# Chapter 7

# Monopoly

## 7.1 Introduction

I examined in a previous chapter the behavior of firms in perfectly competitive industries (i.e., industries in which there is free entry and exit and firms are price-takers). In this chapter I shall consider what happens when there is only one firm in a industry. Such a firm is known as a monopolist.

It is easiest to analyze a monopolistic firm by comparing it to a competitive firm. Competitive firms observe a price—which they cannot affect—and choose an output quantity. Monopolists choose price and quantity simultaneously because they are the only firm in the industry and hence implicitly set the price. Figure 7.1 illustrates.

If the monopolist chooses to produce $X_1$, it can only sell all of its output if it charges $P_1$ or less (since monopolists are profit-maximizers, it will always therefore charge $P_1$). Thus, choosing a quantity is equivalent to choosing a price. I shall assume that the monopolist chooses a quantity for simplicity's sake—it doesn't affect my results. I shall also assume for simplicity that marginal cost is constant and equal to \$C, where $C > 0$.

Both competitive firms and monopolists seek to maximize profit. That is, they seek to maximize

$$\pi = TR - TC = PX - CX \tag{7.1}$$

A competitive firm stops producing when price is equal to marginal cost or $P = MC$. The price $P$ is the firm's marginal revenue (denoted $MR$): the additional amount of revenue it receives if it increases output by one unit.

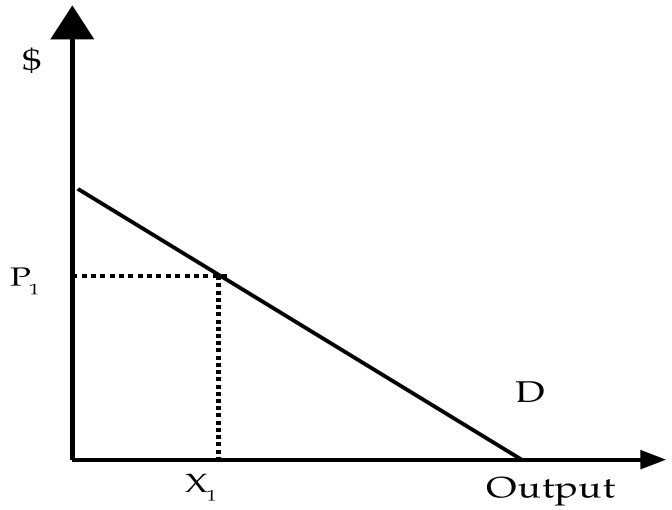


Figure 7.1: The Demand Curve

Thus, the competitive firm chooses the output quantity at which $MR = MC$. In my example $MC = C$ and $MR = P$, so the firm chooses the output level at which $P = C$.

It is helpful to rewrite equation 7.1 for a monopolist. To emphasize that price now depends on quantity, I'll write $P(X)$ instead of $P$. Equation 7.1 becomes

$$\pi = TR - TC = P(X)X - CX \tag{7.2}$$

To maximize profit, monopolists want to choose the output quantity at which $MR = MC$, just like competitive firms. The monopolists marginal cost is equal to $C$—again, just like competitive firms—but their marginal revenue is not equal to the price. If a monopolist changes its output quantity, it changes the price. The marginal revenue for a monopolist is therefore

$$MR = P + X\frac{\Delta P}{\Delta X} \tag{7.3}$$

The first term on the right-hand side is the same as for the competitive firm. The second term is the change in revenue that occurs when the price changes as a result of a change in output. The term $\Delta P/\Delta X$ is negative

because price and output move in opposite directions (to sell more output, the firm must charge a lower price). The term $\Delta P/\Delta X$ is multiplied by $X$ because when the price falls, the firm makes less money on each unit that it sells.

Figure 7.2 illustrates the effect that the differences in marginal revenue have on the output and price under perfect competition and monopoly. Consider first the right-hand pane, which illustrate the industry-wide output and price under perfect competition. The price is equal to marginal cost and the output quantity is $X_{PC}$.

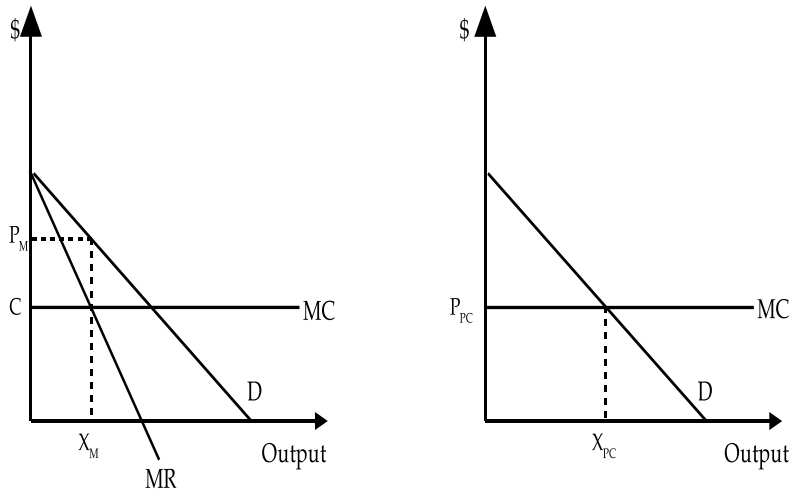


Figure 7.2: The Optimal Decision under Monopoly and Perfect Competition

The left-hand pane illustrates the situation under monopoly. Notice that the marginal revenue curve is below the demand curve at each output quantity except for zero. To see why, consider equation 7.3 again. If the monopolist chooses the output quantity $X_M$, it must charge $P_M$ if it wants to sell all of its output. That is, its prices is the height of the demand curve at $X_M$. Equation 7.3 states the firm's marginal revenue is that height $P$ plus $X$ multiplied by the negative term $\Delta P/\Delta X$. The marginal revenue curve is therefore always below the demand curve except when $X$ is equal to zero. Further, if $\Delta P/\Delta X$ is constant (i.e., the demand curve is a straight line), the distance between the demand and marginal revenue curves grows as $X$

becomes larger.

The monopolist—like the perfectly competitive firm—chooses the output quantity at which $MR = MC$, resulting in a price $P_M$ and an output quantity $X_M$. As figure 7.2 shows, monopoly results in less output and a higher price than perfect competition.

## 7.2 Monopoly Revisited

In the preceding section I examined monopoly in an intuitive manner. In this section I'll derive the same results using calculus. (If you don't know calculus, look up simple rules for differentiating, ask a friend, or skip this section—it isn't critical.) The monopolist's total revenue is given by

$$TR = P(X)X \tag{7.4}$$

The change in total revenue given a change in $X$ is, by definition, marginal revenue. Differentiating equation 7.4 with respect to $X$ therefore defines marginal revenue.

$$MR = P(X) + X\frac{\partial P}{\partial X} \tag{7.5}$$

Total cost is given by

$$TC = CX \tag{7.6}$$

The change in total cost given a change in $X$ is, by definition, marginal cost. Differentiating equation 7.6 with respect to $X$ therefore defines marginal cost.

$$MR = C \tag{7.7}$$

Profit is given by

$$\pi = TR - TC = P(X)X - CX \tag{7.8}$$

Differentiate equation 7.8 with respect to $X$ and setting the result equal to zero yields the profit-maximizing output quantity.

$$\frac{\partial \pi}{\partial X} = MR - MC = P(X) + X\frac{\partial P}{\partial X} - C = 0 \tag{7.9}$$

Rearranging equation 7.9 gives

$$P(X) = C - X\frac{\partial P}{\partial X} \tag{7.10}$$

Because $\partial P/\partial X$ is negative, the right-hand side is greater than $C$ whenever $X$ is greater than zero. This means that $P_M > C$ and therefore $X_M < X_{PC}$.

## 7.3 Marginal Revenue Revisited

Recall that the monopolist's marginal revenue is given by the expression below.

$$MR = P + X\frac{\Delta P}{\Delta X} \tag{7.11}$$

In fact, this is also the marginal revenue for a firm in a perfectly competitive industry. For a firm in a perfectly competitive industry though, $\Delta P/\Delta X$ is equal to zero because, by definition, firms can't affect the price.

I have assumed thus far that a monopolist cannot practice price discrimination; it cannot charge different prices to different people. I shall consider now a monopolist that can charge each consumer exactly the amount that she is willing to pay. A monopolist of this type is known as a price-discriminating monopolist.

For a price-discriminating monopolist, $\Delta P/\Delta X$ is equal to zero because the monopolist doesn't have to change the price it charges me if it charges you less. The marginal revenue curve for a price-discriminating monopolist is therefore equal to the demand, meaning that a price-discriminating monopolist will produce the same quantity of output as a competitive industry.

## 7.4 Efficiency

Suppose that an economy produces two goods called $C$ and $M$ and that both goods are produced by perfectly competitive industries. If consumer's face the same prices, the slope of their budget constraints, $-P_M/P_C$, is equal to the slopes of their indifference curves at their points of consumption. For the equilibrium to be efficient, this slope must also equal the slope of the

production possibilities frontier at the point of production. That is, efficiency requires that

$$-\frac{P_M}{P_C} = \frac{\Delta C}{\Delta M} \tag{7.12}$$

The left-hand side of equation 7.12 is the slope of the aggregate budget constraint. The right-hand side is equal to the slope of the PPF at the point of production. This condition is satisfied under perfect competition. It is also equal to the following.

$$MC_M = -P_C \frac{\Delta C}{\Delta M} \Rightarrow \frac{\Delta C}{\Delta M} = -\frac{MC_M}{P_C} \Rightarrow \frac{\Delta C}{\Delta M} = -\frac{MC_M}{MC_C} \tag{7.13}$$

This implies that efficiency is satisfied when the following condition holds.

$$-\frac{P_M}{P_C} = -\frac{MC_M}{MC_C} \tag{7.14}$$

Now suppose that good $M$ is produced by a monopolist. We know that $P_M$ will be greater than $MC_M$ so equation 7.14 becomes

$$\frac{P_M}{P_C} > \frac{MC_M}{MC_C} \tag{7.15}$$

Equation 7.15 shows the equilibrium under monopoly won't be efficient. Another way to see this is to notice that under monopoly, the slope of the aggregate budget constraint is steeper than the slope of the PPF.

$$P_M > MC_M = -P_C \frac{\Delta C}{\Delta M} \Rightarrow -\frac{P_M}{P_C} > \frac{\Delta C}{\Delta M} \tag{7.16}$$

What does monopoly result in inefficiency? Price doesn't equal marginal cost in the monopolistic industry, so prices aren't reflecting scarcity to consumers. Consumers therefore can't make informed choices and the result is an inefficient equilibrium, as shown in figure 7.3. Notice that the economy produces too much of the perfectly competitive good $C$ and too little of the monopoly good $M$ (to see this, recall that $P_M$ is too high; to make the situation efficient, $P_M$ must decrease and the output of $M$ must increase).

Yet another way to see that monopoly leads to an inefficient equilibrium is to find an mutually beneficial trade. Examine the situation under monopoly that is shown in figure 7.4. There is a consumer $T$ who is will to pay $P_T$ for

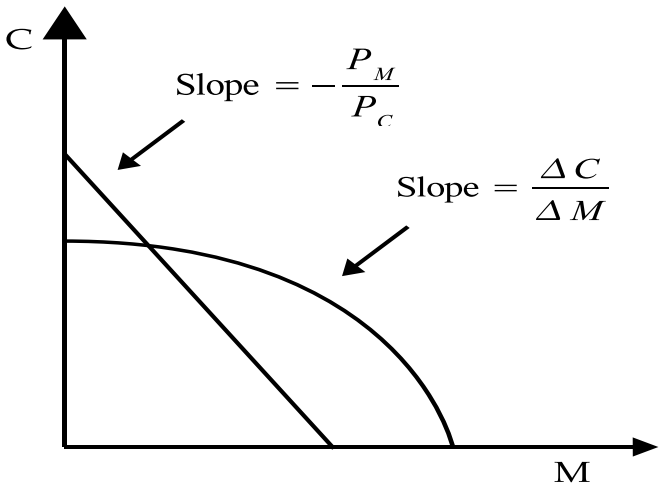


Figure 7.3: Inefficiency due to Monopoly

one unit of good $X$. The monopolist must spend $C$ to produce that unit. If the consumer pays a price between $P_T$ and $C$, both parties are better off: consumer $T$ gets a good worth $\$P_T$ (to her) for a price less than $\$P_T$ while the firm pays $\$C$ to produce a good that it sells for more than $\$C$. The problem is that the monopolist can't charge different prices to different consumers; if it wishes to sell to consumer $T$, it must lower the price that it charges to all other consumers, lowering its total profit.

However, if the monopolist could charge each consumer a different price—if it were a price-discriminating monopolist—then it could make all of the mutually beneficial trades that haven't been made. If all mutually beneficial trades have been made, the equilibrium is efficient. Price discriminating monopoly therefore leads to an efficient equilibrium.

## 7.5 Problems

1. For questions 1-3, assume that the monopolist cannot price-discriminate.

   (a) What is the critical difference between a monopolist and a perfectly competitive firm?

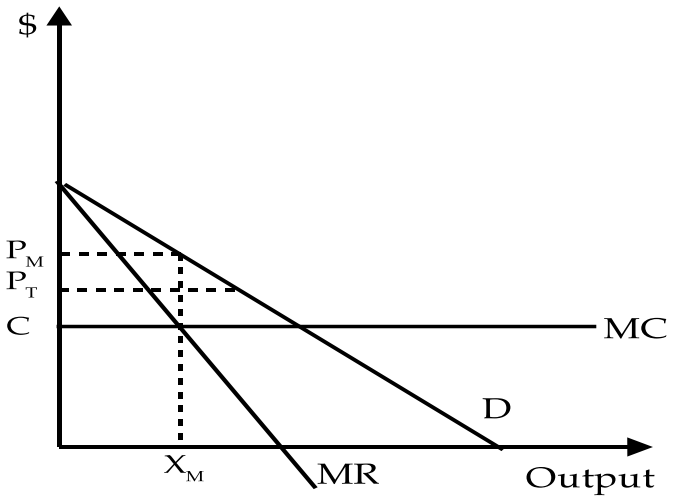


Figure 7.4: The Monopolistic Firm

(b) Do monopolists and perfectly competitive firms use the same rule for choosing their output level? Explain.

(c) For a perfectly competitive firm, $MR = P$. What does $MR$ equal for a monopolist? Why?

(d) Sketch the relationship between demand and marginal revenue for a monopolist. Explain.

2. (a) Draw the equilibrium prices and outputs on the figure below.

   (b) Show profit, total revenue, and total cost.

3. Show that monopoly is not efficient diagrammatically and algebraically.

4. (a) What is a price-discriminating monopoly?

   (b) Is a price discriminating monopoly efficient?

   (c) How does perfect competition and a price discriminating monopolist differ? How are they similar?

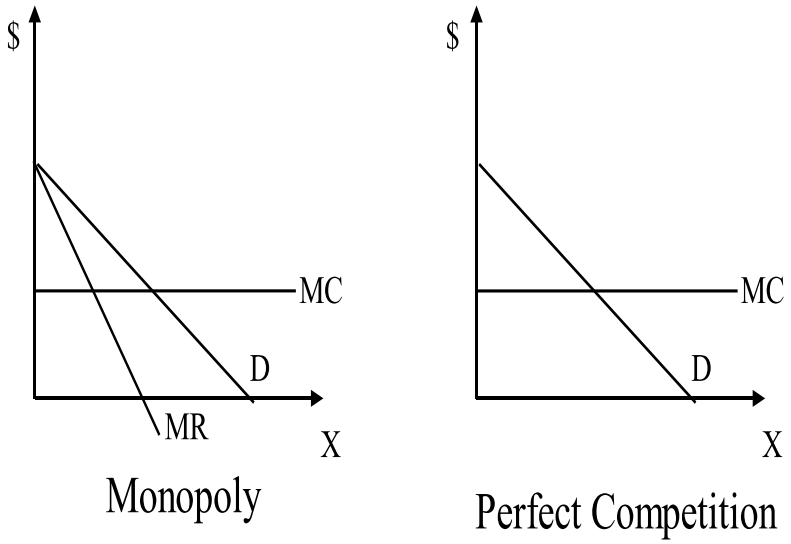


Figure 7.5: Monopoly and Perfect Competition

## 7.6 Solutions

1. (a) Perfectly competitive firms cannot affect the price—they are price-takers by definition. Monopolists choose an output-price combination.

   (b) Yes. Both firms choose an output level at which marginal revenue equals marginal cost When marginal revenue exceeds marginal cost, a firm can increases it profit by increasing its output. When marginal cost exceeds marginal revenue, a firm can increase its profit by decreasing output. When marginal revenue and marginal cost are equal, the firm stops changing output.

   (c) For a monopolist,

$$MR = P + X\frac{\Delta P}{\Delta X} \tag{7.17}$$

   When a monopolist increases output, it gains additional revenue because it sells more—this accounts for the $P$ term on the right-hand side. A monopolist though must charge less to sell more—this accounts for the $\Delta P/\Delta X$ term. This term is multiplied by $X$,

because the monopolist must cut the price to everyone. Finally, note that since $\Delta P/\Delta X$ is negative a monopolist's marginal revenue is less than a competitive firm's marginal revenue.

(d) Look carefully at figure 7.6. Pick any output level that you want. From that point, draw a straight line up to the demand curve. The height of the demand curve is the price at this output level. This would be marginal revenue for a perfectly competitive firm. But for the monopolist we must add the product of $X$ and $\Delta P/\Delta X$, which is negative, so its marginal revenue is below the demand curve. Now notice that the slope of the demand curve is constant (i.e., $\Delta P/\Delta X$ is constant). Thus, the distance between the demand curve and the marginal revenue curve increases as $X$ increases.

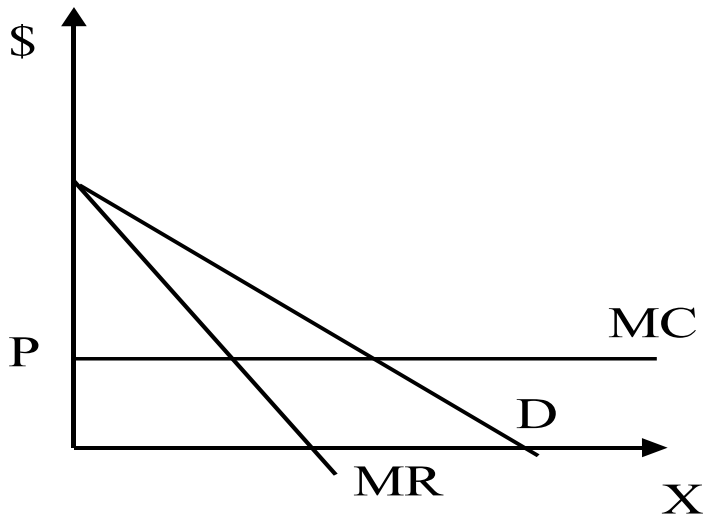


Figure 7.6: Marginal Revenue Under Monopoly

2. See figure 7.7.

3. Suppose that we have two goods called $C$ and $M$ and that both industries are perfectly competitive. We know that $-P_C/P_M$, the slope of consumers' budget constraints, is equal to the slopes of their indifference curves at the point of consumption. $-MC_C/MC_M$ is the slope of

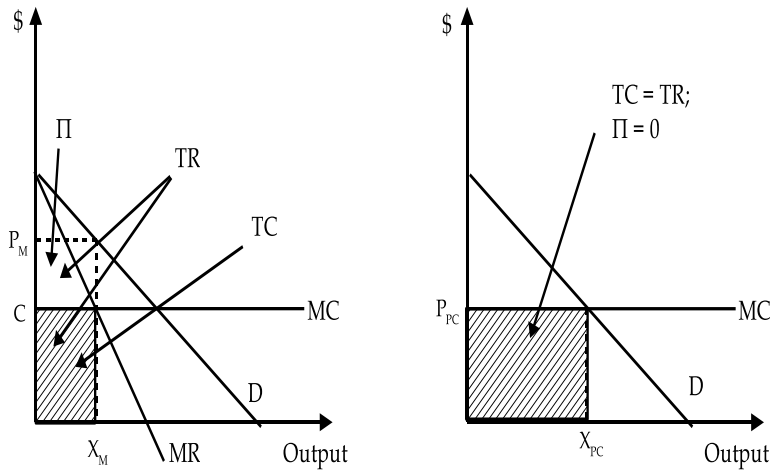


Figure 7.7: Monopoly versus Perfect Competition

the PPF. If the slopes of all indifference curves equal the slope of the PPF, our equilibrium is efficient.

Suppose now that good $M$ is produced by a monopolist and good $C$ is produced by a perfectly competitive industry. We know that $P_M$ will be greater than $MC_M$ so

$$\frac{MC_C}{MC_M} > \frac{P_C}{P_M} \tag{7.18}$$

The slope of the PPF no longer equals the slope of the indifference curves at the point of consumption ($-P_C/P_M$ assuming that consumers face the same prices). An mutually beneficial trade therefore exists and thus the equilibrium is inefficient.

Another way to see that monopoly leads to an inefficient equilibrium is to find an mutually beneficial trade. Examine the situation under monopoly that is shown in figure 7.8. There is a consumer $T$ who is will to pay $P_T$ for one unit of good $X$. The monopolist must spend $C$ to produce that unit. So if the consumer pays a price between $P_T$ and $C$, both parties are better off. The problem is that the monopolist

can't charge different prices to different consumers; if it wishes to sell to consumer $T$, it must lower the price that it charges to all other consumers, lowering its total profit.

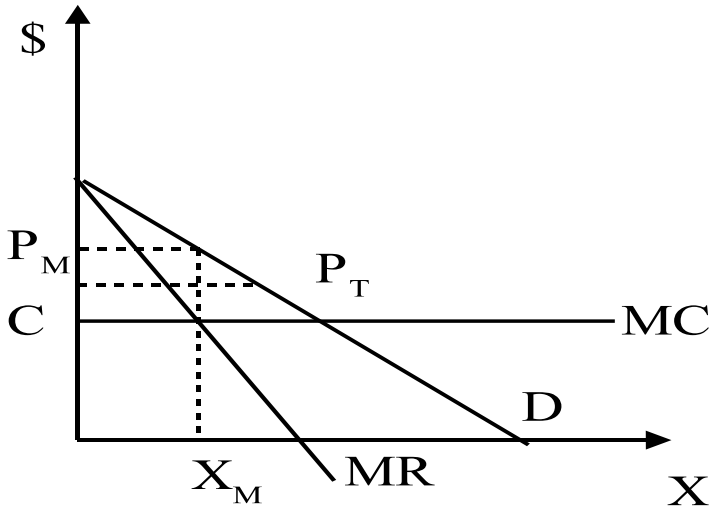


Figure 7.8: A Mutually Beneficial Trade

4. (a) A PDM is monopolist who

   i. Knows exactly what every consumer is willing to pay for good X.

   ii. Can charge a different price to each consumer.

   iii. Can prevent resale of goods by consumers.

   (b) Oddly enough, yes. Marginal revenue for a PDM equals $P$. Thus a PDM produces the same output as a perfectly competitive firm—no mutually beneficial trades are left unexploited.

   (c) A PDM doesn't leave any mutually beneficial trades unexploited, but it captures all the benefits from those trades. Under perfect competition, all mutually beneficial trades are made, but all those consumers who are willing to pay more than the market price capture some surplus. So a PDM benefits the monopolist while perfect competition benefits the consumer.

Both PDMs and perfectly competitive industries are efficient. They also produce the same level of output.