Second-degree Price Discrimination (Nonlinear Pricing)

- Different prices (for the same customer) for different quantities – nonlinear price schedule
- Discounts for bulk purchases
- Entry fees (or Two-part tariffs):
  - Disneyland
  - Clubs and Gyms
- Telephone service providers and utility companies
  - Turkcell packages
- No easy rules here: finding the best nonlinear price schedule is usually a very complex problem
Two-Part Tariffs

- A lump sum fee: $F$
- A per unit charge: $P$
- Average price paid depends on amount consumed
- Examples:
  - Disneyland
  - Monthly fee plus per-minute charge for phone services
  - Club membership

Example: Turkcell

Each customer has demand:
\[ Q = 120 - 200P \]
where $P$ is measured in YTL/min and $Q$ is measured in minutes/month
\[ \text{MC} = \text{AC} = 0.3 \text{ YTL} \]

Plan A: No monthly fee + uniform per minute charge

1. \[ P = 0.6 - Q/200 \]
2. \[ \text{MR} = 0.6 - Q/100 \]
3. \[ 0.6 - Q/100 = 0.3 \rightarrow Q = 30 \text{ min} \rightarrow 0.45 \text{ YTL/min} \]

Profits = \( (0.45 - 0.3)30 = 4.5 \text{ YTL per customer} \)
Plan B: Fixed monthly fee + per minute charge

- $F = 9$ YTL/month
- $P = 0.3$ YTL/min

How many minutes per month does the customer use?

If he buys the plan he gains $(P(Q) - 0.3)$ for each unit $Q$ he uses and pays 9 YTL. Therefore, best is to use 60 minutes.

His net benefit = $CS - 9 = 60 \times 0.3/2 - 9 = 0$ YTL

The same as his net benefit to not buying the plan. Let’s assume he buys when indifferent

Profits = 9 YTL

Turkcell captures the CS and deadweight loss

**General rule**
1. $P = MC$ = per unit fee $\rightarrow Q$
2. Lump-sum fee = CS (at $P = MC$)

**Practical Difficulties**
1. Customers have different types of demands
2. You may not know which customer has which type

You may offer several packages and let the customer choose
Block Pricing

- We buy many products in large quantities
  - Electricity, water, gas, etc.
- Our demand curve is downward sloping
- Quantity discounts allow firms to extract extra surplus

Demand for electricity by a household
P = 20 – Q
MC = AC = 2

Block Pricing Example

Under uniform pricing
MR = 20 − 2Q

MR = MC \rightarrow 20 − 2Q = 2
\rightarrow
Q^* = 9
P^* = $11

Profits = Revenue-TC = 11(9) − 2(9) = $81
PS = Revenue-TVC = 11(9) − 2(9) = $81
CS = 9(20 − 11)/2 = $40.5
Block Pricing Example

Suppose you sell first 9 units at $11 and additional units at $8

How much electricity will the consumer buy?

12 units

What are the profits now?

Profits = (11 – 2) x 9 + (8 – 2) x 3 = 81 + 18 = $99

Can you do better?

Block Pricing Example

Suppose there are two blocks: up to Q₁, price is p₁, and after Q₁, price is p₂

We must have

\[ p₁(Q₁) = 20 - Q₁ \]

Let Q₂ be the total amount purchased

\[ p₂(Q₂) = 20 - Q₂ \]

\[ \pi = p₁(Q₁)Q₁ + p₂(Q₂)(Q₂ - Q₁) - TC(Q₂) \]

\[ = (20 - Q₁)Q₁ + (20 - Q₂)(Q₂ - Q₁) - 2Q₂ \]

and we must choose Q₁ and Q₂ to maximize this profit...

\[ 20 - 2Q₁ - (20 - Q₂) = 0 \rightarrow Q₂ = 2Q₁ \]

\[ (20 - Q₂) - (Q₂ - Q₁) = MC = 2 \]

Can be solved as:

Q₁ = 6, Q₂ = 12

P₁ = 14, P₂ = 8 (a quantity discount)

Profits = (14 – 2) x 6 + (8 – 2) x 6 x 6 = 72 + 36 = $108

This is the best two-block pricing (this is also known as two-part tariff)

Can do even better with three blocks or more
Bundling/Tying/Tie-In Sales

• A **tie-in sale** occurs if customers can buy one product only if they agree to purchase another product as well
• **Requirements tie-in sales** occur when a firm requires customers who buy one product from the firm to buy another product from the firm
  – You buy a copier, you have to buy the paper from the firm
  – You buy a printer, you have to buy the ink cartridge from the firm
    • In 2002 more than half the revenues of HP from cartridges
    • Producers installed a chip that prevents refilling (now outlawed by EU)
• You cannot observe the relative willingness to pay of different customers
• You keep the price of paper high
  – if high-volume user is more willing to pay for the copier you can extract some of his consumer surplus

Bundling/Tying/Tie-In Sales

• Pure bundling: customers have to buy different goods together
  – Cable TV bundles several channels
  – A CD contains many songs
  – A magazine contains many articles
• Mixed bundling: customers have the option to buy a bundle or one or more components separately
  – Software suites (Microsoft Office)
  – Value meals at McDonald’s
• Why?
  – Cost savings (easier to sell several articles bound together in a magazine)
  – Complementarities (word-processor and spreadsheet are more productive together)
• Another reason could be price discrimination
• Can be used for price discrimination when consumers have different willingness to pay for the goods sold in the bundle
Pure Bundling

Two types of customers, 1 million each

<table>
<thead>
<tr>
<th>Willingness to Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Word Processor</td>
</tr>
<tr>
<td>$120</td>
</tr>
<tr>
<td>$100</td>
</tr>
</tbody>
</table>

Suppose $MC = AVC = 0 \rightarrow$ profit maximization $\leftrightarrow$ revenue maximization
Profit maximizing prices when sold separately: $P_W = $100, $P_S = $100 $\rightarrow r = $400 mil
Profit maximizing price of the bundle: $P = $220 $\rightarrow r = $440 mil
Profits increase by $40 mil

Conditions for Price Discrimination

1. Market power: downward sloping firm demand curve
   - not only monopolies
   - downward sloping demand $\rightarrow$ consumer surplus under uniform price
     - price discrimination is an attempt to capture CS

2. Prevent resale
   - nature of commodity
     - services: haircuts, physical examination, legal advice
   - restrictions on use: student discounts require ID, copyright, etc.

3. Different elasticities of demand
Informational Requirements

- Very good information → FDPD
- Only knows there are high- and low-willingness to pay customers; cannot identify them → SDPD
  - customers self-select
  - quantity discounts
  - tie-in sales
- Knows elasticity is related to identifiable group characteristic, such as a sociodemographic trait → TDPD

Double Marginalization

- Goods are usually sold by manufacturers to wholesalers and then to retailers and to consumers
- If each seller has some market power this may lead to a loss in overall profits
- This is known as double marginalization

![Diagram of Double Marginalization]

Manufacturer → p → Retailer → p → Consumer
Example

Honda uses independent dealers to sell cars to the public
Assume constant MC = AC = 2
\[ P = 20 - Q \]

Where \( Q \) is the number of Hondas sold annually

Honda sells the cars at price \( p \) to the dealers
Assume, for simplicity, that dealers' marginal cost of retailing is zero

Dealer's profits = \((20 - Q - p)Q\)
Maximizing gives \( 20 - 2Q = p \) or \( Q = 10 - p/2 \) and \( P = 20 - 10 + p/2 = 10 + p/2 \)

Honda's profits = \((11 - 2) \times 9 = 81\)
Maximizing gives \( p = 11 \)
Therefore \( Q = 4.5 \) and \( P = 15.5 \)

Honda's Profits = \((11 - 2) \times 4.5 = 40.5\)
Dealer's profits = \((15.5 - 11) \times 4.5 = 20.25\)

Retailer demand \( P = 20 - Q \)
Given any wholesale price \( p \) the dealer chooses according to
retail MR = \( p \)
or
\[ 20 - 2Q = p \]
Therefore, retail MR is wholesale inverse demand
Wholesale MR = \( 20 - 4Q \)
Honda chooses according to
Wholesale MR = \( 20 - 4Q \leq 2 \leq MC \)
\( Q = 4.5, p = 11, P = 15.5 \)

Honda's Profits = 40.5
Dealer's profits = 20.25

What if Honda sells directly?
Suppose marginal cost of retailing directly is zero
\[ MR = 20 - 2Q \leq 2 \leq MC \rightarrow Q = 9, P = 11 \]

Honda's profits = \((11 - 2) \times 9 = 81\)
If marginal cost of retailing directly is \( c \)
\[ MR = 20 - 2Q \leq 2 \leq c \leq MC \rightarrow Q = 9 - c/2, P = 11 + c/2 \]

Honda's profits = \((11 + c/2 - 2 - c) \times (9 - c/2) = (9 - c/2)^2\)
c < 5.27 \(\rightarrow (9 - c/2)^2 > 40.5 \rightarrow \) Honda prefers direct retailing
c > 5.27 \(\rightarrow \) Honda prefers dealer system
Can Honda do better?

What if Honda uses an annual franchise fee, $F$, and wholesale price scheme?

Dealer’s annual profits = $(20 - Q - p)Q - F$

Maximizing gives $20 - 2Q = p$ or $Q = 10 - p/2$ and $P = 20 - 10 + p/2 = 10 + p/2$

Dealer’s profits = $(20 - 10 + p/2 - p)(10 - p/2) - F$

= $(10 - p/2)^2 - F$

Assume that as long as this is non-negative some dealer accepts this deal

What should Honda set $F$?

$F = (10 - p/2)^2$

Honda’s profits = $(10 - p/2)^2 + (10 - p/2)(p - 2)$

Maximizing gives $p = 2$, $Q = 9$ and $P = 11$

Honda’s Profits = 81 same as selling directly

What is going on here?

Honda realizes all the profits from manufacturing and retailing. Since the dealer does the retailing, it costs zero

Profits = $(20 - Q)Q - 2Q$ maximized at $Q = 9$

Since the retailer will choose $Q$ according to $MR = MC$ rule, to make him choose $Q = 9$, Honda should pass the $MC$ as wholesale price to the dealer → set $p = MC = 2$