Chapter 7

Imperfect Competition

Market power implies that at least one firm can influence the market price with its output decision. Recall that price-taking behavior in a perfectly competitive market means that neither individual consumers nor producers can influence the market price. Under imperfect competition, there is price-setting behavior and individual producers (or consumers) influence the market price. This chapter covers imperfect competition mostly from the producer's perspective but market power situations also occur for consumers, which are called monopsony (single consumer) or oligopsony (few consumers).

7.1 Monopoly

A monopoly is a market structure characterized by a single producer and many consumers, with no close substitutes for the product offered. In general, a monopolist restricts output to raise the market price. However, to sell a larger quantity, the monopolist must lower the price on all units sold. This means that while the firm earns additional revenue from the extra units, it loses revenue on the units that were previously sold at a higher price. Monopolies typically persist because of barriers to entry that prevent other firms from entering the market:

- **Economies of scale**: A single firm operates at a lower average cost than multiple firms. In such cases, average costs decrease over the entire range of market output, making it most efficient for one firm to serve the entire market. This situation is often referred to as a natural monopoly and may occur when there are large sunk or fixed costs associated with production.
- **Legal barriers**: Legal barriers can also protect monopolies by granting exclusive rights to producers through intellectual property laws such as copyrights or patents, or by enabling firms to control scarce resources or impose strategic barriers to entry that deter potential competitors.

- **Network externalities**: The value of a product or service increases as more people use it. In such cases, joining a large network is more advantageous than joining a small one, as seen with platforms like Facebook and LinkedIn.

As opposed to perfect competition, a monopolist has the opportunity to earn profits in the long-run. It is often difficult to find a clear-cut example of a monopolist because real-world markets are influenced by additional factors such as time and geography. The following examples illustrate how these dimensions can affect the extent to which a firm exhibits monopoly power:

- **Microsoft**: The software company is often considered a monopolist in the market for operating systems which led to antitrust law cases in the U.S. (*United States of America v. Microsoft Corporation*) and the EU (*Microsoft Corporation v. Commission of the European Communities*).
- **EssilorLuxottica**: The company is the result of a merger of the French company Essilor and the Italian company Luxottica and controls a large share of the global lens and sunglasses market. Known brands are Oakley, Ray-Ban, and many more as illustrated on their webpage.
- **De Beers**: The company controls large parts of the global diamond mining industry.
- **University parking systems**: On a smaller scale, universities usually have a monopoly on the parking spaces.
- **Internet providers**: Although there are three large internet providers in Indianapolis, there is a spatial separation of the territory they serve. Some residents only have access to one of the providers which makes it a monopoly in that specific area despite the fact that it is not a single provider in Indianapolis.
- **Electricity Transmission**: The electricity transmission network in the U.S. is owned by many companies. But the system works very much like a road network which can become congested or closed down due to accidents or construction. Thus, it can happen that a particular power transmission company can have a monopoly for a very short period of time if it operates the only open line.

A monopoly is generally inefficient in the sense that it reduces societal welfare. Although the next chapters illustrate under which circumstances a monopoly can be efficient. The general inefficiency is the reason why countries around the world have antitrust laws. Those laws also apply to groups of producers—also known as cartels—who act as if they were a monopoly.

7.1.1 Theoretical Aspects of a Monopoly

The monopolist sets marginal revenue equal to marginal cost, i.e., $MR = MC$, in order to determine the profit maximizing output quantity. Recall marginal cost pricing under perfect competition, i.e., $p = MC$. It is important to understand that a perfectly competitive firm also sets $MR = MC$. But since the

price is determined by the market and is fixed from the firm's perspective, the marginal revenue from selling an additional unit is p. The difference between a perfectly competitive firm and a monopolist is illustrated in Figure 7.1.

In perfect competition, the firm faces constant price and thus, marginal revenue is equal to the price. Profit maximization occurs where marginal cost equals marginal revenue (Panel (a), Figure 7.1). In contrast, a monopolist faces a downward-sloping demand curve, so total revenue initially rises with output but eventually falls as lower prices are needed to sell additional units (Panel (b), Figure 7.1). Profit maximization still occurs where marginal revenue equals marginal cost, but because marginal revenue falls faster, the monopolist produces less output and charges a higher price than a competitive firm. The steeper slope of marginal revenue and the upward-sloping marginal cost together explain why monopoly equilibrium leads to lower quantity, higher price, and positive economic profits, whereas perfect competition drives price to equal marginal cost in the long run.

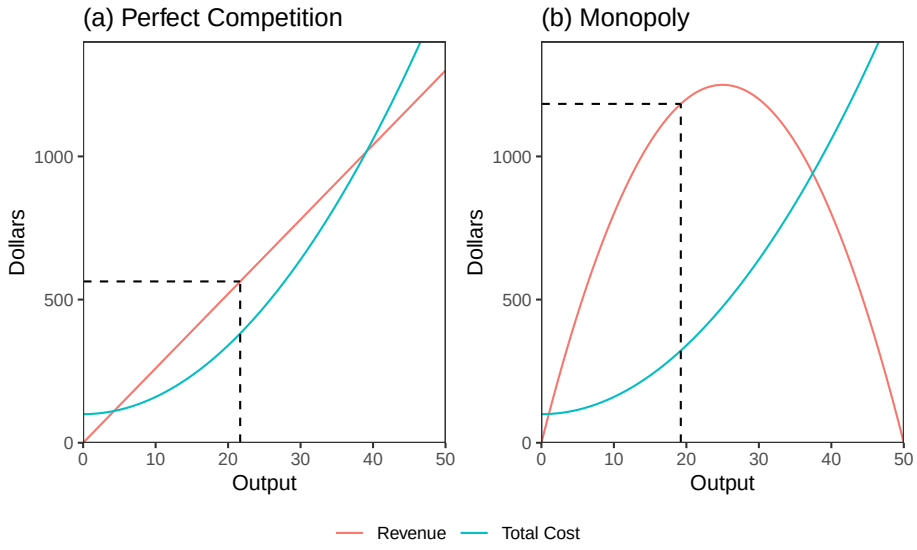

Figure 7.1: Panel(a): Under perfect competition, revenue is a straight line with the slope equal to the price. Panel (b): For a monopoly, the revenue is not proportional to price since the monopolist has to change the price in order to sell more or less output.

The next sections illustrate the monopolist's output decision under (1) constant and (2) increasing marginal cost. A monopolistic market results in a deadweight loss, which is not caused by higher prices for consumers or higher profits for the monopolist but by the underproduction of goods. The difference between constant and increasing marginal cost for a monopolist is that under constant marginal cost, the deadweight loss is a little bit easier to calculate.

Assume a monopolist faces a demand that can be written as $Q = 50 - P/2$ with the inverse demand function of $P = 100 - 2 \cdot Q$. The revenue is:

$$R = P \cdot Q = (100 - 2 \cdot Q) \cdot Q = 100 \cdot Q - 2 \cdot Q^2$$

Using calculus, it can be shown that the marginal revenue is $MR = 100 - 4 \cdot Q$. Assuming $MC = 20$, the monopolist sets $MC = MR$:

$$20 = 100 - 4 \cdot Q$$

Hence, the monopoly output quantity is $Q_m = 20$. This is different from perfect competition under which the firm sets $P = MC$ leading to $20 = 100 - 2 \cdot Q$ and hence, the socially optimum output quantity of $Q_c = 40$. The deadweight loss corresponds to the triangle below the demand function, above the marginal cost, and to the right of the output quantity.

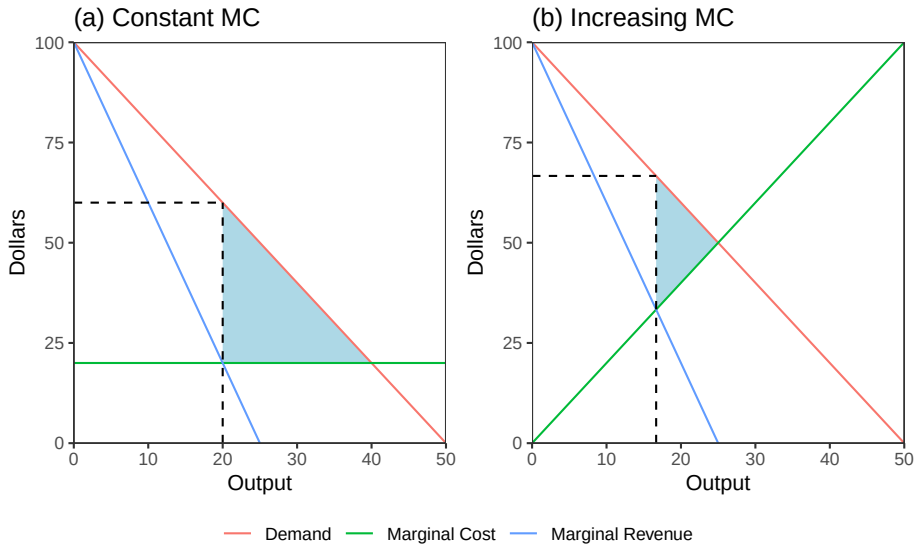

Figure 7.2: Examples of output decisions by a monopolist under constant and increasing marginal cost. The shaded light blue area corresponds to the deadweight loss.

For the second example using increasing marginal cost, suppose that the cost function is written as $C = 100 + Q^2$ resulting in $MC = 2 \cdot Q$. Given the inverse demand function $P = 100 - 2 \cdot Q$, then the marginal revenue is $MR = 100 - 4 \cdot Q$. Similar to the example with constant marginal cost, we set $MR = MC$:

$$100 - 4 \cdot Q = 2 \cdot Q$$

Solving leads to $Q_m = 100/6$ which is illustrated in Panel (b) of Figure 7.2. Again the quantity chosen by the monopolist is not socially optimal since that

quantity is obtained from setting $P = MC$ leading to $Q_c = 25$:

$$100 - 2 \cdot Q = 2 \cdot Q$$

Government regulation of a monopoly can take different forms, each with distinct effects on prices, output, and deadweight loss. A per-unit tax increases the monopolist's marginal cost by the amount of the tax, shifting the marginal cost curve upward. As a result, the monopolist produces less output and raises the price, further reducing consumer surplus and increasing deadweight loss relative to the unregulated monopoly. In contrast, a price ceiling set below the monopoly price but above marginal cost can increase efficiency by forcing the monopolist to expand output closer to the socially optimal level where price equals marginal cost. This reduces deadweight loss by moving production toward the competitive quantity. However, if the ceiling is set too low—below the monopolist's average total cost—it may cause losses and drive the firm out of the market. Thus, while a per-unit tax worsens inefficiency, a properly designed price ceiling can mitigate or even eliminate the deadweight loss of monopoly power.

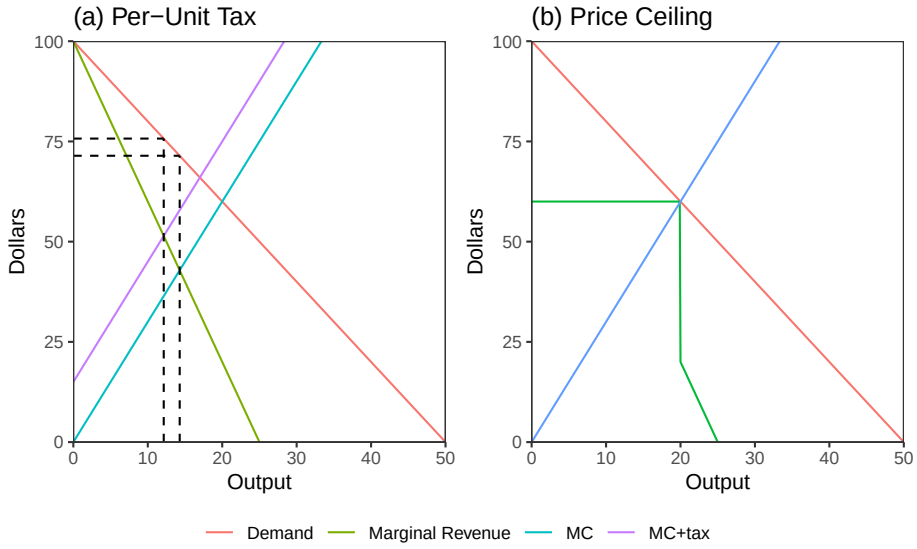

Figure 7.3: Regulation of a monopoly through a per-unit tax and a price ceiling. The deadweight loss increases under the per-unit tax regulation.

7.1.2 Monopoly and Elasticity

A monopolist produces on the elastic portion of the demand curve. It can be shown that the ability to price above the marginal cost is:

$$\underbrace{\frac{p - MC}{p}}_{\text{Lerner Index}} = -\frac{1}{\epsilon_D} \quad \Leftrightarrow \quad p \cdot \left(1 + \frac{1}{\epsilon_D}\right) = MC$$

The interpretation of the above equation is that the more elastic demand, the higher the availability of substitutes. Markup over marginal cost is reduced if the elasticity becomes larger (Figure 7.4).

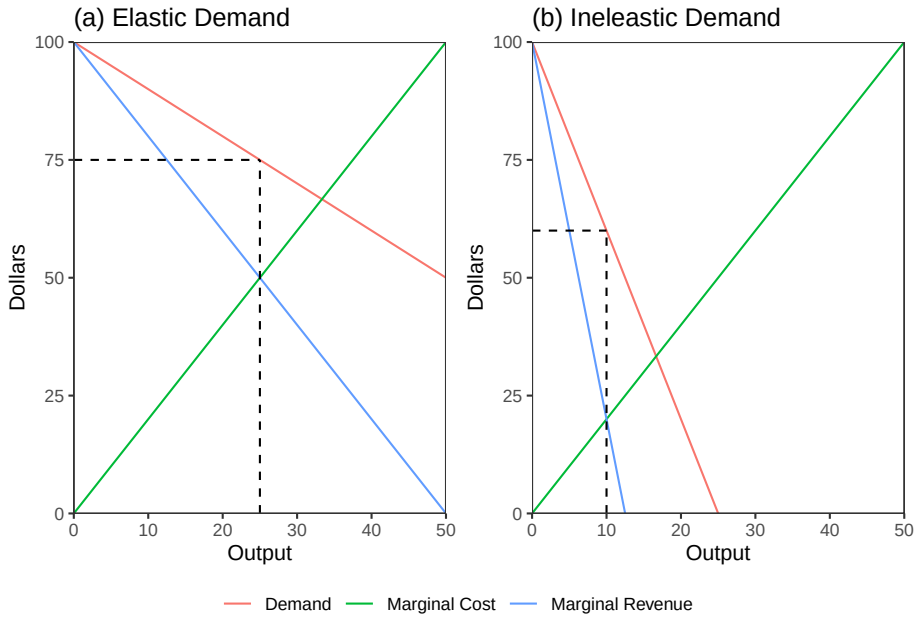

Figure 7.4: The magnitude of above marginal cost pricing depends on the elasticity of the demand function.

7.1.3 Monopsony and the Labour Market

When it comes to increasing the minimum wage, an often heard argument against doing so is that it would decrease employment. This holds true if we assume a perfectly competitive labor market with increasing labor supply and downward sloping labor demand (both as a function of wage). A minimum wage is considered a price floor which is set above the wage prevailing in the market in the absence of any regulation. However, it can be shown that under certain conditions, an increase in the minimum wage can increase employment. Specifically, if the assumption of a perfectly competitive labor market does not hold and we are faced with a monopsony in the labor market. That is, we have a single firm which constitutes the labor demand. A situation in which this could arise is if we have a single firm in an area with a large unskilled labor force.

Consider a firm that faces a constant price $P = 1$ for its output. The quantity of labor and wage are denoted with L and w, respectively. The production function is using labor only and is written as $Q = 5 \cdot \sqrt{L}$. The labor supply is written as $L = 10 \cdot w$, which can also be expressed as $w(L) = L/10$. Given

that the only cost of the firm is associated with labor, the profit function can be written as follows:

$$\pi(L) = 5 \cdot \sqrt{L} - \frac{L}{10} \cdot L = 5 \cdot \sqrt{L} - \frac{L^2}{10}$$

Taking the derivative of the profit function with respect to labor leads to the following first-order conditions:

$$2.5 \cdot L^{-0.5} = \frac{L}{5}$$

The left-hand side represents the marginal revenue product of labor whereas the righthand side represents the marginal cost.

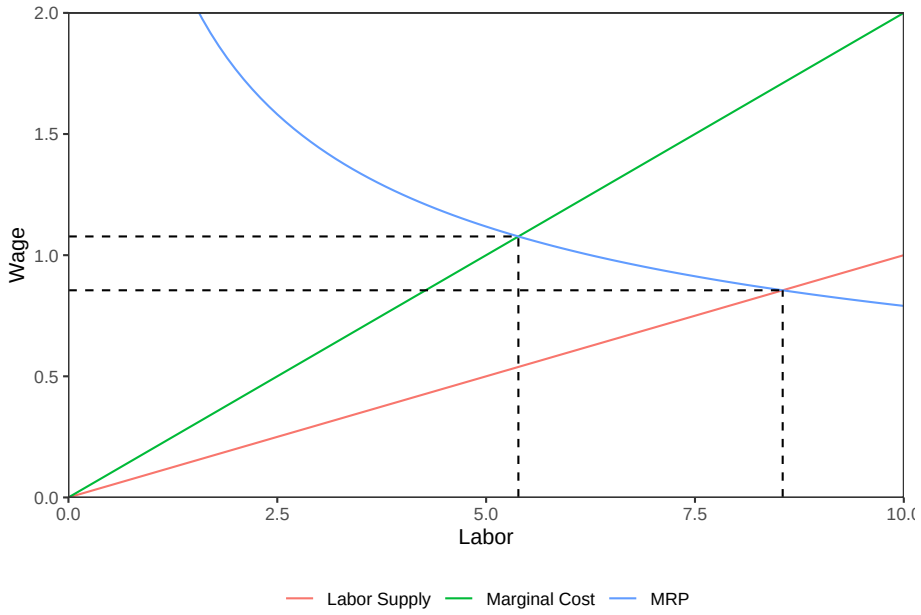

Figure 7.5: Monopsony in the labor market leading to an increase in employment from imposing a minimum wage.

There is also the case of a durable good monopoly which is a monopoly creating competition for itself. A durable good does not depreciate once it is on the market. Imagine being the owner of the only gold mine on Earth. At the beginning, this is a monopoly. But given that gold is never really lost, there will soon be a second hand gold market which competes with the initial monopoly. It can be argued that college textbooks create the problem of a durable good monopoly since some of the books do not really depreciate in terms of information presented in them. Thus, textbook publishers are selling new editions to overcome the problem of a durable goods monopoly.

7.2 Price Discrimination

A single-price monopoly is limited to charging the same price for each unit of output sold. If price discrimination is possible, the monopolist charges different prices to different customers, i.e., the monopolist can divide customers into different categories based on their willingness-to-pay (WTP). The firm must (1) have market power, (2) identify consumers' WTP, and (3) prevent low-price customers from reselling to high-price customers in order for price discrimination to be feasible. Price discrimination is always beneficial to producers otherwise they would not charge different prices to different consumers. It can harm consumers because there will be a higher price for some consumers but it also has lower prices for others. The additional producer's profit represents a monetary loss to consumers. Examples are movie theaters, buses, trains, airplanes, amusement parks, or restaurants where a difference in prices is based on groups, e.g., students, seniors, children. Price discrimination can also be observed for events such as sport games where season tickets and quantity discounts are offered. There are three types of price discrimination:

- **First Degree**: This is also known as perfect price discrimination and is achieved if the marginal revenue curve is equivalent to the demand curve.
- **Second Degree**: This is also known as nonlinear pricing and occurs with different types of consumers without observation of type. This results in offering different quantities of the good at different prices. Consumers self-select into a type. Common examples are different classes of service, hobbling a product (restrictions on the use of a device), quantity discounts, and so on.
- **Third Degree**: Also known as imperfect price discrimination occurs with different types of consumers with observation of type. Common examples for this type of price discrimination are museum or movie theater entries with senior or student pricing.

7.3 Oligopoly

An oligopoly market is characterized by few sellers, blocked entry and exit, imperfect dissemination of information, and the opportunity for positive economic profits in the long-run. As opposed to a monopoly, there is more than one firm in the market each with a certain degree of market power. There is a strategic interdependence among the firms that is commonly represented by the Bertrand model, Cournot model or the Stackelberg model. A very powerful approach to model the strategic interaction among firms is game theory which is covered in the next chapter.

The barriers to entry can result from (1) economies of scale or natural oligopoly, (2) reputation, (3) strategic barriers, or (4) legal barriers. In the case of economies of scale, one firm can supply a large part of the market (not all of it) which leads to lower per-unit cost than many small firms. Strategic

barriers can result from excess production capacity, market saturation, special contracts with distributors or from long-term arrangements with customers. As with the monopoly, legal barriers such as patents, copyrights, or zoning regulations can occur as well.

Oligopoly is a very common market structure. There can be a number of dominant firms surrounded by a number of smaller firms such as for cloud services being led by AWS, Microsoft Azure, and Google. Another example would be the car industry which is dominated (as of 2023) by the large producers such as Toyota, Volkswagen Group, Hyundai Motor Group, Stellantis, General Motors, and SAIC. A duopoly is an oligopoly with only two sellers (Airbus and Boeing). Examples of less concentrated markets are cereals with Kellogg, General Mills, Post, and Quaker Oats. But there are far more examples such as oil/gasoline, cable/internet, smartphones, textbooks, rental cars, airlines, aluminum etc. at the national level or gasoline, food, and various professional services at the local level.

7.3.1 Measurement of Market Concentration

The economic census provides a comprehensive statistical profile of the economy. Industry statistics are classified using the North American Industry Classification System (NAICS). The main categories are Agriculture, Forestry, Fishing and Hunting (Code 11), Mining, Quarrying, and Oil and Gas Extraction (Code 21), Utilities (Code 22), Construction (Code 23), Manufacturing (Code 31-33), Wholesale Trade (Code 42), Retail Trade (Code 44-45), Transportation and Warehousing (Code 48-49), Information (Code 51), Finance and Insurance (Code 52), Real Estate and Rental and Leasing (Code 53), Professional, Scientific, and Technical Services (Code 54), Management of Companies and Enterprises (Code 55), Administrative and Support and Waste Management and Remediation Services (Code 56), Educational Services (Code 61), Health Care and Social Assistance (Code 62), Arts, Entertainment, and Recreation (Code 71), Accommodation and Food Services (Code 72), Other Services (except Public Administration) (Code 81), Public Administration (Code 92). In the table below, we have data from the 2007 Economic Census for military armored vehicle, tank, and tank component manufacturing (336992), dog and cat food manufacturing (311111), quick printing (323114), ready-mix concrete manufacturing (327320).

NAICS	Firms	Sales in billion	CR_4	CR_8	CR_{20}	CR_{50}	HHI
336992	61	10,988	81.8	93.7	98.0	99.9	2,477.1
311111	199	14,505	71.0	83.5	92.6	98.2	2,325.1
323114	6,041	3,263	3.8	5.8	10.3	17.4	8.4
327320	2,460	34,837	22.6	28.2	39.9	52.9	312.9

There are two common measures for the concentration of market power within a particular industry: (1) Concentration ratio and (2) Herfindahl-Hirschman Index.

The concentration ratio measures the combined market share percentage of the n leading firms:

$$CR_n = \sum_{i=1}^{n} \frac{\text{Firm Sales}_i}{\text{Industry Sales}} \times 100$$

For a monopoly, we have $CR_n = 100$ and for a perfectly competitive industry we have $CR_n \approx 0$, that is, the concentration ratio decreases for many firms. The Herfindahl-Hirschman Index (HHI) is the sum of squared market share percentage for all competitors:

$$HHI = \sum_{i} \left(\frac{\text{Firm Sales}_i}{\text{Industry Sales}} \times 100 \right)^2$$

For a monopoly, HHI=10,000 and for a perfectly competitive industry $HHI \approx 0$. Suppose we have four firms (labeled F_i) in the market and three industries (A, B, and C). The revenues of those firms are presented in the table below:

Industry	F_1	F_2	F_3	F_4	Industry Sales	CR_2	HHI
A	30	30	30	30	120	50	2500
B	84	28	17	11	140	80	4209
C	114	110	36	20	280	80	3417

7.3.2 Cournot, Bertrand, and Stackelberg Models

The following models attempt to explain competitive behavior among two or more firms. All three models are relatively old. The Cournot model was published in 1838, the Bertrand model was formulated in 1883, and the Stackelberg model was described in 1934. Although dated, they still have a certain degree of validity today. For example, the case study *Perfect versus Imperfect Competition for the Marijuana Industry* makes use of the Cournot Model described below.

The Cournot model assumes that there are two firms in the market producing an identical good. The inverse market demand is written as $P = A - B \cdot Q$. Assuming that $A = 40$ and $B = 1$ and given that there are only two firms, the demand function can be written as follows:

$$P = 40 - Q = 40 - Q_1 - Q_2$$

where Q_1 and Q_2 are the output quantities of the two firms. The marginal cost is equal to 2. Each firm i maximizes its profits:

$$\pi_i = (40 - Q_i - Q_j) \cdot Q_i - 2 \cdot Q_i = 38 \cdot Q_i - Q_i^2 - Q_i \cdot Q_j$$

Taking the first order condition and setting it to zero yields:

$$38 - 2 \cdot Q_i - Q_j = 0$$

And thus, the reaction function is written as:

$$Q_i = 19 - \frac{Q_j}{2}$$

Since the reaction function is the same for both firms, the resulting quantities are $Q_1 = Q_2 = 12.67$ and the price is $P = 14.67$.

Let us next expand the Cournot model in multiple ways. First, we are going to move beyond two firms but assume N firms. Second, we introduce producer taxes in the form of (1) a per-unit tax and (2) an ad-valorem tax (i.e., similar to a sales tax). Because Cournot results in a symmetrical solution, we only look at one firm whose quantity produced is denoted Q_i and the total quantity produced by all other firms is written as

$$Q_{-i} = (N-1) \cdot Q_i$$

Let us first look at the case without taxes. The inverse demand function:

$$P = A - B \cdot Q = A - B \cdot (Q_i + Q_{-i})$$

Demand function:

$$Q = \frac{A - P}{B}$$

Revenue for firm i:

$$R_i = (A - B \cdot Q_i - B \cdot Q_{-i}) \cdot Q_i$$

Marginal revenue for firm i

$$MR_i = A - 2 \cdot B \cdot Q_i - B \cdot Q_{-i}$$

7.4 Multi-firm Cournot without Taxes: Solution

Setting $MR_i = MC$:

$$A - 2 \cdot B \cdot Q_i - B \cdot Q_{-i} = C$$

Solving for Q_i:

$$Q_i = \frac{A - C}{2 \cdot B} - \frac{Q_{-i}}{2}$$

Since all firms are identical: $Q_i = (N-1) \cdot Q_i$

$$Q_i = \frac{A - C}{(N+1) \cdot B}$$

7.4.1 Multi-firm Cournot with Per-Unit Tax: Setup

Inverse demand function:

$$P = A - t - B \cdot Q = A - t - B \cdot (Q_i + Q_{-i})$$

Demand function:

$$Q = \frac{A - (P + t)}{B}$$

Revenue for firm i:

$$R_i = (A - t - B \cdot Q_i - B \cdot Q_{-i}) \cdot Q_i$$

Marginal revenue for firm i

$$MR_i = A - t - 2 \cdot B \cdot Q_i - B \cdot Q_{-i}$$

7.4.2 Multi-firm Cournot with Per-Unit Tax: Solution

Setting $MR_i = MC$:

$$A - t - 2 \cdot B \cdot Q_i - B \cdot Q_{-i} = C$$

Solving for Q_i:

$$Q_i = \frac{A - t - C}{2 \cdot B} - \frac{Q_{-i}}{2}$$

Since all firms are identical: $Q_i = (N - 1) \cdot Q_i$

$$Q_i = \frac{A - t - C}{(N + 1) \cdot B}$$

7.4.3 Multi-firm Cournot with Ad Valorem Tax: Setup

Inverse demand function:

$$P = \frac{A - B \cdot Q}{(1 + m)} = \frac{A - B \cdot (Q_i + Q_{-i})}{1 + m}$$

Demand function:

$$Q = \frac{A - (1 + m) \cdot P}{B}$$

Revenue for firm i:

$$R_i = \frac{(A - B \cdot Q_i - B \cdot Q_{-i}) \cdot Q_i}{1 + m}$$

Marginal revenue for firm i

$$MR_i = \frac{A - 2 \cdot B \cdot Q_i - B \cdot Q_{-i}}{1 + m}$$

7.4.4 Multi-firm Cournot with Ad Valorem Tax: Solution

Setting $MR_i = MC$:

$$\frac{A - 2 \cdot B \cdot Q_i - B \cdot Q_{-i}}{1 + m} = C$$

Solving for Q_i:

$$Q_i = \frac{A - (1 + m) \cdot C}{2 \cdot B} - \frac{Q_{-i}}{2}$$

Since all firms are identical: $Q_i = (N - 1) \cdot Q_i$

$$Q_i = \frac{A - (1 + m) \cdot C}{(N + 1) \cdot B}$$

The Bertrand Model assumes that competition between the two firms leads to the perfectly competitive outcomes, i.e., price equals marginal cost. In this case, $P = 2$ and $Q_1 = Q_2 = 19$

In the Stackelberg model, the leading firm moves first (i.e., sets the production quantity) and the follower observes the action of the leading firm and decides on output quantity. Assume that the leader is firm 1 and the follower is firm 2. In this case, firm 1 maximizes its profit given the reaction function of firm 2:

$$\pi_1 = \left(40 - Q_1 - 19 + \frac{Q_1}{2}\right) \cdot Q_1 - 2 \cdot Q_1 = 19 \cdot Q_1 - \frac{Q_1^2}{2}$$

Taking the first order conditions results in $19 - Q_1 = 0$ and thus, we have $Q_1 = 19$, $Q_2 = 9.5$, and $P = 11.5$. Note that the leading firm is producing more in the Stackelberg Model than the follower.

7.4.5 Cartel and Collusion

The previous section on the models developed by Cournot, Bertrand, and Stackelberg illustrates that competition reduces the profits and there is a strategic interaction. There is a way around competition which is highly illegal in all countries: cartels. Here cartels for legal products are considered and not drug cartel which adds a whole different category of legal problems.

In a cartel, multiple firms act as if they are a monopolist. In the previous section, the following demand function was considered: $P = 40 - Q$. The marginal revenue associated with this (inverse) demand function is $MR = 40 - 2 \cdot Q$. Thus, setting marginal revenue equal to marginal cost ($MC = 2$) leads to a monopolistic production quantity of $Q = 19$. Both firms could agree to produce 9.5 units each which would lead to a price of 21.

Note that firms do not need to engage in explicit collusion (i.e., direct communication) but can engage in implicit collusion simply by using a tit-for-tat strategy. Assuming multiple periods, an individual firm could raise prices in

one period and see if the other firm follows the signal by raising prices as well. From an economic perspective, cartels are unstable because prices are high and firms can undercut each other. This instability is used by antitrust agencies to destabilize them even more. For example, legislation usually has no penalty for the first firm blowing the whistle on a cartel.

The United Potato Growers of America *aspires to be to potatoes what OPEC is to oil by carefully managing supply to keep demand high and constant, resulting in a more stable return for farmers.* This is how the Wall Street Journal describes the situation in the U.S. potatoes market in This Spud's Not for You: Growing Co-Op of Farmers Seeks to Become OPEC of Potatoes by Controlling Supply. The Capper-Volstead Act exempted farmers from federal antitrust laws which allowed the United Potato Growers of America to destroy 680 million pounds of potatoes in 2005 in order to keep prices high. This increased the price of potatoes by 48.5% which was mostly absorbed by retailers and thus, consumers did not see a large price increase. There has been an issue of overproduction of potatoes which resulted in a decrease of price. Controlling the supply helped stabilize (or increase) the price of potatoes.

There have also been allegations that major container shipping lines engage in price-fixing (cartel) behavior. Those charges were dropped though.

7.5 Exercises

1. ***Drug Monopoly*** (***): Mark is a producer who has the monopoly on a drug curing a particular disease. The following equations characterize his economic environment:

   - Demand:$Q = 150 - 3 \cdot P \Leftrightarrow P = 50 - \frac{Q}{3}$
   - Total revenue: $TR = 50 \cdot Q - \frac{Q^2}{3}$
   - Marginal revenue: $MR = 50 - \frac{2}{3} \cdot Q$
   - Total cost: $TC = 4 \cdot Q$
   - Marginal cost: $MC = 4$

   What is the profit maximizing price and output quantity? What is his profit? What is the efficient price and output quantity? Calculate the deadweight loss associated with the monopoly situation? To regulate the monopoly, a tax of $1 is imposed. Given the tax, calculate the new price, quantity, and deadweight loss.

2. ***Electricity Market Monopoly*** (***): An electric utility company has a monopoly in a large metropolitan area. The inverse demand and marginal revenue functions are $P = 50 - Q$ and $MR = 50 - 2 \cdot Q$. The marginal cost function is $MC = 10 + 2 \cdot Q$. What is the profit maximizing price and output quantity? What is the efficient price and output quantity? Calculate the deadweight loss associated with the monopoly situation? The government sets a price ceiling at $p = MC$. What is the price and

output of the regulated monopoly?

3. ***Monopoly Profit Tax*** (**): Assume a regulator wants to impose a 25% tax on the profit of a monopolist to reduce the inefficiency associated with the monopolist. What is the effect of this policy on the deadweight loss. Use a graph to illustrate.

4. ***Government Monopoly*** (**): A city is considering privatizing their parking spaces because members on the city council are under the impression that handing it over to a private business "increases efficiency." The city currently sets the price equal to (constant) marginal cost. Use graphs to answer the following issues. Assume that the marginal cost and demand do not change in any of the cases.

    a. Explain to the city council members why selling the parking spaces to a single, profit maximizing (unregulated) firm will decrease efficiency.
    b. What price policy can be implemented to avoid the abovementioned loss in efficiency?
    c. If the council members still want to sell the parking spaces but do not want to get involved in price regulation, what third option do they have.

5. ***Concentration Ratio*** (*): Calculate CR_3 for the example about the four firms in three industries.