Introduction to Industrial Organization
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Lecture Note 11

Price discrimination (ch 10)

Charpter 10 explores how firms can have more sophisticated behavior to extract surplus from consumers and maximize surplus.

Non-uniform pricing: charging different customers different prices for the same product or charging a single price that depend on how many units the customer purchases.

Price discrimination and non-uniform pricing basically mean the same.

Example of price discrimination:

- Quantity discounts
- senior citizen discounts
- coupons
- soda prices and cup size

Notes:

1. non-uniform pricing is price discrimination only if the nonlinear pricing reflects differences consumers' preferences, not in their costs. For example, if it cost less to show a movie to senior citizens, then giving them a discount at the movie theater not price discrimination.
2. Price discrimination is only possible in markets where firms have market power. As competition increases and price are driven towards marginal costs, price discrimination becomes much harder. All of the models we consider will be monopoly models. The intuition is oligopoly models will price discrimination is identical, but they are much harder to solve.

Suppose that willingness to pay varies across consumers. Consumers' preferences (or willingness to pay) depends on

1. Observable characteristics (age, income, gender)
2. Unobservable characteristics

There are two general types of price discrimination.

1. Firms charge different prices to consumers with different observable characteristics.
   - 1^{st} degree price discrimination
   - 3^{rd} degree price discrimination
   - Has to be legal
   - Have to be observable characteristics that are correlated with willingness to pay
2. Firms charge different price for different types of goods to induce consumers to reveal their unobserved preferences
   - For example, offer a high quality good and low quality good at prices so that

only the consumers who care about quality purchase the high quality good.
- 2nd degree price discrimination

First type of price discrimination we will look at is 1st degree price discrimination:

1st degree price discrimination:
- Unrealistic, but yields a lot of intuition for why firms would engage in price discrimination
- Also called perfect price discrimination

Setup:
1. A large number of consumers.
   - Each consumer buy one unit
   - Consumers have different willingness to pay for that one unit. Could write that the WTP of individual "I" is WTP: or that if "I" has observable and unobservable characteristics X_i and ϵ_i, then $WTP_i=u[\epsilon_i,X_i]$.
2. There is one monopolist serving the market
   - Constant marginal costs MC(Q) and costs C(Q)=cQ
   - The monopolist observes everything necessary to determine WTP_i for each i.
   - The monopolist I, legally able to charge whatever it wants to each consumer.

Monopolist's problem:
Choose p_i for each i to maximize

$$\pi = \sum_i p_i q_i - c(\sum q_i)$$

$$where\ q_i = \begin{cases} 0 & if\ \ p_i > wtp_i \\ 1 & if\ \ p_i \leq wtp_i \end{cases}$$

Solution:
- Consider an individual "i" whose $wtp_i \geq c$. Clearly the monopolist can earn a profit by charging any p such that $wtp_i \geq p > c$. To maximize profit set $p_i^* = wtp_i$
- Consider an individual "i" whose $wtp_i < c$. If the monopolist sells to "i" (i.e., set $p_i \leq wtp_i$) the monopolist will lose money. So $p_i^* = \infty$ so that "i" will not make the purchase.

Graphically,
- We can sort consumers by their WTP to construct a demand a curve. Let $WTP_1 = highest\ WTP, WTP_2 = secod\ highest\ WTP$ ... figure 10.e1 illustrates this idea.
- If we fill all of the boxes we will see two things (in Figure 10.e2):
  1) The monopolist produces the efficient level
  2) The monopolist captures 100% of surplus

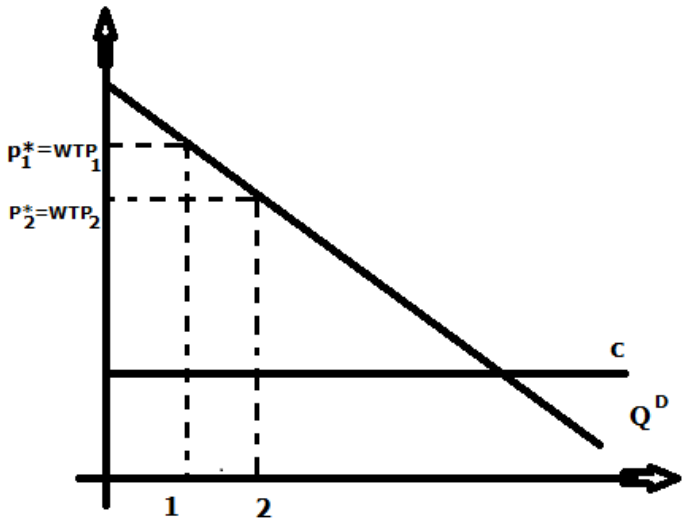

Figure 10. e1 Sorted willingness to pay

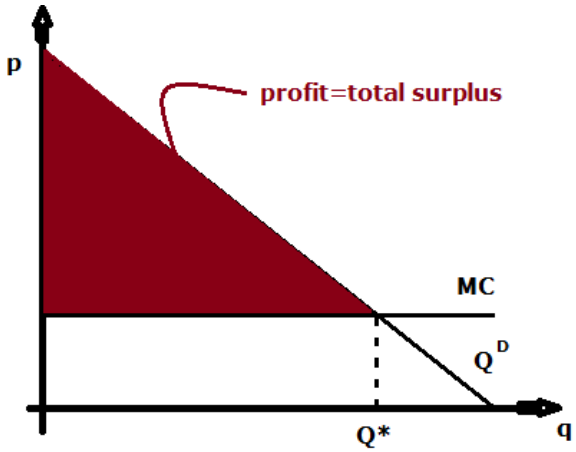

Figure 10.e2 Monopolist pricing at efficiency

The monopolist sells to everyone whose WTP>=cost. This is efficient. Profit=Total surplus since the monopolist is able to charge each individual his WTP. Remember that

$$surplus = WTP - cost$$

$$and$$

$$p = WTP.$$

So $surplus = p - cost = profit.$

The results above explain a lot about the role of price discrimination in the market place.

Recall the monopolist's problem. He chooses the level of output such that MR=MC.

$$MR = MC$$

$$\leftrightarrow$$

$$p + \frac{dp}{dQ}Q = MC$$

This second portion of MR causes all of the inefficiencies in the monopoly markets we

studied. When firms can only charge one price, they end up charging a low price to consumer who value a good the most in order to attract more low valuation customers. They are only willing to do this so much however. That is why they restrict output and we have deadweight loss (DWL).

$$p + \frac{dp}{dQ}Q = MC$$

$\frac{dp}{dQ}$: We can think of price discrimination as an attempt by profit maximizing firms to use sophisticated pricing policies and minimize this effect. To the extent that they are able to do this, firms incentives to restrict output go down and DWL goes down. But although surplus goes up, consumer surplus goes down.

- With 1st degree price discrimination, $\frac{dp}{dQ}Q$ completely disappears.

  Hence $Q^M = Q^*$ and $\pi = TS$
- We said earlier that 1st and 3rd degree price discrimination can occur only if firms have market power ad firms observe (and are allowed to price on) the characteristics that affect WTP/
- What else is also necessary for price discrimination to be practical? It must be the case that resale is not possible. Price discrimination can be implemented only if the consumer who purchase at a low price cannot resell the product to consumer who hold otherwise pay a high price.
- Some markets are by nature conductive to price discrimination. Certain goods (like visits to a museum, different price for students, kids, the elderly, etc.) cannot be resold.
- The firm can practice price discrimination an a level that makes resale difficult. For example, if the firm charges different prices to consumers an different continents, transaction costs of resale (for example: shipping costs) might make resale unprofitable.
- Firms can also design their products to limit resale
  - ✓ Warranties can be voided if ownership is transferred.
  - ✓ Products can be designed to be unfit for certain uses. Example: Alcohol manufacturers purposefully make rubbing alcohol unfit for drinking.
- Regulation/government intervention can make resale difficult.
  For example, drug manufacturers lobby the FDA and Congress to make illegal imported drug from Canada.
- To implement 1st degree price discrimination, necessary to have perfect information about consumers preferences.

Third degree price discrimination is a more limited and feasible version of first degree price discrimination.

Third degree price discrimination:

- The firm knows there are two groups of people, A and B. demand among "A" group is given by $Q_A^D(p)$. demand for group "B" given by $Q_B^D(p)$.
- Assume that the firm doesn't observe individual i's WTP, but does observe which group "i" is a member of.
- 3rd degree price discrimination🡐🡒 setting different prices for members of group A and B.
- Assume for simplicity that marginal costs are constant (C(Q)=cQ) and resale between groups is impossible.

Firm solves:

$$\underset{Q_A, Q_B}{max} \left\{ \underbrace{Q_A p^A(Q_A) - cQ_A + Q_B p^B(Q_B) - cQ_B}_{note\ that\ this\ profit\ function\ is\ just\ the\ sum\ of\ profits\ from\ gruop\ A\ and\ B.} \right\}$$

$$\frac{d\pi}{dQ_A} = MR_A - MC_A = 0$$

$$p^A(Q_A) + Q_A \frac{dp^A(Q_A)}{dQ_A} = c$$
$$p^B(Q_B) + Q_B \frac{dp^B(Q_B)}{dQ_B} = c$$

⇨ At the profit maximizing levels of output.

$$\frac{p_A^* - c}{p_A^*} = -\frac{1}{\varepsilon_A}$$
$$\frac{p_B^* - c}{p_B^*} = -\frac{1}{\varepsilon_B}$$

⇨ $elasticities\ of\ demand\ for\ gruops\ A\ and\ B.$

Interpreting the results? We get the same markup condition? As in monopolu. The group with elastic demand (ε very negative) pays a low price. The group with inelastic demand (ε negative but close to zero) pays a higher price.

It can be shown that for the elastic demand group, price goes down relative to a monopolist that sets only one price. Price for the inelastic group goes up.

Assume the monopolist can set only one price:

$$\pi = p(Q_A(p) + Q_B(p)) - c(Q_A(p) + Q_B(p))$$

$$\frac{d\pi}{dp} = [Q_A(p) + Q_B(p)] + (p - c)\left[\frac{dQ_A(p)}{dp} + \frac{dQ_B 9p)}{dp}\right] = 0$$

⇨ $Q + \frac{P-C}{P}\left[\frac{dQ_A(p)p}{dp\,Q_A}Q_A + \frac{dQ_B(p)}{DP}\frac{p}{Q_B}Q_B\right] = 0$

⇨ $Q + \frac{P-C}{P}[Q_A\varepsilon_A + Q_B\varepsilon_B] = 0$

⇨ $1 + \frac{P-C}{P}\left[\frac{Q_A}{Q}\varepsilon_A + \frac{Q_B}{Q}\varepsilon_B\right] = 0$

⇨ $\frac{p^*-C}{p^*} = -\frac{1}{\frac{Q_A}{Q}\varepsilon_A + \frac{Q_B}{Q}\varepsilon_B}$

⇨ This monopolist finds it optimal to set a price by weighting the elasticities from groups A and B. If $\varepsilon_A < \varepsilon_B$, easy to show that $p_A^* < p^* < p_B^*$

So when price discrimination not allowed, the inelastic group is better off. Figure 10.e3 shows this idea.

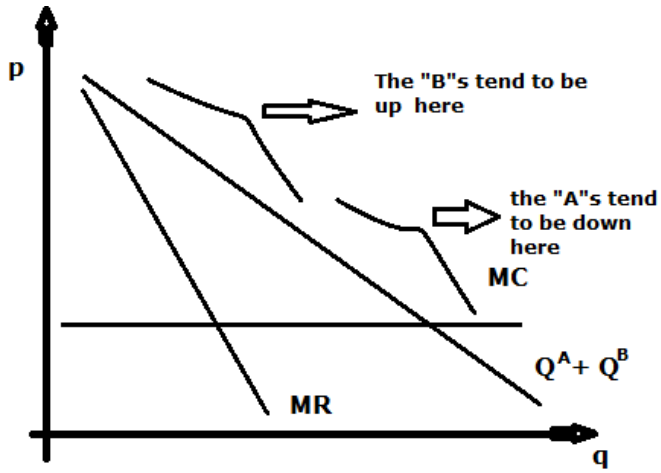

Figure 10.e3: discrimination is not allowed

Without price discrimination, the B types tend to benefit from the monopolist's attempts to increase Q_A by decreasing price. When price discrimination possible, the monopolist does not have to lower the price B's pay to increase Q_A.

What are the welfare implications of 3rd degree price discrimination?

- We know that surplus is not maximized under third degree price discrimination because prices are greater than marginal.
- Relative to a monopoly market without price discrimination, the welfare affects are ambiguous. But welfare usually increases. Why the ambiguous change?
  1. Not because of profits profit increases relative to a market with at price

discrimination. If they did not, the firm would just set one price.

2. Consumers? The consumers surplus realized by the elastic group increasing. They fact a lower price and purchase more. For a inelastic group, consumer surplus decreases because of the opposite reasons. The total effect on surplus depends on the sizes of these two opposing effects.

Other methods of 3rd degree price discrimination?

The monopolist can explicitly set two prices, or it can use instruments that, in effect, create two prices:

- Coupons
- Low-price guarantees
- Triple A discounts, student advantage card