

Unit 8: Imperfect Competition II – oligopoly and monopolistic competition

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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

$$\begin{aligned} - F &= 2, c(q_i) = \mu q \\ - p^D(q_1 + q_2) &= p^{max} - m(q_1 + q_2) \end{aligned}$$

- Demand faced by firm i is $(p^{max} - m q_j) - m q_i$

- 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:

$$\begin{aligned} DWL &= \frac{1}{2} (q^{opt} - 2q^{OL}) (p^{OL} - p^*) \\ &= \frac{1}{2} \left(\frac{1}{3m} (p^{max} - \mu) \right) \left(\frac{1}{3} (p^{max} - \mu) \right) \\ &= \frac{(p^{max} - \mu)^2}{18m} \end{aligned}$$

- NOTE: There is a typo in the video lecture for this expression. This is the correct one.

- 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):

$$\begin{aligned}
- q^{OL} &= \frac{p^{max}-\mu}{3m} \\
- p^{OL} &= \frac{2}{3}\mu + \frac{1}{3}p^{max} \\
- DWL^{OL} &= \frac{(p^{max}-\mu)^2}{18m}
\end{aligned}$$

- After: Monopolistic equilibrium (as in Unit 7):

$$\begin{aligned}
- q^{mon} &= \frac{p^{max}-\mu}{2m} \\
- p^{mon} &= \frac{1}{2}\mu + \frac{1}{2}p^{max} \\
- DWL^{mon} &= \frac{(p^{max}-\mu)^2}{8m}
\end{aligned}$$

- It follows that

$$\begin{aligned}
- 2q^{OL} &> q^{mon} \text{ (i.e., total oligopoly production is greater than total monopoly production)} \\
- p^{OL} &< p^{mon} \\
- DWL^{mon} &> DWL^{OL}
\end{aligned}$$

1.4 Oligopoly with more than two firms

- Basic model:

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

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

$$- \text{Since firms are identical, in equilibrium must have } q_i = q^{OL} \text{ for every firm } i.$$

- Therefore, we get that each firm produces

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

- Equilibrium price is then given by

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

- 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: $DWL \rightarrow 0$ 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

$$\begin{aligned} p^{max} - 2Imq &= \mu \implies q^{MC} = \frac{p^{max} - \mu}{2Im} \\ \implies q^{tot} &= Iq^{MC} = \frac{p^{max} - \mu}{2m} = q^{mon} \\ \implies p^{MC} &= p^{mon} = \frac{p^{max} + \mu}{2} \end{aligned}$$

- Equilibrium profits:

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

- Equilibrium number of firms:

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

- 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, $DWL \rightarrow 0$ as $F \uparrow$. In contrast, in monopolistic competing 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 $2 \leq F < \text{many firms}$
- 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 monopolists within their brands
 - Equilibrium outcome remains at monopolistic level as F increases