Intermediate Microeconomics

Market Structure, Industrial Organisation: Oligopoly

Agribusiness Teaching Center

Easter Term 2015

Market Structure

The interconnected characteristics of a market, such as the number and relative strength of buyers and sellers and degree of collusion among them, level and forms of competition, extent of product differentiation, and ease of entry into and exit from the market

Four basic types of market structure are

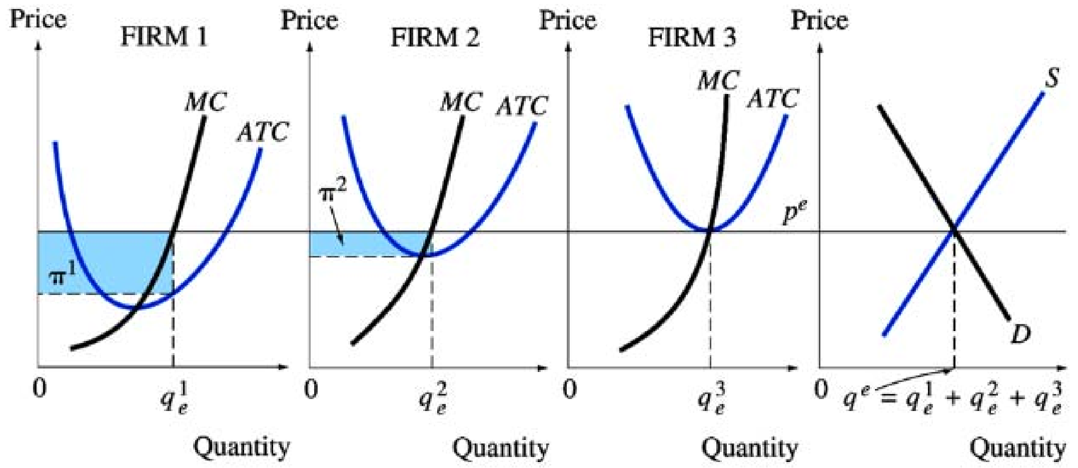
(1) Perfect competition: many buyers and sellers, none being able to influence prices.

(2) Oligopoly: several large sellers who have some control over the prices.

(3) Monopoly: single seller with considerable control over supply and prices.

(4) Monopsony: single buyer with considerable control over demand and prices.

Competitive Market



Definition

A price-quantity combination constitutes a short-run equilibrium for a competitive market if it is such that:

1. no individual firm wishes to change the amount of own supply
2. no individual consumer wishes to change the amount demanded
3. the excess demand is zero in the market.

Monopolistic Market

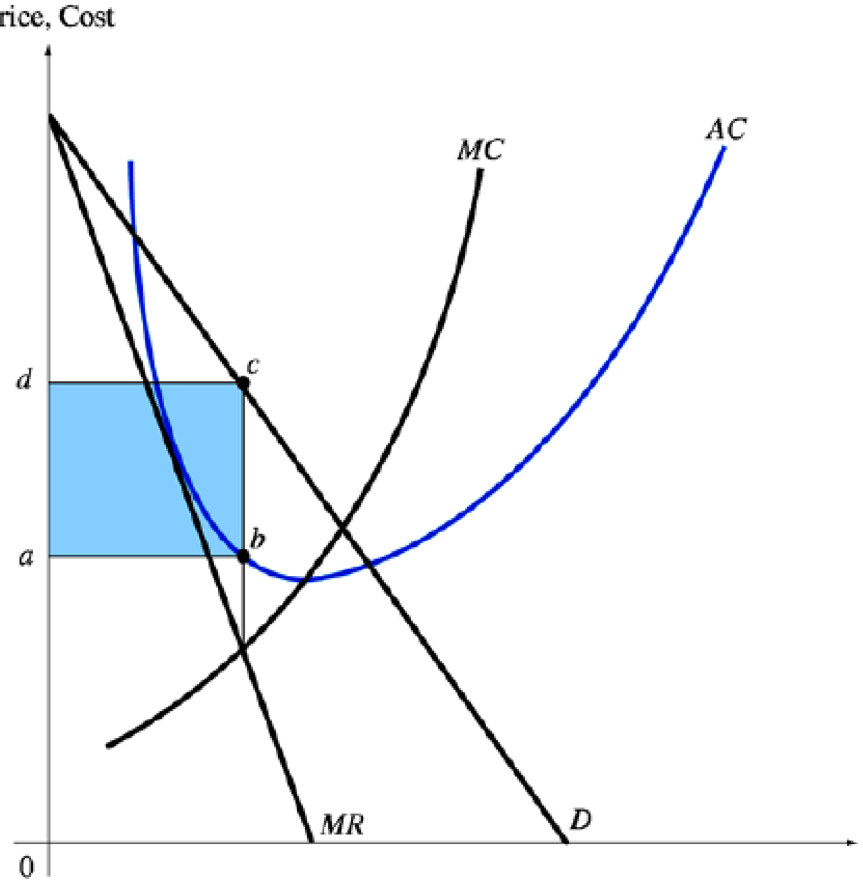
- Inverse Demand function:

$$p = D(q)$$

  - e.g. linear:

$$p = A - bq$$

- Optimal production
  - $\max \pi$.
  - $MR = MC$.



Oligopolistic Markets

Definition

Oligopoly is a market characterised with more than one producer where their individual decision on production has a non-negligible effect on the price of the good.

Definition

Duopoly is a version of Oligopoly with only two producers.

Oligopoly
Antoine Augustin **Cournot** Competition

- Simultaneously choosing the quantity to produce.
- Acknowledging the existence of the other producer.
- In equilibrium neither firm has incentive to change its output decision (Nash equilibrium).

Cournot Duopoly

Best Response and Residual Demand

- Demand:
  $p = A - b\left(q_1 + q_2\right)$
- Cournot conjecture:
  invariable $\bar{q}_2$
- Residual demand:
  $p = \left(A - b\,\bar{q}_2\right) - bq_1$
- Profit:
  $\pi_1 = \left(A - b\left(q_1 + q_2\right)\right) \cdot q_1 - C\left(q_1\right)$
- Optimum: $MR = MC$

Problem

Given firm 2's decision firm 1 should choose an output level that maximises its profit subject to the market demand.

Cournot Duopoly

Best Response and Residual Demand

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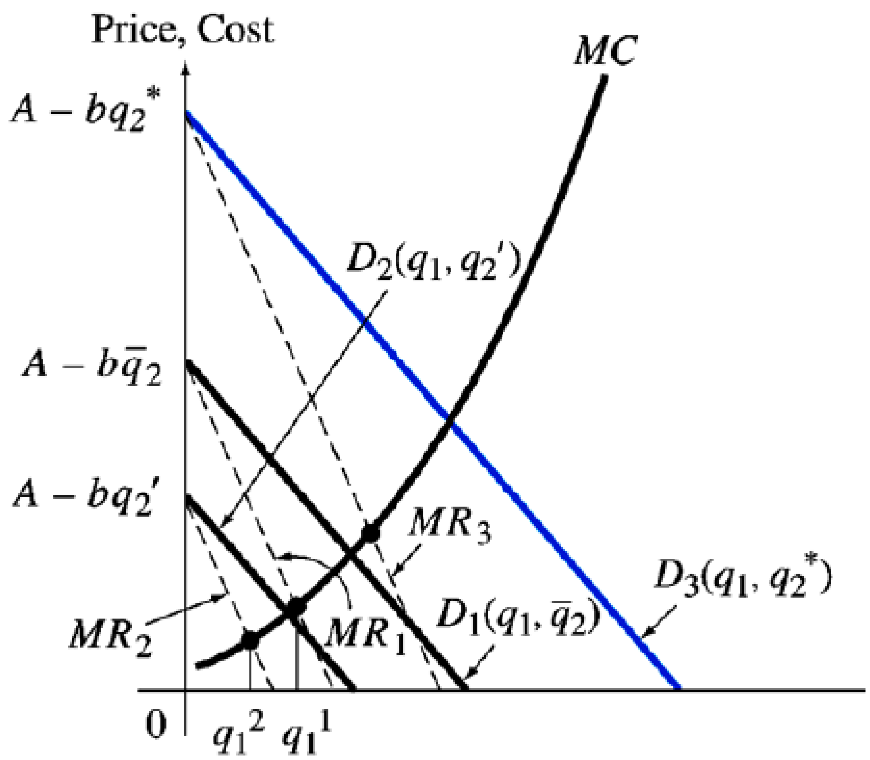
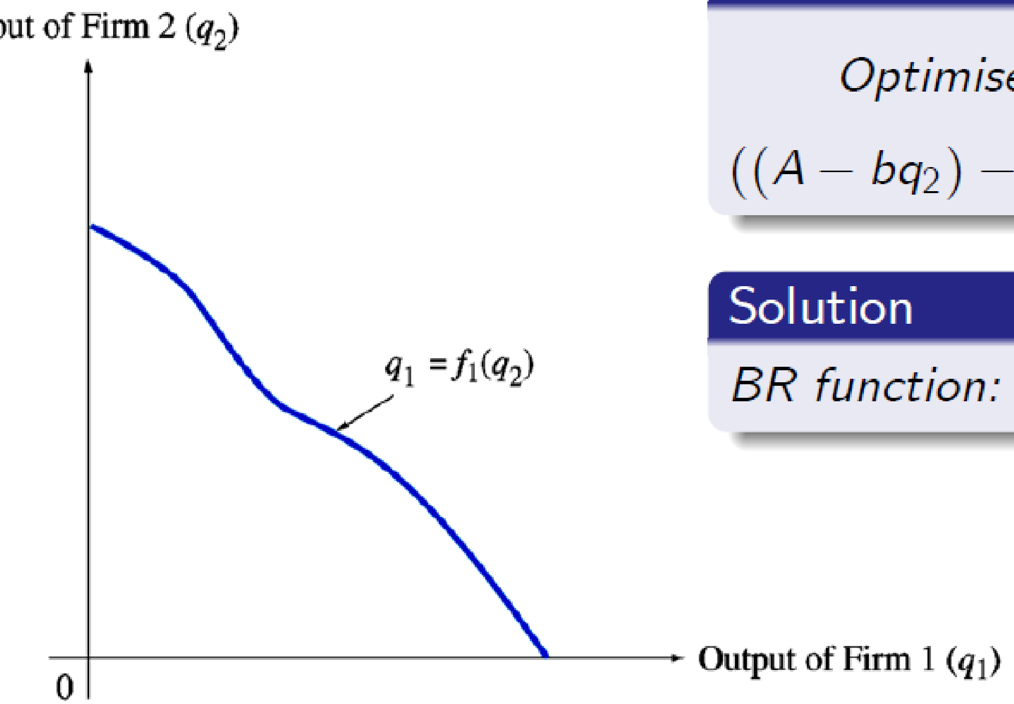


Cournot Duopoly

Best Response

REACTION (BEST RESPONSE) FUNCTION



Problem

Optimise: $\max \pi_1 =$

$$((A - bq_2) - bq_1) \cdot q_1 - C(q_1)$$

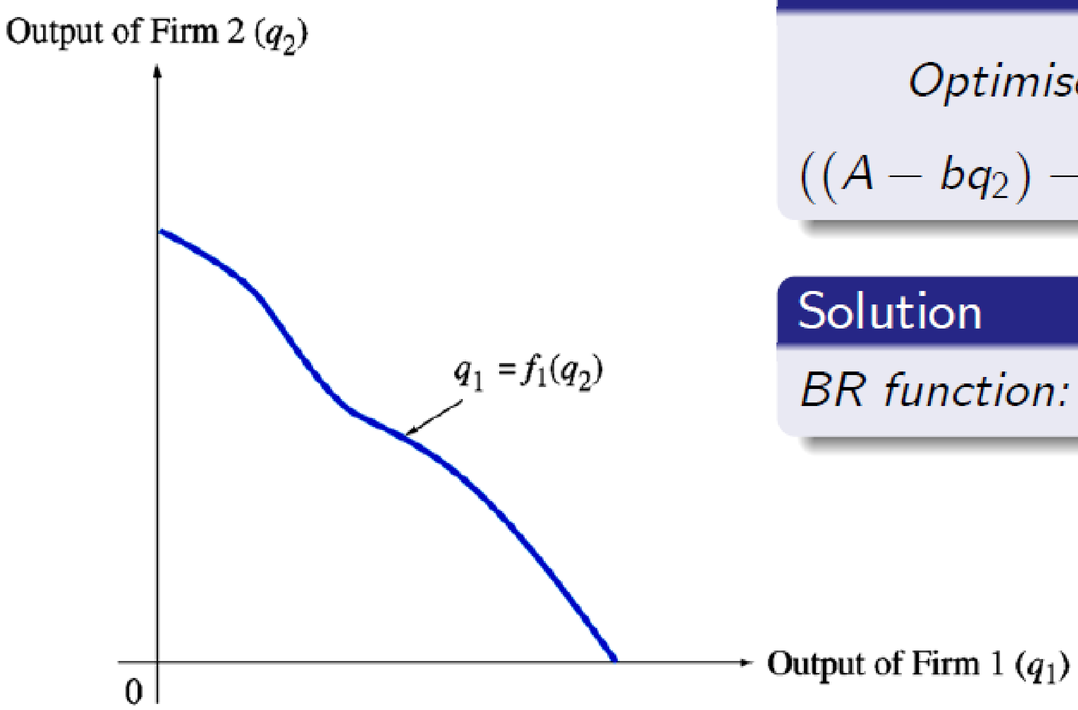
Solution

BR function: $q_1 = f_1(q_2)$

Cournot Duopoly

Best Response

REACTION (BEST RESPONSE) FUNCTION



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Cournot Duopoly
Best Response in Normal Form

$$\pi_1 = p\left(q_1 + q_2\right) \cdot q_1 - C\left(q_1\right)$$

$$a_i, b_i, c_i, d_i \sim \pi_1\left(\bar{q}_2\right)$$

NORMAL FORM

x a_1	x b_1	x c_1	x d_1
x a_2	x b_2	x c_2	x d_2
x a_3	x b_3	x c_3	x d_3
x a_4	x b_4	x c_4	x d_4

Cournot Duopoly

Best Response in Normal Form

$$\pi_1 = p(q_1 + q_2) \cdot q_1 - C(q_1)$$

$$a_i, b_i, c_i, d_i \sim \pi_1(\bar{q}_{2,i})$$

x a_1	x $\pi_1^*(q_{2,1})$	x c_1	x d_1
x $\pi_1^*(q_{2,2})$	x b_2	x c_2	x d_2
x a_3	x b_3	x c_3	x $\pi_1^*(q_{2,3})$
x a_4	x b_4	x $\pi_1^*(q_{2,4})$	x d_4

$$\pi_1^*(q_{2,i}) = \max\{a_i, b_i, c_i, d_i\}$$

Cournot Equilibrium

Best Response in Normal Form

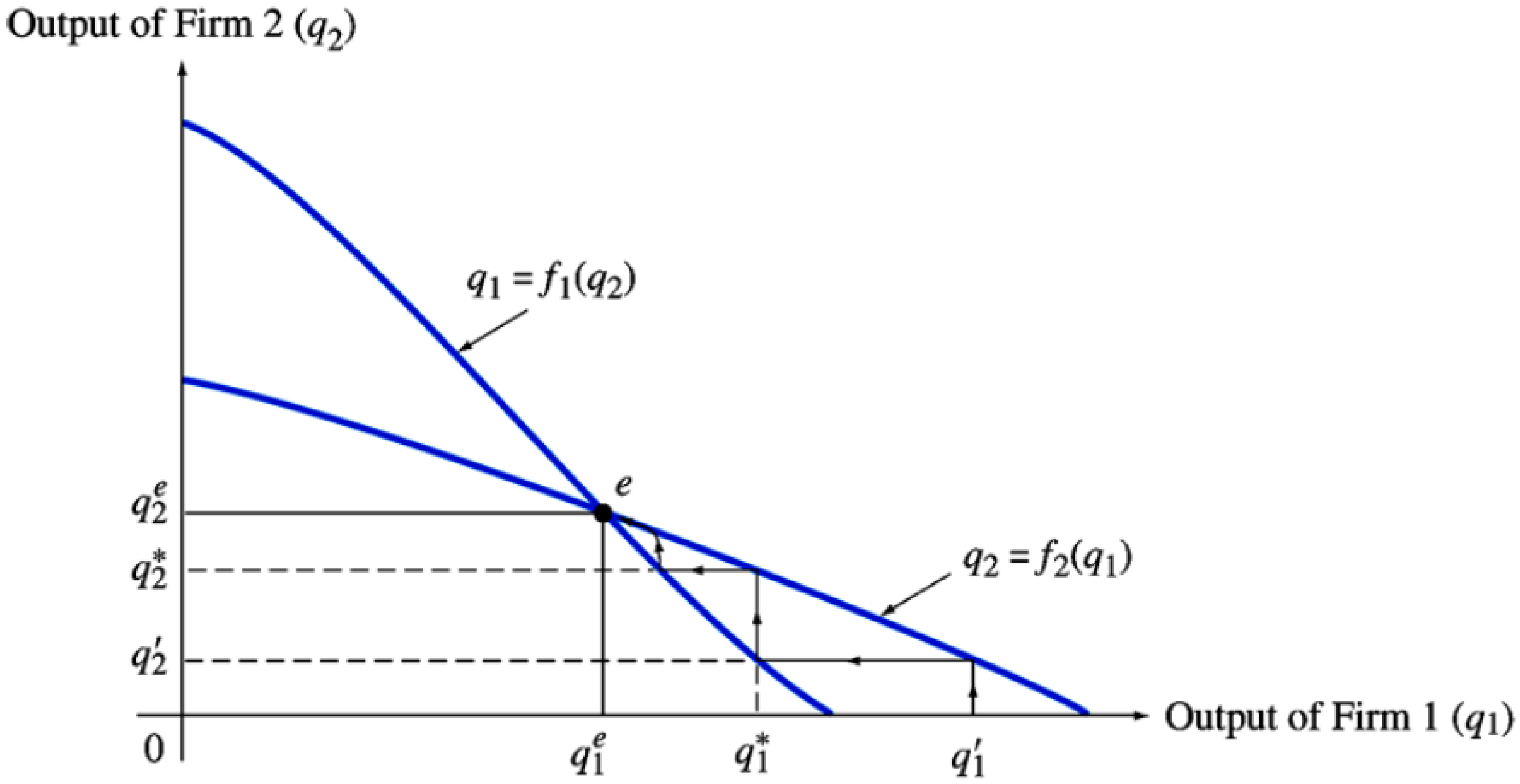
$$\pi_1 = p(q_1 + q_2) \cdot q_1 - C(q_1)$$
$$\pi_2 = p(q_1 + q_2) \cdot q_2 - C(q_2)$$

(v, x)	$(\pi_1^*(q_{2,1}), x)$	$(v, \pi_2^*(q_{1,3}))$	(v, x)
$(\pi_1^*(q_{2,2}), x)$	$(v, \pi_2^*(q_{1,2}))$	(v, x)	(v, x)
(v, x)	(v, x)	(v, x)	$(\pi_1^*(q_{2,3}), \pi_2^*(q_{1,4}))$
$(v, \pi_2^*(q_{1,1}))$	(v, x)	$(\pi_1^*(q_{2,4}), x)$	(v, x)

$$\pi_1^*(q_{2,i}) = \max\{\pi_1(q_{2,i})\}$$
$$\pi_2^*(q_{1,i}) = \max\{\pi_2(q_{1,i})\}$$

Cournot Equilibrium

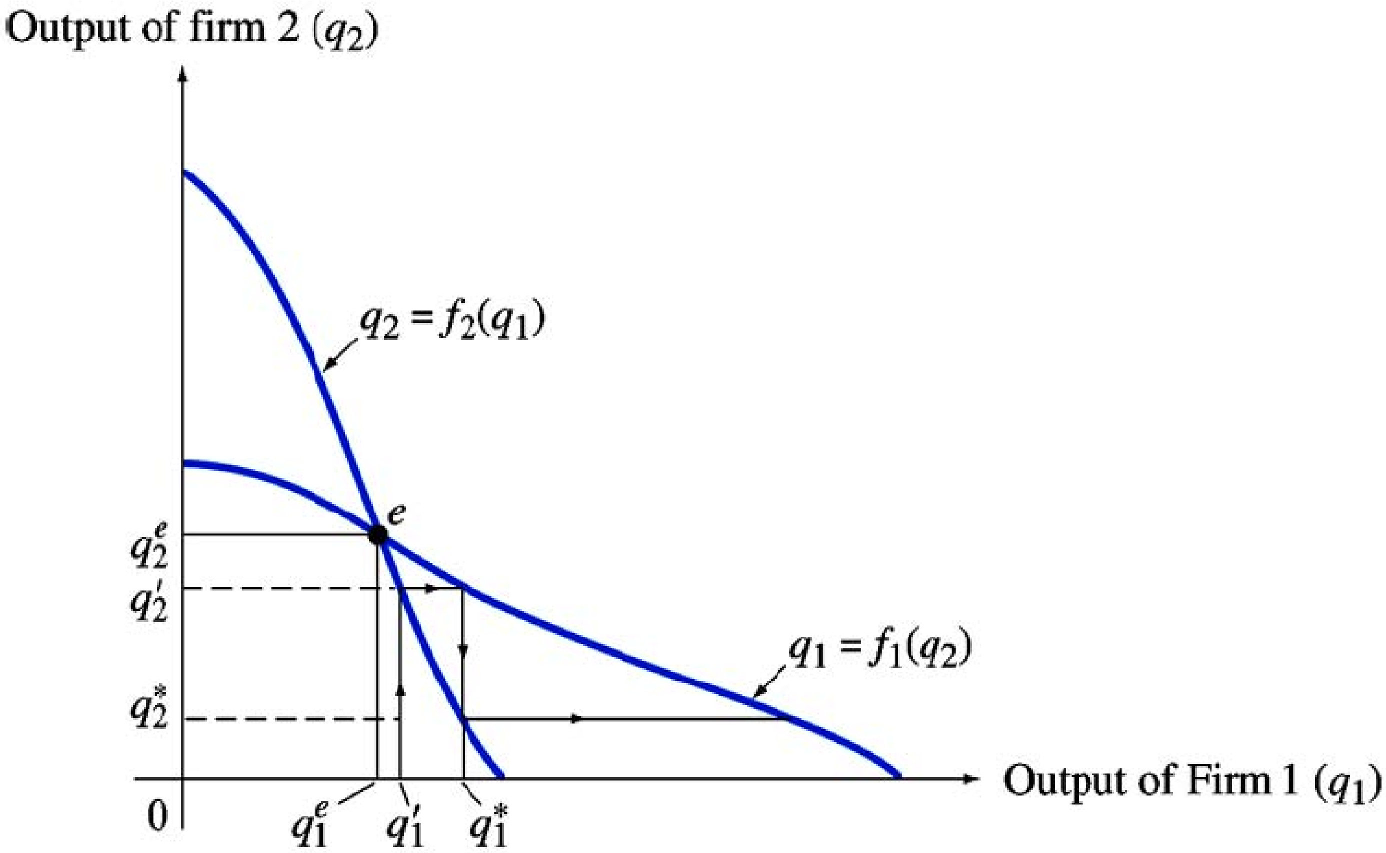
Best Response: Graphical Interpretation



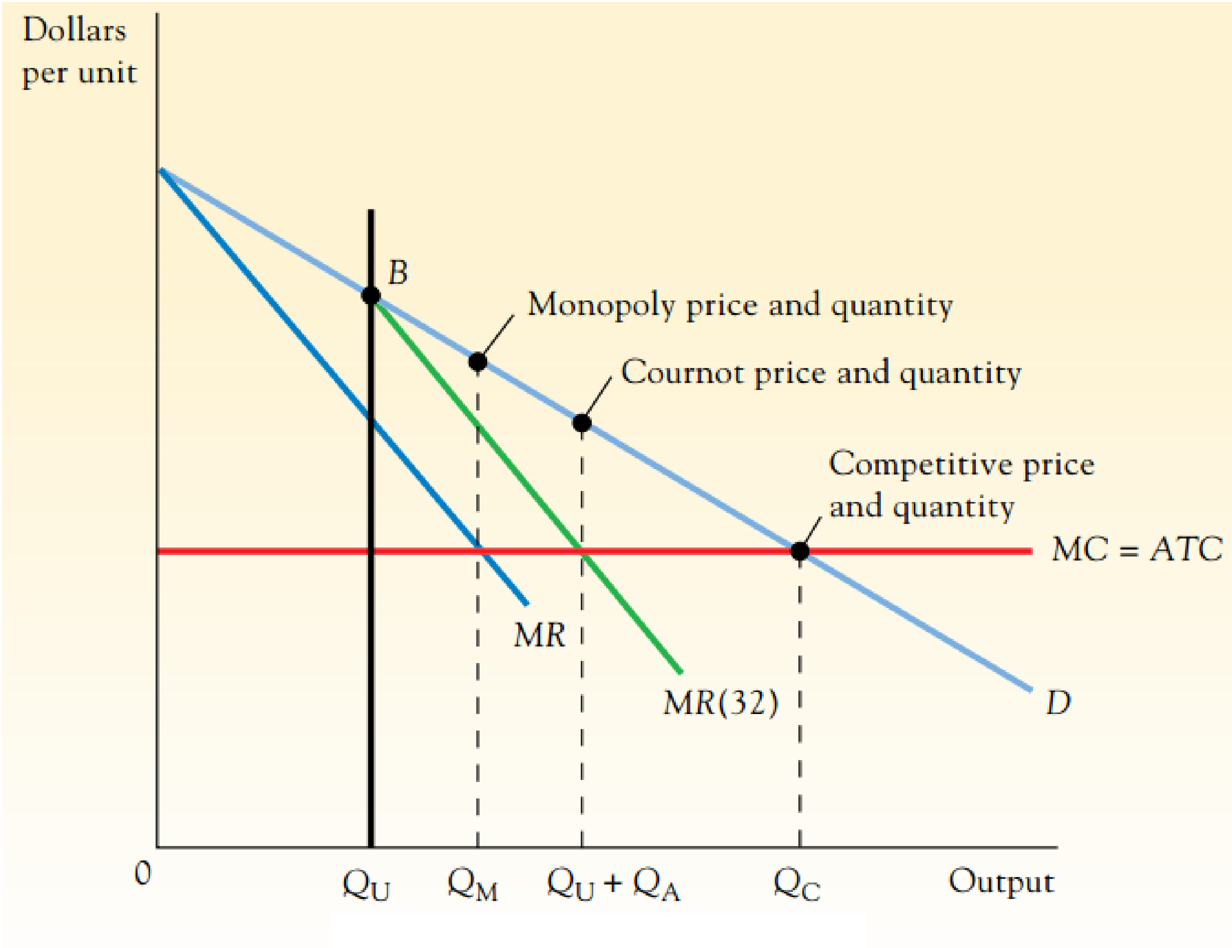
- Convergence of the Cournot equilibrium

Cournot Equilibrium

Stability Issues



Oligopoly



Dollars
per unit
B
Monopoly price and quantity
Cournot price and quantity
Competitive price
and quantity
MC = ATC
MR
MR(32)
D
0
Q_U
Q_M
$Q_U + Q_A$
Q_C
Output

Cournot Model
Big Assumption

Firms Treat Rivals as Equals

Cournot Model

Firm treat rivals as equals

Cournot Model

Firm treat rivals as equals

Cournot Model

Firm treat rivals as equals

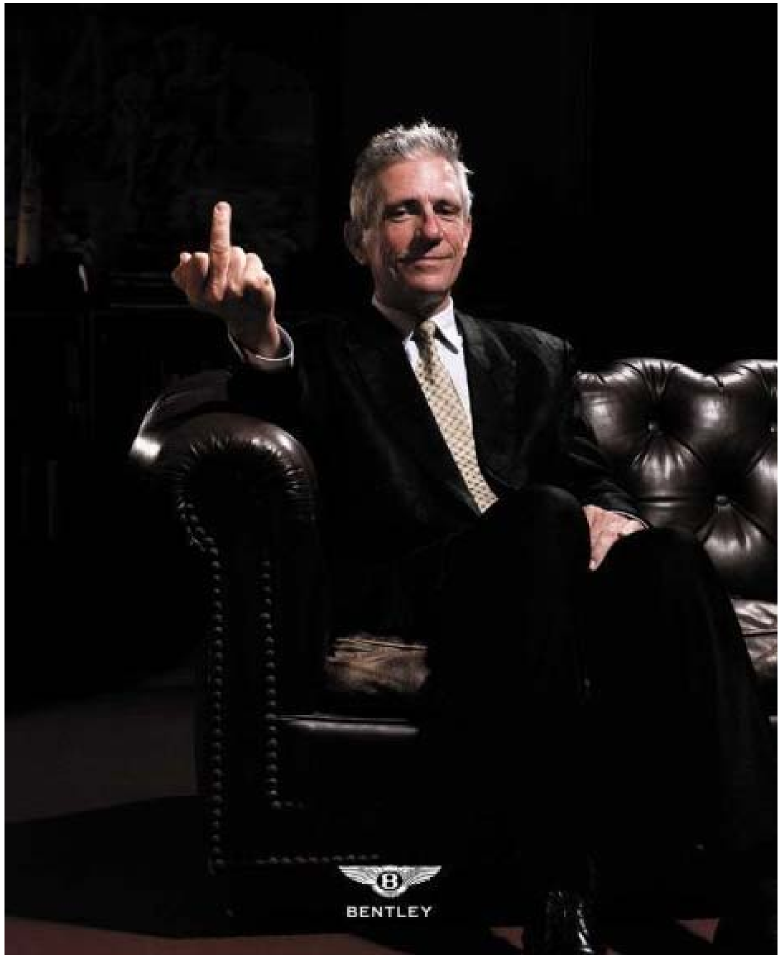
Cournot Model

Firm treat rivals as equals

What's Next?

Cournot Model

Firm treat rivals as equals



Heinrich Freiherr von Stackelberg Equilibrium

Asymmetric Competition

Definition

Stackelberg leader decides on the production quantity acknowledging the existence of the second producer in the market.

Definition

Stackelberg follower decides on the production quantity after observing what the leader firm has done.

Stackelberg Equilibrium

The Algebra

Example (Cournot)

Problem (Firm 1)

$\max \pi_1 =$

$(A - b(q_1 + q_2)) \cdot q_1 - C(q_1)$

solution: $q_1 = f_1(q_2)$

Problem (Firm 2)

$\max \pi_2 =$

$(A - b(q_1 + q_2)) \cdot q_2 - C(q_2)$

solution: $q_2 = f_2(q_1)$

Demand: $p = A - bQ$

Example (Stackelberg)

Problem (Firm 2: Follower)

$\max \pi_2 =$

$(A - b(q_1^* + q_2)) \cdot q_2 - C(q_2)$

solution: $q_2 = f_2(q_1^*)$

Problem (Firm 1: Leader)

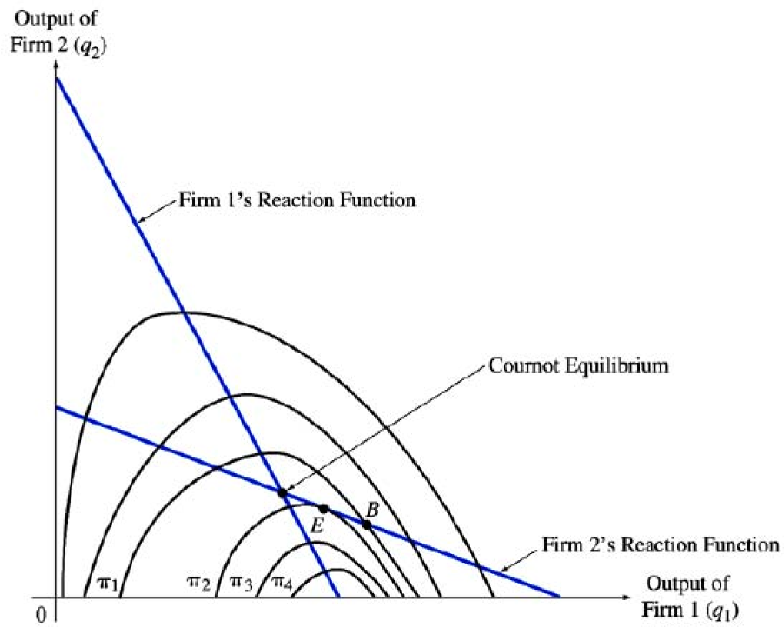
$\max \pi_1 =$

$(A - b(q_1 + f(q_1))) \cdot q_1 - C(q_1)$

solution: q_1^*

Stackelberg Competition

The Equilibrium



- *First-mover advantage*

Example (Stackelberg)

Problem (Firm 2: Follower)

$\max \pi_2 =$

$\left(A - b\left(q_1^* + q_2\right)\right) \cdot q_2 - C\left(q_2\right)$

solution: $q_2 = f_2\left(q_1^*\right)$

Problem (Firm 1: Leader)

$\max \pi_1 =$

$\left(A - b\left(q_1 + f\left(q_1\right)\right)\right) \cdot q_1 - C\left(q_1\right)$

solution: q_1^*

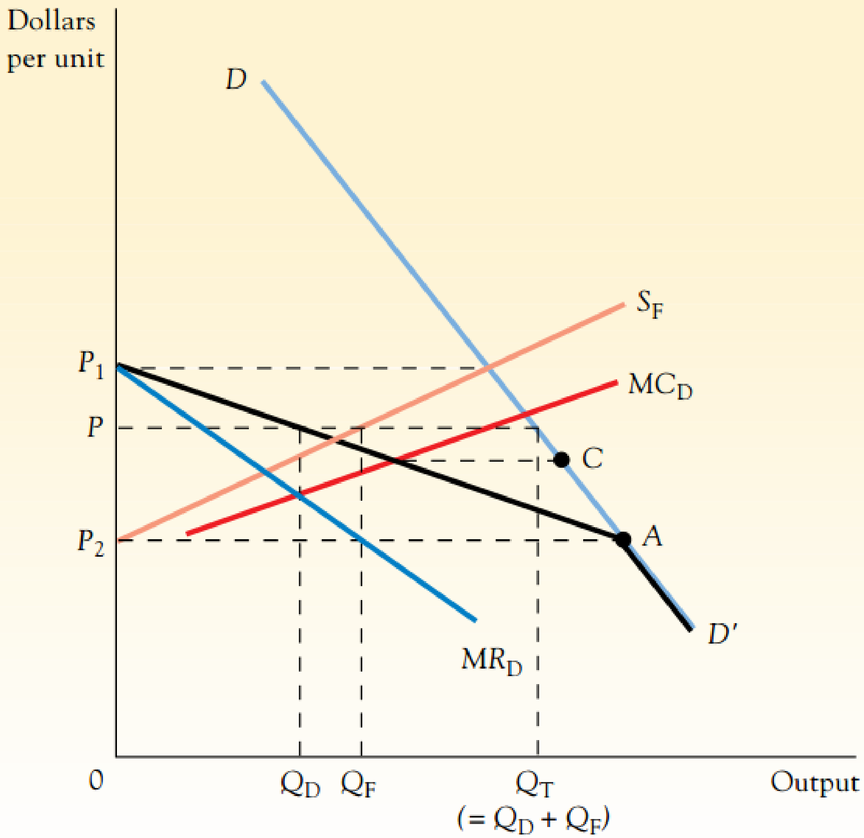
Demand: $p = A - bQ$

Forchheimer Competition

Dominant Firm with Competitive Fringe

The Dominant Firm Model

With the supply curve of fringe firms shown as S_F, the residual demand curve of the dominant firm is derived by subtracting the quantity supplied by fringe firms at each price from total quantity demanded at that price; the result is curve P_1AD'. The dominant firm maximizes profit by producing Q_D and charging price P; fringe firms produce Q_F at that price, so total output is Q_T.



Joseph Louis François Bertrand Competition

Definition

Bertrand model of price competition for oligopolies is a simultaneous-move price-setting market-sharing game.

Joseph Louis François Bertrand Competition

Definition

Bertrand (Nash) equilibrium is a pair of prices that , once set, are such that neither firm has any incentive to change its price given the price of its opponent.

Lemma

In case of Bertrand equilibrium the prices are equal to the marginal cost.

Proof.

If $p_j > c$, $p_i = p_j - \varepsilon > c$ *will capture all the market.* □

Francis Ysidro Edgeworth Competition

Problem

Assume Bertrand price-competition while neither of the firms can satisfy the market demand alone (they are capacity-constrained)

Francis Ysidro Edgeworth Competition

Problem

Assume Bertrand price-competition while neither of the firms can satisfy the market demand alone (they are capacity-constrained)

Fact

Game defined by the Edgeworth model does not have an equilibrium: Prices cycle endlessly and never settle at any particular level. Industry will go through periods when prices fall ("price wars") and periods when prices rise (if prices reach marginal cost, they always move back to a higher level).

Kreps-Scheinkman Competition

- Assume Bertrand price-competition while firms decide on their capacity before deciding how much to price (two-stage game)

‘Bertrand’ competition delivers Cournot results with equal price levels.

Tacit Collusion
Cartels

Fact

In order to make extra-normal (half monopoly level) profit, the producers may collude on price.

Example

	Honour Agreement		Cheat	
Honour Agreement	£1000	£1000	£ 200	£1200
Cheat	£1200	£ 200	£ 500	£ 500

- Simultaneous game
- Sequential game