Chapter 12

Capturing Surplus

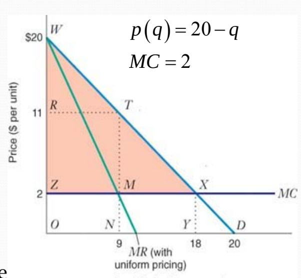
- The monopolist is doing a ton of profits, but…
- Can the monopolist do even better?
  - YES!!!!

Price Discrimination

Monopoly profits are RTMZ = (11-2)×9 =$81

- However, the monopolist would like to capture CS (area WRT) and DWL (area TMX)

In order to capture this additional surplus, the monopolist will try to price discriminate.



$p(q) = 20 - q$

$MC = 2$

Price Discrimination (3 types)

- 1st degree: the monopolist sets a "personalized" price to consumer i which coincides with the willingness to pay of this consumer (reservation price: the consumer's maximum willingness to pay for that unit.)
- 2nd degree: Different prices to different amounts of units bought: Quantity Discount

  $p = \$10 \quad 0-10 \ units, \quad but$

  $p = \$5 \quad 10-20 units$
- 3rd degree: Different prices to different consumer groups who have different demand curves

  $D_1 \rightarrow MR_1 = MC$

  $D_2 \rightarrow MR_2 = MC$

  Example: Airlines
  $200 for an economy class ticket
  $500 for a business class ticket

  UA flight 815 on next slide:

Prices for UA flight 815:

Price discrimination to the extreme!!

Ticket price	number of passengers	average advanced purchase
$2000 or more	18	12 days
$1000-1999	15	14 days
$800-$999	23	32 days
$600-799	49	46 days
$400-599	23	65 days
$200-399	23	35 days
less than $199	34	26 days
$0	19	-

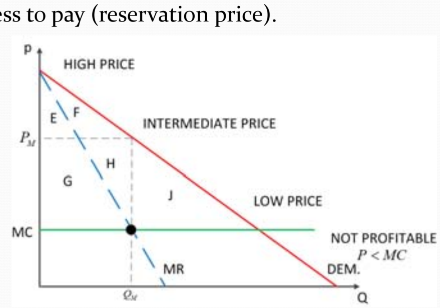
Price Discrimination

- **3 requirements for Price Discrimination:**

1. Some market power to determine prices (not price taker).
   - That is, the firm faces a downward sloping demand curve.
2. Some info. about reservation prices (about the maximum willingness to pay of the potential customers)
3. No arbitrage (cannot resell the good to a new consumer).
   - Otherwise, individuals with a low demand for the good (and who thus obtain the good at a low price) would be able to resell the good to another customers with a higher willingness to pay.

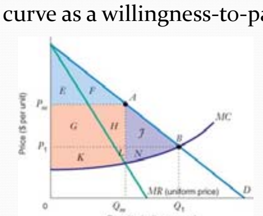
1st degree price discrimination

- The monopolist charges to consumer *i* a personalized price p_i that exactly coincides with his/her maximum willingness to pay (reservation price).



1st Degree Price-Discrimination: P_i= reservation price (willingness to pay)

- Demand curve as a willingness-to-pay schedule



	Uniform monopoly Pricing	1st degree
CS	E+F	Zero
PS	G+H+K+L	(*E* + *F*) + (*G* + *H*+*K*+*L*) + *J* +*N*
DWL	J+N	Zero

1st Degree Price-Discrimination

- It is ideal for the producer!!
- Besides the profits under uniform pricing, the monopolist now captures all the CS that consumers enjoyed under uniform pricing plus the DWL

1st Degree Price-Discrimination

- Let's check the three Requirements of price discrimination to be feasible:
- 1) Some market power (demand is indeed downward sloping)
- 2) Information about willingness to pay: imperfect information is better than none.
- 3) No arbitrage: otherwise the consumer buying at a price p close to MC can sell to the consumers with the highest willingness to pay.

1st Degree Price-Discrimination

- <u>*MR* = Dem. Curve in 1st degree price discrimination</u>
- With each additional unit sold, the producer gets *p* from that consumer.
- However, he doesn't need to reduce the price of all the previous units sold.
- This is something that the monopolist had to do when practicing "uniform monopoly pricing"
- Why did he have to do that?
  - No discrimination was possible; hence, in order to sell more units, the monopolist would need to discount all previous units.

1st Degree Price-Discrimination-Example

Consider an inverse demand curve $P = 20 - Q$ and $MC = 2$

a) <u>Monopolist</u> $MR = 20 - 2Q = 2 = MC \rightarrow 18 = 2Q \rightarrow \mathbf{Q = 9}$ **units**

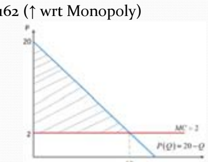
Hence, price is

Price $\rightarrow p = 20 - 9 = 11.$

Producer Surplus = $TR - TC = pQ - MC \cdot Q = 11.9 - 2.9 = \$81$

b) <u>1st Degree</u> Dem = $MC \rightarrow 20 - Q = 2 \rightarrow \mathbf{18 = Q}$

Producer Surplus = $TR - TC = ½ (20\text{-}2) \cdot 18 = 162$ (↑ wrt Monopoly)



Query #1

Suppose that a firm faces an inverse demand curve of
$P = 10 - Q^d$

- The corresponding marginal revenue curve is
$MR = 10 - 2Q^d$

And firm has a constant *MC*= \$4 per unit.

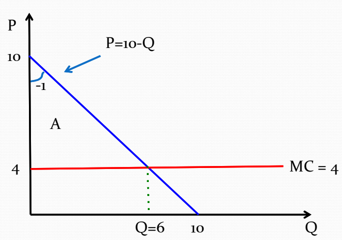
- If the firm engages in First-degree price discrimination, how much producer surplus will it capture?

a) \$21.
b) \$18.
c) \$9.
d) \$4.50.

Query #1 - Answer

- Answer B
- We know that a firm engaging in first-degree price discrimination will sell where the demand curve intersects the y-axis down to where the demand curve equals Marginal Cost. $MC = 4,\ P = 10 - Q^d$
$4 = 10 - Q^d$
  - Solving for Q^d, we obtain $Q^d = 6$
  - Also note that the lowest price the firm will charge is \$4 and the most is \$10 (at the intercept).
- Now just find the area of the triangle to find producer surplus captured: as depicted in the next slide

Query #1 - Figure



- Area of Triangle $A = \frac{1}{2} \cdot (10-4) \cdot 6 = \frac{1}{2} \cdot 36 = \$18$
- Page 461-462

1st Degree Price-Discrimination

- **<u>Application: College Education</u>**

<u>Checking the requirements for 1st degree P.D.:</u>

1) Downward sloping demand curve (↑*Q*⇒↓*p*)

2)Info about willingness to pay?

It is difficult to extract info about your family's willingness to pay for your undergrad education. But if they ask your family for data about their finances when you apply for financial aid, colleges can get a very good approximation of your family's willingness to pay.

Example: FAFSA (Free Application for Federal Student Aid) forms

3) No arbitrage: I can't sell you my education

Result: the price that each student pays for his education (net of loans) ends up being relatively personalized.

2^{nd} Degree Price-Discrimination (quantity discounts)

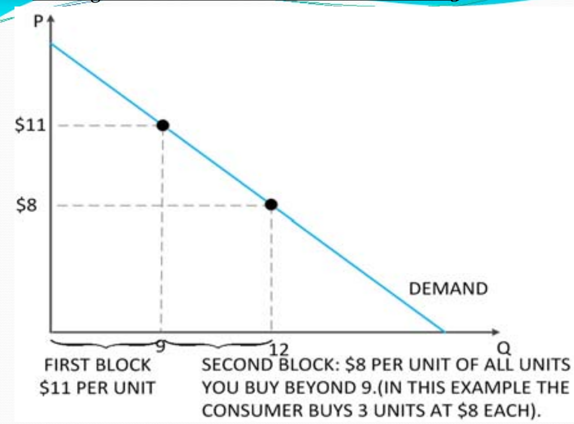
- Block tariff ≠ two part tariff
- A form of 2^{nd} degree price discrimination in which the consumer:

$0 \rightarrow \overline{Q}$ pays one price for units consumed in the first block of output (up to $\overline{Q}$)

$\overline{Q} \rightarrow$ and beyond. He/she pays a different price for any additional units consumed on the second block

Example: Electricity, Mass Transit Systems, etc.

2^{nd} Degree Price Discrimination as Block Pricing



Two practical questions about practicing 2^{nd} degree price discrimination:

1. How can we determine where to set cutoff $\overline{Q}$?
2. And, what price to charge for units *before* and *after* $\overline{Q}$?

Answer: Optimal Block Pricing.

Let's analyze that next.

Optimal Block Pricing

- Consider a monopolist with marginal costs

$$MC = 2$$

- And inverse demand curve

$$p(q) = 20 - q$$

Let's approach this exercise one step at a time

Optimal Block Pricing

1)Constructing total profits that the monopolist obtains from the two blocks:

Revenues from 1st block = $P_1 Q_1$ and from Demand, $(20 - Q_1)Q_1$

Revenues from 2nd block = $P_2 (Q_2 - Q_1)$ and from Demand, $(20 - Q_2)(Q_2 - Q_1)$

Total cost = $MC \cdot Q_2 = 2Q_2$ (since Q_2 is the total number of units you sell.)

Therefore, $PS = (20 - Q_1)Q_1 + (20 - Q_2)(Q_2 - Q_1) - 2Q_2 =$
$= 20Q_1 - Q_1^2 + 20Q_2 - 20Q_1 - Q_2^2 + Q_2Q_1 - 2Q_2$

- 2nd step) in order to find the optimal value of Q_1 and Q_2 (we just need to take F.O.C.s with respect to Q_1 and Q_2.

$$\frac{\partial PS}{\partial Q_1} = 20 - 2Q_1 - 20 + Q_2 = 0 \rightarrow Q_2 = 2Q_1 \quad (1)$$

$$\frac{\partial PS}{\partial Q_2} = 20 - 2Q_2 + Q_1 - 2 = 0 \rightarrow 18 - 2Q_2 + Q_1 = 0 \quad (2)$$

Plugging (1) into (2),

$$18 - 2(\underbrace{2Q_1}_{from(1)}) + Q_1 = 0 \rightarrow 18 - 3Q_1 = 0 \rightarrow Q_1 = \frac{18}{3} = 6 units$$ (First Segment)

Therefore, $Q_2 = 2 \bullet Q_1 = 2 \bullet 6 = 12$ units

(Second Segment)

Hence the monopolist sells 12 units in total, and sets the cutoff to provide customers with quantity discounts at Q1=6 units.

- 4th step)We are done determining output Q_1 and Q_2, but what about prices?
  - We just need to plug Q_1 and Q_2 into the inverse demand function $p(q) = 20 - Q$
  - $p_1 = 20 - Q_1 = 20 - 6 = \$14$ per unit for the first six units
  - $p_2 = 20 - Q_2 = 20 - 12 = \$8$ per unit for all additional units beyond 6 (which in this case are 6 also) i.e.

$$Q_2 - Q_1 = 12 - 6 = 6$$

Block pricing

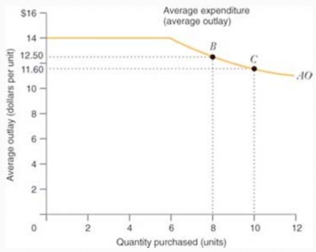
- This implies that the **average expenditure is a non- linear** function.
  - Indeed, average expenditure is given by the ratio of total expenditure (E) over the number of units bought (Q), i.e., E/Q, as follows

$$\frac{14\, xQ}{Q} = \$14$$

↓

$$\frac{E}{Q} = \begin{cases} \$14 \text{ if } Q \leq 6 \\ \dfrac{(14 \bullet 6) + \$8(Q-6)}{Q} \text{ if } Q > 6 \end{cases}$$

- Average expenditure is a non-linear function:



- For this reasons you might read that: "block pricing is a form of non-linear pricing."

What if, instead, the monopolist simply sets a uniform price to all customers?

Uniform pricing

Then MR = MC

$20\text{-}2Q = 2 \rightarrow Q = \frac{18}{2} = 9$ units, $p = 20\text{-}Q = 20\text{-}9 = \$11$

Profits $= \$11 \cdot 9 - 2 \cdot 9 = \$81$

Block pricing

With Block pricing, profits are:

$TR_1 = \$14 \cdot 6 = 84$

$TR_2 = \$8 \cdot 6 = 48$

Total cost $= 2 \cdot 12 = 24$

Profits = $108, which exceeds profits under uniform pricing (No block pricing)

1st degree price discrimination

$\text{profit} = \frac{1}{2}(20-2)18 = \$162$

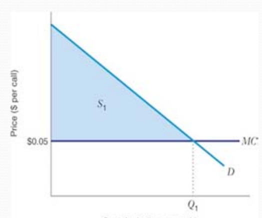
Of course, with the personalized prices of 1st-degree PD, the monopolist obtains the highest profit.

Let's now analyze another form of 2nd degree price discrimination:

Subscription and usage charges

Subscription and Usage Charges

- Example: Telephone company charges $20 on subscription fee and $0.05 per call (usage charge)



How can a producer use Sub. + Usage charges in order to capture more surplus?

By setting, P (usage charge) = MC ← e.g., 5 cents

F (subscription fee)= Consumer Surplus ← Area S_1

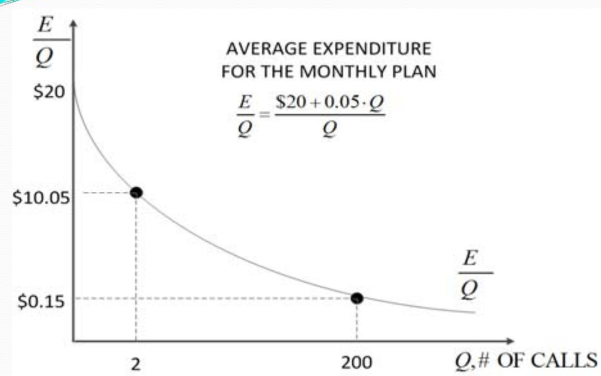
- Note that it is simply another form of Quantity Discount (2nd degree P.D.):
  - If the consumer makes 2 calls a month, he pays:
    - \$20+\$0.05(2)=\$20.10
    - And the average outlay (expenditure)

$$\frac{E}{Q} \; is \; \frac{20.10}{2} = 10.05$$

  - If, instead the consumer makes 200 calls a month, he pays:
    - \$20+\$0.05(200)=\$30, and the average outlay (expenditure) becomes

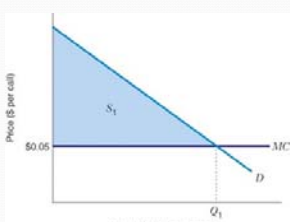
$$\frac{E}{Q} = \frac{\$30}{200} = 0.15$$

    - Hence, average expenditure decreases in quantity purchased in a non-linear fashion as depicted in the next slide



Subscription and Usage Fee

- It is really so easy? No, different consumers may have different demand curves for the good. If the producer sets $F = CS$ of high demand consumers, then all low demand consumers will refrain from buying.



- In some situations, the producer will prefer to offer a menu of phone plans. Each consumer picks the one he likes the best (more advanced courses).

Query #2

All consumers are alike and each has an inverse demand curve for a monopolist's product of

P= 100 – 2Q.

The marginal cost of production is constant at *MC = \$10.*

- Let the monopolist charge a price of \$10 per unit purchased, and a subscription fee of \$2025 that must be paid by each purchaser.

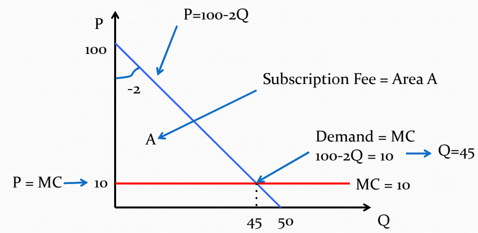
What is the amount of consumer's surplus generated by this scheme?

a) 0
b) \$2025
c) \$2025 multiplied by the number of consumers in the market.
d) \$90 multiplied by the number of units purchased.

Query #2 - Answer

- Answer A
- The marginal cost and the price charged to the consumer are both $10, so there would be no deadweight loss.
- By charging the subscription fee of $2025, the monopolist would capture all of the consumer surplus.
- See the next figure, for an illustration.
- Page 469-470

Query #2 - Figure

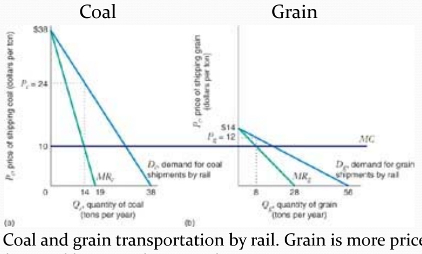


- Area $A = \frac{1}{2} \cdot (100 - 10) \cdot 45 = \frac{1}{2} \cdot 90 \cdot 45 = 2,025$

3rd degree Price-Discrimination

- The monopoly charges different prices to different consumer groups who have different demand curves.

Coal Grain



Example: Coal and grain transportation by rail. Grain is more price sensitive than coal because there are alternative transportation methods, e.g., barges and trucks. In contrast, coal doesn't have so many alternatives to rail.

3rd degree Price-Discrimination

- Example: following with the above example, consider that the inverse demand function for coal and grain are

1)

$P_1 = 38 - Q_1$ Coal

$P_2 = 14 - 0.25Q_2$ Grain

$MC = 10$ (for both)

$MR_1 = 38 - 2Q_1$

$MC = MR_1 \rightarrow 38 - 2Q = 10 \rightarrow 28 = 2Q_1 \rightarrow Q_1 = 14$

Hence, the price on coal is

$P_1 = 38 - 14 = 24$

2)

$MR_2 = 14 - 0.5Q_2$

$MC = MR_2 \rightarrow 10 = 14 - 0.5Q_2 \rightarrow 0.5Q_2 = 14 - 10 \rightarrow Q_2 = \frac{4}{.5} = 8$

Hence, the price on grain is

$P_2 = 14 - 0.25 * 8 = 14 - 2 = 12$

- But then we are dealing with each group of customers as if we had two different monopolies, setting MR=MC for each.
  - EXACTLY!!
- Ok, can we then use the I.E.P.R. we learned in the chapter on monopoly, applying it to each group of customers separately?
  - YES!, Let's see the use of IEPR when the monopolist practices 3rd degree price discrimination

Example in next slide →

3rd degree Price-Discrimination

- Example: $\varepsilon_{Q_b,P_b} = -1.15(Business\ travelers)$
  $\varepsilon_{Q_v,P_v} = -1.52(Vacation\ travelers)$

1) IEPR for Business travelers

$$\frac{p-MC}{p} = -\frac{1}{E_{Q,P}} \leftrightarrow p-MC = p*\frac{1}{1.15}$$

$$\Rightarrow MC = 0.13P_B$$

2) IEPR for Vacation travelers

$$\frac{p-MC}{p} = -\frac{1}{E_{Q,P}} \Leftrightarrow p-MC = p*\frac{1}{1.52}$$

$$\Rightarrow MC = 0.34P_v$$

3rd degree Price-Discrimination

Hence, $0.13P_B=0.34P_V$

Rearranging $\frac{P_B}{P_V} = 2.63 \longrightarrow P_B = 2.63 \cdot P_v$

- <u>Conclusion:</u>
  - The price of business travelers (less price sensitive group of customers), P_B, must be 2.63 times higher than that of vacation traveler (more price sensitive group), P_V.

- Very, very useful practice about 3rd degree P.D. with capacity constraints
- Learning by doing 12.6 in your textbook pp. 476-477

Query #3

Let a monopolist face:

- Consumer group A with inverse demand $P_A = 100 - 2Q_A$, and
- Consumer group B with inverse demand $P_B = 80 - Q_B$

The monopolist can conduct third degree price discrimination, but faces a capacity constraint that

$$Q_A + Q_B \leq 100.$$

What will be the amount supplied to each of the customer groups?

a) $Q_A = 50; Q_B = 50.$
b) $Q_A = 60; Q_B = 40.$
c) $Q_A = 33.67; Q_B = 66.33$
d) $Q_A = 36.67; Q_B = 63.33$

Query #3 - Answer

- Answer D
- First we need to find the marginal revenue for each inverse demand curve,
- $P_A = 100 - 2Q_A$ and $P_B = 80 - Q_B$
  - $MR_A = 100 - 4Q_A$
  - $MR_B = 80 - 2Q_B$
- We equate the marginal revenues, giving us
  - $100 - 4Q_A = 80 - 2Q_B$ (1)
- The second equation we use is assuming that the firm's production equals capacity
  - $Q_A + Q_B = 100$ (2)
- Now we just have an algebra problem; a system of equations, i.e., (1) and (2), with two unknowns, i.e., Q_A and Q_B.
- Let us solve this system of equations in the next slide…

Query #3 - Answer

- Let us solve this system of equations next:
  - $Q_A = 100 - Q_B$, which we plug into our first equation.
  - $100 - 4(100 - Q_B) = 80 - 2Q_B$
  - $100 - 400 + 4Q_B = 80 - 2Q_B$
  - $6Q_B = 380$
  - $Q_B = 63.33$
- Since we know that the firm's total production is at capacity, we can just plug Q_B into equation (2)
  - $Q_A + 63.66 = 100$
  - $Q_A = 36.67$
- Pages 476 – 477

3rd degree Price-Discrimination

- ***Empirical Application*: Forward integrate to price discriminate.**
- Alcoa was a monopoly of aluminum production until the 1930s.
- It considered to price discriminate between its:
  - *High-demand customers*: airplane wings and bridge cable. (They didn't have close substitutes, so their demand for aluminum was relatively inelastic).
  - *Low-demand customers*: cookware. (They had close substitutes, such as cooper, steel or cast iron, making their demand for aluminum more elastic).
- It was profitable for Alcoa to charge a high price to airplane wings and bridge cable producers, and a low price to cookware producers.

3rd degree Price-Discrimination

- **Empirical Application: Forward integrate to price discriminate. (*Cont.*)**
- But, how to guarantee that the cookware manufacturers don't resell aluminum to airplane wings manufacturers at a high price?
  - That is, how to prevent arbitrage?
- ***Forward Integration*****:** Alcoa started its own cookware division, and sold aluminum only at a high price to manufacturers with inelastic demands.
- Generally, we use "forward integration" to describe the process by which the producer of an input chooses to start producing in the same business that its customers are in.

3rd degree Price-Discrimination

- Is it so easy to charge different prices to different consumers? The consumer will need to truthfully reveal the demand for the good. Will the consumer with a high demand willing to do so?
- Solution: Screening is commonly used in practice in order to practice 3rd degree price discrimination.
- Screening: A process for sorting consumers based on a consumer characteristic that:

1. The firm can perfectly observe (such as age or student status), and
2. It is strongly related to a consumer characteristic that the firm cannot see but would like to observe (such as willingness to pay or elasticity of demand.)

- **Example: Screening in Flight Tickets**

Perfectly observable characteristic:

- A vacation traveler books the ticket months in advance
- A business traveler books the ticket just a few days in advance or the same day

OR

- A vacation traveler doesn't care about staying at the destination over Saturday night
- A business traveler does.

Then airlines charge high prices to travelers who book tickets last minute and don't stay Saturday night

And they charge low prices to those who book early and stay Saturday night.

- More Examples:

1) Day/night phone call prices
   - Business have a high willingness to pay, and they must make their phone calls during office hours, but…
   - You can wait and phone your friends after 5 pm.

1. New/Old iPad or computer
   - Some people have high willingness to pay in order to get the newest, coolest gadget (easy to detect by the firm, since they are camping outside of the Apple store), while…
   - Other people have lower willingness to pay and don't care waiting a few months for prices to drop.
2. Coupons and rebates as a screening device
   - People who put the time and effort into collecting coupons have a lower willingness to pay than the people who don't.

- We are done with 1st , 2nd, and 3rd degree of price discrimination
- But we will next describe a few more practices firms use in order to capture a larger surplus: (they are however, not pricing techniques)
  1) tie-in-sales,
  2) bundling,
  3) advertising

Tying (Tie-in-Sales)

- A sales practice that allows a customer to buy one product (the tying product) only if that consumer also agrees to buy another product (the tied product).
- A firm with a patent in a photocopy machine would like to price discriminate by setting a higher price to consumers making a lot of copies than to consumers making few photocopies
- But, how can it know how many copies is the firm doing? By tying the photocopies with the purchase of paper.
- E.g. for a few years the warranty of the Xerox photocopy machine remained valid only if you used Xerox paper.

- Is it legal?
  - It is if the firm practicing tie-in-sale represents a small share of the tied product, e.g., paper
  - Otherwise, courts have determined it is illegal.

  Example: McDonald's cannot require its franchises to buy supplies (such as napkins and cups) from McDonald's. They can buy supplies from any firm meeting the McDonald's standards.

Bundling

- A type of tie-in sale in which a firm requires customers who buy one of its products also to simultaneously buy another of it products.

  Examples: Computer and monitor, or Disney World ticket and all rides inside the park.
- **3 types of bundling:**

  Option 1: *No bundling*. The manufacturer does not bundle any goods.

  Option 2: *Pure bundling*. The manufacturer only offers bundled goods. As a customer either you buy the bundle (i.e., the combo) or you don't buy any good.

  Option 3: *Mixed bundling*. The manufacturer offers customers different prices for bundled and non-bundled goods.

Bundling

Ex: Computers and Monitors. The table reports the willingness to pay for the computer alone, the monitor alone, or the bundle

	Computer	Monitor	Comp + Mon
Customer 1	1,200	600	1,800
Customer 2	1,500	400	1,900
MC	1,000	300	1,300

Bundling

- If there was no bundling, the highest prices that the firm would be able to charge for each separate good are

No Bundling	
Computer	1200 (200 profit *2)=400 (both consumers) 1500=500 profit (only consumer 2) ⟵
Monitor	400 (100profit*2)=200 (both) 600=300 profit (only consumer 1) ⟵
Total Profits	500+300=800

If, instead, we apply bundling

Bundling	
Comp and Monitor	1800 (500 profit*2)=**1000** (both) 1900=600 (only consumer 2)

- Hence, the firm obtains larger profits from practicing bundling ($1000) than from not practicing it ($800).

- For bundling to be beneficial, we need that the demands must be negatively correlated:
- That is, if consumer 1 has the highest willingness to pay for the monitor, he mush have the lowest willingness to pay for the computer; and vice versa.

- Why do we need negatively correlated demands?
  - Let's see what happens if demands are, instead, positively correlated: consumer 2 has the highest willingness to pay for both monitor and computer.

	Computer	Monitor	Both
Cons 1	1,200	400	1,600
Cons 2	1,500	600	2,100
MC	1,000	300	1,300

No Bundling: Computer: 1,200→200(2)=400; 1,500→500. Monitor: 400→100(2)=200; 600→300

Total profits=500+300=**800**

Bundling: Computer and Monitor: 1,600→300(2)=600; 2,100→ 800(1)=800

No increase in profits from bundling, when demands are positive correlated.

What about mixed bundling?

- The firm offers A:
  - Price for the monitor
  - Price for the computer
  - Price for the bundle (monitor + computer)
  - The Consumer chooses.

Next slides →

Mixed Bundling

- Willingness to pay:

	Computer	Monitor	Comp + Mon
Customer 1	900	800	1,700
Customer 2	1,100	600	1,700
Customer 3	1,300	400	1,700
Customer 4	1,500	200	1,700
MC	1,000	300	1,300

If there was no bundling…

No Bundling	
Computer	1,100 (100 profit*3)=300 (consumers 2, 3 and 4 buy it). 1,300 (300 profit *2)=**600** (consumers 3 and 4 buy it). 1,500 (500 profit*1)=500 (only consumer 4 buys it).
Monitor	400 (100 profit*3)=300 (consumers 1, 2 and 3 buy it). 600 (300 profit*2)=**600** (consumers 1 and 2 buy it). 800 (500 profit*1)=500 (only consumer 1 buys it).
Total Profits	600+600=1,200

Mixed Bundling

- Willingness to pay

	Computer	Monitor	Comp + Mon
Customer 1	900	800	1,700
Customer 2	1,100	600	1,700
Customer 3	1,300	400	1,700
Customer 4	1,500	200	1,700
MC	1,000	300	1,300

If there was pure bundling, i.e., selling only the bundle

Bundling	
Computer+Monitor	1,700 (400 profit*4)=1,600 (all consumers buy it). No other price to consider: • A higher price for the bundle leads no consumer to buy it. • A lower price for the bundle will not be profit maximizing.
Total Profits	$1,600

Mixed Bundling

	Computer	Monitor	Comp + Mon
Customer 1	900	800	1,700
Customer 2	1,100	600	1,700
Customer 3	1,300	400	1,700
Customer 4	1,500	200	1,700
MC	1,000	300	1,300

What about ***mixed bundling***?

- With mixed bundling, the firm offers customers three options:
  - Buy the computer separately at a price pc.
  - Buy the monitor separately at a price pm.
  - Buy the bundle (computer and monitor) at a price pb= $1,700

Mixed Bundling

	Computer	Monitor	Comp + Mon
Customer 1	900	800	1,700
Customer 2	1,100	600	1,700
Customer 3	1,300	400	1,700
Customer 4	1,500	200	1,700
MC	1,000	300	1,300

What about mixed bundling?

- First, notice that some customers, such as customer 1, are not attracted to buy one product, e.g., computer, at a price pc=$1,300 but buy the bundle at a price pb=$1,700.
- However, with customer 1, the firm can make more profits.
  - If the firm sells the monitor separately at $799, customer 1 buys it, and the firm makes $499 in profits.
  - This is better for the firm than offering the bundle, where its profits from customer 1 are only $400.
  - Customer 1 is also better off: his CS is now $1, rather than $0 with the bundle.
  - The firm then sets a price for the separate monitor at pm=$799.

Mixed Bundling

	Computer	Monitor	Comp + Mon
Customer 1	900	800	1,700
Customer 2	1,100	600	1,700
Customer 3	1,300	400	1,700
Customer 4	1,500	200	1,700
MC	1,000	300	1,300

What about mixed bundling?

- Similarly for customer 4:
  - Customer 4 is willing to pay for the monitor a price ($200) below its MC ($300).
  - If the firm sells the computer separately at $1,499, customer 4 buys it (since he values it at $1,500), and the firm makes $499 in profits.
  - This is better for the firm than offering the bundle at a price pb=$1,700, where its profits from customer 4 are only $400.
  - Customer 4 is also better off: his CS is now $1, rather than $0 with the bundle.
  - The firm then sets a price for the separate computer at pc=$1,499.

Mixed Bundling

	Computer	Monitor	Comp + Mon
Customer 1	900	800	1,700
Customer 2	1,100	600	1,700
Customer 3	1,300	400	1,700
Customer 4	1,500	200	1,700
MC	1,000	300	1,300

What about mixed bundling?

- Customers 2 and 3 have a willingness to pay for each component (computer or monitor) that exceeds the firm's MC. (And their demands for the two components are negatively correlated):
  - Hence, the firm obtains a larger profit offering them the bundle, at the price pb=$1,700.
  - While the prices for the separate monitor and computer are (as determined in previous steps):
    - pm=$799
    - pc=$1,499

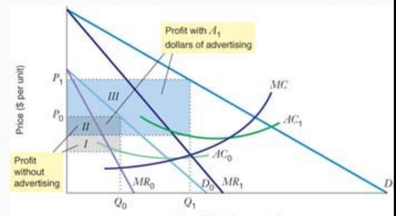
Advertising

- Advertising → non-price strategy to capture surplus.
- Advertising has its pros and cons:
  - ***Pros:*** advertising increases demand as it makes the product known to potential customers who didn't know about it.
  - ***Cons:*** advertising is costly.
- We just identified a trade-off. How much advertising should the monopolist do?

Advertising (explanation of the figure):

No advertising:

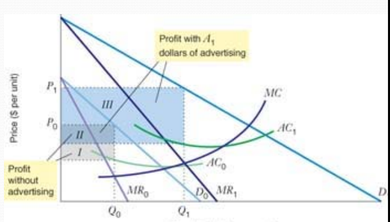
- 1) *Demand*$_0$ and MR_0
- 2) *MC* constant and AC_0
- 3) P_0 and Q_0
- 4) Profits$_{initial}$ = I+II



Advertising (explanation of the figure):

We now introduce advertising:

- 5) Advertising shifts demand to D_1 and MR_1
- 6) *MC* constant, but AC_1 shifts upwards
- 7) P_1 and Q_1
- 8) Profits$_{final}$ = II+III



Advertising

Hence, the monopolist increases its expenditure on advertising if

- Profits with AD> profits without AD.
- That is, if *II+III – A > I +II*
- Rearranging *III – A > I*
- In other words

$$\underbrace{III}_{MR_A} > \underbrace{I+A}_{MC_A}$$

- That is, you will stop advertising when $MR_A = MC_A$ and, regarding output, you should stop producing more units when $MR_Q = MC_Q$

Advertising

- We show next that these two conditions

  $MR_A = MC_A$ and $MR_Q = MC_Q$

  lead to the property that the advertising-to-sales ratio, A/PQ, must satisfy:

$$\frac{A}{PQ} = -\frac{\varepsilon_{Q,A}}{\varepsilon_{Q,P}}$$

Let's find the origin of this condition…

- MR_A $TR = p.q(p,A) \rightarrow \frac{\partial TR}{\partial A} = p.\frac{\partial q(p,A)}{\partial A} \equiv MR_A$
- MC_A $TC = c(q(p,A)) + A \rightarrow \frac{\partial TC}{\partial A} = \frac{\partial c}{\partial q}.\frac{\partial q(p,A)}{\partial A} + 1 \equiv MC_A$

  Using Chain Rule
- Hence, $MR_A = MC_A$ implies:

$$p.\frac{\partial q(p,A)}{\partial A} = \frac{\partial c}{\partial q}.\frac{\partial q(p,A)}{\partial A} + 1$$

- Let us now define the advertising-elasticity of Demand

$$\varepsilon_{Q,A} = \frac{\%IncreaseQ}{\%IncreaseA} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta A}{A}} = \frac{\Delta Q}{\Delta A}.\frac{A}{Q} = \frac{\partial q(p,A)}{\partial A}.\frac{A}{Q}$$

- Hence,

$$\varepsilon_{Q,A} = \frac{\partial q(p,A)}{\partial A}.\frac{A}{Q}$$

- And, rearranging,

$$\varepsilon_{Q,A}.\frac{Q}{A} = \frac{\partial q(p,A)}{\partial A}$$

We can thus rewrite the $MR_A = MC_A$ condition that we obtained in the previous slide:

$$p.\underbrace{\frac{\partial q(p,A)}{\partial A}}_{\varepsilon_{Q,A}.\frac{Q}{A}} = \underbrace{\frac{\partial c}{\partial q}}_{MC_Q}.\underbrace{\frac{\partial q(p,A)}{\partial A}}_{\varepsilon_{Q,A}.\frac{Q}{A}} + 1$$

As follows,

$$p\frac{Q}{A}.\varepsilon_{Q,A} = MC_Q.\frac{Q}{A}.\varepsilon_{Q,A} + 1$$

And multiplying both sides by A, we obtain

$$p.Q.\varepsilon_{Q,A} = MC_Q.Q.\varepsilon_{Q,A} + A$$

- Dividing both sides by $\varepsilon_{Q,A}$, we have

$$p.Q = MC_Q.Q + \frac{A}{\varepsilon_{Q,A}}$$

- Rearranging,

$$(P - MC_Q).Q = \frac{A}{\varepsilon_{Q,A}}$$

- And dividing by Q on both sides, yields

$$p - MC_Q = \frac{1}{\varepsilon_{Q,A}}.\frac{A}{Q}$$

- We can now divide both sides by p, to obtain

$$\frac{p - MC_Q}{p} = \frac{1}{\varepsilon_{Q,A}}.\frac{A}{p.Q}$$

- From the IEPR, we know that price markup in monopoly markets satisfy

$$\frac{p - MC_Q}{p} = -\frac{1}{\varepsilon_{Q,p}}$$

- Hence, the above expression becomes

$$-\frac{1}{\varepsilon_{Q,p}} = \frac{1}{\varepsilon_{Q,A}}.\frac{A}{p.Q}$$

- And multiplying both sides by $\varepsilon_{Q,A}$ gives:

$$-\frac{\varepsilon_{Q,A}}{\varepsilon_{Q,p}} = \frac{A}{p.Q}$$

← Advertising-to-sales ratio

Advertising-To-Sales Ratio

$$\frac{A}{P \cdot Q} = -\frac{\varepsilon_{Q,A}}{\varepsilon_{Q,P}}$$

For two markets with the same $\varepsilon_{Q,P}$, we should observe a larger

Advertising-to-sales ratio ($A/P*Q$) in the market where demand is highly sensible to advertising., i.e., the market with the highest $\varepsilon_{Q,A}$

Advertising

- ***Example***: Consider a market in which the price-elasticity of demand is $\varepsilon_{Q,P} = -1.5$, while the advertising-elasticity of demand is $\varepsilon_{Q,A} = 0.1$

a) Interpretation of $\varepsilon_{Q,A} = 0.1$

The advertising elasticity of demand tells us that a 1% increase in the advertising expenditure leads to a 0.1% increase in the quantity demanded.

Advertising

b) Using the IEPR, determine the monopolist's price markup to marginal costs.

$$\frac{p - MC_Q}{P} = -\frac{1}{\varepsilon_{Q,P}} \Leftrightarrow \frac{P - MC_Q}{P} = -\frac{1}{-1.5} \Leftrightarrow \frac{p - MC_Q}{P} = \frac{2}{3}$$

$$\Leftrightarrow 3p - 3MC_Q = 2 \Leftrightarrow p = 3MC_Q$$

Mark-up to MC, i.e., price should be three times my marginal cost.

Advertising

- C) Determine Advertising-to-sales ratios, and interpret it.

$$\frac{A}{PQ} = -\frac{0.1}{-1.5} = 0.067$$

- Advertising, *A*, should represent a 6.7% of the monopolist's sales revenues, *P**Q*.