Econ 476: Industrial Organization

Oligopoly

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Lecture 06

Intro

- Simultaneous
  - compete on price: Bertrand
  - compete on quantity: Cournot
- Sequential
  - compete on price: Bertrand
  - compete on quantity: Stackelberg

Stackelberg

- Number of firms $= [2, \infty)$
- Leader/follower
- Homogeneous product
  - will go over differentiated products later
- Firms choose **quantity** *independently* and *sequentially*
- Each firm has market power
  - changing q^i will influence the aggregate price P charged for all total units Q in the market

Stackelberg

- Basic idea:
  - leader moves first
  - all other firms (followers) move in the second period given the results of the first period
  - Solve backwards
    - solve period 2, then period 1
- Should the leader choose the monopoly output?
  - Sometimes!

Algorithm

How to solve for optimal 2-period Stackelberg profits (*N firms*):

- Step 1: write out profit function for the follower firms i where $i = 2, 3, \ldots, N$
  - $\pi_i(q_L, q_2, \cdots, q_N) = TR_i(Q) - TC_i(Q)$
- Step 2: take the derivative of π_i with respect to q_i and set to zero $\forall\ i$
  - $\frac{\partial \pi_i}{\partial q_i} = 0$
- Step 3: solve for $q_i\ \forall\ i$
- Step 4a: set-up the profit function for the leader as a function of the follower's q_i^*
  - $\pi_L(q_L; q_2, q_3, \cdots, q_N) = TR_L(Q) - TC_L(Q)$
- Step 4b: simplify the profit function
- Step 5: take the derivative of π_L with respect to q_L and set to zero
- Step 6: solve for q_L^* and $q_i^*\ \forall\ i$
- Step 7: solve for P^*
- Step 8: enter q_i^* and P^* into each profit functions

Stackelberg - 2 firms/periods

- Inverse demand: $P(Q) = a - bQ$ where $Q = q_L + q_F$
- Cost: $TC_i(q_i) = c_i q_i$ where $i = L, F$ and $c_L = c_F = c$
- Solve for $\pi_F(q_L, q_F)$, $\frac{\partial \pi_F}{\partial q_F} = 0$, $q_F(q_L)$, $\pi_L(q_L, q_F)$, q_L^*, q_F^*, P^* and π_i^* in a 2 period game.

Stackelberg - 2 firms

Solution

- $\pi_F(q_L, q_F) = [a - b(q_L + q_F)]\, q_F - cq_F$
- $\frac{\partial \pi_F}{\partial q_F} = a - 2bq_F - bq_L - c = 0$
- $q_F = \frac{a - bq_L - c}{2b}$
- $\pi_L(q_L, q_F) = \left[a - b\left(q_L + \frac{a - bq_L - c}{2b}\right)\right] q_L - cq_L$
- $q_L^* = \frac{a-c}{2b}$; $q_F^* = \frac{a-c}{4b}$
- $P^* = \frac{a+3c}{4}$
- $\pi_L^* = \frac{(a-c)^2}{8b}$; $\pi_F^* = \frac{(a-c)^2}{16b}$

Extensive form - Stackelberg

- [graphs]

Quantity game

- How does the sequential quantity game (Stackelberg) compare with the simultaneous quantity game (Cournot)?
- Is there any advantage to moving in the first period rather than the second period?

Quantity game

- explore in the homework(!)

Sequential Bertrand

If the product is homogeneous ...

- No difference in sequential and simultaneous outcomes
- If $c_i = c_j$
  - $P^* = c_i = c_j$
  - perfectly competitive outcome
- If $c_i > c_j$
  - $P_j^* = c_i - \varepsilon$