PRODUCTION AND COSTS IN THE SHORT RUN

OBJECTIVE OF FIRMS: MAXIMIZE PROFITS (π)

PROFITS (π) = TOTAL REVENUE (TR) − TOTAL COSTS (TC)

TOTAL REVENUE (TR) = PRICE (P) × QUANTITY SOLD (Q)

TOTAL COSTS (TC) = EXPLICIT COSTS + IMPLICIT COSTS

IMPLICIT COSTS = OPPORTUNITY COSTS

PRODUCTION FUNCTION: A TECHNICAL RELATIONSHIP BETWEEN OUTPUT (THE PRODUCT THAT FIRM PRODUCES) AND INPUTS (RESOURCES REQUIRED FOR PRODUCTION)

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

Q = OUTPUT PRODUCED (# UNITS / TIME PERIOD)

L = LABOR INPUTS (# UNITS / TIME PERIOD)

K = CAPITAL INPUTS (# UNIT / TIME PERIOD)

$L, K \rightarrow \boxed{Q = F(L,K)} \rightarrow Q$ PRODUCTION PROCESS

SHORT RUN: PERIOD OF TIME THAT AT LEAST ONE FACTOR OF PRODUCTION CANNOT BE VARIED.

LONG RUN: LENGTHY ENOUGH PERIOD THAT ALL FACTOR OF PRODUCTION CAN BE VARIED.

PRODUCTION FUNCTION IN THE SR: $Q = F(L, \bar{K})$

L IS A VARIABLE INPUT

$\bar{K}$ IS A FIXED INPUT

PRODUCTION FUNCTION IN THE LR: $Q = F(L, K)$.

SINCE WE DID NOT PUT ANY BAR ON L OR ON K, SO THIS IS A LR PRODUCTION FUNCTION.

TOTAL PRODUCT (TP OR Q) = AMOUNTS OF OUTPUT PRODUCED FOR A GIVEN PERIOD OF TIME AND GIVEN STATE OF TECHNOLOGY.

AVERAGE PRODUCT (AP) = $\dfrac{\text{OUTPUT PRODUCED}}{\text{\# WORKERS}}$ $\dfrac{(TP \text{ OR } Q)}{(L)}$

EX:
Q = 1000 COOKIES / DAY

L = 10 WORKERS / DAY

$AP = \dfrac{Q}{L} = \dfrac{1000}{10} = 100$ COOKIES / PERSON

- ON AVERAGE "EACH" WORKER PRODUCES 100 COOKIES / DAY.

$$AP = \frac{Q}{L} = \frac{1000}{10} = 100 \text{ COOKIES / PERSON}$$

- ON AVERAGE, "EACH" WORKER PRODUCES 100 COOKIES / DAY.
- AP IS USED TO MEASURE "LABOUR PRODUCTIVITY"

FACTORY 1 $Q = 1000$, $L = 10$ $\rightarrow$ $AP_1 = \frac{1000}{10} = 100$

FACTORY 2 $Q = 800$, $L = 10$ $\rightarrow$ $AP_2 = \frac{800}{10} = 80$

SINCE $AP_1 > AP_2$, THEN WORKERS IN FACTORY 1 IS MORE PRODUCTIVE, ON AVERAGE.

= INCREMENTAL
= ADDITIONAL
(= MARGINAL)

MARGINAL PRODUCT (MP) = EXTRA OUTPUT FROM AN EXTRA WORKER.

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

ΔQ $\rightarrow$ CHANGE IN OUTPUT
ΔL $\rightarrow$ CHANGE IN VARIABLE INPUT (HERE, L)

EX: $Q_1 = 1000$, $L_1 = 10$ $\rightarrow$ Q_2 1200, $L_2 = 11$

$$MP = \frac{Q_2 - Q_1}{L_2 - L_1} = \frac{1200 - 1000}{11 - 10} = \frac{200}{1} = 200.$$

AS ADDITIONAL OUTPUT RECEIVED FROM ADDING ONE MORE VARIABLE INPUT INTO THE FACTORY.

FROM GRAPHICAL ANALYSIS

OBS #1 (ON TP): WHEN L INCREASES, TP OR Q INCREASES, REACHES ITS PEAK WHEN L = 11 (POINT C), AND DECREASES AFTERWARDS.

OBS #2 (ON AP): WHEN L INCREASES, AP_L INCREASES, REACHES ITS PEAK WHEN L = 6 (POINT b), AND THEN DECREASES.

OBS #3 (ON MP): WHEN L INCREASES, MP INCREASES, REACH ITS PEAK WHEN L = 4 (POINT a), AND THEN DECREASES.
MP = 0 WHEN L = 11. BEYOND L = 11, MP BECOMES NEGATIVE.

OBS #4 ON AP-MP RELATIONSHIP

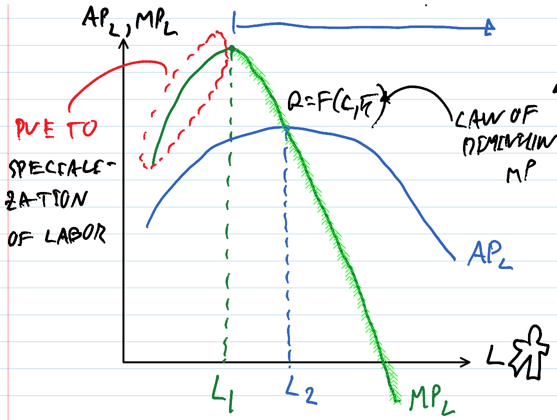
WHEN $L < 6$, $MP_L > AP_L$
WHEN $L = 6$, $MP_L = AP_L$ AND AP_L IS AT MAXIMUM.
WHEN $L > 6$, $MP_L < AP_L$

> * WHEN $MP_L > AP_L$, AP_L IS RISING.
> AND WHEN $MP_L < AP_L$, AP_L IS FALLING.
> WHEN $MP_L = AP_L$, AP_L REACHES AT ITS MAXIMUM.

EX: N = 50 $\rightarrow$ AVERAGE HEIGHT = 160 CM.

N = 50 + DUTCH GUY W/ 200 CM ? NEW AVERAGE HEIGHT WILL BE HIGHER THAN THE CURRENT ONE, 160 CM.

OBSERVATION #5 AS L RISES, MP_L WILL EVENTUALLY FALL. (WHY?)



$MP > AP \rightarrow AP \uparrow$

$MP < AP \rightarrow AP \downarrow$

(BACKWARD REASONING)

A: MISMATCH BETWEEN FIXED INPUT AND VARIABLE INPUT OCCURS!

EX: CROWDED KITCHEN : NOT ENOUGH COOKING UTENSILS FOR MORE AMOUNT OF CHEFS.

THIS OBSERVATION IS CALLED "LAW OF DIMINISHING MP."

GOOGLE : "LAW OF DIMINISHING MARGINAL PRODUCT" + FILE: PPT PDF DOC

NEXT, WE WILL DISCUSS ABOUT COSTS OF PRODUCTION IN THE SHORT RUN

RECALL THAT $\pi = TR - TC$

OBJECTIVE OF THE STUDY : GET A BETTER UNDERSTANDING ABOUT "NATURE" OF COSTS IN THE SHORT RUN.

OUR ROADMAP : 7 COST CURVES : $\boxed{TC, FC, VC}$ $\boxed{AC, AFC, AVC}$ $\boxed{MC.}$

TOTAL COST (TC) = FIXED COST (FC) + VARIABLE COST (VC)

TC = ALL COSTS YOU HAVE TO PAY TO PRODUCE A CERTAIN AMOUNT OF OUTPUT FOR A GIVEN TIME PERIOD (BAHT/DAY)

FC = COSTS THAT DO NOT VARY WITH AMOUNT OF OUTPUT PRODUCED

EX: • RENTAL PAYMENT
• INTERESTS ON LOANS
• COSTS OF BUILDING YOUR FACTORY.

(BAHT/DAY)

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

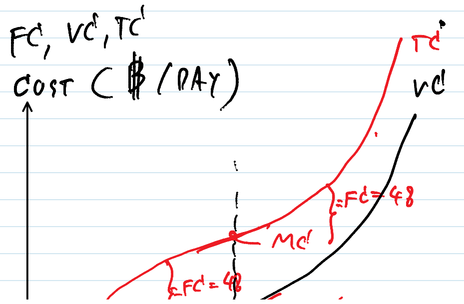
L: # WORKERS

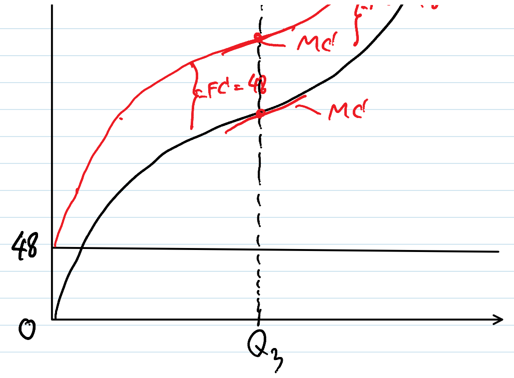
$\bar{K}$: # MACHINE (FIXED)

VC = COSTS THAT VARY WITH AMOUNT OF OUTPUT PRODUCED

EX: • ELECTRICITY
• GAS
• WATER
• PAYMENTS TO WORKERS
• PAYMENTS TO RAW MATERIALS

(BAHT / DAY)

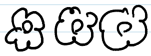




$Q = F(L, K)$ → # WORKERS (L), # MACHINE (FIXED) (K)

$TC = FC + VC$

COOKIE / DAY



OBS #1 : FC IS CONSTANT THROUGHOUT OUTPUT LEVEL.
WHEN $Q = 0$, THE FIRM STILL HAS TO PAY FC.

OBS #2 : WHEN $Q = 0$, $VC = 0$
WHEN Q INCREASES, VC ALSO INCREASES, FIRST AT DECREASING RATE AND THEN AT INCREASING RATE (NOTICE AT SLOPE OF VC)

OBS #3 :
- WHEN Q INCREASES, TC INCREASES, FIRST AT DECREASING RATE AND THEN AT INCREASING RATE. (LOOK AT THE SLOPE OF TC CURVE)
- THE VERTICAL GAP BETWEEN TC AND VC REFLECTS FC.

OBS #4
SLOPE OF VC = MARGINAL COST (MC)
SLOPE OF TC = MARGINAL COST (MC)

"MARGINAL" COST (MC) = EXTRA COST YOU HAVE TO PAY WHEN YOU WANT TO PRODUCE AN EXTRA UNIT OF COOKIE.

ADDITIONAL
EXTRA
INCREMENTAL

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{TC_2 - TC_1}{Q_2 - Q_1}.$$

ANOTHER VERSION :
$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta(FC + VC)}{\Delta Q}$$
$$= \underbrace{\cancel{\frac{\Delta FC}{\Delta Q}}}_{=0} + \frac{\Delta VC}{\Delta Q}$$
$$\boxed{MC = \frac{\Delta VC}{\Delta Q}}$$

15.11.13 (MAKE UP CLASS #1 OF 3)

SO FAR, $TC = FC + VC$. (DEFINITION & GRAPHS)
MC (DEFINITION)

TODAY : AC, AFC, AVC.

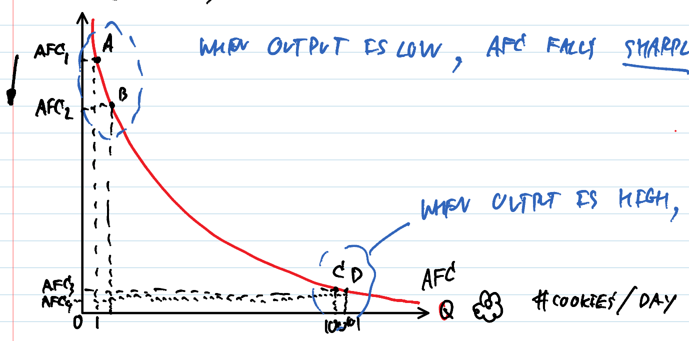
LET'S BEGIN W/ $\boxed{AC = AFC + AVC.}$

AVERAGE FIXED COST (AFC) = FIXED COST PER UNIT OF OUTPUT

$\boxed{AFC = \frac{FC}{}}$ $\frac{\text{BAHT/~~DAY~~}}{}$ [BAHT]

OUTPUT

$$\boxed{AFC = \frac{\overline{FC}}{Q}} \qquad \frac{\text{BAHT}/\cancel{\text{DAY}}}{\text{UNIT}/\cancel{\text{DAY}}} \quad \left[\frac{\text{BAHT}}{\text{UNIT}}\right]$$



WHEN OUTPUT IS LOW, AFC FALLS SHARPLY WHEN Q RISES.

WHEN OUTPUT IS HIGH, AFC FALLS JUST A LITTLE.

AS Q RISES, AFC OR FIXED COST PER UNIT OF OUTPUT FALLS.

Ex: MR. BILL GATES PRODUCES WINDOWS 8 OS.

HE SPENT 1,000,000 US$ TO HIRE A RESEARCH TEAM.

FC = 1,000,000 US$ (DOES NOT VARY W/ OUTPUT)

IF $Q = 1$, $AFC = \frac{FC}{Q} = \frac{1{,}000{,}000}{1} = 1{,}000{,}000$ \$/UNIT

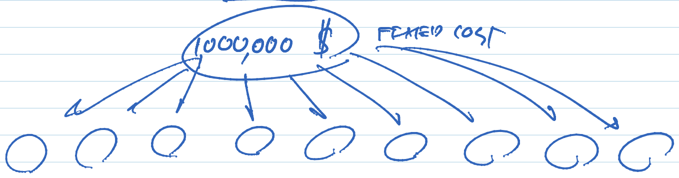
IF $Q = 2$, $AFC = \frac{FC}{Q} = \frac{1{,}000{,}000}{2} = 500{,}000$ \$/UNIT

IF $Q = 1{,}000$ $AFC = \frac{FC}{Q} = \frac{1{,}000{,}000}{1000} = 1000$ \$/CD.

IF $Q = 1{,}000{,}000$, $AFC = \frac{FC}{Q} = \frac{1{,}000{,}000}{1{,}000{,}000} = 1$ \$/CD.

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

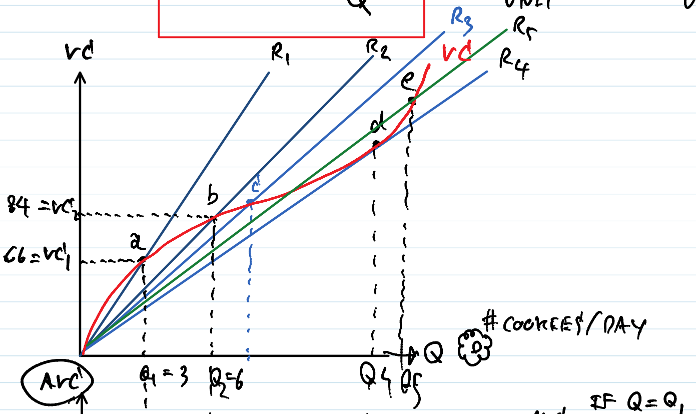
SPREADING EFFECT: WHEN FIXED COST IS SPREADED OVER "EACH UNIT" OF OUTPUT HE PRODUCED.



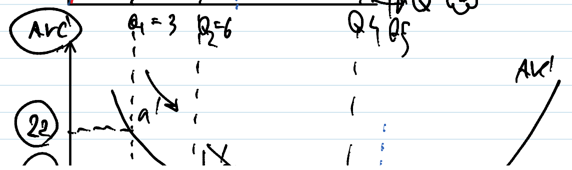
- AVERAGE VARIABLE COST (AVC) = VARIABLE COST PER UNIT OF OUTPUT

$$\boxed{AVC = \frac{VC}{Q}} \qquad \left(\frac{\text{BAHT}}{\text{UNIT}}\right) \leftarrow \frac{\text{BAHT}/\cancel{\text{DAY}}}{\text{UNIT}/\cancel{\text{DAY}}}$$

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

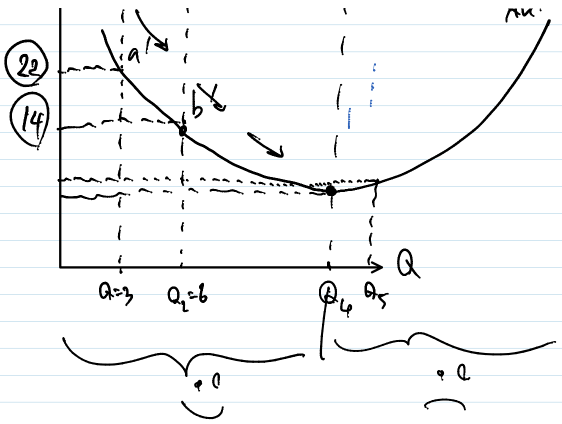


$$AVC = \frac{VC}{Q}$$



IF $Q = Q_1$, $AVC_1 = \frac{VC_1}{Q_1} = \frac{66}{3} = 22$

IF $Q = Q_2 = 6$, $AVC_2 = \frac{VC_2}{Q_2} = \frac{84}{6} = 14$



$Q_1 \quad 3$

IF $Q = Q_2 = 6$, $AVC_2 = \frac{VC_2}{Q_2} = \frac{84}{6} = 14$

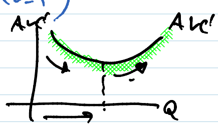
- SLOPE OF LINE FROM THE ORIGIN TO A POINT ON VC CURVE MEASURES "VARIABLE COST PER UNIT" AT THAT CORRESPONDING Q.

- FROM $Q_0 = 0 \rightarrow Q = Q_4$: SLOPES OF LINE FROM THE ORIGIN TO A POINT ON VC CURVE GETS FLATTER AND IT IMPLIES THAT AVC IS FALLING OVER THIS RANGE OF PRODUCTION.
  (SLOPE OF R_4 < SLOPE OF R_3 < SLOPE OF R_2 < SLOPE OF R_1)

  AT $Q = Q_4$: AS R_4 IS THE FLATEST LINE, IT TELLS US THAT AVC REACHES ITS MINIMUM (BOTTOM OF THE VALLEY)

  FROM Q_4 ONWARDS : AVC STARTS TO RISE ...
  (VARIABLE COST PER COOKIES)

Q: WHY IS AVC CURVE U-SHAPED ?



A: $AVC = \frac{VC}{Q}$ $\quad \frac{฿}{🍪}$

$AVC = \frac{\bar{w} \times L}{Q}$

$\bar{w} = 300$ BAHT/DAY
$L = 10$ WORKERS
$VC = \bar{w} \cdot L$
$= 300 \times 10$
$= 3000$ BAHT/DAY

RECALL THAT $AP_L = \frac{Q}{L}$

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

THEREFORE, $\boxed{AVC = \frac{\bar{w}}{AP_L}}$

THIS RELATIONSHIP TELLS US THAT

GIVEN $\overline{w}$, WHEN OUTPUT PER WORKER RISES, (AP_L)
VARIABLE COST PER UNIT WILL FALL, VICE VERA.
(AVC)

IN SHORT: WHEN $AP_L \uparrow$, AVC IS FALLING
AND WHEN $AP_L \downarrow$, AVC IS RISING.

WHEN $MP_L > AP_L \rightarrow AP_L \uparrow \rightarrow AVC \downarrow$ (BY BACKWARD REASONING)

WHEN $MP_L < AP_L \rightarrow AP_L \downarrow \rightarrow AVC \uparrow$

EX: SUPPOSE $\overline{w} = 300$ BAHT / DAY

$L_1 = 10$ WORKERS

$Q_1 = 1000$ COOKIES

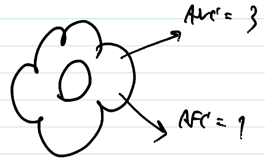
$AP_L = \dfrac{Q_1}{L_1} = \dfrac{1000}{10} = 100$ COOKIES

SUPPOSE $FC = 1000$ BAHT / DAY

$AVC_1 = \dfrac{VC_1}{Q_1} = \dfrac{w \times L_1}{Q_1} = \dfrac{300 \times 10}{1000} = \dfrac{3000}{1000} = 3$ BAHT / COOKIES

$AFC_1 = \dfrac{FC}{Q_1} = \dfrac{1000}{1000} = 1$ BAHT / COOKIE

$AC = AFC + AVC$
UNIT COST OR COST PER UNIT
$= 1 + 3$
$= 4$ BAHT / COOKIES



AC = 4 BAHT / PIECE

$L_2 = 11$ WORKERS
$Q_2 = 1200$ COOKIES

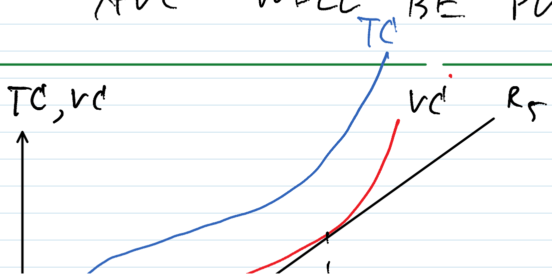
$AP_2 = \dfrac{Q_2}{L_2} = \dfrac{1200}{11} = 109.09$ COOKIES / WORKER.

NOTICE THAT $\underset{(109.09)}{AP_2} > \underset{(100)}{AP_1}$.

$AVC_2 = \dfrac{w \times L_2}{Q_2} = \dfrac{300 \times 11}{1200} = \dfrac{3300}{1200} = 2.75$ BAHT / COOKIE!

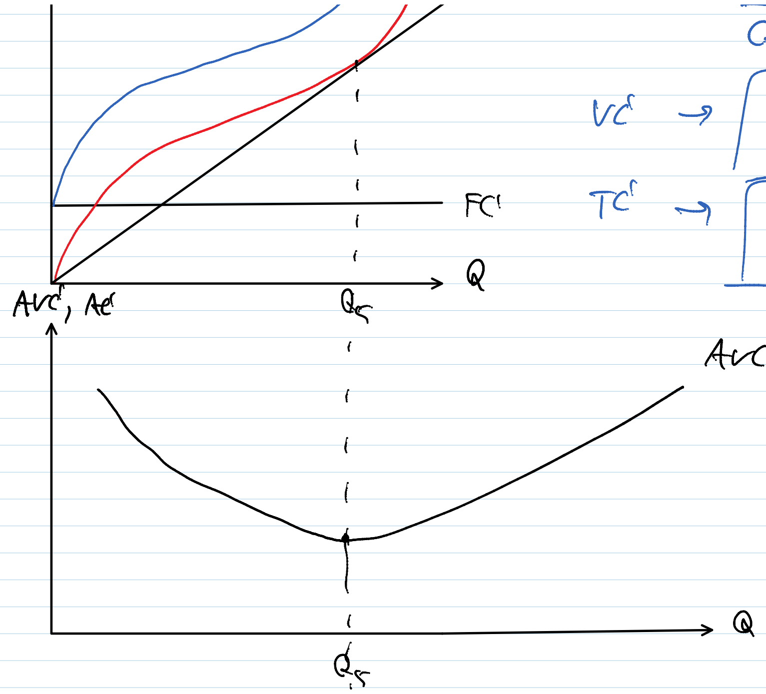
WHEN $AP \uparrow$, AVC WILL BE PUSING DOWN.

DIY AT HOME:



$AC = \dfrac{TC}{Q}$

PLOT AC
FROM
TC



$VC \rightarrow \boxed{AVC = \frac{VC}{Q}}$

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