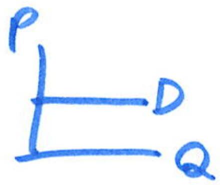
Review : Elasticity

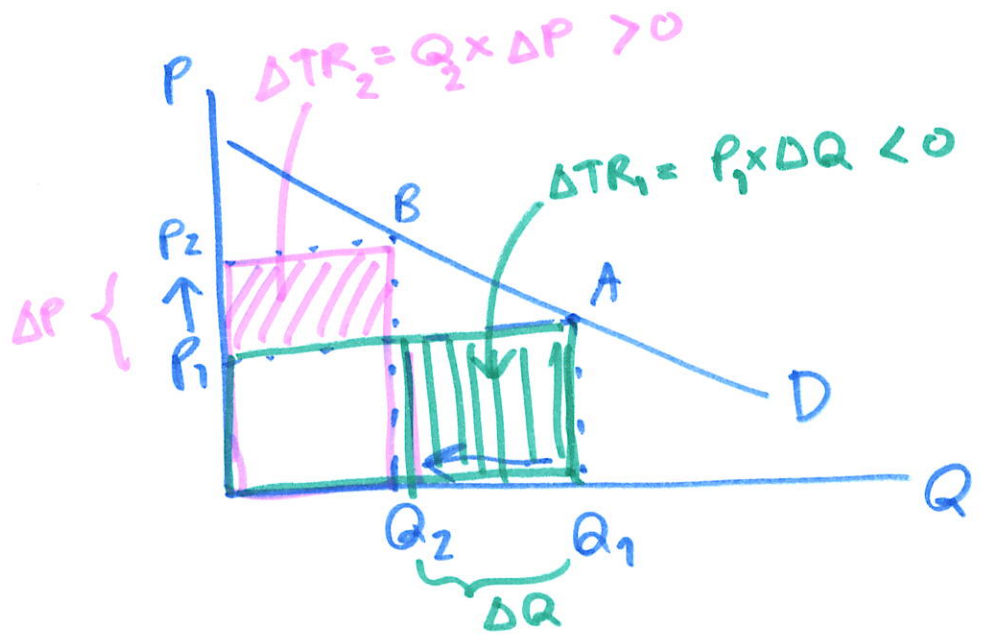
$$\text{Elasticity} = \frac{\%\Delta Y}{\%\Delta X} \quad \text{where} \quad \%\Delta Y = \frac{\Delta Y}{Y}$$

- Price elasticity of demand :

$$\varepsilon d = \frac{\%\Delta Qd}{\%\Delta P}$$

- $|\varepsilon d| = \infty$: Perfectly elastic demand 
- $1 < |\varepsilon d| < \infty$: Elastic demand 
- $0 < |\varepsilon d| < 1$: Inelastic demand 
- $|\varepsilon d| = 1$: Unitary ~~d~~ elastic demand 
- $|\varepsilon d| = 0$: Perfectly inelastic demand 

- Relationship between ε_d and TR



$$\varepsilon_d = \frac{\%\Delta Q_d}{\%\Delta P} = \frac{\Delta Q_d / Q_d}{\Delta P / P}$$

$$\varepsilon_d = \frac{\Delta Q_d}{\Delta P} \cdot \frac{P}{Q_d}$$

(As $P \uparrow$, $\Delta Q_d < 0$)
$\Delta P > 0$

$$TR = P \times Q$$

$$\Delta TR = P \times \Delta Q + Q \times \Delta P$$

<u>Note</u>: $\Delta TR \not\approx d(TR)$

$$d(TR) = d(P \times Q) = P \cdot \underbrace{dQ}_{\approx \Delta Q} + Q \cdot \underbrace{dP}_{\approx \Delta P}$$

$$\therefore \boxed{\Delta TR = \underbrace{P \times \Delta Q}_{\Delta TR_1} + \underbrace{Q \times \Delta P}_{\Delta TR_2}}$$

$$\therefore \Delta TR = \Delta TR_1 + \Delta TR_2$$

$$\Delta TR = \underbrace{P \times \Delta Q}_{\ominus} + \underbrace{Q \times \Delta P}_{\oplus}$$

① If $|\varepsilon_d| > 1$, $|\%\Delta Q_d| > |\%\Delta P|$

$\Rightarrow \underset{\text{Loss}}{|\Delta TR_1|} > \underset{\text{Gain.}}{|\Delta TR_2|}$

$\therefore$ <u>$\Delta TR < 0$</u>. as $P \uparrow$.

② If $|\varepsilon_d| < 1$, $|\%\Delta Q_d| < |\%\Delta P|$

$\Rightarrow$ As $P\uparrow$, $\underbrace{|\Delta TR_1|}_{\text{Loss}} < \underbrace{|\Delta TR_2|}_{\text{Gain}}$ where $\Delta TR_1 = P \times \Delta Q$

$\Delta TR_2 = Q \times \Delta P$

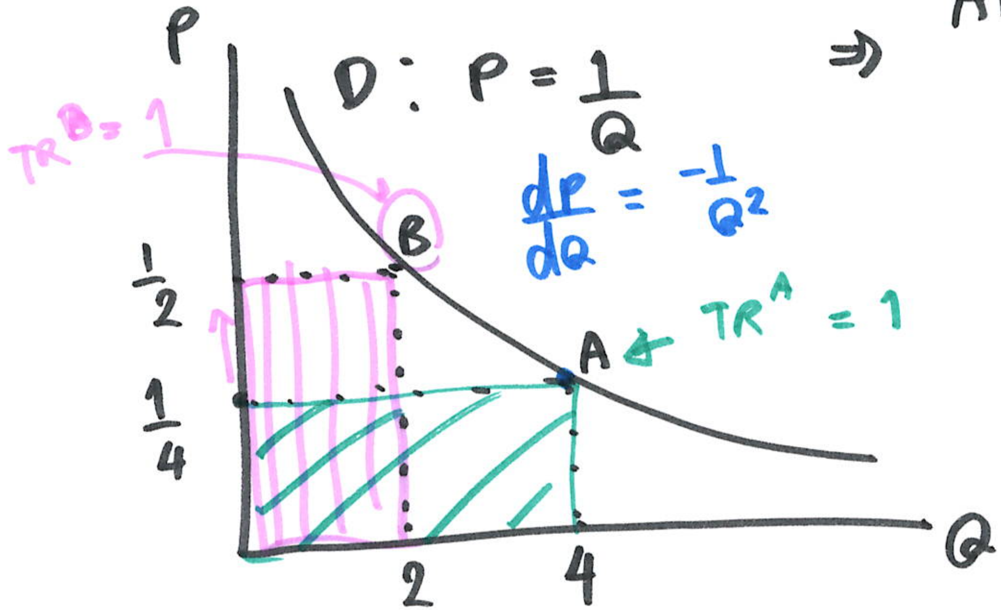
$\therefore$ As $P\uparrow$, $\Delta TR > 0$.

③ If $|\varepsilon_d| = 1$, $|\%\Delta Q_d| = |\%\Delta P|$

$\Rightarrow$ $\Delta TR = 0$ as $P\uparrow$.

$\frac{\Delta P}{\Delta Q} = d\left(\frac{1}{Q}\right)$

$= -\frac{1}{Q^2}$



$\Rightarrow$ At A, $\varepsilon_d = \frac{\%\Delta Q_d}{\%\Delta P} = \frac{\Delta Q_d}{\Delta P} \cdot \frac{P}{Q_d}$

$\hookrightarrow \varepsilon_d^A = -Q_d^2 \times \frac{P}{Q_d} = -(4)^2 \times \underbrace{\frac{1}{4}}_{P} \times \underbrace{\frac{1}{4}}_{1/Q}$

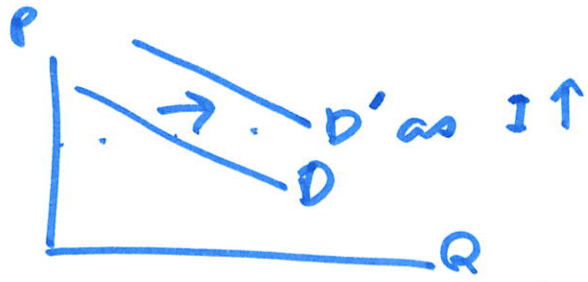
$\varepsilon_d^A = -1$

At B, $\varepsilon_d = \frac{\Delta Q_d}{\Delta P} \times \frac{P}{Q_d} = -Q_d^2 \times \frac{P}{Q_d}$

$\varepsilon_d^B = -(2)^2 \times \frac{1}{2} \times \frac{1}{2} = -1$

Income elasticity of demand

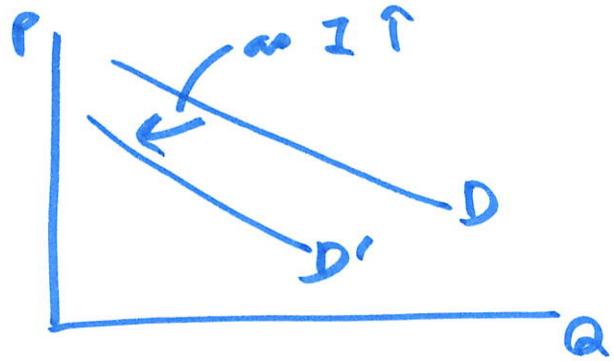
$$\varepsilon_I = \frac{\%\Delta Qd}{\%\Delta I}$$



- $\varepsilon_I \geq 0$: Normal goods

1) $0 \leq \varepsilon_I \leq 1 \Rightarrow |\%\Delta Qd| < |\%\Delta I|$: necessities
2) $\varepsilon_I > 1 \Rightarrow |\%\Delta Qd| > |\%\Delta I|$: luxury.

- $\varepsilon_I < 0$: Inferior goods



Cross-price elasticity of demand

$$\varepsilon_{XY} = \frac{\%\Delta Q_X^d}{\%\Delta P_Y}$$

<u>Ex 1:</u> X is Apple pencil, Y is Ipad.

Complements.

$\Delta P_Y > 0 \Rightarrow \Delta Q_X^d < 0$

↳ $\varepsilon_{XY} < 0$ for complements.

<u>Ex 2:</u> X is Dell computer, Y is MacBook.

$\Delta P_Y > 0 \Rightarrow \Delta Q_X^d > 0$.

↳ $\varepsilon_{XY} > 0$ for substitutes.

Ex Given $I_0 = \$18{,}000$, $I_1 = \$22{,}000$

$Q_d^0 = 40$, $Q_d^1 = 60$. , $\varepsilon_I = ?$

$$\varepsilon_I = \frac{\%\Delta Q_d}{\%\Delta I} = \frac{\Delta Q_d / Q_d}{\Delta I / I}.$$

$\bar{I} = (18{,}000 + 22{,}000) \div 2 = \$20{,}000$

$\overline{Q_d} = (40 + 60) \div 2 = 50$.

$$\therefore \varepsilon_I = \frac{(60-40) \div 50}{\frac{(22{,}000 - 18{,}000)}{20{,}000}} = 2.$$

$\therefore$ $\varepsilon_I > 0$ and $\varepsilon_I > 1$

↳ Normal good ↳ Luxury good.