MICROECONOMICS

Short-hand manual ☺

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Schedule

- Costs
- Perfect competition
- Oligopoly
  - Quantity (Cournot)
  - Price (Bertrand)
  - Leadership (Stackelberg)
- Monopoly
- Entry and entry deterrence

Costs

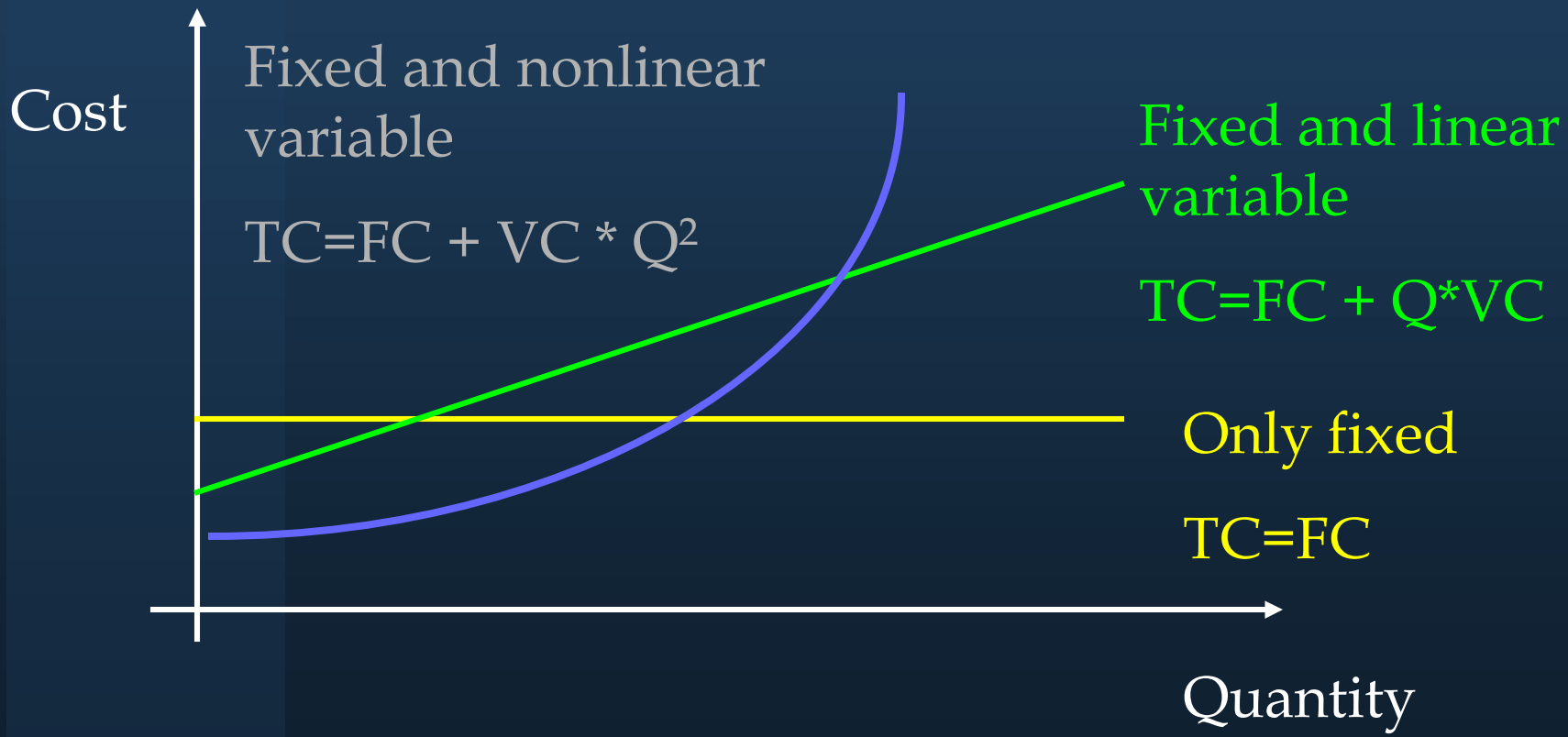
- There can be different perspectives:
  - Accounting and economics
  - Sunk costs
  - Opportunity cost
  - Fixed and variable (a cost function?)

What really matters?

Short run *versus* long run

Cost function

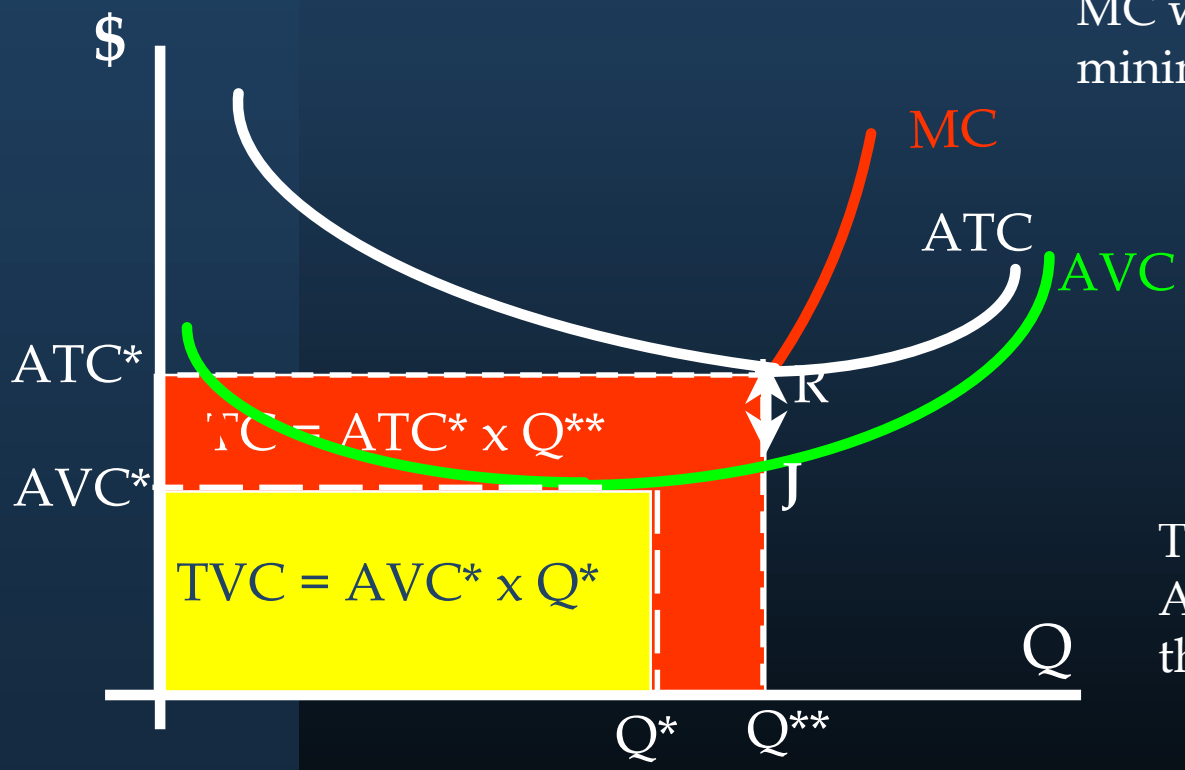
- **Always 'fixed + variable' world**



Cost function

- **Average cost**
  - **ATC=AC=TC/Q,**
  - **AVC=VC/Q**
  - **AFC=FC/Q**
- **Marginal cost**
  - **MC= $\frac{\Delta TC}{\Delta Q}$**

Costs



MC will intersect the AVC at the minimum of the AVC [always].

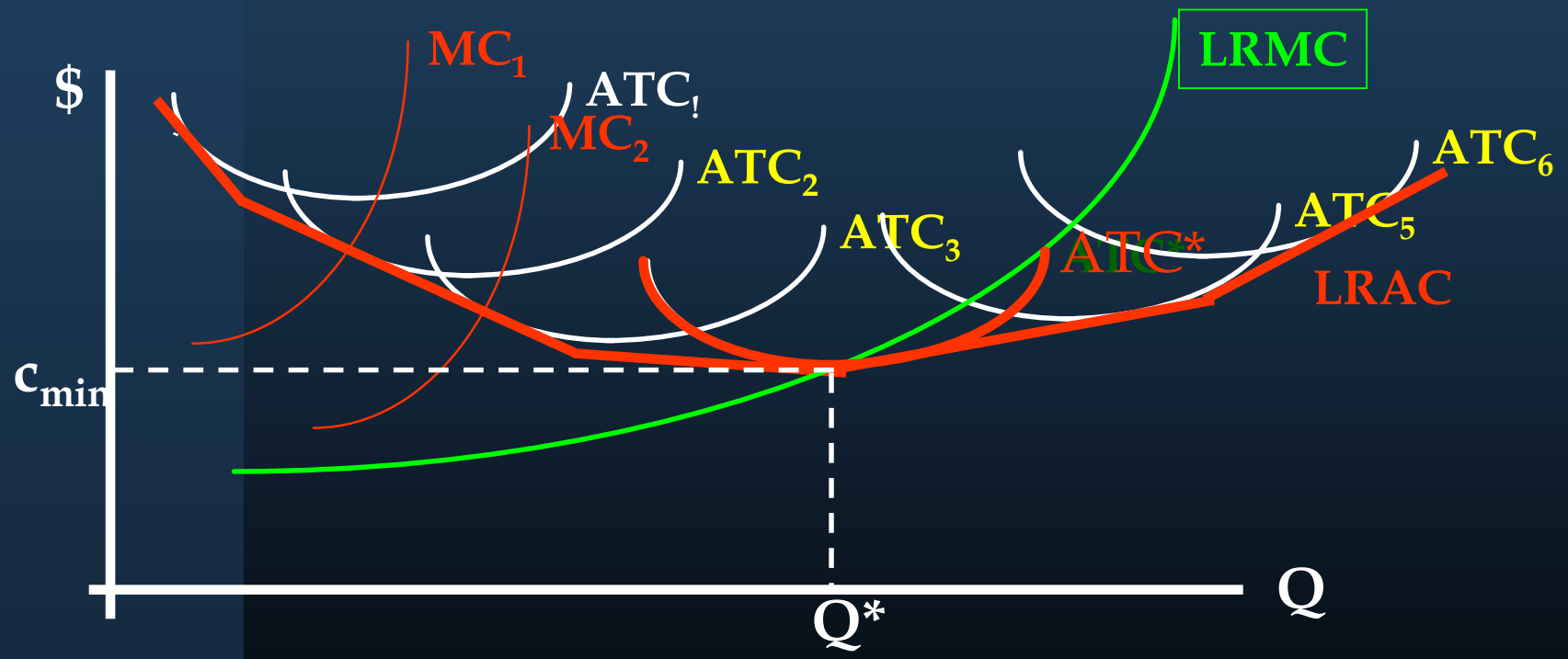
MC will intersect the ATC at the minimum of the ATC.

The vertical distance between ATC and AVC at any output is the AFC. At Q** AFC is RJ.

At Q* output, the AVC is at a minimum AVC*.

At Q** the ATC is at a MINIMUM.

Long run costs



At Q* the cost per unit are minimized [the least inputs used].

Economies of scale

- **Mathematically: homogeneity of order 1**

  Production function: Q(K,L)

  Q(t*K, t*L) ??? t*Q(K,L)

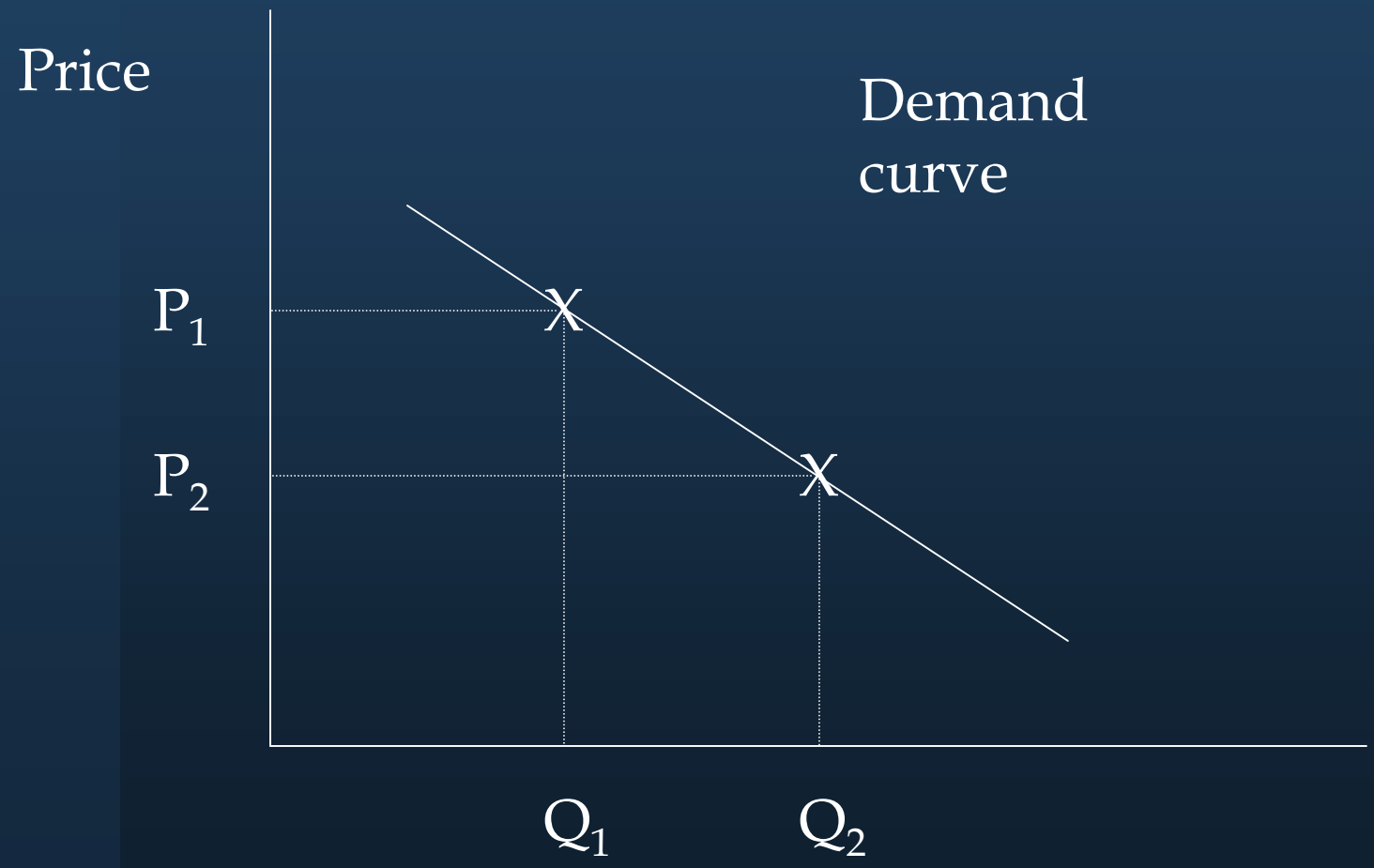
  (1) Q(t*K, t*L) < t*Q(K,L) DECREASING (DRS)

  (2) Q(t*K, t*L) = t*Q(K,L) CONSTANT (CRS)

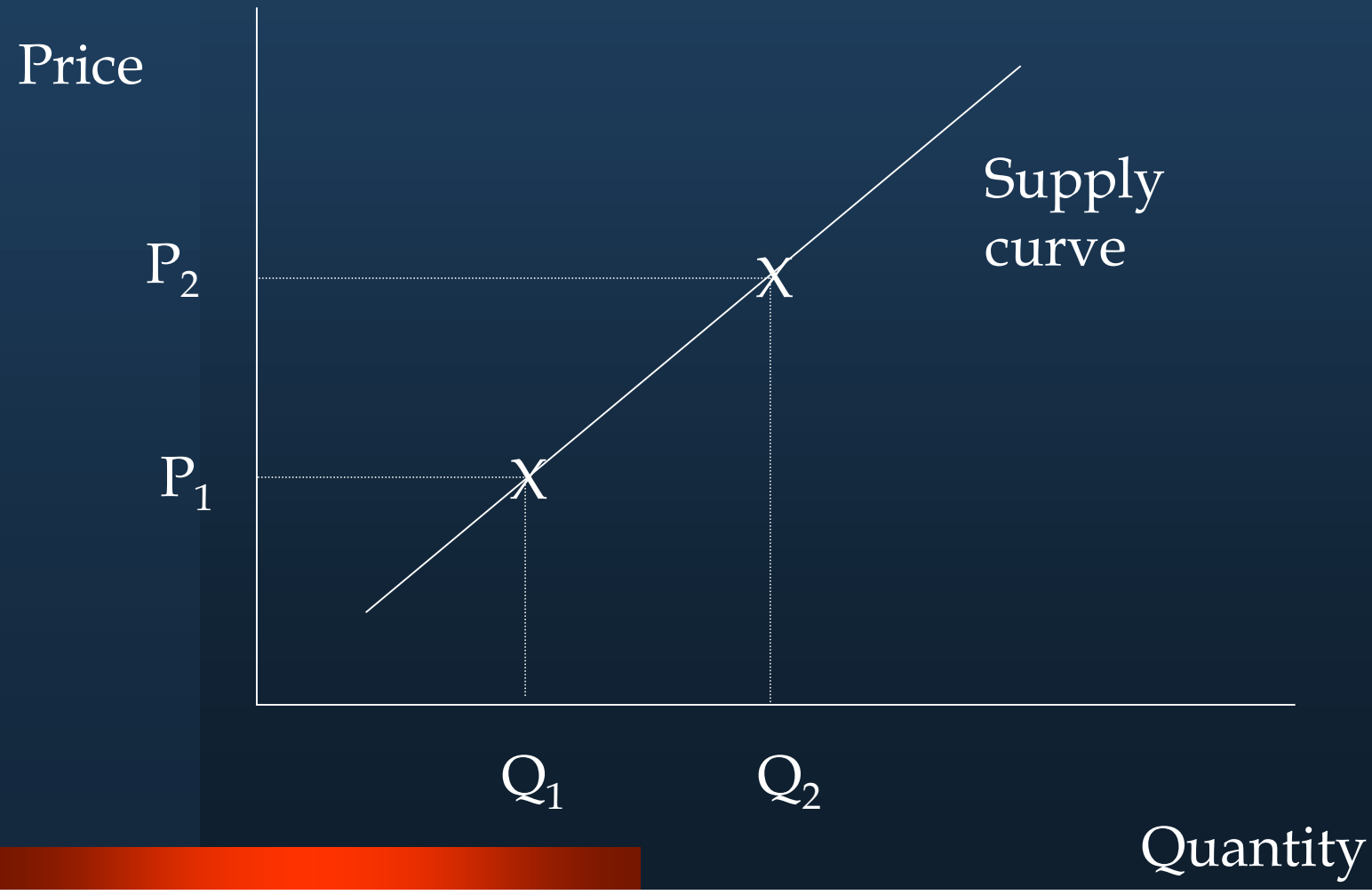
  (3) Q(t*K, t*L) < t*Q(K,L) INCREASING (IRS)

- **Economically: a *perpetuum mobile*?**

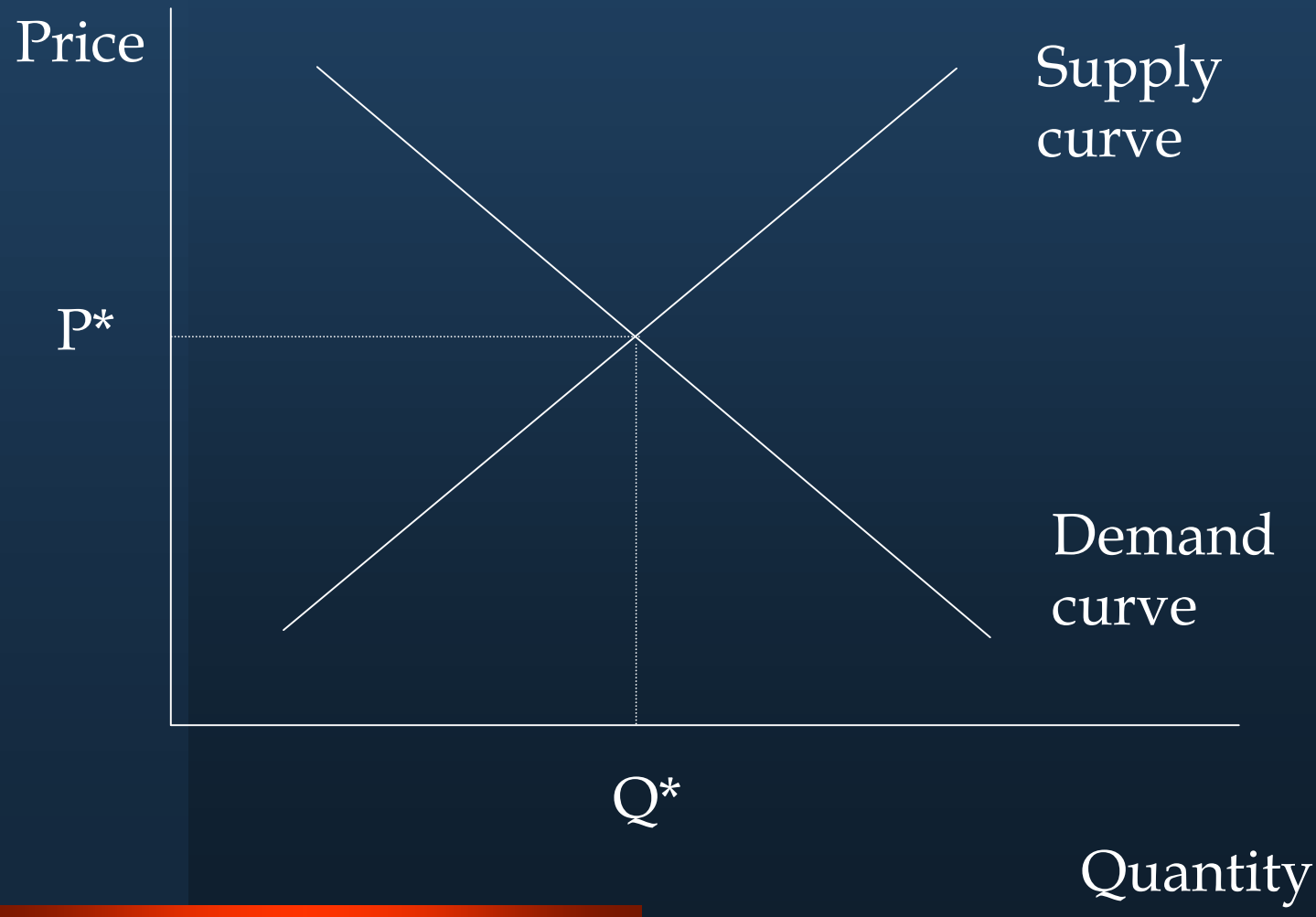
Demand curve



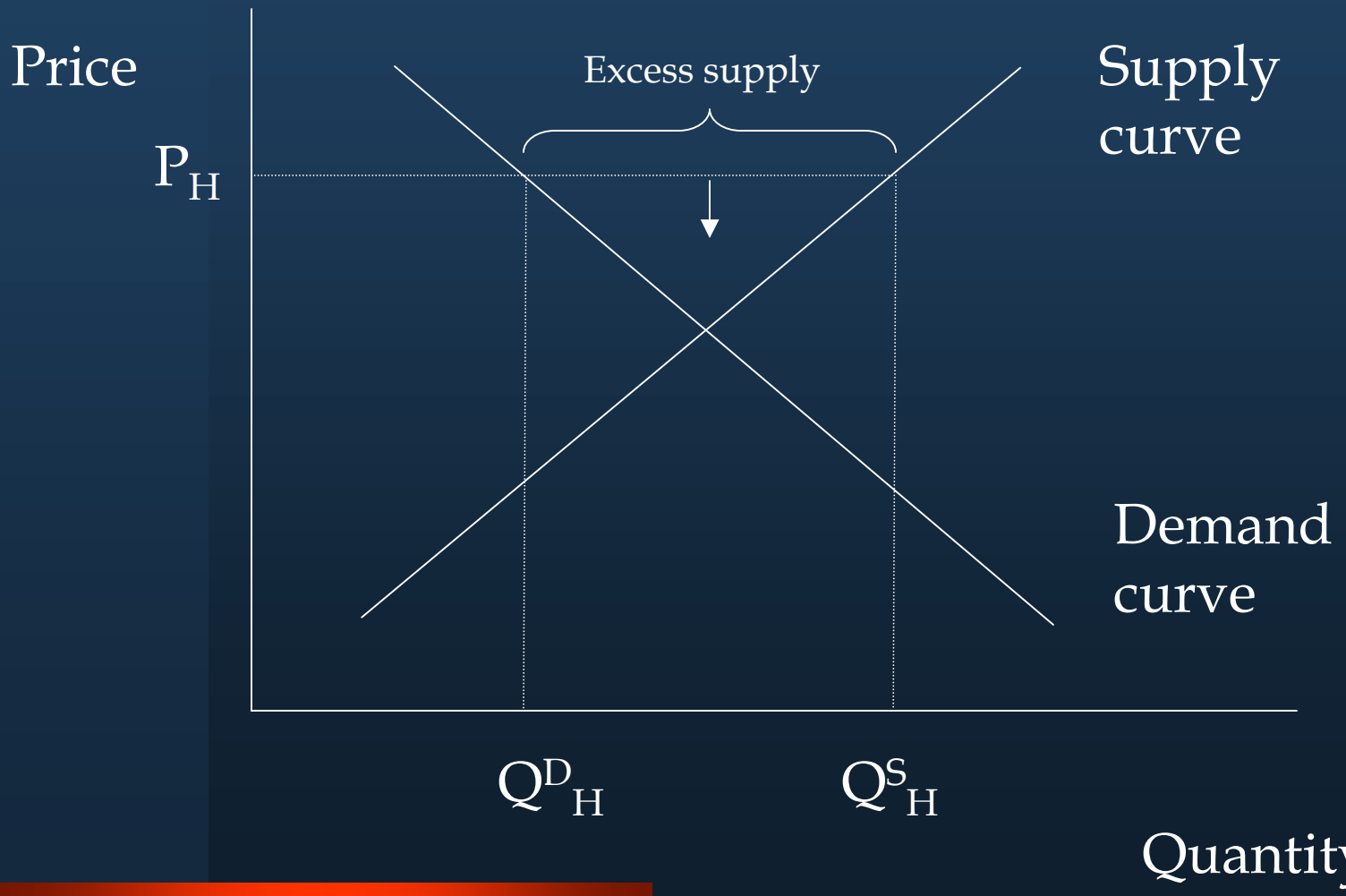
Supply curve



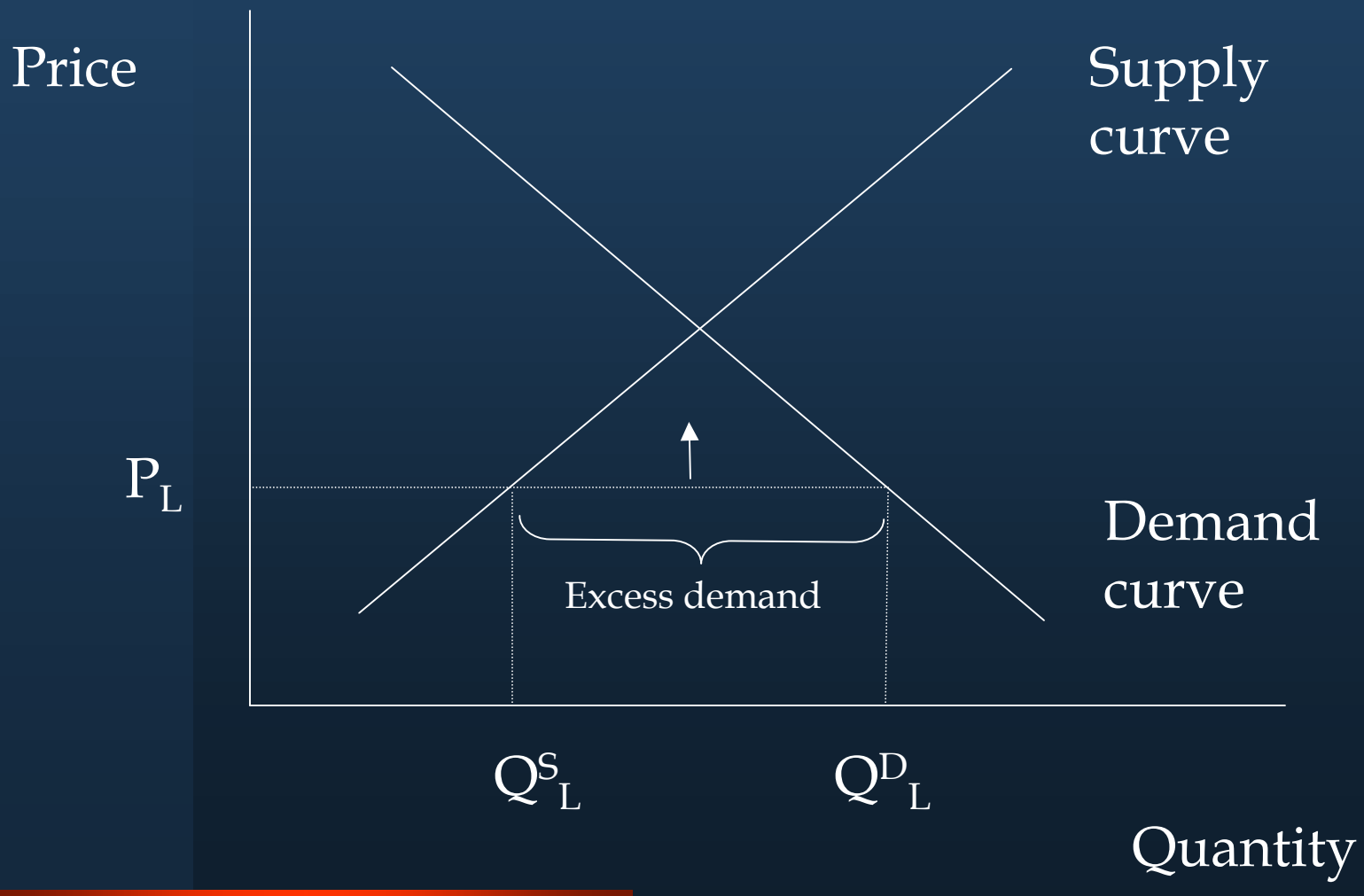
Equilibrium



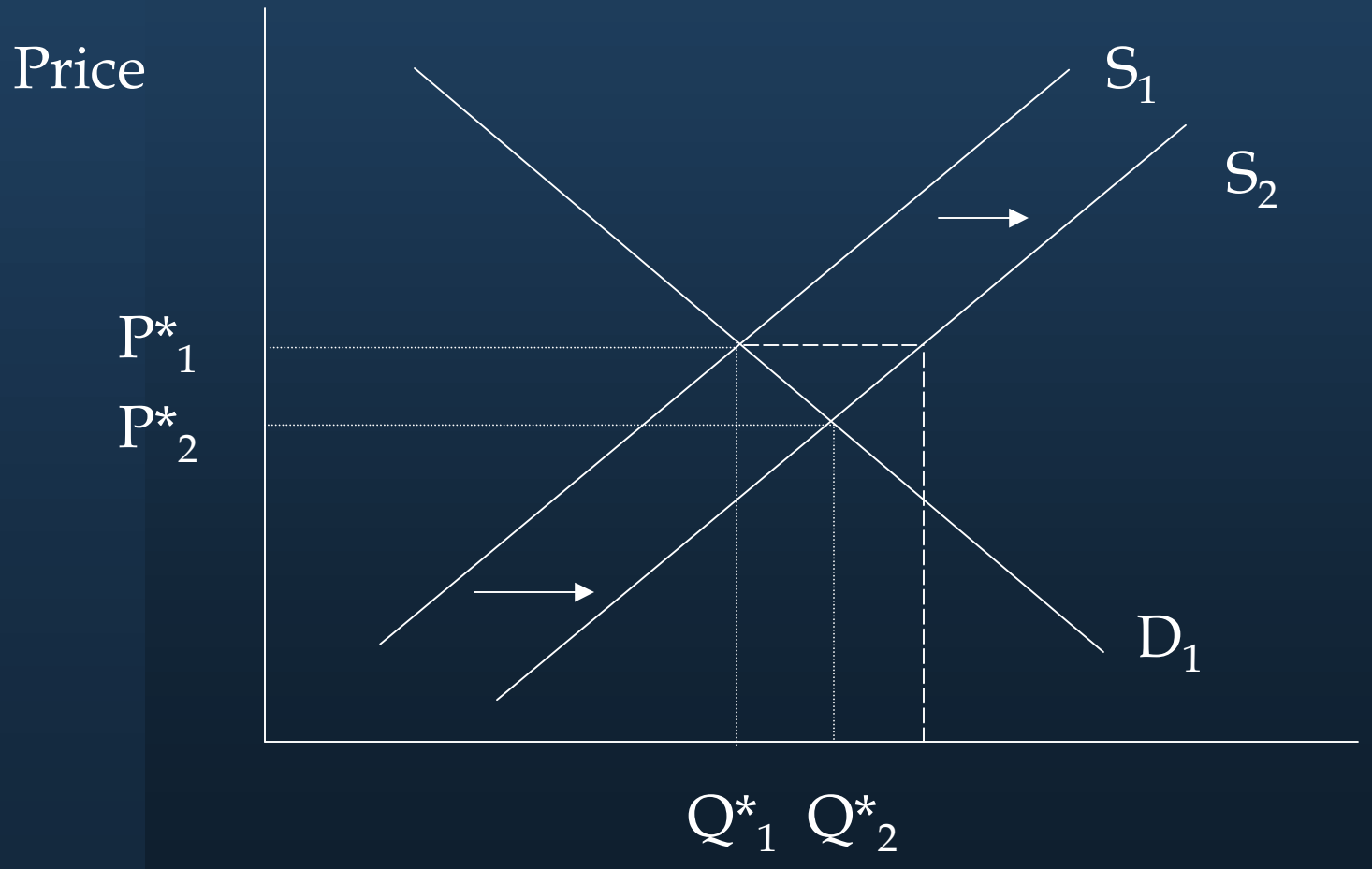
Disequilibrium I: Excess Supply



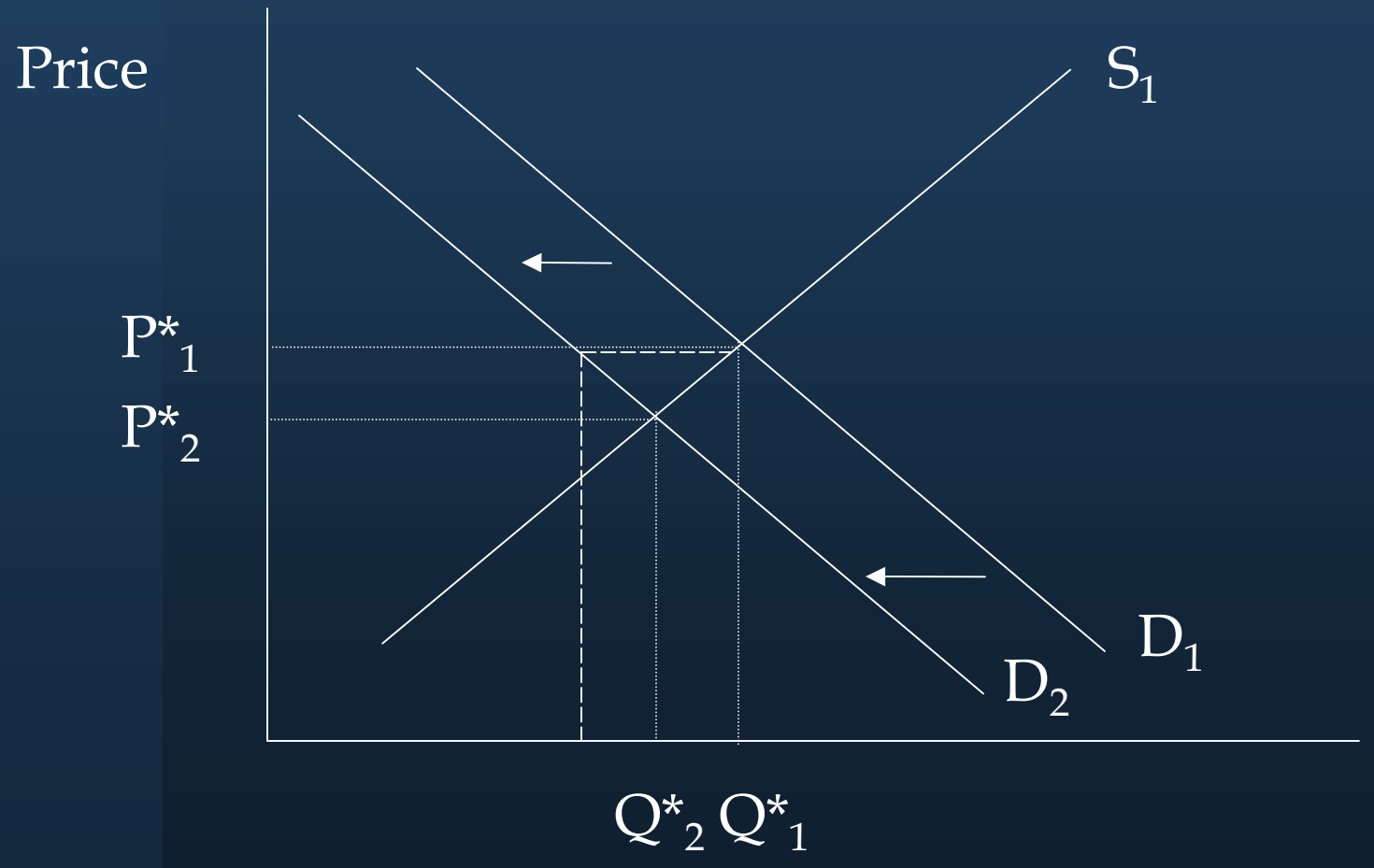
Disequilibrium I: excess demand



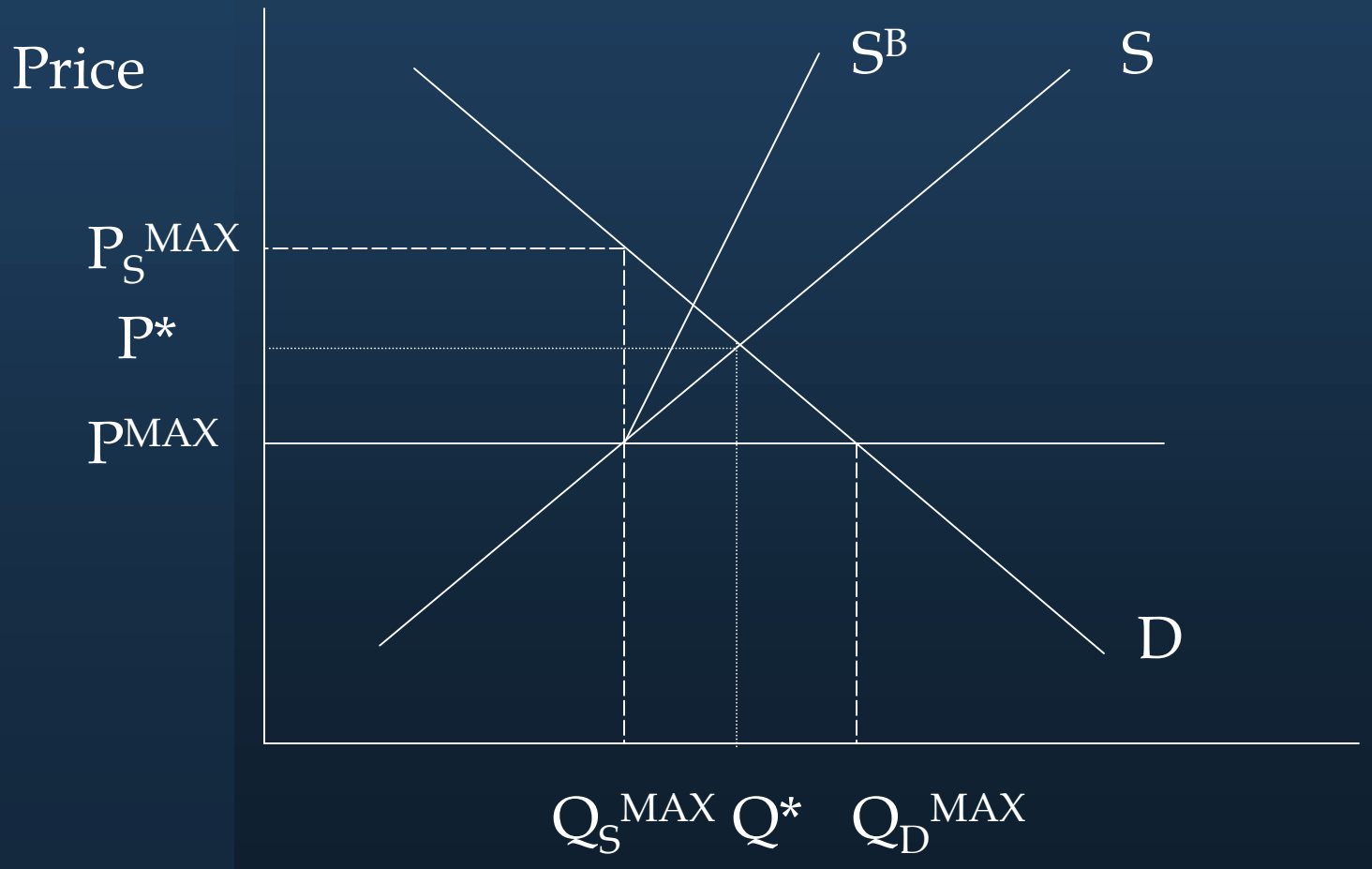
Adjustment I



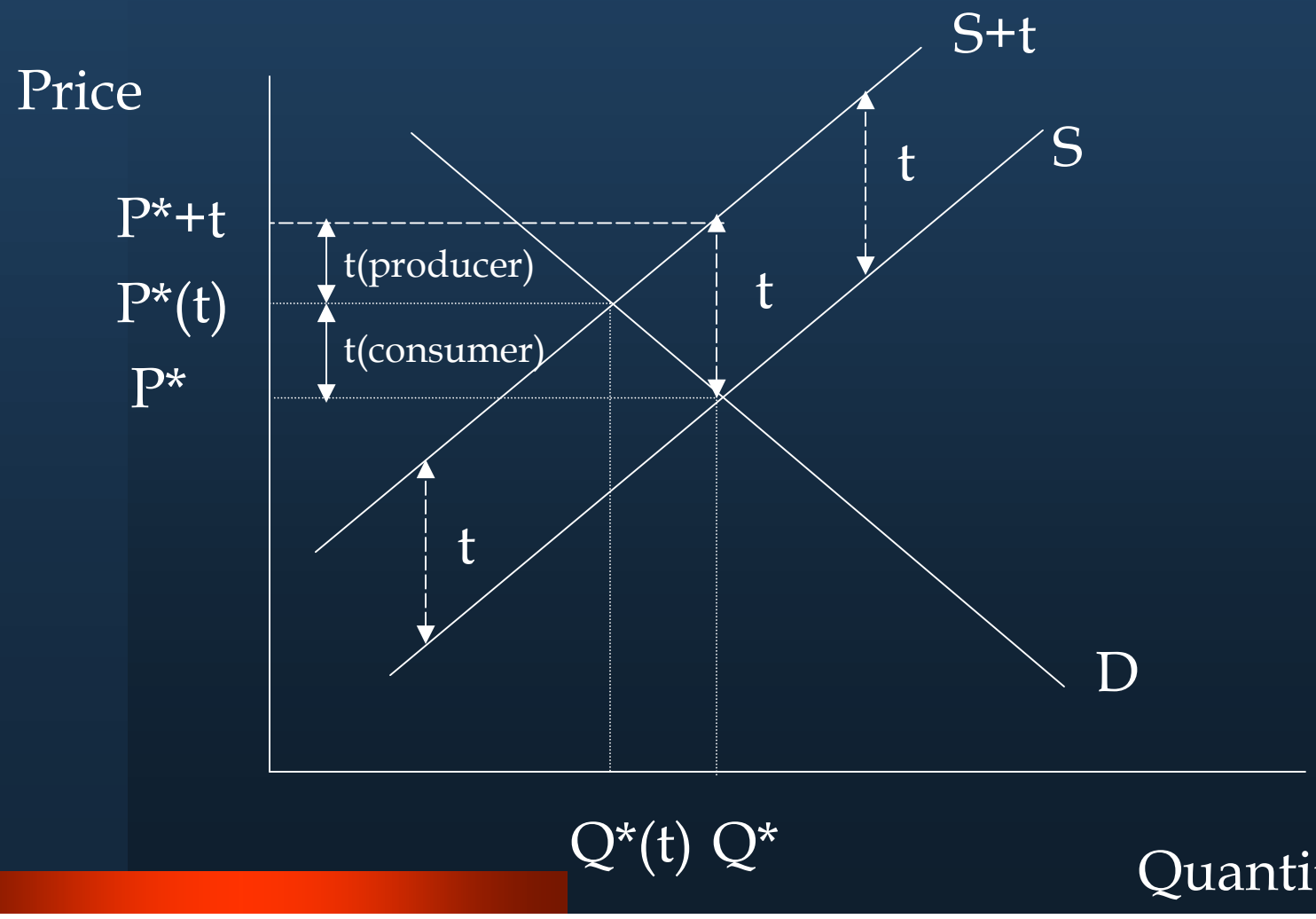
Adjustment II



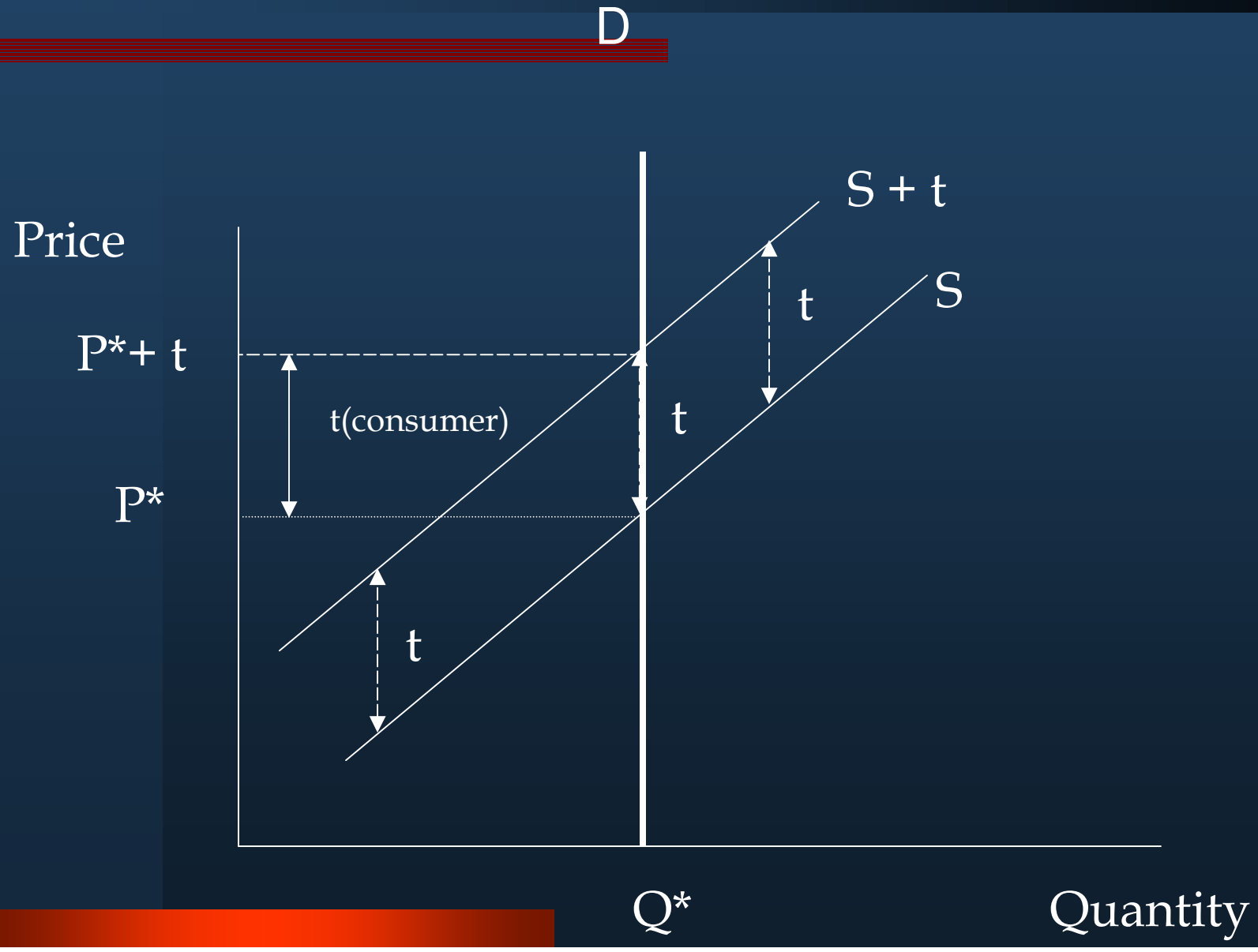
Maximum price



Taxing (and who pays it?)



Stiffer pay more (all?)



Objectives of a firm

- Profit maximisation (MR=MC)
  - What are profits?
- Ideal types
- Ownership and control
- Incentives (!!!)
  - Incomplete information (asymmetry)
  - Formulating a contract
  - Enforceability

Monopoly

- The choice of a monopolist
- Why monopoly is a bad thing?
- Why monopoly is bad for the monopolist?
- Price discrimination

Monopoly

- Demand curve (consumer preference constraint)
  - Assumed functional form $P = a - bQ$
  - "a" is the size of the market, "b" is its sensitivity to price
  - This dictates how much the monopolist can sell at each possible price
- Cost curve (technology constraint)
  - Assumed functional form $TC = F + cQ$
  - "F" is the fixed cost, "c" is marginal cost

"a", "b", "c" and "F" assumed beyond the firm's control

How sensible is that?

Monopoly

- **Objective: maximise profit**
  - **Profit = Revenues – Costs**
  - **Revenues in our model: PQ**
  - **Costs in our model: F + cQ**

  $\Rightarrow$Profit (π) = PQ – F – cQ = (P – c)Q – F

Monopoly

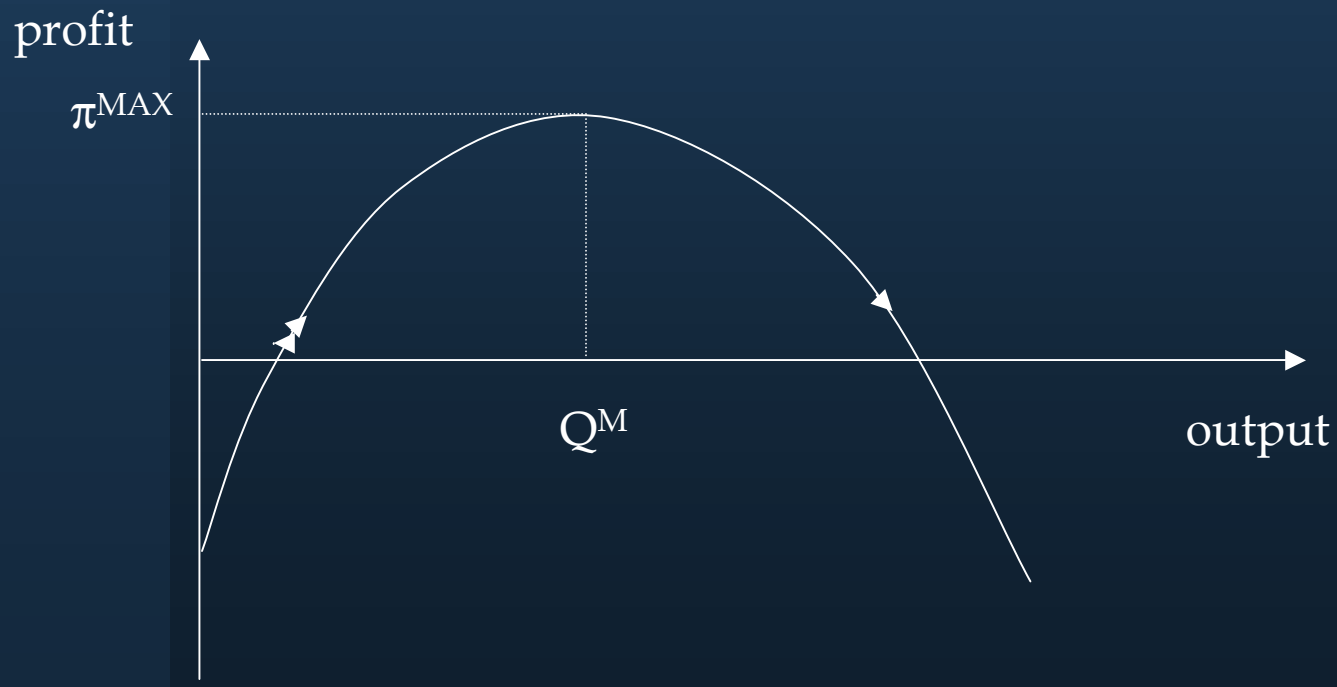
$\pi = (P - c)Q - F$

and

$P = a - bQ,$

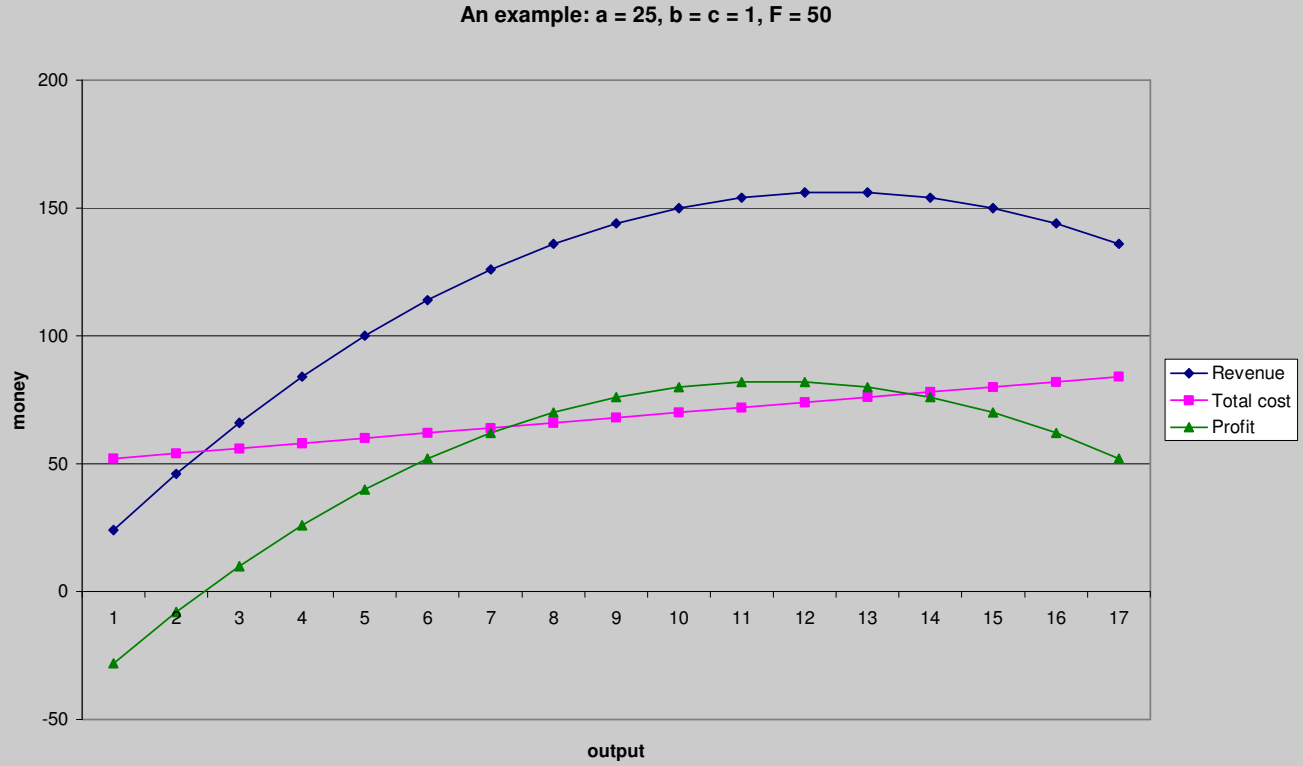
$\Rightarrow \pi = (a - bQ - c)Q - F$

$\Rightarrow \pi = aQ - bQ^2 - cQ - F$

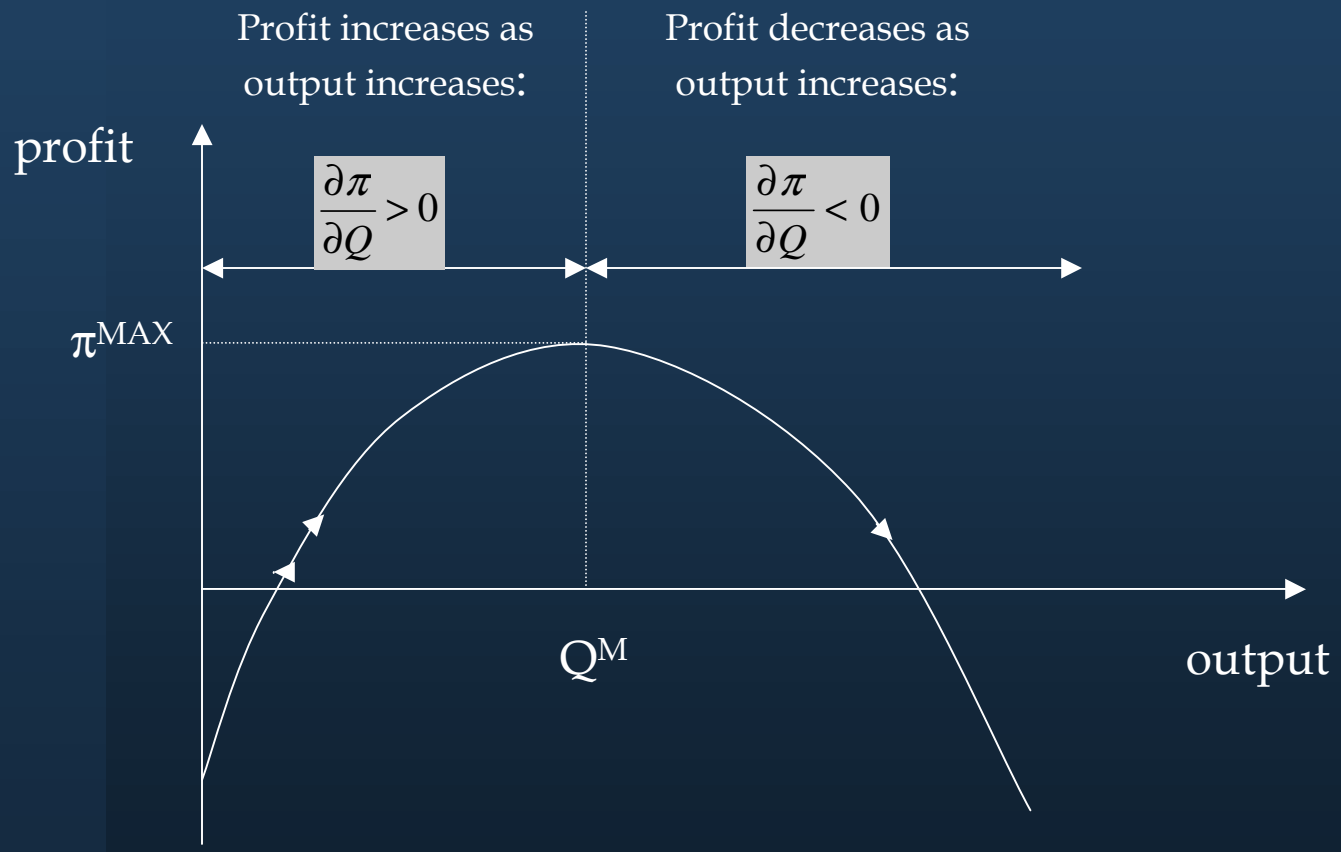


Monopoly – maximising profit

Output	Revenue	Total cost	Profit
1	24	52	-28
2	46	54	-8
3	66	56	10
4	84	58	26
5	100	60	40
6	114	62	52
7	126	64	62
8	136	66	70
9	144	68	76
10	150	70	80
11	154	72	82
12	156	74	82
13	156	76	80
14	154	78	76
15	150	80	70
16	144	82	62
17	136	84	52



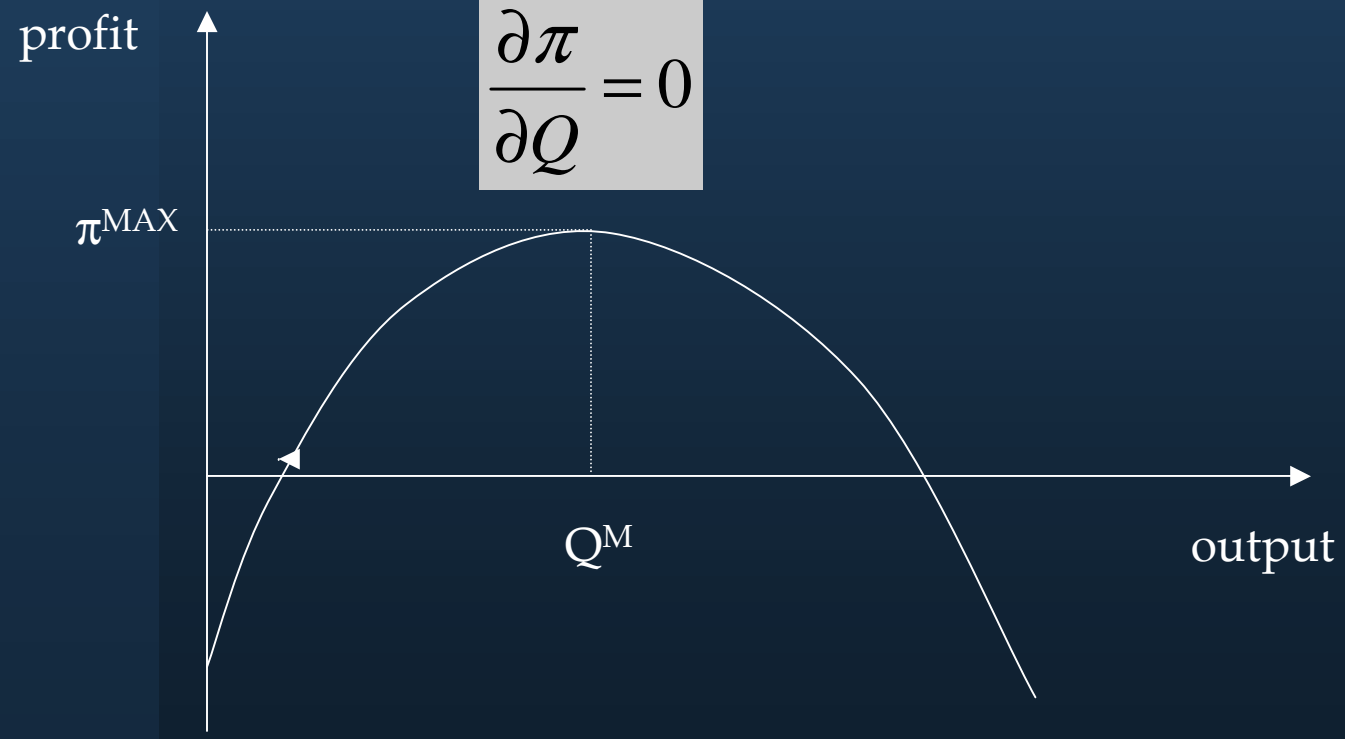
Monopoly – maximising profit



Monopoly – maximising profit

At the peak profit neither increases nor decreases as output increases:

$$\frac{\partial \pi}{\partial Q} = 0$$



Monopoly – finding the maximum

$$\pi = aQ - bQ2 - cQ - F$$

$$\Rightarrow \ \partial\pi/\partial Q = a - 2bQ - c$$

So profit is a maximum when:

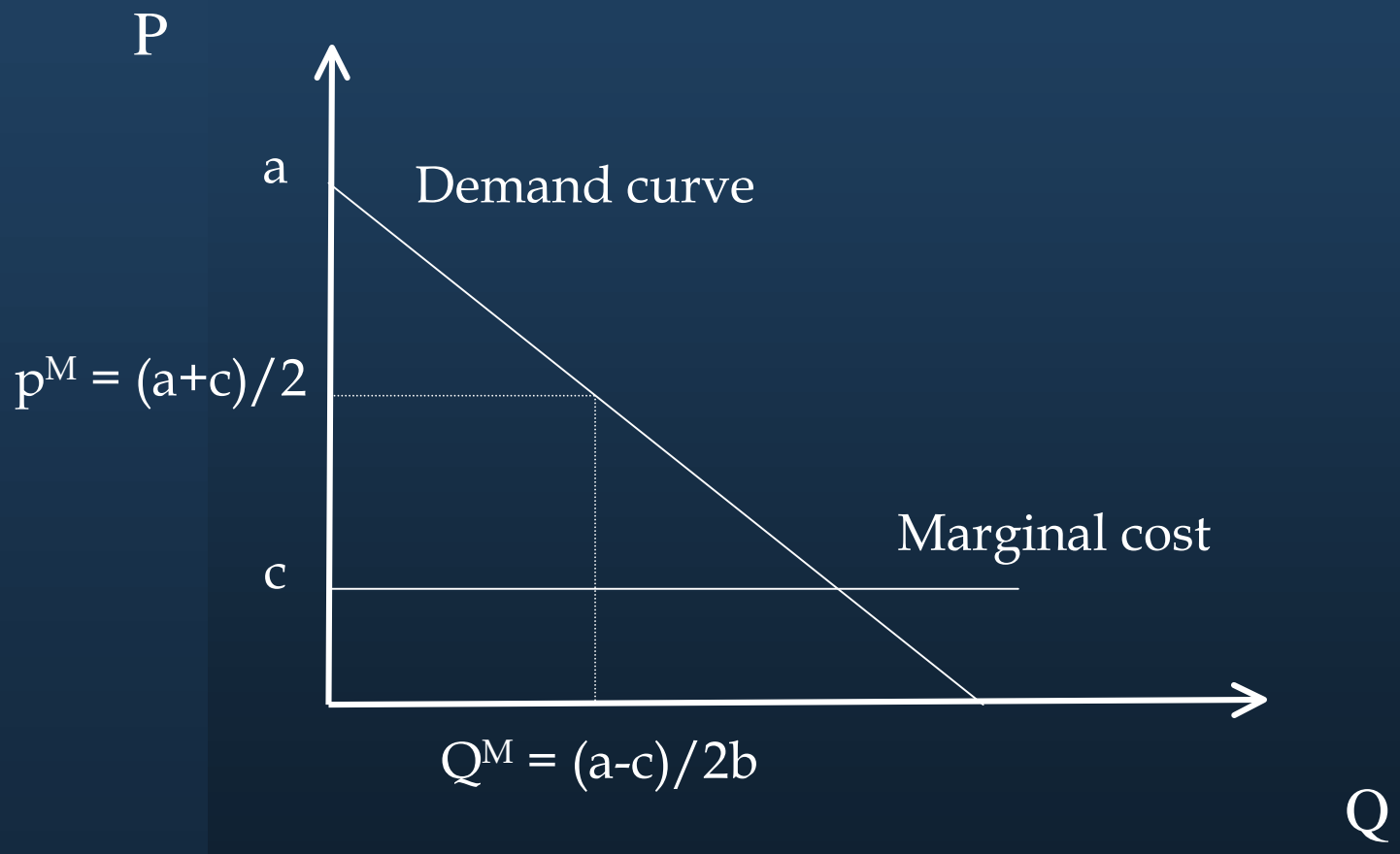
$$a - 2bQ - c = 0$$

This implies

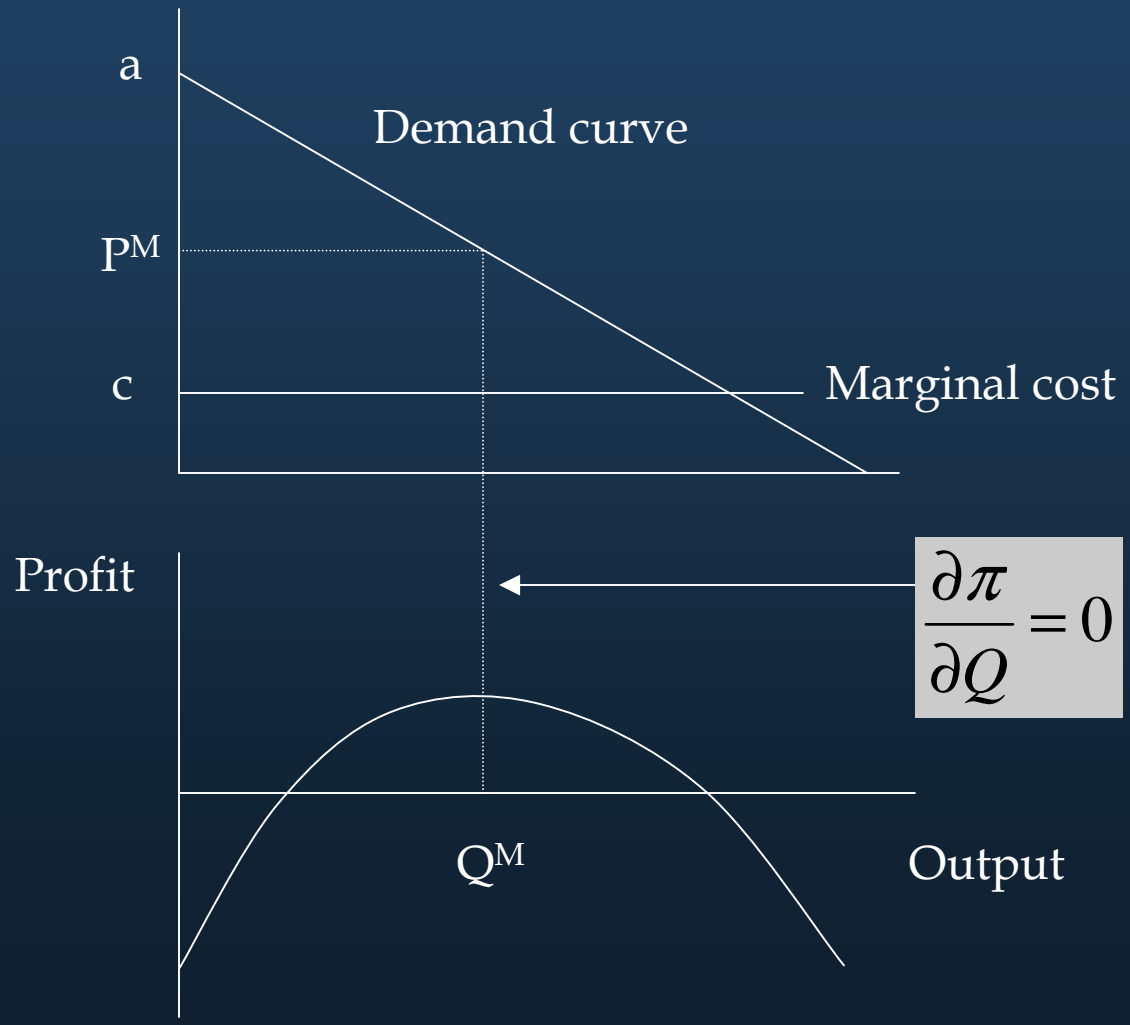
$$Q_M = (a - c)/2b$$

$$p_M = (a + c)/2$$

Monopoly – maximising profit



Monopoly – maximising profit



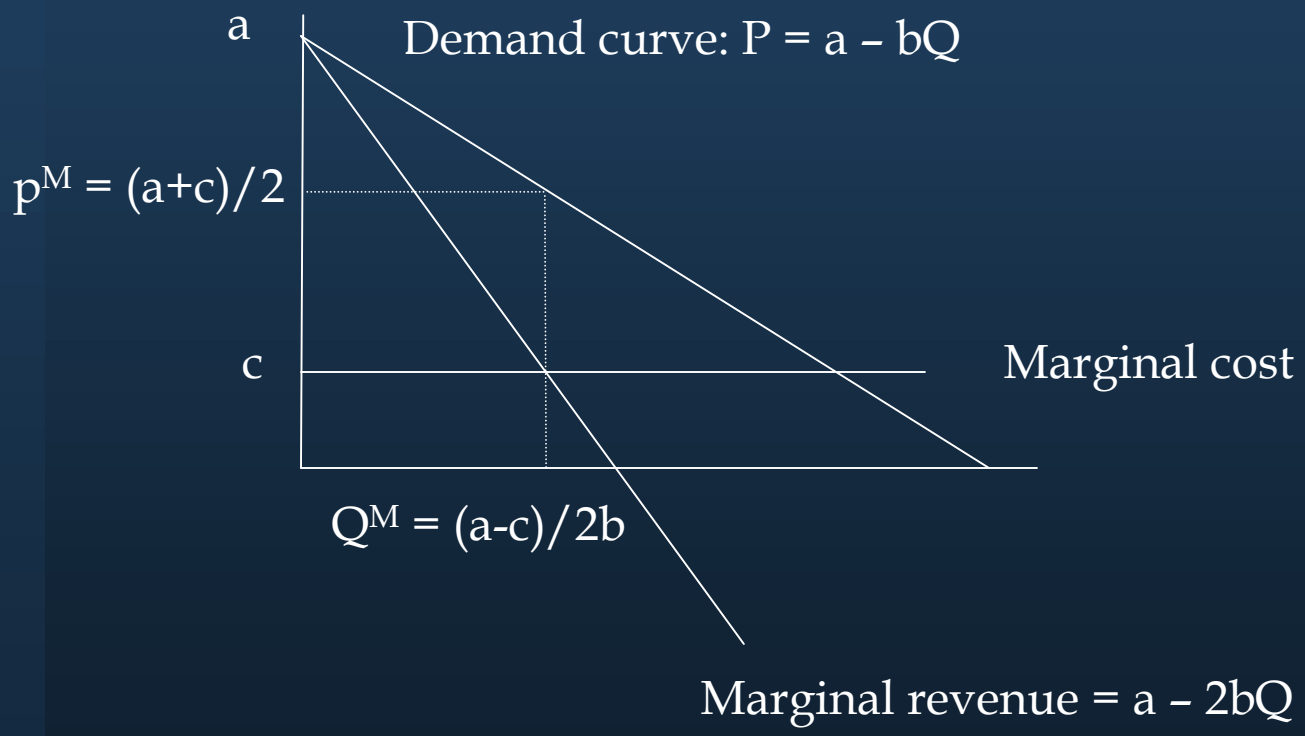
Monopoly – finding maximum (2)

- **Marginal cost is the extra cost of an extra unit of output: $\partial(TC)/\partial Q = c$**
- **Marginal revenue is the extra revenue from an extra unit of output: $\partial(pQ)/\partial Q$**
- **$pQ = (a - bQ)\,Q = aQ - bQ^2$**
- **Therefore marginal revenue = $a - 2bQ$**

Monopoly – finding maximum (2)

- If MR > MC then increasing output adds to profit
- If MR < MC then increasing output reduces to profit
- Thus profit is at a maximum when MR = MC
- That is when $a - 2bQ = c$, i.e. $Q^M = (a - c)/2b$
- This therefore is simply a restatement of the profit maximising conditions
- We can draw MR and MC on a graph

Monopoly – finding maximum (2)

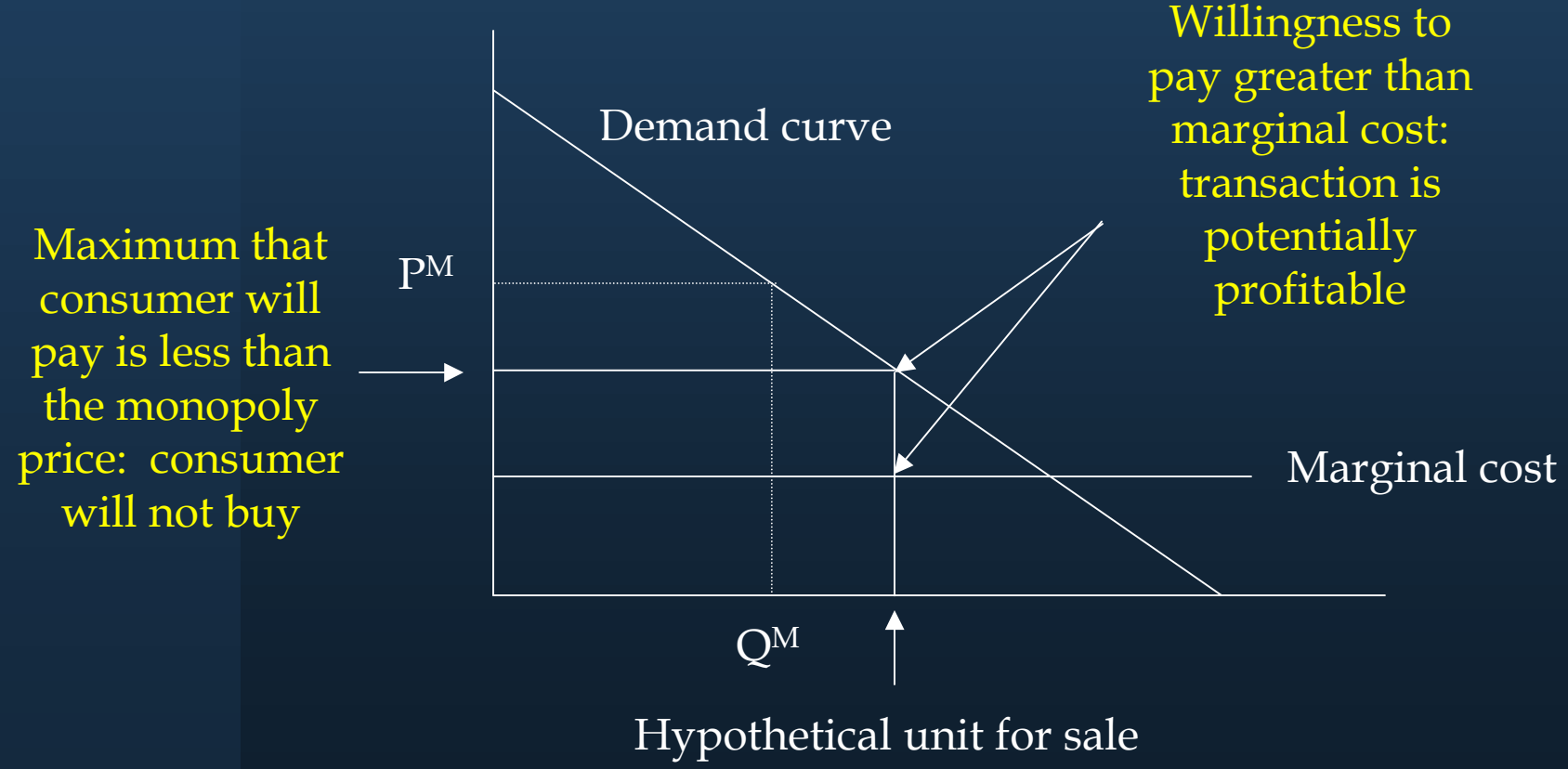


Monopoly – is it bad?

- Prices are too high (?)
  - Sky is not the limit
  - Rational is rational

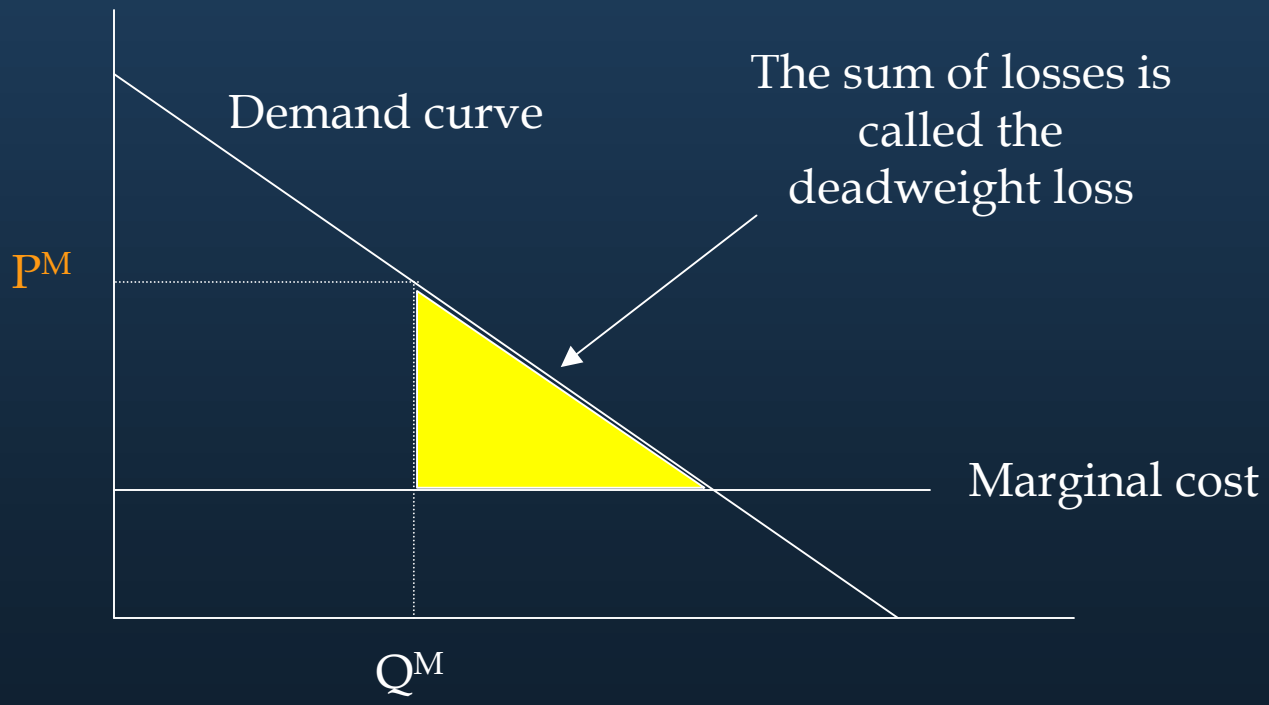
- Rent seeking behaviour
- Lack of incentives to innovate
- Quality
- Social welfare???

Monopoly and consumer



Monopoly and consumer

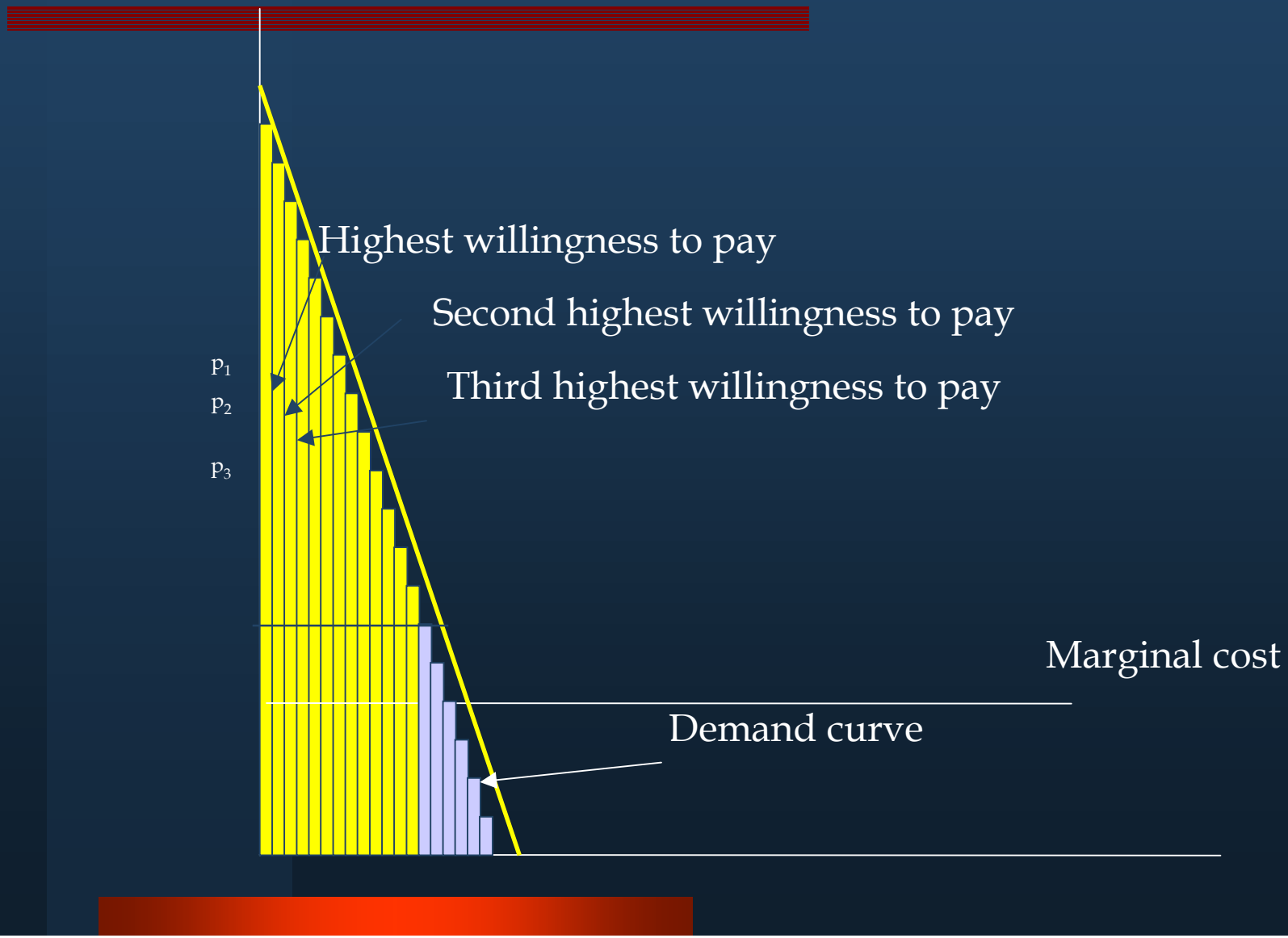
Every unit not sold for which willingness to pay exceeds marginal cost creates a loss



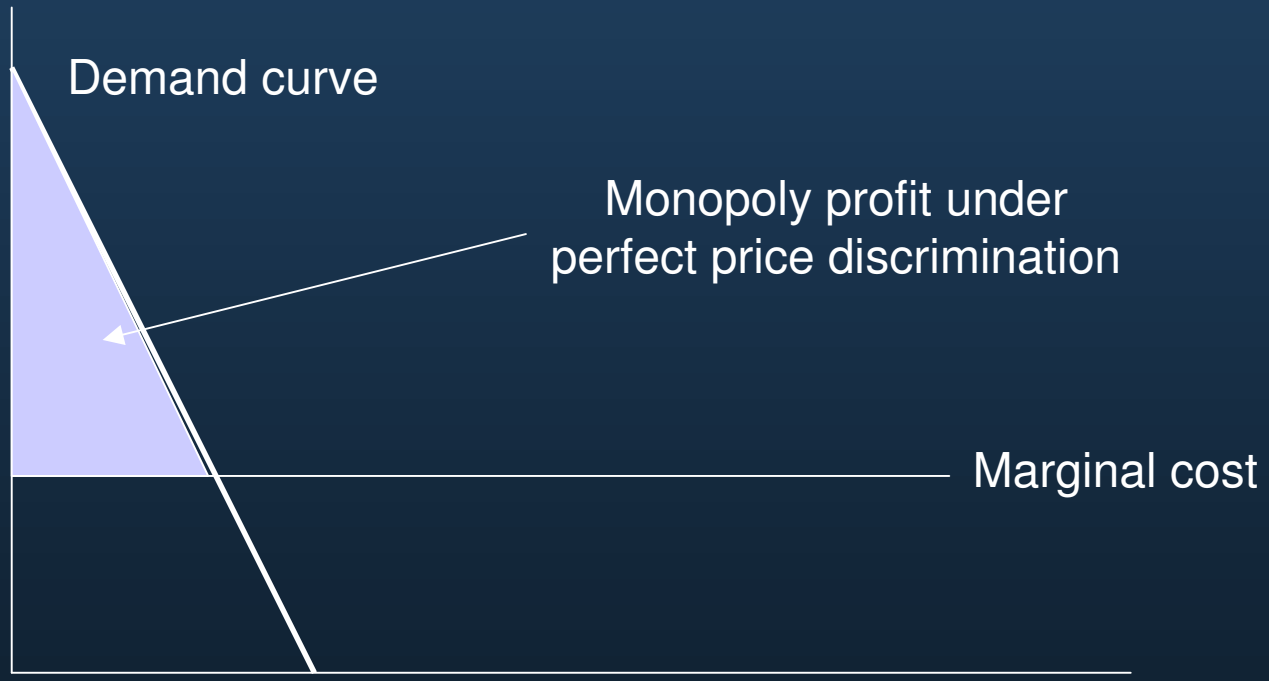
Monopoly - price discrimination

- Charging each consumer their exact willingness to pay is the most profitable solution for the monopolist, but not feasible
- To be feasible, price discrimination requires
  - Market power
  - Scheme to identify consumer types
  - Ability to prevent arbitrage
- Offering consumers a range of choices, to elicit their preferences, allows some discrimination with no information
- Information about consumers can make price discrimination schemes more effective

Monopoly – price discrimination



Monopoly – price discrimination



Monopoly – price discrimination

- **First degree price discrimination**
  - **Each consumer charged exactly their willingness to pay**
- **Second degree price discrimination**
  - **Consumers offered a menu of choices- if designed properly choice will correlated with willingness to pay**
- **Third degree price discrimination**
  - **Consumers broken into distinct markets, price in each market set according to what that market will bear**

Perfect competition

- Many buyers and sellers
- Homogeneous product
- Perfect information
- No transaction costs
- Free entry and exit

⇒No incentives to charge a price above market price

⇒Nor to sell below the market price

⇒Result: firms are price takers (!)

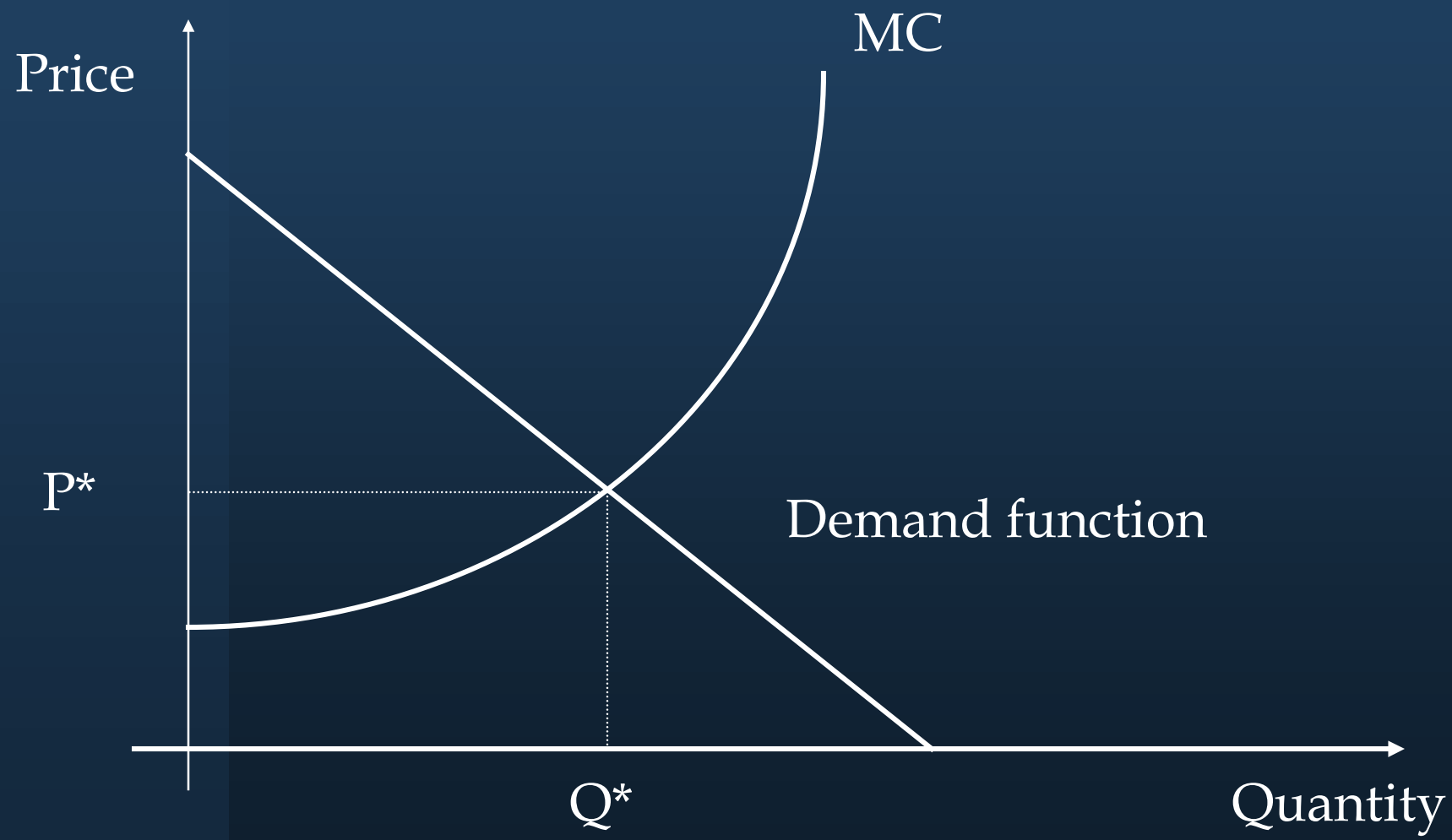
Profits?

Profits in perfect competition

- **Long run *versus* short run**
- **No entry barriers!**
- **Price taking: P=MR**
- **Cost of a product (in the limit): MC**
- **Value of a product (in the limit): MU=p**

$\Rightarrow$**P=MC**

Perfect competition graphically



A numerical example – short run

- Given

P=\$10, $C(Q) = 5 + Q^2$

- Optimal Price?

P=\$10

- Optimal Output?

MR = P = \$10 and MC = 2Q

10 = 2Q

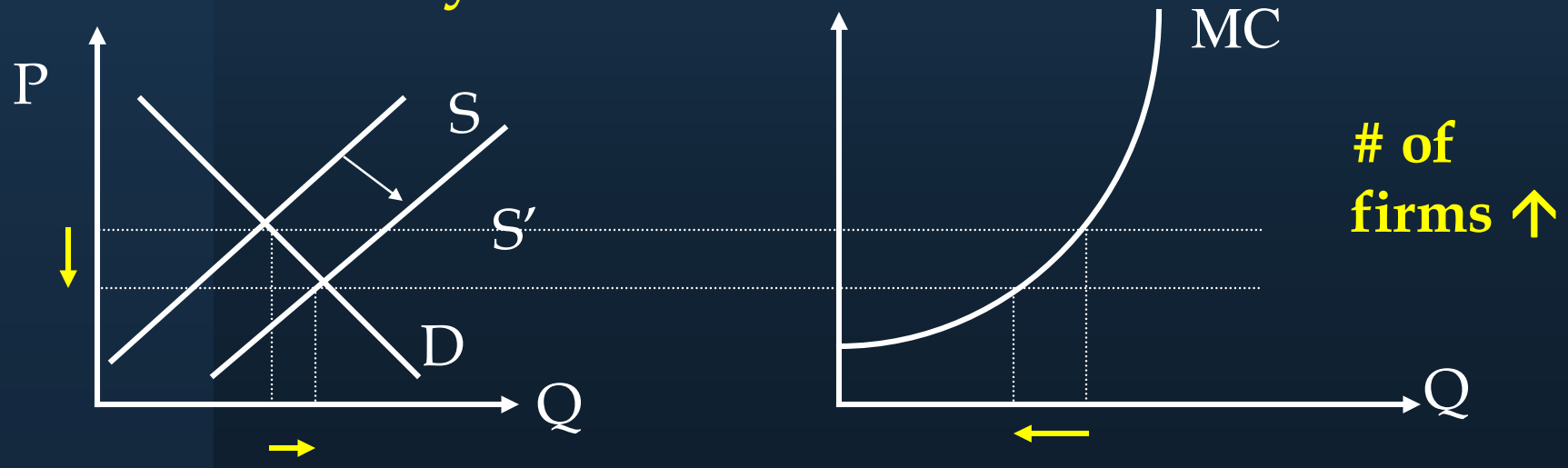
Q = 5 units

- Maximum Profits?

PQ - C(Q) = (10*5) - (5 + 25) = \$20

A numerical example – long run

- If firms are price takers but there are barriers to entry, profits will persist
- If the industry is perfectly competitive, firms are not only price takers but there is free entry.



Perfect competition

Is this unrealistic?

- Many small businesses are "price-takers," and decision rules for such firms are similar to those of perfectly competitive firms (example: computer chip industry)
- It is a useful benchmark
- Illuminates the "danger" to managers of competitive environments
- Importance of product differentiation and building sustainable advantages.

Managing in perfect competition ☺

Top 5 Ways Competition Affects Company That Makes Bubble Wrap

(adapted from David Letterman)

5. Fewer bubbles per square yard

4. No more paying for product placement like the big bubble wrap scene in the upcoming “Harry Potter" movie

3. Cannot afford full-page newspaper ads attacking styrofoam peanuts

2. Bubble wrap no longer shipped in the bubble wrap to prevent damage

1. Employees' Christmas bonus? Bubble wrap !

Oligopoly (only few firms)

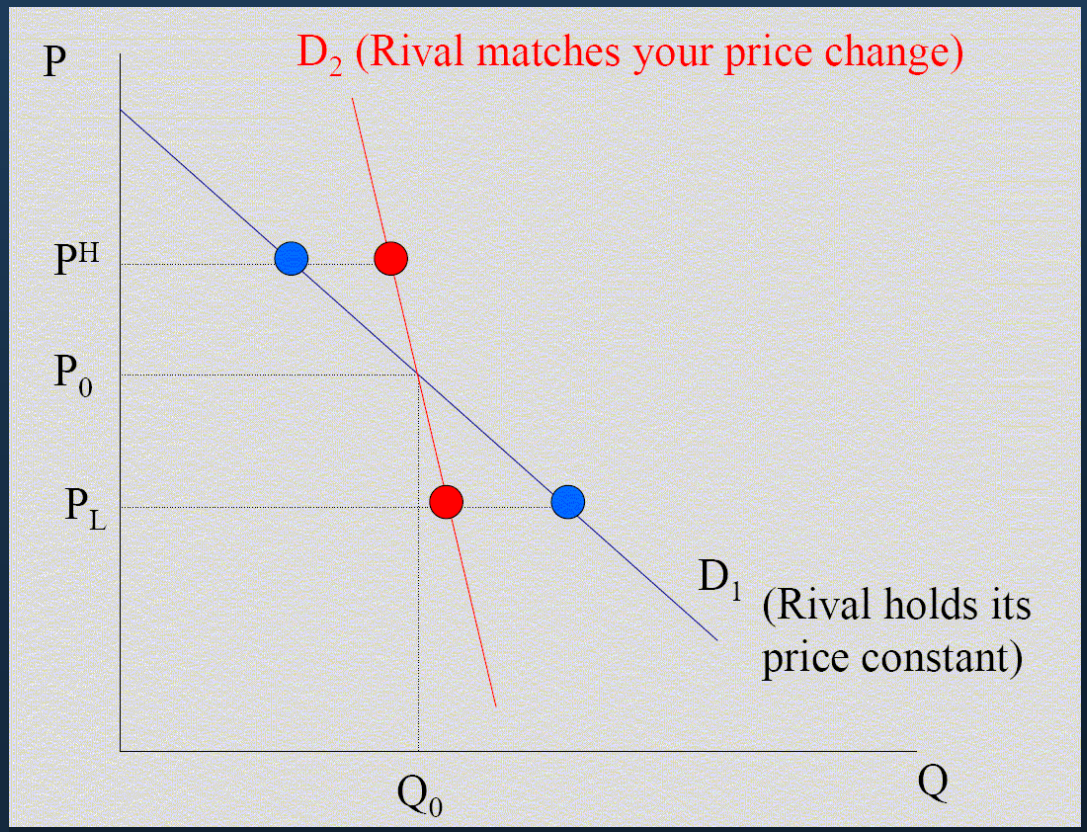
- The products firms offer can be either differentiated or homogeneous.
- There are barriers to entry.
- Strategic interdependence
  - What you do affects the profits of your rivals

Oligopoly (only few firms)

- ***Best response*: not what I want to do, but the best that I can do given what everyone else chooses to do**
- ***Equilibrium*: if everyone choice is a best response, so no deviations.**
- **This is *Nash equilibrium***

Example

- You and another firm sell differentiated products. Impact on Q?



Strategic interdependence

- The effect of a price reduction on the quantity demanded of your product depends upon whether your rivals respond by cutting their prices too.
- The effect of a price increase on the quantity demanded of your product depends upon whether your rivals respond by raising their prices too.
- Strategic interdependence: You aren't in complete control of your own destiny!

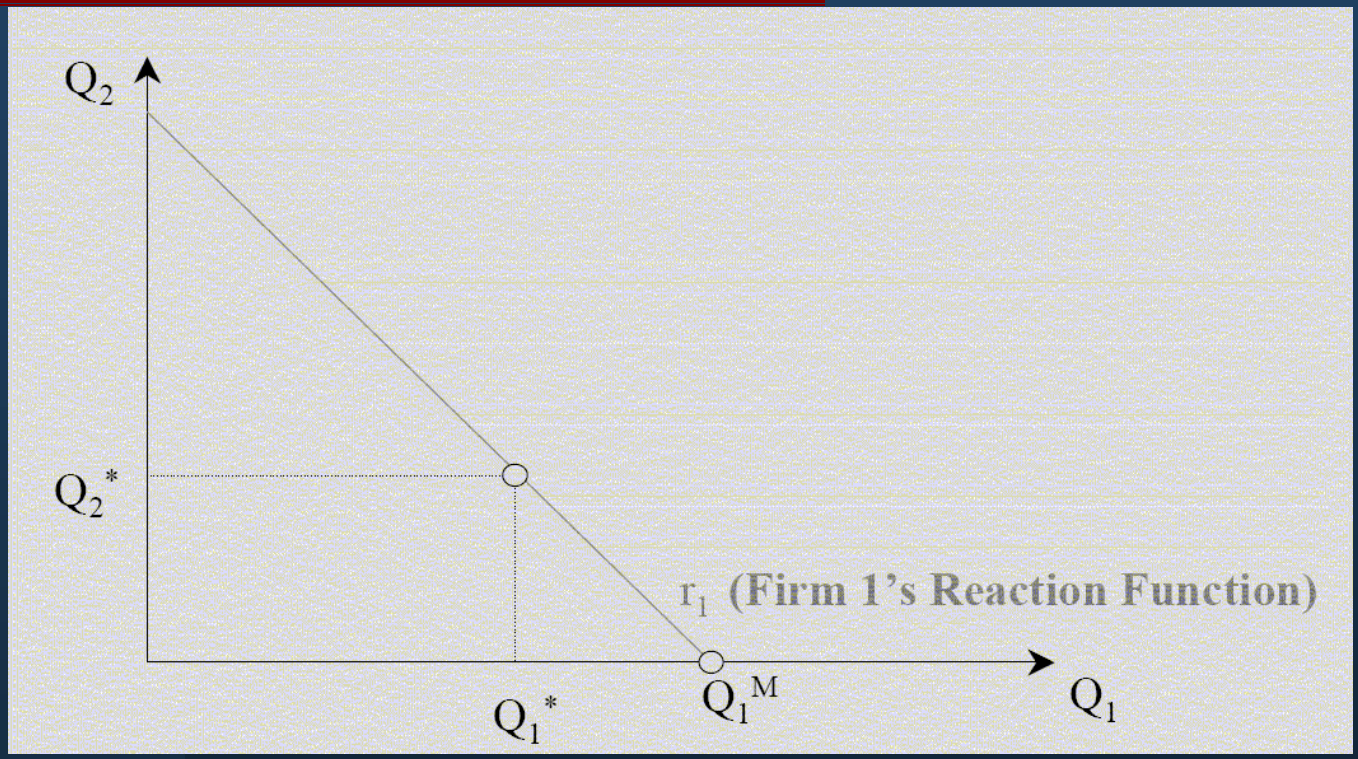
Cournot model

- A few firms produce goods that are either perfect substitutes (homogeneous) or imperfect substitutes (differentiated)
- Firms set output, as opposed to price
- Firms choose output simultaneously - output of rivals is viewed as given or "fixed")
- Barriers to entry?

Cournot model – reaction?

- Suppose homogeneous products.
- Firm 1's reaction (or best-response) function is a schedule summarizing the amount of Q_1 firm 1 should produce in order to maximize its profits for each quantity of Q2 produced by firm 2.
- Since the products are substitutes, an increase in firm 2's output leads to a decrease in the profit-maximizing amount of firm 1's product.

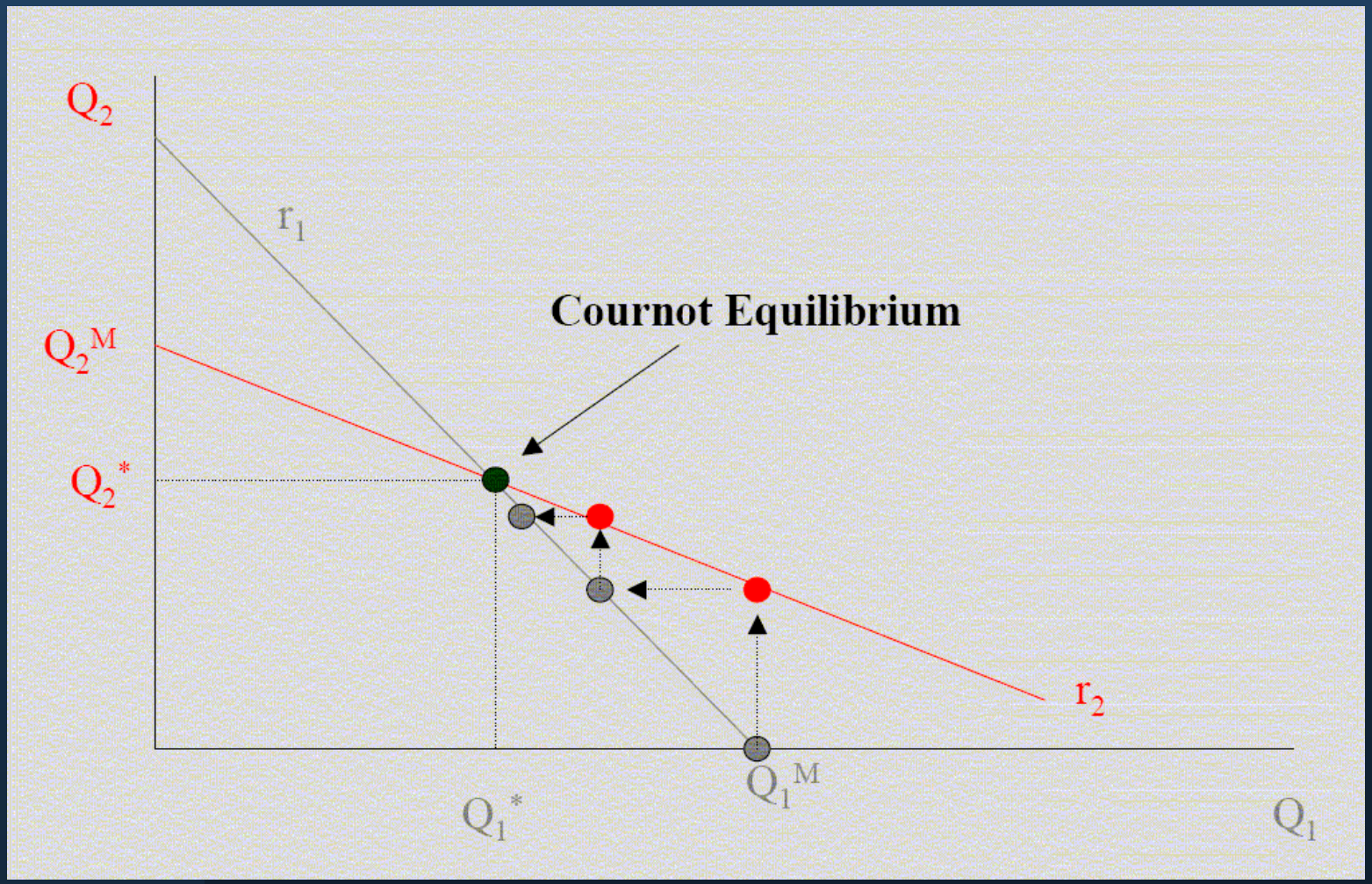
Cournot model – reaction?



Equilibrium

No firm can gain by unilaterally changing its own output

Cournot model – reaction?



Deriving equilibrium

- Assume demand of the following form:

$$P(q_i)=700-Q$$

- The profit for firm 1 could be written as:

$$\pi_1 = (700 - \sum_{i=1}^{7} q_i - c_1)q_1$$

- To keep it simple, suppose that each firm has the same marginal cost (symmetry)

$$\pi_1 = (700 - \sum_{i=1}^{7} q_i - c)q_1$$

- Profit maximisation occurs when the derivative of this equation equals zero

$$\frac{\partial \pi_i}{\partial q_i} = 700 - 2q_1 - q_2 - q_3 - q_4 - q_5 - q_6 - q_7 - c = 0$$

Deriving equilibrium

- Or more conveniently

$$\frac{\partial \pi_1}{\partial q_1} = 700 - 2q_1 - \sum_{j \neq 1} q_j - c = 0$$

- Symmetry simplifies the problem because if marginal costs are the same, the profit maximising output of each firm must the same ($q_i = q_j = q^*$ for every i and j). Hence

$$\frac{\partial \pi_1}{\partial q_1} = 700 - 8q^* - c = 0$$

- And so the symmetric Cournot-Nash equilibrium output for each firm is

$$q^* = \frac{700 - c}{8}$$

Deriving general rule

$$\pi_1 = (a - b\sum_{i=1}^{7} q_i - c)q_1$$

$$\frac{\partial \pi_1}{\partial q_1} = a - 2bq_1 - \sum_{j \neq 1} q_j - c = 0$$

$$\text{since } q_i^* = q_j^* = q^*, then \frac{\partial \pi_1}{\partial q_1} = a - 2bq^* - (n-1)bq^* - c = 0$$

$$\frac{\partial \pi_1}{\partial q_1} = a - (n+1)bq^* - c = 0$$

$$q^* = \frac{a - c}{(n+1)b}$$

What if n goes to infinity?

- **Once quantity is known, price is easily derived from the demand function (Q=n*q).**

$$q^* = \frac{a - c}{(n+1)b}$$

- **What if n goes to infinity?**

What if n goes to infinity?

- **Output of each firm**

$$q^* = \frac{a - c}{(n + 1)b}$$

- **Industry output**

$$Q^* = \frac{n}{n+1}\left(\frac{a-c}{b}\right)$$

- **Market price**

$$p^* = \frac{a+nc}{(n+1)} = \frac{a}{(n+1)} + \left(\frac{n}{(n+1)}\right)c$$

- **Industry profit**

$$\pi^* = \frac{1}{b}\left(\frac{a-c}{(n+1)}\right)^2 - F$$

Stackelberg model

- Few firms
  - Homogenous or differentiated product
- Barriers to entry?
- There is one leader
  - He sets his output (or price) before everybody else
  - A sequential game instead of simultaneous one (!)
- Remaining firms are followers
  - They set output to maximise their profits GIVEN the output of a leader.

Stackelberg model

- Illustrates how commitment can enhance profits in strategic environments
- Leader produces *more* than the average Cournot equilibrium output
  - Larger market share, higher profits
  - First-mover advantage
- Follower produces *less* than the average Cournot equilibrium output
  - Smaller market share, lower profits

Stackelberg model

- **What about overall market outcome?**

Bertrand model

- Few firms
  - Firms produce identical products at constant marginal cost.
- Each firm independently sets its price in order to maximize profits
- Barriers to entry (?)
- Consumers enjoy
  - Perfect information
  - Zero transaction costs

Betrand model

- In equilibrium firms set $P_1 = P_2 = MC$!
- Why?
  - Suppose $MC < P_1 < P_2$
  - Firm 1 earns (P_1 - MC) on each unit sold, while firm 2 earns nothing
  - Firm 2 has an incentive to slightly undercut firm 1's price to capture the entire market
  - Firm 1 then has an incentive to undercut firm 2's price.
  - This undercutting continues...
- Equilibrium: each firm charges $P_1 = P_2 = MC$

Bertrand model

Price competition is tough!

Even only two firms can lead to zero profits !!!

- Three ways to reduce competition
  - Product differentiation
  - Collusion (can even be a noncooperative solution)
  - Capacity constraints (can't flood the market)

- **Credibility?**

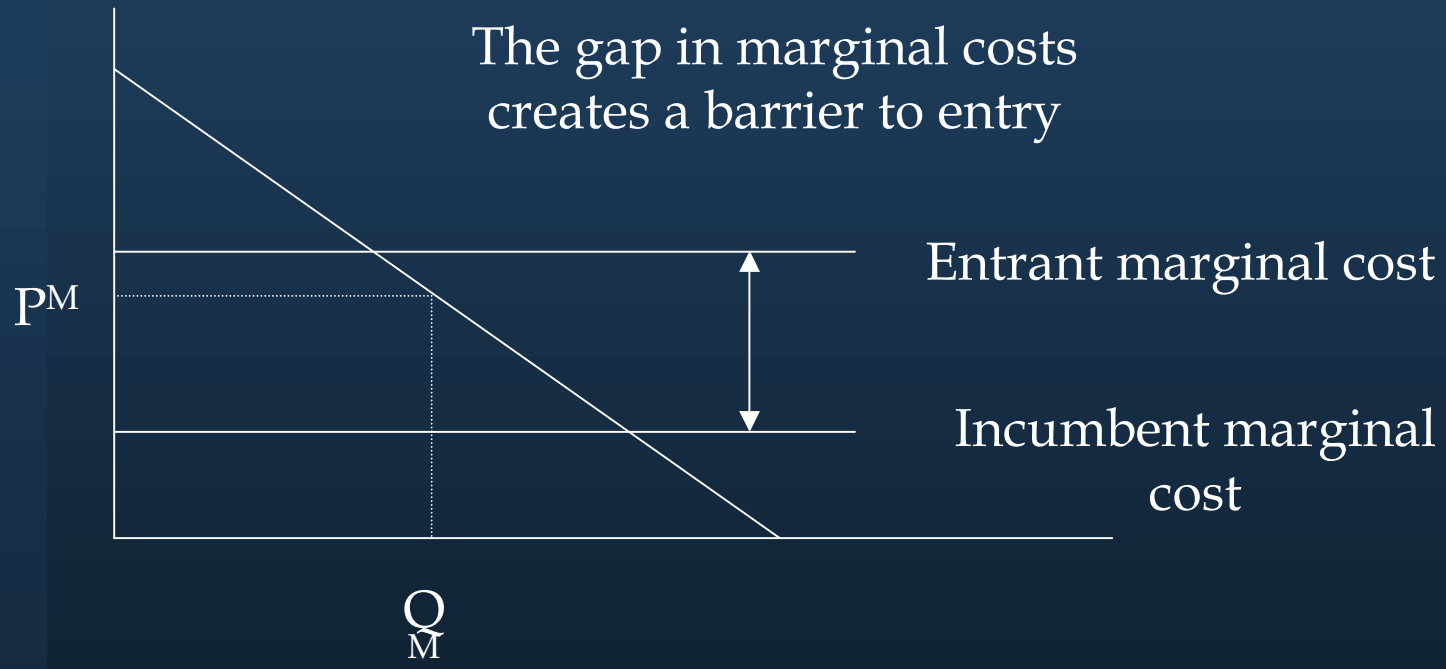
Entry deterrence

Definition of an entry barrier

1. **A potential entrant observes that incumbent generate profits**
2. **The potential entrant believes that upon entering the market it would fail to make profits**

Point 1 is crucial- no one enters a zero profit industry but there is no barrier

Barrier 1 - absolute cost advantages



Barrier 1 – absolute cost advantage

- Technology, R&D
- Patents
- Labour costs
- Access to raw materials
- Tax breaks and government subsidies
- Learning curve (first mover advantage)

Barrier 2 - product advantages

- Brand names
- Can sell more at equal prices
- What generates brand advantages?
- Requires investment (has an NPV)
- Like an asset- depreciates over time

Barrier 3 - sunk costs

- Fixed asset investments
- No alternative use
- Already paid for by the incumbent, must be committed by an entrant
- Implies that the entrant is willing to suffer lower profitability than the incumbent.

Barrier 4 - economies of scale (?)

- Can a monopolist using economies scale charge $P^M > AC$?
- Depends on whether entry is expected
- Entrant must also enter using scale
- Two firms operating implies no sustainable equilibrium if there is competitive undercutting
- Would anyone enter on a large scale in these circumstances?
  - Yes, if fixed costs are not sunk
- *Fixed costs sunk*: public utilities- will charge monopoly prices unless regulated
- *Fixed costs not sunk*: airlines- prices may be competitive even when there is no competition!

Strategic entry barriers

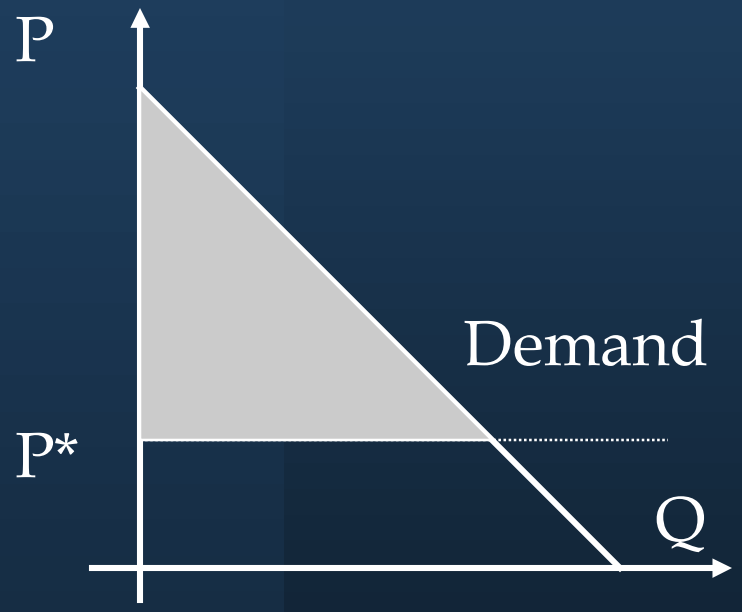
- **Use threats to frighten competitors**
  - **kill the competition"**
- **More than the ordinary process of competition**
- **Not the same as the exploitation of an innocent barrier**
- **When would it make sense to threaten to "fight"?**

Entry deterrence - credibility

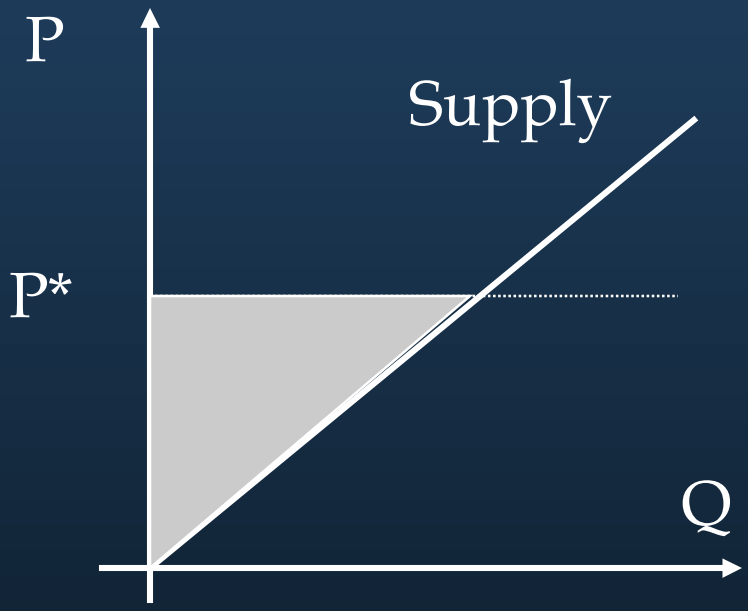
- Business is not like boxing
  - Room for win-win?
- Threats that hurt yourself are not rational
- Would further repetition make the threat rational?
- Would future entrants be deterred
- If there is investment in deterrence, one day there must also be bill

Social welfare

Consumer surplus



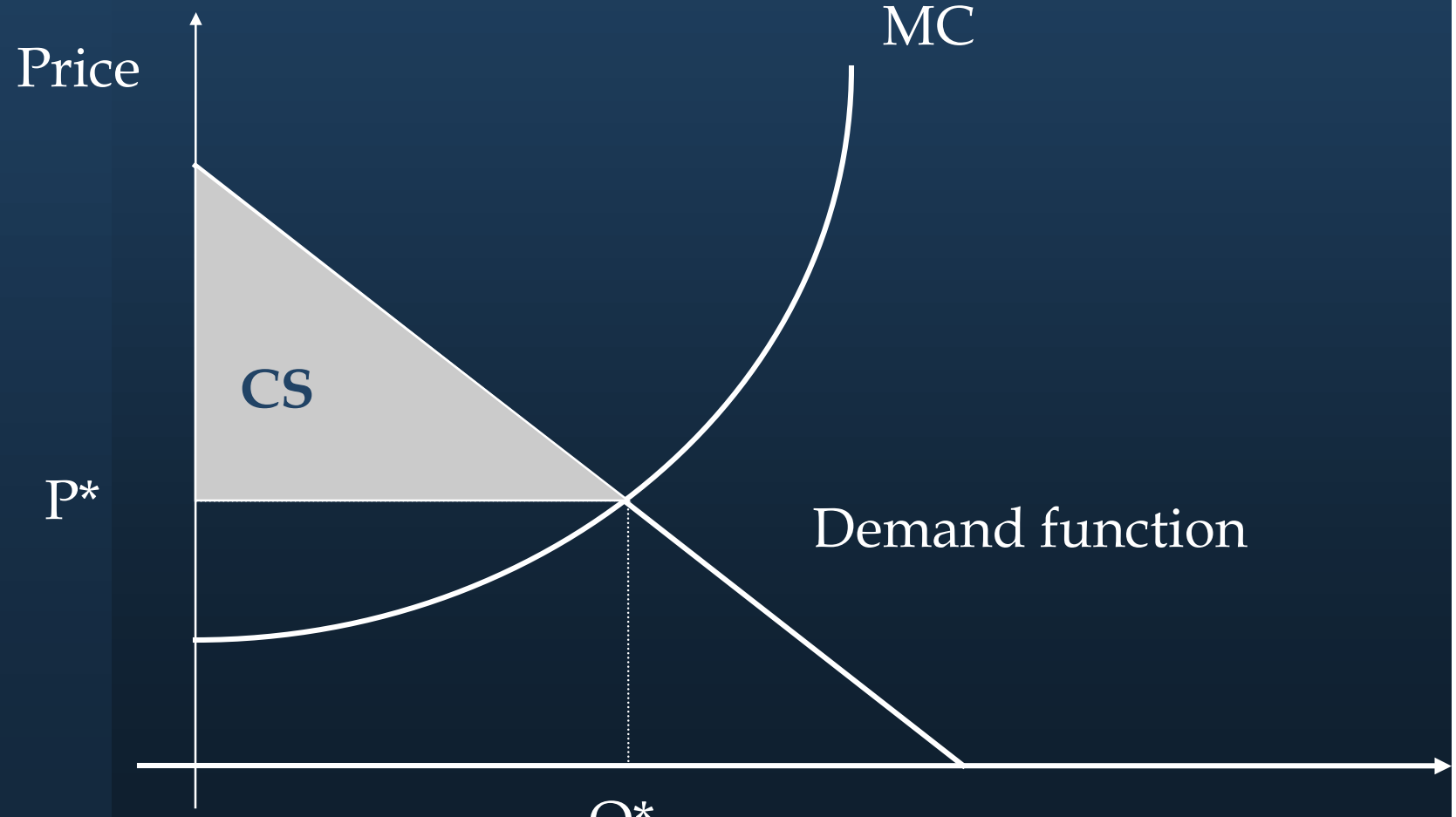
Producer surplus



In general: W=CS+Profits

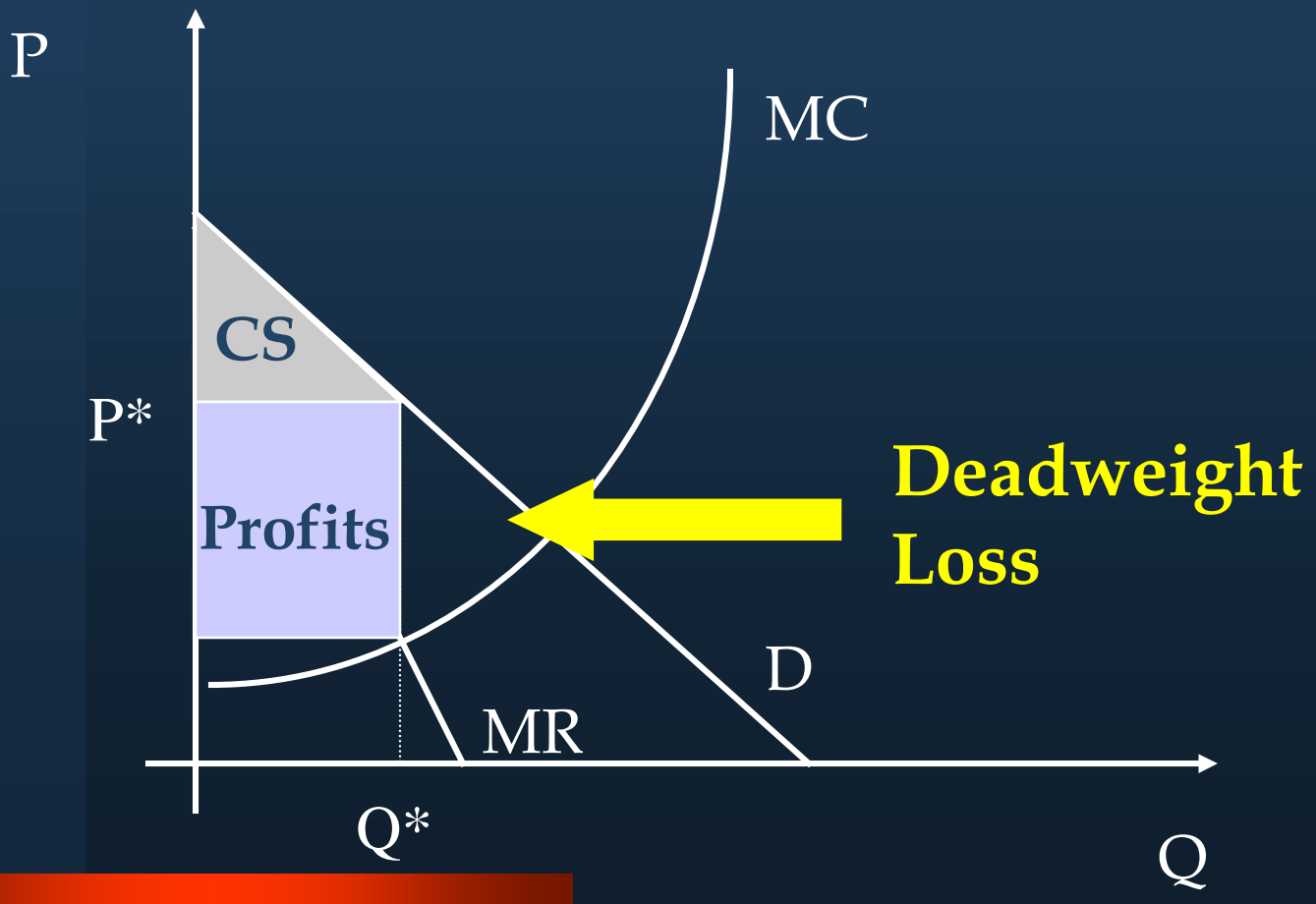
When is social welfare biggest?

- **Perfect competition**



When is social welfare smallest?

- **Monopoly**



Other cases

- **Bertrand like perfect competition ($P^{Bertrand}=P^{PC}=MC$)**
- **Cournot better than monopoly ($P^{M}>P^{Cournot}>P^{PC}=MC$)**
- **Stackelberger better than Cournot ($P^{M}>P^{Stackelberg}>P^{Cournot}>P^{PC}=MC$)**

WHY GOVERNMENTS OPPOSE MONOPOLIES?

What is best for a company?

- **Perfect competition?**
- **Bertrand?**
- **Cournot?**
- **Stackelberg?**
- **Monopoly?**

- **Cooperation maybe ...**