

Topic 5 - Oligopolistic competition

In this topic, we assume there is only a small number of firms (barriers to entry are present) and the product is not differentiated (this last assumption is made to simplify). Firms make strategic decisions and we apply standard game theory concepts to characterize the behavior of firms and the market equilibrium.

- **Quantity competition: Cournot analysis.** Suppose there are two firms facing an inverse demand $P(q)$ where q is the total output. Firms 1 and 2 choose simultaneously quantities q_1 and q_2 . Firm 1 $\max_{q_1} p(q_1 + q_2)q_1 - C_1(q_1)$ to find the best response $BR_1(q_2)$ when firm 2 chooses q_2 . Similarly, firm 2 $\max_{q_2} p(q_1 + q_2)q_2 - C_2(q_2)$ to find the best response $BR_2(q_1)$ when firm 1 chooses q_1 . The equilibrium quantities are q_1^* and q_2^* such that $BR_1(q_2^*) = q_1^*$ and $BR_2(q_1^*) = q_2^*$ (Nash equilibrium).

Under Cournot competition (1) the total output $q_1^* + q_2^*$ is greater than under monopoly and less than under perfect competition and (2) the equilibrium price $P(q_1^* + q_2^*)$ is smaller than under monopoly and higher than under perfect competition. Overall, introducing competition reduces the price and increase the quantity sold. From the perspective of welfare, Cournot competition increases efficiency with respect to the monopoly case. When the number of firms is sufficiently large, the outcome is efficient. Otherwise, there exists a deadweight loss.

- **Price competition: Bertrand analysis.** Suppose there are two firms, they face a demand $D(p)$ and have cost function $C(q) = c * q$. Firm 1 and 2 choose simultaneously prices p_1 and p_2 . In the Bertrand game, the residual demand of firm 1 when firm 2 chooses p_2' is 0 if $p_1 > p_2'$ and total demand if $p_1 < p_2'$. Firms share the market if $p_1 = p_2'$. At the Nash equilibrium (i) both firms set the same price $p_1 = p_2$ and (ii) the equilibrium price is equal to the marginal cost. As a consequence, the equilibrium outcome is the competitive outcome.

From the perspective of firms, competition in quantity is preferred to competition in price. The Bertrand game shows how the equilibrium outcome in an oligopoly can depend crucially on the firms' choice of strategic variable.

- **Sequential choices.** Suppose firms compete on quantity but firm 1 plays first. By backward induction, in the second stage firm 2 $\max_{q_2} p(q_1 + q_2)q_2 - C_2(q_2)$ to find the best response $q_2^*(q_1)$ where q_1 has already been chosen and is therefore observable. In the first stage firm 1 $\max_{q_1} p(q_1 + q_2^*(q_1))q_1 - C_1(q_1)$ where $q_2^*(q_1)$ is the anticipated best response of firm

2 when q_1 is chosen. In this case, firm 1 has a first mover advantage: moves first and chooses a “large” output so that the competitor must set a “low” output in order to get a “reasonable” price. Sequentiality is however not favorable in the case of price competition: firm 2 observes the price of firm 1 and undercuts it to capture the entire market. In equilibrium, firm 1 chooses to price at marginal cost (as in the static game).

- **Collusion.** Under Bertrand price competition for instance, firms would benefit to agree on a higher price than the marginal cost. We know this is not a Nash equilibrium (remember Nash equilibrium is a concept for non cooperative games). Colluding would be beneficial but in order to emerge as an equilibrium, all players must have incentives not only to collude, but also to ‘keep the promise’ of colluding. Collusion is illegal so firms cannot write a contract (not enforceable). Collusion can emerge only if firms repeat their interactions indefinitely, in which case the behavior in the next stage can be made contingent on the behavior today (if you do not collude today, I punish you and do not collude tomorrow). This is the only way to give incentives to other players to ‘keep their promises’. Collusion can also emerge when firms compete on different markets and if a firm can punish the firm by not cooperating in the other market. Collusion acts as if firms were behaving as a monopoly. This results in a social inefficiency.