Oligopoly

Javier Tasso

Introduction

Types of Oligopoly

Cournot’s Duopoly

Bertrand’s Duopoly

Types of Oligopoly

Types

- Homogeneous good vs Differentiated good.
  - Today: Homogeneous good.
  - A few comments on differentiated good.
- Simultaneous choice vs Sequential choice.
  - Today: Simultaneous choice.
  - Sequential choice requires more game theory (sequential move games).
- Quantity competition vs Price competition.
  - Today: Both.

Key Feature: Strategic Interactions

- In perfect competition, firms were too small to have an influence on each other. Strategic interactions were negligible.
- In monopoly there's only one firm. Strategic interactions are irrelevant.
- In oligopoly we need to take them seriously.
- This is why we need tools from game theory.

Cournot’s Duopoly

Premise

- Two firms simultaneously choose output levels q_1 and q_2 of an homogeneous good.
- The market price is then determined by total output through the inverse demand curve.
- Firms recognize their output choices affect the market price.
- Firms recognize their own profits depend on what they do, but also on what the rival firm does.

Inverse Demand, Costs, and Profits

$$\text{Inverse Demand} = p(q_1, q_2)$$

$$\text{Profits}_1 = \text{TR}_1 - \text{TC}_1 = p(q_1, q_2)q_1 - \text{TC}_1$$

$$\text{Profits}_2 = \text{TR}_2 - \text{TC}_1 = p(q_1, q_2)q_2 - \text{TC}_2$$

- Example: $p(q_1, q_2) = 6 - q_1 - q_2$ and $\text{TC}_1 = \text{TC}_2 = 0$.
- Shortcut notation.
- Profits depend on how many units my competitor chooses. Marginal Revenue too.

Strategic Interactions

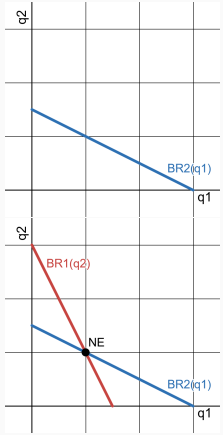
- My choice of quantities affect my competitor's profits.
- Their choices affect my profits.
- How? See example.
- This doesn't happen in perfect competition and doesn't happen in monopoly.
- Use game theory to anticipate, if possible, the output of the game.

Discrete Case

↓F1 / F2→	$q_2 = 0$	$q_2 = 1$	$q_2 = 2$	$q_2 = 3$
$q_1 = 0$	$(0, 0)$	$(0, 5)$	$(0, 8)$	$(0, 9)$
$q_1 = 1$	$(5, 0)$	$(4, 4)$	$(3, 6)$	$(2, 6)$
$q_1 = 2$	$(8, 0)$	$(6, 3)$	$(4, 4)$	$(2, 3)$
$q_1 = 3$	$(9, 0)$	$(6, 2)$	$(3, 2)$	$(0, 0)$

- Profits of F1 decrease as F2 sells more units.
- Find best response.
- Find NE.
- What's the resulting price in the market?

Best Response or Reaction Function



- Set MR = MC to find the BR.
- Negative slope: As the other firm supplies more units, the best thing I can do is to reduce my supply.
- It's useful to graph them in the same (q_1, q_2) plane.
- The point where the two Best Responses intersect each other is the Nash Equilibrium of the game.

Cournot on Best Response

A. A. Cournot

- Antoine Augustin Cournot on Best Responses.
- *Firm 1 can have no direct influence on the determination of q_2: all he can do, when q_2 has been determined by Firm 2, is to choose for q_1 the value which is best for him [...] as Firm 2 who, seeing himself forced to accept this value of q_1, may adopt a new value for q_2, more favourable to his interests than the preceding one.*

Why not monopoly quantities?

- It'd be better for the two firms to produce less (the monopolist quantity) and split the profits in half.
- Why not? There's a profitable deviation of doing so: Even if I convince my opponent, the best thing I can do is to supply more units.
- See example. Profits, and deviation.
- Strategic interactions work in favor of consumers.

In Cournot's Words

A. A. Cournot

- Explains why we won't see the monopoly quantity being produced, and the idea of a profitable deviation.
- *Why is it then that [...] the producers do not stop, as in the case of a monopoly, at the value of the price which would really give them the greatest profits? The reason is that, Firm 1 having fixed his production at the monopoly quantity, Firm 2 will be able to fix his own production at a hither rate with a temporary benefit.*

Comparison

	Perfect Competition	Cournot Oligopoly	Monopoly
Quantity	High	Intermediate	Low
Price	Low	Intermediate	High
Profits	Zero	Positive	Maximum
Cons. Surplus	High	Intermediate	Low
Strategic Int.	Negligible	Important	Absent

Bertrand’s Duopoly

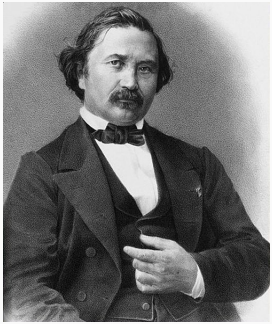
Introduction

Choosing the quantity (as opposed to setting the price) may seem unnatural in some situations:

- Perfect Competition.
- Monopoly.
- Oligopoly.

With one or few firms, it's more natural to think they choose the price instead of how many units to sell. In an oligopoly market this makes a difference.

Bertrand's Critique



Joseph Bertrand

[...] Cournot assumes that one of the proprietors will reduce his prices even more to attract business back to him. They will only stop undercutting each other in this way when either proprietor [...] has nothing more to gain from reducing his prices. One major objection to this is that there is no solution under this assumption, in that there is no limit in the downward movement. Indeed, whatever the common price adopted, if one of the proprietors, alone, reduces his price he will, ignoring any minor exceptions, attract all the buyers and thus double his revenue.

Premise

- Two firms simultaneously choose prices p_1 and p_2. They sell an homogeneous good.
- Consumers buy from the firm offering the lower price.
- If they set the same price, half of the consumers buy from one firm and half of the consumer from the other firm.
- Firms recognize that profits depend on both their own price and the rival's price.

Demand, Costs, and Profits

$$q_1(p_1, p_2) = \begin{cases} 6 - p_1 & \text{if} \quad p_1 < p_2 \\ (6 - p_1)/2 & \text{if} \quad p_1 = p_2 \\ 0 & \text{if} \quad p_1 > p_2 \end{cases} \quad \text{and} \quad q_2(p_1, p_2) = \ldots$$

- Consumers buy from the cheaper firm.
- If they set the same price, they split the market in half.

Demand, Costs, and Profits II

$$\text{Profits}_1 = \text{TR}_1 - \text{TC}_1 = p_1 q_1(p_1, p_2) - \text{TC}_1$$
$$\text{Profits}_2 = \text{TR}_2 - \text{TC}_2 = p_2 q_2(p_1, p_2) - \text{TC}_2$$

- Example $\text{TC}_1 = \text{TC}_2 = 0$.
- Profits depend on what price the competitor sets.

Discrete Case

↓F1 / F2→	$p_2 = 0$	$p_2 = 1$	$p_2 = 2$	$p_2 = 3$
$p_1 = 0$	(0, 0)	(0, 0)	(0, 0)	(0, 0)
$p_1 = 1$	(0, 0)	(2.5, 2.5)	(5, 0)	(5, 0)
$p_1 = 2$	(0, 0)	(0, 5)	(4, 4)	(8, 0)
$p_1 = 3$	(0, 0)	(0, 5)	(0, 8)	(4.5, 4.5)

- As my opponent increases his price, my profits increase.
- Find the BR. Undercutting.
- Find the NE.
- What's the resulting price?

Discrete Case vs Continuous Version

- As you make the grid finer, the two NE will move closer together.
- In the continuous version of this game, there's only one NE: both firms set their price equal to the marginal cost.
- Competition is so strong that we only need two firms to deliver the competitive price.

Bertrand Paradox

Bertrand Paradox: Describes a situation in which two firms reach a state of Nash equilibrium where both firms charge a price equal to marginal cost.

- Requires both firms to have the same marginal cost.
- Requires the good to be homogeneous.
- Requires the absence of capacity contraints.
- What if these are not true?

Summary

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Cournot’s Duopoly

Bertrand’s Duopoly