

Managerial Economics & Business Strategy

Chapter 9

Basic Oligopoly Models

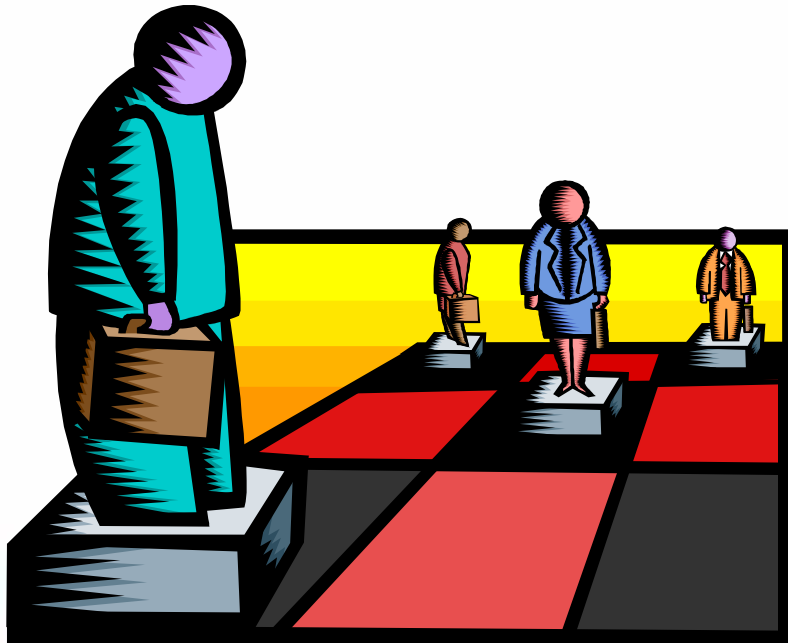
Overview

- I. Conditions for Oligopoly?
- II. Role of Strategic Interdependence
- III. Profit Maximization in Four Oligopoly Settings
 - Sweezy (Kinked-Demand) Model
 - Cournot Model
 - Stackelberg Model
 - Bertrand Model
- IV. Contestable Markets

Oligopoly Environment

- Relatively few firms, usually less than 10.
 - Duopoly - two firms
 - Triopoly - three firms
- The products firms offer can be either differentiated or homogeneous.
- Firms' decisions impact one another.
- Many different strategic variables are modeled:
 - No single oligopoly model.

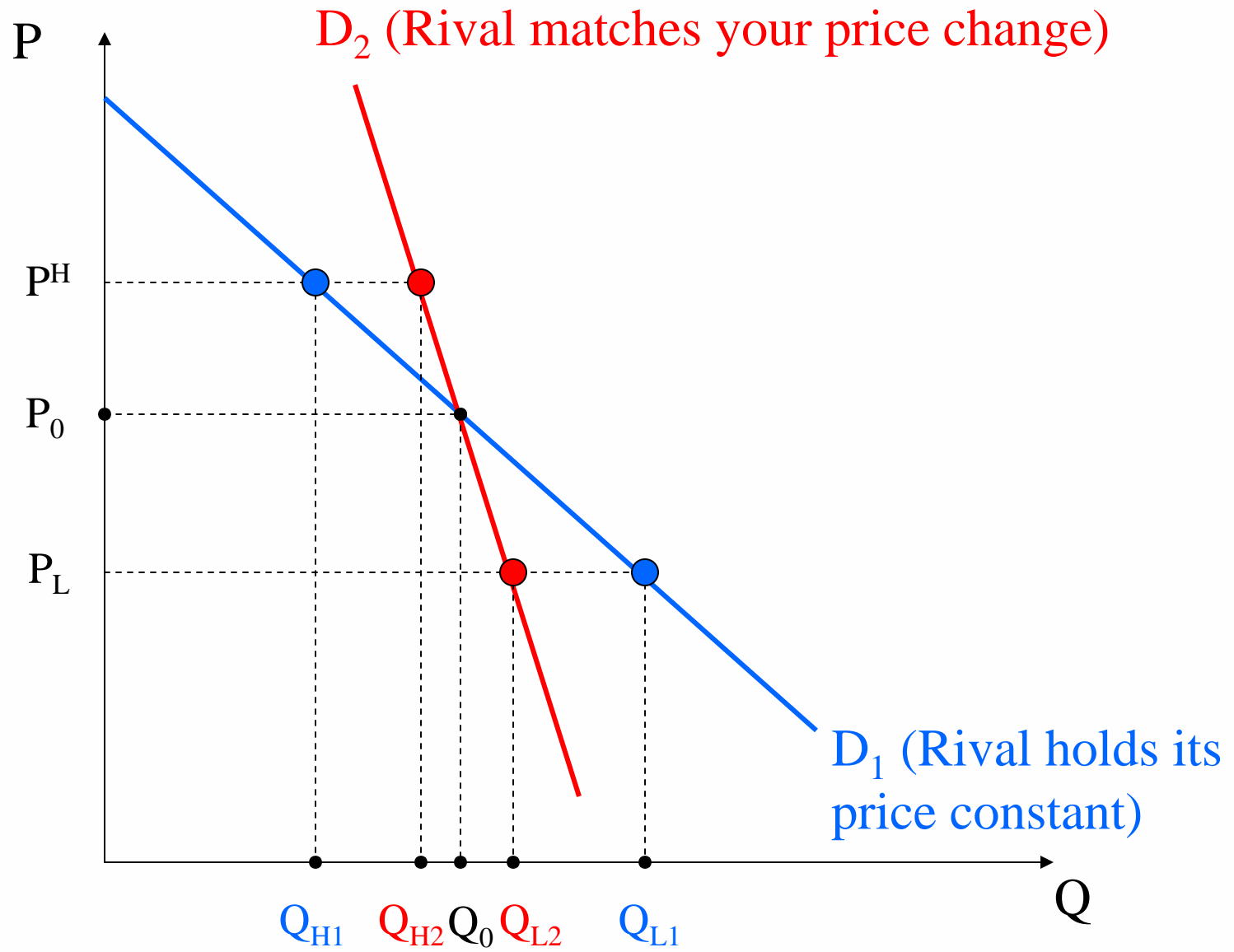
Role of Strategic Interaction

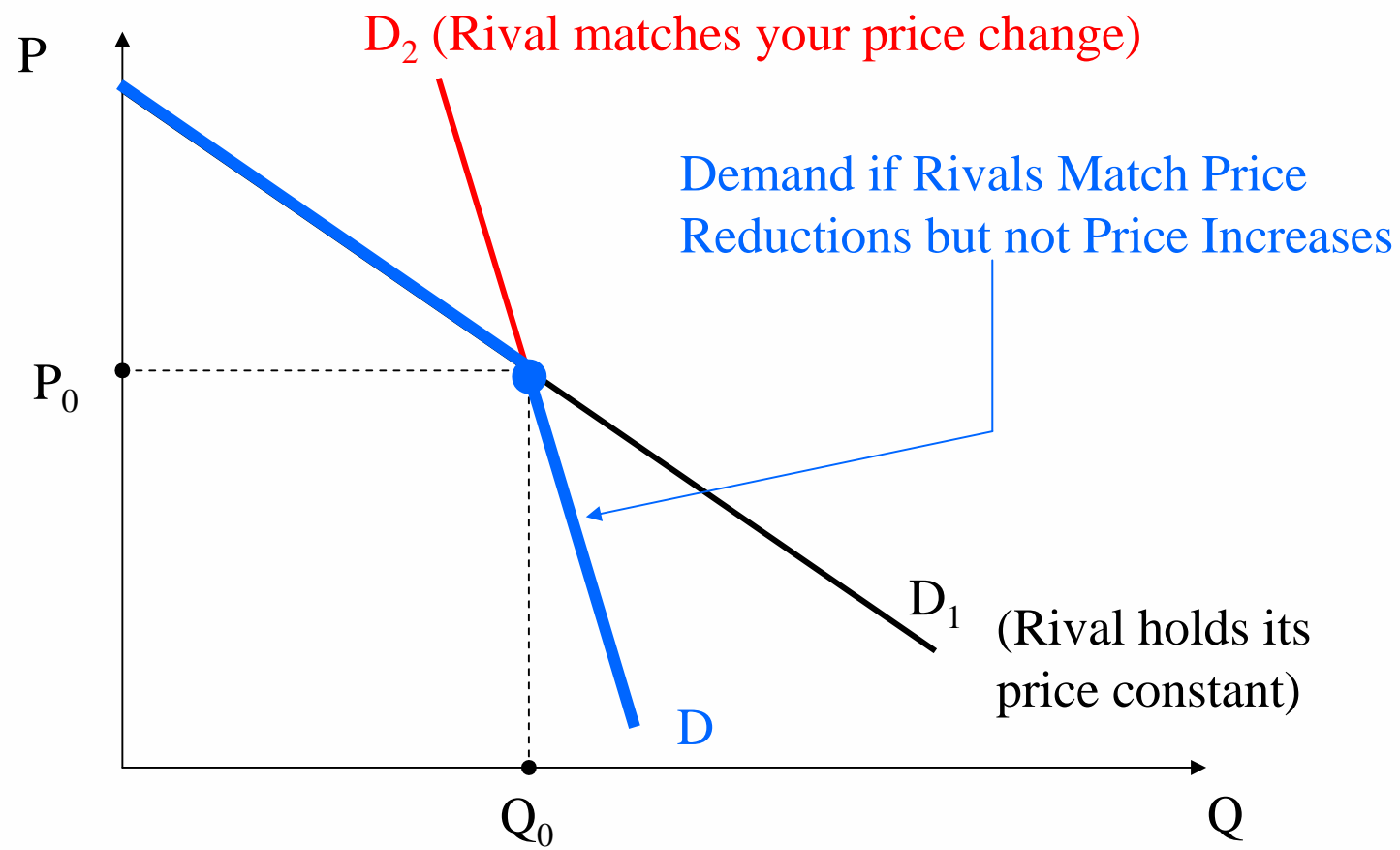


- Your actions affect the profits of your rivals.
- Your rivals' actions affect your profits.
- How will rivals respond to your actions?

An Example

- You and another firm sell differentiated products.
- How does the quantity demanded for your product change when you change your price?





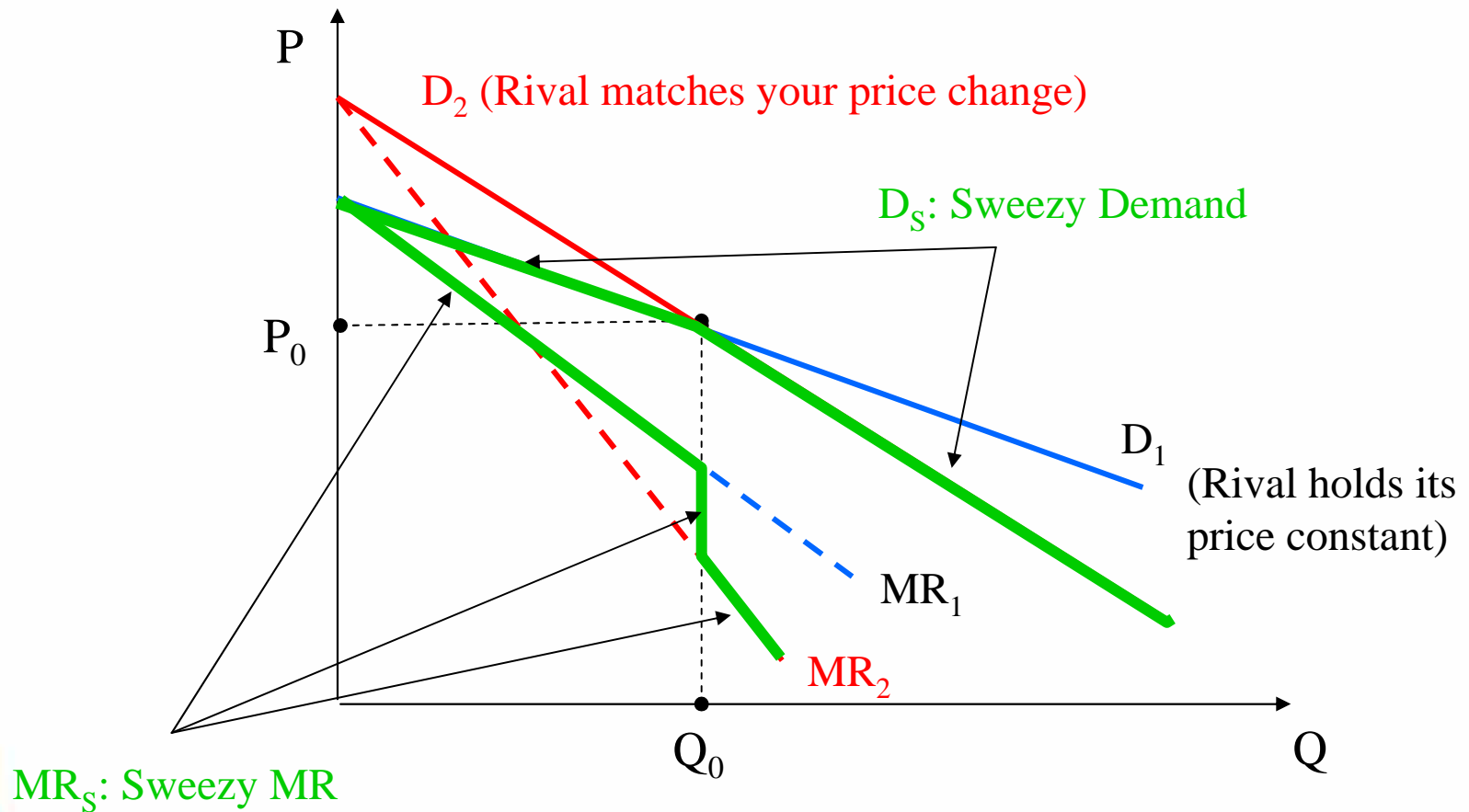
Key Insight

- 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!

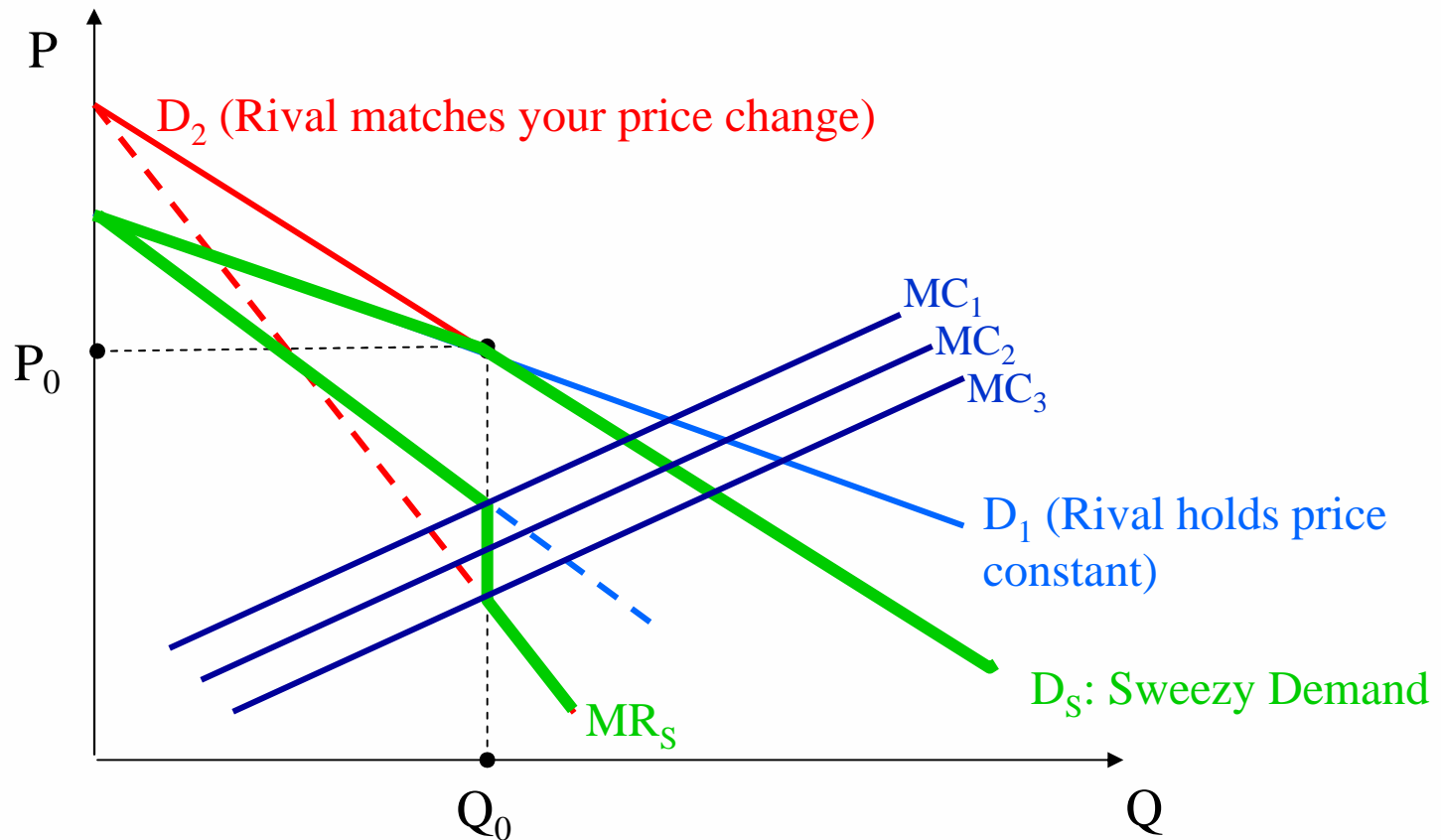
Sweezy (Kinked-Demand) Model Environment

- Few firms in the market serving many consumers.
- Firms produce differentiated products.
- Barriers to entry.
- Each firm believes rivals will match (or follow) price reductions, but won't match (or follow) price increases.
- Key feature of Sweezy Model
 - *Price-Rigidity.*

Sweezy Demand and Marginal Revenue



Sweezy Profit-Maximizing Decision



Sweezy Oligopoly Summary

- Firms believe rivals match price cuts, but not price increases.
- Firms operating in a Sweezy oligopoly maximize profit by producing where

$$MR_S = MC.$$

- The kinked-shaped marginal revenue curve implies that there exists a range over which changes in MC will not impact the profit-maximizing level of output.
- Therefore, the firm may have no incentive to change price provided that marginal cost remains in a given range.

Cournot Model Environment

- A few firms produce goods that are either perfect substitutes (homogeneous) or imperfect substitutes (differentiated).
- Firms' control variable is output in contrast to price.
- Each firm believes their rivals will hold output constant if it changes its own output (The output of rivals is viewed as given or "fixed").
- Barriers to entry exist.

Inverse Demand in a Cournot Duopoly

- Market demand in a homogeneous-product Cournot duopoly is

$$P = a - b(Q_1 + Q_2)$$

- Thus, each firm's marginal revenue depends on the output produced by the other firm. More formally,

$$MR_1 = a - bQ_2 - 2bQ_1$$

$$MR_2 = a - bQ_1 - 2bQ_2$$

Best-Response Function

- Since a firm's marginal revenue in a homogeneous Cournot oligopoly depends on both its output and its rivals, each firm needs a way to “respond” to rival's output decisions.
- Firm 1's best-response (or reaction) function is a schedule summarizing the amount of Q_1 firm 1 should produce in order to maximize its profits for each quantity of Q_2 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.

Best-Response Function for a Cournot Duopoly

- To find a firm's best-response function, equate its marginal revenue to marginal cost and solve for its output as a function of its rival's output.

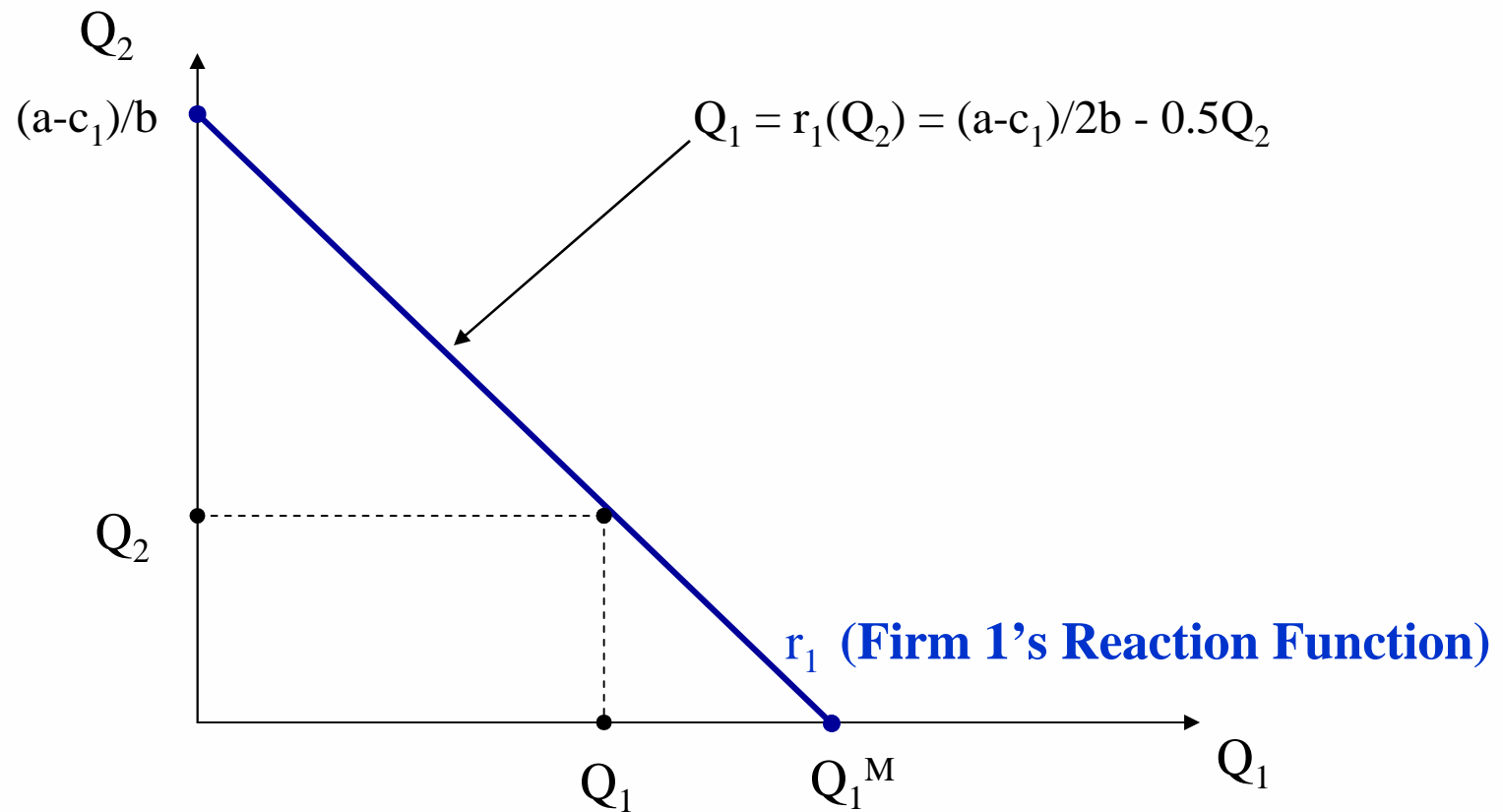
- Firm 1's best-response function is (c_1 is firm 1's MC)

$$Q_1 = r_1(Q_2) = \frac{a - c_1}{2b} - \frac{1}{2}Q_2$$

- Firm 2's best-response function is (c_2 is firm 2's MC)

$$Q_2 = r_2(Q_1) = \frac{a - c_2}{2b} - \frac{1}{2}Q_1$$

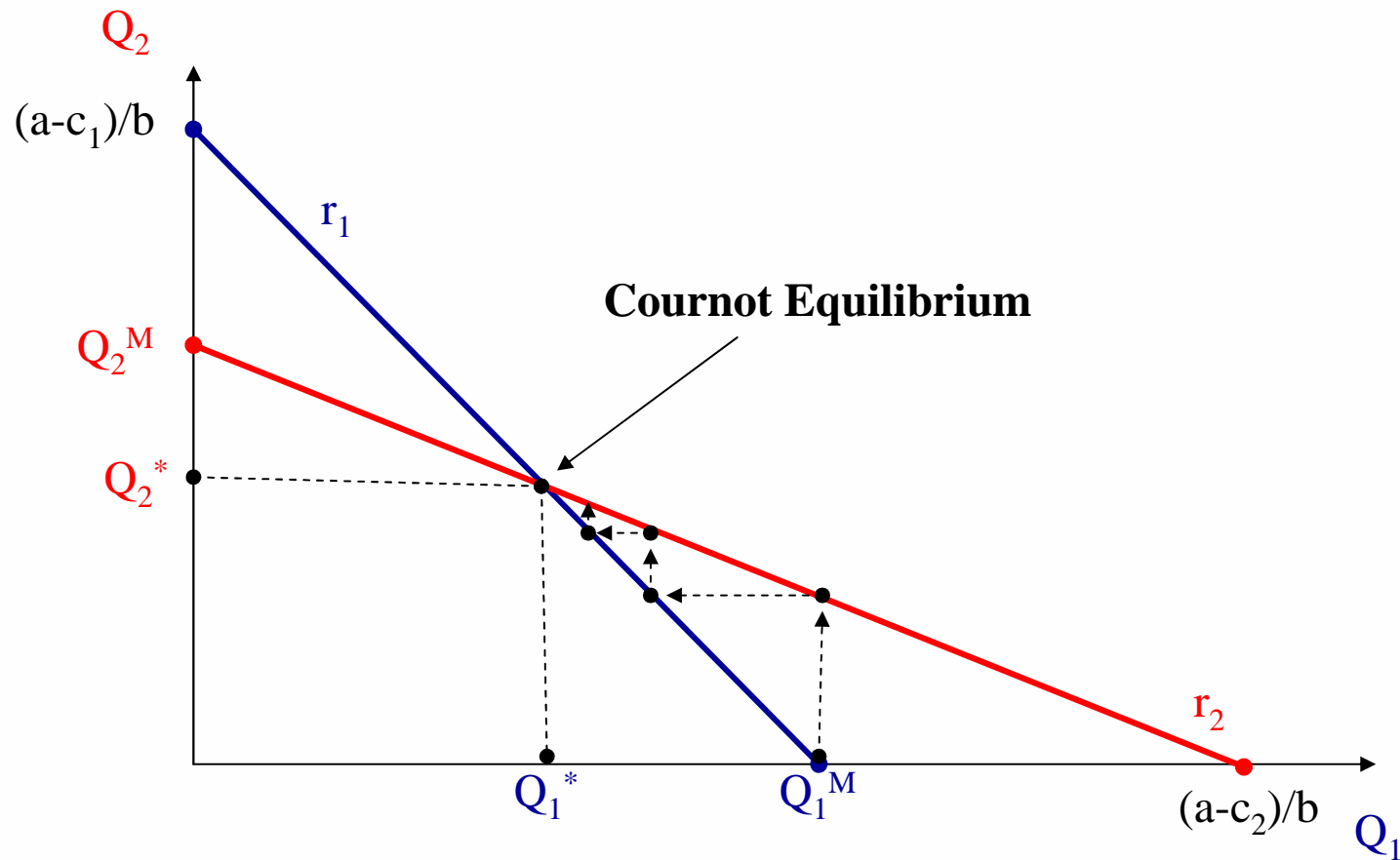
Graph of Firm 1's Best-Response Function



Cournot Equilibrium

- Situation where each firm produces the output that maximizes its profits, given the the output of rival firms.
- No firm can gain by unilaterally changing its own output to improve its profit.
 - A point where the two firm's best-response functions intersect.

Graph of Cournot Equilibrium

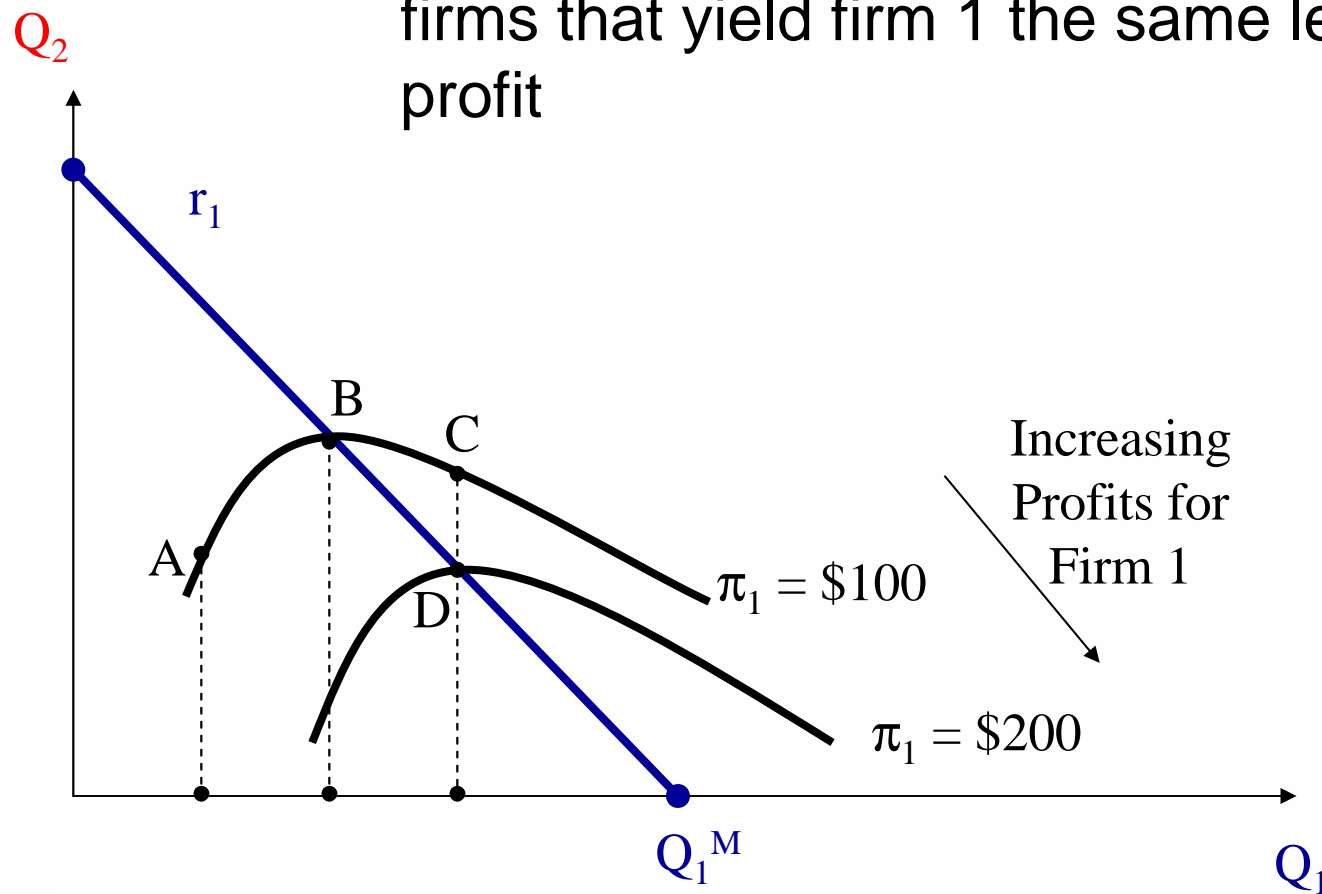


Summary of Cournot Equilibrium

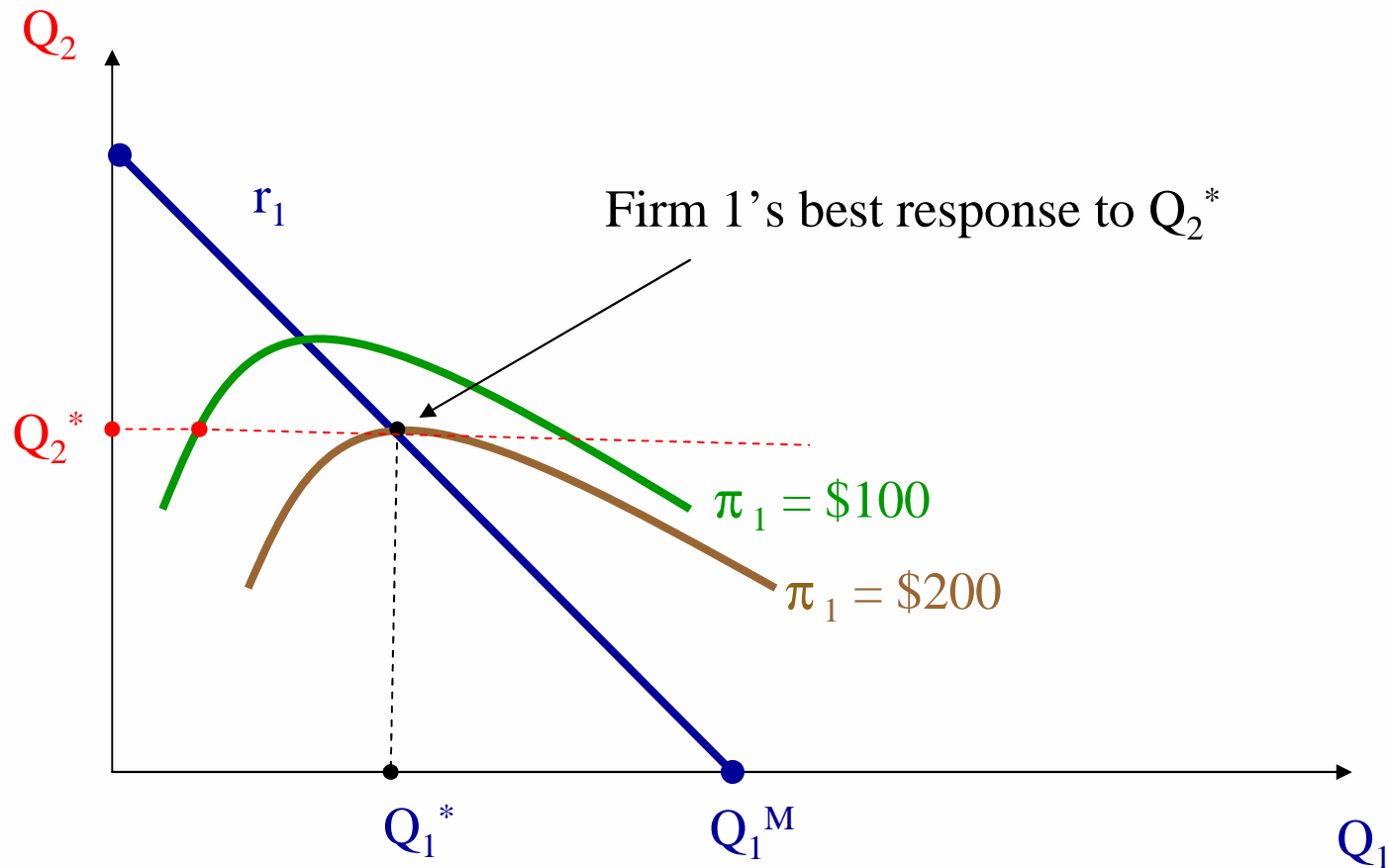
- The output Q_1^* maximizes firm 1's profits, given that firm 2 produces Q_2^* .
- The output Q_2^* maximizes firm 2's profits, given that firm 1 produces Q_1^* .
- Neither firm has an incentive to change its output, given the output of the rival.
- Beliefs are consistent:
 - In equilibrium, each firm “thinks” rivals will stick to their current output – and they do!

Firm 1's Isoprofit Curve

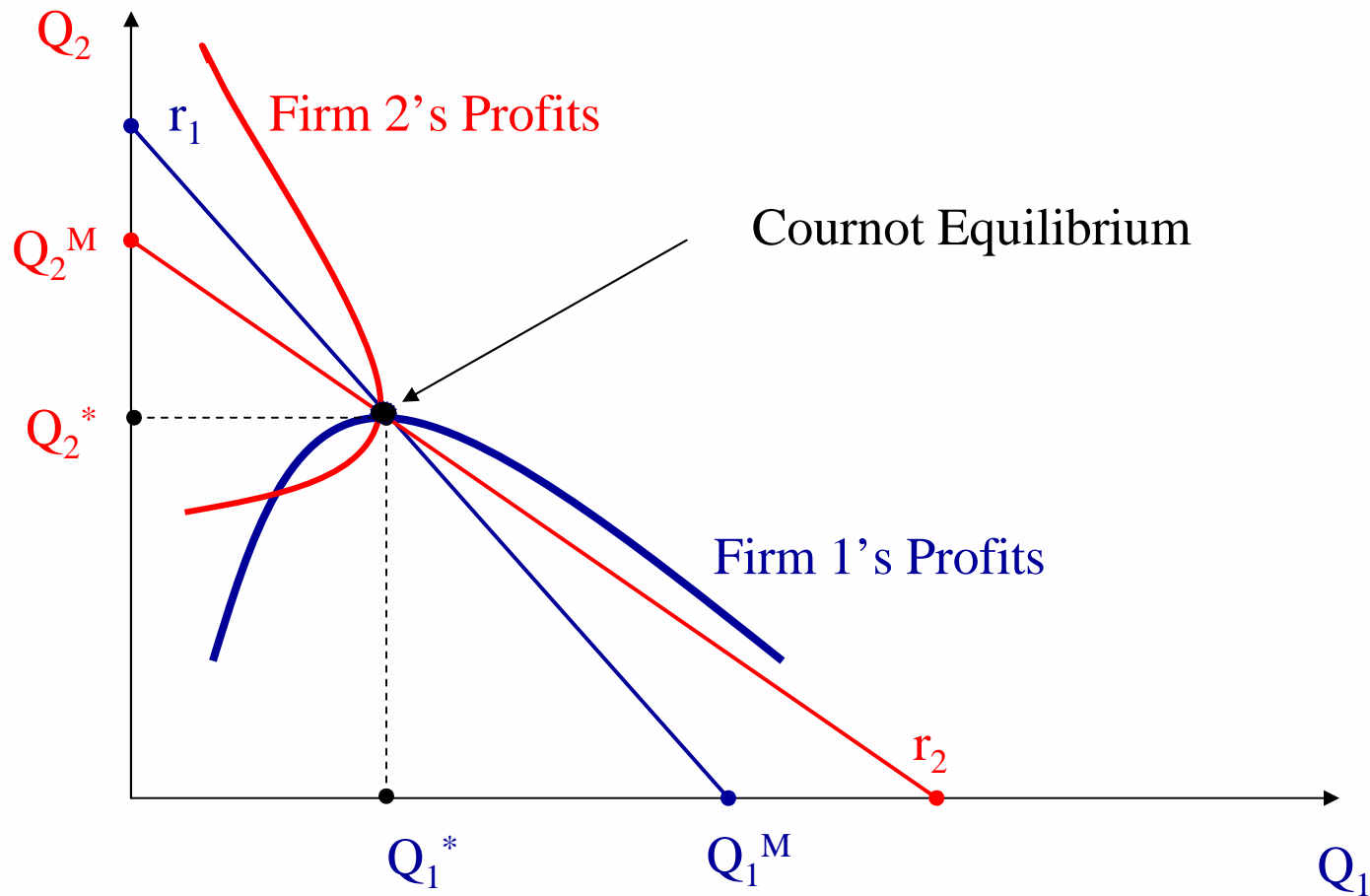
- The combinations of outputs of the two firms that yield firm 1 the same level of profit



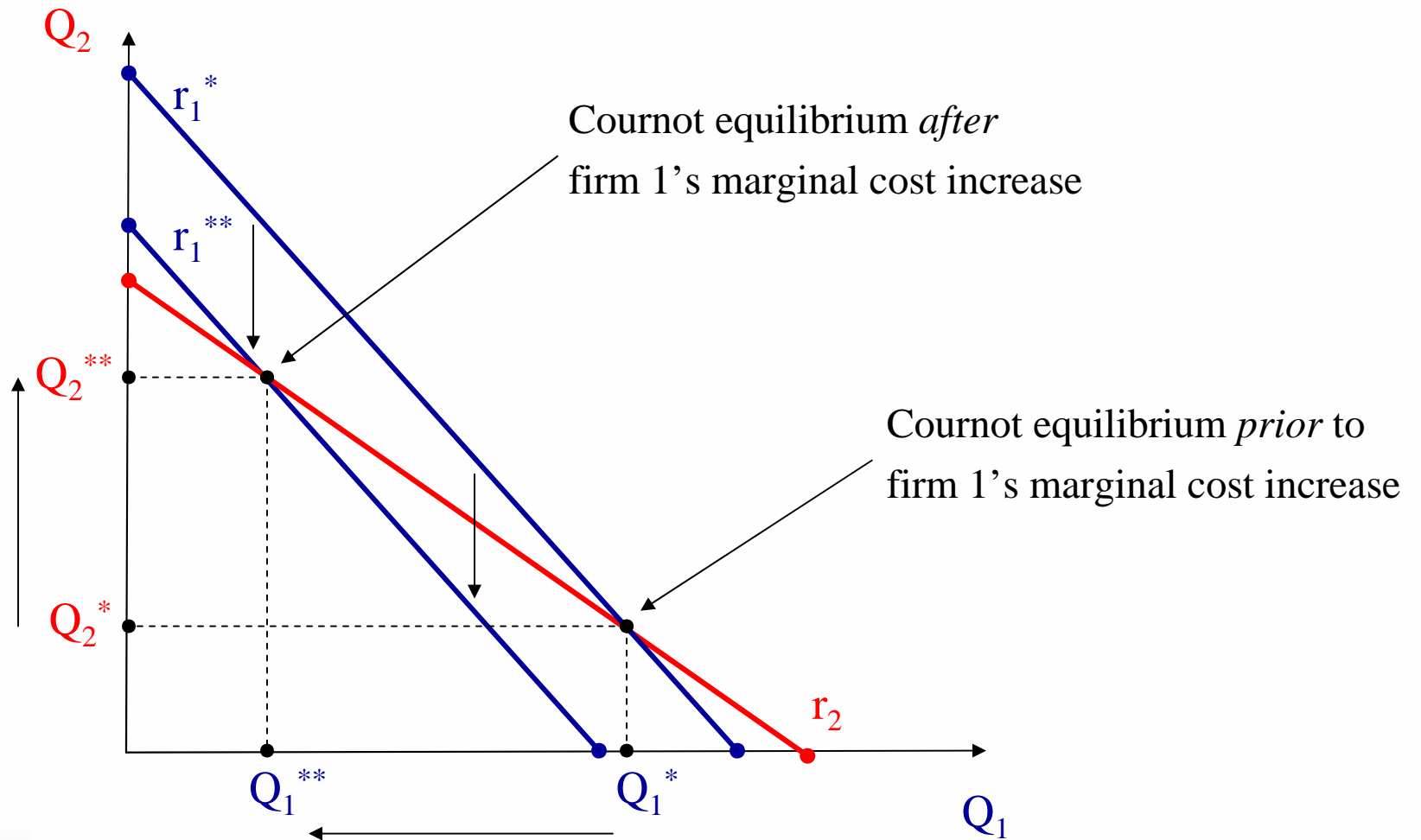
Another Look at Cournot Decisions



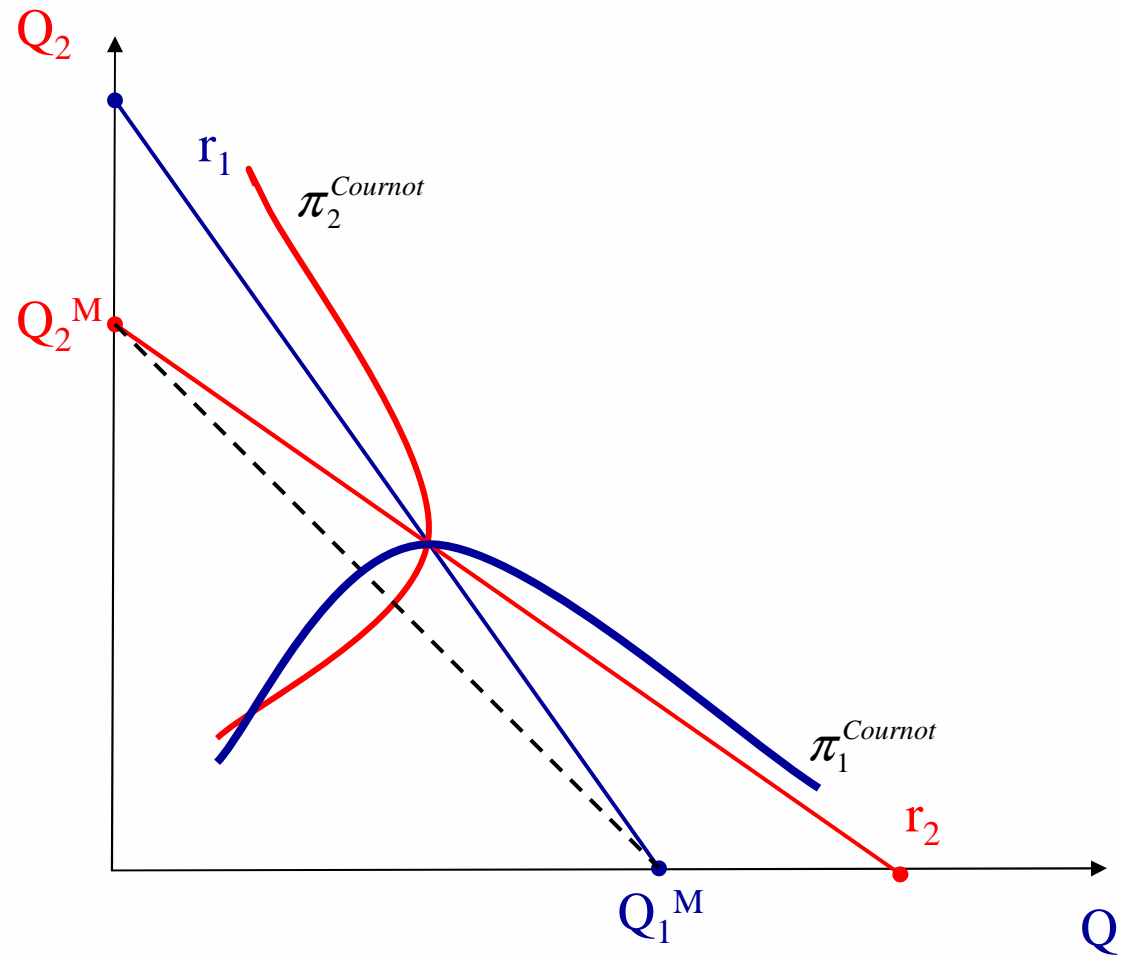
Another Look at Cournot Equilibrium



Impact of Rising Costs on the Cournot Equilibrium



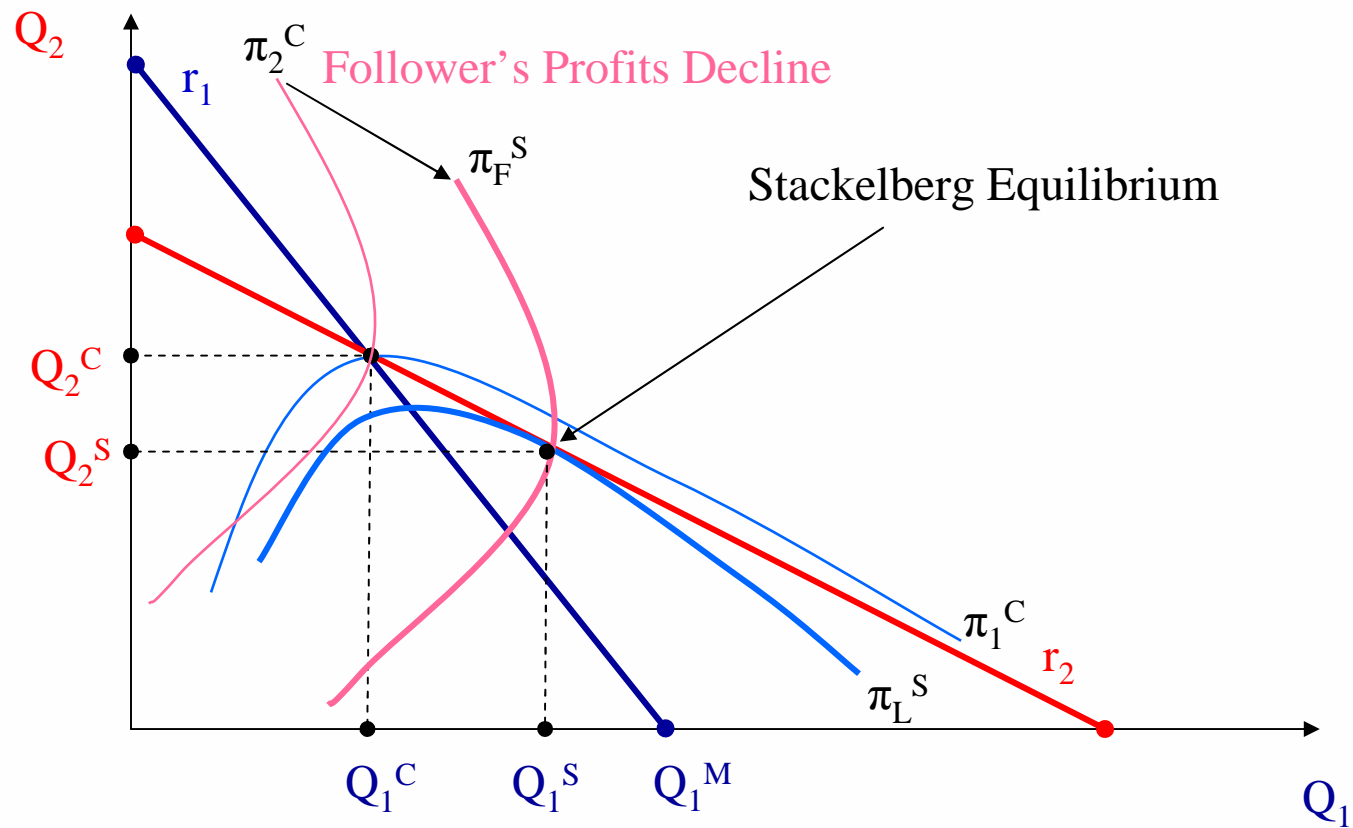
Collusion Incentives in Cournot Oligopoly



Stackelberg Model Environment

- Few firms serving many consumers.
- Firms produce differentiated or homogeneous products.
- Barriers to entry.
- Firm one is the leader.
 - The leader commits to an output before all other firms.
- Remaining firms are followers.
 - They choose their outputs so as to maximize profits, given the leader's output.

Stackelberg Equilibrium



The Algebra of the Stackelberg Model

- Since the follower reacts to the leader's output, the follower's output is determined by its reaction function

$$Q_2 = r_2(Q_1) = \frac{a - c_2}{2b} - 0.5Q_1$$

- The Stackelberg leader uses this reaction function to determine its profit maximizing output level, which simplifies to

$$Q_1 = \frac{a + c_2 - 2c_1}{2b}$$

Stackelberg Summary

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

Bertrand Model Environment

- Few firms that sell to many consumers.
- Firms produce identical products at constant marginal cost.
- Each firm independently sets its price in order to maximize profits (price is each firms' control variable).
- Barriers to entry exist.
- Consumers enjoy
 - Perfect information.
 - Zero transaction costs.

Bertrand 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 $P_1 = P_2 = MC$.

Contestable Markets

- Key Assumptions
 - Producers have access to same technology.
 - Consumers respond quickly to price changes.
 - Existing firms cannot respond quickly to entry by lowering price.
 - Absence of sunk costs.
- Key Implications
 - Threat of entry disciplines firms already in the market.
 - Incumbents have no market power, even if there is only a single incumbent (a monopolist).

Conclusion

- Different oligopoly scenarios give rise to different optimal strategies and different outcomes.
- Your optimal price and output depends on ...
 - Beliefs about the reactions of rivals.
 - Your choice variable (P or Q) and the nature of the product market (differentiated or homogeneous products).
 - Your ability to credibly commit prior to your rivals.