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
 - lacktriangleright changing q^i will influence the aggregate price P charged for all total units Q in the market

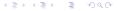
Stackelberg

- 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, ..., N
 - $\qquad \qquad \pi_i\left(q_L,q_2,\cdots,q_N\right) = TR_i\left(Q\right) TC_i\left(Q\right)$
- ▶ Step 2: take the derivative of π_i with respect to q_i and set to zero $\forall i$ $\Rightarrow \frac{\partial \pi_i}{\partial q_i} = 0$
- ▶ 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*
 - $\pi_L(q_L; q_2, q_3, \dots, q_N) = TR_L(Q) TC_L(Q)$
- 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

•
$$\pi_F(q_L, q_F) = [a - b(q_L + q_F)]q_F - cq_F$$

•
$$q_L^* = \frac{a-c}{2b}$$
; $q_F^* = \frac{a-c}{4b}$

►
$$P^* = \frac{a+3c}{4}$$

$$\qquad \qquad \boldsymbol{\pi}_L^* = \frac{\left(a - c\right)^2}{8b}; \; \boldsymbol{\pi}_F^* = \frac{\left(a - c\right)^2}{16b}$$

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 $c_i = c_i$
 - $P^* = c_i = c_j$
 - perfectly competitive outcome
- ▶ If $c_i > c_j$
 - $P_j^* = c_i \varepsilon$