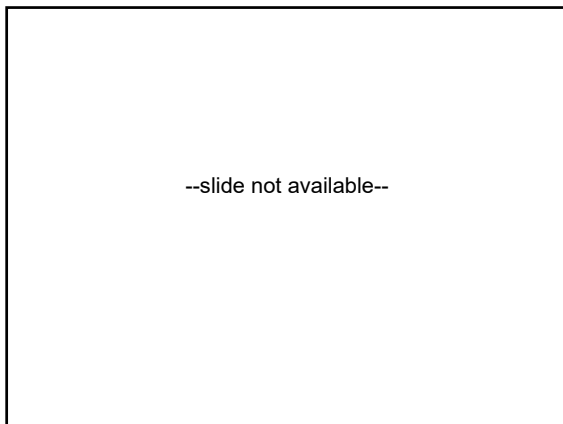
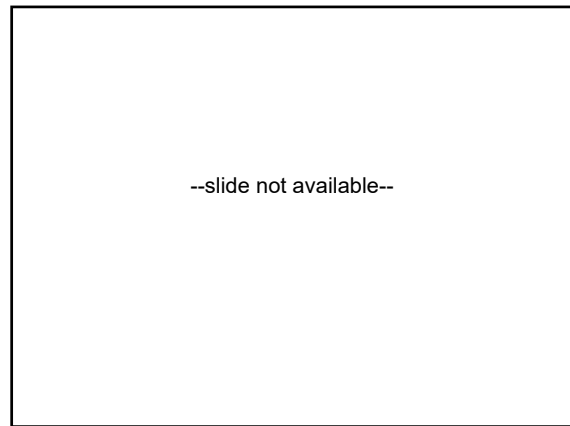
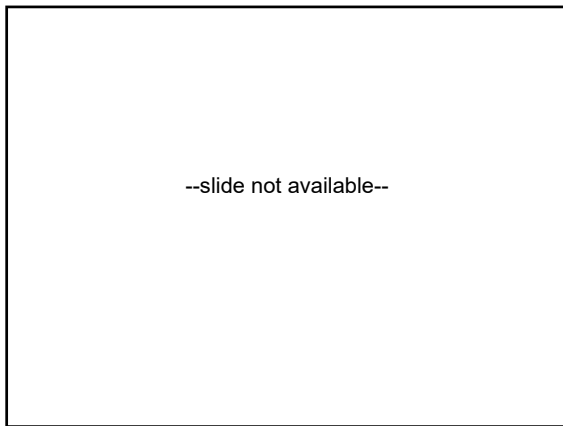
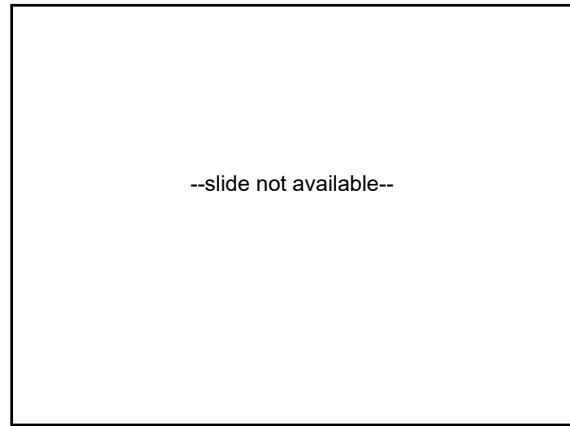


Kosmas Marinakis, Ph.D.

Lecture 8

Short-run competition

Industrial
Economics



Static competition

- ★ We will take a **new look** at a series of models that approach competition when there is **no time depth**
collusion – Cournot – Stackelberg – Bertrand
- ★ **Strategic interaction** between firms is possible and meaningful
every firm must **take into account** other firms' actions
- ★ **Barriers** eliminate the distinction between S-R and L-R
- ★ **Product differentiation** may have an impact but is **not crucial**
firms are assumed to have **market power anyway**.

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Static competition

Competition with respect to what?

- ★ Firms have to choose in **which field** they will compete
 - ◆ **Apple** and **Samsung** are competing with respect to technological advancement
 - ◆ **BMW** and **Benz** are competing with respect to quality
 - ◆ **Coke** and **Pepsi** are competing with respect to advertisement
 - ◆ **DKNY** and **Calvin Klein** compete with respect to design
 - ◆ **Mozilla** and **Chrome** compete with respect to market share
 - ◆ **HSE** and **NES** compete with respect to research
 - ◆ **Oil producing nations** are competing with respect to quantities
 - ◆ **Supermarkets** compete with respect to price . .

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Competition in quantities

- ★ **Firm 1** and **firm 2** compete for a **single period** by producing **simultaneously** a **homogeneous** good
- ★ The **market demand** is $p(q)$
- ★ The **cost** for producing the product is $c(q)$
- ★ The firms' **choice** variable is **quantity** .

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Competition in quantities

Collusion

- ★ Let us first assume that the two firms **act as one**
- ★ Profit is

$$\Pi_M = p(q_1 + q_2) \cdot (q_1 + q_2) - c(q_1 + q_2)$$
- ★ Maximizing w.r.t. $(q_1 + q_2)$ yields

$$p(q_1 + q_2) + (q_1 + q_2) \cdot \frac{dp}{d(q_1 + q_2)} - \frac{dc}{d(q_1 + q_2)} = 0$$
- The FOC is

$$p^* = \frac{dc}{d(q_1 + q_2)} - (q_1 + q_2) \cdot \frac{dp}{d(q_1 + q_2)} \quad (1)$$
- ★ That is,

$$p^* = MC + \text{something} _$$

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Competition in quantities

Cournot (1838)

- ★ Assume now firms **compete in quantity**, q
- ★ For firm i , $i = 1, 2$ and $j \neq i$

$$\Pi_i = q_i \cdot p(q_i + q_j) - c(q_i)$$
- ★ Maximizing w.r.t. q_i

$$p(q_i + q_j) + q_i \cdot \frac{\partial p}{\partial q_i} - \frac{\partial c}{\partial q_i} = 0$$
- ★ The FOC is

$$p^* = \frac{\partial c}{\partial q_i} - q_i \cdot \frac{\partial p}{\partial q_i} \quad (2)$$
- ★ That is,

$$p^* = MC_i + \text{something} _$$

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Competition in quantities

Cournot vs. Collusion

- ★ From (1) and (2) for $i = 1$ and $j = 2$:

$$-(q_1 + q_2) \cdot \frac{dp}{d(q_1 + q_2)} > -q_1 \cdot \frac{\partial p}{\partial q_1}$$
- ★ Because

$$-(q_1 + q_2) \cdot \frac{dp}{d(q_1 + q_2)} > -q_1 \cdot \frac{\partial p}{\partial(q_1 + q_2)}$$
- ★ Thus, under Cournot, **price is higher** than MC but **not as high** as in collusion .

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Competition in quantities

Market power in Cournot

- ★ Relationship (2) can be manipulated as

$$p - MC_i = -q_i \cdot \frac{\partial p}{\partial q_i}$$
- ★ Dividing by p and multiplying the RHS with $\frac{q_i + q_j}{q_i + q_j}$

$$\frac{p - MC_i}{p} = -\frac{q_i + q_j}{p} \cdot \frac{\partial p}{\partial(q_i + q_j)} \cdot \frac{q_i}{q_i + q_j} \Rightarrow$$

$$L_i = -\frac{s_i}{\epsilon_d}$$
- ★ **Lerner's index** is equal to the ratio of share and brand elasticity of demand at equilibrium .

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Competition in quantities

Linear demand – constant costs

- ★ Consider the market demand $p = 1 - q$
- ★ Constant average costs c_1 and c_2
- ★ Profit for firm 1

$$\Pi_1 = (1 - q_1 - q_2) \cdot q_1 - c_1 \cdot q_1 = (1 - q_2 - c_1)q_1 - q_1^2$$
- ★ FOC is

$$1 - q_2 - c_1 - 2q_1 = 0 \Rightarrow q_2 = 1 - c_1 - 2q_1 \quad (R_1)$$
- ★ Similarly, for firm 2

$$q_2 = \frac{1 - c_2}{2} - \frac{1}{2}q_1 \quad (R_2)$$

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Competition in quantities

Optimal response

- ★ Conditions (R_1) and (R_2) are the **optimal response** or **reaction functions**
- ★ Their **simultaneous solution** is a form of NE

$$q_1^* = \frac{1 - 2c_1 + c_2}{3} \quad \text{and} \quad q_2^* = \frac{1 - 2c_2 + c_1}{3}$$
- ★ Observations
 - ◆ Own cost **reduces** own share
 - ◆ Rival's cost **increases** own share
 - ◆ Total quantity is **more** than monopoly and less than PC
- ★ This analysis **carries over** for more than 2 firms

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Competition in quantities

Stability of the Cournot equilibrium

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Competition in quantities

Cournot with n firms

- ★ Analysis stems from Tirole (p220 – 223)
- ★ n firms each with common average cost c
- ★ For $i = 1, \dots, n$

$$q_i = \frac{1 - c}{n + 1}, \quad p = c + \frac{1 - c}{n + 1}, \quad \Pi_i = \left(\frac{1 - c}{n + 1}\right)^2$$
- ★ What happens as $n \rightarrow 1$?
- ★ What happens as $n \rightarrow \infty$?

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Competition in quantities

Stackelberg (1937)

- ★ What if firms can move **sequentially**?
 - firm 1 **leads** and firm 2 **follows**
- ★ Firm 2, as a **follower**, exhibits the **same** optimal response as in **Cournot**
- ★ Firm 1, as a **leader**, can take R_2 **into account**

$$\Pi_1 = (1 - c_1 - q_2)q_1 - q_1^2 = \left(1 - c_1 - \frac{1 - c_2}{2}\right)q_1 - \frac{1}{2}q_1^2$$
- ★ And

$$\frac{d\Pi_1}{dq_1} = 1 - c_1 - \frac{1 - c_2}{2} - q_1 = 0$$

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Competition in quantities

First-mover advantage in Stackelberg

- ★ Optimal quantity for the **leader** is

$$q_1^* = 1 - c_1 - \frac{1 - c_2}{2}$$
- ★ And from (R_2) , optimal quantity for the **follower** is

$$q_2^* = \frac{3}{4}(1 - c_2) - \frac{1 - c_1}{2}$$
- ★ If c_1 is not **much larger** than c_2

$$c_1 < \frac{1}{6} + \frac{5}{6}c_2$$
 the leader will sell **higher quantity** than the follower.

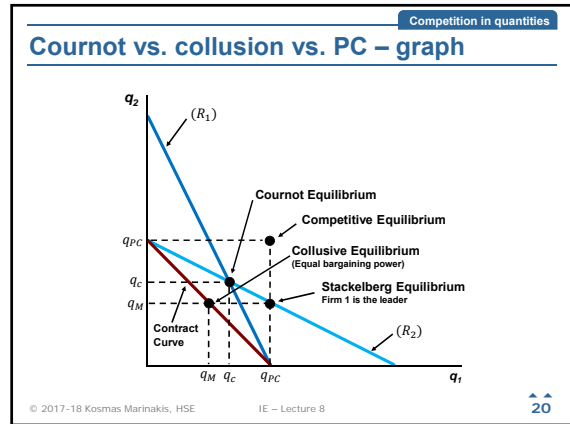
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Competition in quantities

Stackelberg vs. Cournot

- ★ In terms of **quantity**
 - ◆ The leader produces **more** than in Cournot
 - ◆ The follower **less** than in Cournot
 - ◆ Total quantity is **more** than Cournot
- ★ In terms of **profits**
 - ◆ The leader earns **more** than in Cournot
 - ◆ The follower earns **less** than in Cournot
- ★ **Price** is **less** than Cournot

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Thank you!

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