Industrial Organization

Bertrand Model

Bertrand with Differentiated Products

Week 8

The Bertrand Model

EXAMPLES: telecommunications, automobile industry, tech industry, etc.

	Perfect competition	Monopolistic competition	Oligopoly	Monopoly
Characteristics	Homogeneous product Many firms Many consumers Free entry and exit	Many firms Many consumers Differentiated product Free entry and exit ($\pi^{LR} = 0$)	**Some** producers but not many Depending on the characteristics of the oligopoly we will use different models. Examples: → Cournot; → Stackelberg; → **Bertrand**; → …	Only one firm Unique product Entry barriers
Behaviour	Takes market determined price as given and chooses quantity to maximize profits ("Price-takers")	Sets price and quantity to maximize profits ("Price-maker")		Sets price and quantity to maximize profits ("Price-maker")
Optimal decision	$P = MC$	$MR = MC$		$MR = MC$

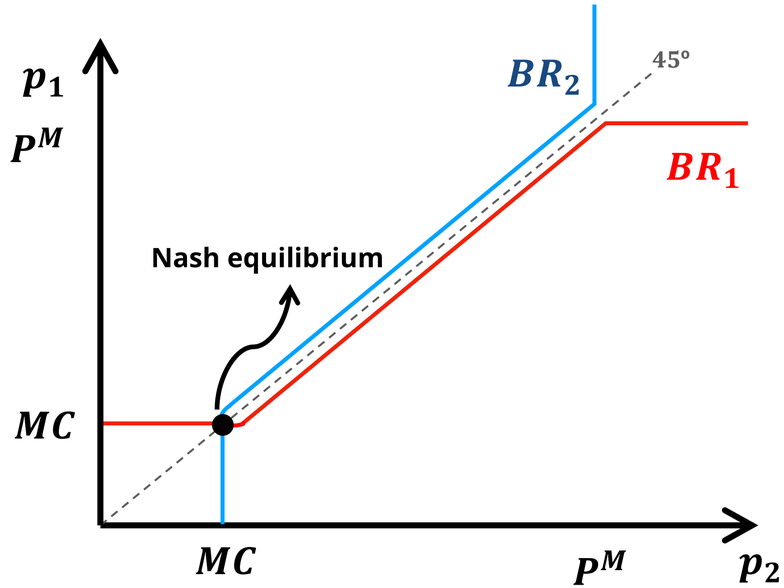
The Bertrand Model

Bertrand Equilibrium/Paradox (when both firms have the same cost structure)

- Each firm has incentives to undercut each other until they reach the marginal cost.

$$BR_i: P_i^*(P_j) = \begin{cases} P^M \text{ if } P_j > P^M \\ P_j - \varepsilon \text{ if } MC \leq P_j \leq P^M \\ MC \text{ if } P_j < MC \end{cases}$$

$MC_1 = MC_2 = c \rightarrow P_1 = P_2 = c$ → **Bertrand Paradox**



Bertrand with homogeneous products

ADDITIONAL EXERCISE

Two firms, 1 and 2, **compete à la Bertrand** when selling a homogeneous good whose demand equals $p = 100 - q$. Each firm's constant marginal and average cost of producing the good equals 30. Suppose that **it is known that a new technology can be found** that lowers the constant marginal and average cost to 20. Without a patent system, each firm can do costly research to find the new technology, but will see its invention copied immediately after discovery (a process called "reverse engineering"). With a patent system, this is rendered illegal.

(a) What is the equilibrium outcome without a patent system?

(b) And with a patent system?

(c) Is the patent system socially desirable?

(d) Suppose that a firm abandons the market for good if it sells nothing. Is the patent system socially desirable?

(e) Compare the two previous answers and explain intuitively.

Betrand with differentiated products

COMPETITION IN PRICES WITH DIFFERENTIATED PRODUCTS

Main assumptions:

- Oligopolistic model (more than one firm)
- Firms choose **simultaneously**
- … the **price they will charge** (in the profit-maximization problem, p_i will be the decision variable)
- … of a **differentiated product**

Betrand with differentiated products

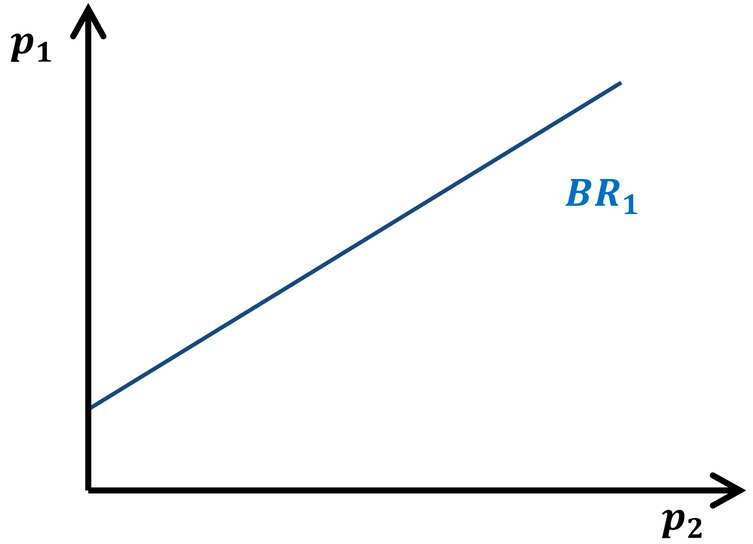
THE CASE OF TWO SYMMETRIC FIRMS

General case → $q_1 = a - bp_1 + dp_2 \wedge q_2 = a - bp_2 + dp_1 \wedge MC_1 = MC_2 = c$

Goal of all firms → Maximize profits

$$\max_{p_1} \pi_1 = (P_1 - c)q_1$$

$$\frac{d\pi}{dp_1} = 0 \leftrightarrow (\dots) \leftrightarrow p_1 = \frac{a + cb}{2b} + \frac{d}{2b}p_2$$



Betrand with differentiated products

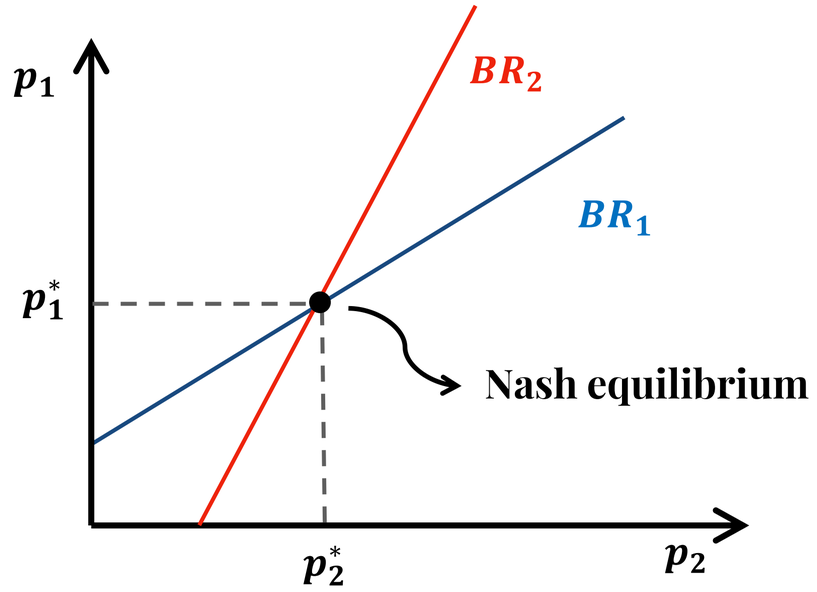
THE CASE OF TWO SYMMETRIC FIRMS

General case → $q_1 = a - bp_1 + dp_2 \wedge q_2 = a - bp_2 + dp_1 \wedge MC_1 = MC_2 = c$

Goal of all firms → Maximize profits

$$\max_{p_2} \pi_2 = (P_2 - c)q_2$$

$$\frac{d\pi}{dp_2} = 0 \leftrightarrow (\dots) \leftrightarrow p_2 = \frac{a + cb}{2b} + \frac{d}{2b}p_1$$



Bertrand with differentiated products

EXERCISE

10. Two firms sell imperfectly differentiated products, denoted 1 and 2, whose demand functions are $q_1 = 10 - p_1 + p_2$ and $q_2 = 10 - p_2 + p_1$, respectively. Each produces its product at a constant marginal and average cost of 6, i.e., $c_1 = 6 = c_2$. They compete in prices, which they set simultaneously and independently.

(a) What price will each firm set? How much will each sell? What profit will each attain? Quantify.

Firm 1 has embarked on an R&D project that has lowered its constant marginal and average cost to 2.

(b) What price will each firm set? How much will each sell? What profit will each attain? Quantify.

Bertrand with differentiated products

EXERCISE

10. Two firms sell imperfectly differentiated products, denoted 1 and 2, whose demand functions are $q_1 = 10 - p_1 + p_2$ and $q_2 = 10 - p_2 + p_1$, respectively. Each produces its product at a constant marginal and average cost of 6, i.e., $c_1 = 6 = c_2$. They compete in prices, which they set simultaneously and independently.

Suppose that firm 2 is unaware of firm 1's R&D project. This gives rise to the **direct effect**. Suppose now that firm 2 becomes aware of the R&D project. This would give rise to additional price changes, which constitute the **strategic effect**. The two together yield the **total effect** of the R&D project.

(c) What is the **direct effect** of the R&D project on firm 1's decision variable, i.e., its **price**? And the **strategic effect**? Quantify and explain.

(d) What is the **direct effect** of the R&D project on firm 1's **profit**? And the **strategic effect**? Quantify and explain.

Recommended readings

CABRAL, LUIS MB. INTRODUCTION TO INDUSTRIAL ORGANIZATION. MIT PRESS, 2017.

- ✓ Chapter 7.1: The Bertrand Model