Lecture 11 - Monopoly and Market Power

ECON 3070 - Intermediate Microeconomic Theory

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November 7, 2022

Overview

Up until now, we have assumed that there are a large number of producers and consumers in the market

- Producers are assumed to have very little market power
- They are unable to individually impact the market price (price takers)
- A result of this assumption is that total welfare is maximized

Overview

In this chapter, we will look at the other extreme.

- A market where only one firm produces the good
- And that firm controls the market
- They have complete market power
- And as we will see, they set the market price so as to maximize their own profit

Monopoly Examples

DeBeers

- Controlled 80% of the diamond market by 2000.

Microsoft Windows (in 1990s)

- Accounted for over 90% of the market for operating systems.

Google

- Ruled to be a monopoly in France, providing about 90% of web searches in France.

Profit Maximization

A perfectly competitive firm maximizes profit by setting

$$MR(Q) = P = MC(Q)$$

- That is, a firm will continue producing until the revenue generated by an additional unit of the good is equal to the additional cost of producing it.

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- A monopolist will follow the same logic, except for the fact that P is not constant

Profit Maximization

For a monopoly, price has to go down as you sell more units (because of market demand):

Q (million ounces)	P ($/oz.)	TR ($ million)	TC ($ million)	Profit ($ million)
0	12	0	0	0
1	11	11.00	0.50	10.50
2	10	20.00	2.00	18.00
3	9	27.00	4.50	22.50
4	8	32.00	8.00	24.00
5	7	35.00	12.50	22.50
6	6	36.00	18.00	18.00
7	5	35.00	24.50	10.50
8	4	32.00	32.00	0
9	3	27.00	40.50	−13.50
10	2	20.00	50.00	−30.00

Profit Maximization

As the monopolist produces more, they push the price down.

- For a while, producing more leads to higher revenue (while MR is positive)
- But after a while, raising the price pushes away too many customers (when MR becomes negative)

Meanwhile, total cost is constantly increasing

Profit Maximization

The firm will keep increasing output until the additional revenue generated by the last unit is equal to the additional cost incurred in it's production.

That is, until $MR(Q) = MC(Q)$

Profit Maximization

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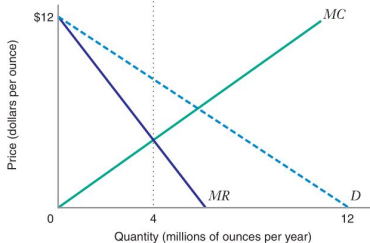
That is, until $MR(Q) = MC(Q)$

This is the **profit-maximization condition for a monopolist**.

Profit Maximization
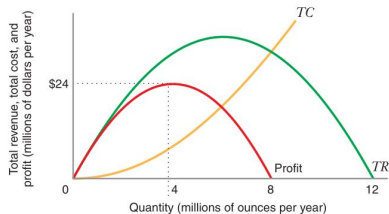
(a)

(b)

- Total Revenue is no longer linear (since you have to lower price to sell more units)
- The maximizing profit is when $MR(Q) = MC(Q)$

If the monopolist is producing where marginal revenue exceeds marginal cost, then the monopolist should _____ to maximize profits.

A) produce more

B) produce less

C) stop producing

D) raise the price
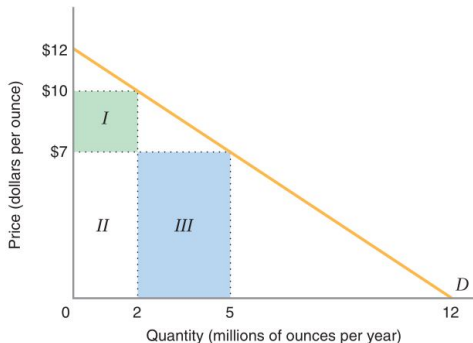
Marginal Revenue Review

For a perfectly competitive firm, *marginal revenue equals the market price*

- If a P.C. firm sells an additional unit, the price does not change, so $MR(Q) = P$

For a monopolist, the relationship does not hold

- In order to sell more units, the monopolist must lower the price on all units
- Their revenue increases by the market price P, but falls by a small amount for every unit they were previously selling.

Marginal Revenue

Original Revenue: I + II

New Revenue: II + III

- Revenue grows because you sell 3 more units (+ III)
- Revenue shrinks because you sell the original 2 units for a lower price (- I)

Marginal Revenue

In the graph, area III represents the revenue gained from selling additional units by lowering the price

- This is called the **quantity effect**

Area I represents revenue lost on the **inframarginal units**, or the units that were previously sold at the higher price.

- This is called the **price effect**

Marginal Revenue

The price and quantity effects move marginal revenue in opposite directions:

- Quantity effect (area III) = Price $\times$ change in quantity = $P\Delta Q$
- Price effect (area I) = Quantity $\times$ change in price = $Q\Delta P$

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The change in total revenue is given by:

$$\Delta TR = \text{Price effect} + \text{Quantity Effect} = P\Delta Q + Q\Delta P$$

Marginal Revenue

If we divide this change in total revenue by the change in quantity, we get the marginal revenue:

$$MR = \frac{\Delta TR}{\Delta Q} = \frac{P\Delta Q + Q\Delta P}{\Delta Q} = P + Q\frac{\Delta P}{\Delta Q}$$

The first part corresponds to the quantity effect

- Another unit is sold at price P

The second part is the price effect.

- The price of Q previous units falls by $\frac{\Delta P}{\Delta Q}$

Monopolist's Profit Maximization Problem

Let's show that the monopolist's profit maximizing optimality condition holds, using the tools we've seen so far.

Because a monopolist's output impacts the price, price is no longer constant, but instead a function of Q. The monopolist's problem becomes

$$\max_{Q} \pi = P(Q)Q - TC(Q),$$

where now P depends on Q

Monopolist's Profit Maximization Problem

To find the profit maximizing quantity, take the derivative w.r.t Q, and set equal to zero

$$\frac{d\pi}{dQ} = \underbrace{Q\frac{dP(Q)}{dQ} + P(Q)}_{MR(Q)} - \underbrace{\frac{dTC(Q)}{dQ}}_{MC(Q)} = 0$$

Rearranging:

$$MR(Q^*) = MC(Q^*)$$

Monopolist's Profit Maximization Problem

Example: Suppose that a monopolist faces the market demand curve $P(Q) = 40 - Q$, and total cost function $TC(Q) = Q^2$.

Remember that the monopolist's optimality condition is $MR(Q) = MC(Q)$. Let's find MR and MC.

$$\begin{aligned}
MR(Q) &= \frac{dTR(Q)}{dQ} \\
&= \frac{d}{dQ}((40 - Q) * Q) \\
&= \frac{d}{dQ}(40Q - Q^2) \\
&= 40 - 2Q
\end{aligned}$$

Monopolist's Profit Maximization Problem

Calculating marginal cost:

$$MC(Q) = \frac{\partial TC(Q)}{\partial Q} = 2Q$$

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$$40 - 2Q = 2Q \implies Q^* = 10$$

Monopolist's Profit Maximization Problem

Calculating marginal cost:

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From our optimality condition, $MR(Q) = MC(Q)$:

$$40 - 2Q = 2Q \implies Q^* = 10$$

Finally, the market price will be the price at which the firm sells exactly Q^* units:

$$P(10) = 40 - 10 = 30$$

Suppose that market demand in a given market can be written as $P(Q) = 20 - \frac{1}{3}Q^2$. What is the marginal revenue function for a monopolist in this market?

Suppose that market demand in a given market can be written as $P(Q) = 20 - \frac{1}{3}Q^2$. What is the marginal revenue function for a monopolist in this market? The firm faces a marginal cost function given by $MC(Q) = 4Q^2$, find the monopolist's profit-maximizing quantity of output.

Monopolist's Profit Maximization Problem
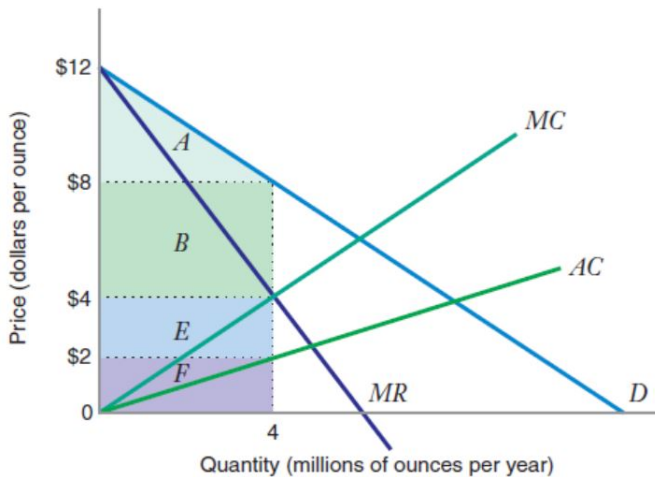
Implications

Three important points about the equilibrium:

1. The profit-maximizing price exceeds marginal cost of the last unit supplied.
2. Economic profits are not zero in the long run. **(why?)**
3. Consumers still receive some consumer surplus.

For a monopolist,

A) selling price is greater than marginal revenue.

B) selling price is equal to marginal revenue.

C) selling price is less than marginal revenue.

D) selling price may be above or below marginal revenue; it depends on the price buyers are willing to pay.

Price Elasticity of Demand and the Profit-Maximizing Price

The gap between the price that a firm charges, and their marginal cost, will depend on how sensitive consumers are to a change in price.

- If consumers are very price sensitive, the monopolist will set the price relatively low (the price effect dominates)
- If the opposite is true, the monopolist will set the price higher (the quantity effect dominates)

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Intuitively, if a firm faces more competition from an outside industry, consumers will be more price-sensitive and the monopolist's price will be lower.

Price Elasticity of Demand and the Profit-Maximizing Price
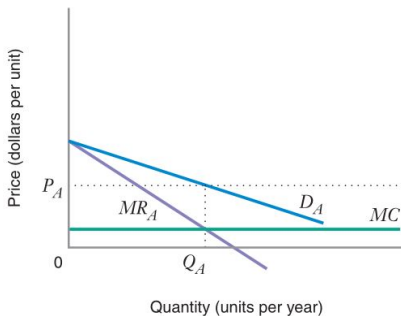
(a) Market A
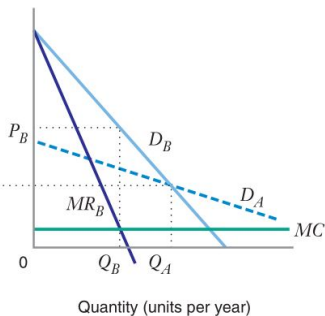
(b) Market B

Marginal Revenue and Price Elasticity of Demand

Formally, we can use the equation for marginal revenue to express the relationship between MR and price:

$$MR = P + Q\frac{\Delta P}{\Delta Q}$$
$$= P + Q\frac{\Delta P}{\Delta Q} * \frac{P}{P}$$
$$= P + P\frac{\Delta P}{\Delta Q} * \frac{Q}{P}$$
$$= P\left(1 + \frac{\Delta P}{\Delta Q} * \frac{Q}{P}\right)$$
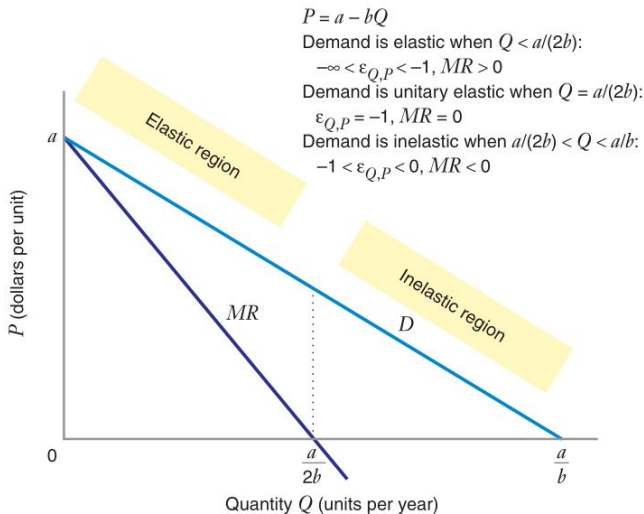
Marginal Revenue and Price Elasticity of Demand

Remember that price elasiticy of demand is given by

$$\epsilon_{Q,P} = \frac{\Delta Q}{Q} / \frac{\Delta P}{P} \text{ or } \frac{\Delta Q}{\Delta P} * \frac{P}{Q} \tag{1}$$

Therefore, marginal revenue can be expressed as

$$MR = P\left(1 + \frac{1}{\epsilon_{Q,P}}\right)$$

Marginal Revenue and Price Elasticity of Demand

$P = a - bQ$

Demand is elastic when $Q < a/(2b)$:

$-\infty < \varepsilon_{Q,P} < -1$, $MR > 0$

Demand is unitary elastic when $Q = a/(2b)$:

$\varepsilon_{Q,P} = -1$, $MR = 0$

Demand is inelastic when $a/(2b) < Q < a/b$:

$-1 < \varepsilon_{Q,P} < 0$, $MR < 0$

Elastic region

Inelastic region

a

MR

D

P (dollars per unit)

0

$\dfrac{a}{2b}$

$\dfrac{a}{b}$

Quantity Q (units per year)

Marginal Cost and Price Elasticity of Demand

Remember that, at Q^*, $MR(Q^*) = MC(Q^*)$.

We can therefore rewrite the previous equation as

$$MC(Q^*) = P\Big(1 + \frac{1}{\epsilon_{Q,P}}\Big)$$

Marginal Cost and Price Elasticity of Demand

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We can therefore rewrite the previous equation as

$$MC(Q^*) = P\Big(1 + \frac{1}{\epsilon_{Q,P}}\Big)$$

Rearranging:

$$P = MC(Q^*)\frac{1}{1 + \frac{1}{\epsilon_{Q,P}}}$$

Since $(1 + \frac{1}{\epsilon_{Q,P}}) < 1$, you will charge a price above your cost

Differentiated Products

Monopolists aren't the only firms that face a downward-sloping demand curve.

- Many firms sell products that are unique (so they do not operate in a perfectly competitive market), but they still face competitors

Think of breakfast cereals (Lucky Charms, Frosted Flakes, Cap'n Crunch).

- These firms still charge a price above their marginal cost

The Lerner Index

If a monopolist faces fewer competitors (few close substitutes), consumers will be less price sensitive and the firm's markup will be greater.

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Intuitively, we can use the firm's markup as a measure of market power.

- This is known as the **Lerner Index**.
- Firms with greater market power, and thus a higher markup, will score higher on the Lerner Index.

Inverse demand for a monopolist's product is given by $P(Q) = 300 - 6Q$ while the monopolist's marginal cost is given by $MC(Q) = 3Q$. What is the profit-maximizing quantity of output for this monopolist?

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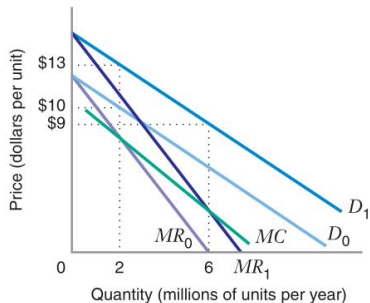
Inverse demand for a monopolist's product is given by $P(Q) = 300 - 6Q$ while the monopolist's marginal cost is given by $MC(Q) = 3Q$.

At the profit-maximizing quantity of output, what is the firm's marginal cost of the final unit produced?
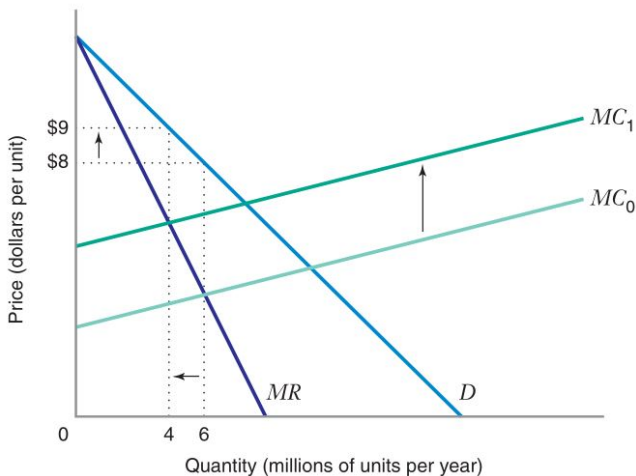
Comparative Statics: Shifts in Market Demand

(a)

(b)

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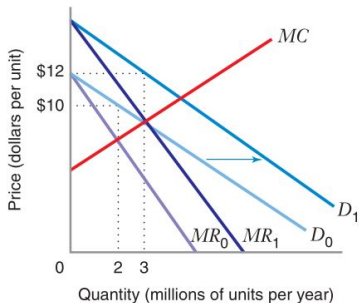
Comparative Statics: Shifts in Marginal Cost

Multi-plant Monopoly

Let's consider the case where a monopolist has two production plants.
Think of a utility company with multiple power plants.

- Each plant has a separate marginal cost; MC_1 and MC_2.
- How should the plant allocate production between the two plants?

Multi-plant Monopoly

Suppose the firm produces equal amounts at both plants:

- Because the marginal cost is different at each plant, the monopoly can produce fewer units at the higher-cost plant, and more units at the lower cost plant
- By doing so, marginal cost of the final unit is decreased and profit rises

Multi-plant Monopoly
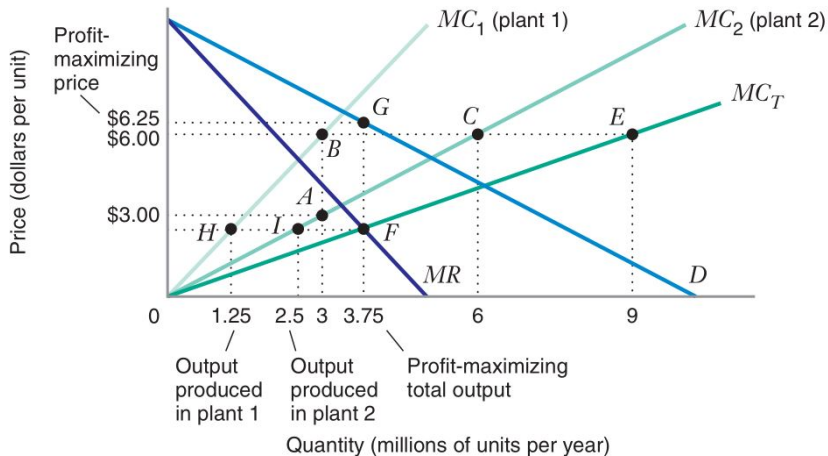
Multi-plant Monopoly

This exercise illustrates the importance of the **multi-plant marginal cost curve**

- This curve denotes the marginal cost of producing a given quantity in the lowest-cost way
- Each additional unit will be produced at the plant where the marginal cost is the lowest

So the multi-plant marginal cost curve is found by simply summing the individual MC curves horizontally

Multi-plant Monopoly

The production decision is the same a single-plant monopolist by using the multi-plant marginal cost curve

- A multi-plant monopolist can find the profit maximizing quantity by setting marginal revenue equal to the multi-plant marginal cost
- The market price is the price that will allow the firm to sell all of it's output from both plants

A monopolist owns two plants in which to produce product A. The marginal cost of producing A is increasing, but currently is lower in plant 1 than in plant 2. How should the monopolist allocate production?

A) Produce all output in plant 1.

B) Produce all output in plant 2.

C) Produce 50 percent in plant 1 and 50 percent in plant 2.

D) Produce in plant 1 up to the point where marginal costs are equated across the plants.

Profit Maximization by a Cartel

A **cartel** is a group of producers that determine the price and output in a market through **collusion**

- An example is the Organization of Petroleum Exporting Countries (OPEC)
- This was a group of some of the world's largest oil producers, including Kuwait, Saudi Arabia, Iran and Venezuela

When a cartel works as intended, it acts as a monopoly firm with multiple plants
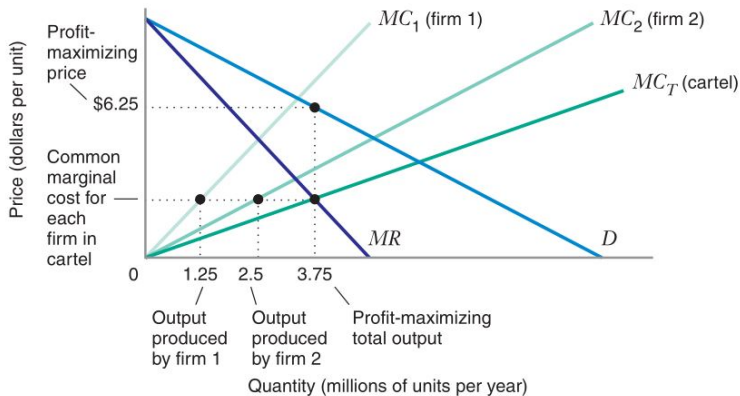
Profit Maximization by a Cartel

At the profit-maximizing solution, the cartel allocates production between the two firms such that marginal cost is equal.

For example, suppose that two firms collude.
Then for $Q^* = Q_1^* + Q_2^*$, the following should be true:

$$MR(Q^*) = MC_1(Q_1^*) \text{ and } MR(Q^*) = MC_2(Q_2^*)$$

Profit Maximization by a Cartel

Profit Maximization by a Cartel

So if cartels are so great for producers, why aren't there more of them?

Profit Maximization by a Cartel

So if cartels are so great for producers, why aren't there more of them?

- They are illegal (we will see why in a few slides).
- They are hard to keep together (one firm can lower the price and sell more units).
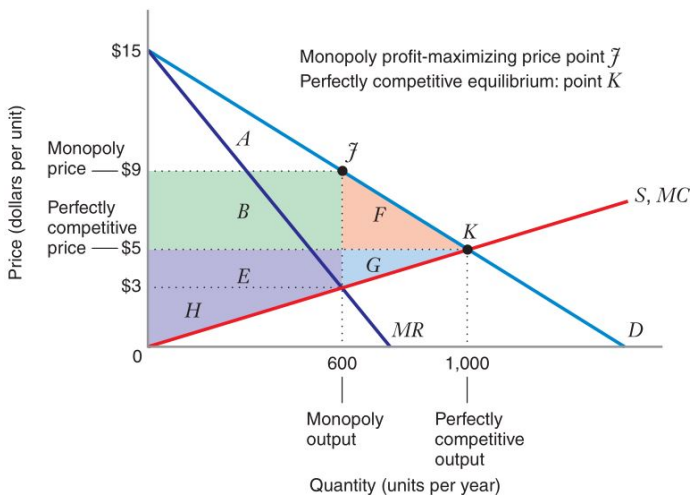
The Welfare Economics of Monopoly

Suppose a perfectly competitive industry was monopolized

- For example, one company bought all of its competitors

Then the industry supply curve would become that firm's marginal cost curve...

- And that firm would set output such that $MC(Q^*) = MR(Q^*)$
- Quantity produced would fall, and price would rise

The Welfare Economics of Monopoly

The Welfare Economics of Monopoly

G and F are the **deadweight loss due to monopoly**

- The monopolist's surplus increases by area B (but they lose G)
- Consumer surplus decreases by B and F

By raising the price and lowering output, the firm has eliminated transactions that are welfare increasing.

- That is, transactions where the marginal benefit to consumers is greater than the marginal cost to the producer

The Welfare Economics of Monopoly

This additional producer surplus encourages firms to acquire monopoly power

- Activities aimed at creating or preserving monopoly power are called **rent-seeking activities**

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For example, lobbying the government to regulate an industry in order to prevent entry (think of Uber in London)

- A firm would be willing to spend some of that additional surplus on rent-seeking activities in order to maintain its market power (through lobbying)

The Welfare Economics of Monopoly

This is why the government typically fights to keep firms from gaining too much market power.

- With some exceptions, the U.S government does not allow monopolies to exist (Microsoft, for example)
- Cartels are also illegal in the U.S.

Enforcement of this varies over time though ...

Why do Monopoly Markets Exist?

One reason may be that the total cost incurred by a single firm to produce output for the market might be lower than the combined total cost for two or more firms

An example is satellite television:

- Large up-front fixed costs (building a satellite and shooting it into space).
- One firm needs one satellite to serve the whole market.
- Two firms need two satellites.

This is known as a **natural monopoly**.

Why do Monopoly Markets Exist?

Another example is an electric company.

- Again, large up-front fixed costs (building transmission lines throughout a city)
- Would be very expensive for two firms to compete for customers in one city

Economies of scale imply it's cheaper for one firm to produce instead of two firms

Why do Monopoly Markets Exist?

A natural monopoly is an example of a **barrier to entry**.

- Barriers to entry allow an incumbent to earn a profit, while making entry unprofitable for newcomers
- Without barriers to entry, if an incumbent is earning a profit, more firms will enter
- Profit will go to zero

Why do Monopoly Markets Exist?

Examples

- Large fixed costs
- Social media platforms (Snapchat, Facebook, Instagram) have positive network externalities
- Government regulation (taxis)

Why do Monopoly Markets Exist?

Legal barriers to entry exist when an incumbent firm is legally protected against competitors.

Patents are the biggest example:

- Drug companies are given monopoly power by the government in order to recoup their R&D costs
- Once the patent expires, new entrants come to the market, and the price usually falls.

Why do Monopoly Markets Exist?

Strategic barriers to entry result when an incumbent firm takes explicit steps to deter entry.

An example is starting a price war if a new firm enters.

Economists consider monopolists:

A) to be efficient, since they earn greater profits than perfect competitors.

B) to be inefficient since all consumer surplus is transferred to the monopolist in the form of profits.

C) to be inefficient since they earn less producers' surplus than all firms taken together in a competitive market.

D) to be inefficient since the monopolist restricts output from the competitive level, thus creating dead-weight loss.