Unit 8. Firm behaviour and market structure: monopolistic competition and oligopoly

Learning objectives:

- to understand the interdependency of firms and their tendency to collude or to form a cartel;
- to use the basic game-theory model and a simple payoff matrix to study the interdependent behaviour of firms in an oligopolistic market and their dominant strategies;
- to understand the importance of product differentiation and the role of advertising in the behaviour of firms under the market structure of monopolistic competition;
- to examine firm behaviour in the short run and in the long run and the existence of excess capacity and its implication for efficiency.

Questions for revision:

- ✓ The relationships among the short-run and long-run costs: total, average and marginal;
- ✓ The profit-maximizing rule;
- ✓ Profit maximization by a competitive firm in the short run and in the long run;
- ✓ Production and allocation efficiency.

8.1. Monopolistic competition

Monopolistic competition exists among a lot of small firms which produce close (but not perfect) substitutes for one another (for example, beer market). Product differentiation is the typical feature of this market structure. It may be caused, for instance, by various brands that are present at the market, or specific location of each producer.

Monopolistic competition is the market structure which combines typical features of monopoly and perfect competition. Similar to perfect competition there are many small firms in the market. Their decisions are assumed to be not interdependent. There is free entry of firms to the market with monopolistic competition.

But due to product differentiation each firm behaves like a monopolist at its narrow segment of an aggregate market of close substitutes. Each firm has market power to influence the price for its product choosing the volume of output, i.e. it faces downward-sloping residual demand curve (*D* on the figure below).

Each firm seeks maximum of profits so it chooses its output so that marginal revenue is equal to marginal cost, i.e. the first order condition of profit maximization is the same as under monopoly: $MR=MC$. The onle difference is that marginal revenue (*MR* on the figure below) depends not on the market demand but on residual demand curve. Residual demand is the demand for the product of a separate firm, that is aggregate market demand net of output of other monopolistic competitors.

In the short run a monopolistic competitor may gain positive economic profit (see the left hand side of the figure below).

Free entry of new firms to the market with positive economic profits shifts residual demand of a monopolistic competitor down until: $P=AC$. Similar to perfect competition free entry to the market yields zero profits of a typical firm in the long run.

Let's write down first order condition of maximum profit of a monopolistic competitor using average costs:

$$\frac{dPR}{dQ}=\frac{dTR}{dQ}-\frac{dTC}{dQ}=\frac{d(Q\cdot P)}{dQ}-\frac{d(Q\cdot AC)}{dQ}=P+Q\frac{dP}{dQ}-AC-Q\frac{dAC}{dQ}=0.$$

It follows that:

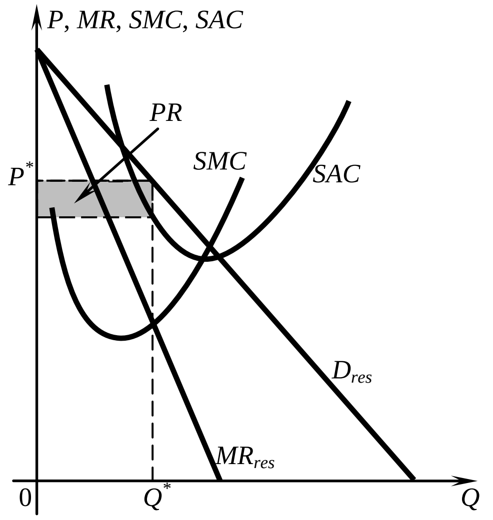
$$P+Q\frac{dP}{dQ}=AC+Q\frac{dAC}{dQ}.$$

Apply zero profit condition to get in the long run:

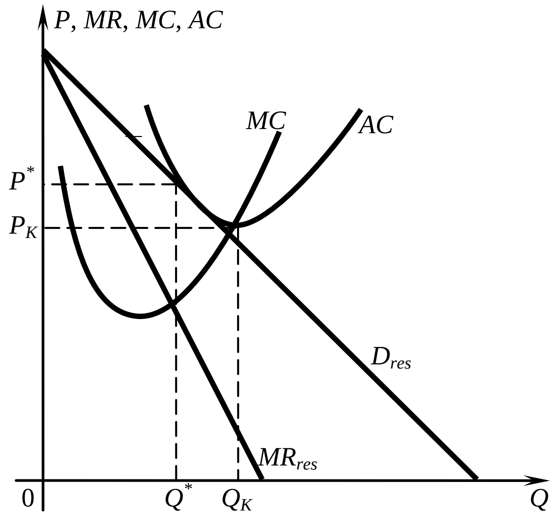
$$\frac{dP}{dQ}=\frac{dAC}{dQ}.$$

Consequently, average cost and residual demand curves for a monopolistic competitor are tangent in long run (see the right hand side of the figure below).

To see relative inefficiency of monopolistic competition let's compare equilibrium price and output under monopolistic (P^* and Q^*) and perfect (P_K and Q_K) competition (see the right hand side of the figure below). One should note, first, that firms are not producing at lowest point of *LRAC* curve; and second, that price exceeds *LRMC*. The difference $Q_K - Q^*$ shows excess capacity of a monopolistic competitor as compared to long run equilibrium of a firm under perfect competition. Unlike perfect competition, a consumer may choose among variety of products at the market of monopolistic competition, so a product may fit the taste of an individual customer. The difference $P^{*}– P_K$ is the cost of product diversity at the market of monopolistic competition.



A monopolistic competitor in short run



A monopolistic competitor in long run

8.2. Oligopoly as a market structure. Kinked demand and sticky prices. Price wars and collusion

Oligopolistic markets consist of few producers with large market shares. Huge economies of scale usually creates high barriers to entry to the market and consequently positive economic profits of incumbent firms in long run. Demand side of the market is represented by a great number of customers. Product may be homogenious or differentiated.

There is mutual interdependence between firms. Each producer recognizes that its own price and output depends on the actions of other firms in the industry (for example, aircraft manufacturing – Boeing and Airbus).

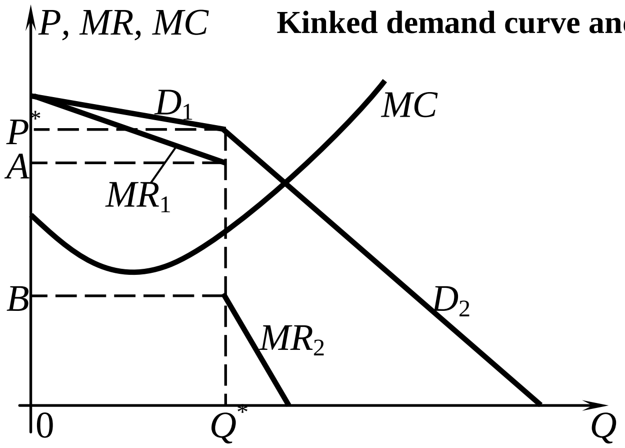
A model of kinked demand curve, or sticky prices, can serve as an example of interdependence of firms at oligopolistic markets. The distinctive feature of the model is nonsmooth firm’s residual demand curve. It consists of two segments (see the figure below).

Elastic segment of demand corresponds to the case when the firm raises price and competitors neglect it. They fill in the drop in sales of the firm, and the latter looses a part of its customers.

Inelastic segment of demand corresponds to the case when the firm reduces price and competitors follow. Consequently, the firm fails to increase the sales and the market share.

There is a kink at the point of intersection of the two segments of residual demand. The corresponding marginal revenue curve is discontinuous at this level of output (Q^*).

Kinked demand curve and sticky prices



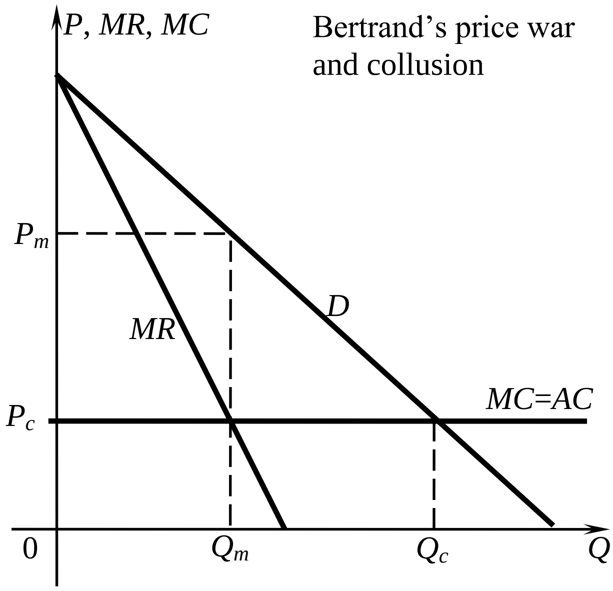
Suppose that the marginal cost curve goes through the vertical segment of discontinuity of marginal revenue. If $Q<Q^*$, MR>MC, and the firm will gain additional profit increasing output. If $Q<Q^*$, MR>MC, and it pays for the firm to cut down output. So Q^* is the profit-maximizing output and P^* is the profit-maximizing price.

There will be sticky prices at the market even if the demand and(or) technology and costs change if MC curve still crosses the gap of MR curve.

Oligopoly is a set of market structures which are situated between the polar cases of perfect competition and monopoly. So there are model of oligopoly which are closer either to perfect competition or to monopoly.

Bertrand's price war model is an example of oligopoly with the competitive outcome. Suppose for simplicity that there is duopoly at the market of a homogenous good, and each of the two firms operates under the same technology with constant returns to scale. That is, MC=AC=const for each firm. It pays for each firm to cut down price for the product as compared to the price of the rival because in this case the first firm gains the whole market and the latter losses it. So the firms have the incentive to engage in a price war which will go on until the price falls down to the level of MC. In this case none of the firms will either reduce or raise the price, because in both cases it will incure losses. As a result each firm will operate at zero economic profit. Market price will be set at the competitive level: P=MC. Total output of the firms will be equal to competitive equilibrium quantity (see the figure below). So interaction between duopolists yields competitive outcome.

A cartel is the opposite model of oligopoly – with monopolistic outcome. In this model all the firms at the market decide to collude and to behave like a monopoly. They all together choose the monopolistic output and set the monopoly price (see the figure below). The primary concern of the cartel is distribution of quotas within this output between its participants.



8.3. Game theory: interdependence and strategic behaviour

Interdependent decisions of firms generate the need for strategic behaviour. Each firm has to estimate how its own decisions affect the decisions of its competitors. Each firm has to work out the strategy of production and marketing that takes into consideration the possible response of the other imperfect competitors.

Game theory is a set of tools applied to analysis of strategic behavior and interdependent decisions when actions of one decision maker affect payoffs of another decision maker.

One can distinguish three elements of any game:

- Players (participants);
- List of possible actions (strategies);
- Payoffs of players (depend on player's own actions and actions of other players); measured as utilities/profits.

Game-theretic models of oligopoly can be classified according to:

- Number of players (classical optimization is a single player game)
- Number of strategies: finite or infinite

- Properties of payoff functions: zero sum (antagonistic), nonzero sum, constant difference (surpluses and losses at the same time)
- Possibility of pre-game negotiations and interaction during the game (cooperative or noncooperative)
- Temporal profile of decision making (simultaneous move or sequential moves)
- Number of interactions (single move or repeated games)

Let's consider at first games with simultaneous moves. In these games each player makes a decision independently (not knowing what the other decides), and then the payoffs are realized. Players have complete information or common knowledge of all factors of the game. Payoff matrix – a table that describes the payoffs in a game for each possible combination of strategies.

Several concepts are applied to find solutions of a game. One of the most important in economic theory is the concept of Nash equilibrium. Nash equilibrium is a set of strategies such that no player has an incentive to deviate from his strategy, if all other players stick to their strategies.

Let's give several examples of games that have important economic applications. A simplest game to solve is a game with dominant strategies. In this type of games each player has a dominant strategy – one that yields a higher payoff no matter what the other players choose. If both players have dominant strategies, solution of the game is found at the crossection of these strategies. Payoff to each player would be higher if all players chose their dominant strategies.

A so called "Prisoners' dilemma" is one of the most familiar examples of games with dominant strategies (see table below). The payoff matrix of the game contains potential losses of players. Suppose that $a<b<c$. In this game both players have a dominant strategy.

		Player 1	
		Cheat	Confess
Player 2	Cheat	→ ↓ (a,a)	$(\underline{0},c)$ ↓
	Confess	$(c,\underline{0})$ →	$(\underline{b},\underline{b})$

Still Nash equilibrium does not provide the highest possible payoffs to both players. Nash equilibrium is the equilibrium in a noncooperative game. But if the players had an opportunity to cooperate they would have chosen another combination of strategies in the game above. Each player would prefer to cheat because (a,a) is the combination of less severe punishments for both prisoners as compared to the Nash equilibrium (b,b).

Let's consider an application of prisoners' dilemma to the choice of market strucrure: oligopoly versus collusion (see the payoff matrix below). If cooperation is not allowed and the two firms can only make decisions independently there will be an oligopolistic industrial structure: Nash equilibrium is (1,1). But if the firms were given an opportunity to cooperate they would choose to collude. Collusion as a cooperative equilibrium can yield higher profits to the participants of the cartel.

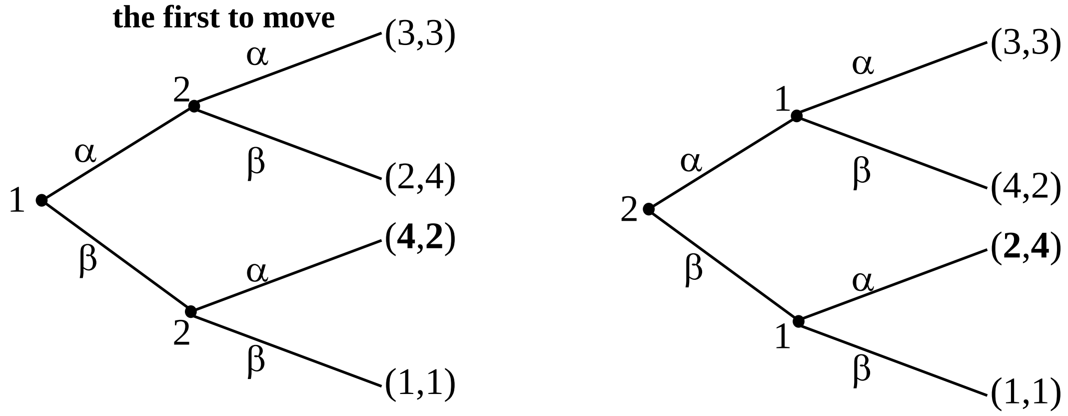
	Firm 2 competes (produces high)	Firm 2 colludes (produces low)
Firm 1 competes (produces high)	1 1	3 0
Firm 1 colludes (produces low)	0 3	2 2

There may be multiple Nash equilibria in a game. For example, there are two Nash equilibria in the game below. Payoffs of player 1 stand at the left side, and payoffs of player 2 – at the right side of a sell. One can see that there are no dominant strategies in this game. Nash equilibria are combinations of strategies (2,4) and (4,2).

		Player 2	
		Strategy α	Strategy β
Player 1	Strategy α	3 3	2 4
	Strategyβ	4 2	1 1

A game with simultaneous moves in a matrix form can be transformed into two games with sequential moves in a tree form. These are the games with first move correspondingly of player 1 or player 2. Nash equilibrium in the first game is (4,2), and in the second game - (2,4).

Sequential moves games: player 1 (left) or player 2 (right) is the first to move



Sequential moves games are solved using the method of backward induction. It is necessary to consider decisions of the players starting from the last decision node and move sequentially towards the root of the tree.

Let's consider backward induction method using an example of strategic entry deterrence - behavior by incumbent firms to make entry less likely. Potential entry affects behaviour of incumbent firms: they can erect entry barriers. Suppose that before an action of potential entrant the incumbent may invest in extra capacity, that is not used when he is not challenged, but can be used in case of entry. If the potential rival decides to enter the market the incumbent may start the price war or give up and leave the price constant.

Backward induction means that we have to consider first the choice of the last decision maker - that of incumbent. If the potential rival enters the market the incumbent faces the choice to start or not to start the price war. It will prefer to refuse to struggle because its payoff will be higher (0.8>0.5 in case of initial capital investments and 1.2>-2 in the other case). This decision of the incumbent is familiar to its potential rival. That's why the latter will choose to enter the market: the payoff of the entrant will be 1 (greater than 0.1 when it gives up) in both cases of strategic investment of the incumbent or absence of initial investments. The incumbent is aware of this choice of the potential rival. That's why the first will refuse to invest at the beginning of the game. So strategic investment cannot be considered to be a credible threat - a threat to take an action that is in the threatener's interest to carry out.

Strategic entry deterrence: incredible threat