Topic 11 Part 3

Oligopoly (Chapter 13)

Bertrand Oligopoly – Assumptions

Assumptions

1) **Firms set prices**
2) Simultaneous-move
3) Non-cooperative
4) **Homogeneous Products VS Differentiated Products**

We will study TWO versions of Bertrand Oligopoly:

- Bertrand Duopoly with **Homogeneous Products**
- Bertrand Duopoly with **Differentiated Products**

Note that in Bertrand, firms engage in Price Competition.

In **Cournot**, firms engage in **Quantity Competition**.

Bertrand – Homogeneous Products

Homogeneity implies that consumers will buy from the low-price seller.

Further, each firm realizes that the demand that it faces depends both on its own price and on the price set by other firms**.**

Any firm charging a higher price than its rivals will sell no output.

Any firm charging a lower price than its rivals will obtain the entire market demand.

Bertrand – Homogeneous Products

Any firm charging a higher price than its rivals will sell no output.

Any firm charging a lower price than its rivals will obtain the entire market demand.

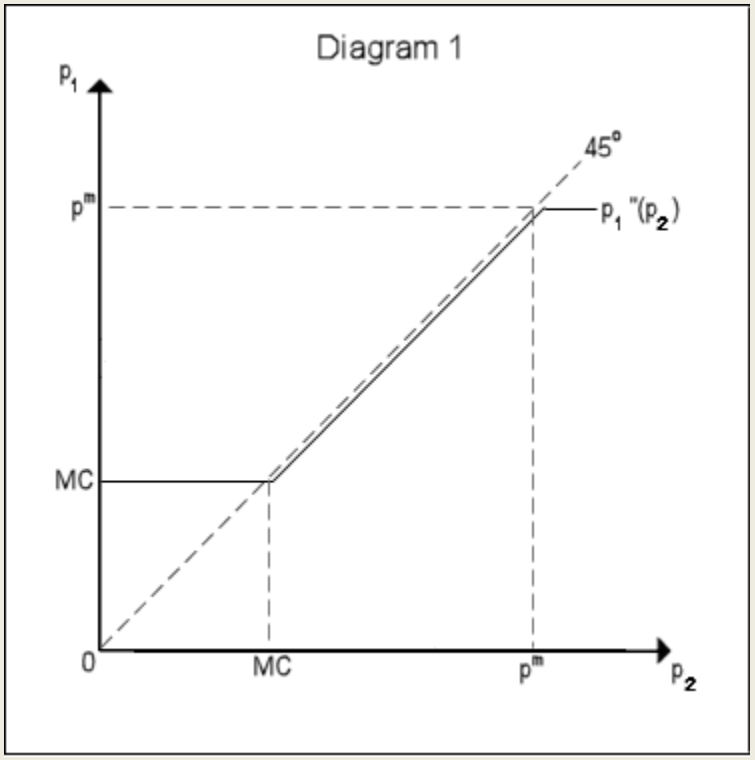
Symbolically, the quantity sold of Firm 1 is given by

$$Q_1 = D(P_1, P_2) \begin{cases} = D(P_1, P_2)/2 & \text{IF } P_1 = P_2 \\ = D(P_1) & \text{IF } P_1 < P_2 \\ = 0 & \text{IF } P_1 > P_2 \end{cases}$$

We use the following result to derive $P_1^* = BR_1(P_2)$.

Bertrand – Homogeneous Products

$P_1^* = BR_1(P_2)$ refers to the profit-maximizing price (best response function) of Firm 1 which depends on the price of Firm 2.



P_m = monopoly price

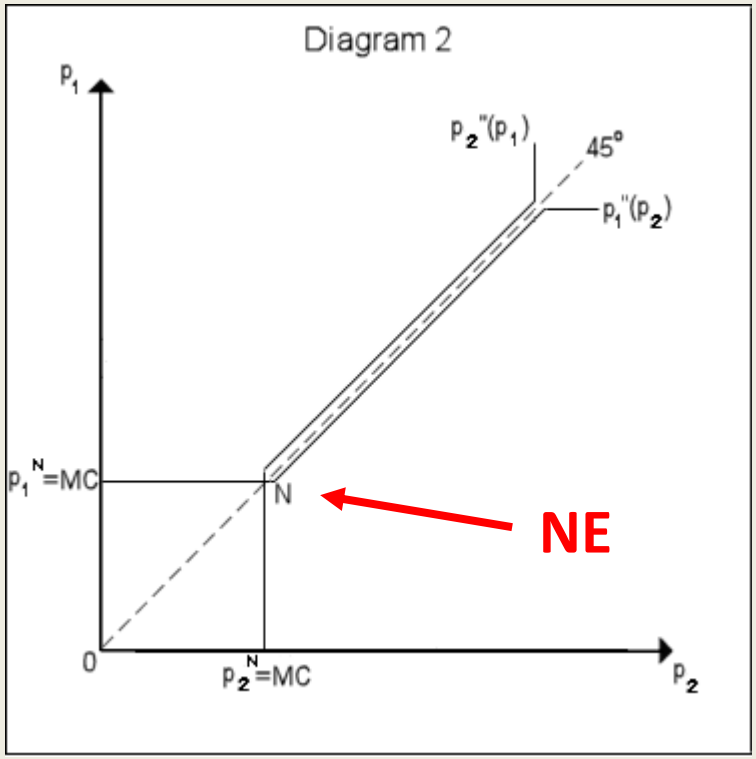
$\underline{P_1^* = BR_1(P_2)}$

$P_1 = MC$	when $0 \le P_2 \le MC$
$P_1 < P_2$	when $MC < P_2 \le P_m$
$P_1 = P_m$	when $P_m < P_2$

Bertrand – Homogeneous Products

Bertrand-NE occurs when $P_1^* = BR_1(P_2^*)$ AND $P_2^* = BR_2(P_1^*)$.

This is where $P_1 = P_2 = MC$.



$P_1^* = BR_1(P_2)$

$P_1 = MC$	**when $0 \le P_2 \le MC$**
$P_1 < P_2$	when $MC < P_2 \le P_m$
$P_1 = P_m$	when $P_m < P_2$

$P_2^* = BR_2(P_1)$

$P_2 = MC$	**when $0 \le P_1 \le MC$**
$P_2 < P_1$	when $MC < P_1 \le P_m$
$P_2 = P_m$	when $P_m < P_1$

Bertrand – Homogeneous Products

Bertrand Paradox

The paradox describes a situation in which two players (firms) reach Nash equilibrium where both firms charge P = MC.

The paradox is that in models such as Cournot competition, an increase in the number of firms is associated with a convergence of prices to marginal costs.

In other words, even with very few firms, the oligopoly market can reach the perfectly competitive outcome.

Bertrand – Homogeneous Products

Bertrand Paradox (Explained)

Neither A nor B will set a higher price than the other because doing so would yield the entire market to their rival.

If they set the same price, the companies will share both the market and profits.

If either firm were to lower its price, even a little, it would gain the whole market and substantially larger profits.

Since both A and B know this, they will each try to undercut their competitor until the product is selling at zero economic profit.

Bertrand – Differentiated Products

Assumptions

1) **Firms set prices**
2) Simultaneous-move
3) Non-cooperative
4) **Differentiated Products**

Product Differentiation means that lowering price below your rivals' will not result in capturing the entire market, nor will raising price mean losing the entire market.

Bertrand – Differentiated Products

In this model, we solve for the Bertrand-NE in a similar way as when we solve for the Cournot-NE.

1) Find the best response function (BR) of each firm, i.e. $P_1^* = BR_1(P_2)$ for Firm 1 and $P_2^* = BR_2(P_1)$ for Firm 2.

2) Bertrand-NE is determined where the two BR's intersect, i.e. where
$P_1^* = BR_1(P_2^*)$ AND $P_2^* = BR_2(P_1^*)$

That is, Firm 1 is doing its best given what Firm 2 is doing, AND Firm 2 is doing its best given what Firm 1 is doing.

Bertrand – Differentiated Products

Example

$Q_1 = 100 - 2P_1 + P_2$ *"Coke's demand"*
$Q_2 = 100 - 2P_2 + P_1$ *"Pepsi's demand"*
$MC_1 = MC_2 = 5$

To find $BR_1(P_2)$, we set $MR_1 = MC_1$, but first we need TR_1.

$TR_1 = P_1Q_1$ with $P_1 = (100 + P_2 - Q_1)/2$

$$TR_1 = P_1Q_1 = \left(50 + \frac{1}{2}P_2 - \frac{1}{2}Q_1\right)Q_1$$
$$MR_1 = \left(50 + \frac{1}{2}P_2 - Q_1\right)$$

Bertrand – Differentiated Products

To find $BR_1(P_2)$, we set $MR_1 = MC_1$.

$MR_1 = \left(50 + \frac{1}{2}P_2 - Q_1\right) = MC_1 = 5$

$Q_1 = 45 + \frac{1}{2}P_2$

Recall that $Q_1 = 100 - 2P_1 + P_2$. We have

$100 - 2P_1 + P_2 = 45 + \frac{1}{2}P_2$

$55 + \frac{1}{2}P_2 = 2P_1$

$BR_1(P_2)$ ➔ $P_1 = 27.5 + \frac{1}{4}P_2$

Bertrand – Differentiated Products

To find Bertrand-NE,

$P_1 = 27.5 + P_2/4$ $\quad\quad$ $P_2 = 27.5 + P_1/4$

Solving these two equations yields

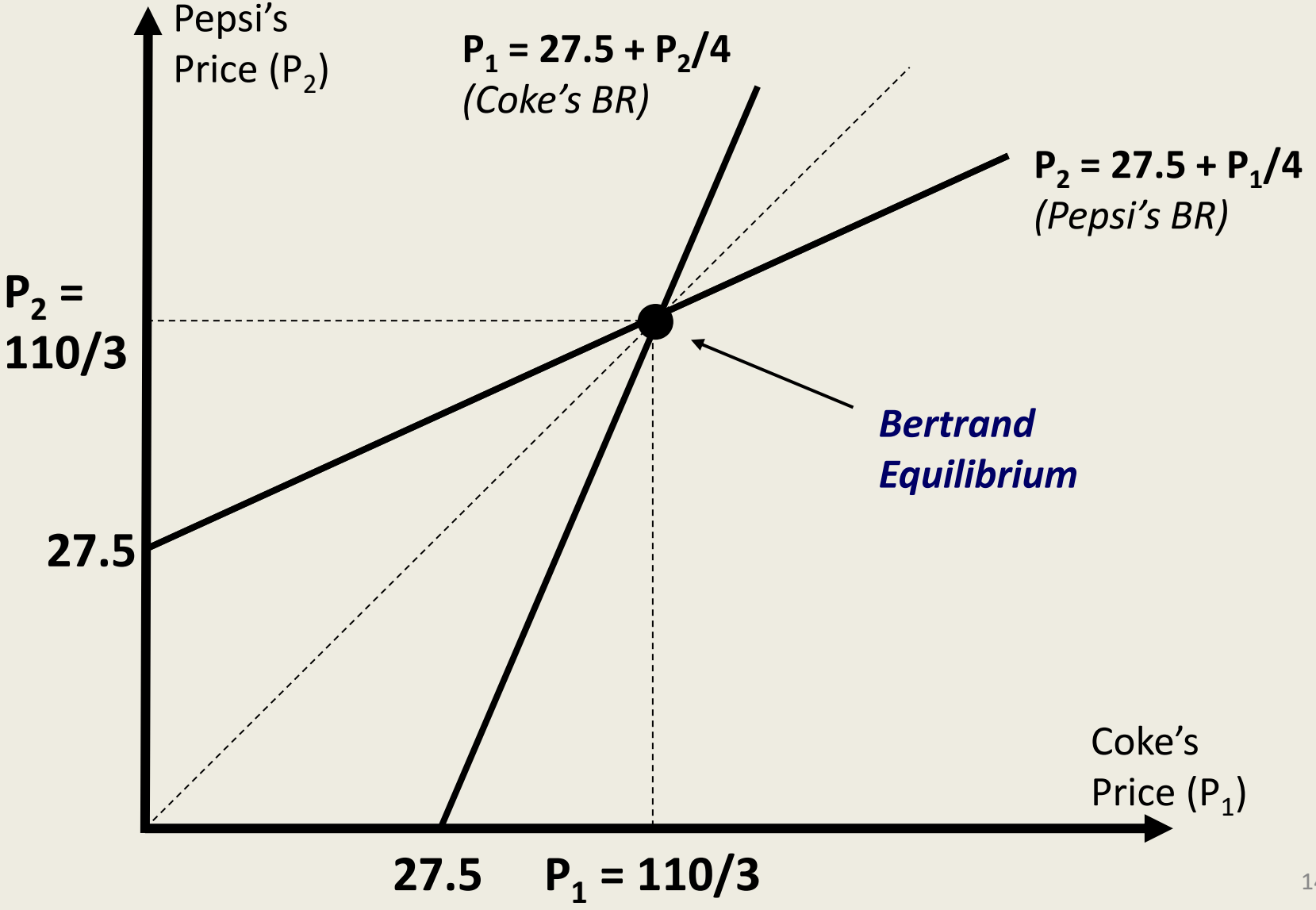
$P_1^* = P_2^* = 110/3$

Plugging these prices into demand, we have

$Q_1^* = Q_2^* = 190/3$

$\pi_1^* = \pi_2^* = 2005.55$ $\quad\quad$ $\Pi = 4011.10$

Bertrand – Differentiated Products



Bertrand – Differentiated Products

LEARNING-BY-DOING EXERCISE 13.4

Computing a Bertrand Equilibrium with Horizontally Differentiated Products

Suppose Coca-Cola's and Pepsi's demand curves are given by $Q_1 = (64 + 2P_2) - 4P_1$ and $Q_2 = (50 + P_1) - 5P_2$, respectively. [These correspond to equations (13.1) and (13.2) with terms rearranged and with parentheses used to highlight terms that the firm views as fixed.] Coca-Cola's marginal cost is \$5 per unit, and Pepsi's marginal cost is \$4 per unit.

Problem

(a) What is Coca-Cola's profit-maximizing price when Pepsi's price is \$8?

(b) What is the equation of Coca-Cola's price reaction function (i.e., Coca-Cola's profit-maximizing price when Pepsi sets an arbitrary price P_2)?

(c) What are Coca-Cola's and Pepsi's profit-maximizing prices and quantities at the Bertrand equilibrium?

Oligopoly Models – Summary

Model	Product Diff.	Setting/ Timing	Cooperation	Max. Profit by setting
Cartel	NO	Simultaneous-move	Cooperative	As if it were a monopolist
Cournot	NO	Simultaneous-move	Quantity Competition	Quantity
Stackelberg (Quantity Leadership)	NO	Sequential-move	One firm is the quantity leader.	Quantity
Dominant Firm (Price Leadership)	NO	Sequential-move	One firm is the price leader.	Price
Bertrand Homogeneous	NO	Simultaneous-move	Price Competition	Price
Bertrand Differentiated	YES	Simultaneous-move	Price Competition	Price