4: Menu Pricing

Games, Competition and Markets 2024/25

Marco Haan

Faculty of Economics and Business
University of Groningen

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Overview

1. Where We Stand
2. Price Discrimination
3. Menu pricing
4. Damaged Goods

Where We Stand

Topics

1. Preliminaries

Introductory lecture. Review of game-theoretic concepts. Some basic models of competition.

2. Consumer Search

What if consumers have to engage in costly search to find out about products and/or prices?

3. Advertising

What if producers have to inform consumers about their products and/or prices?

4. Menu Pricing

What if firms design different products and different prices for different consumers?

5. Durable Goods

What if a monopolist sells a durable good and cannot commit to future quantities?

6. Switching Costs

What if consumers have to pay extra if they switch suppliers?

7. Behavior-Based Price Discrimination

What if firms can base their prices on a consumer’s past behavior?

8. Vertical control

What if firms sell products to retailers who then sell it to final consumers?

9. Bundling

What if firms can sell bundles of products?

10. Network externalities and compatibility

What if products exhibit network effects: they becomes more (or sometimes less) useful if more consumers use it. Also: when do firms want to make their products compatible with that of their competitor?

11. Platform competition

What if online platforms bring buyers and sellers together? Or consumers and advertisers?

Price Discrimination

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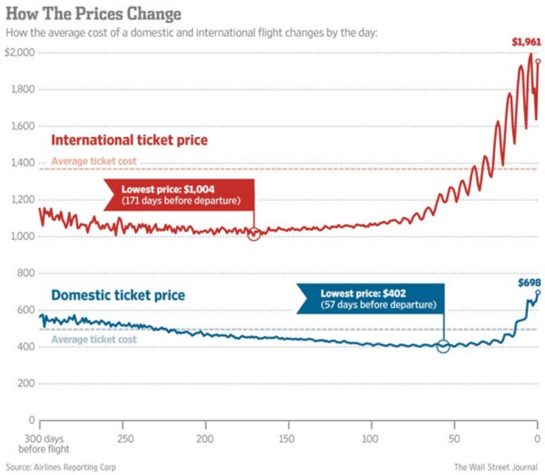
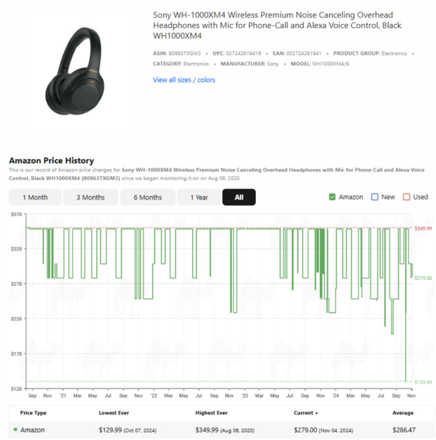
What is Price Discrimination!?

- A seller sells the same product to different buyers at different prices.
- Or: similar products, and price difference is not only due to cost difference.
- This really happens very often:
  - Airlines (different time of purchase, business/tourist class, you often pay less if your stay includes a Saturday night)
  - Telecom (many different packages).
  - Trains (peak/off-peak, senior discounts, 1st and 2nd class).
  - Quantity discounts.
  - But also: your electricity bill.
  - Online! ("dynamic pricing")
- Necessary condition: arbitrage is not possible.

Example: average price for a US flight

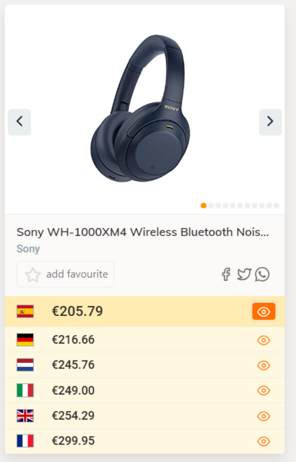


Example: Price at Amazon, over time



Source: www.camelcamelcamel.com

Example: Price at Amazon, across Europe



Source: www.hagglezon.com

Types of price discrimination

- **First degree** (or **perfect** or **personalized pricing**). The firm charges each consumer highest amount she would be willing to pay.
- **Second degree** (or **by self-selection**). The firm cannot distinguish between different types of consumers, but designs products in such a way that consumers choose to reveal themselves by their choices.
- **Third degree** (or **by indicators**). The firm can distinguish between different groups, can charge them different prices and can also avoid arbitrage.

Examples

1. Senior discounts: prove your age to get the senior price. **Third-degree**
2. Student discounts: prove you are a student for student price. **Third-degree**
3. Business class: you don't have to prove that you are (not) a business man to get this rate. Rather, classes (and prices) are designed such that the rich choose to reveal their type. **Second-degree**
4. Mobile phone: different bundles for heavy and light users. **Second-degree**

Menu pricing

Games, Competition and Markets. Lecture 4

Second degree price discrimination

- A firm faces two groups, but cannot tell who belongs to which group.
- Or at least, it cannot base its prices on that.
- There is no card it can ask for.
- For example, some consumers are willing to pay a lot for high quality, and some other consumers that are willing to pay far less.
- Still, also here, there may be a possibility to price discriminate.
- The firm may induce consumers to self-select.
- As an example, take 1st and 2nd class on your train.

Second-degree price discrimination, two types

- Utility of consuming quality q: $U(\theta, q)$.
- Two types of consumers.
- Low types: θ_1. High types: $\theta_2 > \theta_1$.
- Proportion of type-2 consumers is λ.
- Cost of producing quality q: $c(q)$.
- Suppose the monopolist offers two packages: (p_1, q_1) and (p_2, q_2).
- The idea is that each type voluntarily chooses the package designed for her.

Some assumptions

- $U(\theta_2, q) > U(\theta_1, q)$ for all q.
- $U_2 > 0$.
- $U_{22} < 0$.
- $c' > 0$.
- $c'' \leq 0$.
- **Single-crossing condition**: For $q_1 < q_2$,

$$U(\theta_2, q_2) - U(\theta_2, q_1) > U(\theta_1, q_2) - U(\theta_1, q_1)$$

(hence, U is supermodular).

The monopolist's problem

$$\max_{p_1, q_1, p_2, q_2} (1-\lambda)\left(p_1 - c(q_1)\right) + \lambda\left(p_2 - c(q_2)\right)$$

s.t.

$$\begin{cases} U(\theta_1, q_1) - p_1 \geq U(\theta_1, q_2) - p_2 & \text{(IC-1)} \\ U(\theta_2, q_2) - p_2 \geq U(\theta_2, q_1) - p_1 & \text{(IC-2)} \\ U(\theta_1, q_1) - p_1 \geq 0 & \text{(IR-1)} \\ U(\theta_2, q_2) - p_2 \geq 0 & \text{(IR-2)} \end{cases}$$

With complete information...

$$\max_{p_i, q_i} p_i - c(q_i)$$

$$\text{s.t. } U(\theta_i, q_i) - p_i \geq 0$$

At the optimal solution, the constraint will be binding.

$$\max_{q_i} U(\theta_i, q_i) - c(q_i).$$

This implies

$$\begin{aligned} U_2(\theta_i, q_i) &= c_i'(q_i) \\ p_i &= U(\theta_i, q_i). \end{aligned}$$

The consumer is indifferent between buying and not buying.

The welfare maximizing solution...

$$SW_i = (p_i - c(q_i)) + (U(\theta_i, q_i) - p_i) = U(\theta_i, q_i) - c(q_i) .$$

This yields exactly the monopolist's complete information problem!

Back to the monopolist's incomplete information problem

$$\max_{p_1,q_1,p_2,q_2} (1-\lambda)\left(p_1 - c(q_1)\right) + \lambda\left(p_2 - c(q_2)\right)$$

s.t.

$$\begin{cases} U(\theta_1, q_1) - p_1 \geq U(\theta_1, q_2) - p_2 & \text{(IC-1)} \\ U(\theta_2, q_2) - p_2 \geq U(\theta_2, q_1) - p_1 & \text{(IC-2)} \\ U(\theta_1, q_1) - p_1 \geq 0 & \text{(IR-1)} \\ U(\theta_2, q_2) - p_2 \geq 0 & \text{(IR-2)} \end{cases}$$

(IR-1) must be binding...

$$\max_{p_1,q_1,p_2,q_2} (1-\lambda)\left(p_1 - c(q_1)\right) + \lambda\left(p_2 - c(q_2)\right)$$

s.t.

$$\begin{cases} U(\theta_1, q_1) - p_1 \geq U(\theta_1, q_2) - p_2 & \text{(IC-1)} \\ U(\theta_2, q_2) - p_2 \geq U(\theta_2, q_1) - p_1 & \text{(IC-2)} \\ U(\theta_1, q_1) - p_1 = 0 & \text{(IR-1)} \\ U(\theta_2, q_2) - p_2 \geq 0 & \text{(IR-2)} \end{cases}$$

But then (IR-2) is strictly satisfied

$$\max_{p_1,q_1,p_2,q_2} (1-\lambda)\left(p_1 - c(q_1)\right) + \lambda\left(p_2 - c(q_2)\right)$$

s.t.

$$\begin{cases} U(\theta_1, q_1) - p_1 \geq U(\theta_1, q_2) - p_2 & \text{(IC-1)} \\ U(\theta_2, q_2) - p_2 \geq U(\theta_2, q_1) - p_1 & \text{(IC-2)} \\ U(\theta_1, q_1) - p_1 = 0 & \text{(IR-1)} \end{cases}$$

(IC-2) must be binding...

$$\max_{p_1,q_1,p_2,q_2} (1-\lambda)\left(p_1 - c(q_1)\right) + \lambda\left(p_2 - c(q_2)\right)$$

s.t.

$$\begin{cases} U(\theta_1, q_1) - p_1 \geq U(\theta_1, q_2) - p_2 & \text{(IC-1)} \\ U(\theta_2, q_2) - p_2 = U(\theta_2, q_1) - p_1 & \text{(IC-2)} \\ U(\theta_1, q_1) - p_1 = 0 & \text{(IR-1)} \end{cases}$$

Now add (IC-1) and (IC-2)

$$\begin{aligned} U(\theta_1, q_1) - p_1 &\geq U(\theta_1, q_2) - p_2 \\ U(\theta_2, q_2) - p_2 &= U(\theta_2, q_1) - p_1 \end{aligned}$$

$$U(\theta_2, q_2) - U(\theta_2, q_1) \geq U(\theta_1, q_2) - U(\theta_1, q_1)$$

But this must imply $q_2 > q_1$. From (IC-2)

$$p_2 - p_1 = U(\theta_2, q_2) - U(\theta_2, q_1) > U(\theta_1, q_2) - U(\theta_1, q_1)$$

hence (IC-1) is satisfied.

Hence

$$\max_{p_1,q_1,p_2,q_2} (1-\lambda)\left(p_1 - c(q_1)\right) + \lambda\left(p_2 - c(q_2)\right)$$

s.t.

$$\begin{cases} U(\theta_2, q_2) - p_2 = U(\theta_2, q_1) - p_1 & \text{(IC-2)} \\ U(\theta_1, q_1) - p_1 = 0 & \text{(IR-1)} \end{cases}$$

$$\begin{aligned} U_2(\theta_1, q_1) &= \lambda c'(q_1) + (1-\lambda) U_2(\theta_2, q_1) \\ U_2(\theta_2, q_2) &= c'(q_2). \end{aligned}$$

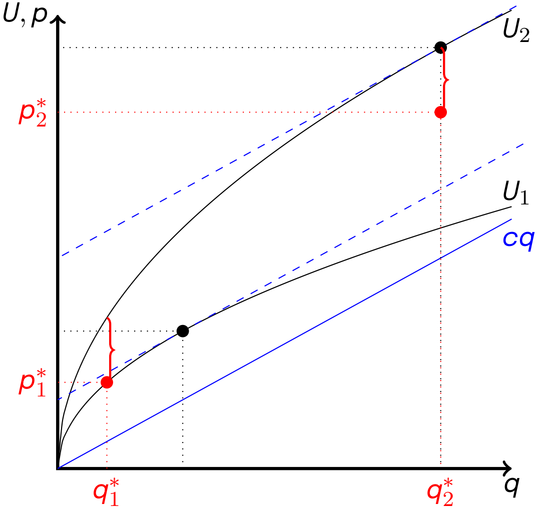
Solving yields

$$
\begin{aligned}
U_2(\theta_1, q_1) &= \lambda c'(q_1) + (1-\lambda) U_2(\theta_2, q_1) \\
U_2(\theta_2, q_2) &= c'(q_2).
\end{aligned}
$$

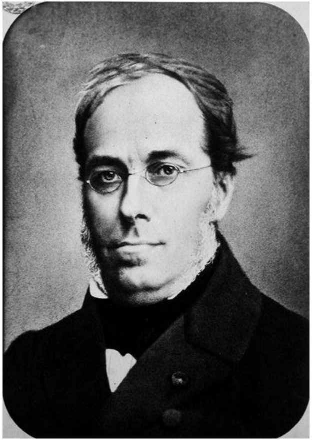
Note:

- No distortion at the top.
- Informational rent.
- No surplus at the bottom.

Important caveat: this assumes that it is indeed profitable to offer the two varieties.


U, p
U_2
p_2^*
U_1
cq
p_1^*
q_1^*
q_2^*
q

Dupuit (1849) (!)



"What the company is trying to do is prevent the passengers who can pay the [first]-class fare from traveling [second] class; ***it hits the poor, not because it wants to hurt them, but to frighten the rich.****"*

Damaged Goods

Games, Competition and Markets. Lecture 4

Damaged Goods

- In May 1990, IBM announced the introduction of the Laserprinter E, a lower cost alternative to its popular Laserprinter.
- The E looked very much like the original Laserprinter, except that the E model printed text at 5 pages per minute (ppm), as opposed to 10 ppm for the Laserprinter.
- The retail price for the E model was some $1400, for the Laserprinter $2300.

What was the difference?

PC Magazine (1990)

"The controllers in our evaluation unit differed only by virtue of four socketed firmware chips and one surface mounted chip. PC Labs' testing of numerous evaluation units indicated that the Laserprinter E firmware in effect inserts wait states to slow print speed."

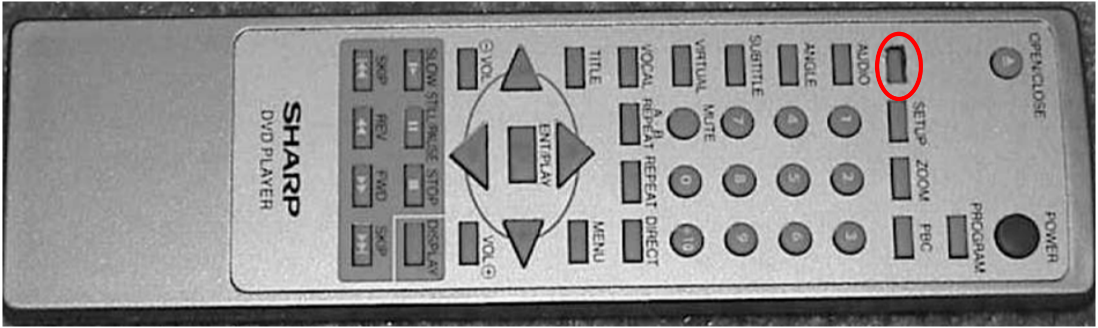
- In other words: IBM has added chips to the LaserPrinter E that **perform no function other than to make the machine pause and hence print more slowly**.
- This is the *only* difference between the two printers.

Another example

- In the early 1990s, Intel decided to introduce a low cost, alternative to its 486DX microprocessor: the 486SX.
- PC Week: "the 486SX is an exact duplicate of the 486DX, with one important difference – **its internal math coprocessor is disabled**."
- Whereas it sold the 486DX for $588, Intel sold the 486SX – identical, but with the math coprocessor physically destroyed, for just $333.

Yet another example (McAfee, 2007)

- Sharp sold many DVD players, including the DVE611 and DV740U.
- The major difference is the former's ability to play PAL DVD discs. PAL is the European standard, while North America uses NTSC.
- The DV740U seems not to be able to play PAL discs to an NTSC television.
- In fact, people found out that it *can*, but this facility is suppressed by using a different plastic cover on the remote, which hides a critical button.
- "Enthusiasts have discovered a simple means to turn the less expensive unit into a full-featured unit, simply by cutting a hole in the plastic cover."


SHARP
DVD PLAYER
OPEN/CLOSE
POWER
PROGRAM
AUDIO
SETUP
ZOOM
PBC
ANGLE
SUBTITLE
VIRTUAL
MUTE
VOCAL
A-B REPEAT
REPEAT
DIRECT
TITLE
MENU
ENT/PLAY
VOL
SLOW
STILL/PAUSE
STOP
DISPLAY
SKIP
REV
FWD

There are many other examples

- Before a hurricane, Florida residents owning a Tesla with a small battery suddenly found they temporarily had a large battery – to help them evacuate.
- Software that comes in a full version and a restricted (student) version.

- What all these examples have in common, is that the producer deliberately takes a costly action to damage its product and sell it at a lower price.
- Explanation: second degree price discrimination.
- Offer a new product with a much lower quality to open up a new market.
- But quality has to be low enough to avoid cannibalizing high-quality sales.

Damaged Goods

Fabrikanten doen hun best om de spullen die ze aan de man willen brengen zo goed mogelijk te krijgen. Toch? Nou, niet altijd. Er zijn er die hun producten moedwillig slechter maken of soms zelfs beschadigen voordat ze naar de klant gaan.

Tekst: **André Kesseler**

De basis

Eerst maar even het waarom. Waarom zou iemand zijn eigen, met veel pijn, moeite en geld gemaakte product minder goed willen maken? We vragen het Marco Haan, hoogleraar industrial organization aan de Rijksuniversiteit Groningen. “Het valt binnen wat wij prijsdiscriminatie noemen”, zegt hij. “Verschillende prijzen voor verschillende consumenten. Je krijgt bijvoorbeeld korting als je een studenten- of 65+-kaart laat zien. Maar als je mensen niet kunt of mag beoordelen op hun eigenschappen, kun je sommige klanten nog steeds meer laten betalen dan andere. In de negentiende eeuw werd bijvoorbeeld bedacht wat nu een klassiek voorbeeld van prijsdiscriminatie is. In Europese treinen werd de eerste, tweede en derde klasse ingevoerd. Het idee erachter was dat sommige rijke mensen bereid zijn om meer te betalen. Die konden natuurlijk niet bij de kaartverkoop om een loonstrookje worden gevraagd. Hoe krijg je ze dan zover dat ze vrijwillig meer betalen voor een treinreis? Door van de derde klasse een soort veredeld veevervoer te maken.”

Jules Dupuit, een çiviel ingenieur en wetenschapper, was de eerste die op grond van de verschillende treinklassen de basis van prijsdiscriminatie uitlegde. De motivatie van de spoorwegen om zulke slechte accommodaties aan te bieden - zelfs als het weinig zou kosten om ze te verbeteren - was volgens hem niet om hun minder kapitaalkrachtige passagiers te treiteren. Het doel was de reiziger die de eerste klasse kon betalen ervan te weerhouden naar de derde klasse te gaan. “Het is niet om de armen te straffen, maar om de rijken bang te maken.”

Hoe dan ook, dat zoeken naar een onaantrekkelijkere, maar goedkopere optie om aan de wensen van zoveel mogelijk klanten te voldoen, neemt soms bizarre vormen aan. Dan hebben we het over *damaged goods*.

KIJK Magazine, november 2024

De basis

Eerst maar even het waarom. Waarom zou iemand zijn eigen, met veel pijn, moeite en geld gemaakte product minder goed willen maken? We vragen het Marco Haan, hoogleraar industrial organization aan de Rijksuniversiteit Groningen. “Het valt binnen wat wij prijsdiscriminatie noemen”, zegt hij. “Verschillende prijzen voor verschillende consumenten. Je krijgt bijvoorbeeld korting als je een studenten- of 65+-kaart laat zien. Maar als je mensen niet kunt of mag beoordelen op hun eigenschappen, kun je sommige klanten nog steeds meer laten betalen dan andere. In de negentiende eeuw werd bijvoorbeeld bedacht wat nu een klassiek voorbeeld van prijsdiscriminatie is. In Europese treinen werd de eerste, tweede en derde klasse ingevoerd. Het idee erachter was dat sommige rijke mensen bereid zijn om meer te betalen. Die konden natuurlijk niet bij de kaartverkoop om een loonstrookje worden gevraagd. Hoe krijg je ze dan zover dat ze vrijwillig meer betalen voor een treinreis? Door van de derde klasse een soort veredeld veevervoer te maken.”

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Damaged Goods

- Deneckere and McAfee (1996).
- A monopolist offers a good with quality q_2.
- He can also ”damage” the good and produces quality $q_1 < q_2$.
- Marginal costs of producing the damaged goods: $c_1 > c_2$.
- Two types of consumers, valuations $\theta_i V(q)$, $\theta_2 > \theta_1$.
- Fraction of type 1 in the population is λ.
- Assumptions:
    1. Absent the damaged good, the monopolist would find it most profitable to serve only the type 2 consumers.
    2. When he would only sell the damaged good, he would find it most profitable to sell it to both.

Assumption 1

Absent the damaged good, the monopolist would find it most profitable to serve only the type 2 consumers.

- Only serving the high types, profit-maximizing price would be $p_2 = \theta_2 V(q_2)$.
- Profits: $\Pi_H = (1-\lambda)\left(\theta_2 V(q_2) - c_2\right)$.
- To serve both consumers: $p_2 = \theta_1 V(q_2)$.
- Profits: $\Pi = \theta_1 V(q_2) - c_2$.
- Hence $(1-\lambda)\left(\theta_2 V(q_2) - c_2\right) > \theta_1 V(q_2) - c_2$
- or $\left(\theta_1 - (1-\lambda)\,\theta_2\right) V(q_2) < \lambda c_2$.

Assumption 2

When he would only sell the damaged good, he would find it most profitable to sell it to both.

- Only serving the high types, he would set $p_1 = \theta_2 V(q_1)$.
- Profits: $\Pi_D = (1-\lambda)\left(\theta_2 V(q_1) - c_1\right)$
- To serve both consumers, he would set $p_1 = \theta_1 V(q_1)$.
- Profits $\Pi = \theta_1 V(q_1) - c_1$.
- Hence, we need $\theta_1 V(q_1) - c_1 > (1-\lambda)\left(\theta_2 V(q_1) - c_1\right)$

So

- $\Pi_D = (1-\lambda)(\theta_2 V(q_1) - c_1)$
- $\theta_1 V(q_1) - c_1 > (1-\lambda)(\theta_2 V(q_1) - c_1)$
- When selling both goods: $\Pi_{HD} = \lambda (p_1 - c_1) + (1-\lambda)(p_2 - c_2)$,
- As before: $p_1 = \theta_1 V(q_1)$ and $p_2 = \theta_2 (V(q_2) - V(q_1)) + p_1$.
- Hence $\Pi_{HD} =$

$$
\begin{aligned}
&= \lambda (\theta_1 V(q_1) - c_1) + (1-\lambda)(\theta_2 (V(q_2) - V(q_1)) + \theta_1 V(q_1) - c_2) \\
&= (1-\lambda)(\theta_2 V(q_2) - c_2) + \theta_1 V(q_1) - \theta_2 V(q_1) + \lambda\theta_2 V(q_1) - \lambda c_1 \\
&= \Pi_H + \theta_1 V(q_1) - \theta_2 V(q_1) + \lambda\theta_2 V(q_1) - \lambda c_1 \\
&= \Pi_H + (\theta_1 V(q_1) - c_1) - (1-\lambda)(\theta_2 V(q_1) - c_1).
\end{aligned}
$$

- Thus $\Pi_{HD} > \Pi_H$!

Thank you for your attention

Marco Haan

Faculty of Economics and Business
University of Groningen

May 6, 2025