Lecture 2: Monopoly

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Introduction

- In Econ 11, we assumed actors (firms, consumers, etc) took price as *given.*
- Even when there were only two consumers in an endowment economy, we assumed price was taken as given.
- This is often not realistic. Sometimes buyers/sellers are so large they impact the price.
- When an entity has the ability to unilaterally influence price, we say it has "market power."
- We will study three types of market power:
  1. Monopoly: Maximum Market Power Supply Side (this lecture)
  2. Oligopoly: Intermediate Market Power Supply Side (in the future)
  3. Monopsony: Maximum Market power Demand Side (practice problems)

Why Care About Monopolies?

- Many real life examples.
  1. DeBeers Diamonds
  2. OPEC Oil (dynamic oligopoly resulting in static monopoly)
  3. Utilities (government granted)
  4. Patents (vaccines, etc).
  5. Unique goods (collectibles, one-of-a-kind)
  6. Network goods: Facebook, dating apps, Google

- The government has long tried to stop them.
  1. Teddy Roosevelt Trust busting back in 1899
  2. Merger reviews by DOJ today.
  3. Congressional hearings on big tech.

- They can greatly reduce consumer surplus.

Source: Lloyd Constantine

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- **Big Takeaway:** Just like every square is a rectangle but not every rectangle is a square, monopolies always have one firm but not all situations with one firm are monopolies.
- There needs to be something stopping the firms from entering.
- The technical term for these: **entry barriers**.

Entry Barriers

- Legal barriers (patents)
- Political barriers (lobbying, secrecy, access to unique resources)
- Technical barriers (knowledge of production techniques, increasing returns to scale)
- Others?

Notation, Terms, Definitions

In this class:

- q is total market quantity.
- $c(q)$ is the cost function.
- $d(p)$ is the demand function given the price.
- $p(q)$ is the inverse demand function: it comes from inverting $d(p)$ so that we have price in terms of quantity.

The Monopoly Model

- One firm (monopolist) which can choose quantity q to produce.
- Cost is given by $c(q)$.
- The firm faces an inverse demand function $p(q)$ (derived from aggregate demand function).
- The firm maximizes profit:
$$\max_q \pi = q \cdot p(q) - c(q)$$
- Notice this is just revenue less cost like in Econ 11.

Solve The Model

- Like in Econ 11, $MC = MR$. Or just take FOC:

$$\frac{\partial \pi}{\partial q} = p(q) + q \cdot p'(q) - c'(q) = 0 \leftrightarrow$$

- The last equation is just $MR = MC$!
- q_{MON} which solves the last equation is the monopoly quanity.
- Monopoly price is $p(q_{MON})$.

Notes About the Monopoly Solution

- The first-order condition:

$$\frac{\partial \pi}{\partial q} = p(q) + q \cdot p'(q) - c'(q) = 0$$

  is the **general solution** to the problem.

- If we are given a specific cost function and inverse demand we can plug in to get the solution.

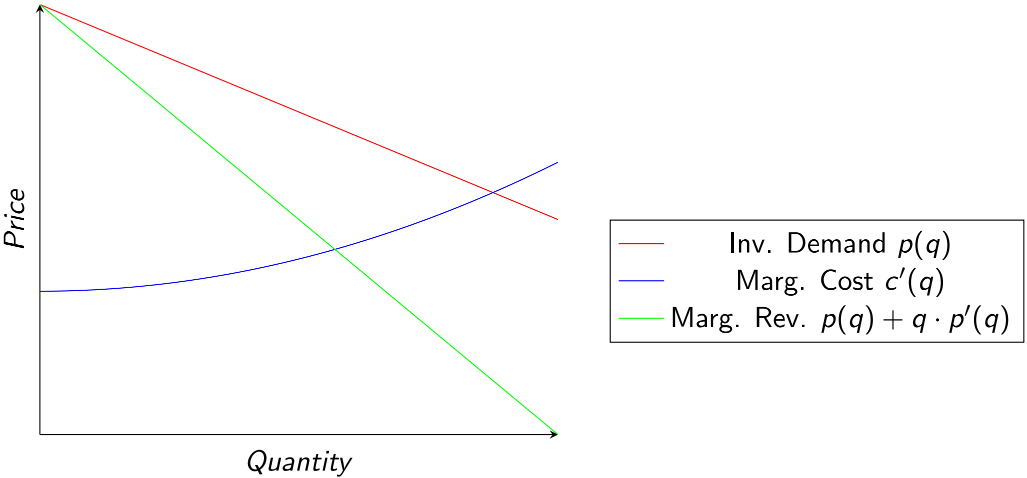
Comparing to Perfect Competition

- In perfect competition, producers take price as given. That is, they assume that their quantity cannot impact price.
- In our model, this is equivalent to producers thinking $p'(q) = 0$.
- This feels weird because price does depend on quantity. We can rationalize this by saying that under perfect competition there are many firms whose totla output equals q. Any individual firm cannot shift price by adjusting quantity.
- Therefore we can think of perfect competition using our monopoly model!
- If we plug in $p'(q) = 0$, to the FOC:

$$\frac{\partial \pi}{\partial q} = p(q) - c'(q) = 0 \leftrightarrow p(q) = c'(q)$$

- We find the result from Econ 11: under perfect competition producers set price equal to marginal cost!

Graphical Comparison of Perfect Competition and Monopoly



From the picture we see that $q_{mon} < q_{perfect}$. It turns out this is true in many cases!

Linear Inverse Demand, Quadratic Costs

Suppose $c(q) = x^2$ and $p(q) = 2 - 3q$. What is the monopolist quantity and price? What is the perfect competition quantity and price?

See hadnwritten notes for solution.

Deriving Linear Demand

- So far, we have assumed inverse demand is given.
- But where does inverse demand come from?
- We will go through deriving it for uniform willingness to pay.
- A good exercise is to solve when inverse demand takes different forms. See recommended problem set.

Deriving Linear Demand

- Suppose we normalize the number of consumers in the economy to be 1.
- Suppose each consumer has a different willingness to pay given by w.
- A consumer buys if the price is less than or equal to w.
- Suppose the distribution of willingness to pay follows some pdf f in the population (could be normal, uniform, Bernoulli, anything).
- Then demand is the integral over all people who value the good more than the price. This is just 1 minus the CDF!

$$d(p) = \int_p^\infty f(w)dw = 1 - F(p)$$

Deriving Linear Demand

- Suppose w is distributed uniform between 0 and 1 in the population.
- So 50% of people value the good at 0.5 or less, 75% value it at 0.75 or less, etc.
- Then the demand is:

$$d(p) = \int_p^1 dw = 1 - p$$

- Inverse demand is just solving for p with $d(p) = q$:

$$d(p) = q = 1 - p(q) \leftrightarrow p(q) = 1 - q$$

- Thus we get linear inverse demand when people's willingness to pay is uniform!
- **Challenge:** Try deriving inverse demand for willingness to pay distributed according to pdf $f(w) = 2e^{-2w}$ where $w \geq w0$.

Big Ideas/Intuition

- We know now that under monopoly, quantity supplied is lower than under perfect competition.
- The reason is that the monopolist can keep the price artificially high and not worry about being undercut by competitors.
- This is market power: one firm controls an entire side of the market.
- Note that this is **not** the same as a firm being able to "charge whatever it wants." The monopolist is still constrained by the law of demand: higher prices means less customers.

Welfare Analysis

- We want to understand how the presence of a monopolist impacts welfare.
- First, recall the idea of consumer surplus:

Definition 1

Consumer surplus is amount of money a consumer would pay to make a transaction at a given price.

- Total consumer surplus is the area below the demand curve and above the price, and can be calculated as:

$$CS(q) = \int_0^q p(x) - p(q)dx$$

Welfare Analysis

- Now consider producer surplus. This is captured by profits, which are given by:

$$\Pi(q) = p(q)q - c(q)$$

- Total welfare is the sum of producer surplus and consumer surplus:

$$TW(q) = CS(q) + \Pi(q) = \int_0^q p(x) - p(q)dx + p(q)q - c(q)$$

- Using the Fundamental Theorem of Calculus we can re-write this as:

$$TW(q) = \int_0^q p(x))dx - c(q)$$

Welfare Analysis

Question: If a social planner could choose q to maximize total surplus, what would they choose? Answer: Just solve the below equation.

$$\max_q \int_0^q p(x)dx - c(q)$$

FOC: $p(q) - c'(q) = 0$
This should look familiar! It is exactly the equation for perfect competition.
Big Idea: Perfect Competition maximizes total surplus, and monopoly does not. There will always be welfare loss from monopoly.

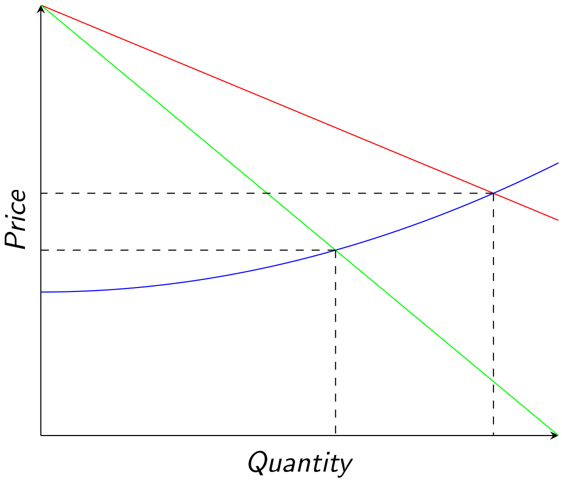
Deadweight Loss

Definition 2

Deadweight loss is the difference between total surplus under the social planner's optimum and the actual situation.

- The social planner's optimum is the competitive outcome.
- Therefore deadweight loss under monopoly is perfect competition total surplus minus monopoly total surplus:
$$DWL = TS(q_{mon}) - TS(q_{perfect})$$
- We can interpret this as the value of the transactions that are foregone under monopoly.
- Individuals with willingness to pay between p_{mon} and $p_{perfect}$ are not buying under monopoly but are buying under perfect competition.

Graphing Deadweight Loss



Monopsony

- So far we have considered when a single entity has all market power on the supply side.
- But what if a single entity has all market power on the demand side?
- This is called **monopsony.**
- Examples:
  1. Large employers in small towns.
  2. Large producers of a final good buying inputs.
- Our analysis so far basically applies identically to monopsony.
- We will now use our monopoly/monosony model to think about minimum wages.

Application: Monopsony and the Minimum Wage

- Prior to Card and Krueger (1993), many economists believed minimum wages should reduce labor demand.
- Why? Because if labor markets are like any other market in perfect competition, the law of demand says that a higher price must mean less demand.
- But a series of studies have found mixed results: sometimes binding minimum wages seem to have no impact or a slight positive impact on employment (quantity in the language of our model).
- But why? A leading argument: because employers have market power, and are buying labor at a price below the competitive price.

Application: Monopsony and the Minimum Wage

Let's apply our model.

- Consider a local labor market, where Walmart is a monopsonist of low-skill labor.
- Using a unit of labor Walmart produces $F(q)$ units of revenue.
- Walmart selects a quantity of labor, call it q, knowing that it is the only buyer and can thus impact the wage w.
- A large number of people in the town supply labor according to labor supply function $l(w)$.
- This induces inverse labor supply function $w(q)$.

Application: Monopsony and the Minimum Wage

Walmart solves:

$$\max_q F(q) - w(q) \cdot q$$

which gives FOC:

$$F'(q) - w'(q)q - w(q) = 0$$

Suppose $F(q) = log(q) + 10$, $w(q) = 2q$:

$$q^{-1} - 2q - 2q = 0 \implies 2q^2 - 4q = 0 \implies q_{mon} = 0.5$$

$$w_{mon} = 1$$

Application: Monopsony and the Minimum Wage

Under a competitive labor market, we have that wages are taken as given. Then $q_{perfect}$ solves:

$$F'(q) - w(q) = 0$$

$$q^{-1} - 2q = 0 \implies 1 - 2q^2 = 0 \implies q_{perfect} \approx 0.707$$

$$w_{perfect} \approx 1.414$$

Thus labor is under supplied and demanded under monopsony. The wage is also lower.

Application: Monopsony and the Minimum Wage

Now suppose the government institutes a binding minimum wage of $\bar{w}$.

- This means the lowest quantity of labor Walmart can purchase is $2\bar{w}$:

$$\max_q log(q) - 2q^2 + 10$$

  s.t.

$$q \geq 2\bar{w}$$

- Notice that the derivative of profit is $q^{-1} - 4q$ which is positive when $q < 1/2$ and negative when $q > 1/2$. Thus profit is decreasing for all $q > 1/2$, so Walmart optimally demands:

$$q_{minwage} = \begin{cases} 0 \text{ if } \bar{q} \geq q^{max} \\ 2\bar{w} \text{ if } q^{max} > \bar{q} > 1 \\ q_{mon} \text{ else} \end{cases}$$

- In the third case the minimum wage is not binding. In the second case it is binding and not high enough to prompt exit. In the first case it is so high it makes operation not profitable.

Minimum Wage Graph

Application: Monopsony and the Minimum Wage

- The bottomline: in a labor market characterized by extreme market power (monopsony) minimum wages can increase employment.
- However: if the minimum wage is too high, it can cause employment to be below both the competitive amount and monopoly amount.
- In the extreme case it can cause market exit.
- How do we know if there is market power?
- Optimal minimum wage is of course to set $\bar{w} = w_{perfect}$.
- But doing this requires knowing the true competitive wage.
- **Discussion:** Given this, do you think a $15 national minimum wage is appropriate?