Tuesday, November 18, 2014 9:48 AM

PRODUCTION AND COSTS IN THE SHORT RUN

PRODUCTION — COSTS OF PRODUCTION — PROFIT MAXIMIZATION

$Q = F(L, \bar{K})$

Q = AMOUNT OF OUTPUT
L = AMOUNT OF LABOR
K = AMOUNT OF CAPITAL

UNITS / TIME PERIOD

$\max \pi = TR - TC$

$\pi = P \cdot Q - TC$

$\frac{\pi}{Q} = \frac{P \cdot \cancel{Q}}{\cancel{Q}} - \frac{TC}{Q}$

$\underbrace{\frac{\pi}{Q}}_{\text{PROFIT PER UNIT OF OUTPUT}} = P - \underbrace{AC}_{\text{AVERAGE COST}}$

SHORT RUN: A PERIOD OF TIME THAT AT LEAST ONE INPUT CANNOT BE VARIED

LONG RUN: A PERIOD OF TIME THAT ALL INPUTS CAN BE VARIED

EX: $Q = F(L, \bar{K})$ → SHORT RUN PRODUCTION FUNCTION

$Q = F(L, K)$ → LONG RUN PRODUCTION FUNCTION

LET'S BEGIN W/ SHORT RUN PRODUCTION:

$$Q = F(\underbrace{L}_{\text{VARIABLE INPUT}}, \underbrace{\bar{K}}_{\text{FIXED INPUT}})$$

- TOTAL PRODUCT (TP) OR Q: TOTAL AMOUNT OF OUTPUT PRODUCED PER TIME PERIOD.
- AVERAGE PRODUCT (OF LABOR):

$$AP_L = \frac{Q}{L} \quad \frac{\to \text{OUTPUT}}{\to \text{WORKER}}$$

EX: $Q = 1000$ COOKIES / DAY
$L = 10$ WORKERS / DAY

$AP_L = \frac{Q}{L} = \frac{1000}{10} = 100$ COOKIES / WORKER / DAY

"ON AVERAGE", EACH WORKER PRODUCES 100 COOKIES/DAY

WE USE AP_L TO MEASURE "LABOR PRODUCTIVITY":
ON AVERAGE, HOW PRODUCTIVE WORKERS ARE.

- MARGINAL PRODUCT OF LABOR (MP_L):
EXTRA UNIT OF OUTPUT FROM EXTRA UNIT OF LABOR

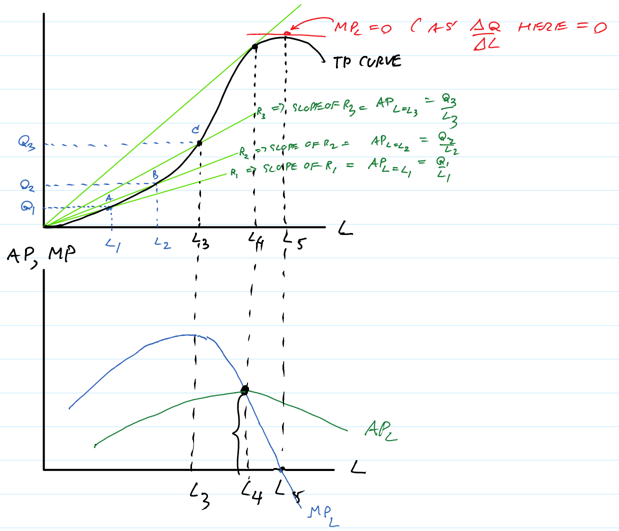
$$MP_L = \frac{\Delta Q}{\Delta L} = \frac{Q_2 - Q_1}{L_2 - L_1}$$

EX: $L_1 = 10 \to Q_1 = 1000$
$L_2 = 11 \to Q_2 = 1200$
+1   +200

$MP_L = \frac{\Delta Q}{\Delta L} = \frac{1200 - 1000}{11 - 10} = \frac{200}{1} = 200$.
Q

19.11.14

- TP OR Q
- $\boxed{AP_L = \frac{Q}{L}}$
- $MP_L = \frac{\Delta Q}{\Delta L}$



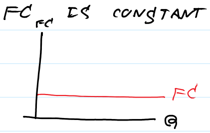
COSTS OF PRODUCTION IN THE SHORT RUN

- $\boxed{\text{TOTAL COST (TC) = TOTAL FIXED COST (TFC OR FC) + TOTAL VARIABLE COST (TVC OR VC)}}$

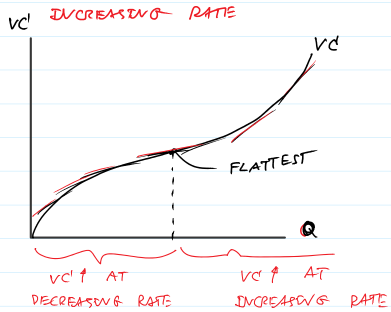
FC : PART OF THE COST THAT DOES NOT VARY WITH OUTPUT PRODUCED. EX: INTERESTS ON BANK LOANS, RENTS

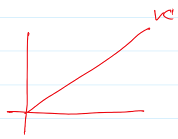
VC : PART OF THE COST THAT DOES VARY WITH OUTPUT PRODUCED. EX: WAGES, RAW MATERIALS, UTILITY BILLS, ETC.

FACT#1 FC IS CONSTANT THROUGHOUT.



FACT#2
- VC IS 0 AT Q = 0.
- VC IS INCREASING AS Q RISES.
- AT THE BEGINNING, VC IS INCREASING AT DECREASING RATE AND THEN INCREASING AT INCREASING RATE





FACT#3
- VERTICAL SUMMATION OF FC AND VC GIVES TC CURVE.
- THE VERTICAL GAP BETWEEN TC AND VC IS FC.
- NOTICE THAT TC CURVE DOES NOT ORIGINATE FROM THE ORIGIN. (WHY?)

AVERAGE COST (AC) OR AVERAGE TOTAL COST (ATC) = AVERAGE FIXED COST (AFC) + AVERAGE VARIABLE COST (AVC)

IN SHORT, $\boxed{AC = AFC + AVC}$

Q: HOW DO WE GET THIS EXPRESSION ABOVE?

A: FROM TC = FC + VC.

DIVIDING THROUGHOUT W/ Q GIVES:

$$\frac{TC}{Q} = \frac{FC}{Q} + \frac{VC}{Q}$$

$$AC = AFC + AVC$$

AC: COST PER UNIT OF OUTPUT OR "UNIT COST" IN BUSINESS TERM.

AFC: FIXED COST PER UNIT OF OUTPUT

AVC: VARIABLE COST PER UNIT OF OUTPUT

EX: FC = 1000 BAHT/DAY
VC = 3000 BAHT/DAY
Q = 100

FIND TC, AC, AFC, AVC.

TC = FC + VC = 1,000 + 3,000 = 4,000 BAHT/DAY.

$AC = \frac{TC}{Q} = \frac{4000}{100} = 40$ BAHT/🍪

$AFC = \frac{FC}{Q} = \frac{1000}{100} = 10$ BAHT/🍪

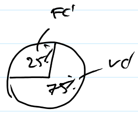
$AVC = \frac{VC}{Q} = \frac{3000}{100} = 30$ BAHT/🍪

AT Q = 100,

$\left.\begin{array}{l}\frac{FC}{Q} = 10 \\ \frac{VC}{Q} = 30\end{array}\right\}$ AC = 40

FC ⇒ $\frac{10}{40}$ 25%

VC ⇒ $\frac{30}{40}$ 75%



$$\boxed{AFC = \frac{FC}{Q}} \Rightarrow$$

AFC IS FALLING THROUGHOUT.
IT FALLS RAPIDLY AT THE LOWER OUTPUT LEVEL AND FALLS STEADILY AT THE HIGH LEVEL OF OUTPUT

THIS IS CALLED "SPREADING EFFECT"

AC = AFC + AVC

EX: MR. BILL GATES HIRED A RESEARCH TEAM TO DEVELOP WINDOWS 8 PLATFORM. HE SPENT 1,000,000 USD.

SO, FC = 1,000,000 USD

IF Q = 1, $\frac{FC}{Q} = \frac{1000000}{1} = 1,000,000$ /◎

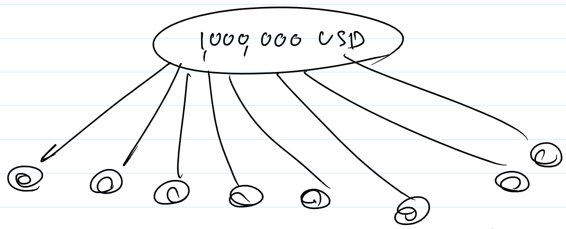
IF Q = 2, $\frac{FC}{Q} = \frac{1,000,000}{2} = 500,000$ USD/◎

IF Q = 10, $\frac{FC}{Q} = \frac{1,000000}{10} = 100,000$ USD/◎

IF Q = 1,000 $\frac{FC}{Q} = \frac{1,000,000}{1,000} = 1000$ USD/◎

IF Q = 1,000,000 $\frac{FC}{Q} = \frac{1,000,000}{1,000,000} = 1$ USD/◎

IF Q = 100,000,000 $\frac{FC}{Q} =$ 1 CENT/◎ !!!

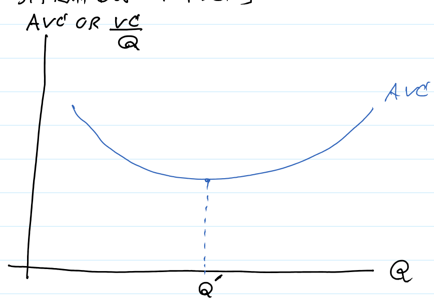


FC IS SPREAD OVER "EACH UNIT" OF CD.
IN OTHER WORDS, EACH UNIT OF CDs HELPS SHARING THE FIXED COST. [SPREADING EFFECT]

$$\boxed{AVC = \frac{VC}{Q}} \quad \frac{฿}{\text{CD}} \Rightarrow$$

VARIABLE COST PER UNIT OF OUTPUT

(฿/CD)



FROM $0 < Q < Q'$, $\frac{VC}{Q}$ IS FALLING. :)

AT $Q = Q'$, $\frac{VC}{Q}$ BOTTOMS OUT.

FROM $Q > Q'$, $\frac{VC}{Q}$ IS RISING :(

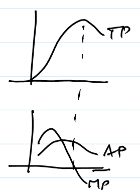
(WHY?)

Q: WHY AVC IS U-SHAPED ?

A: PRODUCTION & COSTS ARE DEEPLY CONNECTED.

ON PRODUCTION ——— ON COST

TC, FC, VC
AC, AFC, AVC
MC



- AVERAGE & MARGINAL RELATIONSHIP
- LAW OF DIMINISHING MARGINAL PRODUCT

CONSIDER
$$AVC = \frac{VC}{Q}$$
$$= \frac{w \cdot L}{Q}$$
$$= w \cdot \frac{L}{Q}$$
$$= w \cdot \frac{1}{\frac{Q}{L}}$$

(SUPPOSE LABOR IS THE ONLY VARIABLE INPUT)

Ex $w = 300$ BAHT/PERSON/DAY
$L = 10$ WORKERS
$VC = w \cdot L = 300 \cdot 10 = 3000$ BAHT/DAY

$$\boxed{AVC = \bar{w} \cdot \frac{1}{AP_L}}$$

GIVEN $\bar{w}$, IF $AP_L \uparrow$, AVC IS FALLING.
IF $AP_L \downarrow$, AVC IS RISING.

IN OTHER WORDS, WHEN LABOR PRODUCTIVITY $\uparrow$, AVC $\downarrow$.
" — " $\downarrow$, AVC $\uparrow$. :(

$$\max \pi = TR - TC$$

$$\frac{\pi}{Q} = \frac{TR}{Q} - \frac{TC}{Q}$$

$$\frac{\Pi}{Q} = \frac{TR}{Q} - \frac{TC}{Q}$$

$$\frac{\Pi}{Q} = \frac{P \cdot \cancel{Q}}{\cancel{Q}} - \frac{TC}{Q}$$

$$\boxed{\frac{\Pi}{Q} = P - AC}$$

AC → AFC, AVC

AVC ← AP_L ← ...

WHEN MP > AP → $AP_L \uparrow$ → AVC $\downarrow$

WHEN MP < AP → $AP_L \downarrow$ → AVC $\uparrow$

→ $L_1 = 10$ WORKERS

→ $Q_1 = 1000$ COOKIES

→ FC = 1,000 BAHT/DAY

→ W = 300 BAHT / PERSON / DAY

$$AFC_1 = \frac{FC}{Q_1} = \frac{1000}{1000} = 1 \text{ BAHT/🍪}$$

$$AVC_1 = \frac{VC_1}{Q_1} = \frac{300 \cdot 10}{1000} = \frac{3000}{1000} = 3 \text{ BAHT/🍪}$$

$$AC = AFC + AVC = 1 + 3 = 4 \text{ BAHT/🍪}$$

NOW, $L_2 = 11$ WORKERS

$Q_2 = 1200$ COOKIES

$$AP_L = \frac{Q_2}{L_2} = \frac{1,200}{11} = 109.09 \text{ COOKIES / WORKER}$$

BEFORE, WHEN $L = 10$

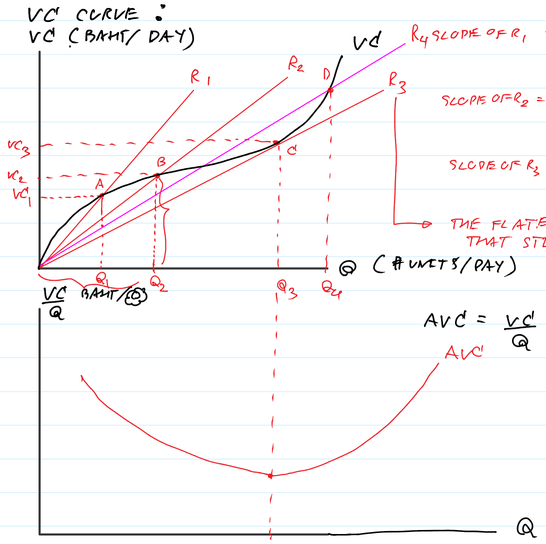
$Q = 1,000$

$$AP_L = \frac{1,000}{10} = 100 \text{ COOKIES / WORKER}$$

$$AVC_2 = \frac{VC_2}{Q_2} = \frac{300 \cdot 11}{1200} = \frac{3,300}{1200} = 2.75 \text{ BAHT/🍪}$$

WHEN AP $\uparrow$ (100 → 109.09), AVC $\downarrow$ (3 → 2.75)

TECHNICAL DETAIL ON HOW TO DRAW AVC WHEN YOU HAVE VC CURVE :



SLOPE OF R_1 = AVC WHEN $Q = Q_1$

↳ $AVC_1 = \frac{VC_1}{Q_1}$

SLOPE OF R_2 = AVC WHEN $Q = Q_2$

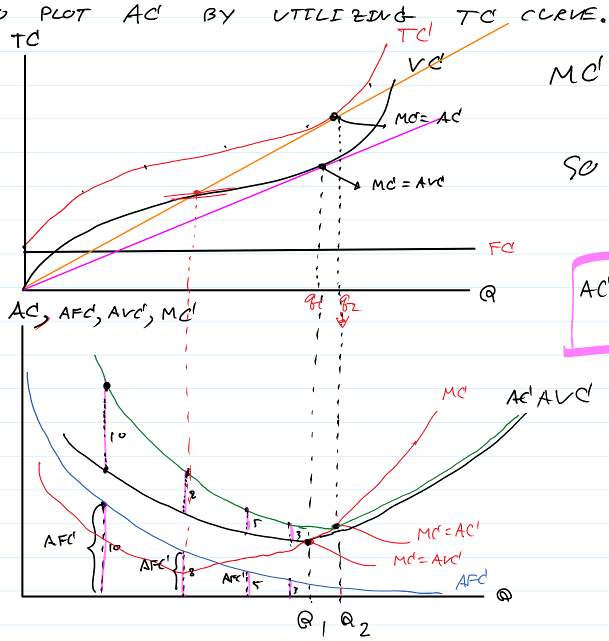
↳ $AVC_2 = \frac{VC_2}{Q_2}$

SLOPE OF R_3 = AVC WHEN $Q = Q_3$

↳ $AVC_3 = \frac{VC_3}{Q_3}$

→ THE FLATEST LINE THAT STILL TOUCHES VC ≡ AVC BOTTOMS OUT HERE AT Q_3.

BY THE SAME MANNER, YOU CAN USE THE SAME TECHNIQUE TO PLOT AC BY UTILIZING TC CURVE.



$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta (FC + VC)}{\Delta Q} = \cancel{\frac{\Delta FC}{\Delta Q}} + \frac{\Delta VC}{\Delta Q} \quad = 0$$

SO $MC = \frac{\Delta VC}{\Delta Q}$ => SLOPE OF VC CURVE

$\boxed{AC = \frac{TC}{Q}}$

OR $MC = \frac{\Delta TC}{\Delta Q}$ => SLOPE OF TC CURVE.

$\boxed{AC = AFC + AVC}$

① GAP BETWEEN AC AND AVC IS AFC.
SO THE GAP GETS NARROWER WHEN Q ↑

② AVC BOTTOMS OUT FIRST AND
AC BOTTOMS OUT SECOND

RELATIONSHIP BETWEEN AVC & AP_L +
RELATIONSHIP BETWEEN MC & MP.

RECALL THAT $\boxed{AVC = \frac{\bar{w}}{AP_L}}$.

PRODUCTION	COST
TP	TC, FC, VC
AP	AC, AFC, AVC
MP	MC

$MP_L = \frac{\Delta Q}{\Delta L}$

$$MC = \frac{\Delta VC}{\Delta Q} = \frac{\Delta (w \cdot L)}{\Delta Q} = w\left(\frac{\Delta L}{\Delta Q}\right) = w \cdot \frac{1}{\frac{\Delta Q}{\Delta L}} = w \cdot \frac{1}{MP_L}.$$

THEREFORE, $\boxed{MC = w \cdot \frac{1}{MP_L}}$

GIVEN $\bar{w}$, WHEN MP_L ↑, MC ↓.
WHEN MP_L ↓, MC ↑.

EX:
w = 300 BAHT/WORKER/DAY
MP_L = 15 COOKIES / WORKER

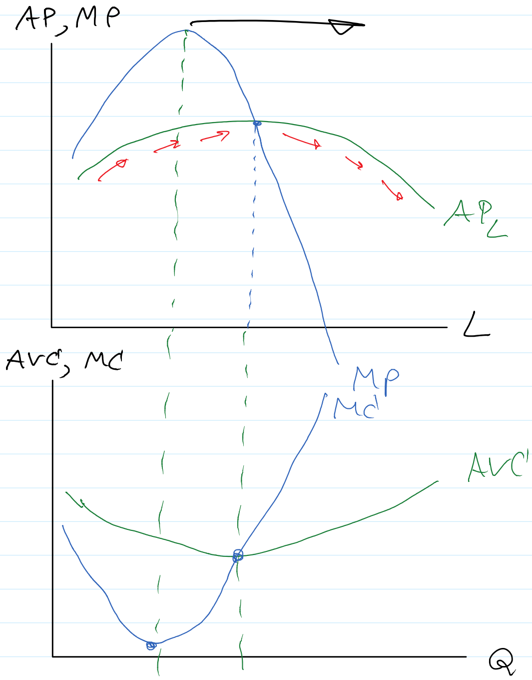
$\boxed{MC = \frac{w}{MP_L} = \frac{300}{15} = 20 \text{ BAHT/🍪}}$

TO GET 15 COOKIES, YOU PAY 300 BAHT

" —— " 1 " ——— "

$\frac{300}{15} = 20$ BAHT/COOKIES

MC = ADDITIONAL COST OF ADDITIONAL UNIT OF OUTPUT.



PRODUCTION

$$\boxed{AVC = \frac{\bar{w}}{AP_L}} \quad \text{—— (1)}$$

COST

$$\boxed{MC = \frac{\bar{w}}{MP_L}} \quad \text{—— (2)}$$

- AVC IS A REFLECTION OR MIRROR IMAGE OF AP_L CURVE
- MC IS A REFLECTION OR MIRROR IMAGE OF MP_L CURVE