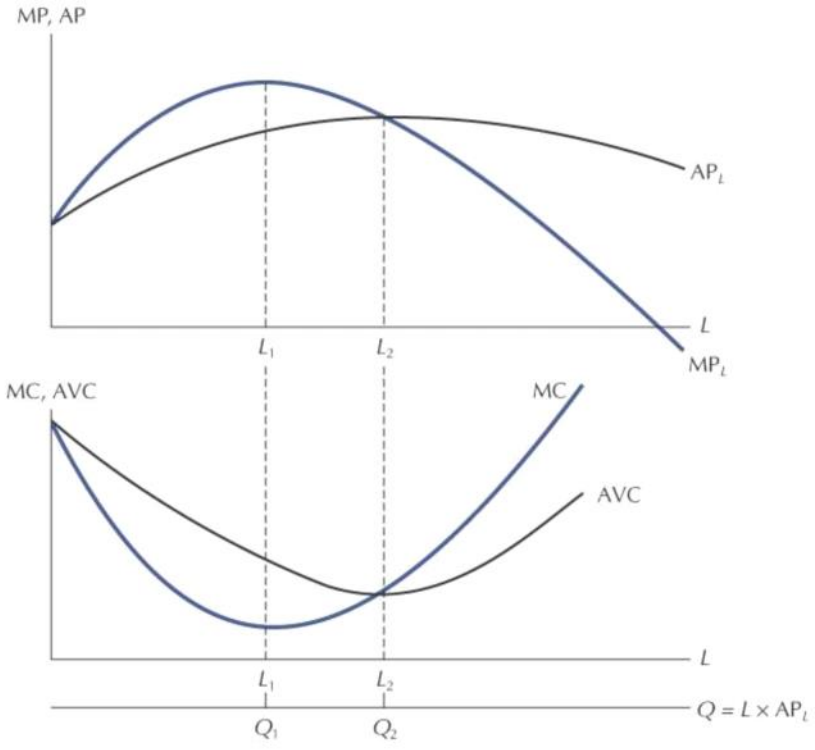
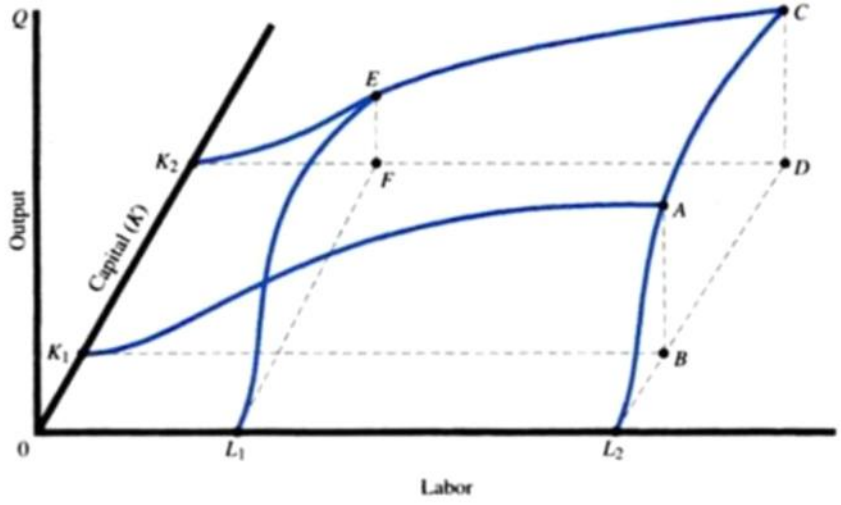
Figure 10.9: The Relationship Between MP, AP, MC, and AVC



Continuous Production Surface



Production Function With Two Inputs

$Q = f(L, K)$

K							Q
6	10	24	31	36	40	39	
5	12	28	36	40	42	40	
4	12	28	36	40	40	36	
3	10	23	33	36	36	33	
2	7	18	28	30	30	28	
1	3	8	12	14	14	12	
	1	2	3	4	5	6	L

PRODUCTION IN THE LONG RUN

- NOW, NO FIXED INPUTS
  ALL INPUTS BECOME VARIABLE.

Production Function With Two Inputs

Discrete Production Surface

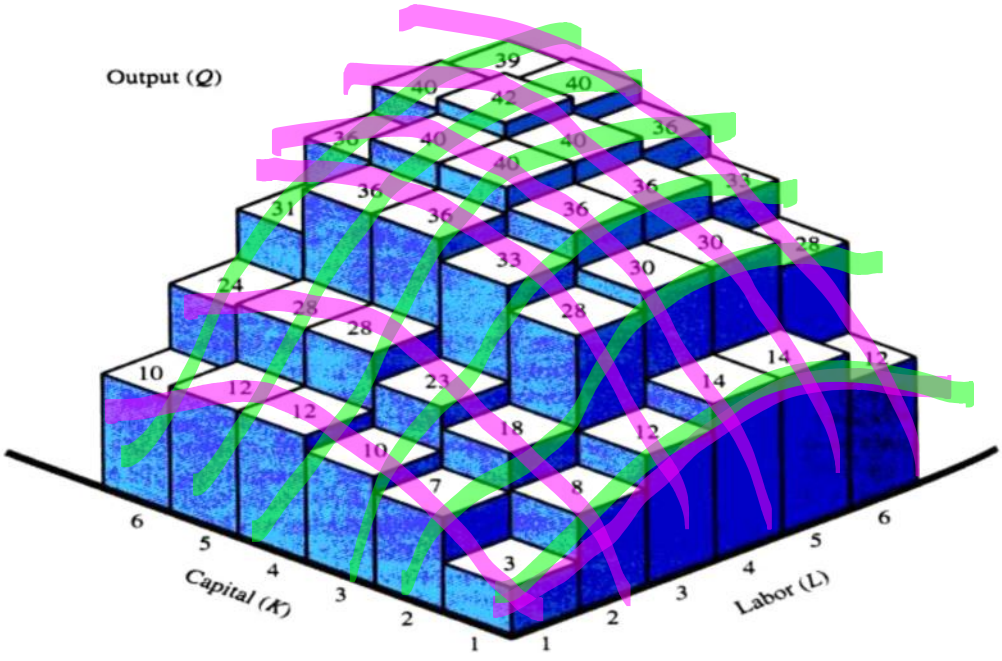
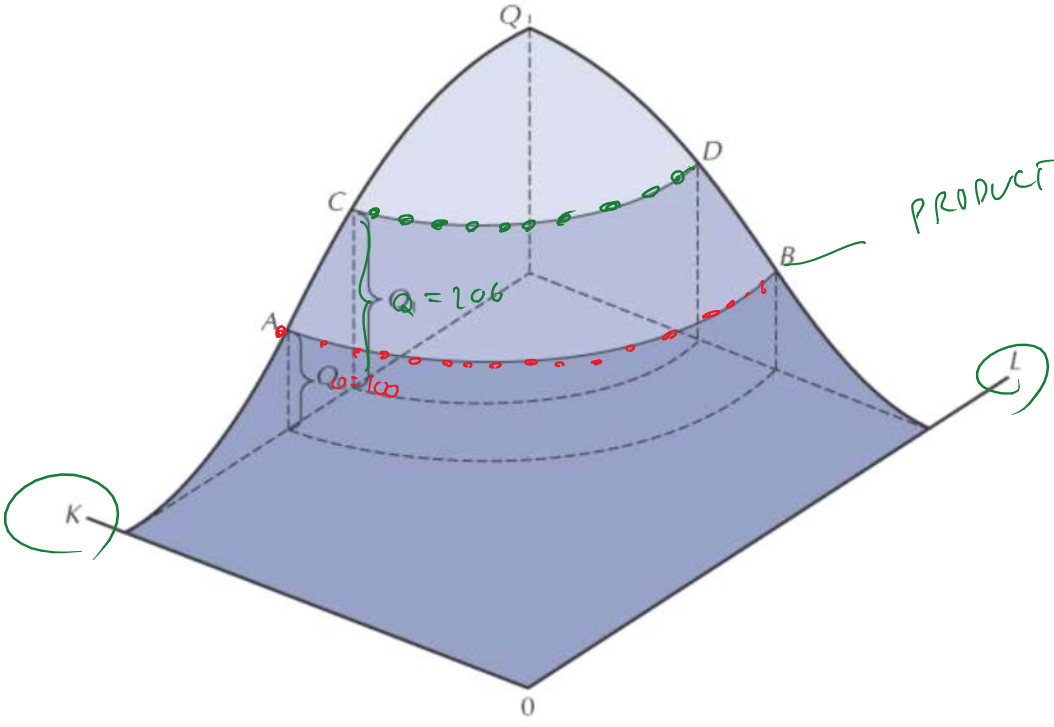
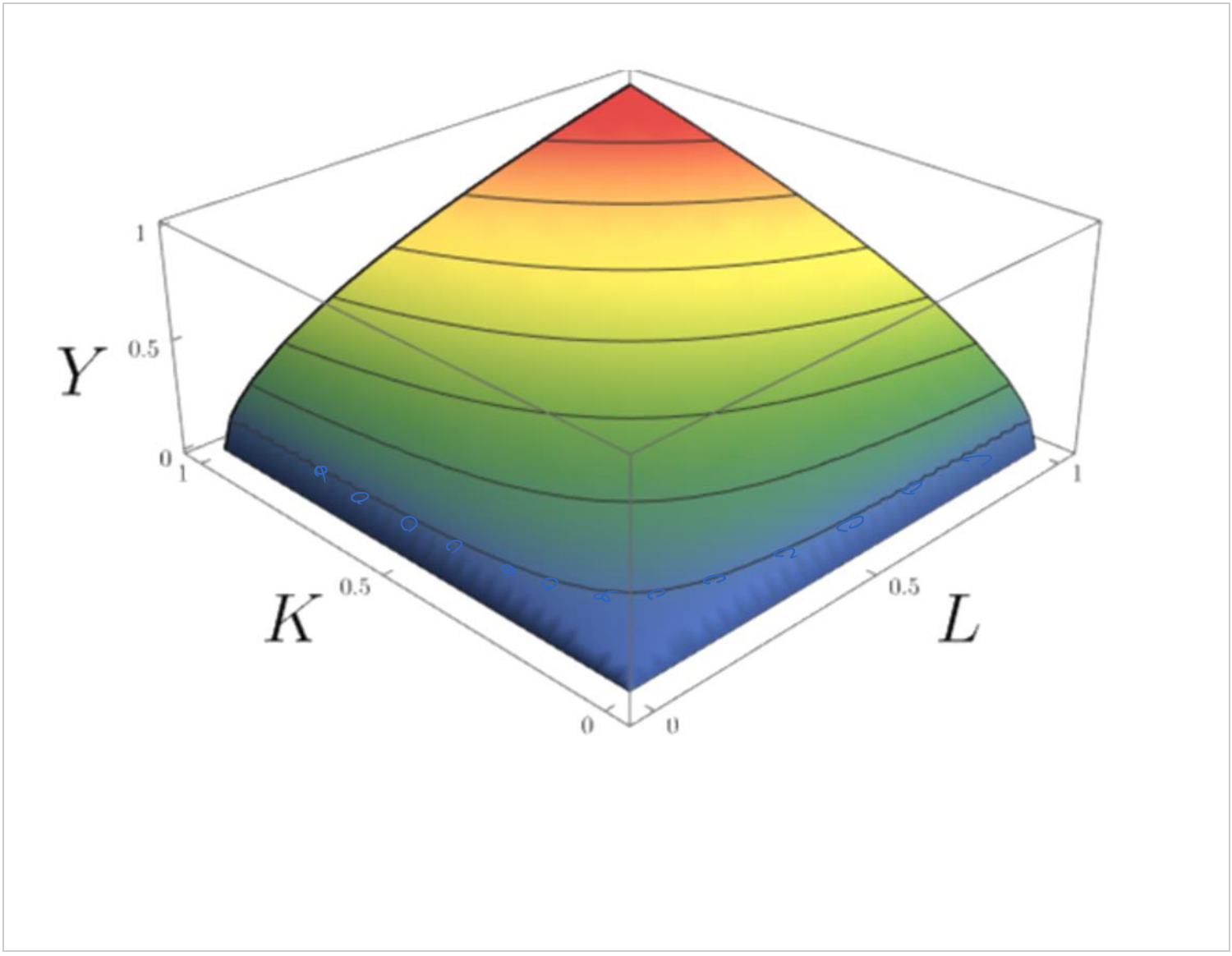
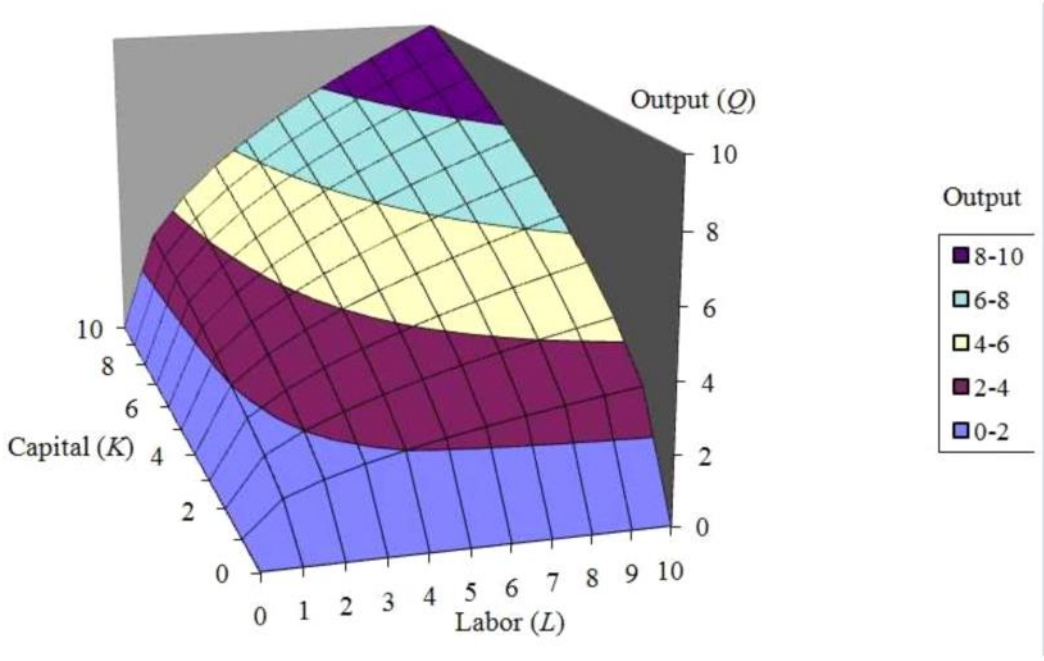
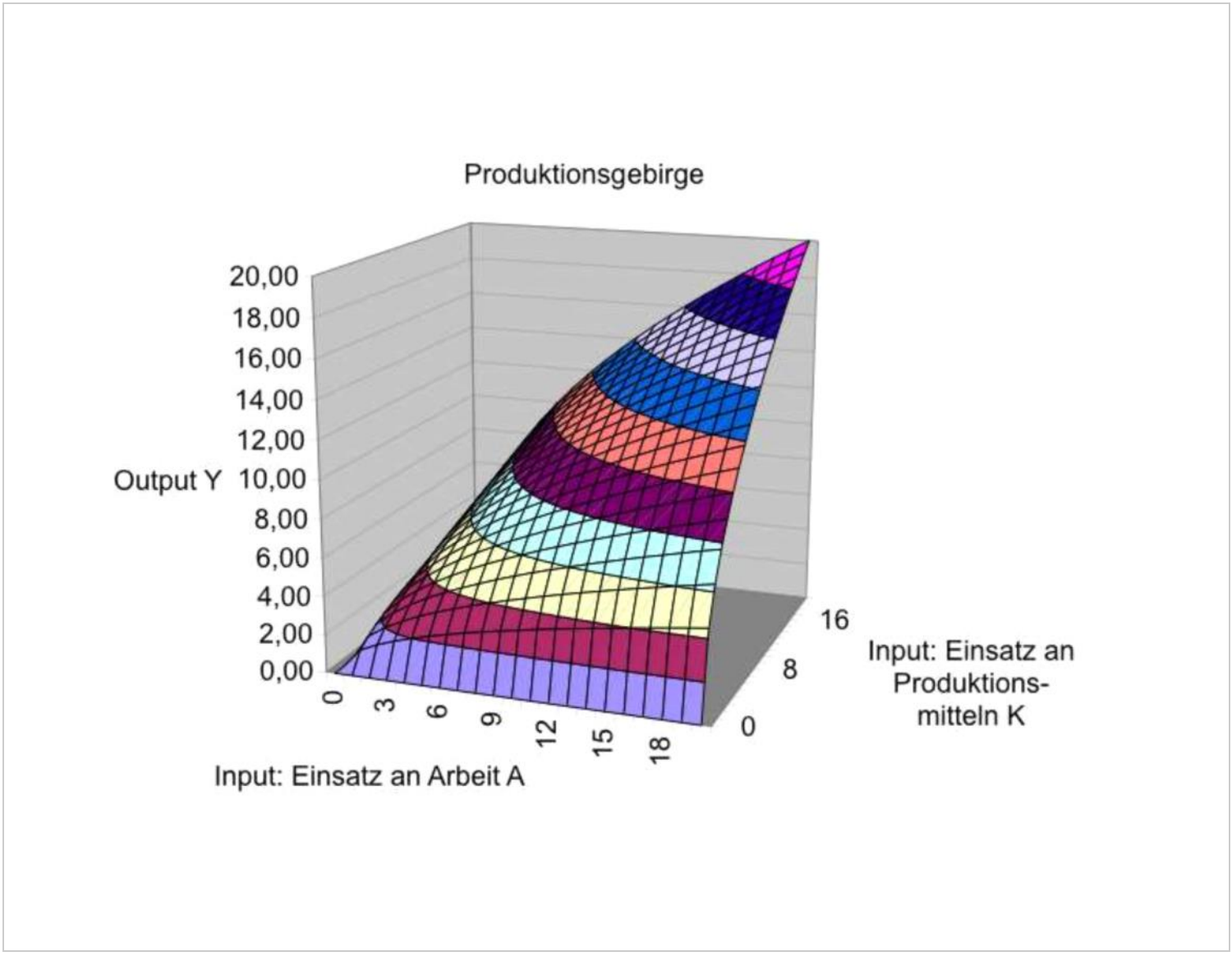


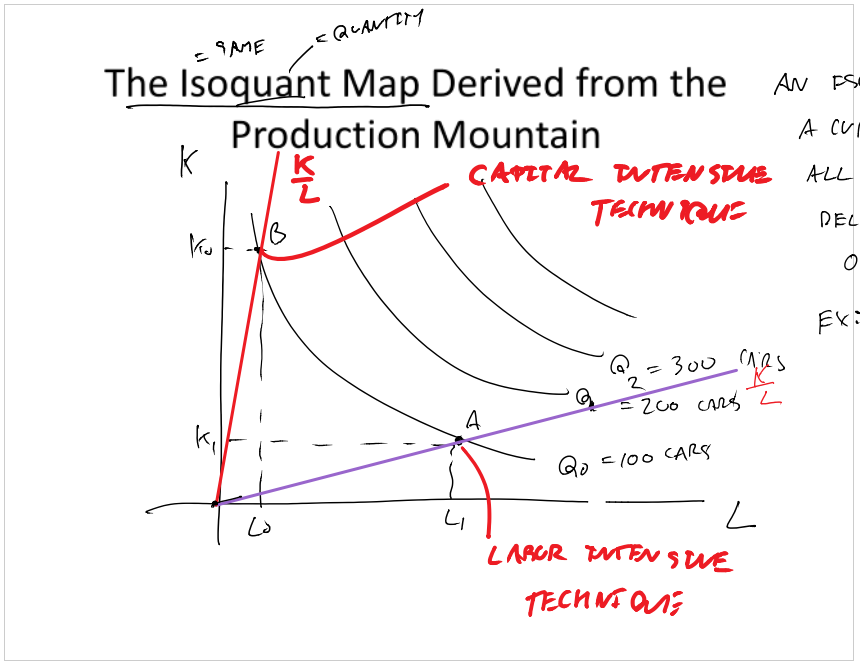
Figure A9-4: The Production Mountain




Y
1
0.5
0
1
0.5
K
0
0
0.5
L
1


Output (Q)
10
8
6
4
2
0
Capital (K)
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8 9 10
Labor (L)
Output
8-10
6-8
4-6
2-4
0-2


Produktionsgebirge
Output Y
20,00
18,00
16,00
14,00
12,00
10,00
8,00
6,00
4,00
2,00
0,00
0
3
6
9
12
15
18
Input: Einsatz an Arbeit A
0
8
16
Input: Einsatz an Produktions-mitteln K



AN ISOQUANT IS A CURVE THAT CONTAINS ALL INPUT COMBINATIONS THAT DELIVER THE SAME AMOUNT OF OUTPUT.

EX: A (L_1, K_1), B (L_0, L_0) → $Q = 100$

$\left(\frac{K}{L}\right)_{AT\ A} < \left(\frac{K}{L}\right)_{AT\ B}$

$Q = F(L, K)$

w → WAGE, r → RENTAL RATE

$P_K = r$ → UNIT / MACHINE / DAY

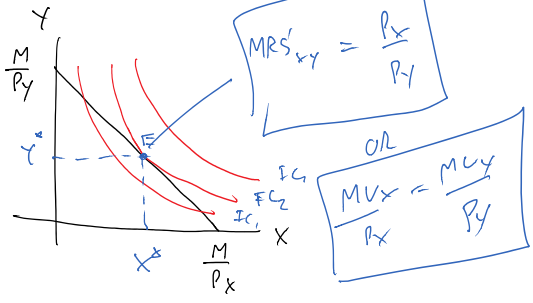
A CONSUMER

MAX $U(X, Y)$
S.T. $P_X X + P_Y Y = M$

UMP

$(X^* = ?, Y^* = ?) \rightarrow$ MAX U

P_X, P_Y, M



A PRODUCER

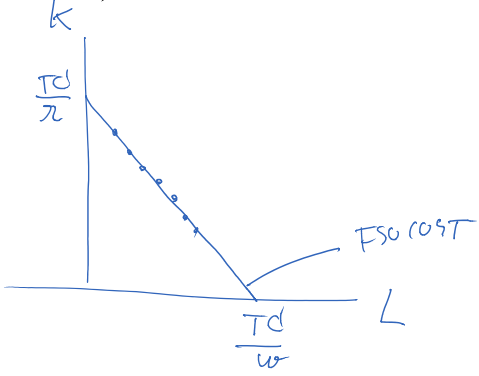
MIN $TC = w \cdot L + r \cdot K$
S.T. $Q = \bar{Q}$

$P_L = w$ UNIT / $ / DAY

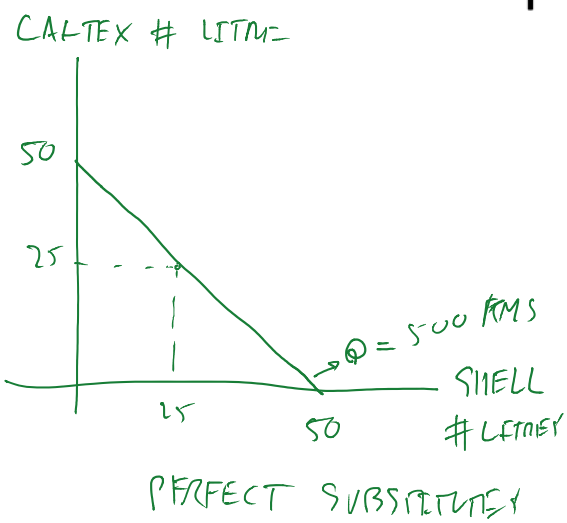
COST - MINIMIZATION PROBLEM

$(L^* = ?, K^* = ?) \rightarrow$ MIN TC

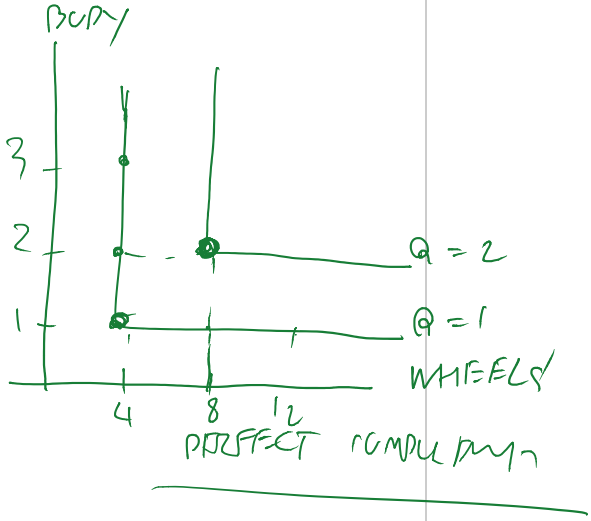
$w = P_L$, $r = P_K$, $\bar{Q}$



Isoquant Maps for Perfect Substitutes and Perfect Complements

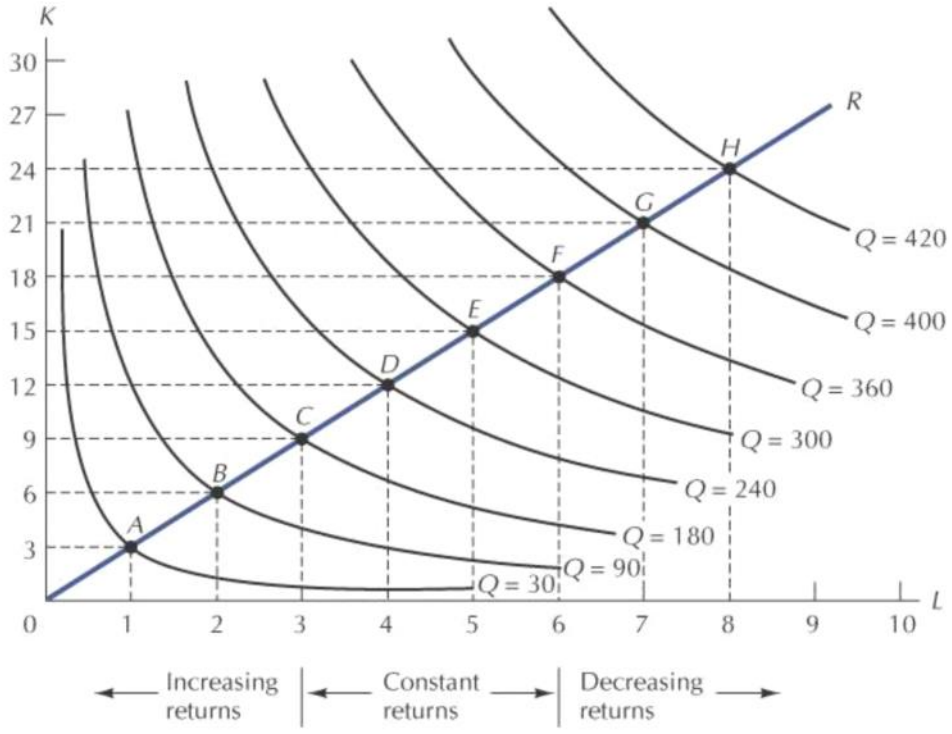


PERFECT SUBSTITUTES



PERFECT COMPLEMENTS

Figure 9-11: Returns to Scale Shown on the Isoquant Map



Point	L	% change	K	% change	Q	% change	RTS
A	1	-	3	-	30	-	
B	2	100.0%	6	100.0%	90	200%	IRS
C	3	50.0%	9	50.0%	180	100%	IRS
D	4	33.3%	12	33.3%	240	33%	CRS
E	5	25.0%	15	25.0%	300	25%	CRS
F	6	20.0%	18	20.0%	360	20%	CRS
G	7	16.7%	21	16.7%	400	11%	DRS
H	8	14.3%	24	14.3%	420	5%	DRS

Note: Calculated from Figure 9-11: Returns to Scale Shown on the Isoquant Map, Frank (2006).

7.4

The Inflexibility of Short-Run Production

Figure 7.7

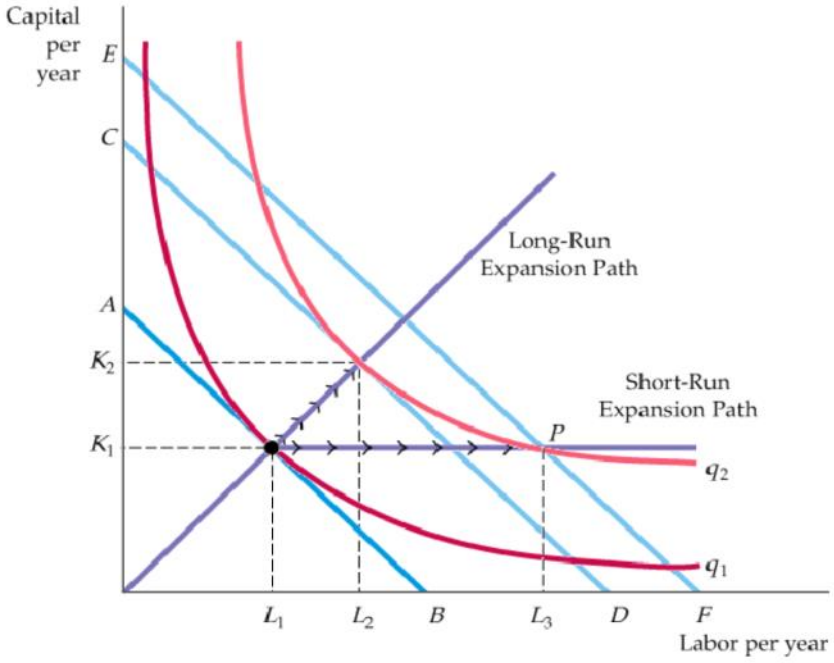
The Inflexibility of Short-Run Production

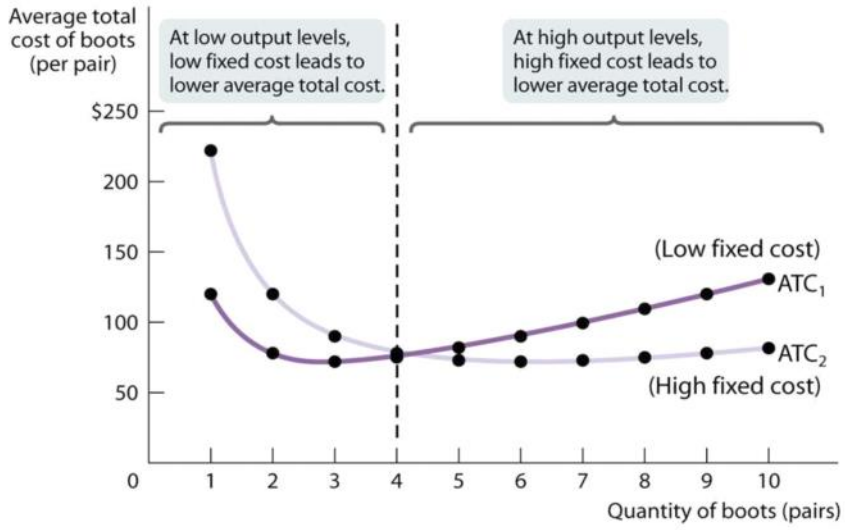
When a firm operates in the short run, its cost of production may not be minimized because of inflexibility in the use of capital inputs.

Output is initially at level q_1.

In the short run, output q_2 can be produced only by increasing labor from L_1 to L_3 because capital is fixed at K_1.

In the long run, the same output can be produced more cheaply by increasing labor from L_1 to L_2 and capital from K_1 to K_2.





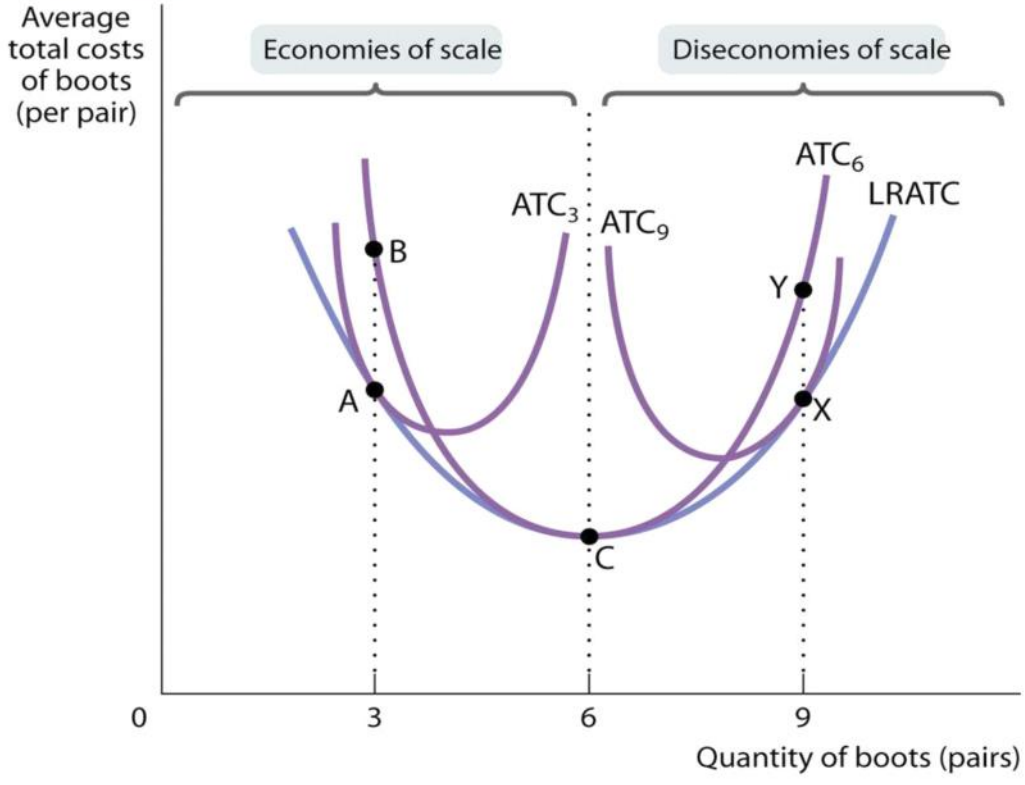
Choosing the Level of Fixed Cost for Ben's Boots

	Low fixed cost (FC = $108)			High fixed cost (FC = $216)		
Quantity of boots (pairs)	Variable cost	Total cost	Average total cost of boots ATC_1 (per pair)	Variable cost	Total cost	Average total cost of boots ATC_2 (per pair)
1	$12	$120	$120	$6	$222	$222
2	48	156	78	24	240	120
3	108	216	72	54	270	90
4	192	300	75	96	312	78
5	300	408	81.6	150	366	73.2
6	432	540	90	216	432	72
7	588	696	99.4	294	510	72.9
8	768	876	109.5	384	600	75
9	972	1,080	120	486	702	78
10	1,200	1,308	130.8	600	816	81.6

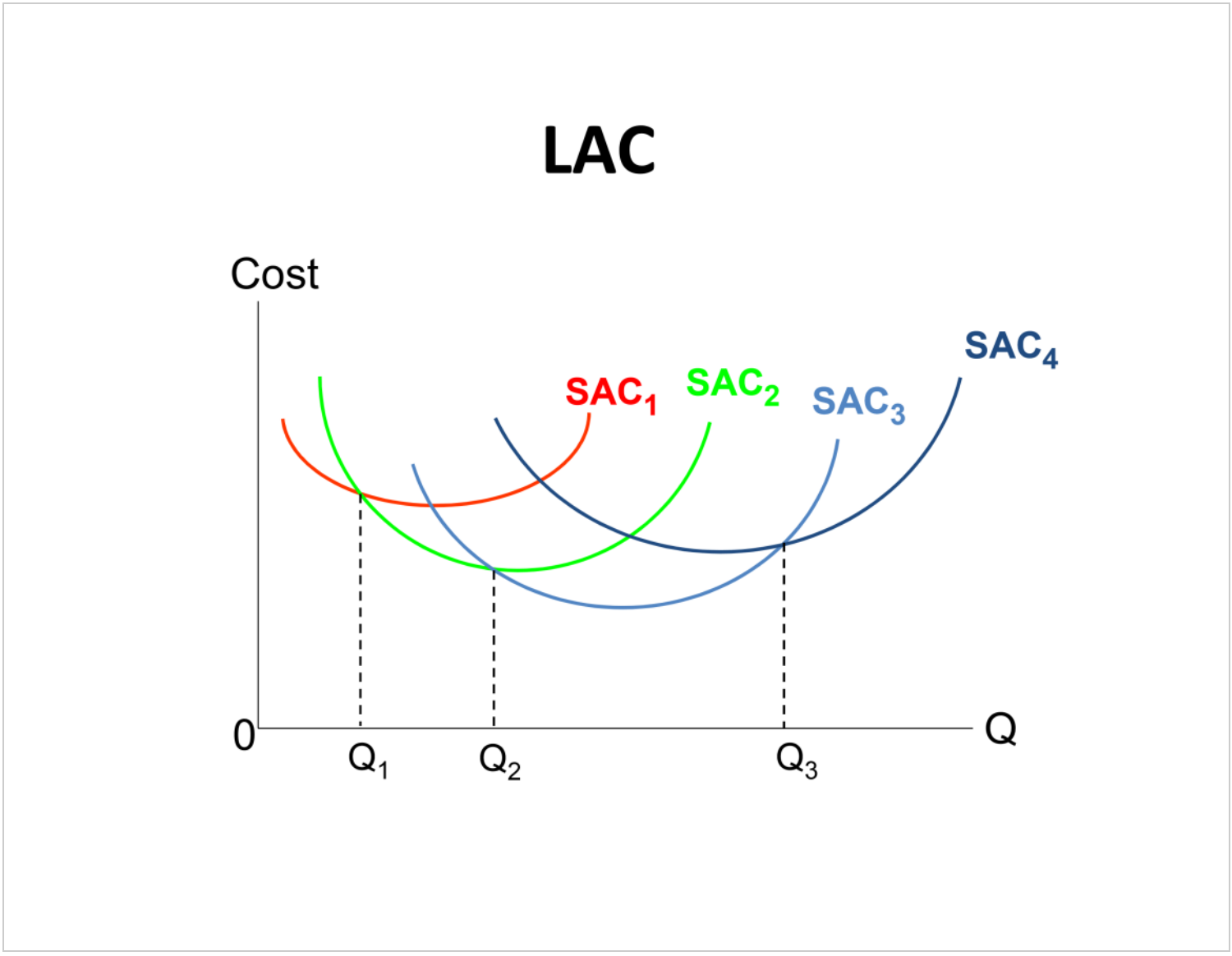
There is a trade-off between higher fixed cost and lower variable cost for any given output level, and vice versa.
But as output goes up, average total cost is lower with the higher amount of fixed cost.

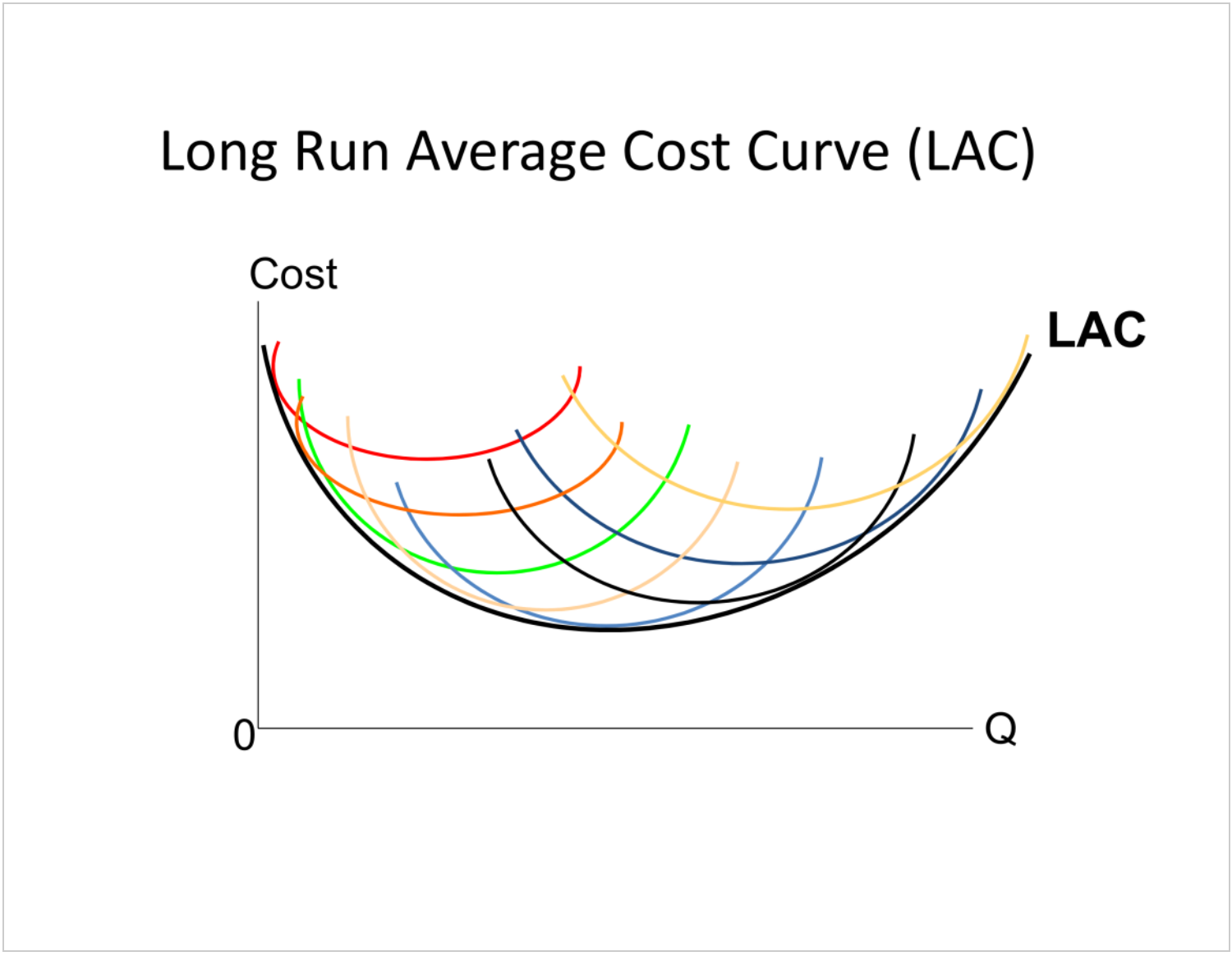
14

Short-Run and Long-Run Average Total Cost Curves



15


LAC
Cost
SAC1
SAC2
SAC3
SAC4
0
Q1
Q2
Q3
Q


Long Run Average Cost Curve (LAC)
Cost
LAC
0
Q

Why would a bathroom equipment manufacturer bake the image of a housefly onto the center of its ceramic urinals?

This example is base on Stefan Verhagen, "Fly in the Pot," Cornell Business, April 21, 1992.