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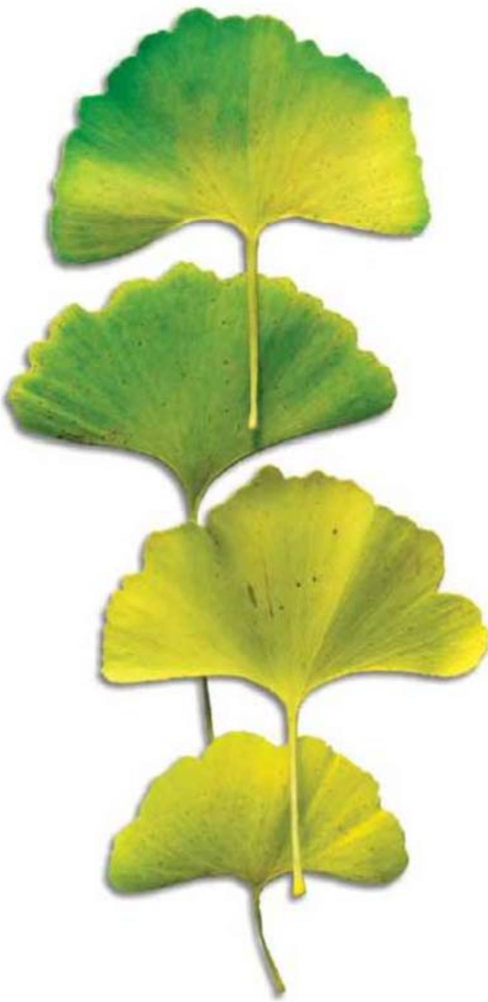

Chapter 4

Individual and Market Demand

Chapter Outline

- The Effects of Changes in the Price on a consumer's choice
- The Effects of Changes in Income " — "
- The Income and Substitution Effects of a Price Change
- Consumer Responsiveness to Changes in Price
- Market Demand: Aggregating Individual Demand Curves
- Price Elasticity of Demand
- The Dependence of Market Demand on Income
- Application: Forecasting Economic Trends
- Cross-price Elasticities of Demand

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- Appendix
  - The Constant elasticity of demand
  - The Income-Compensated Demand Curve

The Effect of Changes in Price

- ***Price-consumption curve (PCC):*** for a good X is the set of optimal bundles traced on an indifference map as the price of X varies (holding income and the price of Y constant).

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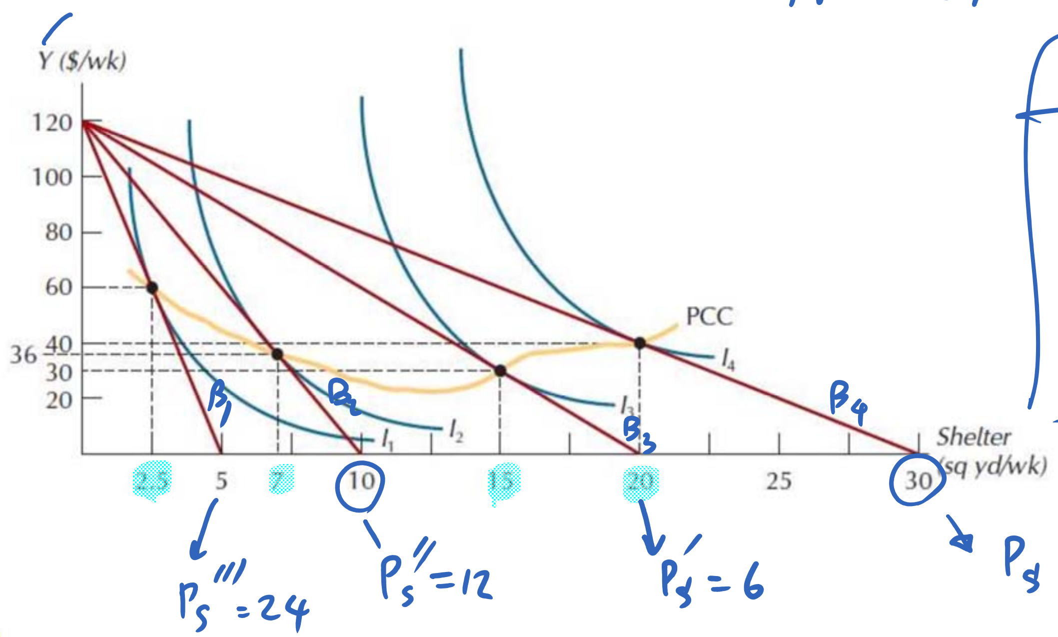
Figure 4.1: The Price-Consumption Curve

income, or composite good

M=120 $/wk



P_s	Q_s^d
4	20
6	15
12	7
24	2.5

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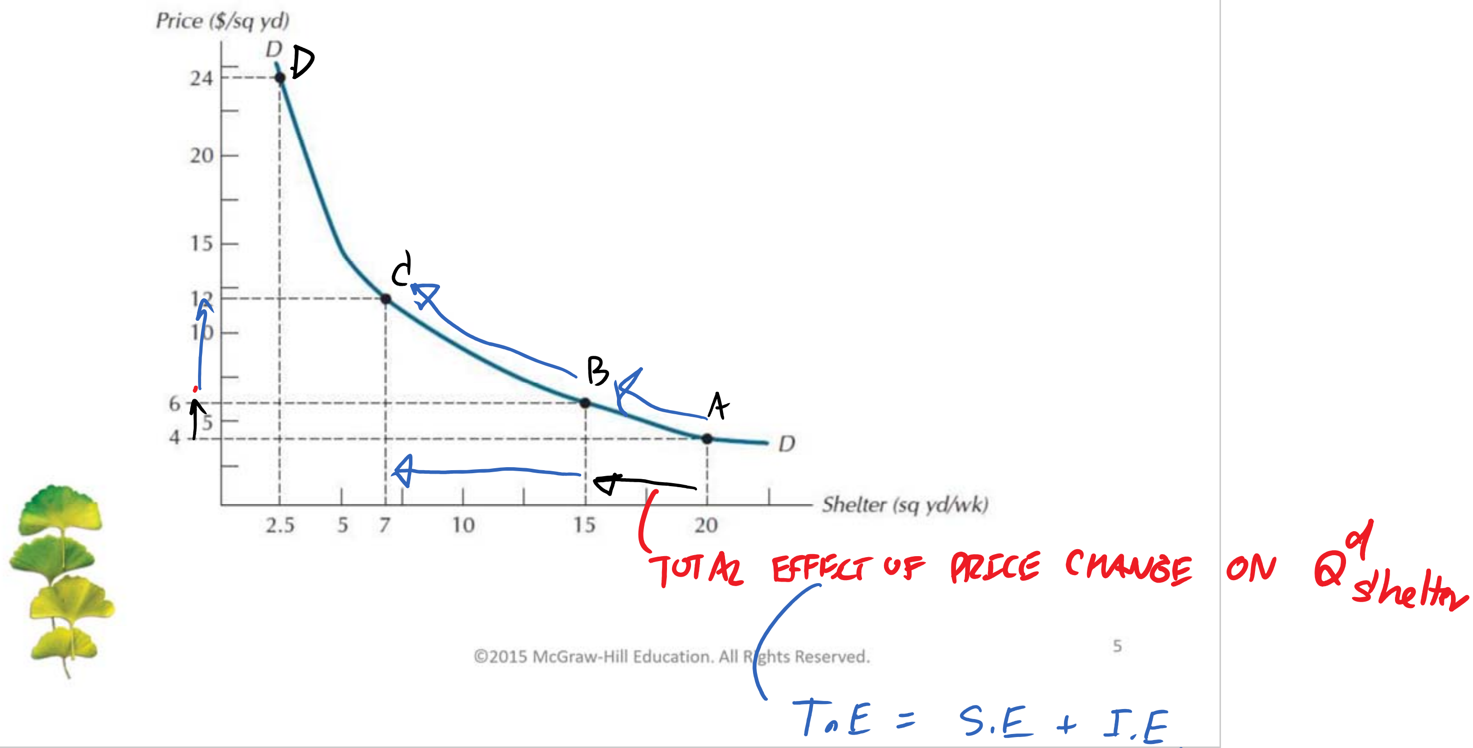
Figure 4.2: An Individual Consumer's Demand Curve



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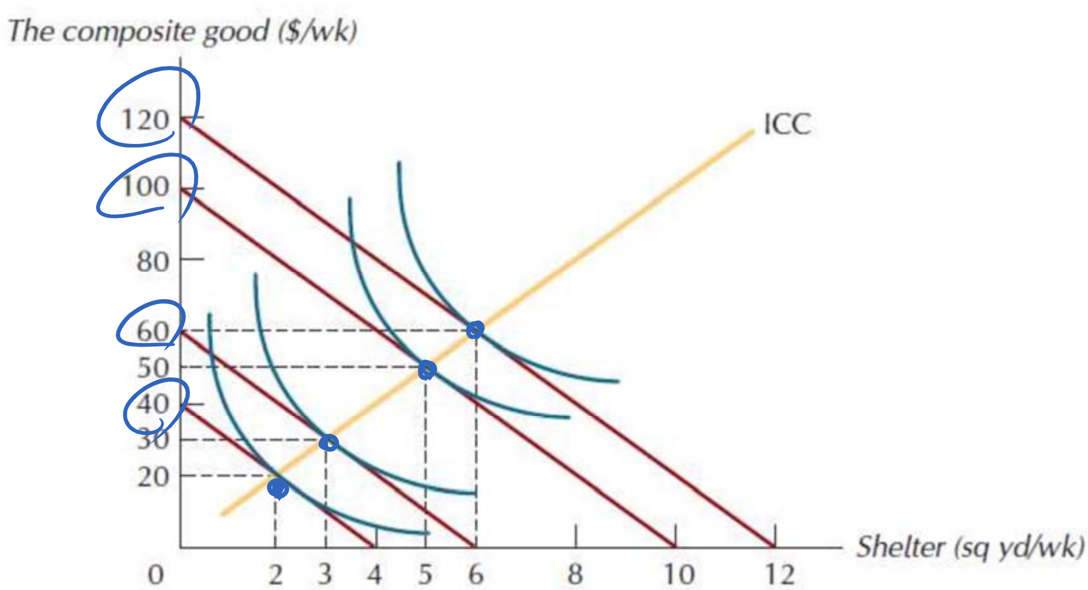
The Effects of Changes in Income

- ***Income-consumption curve (ICC):*** for a good X is the set of optimal bundles traced on an indifference map as income varies (holding the prices of X and Y constant).
- ***Engel curve:*** curve that plots the relationship between the quantity of X consumed and income.

The Effects of Changes in Income

- ***Normal good:*** one whose quantity demanded rises as income rises.
- ***Inferior good:*** one whose quantity demanded falls as income rises.

Figure 4.3: An Income-Consumption Curve



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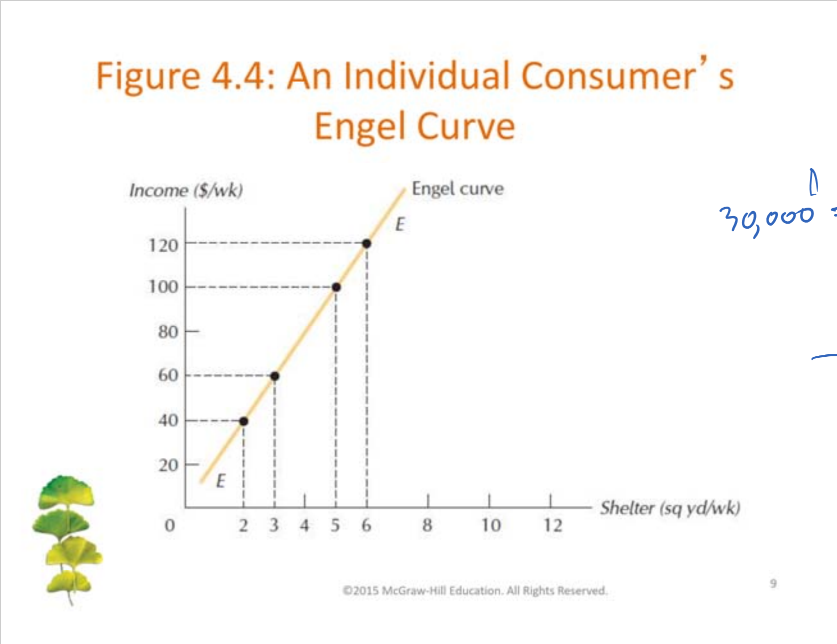


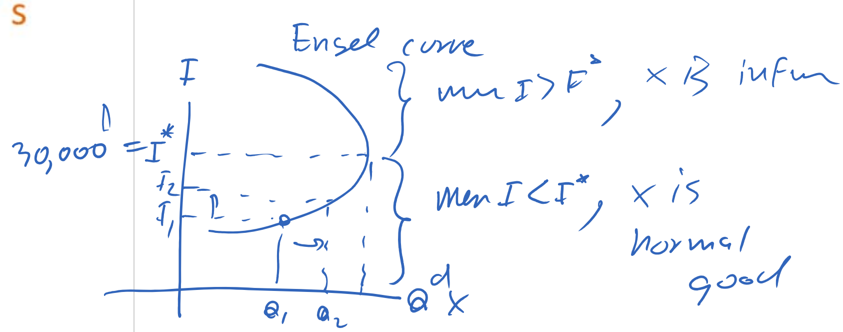
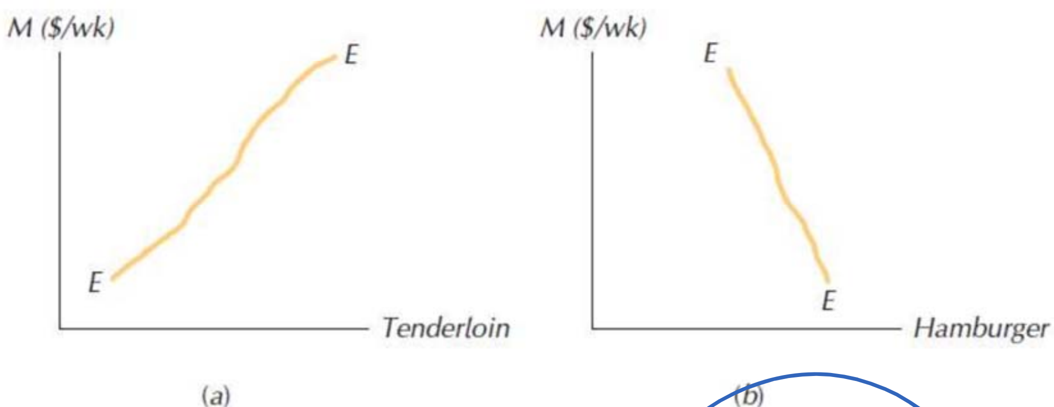


Figure 4.5: The Engel Curve for Normal and Inferior Goods



NORMAL GOOD

INFERIOR GOOD

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Income and Substitution Effects of a Price Change

- ***Substitution effect:*** that component of the total effect of a price change that results from the associated change in the relative attractiveness of other goods.

- ***Income effect:*** that component of the total effect of a price change that results from the associated change in real purchasing power.

- ***Total effect:*** the sum of the substitution and income effects.

T.E = S.E + I.E

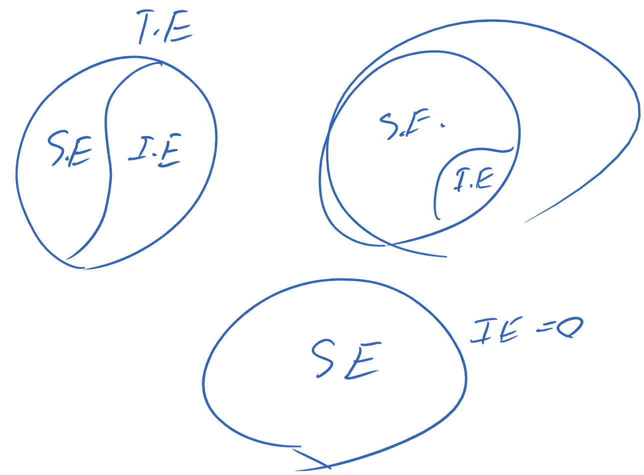
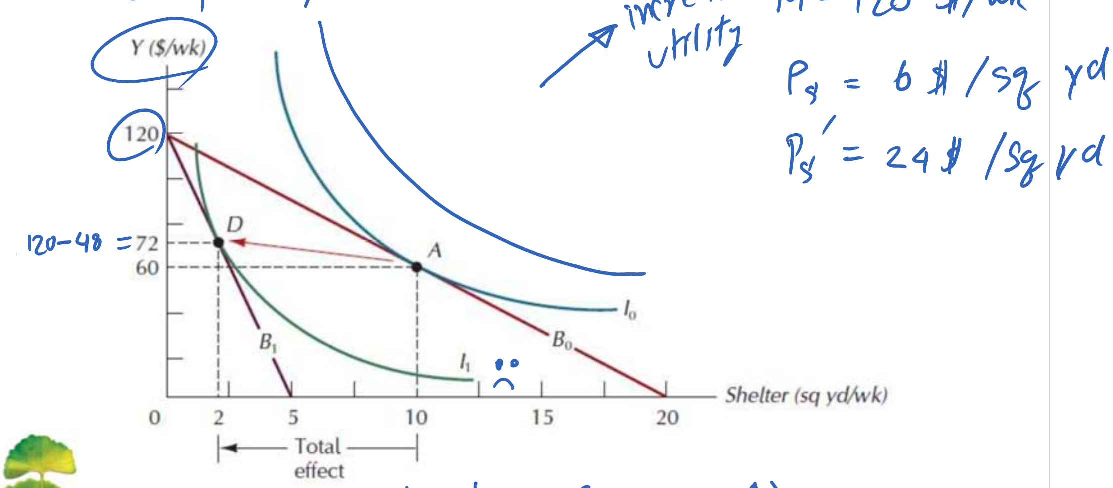


Figure 4.6: The Total Effect of a Price Increase

$M = 120$ \$/wk

$P_s = 6$ \$/sq yd

$P_s' = 24$ \$/sq yd



of price change (here, $P_s \uparrow$)

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$$\Delta Q^d_{s'} = \Delta Q^d_{s', \text{ via S.E.}} + \Delta Q^d_{s', \text{ via I.E}}$$

−8	?	?
(T.E.)	(S.E.)	(I.E)

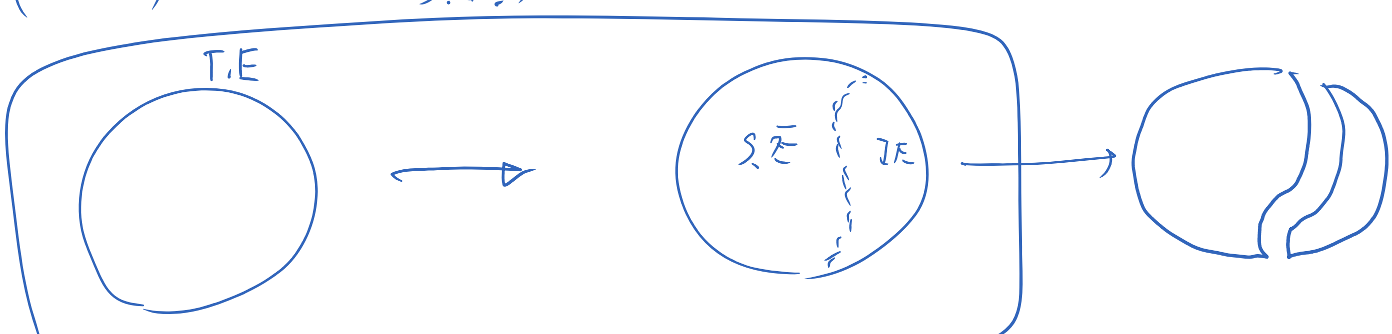
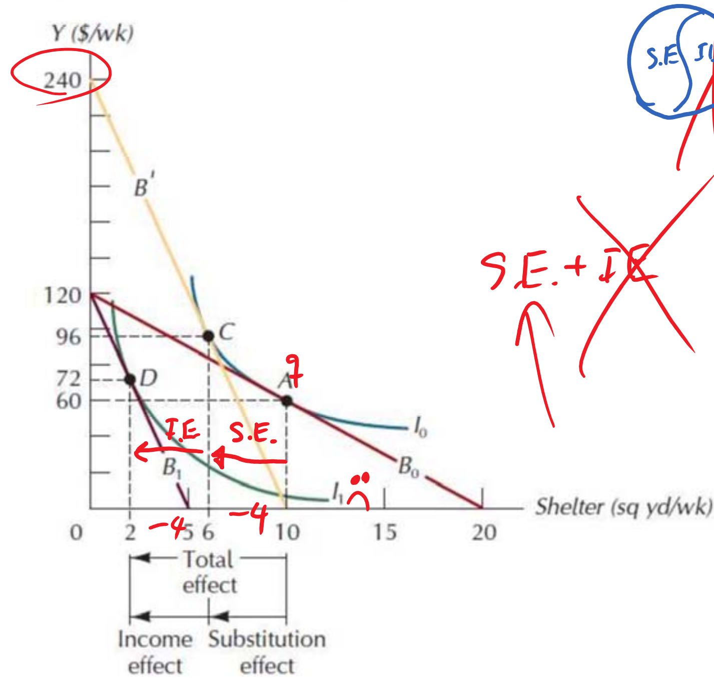
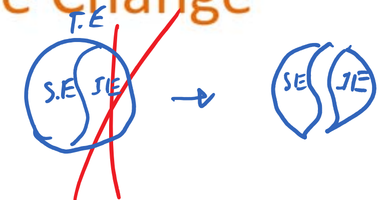


Figure 4.7: The Substitution and Income Effects of a Price Change

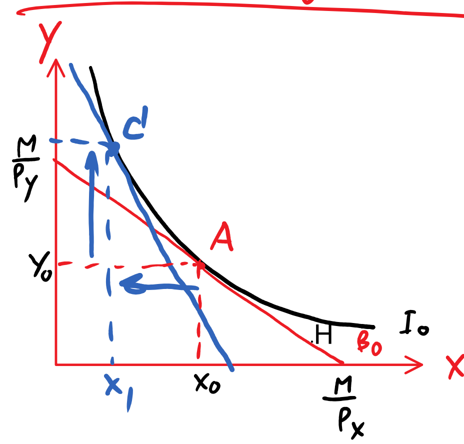




S.E. + I.E

S.E. Q^d_s due to change in relative price $\left(\Delta \frac{P_x}{P_y}\right)$ holding utility constant.

in term of good x & y



Slope of $B_0 = -\frac{\frac{M}{P_y}}{\frac{M}{P_x}} = -\frac{P_x}{P_y}$

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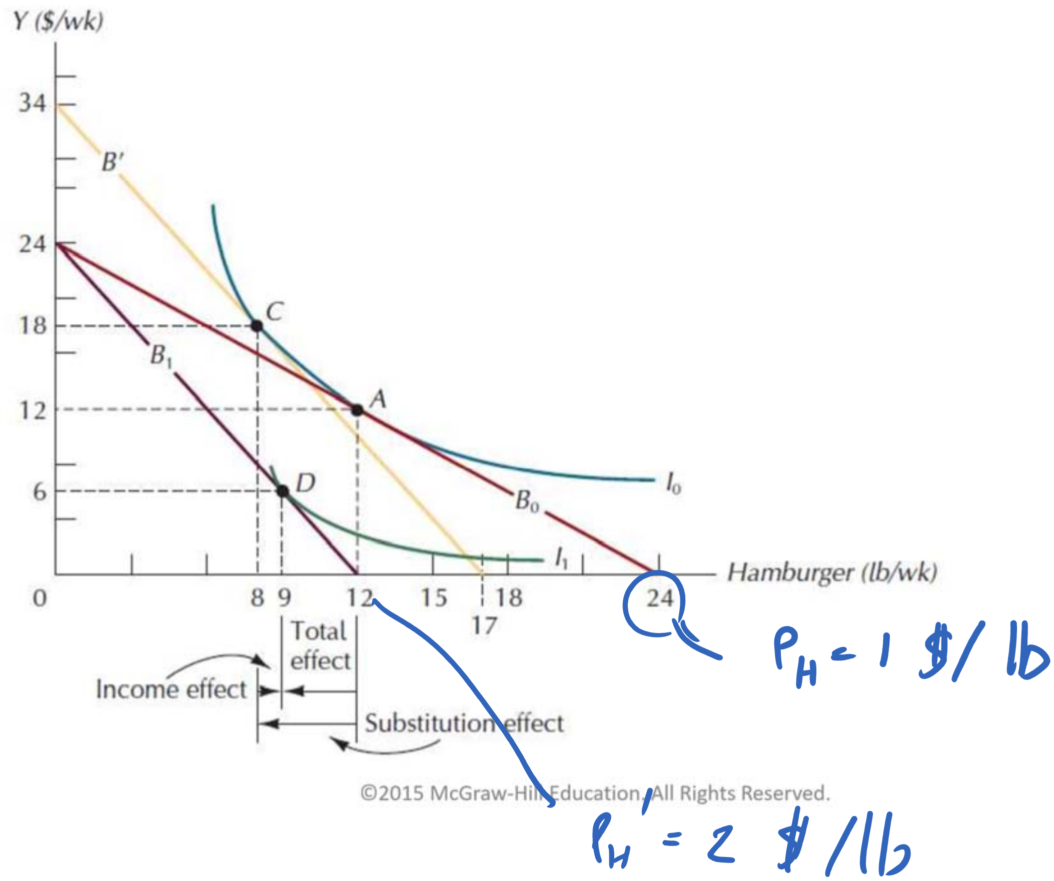
Figure 4.8: Income and Substitution Effects for an Inferior Good



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Giffen Goods = super inferior good :

I.E dominates S.E

- ***Giffen good:*** one for which the quantity demanded rises as its price rises.
  - The Giffen good must be an inferior good

Figure 4.9: The Demand Curve for a Giffen Good

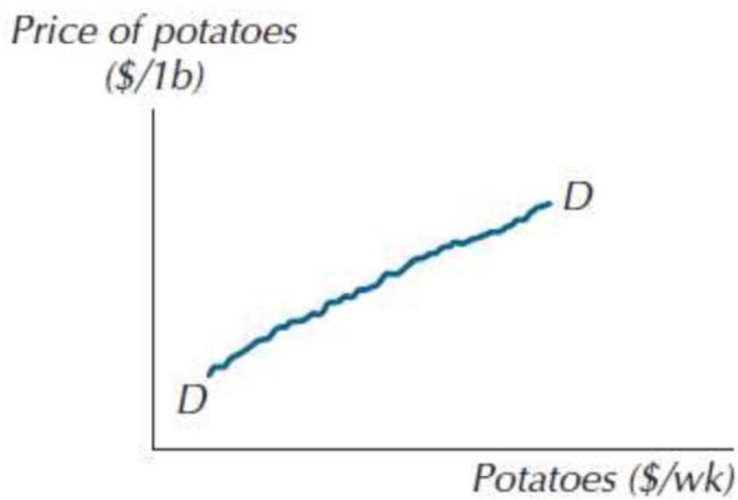

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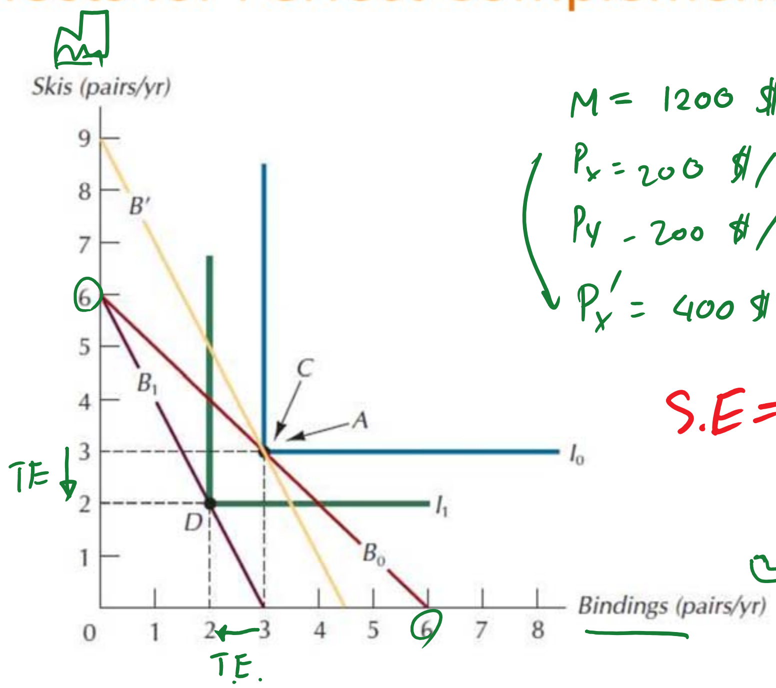
Figure 4.10: Income and Substitution Effects for Perfect Complements



$M = 1200$ \$/yr

$P_x = 200$ \$/pair

$P_y = 200$ \$/pair

$P_x' = 400$ \$/pair

S.E = 0

TE = IE

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TE = I.E.

D (2,2) ← A (3,3)

ONLY INCOME EFFECT PLAYS A ROLE IN EXPLAINING CHANGE IN HIS CONSUMPTION CHOICE.

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Figure 4.11: Income and Substitution Effects for Perfect Substitutes

$P_c \uparrow$

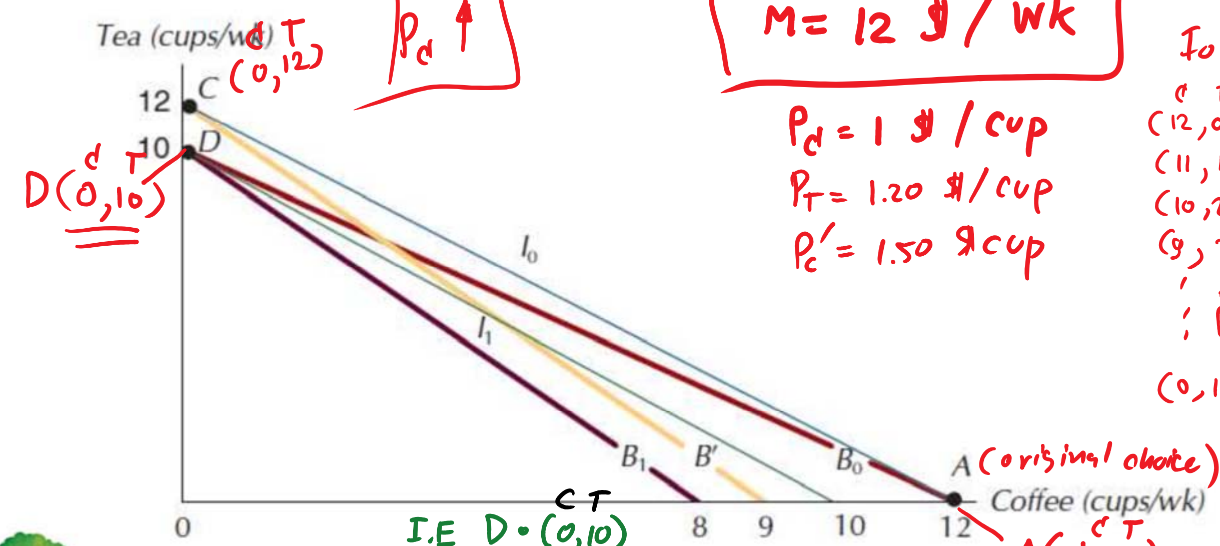
M= 12 $/wk

$P_c = 1$ $/cup

$P_T = 1.20$ $/cup

$P_c' = 1.50$ $/cup

I_0 (c, T)	I_1
(12,0)	(10,0)
(11,1)	(9,1)
(10,2)	⋮
(9,3)	⋮
⋮	⋮
(0,12)	(0,10)



C' (0,12) ← S.E. — A (12,0)

$P_c' = 1.50$ $P_c = 1$

$P_T = 1.20$ $P_T = 1.20$

M= 12

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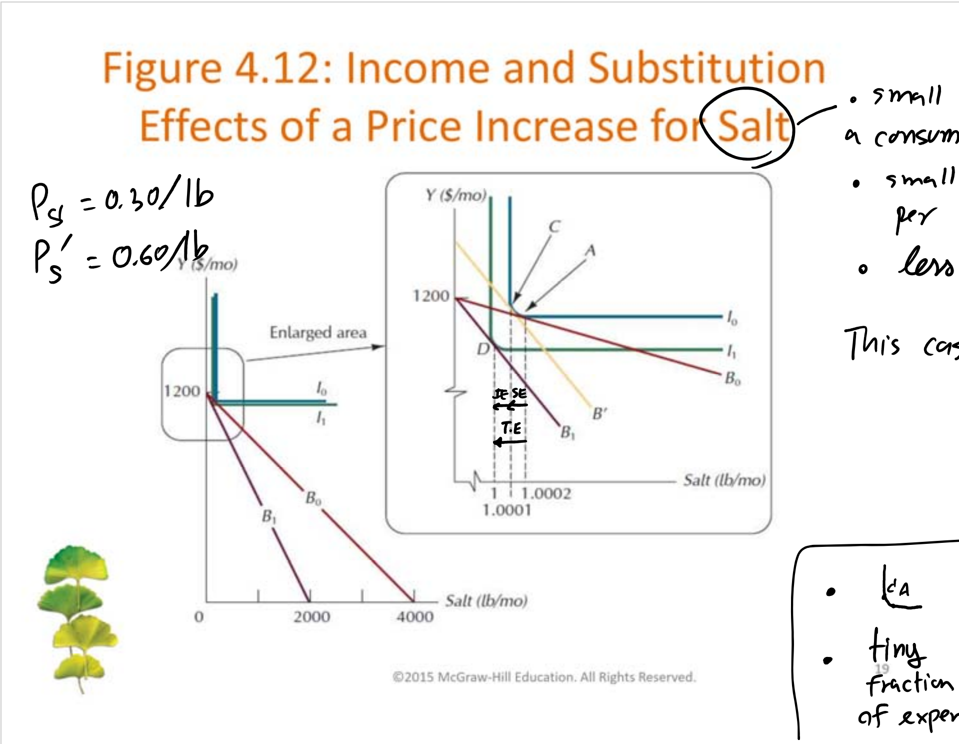
Lesson: When two goods are perfect substitutes, notice that S.E is HUGE !!!



- small fraction of a consumer's total expenditure
- small amount of consumption per time period
- less substitutes for salt

This case: given the characteristics of the good (SALT), when price has increased, S.E. and I.E. would be very very small.

- ϵ_A → small S.E.
- tiny fraction of expenditure → small I.E.

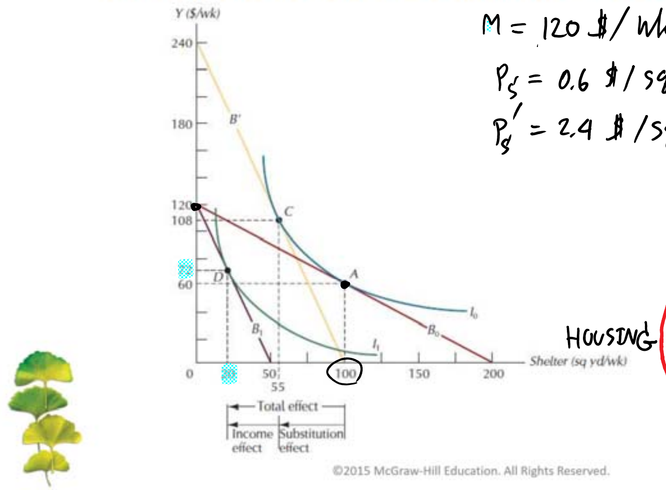
Figure 4.13: Income and Substitution Effects for a Price-Sensitive Good

Ex: HOUSING

$M = 120\ \$/wk$

$P_S = 0.6\ \$/sq\ yd$

$P_S' = 2.4\ \$/sq\ yd$

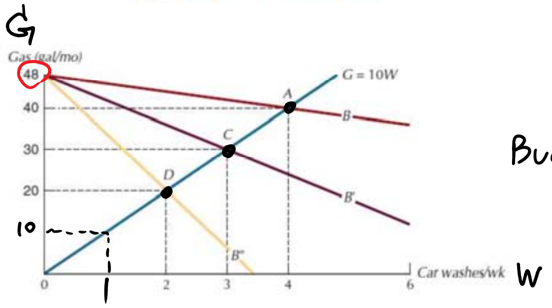


① large share of a consumer's expenditure

② we have some substitutes for housing. Ex: restaurant meals, opera, film, shopping

Given the characteristics of the good, we found large S.E & large I.E. → Σ high

Figure 4.14: A Price Increase for Car Washes



$M = 144$ \$ / month

$P_{GAS} = 3$ \$ / gal

10-TO-1

Budget constraint = ?

○ + ○ = M

$P_x \cdot X + P_y \cdot Y = M$

① — $P_W \cdot W + 3G = 144$ or $G = \frac{144 - P_W \cdot W}{3}$

$G = \frac{144}{3} - \frac{P_W}{3} W.$

② → $G = 10W$

substitute ② into ① :

$P_W \cdot W + 3(10W) = 144$

$P_W \cdot W + 30W = 144$

$W(P_W + 30) = 144$

↳ use to find his demand curve for car washes

For example, at $P_W = 6$, $W = 4$.

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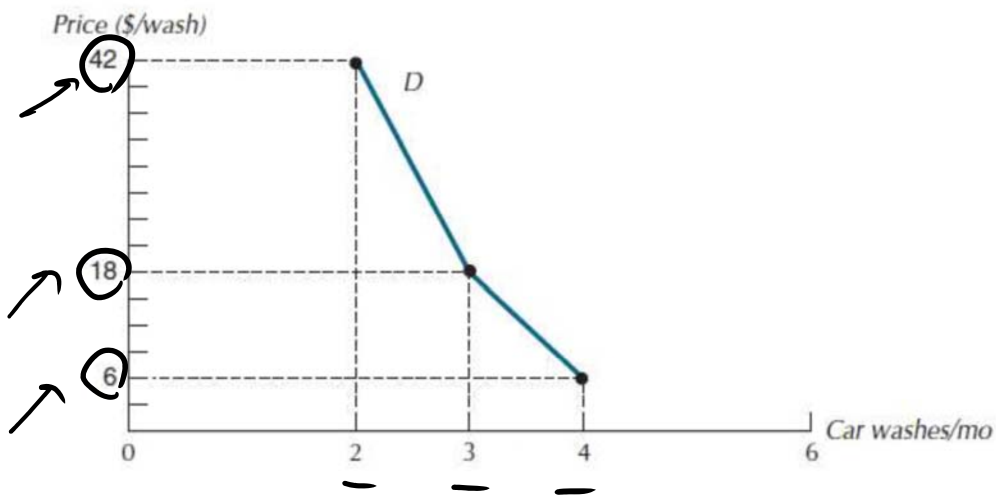
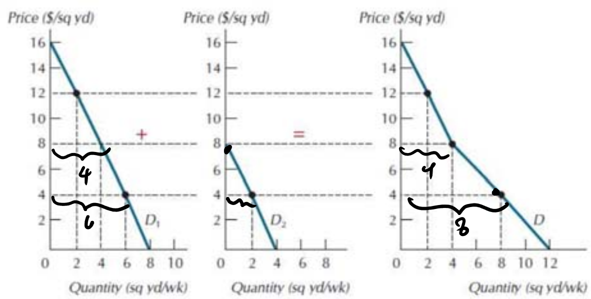
Figure 4.15: James' Demand for Car Washes



Market Demand Curves

- ***Market demand curve:*** the horizontal summation of the individual demand curves.

Figure 4.16: Generating Market Demand from Individual Demands



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at P = 4, total quantity demanded = 8 sq yd/wk

" — " ~~total quantity demand~~ = 8 sq /wk.

" — " ~~total demand~~ = 8 sq yd/wk.

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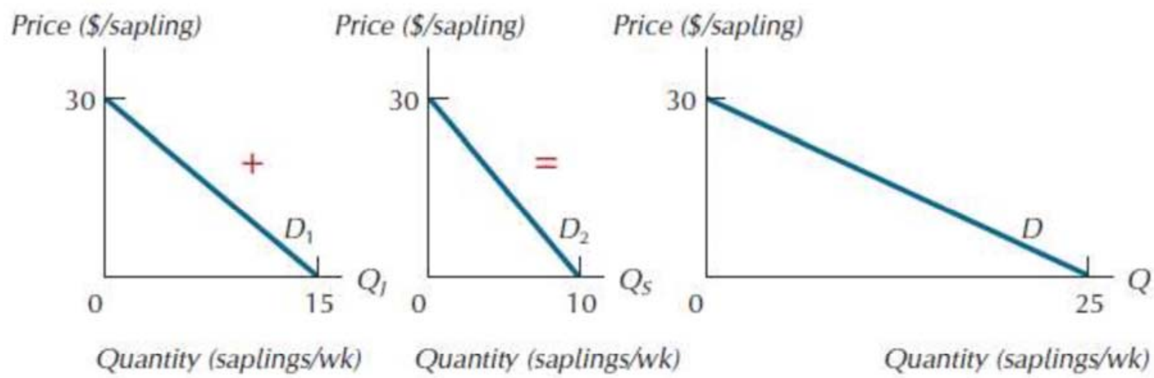
Figure 4.17: The Market Demand Curve for Beech Saplings



$P = 30 - 2Q_J$

$P = 30 - 3Q_S$

$P = 30 - \frac{30}{25}Q$

$P = 30 - \frac{6}{5}Q$

$Q_J = \frac{30 - P}{2}$

$Q_J = 15 - \frac{1}{2}P$

25

$Q_S = \frac{30 - P}{3}$

$Q_S = 10 - \frac{1}{3}P$

+

$$Q_J + Q_S = 15 - \frac{1}{2}P + 10 - \frac{1}{3}P$$
$$= 25 - P\left(\frac{1}{2} + \frac{1}{3}\right)$$
$$= 25 - P\left(\frac{3+2}{6}\right)$$

$$Q = 25 - \frac{5}{6}P$$

$$\frac{5}{6}P = 25 - Q$$

$$P = \frac{6}{5}(25 - Q)$$

$$P = 30 - \frac{6}{5}Q$$ ***

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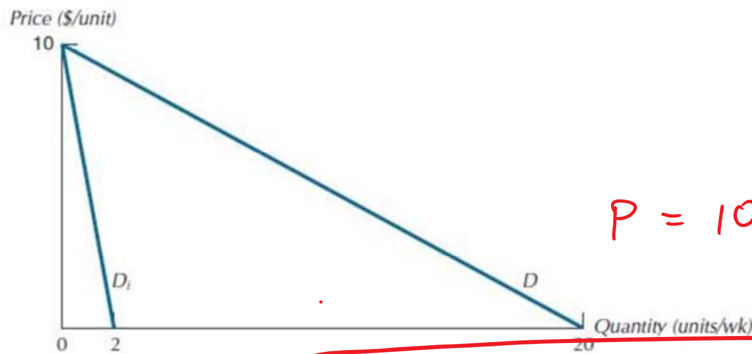
Figure 4.18: Market Demand with Identical Consumers



$P = 10 - \frac{10}{2}Q_i = 10 - 5Q_i$

w/ n=10

$P = 10 - \frac{10}{20}Q = 10 - \frac{1}{2}Q$ (MARKET DEMAND CURVE)

For an individual: $P = a - bQ_i$

For all identical consumers: $P = a - \frac{b}{n}Q$

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Price Elasticity of Demand

- ***Price elasticity of demand:*** the present age change in the quantity of a good demanded that result from a 1 present change in its price.

$$\varepsilon = \frac{\%\Delta Q^D_x}{\%\Delta P_x} \Rightarrow \text{negative numbers}$$

$|\varepsilon|$

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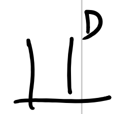
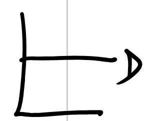
Three Categories of Price Elasticity

- Elastic → $\varepsilon < -1$ or $|\varepsilon| > 1 \Rightarrow |\%\Delta Q| > |\%\Delta P|$
- Inelastic → $\varepsilon > -1$ or $|\varepsilon| < 1 \Rightarrow |\%\Delta Q| < |\%\Delta P|$
- Unit elastic → $\varepsilon = 1$ $|\varepsilon| = 1 \Rightarrow |\%\Delta Q| = |\%\Delta P|$

$|\varepsilon| = 0$ → perfectly inelastic



$|\varepsilon| = \infty$ → perfectly elastic



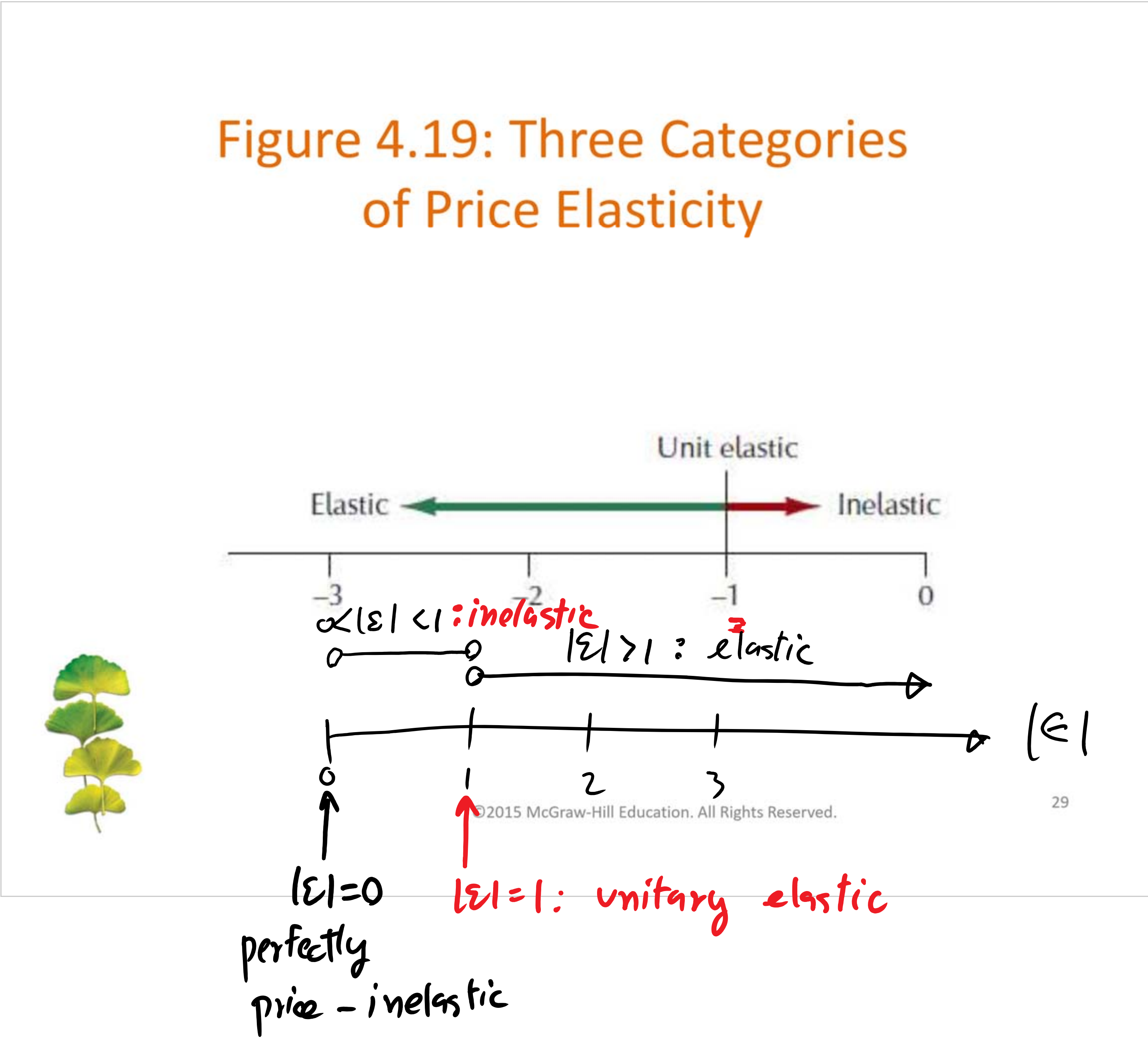


Figure 4.19: Three Categories of Price Elasticity
Unit elastic
Elastic
Inelastic
−3
−2
−1
0
α<|ε|<1 : inelastic
|ε|>1 : elastic
|ε|
0
1
2
3
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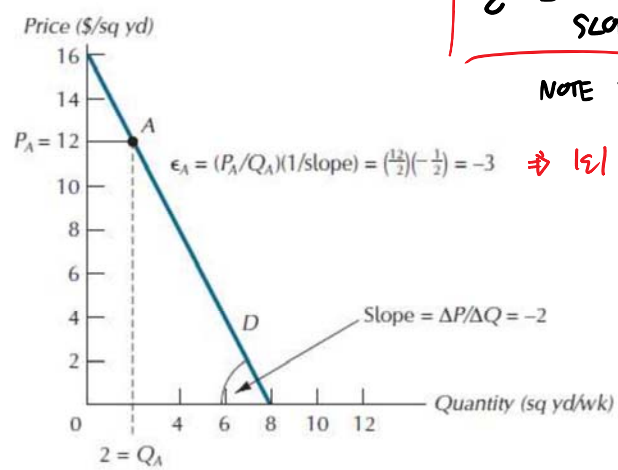
29
|ε|=0
perfectly
prive - inelastic
|ε|=1: unitary elastic

Figure 4.20: The Point-Slope Method

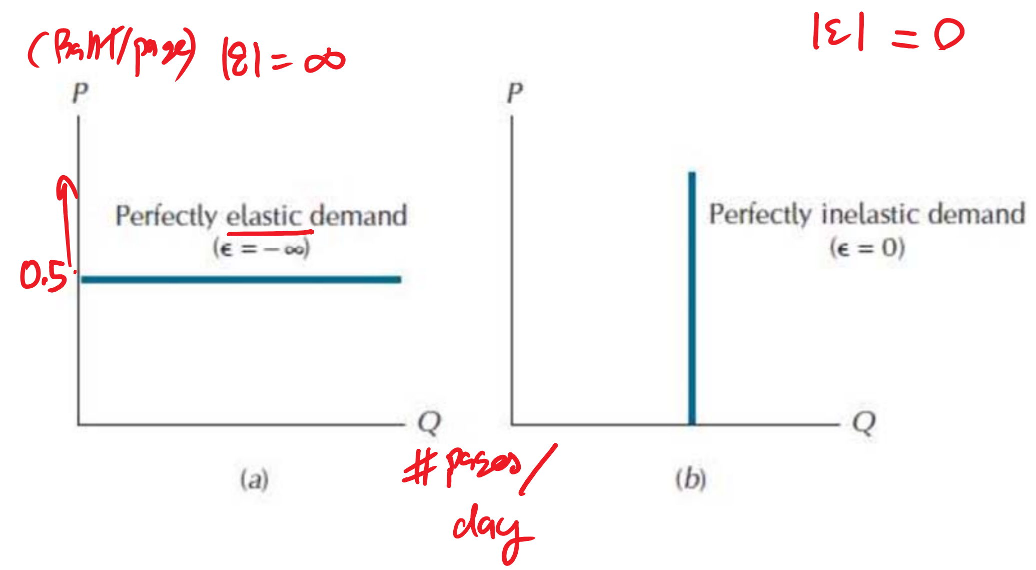
$$\varepsilon = \frac{1}{\text{SLOPE}} \cdot \frac{P}{Q} \left(= \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} \right) \to \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta P}{P} \times 100} \to \frac{\% \Delta Q}{\% \Delta P}$$

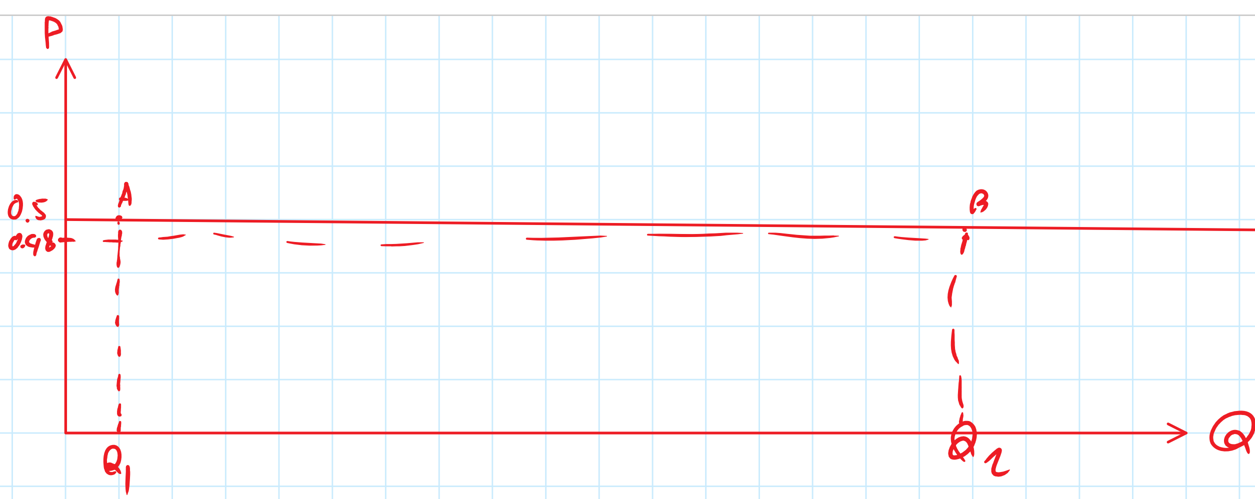
NOTE : SLOPE = $\frac{\Delta P}{\Delta Q}$



$\Rightarrow |\varepsilon| = |-3| = 3 > 1$

Figure 4.21: Two Important Polar Cases





The Unit-Free Property of Elasticity

- When weighing costs and benefits, always compare absolute dollar amounts, not proportions.
- When describing how quantity demanded responds to changes in price, it's generally best to speak in terms of proportions.

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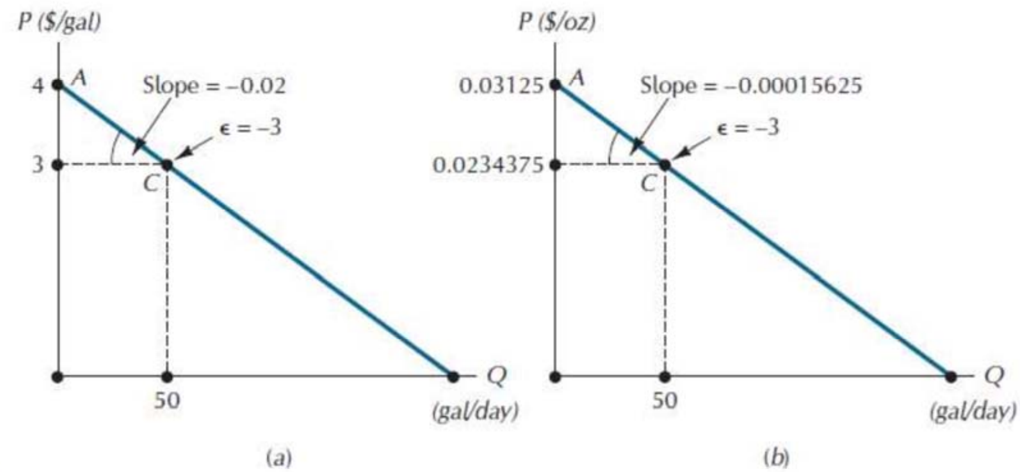
Figure 4.22: Elasticity is Unit-Free

$\varepsilon = \frac{\%\Delta Q}{\%\Delta P} \rightarrow \frac{\%}{\%}$



$\varepsilon = \frac{\%\Delta Q}{\%\Delta P}$ $TR = P \times Q$

Elasticity and Total Revenue

- A price reduction will increase total revenue if and only if the absolute value of the price elasticity of demand is greater than 1.

$|\varepsilon| > 1$

- An increase in price will increase total revenue if and only if the absolute value of the price elasticity is less than 1.

$|\varepsilon| < 1$

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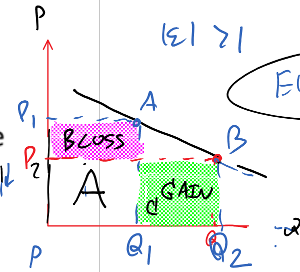
The Flatter the curve, the higher PED
The Steeper the curve, the lower PED

$|\varepsilon| > 1$ Elastic demand

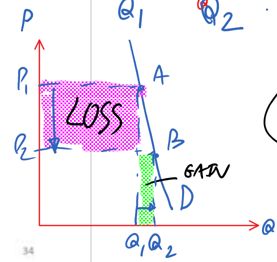


At $P_1 \Rightarrow TR_1 = A + B$
At $P_2 \Rightarrow TR_2 = A + C$

$\Delta TR = TR_2 - TR_1$
$= (A + C) - (A + B)$
$= +C - B > 0$

$\downarrow P \rightarrow TR \uparrow$

Inelastic demand



$\downarrow P \rightarrow TR \downarrow$

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Figure 4.23: The Effect on Total Expenditure of a Reduction in Price

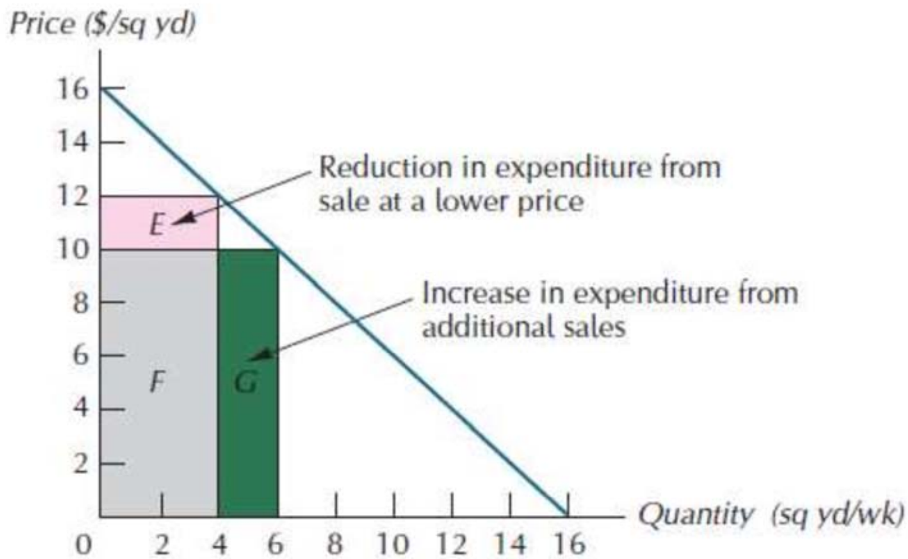

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Figure 4.24: Demand and Total Expenditure

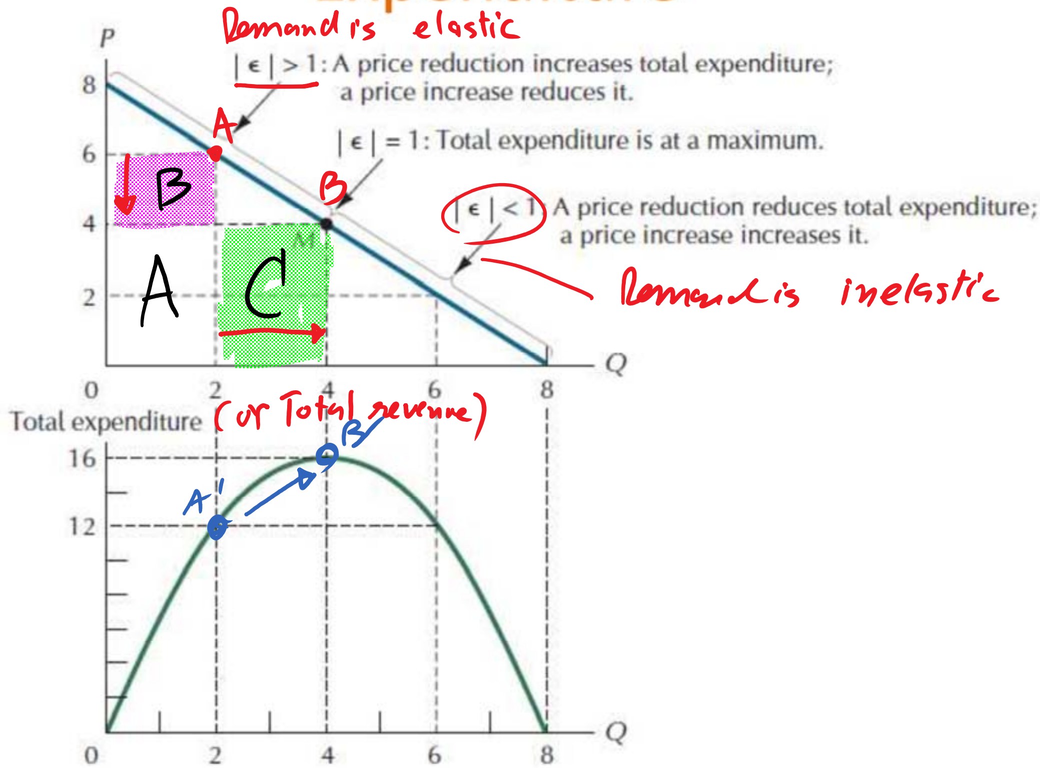

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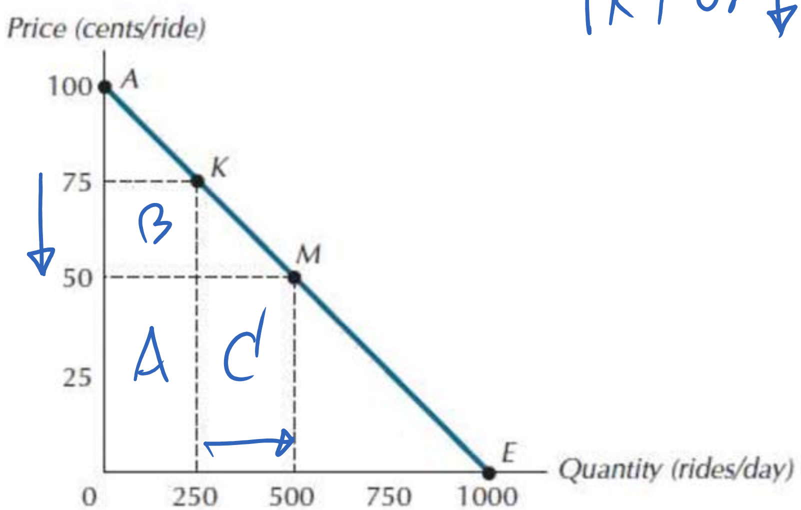
Figure 4.25: The Demand for Bus Rides (P. 118)

TR ↑ or ↓ ?



Determinants of Price Elasticity of Demand

- ***Substitution possibilities:*** the substitution effect of a price change tends to be small for goods with no close substitutes.
- ***Budget share:*** the larger the share of total expenditures accounted for by the product, the more important will be the income effect of a price change.
- ***Direction of income effect:*** a normal good will have a higher price elasticity than an inferior good.
- ***Time:*** demand for a good will be more responsive to price in the long-run than in the short-run.

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Lets say, P_x ↑

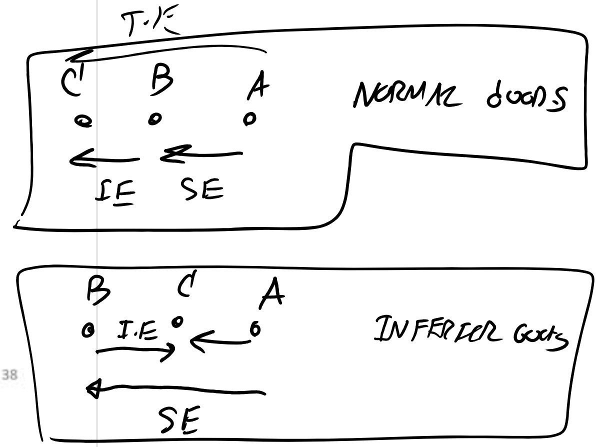
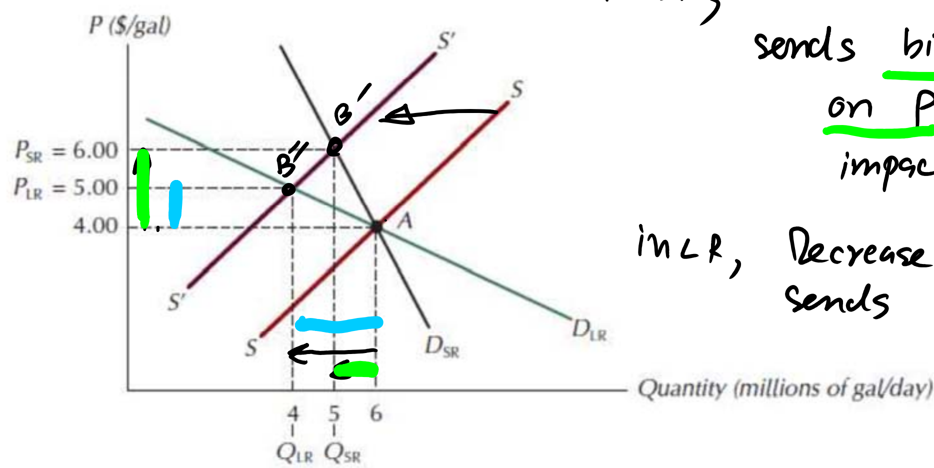


Figure 4.26: Price Elasticity Is Greater in the Long Run than in the Short Run



in SR, Decreace in supply sends bigger impact on P and little impact on Q.

in LR, Decrease in supply sends bigger impact on Q but little impact on P

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Figure 4.27: The Engel Curve for Food of A and B

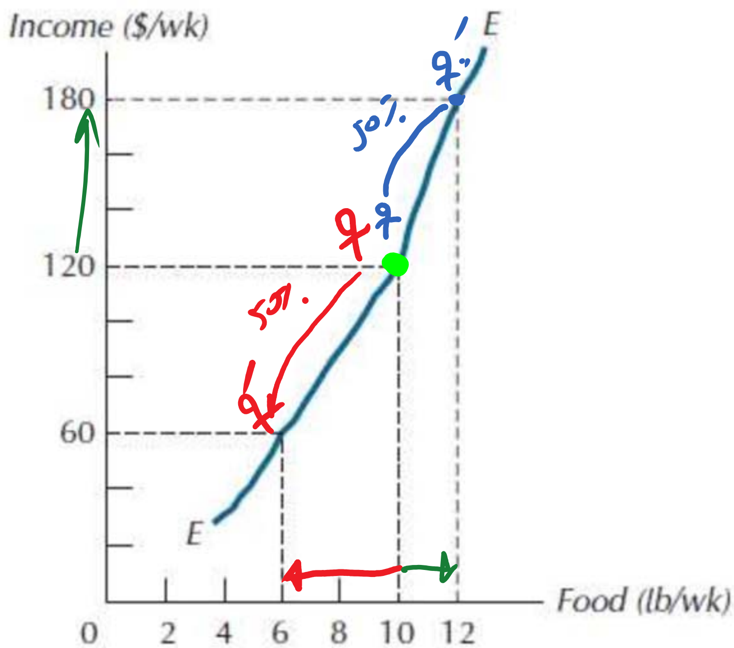

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Figure 4.28: Market Demand Sometimes Depends on the Distribution of Income

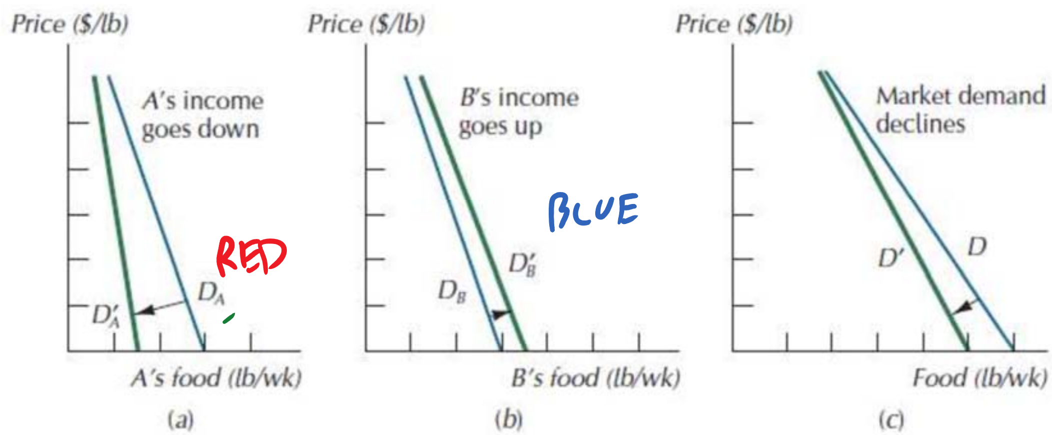
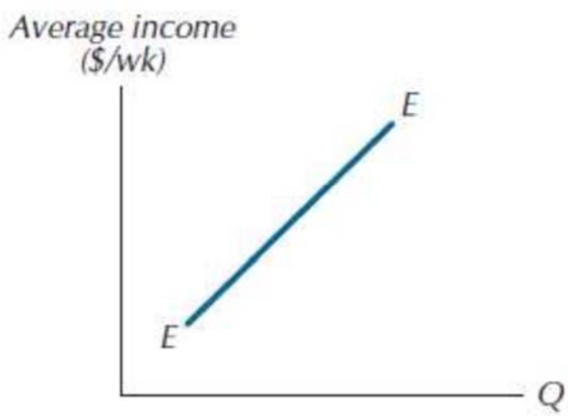


Figure 4.29: An Engel Curve at the Market Level



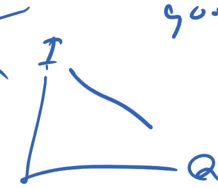
Income Elasticity of Demand

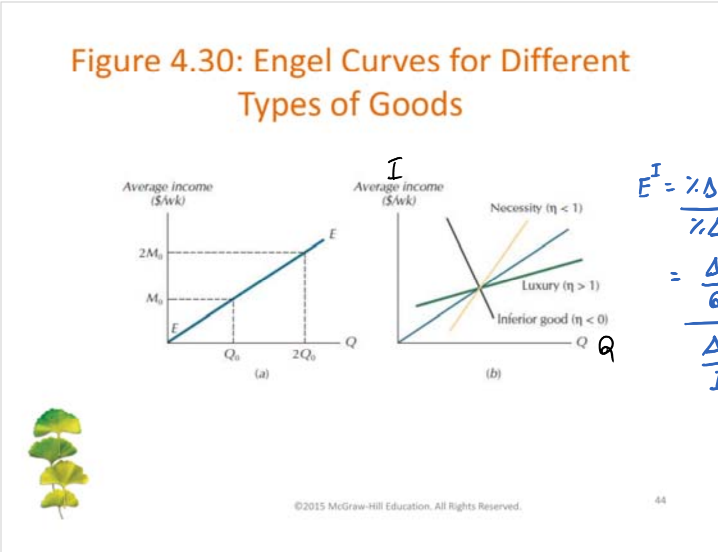
- If a good exhibits a stable Engle curve, we can define its **income elasticity of demand**, the percentage change in the quantity of a good demanded that results from a 1 percent change in income.

$$E^I = \frac{\% \Delta Q_x^D}{\% \Delta I}$$

$E^I > 0$ (normal good)

$E^I < 0$ (inferior good)

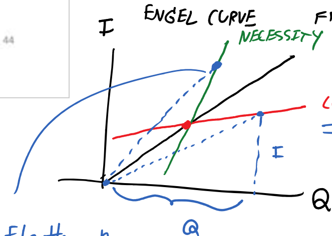




$$E^I = \frac{\%\Delta Q}{\%\Delta I} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta I}{I}} = \underbrace{\frac{\Delta Q}{\Delta I}}_{\text{I}} \cdot \underbrace{\frac{I}{Q}}_{\text{II}}$$

I → SLOPE OF ENGEL CURVE

II → SLOPE OF A STRAIGHT LINE SHOOTING FROM THE ORIGIN TO THE EC CURVE



LUXURY → $\frac{I}{Q}$ is steeper than the slope of engel curve.

↓

E^I will be greater than 1 ($E^I > 1$)

$\%\Delta Q > \%\Delta I$

$\frac{I}{Q}$ is flatter than the slope of engel curve

↓

$E^I < 1$ (necessity)

$\%\Delta Q^D < \%\Delta I$

Cross-Price Elasticities of Demand

- ***Cross-price elasticity of demand***: the percentage change in the quantity of one good demanded that results from a 1 percent change in the price of the other good.

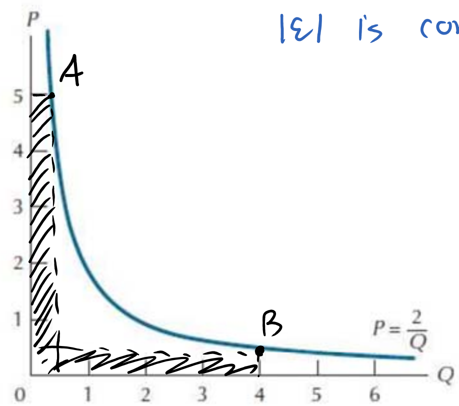
$$E^c = \frac{\%\Delta Q^D_X}{\%\Delta P_Y}$$

x & y are: $E^c < 0$ (complements)

x & y are: $E^c > 0$ (rival goods)

Figure A4.1: A Constant Elasticity Demand Curve → see Appendix

|ε| is constant along the demand curve.



$$P = \frac{k}{Q}$$

here $k = 2$.

k then is total expenditure on the good as $k = P \cdot Q$.

$|\varepsilon| = 1$ ($|1\%\Delta Q| = 1\%\Delta P|$

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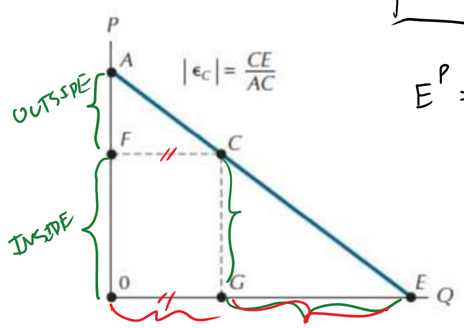
Figure A4.2: The Segment-Ratio Method

$$E^P = \frac{1}{\text{SLOPE}} \cdot \frac{P}{Q}$$



$$E^P = \frac{1}{\frac{AF}{FC}} \cdot \frac{OF}{OG} = \frac{FC}{AF} \cdot \frac{OF}{OG} = \frac{OF}{AF} = \frac{\text{INSIDE}}{\text{OUTSIDE}}$$

$$E^P = \frac{1}{\frac{CG}{GE}} \cdot \frac{OF}{OG} = \frac{GE}{CG} \cdot \frac{OF}{OG} = \frac{GE}{OG} = \frac{\text{OUTSIDE}}{\text{INSIDE}}$$

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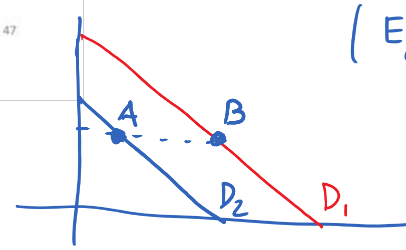
$$|E_{at\,A}| \; > \; < \; = \; |E_{at\,B}| \; ?$$



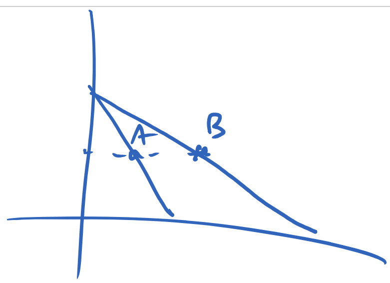


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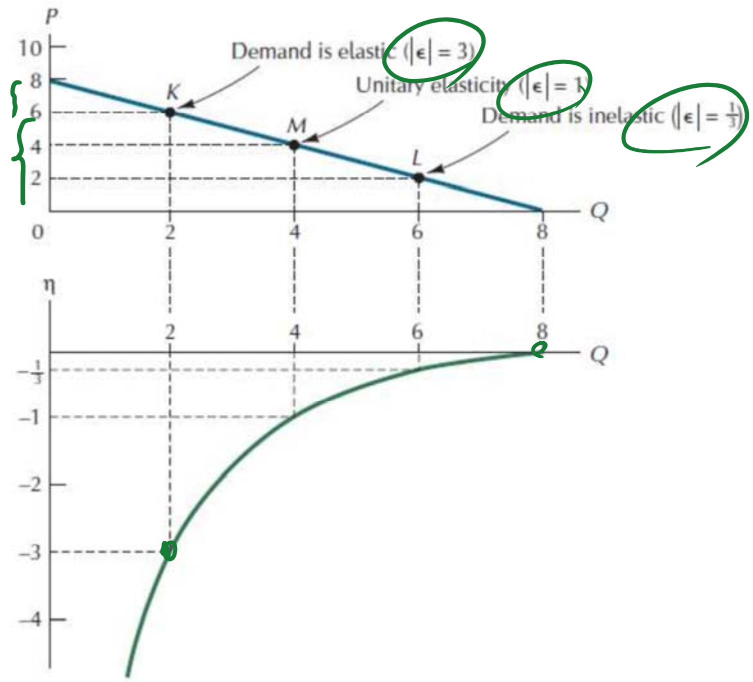
Figure A4.3: Elasticity at Different Positions Along a Straight-Line Demand Curve



Income-Compensated Demand Curve

- ***Income-compensated demand curve***: a demand curve that tells how much consumers would buy at each price if they were fully compensated for the income effects of price changes.

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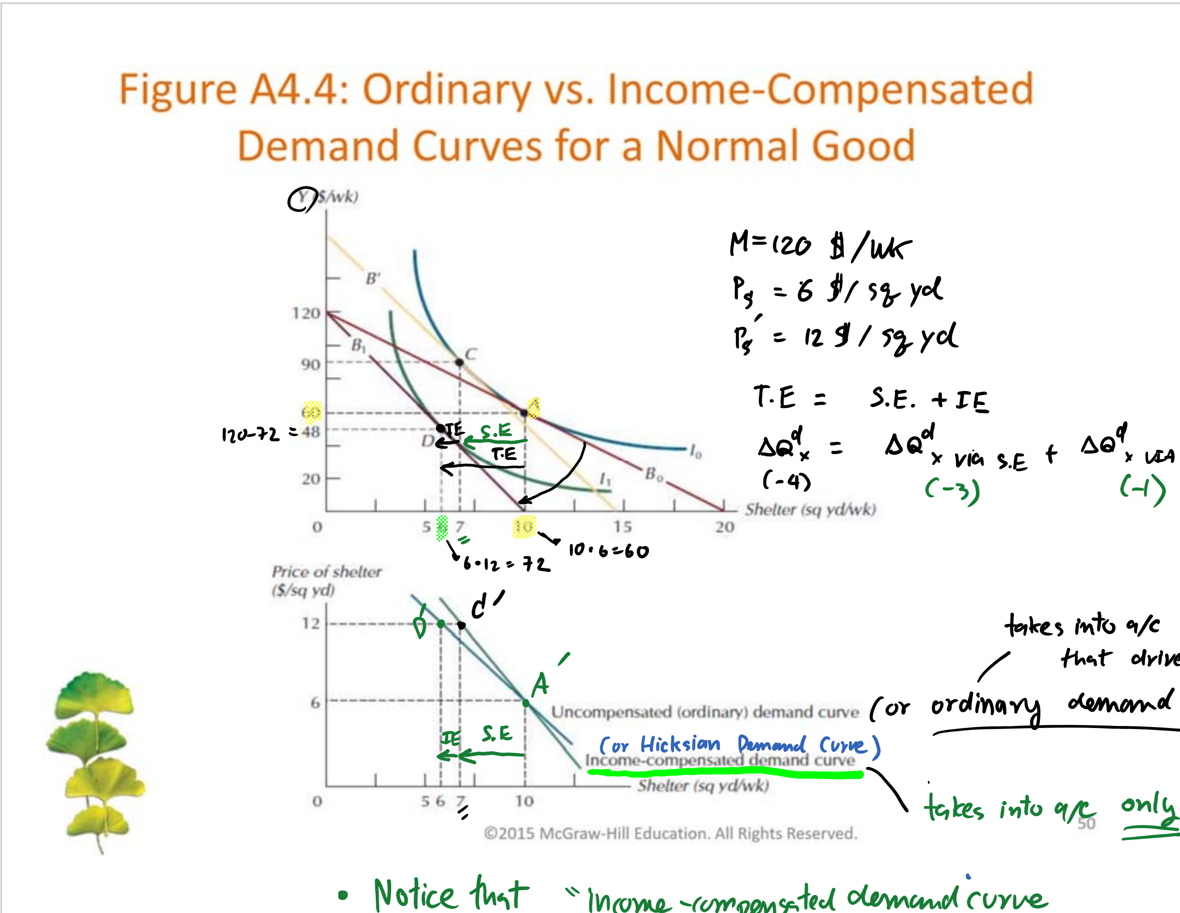


(or ordinary demand curve) — takes into a/c both S.E. and I.E that drive his consumption

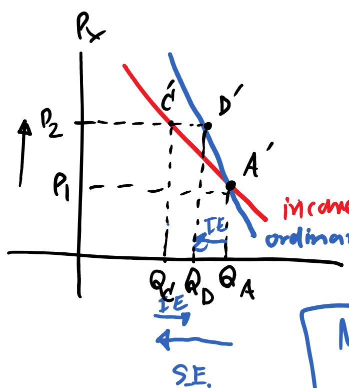
D choice 6 ← 10 A : −4

Income-compensated demand curve — takes into a/c only pure substitution effect

C ← A : 7, 10 : −3

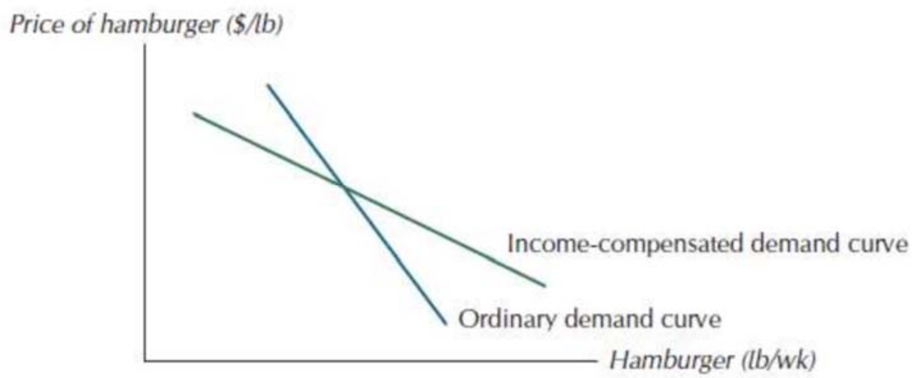
• Notice that "Income-compensated demand curve is steeper than ordinary demand curve in the case of normal good (good x)

IF x is an inferior good



Notice that when x is an inferior, Income compensated demand curve is Flatter than ordinary demand curve!

Figure A4.5: Ordinary vs. Income-Compensated Demand Curves for an Inferior Good



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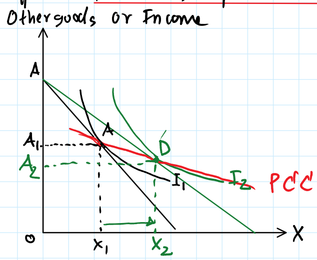
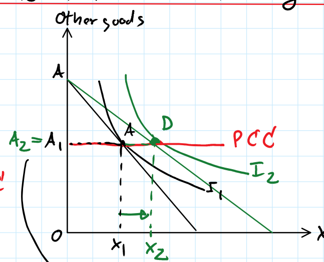
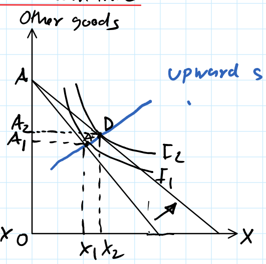
Additional topics

Price consumption curve AND Price elasticity of demand







upward sloping PCC

- x is price - inelastic
- X & Y are complementary goods

At A, he buys x_1 units of X

Expenditure on x = AA_1

Expenditure on 'other goods' then = OA_1

When $P_x \downarrow$, his new choice is D.

He buys more of X from $x_1 \to x_2$

The new total expenditure on X ⇧ !!! ⇒

B/F ⇒ AA_1

Now AA_2 which is bigger

OLD TE NEW TE

$P_1 X_1 = P_2 X_2$

is possible only

when $|\% \Delta Q| = |\% \Delta P|$

Then good x is unitary price - elastic when PCC is horizontal

B/F : $P_x \cdot X_1$ measured by AA_1

A/F : $P_x' \cdot X_2$ measured by AA_2

compare ⇒ $P_x' \cdot X_2 > P_x \cdot X_1$

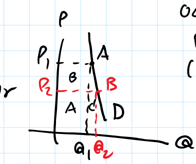
(NEW expenditure) (old expenditure)

Result ⇒ $P_x \downarrow \to$ TE on x ↑

Then demand for good X is price - elastic !!!

When $P_x \downarrow$, TE on good x ↓.

IF this is the case, then demand for x must be price inelastic !!!



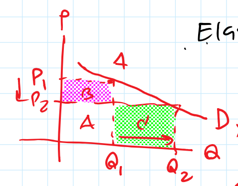
OLD TE > NEW TE

$P_1 \cdot Q_1 > P_2 \cdot Q_2$

$(A+B) > (A+C)$

$\% \Delta Q < \% \Delta P$

$\downarrow P \cdot Q$ ⇧



Elastic demand case

$|\% \Delta Q| > |\% \Delta P|$

$TE_1 = P_1 \cdot Q_1 \ (A+B)$

$TE_2 = P_2 \cdot Q_2 \ (= A+C)$

$\Delta TE = TE_2 - TE_1$

$= (A+C) - (A-B)$

$= C - B > 0$!

As $C > B$, TE ↑ !!!

Discovery #1 When PCC is downward sloping, it implies that

1. Demand for good x is price - elastic.
2. Good x and good y (composite goods) are ... substitutes

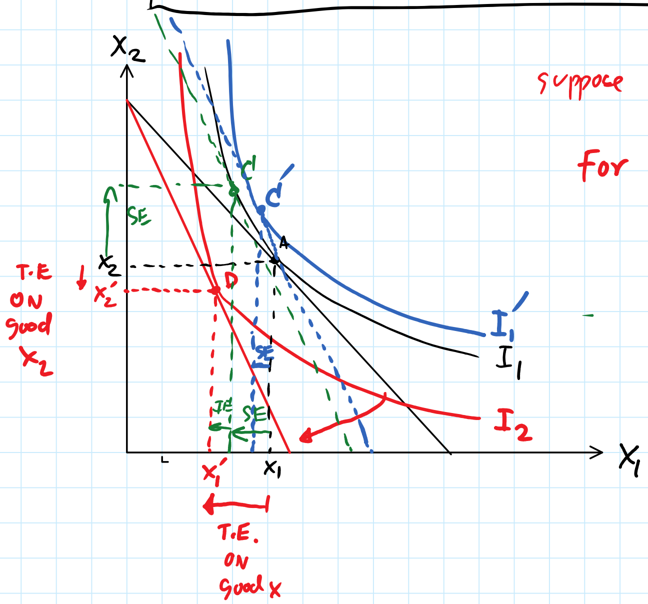
Slutsky's Method of breaking down S.E and I.E.

So far, we have used Hick's method to seperate S.E and I.E. now let's see how Slutsky views this issue.

Recall that S.E ⇒ ΔQ_x^d due to change in price ratio holding real income or purchasing power constant.

I.E ⇒ ΔQ_x^d due to change in buying power (= real income) when a buyer faces with the new price ratio.

Then $\Delta Q_x^d = \Delta Q^d_{x,\text{ VIA S.E}} + \Delta Q^d_{x,\text{ VIA I.E}}$



suppose P_1 rises...

For Hick: To "undo" the injury from "income effect", we must bring him back to the original happiness level (to I_1) when he faces with the new relative price

Slutsky: To "undo" the income effect, we must compensate him until he could by the original basket.

Ex:

$P_1 = 10$	$Q_1^* = 5$
$P_2 = 5$	$Q_2^* = 10$

$M = 100$

$P_1 \cdot Q_1^* + P_2 \cdot Q_2^* = M$

$10 \cdot 5 + 5 \cdot 10 \quad 100$

Now IF $P_1' = 20$ →

$P_1' \cdot Q_1^* + P_2 \cdot Q_2^* = M'$

$$20 \cdot 5 + 5 \cdot 10 = 100 + 50 = 150$$

$$M' - M = 150 - 100 = 50$$