Unit 8: Imperfect Competition II – oligopoly and monopolistic competition

Prof. Antonio Rangel

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1 Oligopoly

- Oligopoly: more than one firm, but not enough for perfect competition
- Firms have some market power
- Intermediate case between monopoly ($F = 1$) and perfect competition (F large)

1.1 Oligopoly with two firms

- Basic model
  - Two firms
  - q_1, q_2 = quantities produced by the two firms
  - $c_i(q_i)$ cost function of each firm, no FCs or SFCs
  - Key assumption: Each firm maximizes profits taking the action taken by the other firm as fixed
  - Note: this assumes that firms anticipate each others' actions correctly
- This gives rise to strategic considerations:
  - Demand faced by firm i depends on choice of firm j

- Firm i's problem
$$\max_{q_i \geq 0} q_i p^D(q_i + q_j) - c_i(q_i)$$
- q_j is taken as given in this problem.
- FOCs (also sufficient):
$$\underbrace{q_i \frac{dP^D}{dq} + p^D}_{\text{MR w.r.t. } q_i \text{given } q_j} = MC_i$$
- Key idea: firm's problem is as in the monopoly case, but with demand shifted due to other firm's actions
- Let $q_i^*(q_j)$ denote the solution to the problem for firm i, as a function of q_j.
- Oligopoly equilibrium: q_1^{OL}, q_2^{OL} such that $q_1^{OL} = q_1^*(q_2^{OL})$ and $q_2^{OL} = q_2^*(q_1^{OL})$
- Remarks:

    1. Model assumes rational expectations: each firm correctly anticipates other's action correctly in equilibrium
    2. Firms best respond to each other
    3. At equilibrium, firms have no incentive to deviate
    4. Equilibrium concept generalizes to $F > 2$ (each firm best responds taking as given the choices of all other firms)

1.2 Example: Two identical firms

- Look at case of oligopolistic competition with two identical firms and linear aggregate demand
    - $F = 2$, $c(q_i) = \mu q$
    - $p^D(q_1 + q_2) = p^{max} - m(q_1 + q_2)$
- Demand faced by firm i is $(p^{max} - mq_j) - mq_i$

- Firm $i's$ problem:

$$\max_{q_i \geq 0} q_i(p^{max} - mq_i - mq_j) - \mu q_i$$

- FOC: $p^{max} - mq_j - 2mq_i = \mu$
- Identical firms $\implies$ symmetric equilibrium: $q_i = q_j = q^{OL}$
  $\implies q^{OL} = \frac{p^{max} - \mu}{3m}$
- DWL from oligopoly:
  - Substituting in the inverse demand function: $p^{OL} = \frac{2}{3}\mu + \frac{1}{3}p^{max}$
  - DWL then given by:

$$\begin{aligned} DWL &= \frac{1}{2}\left(q^{opt} - q^{OL}\right)\left(p^{OL} - p^*\right) \\ &= \frac{1}{2}\left(\frac{2}{3m}(p^{max} - \mu)\right)\left(\frac{1}{3}(p^{max} - \mu)\right) \\ &= \frac{(p^{max} - \mu)^2}{9m} \end{aligned}$$

- Distribution and oligopoly
  (table refers to graph in video lectures)

	Perfect Competition	Oligopoly	Change
PS	0	B	B
CS	A + B + C	A	-(B + C)
SS	A + B + C	A + B	-C

1.3 Example: Oligopoly vs. Monopoly

- Consider oligopoly market with two identical firms:
  - $F = 2$, $p^D = p^{max} - mq$, $MC = \mu$ for both firms
- What happens to DWL if the firms merge?
- Before: Oligopolistic equilibrium (as in previous section):
  - $q^{OL} = \frac{p^{max} - \mu}{3m}$

- $p^{OL} = \frac{2}{3}\mu + \frac{1}{3}p^{max}$
- $DWL^{OL} = \frac{(p^{max}-\mu)^2}{9m}$

- After: Monopolistic equilibrium (as in Unit 7):
  - $q^{mon} = \frac{p^{max}-\mu}{2m}$
  - $p^{mon} = \frac{1}{2}\mu + \frac{1}{2}p^{max}$
  - $DWL^{mon} = \frac{(p^{max}-\mu)^2}{8m}$
- If follows that
  - $q^{OL} > q^{mon}$
  - $p^{OL} < p^{mon}$
  - $DWL^{mon} > DWL^{OL}$

1.4 Oligopoly with more than two firms

- Basic model:
  - $F > 2$
  - Linear symmetric case: $p^D(q) = p^{max} - mq$, $MC_i(q_i) = \mu$ for all i
  - Identical firms $\implies q_i^{OL} = q_j^{OL} = q^{OL}$ for all firms i, j
  - Demand faced by firm i: $\left(p^{max} - (F-1)mq^{OL}\right) - mq_i$
  - Optimal choice for i: $MR_i = MC_i$ implies

$$p^{max} - (F-1)mq^{OL} - 2mq_i = \mu$$

  - Since firms are identical, in equilibrium must have $q_i = q^{OL}$ for every firm i.
  - Therefore, we get that each firm produces

$$q^{OL} = \frac{p^{max} - \mu}{(F+1)m}$$

- Equilibrium price is then given by

$$p^{OL} = p^{max} - mF\frac{p^{max} - \mu}{(F+1)m} = \frac{1}{F}p^{max} + \frac{F}{F+1}\mu$$

- Note: As F increases, p^{OL} converges to μ, which is equal to the competitive equilibrium price
- How does the DWL change with number of firms?

$$\begin{aligned} DWL(F) &= \frac{1}{2}(p^{OL} - p^*)(q^* - Fq^{OL}) \\ &= \frac{1}{2}\left(\frac{p^{max} - \mu}{F+1}\right)\left(\frac{p^{max} - \mu}{m(F+1)}\right) \\ &= \frac{1}{2m}\frac{(p^{max} - \mu)^2}{(F+1)^2} \end{aligned}$$

- Note:$DWL \to 0$ with the square of the number of firms, so don't actually need many firms for the perfect competitive model to provide a good approximation of what happens in the market

2 Monopolistic competition

- Basic model:
  - $F \geq 2$
  - $p^D(q) = p^{max} - mq$
  - Firms:
    * Can pay SFC of F to create a brand and then produce at constant MC of μ
    * Not create a brand and set $q = 0$
  - Key assumption: brands split the market equally and are monopolists within their brand
  - Intuition: Each consumer becomes a loyal buyer of only one of the brands, but his demand curve for that brand is otherwise as before

- Model solution
  - I = number of firms that create a brand and produce a positive amount
  - Each firm faces demand $p^{max} - Imq$
  - Each firm sets $MR = MC$ within its share of the market

$$p^{max} - 2Imq = \mu \implies q^{MC} = \frac{p^{max} - \mu}{2Im}$$

$$\implies q^{tot} = Iq^{MC} = \frac{p^{max} - \mu}{2m} = q^{mon}$$

$$\implies p^{MC} = p^{mon} = \frac{p^m ax + \mu}{2}$$

- Equilibrium profits:

$$\Pi^{MC} = \frac{\Pi^{MC}}{I} - F = \frac{(p^{max})^2}{4mI} - F$$

- Equilibrium number of firms:

$$I^{MC} = \max i \text{ such that } \frac{(p^{max})^2}{4mi} > F$$

- Remarks:
  1. Multiple equilibria: model gives number of firms that create brands, but doesn't say which firms create brands
  2. Logic of equilibrium: some firms don't create brands because they correctly anticipate that other firms do, and given this creating additional brands is not profitable

- DWL analysis:
  - q^{tot} in M.C. $= q^{mon} \implies DWL^{MC} = DWL^{mon} + I^{MC}F$ $= \frac{(p^{max}-\mu)^2}{8m} + I^{MC}F$
  - Remarks:
    1. In oligopoly, $DWL \to 0$ as $F \uparrow$. In contrast, in monopolistic competiting the DWL can increase as $F \uparrow$
    2. SFC of brand creation is socially wasteful
    3. Brand creation induces decision mistakes by consumers in which Decision utility $\neq$ Experienced utility

3 Final remarks

- Here is a summary of the results
- Look at markets with $2 \leq F <$ many firms
- Two types of markets to consider
- Oligopoly:
  - Firms produce identical goods
  - Equilibrium converges quickly to competitive case as F increases
- Monopolistic competition:
  - Firms create brands that induce consumers to have very strong and artificial brand preferences
  - Firms are monopolist within their brand
  - Equilibrium outcome remains at monopolistic level as F increases