# Pricing to Mass Markets

Simple Monopoly Pricing,
Price Discrimination and
the Losses from Monopoly

# Many Buyers

- Costly to set individual prices to each consumer to extract their individual willingness-to-pay.

- If set different prices, some consumers might re-sell to others. Your buyers might be potential competitors.

- Using a discounting strategy may cause some consumers to wait for

# Information Problems

- Sellers do not know buyers' willingnesses-to-pay

- Buyers do not know sellers' costs

- May have a good statistical idea of distribution of types in the population.

# Some Questions

- *Why do unions sometimes strike?*
    - Why do unions ever strike in practice?
    - When would you expect that strikes are most likely?
- *Why do disputes ever go to court?*
    - Why do disputes ever reach the courtroom in practice?
    - When would you expect that court trials are most likely?
    - Are most disputes settled out of court?

# Car Selling

- Seller has many cars for sale. Each is worth $1,000
- There are two kinds of buyers

| Type | Value | Proportion of Population |
|------|-------|--------------------------|
| High | $1,100 | ? |
| Low | $1,040 | ? |

# One-sided Private Information

- Seller does not know each individual buyer's type but knows the proportion of each type
- Buyer's know their own type

# Bargaining

- Seller makes take-it-or-leave-it offer to any potential buyer
- Must offer the same price to all:
  - Charge $1,040 and get expected profit of $40
  - Charge $1,100 and get expected profit of $50
  - These are the only two price candidates
- Seller takes a 50% chance of not realising gains from trade

# No Breakdown

| Type | Value | Proportion of Population |
|------|-------|--------------------------|
| High | $1,100 | ? |
| Low | $1,060 | ? |

# Bargaining Experiment

- Pair-off

- Decide who is the seller and buyer

- If seller's last name is from A-M, they value the good at $1. Otherwise, they value it at $5

- The buyer values the good by $2 more than the seller's value.

- You have 5 minutes, tell me as soon as you have an agreement

# Experiment #2

- Switch pairs and choose roles
- If seller's birthday is an odd numbered year (say 1967), their value is $1. Otherwise it is $5. DO NOT REVEAL THIS TO THE BUYER (YET)
- The buyer values the good $2 more than the seller
- Same deal on reporting.

# Screening

- When it does not have information, the seller may miss out on valuable trades

- What actions can the uninformed seller take to improve this?

- Can the seller use *screening*? That is, structure negotiations to reveal information.

# Example again ...

- Suppose agreement may be reached immediately or one week later
- Buyer dislikes waiting and will evaluate costs and benefits at 80% of this week's value.
- Seller has no delay costs.
- The seller can commit to a price schedule: a price for this week and a price for next week.
- Buyer valuations as in second case (low = $1,060).

# Price Schedule

- What price schedule does the seller choose?
- Choose prices to get sorting
  - Have high value buyer not delay
  - Have low value buyers delay
- If second week price is $1,060: what should immediate price ($p$) be?
  - Make high value buyer indifferent between taking that price and waiting
  - $\$1,100 - p > 0.8 (\$1,100 - \$1,060) = \$32$
  - So long as $p$ is less than $1,068, will get screening.

# Profits from Screening

- Now get $1,060 from low value buyers and $1,068 from high value buyers.

- Thus, on average price will be $1,064.

- Before screening, average price was $1,060.

- But does such haggling always work? What if the low buyer's valuation is $1,040?

# Age-Wage Profiles

- Pay increases with age -- this occurs even when controlling for higher human capital, responsibility and experience. Why?

- Could be a screening device. Turnover is costly to firms. Want to identify people who are less likely to move jobs.

- A positive age-pay profile, attracts workers who intend to stay with the firm and, thus, accept low wages initially.

# Looking forward ...

- Concept of mass market demand
- Relationship between revenue and demand
- Concept of elasticity
- Profit maximising price levels
- Durable goods monopoly
- Price discrimination

# Posted prices versus negotiation

- In mass markets, it is more convenient to simply post a price.

- Consumers whose willingness-to-pay is above that price will purchase from you.

- Consumers will lower their own demand and just purchase units for which their WTP for that unit exceeds price.

# Mass Market Demand

- The monopolist faces a demand schedule or curve.

- This describes the number of units the monopolist will sell for any given price.

- The market demand curve is found by summing up the willingness-to-pay curves of all potential consumers.

# Numerical Example

- Monopoly seller with marginal cost of $200 per unit. Can supply entire market.

- 1,000 potential buyers (only interested in a single unit each). Have different WTP ranging from $0 to $1,000.

# Market Demand Curve
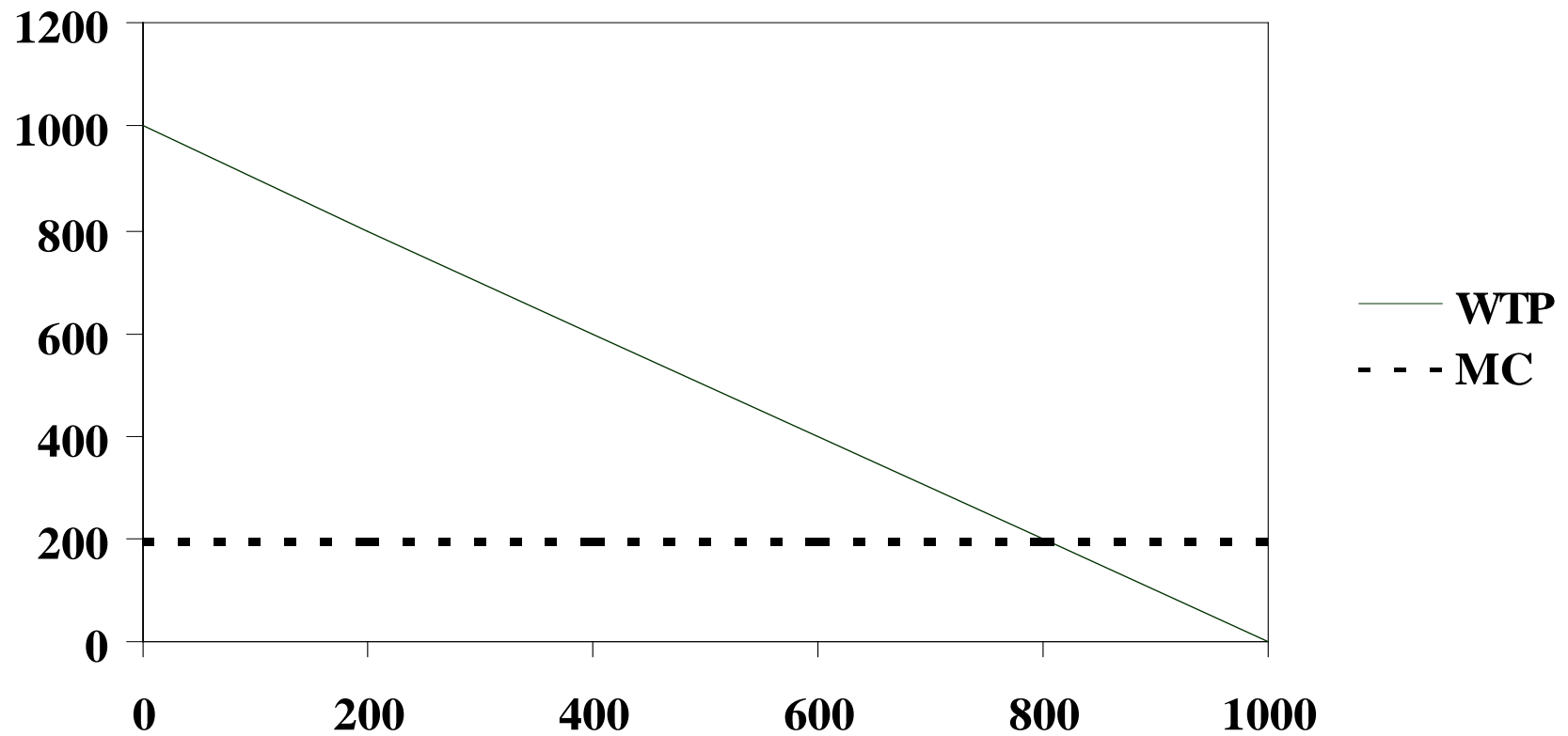
# Value Created

- What is the maximum value created in this market?
  - Simple rule: a unit should be sold if the WTP on that unit exceeds MC
  - Therefore, produce 800 units at $200 each.
  - This yields total value of (1000 – 200)*800/2 or $320,000.
  - This is the maximum *consumer surplus*.

# How does price influence revenue?

- As monopolist raises price:
  - they reduce the number of units sold (buyers are excluded)
  - the increase the mark-up on each unit they do sell.
- This is the price setter's dilemma. By raising price the monopolist can capture more value but at the cost of excluding buyers.

# Price and Revenue

| Price | $1000 | $900 | $800 | $700 | $600 | $500 | $400 | $300 | $200 |
|-------|-------|------|------|------|------|------|------|------|------|
| Revenue | $0 | $90t | $160t | $210t | $240t | $250t | $240t | $210t | $160t |

# Revenue and Elasticity

- Notice that as price rises, revenue increases initially and then falls.
- In determining price it is important to know how sensitive demand is to price changes.
  - If it is relatively insensitive, then by raising price the monopolist does not exclude many buyers.
  - If it is relatively sensitive, raising price can exclude many buyers.
- Sensitivity is related to the mathematical

# Perfectly Elastic Demand

Price
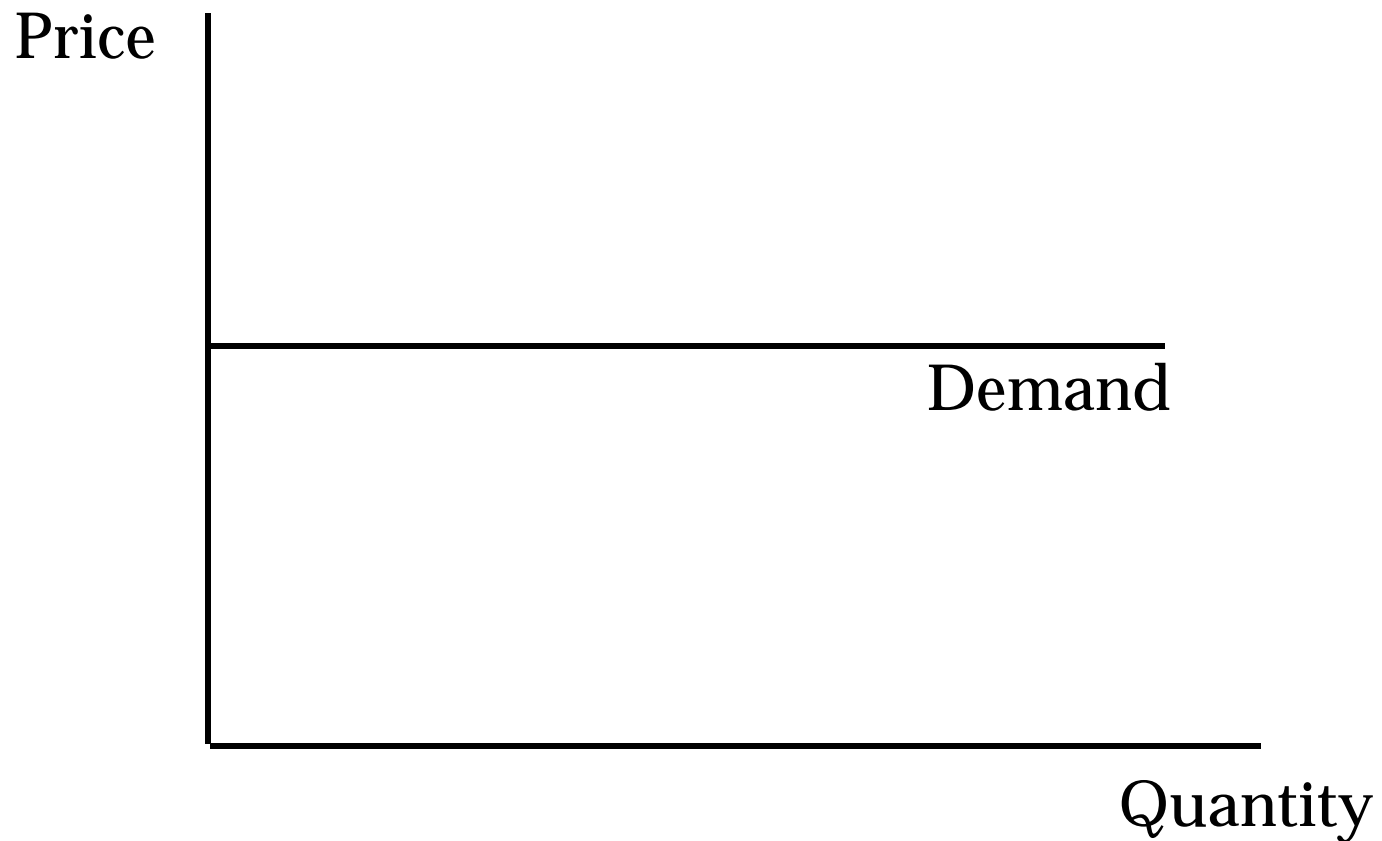
Demand

Quantity

# Perfectly Inelastic Demand

Price
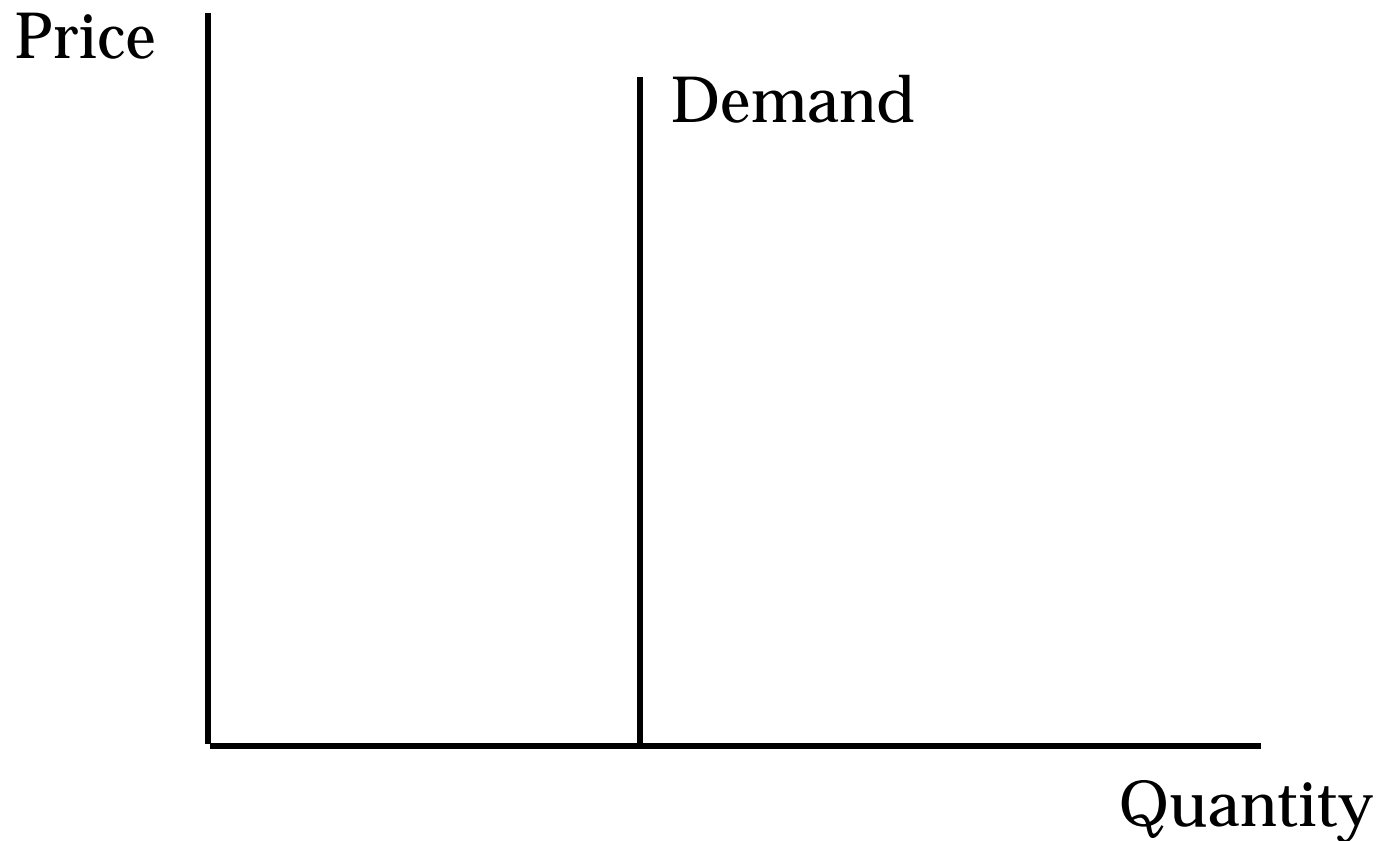
Demand

Quantity

# Algebraic Analysis

▌ In mathematical terms, sensitivity of a demand or supply function is captured by the term elasticity.

▌ For example, price elasticity of demand is the percentage change in quantity demanded divided by the percentage change in price

$$E_D = \frac{\% \text{ change in } Q_D}{\% \text{ change in } P} = \frac{\Delta Q_D / Q_D}{\Delta P / P}$$

# Some Terminology

| Term | Value of Price Elasticity of Demand ($E_D$) |
| --- | --- |
| Perfectly inelastic | 0 (vertical demand) |
| Inelastic | Less than 1 |
| Unit elastic | 1 |
| Elastic | Greater than 1 |
| Perfectly elastic | Infinity (horizontal) |
| Good A is relatively elastic compared with good B | Good A has a higher elasticity than good B. |

# Some Properties of Elasticity

▌ Minus sign is implicit: e.g., a 10% *increase* in the price of oil *decreases* quantity demanded by 20%. Therefore, $E_D$ = –2.

▌ Unit–Free Measure: can compare elasticities among different goods. Is oil more price sensitive than butter?

▌ Elasticity vs. Slope: these are not the same thing. Slope is $\Delta P/\Delta Q$.

▌ Point Elasticity: $E_D = -\dfrac{fQ}{fP}\dfrac{P}{Q}$

# Estimated Price Elasticities

| Type of Good or Service | Price Elasticity |
|---|---|
| Eggs | 0.1 |
| Petrol | 0.2 |
| Shoes | 0.9 |
| Foreign Travel | 1.2 |
| Alcoholic Beverages | 1.5 |
| Jewelry | 2.6 |

# Accounting for Differences

- Degree of Substitutability
- Temporary vs. Permanent Price Changes
- Long-run vs. Short-run elasticity

# The Price Setter's Dilemma

- To increase price, the monopolist must restrict its supply.

- To sell more output, the monopolist must lower its price.

- Which action will increase its total revenue?

- Price elasticity of demand gives the answer as it gives a relationship between percentage changes in

# Unit Elasticity, Total Revenue, and Expenditure

- If demand is unit elastic, an increase in price results in an equal percentage decrease in the quantity demanded and total revenue and total expenditure remain constant.

# Elastic Demand, Revenue and Expenditure

- If demand is elastic, a decrease in price results in an larger percentage increase in the quantity demanded and total revenue and total expenditure increase.

$$E > 1 \text{ then}$$

$$P \downarrow \quad Q \uparrow \quad \text{and} \quad TR \uparrow$$

# Inelastic Demand, Revenue and Expenditure

▍ If demand is inelastic, an increase in price results in an smaller percentage decrease in the quantity demanded and total revenue and total expenditure increase.
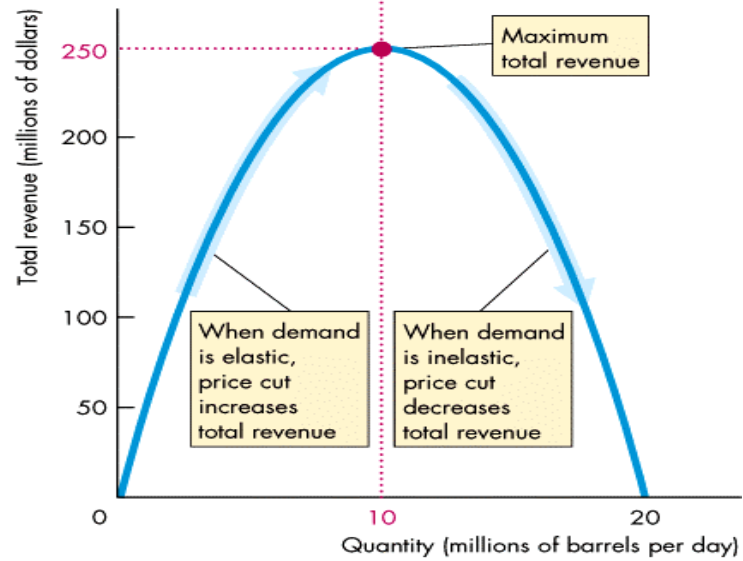
$$E_D < 1 \text{ then}$$

P ↑ Q ↓ and TR ↑

# Total Revenue Test

The *total revenue test* is a method of estimating the price elasticity of demand by observing the change in total revenue that results from a price change (all other things remaining the same).
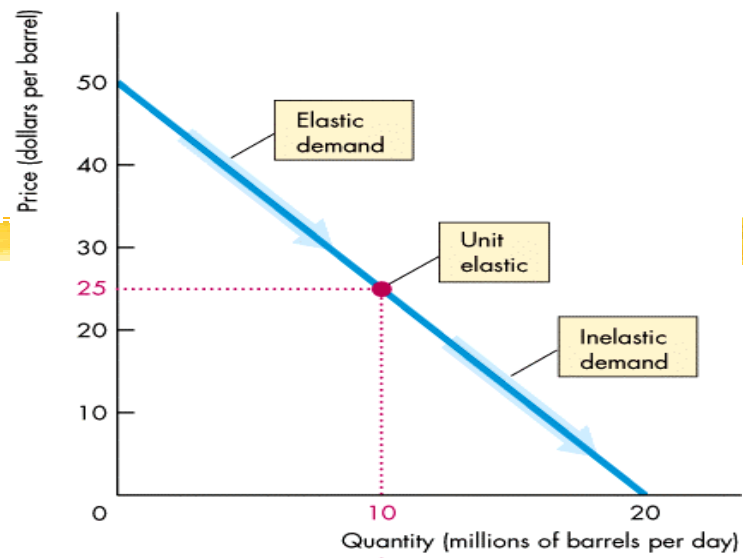
**(a) Demand**



**(b) Total revenue**

# Maximising Revenue

- A monopolist who wishes to maximise revenue will set price equal to $500 and only sell 500 units.

- But a monopolist is interested in maximising its payoff, that is, revenue minus costs or profit.

# Maximising Profit

- When should the monopolist supply an additional unit?

  - Whenever the additional revenue earned by supplying that unit exceeds the marginal cost of producing that unit.

  - In our example, whenever marginal revenue exceeds $200.

- By producing up to the point where marginal revenue equals marginal cost, the monopolist maximises

# Marginal Revenue

| Price | $1000 | $900 | $800 | $700 | $600 | $500 | $400 | $300 | $200 |
|---|---|---|---|---|---|---|---|---|---|
| Revenue | $0 | $90t | $160t | $210t | $240t | $250t | $240t | $210t | $160t |
| Marginal Revenue | | $90t | $70t | $40t | $30t | $10t | -$10t | $-30t | $-40t |

Marginal revenue from $100 price movements
Marginal cost of 100 unit movements equals $20t

# A Snapshot

| Price | $602 | $601 | **$600** | $599 | $598 |
|---|---|---|---|---|---|
| Revenue | $239,596 | $239,799 | $240,000 | $240,199 | $240,396 |
| Marginal Revenue | $205 | $203 | $201 | $199 | $197 |
| Profits | $159,996 | $159,999 | **$160,000** | $159,999 | $159,996 |

# Graphically
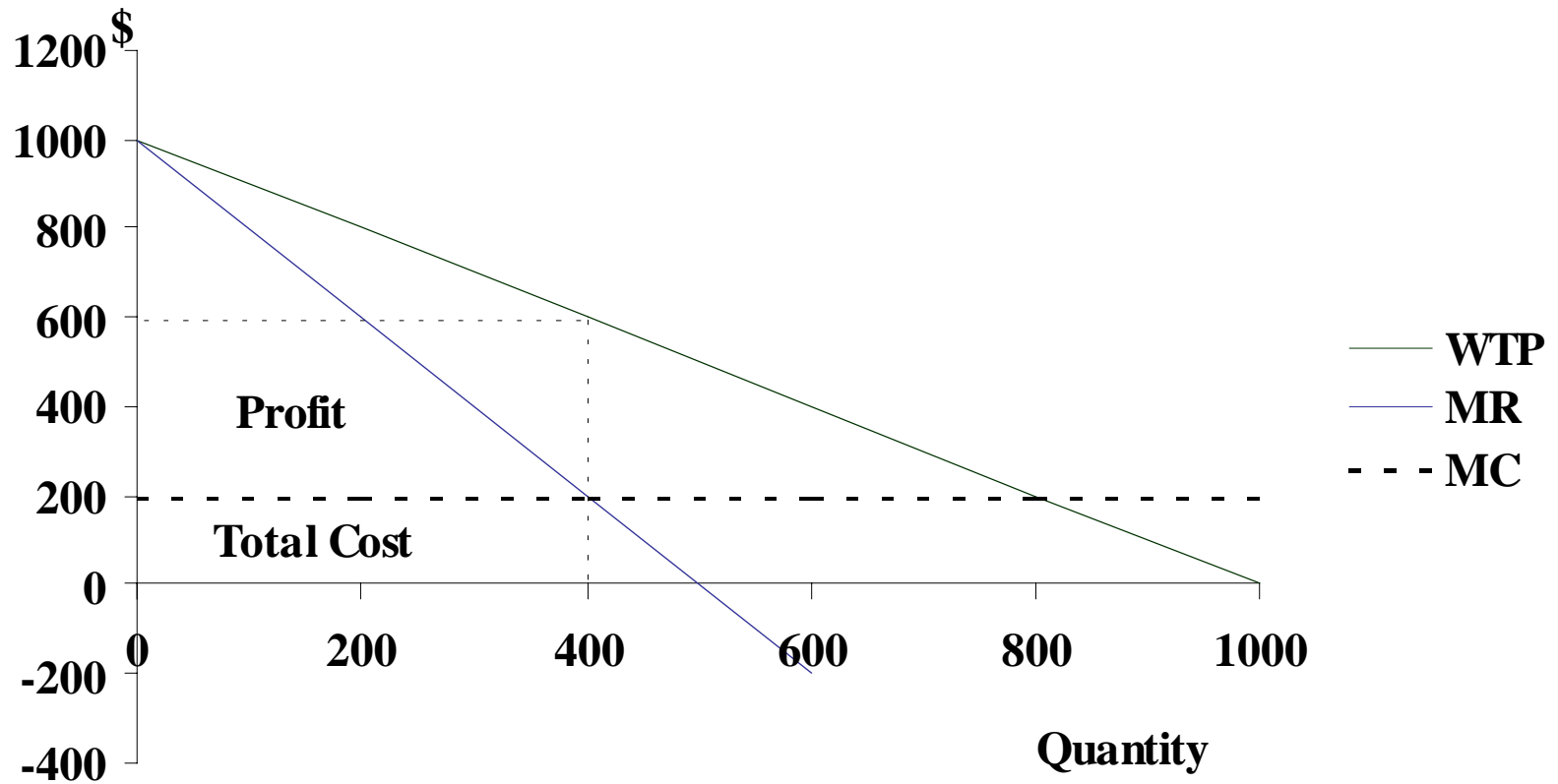
# Mathematically

- Demand:
  - Demand function: $Q_D = 1000 - P$
  - Total Revenue $= P*Q = 1000Q - Q^2$
  - Marginal Revenue $= \dfrac{dTR}{dQ} = 1000 - 2Q$

- Costs:
  - Total Cost function $C(Q) = \text{Fixed} + 200*Q$
  - Marginal Cost $= \dfrac{dC(Q)}{dQ} = 200$

# Marginal Condition

- Set Marginal Revenue equal to Marginal Cost:

$$1000 - 2Q = 200$$

or

$$Q = 400$$

- Find price by substituting this into the inverse demand function $P = 1000 - Q = \$600$.

# Monopoly Price and Elasticity

▎ How does monopoly price relate to elasticity?

▎ Suppose market demand is $Q = D(P)$. The monopolist maximises $D(P)(P - c)$.

▎ Differentiate profits with respect to P:　$\dfrac{\partial Q}{\partial P}(P - c) + Q = 0$ ?　　$P = \dfrac{1}{1 - \frac{1}{E_D}} c$

# Elasticity as a Measure of Monopoly Power

- Recall that demand will be more elastic if close substitutes for a product exist.

- Therefore, elasticity can be a measure of monopoly power.

- In particular, economists look to cross elasticities of demand and supply to define markets.

# Social Losses

▌ By setting price equal to $600, the monopolist earns $160,000. Consumer surplus is $80,000.

▌ The cost of this is that those buyers with valuations between $200 and $600 do not purchase the good, even though WTP exceeds marginal cost.

▌ The loss in potential value is $80,000 or 25% of potential value. This is termed a 'deadweight loss.'

# Deadweight Triangle
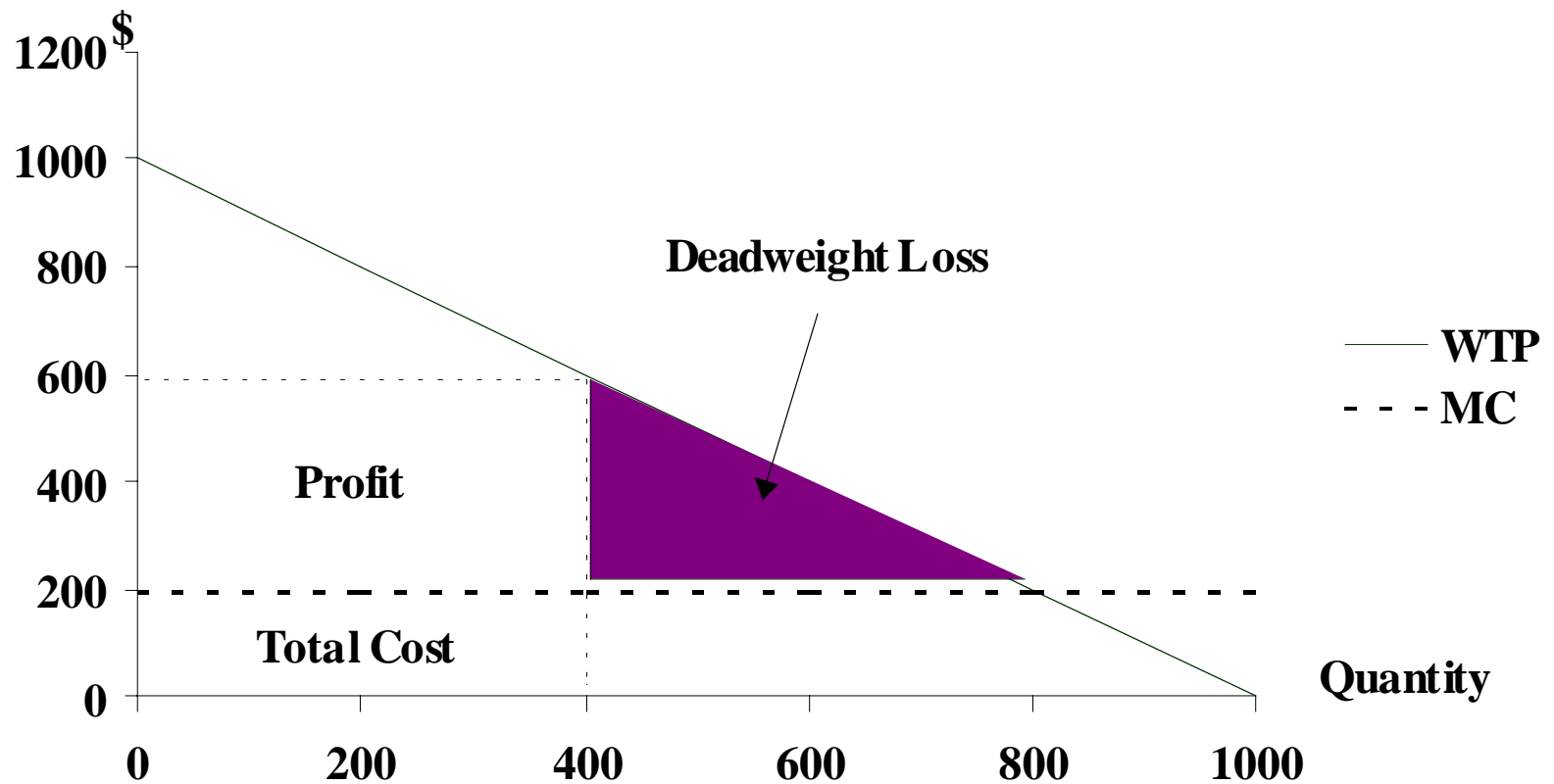
# Modified Example

▐ Suppose that the seller has two products that are similar. One is the 'deluxe' version and the other is a 'budget' version.

▐ The budget version is missing some features that 20% of customers find essential. Their WTP for the budget version is zero. They also happen to be the consumers with the highest WTP for the product.

▐ 80% have no use for the deluxe features and value the two products the same.

▐ Both products cost the same to produce.

# Graphical Depiction



Deluxe Market

WTP - 1
MC

# Graphical Depiction



Budget Market

WTP - 2
MC
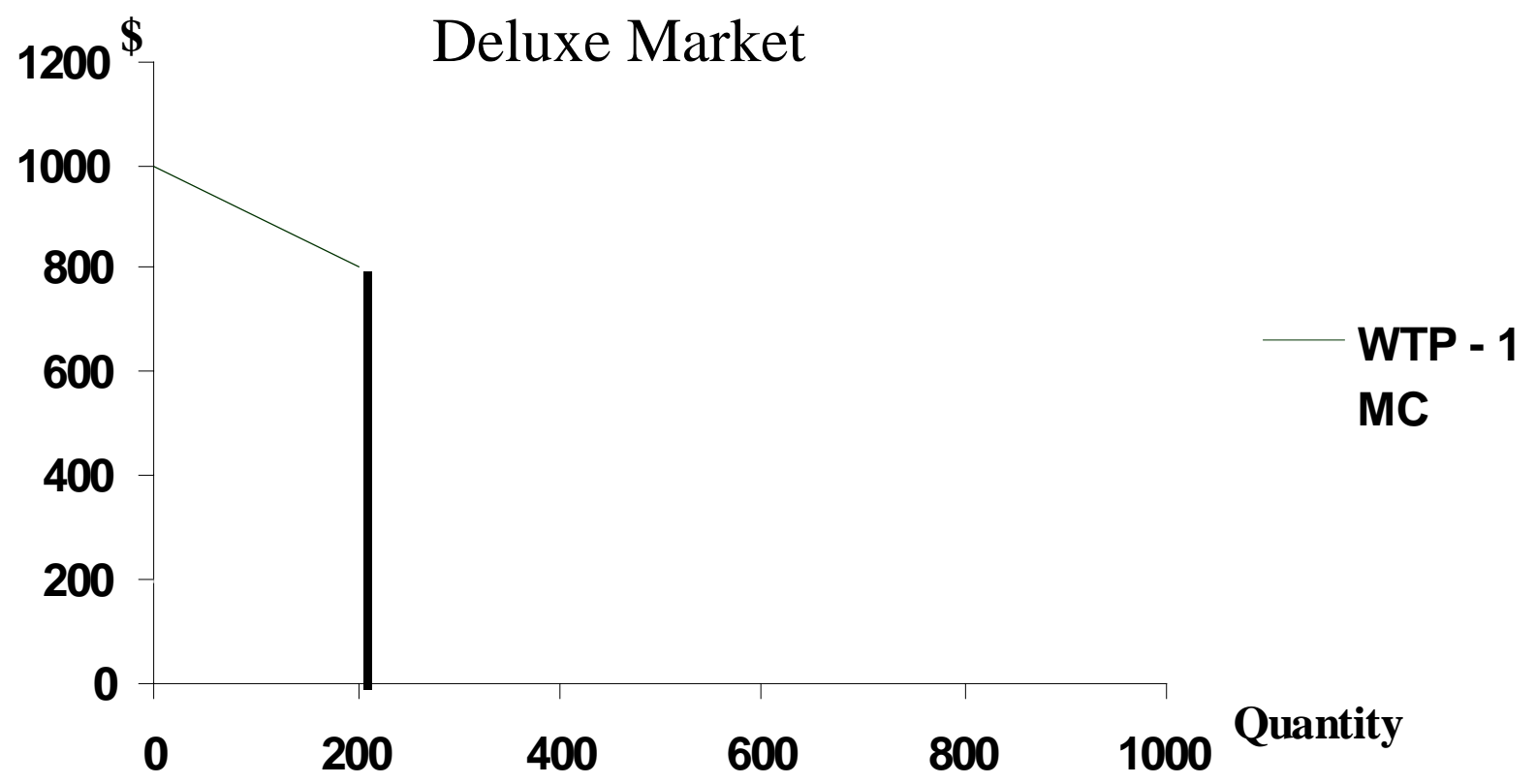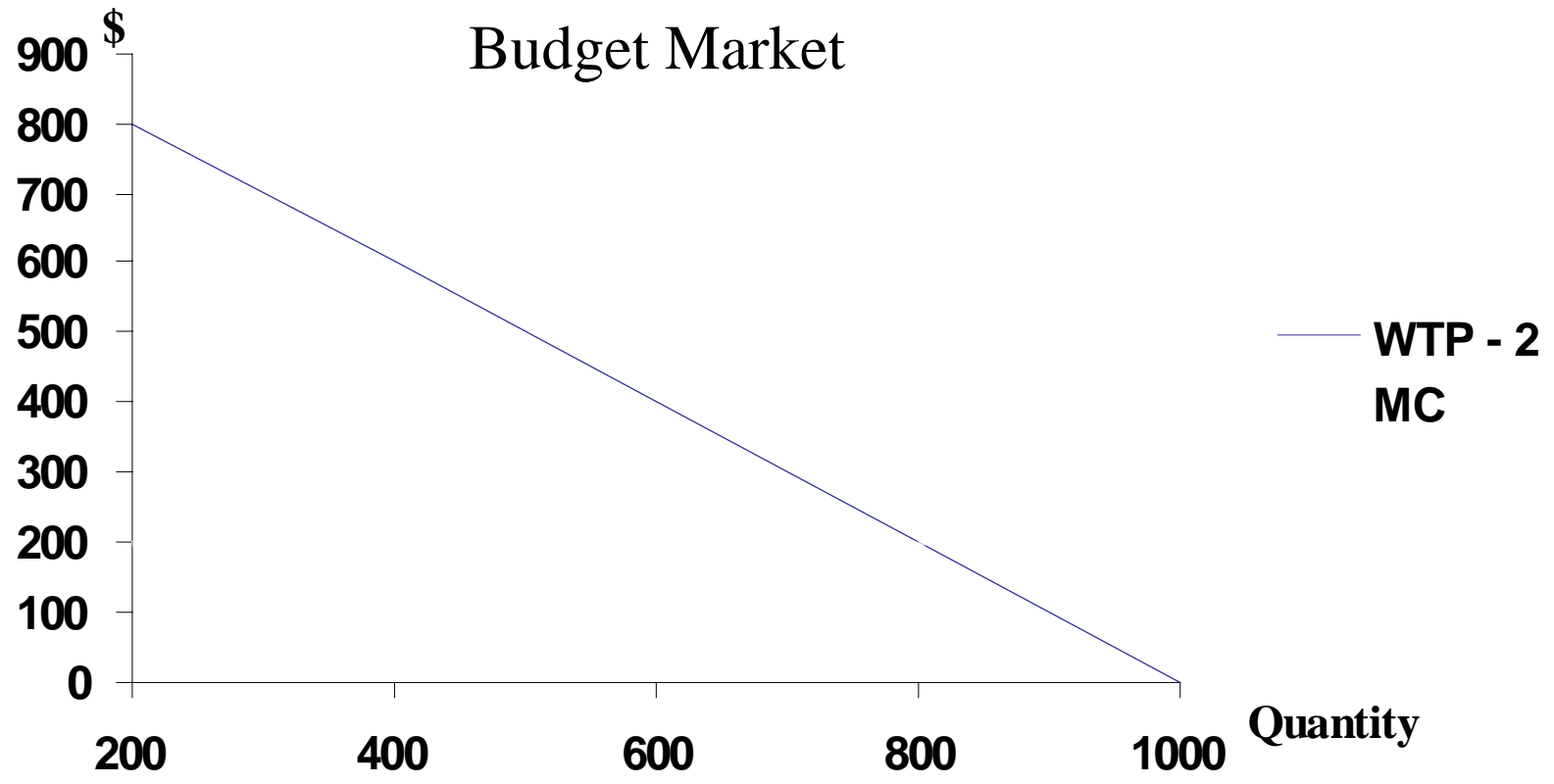
# Price Discrimination

▌ Having two products allows the monopolist to discriminate among customers. It charges different prices for the two products.

▌ Budget product pricing:

▐ MR = 800 − 2$Q$ = 200 or $Q$ = 300, $P_B$ = $500

▌ Deluxe product pricing:

▐ If price is below $800 you are simply losing revenue without gaining customers.

# Enhanced Value

- Monopolist now sells 500 units.

- Its revenue is $310,000 and profit is $210,000. A gain of $50,000.

- What happens to consumer surplus?
  - $20,000 + $45,000 = $65,000
  - A reduction from the single product case

- What happens to value created?
  - Deadweight loss of $45,000

# Damaged Goods

▌ Some firms engage in 'crimping the product.' That is, they engage in costly adjustments to differentiate products.

  Examples: Cannon printers

  Student versions of software

▌ Previous example indicates value to the monopolist from doing this. This can also improve social welfare.

# Price Discrimination in General

- The example indicates that by charging different prices a monopolist can create more value.
- To achieve this, the monopolist must be able to segment the market.
  - Otherwise arbitrage will be possible
  - Change product
  - Identify different customer types.

# Types of Price Discrimination

- First degree (perfect) price discrimination:
    - charge a different price for every consumer and every unit sold.
- Second degree price discrimination
    - volume discounts, multi-part tariffs and non-linear prices
- Third degree price discrimination
    - segment the market; charge a uniform price within each market segment

# First degree price discrimination

- Charge a different price for each unit purchased

- Like bargaining over each unit individually.

- Then monopolist has no incentive to exclude any buyer or unit and restrict supply. Maximum value creation.

- Why might this be difficult?
  - Arbitrage

# Second degree price discrimination

- "Block" Electricity Pricing:
  - suppose there are large and small customers.
  - Charge a certain price up to X MWh
  - Then have a discount.
  - Small buyer demand unchanged
  - Larger buyers purchase more

# Two part tariff

- Telephone pricing
  - set marginal or per unit price at marginal cost
  - capture surplus through rental or continuing charges
- Water pricing

# Third degree price discrimination

- Segment market
- Charge higher price to market with relatively inelastic demand
- This is what occurred in the product crimping story
- Other examples ...

# Example 1: Railroads

- Railroads set different prices for coal and grain
  - coal traffic: relatively inelastic
  - grain traffic: elastic (intermodal competition)
- Coal 2 or 3 times higher than grain
- How are markets segmented?
  - Railroads know who buys coal (electricity generators). They do not buy wheat

# Example 2: Airline Tickets

Why is there a discount for a Saturday night stay?

▍ Way of segmenting market. Business travellers less likely to stay over weekend.

▍ Different elasticities:

  ▍ price elasticity (discount): –1.83

  ▍ price elasticity (full economy): –1.3

▍ Also make it hard to change discount

# Example 3: Stamps

- In Sri Lanka postage of a plain postcard cost 1 rupee (2 cents). Postage of a pictured postcard cost 14 rupees.
- Exploit relatively inelastic demand of tourists.

# Example 4: Intertemporal effects

■ Product life cycle discrimination

■ Early buyers often have much more inelastic demand

    ■ first run movies

    ■ computer software

    ■ computer hardware

    ■ CDs

    ■ new sports equipment

# Application

Pricing and the Internet

# Difficulties in Pricing Information

- Characteristics of information
  - High sunk costs of production
  - Low (or zero) marginal costs of replication
- If no property rights, why produce information?
  - Example: CD phone directories

# Forms of Differential Pricing

- **Personalised pricing**
  - Sell to each user at a different price
- **Versioning**
  - Offer a product line and let users choose
- **Group pricing**
  - Based on group membership/identity

# Personalised Pricing

- Catalog inserts
  - Market research
  - Differentiation
- Easy on the Internet

# Traditional Industries

- Airlines
- Direct mail
- Lexis/Nexis
- Supermarket scanners
  - Profit margin more than doubled 1993-1996
  - More effective than other forms of advertising

# Internet

- Virtual Vineyards
- Auctions
- Closeouts, promotions

# Personalise Your Product

- Personalise product, personalise price
  - PointCast
  - Personalised ads
- Hot words (in cents/view) bulk & target
  - Deja News:        2.0    4.0
  - Excite:           2.4    4.0
  - Infoseek:         1.3    5.0
  - Yahoo:            2.0    3.0

# Versioning

Need to add value to the initial version of a product

- Delay
- User Interface
- Convenience
- Image Resolution
- Speed of Operation
- Flexibility of Use

- Capability
- Features & Functions
- Comprehensiveness
- Annoyance
- Support

# Example

- 40 type As: $100 for speed, $40 for slow

- 60 type Bs:  $50 for speed, $30 for slow

- Identity-based pricing: $7000 revenues

- Offer only speedy: $50 is best price, revenues=$5,000

- Offer only slow: not as profitable

# Versioning Solution

- Try speedy for $100, slow for $30
  - Will this work? Compare benefits and costs
  - 100–100=0, but 40–30=10 > 0
  - Discount the fast version: $100-p=40-30$
  - So, $p=90$
  - Revenues = $5,400 = 90x40 + 30x60

# Making Self-Selection Work

- May need to cut price of high end
- May need to cut quality at low end
- Value-subtracted versions
  - May cost more to produce the low-quality version.
- In design, make sure you can turn features off!

# Pitfalls

- Resentment
  - Victoria's secret
- Arbitrage
  - Windows NT workstation/server

# Online and Offline Versions

- The Whole Internet
- Netscape Navigator
- Dyson Dictum: think of content as free
  - Focus on adding value to online version
- National Academy of Science Press
  - Format for browsing, not printing

# Group Pricing

- Price sensitivity
- Network effects, standardisation
- Lock-In
- Sharing

# Price Sensitivity

- **International pricing**
  - US edition textbook: $70
  - Indian edition textbook: $5
- **Problems raised by Internet**
  - Localization as solution

# Network Effects

- Compatibility
  - Site licenses
  - Variety of schemes: per client, per user, per server, etc.
- Lock-In
  - *Wall Street Journal's* Newspapers-in-education
- Microsoft Office
  - Per seat, concurrent

# Sharing

- Transactions cost of sharing
- Videos
- Desire for repeat play

# Electric Library

- Who to sell to?
- Households
- Schools/libraries