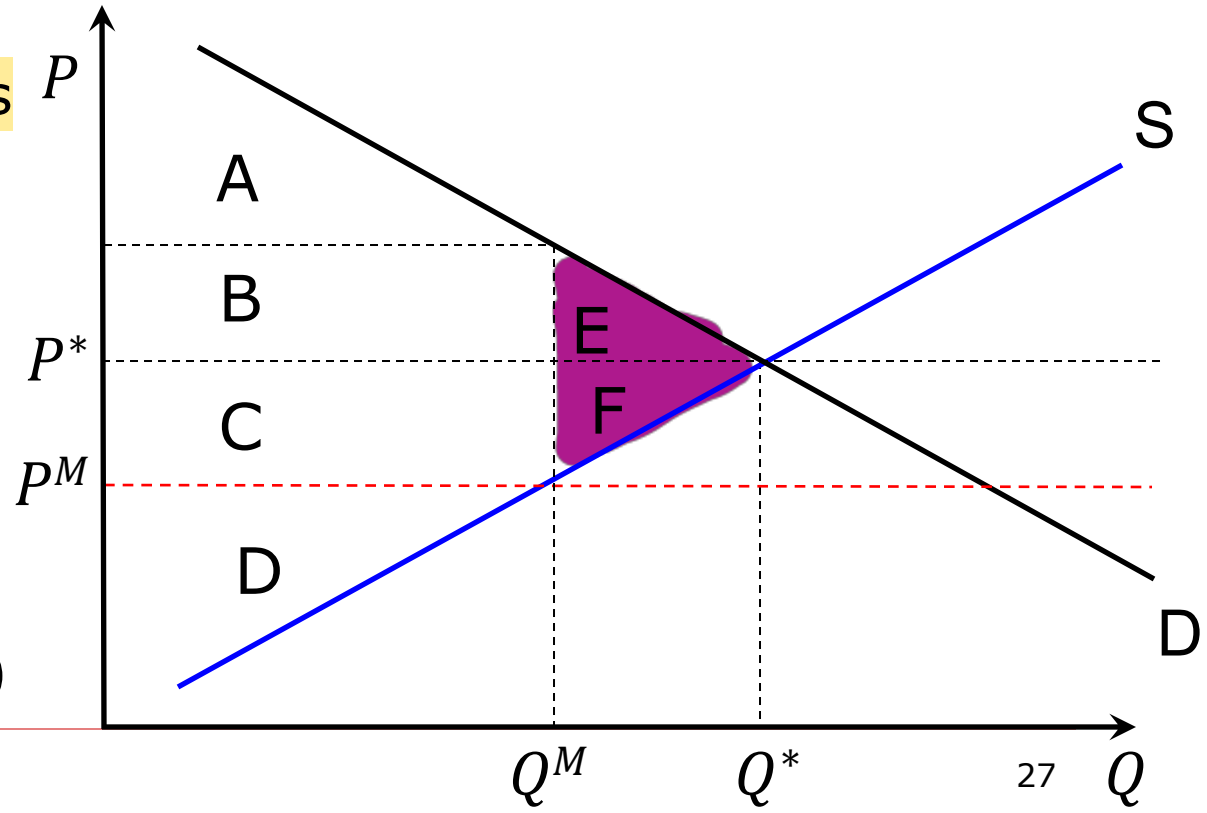


Cause of deadweight loss

- Deadweight loss is created because $Q^M < Q^*$.
  - Price control creates a distortion of quantity away from the competitive level
  - This "distortion" of the quantity exchanged leads to the DWL.
  - It is NOT because price is higher/not equal to the optimal price.

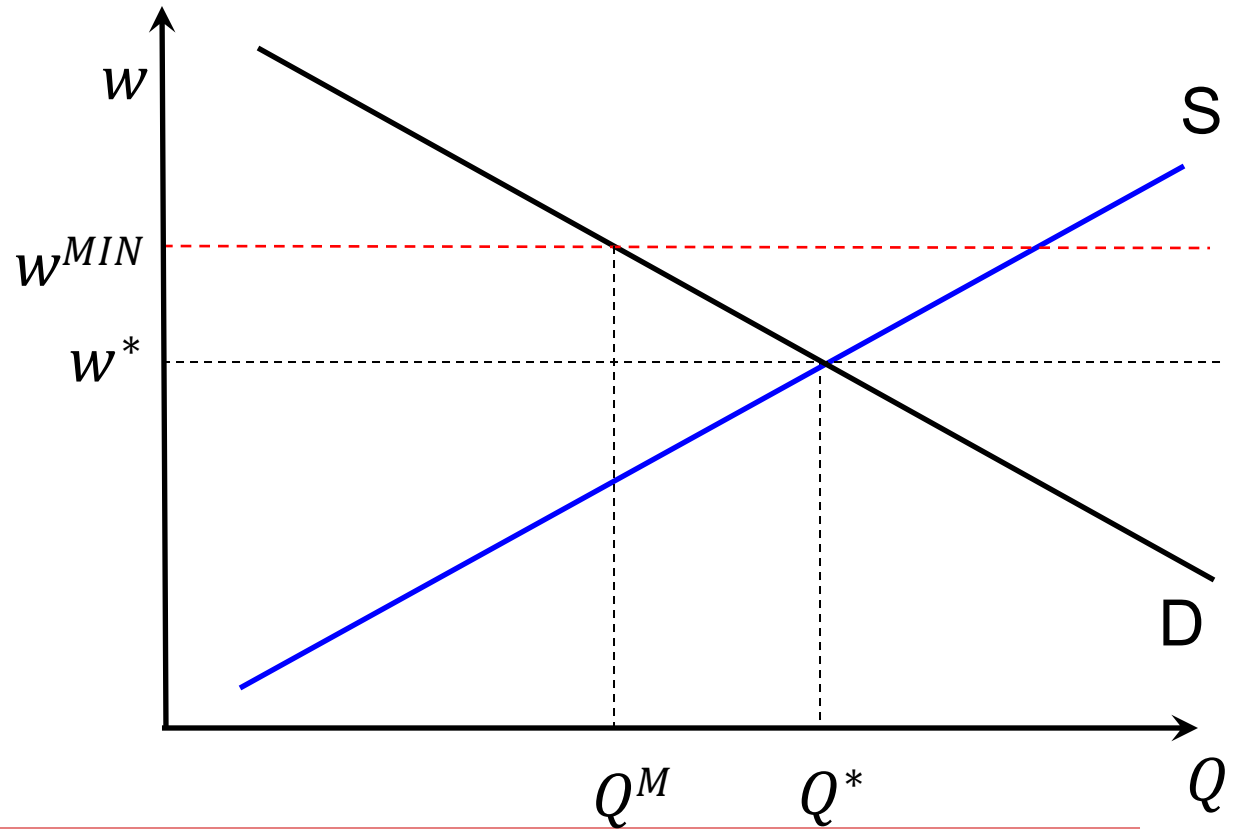
"Deadweight Loss"

- "In theory", when there is a DWL, you can enact policies that make everyone better off.
- Example: no price control, but producers pay consumers a C.
  - Both consumers and producers would prefer this.
- In practice, very difficult to do
  - Requires the government to know shape of demand and supply curves
  - (Recall how difficult it was just to estimate Uber users' demand curve!)



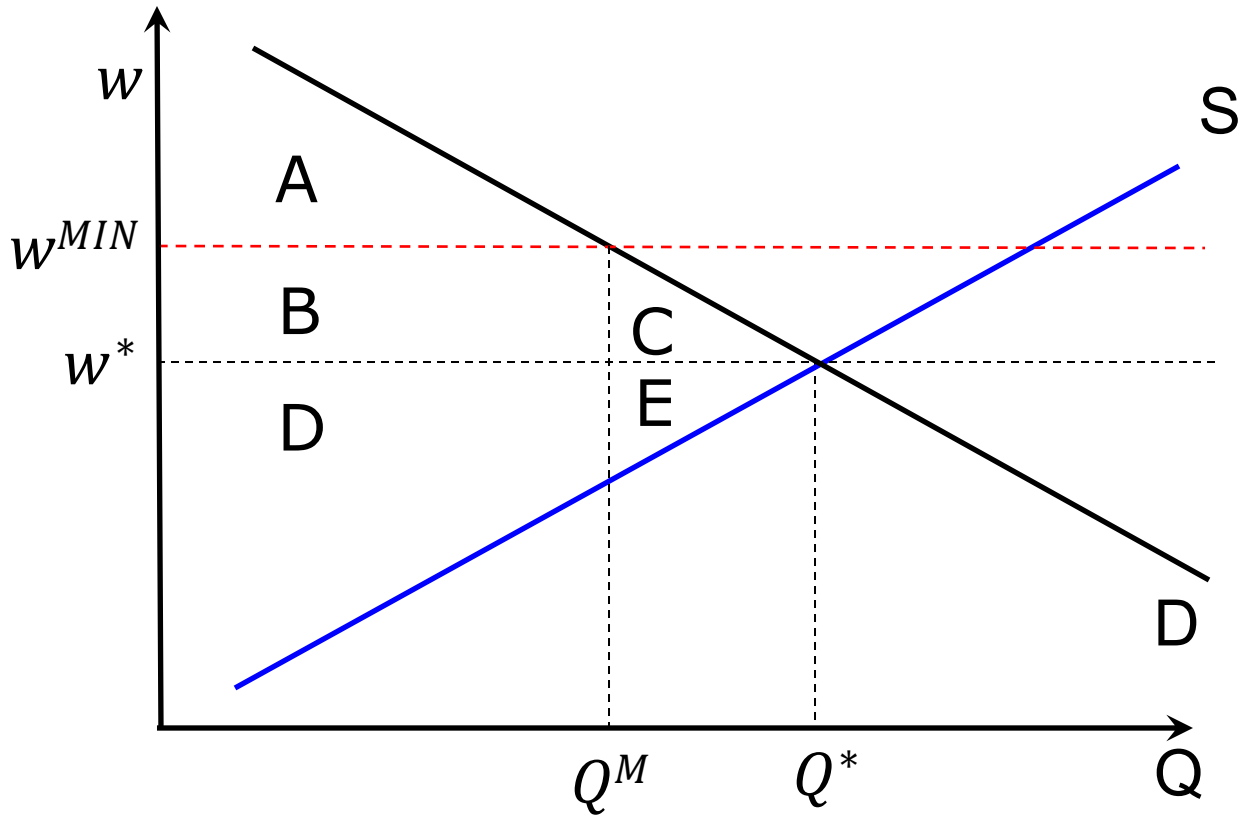
2. Minimum wage

- S is the supply of labor, D is the demand for labor.
- The price is the wage rate, w.
- A minimum price $w^{MIN} > w^*$ is imposed on this market.
- Quantity is reduced from Q to Q^M.
- What happens to CS, PS, TS?



Minimum wage

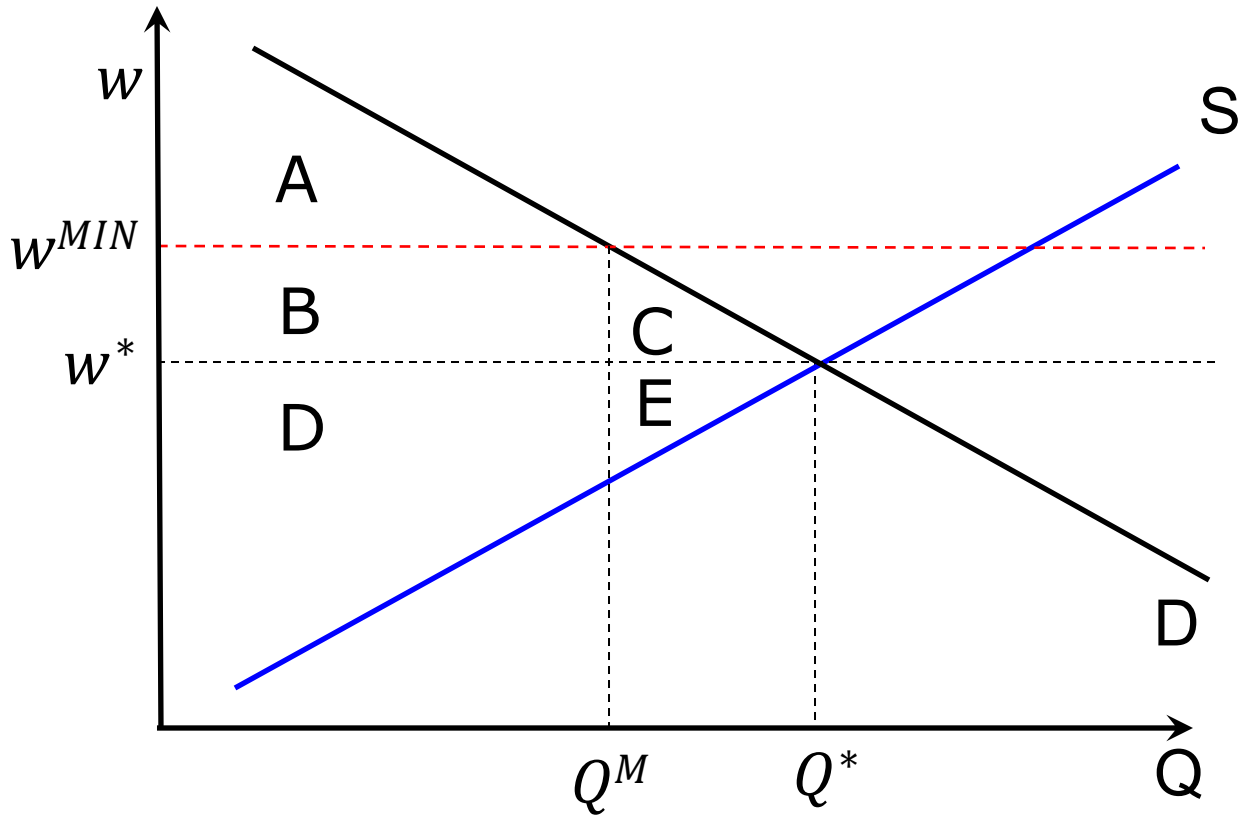
- Before Minimum Wage:
  - $CS =$
  - $PS =$
- After Minimum Wage:
  - $CS =$
  - $PS =$
- Change:
  - $\Delta CS =$
  - $\Delta PS =$
  - $DWL =$



Minimum wage

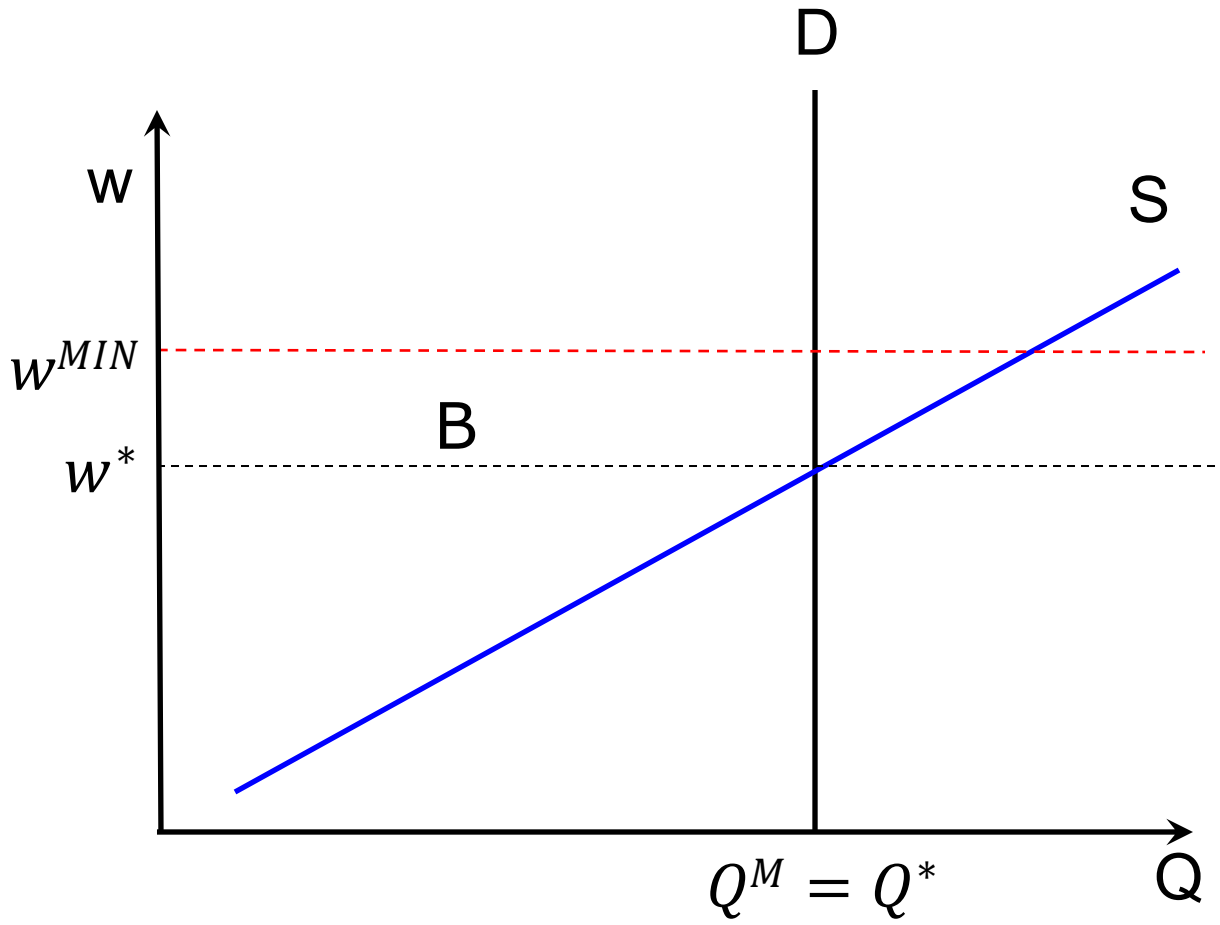
- Minimum wage has two effects on workers:
  - Some people lose their jobs.
  - Those who are still employed make more money.

- The DWL comes from the first effect, and its magnitude depends on the elasticity of demand.



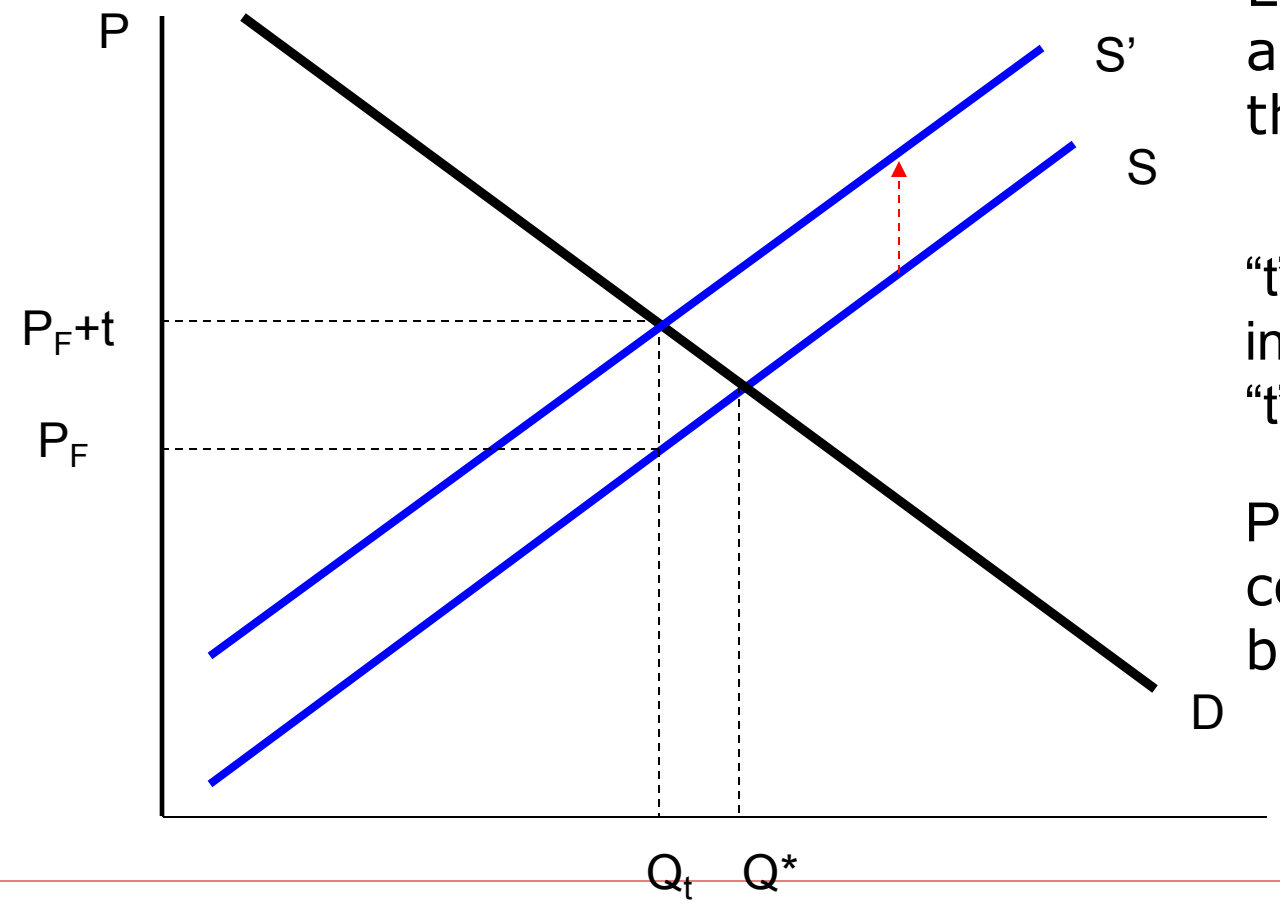
Minimum wage

- *If demand for labor is perfectly inelastic, then the wage rises and there is no reduction in employment!*



Digression:
History and debate on minimum wage

3. Taxation: Suppose government imposes a per unit tax "t" on production

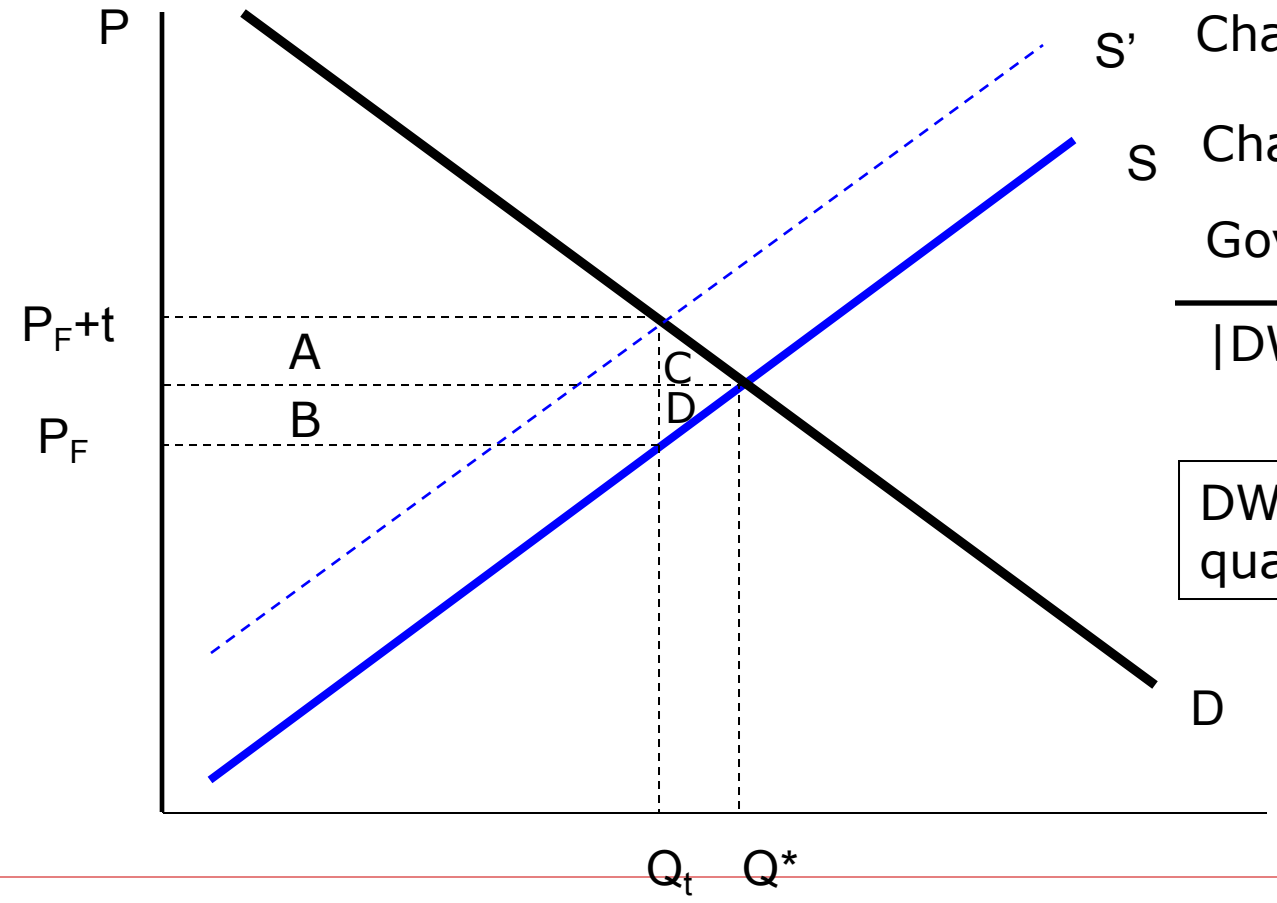


Every time the firm sells a unit, it must send $t to the government.

"t" acts like a per unit increase in costs – an increase in MC of "t" per unit shifts supply up

P_F+t is price paid by consumers,
but firm only gets to keep P_F

Suppose government imposes a per unit tax "t" on production



Change in CS:

Change in PS:

Gov Revenue:

|DWL|:

DWL is due to quantity distortion.

Deadweight loss of taxation

- Taxing an economic activity generally results in less of that activity.
- Combined loss of CS and PS generally exceeds revenue raised because of the quantity distortion.
- This is referred to as the "excess burden" of taxation
  - The cost of raising $1 of government revenue is more than $1, because of the deadweight loss
- **But, if government revenue is put to "good use," benefit of government services provided with revenue may outweigh this excess burden.**
  - E.g., use gasoline tax revenue to build more roads, which helps reduces congestion and air pollution

Practice example

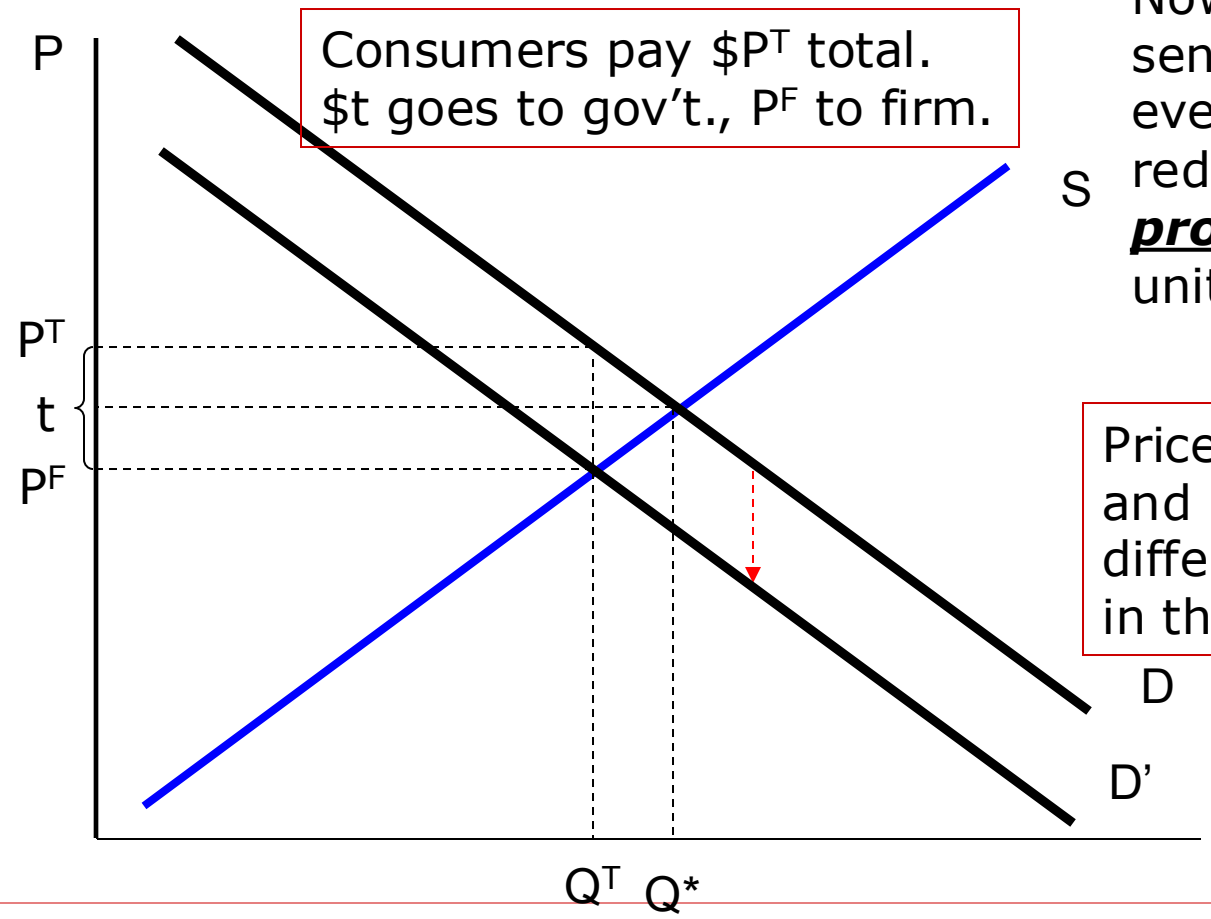
$$Q_D = 90 - 2P;\ Q_S = P$$

- What is the competitive market equilibrium?
- What is the new equilibrium if the government imposes a tax $t = 3$?
- What is the tax revenue raised, and deadweight loss?

Does it matter who(m) we tax?

- In this example, we taxed production.
  - Firms paid tax.
- Would it matter if we taxed consumers instead?
- How does this affect the outcome?
- How to think about a consumption tax:
  - Demand: height of demand curve gives wtp for Q^{th} unit.
  - This is total wtp. Consumer doesn't care if producer or government gets the money.
  - So, if t must go to the government, consumer is willing to pay t less to producers.
  - It is "as if" the willingness to pay (inverse demand) curve has shifted down by t.

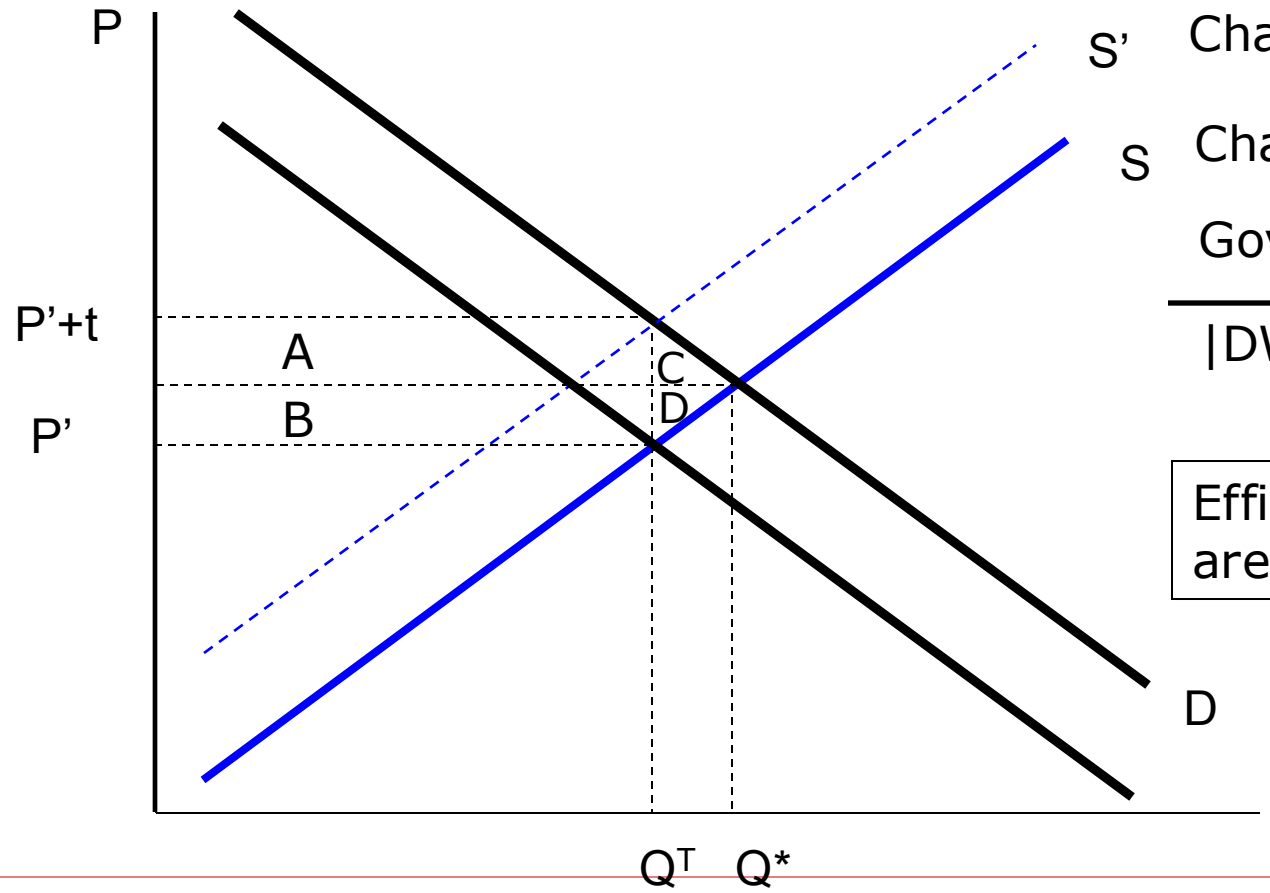
Per unit tax "t" on consumption



Now, consumers send $t to gov't for every unit. This reduces wtp ***producers*** for any unit by $t.

Price consumers pay and price firms keep differs by t, just like in the production tax.

Per unit tax on consumption.



Change in CS:

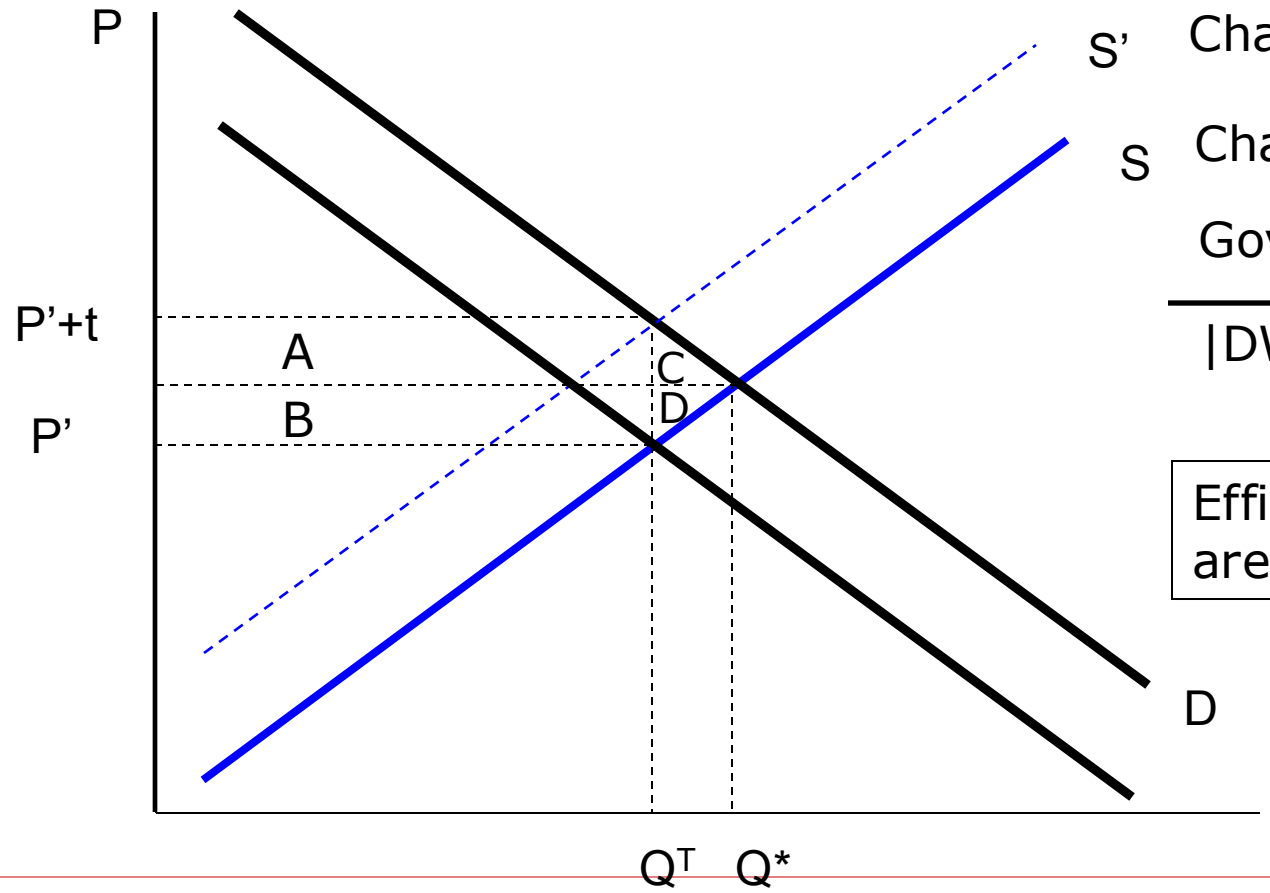
Change in PS:

Gov Revenue:

|DWL|:

Efficiency implications are the same.

Per unit tax on consumption.



Change in CS: - A - C

Change in PS: - B - D

Gov Revenue: A + B

|DWL|: C + D

Efficiency implications are the same.

Why doesn’t it matter?

- The reason why it doesn’t matter whether consumers or firms pay the tax is that the equilibrium conditions do not change.

- If we tax the consumer, the equilibrium solves:
  - $P_F + t = P_C$.
  - $S(P_F) = D(P_C) = D(P_F + t)$.

- If we tax the producer, the equilibrium solves:
  - $P_F = P_C - t$.
  - $S(P_F) = S(P_C - t) = D(P_C)$.

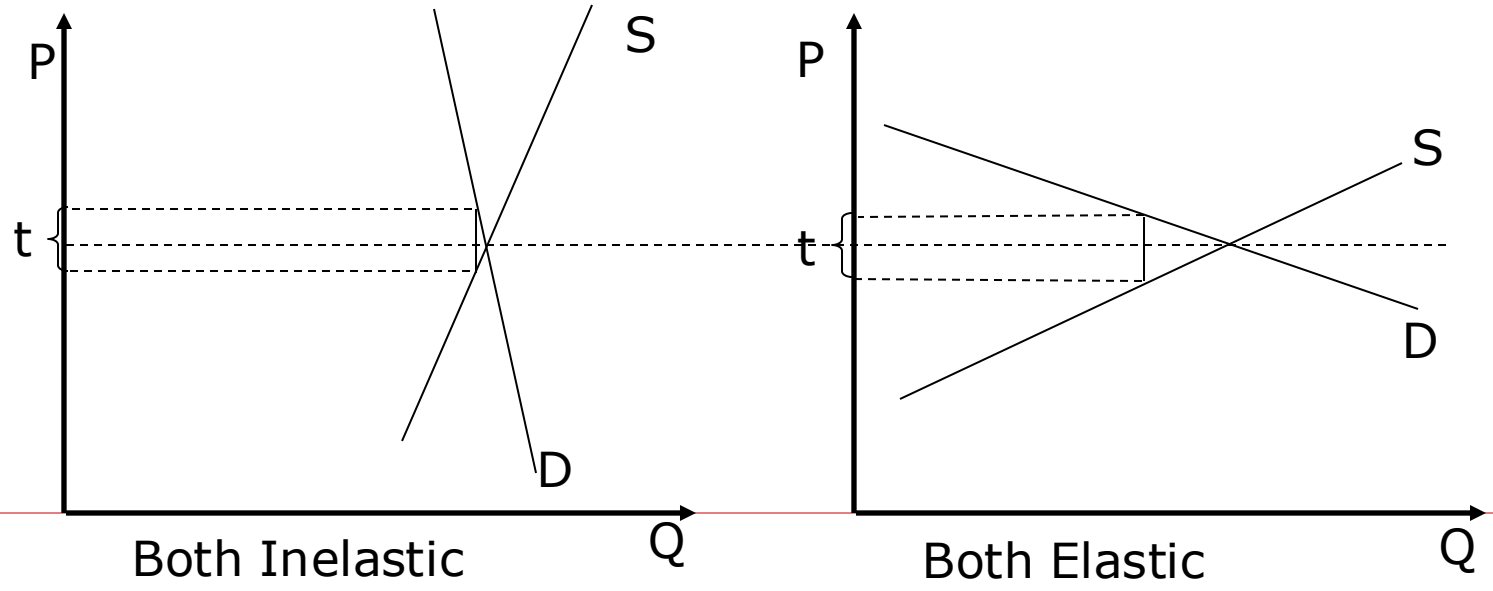
- These two set of equations determine the same equilibrium, regardless of who pays the tax.

Taxes and elasticity

- While the legal incidence of a tax (who pays the tax) doesn't matter, the **size of the distortion** and **which side of the market is more affected** depends on the elasticities of demand and supply.

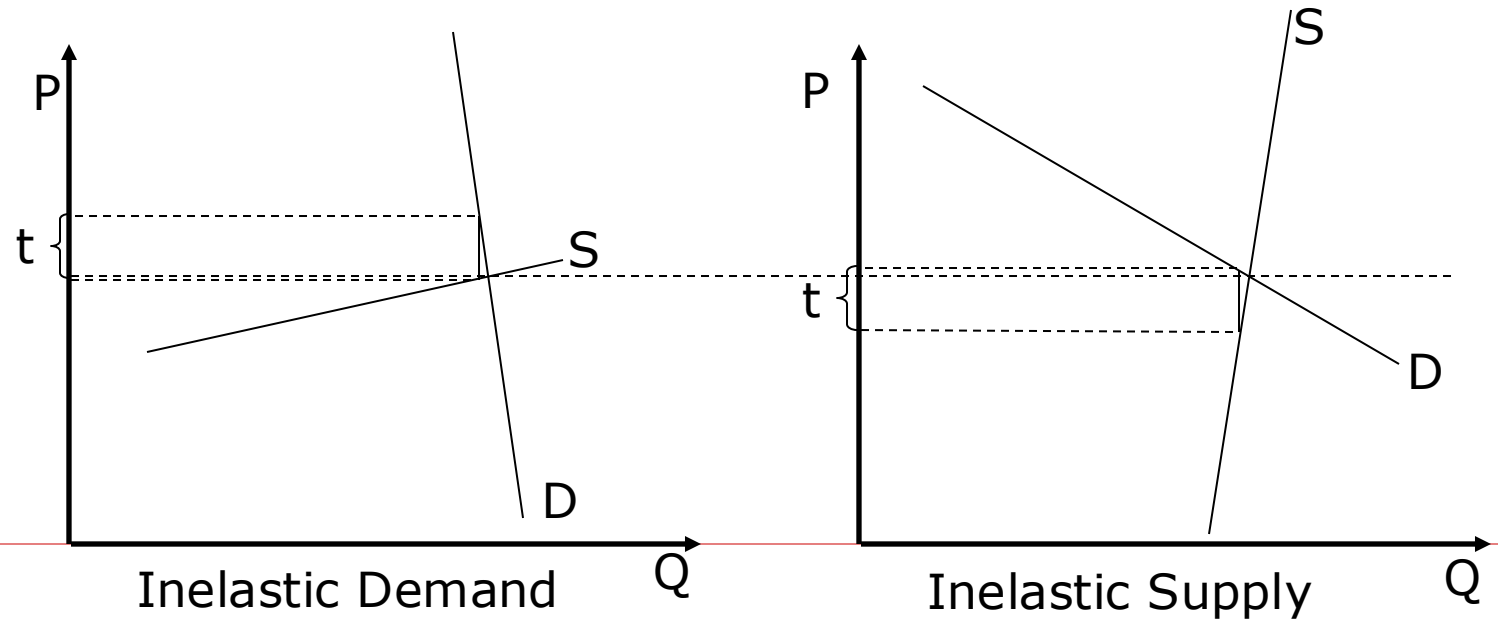
Taxes and elasticity

- Magnitude of deadweight loss: Deadweight loss from taxing inelastic goods ***tends to be smaller*** than from taxing elastic goods.



Taxes and elasticity

- Relative burden: The side of the market that is relative inelastic tends to have a larger price change, and therefore bears more of the tax burden.



Key takeaways

- A competitive market equilibrium outcome is quite desirable
  - It's decentralized: Every market participant solves her/his own maximization problem; no need for government to know a lot about consumers and firms
  - It's efficient (First Welfare Theorem): If people can trade freely, the market outcome is Pareto Optimal

- For these reasons, competitive equilibrium often serves as the "baseline" of microeconomics.
  - Not that economists believe all markets are competitive, all participants are rational and maximizing utility / profit, etc. But it's a nice and simple (perhaps simplest!) "baseline" situation where we know market would work

- A big part of microeconomics is to study how real-world situations deviate from this baseline, and what's the implications for social welfare. We will have several classes devote to this **("Market failures")**

Key takeaways

- Competitive equilibrium says nothing about equity. Markets sometimes make some people rich and some people poor. One can depart from markets in order to "improve" the distribution of wealth.
- While redistribution may be desirable, departing from markets frequently means moving to an allocation that is not Pareto Optimal.
- In practice, a lot of the debate is: is the efficiency loss worth it?
- Frequently it is better to let markets and market prices allocate goods to individuals, and redistribute through the tax system than to distort prices.
  - Lower efficiency loss.
  - Easier to implement.