

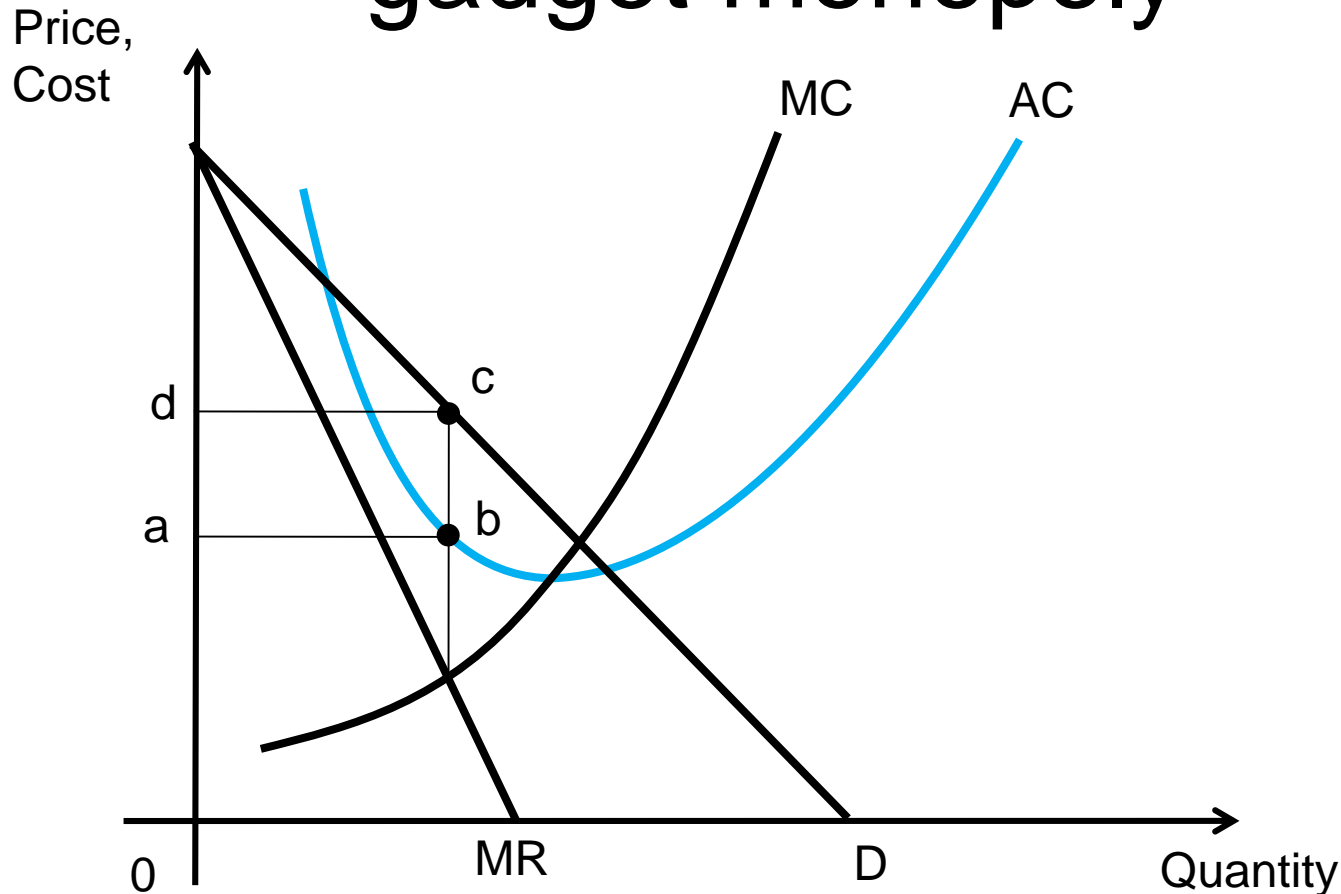
Course: Economics of Industry



Lecture 10: The World of Oligopoly

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The profit-maximizing output for the gadget monopoly



If there are no other market entrants, the entrepreneur can earn monopoly profits that are equal to the area dcba.

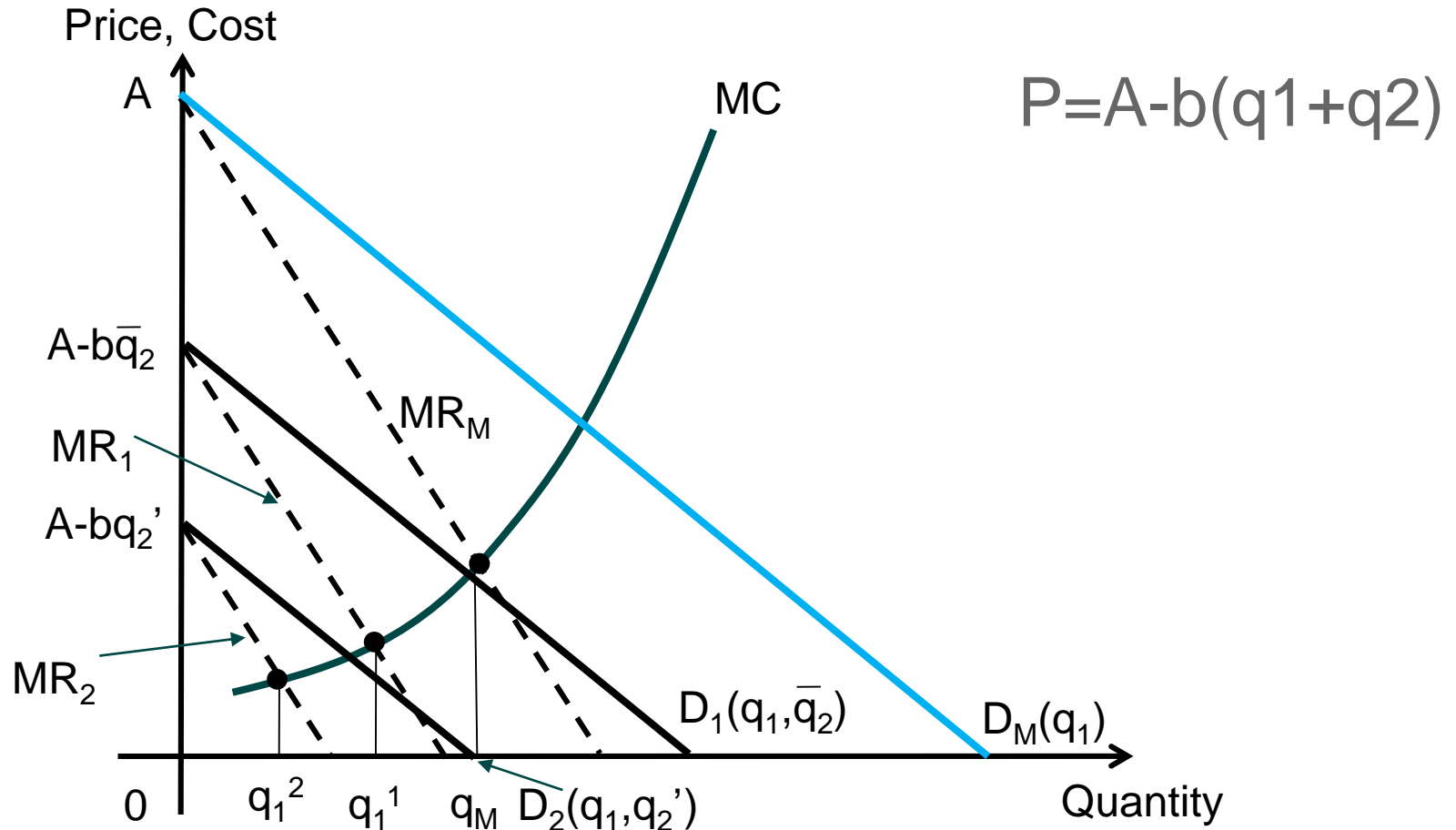
Cournot Theory of Duopoly & Oligopoly

- Oligopoly market
 - Few sellers of a product that are interdependent
 - May produce the same good or a differentiated product
 - Entry barriers allows the oligopoly to make a profit
- Duopoly
 - Two firms
 - One product

Cournot Theory of Duopoly & Oligopoly

- Cournot model
 - Two firms
 - Choose quantity simultaneously
 - Price - determined on the market
- Cournot equilibrium
 - Nash equilibrium

The demand curve facing firm 1



q_1 declines as firm 2 enters the market and expands its output

Profit Maximization in a duopoly market

- Inverse demand function – linear

$$P=A-b(q_1+q_2)$$

- Maximize profits

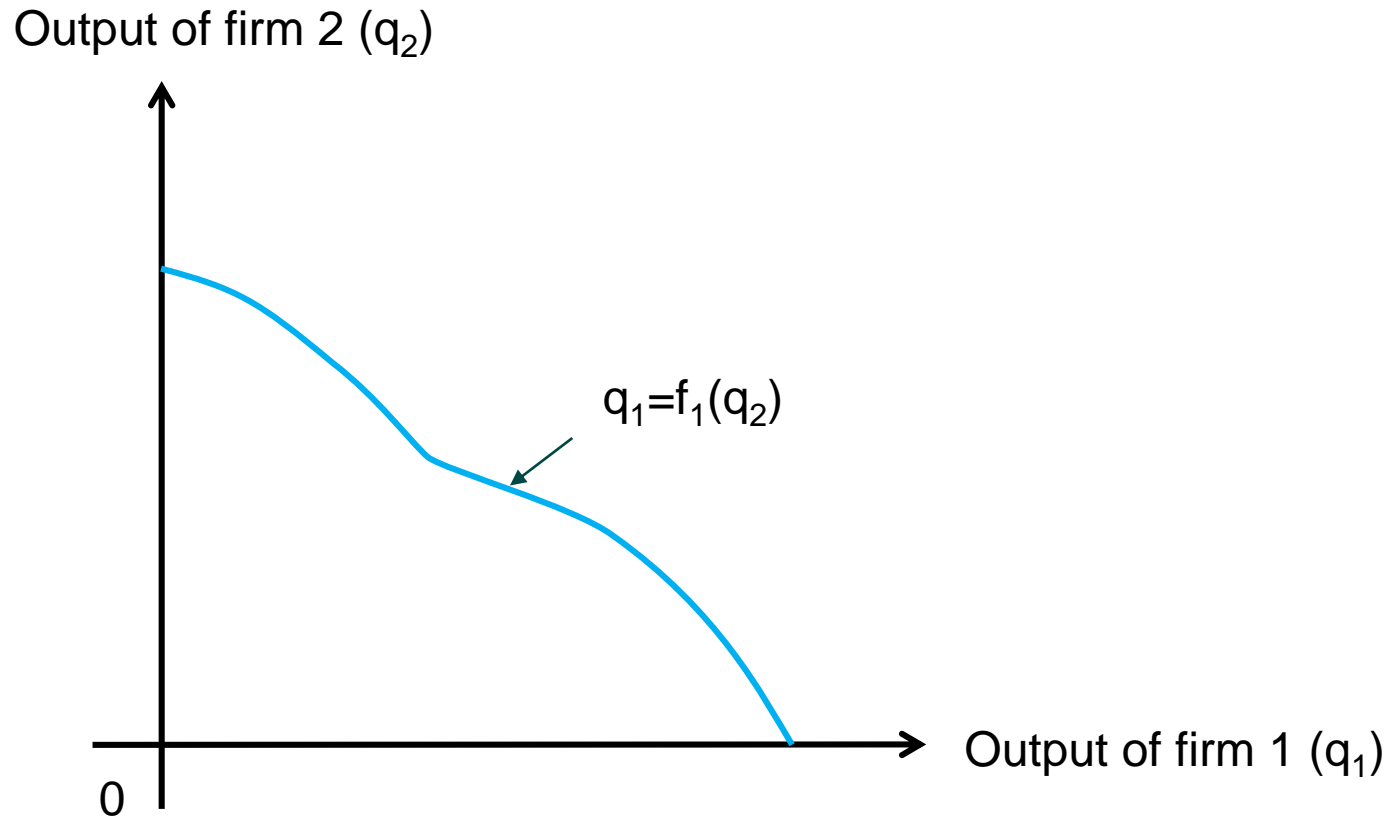
$$\pi_1 = [A-b(q_1+q_2)] \cdot q_1 - C(q_1)$$

$$\pi_2 = [A-b(q_1+q_2)] \cdot q_2 - C(q_2)$$

Reaction functions (best-response)

- Profit maximization:
 - Set $MR=MC$
 - MR now depends on the output of the competing firm
 - Setting $MR_1=MC_1$ gives a reaction function for firm 1
 - Gives firm 1's output as a function of firm 2's output

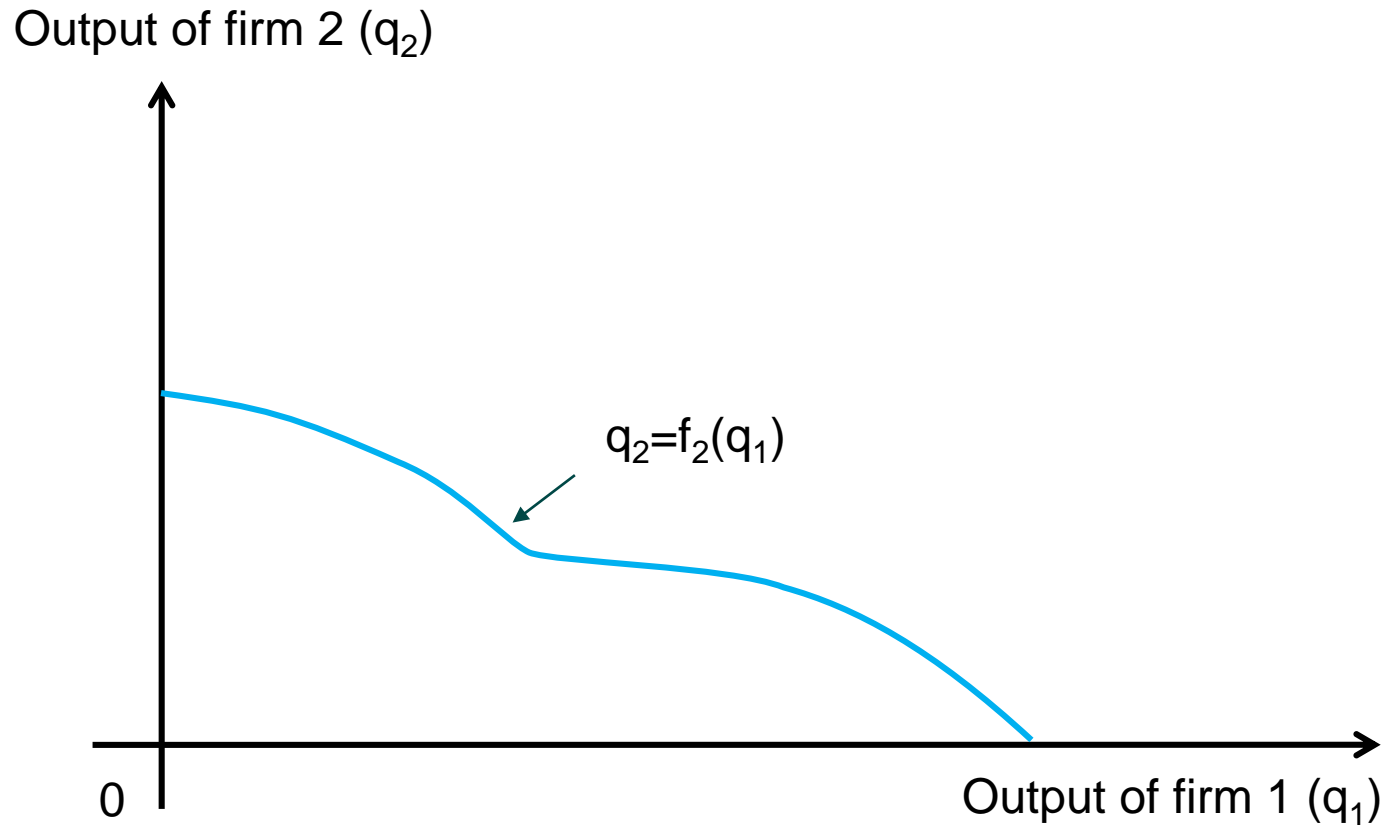
Reaction functions (best-response)



Reaction Functions

- Points on reaction function
 - Optimal/profit-maximizing choice/output
 - Of one firm
 - To a possible output level – other firm
- Reaction functions
 - $q_1 = f_1(q_2)$
 - $q_2 = f_2(q_1)$

Reaction functions (best-response)

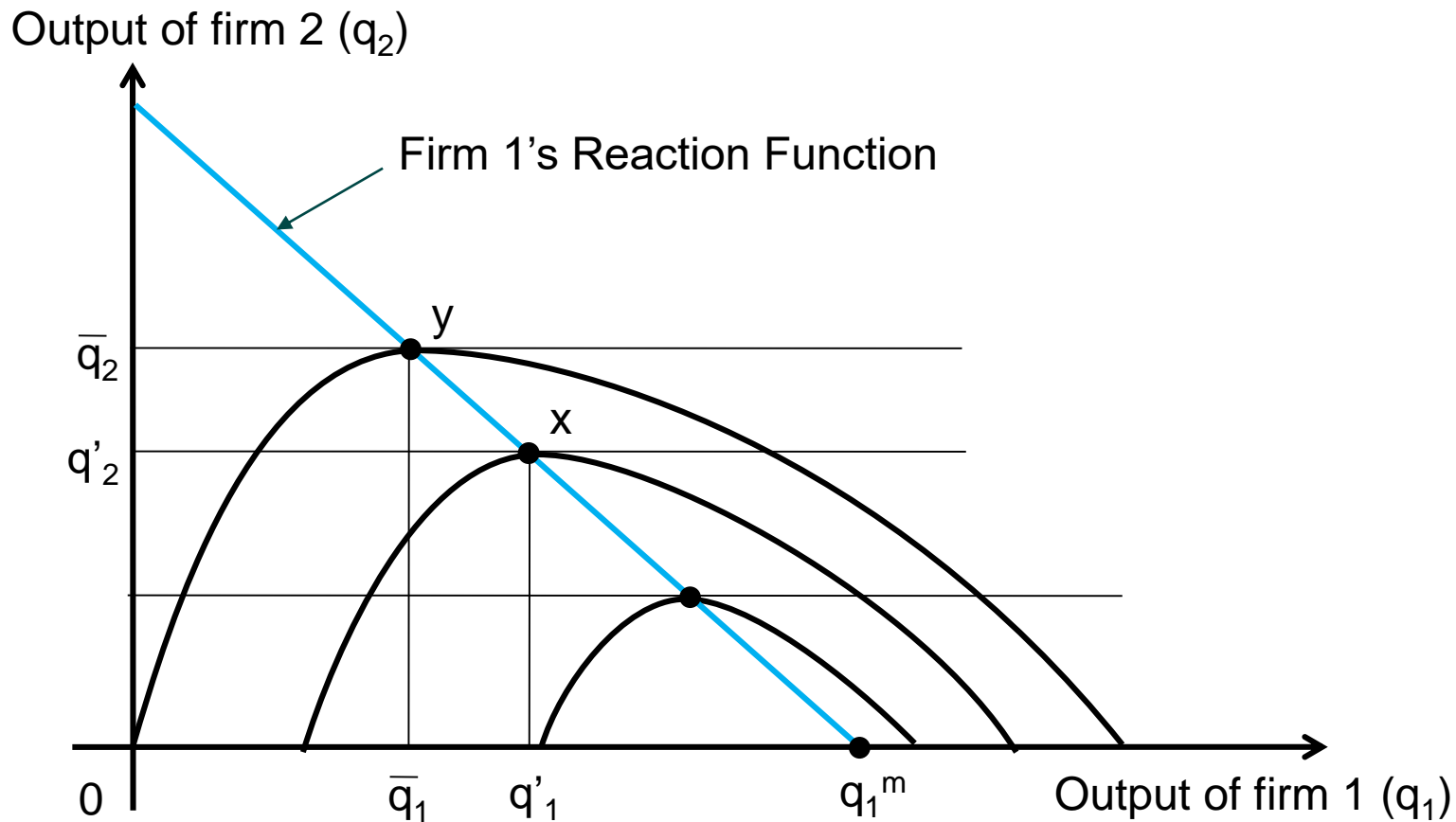


10 Given firm 1's choice of q_1 , firm 2's optimal response is $q_2 = f_2(q_1)$.

Alternative Derivation -Reaction Functions

- Isoprofit curves
 - Combination of q_1 and q_2 that yield same profit
- Reaction function (firm 1)
 - Different output levels – firm 2
 - Tangency points – firm 1

Reaction Function



Deriving a Cournot Equilibrium

- Cournot equilibrium
 - Intersection of the two Reaction functions
 - Same graph

Using Game Theory to Reinterpret the Cournot Equilibrium

- Simultaneous-move quantity-setting duopoly game
 - Strategic interaction
 - Firms choose the quantity simultaneously

Using Game Theory to Reinterpret the Cournot Equilibrium

- Strategies: two output levels
- Payoffs
 - $\pi_1 = [A - b(q_1 + q_2)] \cdot q_1 - C(q_1)$
 - $\pi_2 = [A - b(q_1 + q_2)] \cdot q_2 - C(q_2)$
- Equilibrium Cournot
 - Nash equilibrium

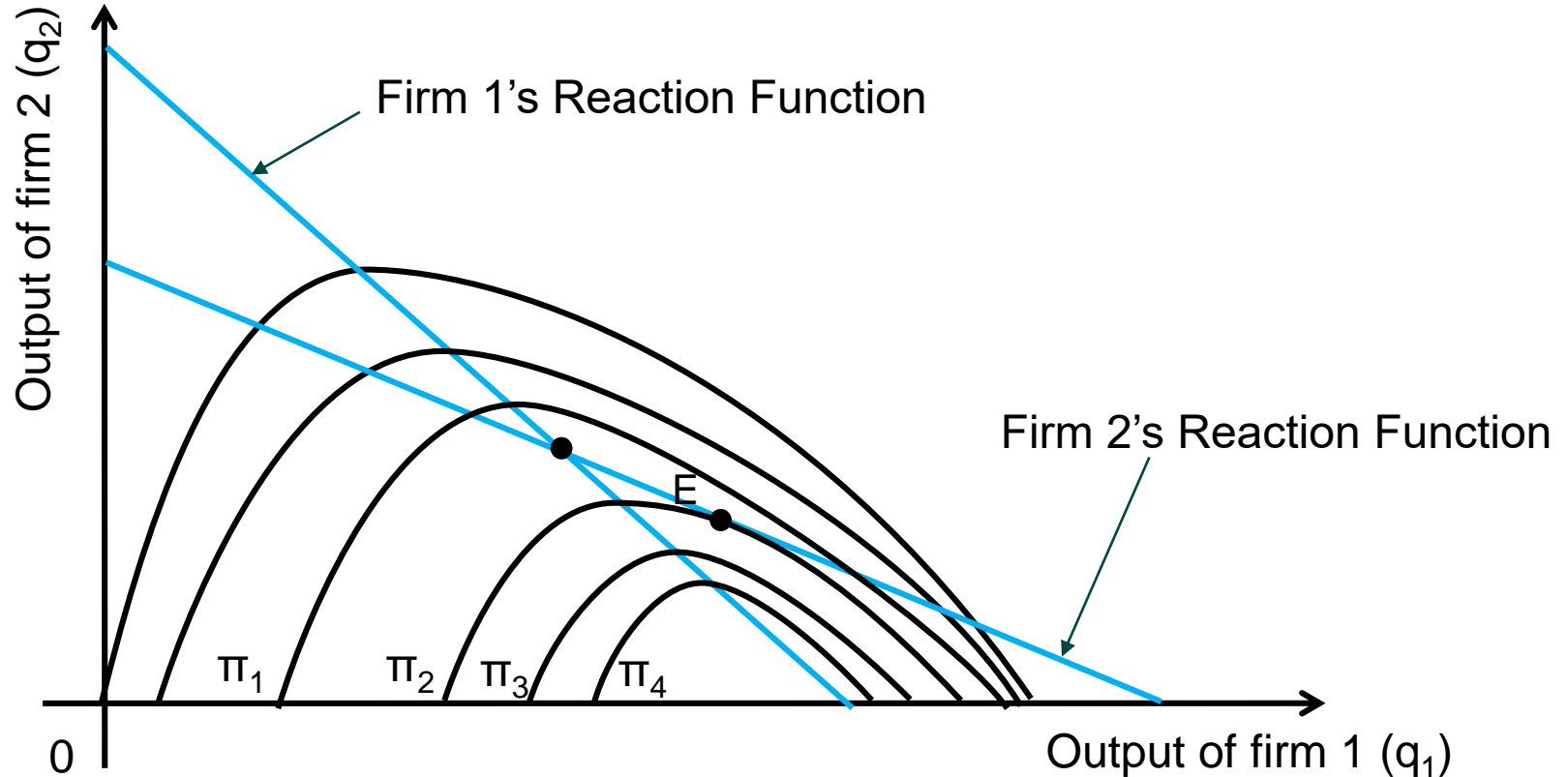
Criticisms of the Cournot Theory: The Stackelberg Duopoly Model

- Asymmetric model
- Stackelberg model
 - First: firm 1 – quantity
 - Then: firm 2 – quantity
 - Finally:
 - Price – market
 - Profits

Criticisms of the Cournot Theory: The Stackelberg Duopoly Model

- Stackelberg leader
 - Firm - moves first
- Stackelberg follower
 - Firm - moves second
- Stackelberg equilibrium
 - Equilibrium prices and quantities
 - Stackelberg game

The Stackelberg solution



Firm 1 (the leader) chooses the point on the reaction function of firm 2 (the follower) that is on the lowest attainable isoprofit curve of firm 1: point E.

Criticisms of the Cournot Theory: The Stackelberg Duopoly Model

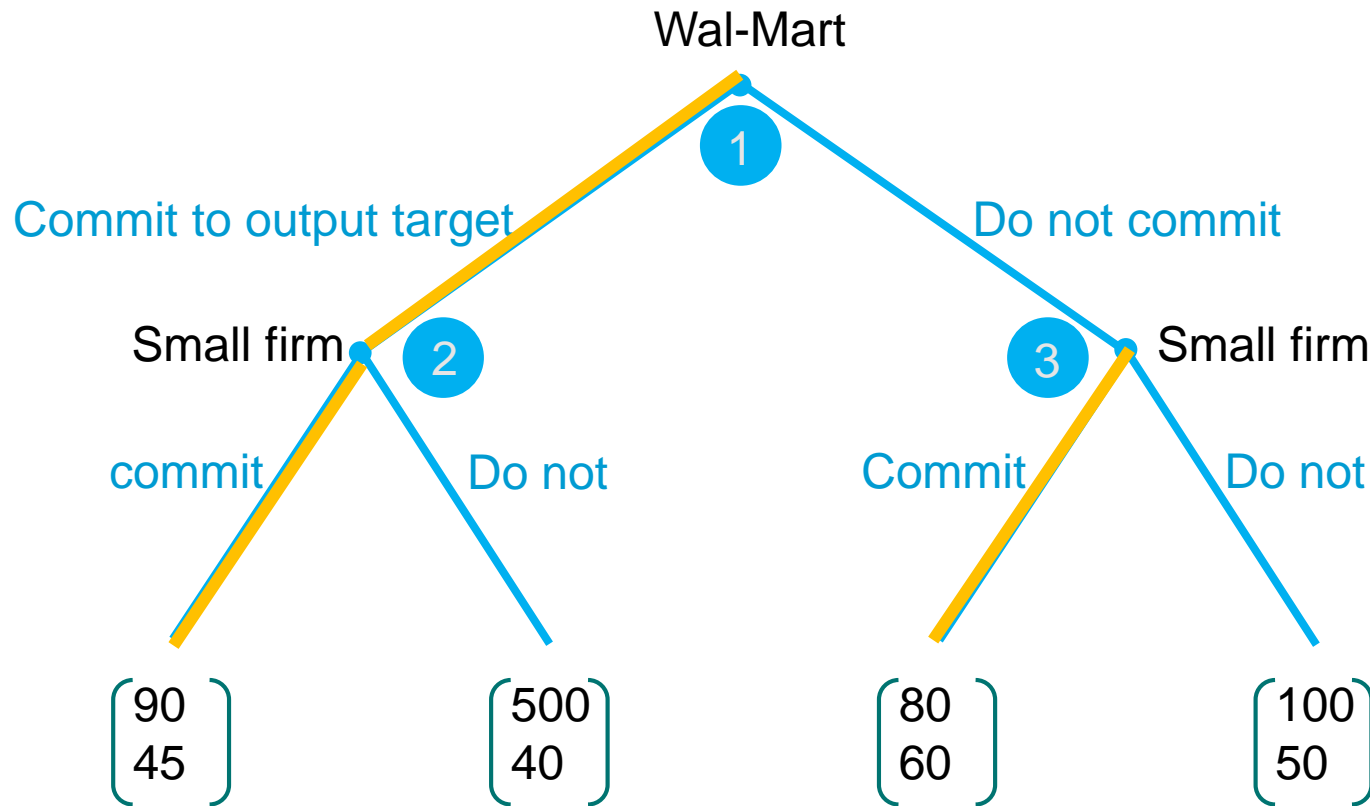
- First-mover advantage
 - Leader has a higher level of output and gets greater profits

Wal-Mart and CFL bulbs market

- In 2006 Wal-Mart committed itself to selling 1 million CFL bulbs every year
- This was part of Wal-Mart plan to be more socially responsible
- Ahmed(2012) shows that this commitment can be an attempt to raise profit.

Wal-Mart and CFL bulbs market

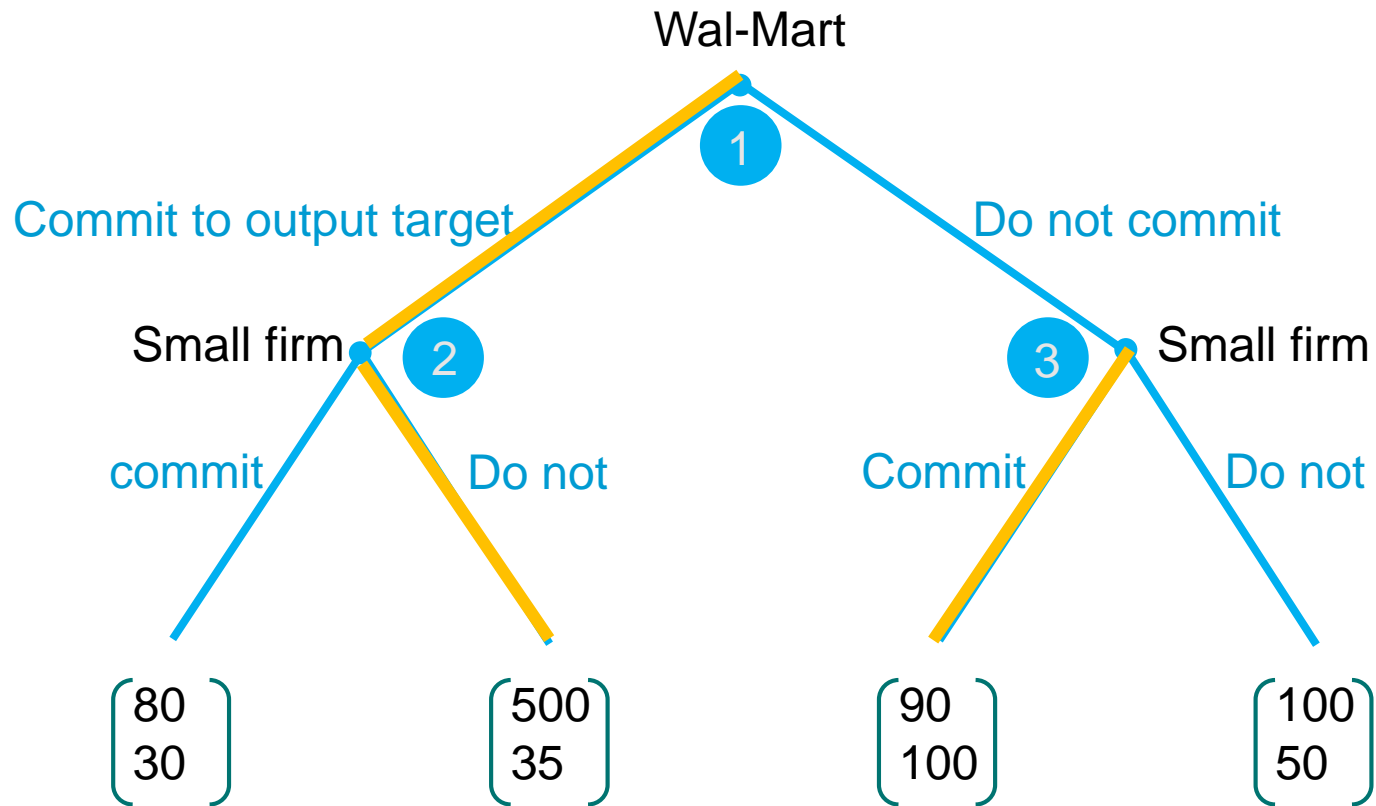
When the target is small



The outcome is similar to a prisoners dilemma

Wal-Mart and CFL bulbs market

When the target is large

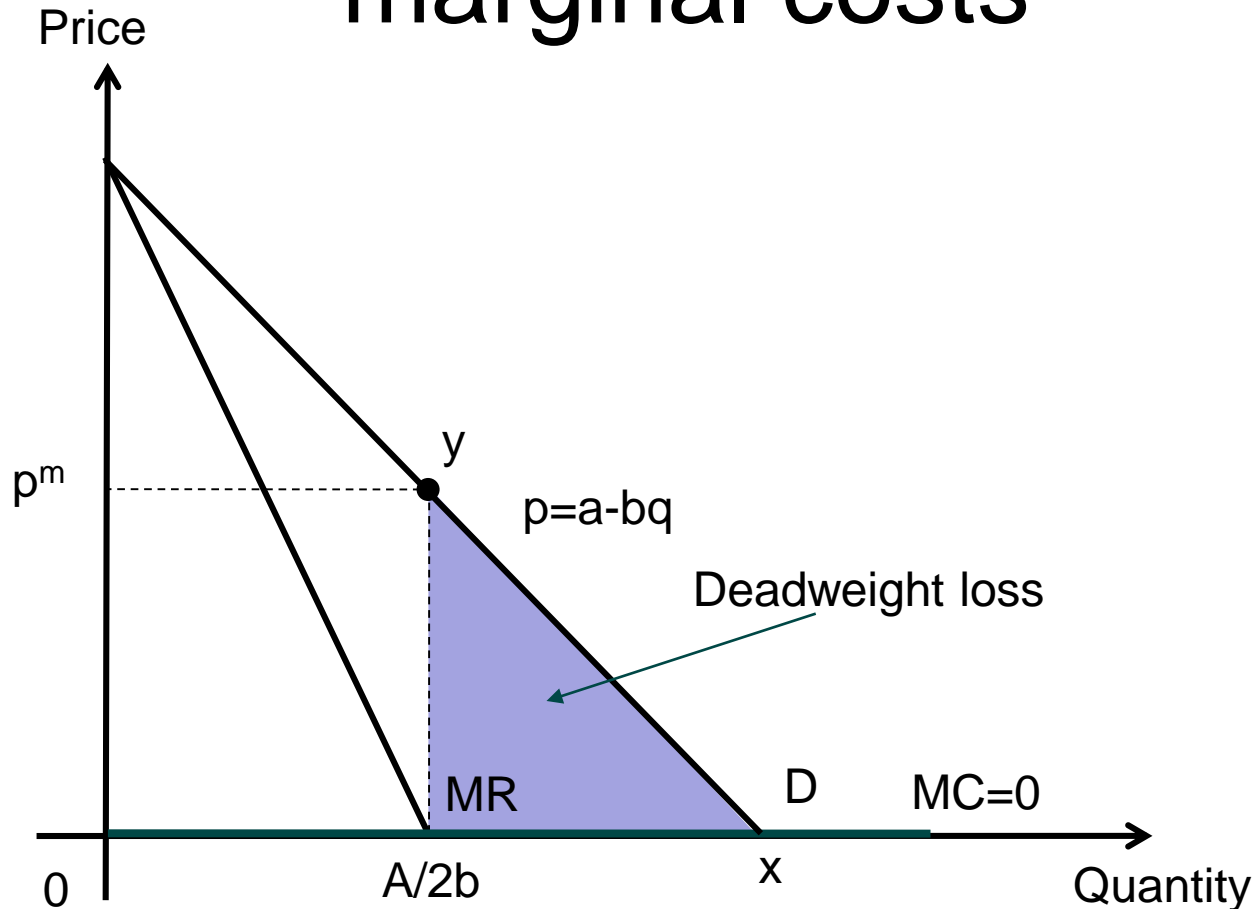


When the target is large enough, we have a game of chicken

Welfare Properties: Duopolistic Markets

- Cournot equilibrium outputs
 - Firms - duopolistic markets
 - Welfare (consumer + producer surplus)
 - Better than monopoly
 - Not optimal
 - Worse than perfect competition

The monopoly solution with zero marginal costs



The monopolist will choose output $A/2b$, at which the marginal revenue equals the marginal cost of zero. At the welfare-optimal output level, x , the price equals zero. The deadweight loss is area $(A/2b)xy$ under the demand curve and between the monopoly and welfare-optimal output levels.

Welfare: Monopoly, Stackelberg, Cournot

Variable	Cournot	Stackelberg	Collusion/ Monopoly
Individual quantity	$q=30$	$q_{\text{leader}}=45$ $q_{\text{follower}}=22.5$	$Q=45$
Total quantity	$Q=60$	$Q=67.5$	$Q=45$
Profits	$\pi=900$	$\pi_{\text{leader}}=1012.5$ $\pi_{\text{follower}}=506.25$	$\pi=2025$
Consumer surplus	1800	2278.125	1012.5
Welfare	3600	3796.875	3037.5

Criticisms of the Cournot Theory: The Bertrand Duopoly Model

- Bertrand model
 - Oligopolistic competition
 - Firms compete - setting prices

- Demand function

$$D_i(p_i, p_j) = \begin{cases} D(p_i) & \text{if } p_i < p_j \\ (1/2)[D(p_i)] & \text{if } p_i = p_j \\ 0 & \text{if } p_i > p_j \end{cases}$$

- Payoff to each firm

$$\pi_i = p_i[D_i(p_i, p_j)] - c[D_i(p_i, p_j)]$$

Criticisms of the Cournot Theory: The Bertrand Duopoly Model

- The Nash equilibrium: $P_1 = P_2 = MC$
- Proof: At each of the following an individual firm has an incentive to deviate
 - $P_1 = P_2 > MC$
 - $P_1 > P_2$
- The equilibrium is socially optimal

Criticisms of the Cournot Theory: The Bertrand Duopoly Model

- Bertrand equilibrium
 - Nash equilibrium
 - Price-setting game
 - Competition
 - Price - down to marginal cost
 - Welfare-optimal price, quantity

Collusive Duopoly

- Collusive duopoly
 - Firms collude and set price above marginal cost
 - Arrangements – unstable
 - Great incentive to cheat
 - Price – driven down to marginal cost

Collusive Duopoly

- Matrix of the payoffs from a game involving a collusive pricing arrangement

		Firm 2			
		Honor Agreement		Cheat	
Firm 1	Honor Agreement	\$1,000,000	\$1,000,000	\$200,000	\$1,200,000
	Cheat	\$1,200,000	\$200,000	\$500,000	\$500,000

Collusive Duopoly

- Example: The European voluntary agreement for washing machines.
- The agreement requires firms to eliminate from the market inefficient models
- Ahmed and Segerson (2011) show that the agreement can raise firm profit, however, it is not stable

		Firm 2			
		eliminate	eliminate	Keep	Keep
Firm 1	eliminate	\$1,000	\$1,000	\$200	\$1,200
	keep	\$1,200	\$200	\$500	\$500

Reference

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