

Oligopoly

"few sellers"

from one seller to two ("duopoly") - "competition"

Questions:

- i) what will firms produce?
- ii) what will price(s) be?

Will depend on what firms expect others to do,
and on choice variable (price or quantity)

Assume:

- i) homogeneous product (so market demand curve)
- ii) identical technology

Let inverse market demand curve be

$$p = A - bQ, \quad Q = q_1 + q_2$$

Cost for firm $i=1,2$: $C(q_i) = cq_i$

Model # 1: Cournot duopoly

Cournot conjecture:

- each firm takes other firm's output as given
- each firm assumes that if it varies own output, other firm does not respond

Given this assumption, what is profit function for firm 1?

$$\begin{aligned}\pi_1(q_1, q_2) &= q_1(A - bq_1 - bq_2) - cq_1 \\ &= q_1[(A - b\bar{q}_2) - bq_1 - c]\end{aligned}$$

for some given value of $q_2 = \bar{q}_2$.

Larger is output of firm 2, smaller is "residual demand" for firm 1

[Picture]

Profit max'g output for firm 1? Equate MR, MC

$$MR(q_1) = A - b\bar{q}_2 - 2bq_1, \quad MC=c$$

solves for *Cournot best response function*

$$q_1 = f(q_2) = \frac{A - b\bar{q}_2 - c}{2b}$$

Derive firm 2's best response function analogously

Market equilibrium?

quantities: intersection of best responses
(simultaneous solution of equations)
price: from inverse demand curve

Note: Cournot equilibrium is a Nash equilibrium, when firms choose quantities.

Comparison with monopoly market outcome?

- quantity higher, price lower in Cournot equilibrium (than in monopoly)

Model #2: *Stackelberg duopoly*

"Leader-follower" model

- sequential rather than simultaneous game
- one firm has Cournot conjectures (follower)
- other (leader) takes as given follower's Cournot best response function

(subgame perfect Nash equilibrium, where leader moves first in quantity-setting game)

Suppose firm 1 is leader: profit is

$$\pi_1(q_1, q_2) = q_1(A - bq_1 - bg(q_1) - c)$$

where $g(q_1)$ is follower's best response function

Market outcome, compared to Cournot?

- leader's output higher, follower's smaller than Cournot firm with same costs, same market demand.

Model # 3: *Bertrand duopoly*

Fundamental issue with above models - who sets price?

Monopoly - choice variable irrelevant (chooses point on market demand curve)

Does choice matter in duopoly model?

Turns out... *YES!*

Bertrand model:

same as Cournot, *except* for choice variable

- here, firms choose price,
- quantity? firms sell all demanded at set price

Keep linear market demand curve
(homogeneous good):

$$p = A - bQ \quad \text{or} \quad Q = \frac{A - p}{b} = \alpha - \beta p$$

Firm's demand? - depends on own price, rival's price:

$$q_1(p_1, p_2) = \begin{cases} 0 & \text{if } p_1 > p_2 \\ 0.5(\alpha - \beta p) & \text{if } p_1 = p_2 = p \\ \alpha - \beta p_1 & \text{if } p_1 < p_2 \end{cases}$$

Key difference from Cournot model?

- small differences in price (choice variable) can lead to large changes in quantity - hence large changes in profits
- Nash equilibrium here? price = MC

So: equilibrium in duopoly market depends on assumptions about firms' behaviours, and choice variables.

Market outcome can be efficient, with just two firms.

Which is "correct" model? Depends....