These slides are by courtesy of Prof. 李稻葵 and Prof. 郑捷.

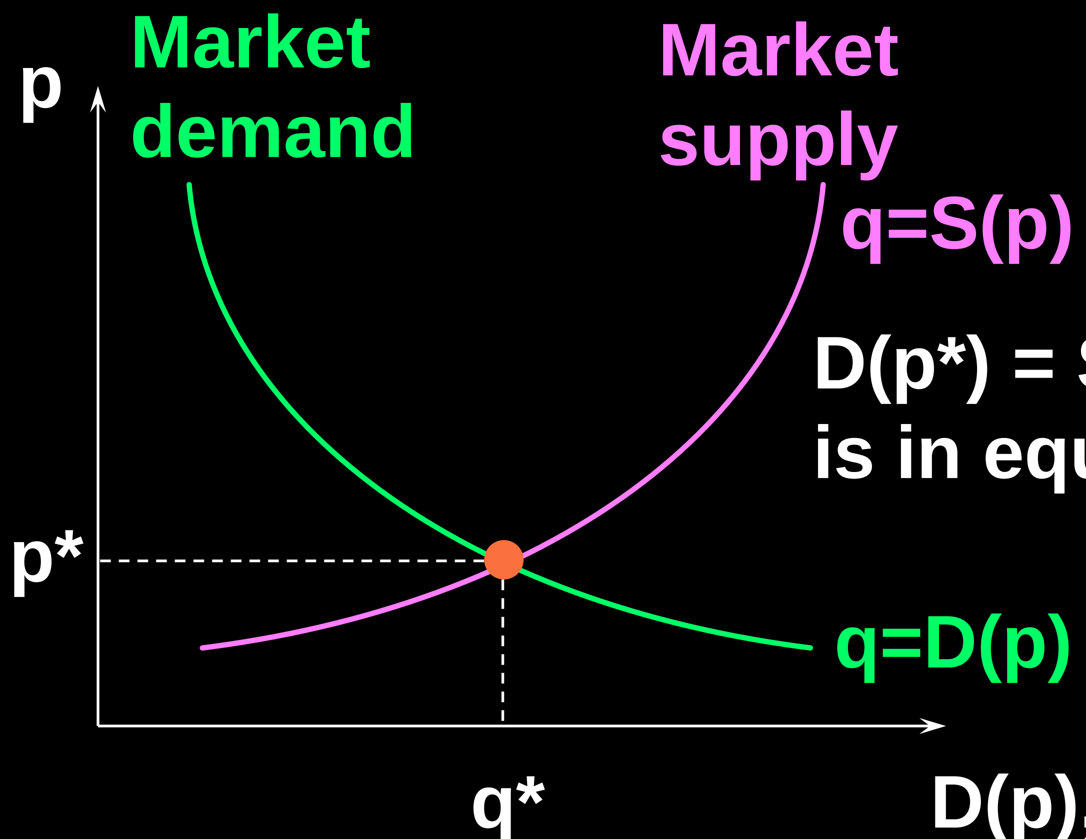
Chapter Sixteen

Equilibrium

Market Equilibrium

- A market is in **equilibrium** when total quantity demanded by buyers equals total quantity supplied by sellers.

Market Equilibrium



D(p*) = S(p*); the market is in equilibrium.

Quantity Taxes

- A quantity tax levied at a rate of \$t is a tax of \$t paid on each unit traded.
- If the tax is levied on sellers then it is an **excise tax**. (Price includes tax.)
- If the tax is levied on buyers then it is a **sales tax**. (Price does not include tax.)

Quantity Taxes

- What is the effect of a quantity tax on a market’s equilibrium?
- How are prices affected?
- How is the quantity traded affected?
- Who pays the tax?
- How are gains-to-trade altered?

Quantity Taxes

- A tax rate t makes the price paid by buyers, p_b, higher by t from the price received by sellers, p_s.

$$p_b - p_s = t$$

Quantity Taxes

- Even with a tax the market must clear.
- I.e. quantity demanded by buyers at price p_b must equal quantity supplied by sellers at price p_s.

$$D(p_b) = S(p_s)$$

Quantity Taxes

$p_b - p_s = t$ and $D(p_b) = S(p_s)$

describe the market's equilibrium.

Notice that these conditions apply no matter if the tax is levied on sellers or on buyers.

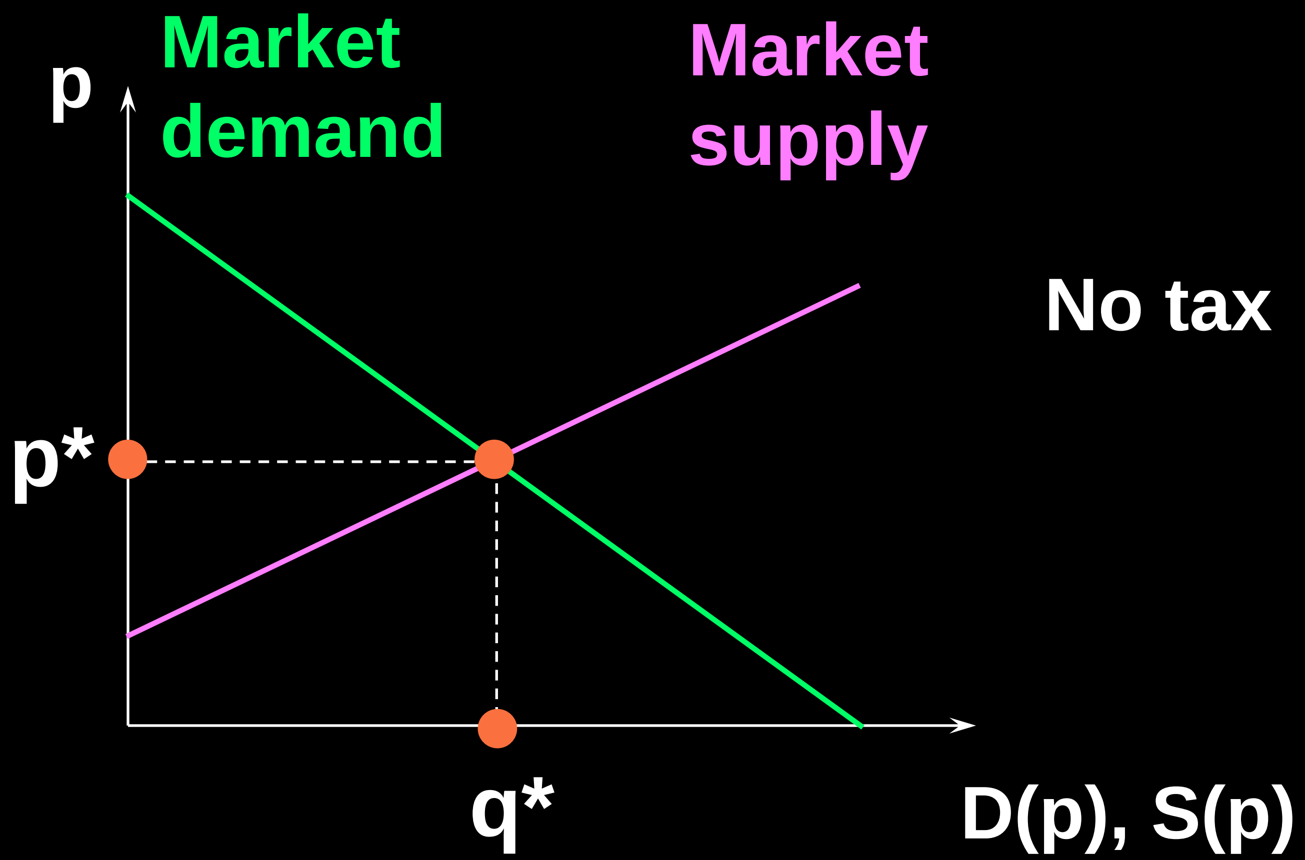
Quantity Taxes

$p_b - p_s = t$ and $D(p_b) = S(p_s)$

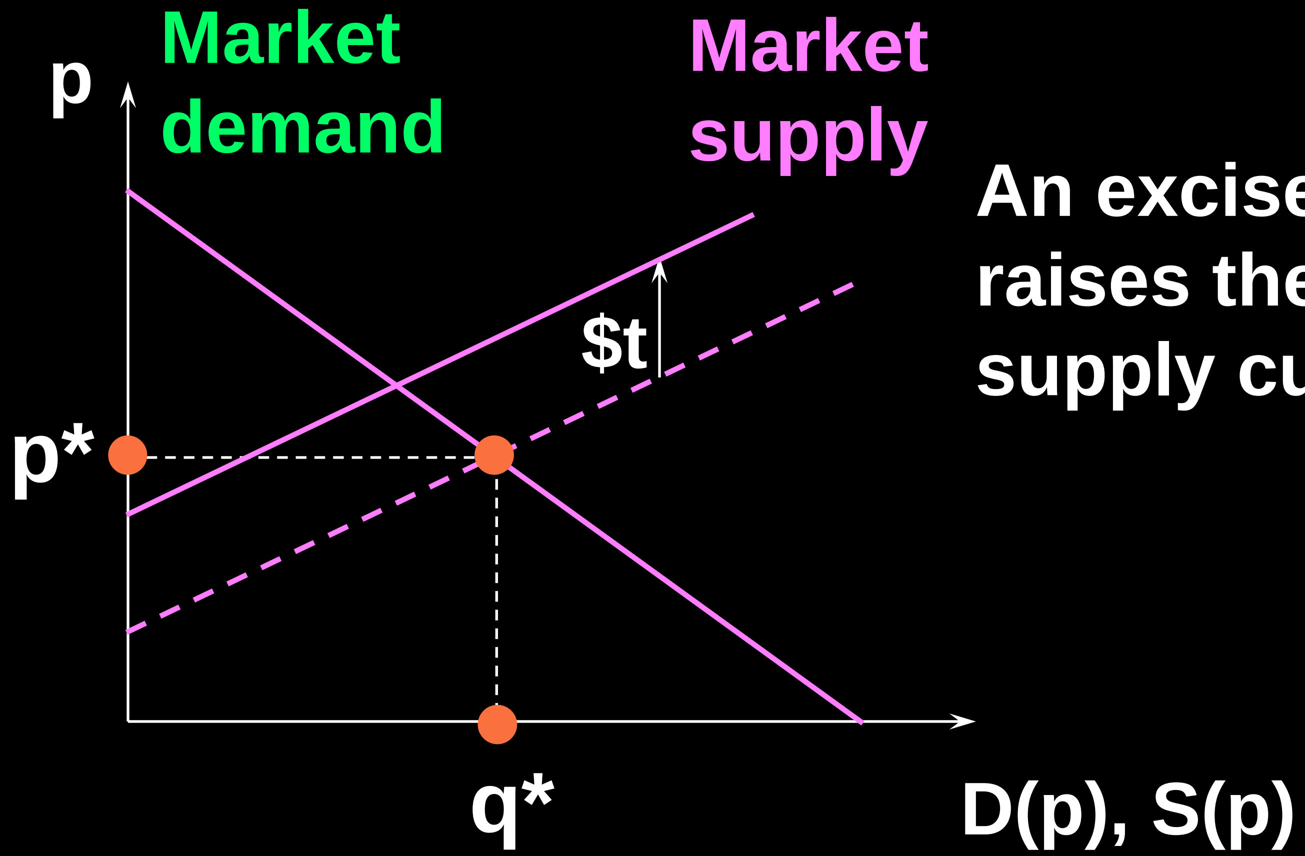
describe the market's equilibrium. Notice that these conditions apply no matter if the tax is levied on sellers or on buyers.

Hence, **a sales tax rate $t has the same effect as an excise tax rate $t.**

Quantity Taxes & Market Equilibrium

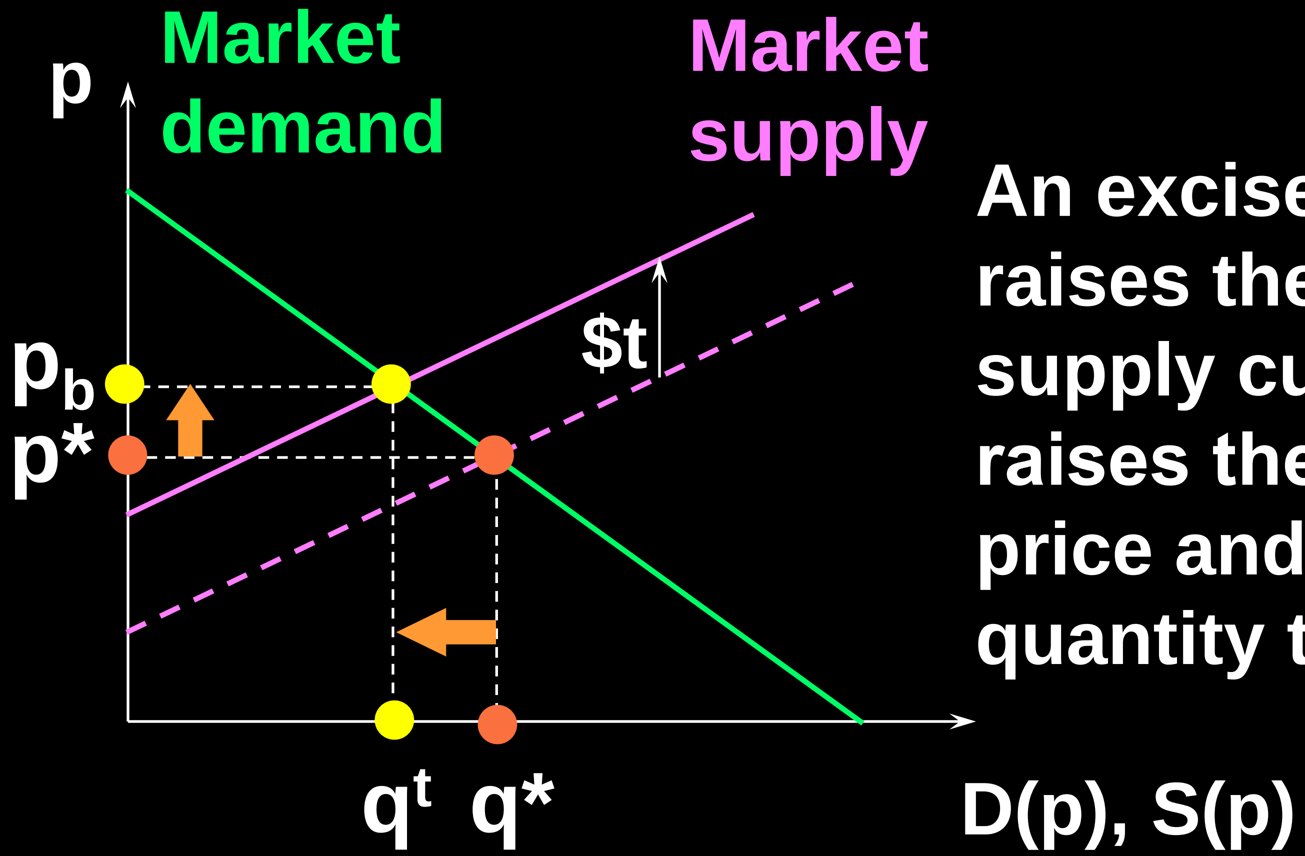


Quantity Taxes & Market Equilibrium



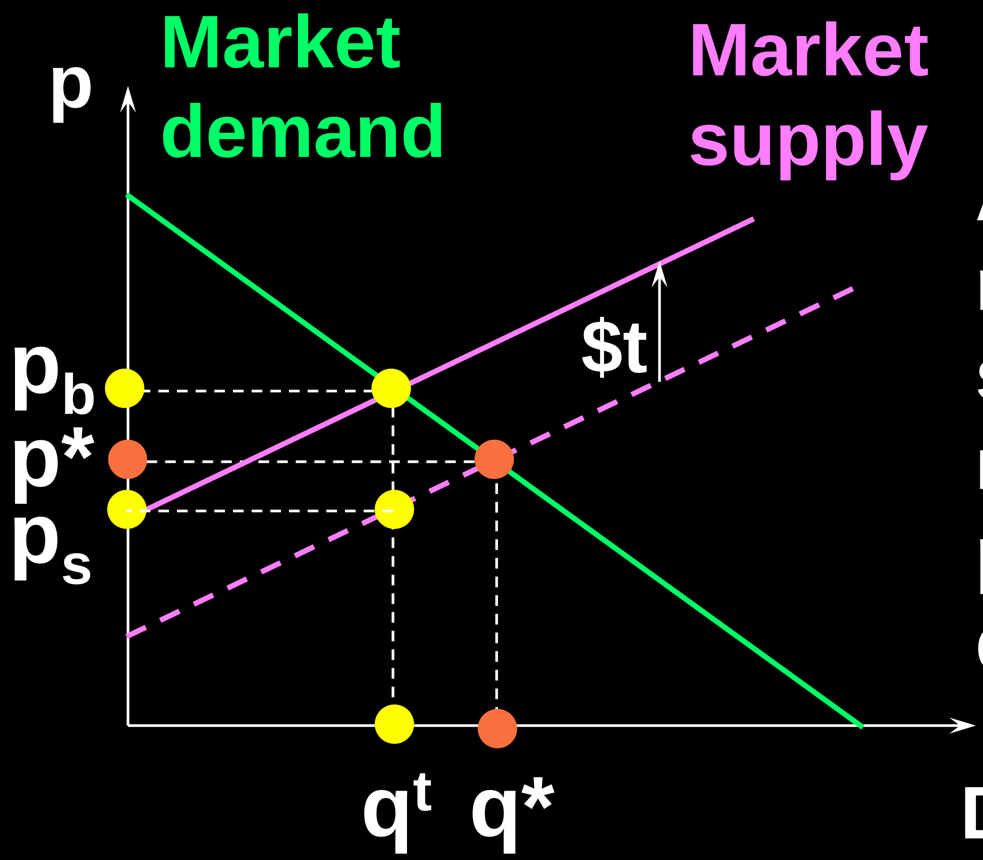
An excise tax raises the market supply curve by $t

Quantity Taxes & Market Equilibrium



An excise tax raises the market supply curve by $t, raises the buyers' price and lowers the quantity traded.

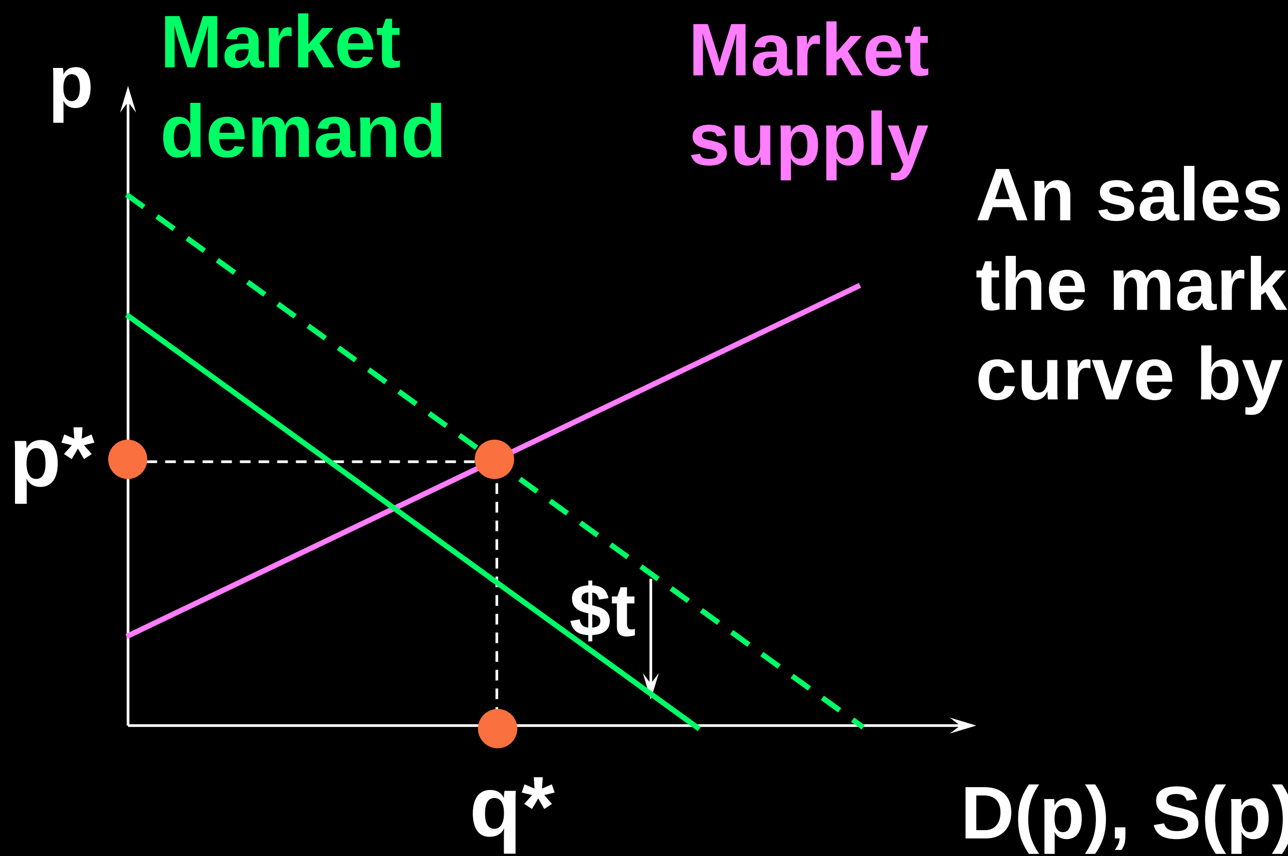
Quantity Taxes & Market Equilibrium



An excise tax raises the market supply curve by $t, raises the buyers' price and lowers the quantity traded.

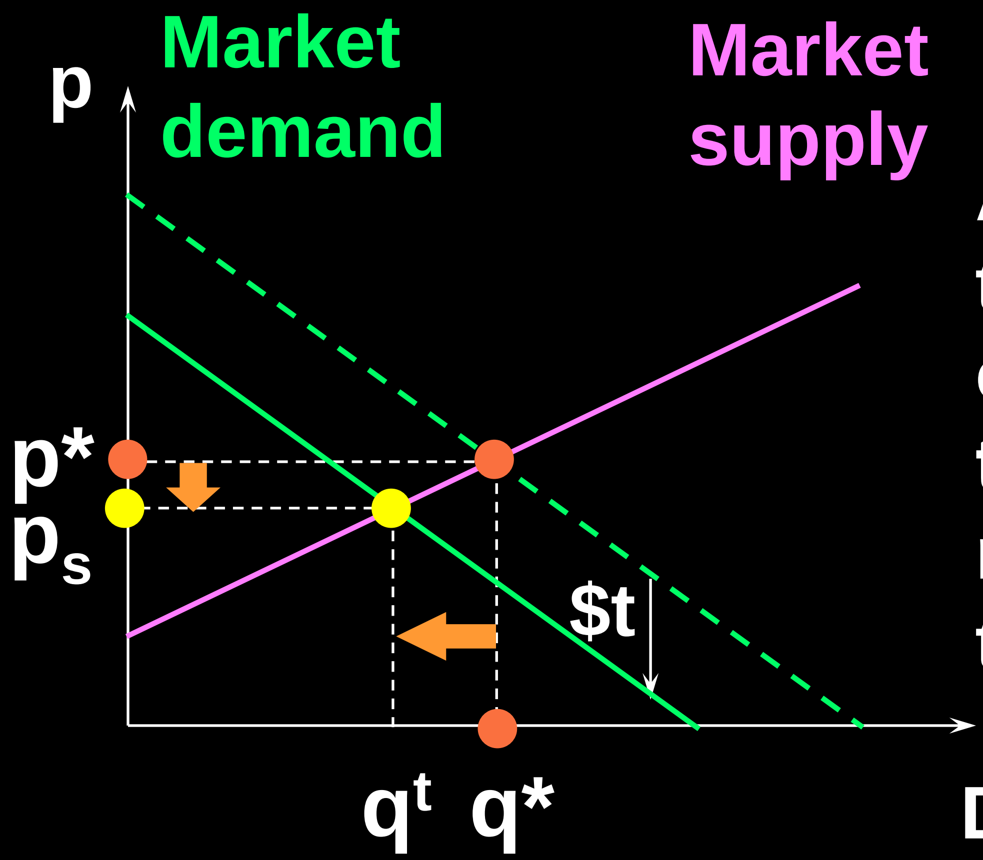
And sellers receive only $p_s = p_b - t$.

Quantity Taxes & Market Equilibrium



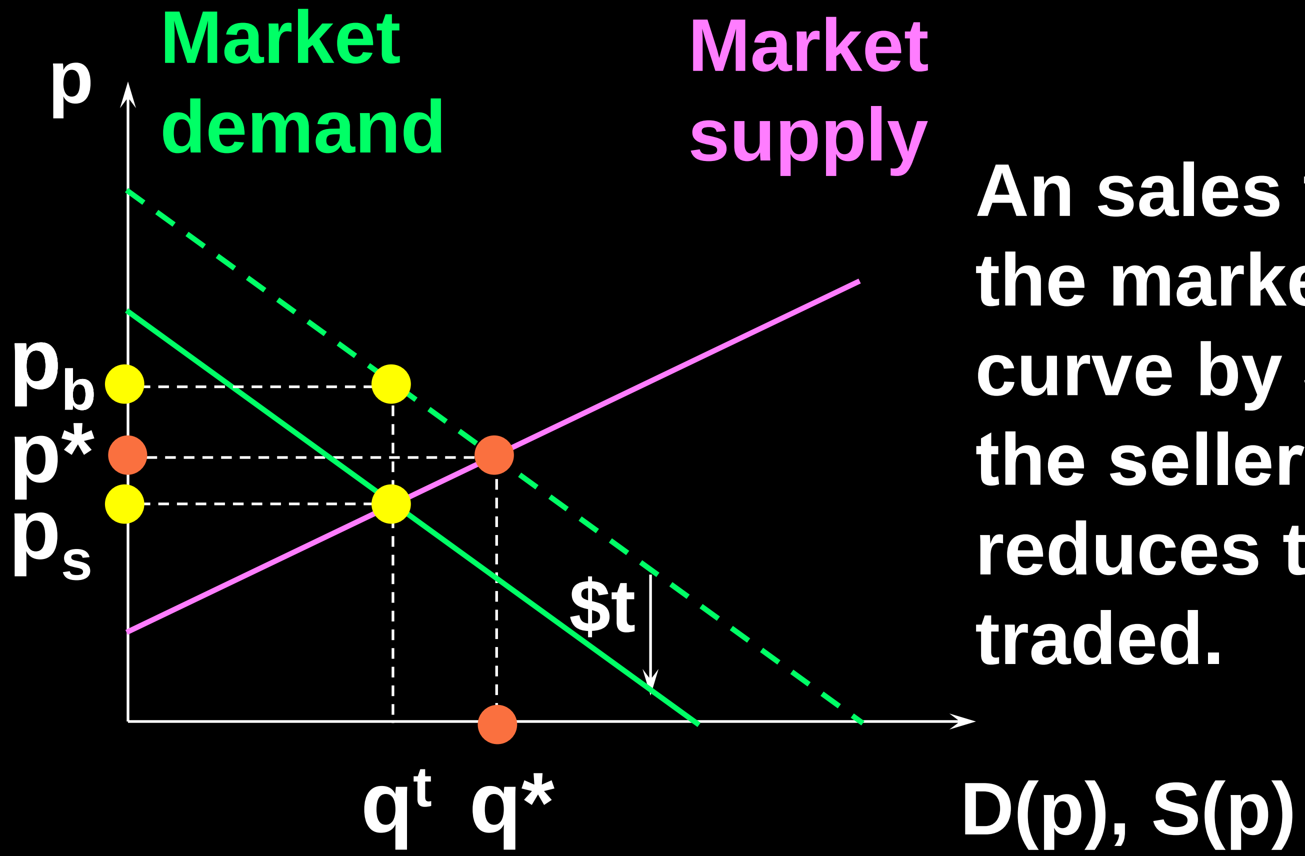
An sales tax lowers the market demand curve by $t

Quantity Taxes & Market Equilibrium



An sales tax lowers the market demand curve by $t, lowers the sellers' price and reduces the quantity traded.

Quantity Taxes & Market Equilibrium



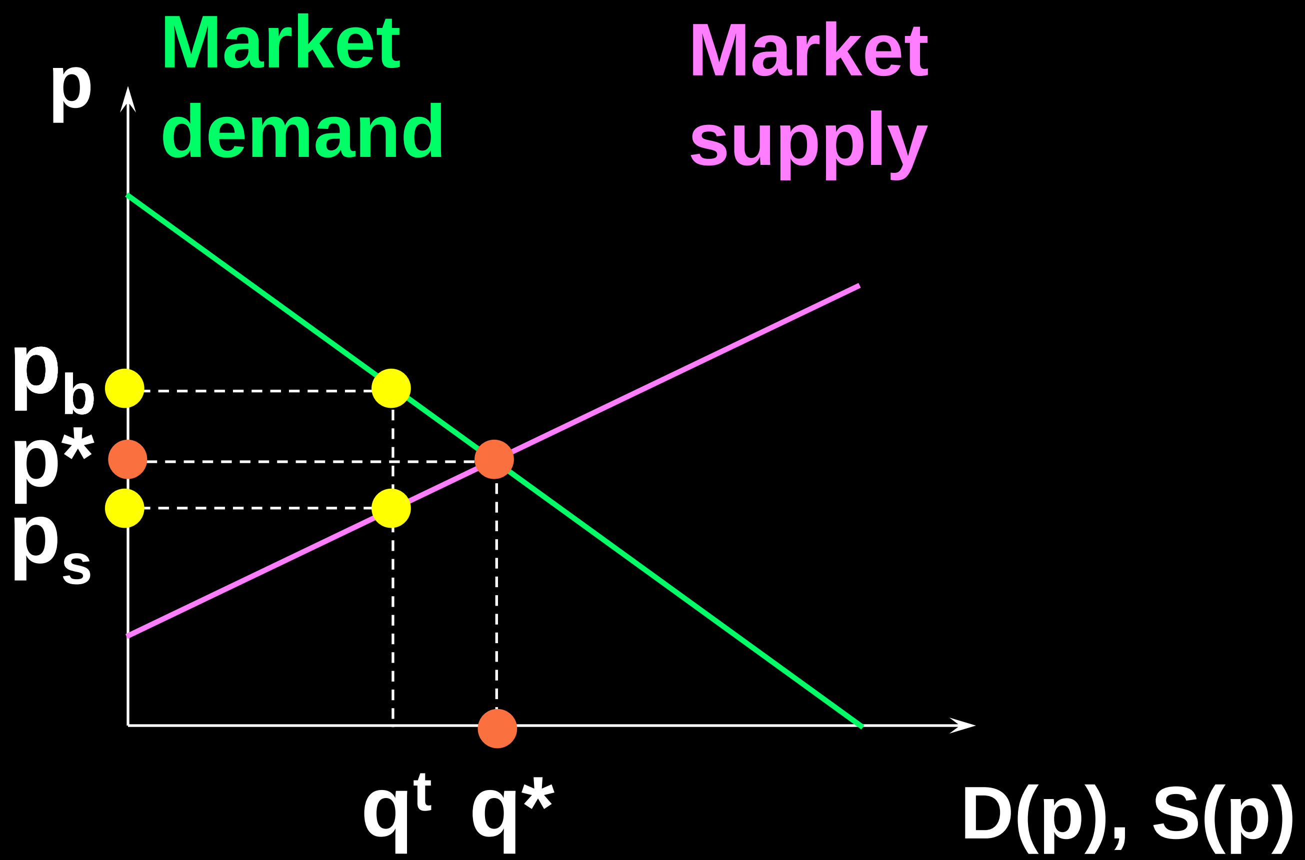
An sales tax lowers the market demand curve by $t, lowers the sellers' price and reduces the quantity traded.

And buyers pay $p_b = p_s + t$.

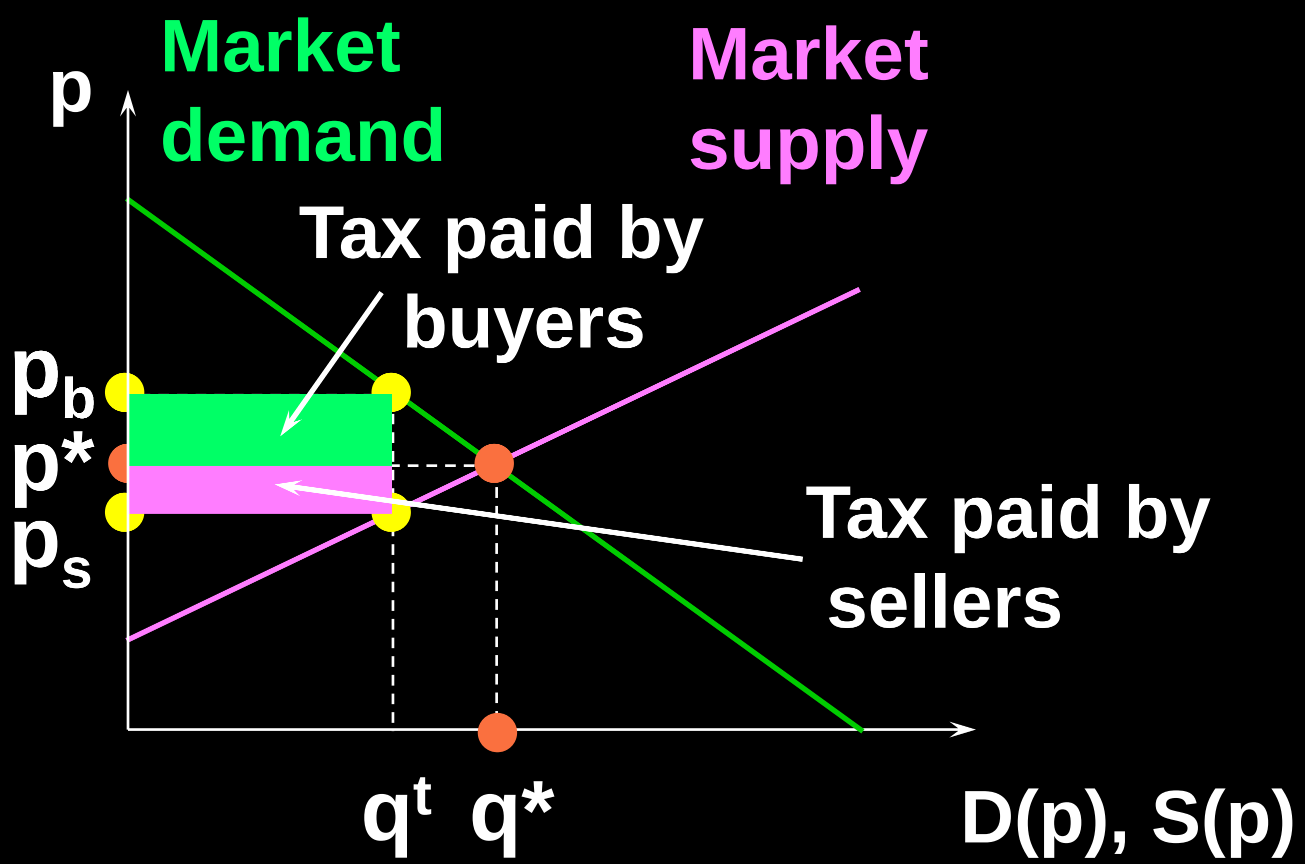
Quantity Taxes & Market Equilibrium

- **Who “actually” pays the tax of $t per unit traded?**
- **The division of the $t between buyers and sellers is the incidence of the tax.**

Quantity Taxes & Market Equilibrium



Quantity Taxes & Market Equilibrium



Quantity Taxes & Market Equilibrium

- **E.g. suppose the market demand and supply curves are linear.**

$$D(p_b) = a - bp_b$$

$$S(p_s) = c + dp_s$$

Quantity Taxes & Market Equilibrium

$$D(p_b) = a - bp_b \text{ and } S(p_s) = c + dp_s.$$

With the tax, the market equilibrium satisfies

$$p_b = p_s + t \quad \text{and} \quad a - bp_b = c + dp_s.$$

Substituting for p_b gives

$$a - b(p_s + t) = c + dp_s \Rightarrow p_s = \frac{a - c - bt}{b + d}.$$

Quantity Taxes & Market Equilibrium

$$p_s = \frac{a - c - bt}{b + d}$$ and $$p_b = p_s + t$$ give

$$p_b = \frac{a - c + dt}{b + d}$$

The quantity traded at equilibrium is

$$q^t = D(p_b) = S(p_s)$$

$$= a - bp_b = \frac{ad + bc - bdt}{b + d}.$$

Quantity Taxes & Market Equilibrium

$$p_s = \frac{a - c - bt}{b + d}$$

$$q^t = \frac{ad + bc - bdt}{b + d}$$

$$p_b = \frac{a - c + dt}{b + d}$$

As t increases, p_s falls,

p_b rises,

and q^t falls.

Quantity Taxes & Market Equilibrium

$$p_s = \frac{a - c - bt}{b + d}$$

$$q^t = \frac{ad + bc - bdt}{b + d}$$

$$p_b = \frac{a - c + dt}{b + d}$$

The tax paid per unit by the buyer is

$$p_b - p^* = \frac{a - c + dt}{b + d} - \frac{a - c}{b + d} = \frac{dt}{b + d}.$$

The tax paid per unit by the seller is

$$p^* - p_s = \frac{a - c}{b + d} - \frac{a - c - bt}{b + d} = \frac{bt}{b + d}.$$

Quantity Taxes & Market Equilibrium

$$p_s = \frac{a - c - bt}{b + d}$$

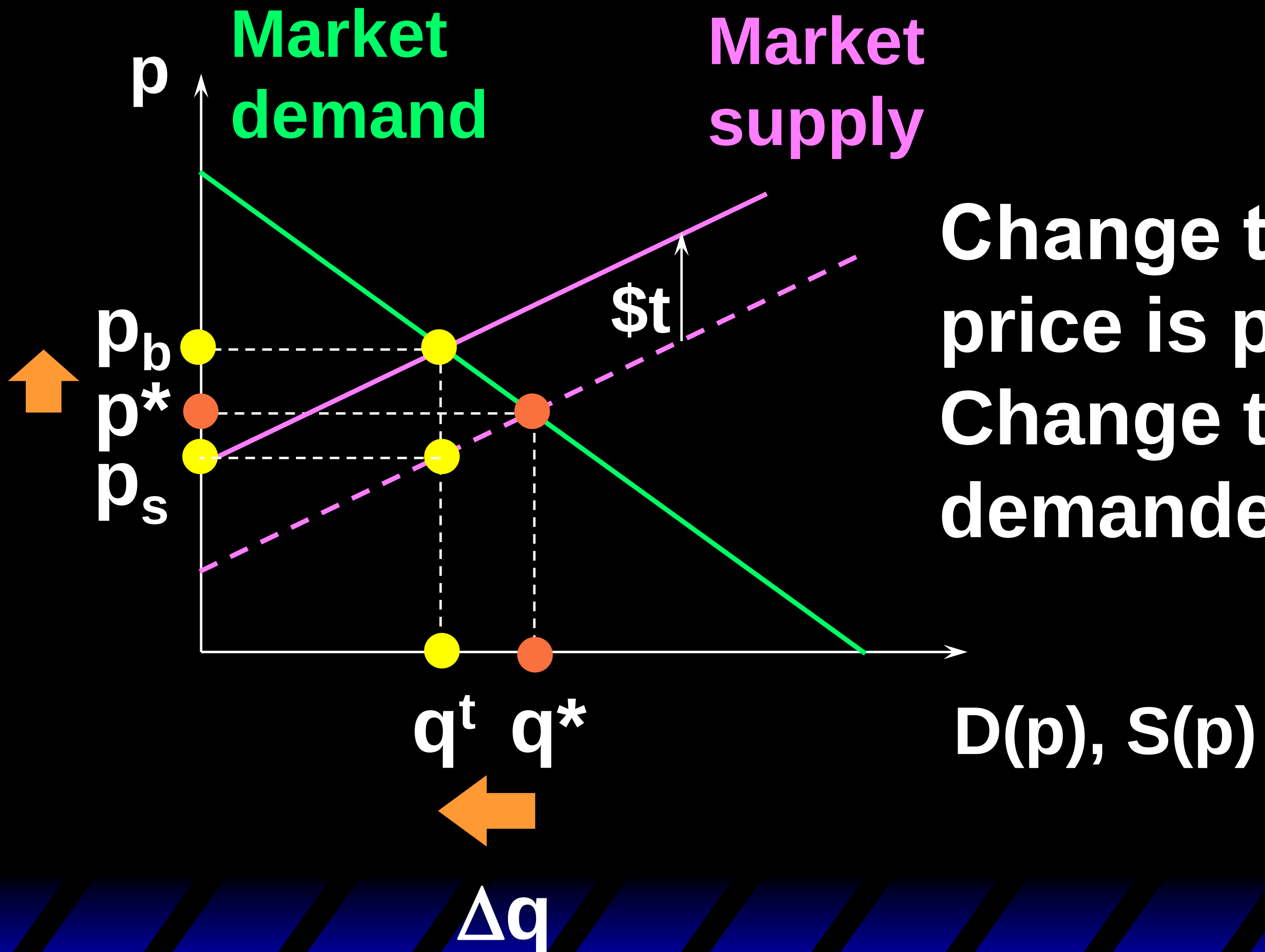
$$q^t = \frac{ad + bc - bdt}{b + d}$$

$$p_b = \frac{a - c + dt}{b + d}$$

The total tax paid (by buyers and sellers combined) is

$$T = tq^t = t\frac{ad + bc - bdt}{b + d}.$$

Tax Incidence and Own-Price Elasticities



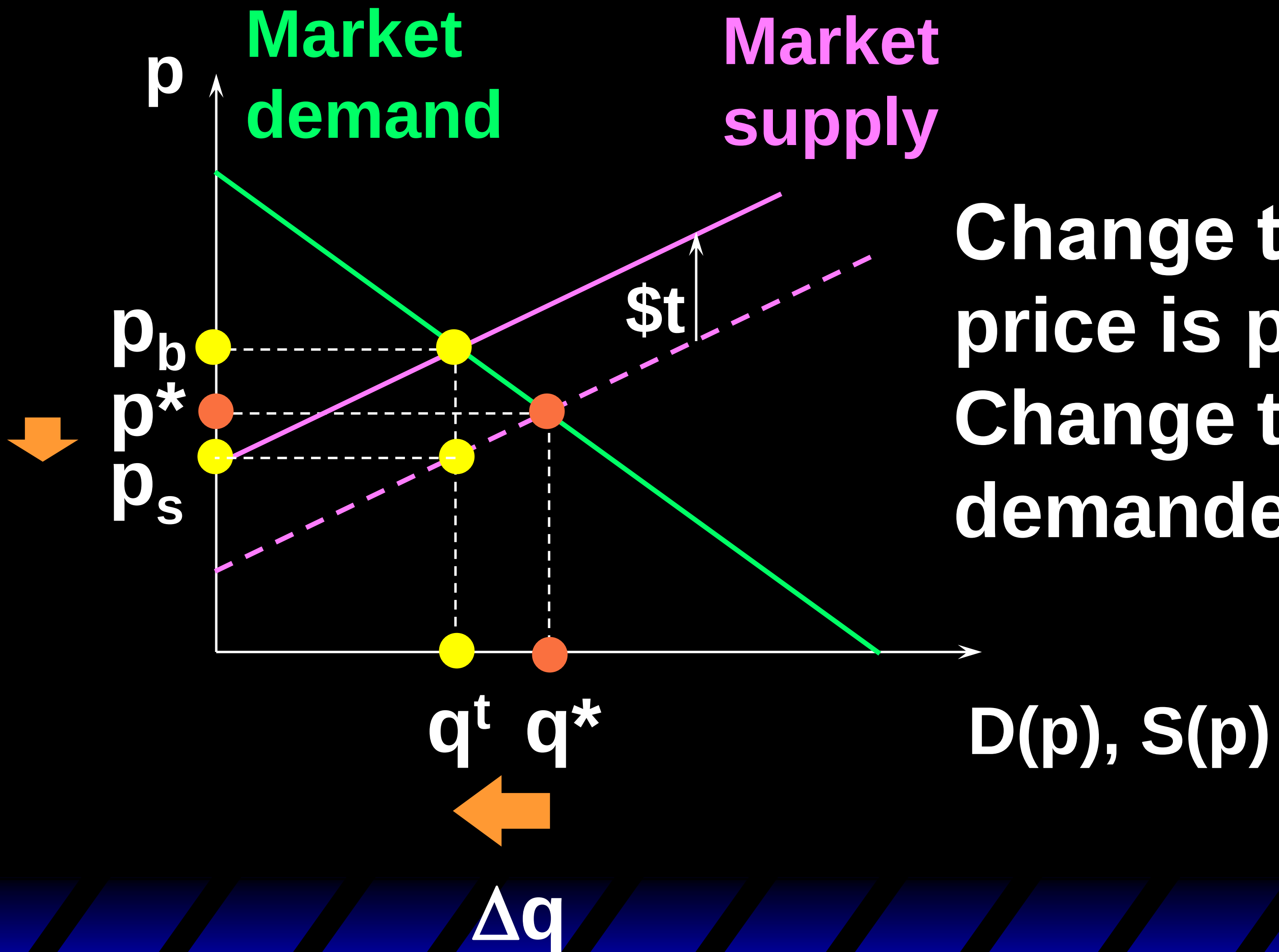
Change to buyers' price is p_b - p*. Change to quantity demanded is Δq.

Tax Incidence and Own-Price Elasticities

Around p = p* the own-price elasticity of demand is approximately

$$\varepsilon_D \approx \frac{\dfrac{\Delta q}{q^*}}{\dfrac{p_b - p^*}{p^*}} \quad \Rightarrow \quad p_b - p^* \approx \frac{\Delta q \times p^*}{\varepsilon_D \times q^*}.$$

Tax Incidence and Own-Price Elasticities



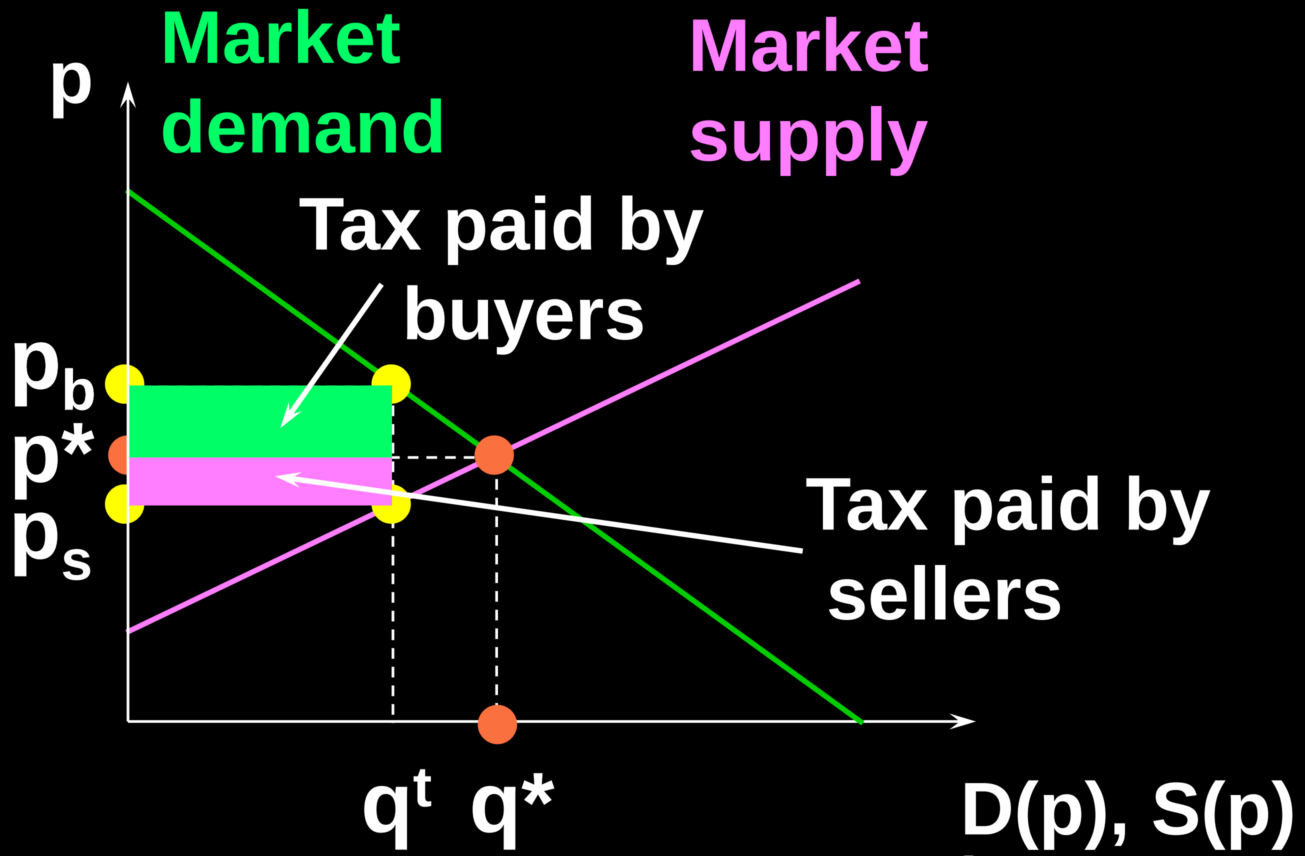
Change to sellers' price is p_s - p*. Change to quantity demanded is Δq.

Tax Incidence and Own-Price Elasticities

Around p = p* the own-price elasticity of supply is approximately

$$\varepsilon_S \approx \frac{\dfrac{\Delta q}{q^*}}{\dfrac{p_s - p^*}{p^*}} \quad \Rightarrow \quad p_s - p^* \approx \frac{\Delta q \times p^*}{\varepsilon_S \times q^*}.$$

Tax Incidence and Own-Price Elasticities



$$\text{Tax incidence} = \frac{p_b - p^*}{p^* - p_s}.$$

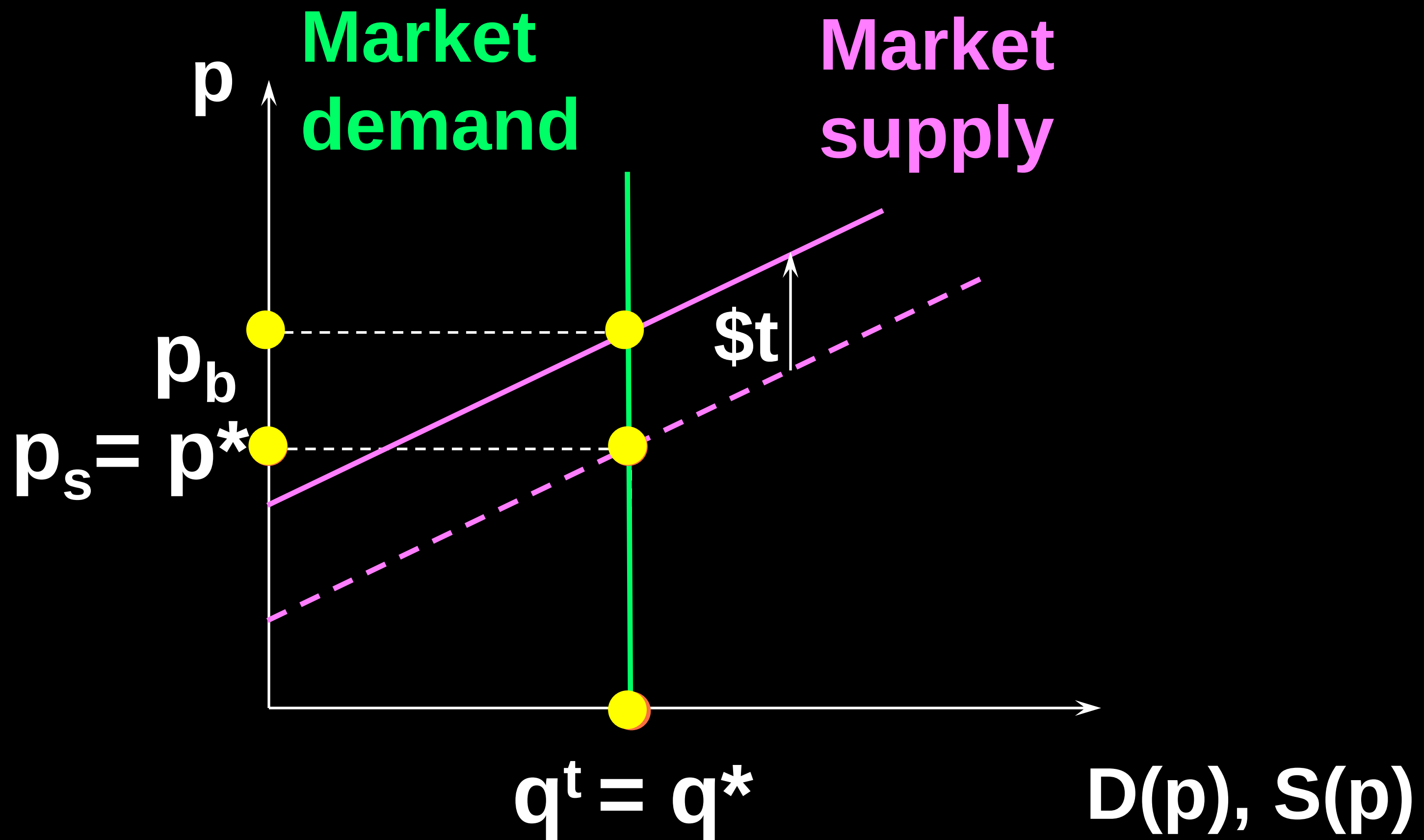
Tax Incidence and Own-Price Elasticities

$$p_b - p^* \approx \frac{\Delta q \times p^*}{\varepsilon_D \times q^*}. \qquad p_s - p^* \approx \frac{\Delta q \times p^*}{\varepsilon_S \times q^*}.$$

Tax incidence = $$\frac{p_b - p^*}{p^* - p_s} \approx -\frac{\varepsilon_S}{\varepsilon_D}.$$

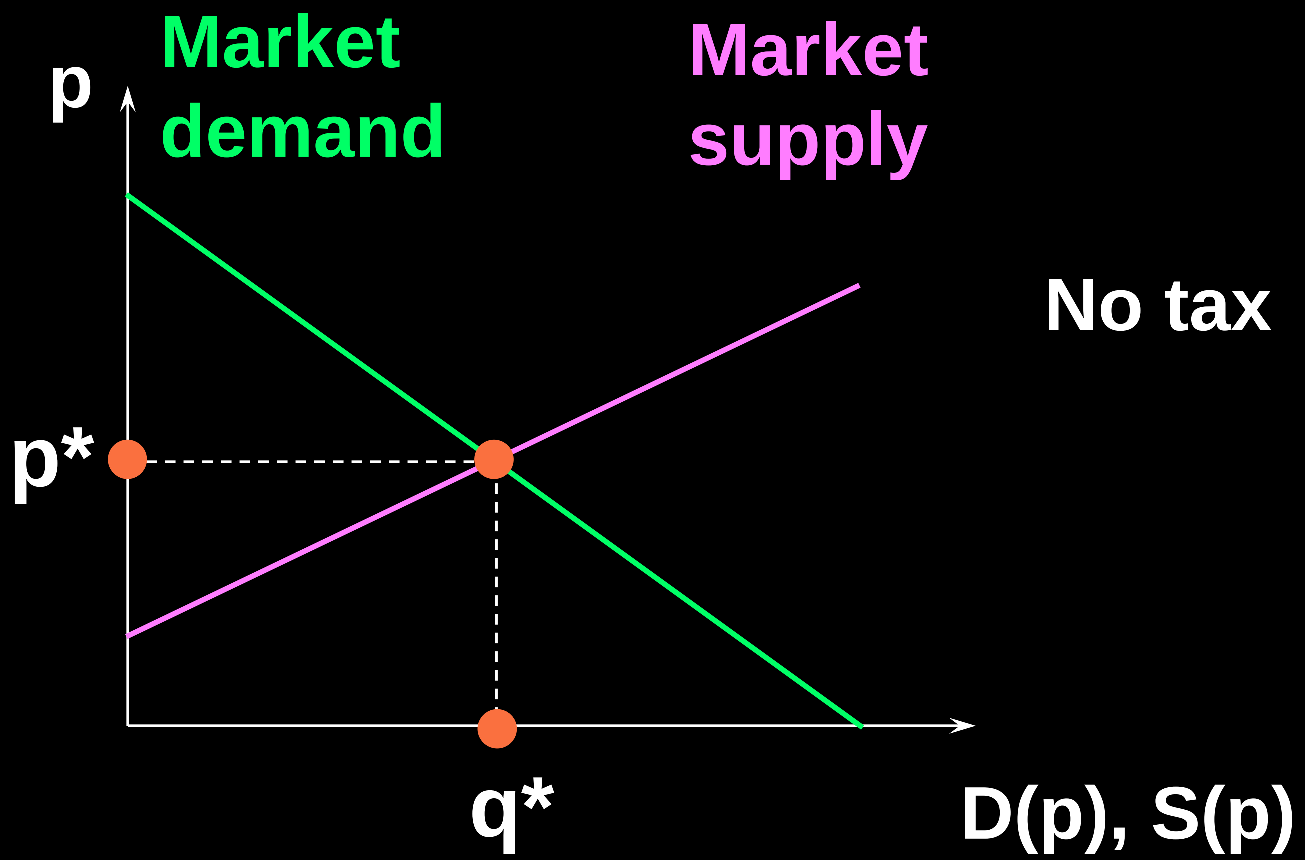
The inelastic side will bear more tax.

Tax Incidence and Own-Price Elasticities

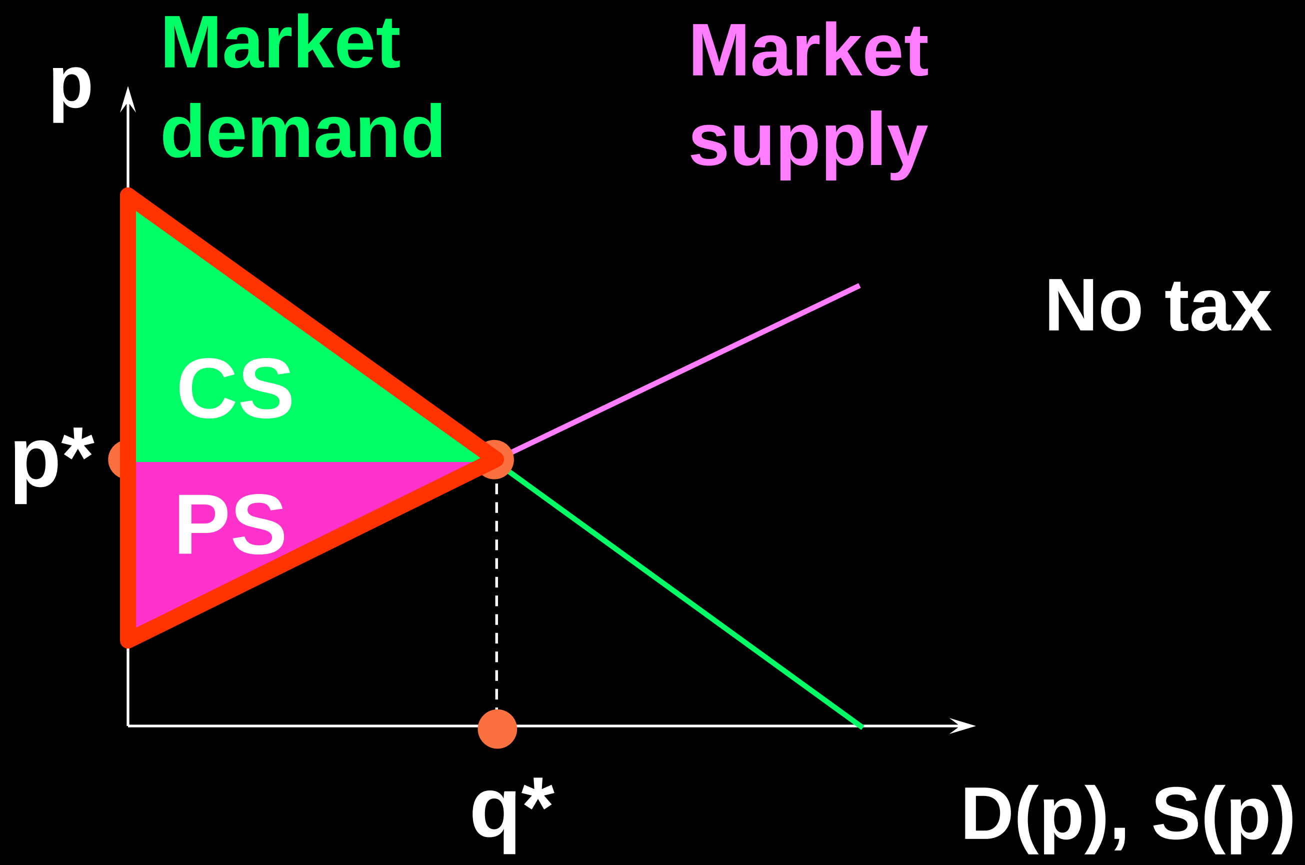


When $\varepsilon_D = 0$, buyers pay the entire tax.

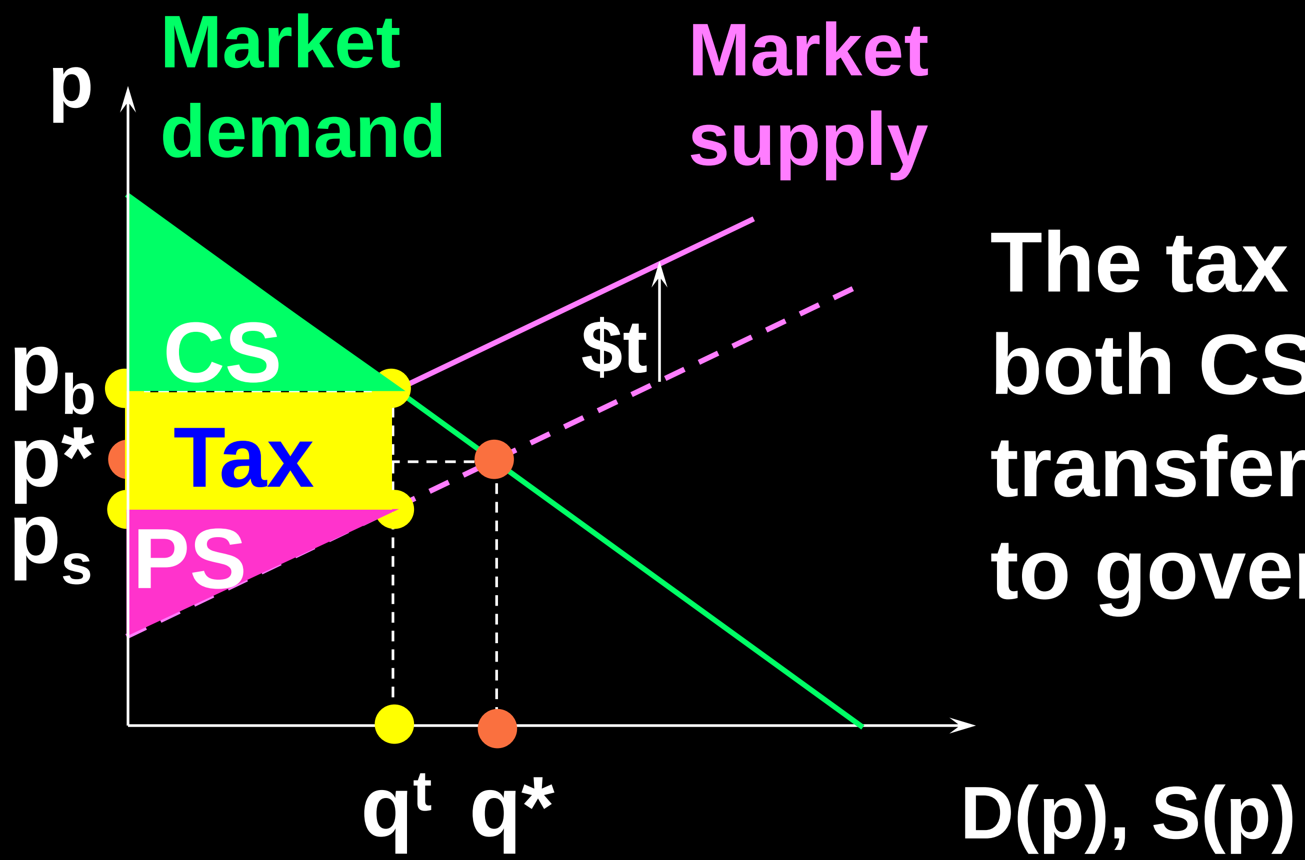
Deadweight Loss



Deadweight Loss

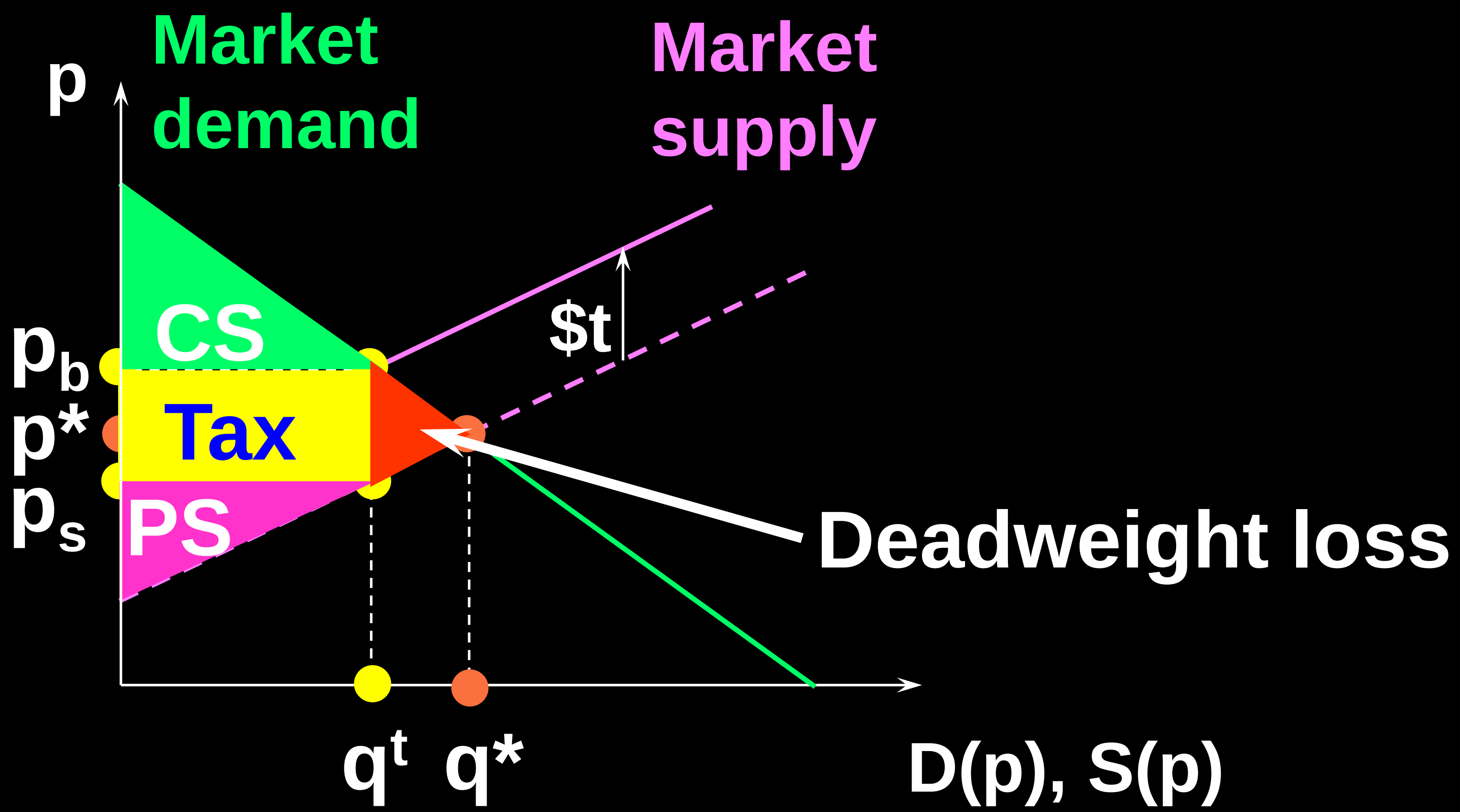


Deadweight Loss and Own-Price Elasticities

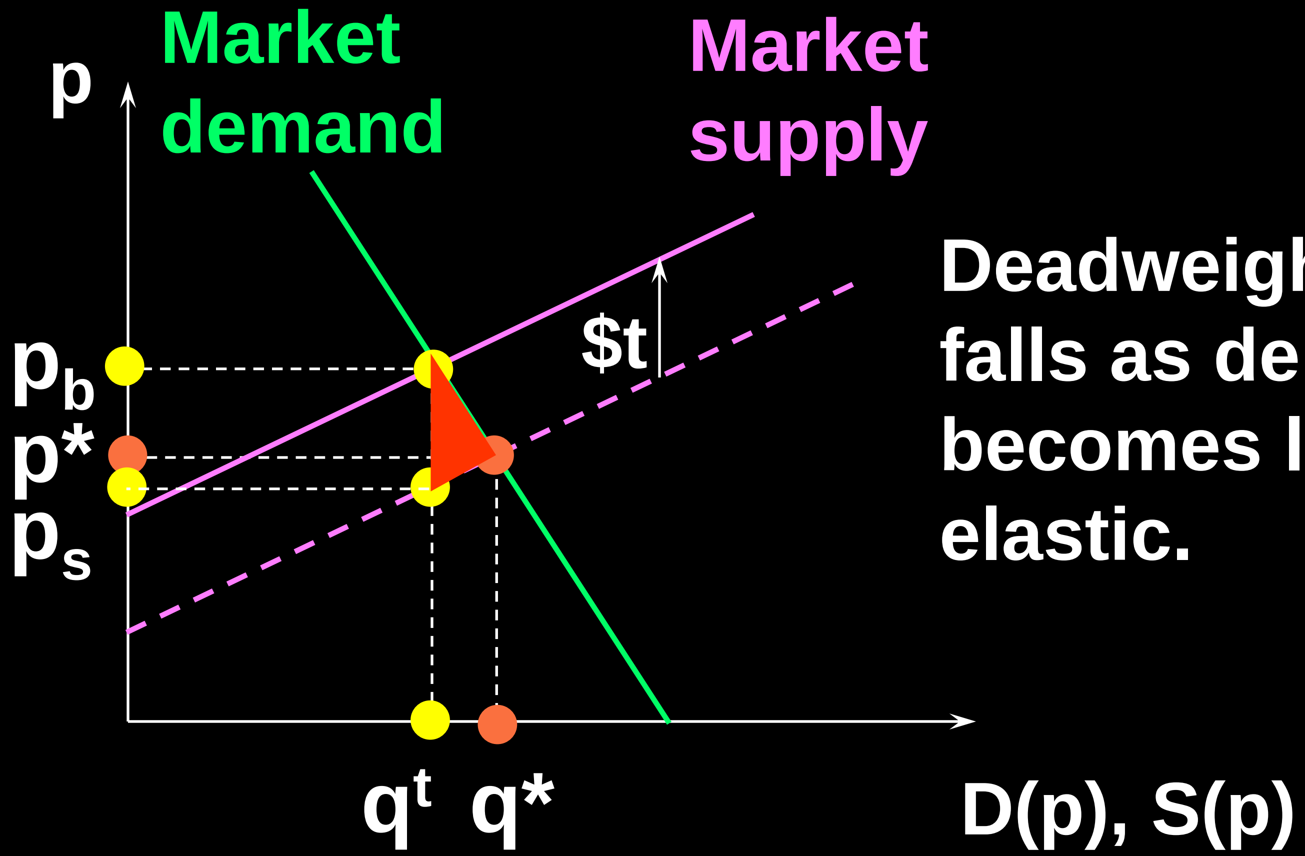


The tax reduces both CS and PS, transfers surplus to government

Deadweight Loss and Own-Price Elasticities

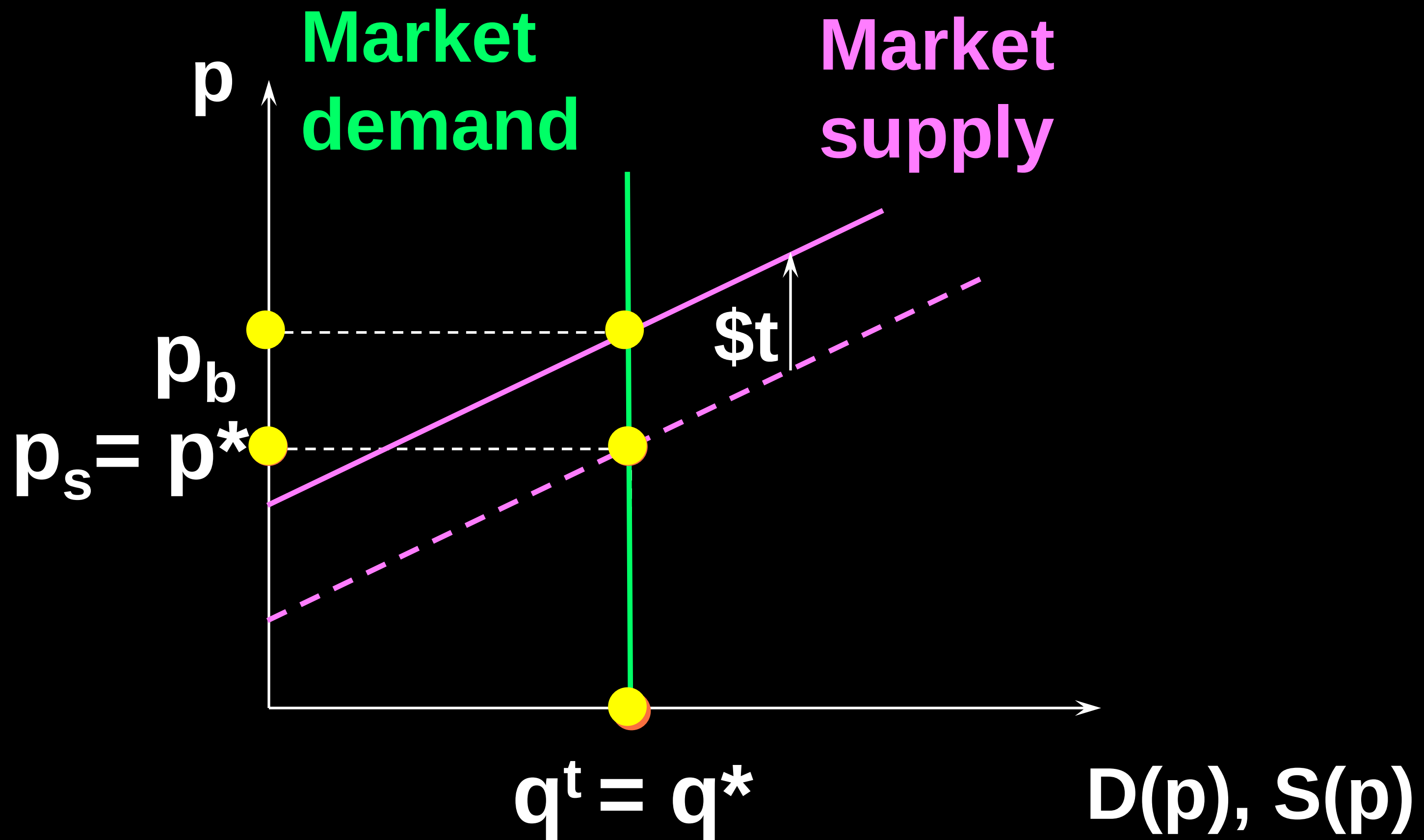


Deadweight Loss and Own-Price Elasticities



Deadweight loss falls as demand becomes less elastic.

Deadweight Loss and Own-Price Elasticities



When $\varepsilon_D = 0$, the tax causes no deadweight loss.

Deadweight Loss and Own-Price Elasticities

- **Deadweight loss** due to a quantity tax **rises** as either market demand or market supply becomes **more elastic**.
- If either $\varepsilon_D = 0$ or $\varepsilon_S = 0$ then the deadweight loss is zero.