Monopolistic Competition and Oligopoly

This chapter looks at market structures other than pure monopoly that lead to monopoly power. Monopolistic competition, oligopoly, and a cartel are examples of such market structures.

In a monopolistically competitive market, there are many firms and entry is not restricted. But the different firms’ products are differentiated. Each firm’s product differs in quality, appearance or reputation from other firms’ products. Examples of such industries are toothpaste, laundry detergent and packaged coffee. Also, most retail trade is monopolistically competitive because the different stores are differentiated from each other by location, services provided, availability of goods, etc.

Two defining characteristics of a monopolistically competitive market are that firms sell differentiated, but highly substitutable products, and there is free entry and exit.

Firms in monopolistic competition have downward-sloping demand curves. But they do not necessarily earn profits, because of free entry. If there are profits to be made, more firms will enter the market, the demand curve for the individual firm will shift down, and price will decrease, bringing profits to zero.
In the short-run equilibrium, shown on the left, the firm makes a positive profit. In the long-run, the firm’s profits attract other firms into the market, and the demand curve for this firm shifts down. The profits go to zero.

In some cases, some firms will have lower costs than others, and some brands will be more distinctive and difficult to imitate. This allows some firms to make positive profits in the long run in monopolistic competition. An example is the difference between Apple computers and PCs. For many years Apple charged a 30% higher price for given RAM capacity than PCs (which were clones of IBM’s original PC and had the Microsoft operating system). Gradually, as Microsoft improved its imitation of Apple, they gained market share. The fixed costs of development were spread over more units, making average costs lower. This is an example of a short run profit that disappeared – Apple’s profit in the computer market went to zero (since then it has risen again with IPod, IPhone, etc).

Efficiency

Monopolistically competitive markets tend to be inefficient.

The equilibrium price exceeds marginal cost. So the value to consumers of additional units of the good is greater than the cost of producing those additional units. Total surplus would be increased if output were increased to the point where the marginal cost curve intersects the demand curve. However, in long-
run equilibrium, if a firm produced at that output level, it would earn negative profits.

The point where $MC = D$ is actually not necessarily the efficient point of production for this firm, because a change in the price of this firm’s output changes the demand for other firms (since the goods are substitutes). To get an efficient output level for all firms, you have to take into consideration all the effects of changing prices on other firms’ demands.

Another way of showing that price exceeds marginal cost is to notice that output is below the level that minimizes average cost. Since the demand curve is downward-sloping, the zero profit point (the point where it is tangent to the average cost curve) is at a lower output level than the minimum of average cost. Since average cost is decreasing at that point, marginal cost is below average cost, so price exceeds average cost.

Despite these inefficiencies, it is probably better not to regulate monopolistically competitive markets. Because since no single firm has much monopoly power, the deadweight loss due to underproduction is relatively small.

Also, a benefit from monopolistic competition is product diversity. Many consumers like being able to choose from differentiated products to fit their particular tastes.

Oligopoly

In oligopolistic markets there are few firms producing a good that may or may not be differentiated. Barriers to entry make it difficult for new firms to enter. It is possible for firms in an oligopoly to earn positive profits in the long run. This is a common market structure, examples include cars, steel, aluminum, computers.

Some causes of barriers to entry are economies of scale (an entering firm would have to immediately start by producing large quantities to get costs comparable with those of its rivals already in the market), patents or secrecy about technology that prevent new firms from gaining access to that technology, and the better reputation of already established firms. These barriers are called “natural” because they result from the structure of the market.

Another barrier would be strategic actions taken by incumbent firms to prevent an entrant from succeeding or deter it from entering in the first place. For example, incumbents could threaten to flood the market and drive prices down if entry occurs. They can make this threat credible by building excess production capacity.

In setting prices a firm has to consider not only the demand and costs, but also how other firms will react to the price. Suppose Ford is considering lowering prices by 10%. It has to try to predict how its rivals will respond. They might not respond at all, or they could lower their prices to match Ford’s, or they could make their prices even lower than Ford’s to punish Ford for not keeping
high prices.
The concept of equilibrium used for an oligopoly is Nash equilibrium. In Nash equilibrium, each firm is doing the best it can given its rivals’ strategies (actions and plans of action).

We will focus on duopolies, markets with two firms, but the results can be extended to markets with more firms.

The Cournot model
Two firms produce a homogeneous good. They know the market demand curve. The two firms decide simultaneously how much to produce. They take their competitor’s likely decision into account, because the market price depends on total output from both firms. When deciding how much to produce, a firm treats its competitor’s output level as given. This makes sense if the output is determined by capacity, which cannot be changed quickly and easily.

A firm’s reaction curve gives the firm’s optimal output level for every possible output of its rival. For example, if firm 1 thinks that firm 2 will produce nothing, then firm 1’s demand curve is the market demand curve, and firm 1 will produce where the market marginal revenue intersects marginal cost.

As firm 2’s believed output increases, firm 1’s optimal output choice decreases. The Cournot equilibrium is at the intersection of the two reaction curves. This is where each firm is producing optimally given what the other firm is producing. This equilibrium is an example of a Nash equilibrium.

A problem with the Cournot model is that it does not predict how adjustment from non-equilibrium output levels will happen.

Example. Two identical firms face a linear demand curve. We want to find a Cournot equilibrium and compare it with competitive equilibrium and the result if the firms collude.

Suppose the market demand curve is $P = 30 - Q$ where $Q = Q_1 + Q_2$. Both firms have zero marginal cost, $MC_1 = MC_2 = 0$.

To find firm 1’s reaction curve, maximize its profit taking firm 2’s output as given. Profit is $(30 - Q_1 - Q_2)Q_1$. Taking the derivative and setting it equal to zero, $Q_1 = 15 - (1/2)Q_2$. Similarly firm 2’s reaction curve is $Q_2 = 15 - (1/2)Q_1$.

The Cournot equilibrium output levels are where the reaction curves intersect. These can be found by solving the two equations for $Q_1$ and $Q_2$. Plug $Q_2 = 15 - (1/2)Q_1$ into $Q_1 = 15 - (1/2)Q_2$. The solution is $Q_1 = Q_2 = 10$.

If there were no antitrust laws, the two firms could collude. They would set outputs to maximize the sum of their profits. To do this, they set total marginal revenue equal to marginal cost, which is zero in this case.

Total revenue is $(30 - Q)Q$, so total marginal revenue is $30 - 2Q$. Setting it equal to zero we get $Q = 15$. If the firms split the output in half (the cooperative
solution, the result of Nash bargaining), they will each produce 7.5. Their profits are higher than in the Cournot equilibrium. There both firms had a profit of 100. With collusion, both firms get \((30 - 15)(7.5) = 112.5\). Both of these are better than the competitive outcome, where both firms get zero profits.

Is collusion stable? Suppose firm 1 knows firm 2 is producing at the collusion level. Then firm 1’s best response is to produce \((1/2)(30 - 7.5) = 11.25\). In that case, it gets \((30 - 7.5 - 11.25)(11.25) = 11.25^2 = 126.5625\) in profits. This is more than the collusion profits. So if the game is played only once, both firms will have an incentive to defect from the collusion output level, so collusion is not a Nash equilibrium. However, if the game is infinitely repeated, the players may have strategies in which someone who defects from the collusion output level is punished in the next period by the other firm producing a high output. Also, if the firms interact in another market, it could make it even easier to enforce an agreement to collude.

An illustration of how firms can maintain collusive prices (or outputs) is when firms offer to match a rival’s price if it is lower than their own. In this way, firms will be informed if the rival defects from the collusion output or price.

The Stackelberg model

In this model, one of the firms sets its output before the other. Suppose that firm 1 chooses its output first. Firm 2 can therefore treat 1’s output as given, and sets its output to maximize profits given 1’s output. As above, the best response to \(Q_1\) is \(Q_2 = 15 - (1/2)Q_1\).

Firm 1, however, regards firm 2’s output as variable – it varies with firm 1’s output. So firm 1 can choose the optimal output level given that firm 2 responds in the best way to 1’s choice.

Thus, firm 1 maximizes \((30 - Q_1 - (15 - (1/2)Q_1))Q_1 = (15 - (1/2)Q_1)Q_1\). Taking the derivative and setting it equal to zero, \((-1/2)Q_1 + (15 - (1/2)Q_1) = 15 - Q_1 = 0\). So \(Q_1 = 15\). Then \(Q_2 = 15 - (1/2)(15) = 7.5\).

Firm 1’s profit is 112.5. Firm 2’s profit is 56.25. So the first mover has an advantage.

In some cases the Cournot model fits the situation better and in other cases the Stackelberg model does. If the industry is composed of similar firms, none of which has a particular advantage or leadership position, the Cournot model would be more appropriate. If the industry is dominated by one firm that tends to lead in setting price and introducing new products, the Stackelberg model would be better.

The Bertrand model

This model applies to firms producing the same homogeneous good and making their decisions at the same time. But in this case, the firms announce prices rather than output levels.
Suppose there are two firms and the market demand curve is 
\[ P = 30 - Q, \]
and marginal cost is $3 for each firm.

Suppose that if one firm has a higher price than the other, all consumers will buy from the lower-priced firm. If both firms have the same price, the demand is split in half between them.

The unique Nash equilibrium is for both firms to charge $3. At any other price, one firm will want to undercut the other, so no other set of prices can be a Nash equilibrium. But at a price of 3, neither firm can do better by changing their price. The firms both make zero profits.

Competition versus collusion. The prisoner’s dilemma.

A Nash equilibrium is a noncooperative solution to a game, because each firm takes the action that gives it the highest possible profit given its competitors’ actions. The profit in Nash equilibrium is lower than if the firms colluded but higher than if they acted competitively.

Collusion is illegal, but firms can cooperate without colluding explicitly. For example, a firm could set its price at the collusive level and hope that its rival does the same thing.

But if it is only a one-time interaction, the competitor probably will not choose the collusive price. Consider an example of price competition with differentiated products where two firms each have a fixed cost of $20, zero variable cost, and the following demand curves:

Firm 1’s demand: 
\[ Q_1 = 12 - 2P_1 + P_2 \]
Firm 2’s demand: 
\[ Q_2 = 12 - 2P_2 + P_1. \]

What is the Nash equilibrium set of prices? Firm 1’s profit is revenue minus fixed costs, which is \((12 - 2P_1 + P_2)(P_1) - 20\). To maximize this, taking \(P_2\) as fixed, take the derivative with respect to \(P_1\) and set it equal to zero. The derivative is 
\[ 12 - 2P_1 + P_2 - 2P_1 = 12 + P_2 - 4P_1 = 0. \]
So \(P_1 = 3 + P_2/4\) is firm 1’s reaction curve. By symmetry, \(P_2 = 3 + P_1/4\) is firm 2’s reaction curve. Solving these equations for \(P_1\) and \(P_2\), we get \(P_1 = 3 + (1/4)(3 + P_1/4)\), so \((15/16)P_1 = 15/4\), and \(P_1 = 4\). Then \(P_2 = 4\) as well.

Each firm earns a profit of \(12 = (12 - 2(4) + 4)(4) - 20\).

On the other hand, if the firms collude, they will each earn a profit of \(16\). If they collude, they will set prices so as to maximize the sum of their profits. The sum of their profits is 
\[ (12 - 2P_1 + P_2)(P_1) + (12 - 2P_2 + P_1)(P_2) - 40 = 12P_1 + 12P_2 + 2P_1P_2 - 2P_1^2 - 2P_2^2. \]
To find \(P_1\) and \(P_2\) that maximize this expression, take its partial derivatives with respect to \(P_1\) and \(P_2\) and set them equal to zero.

So \(12 + 2P_2 - 4P_1 = 0\), and
12 + 2P_1 - 4P_2 = 0.

Solving these for $P_1$ and $P_2$, we get $P_1 = 3 + (1/2)(3 + (1/2)P_1) = (9/2) + P_1/4$, and $P_1 = 6$. By symmetry, $P_2 = 6$.

Each firm’s profit is $(12 - 2(6) + 6)(6) - 20 = 16$. This is more than what they get in Nash equilibrium.

But if one firm knows that the other firm is charging the collusive price, it has an incentive to charge the lower price, undercutting the other firm and getting $20 in profits. Specifically, if firm 1 charges $6, firm 2 can charge $4 and get profit of $(12 - 2(4) + 6)(4) - 20 = 20$.

The payoffs from these two strategies are summarized in the table below.

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<td>Charge $4$</td>
<td>12,12</td>
<td>20,4</td>
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<tr>
<td>Charge $6$</td>
<td>4,20</td>
<td>16,16</td>
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This game is an example of the prisoner’s dilemma. Charging $4 is a dominant strategy for both players, but they end up with a lower payoff than if they had both charged $6.

Exercises

page 477, exercise 11.

Two firms compete by choosing price. Their demand functions are

$Q_1 = 20 - P_1 + P_2$ and

$Q_2 = 20 + P_1 - P_2$,

where $P_1$ and $P_2$ are the prices charged by each firm, respectively, and $Q_1$ and $Q_2$ are the resulting demands. Note that the demand for each good depends only on the difference in prices; if the two firms colluded and set the same price, they could make that price as high as they wanted and earn infinite profits. Marginal costs are zero.

a. Suppose the two firms set their prices at the same time. Find the resulting Nash equilibrium. What price will each firm charge, how much will it sell, and what will its profit be? (Hint: Maximize the profit of each firm with respect to its price).

Firm 1’s profit is $(20 - P_1 + P_2)P_1$. The derivative with respect to $P_1$ is $20 - 2P_1 + P_2 = 0$ when $P_1 = 10 + (1/2)P_2$. By symmetry, firm 2’s best response is $P_2 = 10 + (1/2)P_1$. Thus, $P_1 = 10 + (1/2)(10 + (1/2)P_1) = 15 + (1/4)P_1$, so $(3/4)P_1 = 15$ and $P_1 = 20$.

Each firm sells $20 - 20 + 20 = 20$ units, and profits are 400 for each firm.

b. Suppose firm 1 sets its price first and then firm 2 sets its price. What price will each firm charge, how much will it sell, and what will its profit be?
Firm 1 maximizes \((20 - P_1 + 10 + (1/2)P_1)P_1 = (30 - (1/2)P_1)P_1\). This is maximized at \(P_1 = 30\). Then firm 2's price is \(10 + (1/2)(30) = 25\). Firm 1 sells \(20 - 30 + 25 = 15\) units and makes a profit of 450. Firm 2 sells \(20 - 25 + 30 = 25\) units and makes a profit of 625.

c. Suppose you are one of these firms and that there are three ways you could play the game: (i) Both firms set price at the same time; (ii) you set price first; or (iii) your competitor sets price first. If you could choose among these options, which would you prefer? Explain why.