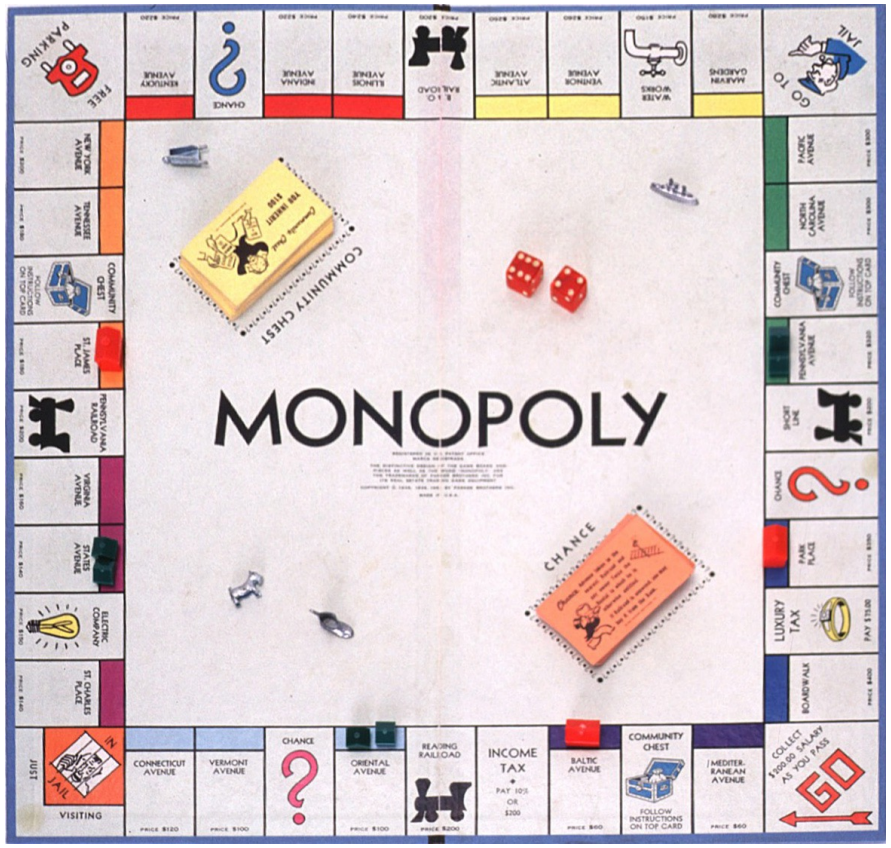
MONOPOLY

Week 3

(Chapter 25, except Appendix)

Monopoly



Board Game developed during the Great Depression

- 22 streets in Atlantic City (New Jersey), divided into 8 color groups; player must own all of a color group to build hotels
- 4 railways, player collects $25 rent if she owns one station, $50 for two, $100 for three and $200 for all four
- 2 utilities, rent is four times the dice value if one utility is owned, but ten times if both are owned

What is a monopoly?

	Perfect Competition	Monopoly
Industry structure	Fragmented; No firm has significant market share	Concentrated; One firm dominates
Pricing	Price takers	Price maker
Barriers to entry	No	Significant
Herfindahl index	0	1

Herfindhal index

$$H = \sum_{i=1}^{N} s_i^2$$

- Industry of *N* firms; s_i : market share of firm *i*
- Measures market concentration: 0 (most competitive) to 1 (no competition)
- United States Department of Justice's Horizontal Merger Guideline:
  - *H* below 0.15: unconcentrated market
  - *H* between 0.15 to 0.25: moderate concentration
  - *H* above 0.25: high concentration
  - Singapore's retail petrol market: 0.31 (in 2011)
- Equivalent to *Simpson diversity index* in ecology and *inverse participation ratio* (IPR) in physics

Consider the following monopoly

- Only airline serving the only airport in Island *Baro Baro*
- Linear market demand curve $Q = 50 - \frac{P}{40,000}$
- Total cost $TC = 10,000Q^2 + 50,000$
- Hence marginal cost $MC = \frac{dTC}{dQ} = 20,000Q$

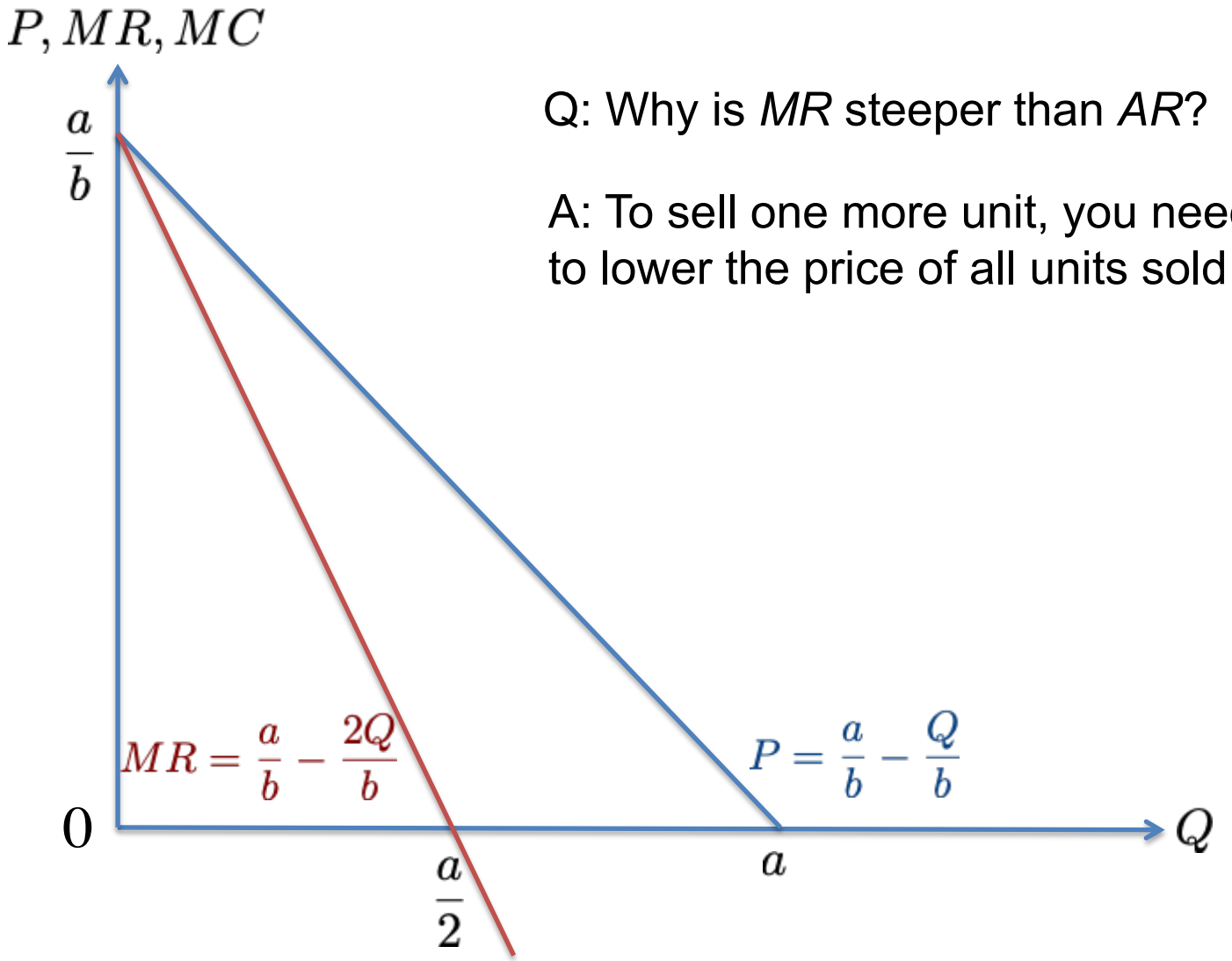
Total Revenue and Marginal Revenue

- The demand for air travel is $$Q = 50 - \frac{P}{40,000}$$
- The inverse demand function is therefore $$P = 2,000,000 - 40,000Q$$
- Thus we can write down *TR* in terms of *Q* : $$TR = PQ = (2,000,000 - 40,000Q)Q$$
- Thus, $$MR = \frac{dTR}{dQ} = 2,000,000 - 80,000Q$$

MR for Linear Demand Curve

- More generally, the (linear) demand curve is $Q = a - bP$
- The inverse demand curve is $P = \frac{a}{b} - \frac{Q}{b}$
- The total revenue is $TR = PQ = (\frac{a}{b} - \frac{Q}{b})Q$
- The marginal revenue is $MR = \frac{a}{b} - \frac{2Q}{b}$ (linear)

MR for Linear Demand Curve



Q: Why is *MR* steeper than *AR*?

A: To sell one more unit, you need to lower the price of all units sold

Profit maximizing condition: *MR*=*MC*

- If *MR*>*MC*,
  - Increasing *Q* increases *TR* faster than *TC*
  - If you sell a bit more, your profit will increase
  - You have not gone far enough

- If *MR*<*MC*,
  - Increasing *Q* increases *TC* faster than *TR*
  - If you sell a bit less, your profit will increase
  - You have gone too far

Profit maximizing condition: *MR=MC*

(Back to example)

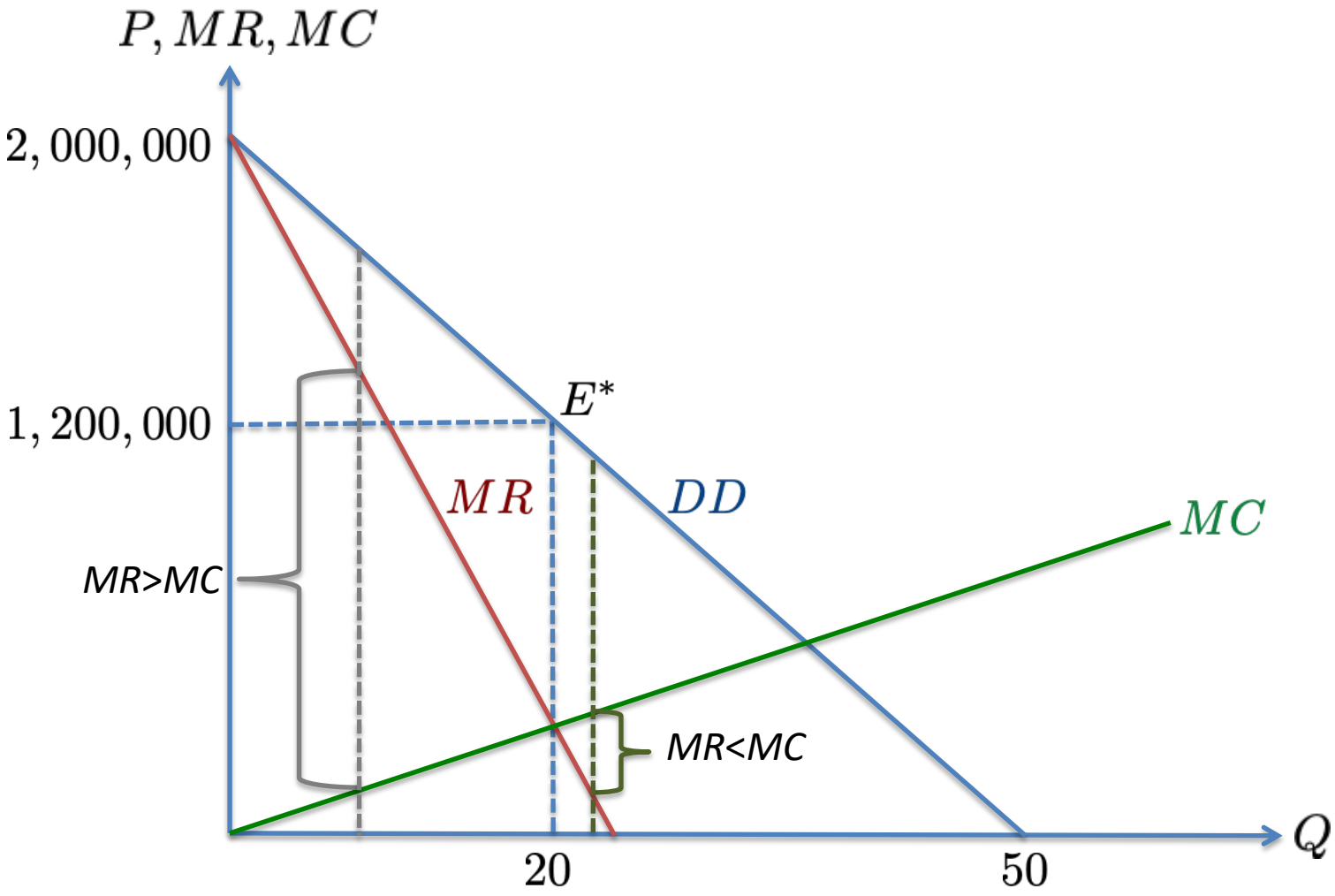
- To maximize profit, airline should set $MR = MC$

$$\implies 2,000,000 - 80,000Q = 20,000Q$$

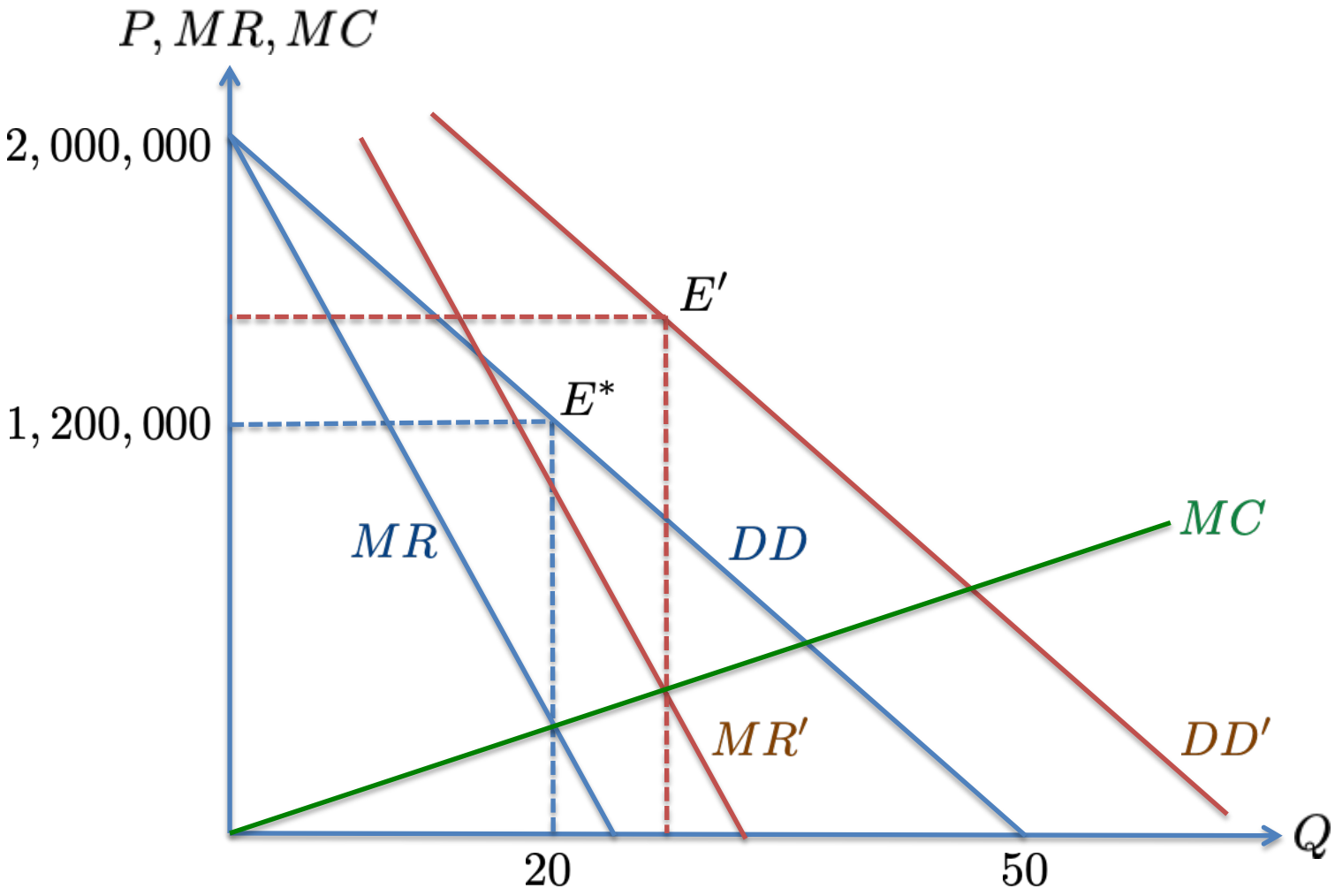
- The optimal number of trips is $Q = 20$

- The optimal price of a trip is $P = 2,000,000 - 40,000 \times 20 = 1,200,000$

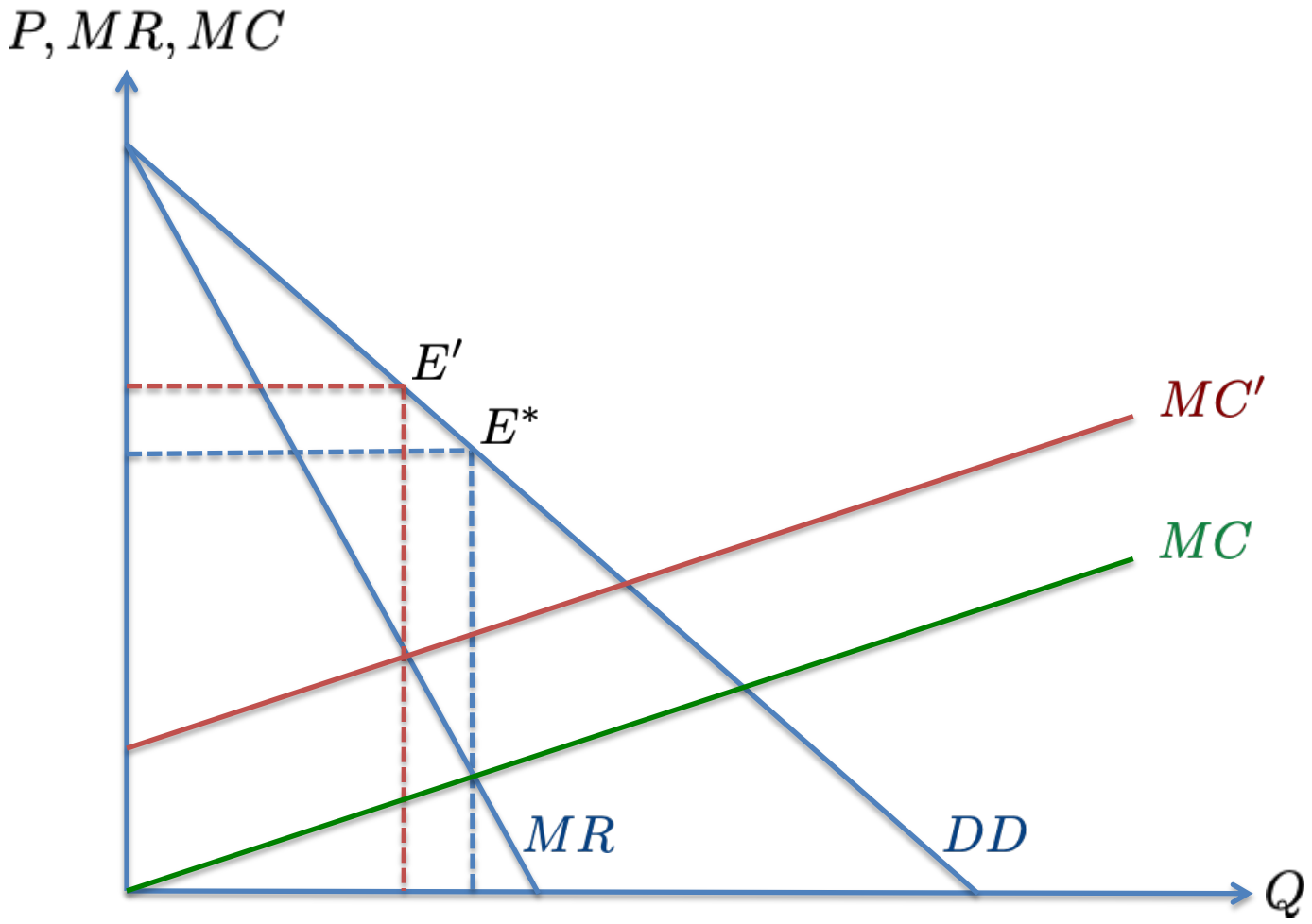
Optimal *P* and *Q*



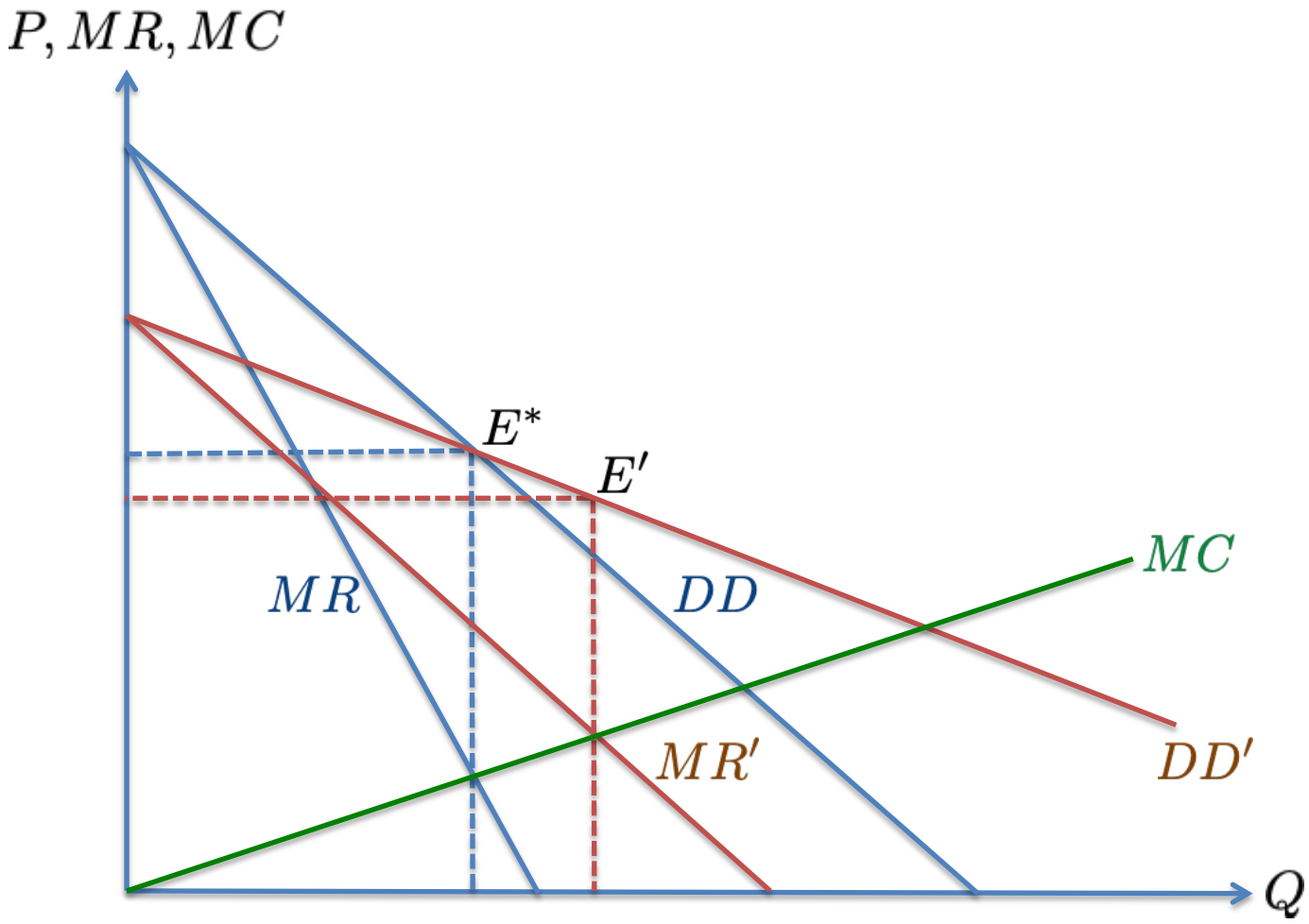
(1) What if demand increases?



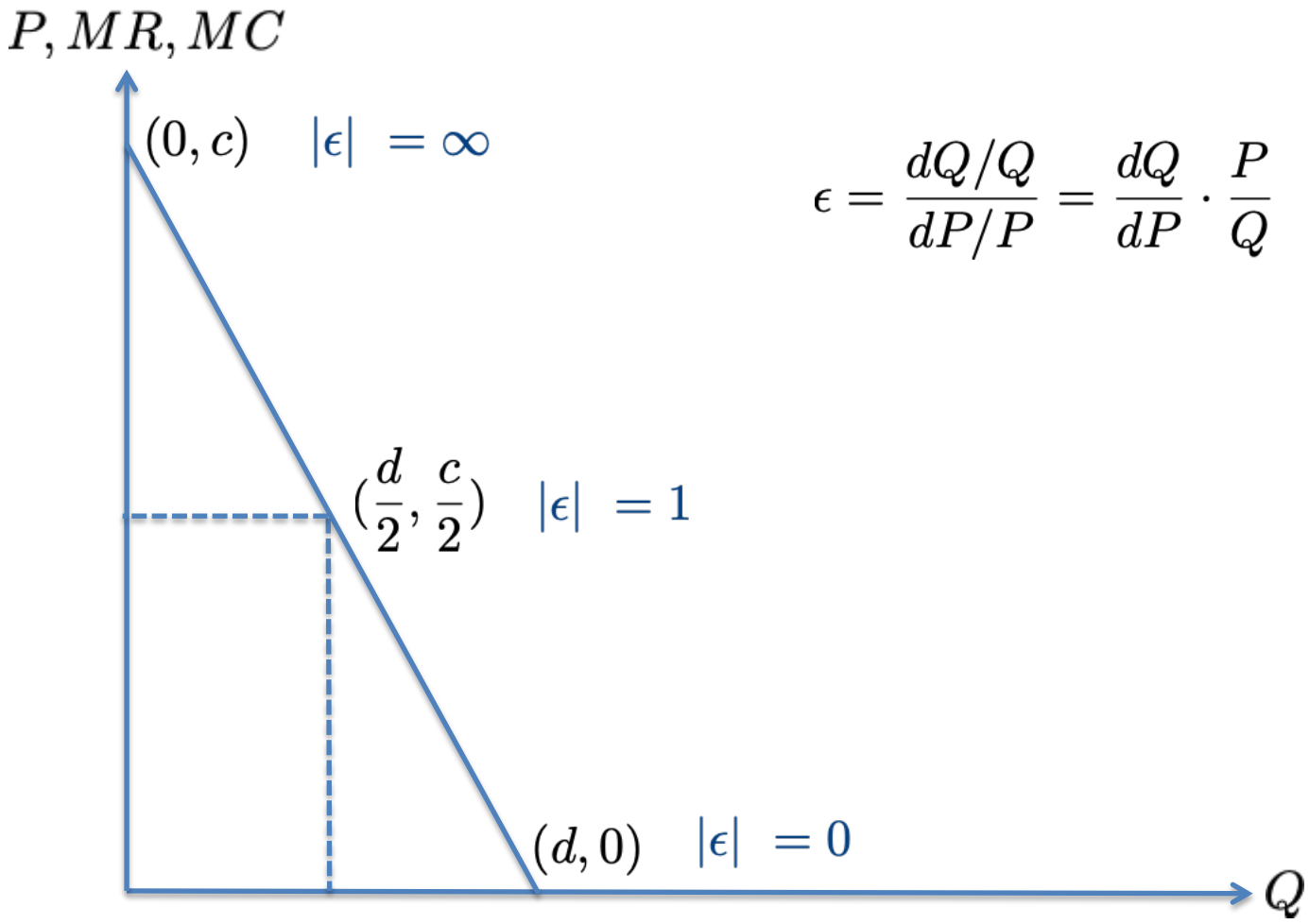
(2) What if marginal cost increases?



(3) What if demand becomes more elastic?



Price Elasticity of Demand



$$\epsilon = \frac{dQ/Q}{dP/P} = \frac{dQ}{dP} \cdot \frac{P}{Q}$$

Inverse Elasticity Pricing Rule

- Relationship between price elasticity of demand and optimal price can be quantified

$$\frac{P^* - MC^*}{P^*} = -\frac{1}{\epsilon^*}$$

  - P^* is the profit-maximizing price
  - MC^* is the marginal cost at the profit-maximizing output
  - ϵ^* is the price elasticity of demand at the profit-maximizing output

Deriving the Rule

$$TR = PQ$$

$$dTR = PdQ + QdP$$

$$\frac{P^* - MC^*}{P^*} = -\frac{1}{\epsilon^*}$$

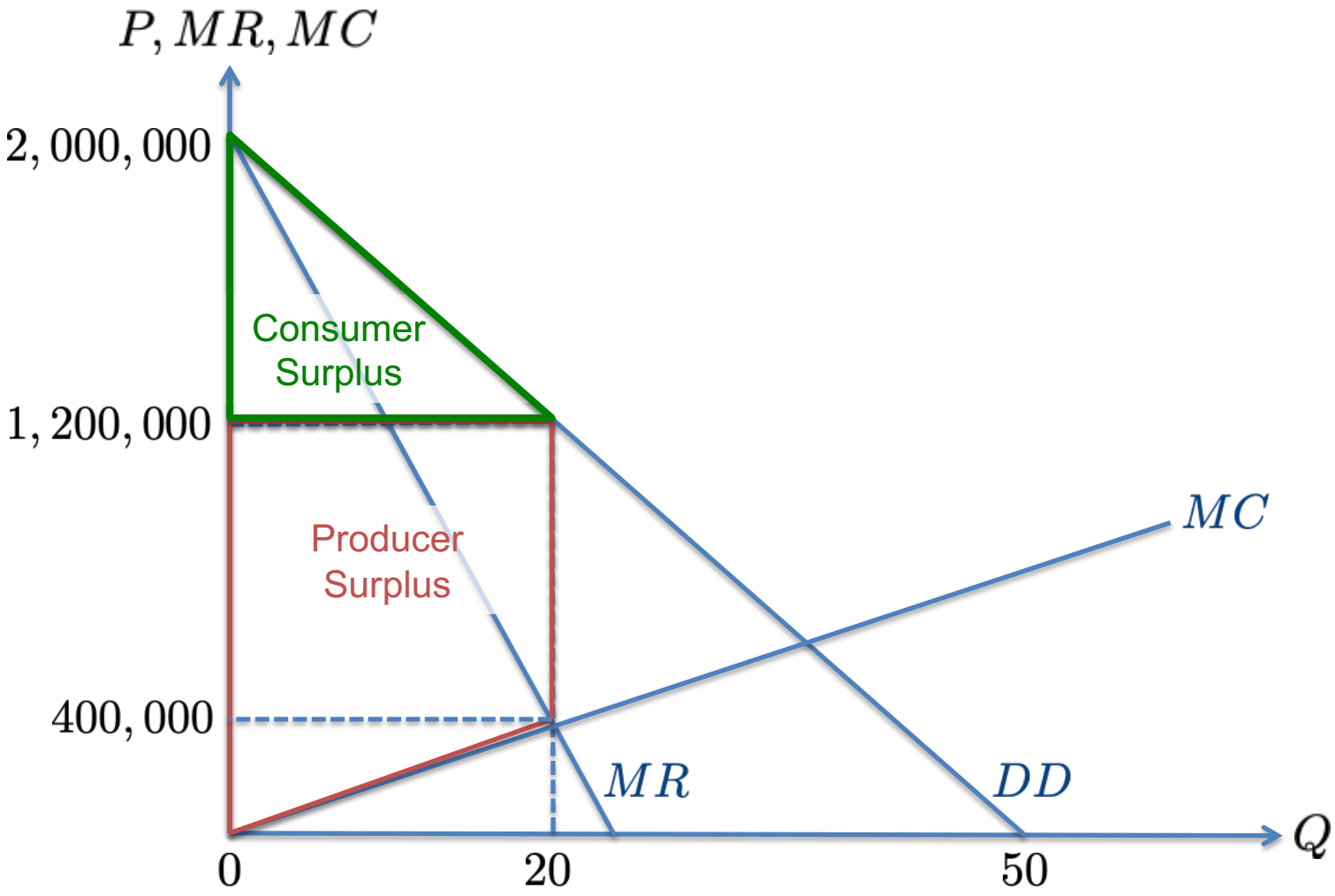
Market Power

- Generally, a monopolist's profit maximizing price is above the level of marginal cost at the profit maximizing quantity
- Generally, a monopolist's price markup $(P^* - MC^*)$ is strictly positive
- If a firm has some control over price, it has *market power*
  - In perfectly competitive market, no firm has market power
- Even if a firm is not a monopolist, it may still have market power (next lecture)

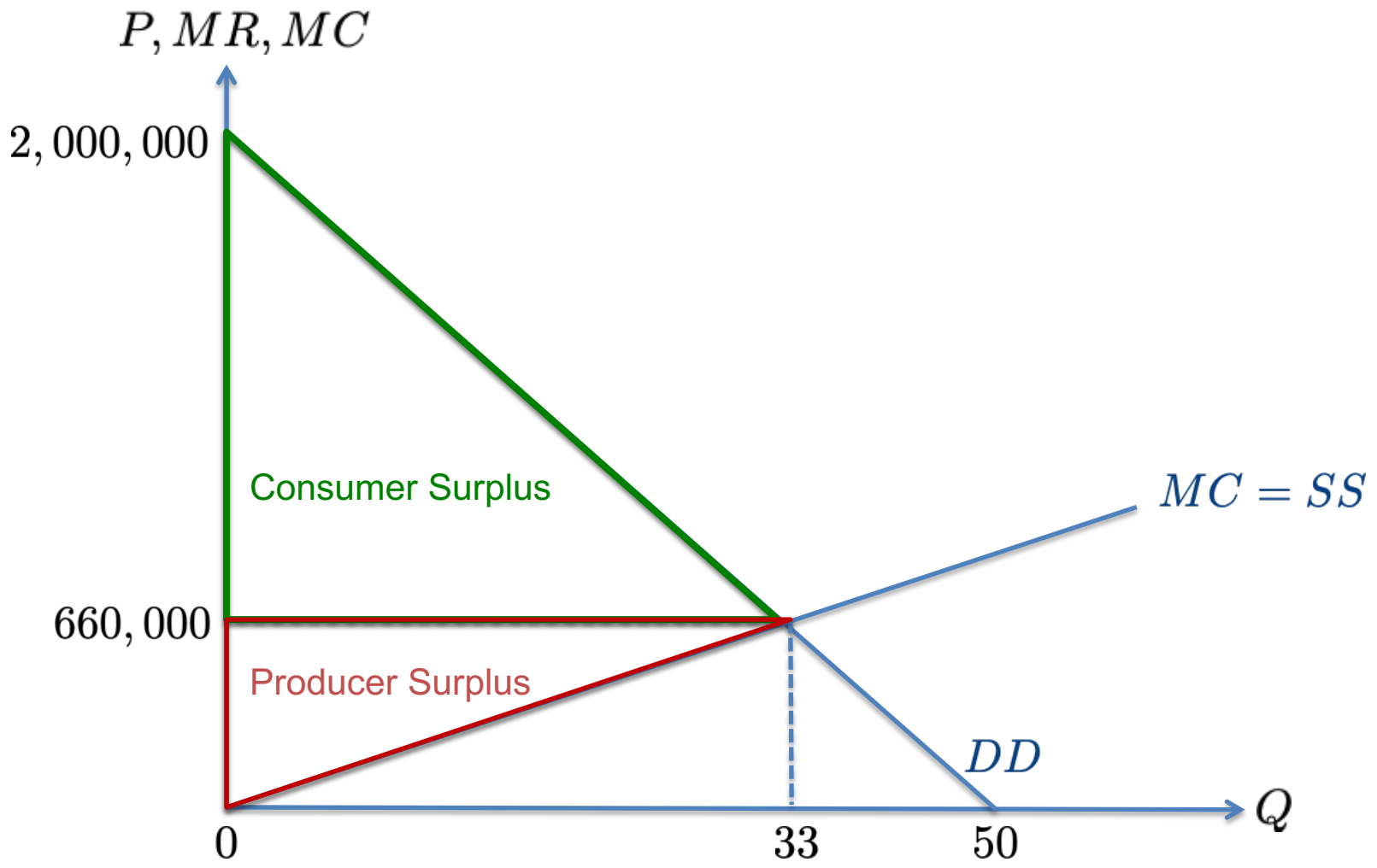
Lerner Index

- $\frac{P^* - MC^*}{P^*}$ is known as the Lerner index of market power
- In perfectly competitive market, every firm has a Lerner index of 0
- A firm with market power has a Lerner index above 0 and below 1

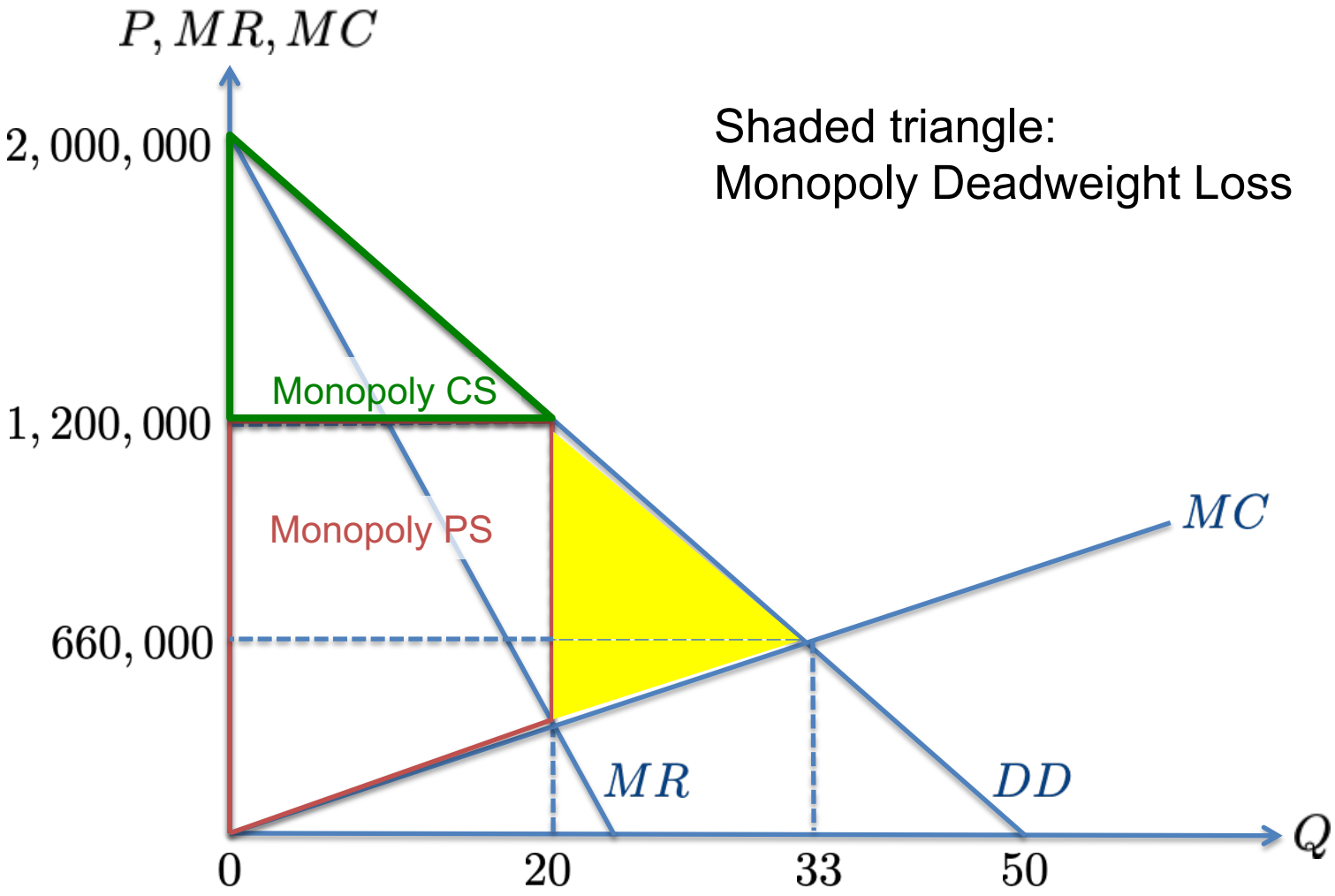
Welfare of Monopoly



CS and PS under Perfect Competition



Monopoly vs. Perfect Competition



Shaded triangle:
Monopoly Deadweight Loss

Monopoly Deadweight Loss

- DWL: Difference between the total surplus if the market were perfectly competitive and the total surplus attained in monopoly market

- Arises because a monopolist produces less quantity and sets higher price than perfectly competitive market

Monopoly vs. Perfect Competition

	Perfect Competition	Monopoly
Equilibrium price	Lower ($P=MC$)	Higher ($P>MC$)
Equilibrium quantity	Higher	Lower
Consumer surplus	Higher	Lower
Producer surplus	Lower	Higher
Total surplus	Higher	Lower

Monopoly harms consumers and society

Barriers to Entry

- Why do monopoly markets exist?
  - In perfectly competitive market, if existing firms are making profit, new entrants will enter the market and drive the profit down

- Monopoly markets have *barriers to entry*
  - i.e., Factors that allow an existing firm to earn positive profit while making it unprofitable for newcomers to enter the industry

Types of Barriers to Entry

- Legal

  Patents prevent entry of generic drug companies

- Strategic

  Incumbent firms actively take steps to deter entry
  - Marketing
  - Limit pricing
    - Incumbent firm charges a lower price before entry occurs
  - Predatory pricing
    - Firm with deep pockets lowers price to drive rivals out of market

- Structural
  - Positive network externality
  - Natural monopoly

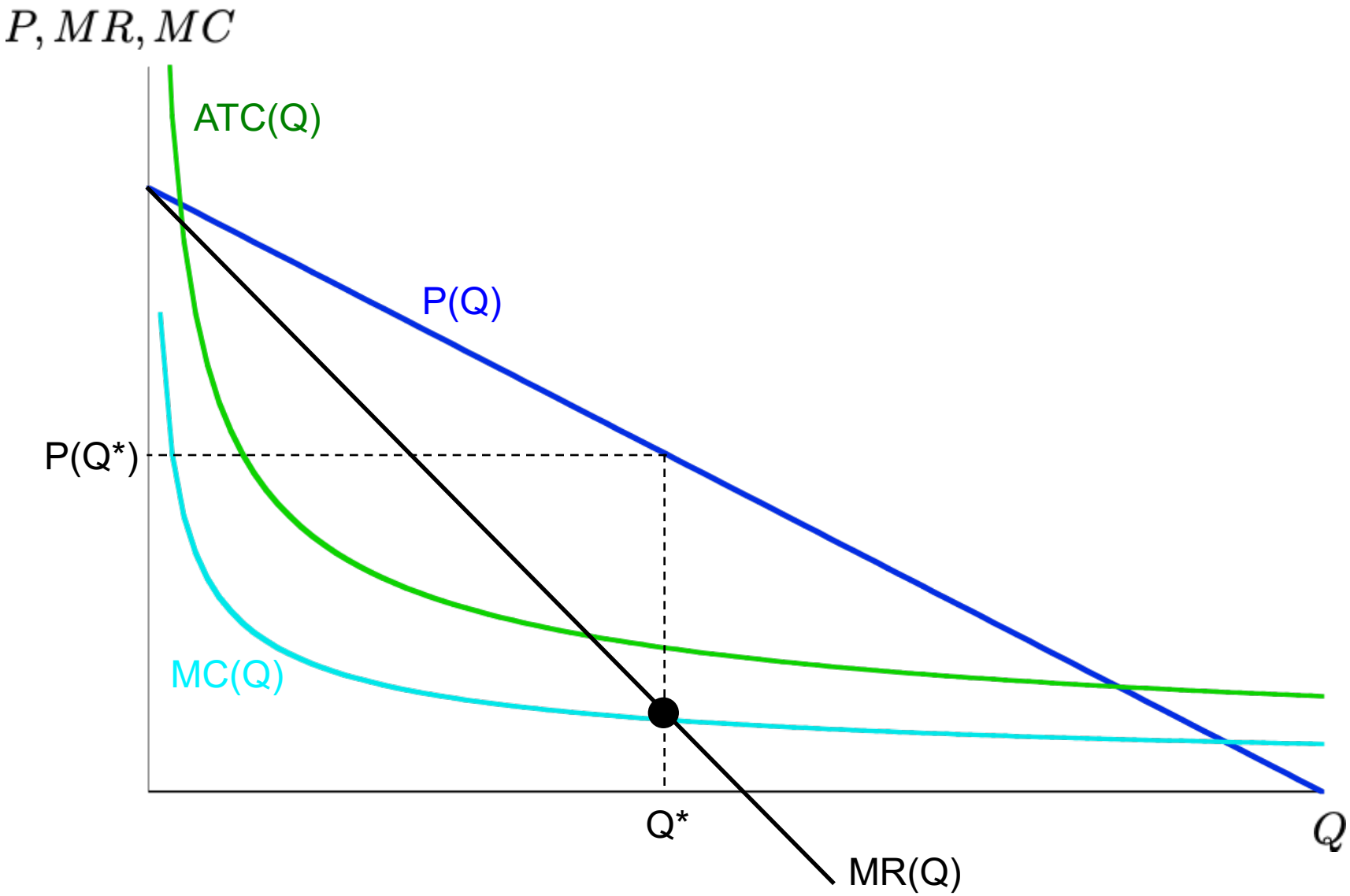
Natural Monopoly

- A market is a *natural monopoly* if the total cost a single firm would incur is less than the combined total cost that two or more firms would incur if they divide the output among them

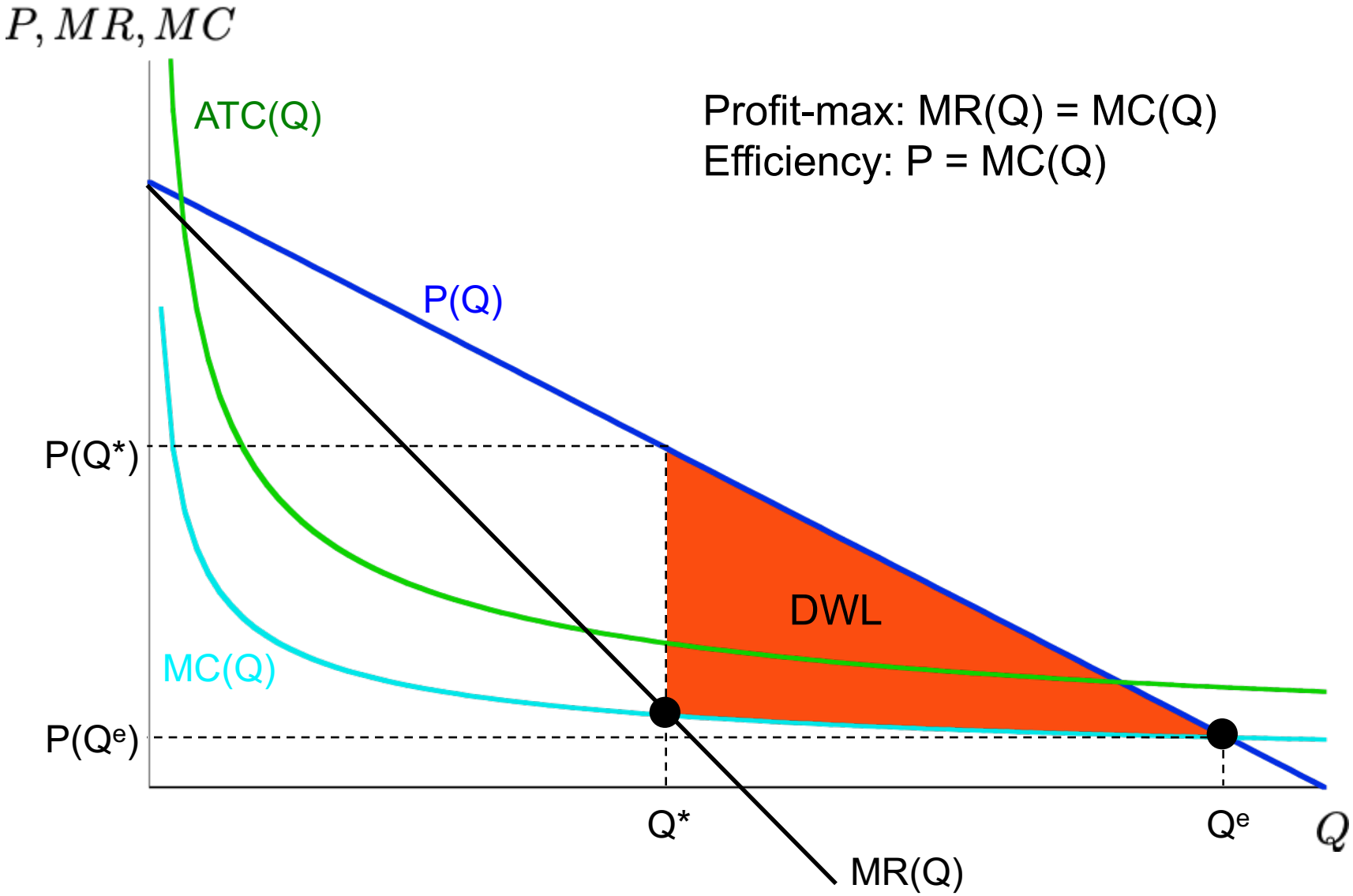
- Economies of scale
  - High fixed cost/Low MC
  - ATC decreasing

- Demand is small (relative to cost structure)
  - TV stations in Singapore

Natural Monopoly



Inefficiency of a Natural Monopoly

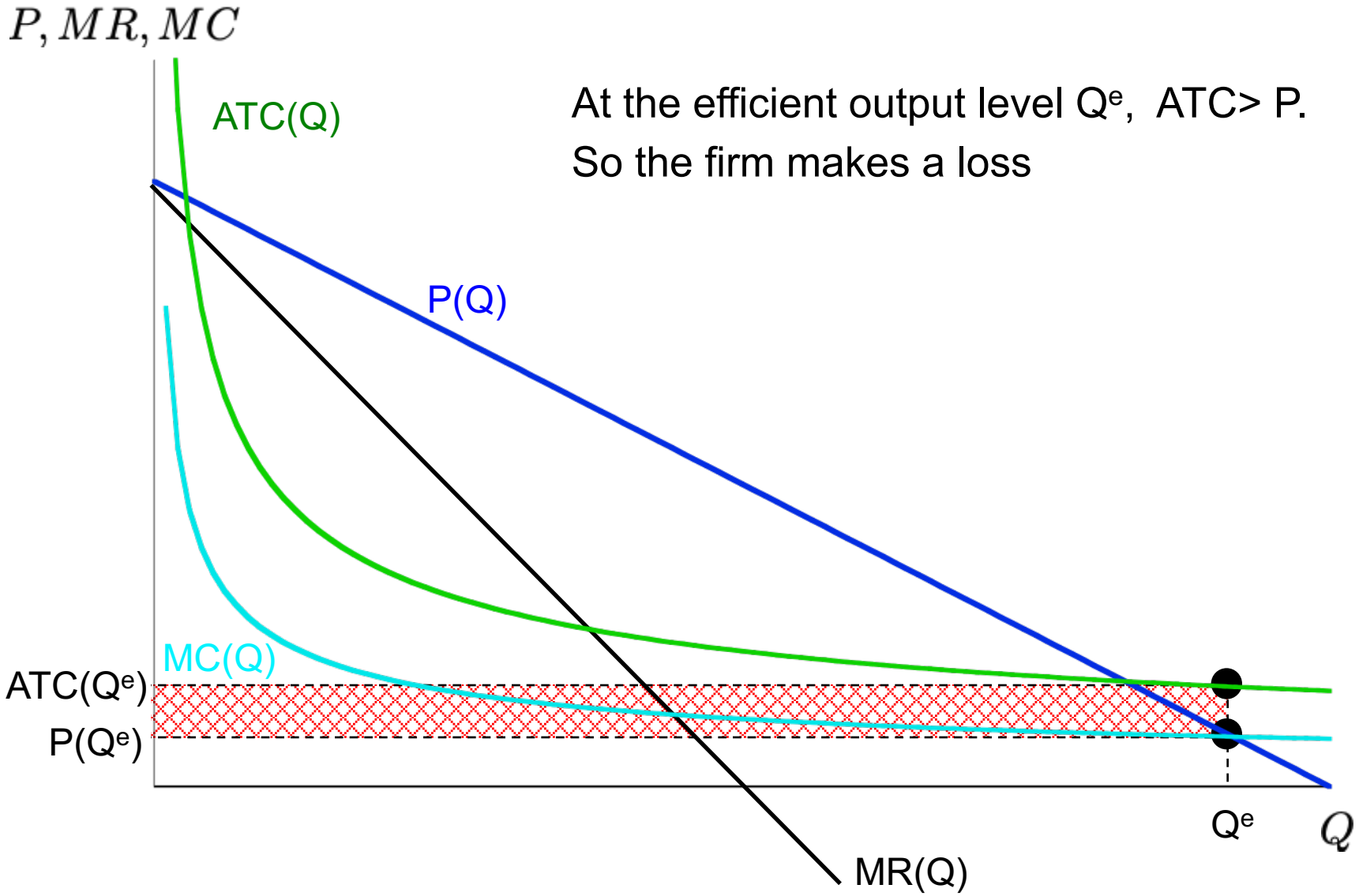


Regulating a Natural Monopoly

Solution 1: Legislate P=MC

- Why not command that a natural monopoly produce the efficient amount of output (P=MC)?
- Then the deadweight loss will be zero?

Regulating a Natural Monopoly



At the efficient output level Q^e, ATC> P.

So the firm makes a loss

A Profits Tax Levied on a Monopoly

Solution 2: Levy a Profits Tax

- A profits tax levied at rate t reduces profit from $\pi(Q^*_{pretax})$ to $(1-t)\cdot\pi(Q^*_{posttax})$

- Profits tax is non-distortionary tax (i.e., $Q^*_{pretax} = Q^*_{posttax}$)

- It does not create new distortions, but neither does it fix existing distortions

An Example: (a) No tax

- Suppose inverse demand function is $P = 100 - Q$, and total cost is given by $C = 10Q$
- So the monopolist's profit function is $\pi = TR - TC = PQ - 10Q = (100 - Q)Q - 10Q$
- To max profit, set

$$\frac{d\pi}{dQ} = 0$$

$$100 - 2Q - 10 = 0$$

$$Q = 45, P = 55, \pi = 2025$$

An Example: (b) Profit tax

- Suppose government set a 10% tax on the monopolist's profits.
- So the monopolist's profit function is $\pi_{posttax} = 0.9\pi$

$$= 0.9(TR - TC) = 0.9(PQ - 10Q) = 0.9(100 - Q)Q - 9Q$$

- To max profit, set $\frac{d\pi_{posttax}}{dQ} = 0$

$$90 - 1.8Q - 9 = 0$$

$$Q = 45, P = 55, \pi = 1822.5$$

- Equilibrium output and price unchanged because $90 - 1.8Q - 9 = 0.9(100 - 2Q - 10) = 0$

has the same solution as $100 - 2Q - 10 = 0$

Quantity Tax Levied on a Monopolist

Solution 3: Levy a Quantity Tax

- A quantity tax of $$t$ per unit of output raises the marginal cost of production by $$t$
- So the tax reduces the profit-maximizing output level, causes the market price to rise, and input demands to fall
- The quantity tax is distortionary

Same Example: (c) Quantity tax

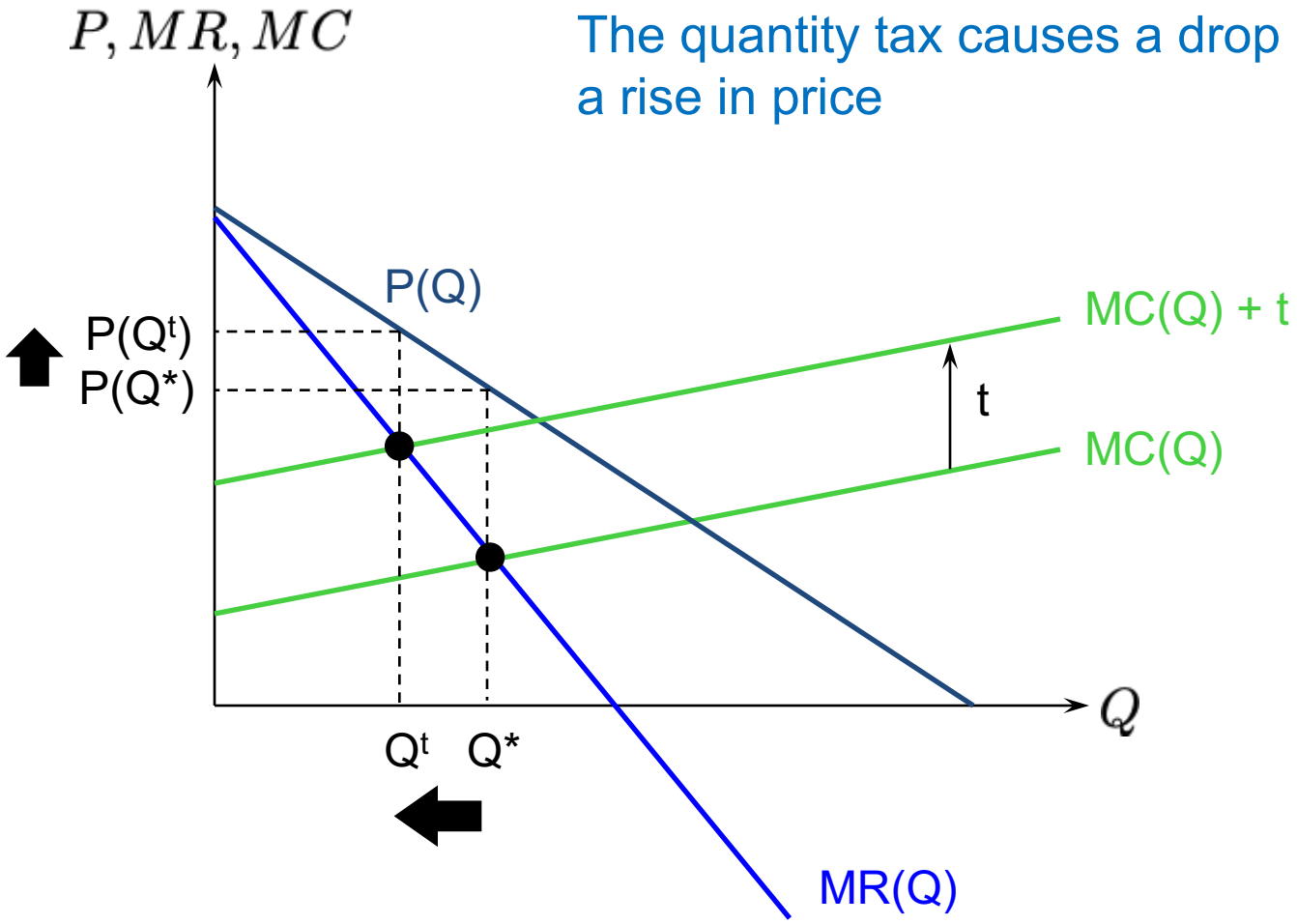
- Suppose government set a tax of $10 on each unit sold
- Now the monopolist's profit function is $\pi' = TR - TC - Tax = PQ - 10Q - 10Q = (100 - Q)Q - 20Q$
- To max profit, set $\frac{d\pi'}{dQ} = 0$

$$100 - 2Q - 20 = 0$$

$$Q = 40, P = 60, \pi = 1600$$

- Equilibrium output and price changed because the quantity tax discourages the monopolist from selling more

Quantity Tax Levied on a Monopolist



The quantity tax causes a drop in output and a rise in price

Competition Policy in Singapore

- Competition Commission Singapore (CCS) oversees anti-competitive activities

- Competition Act (effective since 2004) is the law in Singapore that protects consumers and businesses from anti-competitive activities
  - Abuse of dominance
  - Anti-competitive agreements
  - Merger

Abuse of Dominance

- Being a dominant player is fine

- Anti-competitive activities that protects/enhances one's dominant position are illegal
  - deter other competitors from entering the market
  - intend to drive competitors out of the market

- Examples
  - Exclusive dealing
  - Aggressive pricing

Price Discrimination

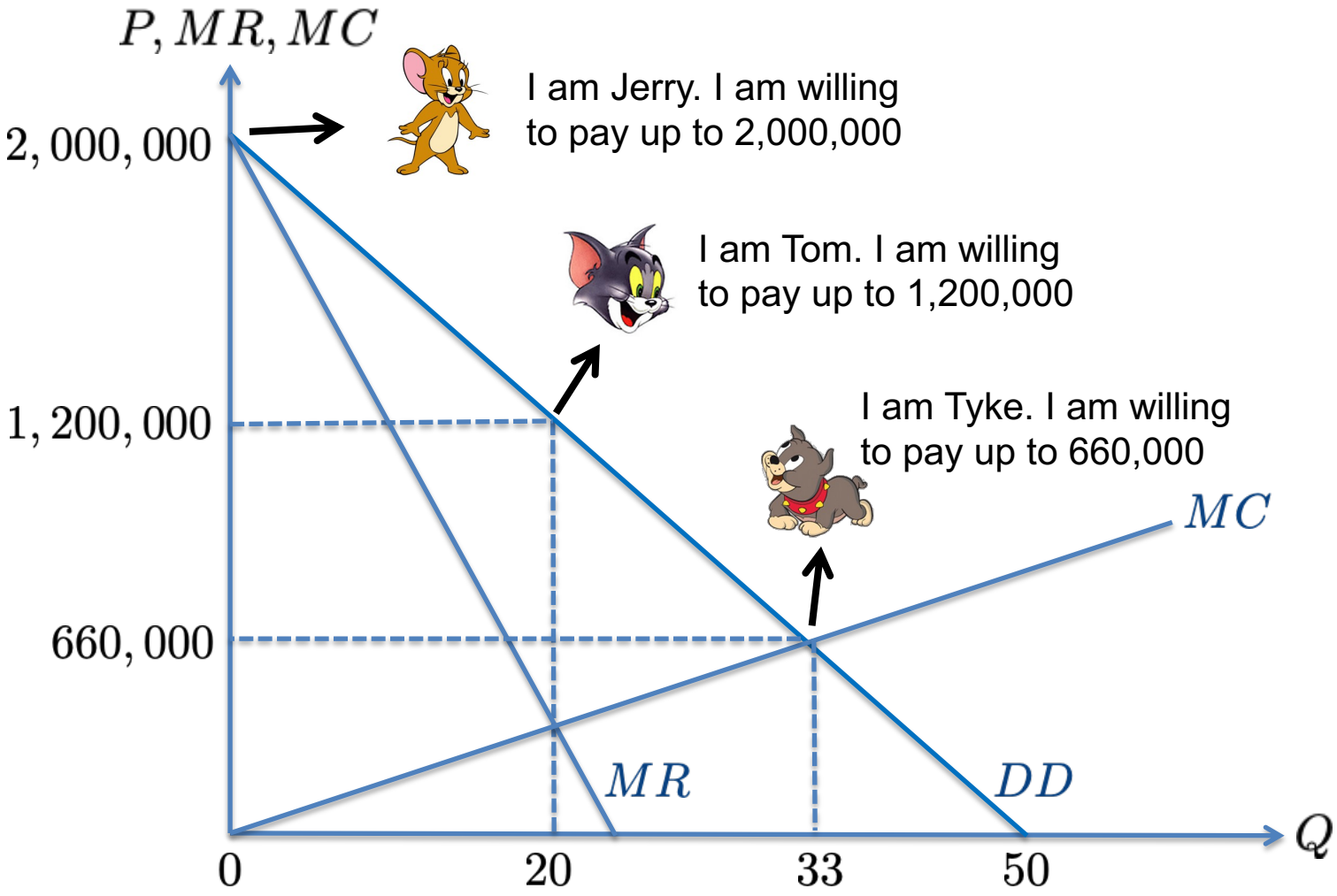
(Firm may increase its profit further by charging different prices for its good)

- 1st-degree
  - Each output unit is sold at a different price
  - Prices differ across buyers

- 2nd-degree
  - Price paid by a buyer varies with quantity purchased
  - All buyers face the same price schedule
  - Example: bulk discount

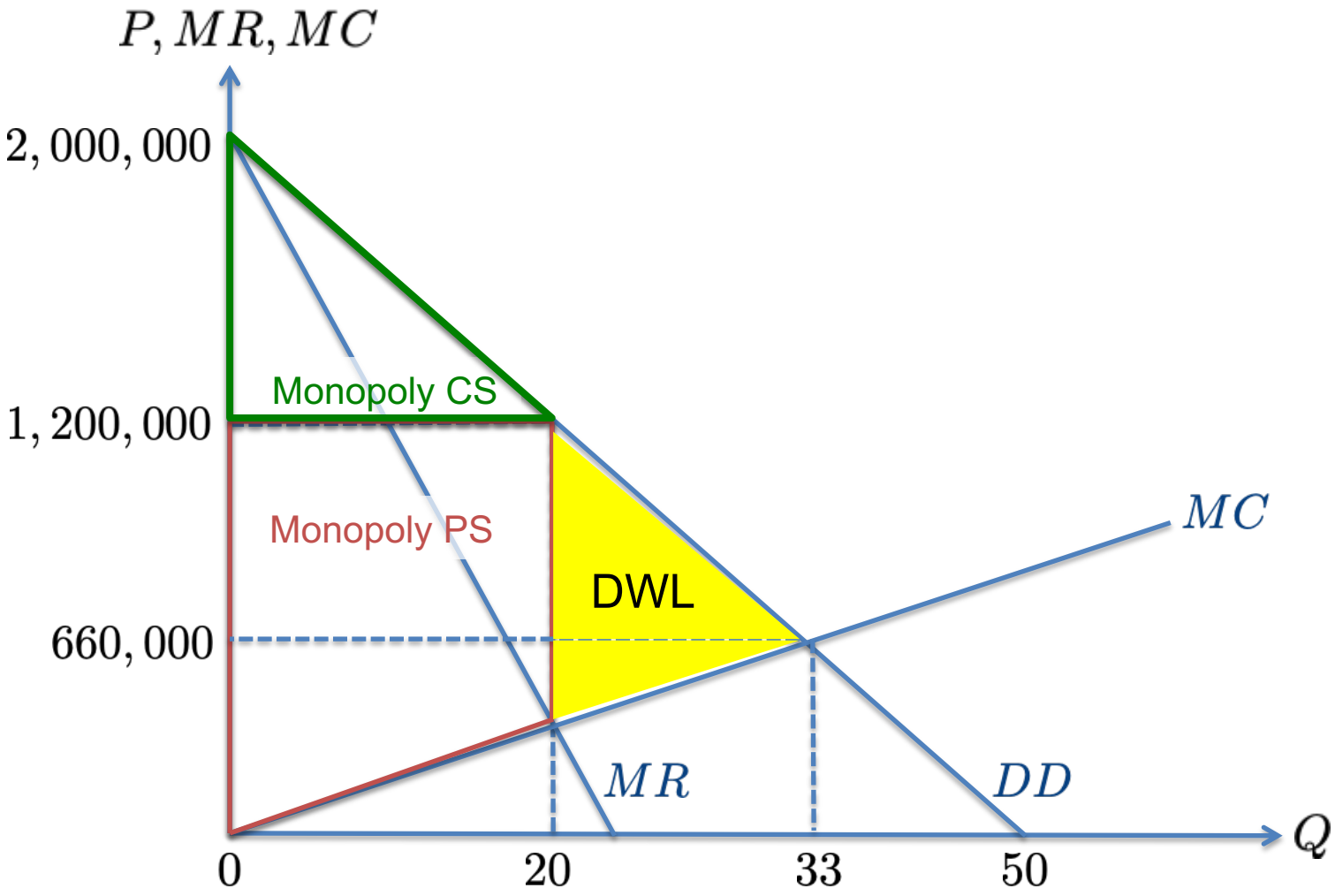
- 3rd-degree
  - Firm offers different prices to different groups
  - All buyers in the same group face the same price schedule
  - Example: senior citizen/student discounts

Uniform Pricing

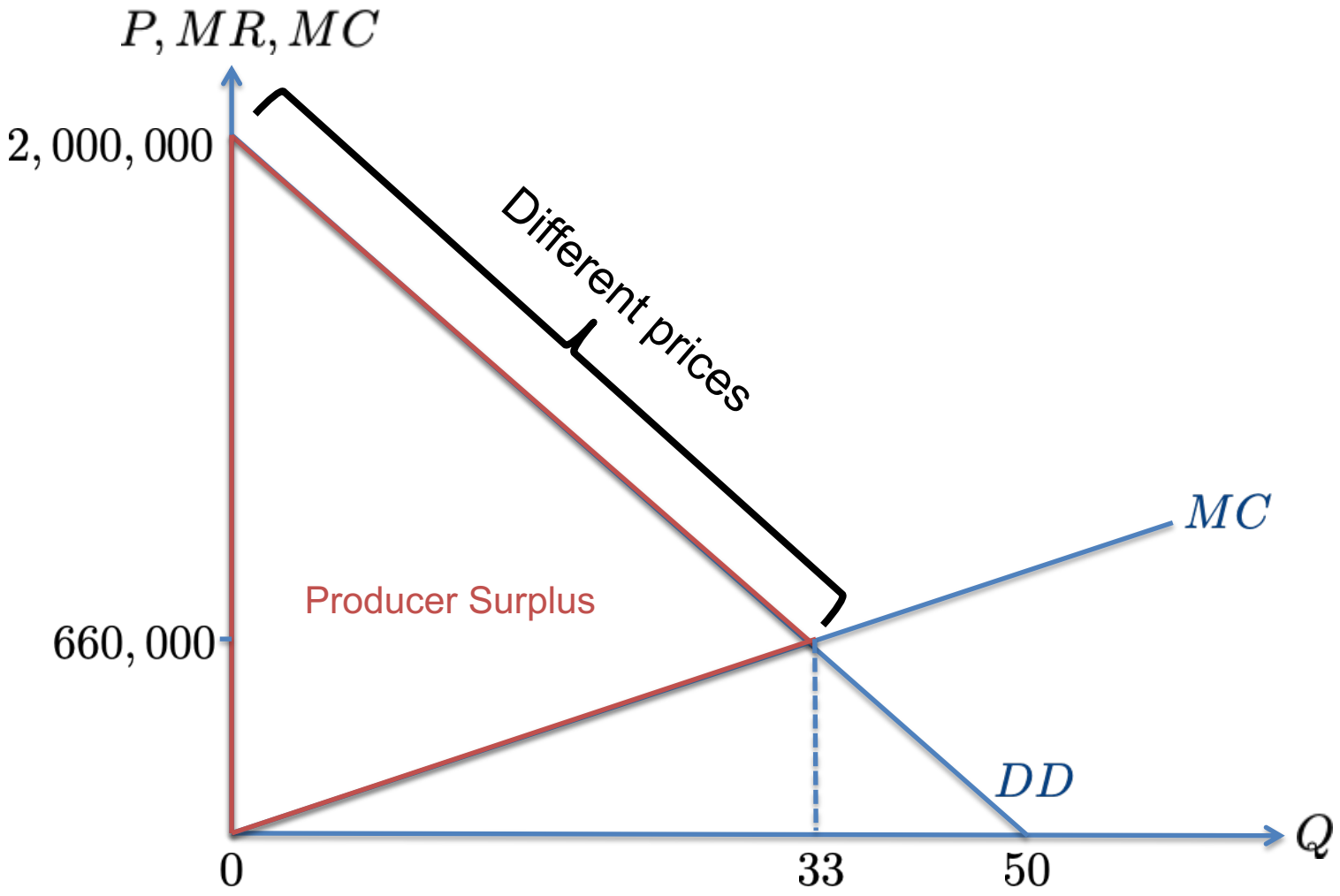


Under uniform pricing, Tyke will not consume

Welfare Under Uniform Pricing



First-Degree Price Discrimination



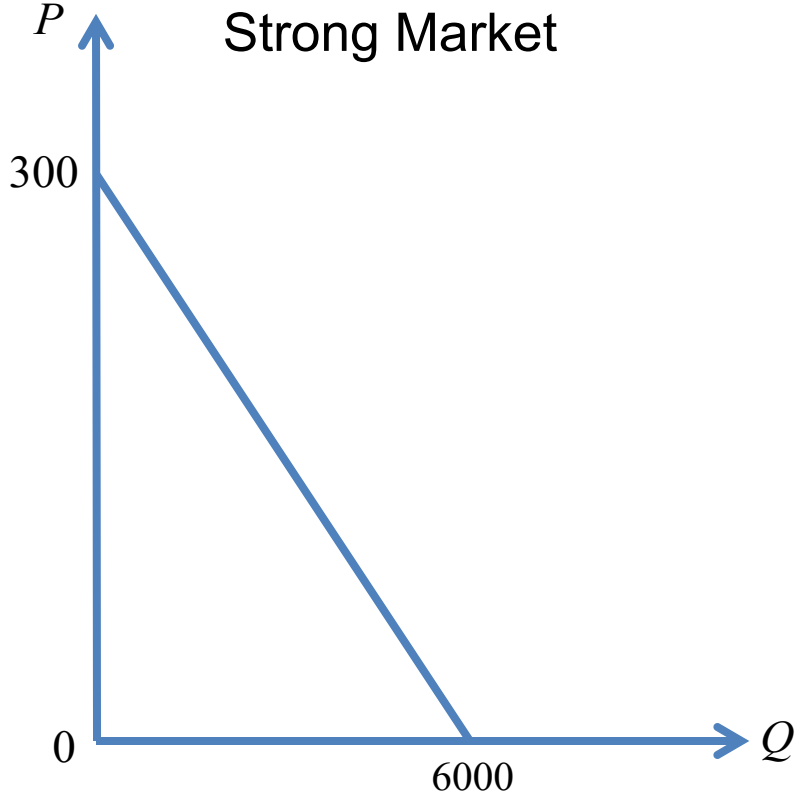
- Firm sells 33 units (at different prices) in total, instead of 20
- Tyke will consume

Third-Degree Price Discrimination

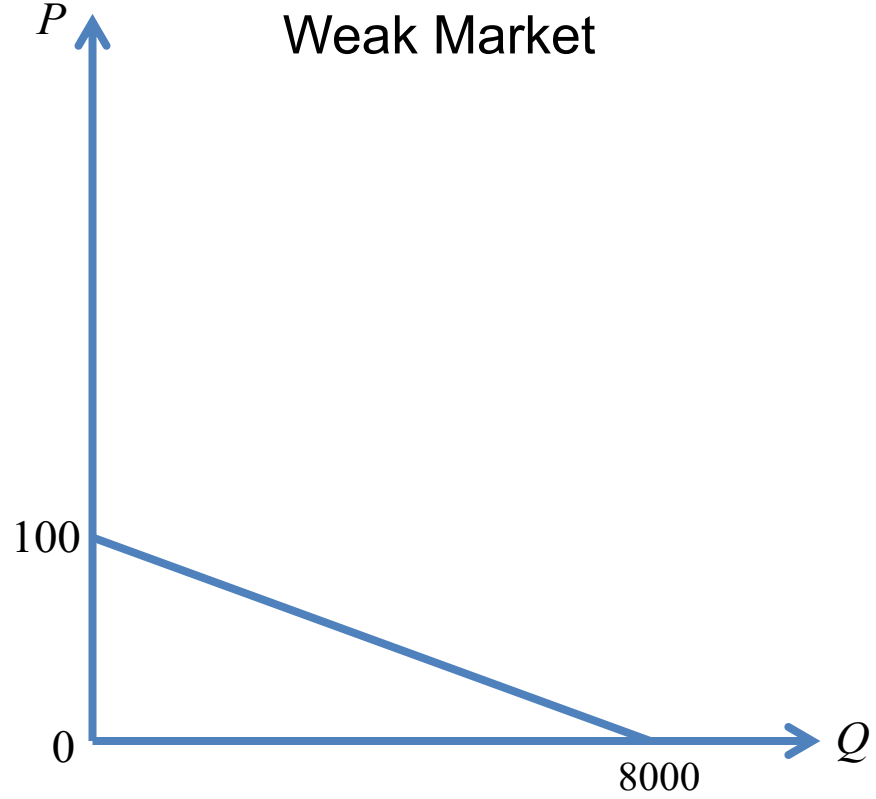
- Suppose Wiley sells textbook *Microeconomics* in two markets, US and Outside US
- Demand
  - Demand in US is $Q=6000-20P$
  - Demand outside US is $Q=8000-80P$
- Cost
  - Wiley's marginal cost is $MC=10$ in both markets
  - No fixed cost

Demand in US vs. outside US

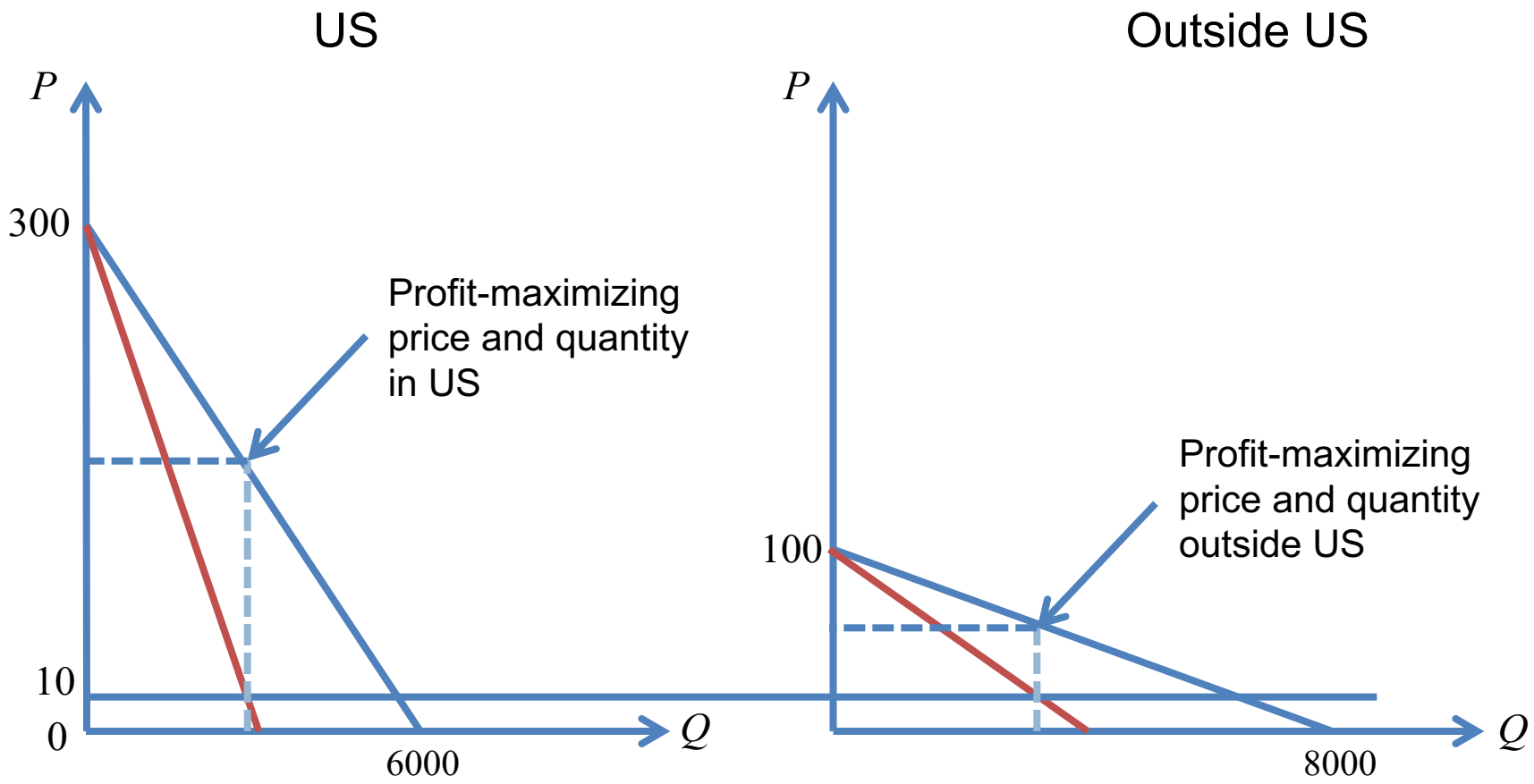
Demand in US:
Strong Market



Demand outside US:
Weak Market



Profit-Maximizing Price in Each Market



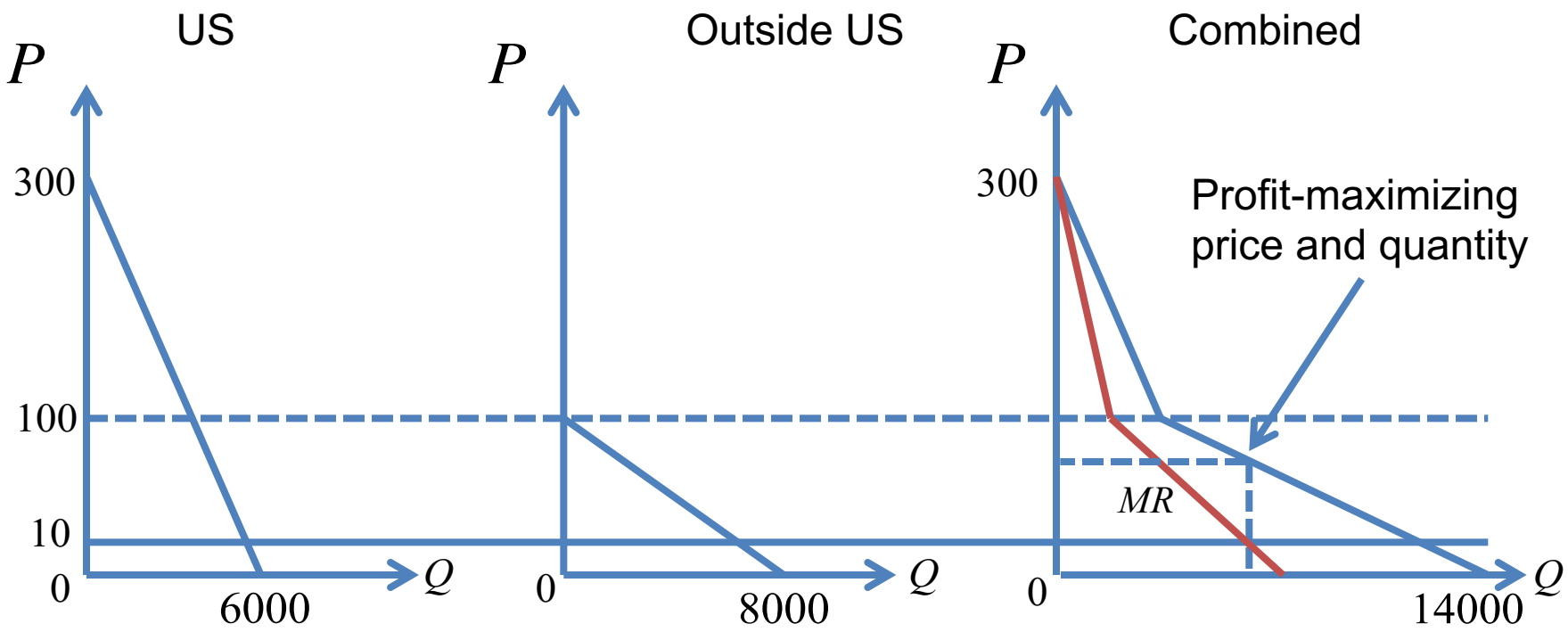
Profit-Maximizing Price in US

- In US, $MR = 300 - Q/10$
- Setting *MR*=*MC*, $300 - Q/10 = 10 \Rightarrow Q = 2900$
- Profit-maximizing price $P = 300 - 2900/20 = 155$
- Profit in US $TR - TC = 155 \times 2900 - 10 \times 2900 = 420{,}500$

Profit-Maximizing Price outside US

- Outside US, $MR = 100 - Q/40$
- Setting *MR*=*MC*, $100 - Q/40 = 10 \Rightarrow Q = 3600$
- Profit-maximizing price $P = 100 - 3600/80 = 55$
- Profit outside US $TR - TC = 55 \times 3600 - 10 \times 3600 = 162{,}000$

What if Wiley can only charge one price?



$$Q = Q_{US} + Q_{exUS} \implies Q = (6000 - 20P) + (8000 - 80P)$$

$$\implies P = 140 - \frac{Q}{100}$$

Profit-maximizing Uniform Price

- Wiley sets *MR*=*MC*, $140 - Q/50 = 10 \Rightarrow Q = 6{,}500$
- The profit-maximizing uniform price is $P = 140 - 6500/100 = 75$
- Wiley's profit is $TR - TC = 75 \times 6500 - 10 \times 6500 = 422{,}500$
- US consumers buy $6000 - 20 \times 75 = 4500$
- International consumers buy $8000 - 80 \times 75 = 2000$

Comparison

	Uniform Pricing	Third-Degree Price Discrimination
Optimal price	75	155 (US) 55 (Outside US)
Profit	422,500	582,500
Quantity sold in US	4500	2900
Quantity sold outside US	2000	3600