

Intermediate Microeconomics — Week 11

Professor Boyd

November 1 & 3, 2022

QUIZ: Thursday's quiz covers weeks 9 and 10, including all of Chapter 8 and Chapter 9 through section 9.5 (pp. 255–321).

9.6 Welfare Analysis of Monopoly

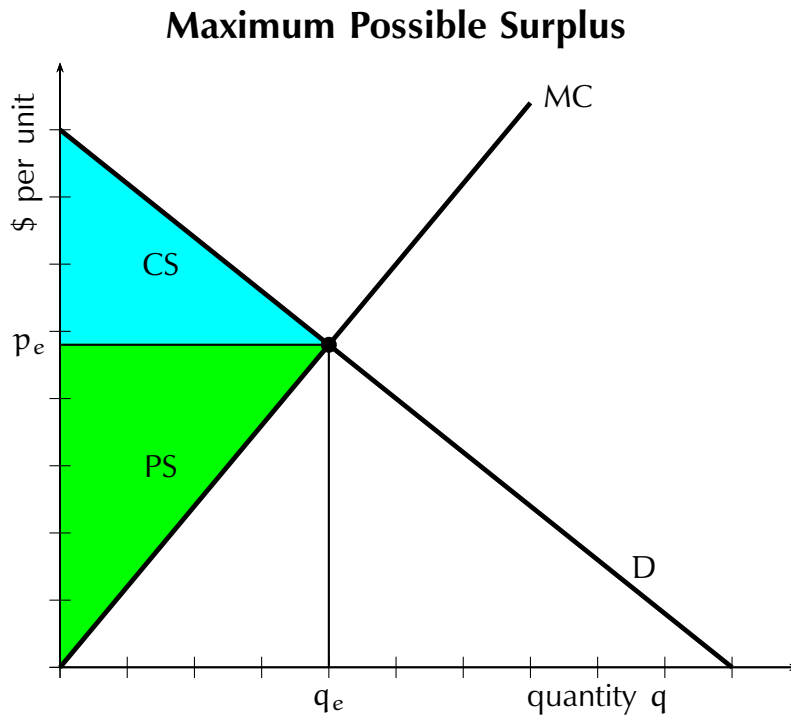
Perfectly competitive markets are described by supply/demand models. We previously found that the equilibrium in such models maximizes total surplus.

We will compute surpluses for the monopoly solution and see how efficient (or not) monopoly is.

9.6.1 Efficient Output

The fully efficient solution is determined by the intersection of demand and marginal cost (under perfect competition, equal to supply). This maximizes total surplus. This intersection determines both the efficient price p_e and efficient quantity q_e .

We have returned to using the standard way of computing producer's surplus, which works better for comparisons with consumer's surplus.

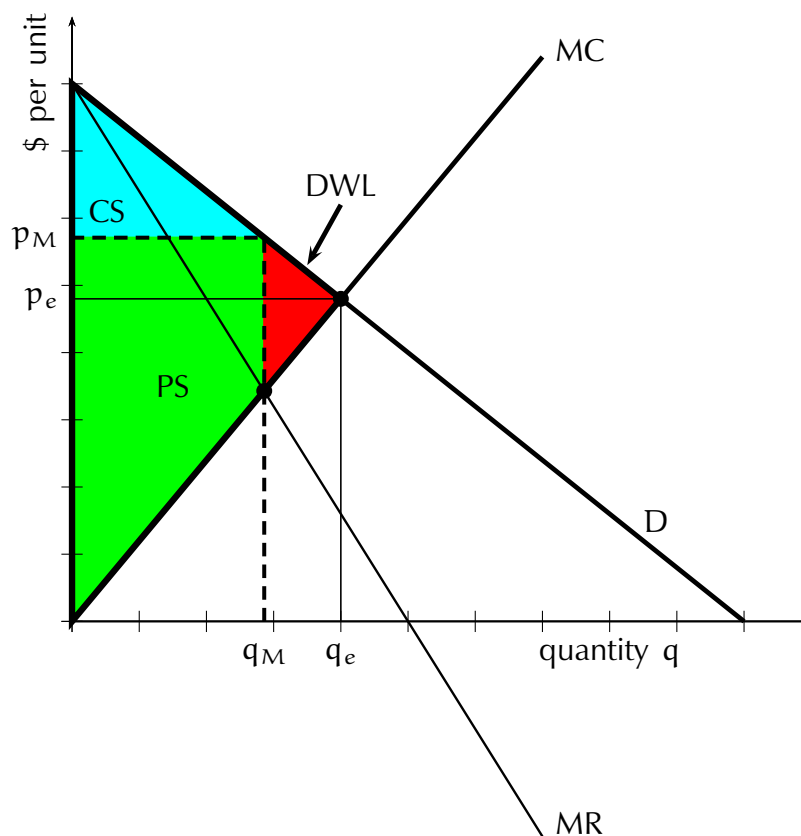


9.6.2 Surplus under Monopoly

The maximum possible total surplus is indicated by the triangle with heavy lines. The consumer's surplus is in light blue, the producer's surplus in green. The remainder of the triangle, representing mutually beneficial trades that are not made under monopoly, is shown in red. It is the deadweight loss due to monopoly.

The monopoly price is p_M and the monopoly quantity q_M . The monopoly quantity is less than the efficient quantity, causing the deadweight loss. The monopoly price is higher than the efficient price, causing profit to increase.

Monopoly Surplus



The deadweight loss means that at the monopoly price, there are consumers who would be willing to buy more at the marginal cost of production. This happens because of the gap between marginal cost and price under monopoly pricing.

9.6.3 Reducing the Deadweight Loss: Price Ceilings

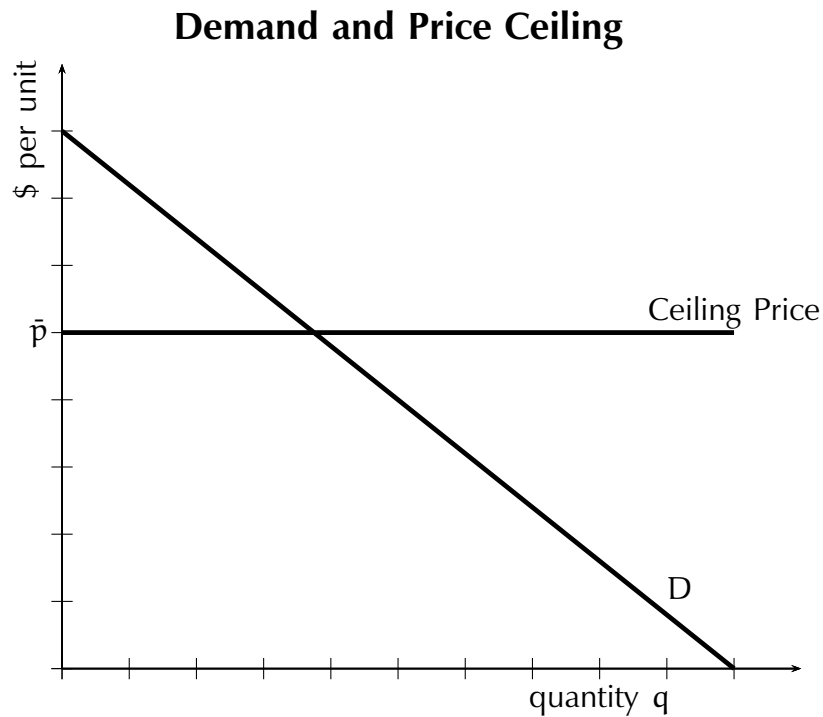
Now that we know there is a deadweight loss, what can be done about it? In the next chapter, we will see that monopolists may have strategies at their disposal to reduce the deadweight loss.

The government can also try to reduce the deadweight loss via policy — price ceilings.

Although price ceilings reduce total surplus in perfectly competitive markets, they can increase total surplus when there is monopoly.

9.6.4 How does a Price Ceiling Work Under Monopoly?

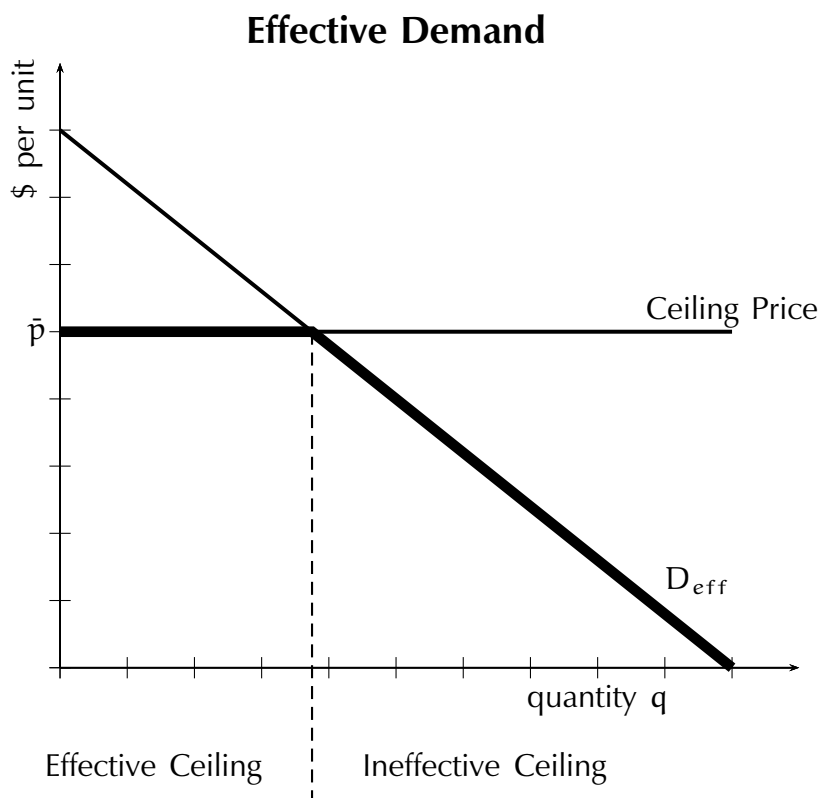
Suppose we have a demand curve and a price ceiling at \bar{p} , as in the diagram below. We can ask whether the price ceiling is effective, whether it is below or above the monopoly price.



9.6.5 When is a Price Ceiling Effective?

It depends. It depends on the price that the monopolist wants to charge. The most they can charge is given by the demand curve, so the ceiling is effective when the ceiling price is below the demand price.

This divides the range of quantities into two parts. To the left of the dividing line, the monopolist will charge the ceiling price, to the right, the demand price. The effective demand curve is given by the heavy line.

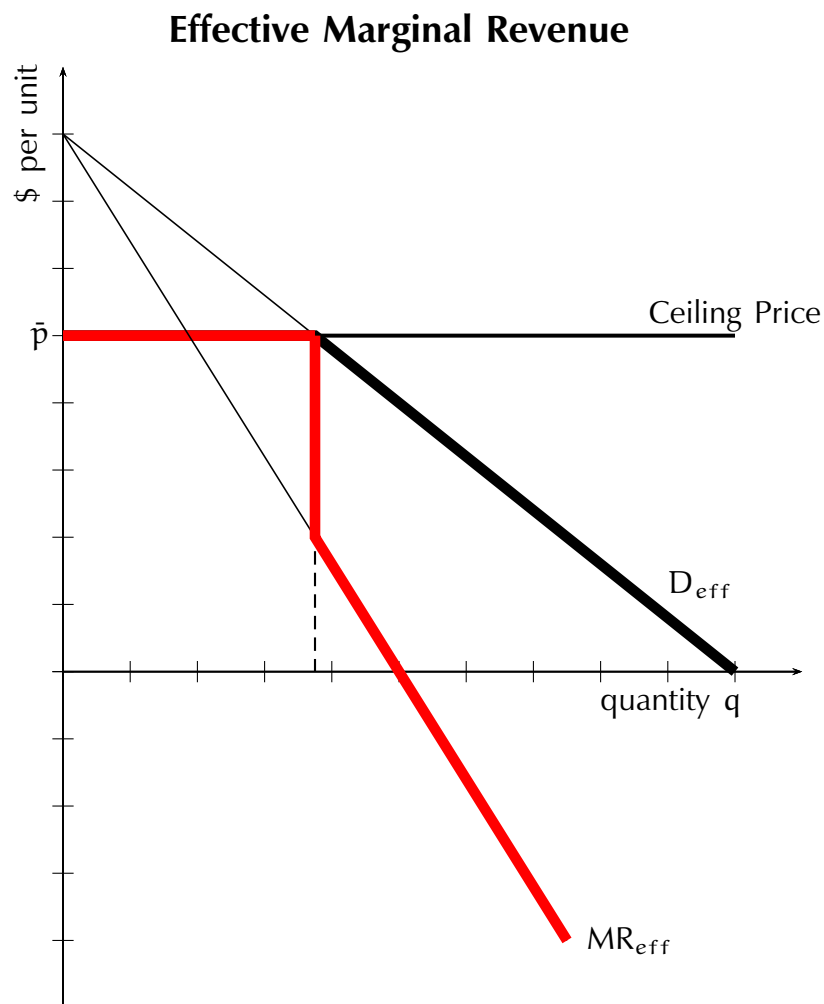


9.6.6 Marginal Revenue with a Price Ceiling

On the horizontal portion of effective demand, the monopolist has been turned into a price taker. The marginal revenue curve is equal to price there (red).

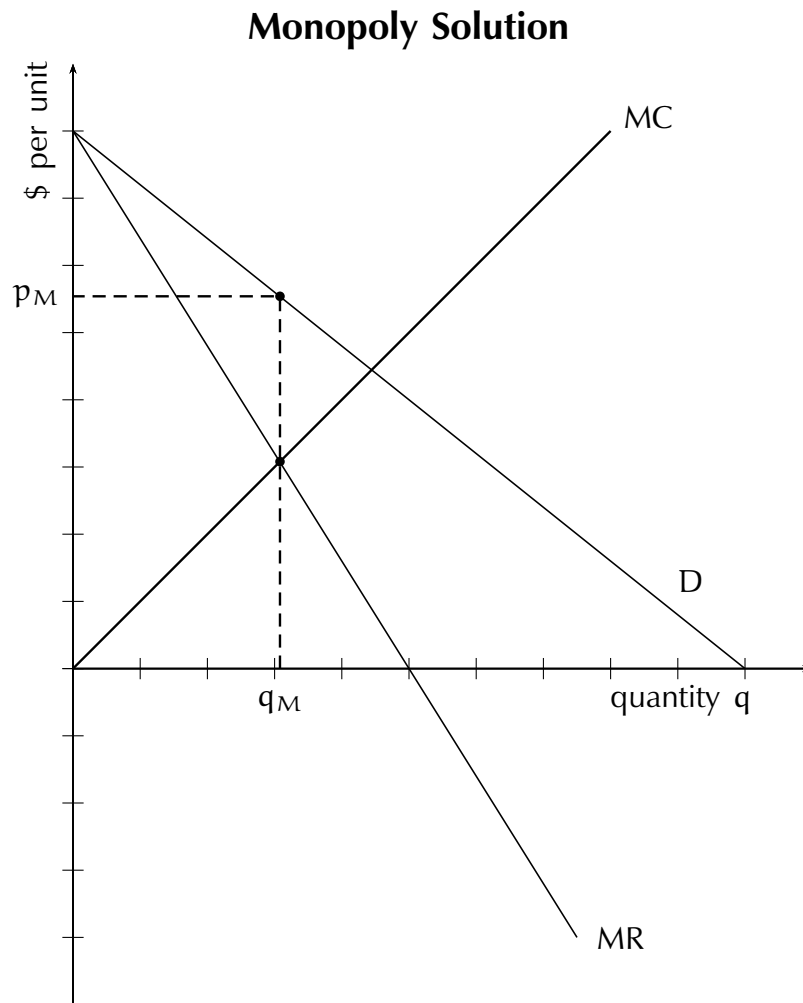
At higher quantities, the effective demand is equal to the original demand and the marginal revenue follows the original marginal revenue curve (also red).

We connect the two pieces with a red vertical line to keep the marginal cost curve from slipping between them.



9.6.7 Monopoly Solution

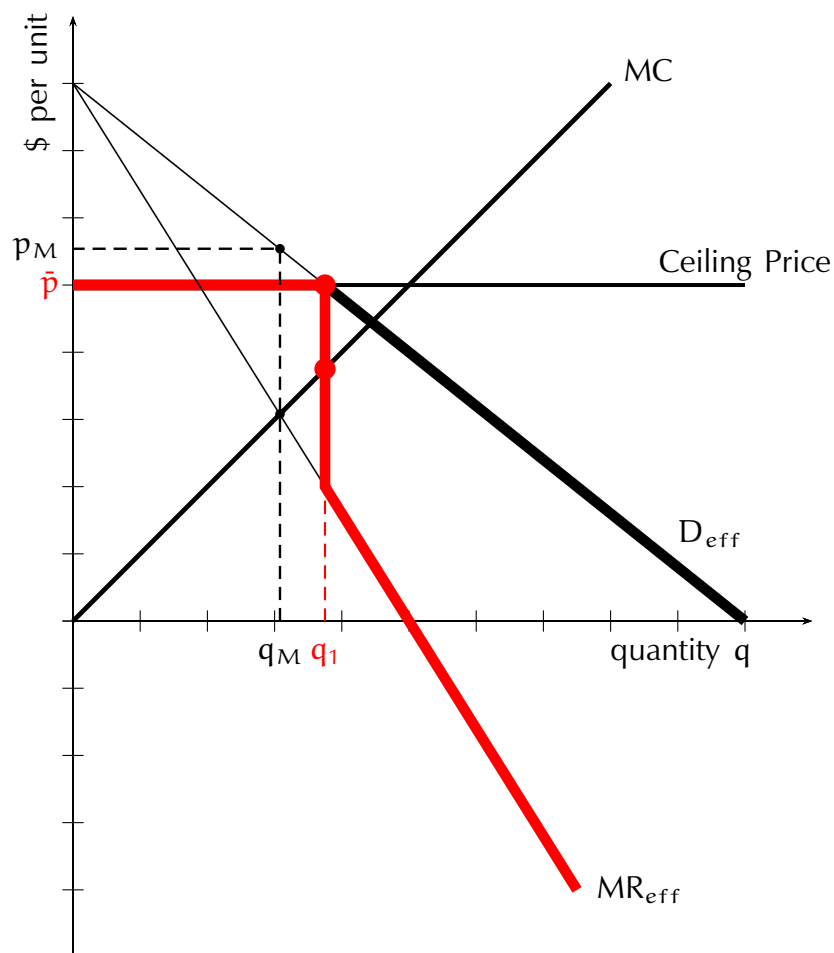
Recall that the intersection of marginal revenue and marginal cost determines the monopoly quantity. We then use the demand curve at that quantity to determine the corresponding monopoly price.



9.6.8 High Price Ceiling

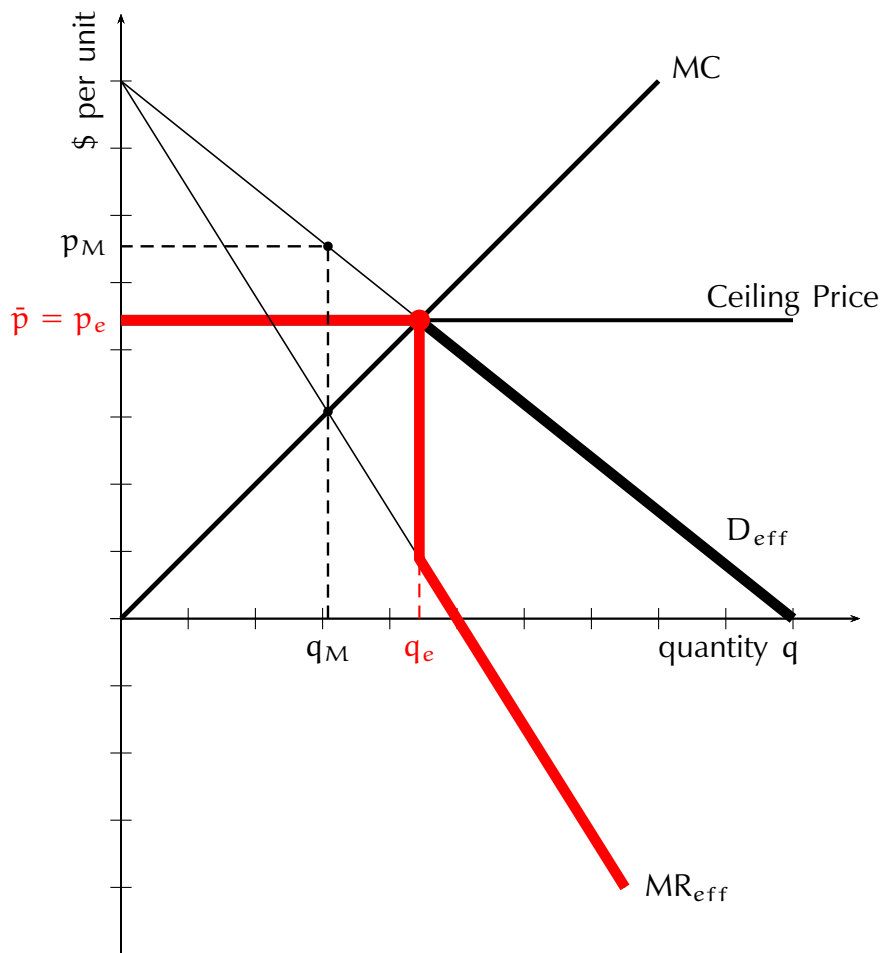
We now chose a price ceiling below the monopoly price but above the efficient price. The quantity produced increase to q_1 and the price is reduced to the ceiling price \bar{p} . Quantity is determined by the demand curve and ceiling price.

As the price ceiling is lowered, the quantity produced increases. This is quite unlike a price ceiling in a competitive market where lowering the ceiling price decreases production and causes a shortage. Here, there is no shortage as we remain on the demand curve.



9.6.9 Efficient Ceiling Price

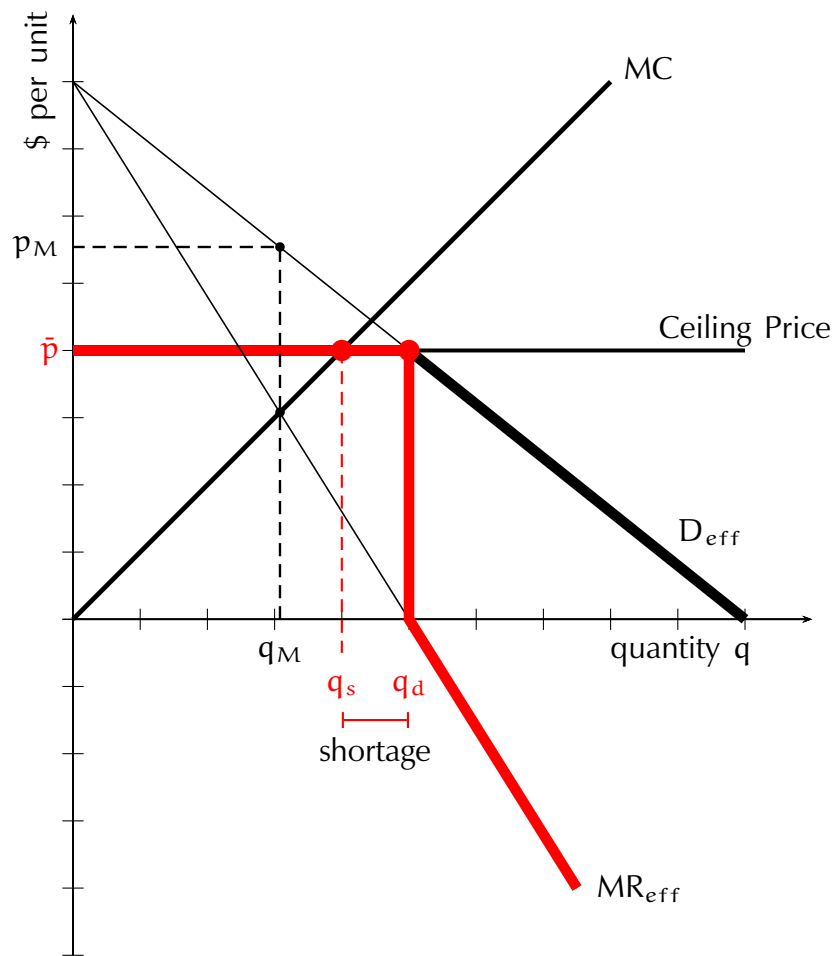
When the price is lowered to price determined by the intersection of demand and marginal cost, we have reached the efficient price. Total surplus reaches its maximum here.



9.6.10 Low Ceiling Price

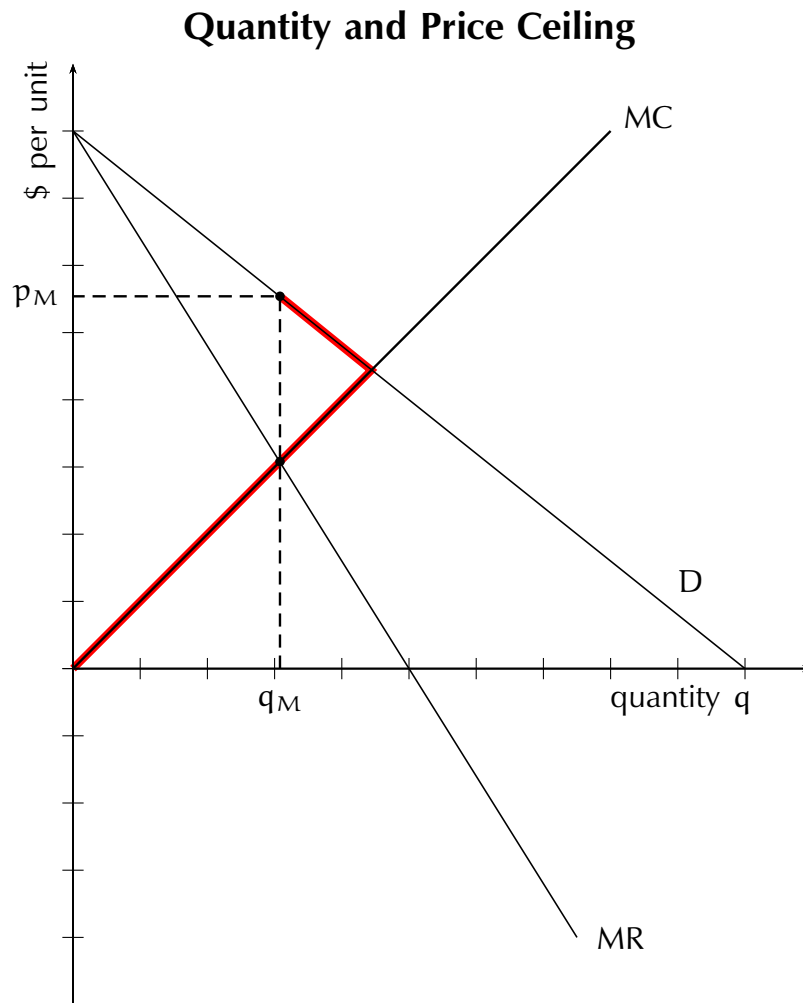
When we lower the price ceiling below the efficient price, below the intersection of marginal cost and demand, things change.

Quantity produced falls from the efficient quantity while quantity demanded increases. A shortage appears. This gets worse the more we lower the ceiling price.



9.6.11 Quantity Changes with Price Regulation

The diagram below shows how the profit-maximizing quantity changes as the ceiling price changes. For each ceiling price $\bar{p} \leq p_M$, the red line shows the corresponding quantity produced.



9.6.12 Summary of Monopoly Price Ceilings

The monopolist will behave differently depending on where the price ceiling is.

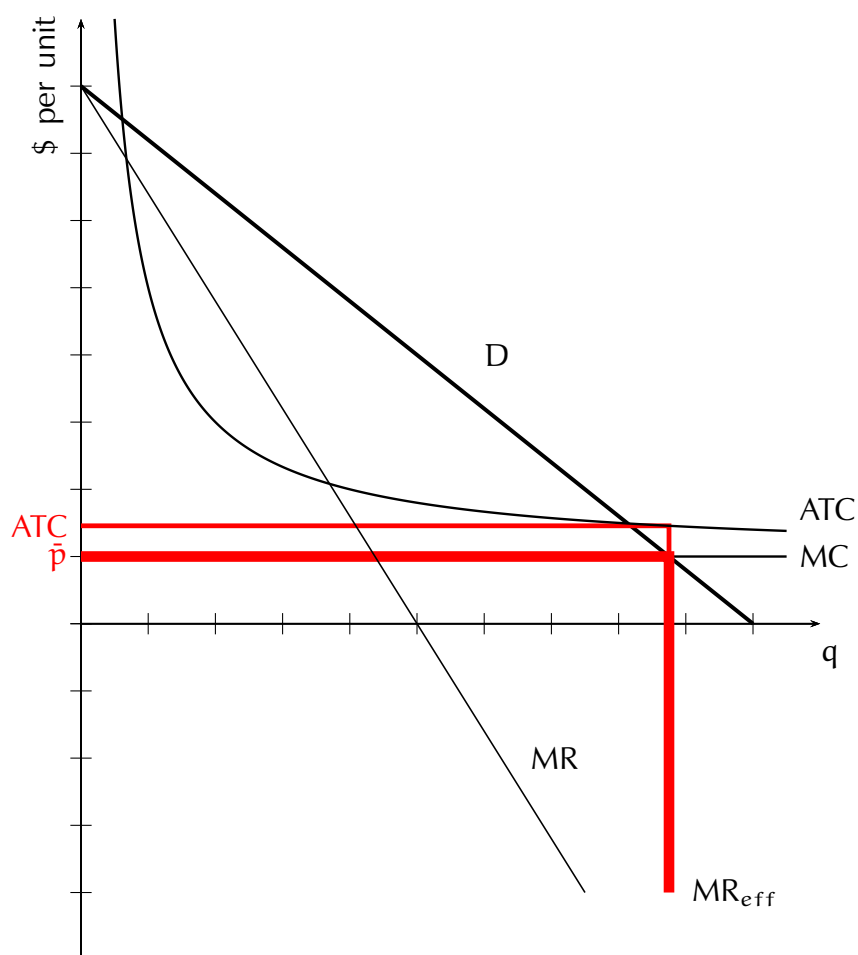
- **Ineffective Price Ceiling.** The price ceiling is above the monopoly price. The monopolist responds by maximizing profit as usual—producing q_M and changing price p_M . We will not consider it further.
- **High Price Ceiling.** Here the price ceiling is below the monopoly price but above the efficient price. The monopolist responds by choosing the quantity determined by the intersection of marginal cost and the vertical part of the effective marginal revenue curve. Surprisingly, lowering the price ceiling leads to increased production. Surplus also increases as we lower the high price ceiling toward the efficient price.
- **Ideal Price Ceiling.** The price ceiling is equal to the efficient price (itself below the monopoly price). The marginal cost and effective marginal revenue intersect at the corner formed by the vertical and horizontal segments of effective marginal revenue. The monopolist responds by producing the efficient quantity and sets price according to the demand curve. The efficient quantity is produced and consumed. Total surplus is maximized here.
- **Low Price Ceiling.** The price ceiling is set below the efficient price. The monopolist responds by producing the quantity where marginal cost is equal to the ceiling price. A lower ceiling reduces production while increasing quantity demanded. Actual demand is on the demand curve, and a shortage results. Surplus falls. This gets worse as the price is reduced.

9.6.13 Optimal Price Regulation

It would appear that if we want to maximize total surplus, we should regulate the price to be at the efficient level. Aside from the practicalities of finding it, there is another potential problem.

What if we have a natural monopoly, with decreasing average total cost. The marginal cost will lie below the average total cost, meaning that the price will also be below ATC. The firm will lose money and eventually exit the industry.

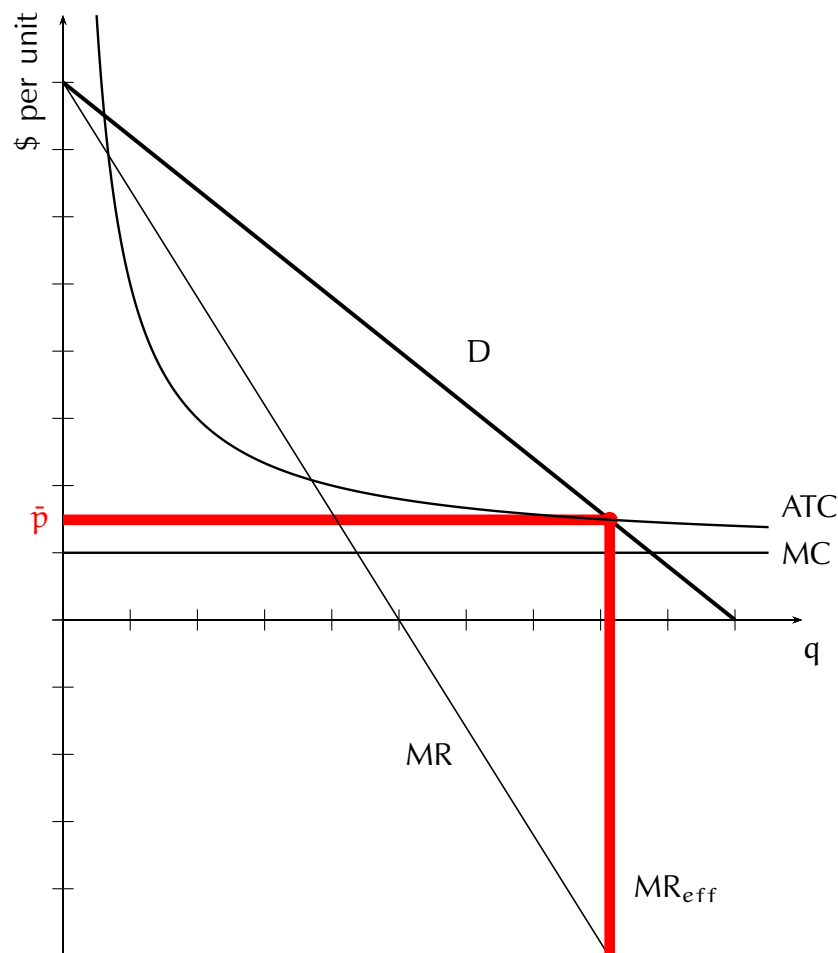
This is illustrated below.



9.6.14 Regulating Natural Monopolies

When there is a natural monopoly, the price that gives the largest surplus without putting the monopoly out of business is to use the intersection of demand and average total cost to set the price.

This doesn't attain the maximum possible total surplus, but at least we haven't driven the monopoly out of business, meaning no surplus for anyone. On the plus side, we have achieved the maximum possible long-run surplus.



9.6.15 Subsidizing and Regulating Natural Monopolies

Another possibility is to regulate the price at marginal cost. To keep the monopolist in business, the government pays a subsidy that covers the monopolist's loss, bringing the firm to earn zero economic profit.

Of course, there is an excess burden from taxation, so this would mean that total surplus is not actually at the maximum possible here either.

Other methods of paying for the subsidy will also create excess burdens.

Whatever is chosen will not get us to the maximum surplus, which at this point we have to think of as more theoretical than something that is actually possible.

10.1 Chapter 10: Market Power and Pricing Strategies

Recall our four model markets:

Chap.	Type of Market	Number of Firms	Differentiation	Barriers to Entry/Exit
✓ 8.	Perfect Competition	Many	None	None
✓ 9.	Monopoly	One	Unique	A lot
11.	Oligopoly	A Few	Maybe	Some
11.	Monopolistic Competition	Many	Yes	Maybe

We've now finished studying both the perfectly competitive model (supply and demand) and have covered the basics of the monopoly model (plus a little bit). But we're not done with monopoly.

Perfectly competitive markets obey the Law of One Price. There is only one price for a good in a perfectly competitive market—the market price.

We analyzed monopoly markets as if they also obey the Law of One Price. But is it true?

10.1.1 Resale

If we have a market where firms have market power (are price-setters) and where firms can prevent or at least discourage re-sale of their products, they may be able to charge more than one price.

If consumers can easily re-sell the products they buy, it is hard to maintain price differentials. The problem is that consumers who can buy at a low price have an incentive to do so, and then turn around and sell those goods at a higher price to other consumers. This will work for them if you are charging those other consumers a higher price than the first group. Your own consumers can undercut your attempts to charge a higher price to some consumers.

When resale is too easy, it forces the monopolist to charge a single price.

10.1.2 Price Discrimination

Price Discrimination means:

- Charging different people different prices.
- Charging the same person different prices depending on how much they buy, or for when they buy it (or maybe other reasons).

An active resale market discourages price discrimination. Barriers to resale encourage it.

Generally speaking, personal services (including medical services) can't be resold. You can't get heart surgery for yourself and then resell it to another. Many other services, such as those of a personal trainer, are not transferable.

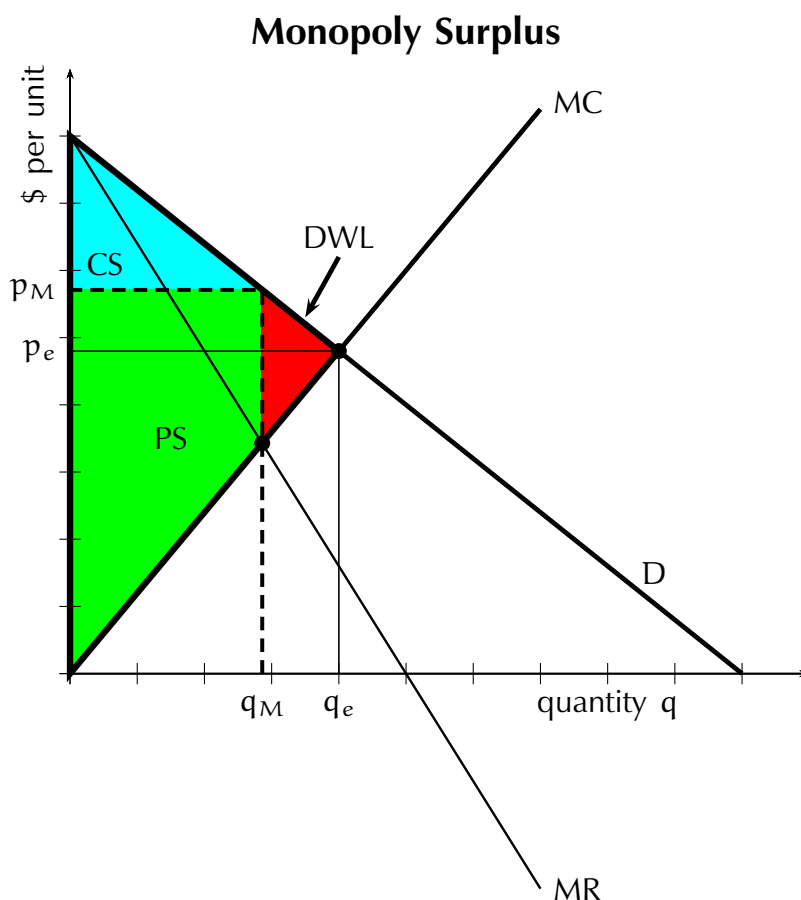
Under the current security regime, it is difficult to purchase an airline ticket for yourself and sell it to another.

In some cases, simple geographical separation serves to separate markets. The price of cameras is different in the US, UK, and Japan. The cameras are not significantly different, but the pricing can differ a lot. E.g., historically, SLR and DSLR cameras cost almost twice as much in the UK as the US.

10.1.3 Incentives for Price Discrimination

Recall that monopoly leads to a deadweight loss, shown in red on the diagram. The monopoly price is greater than marginal cost. This means there are consumers who are willing to buy at price below the current monopoly price, but above marginal cost.

If all are charged the same price, the monopolist can't cut price for just this individual, but must do so for all. However, if price discrimination is possible, there is an opportunity for extra profit by selling to this new customer at a lower price than you sell to existing customers.



10.1.4 Types of Pricing Strategies

We will examine the following pricing strategies. All but the first two, which we've already done, involve price discrimination.

1. $P = MC$ (price taking firm, perfect competition)
2. Standard Monopoly Pricing: $MR = MC$, Demand determines p
3. Block Pricing (quantity discounts, where the seller determines quantities)
4. Two-part Tariff (e.g., utility pricing with a charge for being connected, and another charge based on usage)
5. Quantity Discounts
6. Versioning (e.g., Tesla features that you pay extra to turn on)
7. Coupons
8. Bundling (e.g., cable TV)
9. Segmenting (separating the market into two or more markets)
10. Perfect Price Discrimination

10.1.5 Organizing the Pricing Strategies

We can organize the pricing strategies by asking a series of questions. If the answer is yes, we go to the next question. If no, we use the options given

1. Does the firm have market power? If not, they are a perfect competitor (case 1). See Chapter 8.
2. Can the firm prevent, or at discourage, resale? If not, they are a single-priced monopolist (case 2), studied in Chapter 9.
3. Do consumer demands differ? If not, they can try advanced pricing strategies such as block pricing (case 3) or a two-part tariff (case 4).
4. Can the firm identify consumer demands prior to purchase? If not, they can try indirect (2nd degree) price discrimination. Options include quantity discounts (case 5), versioning (case 6), coupons (case 7), and bundling (case 8).
5. Does the firm have complete information about every consumer's demand? If not, market segmentation (3rd degree price discrimination) is possible.
6. If all the answers are yes, perfect (1st degree) price discrimination is possible.

10.1.6 Perfect Price Discrimination: Pricing Schedule

The ability to practice perfect price discrimination requires

1. Market Power
 2. No Resale
 3. Perfect knowledge of every consumer's demand curve
-

The last requirement is usually impossible to meet. We'll say more about how we might try to gain that knowledge later. Perfect price discrimination is more of a benchmark than something we see in reality.

10.1.7 Setting the Perfect Pricing Schedules

When we first studied consumer's surplus, we interpreted the demand curve as telling us how much a consumer is willing to pay for each unit they purchase. The perfect price discriminator uses that information to construct custom price schedules for each consumer.

Here's a table that shows how much each consumer is willing to pay for the first unit, the second unit, the third unit, etc. That is the price our perfect price discriminator will charge them! Notice how each person gets a different price for each unit they buy. That too is price discrimination.

Name	1st	2nd	3rd	4th	5th	6th	...
John	20	18	15	10	6.50	3	...
Paul	40	27	25	12	5	2.50	...
George	75	30	25	10	8	3	...
Ringo	15	12	8	6	2.50	1	...

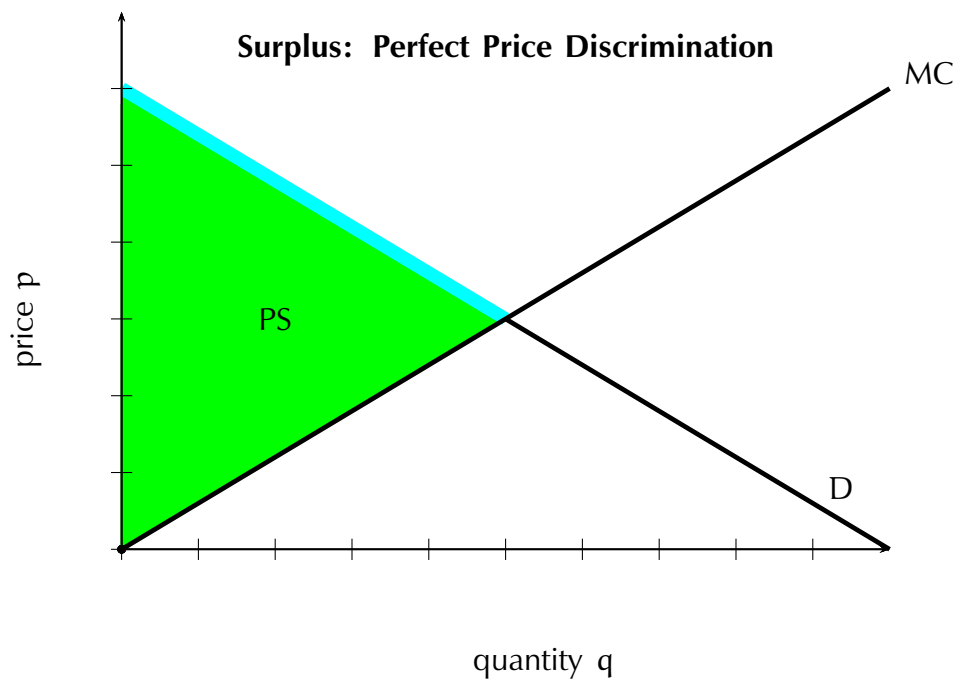
In practice, taking the whole surplus might discourage customers from buying, so the monopolist would actually charge slightly less than this.

10.1.8 Surplus with Perfect Price Discrimination

With such pricing schemes, the monopolist manages to capture almost exactly what the consumers are willing to pay. The monopolist marginal revenue for a given unit is the willingness to pay of the consumer who buys it. Each consumer pays their marginal value (demand price) for each unit, so marginal revenue for each unit is its marginal revenue.

The surplus looks something like this. Virtually all of the surplus goes to the monopolist. The light blue fringe indicates that a small amount of surplus is given to consumers to ensure they will buy.

The perfect price discriminating monopolist produces the fully efficient quantity, and captures virtually all of the surplus.



10.2 Auctions

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The problem of discovering detailed information about consumers can be more easily investigated in auctions.

One type of auction involves bringing everyone together in the same room. When a bid is made, everyone knows what the bid is, and has a chance to see who made it. This is referred to as an **open auction**, where everyone is informed about the current bid.

An example of an open auction would be the auctioning of cars at the Concours d'Elegance on Amelia Island. Usually there is a reserve price. If no one bids at least the reserve, the car is not sold. The auctioneer will suggest an opening bid. Once someone bids, the auctioneer asks for a higher bid. This continues until there are no more bids. At the point, the person who made the highest bid wins. He or she gets the car in exchange for the bid amount of money.

This is a **first-price auction**, where the winner pays the highest bid to the seller. It is an **open auction**, where everyone is, or at least can be, fully informed about what has been bid. They see the bids being made, unless they show up after the bidding starts.

10.2.1 Sealed Bid Auctions

Another type of auction is a **sealed bid auction**. This is often used for government contracts. Each participant submits a single bid, traditionally in a sealed envelope. The bids are collected and examined by the auctioneer. Sealed-bid auctions are often run as first-price auctions. The auctioneer awards the item to the highest bid, and the highest bidder pays their bid for the item.

The information known by the other bidders is quite different here. In contrast with open auctions, bidders make their bids in ignorance of what other bidders have bid. The only bid that is revealed is the winner's bid, and that only occurs after all bids have been submitted.

10.2.2 Second-Price Auctions

An important variant on sealed bid auctions is a second-price sealed bid auction. It works the same way, except for the price paid. The highest bidder still wins the auction, but pays the the second highest bid for the item, rather than their own bid, which is higher.

So if the bids for a painting are \$10,000, \$15,000, and \$17,000, the winner is the person who bid \$17,000, but they pay \$15,000 (the second highest bid) for the painting.

William Vickery (1914-1996), who won the Nobel Prize in 1996, just 3 days before his death, found that second-price sealed bid auctions have an interesting property. They give every bidder an incentive to truthfully report how much the item is worth to them.

This doesn't happen in first-price auctions, where bidders try to bid just enough to secure the item, but not too much as they don't want to overpay. In a sealed bid first-price auction, the winner may even pay less than the second-highest valuation, who is also bidding less than his true valuation.

10.2.3 Incentives in Second Price Sealed Bid Auctions

So how do the incentives work? You don't know what the other participants have bid. Suppose the item is worth \$10,000 to you, but you bid \$5,000. Whether you win the item depends on what the other people bid.

If someone bids more than \$5,000, you lose and get nothing. If the winning bid was \$8,000, you could have gained by bidding truthfully that it was worth \$10,000. In that case you would have won, and paid \$8,000, for a net gain of \$2,000. Any time you underbid, there's a possibility of losing out this way.

What if no one bid more than your \$5,000? If the highest other bid was \$4,500, you win and pay \$4,500, for a gain of \$5,500. Had you bid \$10,000, you would also win and pay \$4,500, gaining \$5,500 in value. Underbidding will not help you here.

Worse, if someone bid \$7,000, your bid of \$5,000 would lose, and you would have forfeited a gain of \$3,000.

Underbidding will never gain anything, and might cost you, so you don't want to underbid.

Of course, an overbid could force you to pay too much, so you don't want to overbid. The only bid that gives you the maximum gain in all circumstances is to bid truthfully that the item is worth \$10,000.

10.2.4 Second Price Sealed Bid Auctions

The result is that in second-price sealed bid auctions, it is a best response for everyone to bid their true value. In Nash equilibrium, everyone bids their true value. In equilibrium, the person who values the item the most will win it, and pay the second highest bid. The winner gets a surplus (which may be modest, depending on the competitor's bids). The seller has had to give up the chance of receiving the full value of the item, settling for the second-higher bid.

Getting the bidders to reveal their true values has come at a cost. You can't collect the highest value, only the second highest.

10.2.5 Lessons for Demand Revelation

Economists have also concocted schemes for getting consumers to reveal their full demand curves. The method used is similar to the second-price auction, but much more complex. Getting that much information is also much more expensive, and if the monopolist tries it, they likely will not end up with the full surplus, and may even have to pay out so much that they make a loss!

The bottom line is that perfect price discrimination is not attainable. It only serves as a theoretical benchmark.

10.2.6 Pricing Strategy Update

1. ✓ $P = MC$ (price taking firm, perfect competition) (chapter 8)
2. ✓ Monopoly Pricing: $MR = MC$, Demand determines p (chapter 9)
3. Block Pricing
4. Two-part Tariff
5. Quantity Discounts
6. Versioning
7. Coupons
8. Bundling
9. Segmenting
10. ✓ Perfect Price Discrimination (just done)

10.3 Segmenting a Market

The ability to segment markets—divide them into two or more pieces—requires

1. Market Power
 2. No Resale
 3. Knowledge of market demand for two or more groups of consumers who can be identified prior to purchase.
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The information demands to segment markets are substantially lower than for perfect price discrimination. Segmentation does not require individual demand curves, merely market demand for at least two groups.

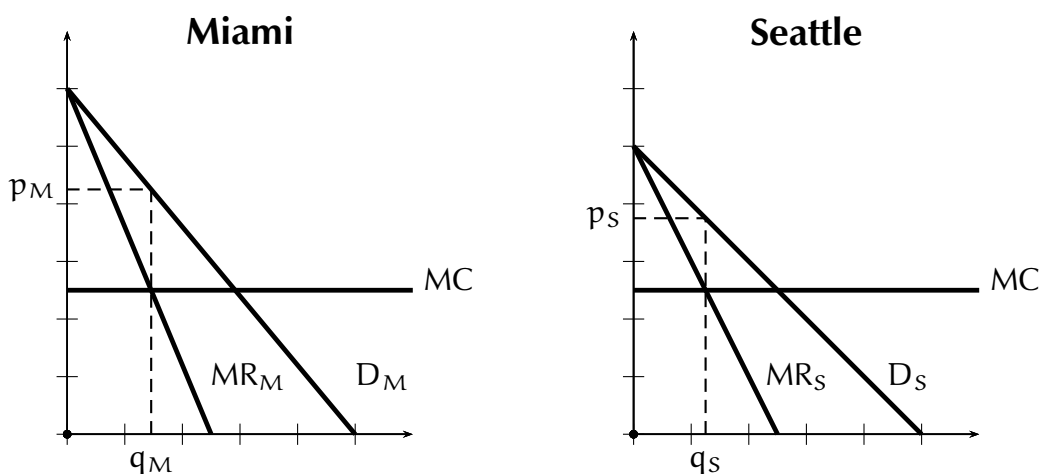
There are many ways to segment markets. One of the simplest happens automatically. Markets can be segmented by location. If you know that demand for your product is different in New York City than it is in Miami, and know what demand is in each market, you can profitably segment them. In other words, by charging different prices in the two markets, you can increase your profit.

There are other ways to segment markets, including: age, student status, group membership (AARP members, veterans, etc.). Markets can also be segmented based on purchase history or time of purchase. Airlines often segment markets based on whether your trip spans the weekend.

10.3.1 Pricing Segmented Markets

Suppose we have demand curve D_M in Miami and D_S in Seattle. That gives us two different marginal revenue curves, MR_M and MR_S . Suppose marginal cost is constant at c . Then we set $MR_M(q_M) = c$ and $MR_S(q_S) = c$ to determine the quantities to sell in each market, and use demand to find the prices.

Segmented Markets



Since the profit maximizing prices are different in each market, profit is higher than it would be if both had the same price. Here $p_M = 4.24$ while $p_S = 3.75$.

10.3.2 Pricing Segmented Markets: Elasticity

We can use the fact that marginal revenue and price are related by the elasticity to explore pricing in segmented markets. This time, we'll let marginal cost vary. It depends on the total quantity produced, but at the margin, it will be the same in both markets.

Then

$$MC = MR = p \left(1 + \frac{1}{e_d} \right)$$

Let e_d^1 and e_d^2 be the elasticities in the two markets. Then

$$p_1 \left(1 + \frac{1}{e_d^1} \right) = MC = p_2 \left(1 + \frac{1}{e_d^2} \right),$$

so

$$\frac{p_1}{p_2} = \frac{1 + \frac{1}{e_d^2}}{1 + \frac{1}{e_d^1}}$$

10.3.3 Comparison of Segmented Markets

If $e_d^1 = -2$ and $e_d^2 = -4$, we have

$$\frac{p_1}{p_2} = \frac{1 - \frac{1}{4}}{1 - \frac{1}{2}} = \frac{3/4}{1/2} = \frac{3}{4} \cdot \frac{2}{1} = \frac{3}{2},$$

so

$$p_1 = \frac{3}{2}p_2.$$

The price of good one is 50% higher than the price of good two.

The fact that demand is less elastic in market one allowed the monopolist to charge a higher price there.

10.3.4 Comparison of Segmented Markets: The Role of Elasticity

In general, suppose we segment markets 1 and 2, and that the price in market 1 is larger: $p_1 \geq p_2$. Now apply the elasticity formula to find that

$$\begin{aligned}
 1 &\leq \frac{p_1}{p_2} = \frac{1 + 1/e_d^2}{1 + 1/e_d^1} \\
 \Leftrightarrow &\frac{1 + 1/e_d^2}{1 + 1/e_d^1} \geq 1 \\
 \Leftrightarrow &1 + \frac{1}{e_d^2} \geq 1 + \frac{1}{e_d^1} \\
 \Leftrightarrow &\frac{1}{e_d^2} \geq \frac{1}{e_d^1} \\
 \Leftrightarrow &e_d^1 \geq e_d^2 \\
 \Leftrightarrow &|e_d^2| \geq |e_d^1|.
 \end{aligned}$$

To get the next to last line, we multiplied by $e_d^1 e_d^2$ which is positive, and preserves the order of inequality. In the last line we multiply by -1 , flipping the inequality.

If $p_1 \geq p_2$, the demand for good one is less elastic than the demand for good two.

If there are many markets that are segmented, the prices will still line up according to elasticity of demand in each of the markets.

10.3.5 Pricing Strategy Update

1. ✓ $P = MC$ (price taking firm, perfect competition) (chapter 8)
2. ✓ Monopoly Pricing: $MR = MC$, Demand determines p (chapter 9)
3. Block Pricing
4. Two-part Tariff
5. Quantity Discounts
6. Versioning
7. Coupons
8. Bundling
9. ✓ Segmenting
10. ✓ Perfect Price Discrimination (just done)

10.4 Indirect (2nd Degree) Price Discrimination

Indirect price discrimination can be tried in markets with:

1. Market Power
 2. No Resale
 3. Consumer's demand cannot be identified prior to purchase.
-

In this case, a firm needs a pricing schedule that separates the different types of consumers from one another. If there are two types, the pricing schedule needs to give incentives for one type to voluntarily pay a higher price, while the other group chooses to pay a lower price.

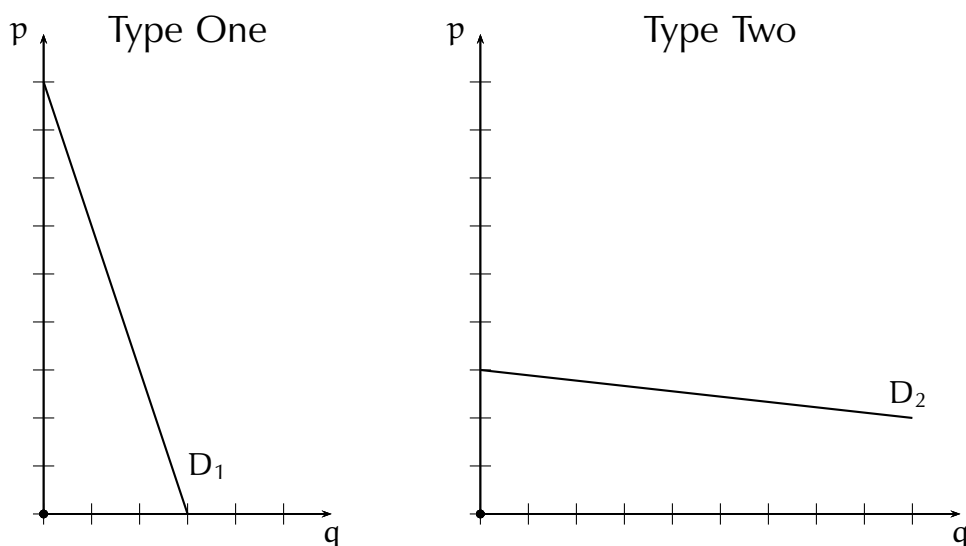
This usually involves offering a low price to those who will buy a lot, and a high price to those who will buy only a little. One way get the consumers to sort themselves into groups is to require a minimum purchase for those who get the low price. Some consumers may then prefer to buy a little at a high price on the ground that is is cheaper than buying a lot at a low price.

Three methods that can sometimes accomplish this are quantity discounts (case 5), versioning (case 6), and coupons (case 7).

10.4.1 Quantity Discounts

One case where quantity discounts are useful is when we have one type of consumer who values small amounts of a product highly, but has little use for large quantities. This is illustrated on the left. A second type of consumer will not pay a high price for the product, but would like to buy a lot of it. This is illustrated on the right.

Quantity Discounts



10.4.2 Incentive Compatibility

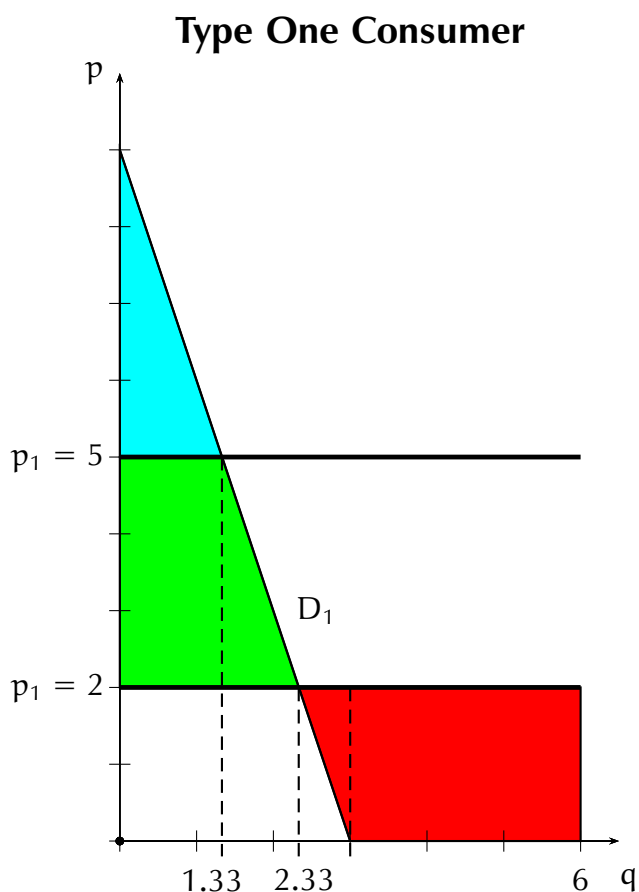
We want to get the type one consumers (high-value, low-quantity) to pay a high price, and the type two consumers (low-value, high quantity) to pay a low price and buy a lot. To get them to do this voluntarily, we need a price scheme that is **incentive compatible**. That is, it gives type one consumers an incentive to pay a lot, and type two consumers an incentive to buy a lot.

Suppose we set the price at $p_1 = \$5$, and offer a discounted price of $p_2 = \$2$ if you buy more than 6 units.

10.4.3 Incentive Compatibility: Type One

Let's consider the type one consumers first. At $p_1 = 5$, they buy $q_1 = 1.33$, obtaining consumer's surplus marked in light blue. At $p_2 = 2$, they would like to buy 3 units, but end up having to buy 6. This adds the green area to their surplus, but subtracts the red area.

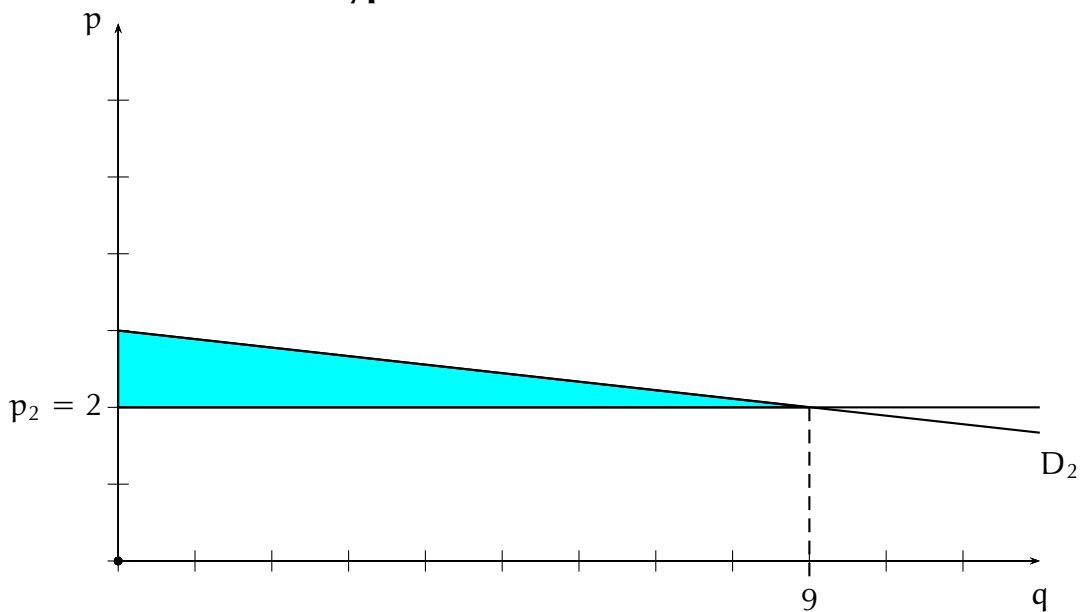
The green area is $4 + \frac{1}{2}(3)(1) = 5.5$ and the red area is $6 + \frac{1}{2}(2/3)(2) = 6.67$. Type one consumers will lose \$1.17 of surplus if they take the discount. It is better for them to pay the high price.



10.4.4 Incentive Compatibility: Type Two

We now consider the type two consumers. The higher price, $p_1 = 5$ is above their choke price of \$3. They will only buy this product on discount. At $p_2 = \$2$, type two consumers want to buy 9 units of the product, easily exceeding the minimum purchase requirement of 6 units for the discounted price. Their consumer's surplus from buying 9 units at \$2 each is shown in light blue. It is better for them to buy 9 units.

Type Two Consumer



November 3, 2022