Monopoly 2: Price Discrimination and Natural Monopoly

Monopoly

Overview

Definition: A firm is a monopoly if it is the **only** supplier of a product in a market. A monopolist's demand curve slopes down because firm demand equals industry demand.

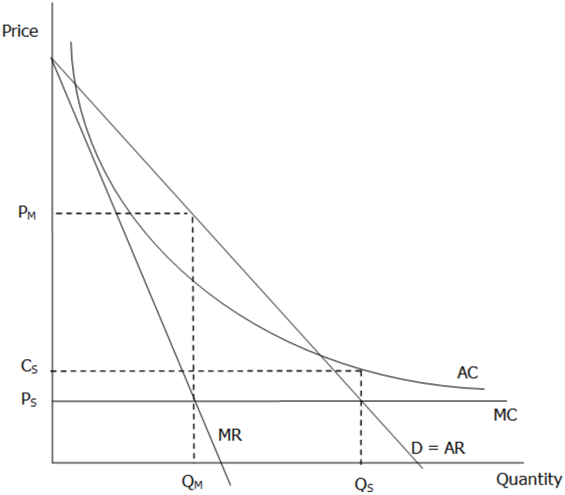
Five cases:

1. Base Case (One price, perishable good, non-IRS Costs).
2. Natural Monopoly
3. Price Discrimination - MAIN FOCUS!
4. Bundling
5. Durable Goods

Natural Monopoly

- A firm is a natural monopoly if it can produce the market quantity Q, at lower cost than two or more firms.
- To argue for a natural monopoly, have to establish subadditivity of cost function: $C(Q) < C(q_1) + C(q_2) + ... + C(q_K)$ where $Q = \sum_{i=1}^{K} q_i$.
- Claim: if AC is declining everywhere, subadditivity is satisfied.
- However, the reverse is not always true, i.e. economies of scale is sufficient but not necessary for natural monopoly.
- It is often argued that electrical, gas, telephone and other utilities are natural monopolies. Why?

Natural Monopoly



Natural Monopoly

Monopoly will maximize profits at (P_M, Q_M).
$(P_s; Q_s)$ are perfectly competitive and, hence, welfare maximizing (not counting fixed costs), but a firm would make a loss in this case.

How to regulate a natural monopoly?

1. Pay a subsidy to the firm to cover losses,
2. or have firms bid based on price: "franchise bidding"
3. or, even better, have firms bid based on both a fee to operate, but also the price they will charge consumers.

Price Discrimination

We distinguish between three types of price discrimination:

1. First degree ("personalized" prices to extract full surplus)
2. Second degree (have customers choose between a menu of quantities/prices - "self-selection")
3. Third degree ("market segment" based pricing)

Price discrimination always increases firm profits, but its effects on consumer surplus are ambiguous.

First-Degree Price Discrimination

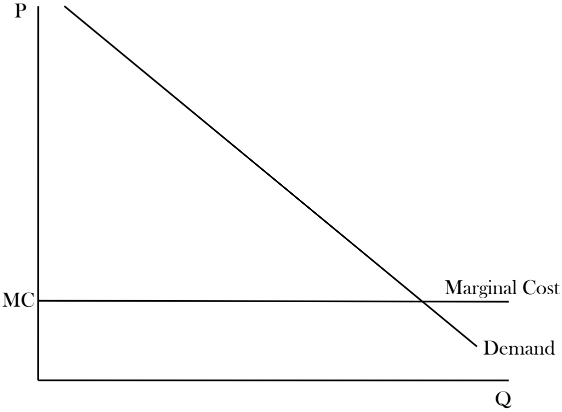
Monopolist knows the WTP of each customer, and charges a different price from each.

The key idea is all the consumer surplus is extracted.

The best way to think of this is that it is done with a lump sum fee and quantity restriction, or an access fee and $P = MC$

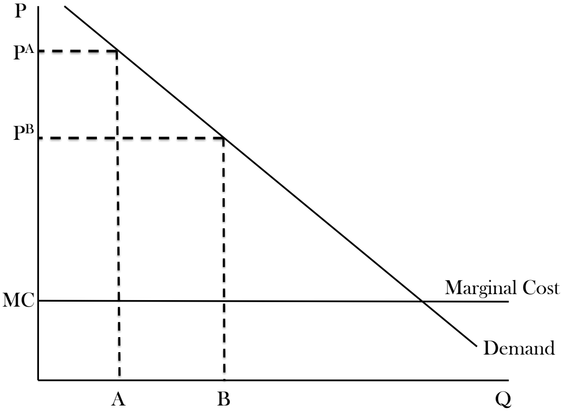
Price Discrimination

First Degree



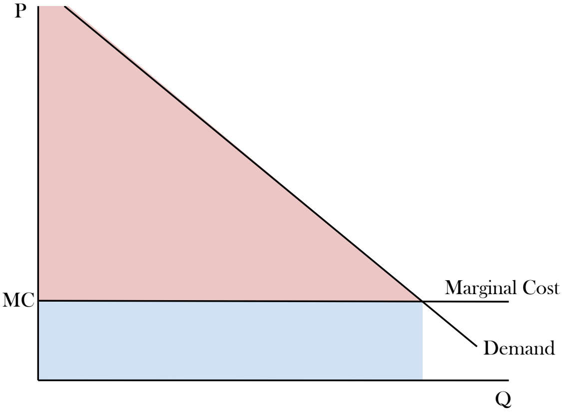
Price Discrimination

First Degree



Price Discrimination

First Degree



Claim: This type of price discrimination leads to an efficient outcome.

What's the MR curve of a monopolist who can charge the area under the demand curve?

Implementation problem: how does the monopolist know its demand curve?

Price Discrimination
Third Degree

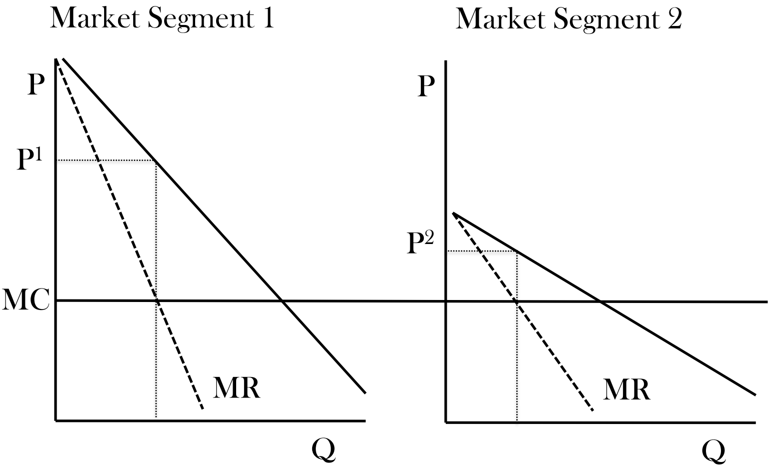
This is "market segmentation".

Two segments:

- $\max_{q_1,q_2} \pi(q_1, q_2) = TR_1(q_1) + TR_2(q_2) - TC(q_1 + q_2)$
- $MR_1(q_1^m) = MC(q_1^m + q_2^m)$
- $MR_2(q_2^m) = MC(q_1^m + q_2^m)$
- Equate marginal revenues across two markets!
- Marginal revenues might be the same, but not the resulting prices!

Price Discrimination

Third Degree



Price Discrimination

Third Degree

- Claim: $p_1^m(1+\frac{1}{-|\varepsilon_1|}) = p_2^m(1+\frac{1}{-|\varepsilon_2|})$
- Price in market with less elastic demand is higher (Ramsey pricing principle)
- Examples: Cinema pricing; Book Pricing
- In general, welfare consequences are ambiguous.

Second-Degree Price Discrimination

This is the case where you can't effectively segment the market.

Instead you get people to choose between different pricing plans ("tariffs").

- Cell phone plans are a good example.
- Quantity discounts (ever wonder how Starbucks sets prices across sizes?)

In some cases, a much harder problem to analyze.

We will do a simple version to build intuition, then a more rigorous treatment to show generality of intuition.

Price Discrimination

Second Degree: Easy version (also assuming MC = 0)

		Willingness to Pay	
Type	No.	No Restr	Restr's
Tourist	10	350	300
Business	10	800	**200**

- Strategy 1: price single ticket (NR) at 350
  Revenue = 350 x 20 = 7000
- Strategy 2: price single ticket (NR) at 800
  Revenue = 800 x 10 = 8000
- Strategy 3: price (R,NR) at (300,800)
  Revenue = 300 x 10 + 800 x 10 = 11,000

Price Discrimination

Second Degree: Easy version (also assuming MC = 0)

		Willingness to Pay	
Type	No.	No Restr	Restr's
Tourist	10	350	300
Business	10	800	**400**

- Strategy 3: price (R,NR) at (300,800)
  Revenue = 300 x 10 + 800 x 10 = 11,000

... DOESN'T WORK: business buys restricted fare!

- Strategy 4: price (R,NR) at (300,700)
  Revenue = 300 x 10 + 700 x 10 = 10,000

Price Discrimination; Rigorously...

Second Degree

Two type example:

- Consumer surplus from drinking q ounces of coffee and paying t_i is given by:
- $\theta_i q - t$ where $i = 1; 2;$
- with $(\lambda, 1 - \lambda)$ percent of each type in population
- $\theta_1 < \theta_2$, i.e. θ_2 people get higher marginal utility from each ounce of coffee ("H" types).
- Costs are given by $C(q_i)$

Price Discrimination

Second Degree

- Monopolist offers two sizes of coffee: (q_1, t_1), (q_2, t_2) and corresponding pricing.
- Maximization problem:

$$\max_{\{(q_1,t_1),(q_2,t_2)\}} \lambda(t_1 - C(q_1)) + (1-\lambda)(t_2 - C(q_2))$$

- such that people (a) buy and (b) buy the bundle they are supposed to

$$\begin{aligned} \theta_1 q_1 - t_1 &\geq 0 \quad \text{(IR-L)} \\ \theta_2 q_2 - t_2 &\geq 0 \quad \text{(IR-H)} \\ \theta_1 q_1 - t_1 &\geq \theta_1 q_2 - t_2 \quad \text{(IC-L)} \\ \theta_2 q_2 - t_2 &\geq \theta_2 q_1 - t_1 \quad \text{(IC-H)} \end{aligned} \tag{1}$$

Price Discrimination

Second Degree

- Let's get rid of some of these constraints:
- *Claim*: IR-L and IC-H automatically imply IR-H.
  Proof:

$$\begin{aligned}
\theta_2 q_2 - t_2 &\geq \theta_2 q_1 - t_1 \quad \text{(IC-H)} \\
&> \theta_1 q_1 - t_1 \quad \text{(since } \theta_2 > \theta_1\text{)} \\
&> 0 \qquad\qquad\quad \text{(IR-L)}
\end{aligned}$$

- *Claim*: IR-L binds at an optimum.
  Proof: Suppose not. If monopolist increases t_1 and t_2 by ε, he still satisfies IR-L. IC-L and IC-H are unchanged (ε cancels from both sides), and IR-H continues to hold. But then monopolist increases profit (price increased by ε, so we can't be at an optimum. Contradiction.

- *Claim*: IC-H binds.
  Proof: Suppose not. Increase t_2 by ε such that IC-H still holds. IR-L not affected, so IR-H still holds. IC-L not affected. So once again monopolist increased profits! Contradiction.
- Claim: IC-L is satisfied automatically given other constraints. Assume for now and verify at optimum.

"Simplified" Maximization problem:

$$\max_{\{(q_1,t_1),(q_2,t_2)\}} \{\lambda\,(t_1 - C(q_1)) + (1-\lambda)(t_2 - C(q_2))\}$$

$$\begin{aligned} s.t. \quad t_1 &= \theta_1 q_1 \\ t_2 - t_1 &= \theta_2 q_2 - \theta_2 q_1 \end{aligned}$$

So we can write the problem as:

$$\max_{(q_1,q_2)} \lambda\left(\theta_1 q_1 - C(q_1)\right) \\ +(1-\lambda)(\theta_2 q_2 + (\theta_1 - \theta_2) q_1 - C(q_2))$$

Giving FOC's:

$$\begin{aligned} \theta_1 - (1-\lambda)\theta_2 &= \lambda C'(q_1) \\ \theta_2 &= C'(q_2) \end{aligned}$$

For H-types, "large" coffee size is socially optimal

Price Discrimination
Second Degree

For L-types, suboptimal:

$\theta_1 - (1-\lambda)\theta_2 < \theta_1 - (1-\lambda)\theta_1 = \lambda\theta_1$, so $\theta_1 > C'(q_1)$.

That is, small coffee size is too small.

Moreover, L-types enjoy zero surplus: $\theta_1 q_1 - t_1 = 0$, and are just indifferent between buying coffee and not.

Last step:

- Verify IC-L: since IR-L binds, $\theta_1 q_2 \leq t_2$. Subtract IR-L (which binds) from both sides: $\theta_1 q_2 - \theta_1 q_1 \leq t_2 - t_1$.
- H-types enjoy surplus: $\theta_2 q_2 - t_2 \geq 0$. Proof: Use IC-H and IR-L.

Price Discrimination

Second Degree

More than 2 types of consumers:
If there are K types, $\theta_1 < \theta_2 < \theta_3 < ... < \theta_K$

1. Optimality at the top. Marginal cost of largest coffee cup is equal to marginal benefit of "H" types.
2. Lowest type gets no surplus
3. All other types enjoy some surplus
4. Only downward IC constraints matter, i.e.

$$t_i - t_{i-1} = \theta_i q_i - \theta_{i-1} q_{i-1}$$

5. $q_i > q_{i-1}$

Problems and Examples: See Handout

Second-Degree Price Discrimination with Competition

What happens to the results above when there are many competing firms, with each competitor offering a menu of prices and quantities?

This is probably a situation that you are more likely to encounter in everyday life.

Intuition:

1. Individual rationality constraint becomes important. No longer clear that participation constraint will bind for lowest type consumer; this person can be "lured" by the competitor.
2. You'll end up leaving some surplus to the marginal consumer.
3. As n grows larger, quantity distortion decreases

Largely an empirical question right now.

Price Discrimination

Second Degree

Borenstein and Rose (1994): Competition and Price Dispersion in Airline Industry

- Considerable price dispersion within airline (across customers). Average dispersion between two tickets on same carrier and same route is 36 percent of ticket price
- Much less price dispersion across airlines serving the same route (97 per cent of total price dispersion is within airline)
- Variation in dispersion across markets: 3.6 percent of ticket price (Eastern Boston-LaGuardia shuttle) to 86 percent of ticket price (TWA, Phoenix-Las Vegas flight)
- Price dispersion increases with number of competing airlines