


# 7. OLIGOPOLY

# Contents

- ▶ oligopoly features
  - ▶ specific models of oligopoly behaviour:
    - cartel
    - Cournot model
    - dominant firm (price leader) oligopoly
    - Sweezy model with kinked demand curve
  - ▶ Nash equilibrium
- 

# Oligopoly features

- ▶ relatively few firms in the industry (two at least)
- ▶ firms are highly dependent on each other's behaviour (tendency to copy the behaviour)... why?
- ▶ product can be homogenous or different
- ▶ meaningful barriers to enter/leave the industry (but not impassable), often:
  - ▶ economies of scale, limit prices, legal restrictions, differentiation costs etc.
- ▶ oligopolistic firm is a price maker

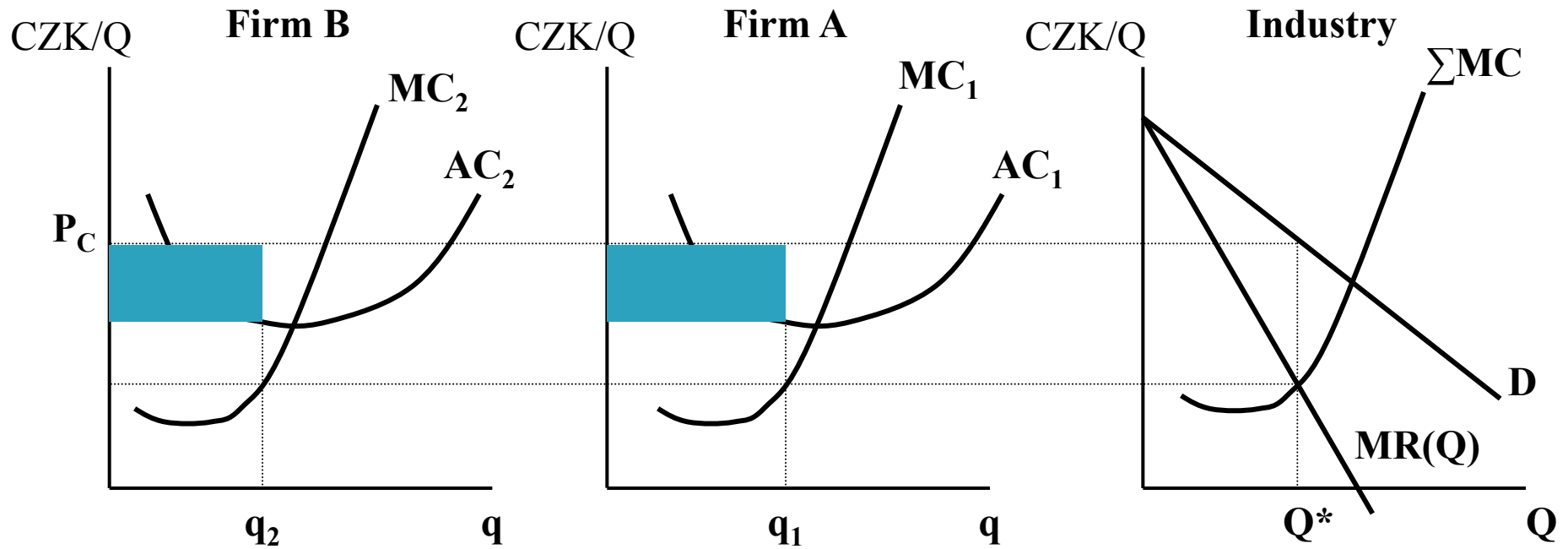
# Specific models of oligopoly behaviour

# Cartel

- ▶ cartel = collusive oligopoly
- ▶ group of firms behaving like a monopoly with several factories
- ▶ cartel's aim = to maximize economic profit of the entire cartel (not each firm)
- ▶  $\pi = P.Q - [TC_1(q_1) + TC_2(q_2) + \dots + TC_n(q_n)] \max.$
- ▶  $MR(Q) = MC_i(q_i)$
- ▶ cartels: OPEC (explicit cartel), gas retailers + banks (inspected cases in the CR)

# Cartel equilibrium

$$MR(Q) = MC_i(q_i)$$



Equilibrium output and price of cartel si derived from intersection of industry MC and MR

$P_C$  - cartel equilibrium price,  $q_1, q_2$  equilibrium outputs of cartel firms

# Fundamental problems of cartel

Cartel is generally unstable, because:

1. *mostly illegal...*
2. *...so legally unenforceable to keep the cartel price (or production quota)*
3. *if different profits of cartel firms, tendencies to break the cartel price (or production quota)*
4. *tendencies to decrease the price (or increase production) to increase firm's profit*

# Cournot model

Assumptions:

1. *2 firms in the industry (duopoly)*
2. *homogenous production – equal cost functions*
3. *firms know the market demand*
4. *firms consider the other firm's output as constant – firms do not anticipate each other's reaction on the change of output or price*
5.  *$MC = AC$  – constant (we assume that  $MC=0$ )*



# Cournot model - equilibrium formation

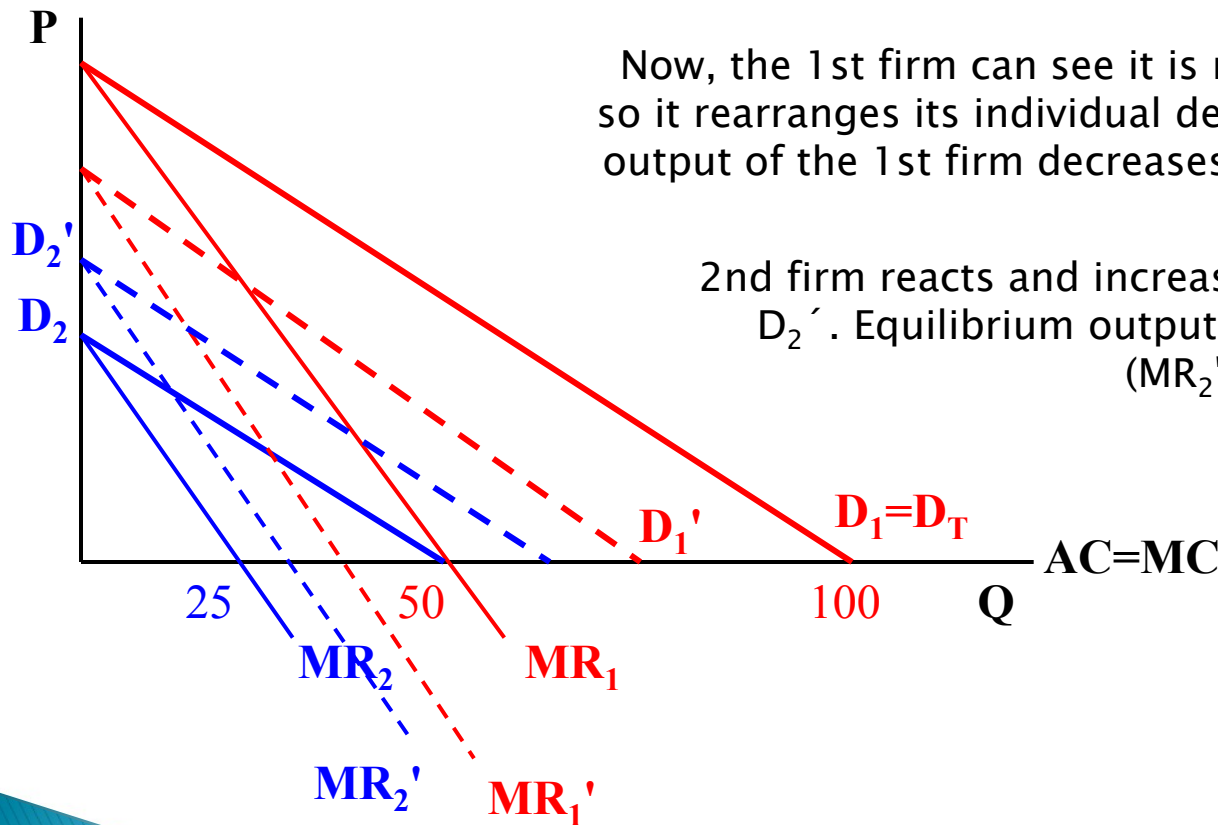
1st firm enters the market and behaves as monopoly –  $MR_1$  derived from the market demand, equilibrium output = 50

2nd firm enters the market and knows about the production of the 1st firm. 2nd derives its individual demand  $D_2$  and  $MR_2$  functions, equi.  $q=25$

Now, the 1st firm can see it is not alone on the market, so it rearranges its individual demand to  $D_1'$ . Equilibrium output of the 1st firm decreases to 37,5 units ( $MR_1'=MC$ )

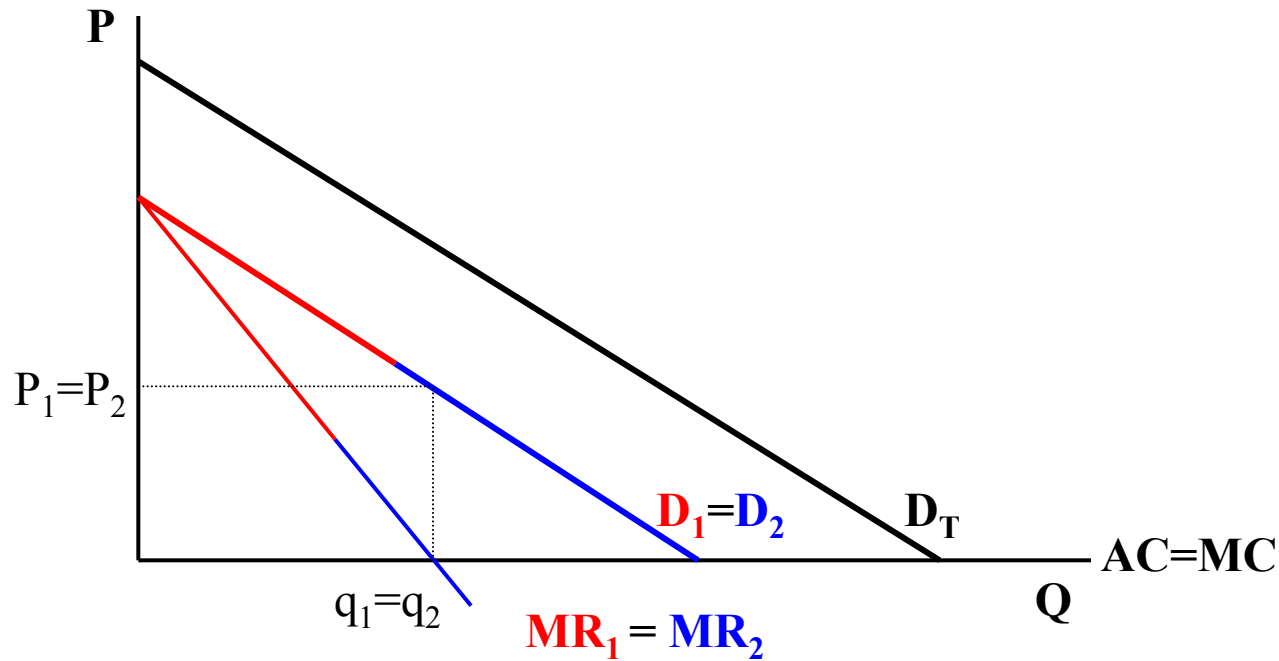
2nd firm reacts and increases its individual demand to  $D_2'$ . Equilibrium output increases to 31,25 units ( $MR_2'=MC$ )

etc.



# Cournot model – equilibrium

Demand curves of both firms are approaching to each other until they are equal.  
Both firms produce equal outputs for equal prices



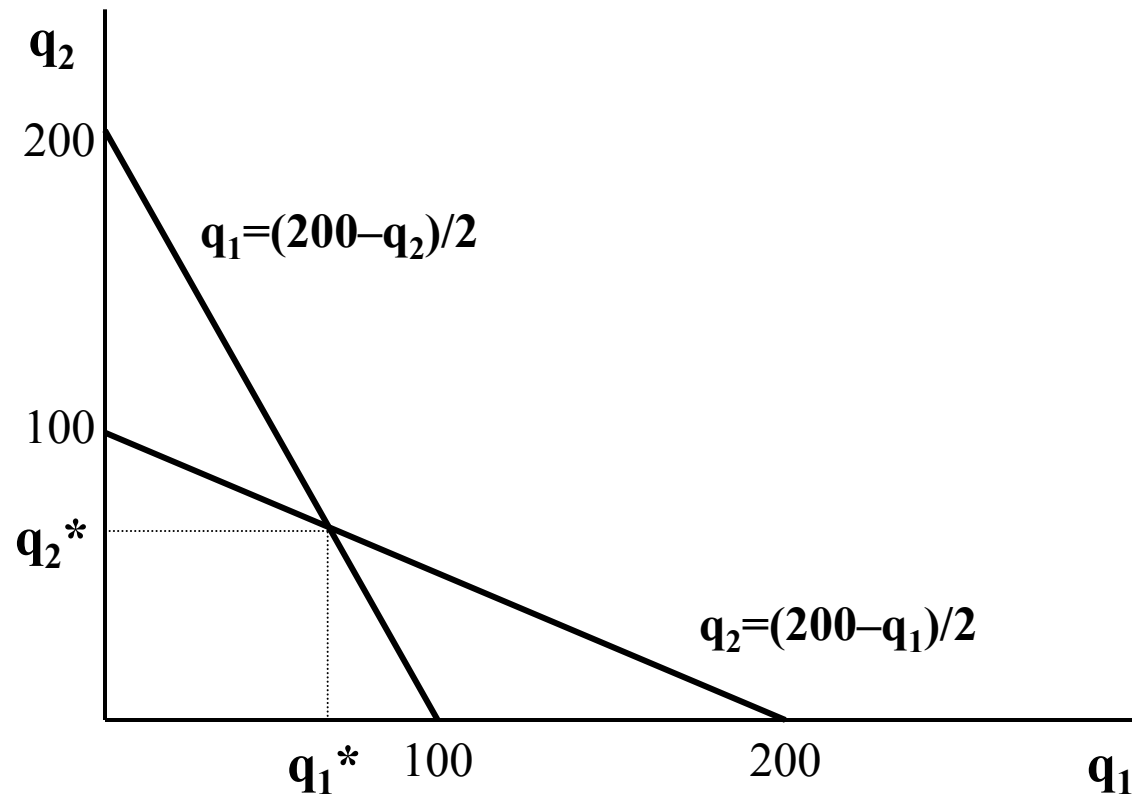
# Cournot model – reaction curves

- ▶ each firm while deriving of the equilibrium output  $q_1$  expects that the other firm supplies output  $q_2 \rightarrow Q = q_1 + q_2$
- ▶ then profit functions of both firms:  
$$\pi_1 = TR_1 - TC_1 = P(q_1 + q_2) \cdot q_1 - TC(q_1)$$
$$\pi_2 = TR_2 - TC_2 = P(q_1 + q_2) \cdot q_2 - TC(q_2)$$
- ▶ for the specific market demand curve:  
 $P = 200 - Q$ , stands:
- ▶  $P = 200 - (q_1 + q_2) \rightarrow TR_1 = [200 - (q_1 + q_2)] \cdot q_1$   
 $TR_2 = [200 - (q_1 + q_2)] \cdot q_2$

# Cournot model – reaction curves

- ▶ upon zero MC, for maximal profit MR equals to zero:
- ▶  $MR_1 = 200 - 2q_1 - q_2 = 0 \rightarrow q_1 = (200 - q_2) / 2$
- ▶  $MR_2 = 200 - q_1 - 2q_2 = 0 \rightarrow q_2 = (200 - q_1) / 2$
- ▶ equations for  $q_1$  and  $q_2$  represent the functions of reaction curves
- ▶ reaction curve as a function of output of the other firm:  $q_1 = f(q_2)$ ,  $q_2 = f(q_1)$

# Cournot model – equilibrium upon reaction curves



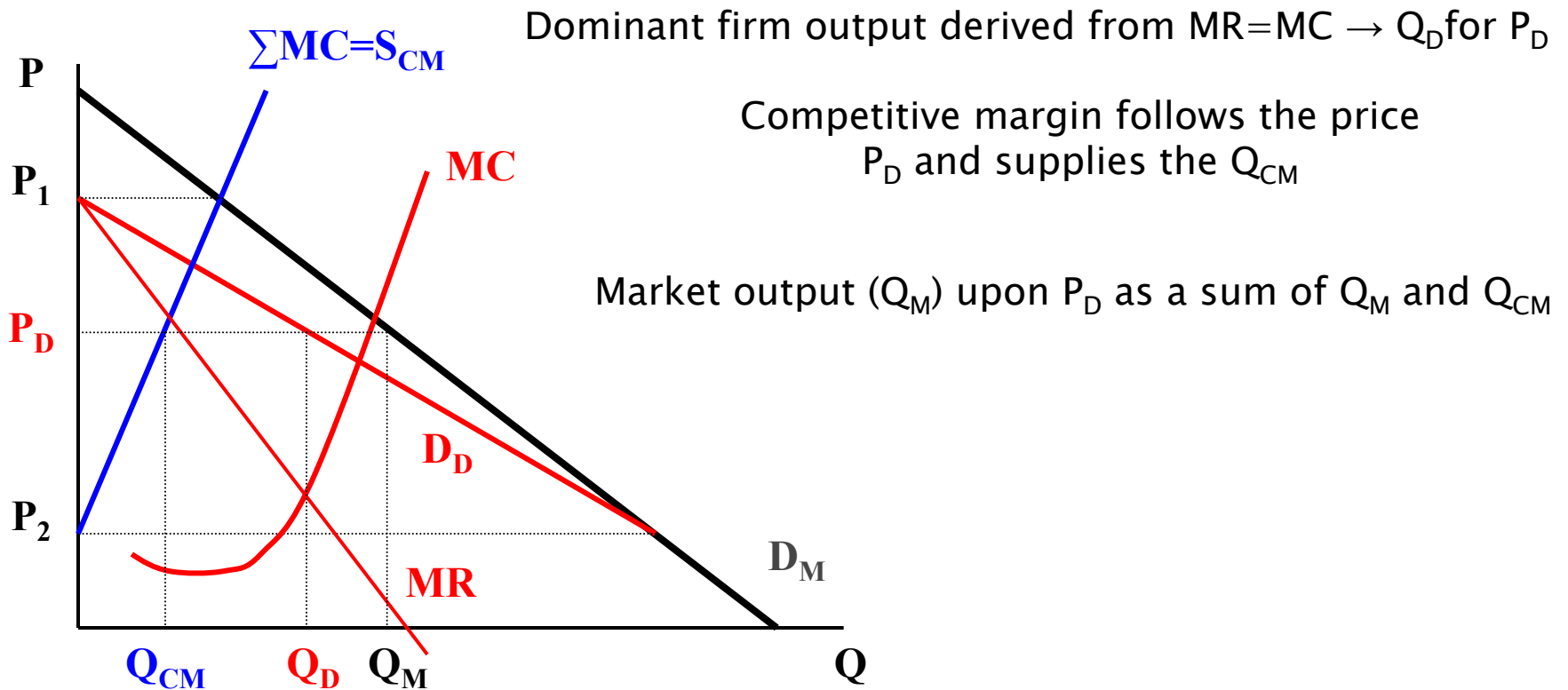
# Cournot model – application

- ▶ we probably do not find examples of „pure“ Cournot model markets, but.....
- ▶ ...we can find a Cournot model behaviour
- ▶ KFC vs. McD... Twister vs. Chicken Roll respectively
- ▶ Conservatives vs. Social democrats... their programs respectively
- ▶ Mobile telecommunication providers (more than 2 firms)

# Dominant firm (price leader) oligopoly

- ▶ dominant firm = price leader
- ▶ other firms = competitive margin firms
- ▶ competitive margin has to follow the price of the dominant firm (perfect competition conditions)
- ▶ max. profit of dominant firm:  $MR=MC$
- ▶ max. profit of competitive margin:  $P=MC_i(q_i)$

# Dominant firm oligopoly – equilibrium



Upon  $P_1$  and above the entire market demand is served with the competitive margin firms

Upon  $P_2$  and below,  $Q_D = Q_M$

Price  $P_2$  represents the shut down point of competitive margin firms



# Dominant firm oligopoly – application

- ▶ electricity production in the CR – ČEZ, a.s.  
approx. 75% market share
- ▶ Student Agency (bus traffic between Brno and Prague)
- ▶ Telefónica O2 CR – approx. 84% market share  
in the segment of fixed lines

# Sweezy model with kinked demand curve

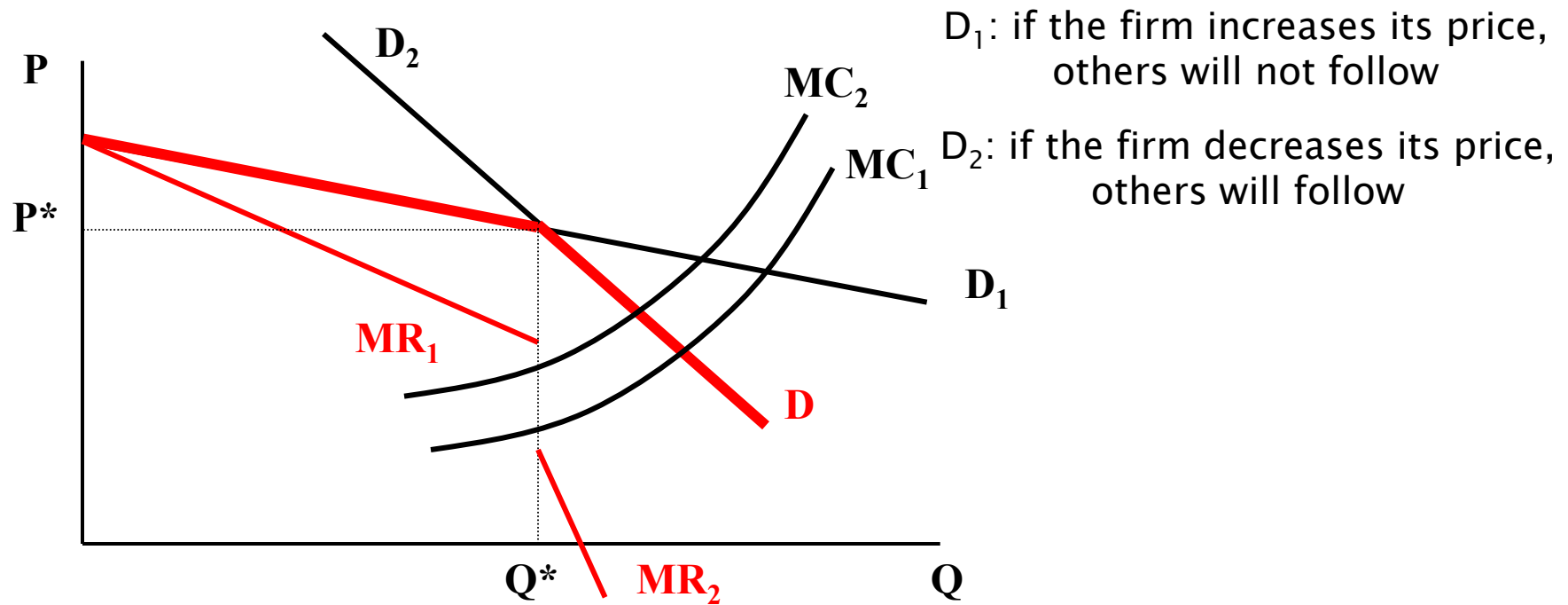
Assumptions:

1. *heterogenous production*
2. *if the specific firm decreases its equilibrium price, other firms will follow*
3. *if the specific firm increases its equilibrium price, other firms will not follow*



Kinked individual demand curve

# Sweezy model with kinked demand curve




If the specific firm increases its price, it shifts alongside  $D_1$ , if decreases its price, it shifts alongside  $D_2$

If MC functions come through the discrete interval of MR function, equilibrium output lies in  $Q^*$ , equilibrium price in  $P^*$  – firm's equilibrium lies in the spot of kinked demand

This model explain the price rigidity in the oligopolistic markets

# Nash equilibrium

- ▶ game theory models
  - ▶ players – strategy – results
  - ▶ firms' behaviour: cooperative or non-cooperative
  - ▶ cooperative behaviour – firms are allowed to make deals about their strategies
  - ▶ non-cooperative – firms are disallowed to make any deals
  - ▶ one-shot games vs. repeated games (one attempt to choose the strategy vs. several attempts to choose the strategy)
  - ▶ we assume 2 players with 2 strategies
- 

# Nash equilibrium

= consequence of specific strategies that lead to the stable solution – no need to re-value the behaviour

**Nash equilibrium turns up, if:**

2 players **A** and **B** take out of 2 strategies *a* and *b*, whereas *a* is the best strategy for player **A** if player **B** picks strategy *b* and vice versa

# Nash equilibrium

- ▶ Nash equilibrium does not have to lead allways to the Pareto equilibrium – i.e. „prisoners´ dilemma“
- ▶ prisoners´ dilemma – one–shot non–cooperative game
- ▶ 2 suspects, 2 strategies: *to confess/not to confess*
- ▶ the police offers to each suspect: „*if you confess, you will be free, while your complice who did not confess would be jailed for 36 months*“

# Prisoners' dilemma

Prisoner		Clyde	
		Confess	Not confess
Bonnie	Confess	24 ; 24	0 ; 36
	Not confess	36 ; 0	6 ; 6

Both suspects confess, because if they would not, they would risk 36 months in jail – strategy *confess/confess* means 24 months in jail for both of them

Strategy *confess/confess* represents the Nash (but not Pareto) equilibrium

Pareto equilibrium means the strategy *not confess/not confess* – the best solution for both suspects, but this strategy will be not chosen, it is too risky

Each suspect picks the „lesser evil“

# Prisoners' dilemma – application on price strategy of 2 firms

Firm		Pepsi	
		P=10	P=15
Coca-Cola	P=10	10 ; 8	18 ; 3
	P=15	5 ; 17	15 ; 12

Firms' profits upon several strategies

Coca-Cola prefers P=10 if Pepsi prefers P=15

Pepsi prefers P=10 if Coca-Cola prefers P=15

Both firms pick strategy P=10, which represents the Nash (but not Pareto) equilibrium

Pareto equilibrium is represented with the strategy P=15/P=15 – if both firms pick strategy P=15, both firms would gain higher profits – but this strategy is too risky



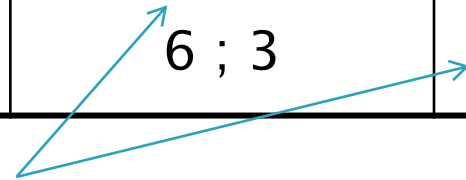
# Repeated games

- ▶ firms are allowed to pick strategies repeatedly...
- ▶ ...according to the strategy of the other firm
- ▶ tendency to make deals to improve the position of both firms
- ▶ may lead to the different solutions (unlike the one-shot games)
- ▶ i.e. *to keep/not to keep* the cartel treaty

# Repeated games

Firm		Pepsi	
		Keep	Not keep
Coca-Cola	Keep	5 ; 5	3 ; 6
	Not keep	6 ; 3	4 ; 4

Firms' profits upon several strategies




Upon one-shot game both firms pick the strategy *not keep/not keep* because to keep the cartel treaty is too risky

Upon repeated games if a specific firm does not keep the treaty, the other firm can re-value its strategy and brake the treaty as well



Upon repeated games the result is not sure - keeping the cartel treaty means higher profits for both firms, but still a tendency to brake the treaty...

# Nash equilibrium upon the dominant strategy

- ▶ special case of Nash equilibrium
  - ▶ if the specific firm has a dominant strategy, its choice is not influenced by the choice of the other firm, or...
  - ▶ ...firm picks its dominant strategy regardless of the strategy of the other firm
- 

# Nash equilibrium upon the dominant strategy

Firm		Pepsi	
		1 mio.	2 mio.
Coca-Cola	1 mio.	10 ; 8	8 ; 6
	2 mio.	9 ; 6	9 ; 4

Firms pick-out of 2 advertisement expenditures (1 or 2 million of EUR)

Pepsi has a dominant strategy to spend 1 million on advertisement because: if Coca-Cola spends 1 or 2 million, Pepsi's best choice is to spend 1 million anyway

If Coca-Cola recognizes the Pepsi's dominant strategy, it picks the better option, which is: 1 million EUR on advertisement