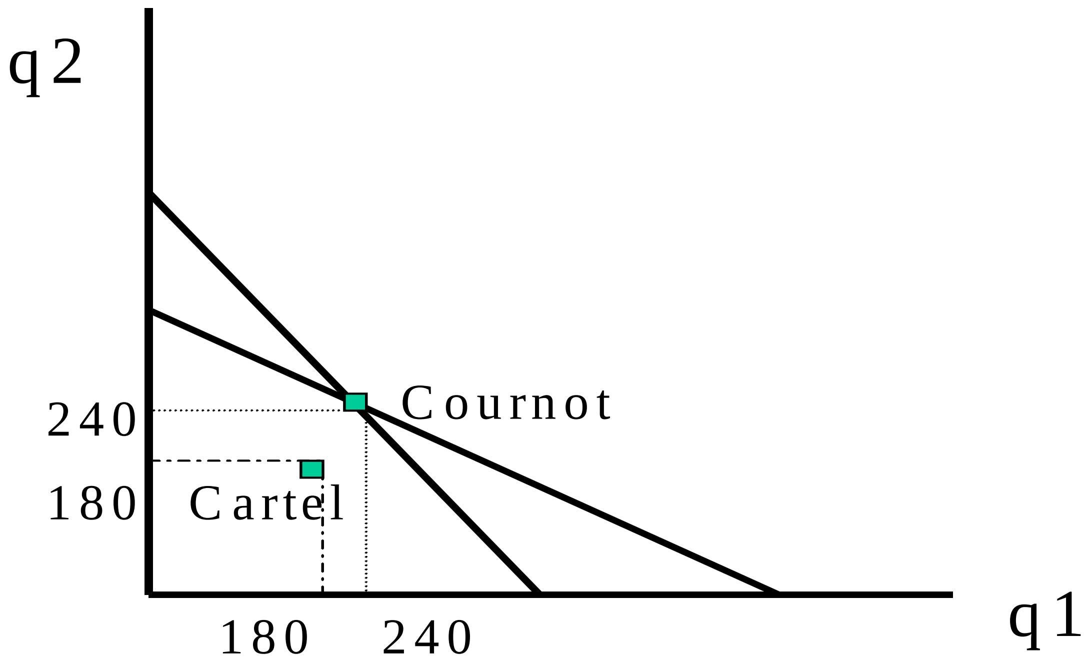
Cartel and Cournot Equilibrium

- Cartel equilibrium
  - q1=q2=180 and profits ο1=ο2=129/2
- Cournot
  - q1=q2=240 and profits ο1=ο2=115.2/2
- Cournot firms would have an incentive to form a cartel
- But each firm would have an incentive to deviate by increase production given that other firms produce at cartel level output

Cartel and Cournot Equilibrium

– Cartel :q1=q2=180 and profits o1=o2=129/2

– Cournot : q1=q2=240 and profits o1=o2=115.2/2



Stackelberg Model: Firm 1 is leader

• Firm 1, the leader, knowing how the follower, firm 2, will behave will *profit at the follower's expense*

• Firm 1 sets q1

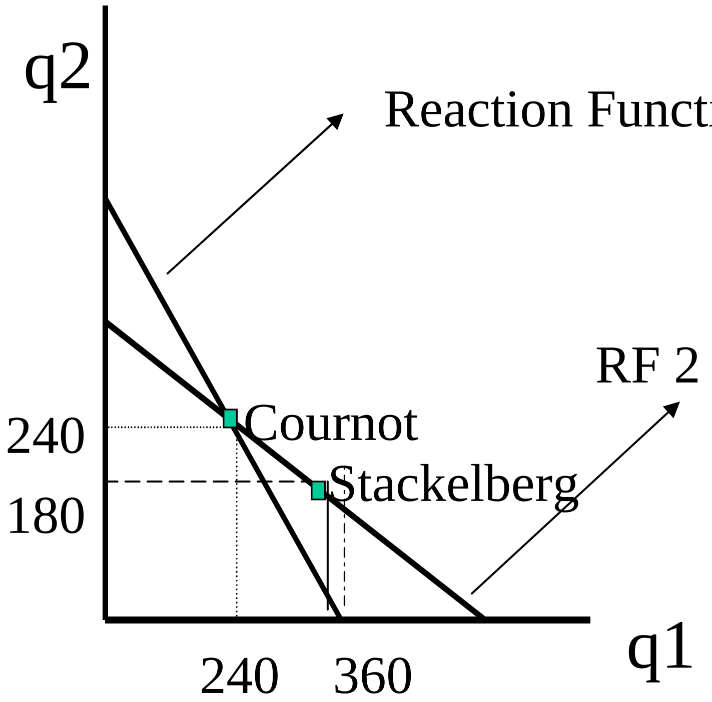
• Given q1 firm 2 picks its best response q2=R_1(q1)

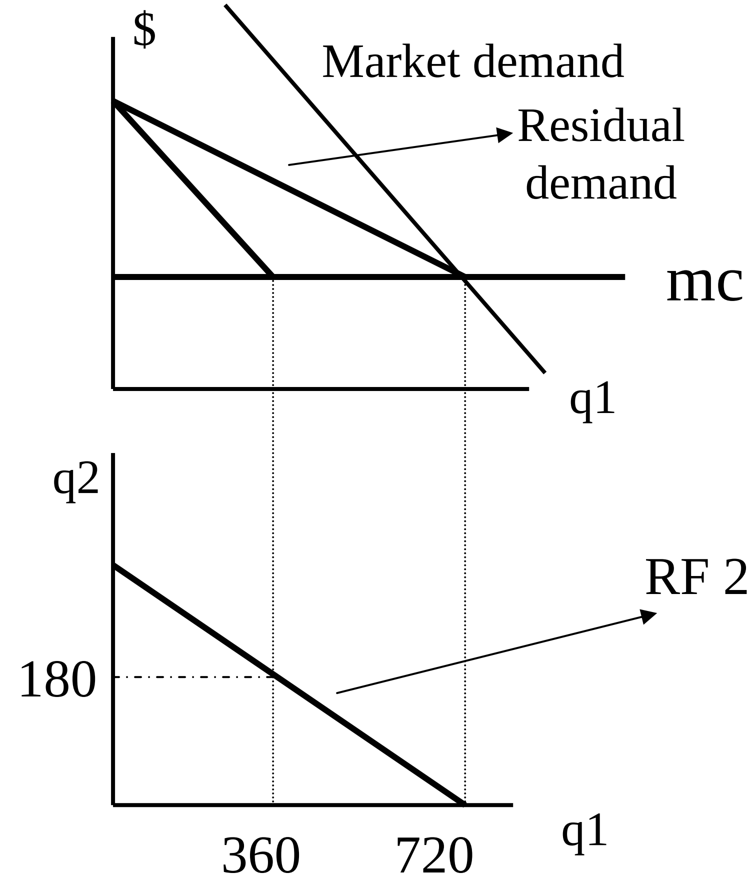
• So the leader gets residual demand by subtracting from total demand the follower's output, summarized by the follower's best response function

• The leader chooses q1 such that MC=MR(residual demand)

• q1_stack=360, q2_stack=180

Stackelberg Model: Firm 1 is leader





Bertrand Model

– Firms set prices rather than output for identical products

– Consumers have complete information

==>Consumers buy product with lowest price

– Each firm believes the rival's price is fixed and by slightly undercutting the rival's price the firm will capture **all** of the rival's business

– In equilibrium firms make zero profits and price equals MC which is equal to social optimum

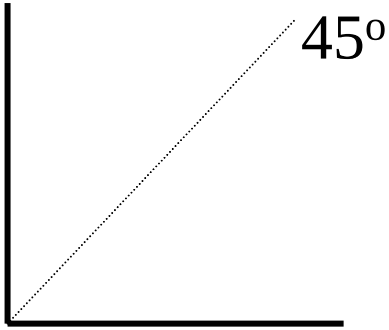
Bertrand Model, contin.

– Equilibrium: no firm wants to raise or lower its price to increase profits

– The only possible equilibrium is p=MC (=28cents in example of previous lecture)

– "Bertrand Trap": In equilibrium firms make zero profits!!

– How do the best response functions look like?



Bertrand pricing if firms have different costs.

- In the "Bertrand Trap" example, the firms each had identical costs.
- If the good is homogenous, but one firm has lower costs than the other, what will the equilibrium look like?
  - E.g. assume Firm A has MC = 7 and Firm B has MC = 10.

Escaping the Bertrand Trap.

For firms to fall into the Bertrand Trap, several conditions must be true:

– Firms can supply the whole market (no capacity constraints). ------------------------> Capacity constraints

– Firms aren't cooperating. --------> Collusion

– The good is homogenous. ------> Product differentiation

– NEXT……….. PRODUCT DIFFERENTIATION

Differentiated products: the "linear city."

– Two sellers at opposite ends of a "city."

– Consumers are spread evenly along the whole line.

– Consumers incur a transportation cost to get to either seller A or seller B.

Types of product differentiation.

- Geographic.
- Based on consumer tastes.
- Based on consumer information/switching costs.
- Quality.

Bertrand oligopoly with differentiated goods.

– Low price now **does not steal the whole market**.

– Market share increases smoothly with price reductions.

– A Nash equilibrium exists when every firm is pricing at its *best response* given other firms' price and output.

An example.

– Two firms, 1 & 2.

– Both have constant marginal costs: $MC_1 = 10$, $MC_2 = 10$ and no fixed costs.

– Firm 1's demand is a function of it's own price and firm 2's price:

$$q_1 = 1000 – 20p_1 + 4p_2$$

– Same for firm 2:

$$q_2 = 1000 – 20p_2 + 4p_1$$

Step 1: write down the profit function.

Profit function for firm 1 in terms of p_1 and p_2:

$\pi_1(p_1, p_2) = p_1q_1 – 10q_1 = (p_1-10)(1,000-20p_1+4p_2)$

$= 1,200p_1 – 20p_1^2+4p_1p_2-10,000-40p_2$

Step 2: differentiate π_1 with respect to p_1.

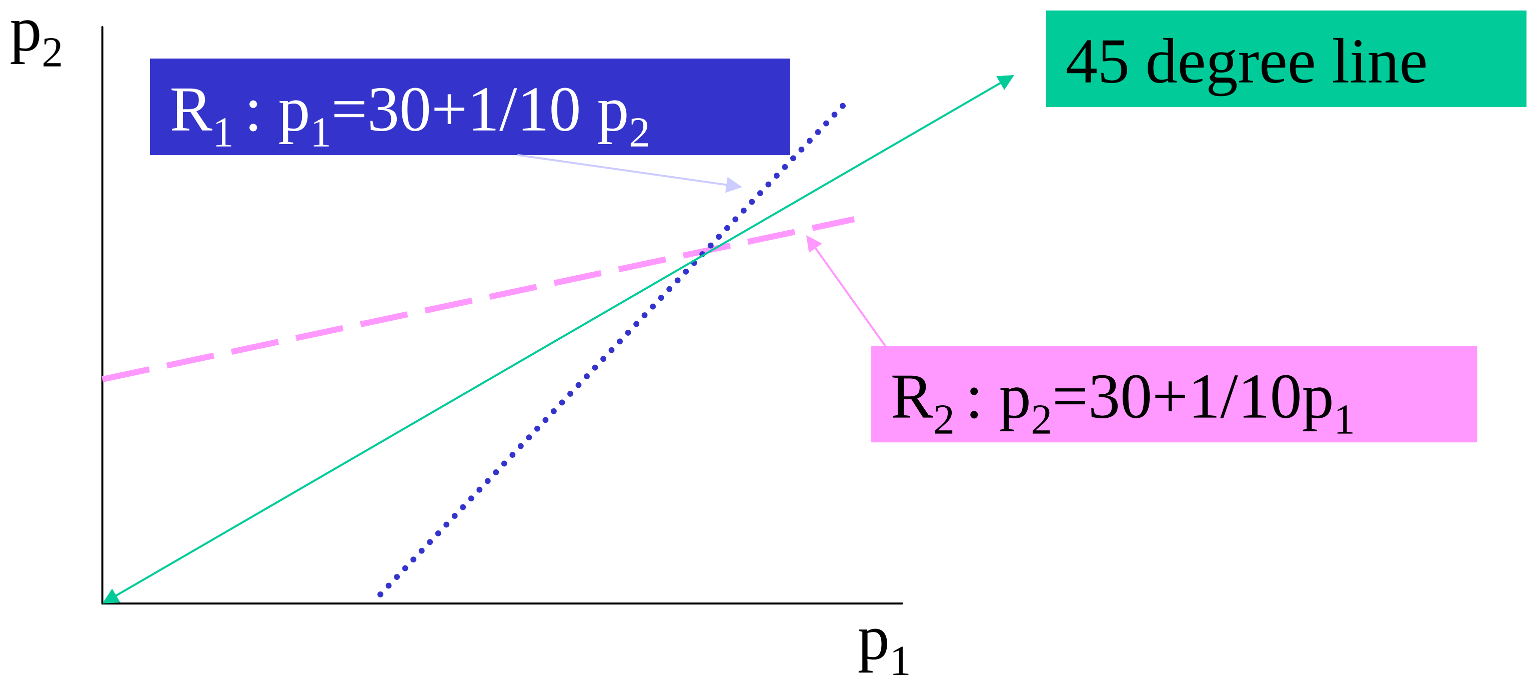
$$^{d\pi}/_{dp} = 1{,}200 - 40p_1 + 4p_2 = 0$$

$$\Rightarrow p_1 = 30 + {}^{1}/_{10}\, p_2$$

This is called firm 1's *best response* (or *reaction*) function.

– This is the best price firm 1 can charge in response to firm 2 charging p_2.

Picture of best response functions.



Step 3: solve for the Nash Equilibrium prices.

Recall: at a Nash Equilibrium, both players are happy with their choices and don't want to change.

Result: a Nash Equilibrium occurs where the best response functions intersect.

$p_1 = 30 + {}^{1}/_{10}\, p_2$ and $p_2 = 30 + {}^{1}/_{10}\, p_1$

$\Rightarrow p_1 = p_2 = 33.33$

Step 4: compute profits.

$q_1 = 1000 – 20p_1 + 4p_2$

$= 1000 - 20•33.33 + 4•33.33$

$= 466.66$

$\pi_1 = (p_1 – 10)•q_1 = 23.33•466.66$

$= 10,889$

Firms are not necessarily symmetric in demand and costs.

Recap: Cournot versus Bertrand model

- Best response functions are usually downward sloping for Cournot and upward for Bertrand.

Cournot versus Bertrand?

- – Cournot more appropriate when capacity constraints matter (e.g. electricity).
- – Bertrand more appropriate where capacity constraints aren't binding (e.g. information goods).

Next lecture - Lecture 9

- Monopolistic Competition model
- Differentiated product classroom experiment