Printout

Friday, March 24, 2017 1:52 PM

EE481

Price Discrimination & Advanced Topics in Pricing(I)

Case Study (Grabowski and Vernon, 1992)

Question: Does competition always lower price?

- New drugs get patents to grant their monopoly rights.
- But after the patent expires, anyone else can use the formula to produce their drugs (generic brands).
- Grabowski and Vernon (1992) found that after the patent (of 18 major drugs) expires, sale dropped by 50% but price increased 10%.
  - Apparently, there are 2 types of consumers - the loyal and the price-sensitive.
  - The loyals do not switch to generics and are willing to pay more.
  - The patented firm then focus only on the loyal customers -> and charge a higher price.

Price Discrimination

Up to now, consider situations where each firm sets one uniform price.

- Consider cases where firm engages in non-uniform pricing:
  1 Charging customers different prices for the same product (airline tickets)
  2 Charging customers a price depending on the quantity purchased (electricity, telephone service)
- Consider three types of price discrimination:
- **Perfect price discrimination:** charging each consumer a different price. Often infeasible.
- **Third-degree price discrimination:** charging different prices to different groups of customers
- **Second-degree price discrimination:** each customer pays her own price, depending on characteristics of purchase.
- Throughout, consider just monopoly firm.

Price Discrimination Mind Map

KNOWING EACH CONSUMER'S WTP

YES

DO 1ST DEGREE

NO

BUT FIRMS CAN IDENTIFY CONSUMERS AS GROUPS

DO 3RD DEGREE

BUT FIRMS CANNOT IDENTIFY WHO HAS HIGH WTP OR WHO HAS LOW WTP

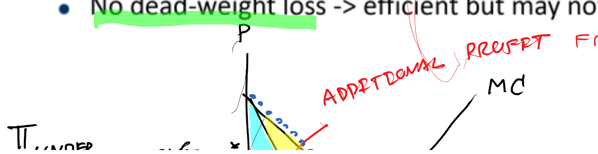
DO 2ND DEGREE

(LET CONSUMERS REVEAL THEIR TYPE WHEN THEY CHOOSE THE MENU

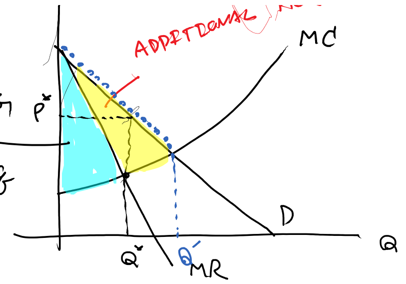
(SELF-SELECTION)

Perfect Price Discrimination (PPD)

- Firm can identify the willingness to pay of every consumer.
- Perfectlly discriminating monopolist makes much higher profits (takes away all of the consumer surplus)
- No dead-weight loss -> efficient but may not be fair.



Π UNDER UNIFORM PRICING $= \int_{q=0}^{Q^*} (MR - MC)\, dq$



Ton Wrasai 5

Third-Degree Price Discrimination (3PD)

- Monopolist only knows demand functions for dierent groups of consumers (graph): groups differ in their price responsiveness.
- Cannot distinguish between consumers in each group (ie., resale possible within groups, not across groups)
  - Student vs. Adult tickets
  - Journal subscriptions: personal vs. institutional
  - Gasoline prices: urgent vs. non-urgent
- Main ideas: under optimal 3PD|
- Charge different price to different group, according to inverse-elasticity rule. Group with more elastic demand gets lower price.
- Can increase consumer welfare: group with more elastic demand gets lower price under 3PD.

Ton Wrasai 6

Third-Degree Price Discrimination (maths)

- In general, price-discriminating monopolist follows inverse elasticity rule with respect to each group:

$$\frac{(p_i - MC(q_i))}{p_i} = -\frac{1}{\epsilon_i}$$

- or (assuming constant marginal costs)

$$\frac{p_i}{p_j} = \frac{1 + \frac{1}{\epsilon_j}}{1 + \frac{1}{\epsilon_i}}$$

Ton Wrasai 7

$$\frac{P - MC}{P} = -\frac{1}{\varepsilon} = \frac{1}{|\varepsilon|}$$

$$P - MC = \frac{P}{|\varepsilon|}$$

$$P - \frac{P}{|\varepsilon|} = MC$$

$$P\left(1 - \frac{1}{|\varepsilon|}\right) = MC$$

$$P = \frac{MC}{1 - \frac{1}{|\varepsilon|}}$$

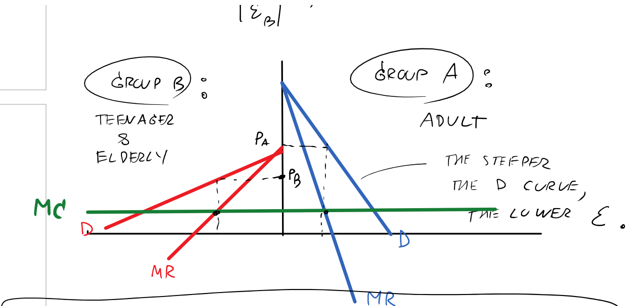
$$P_A = \frac{MC_i}{1 - \frac{1}{|\varepsilon_A|}} \qquad P_B = \frac{MC}{1 - \frac{1}{|\varepsilon_B|}}$$

WHEN $|\varepsilon_B| > |\varepsilon_A|$,

THEN $P_B < P_A$.

GROUP B

GROUP A :



Third-Degree Price Discrimination (maths)

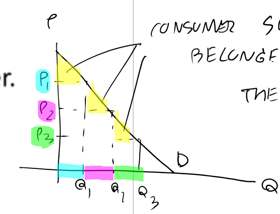
- This is the "Ramsey pricing rule": (roughly speaking) consumers with less-elastic demands should be charged higher price
  - Senior discounts
  - Food at airports, ballparks, concerts
  - Optimal taxation
- Caveat: this condition is satisfies only at optimal prices (and elasticity is usually a function of price)

WE CHARGE A HIGHER PRICE TO CONSUMERS W/ LOW PRICE ELASTICITY AND CHARGE A LOWER PRICE TO CONSUMERS W/ HIGH PRICE ELASTICITY.

"RAMSEY PRICING RULE"

Second-Degree Price Discrimination (2PD)

- Price discrimination can be categorized into 3 types according to the completeness of information
- 1st degree - firm observes the willingness to pay of EACH buyer.
- 2nd degree - firm does not observe the willingness to pay of EACH buyer. But knows that different buyers have different willingness to pay.
- 3rd degree - firm observes the willingness to pay of EACH... GROUP of buyers.



CONSUMER SURPLUS BELONGED TO THE CONSUMER.

Second-Degree Price Discrimination (2PD)

- Some forms of second-degree price discrimination
  - Two-part tariff
  - Multi-part tariff
  - Menu of Price or Price schedule
  - Bundling, Tie-in sale

Second-Degree Price Discrimination

- Second-degree price discrimination is a form of non-linear pricing.
- Nonlinear Pricing = consumer's price per unit is not a constant
- Second-degree price discrimination uses the nonlinear pricing method to extract welfare from consumers.

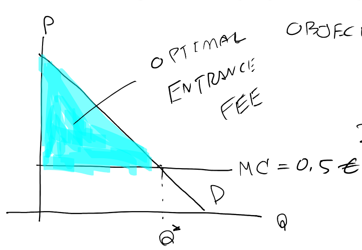
Examples of Two-Part Tariff

Firm changes a lump-sum fee AND a per-unit fee.

Product	Lump-sum	Per-unit fee
PRINTER	PRINTER	INK
PLAYSTATION	BOX	GAMES
NESPRESSO	COFFEE MACHINE	CAPSULES
DISNEYLAND	ENTRANCE FEE	PER UNIT CHARGE FOR PLAYING INSTRUMENTS
FOOTBALL GAME	MEMBERSHIP FEE	TICKETS

A Single Two-Part Tariff

- Suppose there are 2 types of consumers
  - the High willingness to pay (high-type)
  - the Low willingness to pay (low-type)



OBJECTIVE : TO CAPTURE OR EXTRACT MORE OF CS

2-PART TARIFF
- FIXED, ONE-TIME FEE
- A PRICE PER EACH UNIT PURCHASED.

THE STRATEGY ⇒ ① CHARGE THE ONE-TIME FEE = CS

② CHARGE PER UNIT PRICE = MARGINAL COST!

Two Two Part Tariff

- Firms can increase their profits from offering two two-part tariff instead of a single two-part tariff
- different collateral-interest rate combinations
- different co-payment and insurance premium combinations
- offering buffet or a'-la-carte

NUMERICAL EXAMPLE

SUPPOSE YOU DECIDE TO OPEN A BAR.

FIXED COST

$TC = 1000 + 0.5Q$ → NUMBER OF DRINKS, COST IN €

$MC = 0.50$ € / DRINK

CASE 1 ONLY ONE TYPE OF CUSTOMERS: THEY ARE PARTY ANIMALS.

$$\boxed{Q_{ANIMAL} = 10 - 2P}$$

IF WE FIRST DO NOT USE 2-PART TARIFF, OUR PROFIT WOULD BE:

$$P = 5 - \frac{Q}{2}$$

$$TR = P \cdot Q = \left(5 - \frac{Q}{2}\right)Q = 5Q - \frac{1}{2}Q^2$$

$$MR = 5 - Q.$$

SET $MR = MC$ TO FIND A PROFIT MAXIMISING OUTPUT (Q^*)

$$5 - Q = 0.5$$

$Q^* = 4.5$ DRINKS / PERSON PER NIGHT

$P = 5 - \frac{Q}{2} = 5 - \frac{4.5}{2} = 5 - 2.25 = 2.75$ € / DRINK.

SUPPOSE $N = 500$ DRINKERS.

$$\pi = TR - TC$$

$$= P \cdot Q_{TOTAL} - (1000 + 0.5\, Q_{TOTAL})$$

$$= 2.75 \times 2250 - (1000 + 0.5 \times 2250)$$

$Q_{TOTAL} = 4.5 \times 500$

$= 2250$ DRINKS

$$\boxed{\pi = 4062.50 \text{ € PER NIGHT}}$$

Bundling

Reference and Further Reading

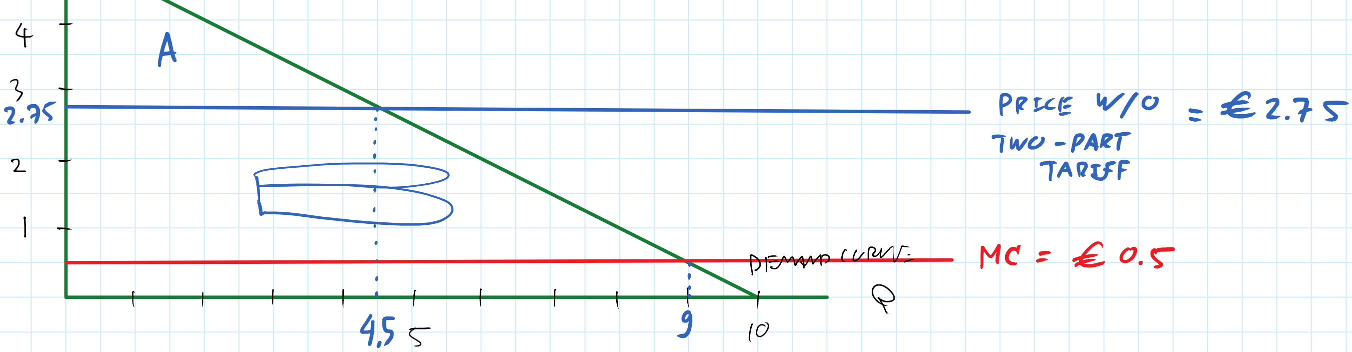
- Carlton, D.W. and J.M., Perloff, *Modern Industrial Organization*. 4th Edition, Pearson Addison Wesley Press, 2005.
- Church, J. and R. Ware. *Industrial Organization*: A Strategic Approach. International Edition. McGraw-Hill Press, 2000.
- Grabowski, H., and J. Vernon. *Brand Loyalty, Entry and Price Competition in Phamaceuticals after the 1984 Drug Act*. Journal of Law and Economics 35: 331-50, 1992.

Friday, March 24, 2017 4:18 PM

W/ TWO-PART TARIFF:

① FEE OR COVER CHARGE $= A + B = \frac{1}{2} \cdot 4.5 \cdot 9 =$ € 20.25 / PERSON

② OPTIMAL PRICE PER DRINK $= MC = €\ 0.5$



$Q_{TOTAL} = 9 \cdot 500 = 4500$ DRINKS / NIGHT

$\pi = TR - TC = (500 \cdot FEE) + \cancel{0.5 \cdot Q_{TOTAL}} - (1000 + \cancel{0.5 \cdot Q_{TOTAL}})$

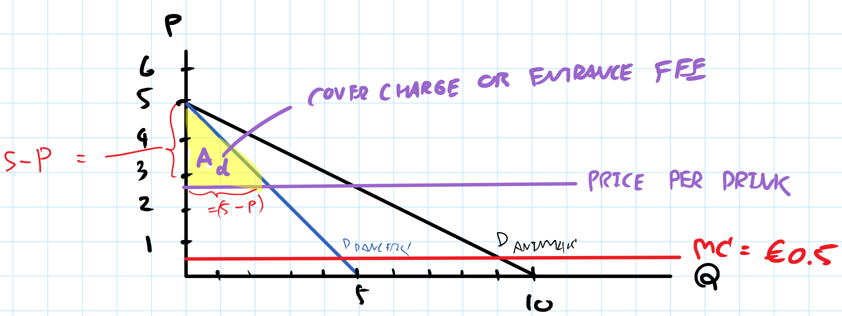
$= 500 \cdot FEE - 1{,}000$

$= 500\,(20.25) - 1{,}000$

$=$ € 9,125 PROFIT PER NIGHT

CASE 2 TWO-PART TARIFF W/ TWO KINDS OF CUSTOMERS — PARTY ANIMALS / DANCERS

- $Q_{ANIMAL} = 10 - 2P$ OR $P = 5 - \frac{1}{2} Q_{ANIMAL}$ $M = 500$ DRINKERS
- $Q_{DANCER} = 5 - P$ OR $P = 5 - Q_{DANCER}$ $N = 500$ DANCERS



$T(P)$: COVER CHARGE IS A FUNCTION OF PRICE PER DRINK

TO ATTRACT BOTH HIGH-TYPE CUSTOMERS AND LOW-TYPE CUSTOMERS, THE COVER CHARGE CANNOT BE BIGGER THEN THE CONSUMER SURPLUS OF CUSTOMER WITH SMALLEST CONSUMER SURPLUS! $(= A_d)$

IF COVER CHARGE IS HIGHER THAN A_d, THE DANCERS WILL NOT GO TO THE BAR!

LET'S FIND THE OPTIMAL COVER CHARGE (T^*)

$T(P) = \frac{1}{2} \times (5-P) \times (5-P) = 12.5 - 5P + \frac{1}{2}P^2$.

$\pi = TR - TC = 1000 \cdot T(P) + 500 \cdot P \cdot \underbrace{(10-2P)}_{Q_{ANIMAL}} + 500 \cdot P \cdot (5-P)$

$$- \left[1000 + 0.5 \left(\underbrace{500(10-2P) + 500(5-P)}_{Q_{TOTAL}} \right) \right]$$

$$\pi = -1000 \times P^2 + 3250\,P + 7750$$

$$\frac{\partial \pi}{\partial P} = -2000\,P + 3250 = 0$$

$$\boxed{P^* = \frac{3250}{2000} = €\,1.625 \text{ PER DRINK}}$$

$$\boxed{T = 12.5 - 5P + \frac{P^2}{2} = 12.5 - 5(1.625) + \frac{(1.625)^2}{2} = €\,5.70}$$

$Q_{ANIMAL} = 10 - 2P = 10 - 2(1.625) = 6.75$ DRINKS PER PARTY ANIMAL PER NIGHT.

$Q_{DANCER} = 5 - P = 5 - 1.625 = 3.375$ DRINKS PER DANCER PER NIGHT.

$$\pi = -1000 \times P^2 + 3250\,P + 7750$$

$$= -1000 \times (1.625)^2 + 3250(1.625) + 7750$$

$$= €\,10{,}391 \text{ PER NIGHT!}$$

SUMMARY

	COVER CHARGE	PRICE/DRINK	DRINKS/♀	π
NO TWO-PART TARIFF	0	€ 2.75	4.5	€ 4063
ONE KIND OF CUSTOMERS	€ 20.25	€ 0.5	9.0	€ 9,125
TWO KINDS OF CUSTOMERS	€ 5.70	€ 1.625	6.75 FOR ANIMALS 3.375 FOR DANCERS	€ 10,391

BUNDLING : A PRACTICE OF SELLING TWO OR MORE PRODUCTS AS A PACKAGE

- PURE BUNDLING
- MIXED BUNDLING

EXAMPLE

	BEAUTY & THE BEAST	LOGAN
THEATER 1	€ 12,000	€ 3000
	$\vee$	$\wedge$
THEATER 2	€ 10,000	€ 4000

(NUMBERS IN THE CELLS REPORT WTP BY EACH THEATRE.)

OPTION 1 SELL THEM SEPARATELY

$P_B = 10{,}000$

$P_L = 3000$

TOTAL REVENUE $= 10{,}000 \times 2 + 3000 \times 2 =$ € 26,000

OPTION 2 : SELL THEM AS A PACKAGE

$P_{BUNDLING} = 14{,}000$

TOTAL REVENUE $= 14{,}000 \times 2 =$ € 28,000

BUNDLING YIELDS HIGHER REVENUE THAN SELLING SEPARATELY (WHY?)

B/C DEMANDS ARE NEGATIVELY CORRELATED : THEATER WILLING TO PAY THE MOST FOR B&B IS WILLING TO PAY THE LEAST FOR LOGAN, VICE VERSA.

MODIFIED EXAMPLE :

	B&B	LOGAN
T1	12,000	4000
	$\vee$	$\vee$
T2	10,000	3000

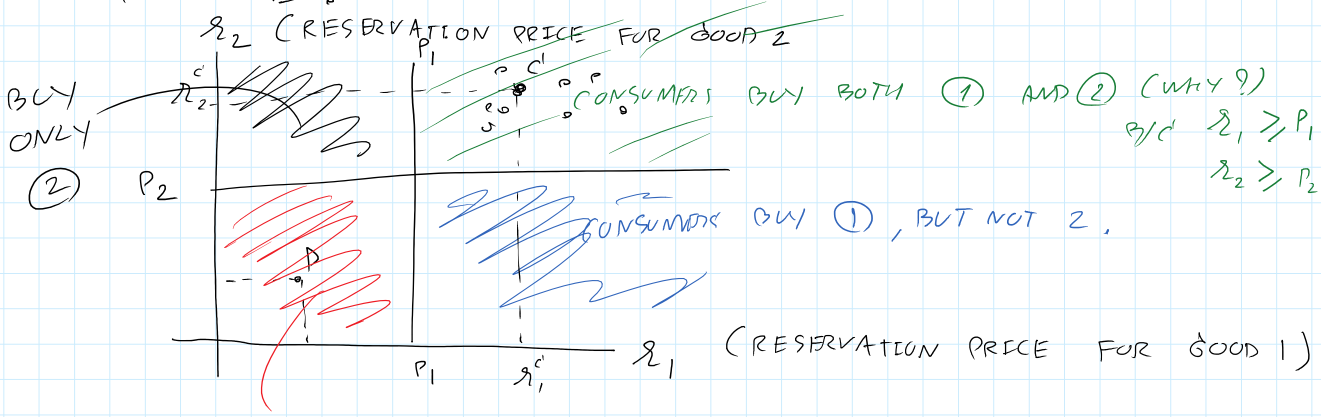
OPTION 1 : SELLING SEPARATELY $\Rightarrow$ $P_B = 10000$, $P_L = 3000$

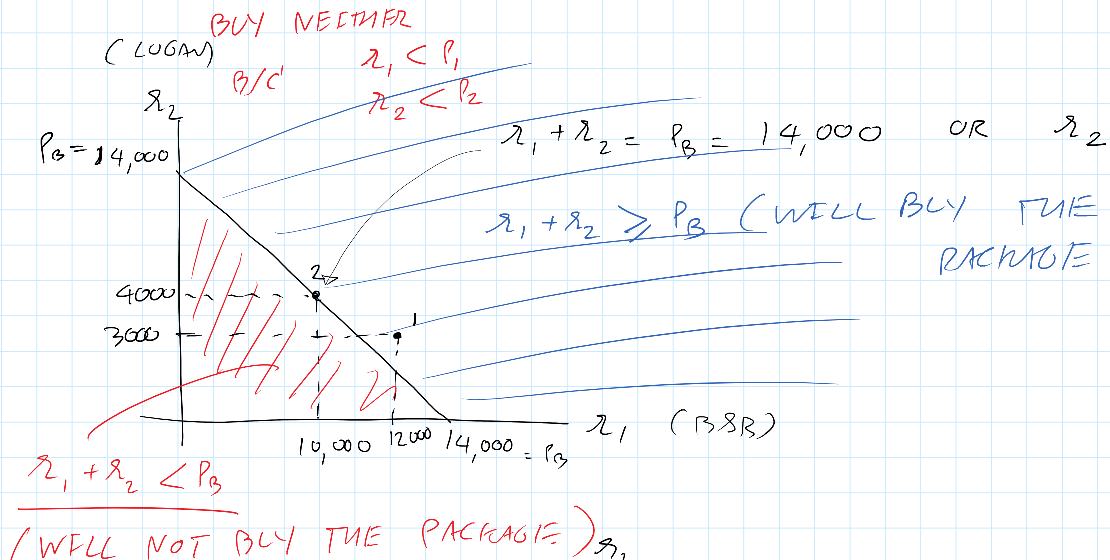
TR $= 10000 \times 2 + 3000 \times 2 = 26{,}000$ €

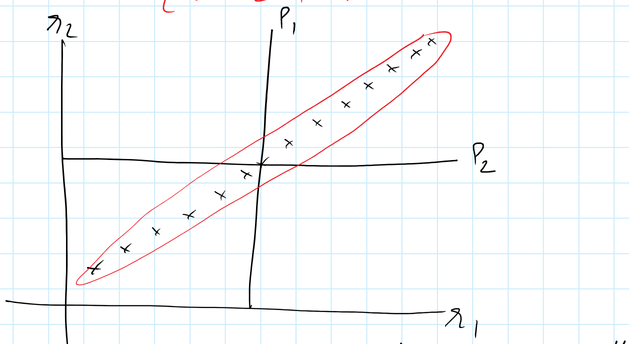
OPTION 2 : BUNDLING $\Rightarrow$ $P_{BUNDLED} = 13{,}000$

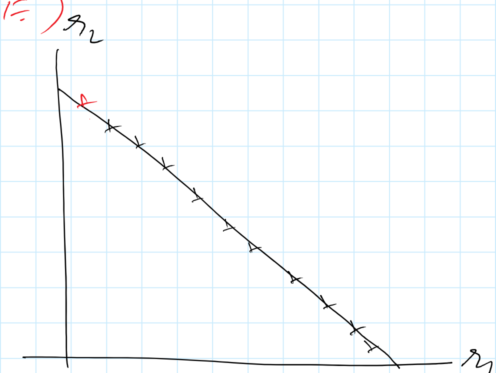
TR = 13,000 × 2 = 26,000 €

WHEN DEMANDS ARE "POSITIVELY CORRELATED", SELLING SEPARATELY AND BUNDLING GIVE THE SAME REVENUE.









WHEN DEMANDS ARE "POSITIVELY" CORRELATED, BUNDLING GIVES SAME TR AS SELLING SEPARATELY.

WHEN DEMANDS ARE "NEGATIVELY CORRELATED", BUNDLING GIVES HIGHER TR.

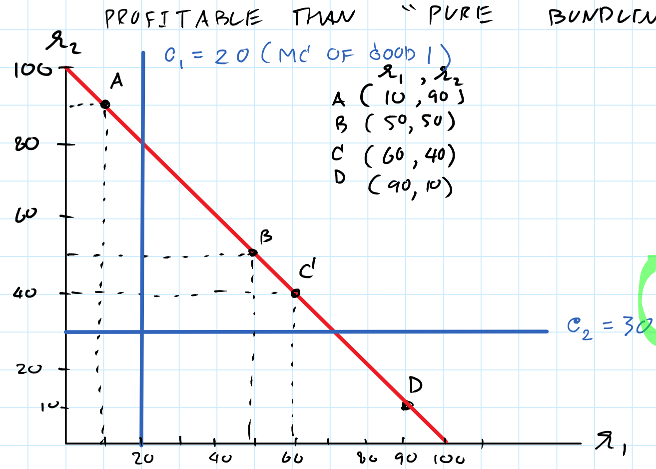
Wednesday, March 29, 2017 2:04 PM

MIXED BUNDLING VS PURE BUNDLING

MIXED BUNDLING : SELLING TWO OR MORE GOODS BOTH "AS A PACKAGE" AND "INDIVIDUALLY"

PURE BUNDLING : SELLING TWO OR MORE GOODS AS A PACKAGE ONLY.

Q: UNDER WHICH CONDITIONS "MIXED BUNDLING" IS PROFITABLE THAN "PURE BUNDLING"?



OPTION 1 SELLING SEPARATELY

$P_1 = ?$ $P_2 = ?$

CONSIDER GOOD 1 FIRST.

IF $P_1 = 40$, B, C, D BUY.

$\Pi_1 = (P_1 - MC_1) \cdot Q_1 = (40 - 20) \cdot 3 = 60.$

IF $P_1 = 50$, B, C, D BUY

$\Pi_1 = (P_1 - MC_1) \cdot Q_1 = (50 - 20) \cdot 3 = 90.$

IF $P_1 = 60$, C, D BUY

$\Pi_1 = (P_1 - MC_1) \cdot Q_1 = (60 - 20) \cdot 2 = 80.$

IF $P_1 = 90$, D BUYS

$\Pi_1 = (P_1 - MC_1) \cdot Q_1 = (90 - 20) \cdot 1 = 70.$

CONSIDER GOOD 2.

IF $P_2 = 40$, A, B, C BUY

$\Pi_2 = (P_2 - MC_2) \cdot Q_2 = (40 - 30) \cdot 3 = 30.$

IF $P_2 = 50$, A AND B BUY

$\Pi_2 = (P_2 - MC_2) \cdot Q_2 = (50 - 30) \cdot 2 = 40.$

IF $P_2 = 90$

$\Pi_2 = (P_2 - MC_2) Q_2 = (90 - 30) \cdot 1 = 60$

$\therefore$ $P_1^* = 50 \rightarrow \Pi_1^* = 90$

$P_2^* = 90 \rightarrow \Pi_2^* = 60$

$\Pi_{TOTAL} = 90 + 60 = 150$ #

OPTION 2 : PURE BUNDLING

$P_B = 100$, A, B, C, D WILL BUY

$\Pi_B = (P_B - MC_{1+2}) Q_B$

$= (100 - 50) \cdot 4$

$= 200$ #

OPTION 3 : MIXED BUNDLING

$P_1 = ?$ $P_2 = ?$ $P_B = ?$

$P_B = 100$ $P_1 = 89.95$ $P_2 = 89.95$

RESULTS : B AND C BUY BUNDLE

A WILL BUY ONLY GOOD 2

D WILL BUY ONLY GOOD 1

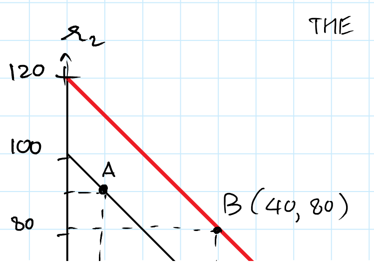
$$\Pi_{MB} = \underbrace{(P_B - MC_B) \cdot Q_B}_{B+C} + \underbrace{(P_1 - MC_1) \cdot Q_1}_{MR.\,D} + \underbrace{(P_2 - MC_2) \cdot Q_2}_{MR.\,A}$$

$= (100 - 50) \cdot 2 + (89.95 - 20) \cdot 1 + (89.95 - 30) \cdot 1$

$= 100 + 69.95 + 59.95$

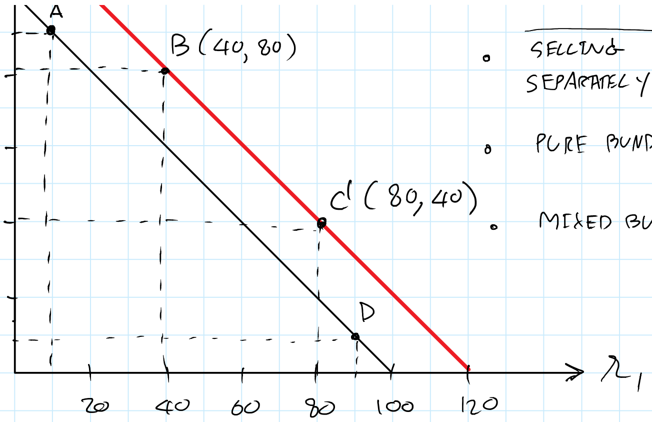
$= 229.9$

CONCLUSION MIXED BUNDLING IS MORE PROFITABLE THAN PURE BUNDLING WHEN MARGINAL COST OF PRODUCING THE TWO GOODS ARE POSITIVE.



SUPPOSE MC OF PRODUCING THE TWO GOODS = 0

	P_1	P_2	P_B	Π
SELLING SEPARATELY	80	80	—	$\underbrace{80 \cdot 2}_{C\,\&\,D} + \underbrace{80 \cdot 2}_{A\,\&\,B} = 320$



	P_1	P_2	P_B	
• SELLING SEPARATELY	80	80	–	$80 \cdot 2 + 80 \cdot 2 = 320$
• PURE BUNDLING	—	—	100	$100 \cdot 4 = 400$
• MIXED BUNDLING	90 (D)	90 (A)	120 (B & C')	420 *

CONCLUSION

MIXED BUNDLING IS MORE PROFITABLE THAN PURE BUNDLING WHEN DEMANDS ARE NOT PERFECTLY NEGATIVELY CORRELATED.

INTERRELATED DEMANDS (CHAPTER 10)

VERY OFTEN, THE DEMANDS FOR GOODS ARE INTERRELATED:

DEMAND FOR PRODUCT A DEPENDS NOT ONLY ON PRICE OF A BUT ALSO PRICE OF B & DEMAND FOR PRODUCT B DEPENDS NOT ONLY ON PRICE OF B BUT ALSO PRICE OF A, i.e., $D_A(P_A, P_B)$ & $D_B(P_A, P_B)$

SUPPOSE MARGINAL COST OF PRODUCTION FOR PRODUCT A $= m_A$

" — " B $= m_B$

PRICE OF PRODUCT A $= P_A$

" — " B $= P_B$

(A)	(B)
CAMERA	FILM
PRINTER	TONER
RAZOR	BLADE

$$\pi_A(P_A, P_B) = \underbrace{(P_A - m_A)}_{\text{PROFIT PER UNIT SOLD}} \cdot D_A(P_A, P_B)$$

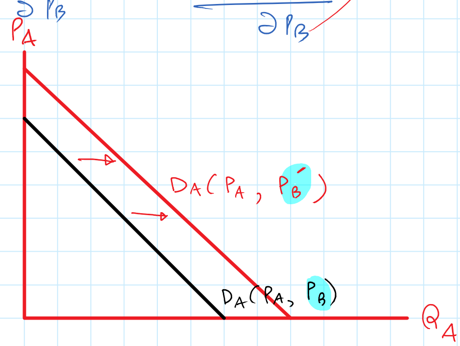
$$\pi_B(P_A, P_B) = (P_B - m_B) \cdot D_B(P_A, P_B)$$

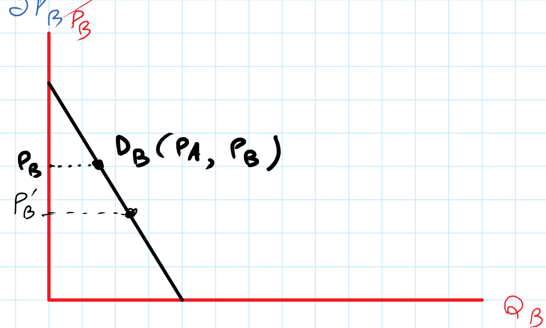
$$\pi(P_A, P_B) = \pi_A(P_A, P_B) + \pi_B(P_A, P_B)$$

$$= (P_A - m_A) \cdot D_A(P_A, P_B) + (P_B - m_B) \cdot D_B(P_A, P_B)$$

$$\frac{\partial \pi}{\partial P_A} = \frac{\partial \pi_A(P_A, P_B)}{\partial P_A} + \frac{\partial \pi_B(P_A, P_B)}{\partial P_A} = 0 \quad \text{—— (1)}$$

$$\frac{\partial \pi}{\partial P_B} = \frac{\partial \pi_A(P_A, P_B)}{\partial P_B} + \frac{\partial \pi_B(P_A, P_B)}{\partial P_B} = 0 \quad \text{—— (2)}$$





$P_B \downarrow \rightarrow$ DEMAND FOR A SHIFTS OUTWARD FROM $D_A(P_A, P_B)$ TO $D_A(P_A, P_B')$ WHERE $P_B' < P_B \rightarrow$ SALES OF PRODUCT A $\uparrow \rightarrow$ PROFITS OF PRODUCT A $\uparrow$ WHICH CAN BE LARGE ENOUGH TO "OFFSET" THE DECLINE IN THE PROFIT FROM SALES OF B.

IN CONTRAST,

NOTE SINGLE MONOPOLIST W/ NO INTERRELATED DEMANDS $\Rightarrow \frac{\partial \pi_A(P_A)}{\partial P_A} = 0$ & $\frac{\partial \pi_B(P_B)}{\partial P_B} = 0$