Chapter 8

Profit Maximization and Supply Behavior

Profit Maximization

- A basic assumption for firm's rational behavior
- Do firms really maximize profits?
- The agency problem for CEOs
- The presence of not-for-profit organizations (hospitals and universities)
- Alchian's survival test theory: a strong argument for profit maximization as an approximation

Economic Profit

- A firm uses inputs j = 1…,m to make products i = 1,…n.
- Output levels are $y_1,\ldots,y_n$.
- Input levels are $x_1,\ldots,x_m$.
- Product prices are $p_1,\ldots,p_n$.
- Input prices are $w_1,\ldots,w_m$.

Perfectly Competitive Markets

- Price Taking
  - The individual firm sells a very small share of the total market output and, therefore, cannot influence market price
  - Each firm takes market price as given – ***price taker***
  - The individual consumer buys too small a share of industry output to have any impact on market price

The Competitive Firm

- The competitive firm takes all output prices $p_1,\ldots,p_n$ and all input prices $w_1,\ldots,w_m$ as given constants.

Economic Profit

- The economic profit generated by the production plan $(x_1,\ldots,x_m,y_1,\ldots,y_n)$ is

$$\Pi = p_1 y_1 + \cdots + p_n y_n - w_1 x_1 - \cdots w_m x_m.$$

Economic Profit

- How do we value a firm?
- Suppose the firm's stream of periodic economic profits is $\Pi_0, \Pi_1, \Pi_2, \ldots$ and r is the rate of interest.
- Then the present-value of the firm's economic profit stream is

$$\mathbf{PV} = \Pi_0 + \frac{\Pi_1}{1+r} + \frac{\Pi_2}{(1+r)^2} + \cdots$$

Marginal Revenue, Marginal Cost, and Profit Maximization

- We can study profit maximizing output for any firm, whether perfectly competitive or not
  - Profit (π) = Total Revenue - Total Cost
  - If q is output of the firm, then total revenue is price of the good times quantity
  - Total Revenue (R) = Pq

Marginal Revenue, Marginal Cost, and Profit Maximization

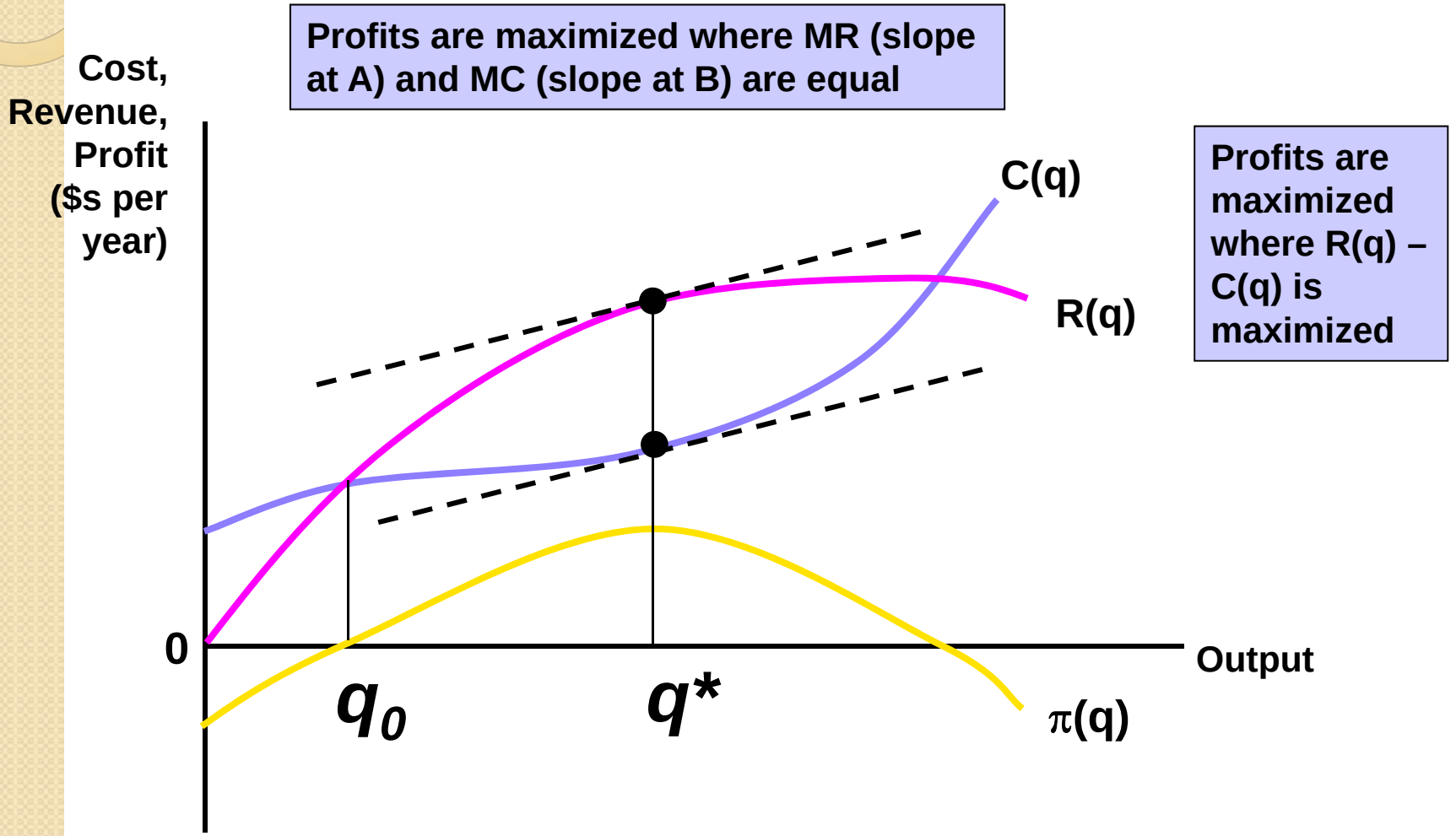
- Costs of production depends on output
  - Total Cost (C) = C(q)
- Profit for the firm, π, is difference between revenue and costs

$$\pi(q) = R(q) - C(q)$$

Marginal Revenue, Marginal Cost, and Profit Maximization

- Firm selects output to maximize the difference between revenue and cost
- We can graph the total revenue and total cost curves to show maximizing profits for the firm
- Distance between revenues and costs show profits

Profit Maximization



Marginal Revenue, Marginal Cost, and Profit Maximization

- Profit is maximized at the point at which an additional increment to output leaves profit unchanged

$$\pi(q) = R(q) - C(q)$$

$$\frac{d\pi}{dq} = \frac{dR}{dq} - \frac{dC}{dq} = 0$$

$$= MR - MC = 0$$

$$MR = MC$$

New Assignment

- Problem Set 2
- Due day: November 15
- Lectures for chapters 7, 8, and 9 have been placed in my public folder

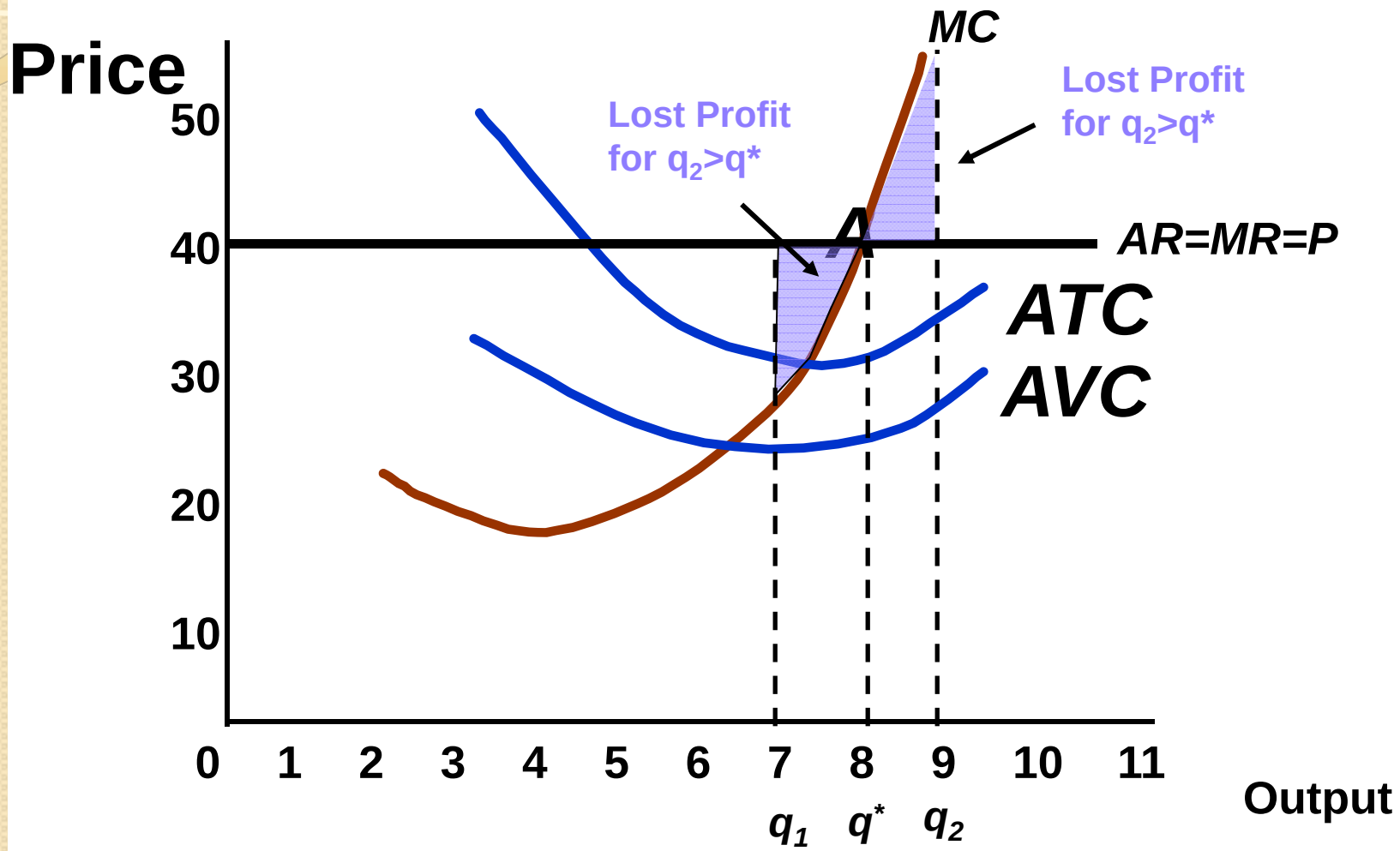
Choosing Output: Short Run

- We will combine revenue and costs with demand to determine profit maximizing output decisions
- In the short run, capital is fixed and firm must choose levels of variable inputs to maximize profits
- We can look at the graph of MR, MC, ATC and AVC to determine profits

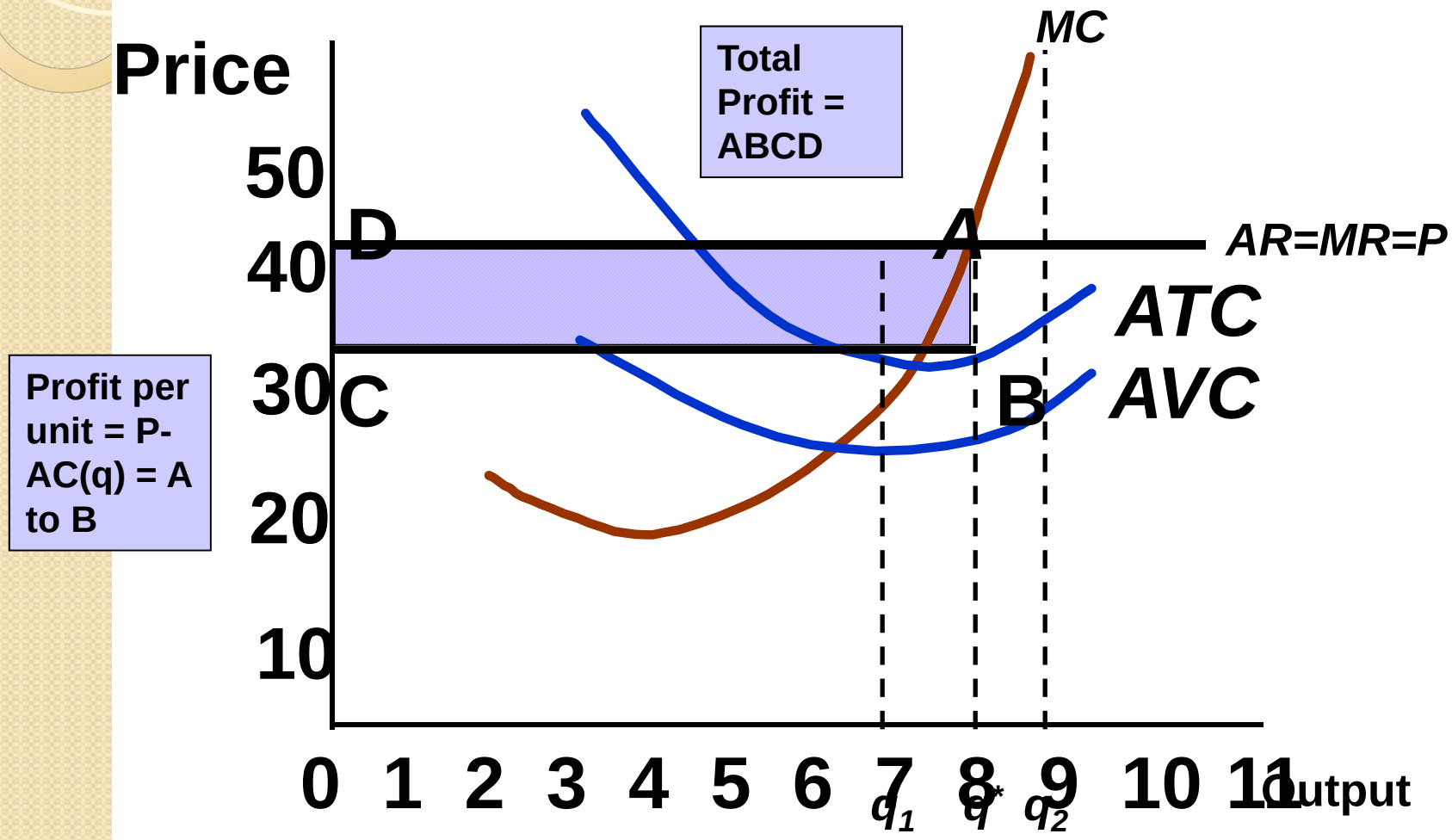
Choosing Output: Short Run

- The point where MR = MC, the profit maximizing output is chosen
  - MR = MC at quantity, q*, of 8
  - At a quantity less than 8, MR > MC, so more profit can be gained by increasing output
  - At a quantity greater than 8, MC > MR, increasing output will decrease profits

A Competitive Firm



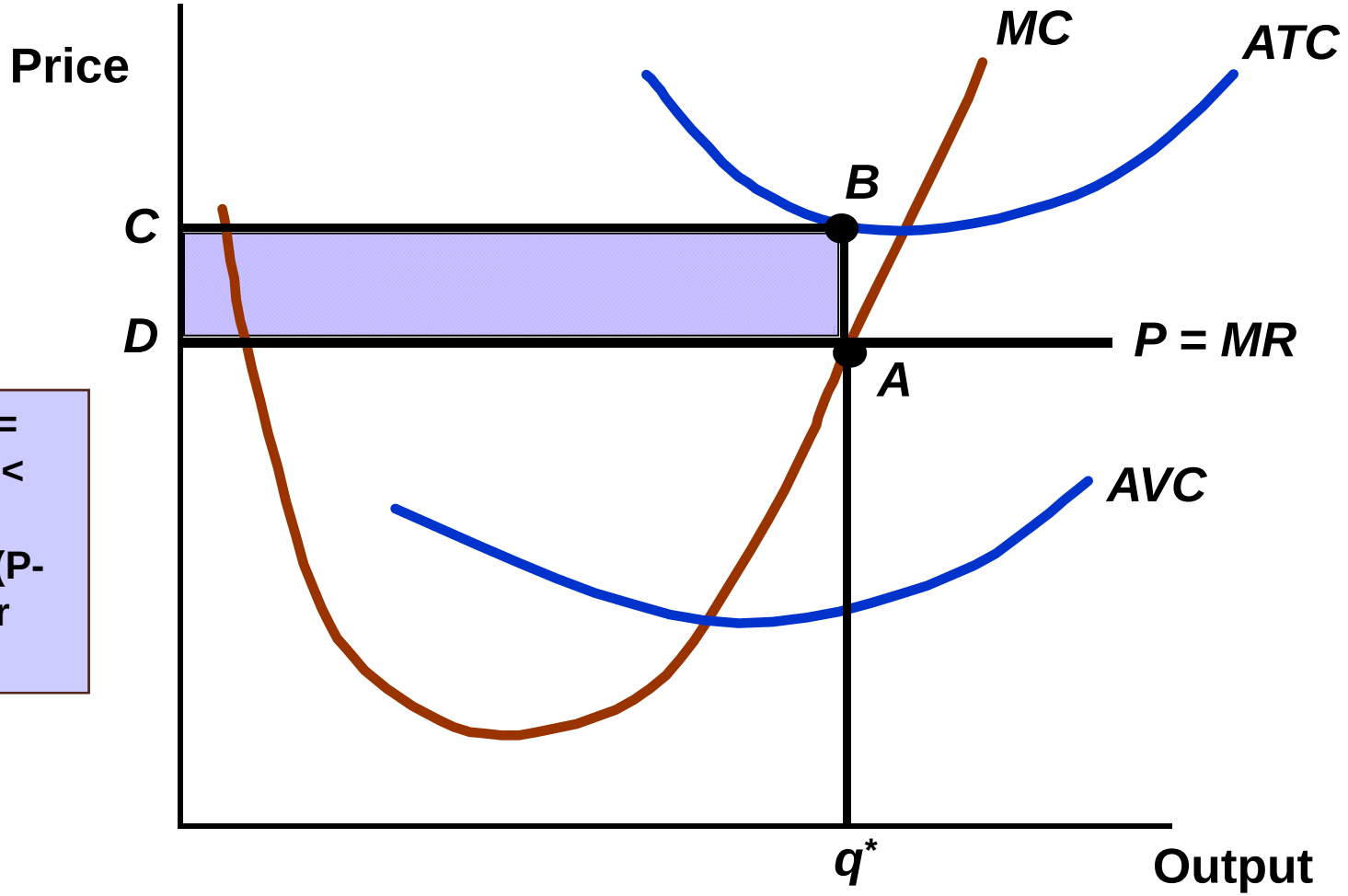
A Competitive Firm – Positive Profits



The Competitive Firm

- A firm does not have to make profits
- It is possible a firm will incur losses if the P < AC for the profit maximizing quantity
  - Still measured by profit per unit times quantity
  - Profit per unit is negative (P – AC < 0)

A Competitive Firm – Losses



At q^*: MR = MC and P < ATC
Losses = (P-AC) x q^* or ABCD

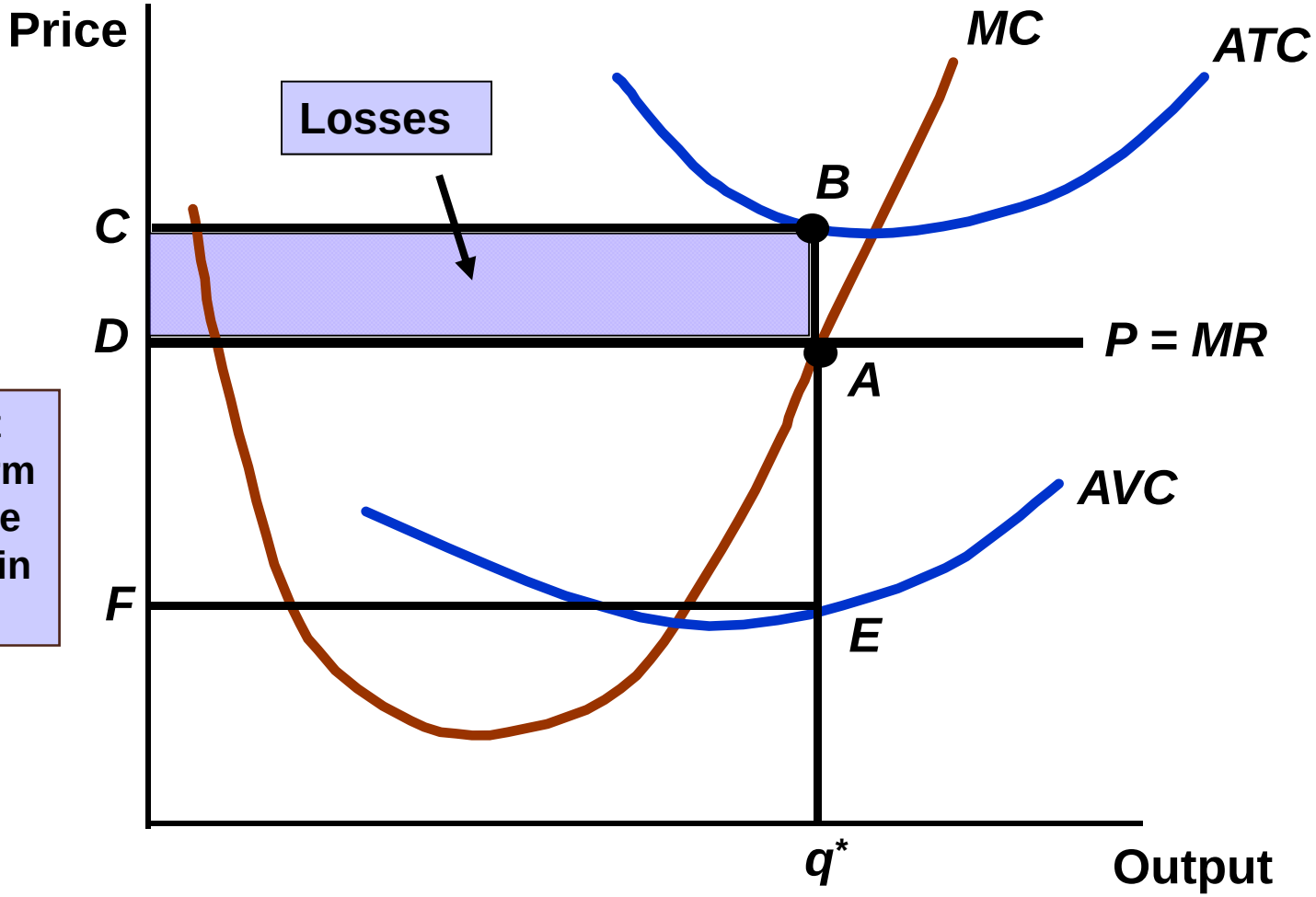
Short Run Production

- Why would a firm produce at a loss?
  - Might think price will increase in near future
  - Shutting down and starting up could be costly
- Firm has two choices in short run
  - Continue producing
  - Shut down temporarily
  - Will compare profitability of both choices

Short Run Production

- When should the firm shut down?
  - If AVC < P < ATC, the firm should continue producing in the short run
    - Can cover all of its variable costs and some of its fixed costs
  - If AVC > P < ATC, the firm should shut down
    - Cannot cover its variable costs or any of its fixed costs

A Competitive Firm – Losses

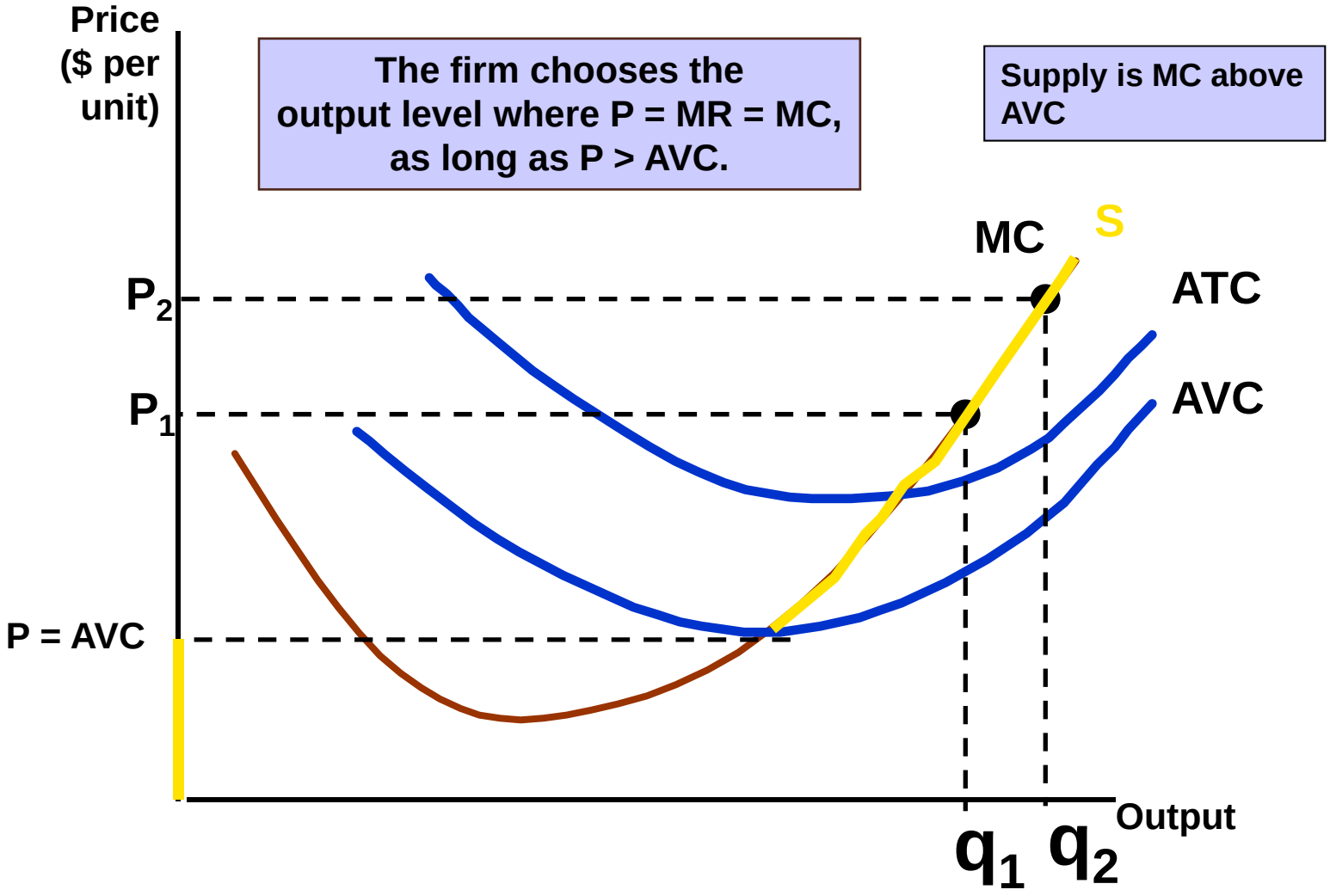


P < ATC but
- AVC so firm will continue to produce in short run

Competitive Firm – Short Run Supply

- Supply curve tells how much output will be produced at different prices
- Competitive firms determine quantity to produce where P = MC
  - Firm shuts down when P < AVC
- Competitive firms' supply curve is portion of the marginal cost curve above the AVC curve

A Competitive Firm's Short-Run Supply Curve



A Competitive Firm's Short-Run Supply Curve

- Supply is upward sloping due to diminishing returns
- Higher price compensates the firm for the higher cost of additional output and increases total profit because it applies to all units

Derivation of the Supply Curve

$$Max\ \pi(q) = pq - C(q)$$

$$s.t.\ \pi \geq -F \Rightarrow p \geq AVC$$

$$d\pi / dp = p - C'(q) = 0 \Rightarrow p = C'(q)$$

$$dp / dq = C''(q) > 0$$

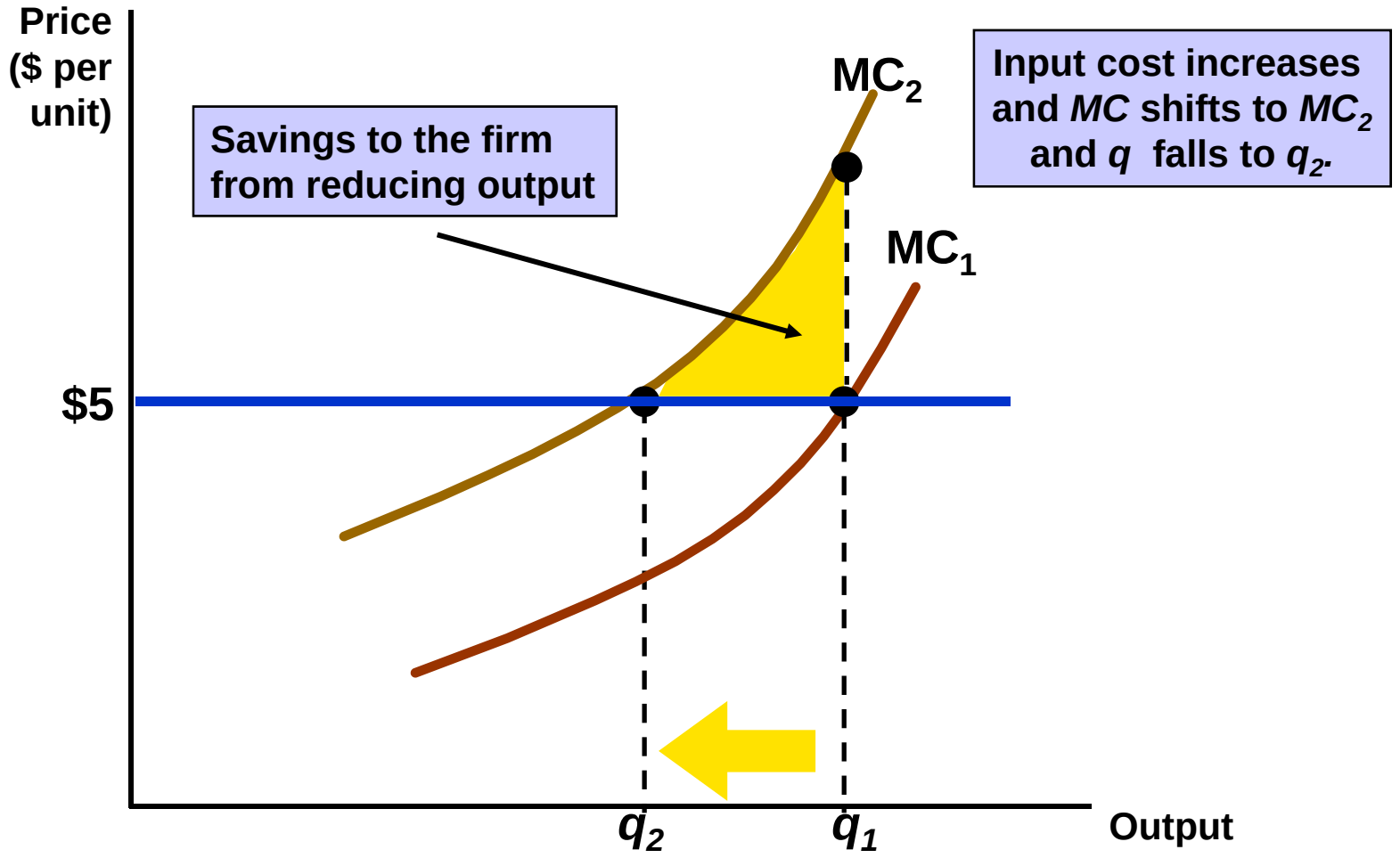
Announcement

- Problem Set 2: Due on Nov 12

A Competitive Firm's Short-Run Supply Curve

- Over time, prices of product and inputs can change
- How does the firm's output change in response to a change in the price of an input?
  - We can show an increase in marginal costs and the change in the firm's output decisions

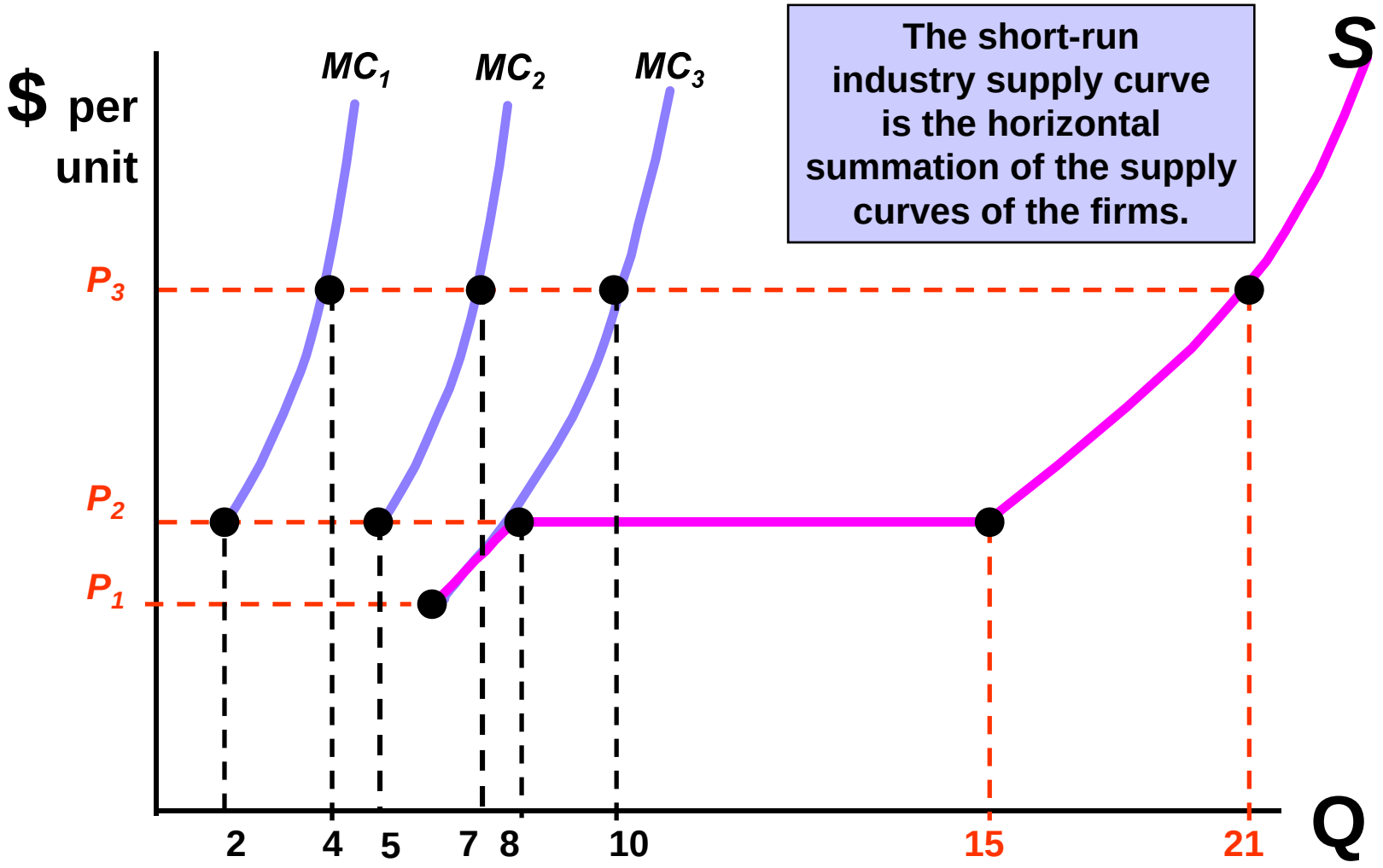
The Response of a Firm to a Change in Input Price



Short-Run Market Supply Curve

- Shows the amount of product the whole market will produce at given prices
- Is the sum of all the individual producers in the market
- We can show graphically how we can sum the supply curves of individual producers

Industry Supply in the Short Run



Elasticity of Market Supply

- Elasticity of Market Supply
  - Measures the sensitivity of industry output to market price
  - The percentage change in quantity supplied, Q, in response to 1-percent change in price

$$E_s = (\Delta Q / Q) / (\Delta P / P)$$

Elasticity of Market Supply

- When MC increases rapidly in response to increases in output, elasticity is low
- When MC increases slowly, supply is relatively elastic
- **Perfectly inelastic** short-run supply arises when the industry's plant and equipment are so fully utilized that new plants must be built to achieve greater output
- **Perfectly elastic** short-run supply arises when marginal costs are constant

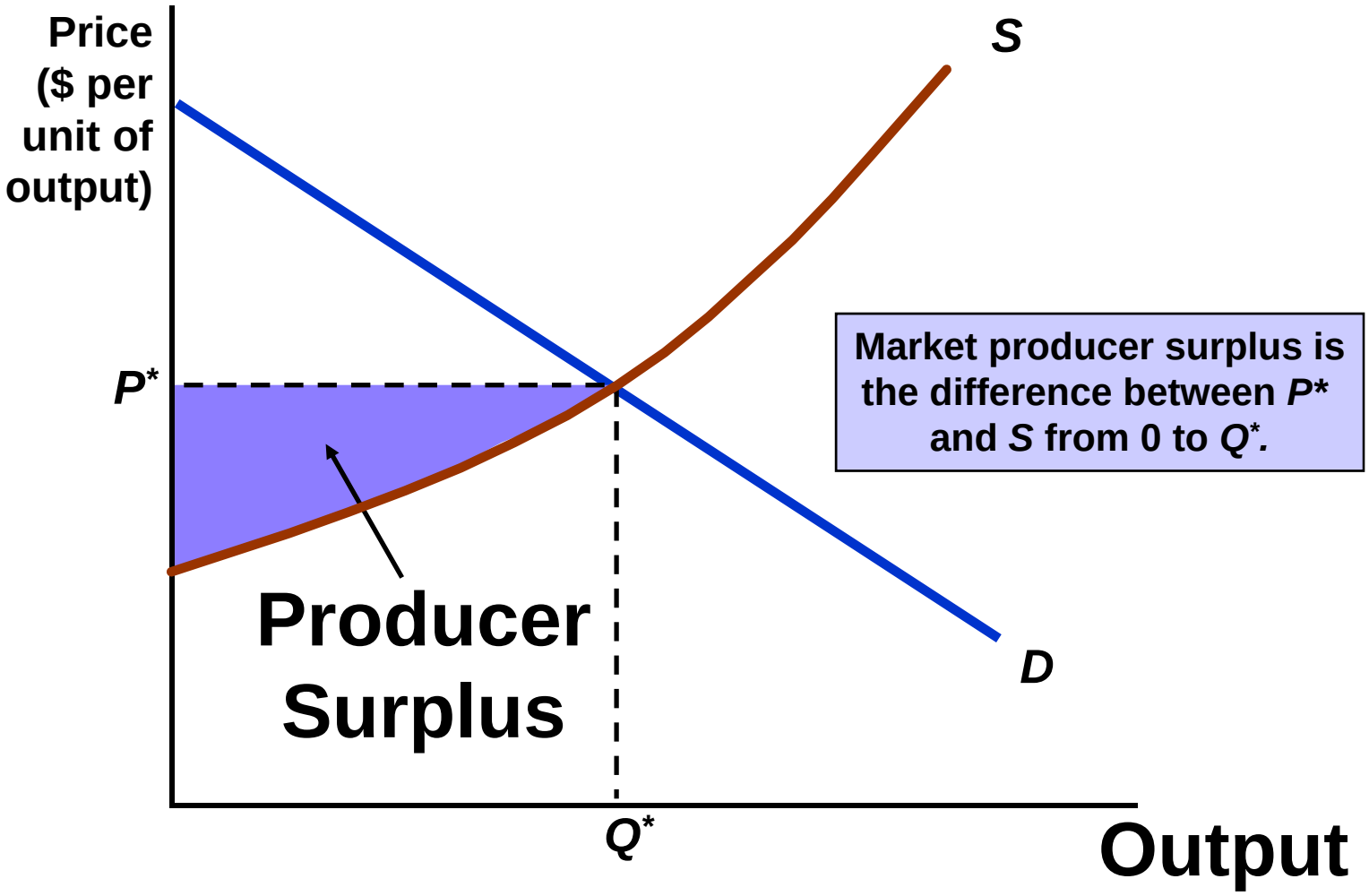
Announcements

- Problem Set 2 has been assigned;
- Due Day: Nov. 14, 2011
- Chapters 8-9 have been uploaded

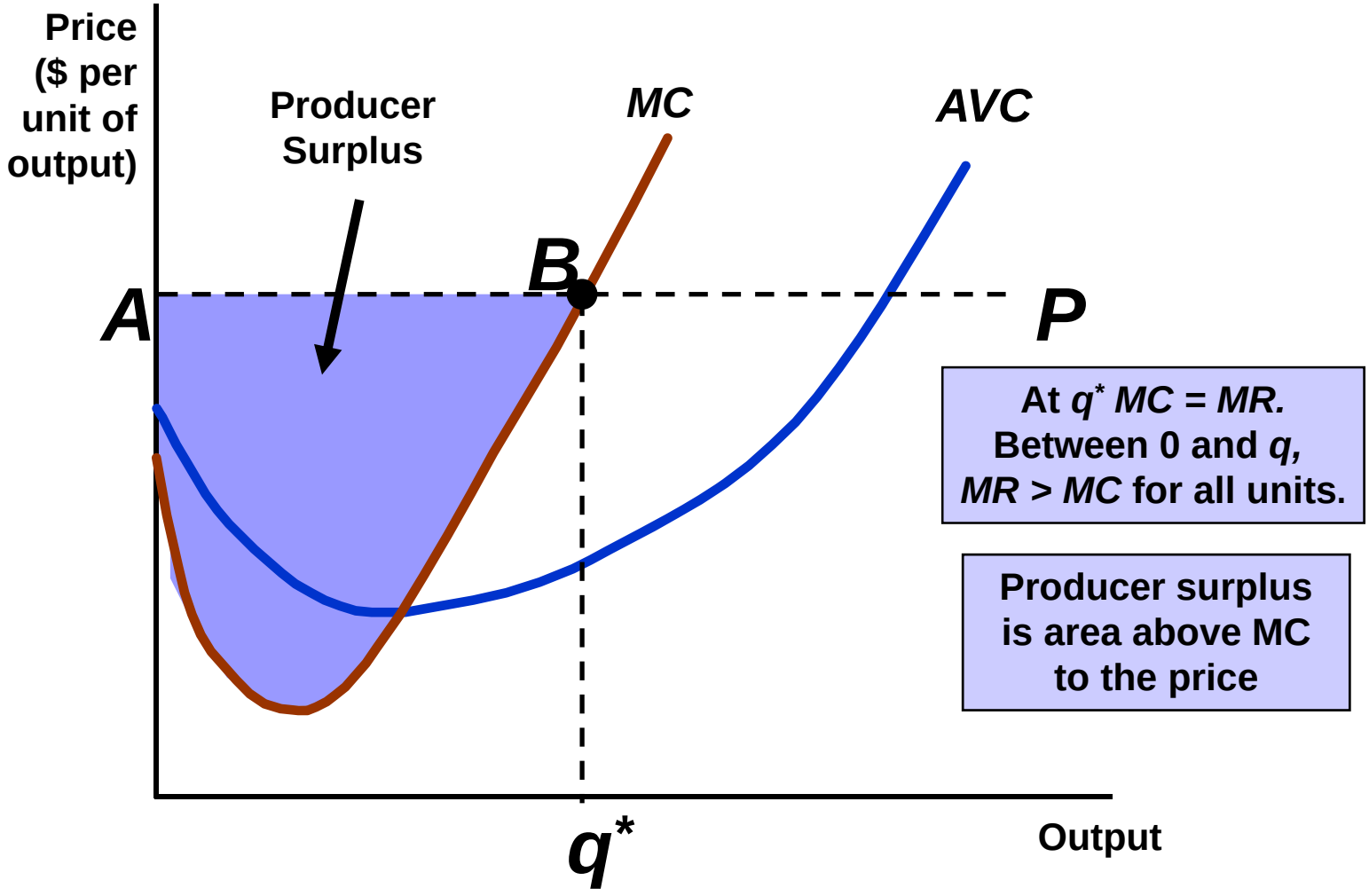
Producer Surplus in the Short Run

- Price is greater than MC on all but the last unit of output
- Therefore, surplus is earned on all but the last unit
- The **producer surplus** is the sum over all units produced of the difference between the market price of the good and the marginal cost of production
- Area above supply curve to the market price

Producer Surplus for a Market



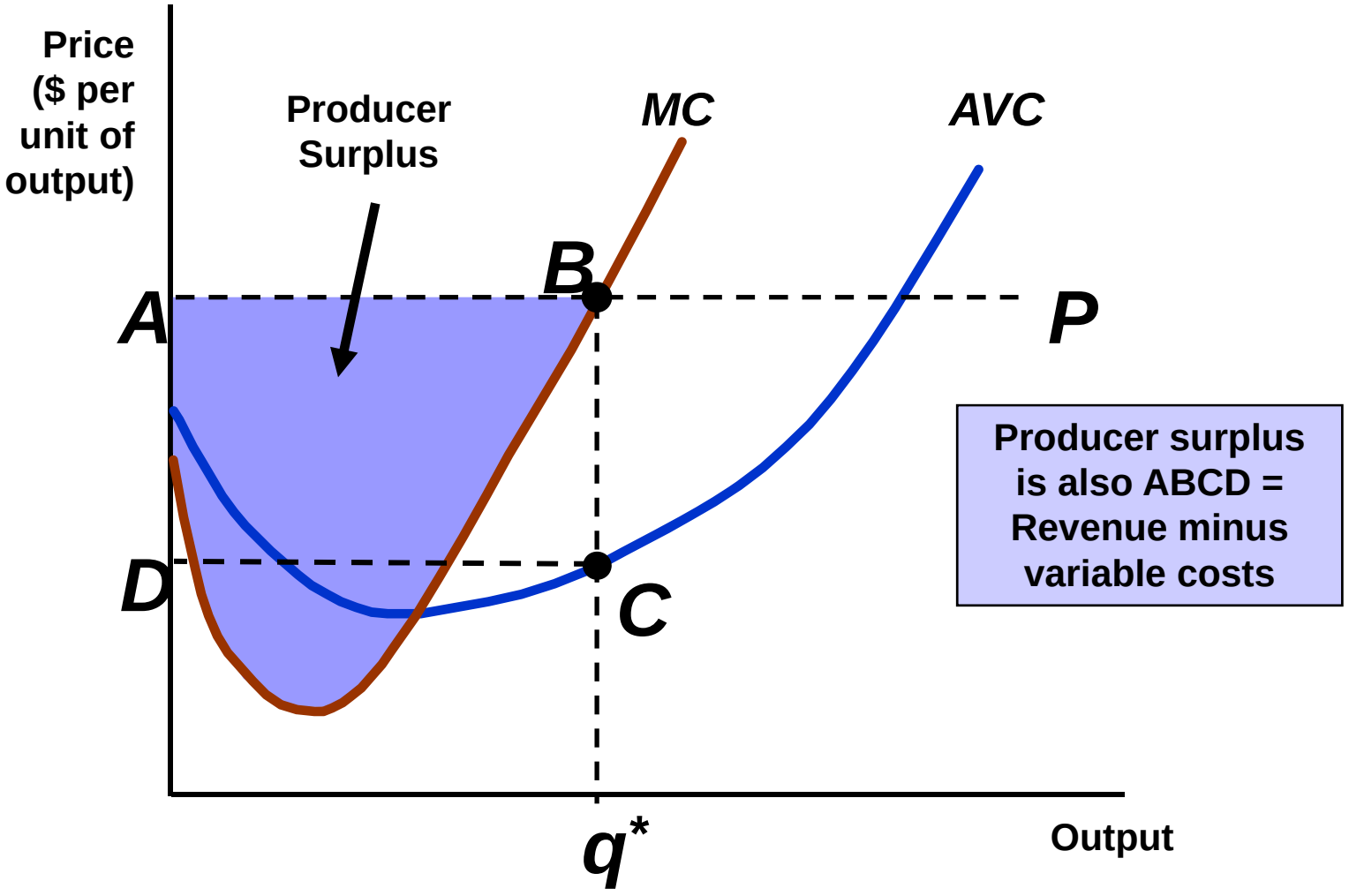
Producer Surplus for a Firm



The Short-Run Market Supply Curve

- Sum of MC from 0 to q*, it is the sum of the total variable cost of producing q*
- Producer Surplus can be defined as the difference between the firm's revenue and its total variable cost
- We can show this graphically by the rectangle ABCD
  - Revenue (0ABq*) minus variable cost (0DCq*)

Producer Surplus for a Firm



Producer Surplus Versus Profit

- Profit is revenue minus total cost (not just variable cost)
- When fixed cost is positive, producer surplus is greater than profit

$$\text{Producer Surplus} = \text{PS} = \text{R - VC}$$

$$\text{Profit} = \pi = \text{R - VC - FC}$$

Producer Surplus Versus Profit

- Costs of production determine magnitude of producer surplus
  - Higher cost firms have less producer surplus
  - Lower cost firms have more producer surplus
  - Adding up surplus for all producers in the market given total market producer surplus
  - Area below market price and above supply curve

Profit Max: Another Look

- Suppose the firm is in a short-run circumstance in which $x_2 \equiv \tilde{x}_2$.
- Its short-run production function is

$$y = f(x_1, \tilde{x}_2).$$

- The firm's fixed cost is $FC = w_2\tilde{x}_2$ and its profit function is

$$\Pi = py - w_1x_1 - w_2\tilde{x}_2.$$

Short-Run Iso-Profit Lines

- A $\$\Pi$ iso-profit line contains all the production plans that provide a profit level $\$\Pi$.
- A $\$\Pi$ iso-profit line's equation is

$$\Pi \equiv \mathbf{p}y - \mathbf{w}_1 x_1 - \mathbf{w}_2 \tilde{x}_2.$$

Short-Run Iso-Profit Lines

- A $\$\Pi$ iso-profit line contains all the production plans that yield a profit level of $\$\Pi$.
- The equation of a $\$\Pi$ iso-profit line is
- I.e.

$$\Pi \equiv py - w_1 x_1 - w_2 \tilde{x}_2.$$

$$y = \frac{w_1}{p} x_1 + \frac{\Pi + w_2 \tilde{x}_2}{p}.$$

Short-Run Iso-Profit Lines

$$y = \frac{w_1}{p} x_1 + \frac{\Pi + w_2 \tilde{x}_2}{p}$$

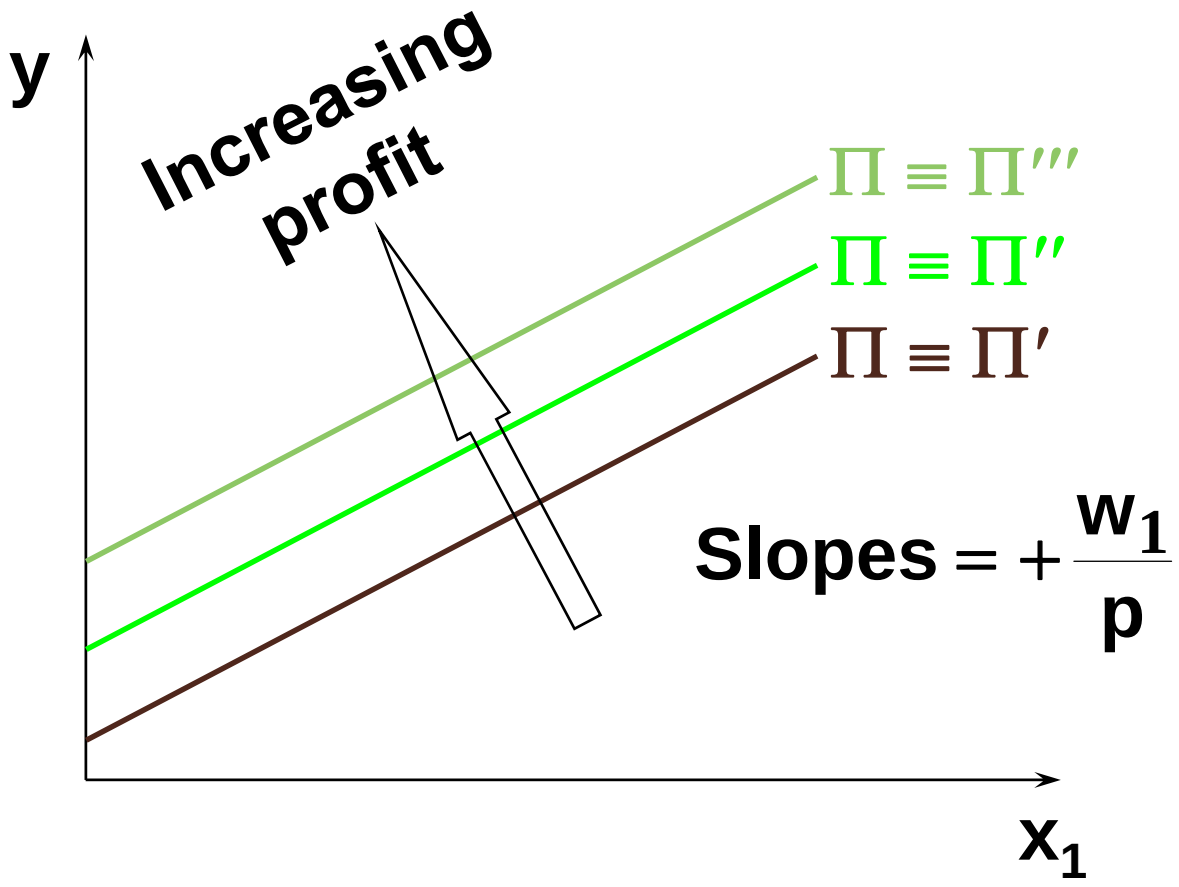
has a slope of

$$\frac{w_1}{p}$$

and a vertical intercept of

$$\frac{\Pi + w_2 \tilde{x}_2}{p}.$$

Short-Run Iso-Profit Lines



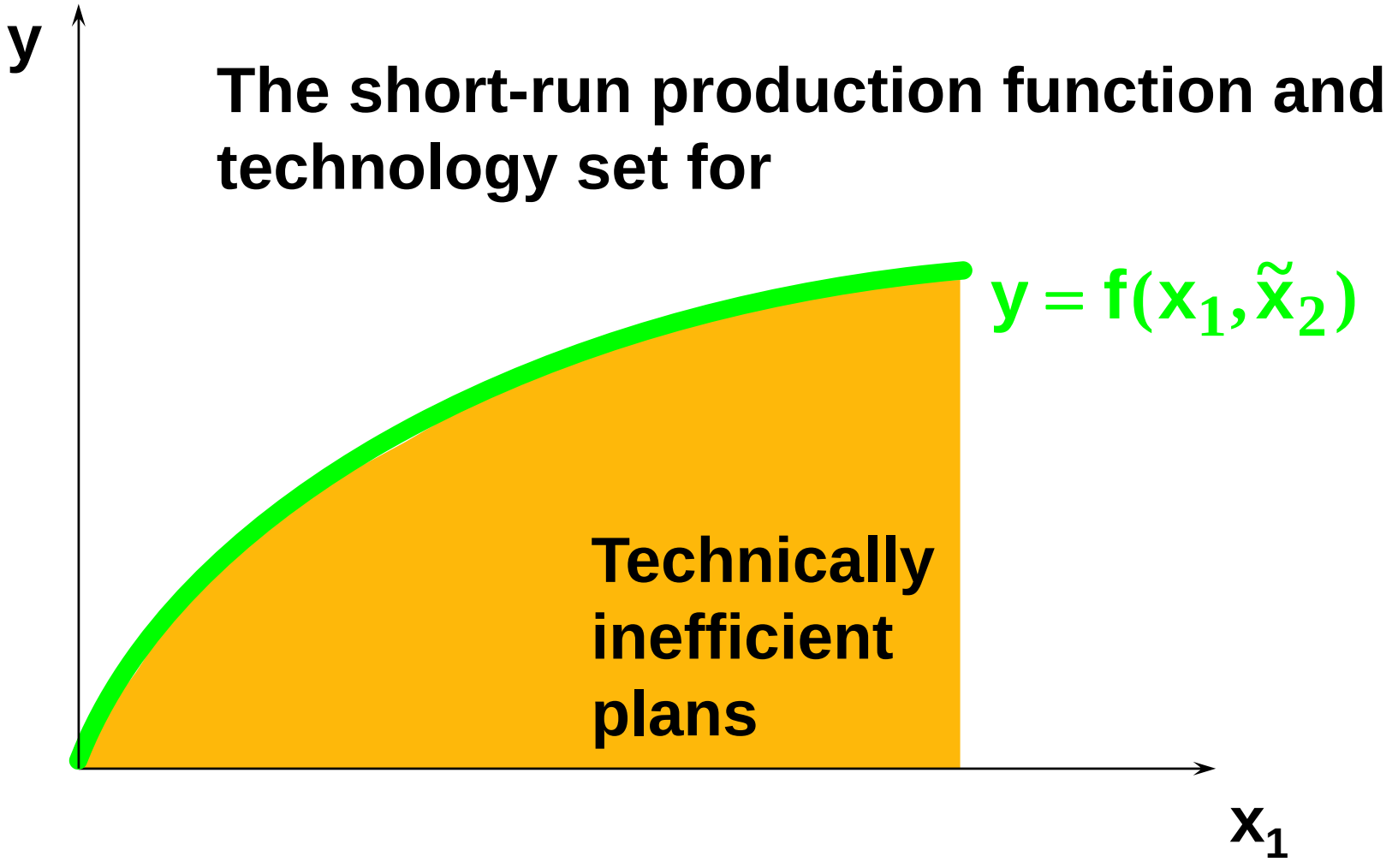
Short-Run Profit-Maximization

- The firm's problem is to locate the production plan that attains the highest possible iso-profit line, given the firm's constraint on choices of production plans.
- Q: What is this constraint?

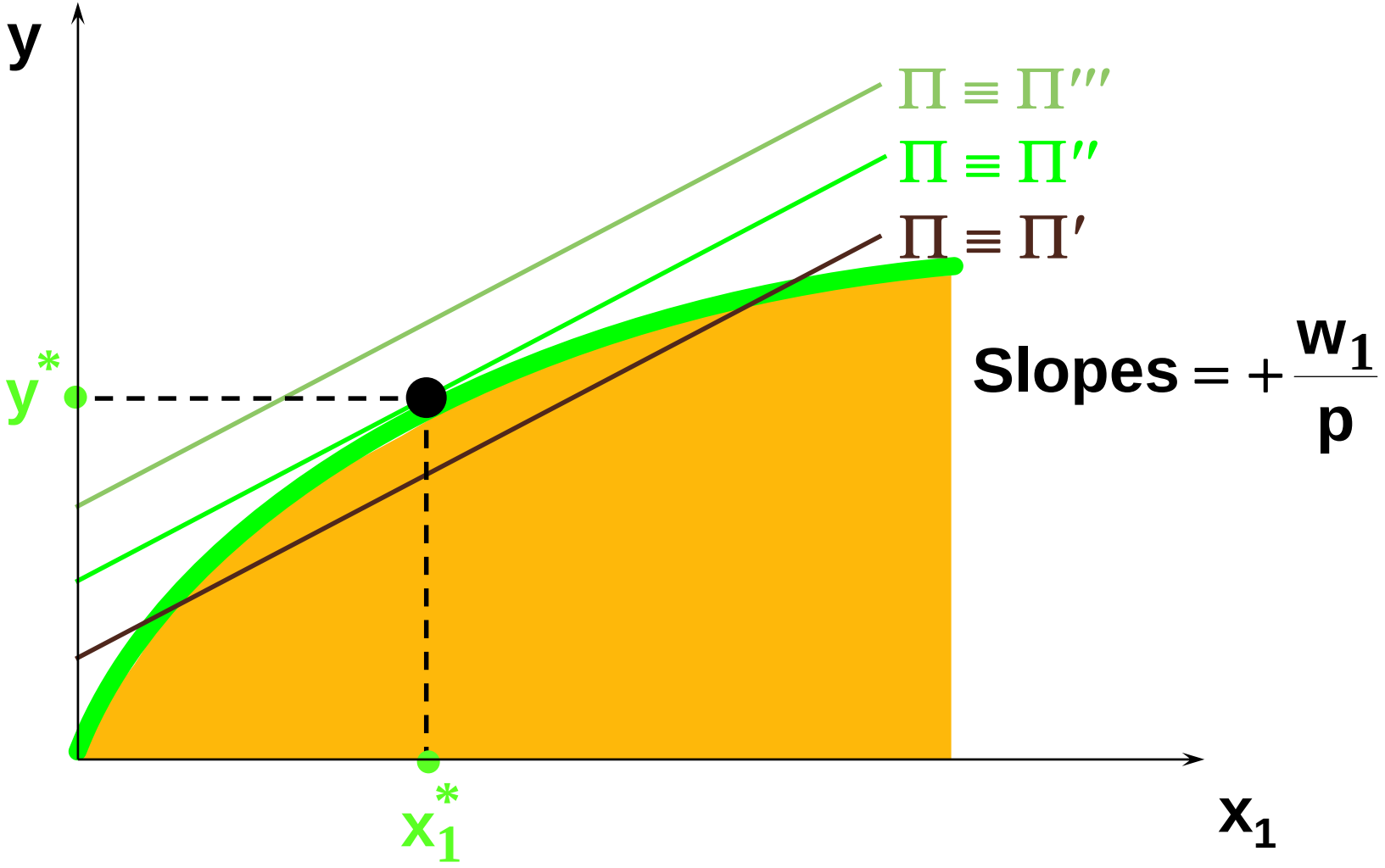
Short-Run Profit-Maximization

- The firm's problem is to locate the production plan that attains the highest possible iso-profit line, given the firm's constraint on choices of production plans.
- Q: What is this constraint?
- A: The production function.

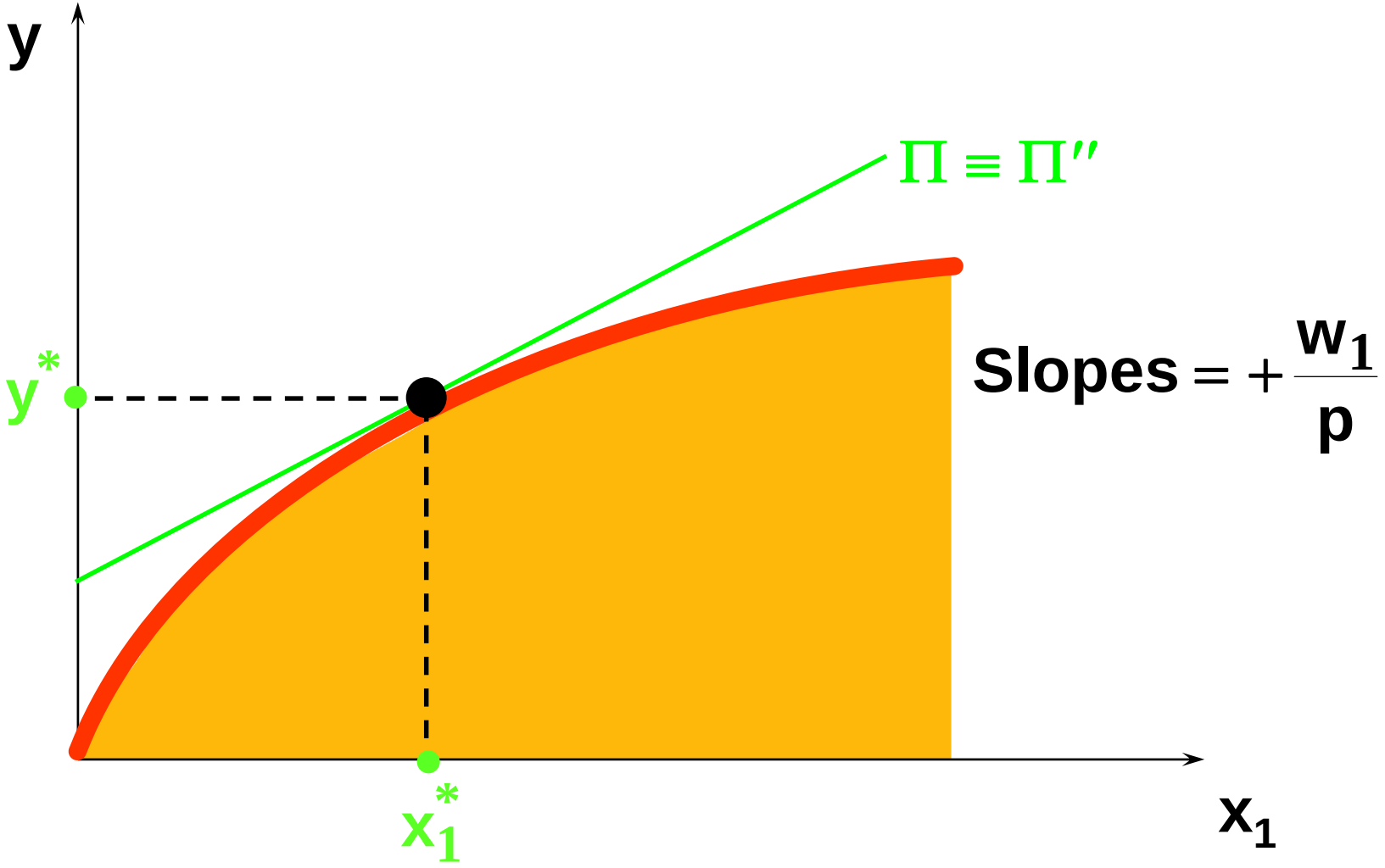
Short-Run Profit-Maximization



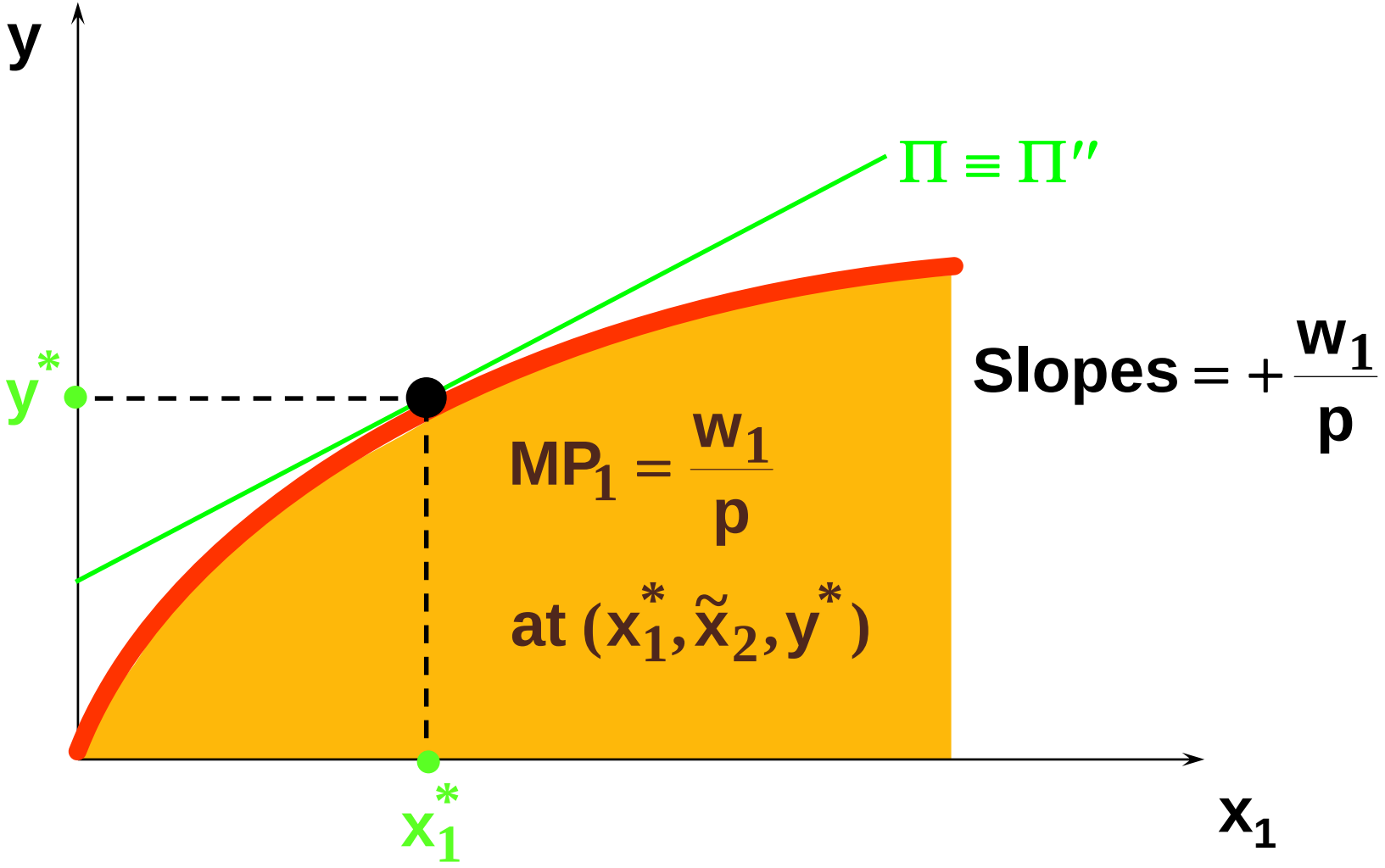
Short-Run Profit-Maximization



Short-Run Profit-Maximization



Short-Run Profit-Maximization



Short-Run Profit-Maximization

$$MP_1 = \frac{w_1}{p} \quad \Leftrightarrow \quad p \times MP_1 = w_1$$

$p \times MP_1$ is the marginal revenue product of input 1, the rate at which revenue increases with the amount used of input 1.

If $p \times MP_1 > w_1$ then profit increases with x_1.

If $p \times MP_1 < w_1$ then profit decreases with x_1.

Profit Max:
A Mathematical Approach

$$Max\ \Pi = py - w_1 x_1 - w_2 \bar{x}_2$$

$$s.t. \quad y = f(x_1, x_2)$$

$$\Rightarrow \quad Max\ \Pi = pf(x_1, x_2) - w_1 x_1 - w_2 \bar{x}_2$$

$$\Rightarrow \quad p\frac{\partial f}{\partial x_1} = w_1 \quad or \quad \frac{\partial f}{\partial x_1} = w_1 / p$$

Comparative Statics of Short-Run Profit-Maximization

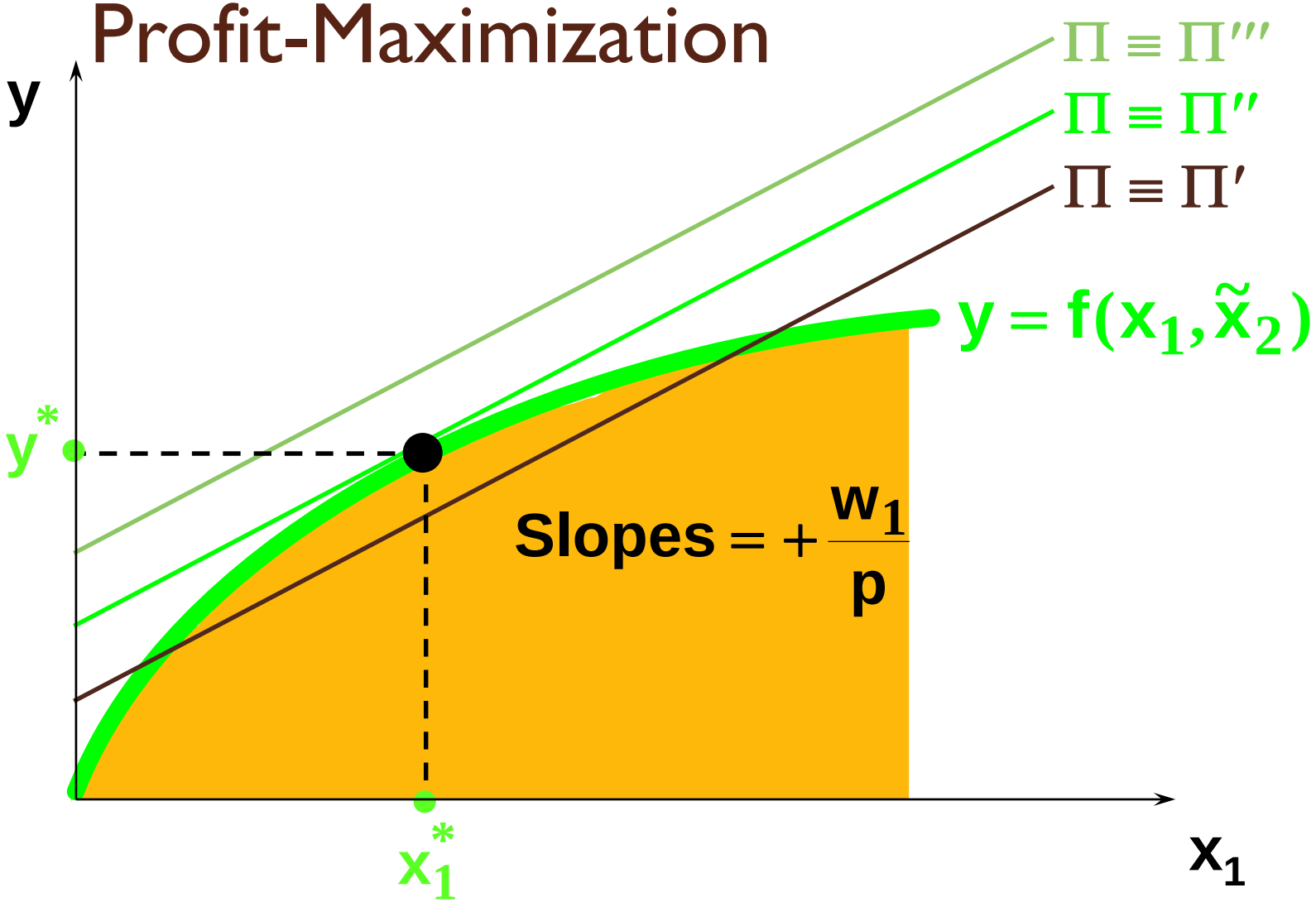
The equation of a short-run iso-profit line is

$$y = \frac{w_1}{p} x_1 + \frac{\Pi + w_2 \tilde{x}_2}{p}$$

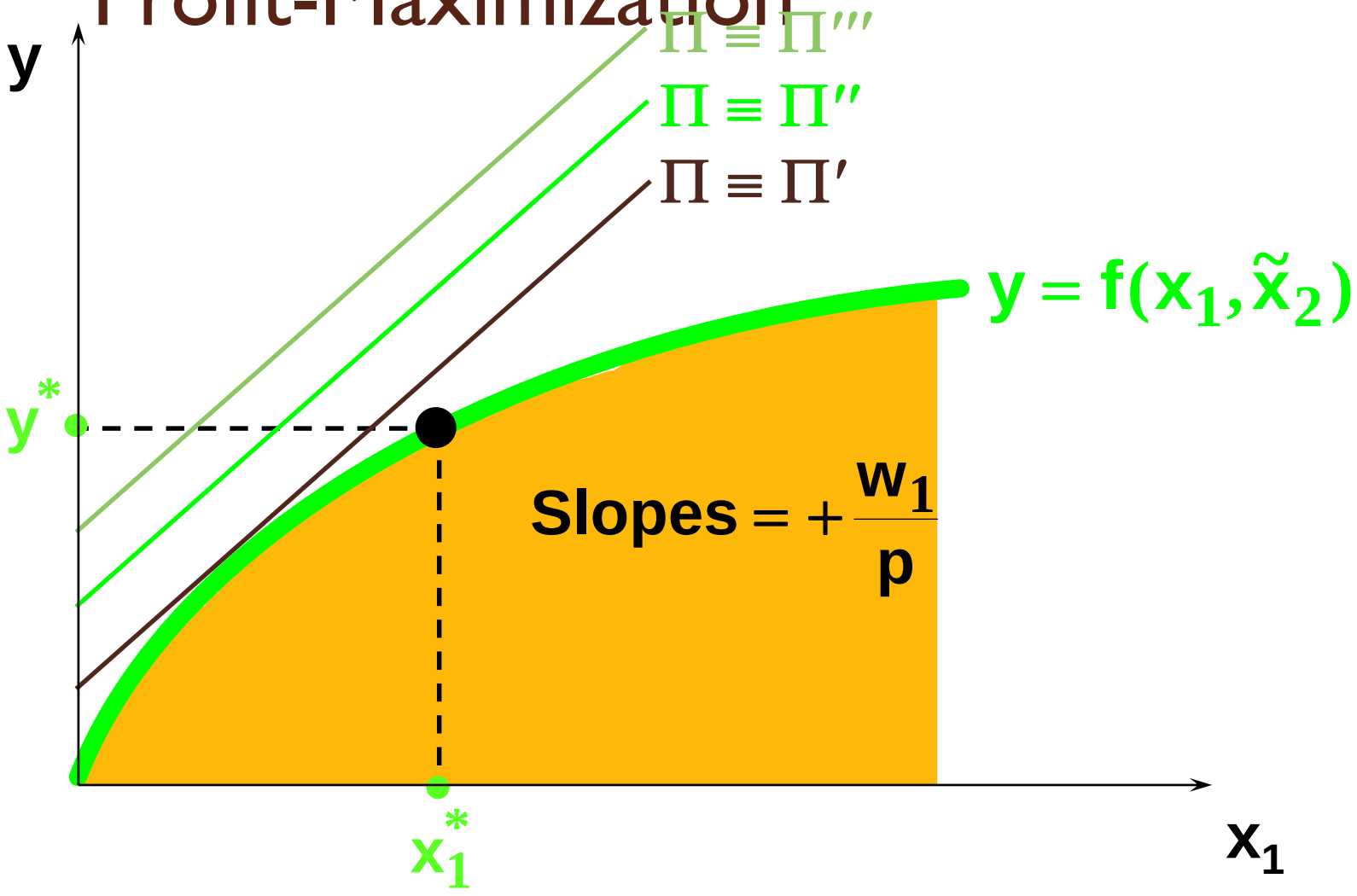
so an increase in w_1 causes

- **an increase in the slope, and**
- **no change to the vertical intercept.**

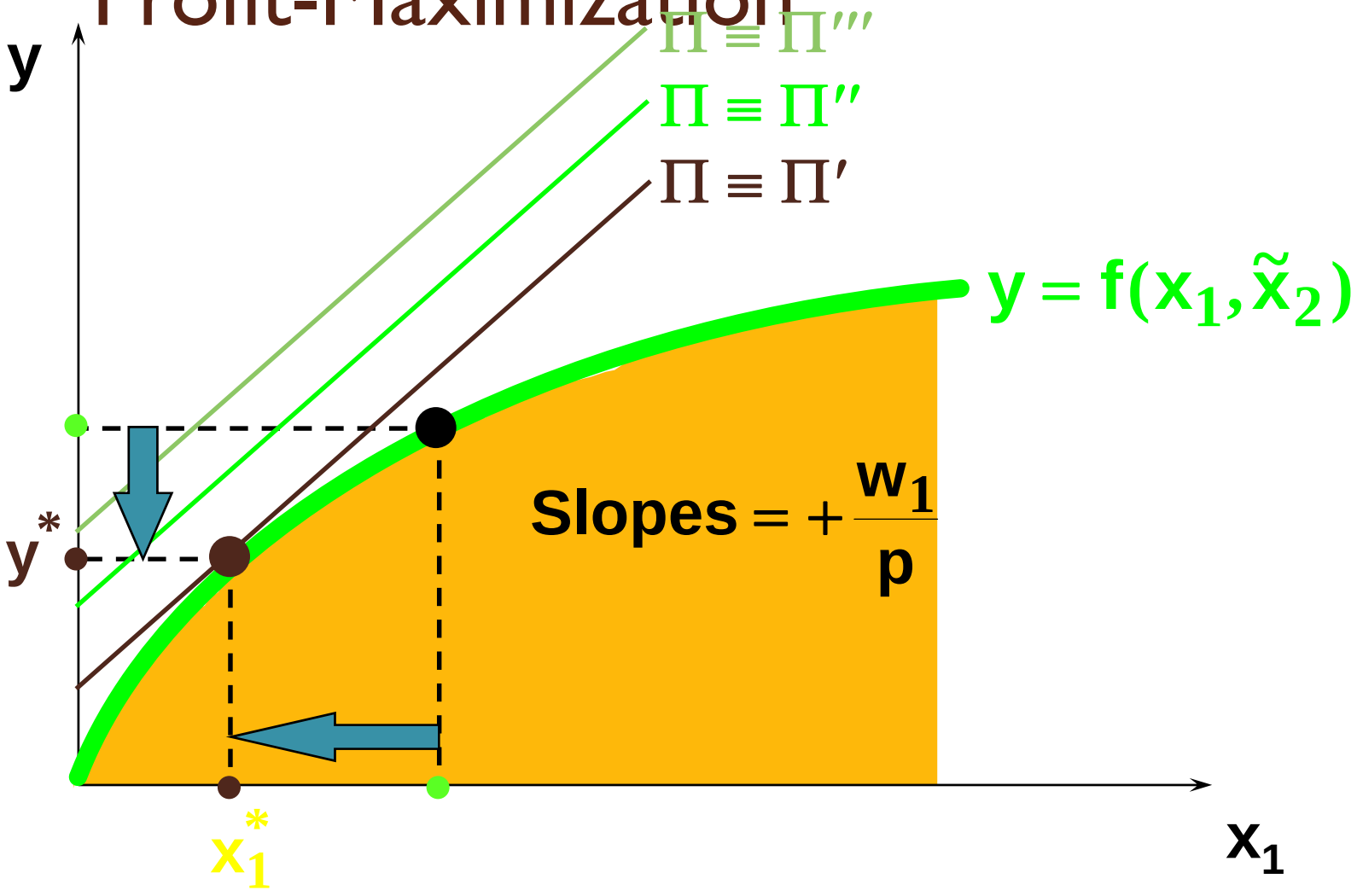
Comparative Statics of Short-Run Profit-Maximization



Comparative Statics of Short-Run Profit-Maximization



Comparative Statics of Short-Run Profit-Maximization



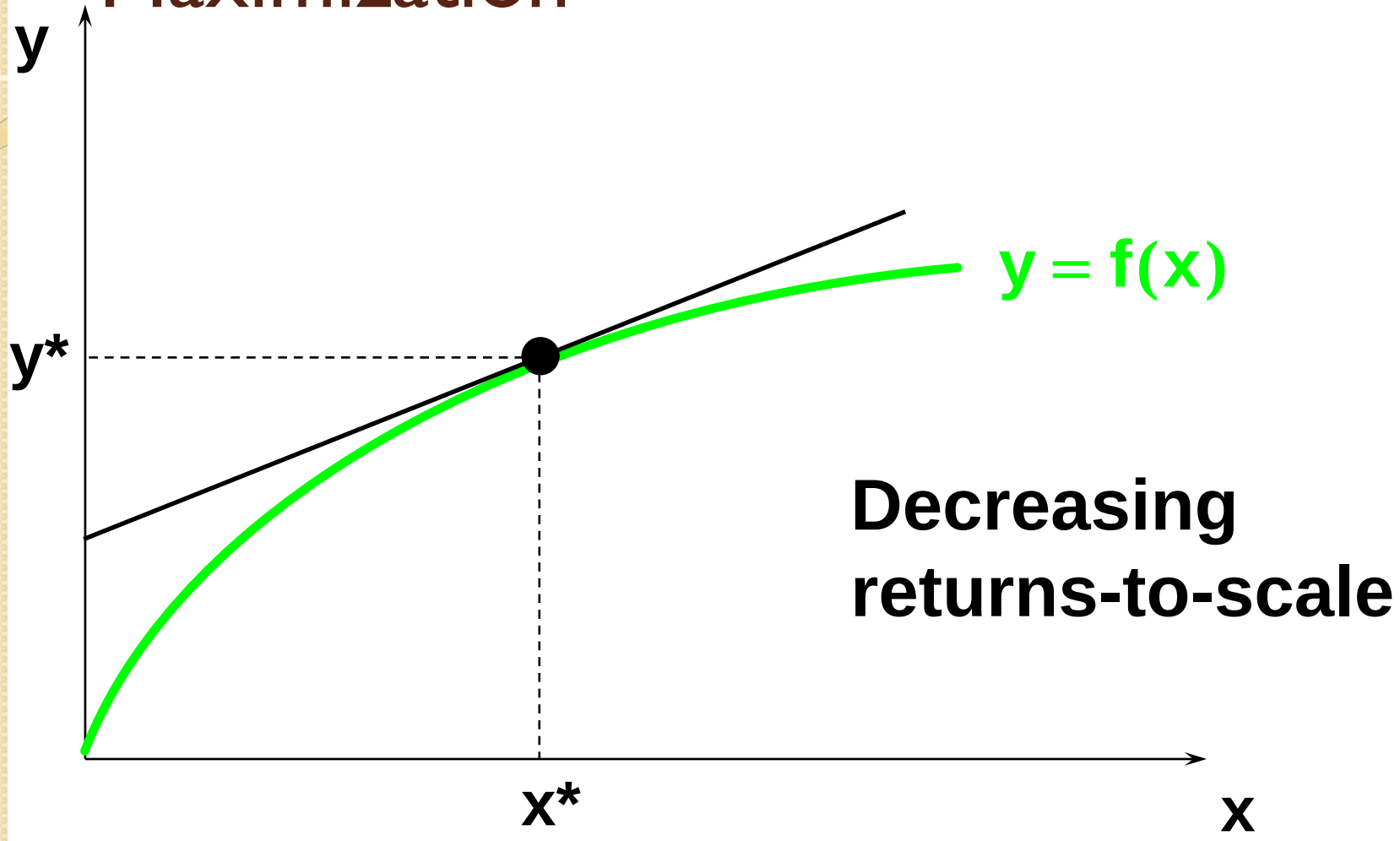
Comparative Statics of Short-Run Profit-Maximization

- An increase in w_1, the price of the firm's variable input, causes
  - a decrease in the firm's output level (the firm's supply curve shifts inward), and
  - a decrease in the level of the firm's variable input (the firm's demand curve for its variable input slopes downward).

Returns-to-Scale and Profit-Maximization

- If a competitive firm's technology exhibits decreasing returns-to-scale then the firm has a single long-run profit-maximizing production plan.

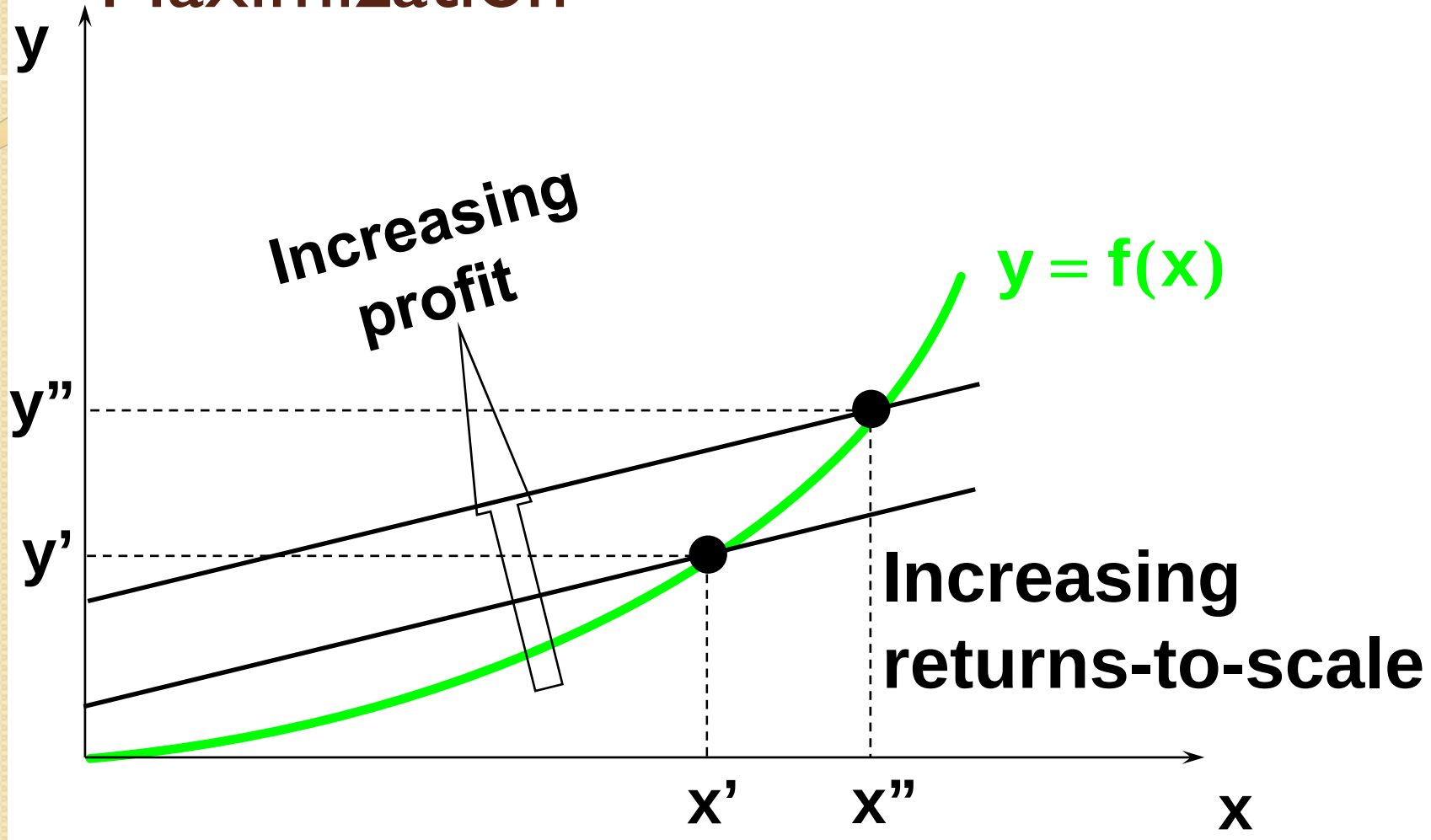
Returns-to Scale and Profit-Maximization



Returns-to-Scale and Profit-Maximization

- If a competitive firm's technology exhibits exhibits increasing returns-to-scale then the firm does not have a profit-maximizing plan.

Returns-to Scale and Profit-Maximization



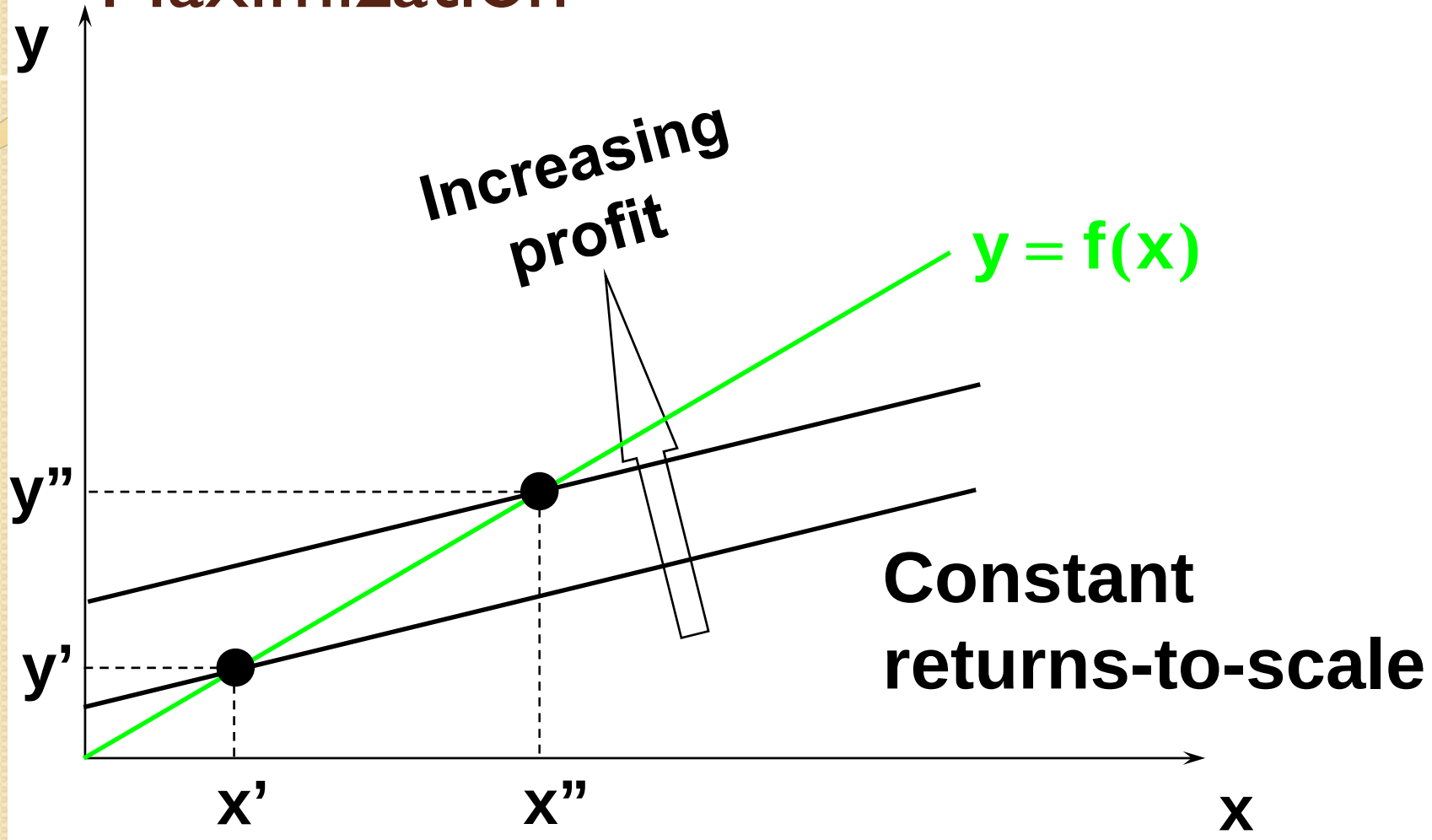
Returns-to-Scale and Profit-Maximization

- So an increasing returns-to-scale technology is inconsistent with firms being perfectly competitive.

Returns-to-Scale and Profit-Maximization

- What if the competitive firm's technology exhibits constant returns-to-scale?

Returns-to Scale and Profit-Maximization



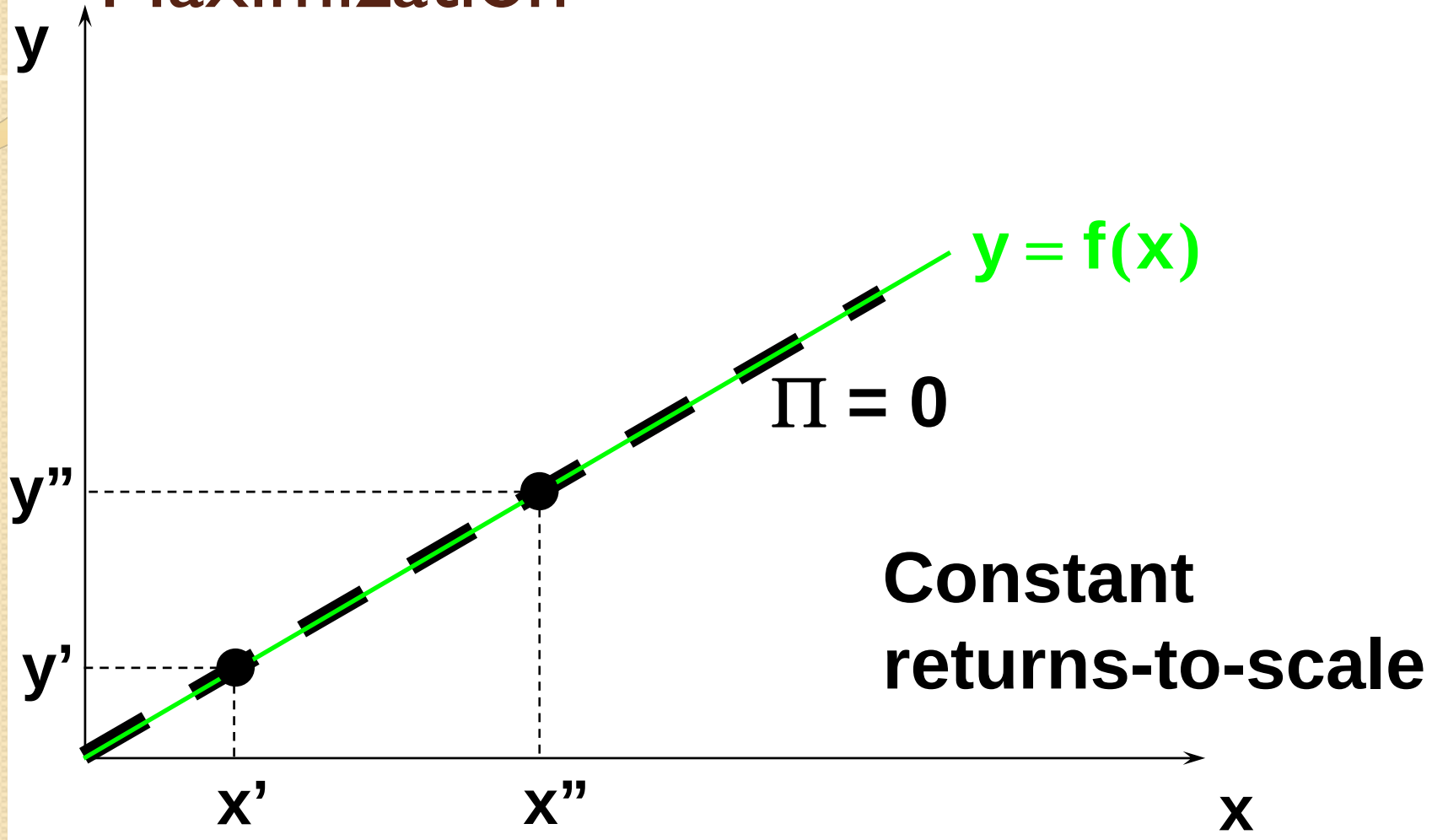
Returns-to Scale and Profit-Maximization

- So if any production plan earns a positive profit, the firm can double up all inputs to produce twice the original output and earn twice the original profit.

Returns-to Scale and Profit-Maximization

- Therefore, when a firm's technology exhibits constant returns-to-scale, earning a positive economic profit is inconsistent with firms being perfectly competitive.
- Hence constant returns-to-scale requires that competitive firms earn economic profits of zero.

Returns-to Scale and Profit-Maximization



Long-Run Competitive Equilibrium

- For long run equilibrium, firms must have no desire to enter or leave the industry
- We can relate economic profit to the incentive to enter and exit the market
- Need to relate accounting profit to economic profit

Long-Run Competitive Equilibrium

- Accounting profit
  - Difference between firm's revenues and direct costs
- Economic profit
  - Difference between firm's revenues and direct and indirect costs
  - Takes into account opportunity costs and entrepreneur ability

Long-Run Competitive Equilibrium

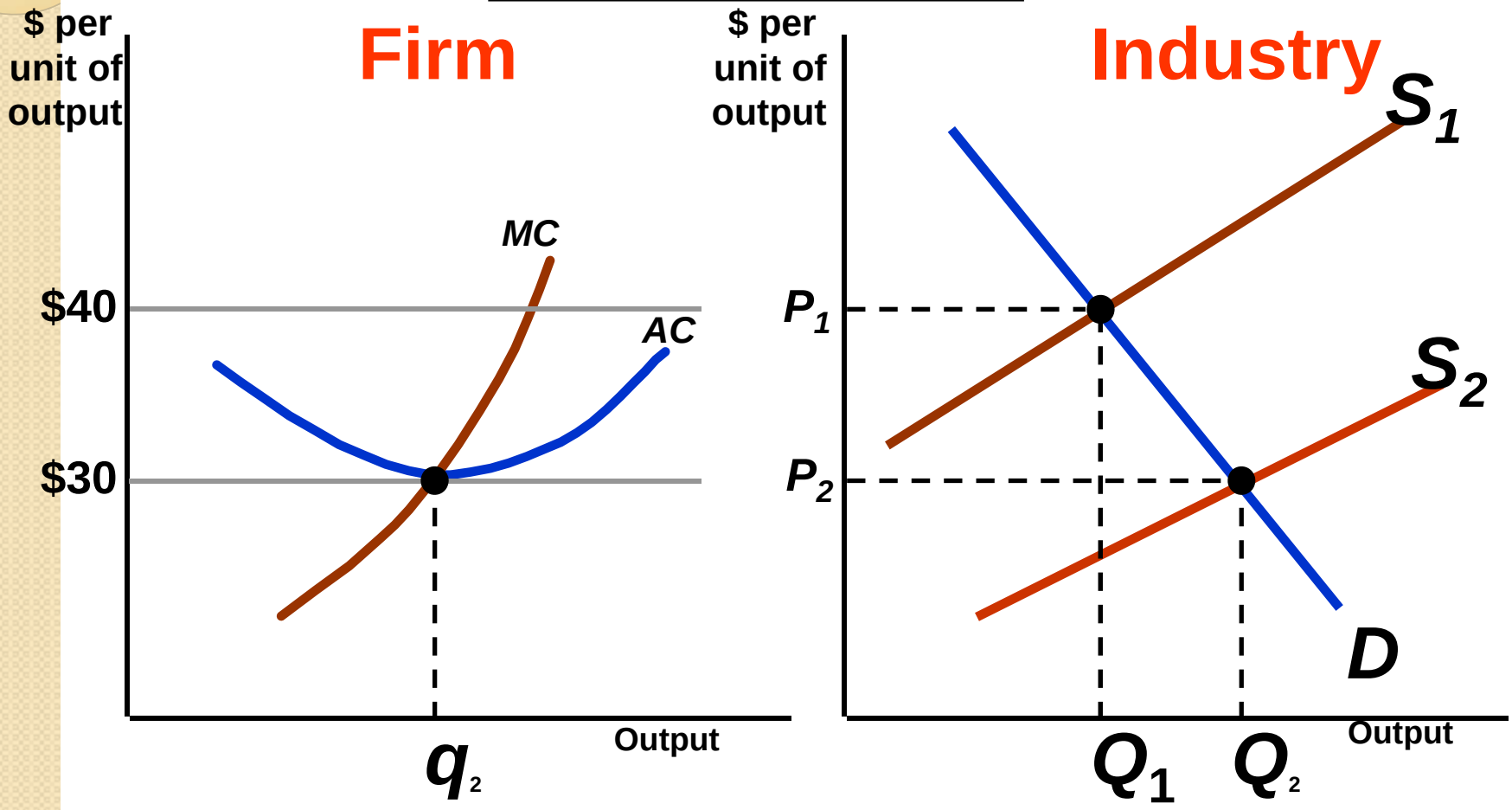
- Zero-Profit
  - A firm is earning a normal return on its investment
  - Doing as well as it could by investing its money elsewhere
  - Normal return is firm's opportunity cost of using money to buy capital instead of investing elsewhere
  - Competitive market long run equilibrium

Long-Run Competitive Equilibrium

- Entry and Exit
  - The long-run response to short-run profits is to increase output and profits
  - Profits will attract other producers
  - More producers increase industry supply, which lowers the market price
  - This continues until there are no more profits to be gained in the market – zero economic profits

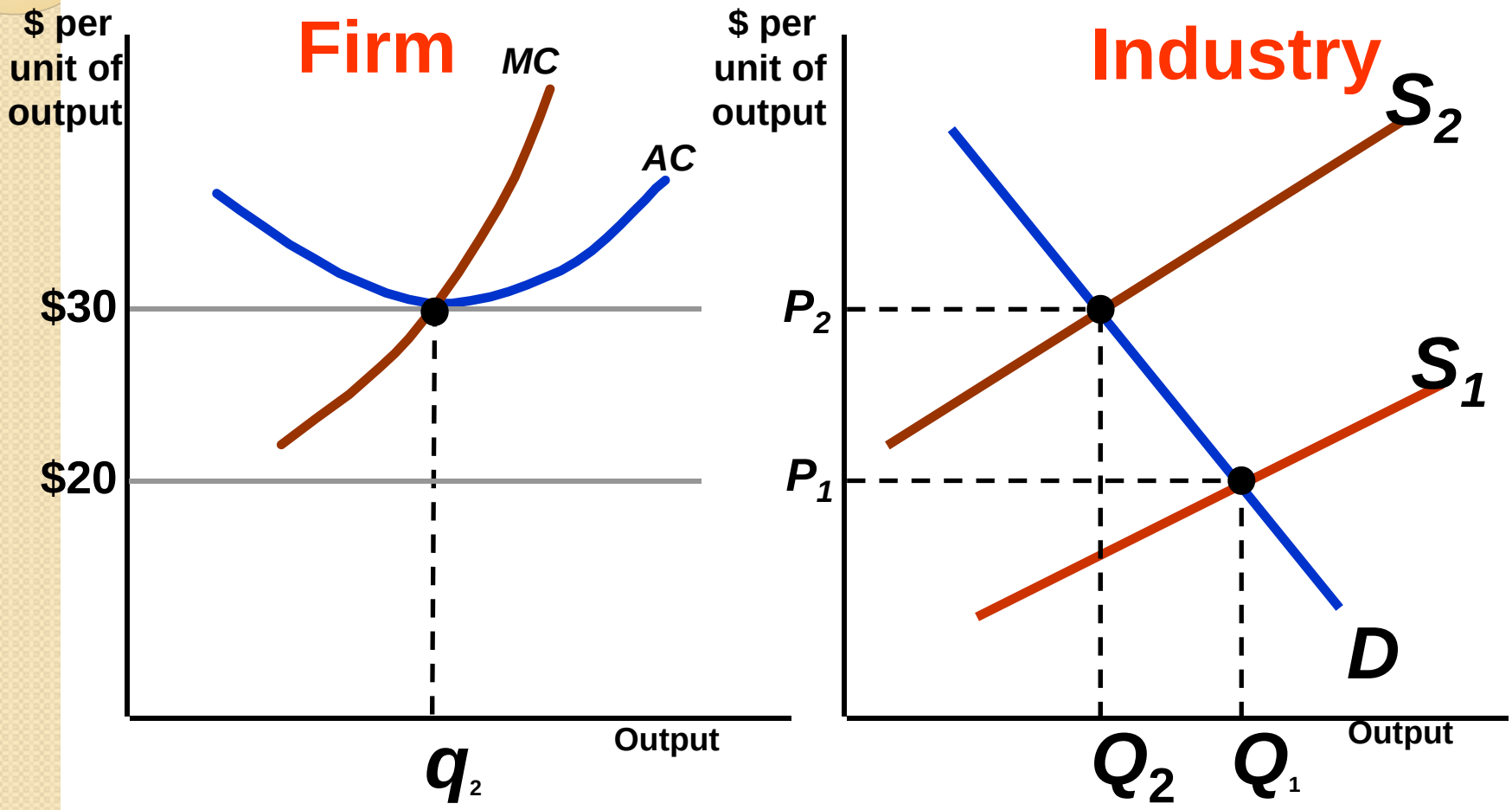
Long-Run Competitive Equilibrium – Profits

- Profit attracts firms
- Supply increases until profit = 0



Long-Run Competitive Equilibrium – Losses

- Losses cause firms to leave
- Supply decreases until profit = 0



Long-Run Competitive Equilibrium

1. All firms in industry are maximizing profits
   - MR = MC
2. No firm has incentive to enter or exit industry
   - Earning zero economic profits
3. Market is in equilibrium
   - $Q_D = Q_S$

The Industry's Long-Run Supply Curve

- The shape of the long-run supply curve depends on the extent to which changes in industry output affect the prices the firms must pay for inputs

The Industry's Long-Run Supply Curve

- Assume
  - All firms have access to the available production technology
  - Output is increased by using more inputs, not by invention

The Industry's Long-Run Supply Curve

- To analyze long-run industry supply, will need to distinguish between three different types of industries
  1. Constant-Cost
  2. Increasing-Cost
  3. Decreasing-Cost

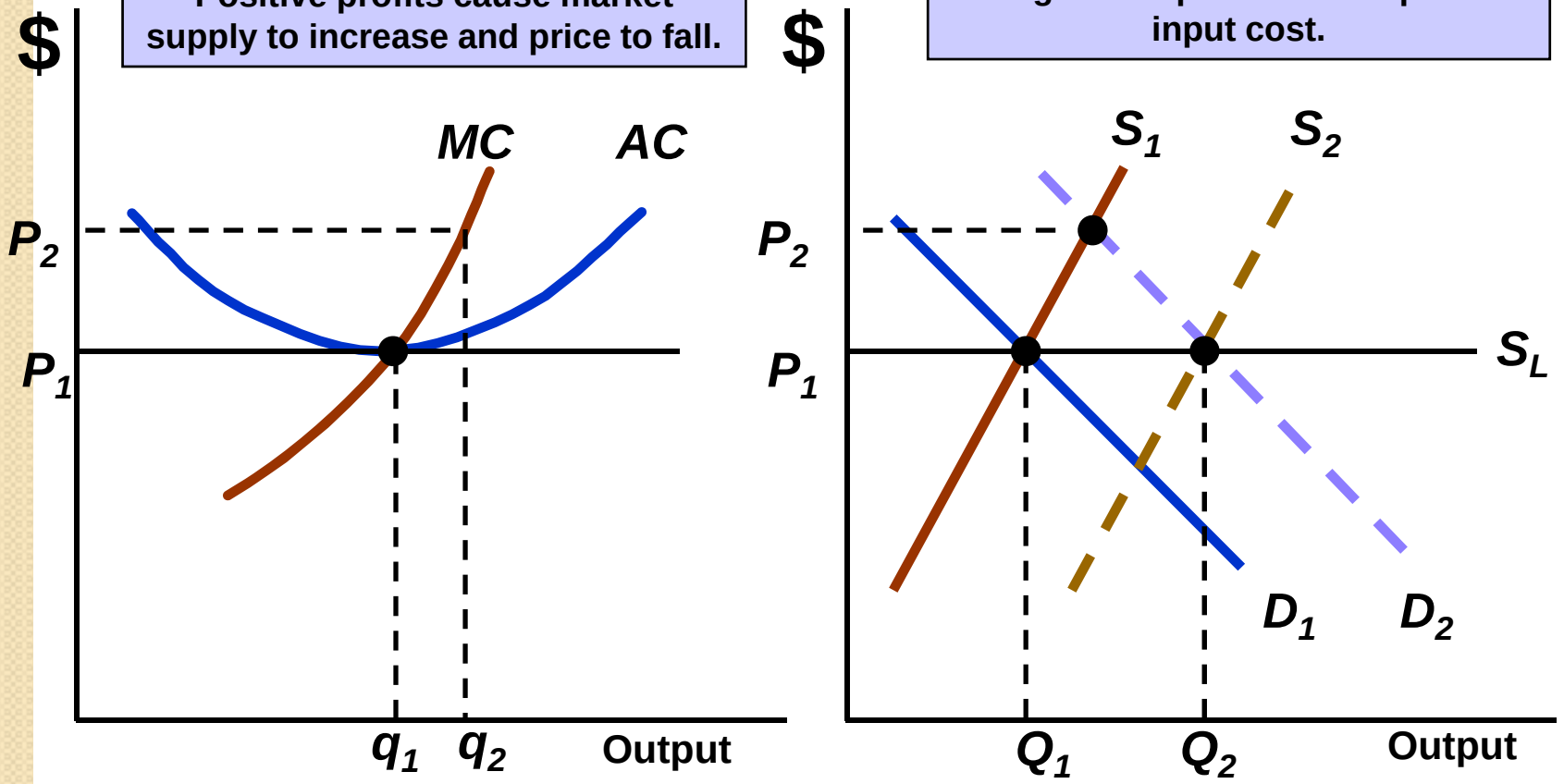
Constant-Cost Industry

- Industry whose long-run supply curve is horizontal
- Prices of inputs do not change as firms enter or exit
  - Firms' cost curves do not change
- Assume a firm is initially in equilibrium
  - Demand increases, causing price to increase
  - Individual firms increase supply
  - Causes firms to earn positive profits in short run
  - Supply increases, causing market price to decrease
  - Long run equilibrium – zero economic profits

Constant-Cost Industry

Increase in demand increases market price and firm output. Positive profits cause market supply to increase and price to fall.

Q_1 increases to Q_2. Long-run supply = S_L = LRAC. Change in output has no impact on input cost.



Long-Run Supply in a Constant-Cost Industry

- In a constant-cost industry, the long-run supply is a horizontal line at a price that is equal to the minimum average cost of production

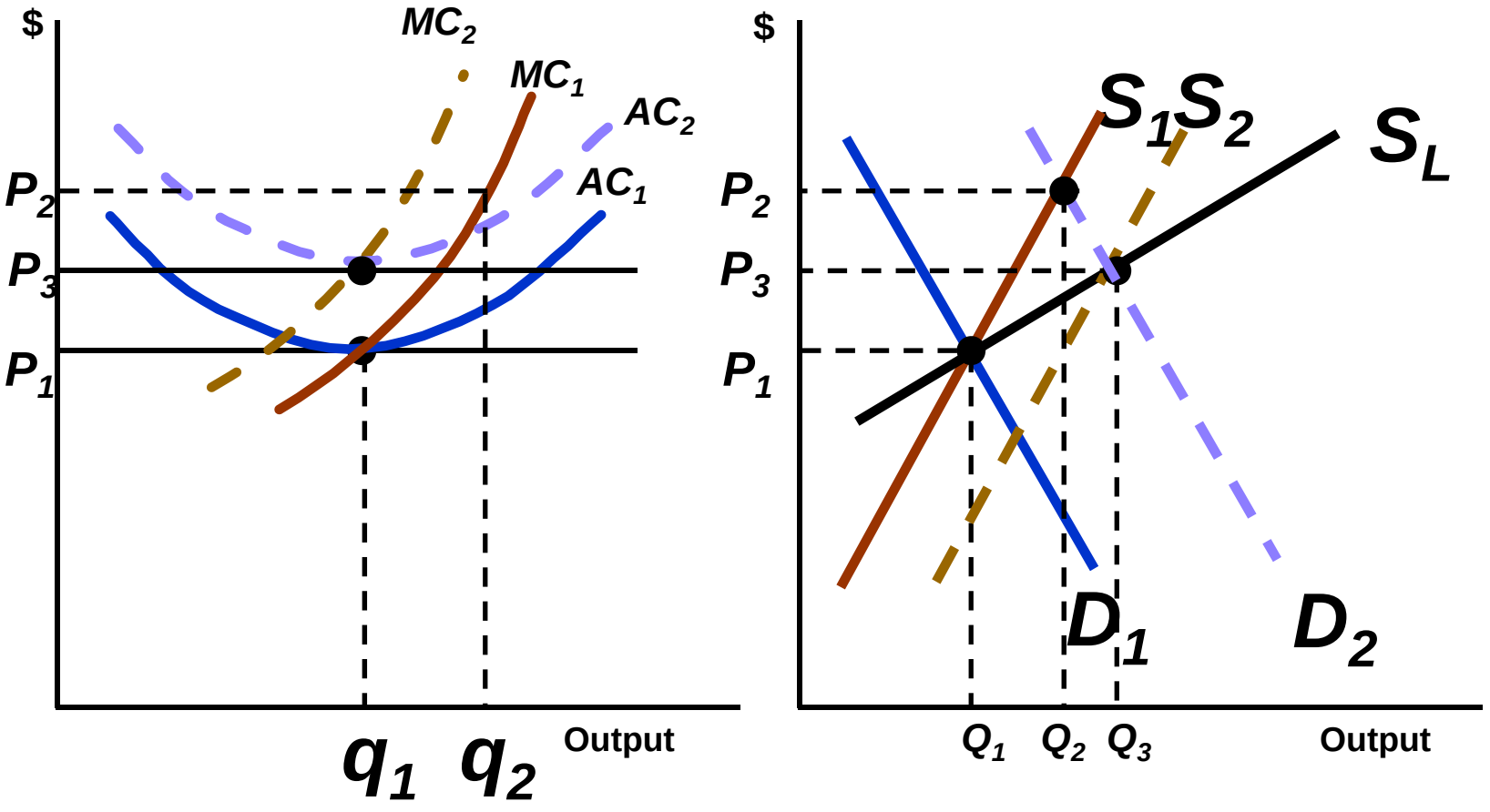
Increasing-Cost Industry

- Prices of some or all inputs rises as production is expanded when demand of inputs increases
- When demand increases, causing prices to increase and production to increase
  - Firms enter the market increasing demand for inputs
  - Costs increase, causing an upward shift in supply curves (congestion, shortage, and so on)
  - Market supply increases but not as much

Long-Run Supply in an Increasing-Cost Industry

Due to the increase in input prices, long-run equilibrium occurs at a higher price.

Long Run Supply is upward Sloping



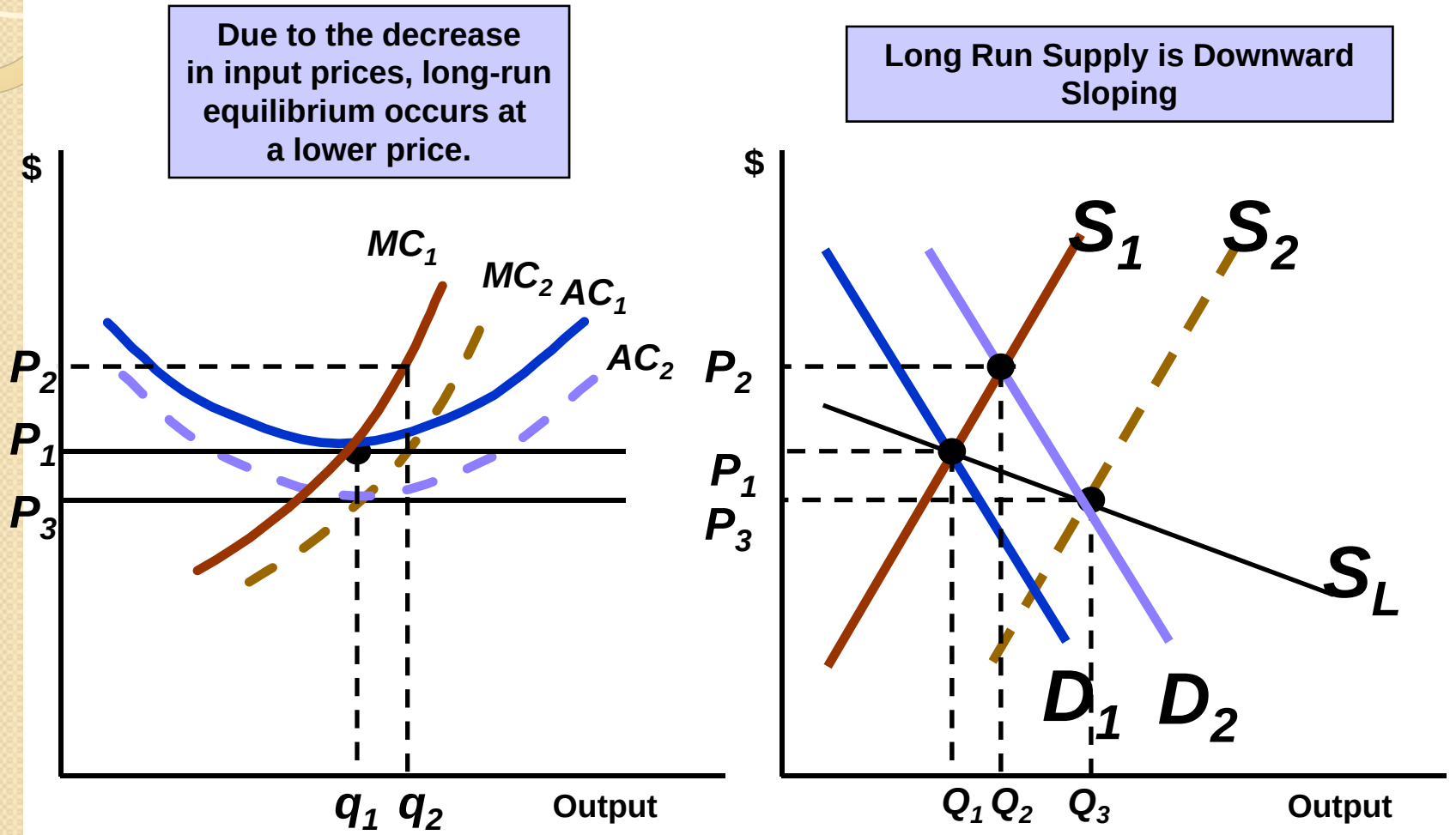
Long-Run Supply in an Increasing-Cost Industry

- In an increasing-cost industry, long-run supply curve is upward sloping
- More output is produced, but only at the higher price needed to compete for the increased input costs

Decreasing-Cost Industry

- Industry whose long-run supply curve is downward sloping
- Increase in demand causes production to increase
  - Increase in size allows firm to take advantage of size to get inputs cheaper
  - Increased production may lead to better efficiencies or quantity discounts
  - Costs shift down and market price falls

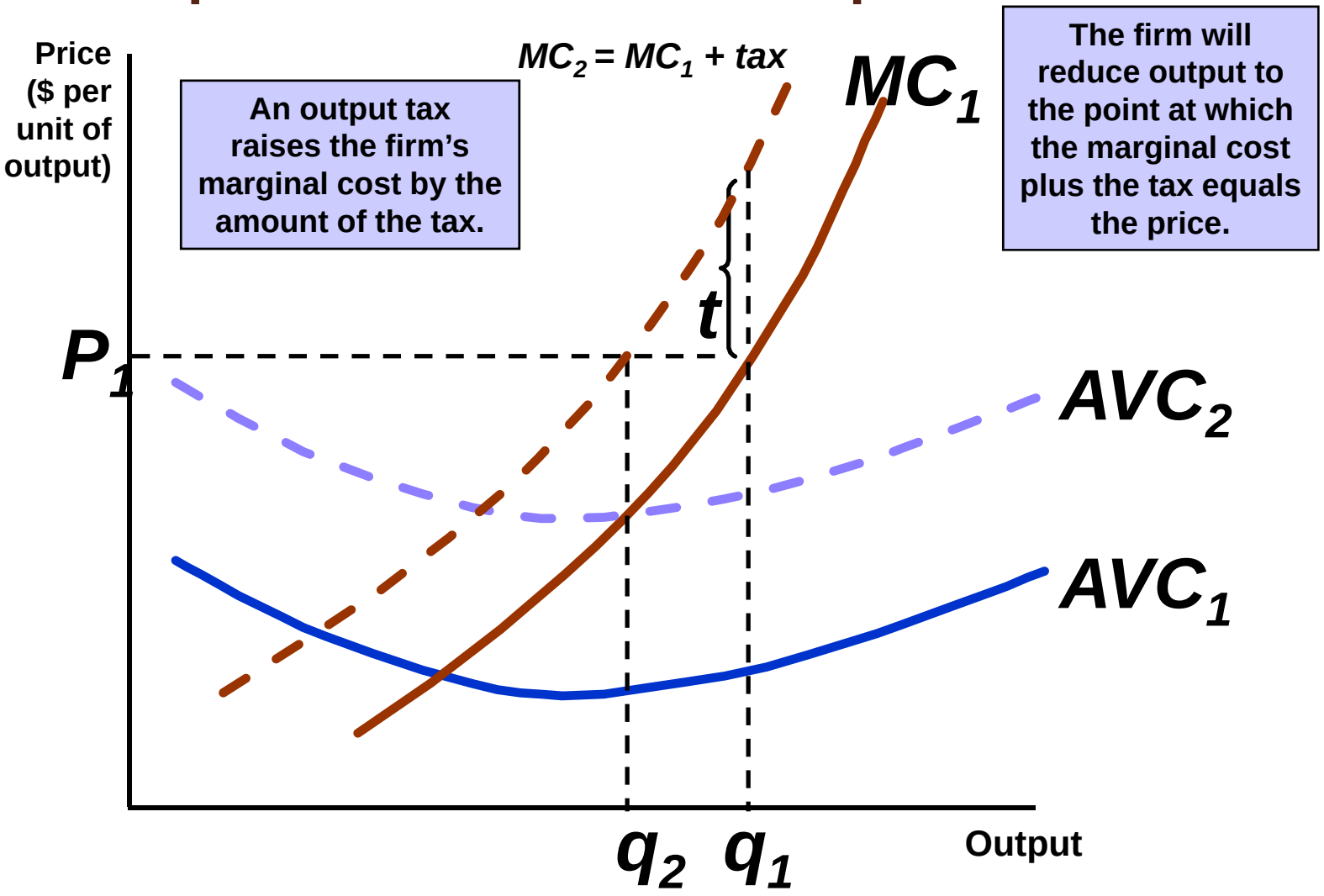
Long-Run Supply in a Decreasing-Cost Industry



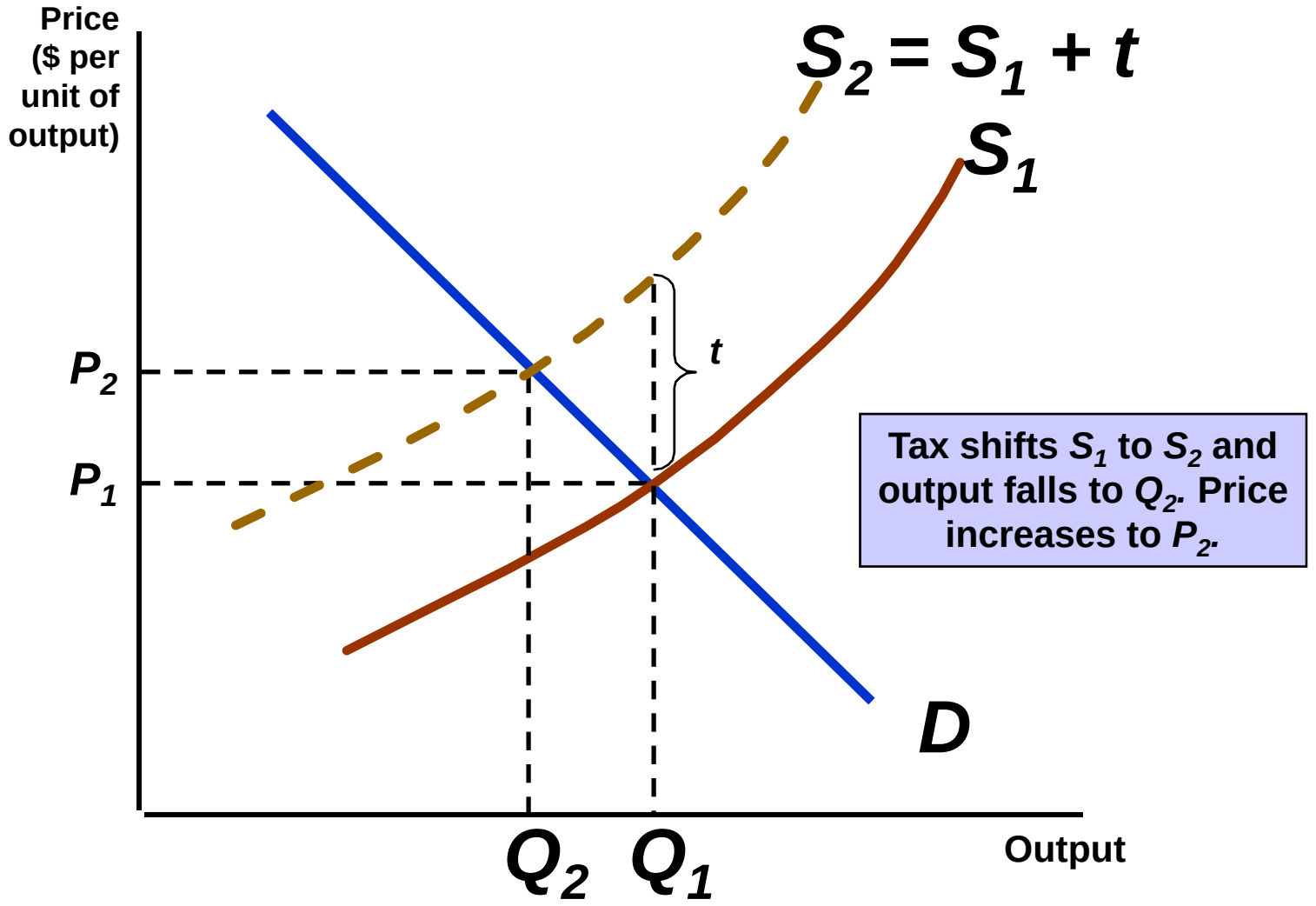
Short-Run Implications for Taxation

- The Effects of a Tax
  - We will consider how a firm responds to a tax on its output
  - The tax impact on the in industry supply curve in the short run

Effect of an Output Tax on a Competitive Firm's Output



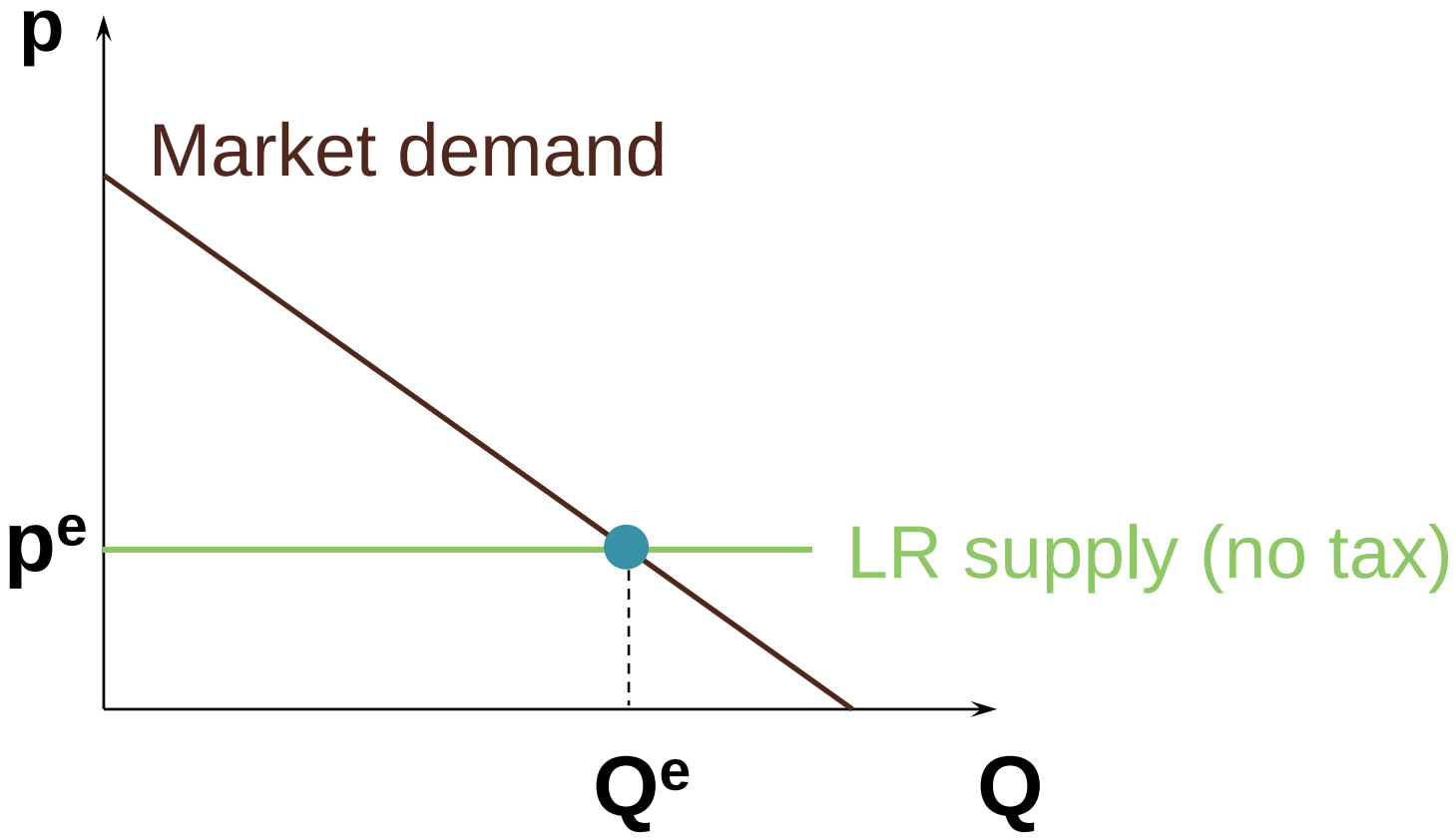
Effect of an Output Tax on Industry Output



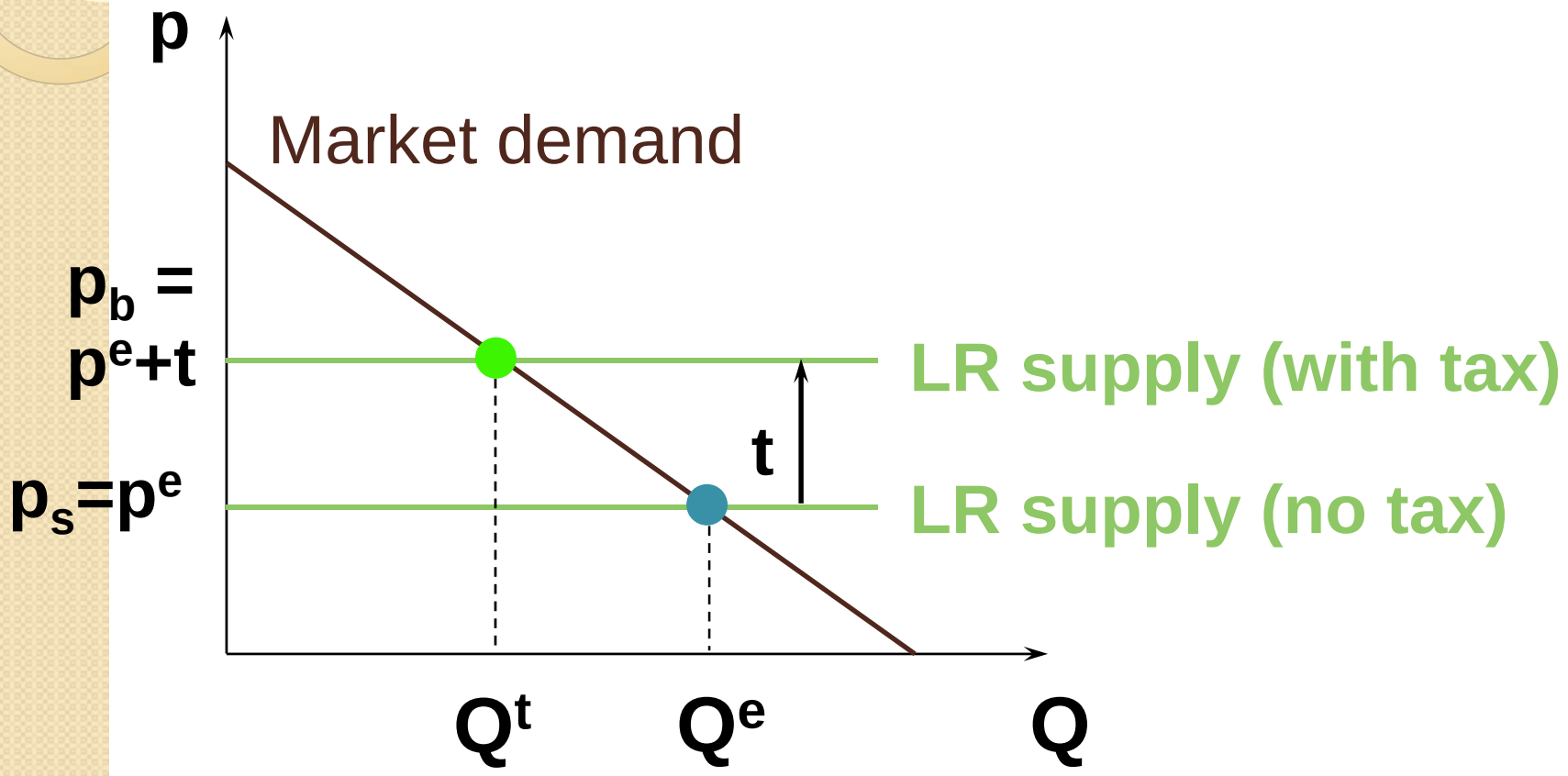
Long-Run Implications for Taxation

- In a short-run equilibrium, the burden of a sales or an excise tax is typically shared by both buyers and sellers, tax incidence of the tax depending upon the own-price elasticities of demand and supply.
- Q: Is this true in a long-run market equilibrium?

Long-Run Implications for Taxation

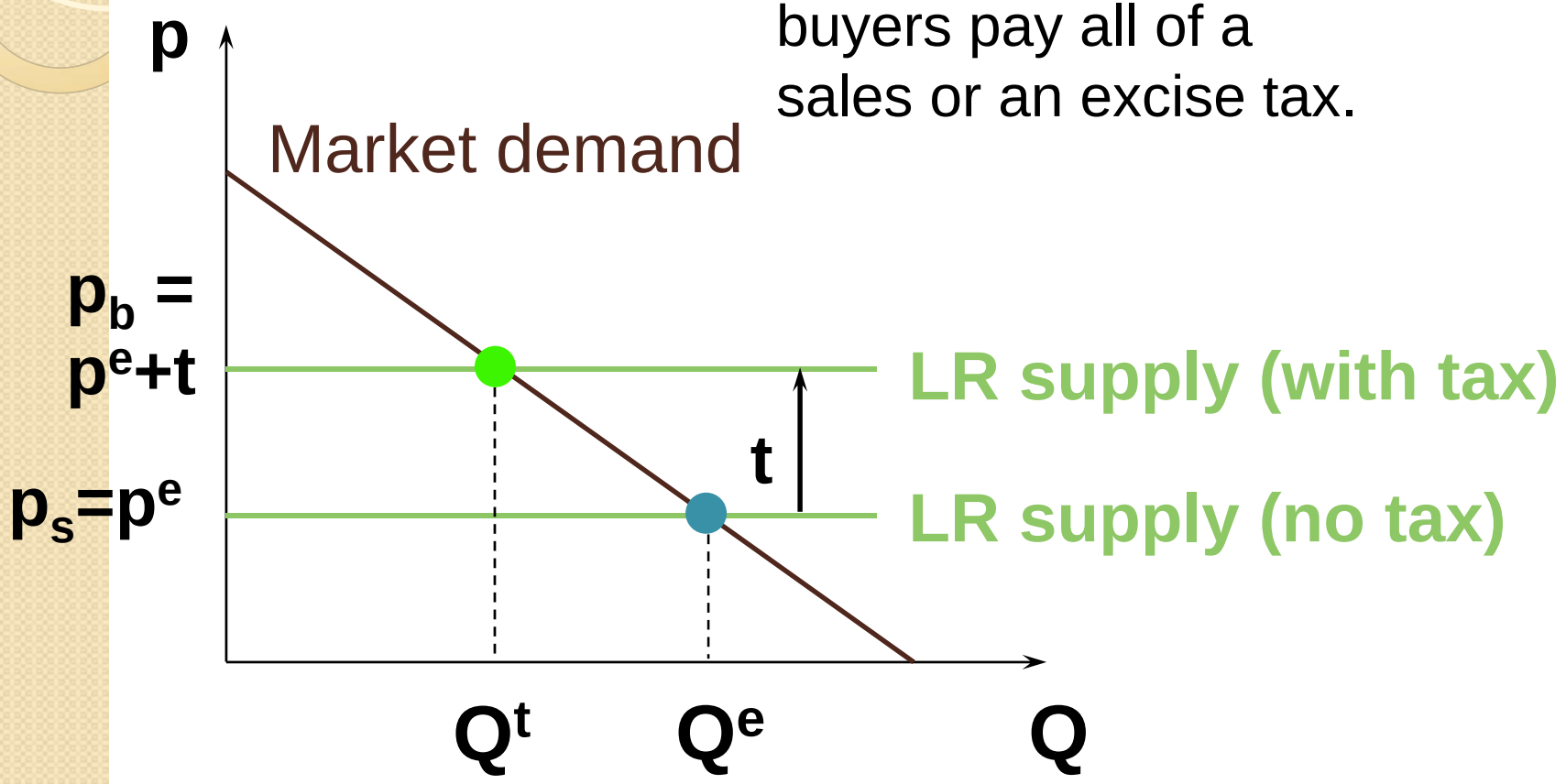


Long-Run Implications for Taxation



Long-Run Implications for Taxation

In the long-run the buyers pay all of a sales or an excise tax.



Fixed Inputs and Economic Rent

- There may be some fixed factor(s) even in the long run
- E.g., the taxi-cab industry has a barrier to entry even though there are lots of cabs competing with each other.
- Cigarette production licensing is a barrier to entry into a competitive industry.
- Other examples of fixed inputs: land, natural resources, talents, or govt. regulation (licensing)

Fixed Inputs and Economic Rent

- Q: When there is a barrier to entry, will not the firms already in the industry make positive economic profits?

Fixed Inputs and Economic Rent

- Q: When there is a barrier to entry, will not the firms already in the industry make positive economic profits?
- A: No. Each firm in the industry makes a zero economic profit. Why?

Fixed Inputs and Economic Rent

- Think of a firm that needs an operating license -- the license is a fixed input that is rented but not owned by the firm
- If the firm makes a positive economic profit then another firm can offer the license owner a higher price for it
- In this way, all firms' economic profits are competed away, to zero

Fixed Inputs and Economic Rent

- So in the long-run equilibrium, each firm makes a zero economic profit and each firm's fixed cost is its payment for its operating license
- If the opportunity cost of the input (rent) is not taken into consideration, it may appear that economic profits exist in the long run

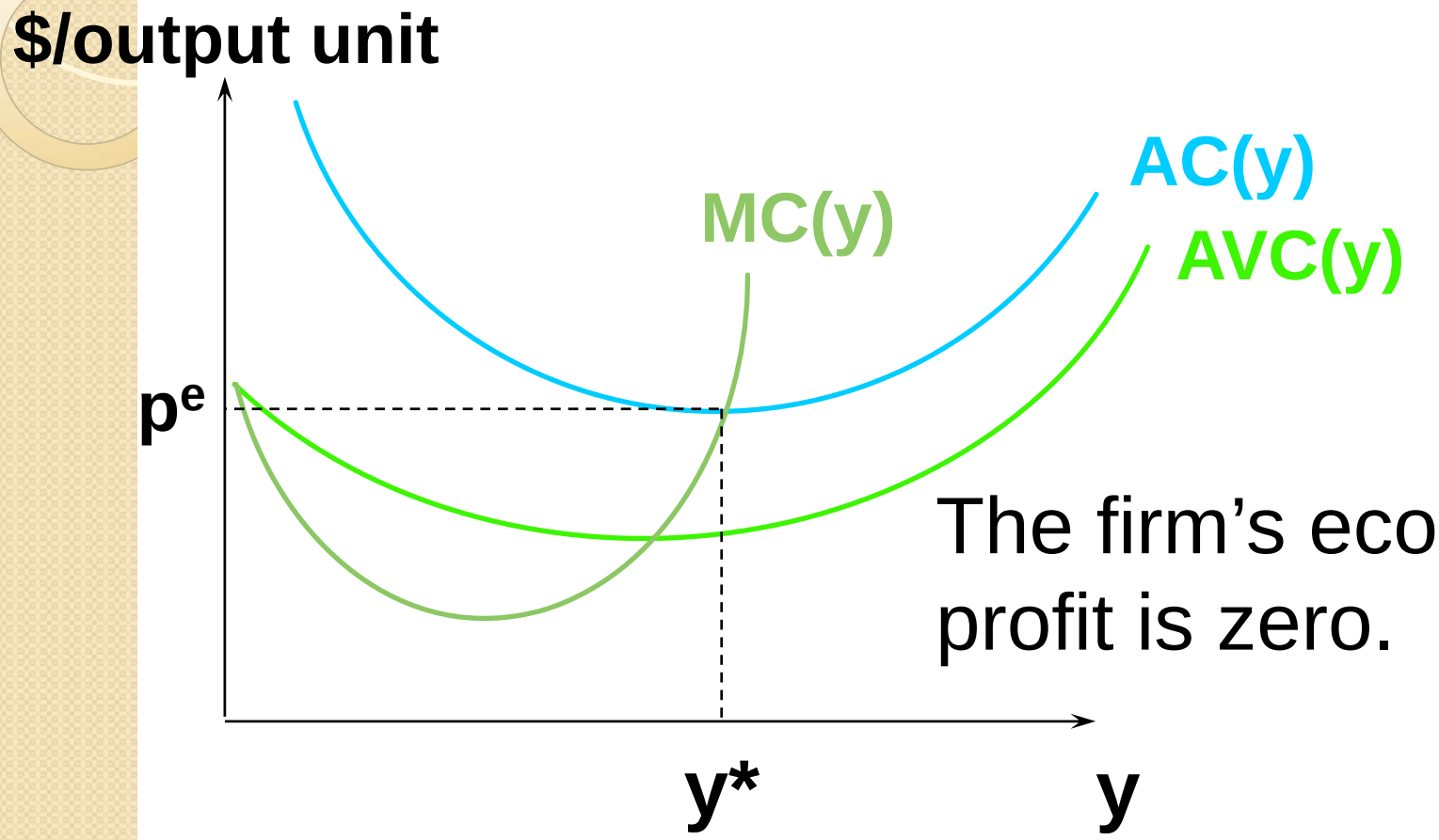
Fixed Inputs and Economic Rent

- An input (e.g. an operating license) that is fixed in the long-run causes a long-run fixed cost, F.
- Long-run total cost, $c(y) = F + c_v(y)$.
- And long-run average total cost,

$$AC(y) = AFC(y) + AVC(y).$$

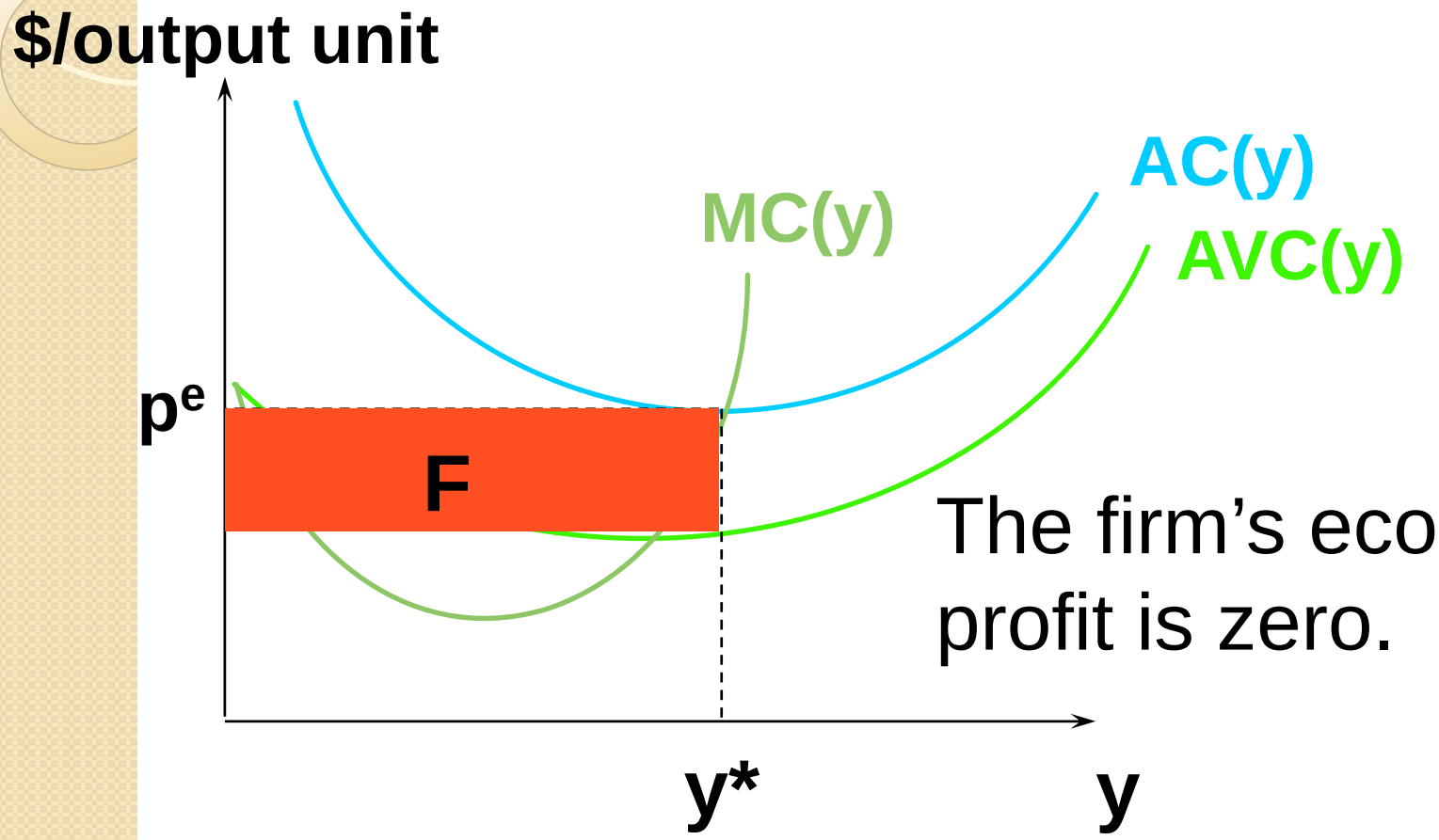
- In the long-run equilibrium, what will be the value of F?

Fixed Inputs and Economic Rent



The firm's economic profit is zero.

Fixed Inputs and Economic Rent



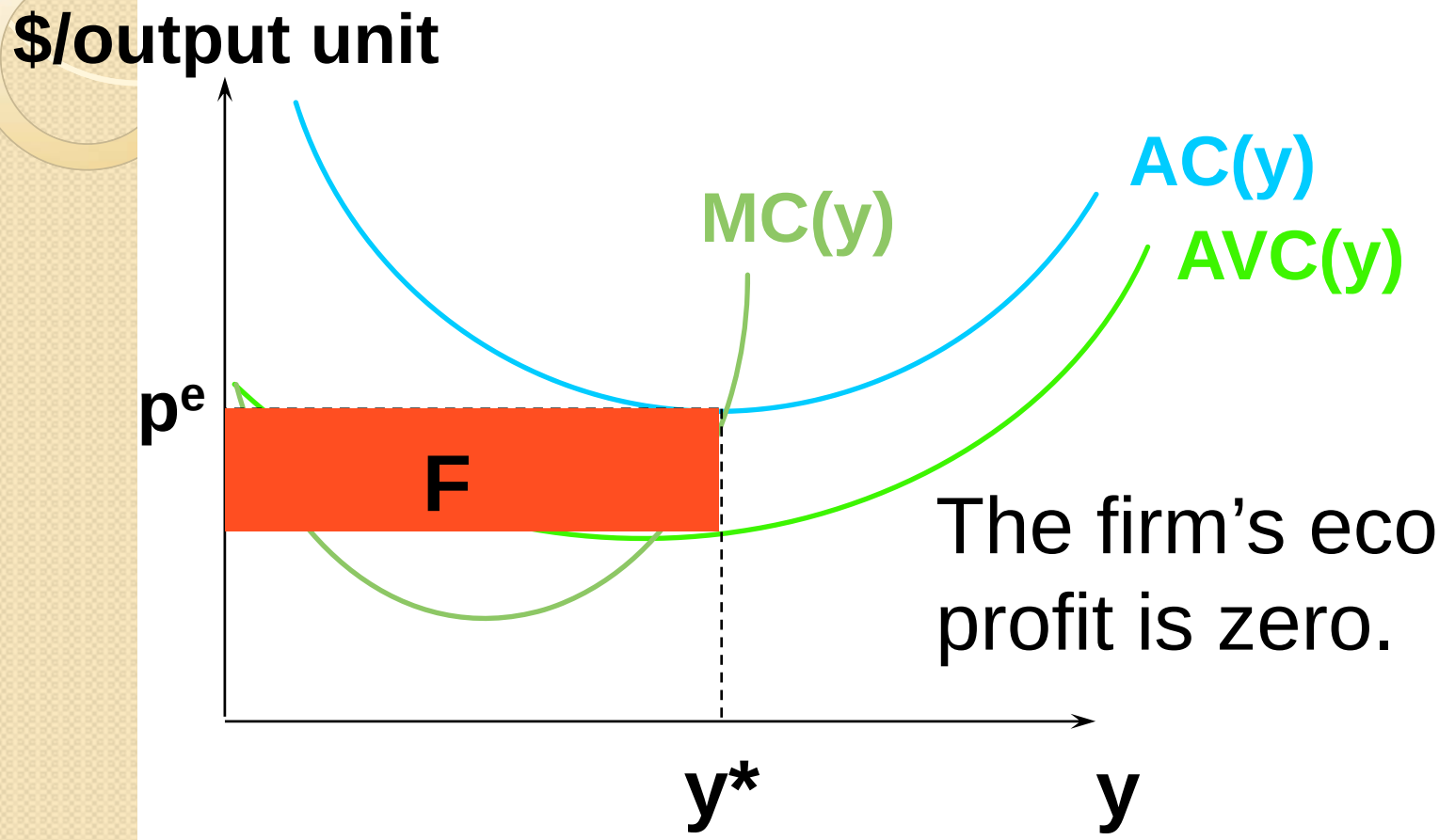
The firm's economic profit is zero.

F is the payment to the owner of the fixed input (the license).

Fixed Inputs and Economic Rent

- Economic rent is the payment for an input that is in excess of the minimum payment required to have that input supplied.
- Each license essentially costs zero to supply, so the long-run economic rent paid to the license owner is the firm's long-run fixed cost.

Fixed Inputs and Economic Rent



The firm's economic profit is zero.

F is the payment to the owner of the fixed input (the license); F = economic rent.

The Implication of Economic Rent

- The equilibrium rent for the fixed input will be whatever it takes to drive profits to zero
- P*y* - Cv(y*) – rent = 0
- Rent = P*y* - Cv(y*)
- ***It is the equilibrium price that determines rent, not the reverse***
- Note that y* is determined by p*=MC(y*)

which has nothing to do with rent

Land and Housing Prices

- Many scholars claim that China's high housing prices are due to the high fees levied on the land
- The implication of this claim is that China's housing prices will go down if the government reduces land prices
- Is it true?
- The shops in the airport sell products at the higher price than elsewhere. Shop owners say it is because of high rent in the airport. True or not?

Rent-Seeking

- Restrictions on entry or fixed input creates sizable rents
- This leads to so-called ***rent seeking*** activities
- Efforts directed at keeping or acquiring claims to factors fixed in supply
- These efforts represent a *pure deadweight loss* since no more output is produced and they simply grab rents

Chapter 9

Market Equilibrium

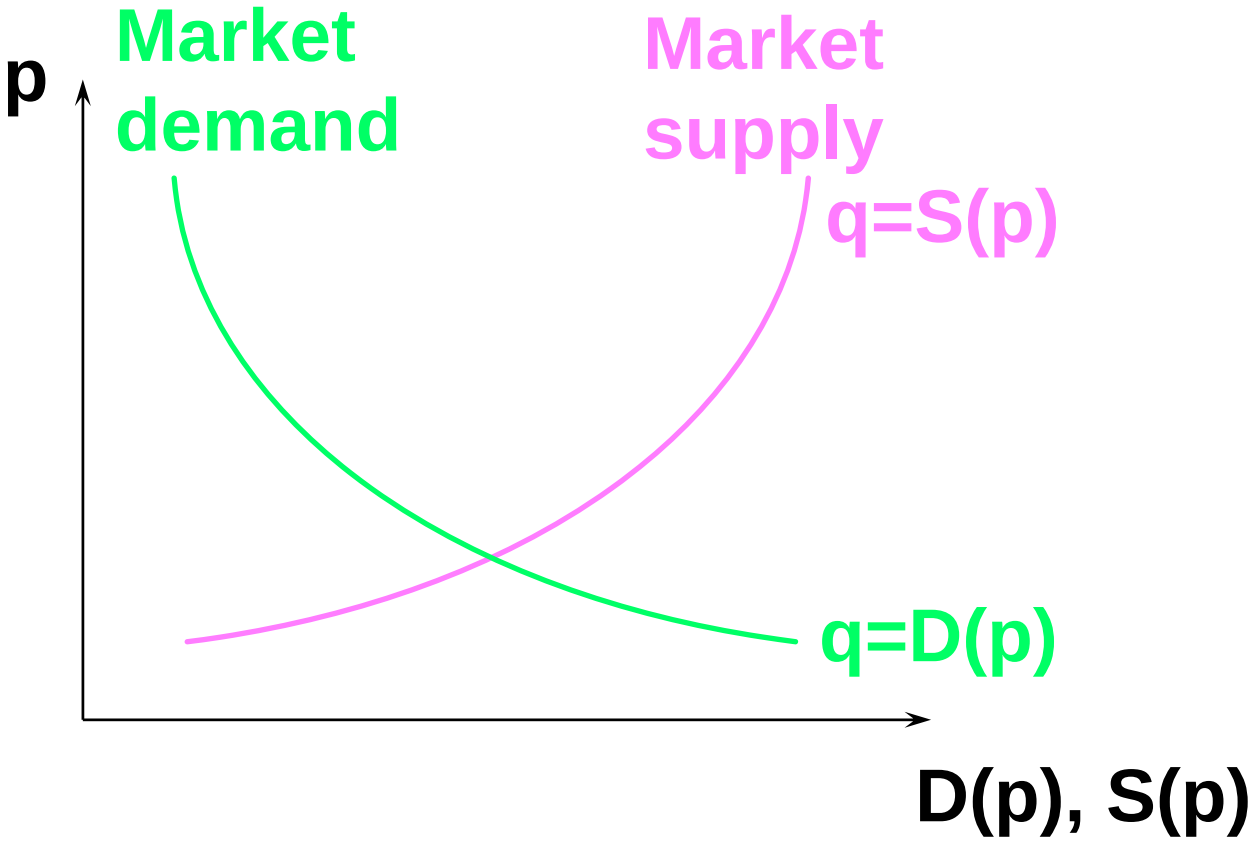
Topics to be Discussed

- Market equilibrium
- Quantity tax and equilibrium
- Tax incidence
- Deadweight loss

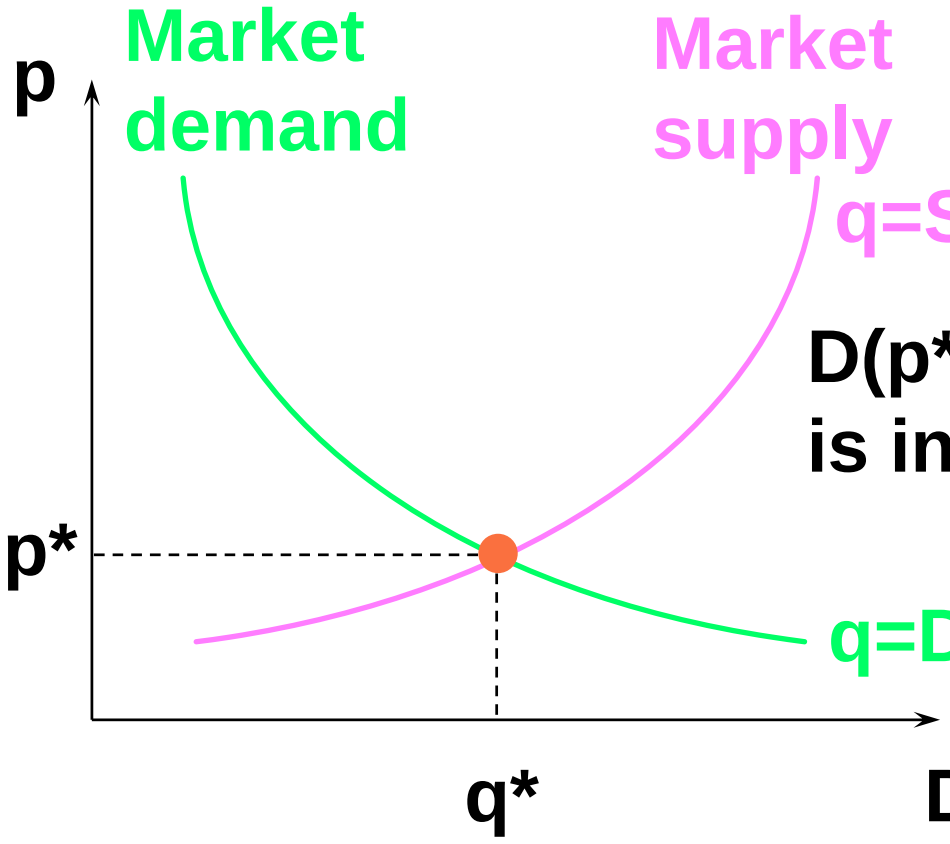
Market Equilibrium

- A market is in equilibrium when total quantity demanded by buyers equals total quantity supplied by sellers.
- Also called "market is cleared"

Market Equilibrium

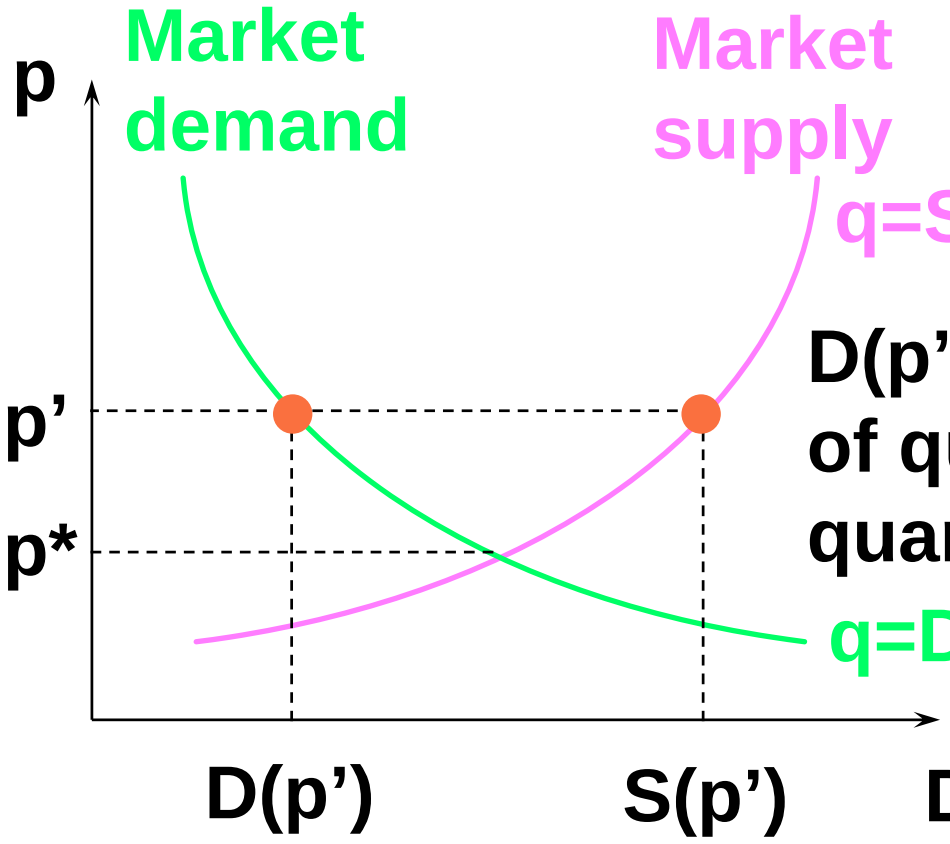


Market Equilibrium



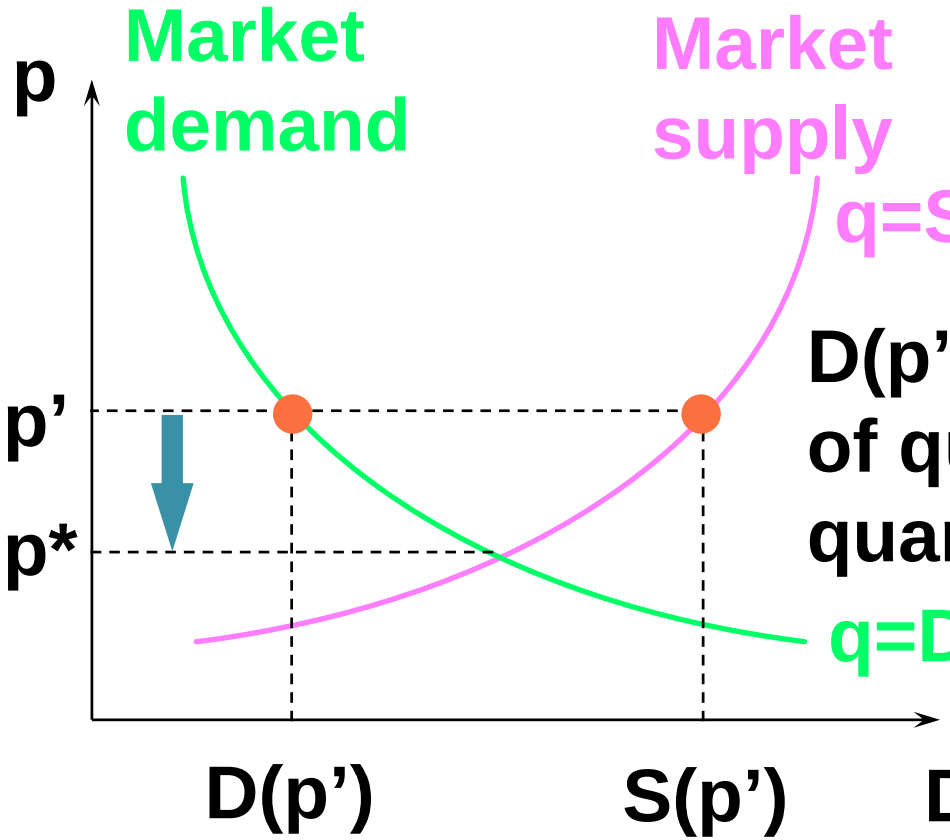
D(p*) = S(p*); the market is in equilibrium.

Market Equilibrium



D(p') < S(p'); an excess of quantity supplied over quantity demanded.

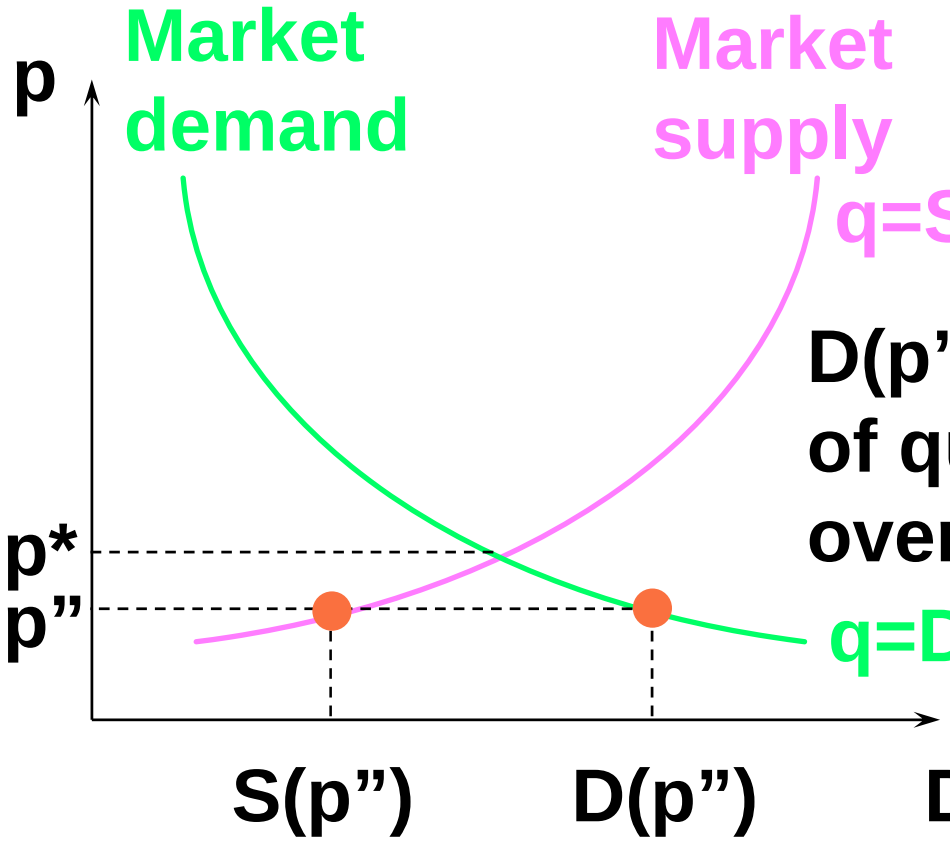
Market Equilibrium



D(p') < S(p'); an excess of quantity supplied over quantity demanded.

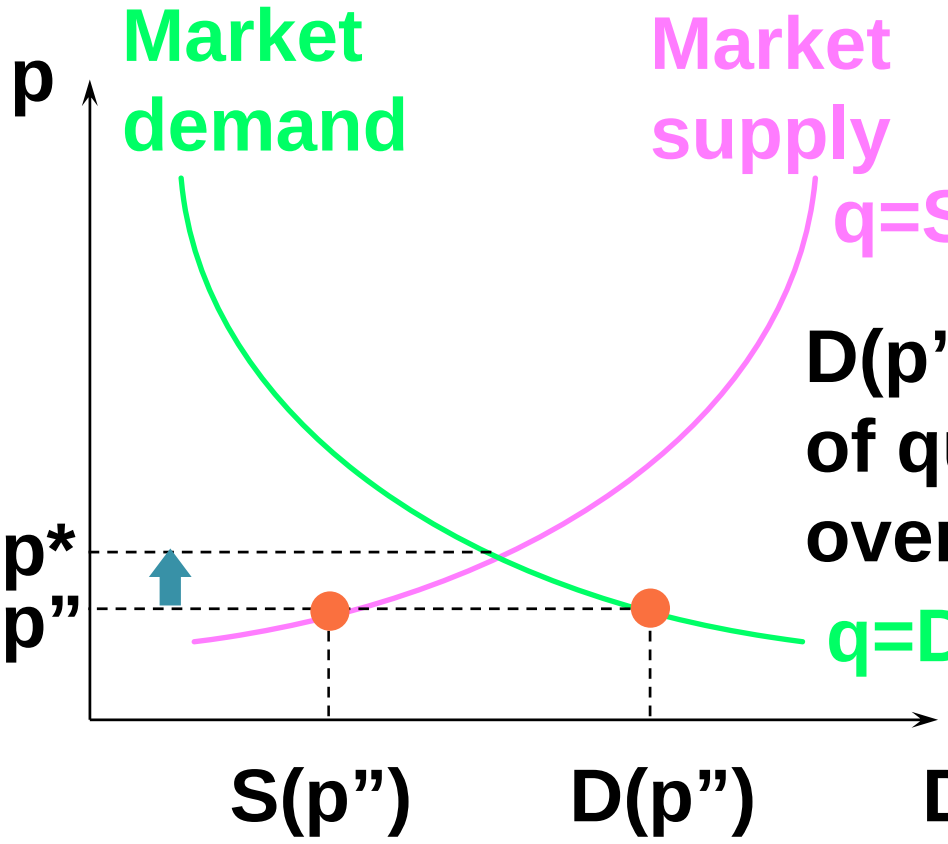
Market price must fall towards p*.

Market Equilibrium



D(p”) > S(p”); an excess of quantity demanded over quantity supplied.

Market Equilibrium



D(p”) > S(p”); an excess of quantity demanded over quantity supplied.

Market price must rise towards p*.

Market Equilibrium

- We can calculate the market equilibrium price and quantity using D(p)=S(p)
- Can we calculate the market equilibrium using the inverse market demand and supply curves?
- Yes, it is the same calculation
- Pd(q)=Ps(q).

Market Equilibrium

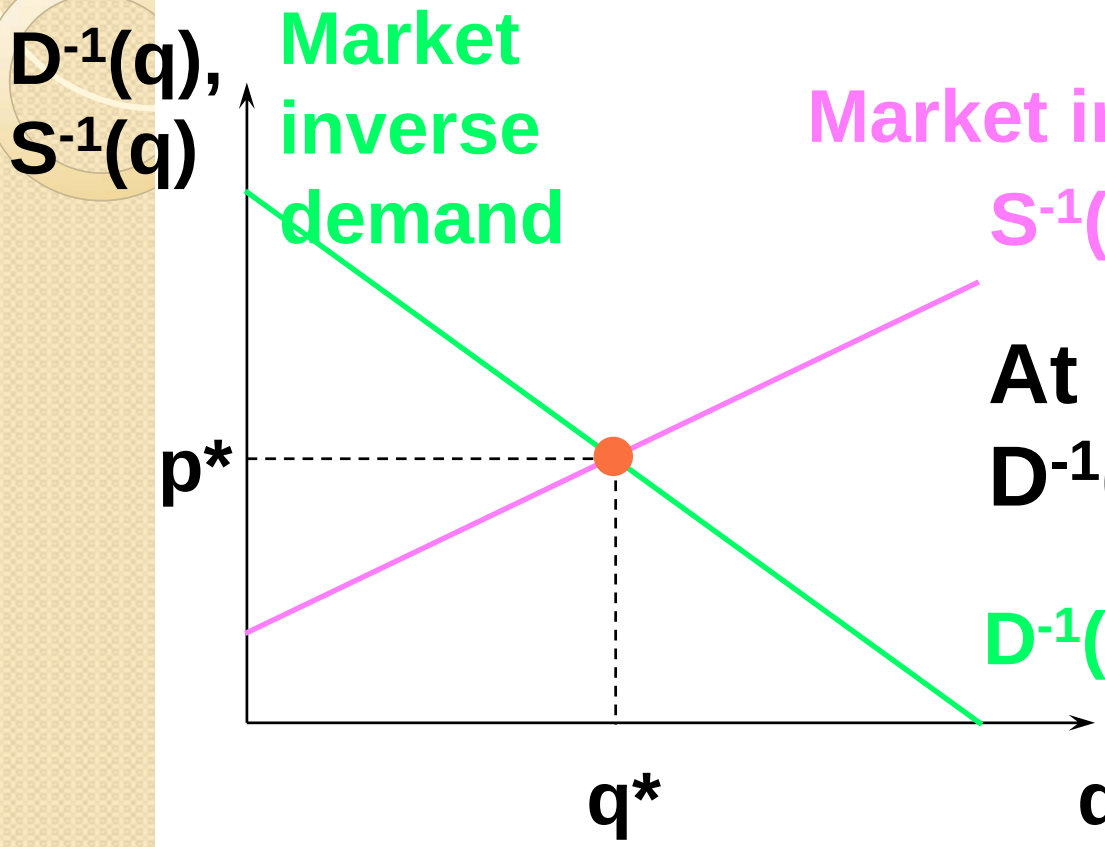
$$q = D(p) = a - bp \Leftrightarrow p = \frac{a-q}{b} = D^{-1}(q),$$

the equation of the inverse market demand curve. And

$$q = S(p) = c + dp \Leftrightarrow p = \frac{-c+q}{d} = S^{-1}(q),$$

the equation of the inverse market supply curve.

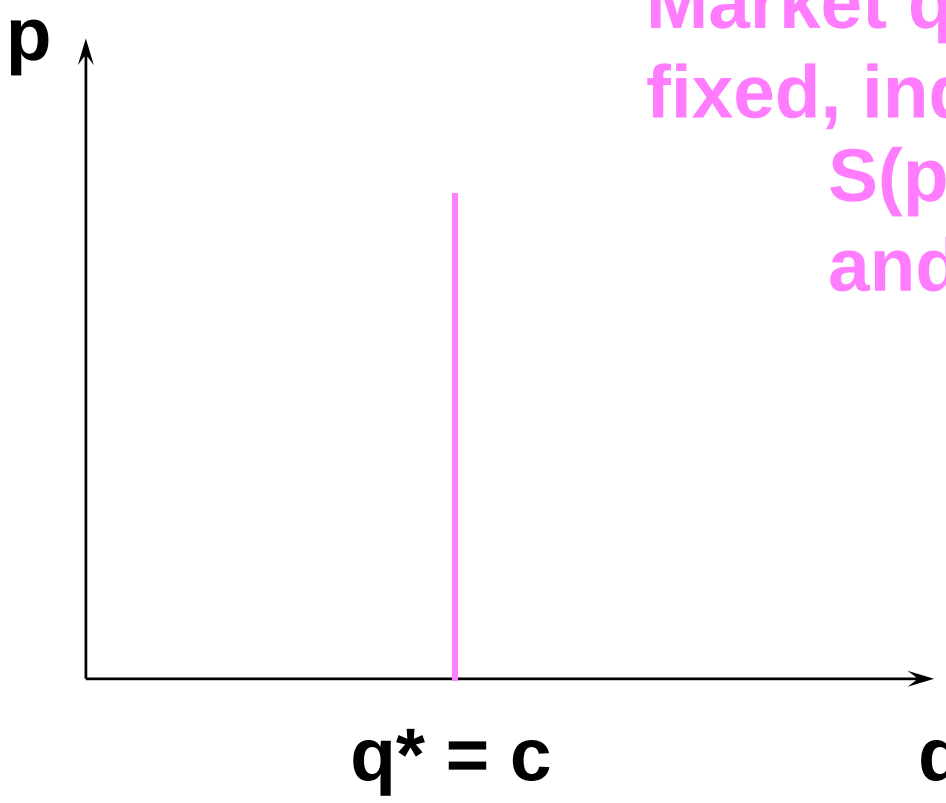
Market Equilibrium



Market Equilibrium

- Two special cases:
  - quantity supplied is fixed, independent of the market price, and
  - quantity supplied is extremely sensitive to the market price.

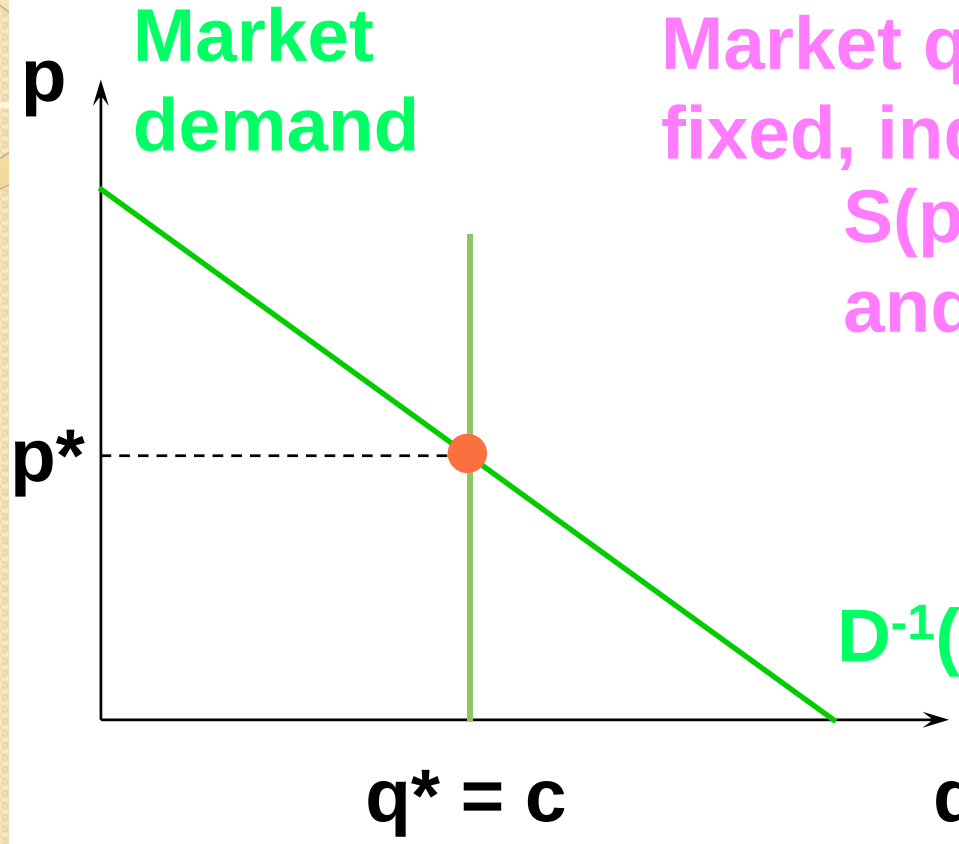
Market Equilibrium



Market quantity supplied is fixed, independent of price.

S(p) = c+dp, so d=0 and S(p) ≡ c.

Market Equilibrium

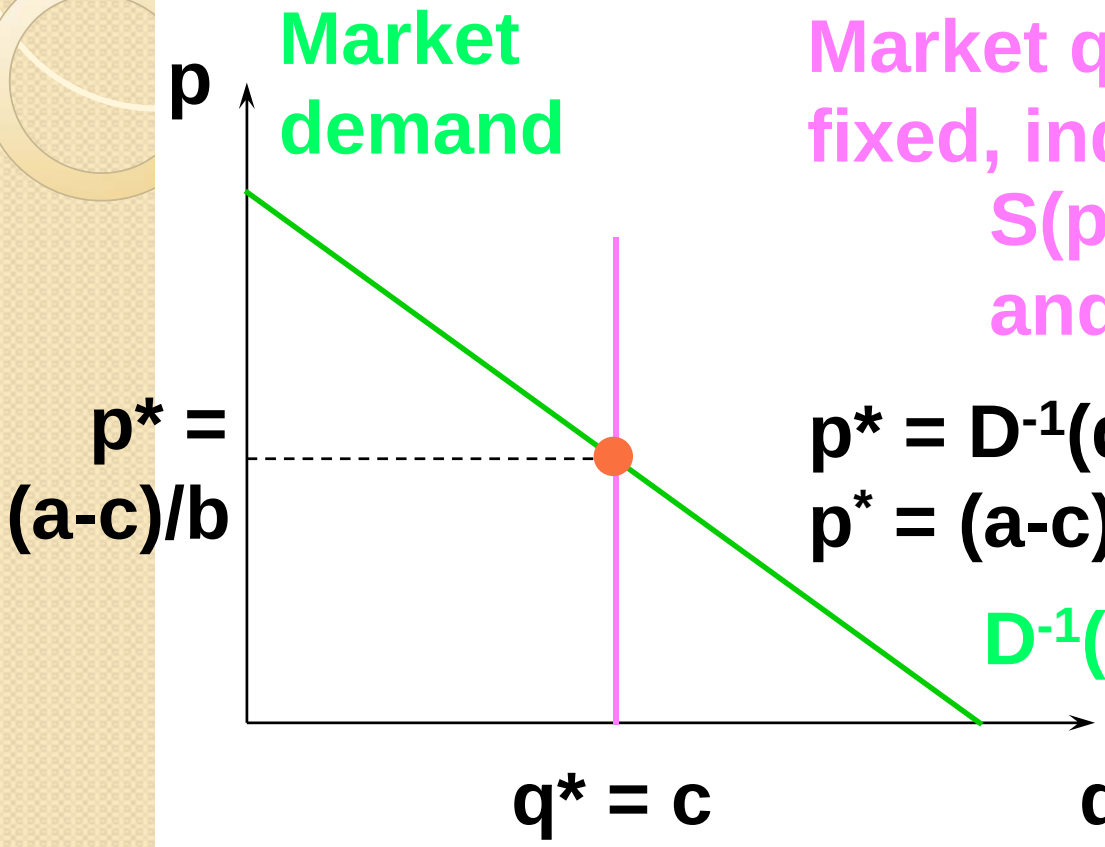


Market quantity supplied is fixed, independent of price.

$S(p) = c+dp$, so $d=0$ and $S(p) \equiv c$.

$D^{-1}(q) = (a-q)/b$

Market Equilibrium



Market quantity supplied is fixed, independent of price.

S(p) = c+dp, so d=0 and S(p) ≡ c.

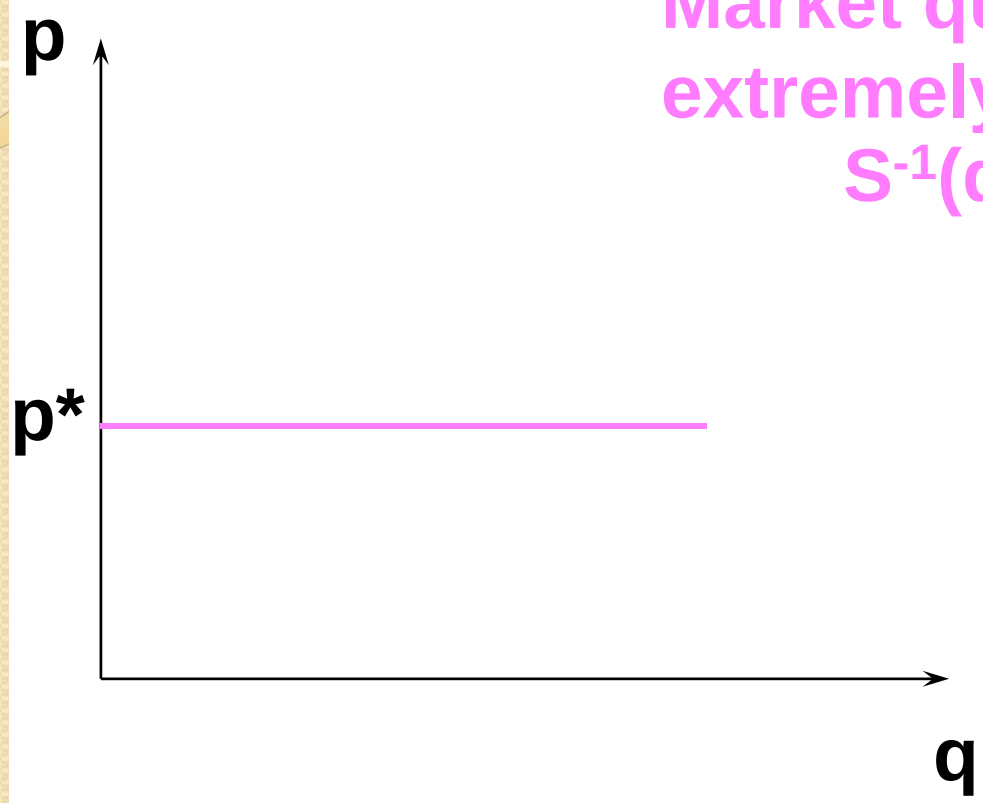
$p^* = D^{-1}(q^*)$; that is, $p^* = (a-c)/b$.

$D^{-1}(q) = (a-q)/b$

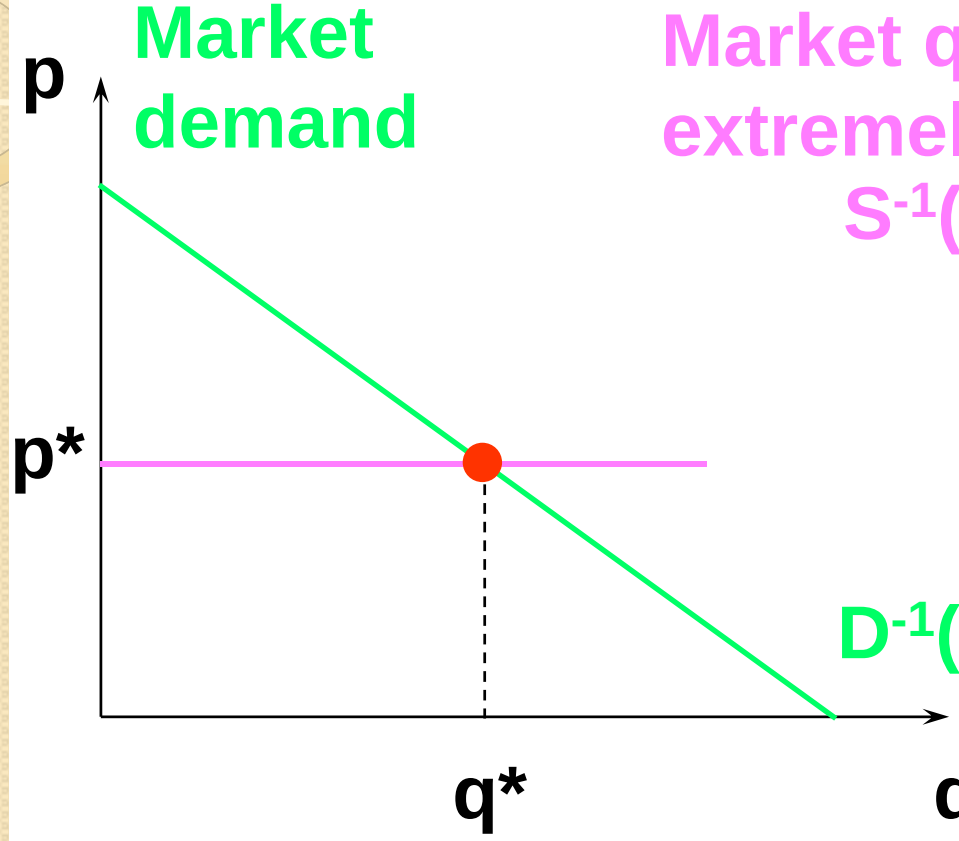
Market Equilibrium

Market quantity supplied is extremely sensitive to price.

$S^{-1}(q) = p^*$.



Market Equilibrium



Market quantity supplied is extremely sensitive to price.

$S^{-1}(q) = p^*$.

$D^{-1}(q) = (a-q)/b$

Comparative Statics

- Shifting demand curves
  - Income
  - Price of other products
- Shifting supply curves
  - Technology
- Taxes

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.
- If the tax is levied on buyers then it is a sales 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.

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

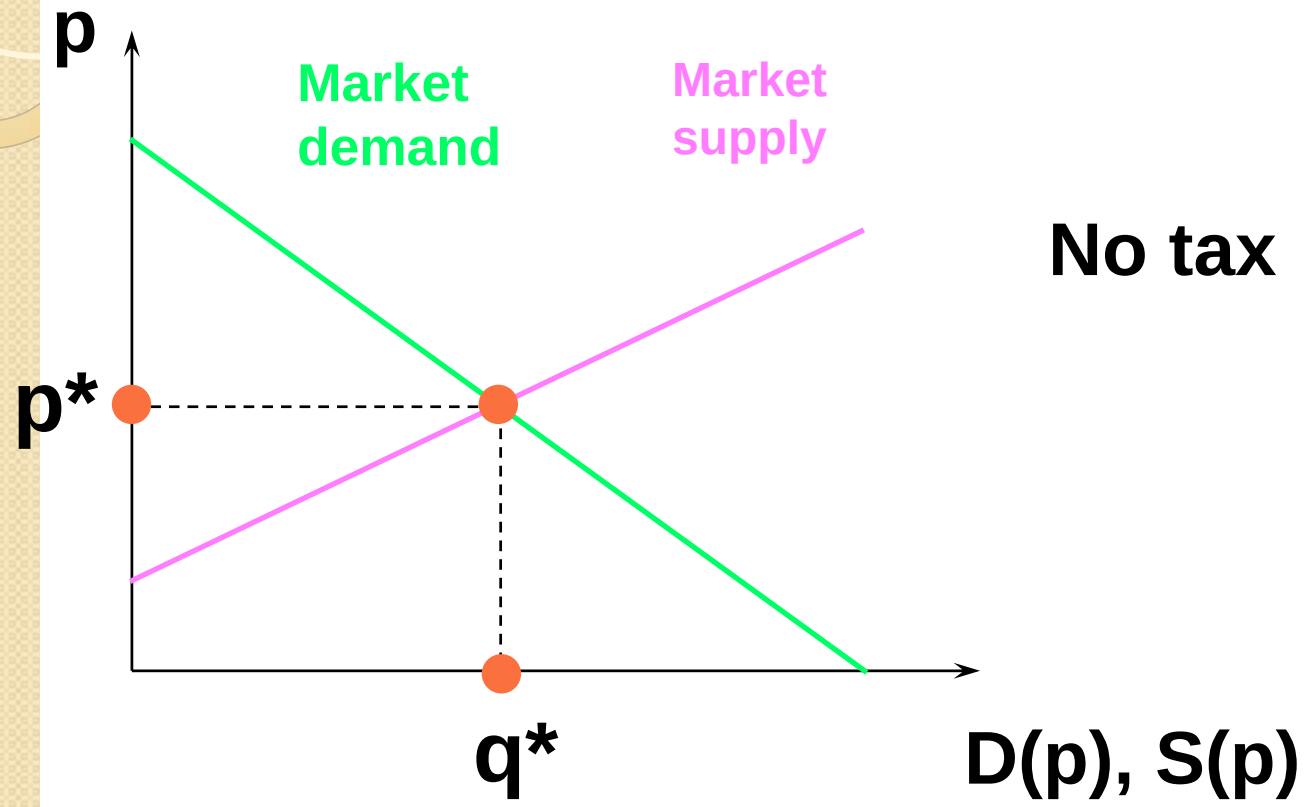
Quantity Taxes

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

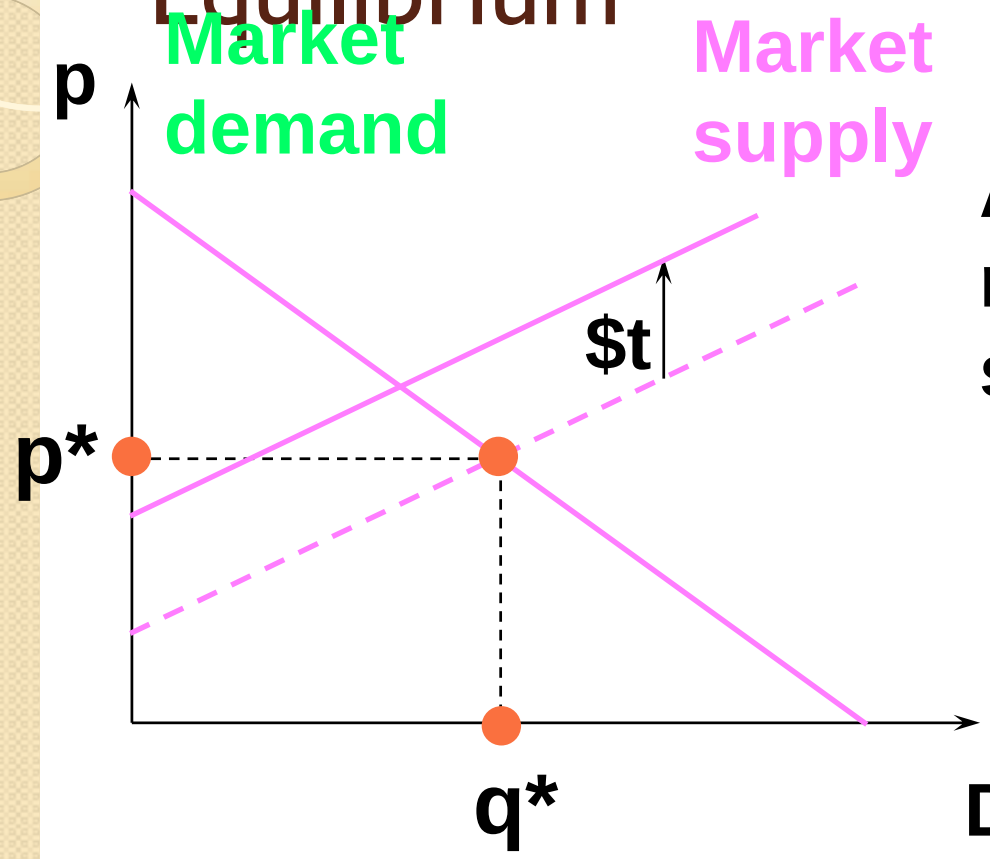
describe the market's equilibrium. Notice that these two conditions apply no matter if the tax is levied on sellers or on buyers.

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

Quantity Taxes & Market Equilibrium

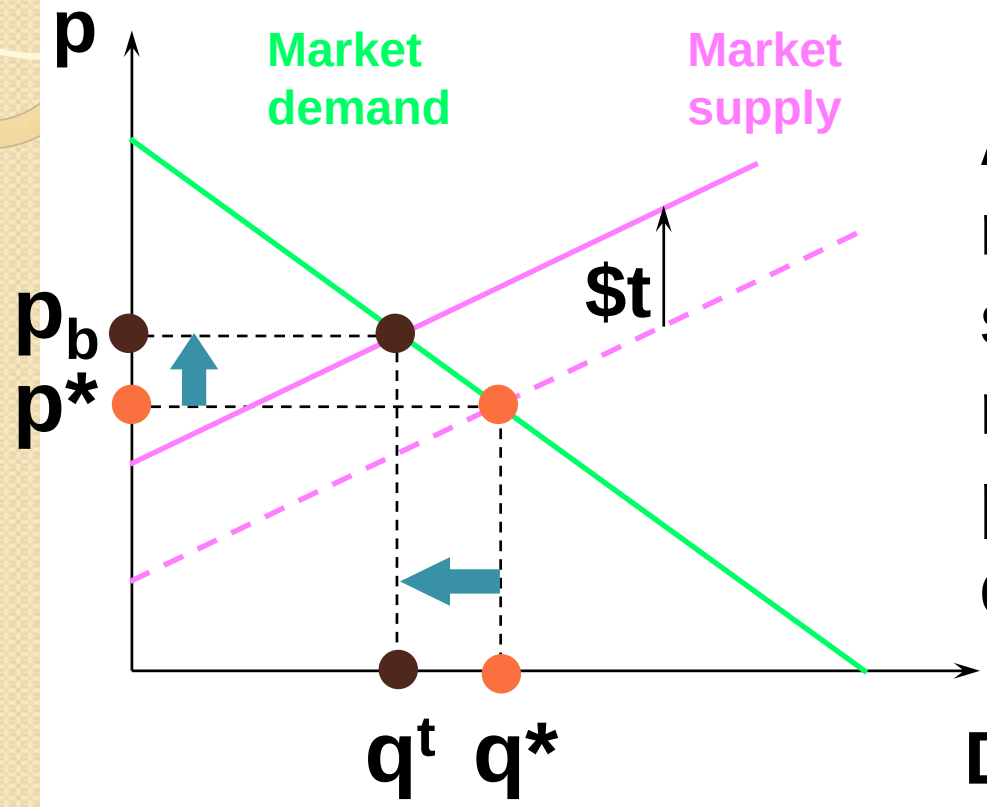


Quantity Taxes & Market Equilibrium



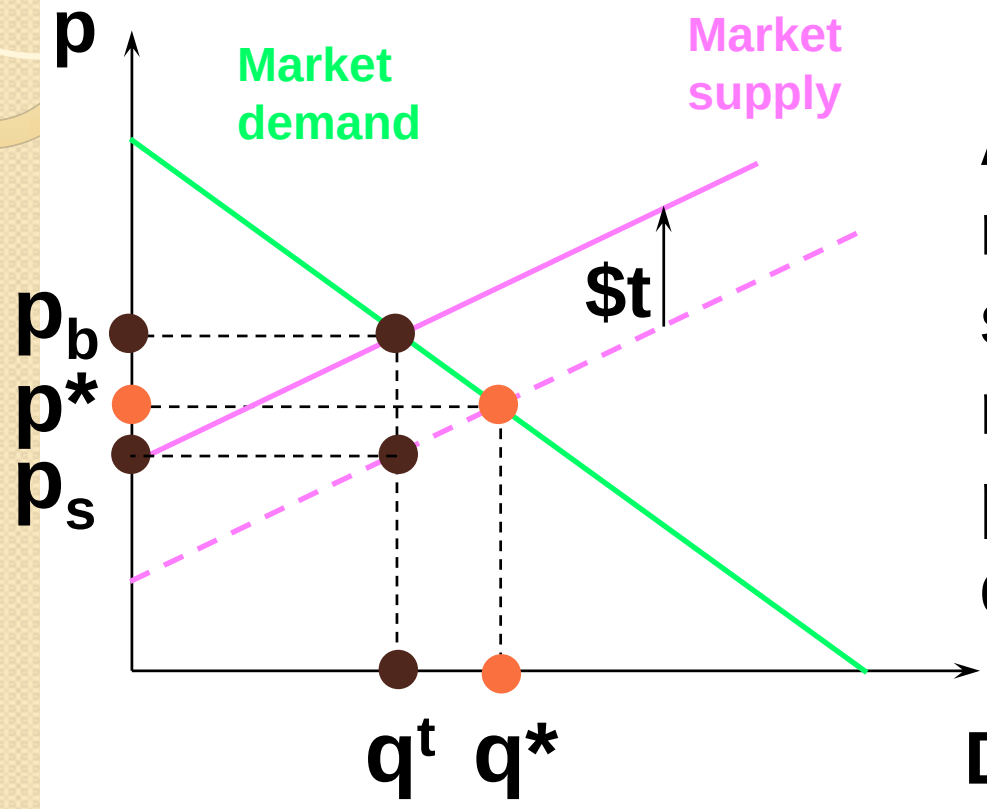
An excise tax raises the market supply curve by $t

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

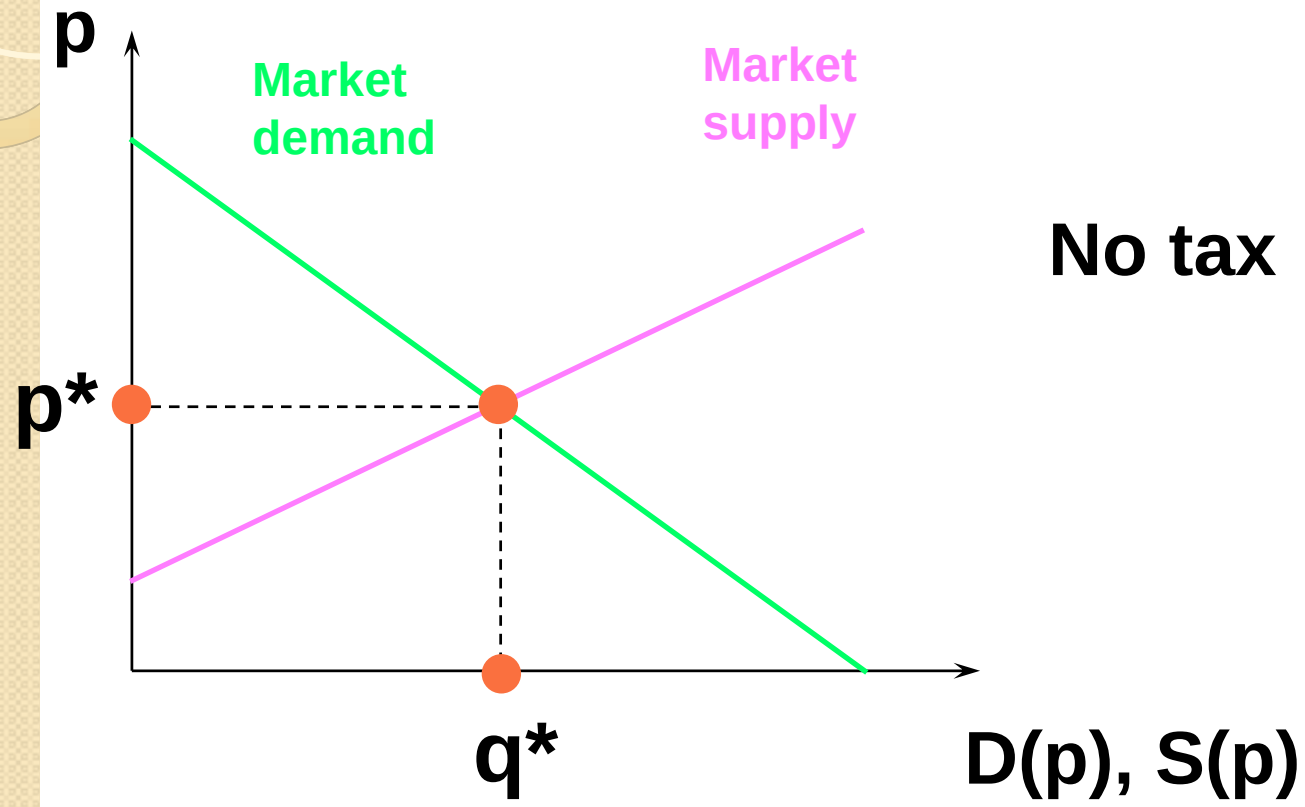


An excise tax raises the market supply curve by $t, raises the buyers' price and lowers the quantity traded.

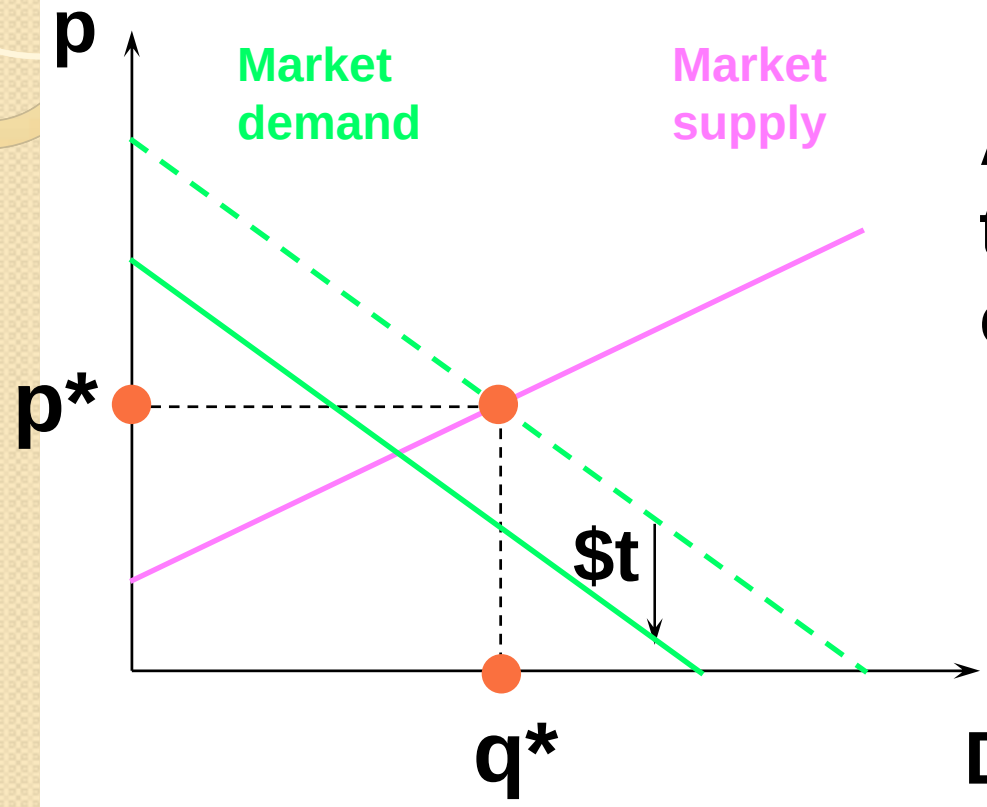
D(p), S(p)

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

Quantity Taxes & Market Equilibrium

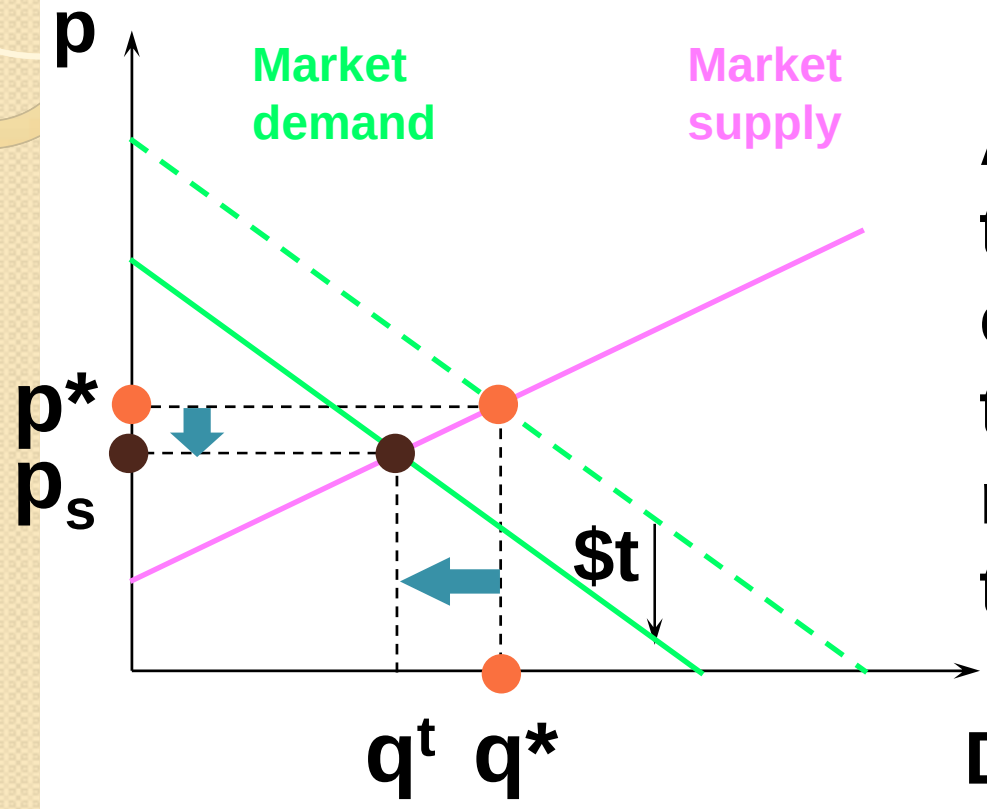


Quantity Taxes & Market Equilibrium



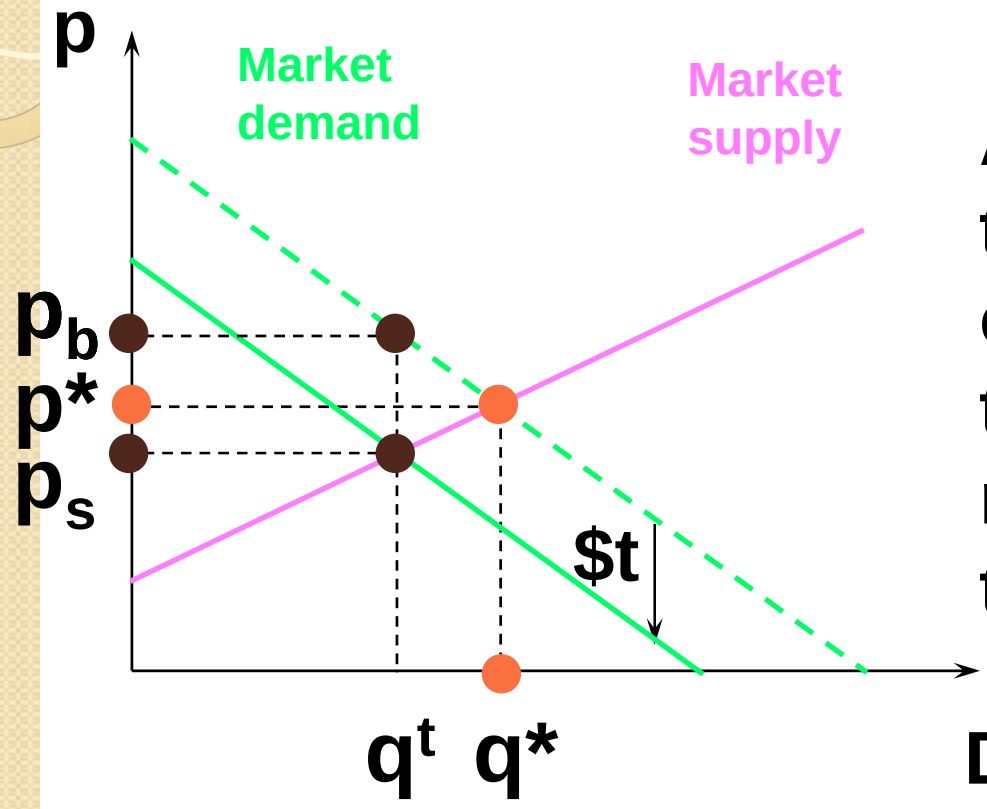
An sales tax lowers the market demand curve by $t

Quantity Taxes & Market Equilibrium



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

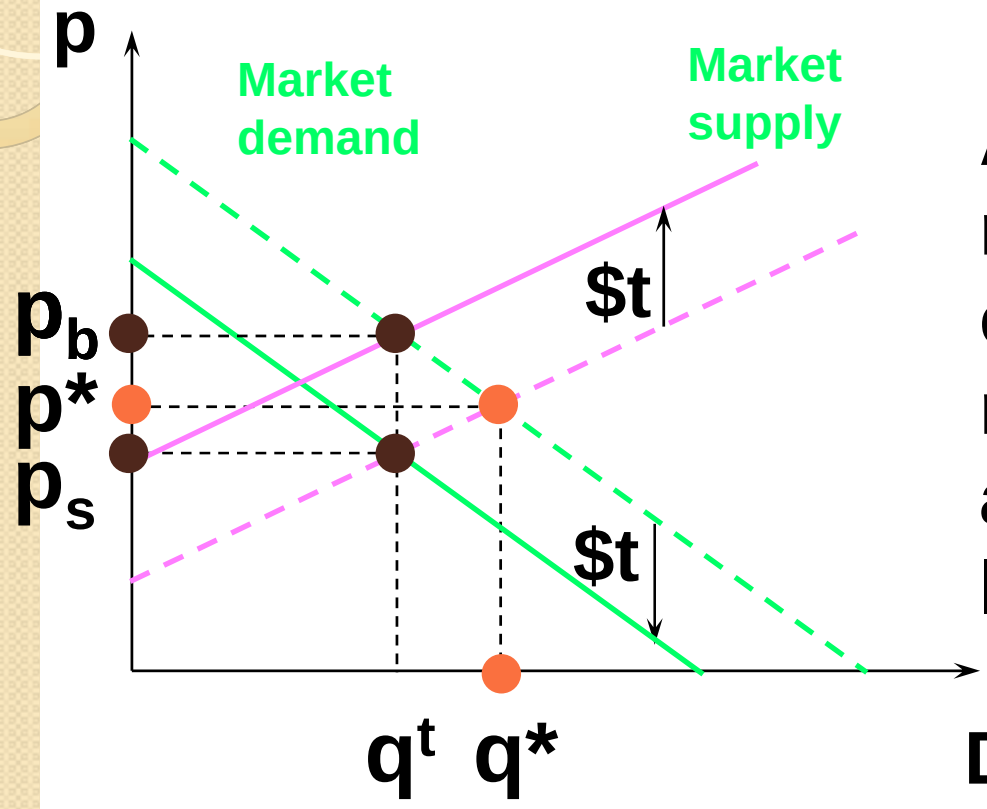
Quantity Taxes & Market Equilibrium



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

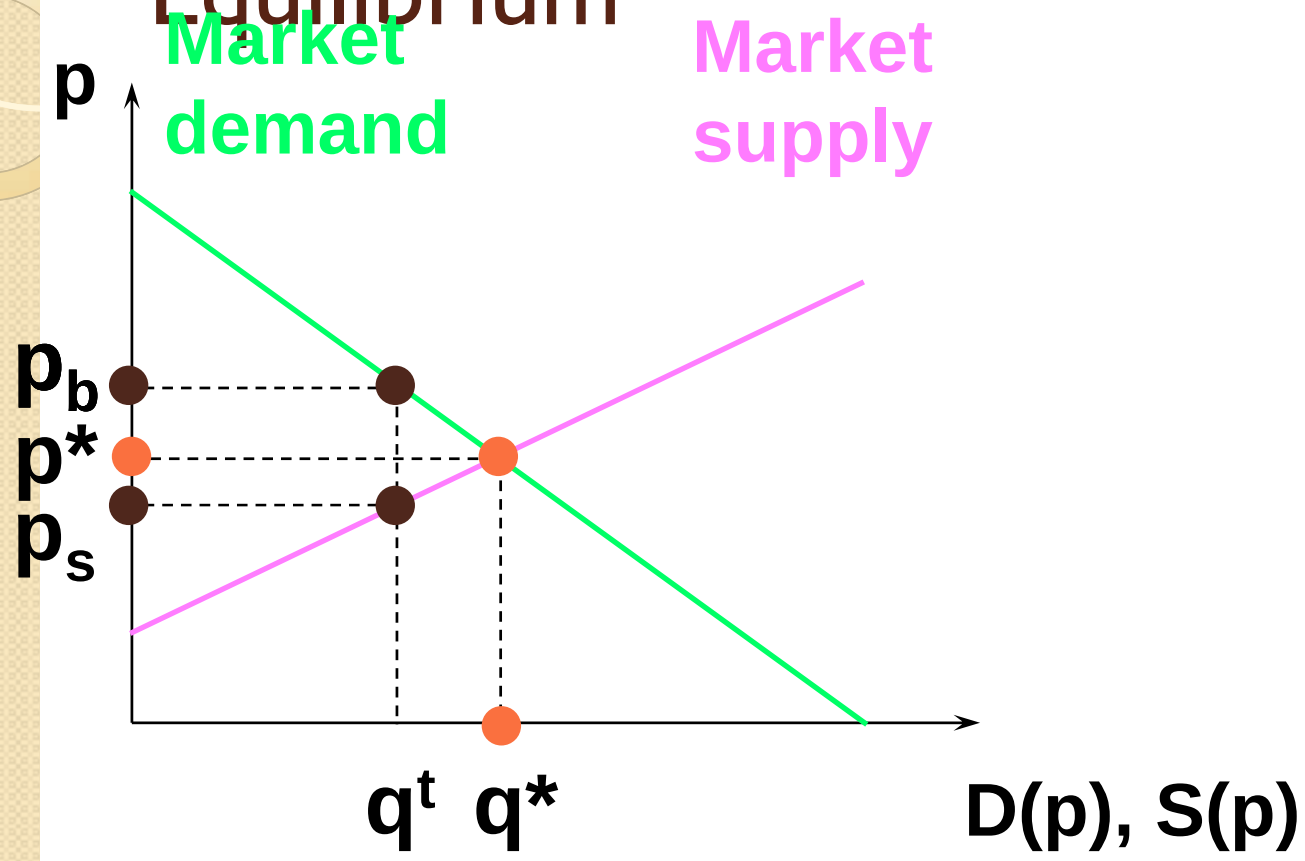


A sales tax levied at rate $t has the same effects on the market's equilibrium as does an excise tax levied at rate $t.

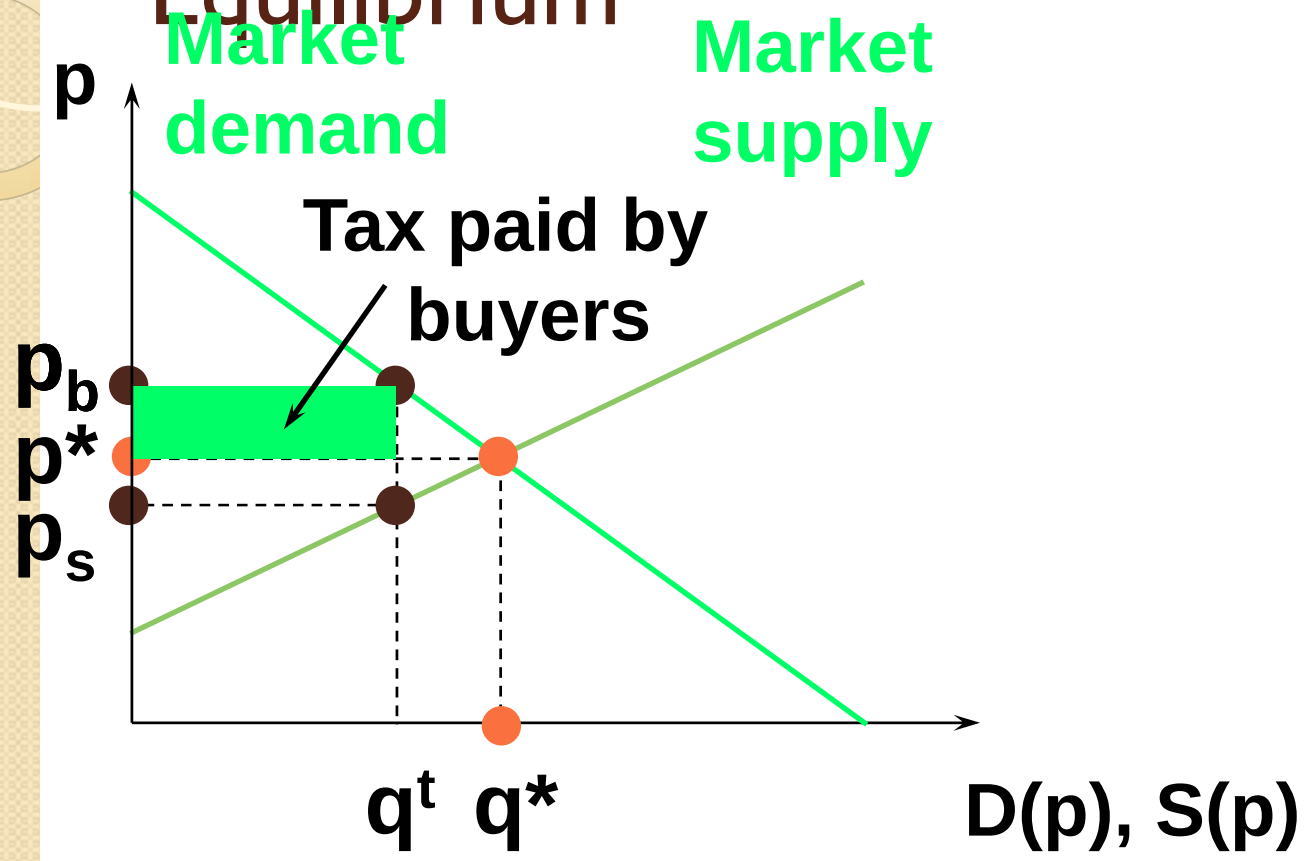
Quantity Taxes & Market Equilibrium

- Who pays the tax of $t per unit traded?
- The division of the $t between buyers and sellers is the incidence of the tax
- The incidence of a quantity tax depends upon the own-price elasticities of demand and supply

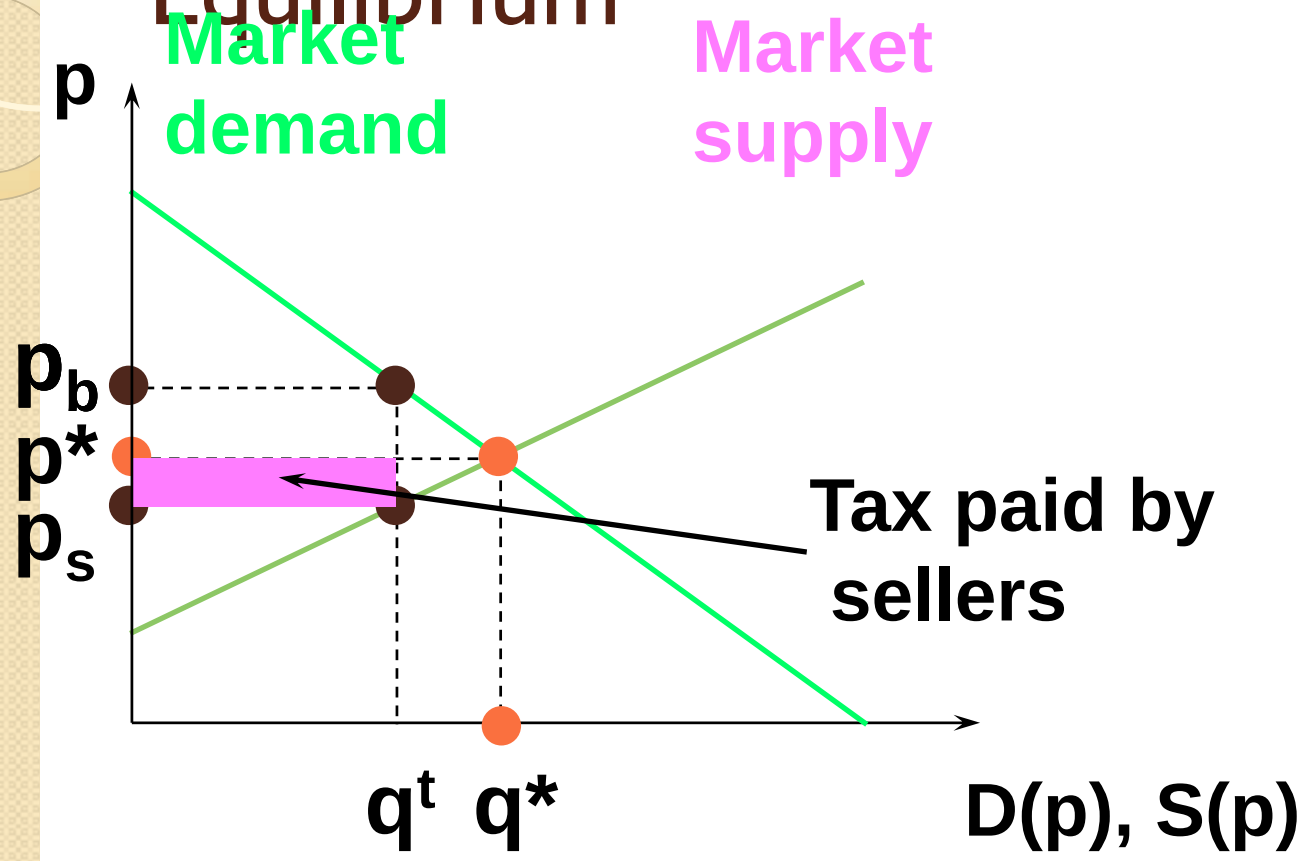
Quantity Taxes & Market Equilibrium



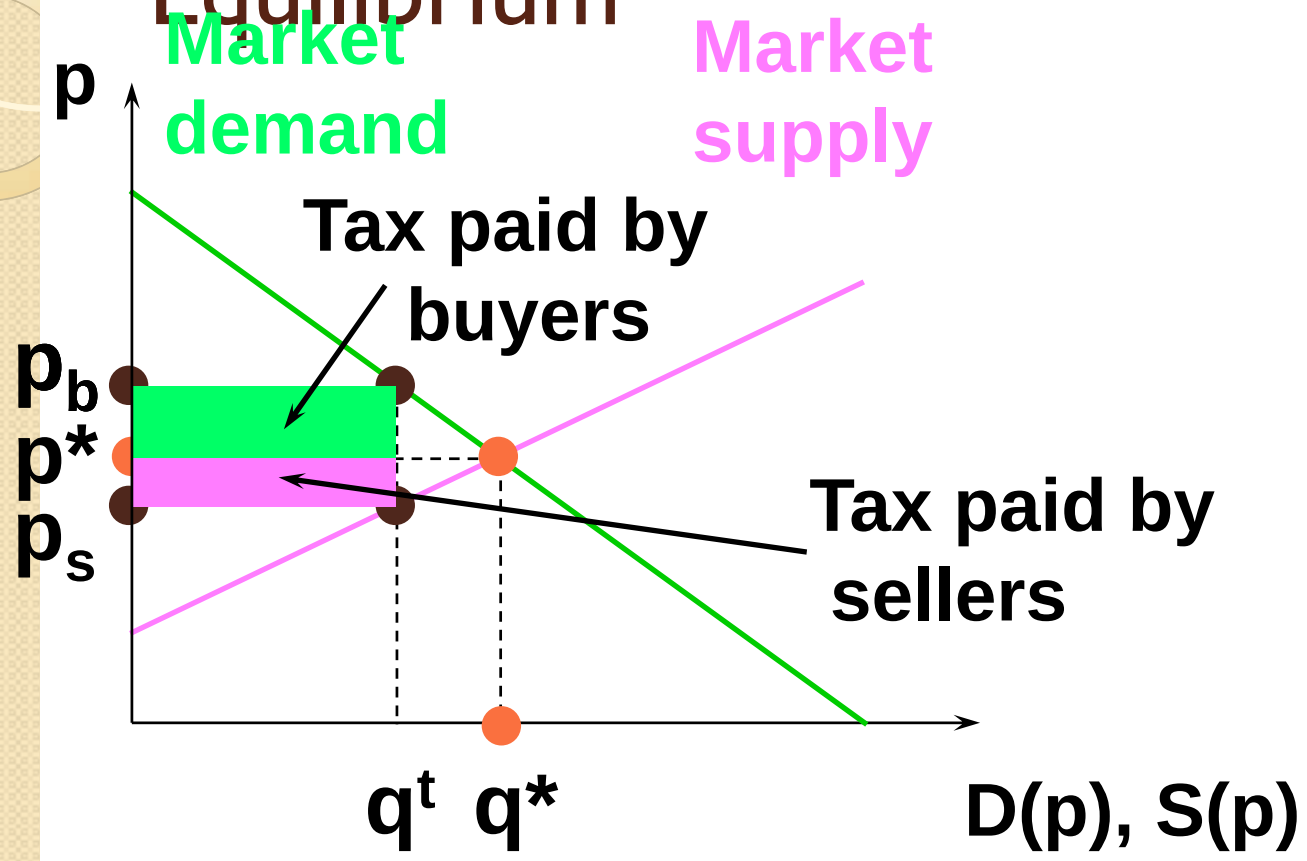
Quantity Taxes & Market Equilibrium



Quantity Taxes & Market Equilibrium



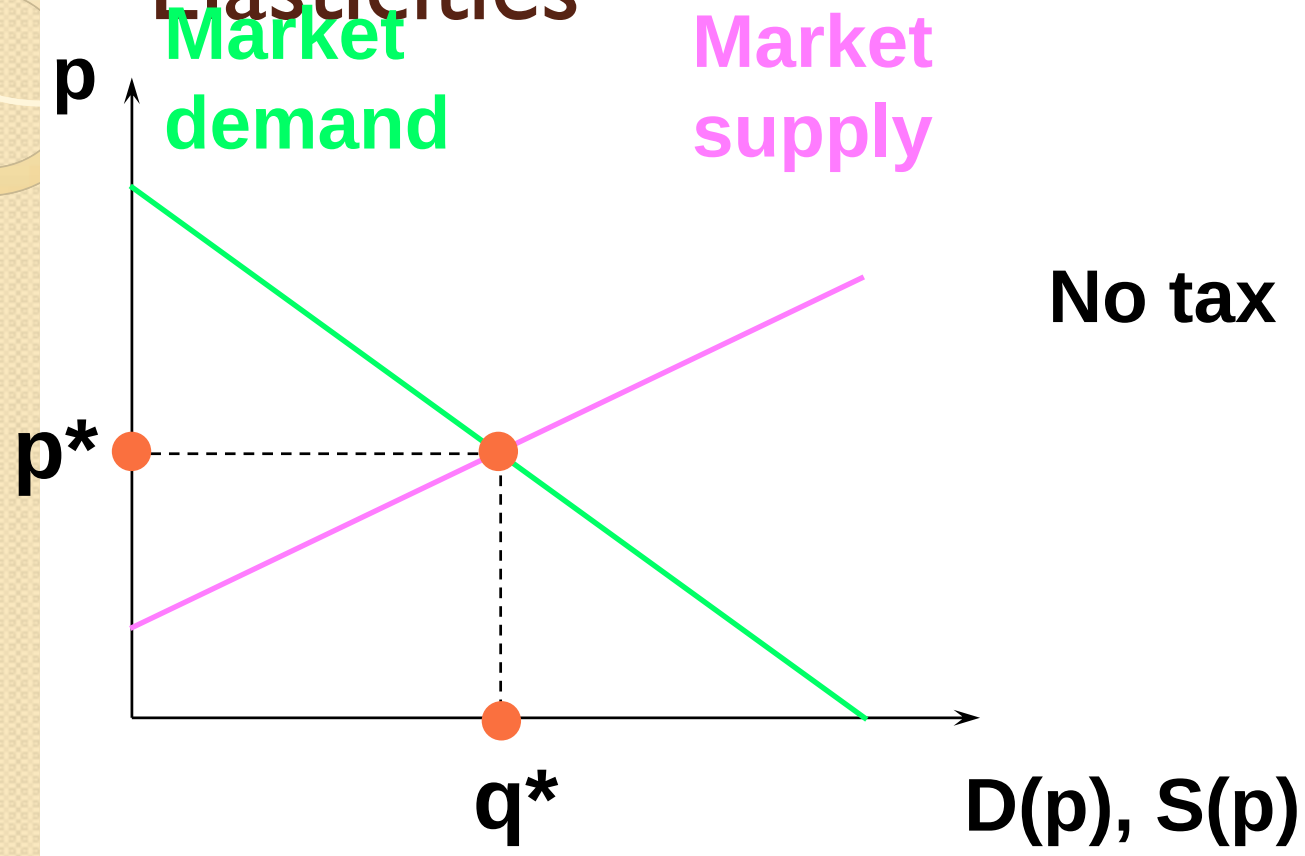
Quantity Taxes & Market Equilibrium



Deadweight Loss and Own-Price Elasticities

- A quantity tax imposed on a competitive market reduces the quantity traded and so reduces gains-to-trade (*i.e.* the sum of Consumers' and Producers' Surpluses).
- The lost total surplus is the tax's deadweight loss, or excess burden.

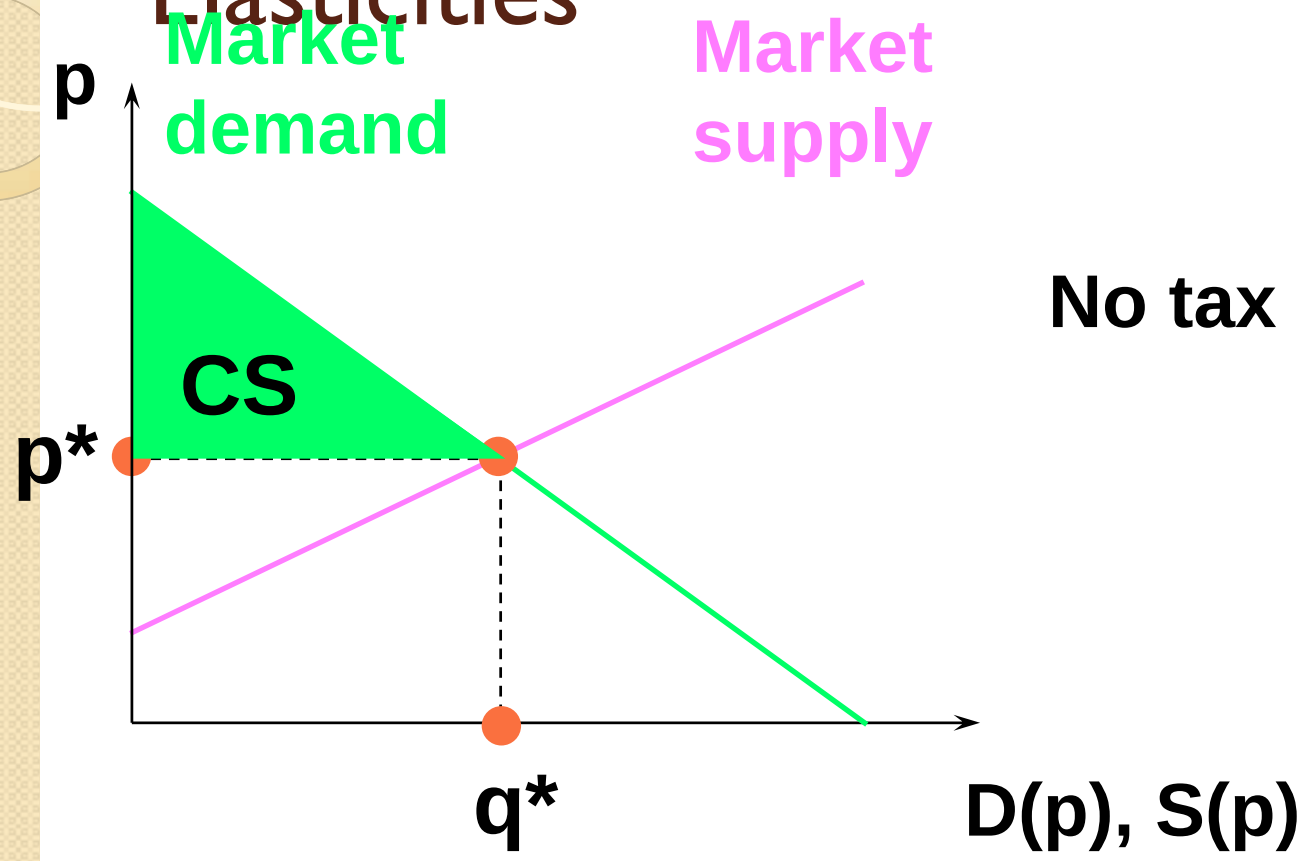
Deadweight Loss and Own-Price Elasticities



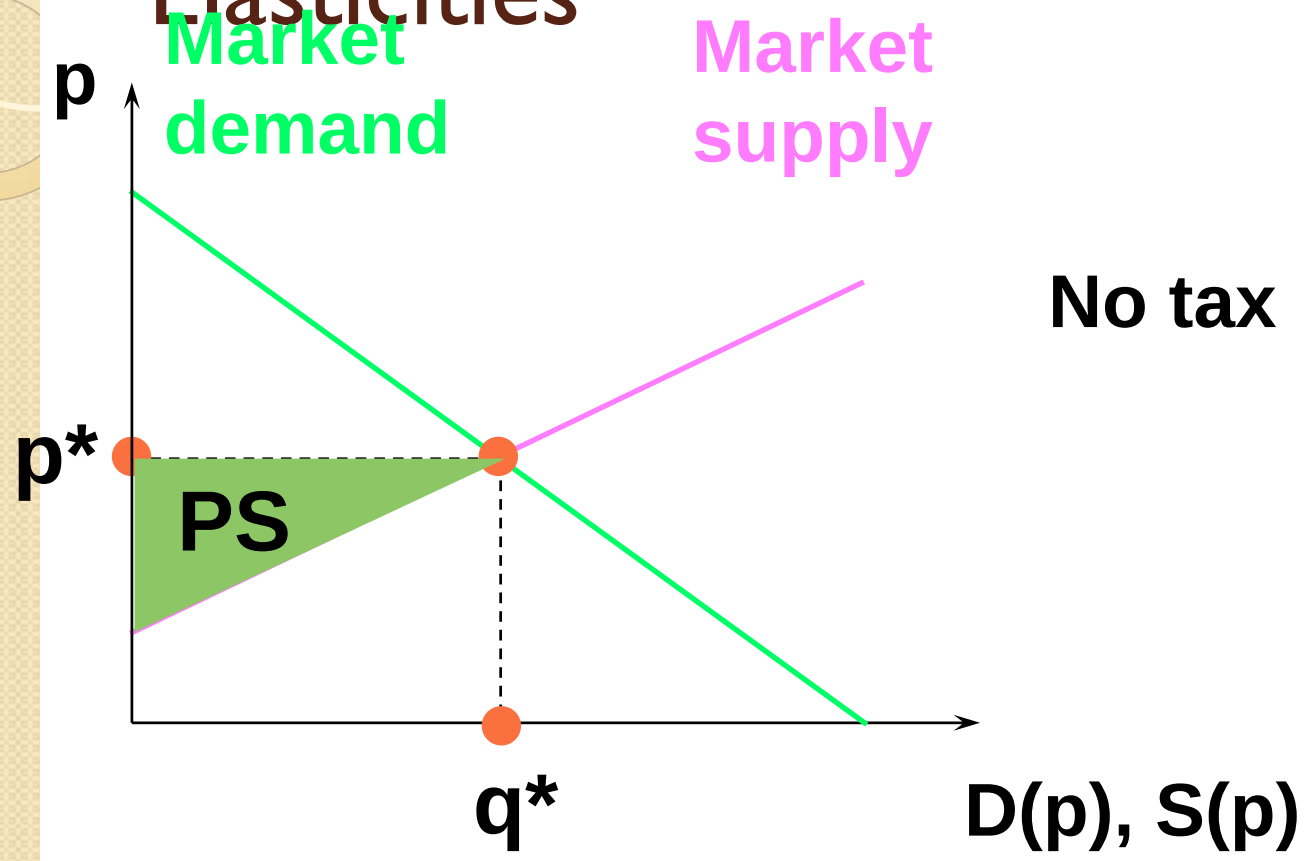
Pareto Efficiency

- At the market equilibrium q* we have a Pareto efficient outcome: at q*, the willingness to pay for an extra unit is just equal to the willingness to supply an extra unit at that price
- Q* maximizes the social welfare (CS+PS)

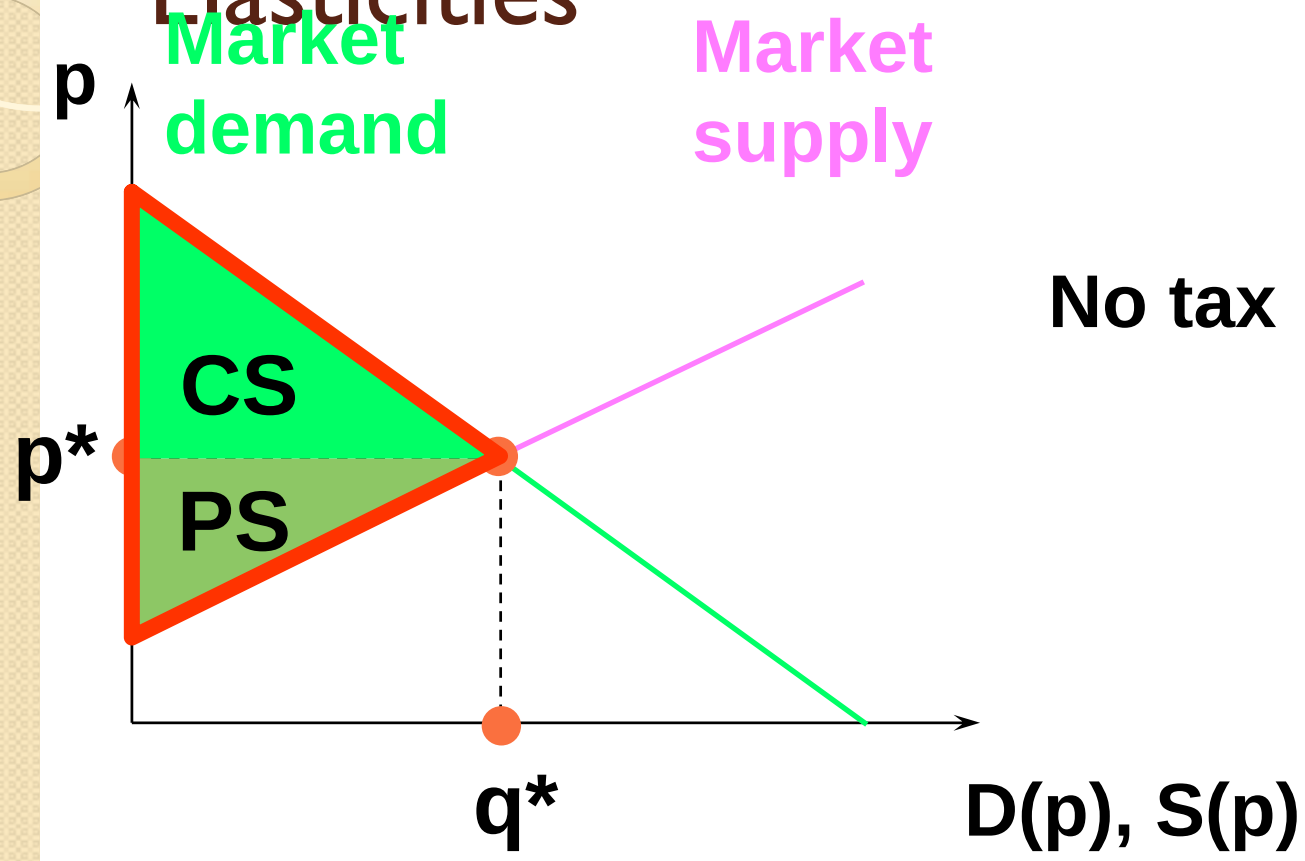
Deadweight Loss and Own-Price Elasticities



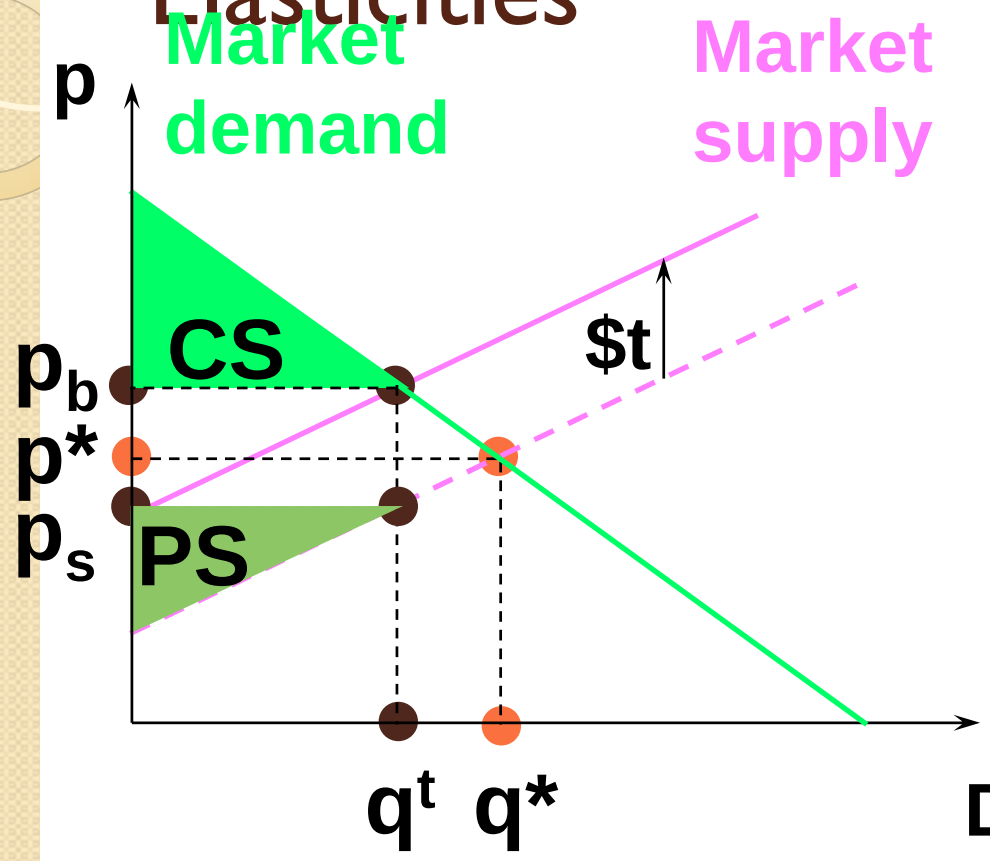
Deadweight Loss and Own-Price Elasticities



Deadweight Loss and Own-Price Elasticities

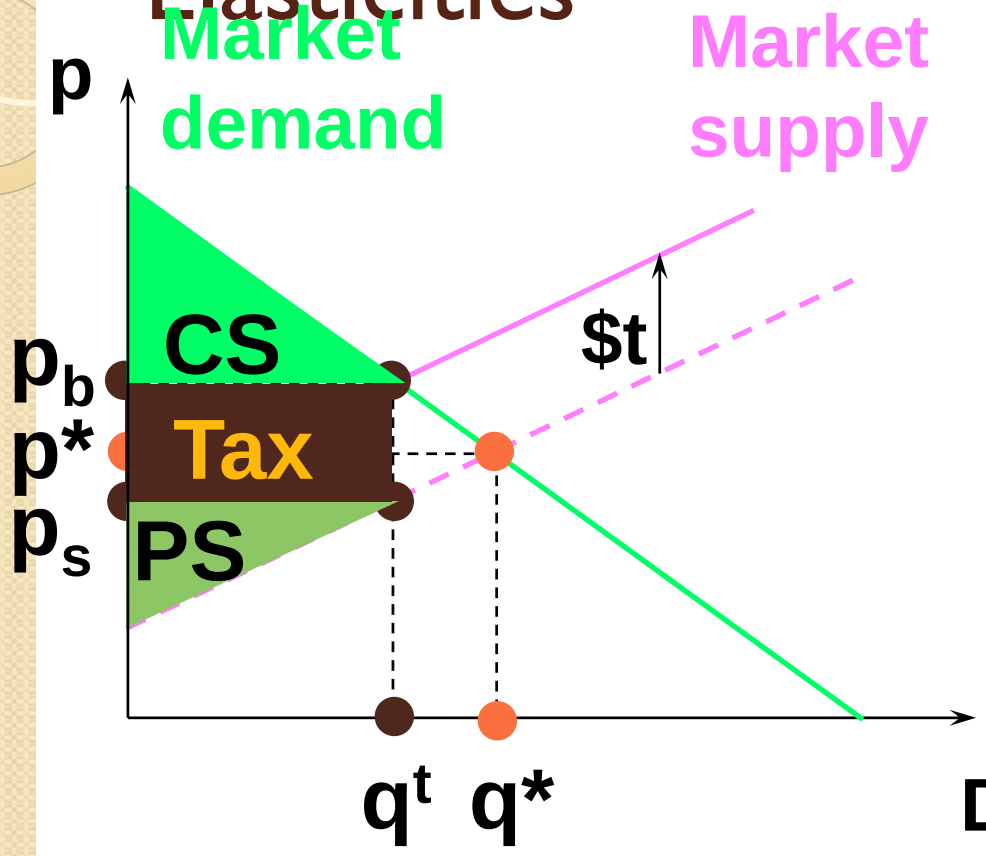


Deadweight Loss and Own-Price Elasticities



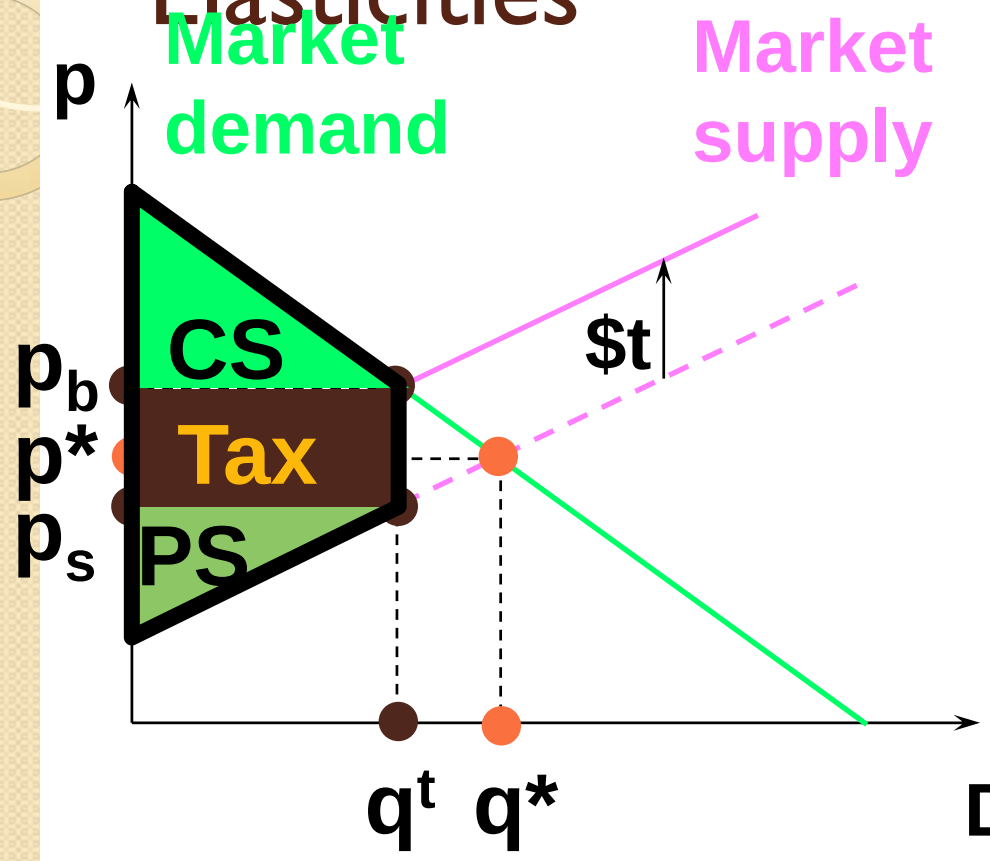
The tax reduces both CS and PS

Deadweight Loss and Own-Price Elasticities



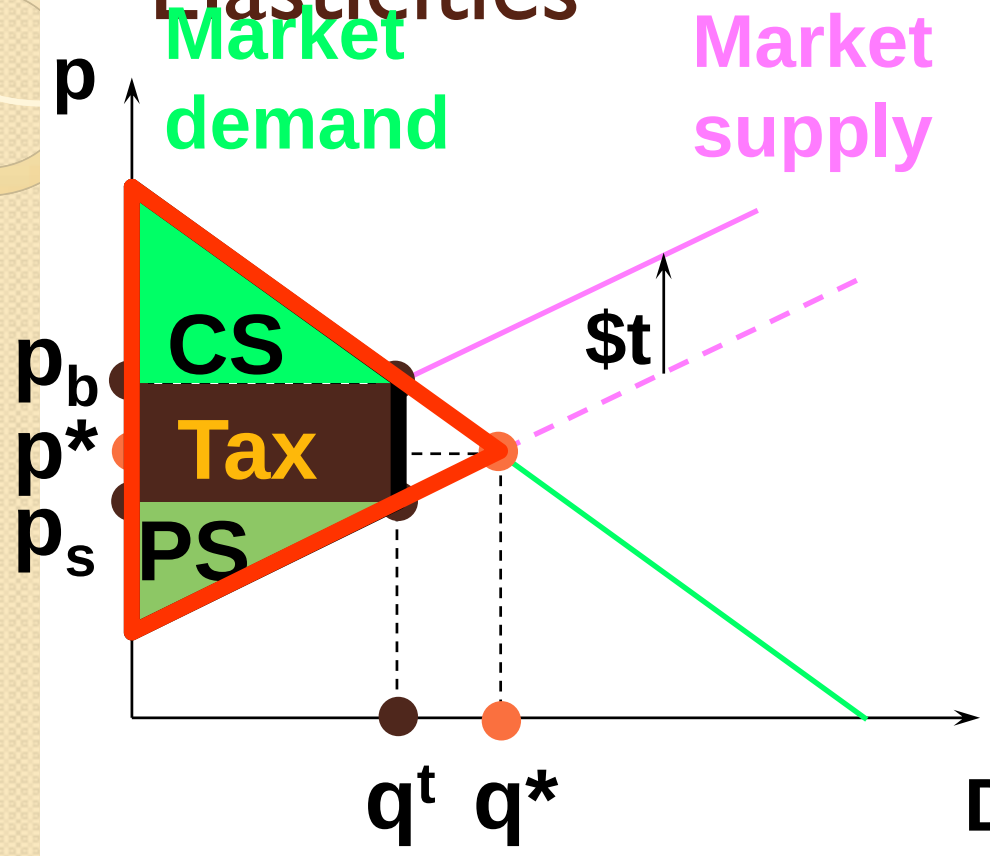
The tax reduces both CS and PS, transfers surplus to government

Deadweight Loss and Own-Price Elasticities



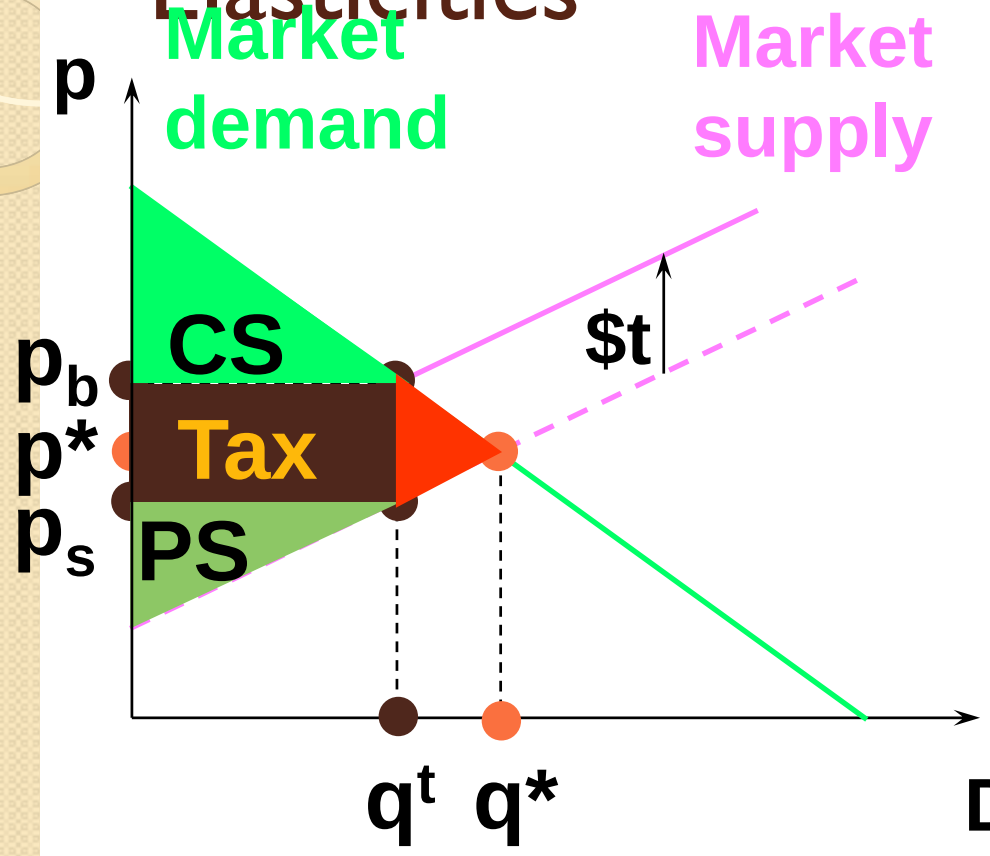
The tax reduces both CS and PS, transfers surplus to government

Deadweight Loss and Own-Price Elasticities



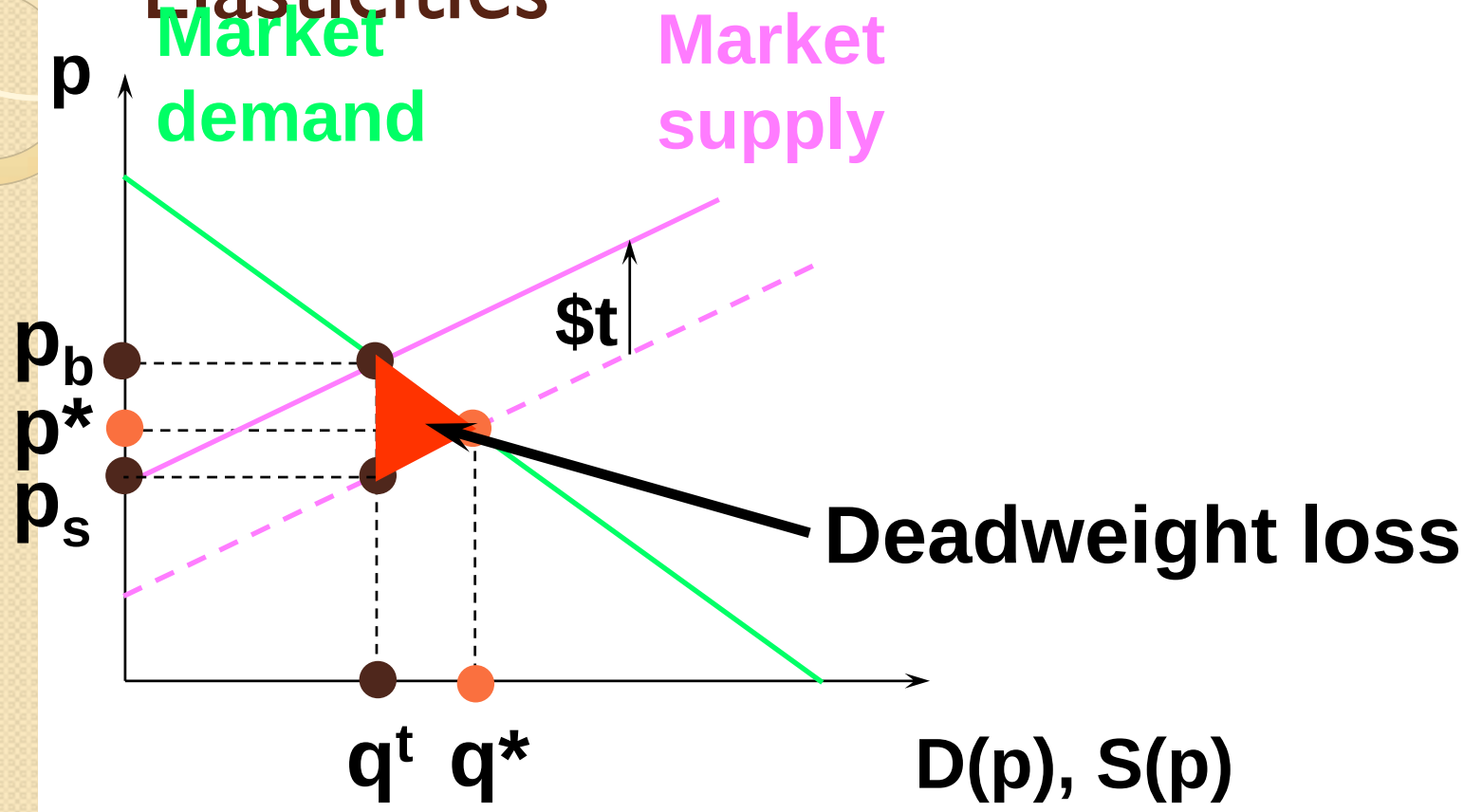
The tax reduces both CS and PS, transfers surplus to government

Deadweight Loss and Own-Price Elasticities

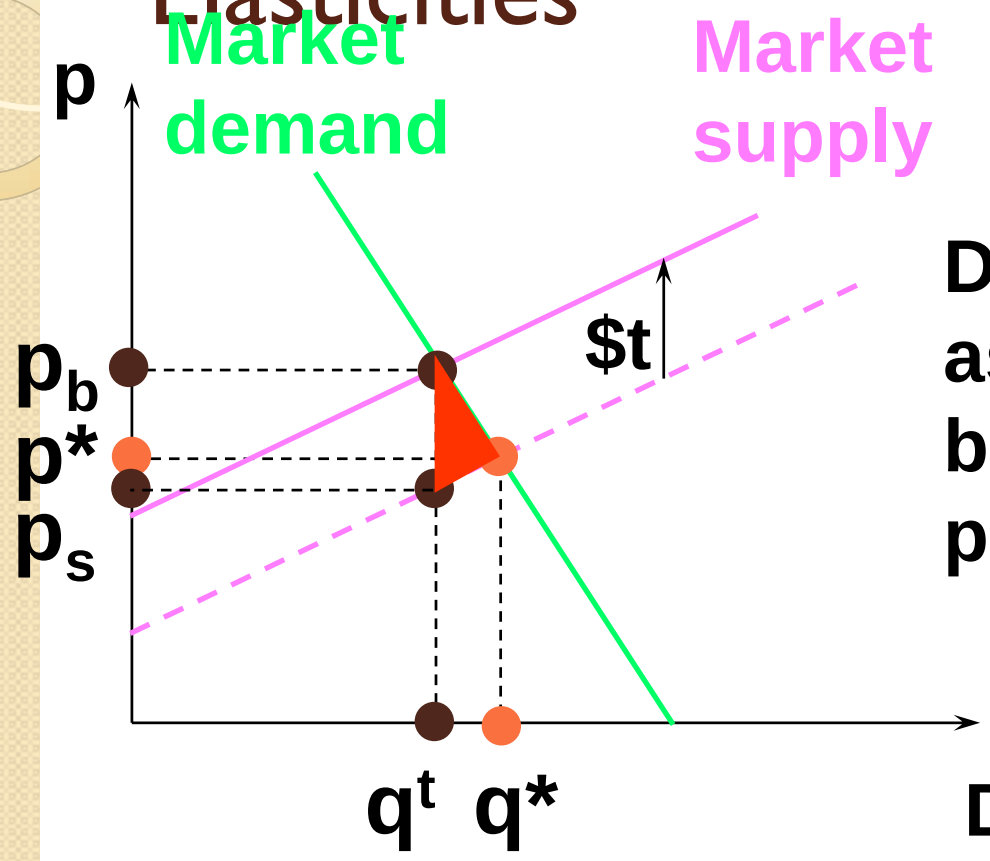


The tax reduces both CS and PS, transfers surplus to government, and lowers total surplus.

Deadweight Loss and Own-Price Elasticities

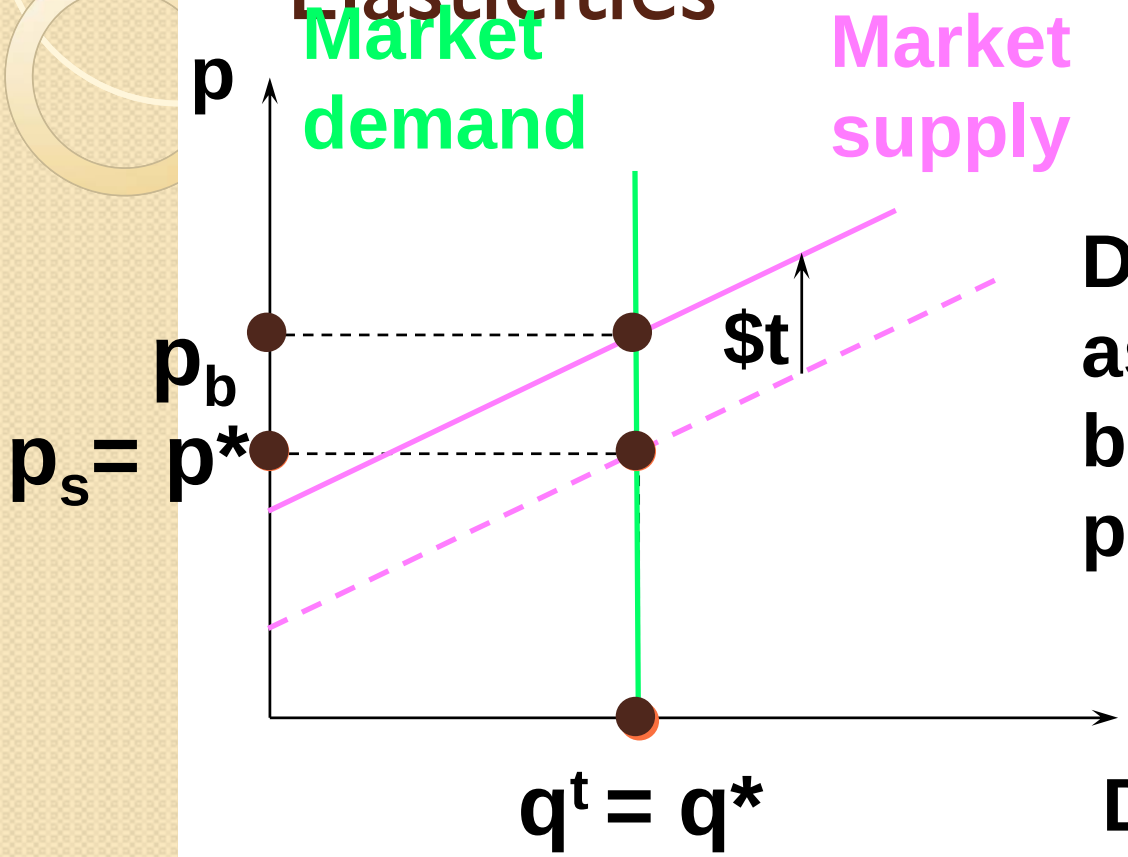


Deadweight Loss and Own-Price Elasticities



Deadweight loss falls as market demand becomes less own-price elastic.

Deadweight Loss and Own-Price Elasticities



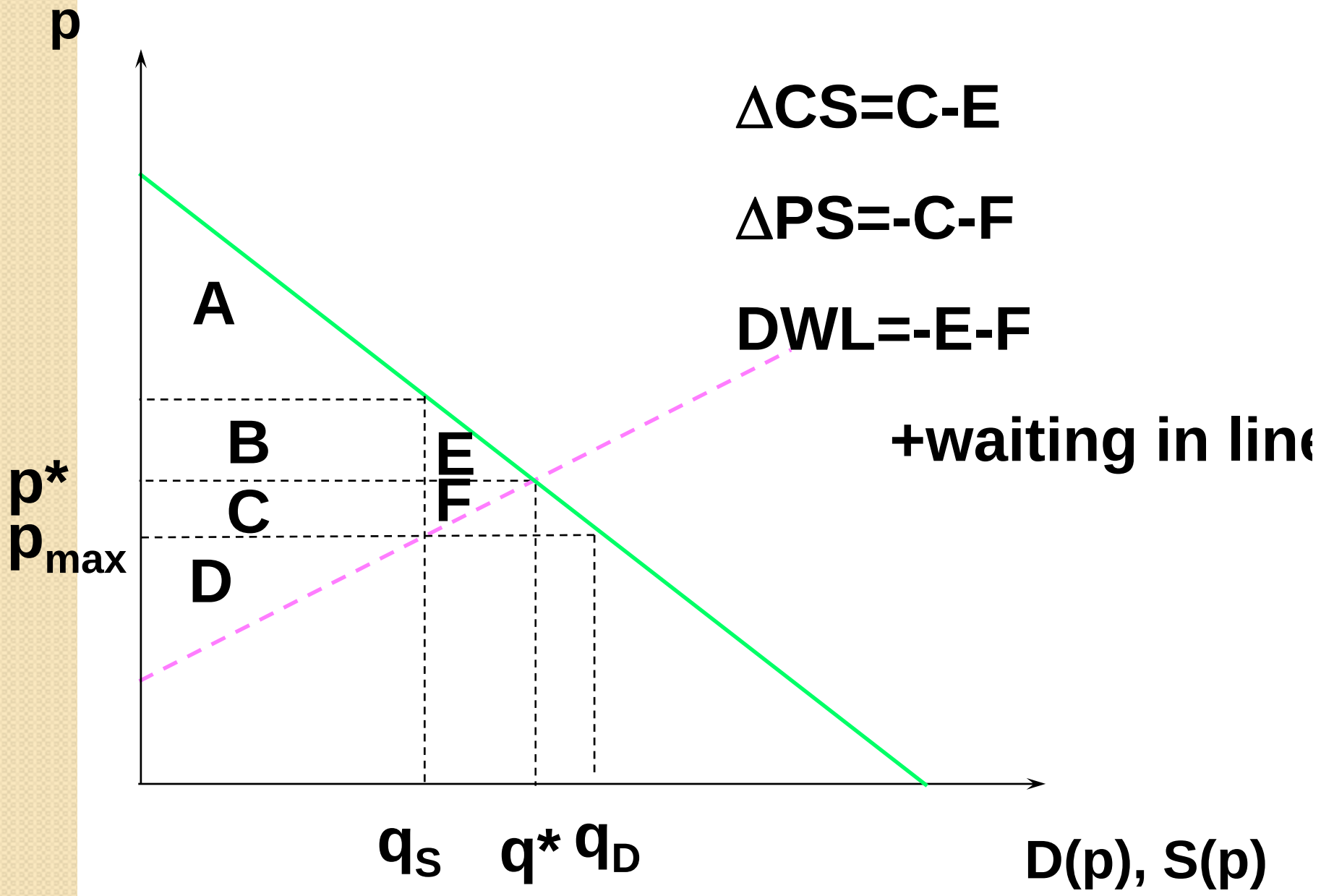
Deadweight loss falls as market demand becomes less own-price elastic.

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

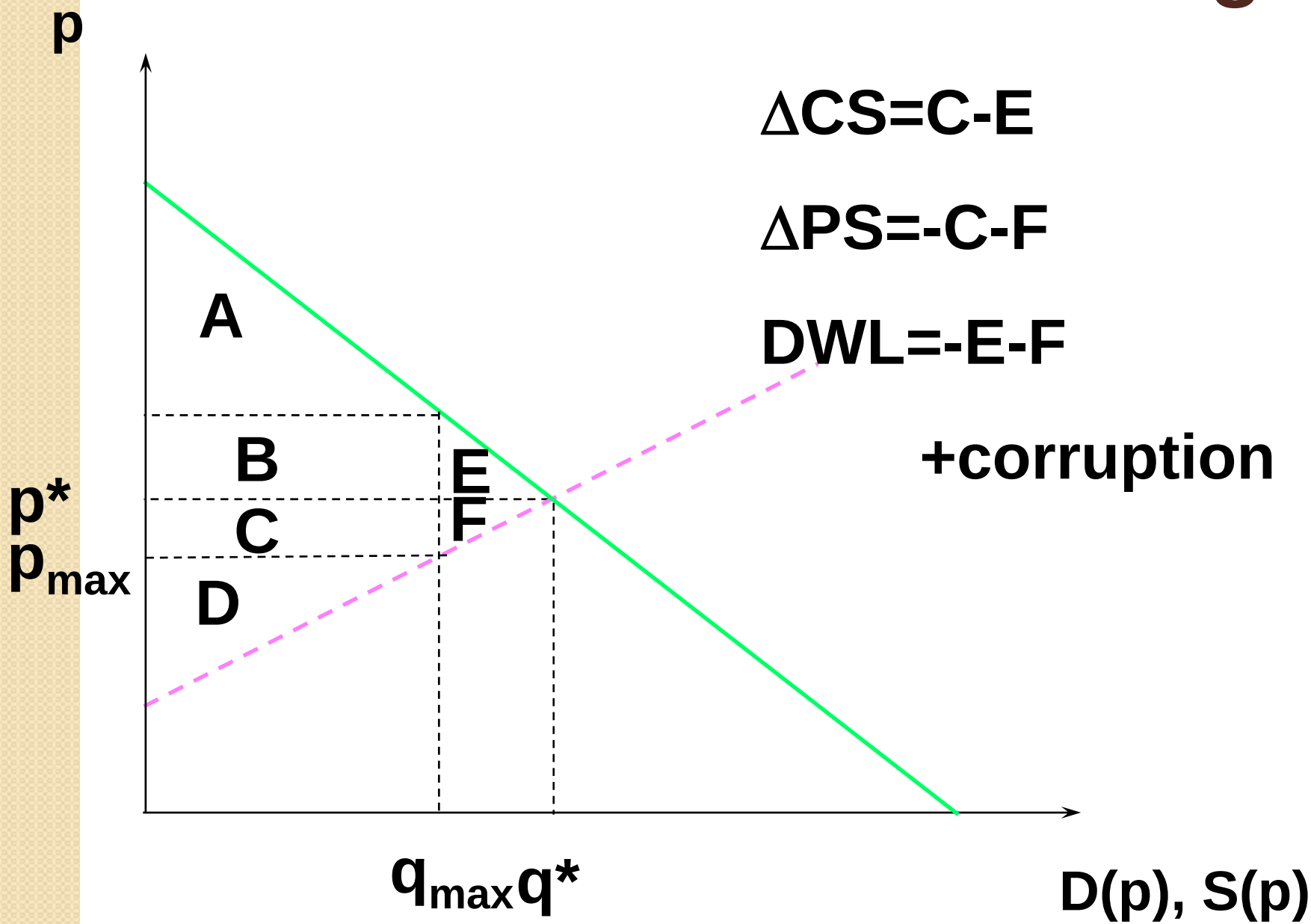
Deadweight Loss and Own-Price Elasticities

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

Price control



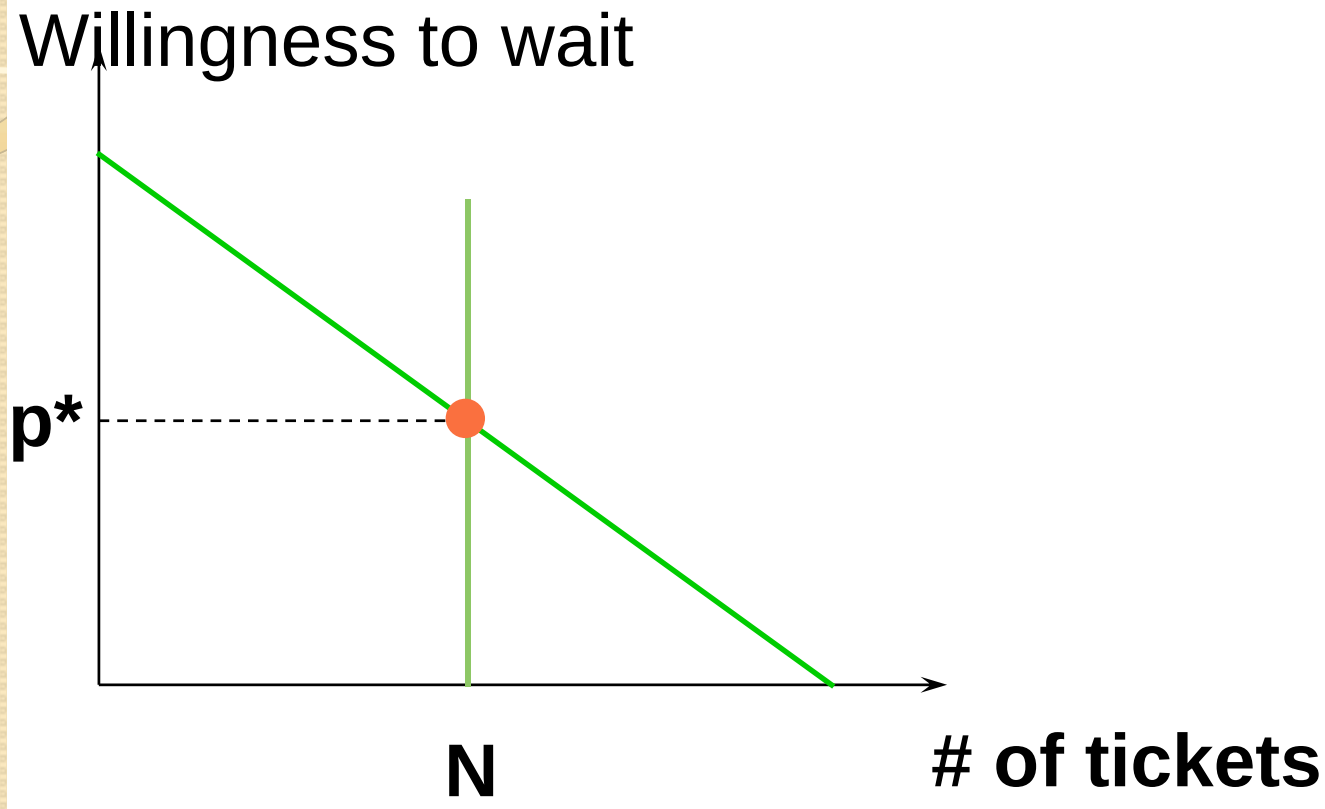
Price control with rationing



Application: Waiting in Line

- Waiting in line is an alternative (non-market) way of allocating scarce resources
- Is it efficient compared to market mechanism?
- Suppose there is a championship basketball game and tickets are free but limited
- The tickets will be distributed according to the principle of "first-come-first served"
- Willingness to pay vs. willingness to wait

Waiting in Line



Why is it so different?

- Waiting time is a private cost and provides no benefits to suppliers
- Waiting time is a pure deadweight loss
- Allocation by waiting time will leave room for ***gain from trade***
- Market price measures both private cost and social benefit
- Market mechanism assures that scarce resources are allocated to most-productive uses