Chapter 9: Monopoly and Imperfect Competition

A. Total revenue and marginal revenue

Definition:

total revenue = total amount received from selling product

Definition:

total revenue = total amount received from selling product

P = price of product

Q = number of units sold

PQ = total revenue

Definition:

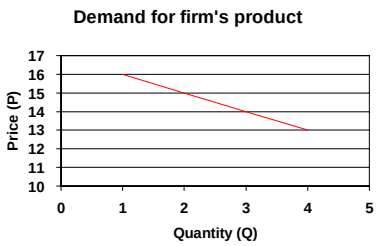
marginal revenue = amount received from selling one more unit of product

Definition:

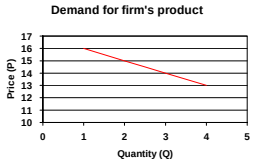
marginal revenue = amount received from selling one more unit of product

$\frac{\Delta(PQ)}{\Delta Q}$ or $\frac{d(PQ)}{dQ}$

Firm with downward-sloping demand curve

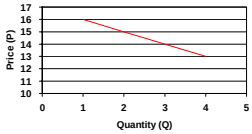


Example: Firm with downward-sloping demand curve



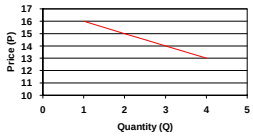
Q	P		
1	16		
2	15		
3	14		
4	13		

Example: Firm with downward-sloping demand curve



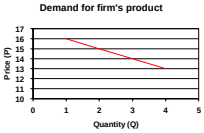
Q	P	TR	
1	16	16	
2	15	30	
3	14	42	
4	13	52	

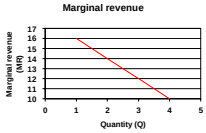
Example: Firm with downward-sloping demand curve



Q	P	TR	MR
1	16	16	16
2	15	30	14
3	14	42	12
4	13	52	10

Example: Firm with downward-sloping demand curve





Q	P	TR	MR
1	16	16	16
2	15	30	14
3	14	42	12
4	13	52	10

Note: MR < P

Reason: more quantity means lower price

Special case: linear demand curve

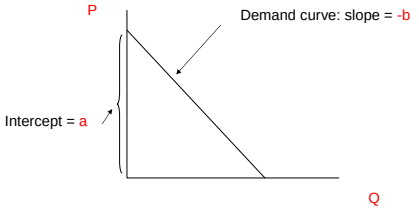
$P = a + bQ$

a is the intercept

$-b$ is the slope

Special case: linear demand curve

Demand for firm's product: P = a - bQ



$P = a + bQ$

total revenue:

$PQ = (a - bQ)Q$

$= aQ - bQ^2$

marginal revenue:

$$\frac{d(PQ)}{dQ} = a - 2bQ$$

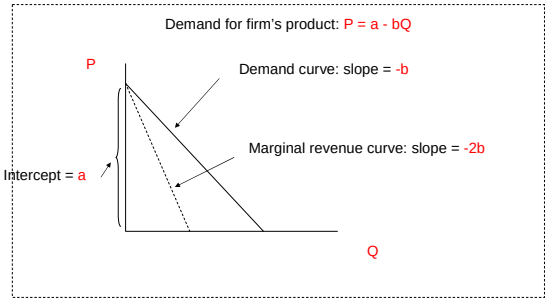
Marginal revenue:

$a - 2bQ$

This is equation of a line where

a is the intercept

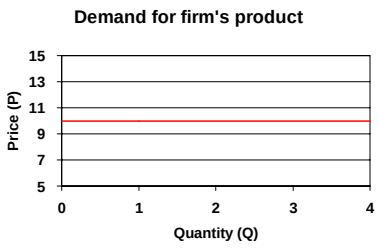
$-2b$ is the slope



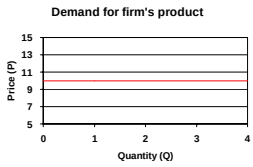
Chapter 9: Monopoly and Imperfect Competition

A. Total revenue and marginal revenue
B. Marginal revenue for a perfectly competitive firm

Extreme case: Firm with perfectly elastic demand curve

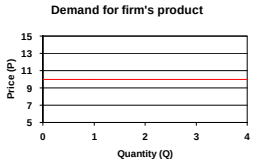


Extreme case: Firm with perfectly elastic demand curve



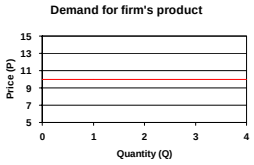
Q	P	TR	MR
1	10		
2	10		
3	10		
4	10		

Extreme case: Firm with perfectly elastic demand curve



Q	P	TR	MR
1	10	10	
2	10	20	
3	10	30	
4	10	40	

Extreme case: Firm with perfectly elastic demand curve



Q	P	TR	MR
1	10	10	10
2	10	20	10
3	10	30	10
4	10	40	10

Conclusion: if demand is perfectly elastic, then MR = P

If demand is less than perfectly elastic, then MR < P

Question: but don't demand curves always slope down (i.e., always less than perfectly elastic)?

Answer: yes, but it's a question of degree

Key issue: how much of market does each firm control?

Chapter 9: Monopoly and Imperfect Competition

A. Total revenue and marginal revenue
B. Marginal revenue for a perfectly competitive firm
C. The difference between individual firm's demand curve and market demand curve

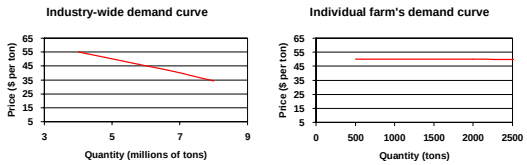
Consider entire U.S. market for tomatoes

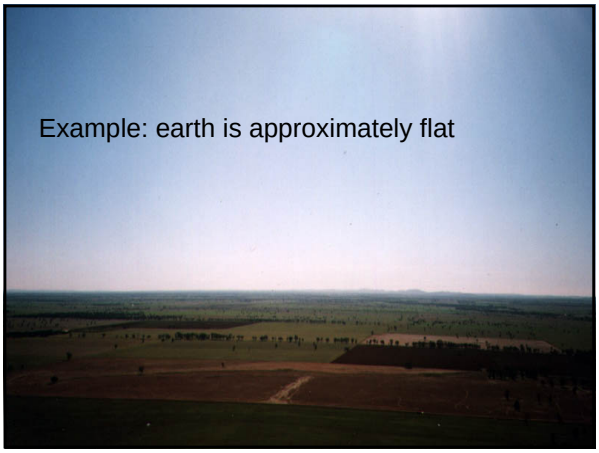
- More than five million tons produced each year
- Sell wholesale around $50/ton
- Suppose demand has elasticity of -1
- Means 10% increase in U.S. production (500,000 more tons) would lower price by 10% (from $50 to $45)

Consider individual tomato farm

- Produces 1,000 tons per year
- 10% increase in one farm's production is 100 tons
- This is 1/50,000 = 0.002 % of U.S. market
- U.S. price would drop 0.002% (from $50/ton to $49.99/ton)

Comparison of industry-wide demand curve with individual producer's demand curve



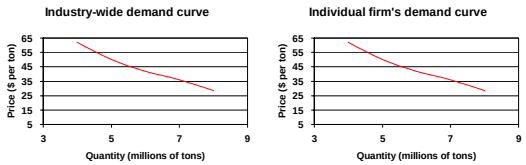


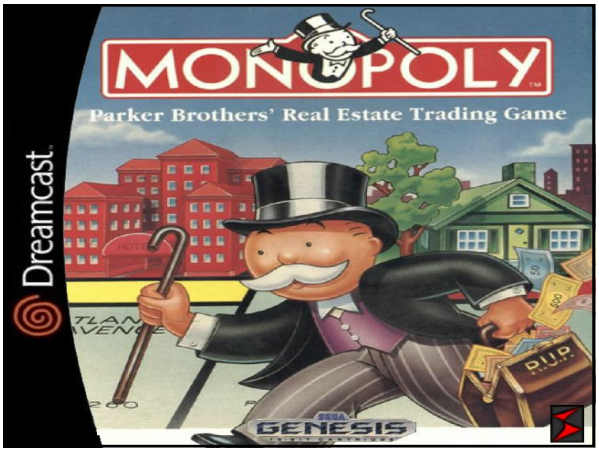
Perfect competition: firm for all practical purposes ignores any potential effect of its actions on the market price

- Represent as: perfectly elastic demand curve
- Justification: this firm is a very small part of the total market

- Imperfect competition: firm takes into account the effect of its actions on price
- Monopoly: firm is the only seller in the entire market

Comparison of industry-wide and individual producer's demand curve when there is a monopoly





Chapter 9: Monopoly and Imperfect Competition

A. Total revenue and marginal revenue
B. Marginal revenue for a perfectly competitive firm
C. The difference between individual firm's demand curve and market demand curve
D. Total cost and marginal cost

Definition:

total cost = total expenses firm would incur in order to produce quantity Q

marginal cost = additional cost of producing one more unit

$$\frac{\Delta(TC)}{\Delta Q} \text{ or } \frac{d(TC)}{dQ}$$

Q	Total cost	
1	4	
2	10	
3	18	
4	28	
5	40	
6	54	

Q	Total cost	Marginal cost
1	4	4
2	10	6
3	18	8
4	28	10
5	40	12
6	54	14

Chapter 9: Monopoly and Imperfect Competition

A. Total revenue and marginal revenue
B. Marginal revenue for a perfectly competitive firm
C. The difference between individual firm's demand curve and market demand curve
D. Total cost and marginal cost
E. Profit maximization

Proposition: any firm maximizes profit by setting marginal revenue equal to marginal cost

First method of proof: calculus

TR = total revenue

TC = total cost

$TR - TC$ = profit

Firm maximizes profit by finding derivative of profit with respect to Q and setting it to zero

$$\frac{d(TR - TC)}{dQ} = 0$$

requires

$$\frac{d(TR)}{dQ} = \frac{d(TC)}{dQ}$$

or marginal revenue = marginal cost

Second method of proof: intuition

Suppose the firm wasn't following our advice, and operated at a level where MR > MC

Then if it produced one more unit:

- its revenues would go up by MR
- its costs would go up by MC
- if MR > MC, its revenues would go up by more than its costs if it produced one more unit
- Conclusion: if MR > MC, firm can increase profits by producing one more unit

Or, suppose instead the firm wasn't following our advice, and operated at a level where MR < MC

Then if it produced one less unit:

- its revenues would go down by MR (bad)
- its costs would go down by MC (good)
- if MR < MC, its cost savings more than make up for lost revenue
- Conclusion: if MR < MC, firm can increase profits by producing one less unit

Combined implication: firm is only maximizing profits if it sets MR = MC

Any firm will try to set MR = MC

- For a perfectly competitive firm, MR = P
- Therefore, a perfectly competitive firm will set P = MC
- That is, it will choose a level of production at which the marginal cost of producing one more unit is equal to the price

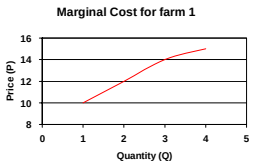
Any firm will try to set MR = MC

- For an imperfectly competitive firm or monopolist, MR < P
- Therefore, an imperfectly competitive firm will set MC < P
- That is, it will choose a level of production at which the marginal cost of producing one more unit is less than the price

Chapter 9: Monopoly and Imperfect Competition

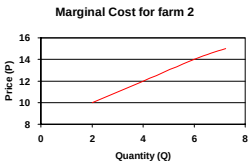
E. Profit maximization
F. Price and output under perfect competition

Supply decisions for farm 1



If P = 10, farm 1 produces 1 unit
If P = 12, farm 1 produces 2 units
If P = 14, farm 1 produces 3 units

Supply decisions for farm 2

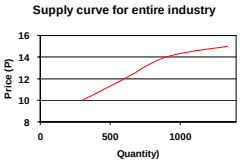


If P = 10, farm 2 produces 2 units
If P = 12, farm 2 produces 4 units
If P = 14, farm 2 produces 6 units

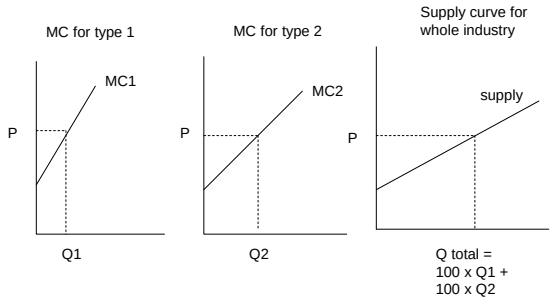
Suppose there are 100 different farms like farm 1 and 100 farms like farm 2
If P = 10, type 1 farms produce 1 unit each (100 total), type 2 farms produce 2 units each (200 units total)
So if P = 10, all farms together produce 300 units

If P = 12, type 1 farms produce 2 units each (200 total), type 2 farms produce 4 units each (400 units total)
So if P = 12, all farms together produce 600 units

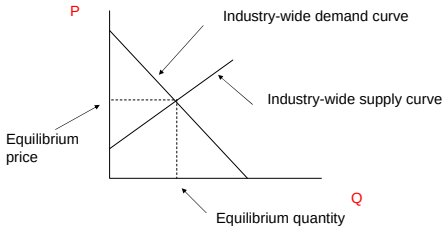
If P = 10, all farms together produce 300 units
If P = 12, all farms together produce 600 units
If P = 14, all farms together produce 900 units



Conclusion: under perfect competition, industry-wide supply curve is horizontal summation of each firm's individual marginal cost curve



Market equilibrium under perfect competition



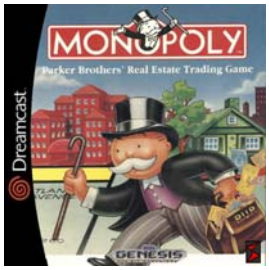
Chapter 9: Monopoly and Imperfect Competition

E. Profit maximization
F. Price and output under perfect competition
G. Price and output under monopoly

Suppose now that a single company buys up all the farms.

John D. Rockefeller set out to acquire all oil production and refining operations in the 1870's

If one single company controlled all these farms, what would the marginal cost curve for the company look like?



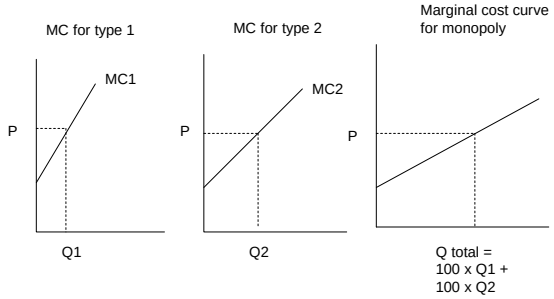
If company wants to produce 300 units, cheapest way is 1 unit from each of type 1 farms and 2 units from each of type 2 farms

(If it produced a second unit from a type 1 farm or a third unit from a type 2 farm, would cost more than $10 to produce)

This means that the marginal cost of producing 300th unit is $10

To produce 600 units, should produce 2 units on each type 1 farm and 4 units on each type 2

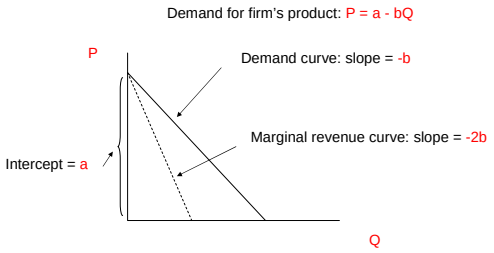
So marginal cost of producing 600th unit is $12



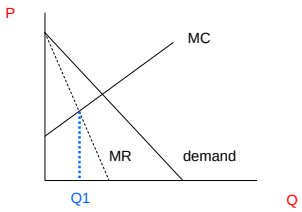
Conclusion: the marginal cost curve for the megafirm is the horizontal summation of the individual marginal cost curves for each individual farm

In other words, the marginal cost curve for the monopolist is the same as the industry-wide supply curve under perfect competition

But rather than face a relatively flat demand curve, monopolist would operate on the scale of the entire market demand

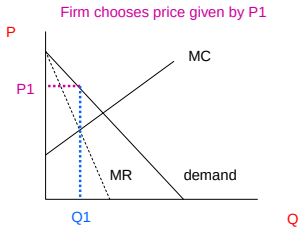


Monopolist will choose Q so that MR = MC



Firm chooses level of output given by Q1

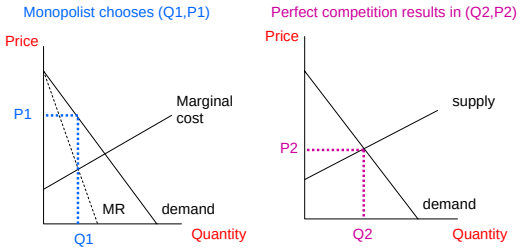
Firm will charge highest price it can

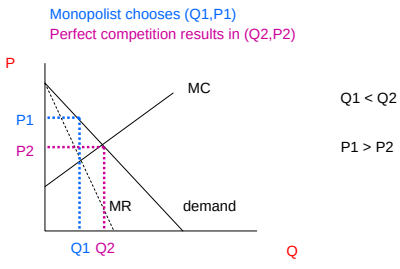


Firm chooses level of output given by Q1

Chapter 9: Monopoly and Imperfect Competition

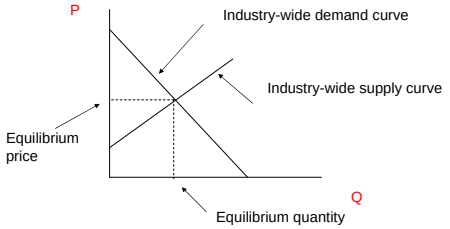
E. Profit maximization
F. Price and output under perfect competition
G. Price and output under monopoly
H. Comparison of perfect competition with monopoly



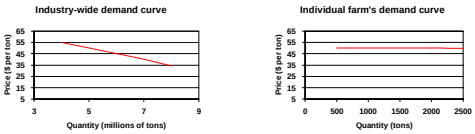


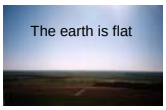
Chapter 9: Monopoly and Imperfect Competition

E. Profit maximization
   MR = MC
F. Price and output under perfect competition



Comparison of industry-wide demand curve with individual producer's demand curve





Chapter 9: Monopoly and Imperfect Competition

E. Profit maximization
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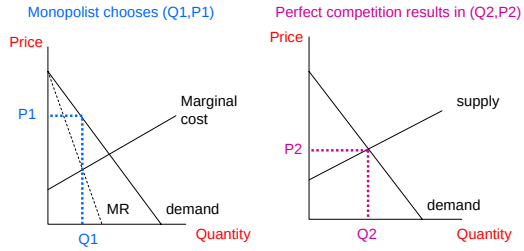
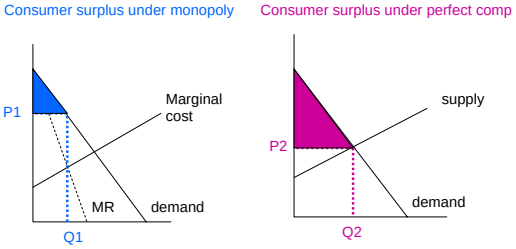
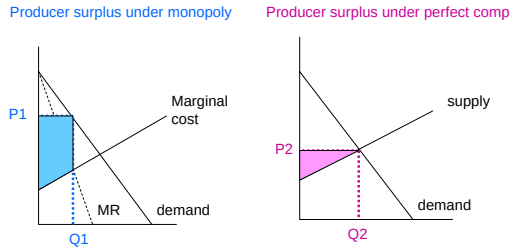


Conclusion: monopoly results in a higher price and less output being produced

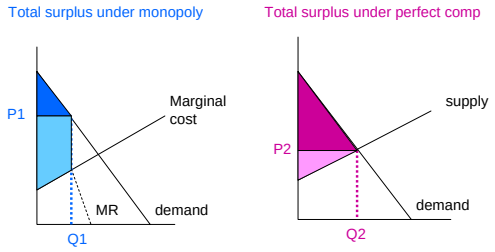
Consumers worse off under monopoly



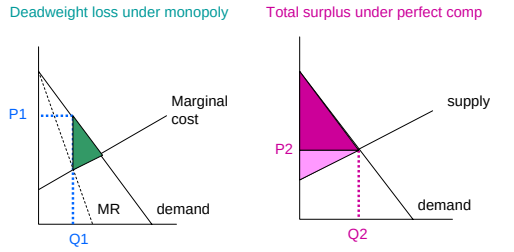
Firms better off under monopoly

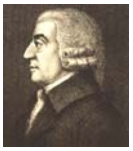


Society worse off under monopoly



Society worse off under monopoly





Adam Smith (1776):

An individual producer "neither intends to promote the public interest, nor knows how much he is promoting it ... [but is] led by an invisible hand to promote an end which was no part of his intention."

Why "invisible hand" works under perfect competition:

Marginal cost to firm from producing one more unit = resources that must be surrendered to produce the good

Marginal benefit to customer from producing one more unit is the price they're willing to pay

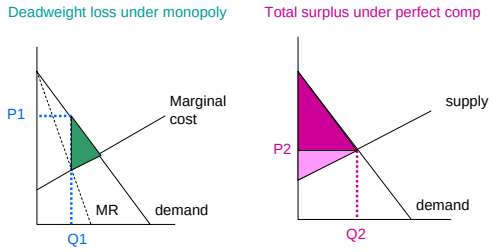
If marginal benefit to consumer (price) were greater than marginal cost of production, society would be better off producing one more unit.

Under perfect competition, marginal benefit to consumer (price) is set equal to marginal cost, and so social surplus is maximized.

Under monopoly, price (marginal benefit to consumer of getting more goods) is greater than marginal cost to society of producing one more unit.

Deadweight loss results when these desired goods don't get produced.

Deadweight loss represents goods that should be produced but aren't



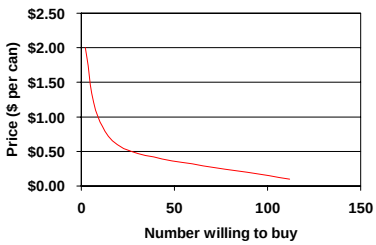
Chapter 9: Monopoly and Imperfect Competition

E. Profit maximization
F. Price and output under perfect competition
G. Price and output under monopoly
H. Comparison of perfect competition with monopoly
I. Price discrimination

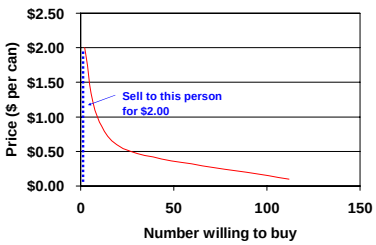
Up to this point, we assumed that monopolist had to charge all customers the same price

Price discrimination: monopolist has the power to charge different people different prices for the same product

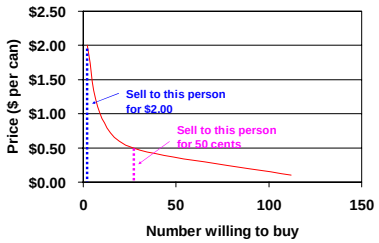
Demand for coke curve



Demand for coke curve



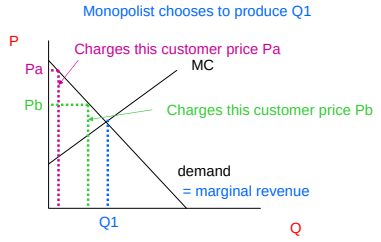
Demand for coke curve



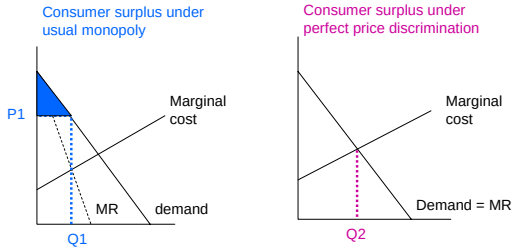
"Perfect price discrimination": monopolist can charge each customer the maximal amount that customer is willing to pay

Under perfect price discrimination, marginal revenue would be the price

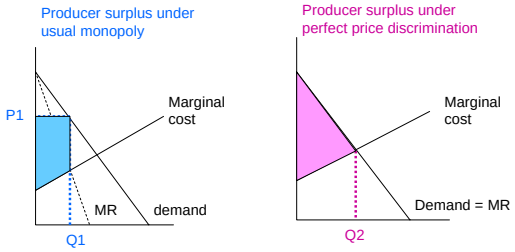
Monopolist that can discriminate perfectly



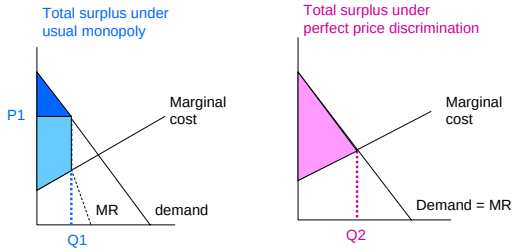
Consumers have zero surplus under perfect price discrimination



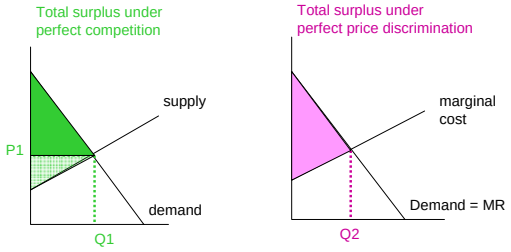
Firm is better off under perfect price discrimination



Value of benefit to firm of price discrimination exceeds loss to consumers



There is no deadweight social loss from perfect price discrimination



Price discrimination is hard to implement:

(1) It's against the law

Clayton Act of 1914:

"It shall be unlawful for any person engaged in commerce, in the course of such commerce, either directly or indirectly, to discriminate in price between different purchasers of commodities of like grade and quality"

Price discrimination is hard to implement:

(1) It's against the law

(2) All customers will try to buy at the lowest price

(3) Firm doesn't know each customer's maximal price

(4) Firm must be able to prevent resale

Many firms find ways to implement partial price discrimination anyway:

(1) Each passenger on this flight may have paid a different price

(2) Sales and promotions

You could buy coke at Ralph's for:

$3.33 a 12-pack on Jan 13 (3 for $9.99)

$3.00 for 6-pack on Jan 13 (2 for $6.00)

$3.00 for 12-pack on Jan 10

(3) Discounts for seniors, students, children, …

- ***Problem set 2: due week of Jan 23-27***
- **pages 247-248, probs #2 a-b-c, #5, #6, #7 a-e, #9 a-e**

First exam will be Thursday Feb 2 in class

Exam will only cover Chapters 7, 9 &10

Exam will have some multiple choice, some fill in the blank

Discussion sections that meet Feb 2 after the exam won't meet

Discussion sections that meet Jan 30-Feb 2 before the exam will meet

Chapter 9: Monopoly and Imperfect Competition

H. Comparison of perfect competition with monopoly

- Monopoly makes consumers worse off
- Monopoly makes producers better off
- Monopoly is inefficient

Chapter 9: Monopoly and Imperfect Competition

H. Comparison of perfect competition with monopoly

I. Price discrimination

- Consumers worse off under price discrimination than usual monopoly
- Firm better off under price discrimination than usual monopoly
- Perfect price discrimination is efficient

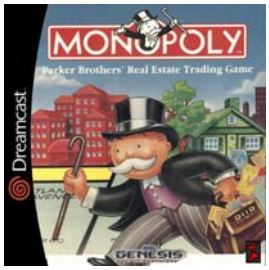
Chapter 9: Monopoly and Imperfect Competition

H. Comparison of perfect competition with monopoly

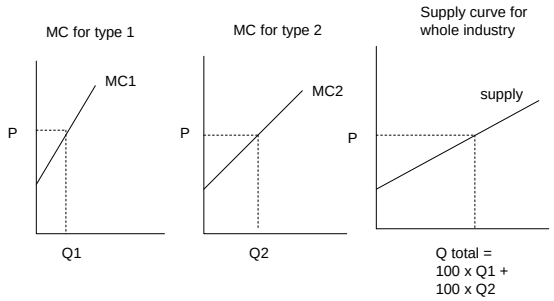
I. Price discrimination

J. Natural monopoly

We motivated our discussion by supposing that the industry started out as perfectly competitive and one company bought up all the firms



We also assumed that each individual firm's marginal cost curve sloped up, so that industry-wide supply curve was the horizontal sum of all the individual MC curves



The assumption of increasing average costs (also called decreasing returns to scale) is natural in some industries (e.g. agriculture) but not in others (e.g., petroleum refining)

Definition:

An industry in which an increase in the quantity produced leads to a decrease in average cost per unit is called a "natural monopoly"

This property is sometimes referred to as "increasing returns to scale"

Example: to refine petroleum products, there is an enormous fixed cost (build refinery) but thereafter marginal cost of additional production is roughly constant up to the capacity of the plant

Suppose you build an oil refinery for $2 billion.

Each year you will have to pay interest on the debt, taxes, maintenance, insurance, etc. of say $200 million.

This $200 million per year is a fixed cost you pay even if you produce nothing.

For each gallon of gasoline you refine, you'll need to buy more crude oil, pay for more labor, energy, …

Suppose this marginal cost of producing each additional gallon of gasoline is $1 per gallon.

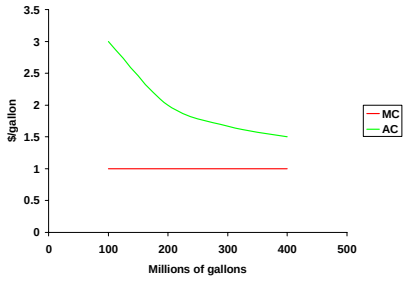
Quantity (gals/yr)	Fixed cost	Marginal cost	Total cost	Average cost
0	$200 M			
100 M	$200 M			
200 M	$200 M			
300 M	$200 M			
400 M	$200 M			

Quantity (gals/yr)	Fixed cost	Marginal cost	Total cost	Average cost
0	$200 M	$1/gal		
100 M	$200 M	$1/gal		
200 M	$200 M	$1/gal		
300 M	$200 M	$1/gal		
400 M	$200 M	$1/gal		

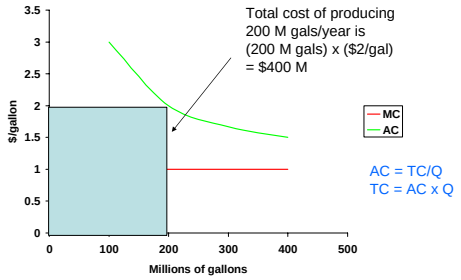
Quantity (gals/yr)	Fixed cost	Marginal cost	Total cost	Average cost
0	$200 M	$1/gal	$200 M	
100 M	$200 M	$1/gal	$300 M	
200 M	$200 M	$1/gal	$400 M	
300 M	$200 M	$1/gal	$500 M	
400 M	$200 M	$1/gal	$600 M	

Quantity (gals/yr)	Fixed cost	Marginal cost	Total cost	Average cost
0	$200 M	$1/gal	$200 M	∞
100 M	$200 M	$1/gal	$300 M	$3/gal
200 M	$200 M	$1/gal	$400 M	$2/gal
300 M	$200 M	$1/gal	$500 M	$1.67/gl
400 M	$200 M	$1/gal	$600 M	$1.50/gl

Marginal and average cost

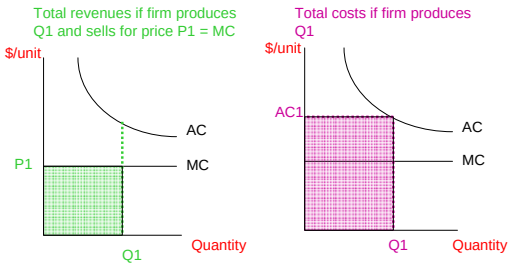


Total cost is area of rectangle

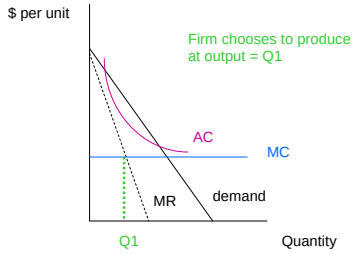


Note that if the perfect competition condition (P = MC) held in this industry, the firm would make a loss

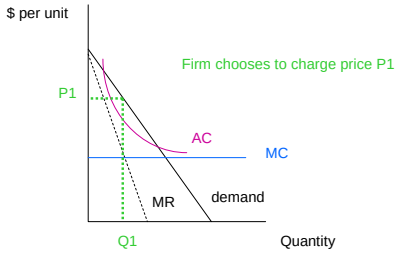
Firm would make a loss if P = MC



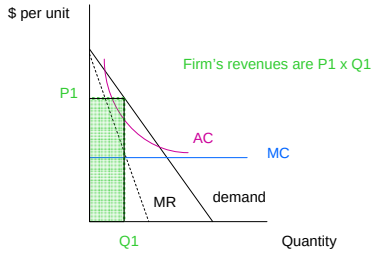
Price and output decisions for natural monopoly



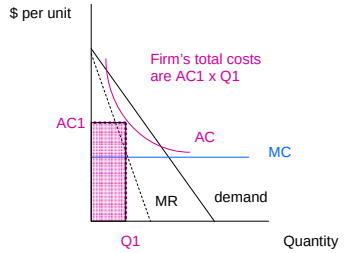
Price and output decisions for natural monopoly



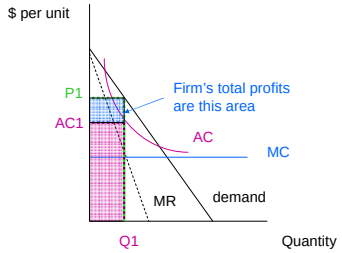
Price and output decisions for natural monopoly



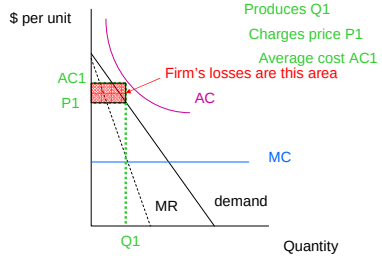
Price and output decisions for natural monopoly



Price and output decisions for natural monopoly



Even a monopolist can still make a loss



Chapter 9: Monopoly and Imperfect Competition

H. Comparison of perfect competition with monopoly
I. Price discrimination
J. Natural monopoly
K. Where do monopolies come from?
   1. Cartels or producer co-operatives

Definition:

A *cartel* is a group of producers who agree to restrict output in order to raise the price

Obstacles to running a cartel:

(1) They're illegal in the United States

Sherman Antitrust Act (1890):

"Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal. Every person who shall make any contract or engage in any combination or conspiracy hereby declared to be illegal shall be deemed guilty of a felony, and, on conviction thereof, shall be punished by fine not exceeding $10,000,000 if a corporation, or, if any other person, $350,000, or by imprisonment not exceeding three years, or by both said punishments, in the discretion of the court."

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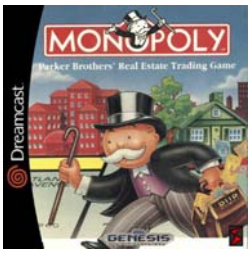
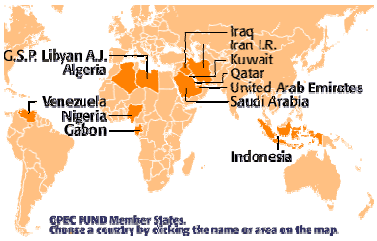
Amended to: $100 M and 10 years under H.R. 1086 (signed into law June 2004)



Prosecution of cartels is taken seriously.

OPEC: Organization of Petroleum Exporting Countries



Obstacles to running a cartel :

(1) They're illegal in the United States.

(2) Each member of a cartel has an incentive to cheat on their agreement.

Example: consider a cartel consisting of 10 countries each producing 2 million barrels of oil per day.

Marginal cost of production:

- Physical cost of added production
- Opportunity cost (oil may be worth more next year)

Suppose total marginal cost is $20/barrel and current price is $41/barrel

Suppose further that if OPEC increased production 1 million barrels per day, price would fall from $41/barrel to $40/barrel

Then the marginal revenue for OPEC as a whole from producing another million barrels per day is:

$40/b x 1 M b/day - $1/b x 20 M b/day
= $20 M /day

Marginal cost we supposed was $20/b, so additional cost of producing extra 1 M b/day is $20 M

Conclusion: MR = MC = $20 M

So for these figures, OPEC would currently be maximizing the collective profit of all its members

However, suppose one country (say Kuwait) by itself could produce an extra 1 M b/day without the other countries finding out

Kuwait's marginal revenue:

$40/b x 1 M b/day - $1/b x 2 M b/day
= $38 M /day

Kuwait's marginal cost:

$20 M/day

So Kuwait would make an extra $18 M each day by "cheating" on the rest of the cartel

Most international cartels throughout history have fallen apart after a short period from these forces.

But what about OPEC?

Many economists believe that OPEC in fact is not operating as a cartel, but is just a collection of countries each acting in its own interests.

Actual figures:

OPEC produces 30 M bl/day

Saudi Arabia alone produces 9 M bl/day

OPEC = Saudi Arabia

Chapter 9: Monopoly and Imperfect Competition

K. Where does monopoly or oligopoly come from?

1. Cartels or producer co-operatives

Problems: illegal in U.S. and incentive to cheat

2. Mergers or acquisitions

Problems with merging to create monopoly:

(1) The merger can be challenged by

U.S. Department of Justice or Federal Trade Commission

Celler-Kefauver amendment to Clayton Act (1950):

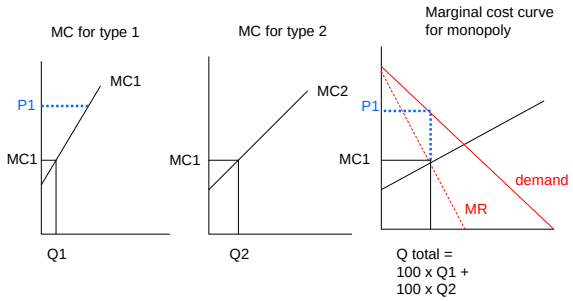
Prohibits mergers or acquisitions that would reduce competition

- 1997: FTC blocked merger of Office Depot with Staples
- 2000: U.S. Department of Justice blocked merger of WorldCom and Sprint
- 1999: FTC approved the merger of Mobil and Exxon

Problems with merging to create monopoly:

(1) The merger can be challenged by
U.S. Department of Justice or
Federal Trade Commission

(2) If you act as a monopoly, new competitors will appear



There is strong incentive for new firms to enter market

Conclusion: a successful monopoly or oligopoly requires barriers to new entry

Chapter 9: Monopoly and Imperfect Competition

K. Where does monopoly or oligopoly come from?
   1. Cartels or producer co-operatives
   2. Mergers or acquisitions
   3. High fixed costs and barriers to entry

Increasing returns to scale only hold up to the efficient scale of the plant

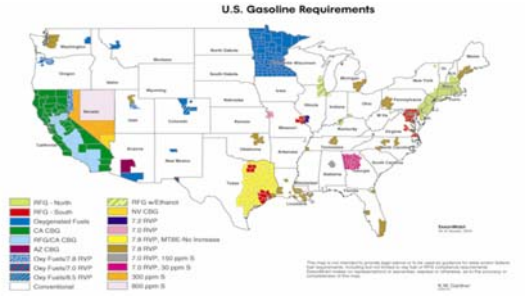
Example: there are 159 refineries in the U.S. today

However, there were 263 refineries in the U.S. in 1982

No new refineries built in last quarter century and 100 shut down

Reason: difficulties in getting new sites approved

The kind of gasoline that can be legally sold varies from county to county



Conclusion: environmental regulation can raise substantial barriers to entry and has made the U.S. gasoline industry substantially less competitive over the last 25 years

Chapter 9: Monopoly and Imperfect Competition

K. Where does monopoly or oligopoly come from?

1. Cartels or producer co-operatives
2. Mergers or acquisitions
3. High fixed costs and barriers to entry
4. Explicit government restrictions
   a. Government licenses or franchises

Yosemite Concession Services

Permits to operate a taxi

Chapter 9: Monopoly and Imperfect Competition

K. Where does monopoly or oligopoly come from?

4. Explicit government restrictions

a. Government licenses or franchises

b. Patents and copyrights

Reason for copyright or patent:

There were big fixed costs in creating book (say, $300,000)

Before book was written, "fixed costs" weren't fixed.

Before book was written, made a guess that would sell 10,000 copies

Marginal cost of writing one more book:
$300,000 "fixed cost"
+ 10,000 books x $20 "marginal cost" per book
= $500,000

Marginal revenue from one more book:

10,000 books x $60/book
= $600,000

Based on this market expectation, looked like a good deal

But if price only covered the marginal production cost of $20/book, book would never have been written

Patents and copyright:

Government intentionally creates a legal monopoly for creator of original work in order to provide incentive for the work to have been created in the first place

Lipitor (lowers cholesterol)

- 100 pills (20 milligrams) cost $290 in U.S.
- cost $201 in Canada
- Pfizer spent $7.5 billion on research this year

Downloading music from the web

Marginal cost is nearly zero

"If I had to pay I wouldn't buy it, so what's the harm?"

Suppose you'd pay 50 cents for a recording

- If you were charged $1.00, wouldn't buy it
- This would be example of deadweight loss from monopoly

Problem: if everybody could do this, what would be incentive to have produced music in the first place?

Issue: from the point of view of policy, are "fixed costs" really fixed?

Practical solution: patents and copyrights don't last forever

Chapter 9: Monopoly and Imperfect Competition

K. Where does monopoly or oligopoly come from?

4. Explicit government restrictions

5. Exclusive control over important inputs

- 63% of the world's known oil reserves are in the Middle East
- 23% of the world total are in Saudi Arabia alone

Much of the gasoline delivered to San Diego comes through a single pipeline owned by Kemper Morgan

Ability to exercise monopoly control limited by close substitutes

E.g., gasoline can be shipped from L.A. to San Diego by truck at extra cost over pipeline

Chapter 9: Monopoly and Imperfect Competition

K. Where does monopoly or oligopoly come from?

4. Explicit government restrictions

5. Exclusive control over important inputs

6. Network economies

Network economies: users receive benefits when they all are using the same product

Example: computer operating system

Here again, potential substitutes limit ability to exercise monopoly power

First exam will be Thursday Feb 2 in class
Exam will only cover Chapters 7, 9 & 10

DIRECTIONS: No calculators, books, or notes of any kind are allowed. All papers and notebooks must remain closed and on the floor at all times throughout the exam, and students are not allowed to leave the examination room until finished. Answer all questions in the space provided with the exam. 105 points are possible on this exam.

HINTS: Feel free to use either of the following formulas if you find them useful.

Area of a triangle = (1/2) (base) (height)

Area of a trapezoid = (1/2) (base1 + base2) (height)

PART I: MULTIPLE CHOICE—circle the correct answer (4 points each, 72 points total)

PART II: FILL IN THE BLANK (33 points total)—credit for correct answer only (no partial credit)

For sample problems see problem sets 1 and 2.

Reminders of study resources:

- Lecture slides available from class web page
- Your text book and its study questions
- Copies of old exams from class web page
- AS Lecture notes available for sale in Old Student Center in Revelle College