LECTURE NOTES ON PRICE DISCRIMINATION

October 16 and 18, 2012

❖ On price discrimination

Price discrimination is when the same firm charges different prices to different people for the same product.

- Some types of price discrimination involve verifying consumer types, e.g., student I.D.s.
- Other types involve creating products with different levels of attractiveness, e.g., Cheerios vs. Joes’s O’s.
- Price discrimination is only relevant for the case of monopoly or oligopoly. A perfectly competitive industry sets $P = MC$ so price does not depend on the characteristics of demand. We’re going to focus on monopoly as price discrimination for oligopoly is very hard to model. The same intuition applies to monopoly and oligopoly.

❖ We can divide price discrimination into 3 types:

- (i) Perfect price discrimination or first degree price discrimination.
  This means that firms can perfectly figure out the demand for each consumer

- (ii) Second degree price discrimination
  Firms offer different ”versions” of the product that appeal to different types of consumers.

- (iii) Third degree price discrimination
  Firms can segment consumers based on some observable characteristics.

❖ First degree price discrimination

- This would be the case where the firm can uncover the willingness-to-pay (WTP) for each customer and then charge based on the WTP. This rarely happens in the real world. The closest example is some elite private universities such as Harvard. They will charge a high sticker price and then give a discount based on ”need” e.g., WTP. They can figure out WTP pretty effectively from financial aid forms.

- The analysis of models with perfect price discrimination is straightforward. The monopolist will offer each customer the product at a price exactly equal to her WTP, so long as the WTP is greater than MC. Why? Because if the monopolist charge a higher price, the consumer
would not buy the product. If it charged a lower price, it would be leaving money on the table. Let’s consider this graphically.

![Graph showing welfare under monopoly with perfect price discrimination](image)

**Figure 1.** Welfare under monopoly with perfect price discrimination. Triangle A is the consumer surplus, Area B and D is the monopoly surplus (or profit) and triangle C is the deadweight loss under monopoly without price discrimination. Area A+B+C+D is the monopoly surplus with perfect price discrimination.

- This example shows that the perfectly price discriminating monopolist does not leave any consumer surplus! Yet it also does not have any deadweight loss.

**Third degree price discrimination**
- This is the case where the firm can segment consumers into 2 or more groups with different WTP.

**Example 1.** Suppose there are 2 groups and demand is:

\[
Q = 5 - P \text{ for group 1} \\
Q = 5 - 2P \text{ for group 2}
\]

- Note that group 2 is more elastic in its demand. Thus we expect the monopolist to charge a lower price for it than for group 1. We can solve the monopoly problem by figuring out what price it charges in each group separately. For each group the monopolist problem looks like the standard (no price discrimination) monopolist problem. Formally the monopolist picks \(p_1\) and \(p_2\) to maximize profits.

\[
\Pi(p_1, p_2) = \Pi_1(p_1) + \Pi_2(p_2)
\]

where \(\Pi_1(p_1)\) and \(\Pi_2(p_2)\) are the profits for group 1 and profit for group 2, respectively.
Table 1. Demand schedule for the third degree discrimination example

<table>
<thead>
<tr>
<th>Price</th>
<th>$Q_1$</th>
<th>$Q_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2.5</td>
<td>0</td>
</tr>
</tbody>
</table>

Let’s assume $MC = 0$.

- We can write this down either as a function of $p_1$ or $q_1$. In terms of $q_1$,

  $$
  \Pi_1(q_1) = q_1 \times p_1 = q_1 \times (5 - q_1)
  $$

  Similarly,

  $$
  \Pi_2(q_2) = q_2 \times p_2 = q_2 \times \left(\frac{5 - q_2}{2}\right)
  $$

- Let’s differentiate this to solve for the optimal $q_1$ and $q_2$.

  $$
  \frac{d\Pi_1(q_1)}{dq_1} = q_1(-1) + (5 - q_1) = 0
  $$

  $$
  \Rightarrow -2q_1 = -5
  $$

  $$
  \Rightarrow q_1 = \frac{5}{2}
  $$
\[
\frac{d\Pi_2(q_2)}{dq_2} = q_2\left(-\frac{1}{2}\right) + \left(\frac{5}{2} - q_2\right) = 0
\]
\[
\Rightarrow -\frac{1}{2}q_2 - \frac{1}{2}q_2 = -\frac{5}{2}
\]
\[
\Rightarrow q_2 = \frac{5}{2}
\]
so \( p_1 = \frac{5}{2} = 2 \frac{1}{2} \), \( p_2 = \frac{5 - \frac{5}{2}}{2} = \frac{5}{4} = 1 \frac{1}{4} \) As we have thought group 2 with more elastic demand receive a lower price. Now let’s figure out the monopoly profits. They are:
\[
\Pi_{total} = p_1 \times q_1 + p_2 \times q_2
\]
\[
= \frac{5}{2} \times \frac{5}{2} + \frac{5}{4} \times \frac{5}{2}
\]
\[
= \frac{25}{4} + \frac{25}{8}
\]
\[
= \frac{50 + 25}{8}
\]
\[
= \frac{75}{8}
\]
• This the monopoly profits with price discrimination are \( \frac{75}{8} = 9 \frac{3}{8} \). Now let’s consider the monopolist who cannot price discriminate. We first need to figure out its demand for any price, its quantity demanded is the sum of \( q_1 \) and \( q_2 \). Graphically, this means we sum horizontally, not vertically. In equations, we get \( Q = 5 - P + 5 - 2P = 10 - 3P \).
• The monopoly profit without price discrimination is:
\[
Q = 10 - 3P
\]
\[
\Rightarrow P = \frac{10 - Q}{3}
\]
The optimal quantity and price is then:
\[
\Pi(Q) = \left(\frac{10 - Q}{3}\right)Q
\]
\[
\frac{d\Pi}{dQ} = 0
\]
\[
\Rightarrow \left(\frac{10 - Q}{3} + Q\right) + \left(-\frac{1}{3}\right) = 0
\]
\[
\Rightarrow \frac{10}{3} - \frac{Q}{3} - \frac{Q}{3} = 0
\]
\[
\Rightarrow 10 - 2Q = 0
\]
\[
\Rightarrow Q = 5
\]
Now we can plug in price
\[
P = \frac{10 - Q}{3} = \frac{10 - 5}{3} = \frac{5}{3}
\]
Profit is then
\[
\Pi = 5 \times \frac{5}{3} = \frac{25}{3} = \frac{8 \frac{1}{3}}{3}
\]
• Notice that monopolist that adopts third degree price discrimination does better than the monopolist without price discrimination strategy ($9\frac{2}{8} > 8\frac{1}{2}$). We didn’t need to solve for prices to obtain this result: the ability to price discriminate increases the tools available to the monopolist. It couldn’t possibly earn more money from not price discriminating, or it would simply choose the same prices across groups when it does have the ability to price discriminate.

Also notice that for single agent case it’s better to have more information but this doesn’t apply to the game setting. Think about the chicken game for example, if one doesn’t think about the outcome and just throw out his steering wheel along the road to go straight on. His opponent might back off due to this commitment. Or use Ronald Reagan for another example that some contributes the collapse of the Soviet Union is part of his "simplicity" in terms of foreign affair policy.

❖ **Second degree price discrimination**

• This is the situation when the firm cannot verify which consumer is in which group. Hence, the firm offer a different version for each group. The WTP groups will end up sorting into a better version. But this group will pay a big premium over cost.

The low WTP group will get the worse version but will pay a smaller markup over cost.

• As an example, on a trans-atlantic flight a coach ticket might cost $1,200 round trip but a business class ticket $6,000. The b-class costs are probably twice as high, but they are paying 5 times as much.