ECN 453: Pricing and Price Discrimination 1

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Price Discrimination

- Price discrimination: **setting different prices for the same good**.

- Examples: airline tickets, software, pharmaceuticals

Figure: Photo: Flickr

- We will look at different ways that firms price discriminate and the implications for policy.

Plan

1. Why price discriminate?
2. Price discrimination: selection by indicators

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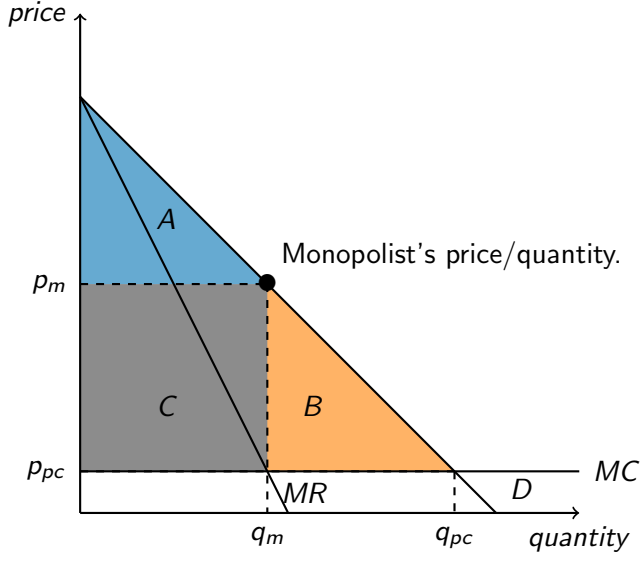
1. **Why price discriminate?**
2. Price discrimination: selection by indicators

Why price discriminate?

- Previously, we studied a monopolist who could only set **one price**.
- In the following diagram, I argue that a monopolist could increase profit if it could set **different prices for different consumers**.

Why price discriminate?: Monopoly diagram



Why price discriminate?: Monopoly diagram

- On the previous slide there are three areas:

1. **Area A**: consumers who are willing to pay a price higher than p_m.
   - This was consumer surplus (when monopolist can only set one price)
   - Monopolist could increase profits if it set higher prices for these consumers.
2. **Area B**: consumers who are willing to pay a price lower than p_m, but higher than MC.
   - This was dead-weight-loss (when the monopolist can only set one price)
   - The monopolist could increase profits if it set lower prices for these consumers and sold to them.
3. **Area C**: this is the current profit of the monopolist.

Why price discriminate?: Monopoly diagram

- In order to fully extract all of area A and B in the previous diagram, the monopolist would have to know the exact willingness to pay of each consumer in the market.

- This is called **perfect price discrimination**.
  - Specifically, the monopolist charges each consumer a price equal to their exact willingness to pay.
  - It is also known as 'first-degree price discrimination'.

- Perfect price discrimination is a useful - but unrealistic - benchmark

- In practice, firms only have limited information about each consumer's willingness to pay.
  - We will now see some alternative forms of price discrimination when firms have more limited information about consumers.

Plan

1. Why price discriminate?
2. **Price discrimination: selection by indicators**

Price discrimination: selection by indicators

- **Selection by indicators** is when the seller divides buyers into groups, setting a different price for each group.

- **Example:** Car sales

Model	Italy	UK
Fiat Uno	21.7	8.7
Nissan Micra	36.1	12.5
Mercedes 190	15.6	12.3

Figure: Car margins across countries

Price discrimination: selection by indicators

- Selection by indicators requires the buyer to have information about which groups consumers belong to.
- Other examples:
  - Movie tickets (students vs non-students)
  - Other forms of geographical price discrimination (pharmaceuticals in developing vs non-developing countries)
  - Different prices due to differences in browsing history/cookies on the internet
- Selection by indicators is also known as 'third-degree price discrimination'.

Price discrimination: selection by indicators

- **Setup**:
- Two markets denoted 1 and 2.
- Demand:
  - market 1: $q_1 = D_1(p_1)$
  - market 2: $q_2 = D_2(p_2)$
- Total cost: $C(Q)$ where the total quantity Q is:

$$Q = q_1 + q_2 = D_1(p_1) + D_2(p_2)$$

- **Aim:** Find the optimal price (the profit maximizing price) in each market.

Price discrimination: selection by indicators

- **Solution**: Idea - **"optimal pricing rule in each market"**

- Method 1: The optimal price is where:

$$MR_1 = MC \text{ and } MR_2 = MC$$

- In the above equation, MR_1 is marginal revenue in market 1, MR_2 is marginal revenue in market 2

- Method 2: Optimal prices must satisfy the elasticity rule:

$$p_1(1 + \frac{1}{\epsilon_1}) = MC \text{ and } p_2(1 + \frac{1}{\epsilon_2}) = MC$$

- In the above equation, ϵ_1 and ϵ_2 are the price elasticities of demand.

Price discrimination: selection by indicators

- Implication of optimal pricing under discrimination by market segmentation:

A seller should charge a higher price in those market segments with more inelastic demand.

- **Why?** Dividing the two optimal prices in terms of the elasticity rule:

$$\frac{p_1}{p_2} = \frac{(1 + \frac{1}{\epsilon_2})}{(1 + \frac{1}{\epsilon_1})}$$

- Since demand elasticities are negative, the elasticity in market 1 is more inelastic than market 2 if $\epsilon_1 > \epsilon_2$.

- If $\epsilon_1 > \epsilon_2$, then $1 + \frac{1}{\epsilon_2} > 1 + \frac{1}{\epsilon_1}$ and so $\frac{(1+\frac{1}{\epsilon_2})}{(1+\frac{1}{\epsilon_1})} > 1$

- Using the above equation implies that $p_1 > p_2$.

Price discrimination: selection by indicators

- Implication of optimal pricing under discrimination by market segmentation:

  A seller should charge a higher price in those market segments with more inelastic demand.

- Note: this statement can be a little confusing when you come to apply it because demand price elasticity is negative
  - Just remember that 'more inelastic' means lower absolute values so that e.g. a market with $\epsilon = -2$ is more inelastic than a market with $\epsilon = -4$

- We will now see particular example of the above statement.

Price discrimination: selection by indicators - example 1, p126

- **Setup:**
- Demand elasticities for market 1 and market 2: $\epsilon_1 = -4, \epsilon_2 = -2$.
- Marginal cost $= 6$
- **Question:** What are the optimal prices in market 1 and market 2?
- **Solution:**

Price discrimination: selection by indicators - example 1, p126

- **Setup:**
- Demand elasticities for market 1 and market 2: $\epsilon_1 = -4, \epsilon_2 = -2$.
- Marginal cost $= 6$
- **Question:** What are the optimal prices in market 1 and market 2?
- **Solution:**
  - Apply elasticity rule ($p_1(1 + \frac{1}{\epsilon_1}) = MC$ and $p_2(1 + \frac{1}{\epsilon_2}) = MC$):

$$p_1(1 - 1/4) = 6$$
$$p_2(1 - 1/2) = 6$$

  - Solving for p_1 and p_2 implies: $p_1 = \$8, p_2 = \$12$.
  - Note that $p_1 < p_2$ since market 1 is more elastic than market 2.

Price discrimination: selection by indicators - example 2, p127

- **Setup:**
- Market 1 demand: $q_1 = 12 - 2p_1$
- Market 2 demand: $q_2 = 4 - p_2$
- Marginal cost $= 1$
- **Questions:**
- 1. What is the optimal uniform price?
- 2. What are the optimal prices in each market when the monopolist can charge different prices in each market?
- 3. How much does profit increase between 1. a uniform price vs 2. different prices?

Price discrimination: selection by indicators - example 2

- **Solution:**

- 1. What is the optimal uniform price?

  - Idea: combine the two markets to a single market with the same price $p = p_1 = p_2$, and apply the usual monopoly solution.

  - Total demand (add curves *horizontally*):
    - $Q = q_1 + q_2 = 12 - 2p_1 + 4 - p_2 = 16 - 3p$ if $p \leq 4$
    - $Q = 12 - 2p$ if p>4 and p ≤ 6

  - Marginal revenue (rearranging demand and using the 'twice the slope' trick):
    - $MR = \frac{16}{3} - \frac{2}{3}Q$ if $Q > 4$
    - $MR = 6 - Q$ if $Q < 4$

Price discrimination: selection by indicators - example 2

- **Solution:**
- 1. What is the optimal uniform price?
  - We will assume for now that demand is positive in both markets, and check that the final price $p \leq 4$.
  - Rearrange for price: $p = \frac{16}{3} - \frac{1}{3}Q$
  - Get MR using 'twice the slope trick': $MR = p = \frac{16}{3} - \frac{2}{3}Q$
  - Use MR=MC and solve for optimal Q: $\frac{16}{3} - \frac{2}{3}Q = 1$. So, $Q = 6.5$
  - Solve for optimal price using Q: $p = \frac{16}{3} - \frac{1}{3}\frac{13}{2} = 3.1667$

Price discrimination: selection by indicators - example 2

- **Solution:**

- 2. What are the optimal prices in each market when the monopolist can charge different prices in each market?

- Since marginal cost is constant, we can treat market 1 and market 2 separately.
  - The main idea is that constant marginal cost implies - for example - that the marginal cost in market 1 is not dependent on the quantity produced in market 2.

  - Market 1:

  - Demand: $q_1 = 12 - 2p_1$

  - Rearrange for price: $p_1 = 6 - \frac{1}{2}q_1$

  - Get MR_1 using 'twice the slope trick': $MR_1 = 6 - q_1$

  - Use $MR_1 = MC$ and solve for optimal q_1: $6 - q_1 = 1$, so $q_1 = 5$

  - Plug in $q_1 = 5$ into demand to get price: $p_1 = 6 - \frac{1}{2} \times 5 = 3.5$

Price discrimination: selection by indicators - example 2

- **Solution:**

- 2. What are the optimal prices in each market when the monopolist can charge different prices in each market?

  - Market 2:

  - Demand: $q_2 = 4 - p_2$

  - Rearrange for price: $p_2 = 4 - q_2$

  - Get MR_2 using 'twice the slope trick': $MR_2 = 4 - 2q_2$

  - Use $MR_2 = MC$ and solve for optimal q_2: $4 - 2q_2 = 1$, so $q_2 = 1.5$

  - Plug in $q_2 = 1.5$ into demand to get price: $p_2 = 4 - 1.5 = 2.5$

Price discrimination: selection by indicators - example 2

- **Solution:**
- 3. How much does profit increase between 1. a uniform price vs 2. different prices?
  - Profit with uniform prices ($Q = 6.5, p = 3.1667$):

$$TR - TC = 6.5 \times 3.1667 - 6.5 \times 1 = 14.08$$

  - Profit with different prices ($q_1 = 5, p_1 = 3.5, q_2 = 1.5, p_2 = 2.5$)

$$\begin{aligned} \text{Market 1:} \quad & TR - TC = 5 \times 3.5 - 5 \times 1 = 12.5 \\ \text{Market 2:} \quad & TR - TC = 1.5 \times 2.5 - 1.5 \times 1 = 2.25 \end{aligned}$$

  - So, total profit with different prices $= 12.5 + 2.25 = 14.75$.
  - Profit increases from 14.08 to 14.75 (i.e. by 0.67) moving from uniform to different prices.

Summary for how to solve these problems (with constant marginal cost)

- Solving for the uniform price:
  - 1. Sum the demand curves horizontally to get the total (combined) demand. The demand curve may have several 'sections' where different markets are operating.
  - 2. Get the marginal revenue for each 'section' of the demand curve.
  - 3. Use MR=MC to solve for the optimal quantity
  - 4. Use the total demand curve to solve for the optimal price.
- Solving for different prices (with constant marginal cost):
  - Constant marginal cost implies - for example - that the marginal cost in market 1 is not dependent on the quantity produced in market 2.
  - Therefore, we can just solve for the monopoly price and quantity in each market separately.

The limits of selection by indicators

- There are often limits to how finely a monopolist can segment a market by different groups.

- For example, consider selling cars for different prices in different locations.
  - What happens if you set different prices at the country level? At the city level? At the suburb level? At the car dealer level?

  - As the monopolist more finely segments the market, the price discrimination scheme might be undermined by *consumer arbitrage*.

  - E.g. consider price discrimination at the car dealer level - here, consumers might change where they buy and instead switch to a lower price dealer, making it difficult to segment consumers this finely.

Summary of key points*

- Understand why a monopoly might find it profitable to price discriminate rather than set a uniform price for all consumers.
- Know that 'selection by indicators' is used when a monopolist can observe some characteristics about the consumers.
- Know how to solve for the optimal prices (and the corresponding total profits, consumer surplus, etc) under selection by indicators using:
  - MR=MC
  - Elasticity rule

*To clarify, all the material in the slides, problem sets, etc is assessable unless stated otherwise, but I hope this summary might be a useful place to start when studying the material.