Price Discrimination

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Introduction

Key assumption of last lecture was uniform pricing

- Everyone pays same for ever unit of the good
- Drawn from competitive market, where it makes sense
  - Same marginal cost of production, so competition drives
- Much less obvious with a monopoly

Today we’ll explore many alternative ways of pricing

1. Perfect or first-degree price discrimination
2. Second-degree or quantity-based price discrimination
3. Third degree or identity-based price discrimination
4. Other common forms of price discrimination
5. Policy applications and implications

- When is price discrimination beneficial and when harmful?
- Price discrimination in the design of auctions
- Price discrimination in taxation and criminal punishment
The idea of first-degree price discrimination

First-degree price discrimination is ideal:

1. Charge every person personalized price
2. Different price for each unit sold
3. Match everything exactly to willingness-to-pay
   - Capture full surplus consumers gain

Rarely observed in real world (theoretical benchmark), but

1. Bargaining institution with very competent bargainer
2. Personalized pricing systems on the internet
3. CVS coupon systems

Best possible thing for monopolist, gets everything

- Therefore companies are always looking for better ways
- But terrible for consumers, gain no surplus
- But what about total social value?
  - Very attractive in many dimensions
First-degree price discrimination is highly efficient

- In fact, as efficient as perfect competition
- Every consumer willing to pay above cost served
  1. Can’t make anyone pay more than worth to them
  2. So charge them exactly that, for each unit
  3. Anytime willing-to-pay above cost, profit available
  4. Thus monopoly sells efficiently

Why does 1st degree discrimination do so well?

- Selling more doesn’t require lowering price
- Seller can capture full value created
- Thus tries to maximize value created

However, seller captures all value

- Consumers gain no surplus
  ➞ Distributive issues important objection
Thus perfect price discrimination often unpopular

- But more efficient...so should be possible to redistribute
- Economists advocate pairing with redistributive method
  1. Bidding for right to monopoly (franchise)
     - Government auction, captures all profits for other things
  2. Profit taxes
     - Government taxes away profits, distributes as pleases
  3. Labor unions
     - Unions extract profits as higher wages

None of these solutions as perfect as it sounds

- Redistributive authority, competitor needs to know profits
- Also may be benefits not to redistributing
  - Allows firm to capture full value created (Lecture 13)
- Lessons apply to broader price discrimination
Whatever its merits, first-degree discrimination difficult

- This is why we rarely see it in practice
- Barriers to implement include?
  1. Administrative and “menu” costs
     - Requires quoting different price to consumers
     - Could they even process this? Predict? Plan?
  2. Fairness constraints
     - Many people think that price discrimination is unfair
     - Can alienate consumers
  3. Arbitrage and keeping track of consumers
     - Drug companies and publishers in developing countries
  4. Information about willingness to pay
     - Most important, how to know what to charge each?
     - Fundamentally, distortion because monopolist *uniformed*
Non-linear pricing and quantity discounts (surcharges)

Thus, in practice, price discrimination much less perfect

- One way firms commonly do this is *non-linear tariffs*
  - Different prices for different numbers of units
  - Often choice of different discrete bundles

- Examples of this (typically discount) abound?
  1. Bulk discounts in commercial goods
  2. Punch cards for loyal customers
  3. New York Times: free for 20 articles, charge after that
  4. Pricing of cloud file-sharing services
  5. Income taxes: rates vary depending on income level

- Goal: consumers *self-select* into right price
  - Lower price if they don’t mind storing, keeping track of card
  - Lower price to those who don’t value enough to use often

⇒ Not as effective, as must incentivize limited cheating
Qualities of service and multiple products

Can offer not just different *quantities* but also *qualities*

- This is very common strategy?
  - Classes of service in airlines
  - Qualities of rooms at a hotel
  - Different levels of American Express card
  - Tiers of cable and internet service

- Common observation: low-quality deliberately degraded
  - Not that the airline can’t offer better service
  - Deliberately makes Coach experience bad
  - This forces those who can to pay for business, first
  - Thus monopolist distorts *quality* as well as *quantity*
    - Particularly large for low-end customers
    - Less reason to make first-class worse

- We’ll return to these issues in Lecture 14
Explicit price discrimination

Another, imperfect, approach is to group people

- Use some objective characteristic
- Charge different prices to people with these characteristics
  \[ \Rightarrow \] Charge higher prices to those with more elastic demand
- Most commonly used in entertainment, transportation?
  1. Senior, student and other discounts
  2. Library surcharges for journals
  3. Educator and public servant discounts
  4. Prescription drug pricing in developing world
  5. Home and office software licensing
  6. Unemployment insurance, height tax and other tagging
    \[ \Rightarrow \] More on this below
  7. Resident and tourist pricing in public services
  8. Discounting menus in foreign languages (Chinese)
Pricing principles for explicit discrimination

Before discrimination, markets pooled; demand \( \bar{Q} = Q_1 + Q_2 \)

- Let’s derive the elasticity of pooled demand?
- Elasticity of total is \( \frac{d\bar{Q}}{d\bar{p}} \frac{\bar{p}}{\bar{Q}} \)
  \[ \left( \frac{dQ_1}{dp} + \frac{dQ_2}{dp} \right) \frac{\bar{p}}{Q_1+Q_2} = \frac{Q_1 \epsilon_1 + Q_2 \epsilon_2}{Q_1 + Q_2} \]
  - Thus \( \bar{\epsilon} \) is quantity-weighted average elasticity
- Lerner Rule, price absent discrimination is \( \frac{\bar{p} - MC}{\bar{p}} = \frac{1}{\bar{\epsilon}} \)

After discrimination, price in each market is \( \frac{p_i - MC}{p_i} = \frac{1}{\epsilon_i} \)

\[ \Rightarrow \] Discrimination useful to extent that elasticities are different
\[ \Rightarrow \] Price rises in market with lower elasticity, falls in other
  - We call market where rises “high” or “strong” market
  - Market where price falls is “low” or “weak”

\[ \Rightarrow \] Output and social welfare may rise or fall
  - Depends whether price rises more in high or falls more in low
  - We’ll analyze this more in a bit
  - Clear: profits rise (firm’s choice), high worse off, low better
Price discrimination takes related (more specific) forms

- Some of these achieve efficiency just like perfect
- Also transfer all value to the monopolist

1. Bundling: two products cheaper together than apart
   - Two pieces of software free to produce: Excel and Word
   - Some people like Excel better, some Word
   - Values for the package much more homogeneous
   - Then monopolist can capture much more value in package
   ⇒ Packaging/bundling clarifies information

2. Extreme form is “two-part tariff”
   - Extreme form of bundling; charge for right to buy
   - Low pricing for various services, near (or below) cost
   - Rides at Disneyland, Costco, Rhapsody, etc.
   - Achieves efficiency, but takes all from consumers
   ⇒ Just like perfect price discrimination (information perfect)
Loyalty, sales and add-ons

Other forms of discrimination less perfect, efficient

1. Loyalty and personalized discounts
   - CVS and others track your purchasing
   - Offer targeted discounts based on purchasing behavior
   - Helps get closer to perfect, but incentives to manipulate

2. Inter-temporal (sales)
   - Department, outlet stores’ periodic sales/discounts
   - Those whose demand is time-sensitive willing to pay a lot
   - Thus discriminate by offering less to those willing to wait
   - Airline ticket and hotel room pricing similar

3. Add-ons and obfuscation
   - Hotels, printers, banks and others cheap to get into
   - But soak you for lots of extras once you are on board
   - Discriminate against those who don’t read small print
When are prices discriminatory?

Some of these practices can be explained by costs

1. Peak-load pricing leads to variation across time
   - Little marginal cost of movie tickets when not full
   - Very valuable during rush times

2. May be cheaper to sell goods in bundles
   - Most of cost of software is the CD; cheaper to put together

3. Some populations cheaper to serve than others
   - Different prices for different insurance risks
   - Senior citizens less disruptive to other movie watchers

Then what makes something price discrimination?

1. Different prices reflect demand not cost conditions
   - This would never happen in competitive market
   - Efficiency variation even more likely in competitive

2. Lack of variation when costs vary just as discriminatory
Framework for the effects of 3rd-degree discrimination

Let’s return to whether 3rd degree discrimination is good:

1. Does it raise output? Which price moves more?
2. Does it raise social welfare?
   - Might lower even with more output as valued more in High
3. Could it benefit consumers? Needs to raise welfare a lot

Clear: if Low unserved without discrimination, pure benefit

- If not, think about optimum before and after discrimination?
- Before, we set $\pi'_H(\bar{p}) + \pi'_L(\bar{p}) = 0$
  - $\pi'_H(\bar{p}) > 0$ and $\pi'_L(\bar{p}) < 0$; balance each other
- After discrimination $\pi'_H(p_H) = 0$ and $\pi'_L(p_L) = 0$
- With constant MC, $\pi'(p) = (p - c)Q'(p) + Q(p)$
  - Exogenous competition $\ddot{q}$, $\pi'(p) = (p - c)Q'(p) + Q(p) - \ddot{q}$
  $\implies$ Discrimination moves $\ddot{q} \equiv \pi'_H(\bar{p}) \equiv -\pi'_L(\bar{p})$ from high to low
Output and social welfare effects of discrimination

We can use this to calculate impact on output, welfare

1. Output?
   - How much does change in competition affect output?
     - Last class we showed \( \rho = \rho_q \equiv \frac{dq^*}{dq} \)
     - Quantities thus change proportional to average \( \rho \) times \( \tilde{q} \)
     - \( \tilde{q} \) same in markets, so net effect \( (\bar{\rho}_L - \bar{\rho}_H) \tilde{q} \)
     - Thus raises output if (average) PT higher in L

   \[ \implies \text{For example, if both demands linear, no effect on output} \]
   - Could test based on discriminatory prices

2. Welfare?
   - The externality is the mark-up \( m \equiv p - c \)
   - So welfare rises if \( \bar{\rho}m \) greater in low market
     - But \( m \) greater in higher market, by definition

   \[ \implies \text{More stringent than increasing output} \]
Consumer surplus effects of discrimination

We can use a similar approach to measure effect on CS

- Now view move to discrimination as change in cost?
- Prior to discrimination (denote by subscript $n$), balance $\pi'$
- One percent price change has equal gains and losses
  \[ \epsilon_n^H q_n^H (MR_n^H - c) = -\epsilon_n^L q_n^L (MR_n^L - c) \]
  \[ \implies \Delta c^L = -\frac{\epsilon_n^H q_n^H}{\epsilon_n^L q_n^L} \Delta c^H \]
- Cost increase harms consumers equal to $\rho q$
  - Basic consumer surplus formula

\[ \implies \text{Benefits consumers if } \frac{\rho q^L \epsilon_n^H q_n^H}{\epsilon_n^L q_n^L} > \rho q^H \]
- One natural simplification is to cancel quantities
  - $\bar{q}^L > q_n^L$, $\bar{q}^H < q_n^H$ by law of demand

\[ \implies \text{If } \frac{\rho^L}{\rho^H} > \frac{\epsilon_n^L}{\epsilon_n^H} \text{ then raises CS; why is this more stringent?} \]
- $\frac{\bar{p}}{\epsilon} \approx m_d$, so $\bar{p}^L m_d^L > \rho^H m_d^H$, more extreme than average
Can effects be as unpredictable as they look?

That was a bit complicated, but can be solved

- But results are a bit puzzling
- Everything seems ambiguous, depends on details
- But we know perfect price discrimination...
  1. Produces more and is more socially efficient
  2. Reduces consumer surplus
- We can also get to perfect by many 3rd-degree
  - Slice up market once, then slice up submarkets, etc.

⇒ Any given 3rd-degree ambiguous, eventually clear
- Suggests that “typical” slicing of demand falls in right way
- Simple example:
  - Segment for everyone willing-to-pay above/below $x$
  - If $x < \bar{p}$ don’t change in high, serve low, good for all
  - If $x > \bar{p}$ serve all in high, drop price in low

⇒ Welfare increases every step, likely more accurate
Auctions and the monopoly problem

Common application of price discrimination is auction design

- Auctions very much like monopoly: set reserve price
  1. Higher price means less sales, but higher price
  2. Only difference is opportunity cost of sale
     - Determined by other buyers’ willingness-to-pay
- Quantity is probability of sale, revenue is $p [1 – F(p)]$
  - $F$ is cumulative distribution of values
- If marginal revenue decreasing, award to highest value
  - Marginal revenue is opportunity cost
- English auction a simple implementation of this
- But this assumes everyone has same marginal revenue!
- What if some sellers are more elastic?
  - This means they are expected to value less
  - Elasticity from distribution of values
Then you want to discriminate in favor of elastic buyers

- You can give them a “handicap”
- This forces others not just to beat them by a lot
- This is beneficial intuitively because:
  - Forces bidders with higher value to admit this
  - If he only had to win by little, he would just pay low value
  - But if he has to win by a lot you can get more out of him
  - Without such discrimination, uniform reserve for everyone!

This sort of discrimination works exactly like standard

1. Compared to no discrimination, lower overall reserve
   → Those thought to have low values win more often when high
2. High value bidders (inefficiently) win less often
   - But pay higher price, so profitable
3. Similar pass-through analysis can be applied
On Tuesday, we’ll talk lots about redistributive taxation

- But basic goal is much like monopoly:
  1. Want to raise revenue to redistribute
     - From each according to ability...
  2. But tax on everyone discourages work, lowers revenue

- Could solve if you knew everyone’s ability to earn
  1. Just charge them this, don’t worry about discouraging work
  2. Equivalent of perfect price discrimination

- Absent this, use imperfect forms of price discrimination
  1. Find categories to put people
  2. Charge higher taxes to those with greater earning potential
  3. Allows more redistribution without high taxes on margin
  4. Exactly the same logic as 3rd-degree discrimination!

- Obvious category height: easy to observe, hard to change
  1. Data shows tall earn more! Should we be taxing height?
Mankiw and Weinzierl’s case for taxation of height

![Graph showing probability of height group being in each wage bin vs. mean hourly wage ($) for Short, Medium, and Tall individuals.]

- Short
- Medium
- Tall

Weyl (Fall 2011)
Broader forms of tagging

More broadly (and seriously) trade-off key in policy

- One hand: don’t want to distort decisions, tax directly
- Other: if clear, price discriminations tells us to use
- Many areas of public policy can be interpreted in this way

1. Affirmative action and racial preferences
   - Basing too much on income may discourage parental work
   - Cannot change their race, minorities poorer on average
   =⇒ Price discrimination suggests favorable treatment

2. Complicated tagging and deductions in taxes
   - Aid to handicapped, single mothers, unemployed, etc.
   - If people cannot easily adjust, useful “tag” for discrimination

=⇒ Economists should not instinctively oppose

- While seems to violate equity, 2nd welfare theorem...
- Actually just follow from logic of price discrimination
Intentions, situation and criminal justice

One particularly interesting instance is criminal justice

- Becker famously argued justice like monopoly problem
- Enforcement, jail time are costly, activity bad
  - Costly to police, uncompensated loss to punished
    → Higher elasticity, more enforcement called for
- Different circumstances imply different elasticities
  → Punishments meted out should depend on these
- Examples?
  1. Age of offender
     - Young get off with lighter sentence as less planning
  2. Degree of murder
     - More planned, more responsive it is to incentives
  3. Temporary insanity defense
- More general lesson about why motive, intention matters