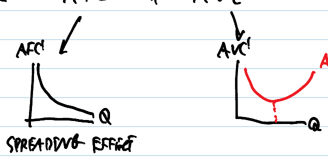
Tuesday, November 19, 2013
7:47 AM

WEEK 14 (19.11.13)

PRODUCTION AND COSTS IN THE SHORT RUN (CONT.)

CONTINUED FROM LAST LECTURE:

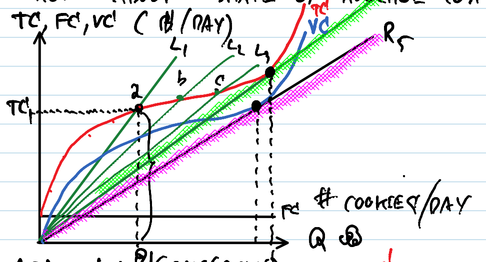
$AC = AFC + AVC$



Q: WHY AVC IS U-SHAPED?

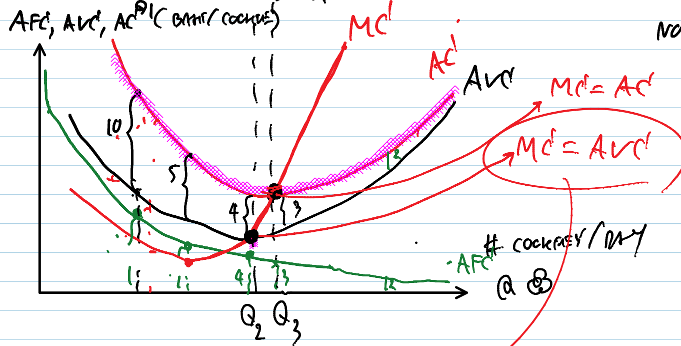
A: LOOK AT THE RELATIONSHIP BET. AVC & AP.

• HOW ABOUT SHAPE OF AVERAGE COST CURVE (AC)?



AT $Q_1 \Rightarrow AC_1 = \frac{TC_1}{Q_1}$ WHICH IS EQUAL TO SLOPE OF L_1.

$AC = AFC + AVC$



$MC = AC$

$MC = AVC$

NOTE: SLOPE OF LINE FROM THE ORIGIN TO A POINT ON VC CURVE = AVC!

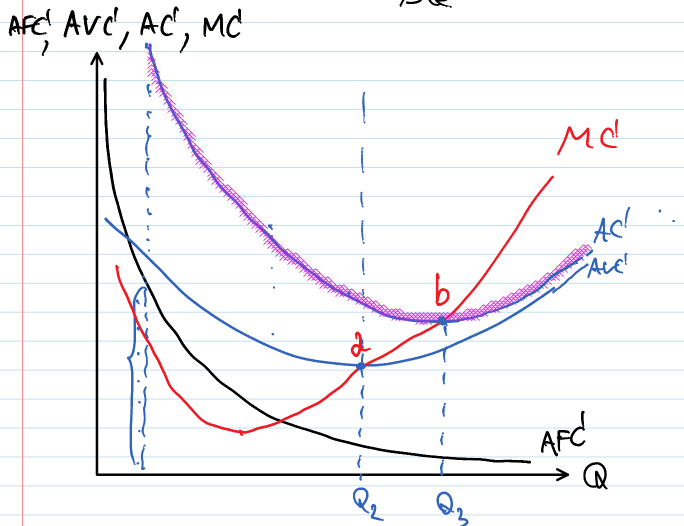
SLOPE OF LINE FROM THE ORIGIN TO A POINT ON TC CURVE = AC! $\Rightarrow AC = \frac{TC}{Q}$

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

$MC \rightarrow \frac{\Delta TC}{\Delta Q} \Rightarrow$ SLOPE OF TC CURVE!

$MC \rightarrow \frac{\Delta VC}{\Delta Q} \Rightarrow$ SLOPE OF VC CURVE!

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



$\boxed{\text{Q: WHY AC IS U-SHAPED?}}$

• $AC = AFC + AVC$

• AC' = AFC' + AVC'

FROM Q=0 → Q = Q_2 : AFC' ↓ + AVC' ↓ = AC' ↓

REASON ?

① SPREADING EFFECT : AFC' ↓

② MP > AP → AP ↑ → AVC' ↓ [AVC' = $\frac{w}{AP}$]

FROM Q=Q_2 → Q=Q_3 AFC' ↓ + AVC' ↑ = AC' ↓

AS THE FALL IN AFC' IS STRONGER THAN THE RISE IN AVC', AC' CONTINUES TO FALL.

IN OTHER WORDS, WE SAY THAT

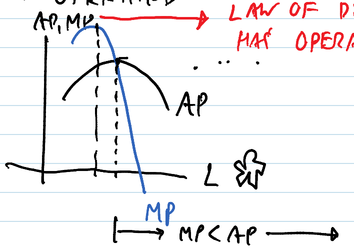
" SPREADING EFFECT (↓ AFC') IS STRONGER THAN DIMINISHING RETURN EFFECT (↑ AVC')".

THE REASON WHY WE CALL ↑ AVC' AS "DIMINISHING RETURN EFFECT" IS THAT AVC' INCREASES BECAUSE AP ↓ AND AP FALLS B/C MP < AP!

i.e., MP < AP → AP ↓ → AVC' ↑

LAW OF DIMINISHING MP HAS OPERATED NOW.

LAW OF DIMINISHING MP: MP FALLS WHEN L RISES HAS OPERATED



FROM Q_3 ONWARDS : AFC' ↓ + AVC' ↑ = AC' ↑

" DIMINISHING RETURN EFFECT (↑ AVC') DOMINATES SPREADING EFFECT (↓ AFC') "

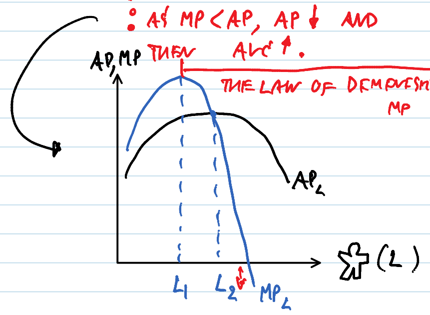
WHEN Q > Q_3 : AFC' ↓ + AVC' ↑ = AC' ↑

IT WOULD IMPLY THAT ↑AVC > ↓AFC.

IN OTHER WORDS, DIMINISHING RETURN EFFECT > SPREADING EFFECT.

: AS $MP < AP$, AP↓ AND THEN AVC↑.

THE LAW OF DIMINISHING MP SETS IN SINCE $L = L_1$



$MP < AP$ → AP IS FALLING.

SO FAR,

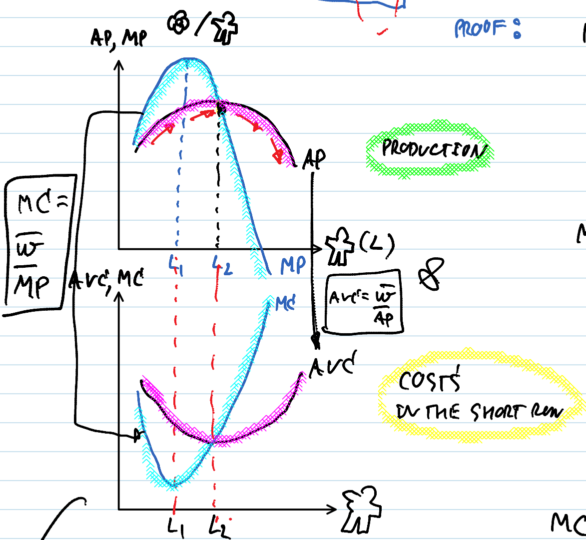
PRODUCTION	COSTS		
TP	TC	FC	VC
AP	AC	AFC	AVC
MP	MC		
(3 CURVES)	(7 CURVES)		

IN THE SHORT RUN

$\boxed{AVC = \frac{\bar{w}}{AP}}$

$\boxed{MC = \frac{\bar{w}}{MP}}$

GIVEN $\bar{w}$, WHEN MP RISES, MC WILL FALL, VICE VERSA



PROOF:

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

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

$$MC = w \cdot \frac{1}{MP_L} \quad \#$$

SWANS REFLECTING ELEPHANTS (DALI, 1937)

"NATURE OF COST CURVES IS "A REFLECTION" FROM NATURE OF PRODUCTION IN THE SHORT RUN"

PRODUCTION IN THE LONG RUN

$$Q = F(L, K)$$

NOW LABOR (L) AND CAPITAL (K) ARE "VARIABLE INPUTS"

TOOLS USED WHEN WE STUDY PRODUCTION IN THE LONG RUN:

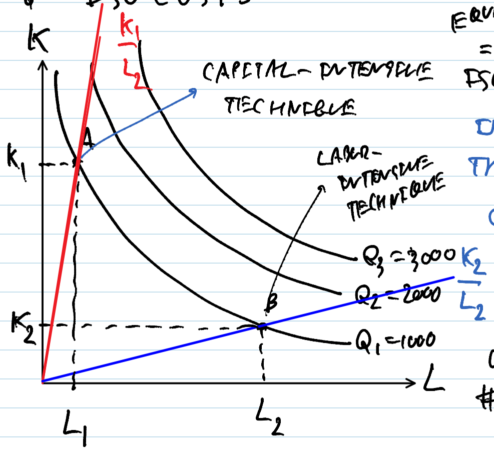
CONSUMER CHOICE

TOOLS USED WHEN WE STUDY PRODUCTION IN THE LONG RUN:

- ISOQUANTS
- ISOCOSTS

CONSUMER CHOICE THEORY

- INDIFFERENCE CURVES
- BUDGET LINE



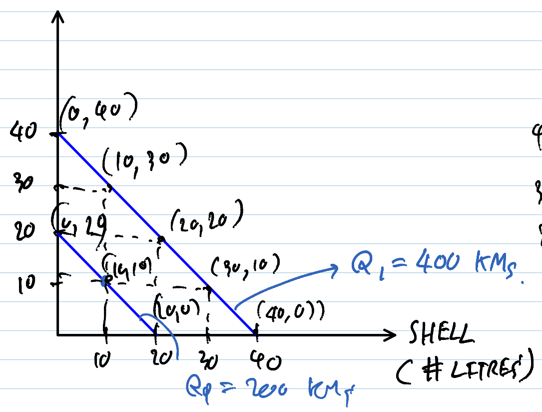
EQUAL QUANTITY

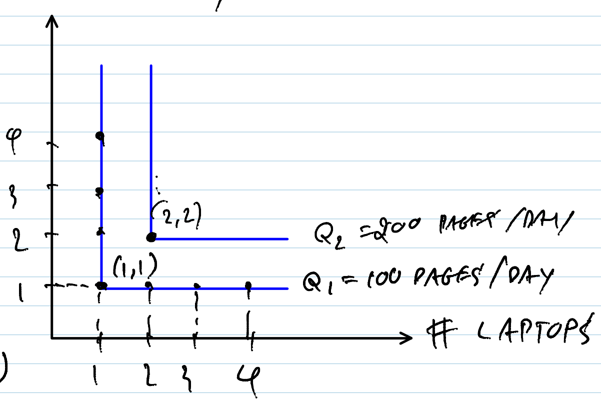
ISOQUANTS: A SET OF INPUT COMBINATIONS THAT GIVES THE SAME QUANTITY OF OUTPUT.

$Q = F(L, K)$

OUTPUT # CARS/DAY — TWO INPUTS

OBSERVE THAT $\frac{K_1}{L_1} > \frac{K_2}{L_2}$





TWO INPUTS ARE "PERFECT SUBSTITUTES"

⇓

STRAIGHT-LINE ISOQUANTS

TWO INPUTS ARE "PERFECT COMPLEMENTS"

⇓

L-SHAPED ISOQUANTS

ISO COST CURVES

- 2 VARIABLE INPUTS: L, K
- PRICE OF LABOR $= w$ (WAGE) BAHT/PERSON/DAY
- PRICE OF CAPITAL $= r$ (RENT) BAHT/MACHINE/DAY
- AS A PRODUCTION MANAGER, CEO GIVES YOU TC (TOTAL COST) BAHT TO SPEND ON BUYING INPUTS.

$$\boxed{w \cdot L + r \cdot K = TC}$$

ISOCOST EQUATION

EX: $w = 300$

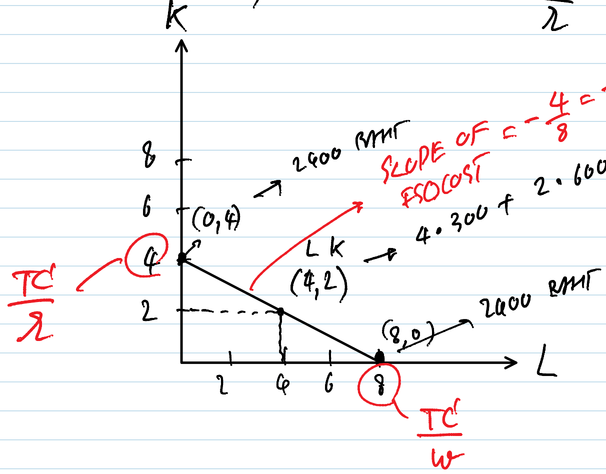
$r = 600$

$\Rightarrow \frac{TC}{w} = \frac{2400}{300} = 8$ WORKERS/DAY

Ex: $w = 300$ $\Rightarrow$ $\dfrac{TC'}{w} = \dfrac{2400}{300} = 8$ WORKERS/DAY

$r = 600$

$TC' = 2400$ $\qquad \dfrac{TC'}{r} = \dfrac{2400}{600} = 4$ MACHINES/DAY



SLOPE OF ISOCOST $= -\dfrac{4}{8} = -\dfrac{1}{2}$

$4 \cdot 300 + 2 \cdot 600 = 1200 + 1200 = 2400$ BAHT

ISO COST: A SET OF INPUT MIX THAT COSTS THE SAME AMOUNT OF MONEY

IN ABSTRACT FORM: SLOPE OF ISOCOST $= -\dfrac{\cancel{TC'}/r}{\cancel{TC'}/w} = -\dfrac{w}{r}$

WE CALL $-\dfrac{w}{r}$ (w: P_L, r: P_K) A RELATIVE PRICE OF LABOR AND CAPITAL

Ex $\dfrac{w}{r} = \dfrac{1}{2} \Rightarrow r = 2w$.

PROBLEM OF A PRODUCTION MANAGER: MINIMIZE COST GIVEN A REQUIRED AMOUNT OF PRODUCTION.

MINIMIZE $TC = w \cdot L + r \cdot K$

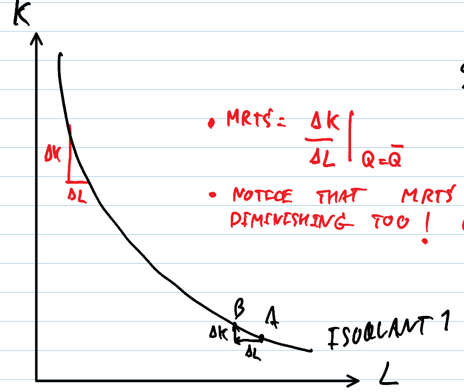
SUBJECT TO $Q = \bar{Q}$ (CERTAIN LEVEL OF

$(L^*, K^*) \rightarrow$ MINIMIZE TC'

"COST MINIMIZATION PROBLEM"

SO FAR, ISOQUANT & ISO COST LINES.

NEXT, LET'S DISCUSS ABOUT <u>SLOPE OF ISOQUANT</u>



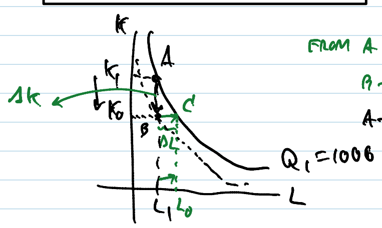
• $MRTS = \frac{\Delta K}{\Delta L}\Big|_{Q=\bar{Q}}$

• NOTICE THAT MRTS IS DIMINISHING TOO ! (WHY?) * → DIY

SLOPE OF ISOQUANT = MARGINAL RATE OF TECHNICAL SUBSTITUTION = THE RATE AT WHICH ONE INPUTS CAN BE SUBSTITUTED W/ ANOTHER INPUT SO THAT OUTPUT REMAINS UNCHANGED.

$$\boxed{MRTS = -\frac{MP_L}{MP_K}}$$

$$\left(\approx MRS = -\frac{MU_x}{MU_y}\right)$$



FROM $A \to B$: $MP_K \cdot \Delta K$ = LOSS IN OUTPUT

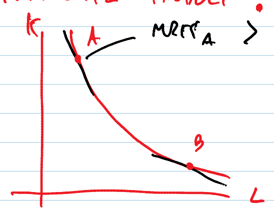
$B \to C'$: $MP_L \cdot \Delta L$ = GAIN IN OUTPUT

$A \to B \to C'$: $MP_K \cdot \Delta K + MP_L \cdot \Delta K = \Delta Q = 0$

$$MRTS = \frac{\Delta K}{\Delta L} = -\frac{MP_L}{MP_K}$$

END OF THE PROOF

HINT: IF YOU WOULD LIKE TO EXPLAIN WHY MRTS IS DIMINISHING, LOOK AT LAW OF DIMINISHING MARGINAL PRODUCT.



$MRTS_A > MRTS_B$ OR $\left(\frac{MP_L}{MP_K}\right)_{AT\ A} > \left(\frac{MP_L}{MP_K}\right)_{AT\ B}$.

$\underbrace{\qquad\qquad}_{\text{SO WHAT ?}}$

• <u>COST MINIMIZATION PROBLEM</u>

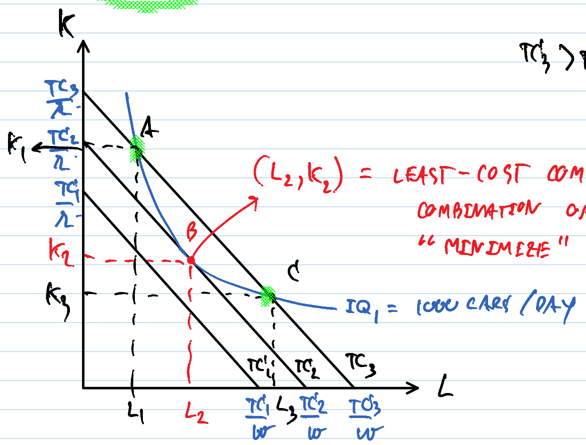
MIN $TC = w \cdot L + r K$

SUBJECT TO $Q = \bar{Q}$

L^*, K^* → TC IS MINIMIZED

? ? GIVEN $Q = \bar{Q}$ (LET'S SAY 3000 CARS/DAY)

$TC_3 > TC_2 > TC_1$



(L_2, K_2) = LEAST-COST COMBINATION: COMBINATION OF INPUTS THAT "MINIMIZE" THE TOTAL COST" GIVEN REQUIRED AMOUNT OF OUTPUT.

AT POINT B: SLOPE OF ISOQUANT = SLOPE OF ISOCOST

$$MRTS = -\frac{w}{r}$$

$$-\frac{MP_L}{MP_K} = -\frac{w}{r}$$

$$\frac{MP_L}{MP_K} = \frac{w}{r}$$

$$\boxed{\frac{MP_L}{w} = \frac{MP_K}{r}} \qquad \approx \left[\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}\right]$$

GOLDEN RULE OF COST MINIMIZATION:

MARGINAL PRODUCT OF LABOR PER BAHT

MARGINAL PRODUCT OF CAPITAL PER BAHT

TO MINIMIZE COSTS, THE MANAGER MUST CHOOSE AN INPUT MIX SUCH THAT LAST BAHT SPENT ON L AND LAST BAHT SPENT ON K GIVE THE SAME MARGINAL PRODUCT (MP).

SO IF $\frac{MP_L}{w} > \frac{MP_K}{r}$, HE SHOULD BUY MORE ____ AND LESS ____,

AND IF $\frac{MP_L}{w} < \frac{MP_K}{r}$, HE SHOULD ________ ________.

EX: $MP_L = 4$ COOKIES

Ex:

$MP_L = 4$ COOKIES

$MP_K = 4$ COOKIES

$w = 2$ BAHT / WORKER

$r = 1$ BAHT / MACHINE

$$\frac{MP_L}{w} = \frac{4}{2} = 2 < \frac{MP_K}{r} = \frac{4}{1} = 4$$