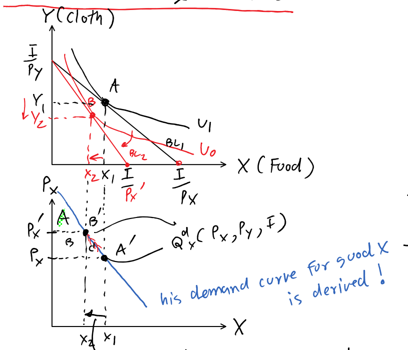
Ch.5 Theory of Demand

Effect of a change in Price



B/F	A/F	
P_X	P_X'	where $P_X' > P_X$.
P_Y	P_Y	
I	I	

- w/ higher price of good x,
- → new choice is at B (X_2, Y_2)
- → He consumes less of X & less of Y
- → Utility falls.
- → $\uparrow P_X$ → reduction in his CS'

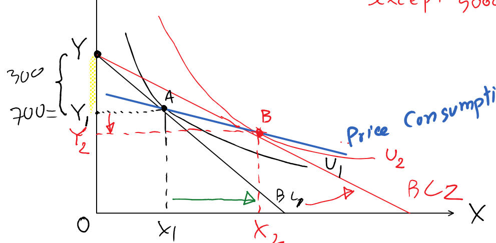
CS'	B/F	A/F	Δ
	A+BC	A	−B−C :(

due to S.E and I.E !

If $P_X \uparrow$ → $\frac{P_X}{P_Y} \uparrow$ → via S.E → $Q_X^d \downarrow$ → $Q_X^d \downarrow$

If $P_X \uparrow$ → hurts his purchasing power → via I.E → $Q_X^d \downarrow$ → $Q_X^d \downarrow$
(Note: x is normal good)

Now, PRICE CONSUMPTION CURVE (PCC) ...



X = Food
Y = Composite good w/ $P_Y = 1$ \$ / unit
I = income

Fact#1 Originally, he is at basket A on U_1.
He buys good x = x_1 units.
his expenditure on good x = YY_1 \$

Numerical Example

- OY = 1000 \$ or 1000 units of composite good
- OY_1 = 700 \$ spent on Y

So $YY_1 = 300$ → total expenditure spent on good X

Fact#2 Suppose $P_X \downarrow$ ...
And as a result, he buys more X and less Y

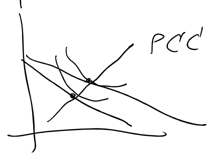
Fact#3 The line connecting old choice and new choice is so called " Price Consumption Curve (PCC)."
PCC is a collection of utility maximizing baskets as price of a good varies, holding income and price of other goods constant!

Fact#4 In this case, PCC is negatively sloped.

Q: What is the implication behind this negative PCC?

At P_X (old price of x): Total expenditure on good $x = P_X \cdot X_1$
which is measured by YY_1.

At P_X' (new lower price of x): Total expenditure on good x $= P_X' \cdot X_2$
which is measured by $= YY_2$.

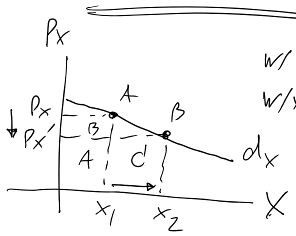


As $YY_2 > YY_1$, it means that
(NEW TE_X) (OLD TE_X)
$\downarrow P_X$ → he buys more X

(NEW TE_x) (OLD TE_x)

$\downarrow P_x \rightarrow$ he buys more X

$\rightarrow$ his TE on X $\uparrow$.



W/ x_1, $TE_1 = A + B$

W/ x_2, $TE_2 = A + C$

as $(A+C) > (A+B)$ then demand for good x is price-elastic !!!

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

$$|E| = \left|\frac{\%\Delta Q}{\%\Delta P}\right| > 1$$

$\Downarrow$

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

$\%\Delta Q \Uparrow$ $\%\Delta P \Downarrow$ $\rightarrow TE_x \uparrow$

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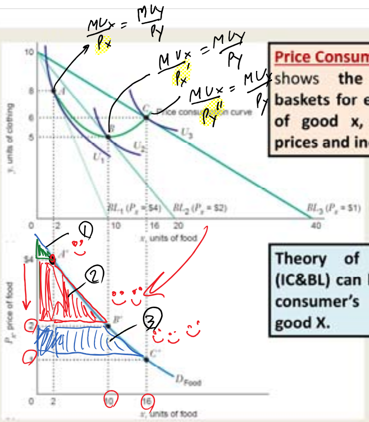
The Theory of Demand (Chapter 5)

Individual Demand Curve

- We have learnt how to find the optimal choice.
- Given income and prices of other goods, we know how much a consumer will demand of X for a given price of X, e.g. (X1, P1) and (X2, P2).
- Note that (X1, P1) and (X2, P2) are essentially points on a demand curve.
- Finding all points by varying the price of X allows us to draw the whole demand curve.



Price Consumption Curve (PCC) shows **the set of optimal baskets for every possible price of good x, holding all other prices and income constant.**

Theory of consumer choice (IC&BL) can be used to derive a consumer's demand curve for good X.

At $P_x = 4$, CS = ①

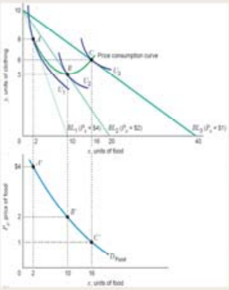
At $P_x = 2$, CS = ① + ②

At P = 1, CS = ① + ② + ③

ΔCS = ②

ΔCS' = ③

Individual Demand Curve



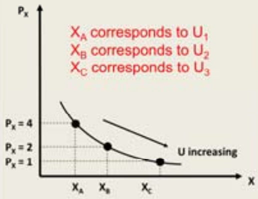
Key Points #1

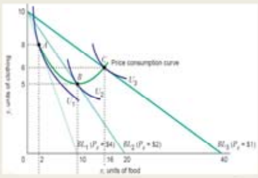
- The consumer is maximizing utility at every point on the demand curve.
- As P_x falls, it causes the consumer to move down and to the right along the demand curve as utility increases in that direction.
- The MRS_{xy} (= P_x/P_y) falls along the demand curve as the price of x falls (assuming an interior solution).

Individual Demand Curve

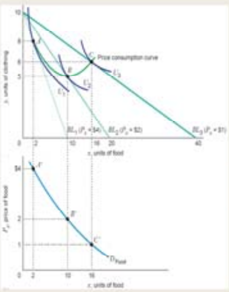
Key Points #1 (Explained)

- As P_x falls, it causes the consumer to move down and to the right along the demand curve as utility increases in that direction.





Individual Demand Curve



Key Points #2

- As MRS_{xy} falls, this means the consumer is willing to trade smaller Y in exchange for one more unit of X.
- The demand curve also shows the "willingness to pay", and <u>willingness to pay for an additional unit of X falls as more X is consumed.</u>
- When Px changes, we have a <u>movement</u> along the demand curve.

Price Consumption Curve (PCC)

- Price Consumption Curve can have different shapes.
  - Upward-Sloping Curve
  - Downward-Sloping Curve
  - Horizontal Straight Line
  - Backward-Bending Curve
- **Assuming a composite good on the Y-axis**, shapes of the PPC tell us two things:
  - Price Elasticity of Demand of the good on the X-axis. — (1)
  - How goods X and Y are related. — (2)

PCC & PED — (1) case 1, case 2, case 3

PCC & relationship bet. X & Y — (2)

PCC and how goods X & Y are related

Consider the case where P_x falls.
Note: Y is a composite good with $P_y = 1$.

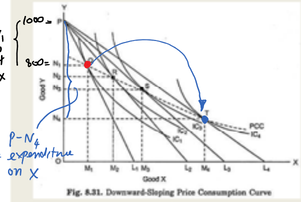


Fig. 6.31. Downward-Sloping Price Consumption Curve

w/ downward sloping PCC, it implies that... X & Y are substitutes! (Why?)

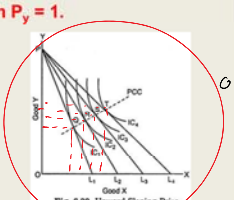


Fig. 6.32. Upward-Sloping Price Consumption Curve

w/ upward sloping PCC, it implies that X & Y are complementary goods! (Why?)

OP = Total amount of the composite good he can buy If he buys no X.

OP = his total income as $P_y = 1$

PCC and how goods X & Y are related

Consider the case where P_x falls.
Note: Y is a composite good with $P_y = 1$.

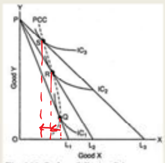


Fig. 6.33. Backward-Sloping Price Consumption Curve

when $P_x \downarrow$, $Q_x^d \downarrow$.
So, good x is a Giffen good!

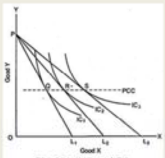


Fig. 6.34. Horizontal Price Consumption Curve

when $P_x \downarrow$, he buys more of x and the same amount of Y.
So, x & y are "unrelated goods"!

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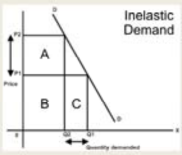
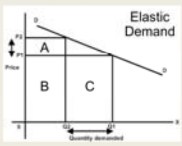
PCC and Price Elasticity of Demand (PED)

- To understand about PCC and PED, we must first understand the implications of PED.
- **Consider the case when Price falls** (i.e. from P_2 to P_1).



When Price falls, the expenditure on the good falls
i.e. A+B decreases to B+C
=>



When Price falls, the expenditure on the good rises.
i.e. A+B increases to B+C
=>

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PCC and Price Elasticity of Demand (PED)

Consider the case where P_x falls.
Income = P, and Y is a composite good with $P_y = 1$.

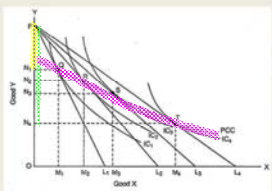

Fig. 6.31. Downward-Sloping Price Consumption Curve

For simplicity, we will consider Point Q (before P_x falls) and Point T (after P_x falls).

At Q, we spend N_1 on Y.
(At Q, there are N_1 units of Y, which costs P_y = $1 per unit.)
Our income = P, and we spend the rest on X, so we spend P−N1 on X.

At T, we spend N_4 on Y.
Our income = P, and we spend the rest on X, so we spend P−N4 on X.

Here, after Px falls, our expenditure on X increases from P-N1 to P-N4
Thus, the demand for X is price-elastic

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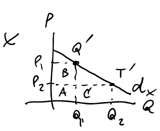
CONCLUSION: when PCC is downward sloping, demand for X is price-elastic

• $P_x \downarrow$ → Buy more X
→ $TE_x \uparrow$

Then,

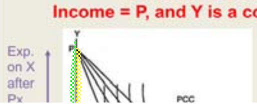


At Q', TE_1 = A+B
At T', TE_2 = A+C
As A+C > A+B, then TE↑
So, it implies that $|\%\Delta Q| > |\%\Delta P|$.
Demand for X is price-elastic!!!

$\%\Delta Q \uparrow > \%\Delta P \downarrow \Rightarrow TE \uparrow$

PCC and Price Elasticity of Demand (PED)

Consider the case where P_x falls.
Income = P, and Y is a composite good with $P_y = 1$.



For simplicity, we will consider Point Q (before P_x falls) and Point T (after Px falls).

Income = P, and Y is a composite good with $P_y = 1$.

Exp. on X after Px falls

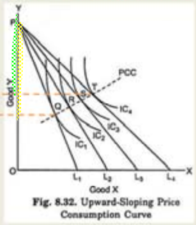


Fig. 8.32. Upward-Sloping Price Consumption Curve

For simplicity, we will consider Point Q (before P_x falls) and Point T (after Px falls).

At Q, ~~we~~ he spend~~s~~ N on Y.
Our income = P, and we spend the rest on X, so we spend ...P−N... on X.

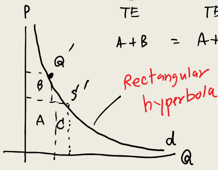
At T, we spend M on Y.
Our income = P, and we spend the rest on X, so we spend...P−M...on X.

Here, after Px falls, our expenditure on X decreases from ...P−N... to ...P−M...
Thus, the demand for X is ....

Demand for x is price-elastic !!!

PCC and Price Elasticity of Demand (PED)

Consider the case where Px falls.
Income = P, and Y is a composite good with Py = 1.



Exp on X
Exp on Y

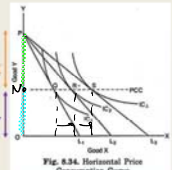


Fig. 8.34. Horizontal Price Consumption Curve

When Price changes, the expenditure on the good does not change. i.e. A+B is still equal to ~~A+C~~ A+C'

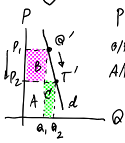
Here, after P_x falls, we buy...MORE...X, but our expenditure on X remains the same. (= PN)
Thus, demand is price unitary elastic.

$|E| = 1$ as $\%\Delta Q = \%\Delta P$!!!

When PCC is horizontal, demand for x is unitary price-elastic.

$\boxed{P_x \downarrow \to TE_x \downarrow}$

$\%\Delta Q < \%\Delta P \to$ Demand for x is price-inelastic.



B/F : $TE_x = A+B$ $(= P_1 \times Q_1)$
A/F : $TE_x' = A+C'$ $(= P_2 \times Q_2)$

$\Delta TE = TE_x' - TE_x$
$= (A+C') - (A+B)$
$= \cancel{A}+C' - \cancel{A} - B$
$= +C' - B < 0$

When: $P_x \downarrow$ and demand for x is price-inelastic
TE on x must be falling.

EX:
$P_1 = 100$, $P_2 = 50$
$Q_1 = 100$, $Q_2 = 110$
$\to TE_1 = 100 \times 100 = 10{,}000$ baht on x
$\to TE_2 = 50 \times 110 = 5{,}500$ baht on x

$\%\Delta P$
$= \frac{P_2 - P_1}{P_1} \times 100$
$= \frac{50-100}{100} \times 100$
$= -50\%$

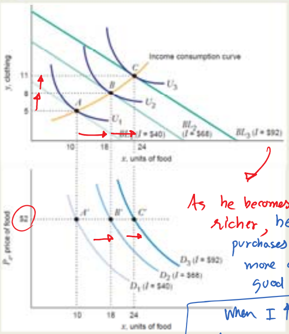
$\%\Delta Q$
$= \frac{Q_2 - Q_1}{Q_1} \times 100$
$= \frac{110-100}{100} \times 100$
$= 10\%$

$|\%\Delta P| = 50\% > |\%\Delta Q| = 10\%$

$|E| = \left|\frac{\%\Delta Q}{\%\Delta P}\right| = \frac{10}{50} = \frac{1}{5} = 0.2$!!!

$|E| < 1$

Income Consumption Curve (ICC)



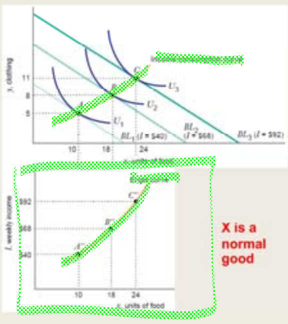
The ICC of good x is the set of optimal baskets for every possible level of income.

As he becomes richer, he purchases more of good x.

We can graph the points on the ICC as points from shifting the demand curve.

When $I \uparrow$, $Q^d_x \uparrow$
and when $I \downarrow$, $Q^d_x \downarrow$
$\to$ x is a normal good.

Engel Curve of a normal good



X is a normal good

The ICC for good x can be written as the quantity consumed of good x for any income level.

This is the **Engel Curve for good x.** When the income consumption curve is positively sloped, the slope of the Engel Curve is positive.

Engel Curve of an inferior good

X is an inferior good

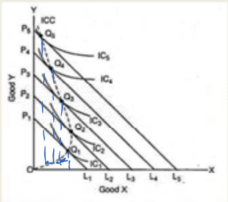


Fig. 8.22. Income Consumption Curve in Case of Good X being Inferior Good

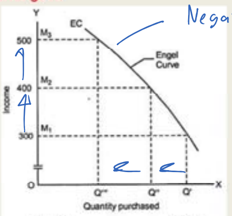


Fig. 8.28. Engel Curve of an Inferior Good

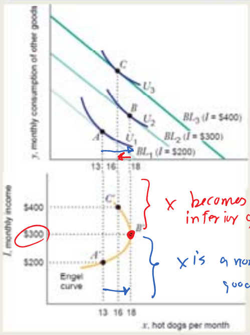
Negatively sloped.

Summary: ICC, Engel Curve, and Types of Goods

- If the ICC shows that the consumer purchases more of good x as her income rises, good x is ......normal good......
- Equivalently, if the slope of the Engel curve is positive, the good is a normal good.

- If the ICC shows that the consumer purchases less of good x as her income rises, good x is ......an inferior good.
- Equivalently, if the slope of the Engel curve is negative, the good is an inferior good.

Backward-Bending Engel Curve



x becomes inferior good

x is a normal good

Backward-Bending Engel Curve

A good can be normal over some ranges and inferior over others.

(a) As income rises from $200 to $300, the consumer's weekly consumption of hot dogs increases from 13 (basket *A*) to 18 (basket *B*). However, as income rises from $300 to $400, the consumer's weekly consumption of hot dogs decreases from 18 to 16 (basket *C*).
(b) Hot dogs are a normal good between points *A'* and *B'* (i.e., over the income range $200 to $300), where the Engel curve has a positive slope. But between points *B'* and *C'* (i.e., over the income range $300 to $400), hot dogs are an inferior good, and the Engel curve has a negative slope.

LEARNING-BY-DOING EXERCISE 5.2

Finding a Demand Curve (No Corner Points)

A consumer purchases two goods, food and clothing. The utility function is $U(x, y) = xy$, where x denotes the amount of food consumed and y the amount of clothing. The marginal utilities are $MU_x = y$ and $MU_y = x$. The price of food is P_x, the price of clothing is P_y, and income is I.

Problem

(a) Show that the equation for the demand curve for food is $x = I/(2P_x)$.

(b) Is food a normal good? Draw D_1, the consumer's demand curve for food when the level of income is $I = \$120$. Draw D_2, the demand curve when $I = \$200$.

D-I-Y

LEARNING-BY-DOING EXERCISE 5.3

Finding a Demand Curve (with a Corner Point Solution)

A consumer purchases two goods, food and clothing. He has the utility function $U(x, y) = xy + 10x$, where x denotes the amount of food consumed and y the amount of clothing. The marginal utilities are $MU_x = y + 10$ and $MU_y = x$. The consumer's income is \$100, and the price of food is \$1. The price of clothing is P_y.

Problem Show that the equation for the consumer's demand curve for clothing is

$$y = \frac{100 - 10P_y}{2P_y}, \quad \text{when } P_y < 10$$

$$y = 0, \quad \text{when } P_y \geq 10$$

Use this equation to fill in the following table to show how much clothing he will purchase at each price of clothing (these are points on his demand curve):

P_y	2	4	5	10	12
y					

DIY

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Decomposition of the Total Effect

- When the price of a good changes, its quantity demanded changes.
- Economists believe that **this change in quantity demanded for a good** is due to **mixture of two effects**:
  - Substitution Effect (SE)
  - Income Effect (IE)
- That is, **TE = SE + IE**.
- TE refers to Total Effect of the price change. (or Price effect)

$\boxed{T.E = S.E + I.E}$

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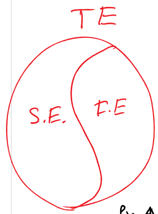


$P_x \uparrow$ → $\frac{P_x}{P_y}\uparrow$ ≡ opp. cost of good x ↑ $\xrightarrow{\text{via S.E.}}$ buy less of x

→ purchasing power ↓ (or real income ↓) $\xrightarrow{\text{via I.E}}$ buy less of x

→ Q^d_x ↓

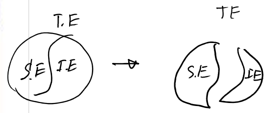
HICKS Approach Vs. Slutsky Approach

Sir John R. Hicks (1904-1989)

The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1972 (with Kenneth J. Arrow)

Eugen Slutsky (1880-1948)

On the Theory of the Budget of the Consumer, 1915



Hicks vs Slutsky Method

- The Hicksian Method of eliminating the I.E.
  After the price change, to undo the I.E., we must compensate the consumer such that he/she can obtain (or resume) the old utility level

  In other words, Hicks Method virtually gives the consumer compensated income to get back to **his original IC**.

- The Slutskian Method of eliminating the I.E.
  After the price change, to undo the I.E., we must compensate the consumer such that he/she can obtain (or resume) the old basket at the old IC.
- In other words, Slutsky Method virtually gives the consumer compensated income to be able to afford **his original bundle** on his original IC.

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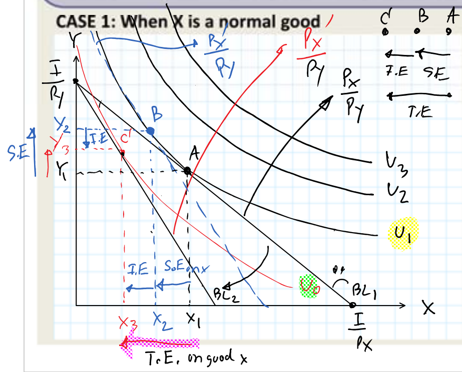
Decomposition of the Total Effect

CASE 1: When X is a normal good



P_x, P_y, I

Max $U(X, Y)$

s.t. $P_x X + P_y \cdot Y = I$

If P_x rises...

• BL swings inward from BL_1 to BL_2

slope of $BL_1 = -\frac{P_x}{P_y}$

slope of $BL_2 = -\frac{P_x'}{P_y}$ } where $P_x' > P_x$.

BL becomes steeper.

① When $P_x \uparrow$,

$A(x_1, y_1)$ OLD CHOICE

$C(x_3, y_3)$ NEW CHOICE

He consumes less X $(x_1 \to x_3)$

and

more y $(y_1 \to y_3)$

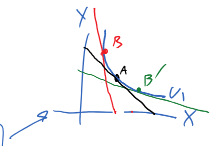
$$\boxed{\underbrace{\Delta Q^d_{x,T.E}}_{T.E} = \underbrace{\Delta Q^d_{x,S.E}}_{S.E} + \underbrace{\Delta Q^d_{x,I.E}}_{I.E}}$$

T.E (S.E | I.E) EXPLODE → DECOMPOSE (S.E) (~~I.E~~)

HICKS SLUTSKY

How?

$\boxed{S.E = \Delta Q^d_x \text{ due to } \Delta \frac{P_x}{P_y}, \text{ holding } \bar{U}}$



I.E = ΔQ^d_x due to Δ in real income or Δ in purchasing power when he faces w/ the new relative price

Example – Income and Substitution Effects

Example:

Suppose U(x,y) = xy ➔ MU_x = ..., MU_y = ...

P_y = \$1/unit and I = \$72

Suppose that P_{x1} = \$9/unit. What is the (initial) optimal consumption basket?

Tangency Condition: $MU_x/MU_y = P_x/P_y$ ➔ ....

Constraint: $P_x x + P_y y = I$ ➔ ....

Solving: x = ... and y = ...

Hicks : To undo "the change in Real income" or the change in purchasing power" he must be "virtually" compensated until he arrives at his old utility curve!

Example – Income and Substitution Effects

Find the decomposition basket B.

1. It must lie on the *original* indifference curve U_1 along with basket A ➔ U_1 = XY = 4(36) = 144.
2. It must lie at the point where the decomposition budget line is tangent to the indifference curve.
3. Price of X (P_X) on the decomposition budget line is final price of \$4.

Tangency Condition: $MU_x/MU_y = P_x/P_y$ ➔ ....

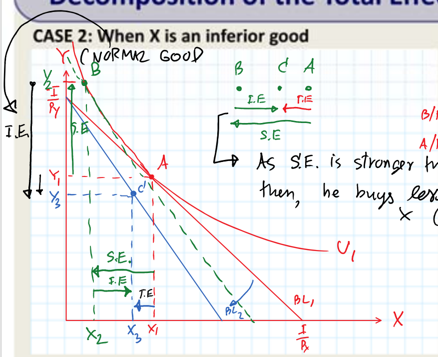
Combined with XY = 144 ➔ x = ..., y = ...

Substitution Effect: ....units of X

Income Effect: .... units of X

Decomposition of the Total Effect

CASE 2: When X is an inferior good



B C A

I.E T.E

S.E

As S.E. is stronger than I.E, then, he buys less of X $(x_3 \leftarrow x_1)$

B/F : $P_x, P_y, I \to A(x_1, y_1)$, U_1 level

A/F : $P_x', P_y, I \to C(x_3, y_3)$, U_0 level $(P_x' > P_x)$

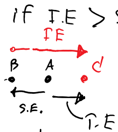
$u_0 < u_1$

:(

Decomposition of the Total Effect

CASE 3: When X is a Giffen Good (super inferior good)

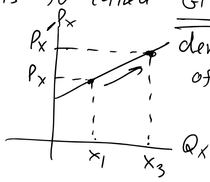
What happens if I.E > SE?



it shows that

When $P_x \uparrow$, he buys more of X !!!

So X is so called "Giffen Good"



demand curve of Giffen Good is upward sloping (B/C I.E. > S.E)

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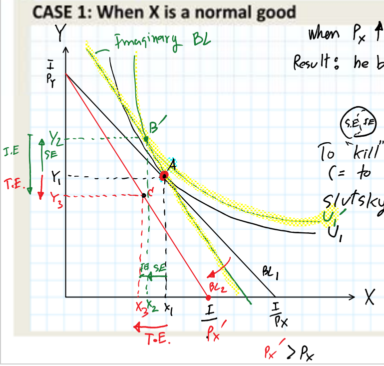
Decomposition of the Total Effect

CASE 1: When X is a normal good



When $P_x \uparrow$...

Result: he buys less of x & less of y SLUTSKY

(S.E, I.E) → (S.E)(I.E)

To "kill" or "eliminate" I.E,
(= to undo the change in real income)

slutsky said " we must virtually compensate him w/ enough income so that he could afford "HIS ORIGINAL BASKET" at the new relative price $\left(\frac{P_x'}{P_y}\right)$ he are dealing with

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Notice that ① the imaginary BL must pass through the old basket (basket A)
② the imaginary BL will touch a higher IC (U_1') [not U_1] !!!

Decomposition of the Total Effect

CASE 2: When X is an inferior good

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Decomposition of the Total Effect

CASE 3: When X is a Giffen Good

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