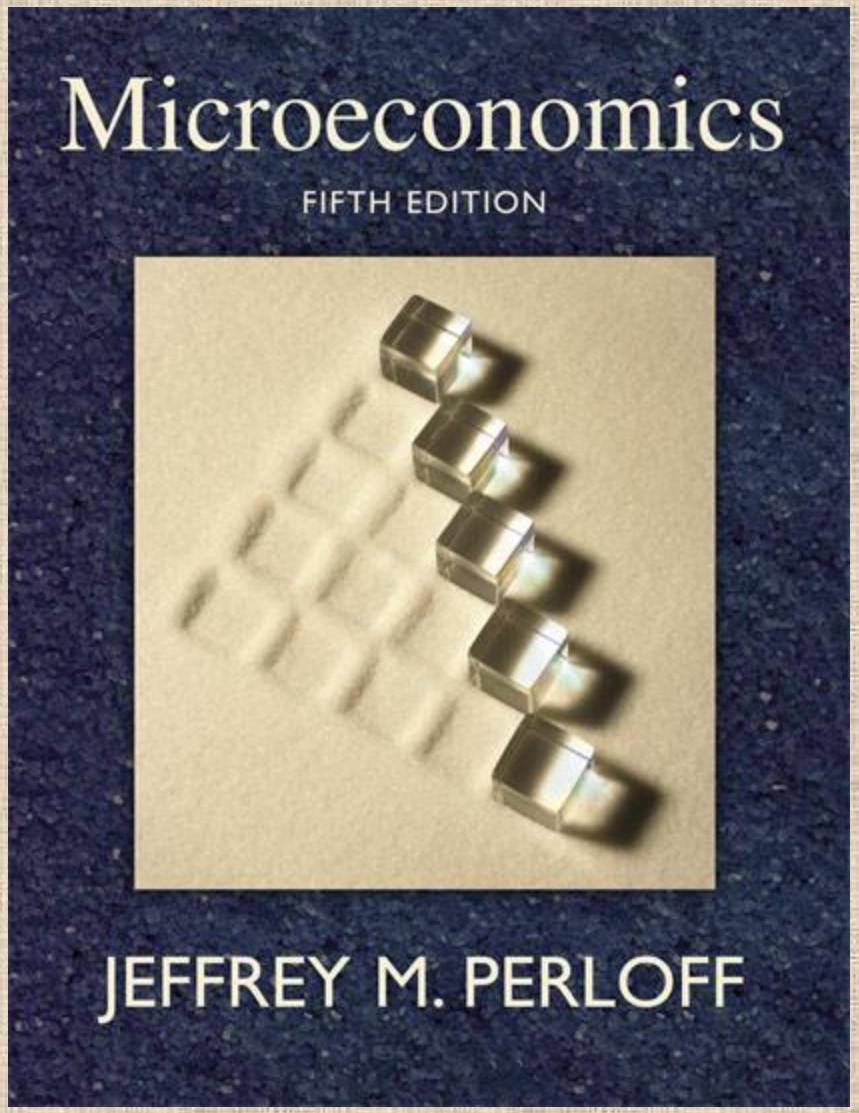


Chapter Seven

Costs

Topics

- **Measuring Costs.**
- **Short-Run Costs.**
- **Long-Run Costs.**
- **Lower Costs in the Long Run.**
- **Cost of Producing Multiple Goods.**

Economic Cost

- **Economic cost or opportunity cost -** the value of the best alternative use of a resource.
  - *Explicit costs -* firm's direct, out-of-pocket payments for inputs to its production process during a given time period. ,

    Workers' wages, managers' salaries, etc. and payments for materials.
  - *Implicit costs –* cost of use inputs that may not have an explicit price.

    value of the working time of the firm's owner

Economic Vs Accounting Cost

- **According to Bookkeepers**:

  The purpose of cost estimation:

  a. To minimize firm's tax for this year

  b. To reflect good impression for stock holders about the firm's performance

SO: Accounting Profits = TR – TC

Where TC = **Explicit costs**, such as:

- Wages - Salaries - Rent
- Row material payment
- Amortization OR (Depreciation)

Economic Vs Accounting Cost

- **According to Economists:**

To run a firm profitably, a manager acts like an economist and consider all relevant costs:

SO: Econ. Profits = TR – TC

Where TC = Explicit cost + Implicit cost

- Explicit costs do not contain depreciation, economists amortizes capital using the rule of the best rental rate for capital, which is an implicit cost

- Implicit cost: Such as:

a. Opportunity cost for capital, or the best alternative use (Rental rate)

b. Opportunity cost for the production factors owned to owner, or the best alternative use.

Short-Run Cost Measures

- **Fixed cost (*F*) -** a production expense that does not vary with output.
- **Variable cost (VC) -** a production expense that changes with the quantity of output produced.
- **Cost (total cost, C) -** the sum of a firm's variable cost and fixed cost:

$$C = VC + F$$

Marginal Cost.

- **marginal cost (*MC*) -** the amount by which a firm's cost changes if the firm produces one more unit of output.

$$MC = \frac{\Delta C}{\Delta q}$$

  - And since only variable costs change with output:

$$MC = \frac{\Delta VC}{\Delta q}$$

Average Costs.

- **average fixed cost (*AFC*) -** the fixed cost divided by the units of output produced:

$$AFC = F/q.$$

- **average variable cost (*AVC*) -** the variable cost divided by the units of output produced:

$$AVC = VC/q.$$

- **average cost (AC) -** the total cost divided by the units of output produced:

$$AC = C/q$$

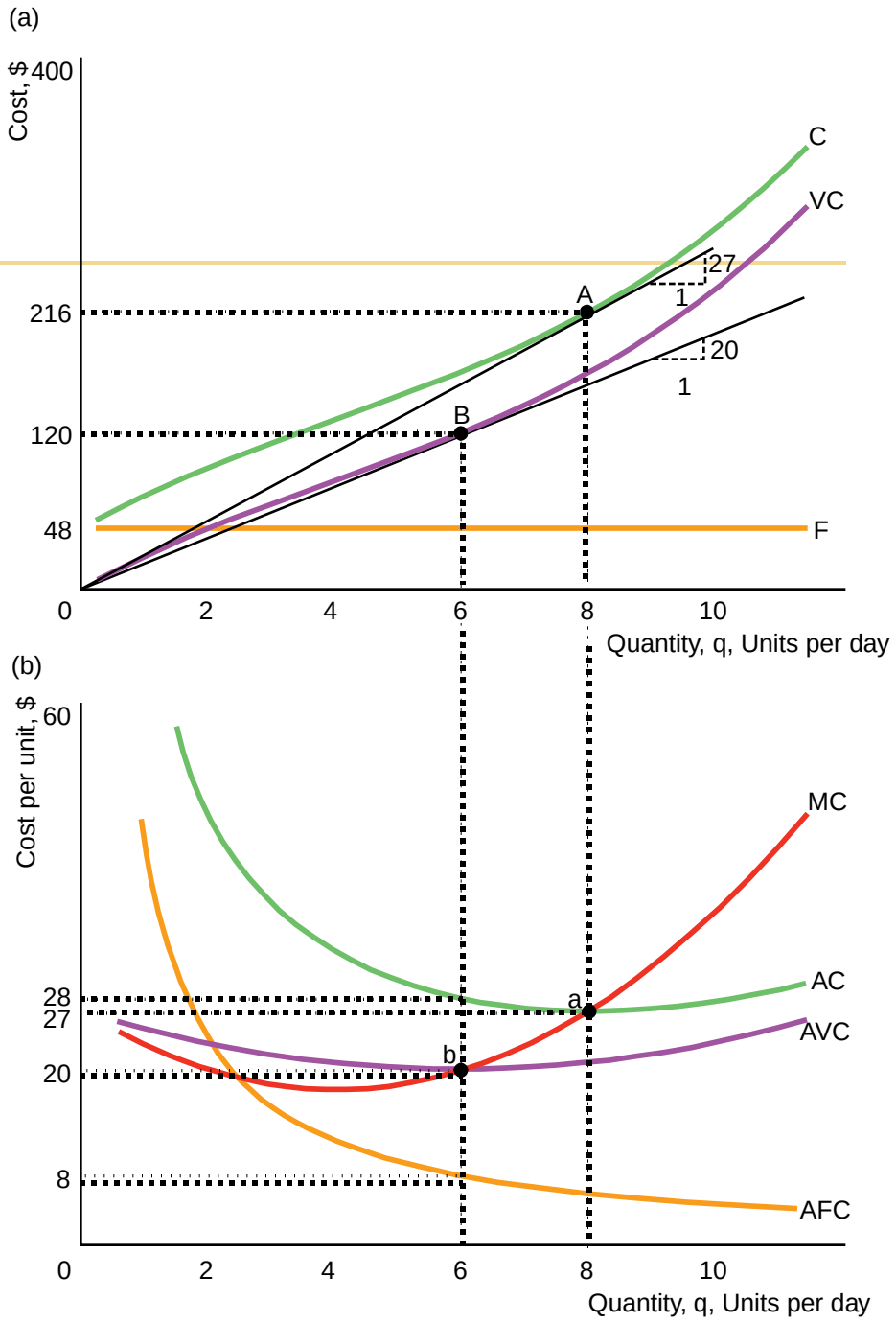
$$AC = AFC + AVC.$$

Table 7.1 Variation of Short-Run Cost with Output

Output, q	Fixed Cost, F	Variable Cost, VC	Total Cost, C	Marginal Cost, MC	Average Fixed Cost, $AFC = F/q$	Average Variable Cost, $AVC = VC/q$	Average Cost, $AC = C/q$
0	48	0	48				
1	48	25	73	25	48	25	73
2	48	46	94	21	24	23	47
3	48	66	114	20	16	22	38
4	48	82	130	16	12	20.5	32.5
5	48	100	148	18	9.6	20	29.6
6	48	120	168	20	8	20	28
7	48	141	189	21	6.9	20.1	27
8	48	168	216	27	6	21	27
9	48	198	246	30	5.3	22	27.3
10	48	230	278	32	4.8	23	27.8
11	48	272	320	42	4.4	24.7	29.1
12	48	321	369	49	4.0	26.8	30.8

Figure 7.1 Short-Run Cost Curves

Output, q	Fixed Cost, F	Variable Cost, VC	Total Cost, C
0	48	0	48
1	48	25	73
2	48	46	94
3	48	66	114
4	48	82	130
5	48	100	148
6	48	120	168
7	48	141	189
8	48	168	216
9	48	198	246
10	48	230	278
11	48	272	320
12	48	321	369



Relationship between average and marginal cost curves

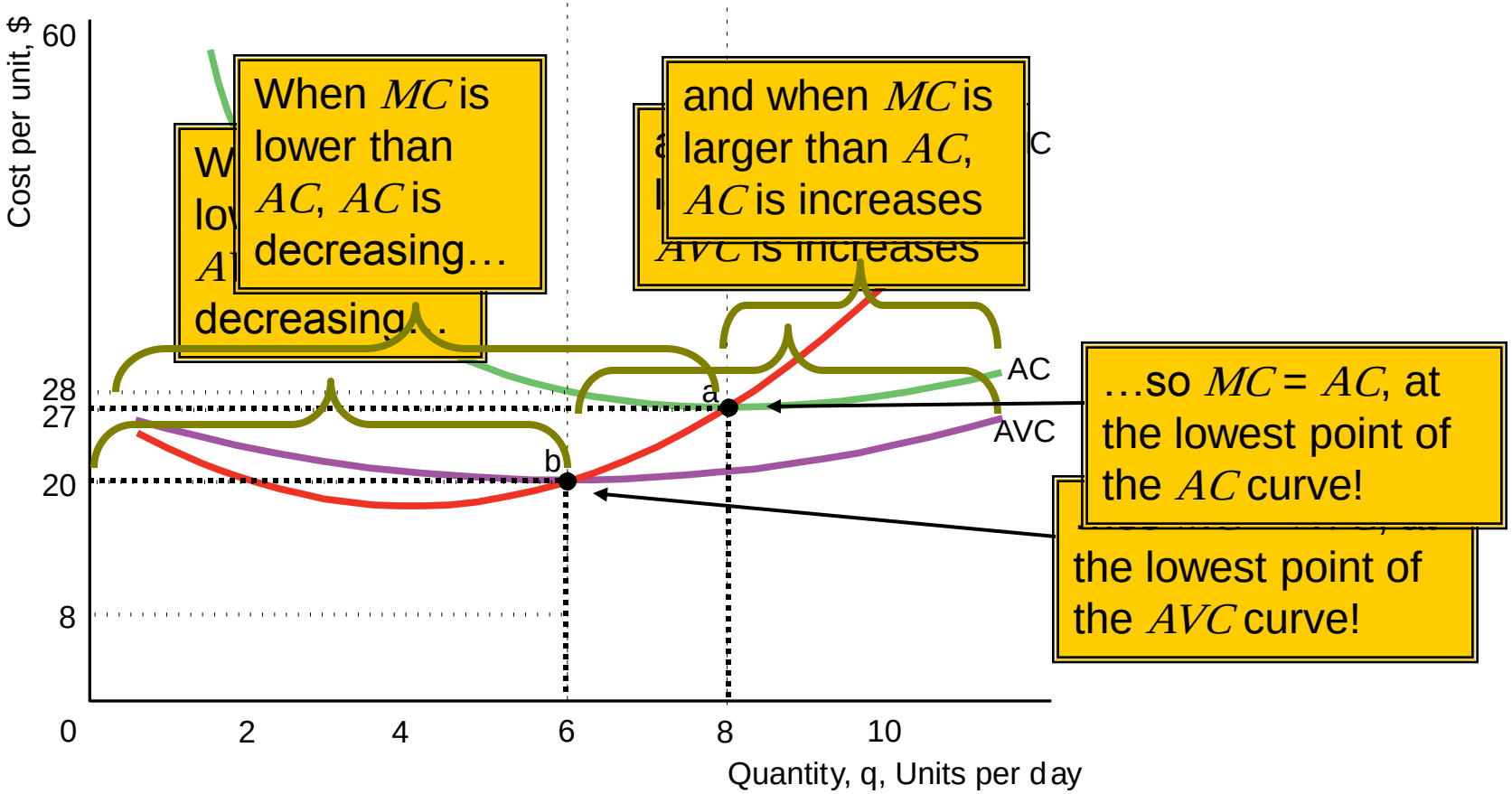
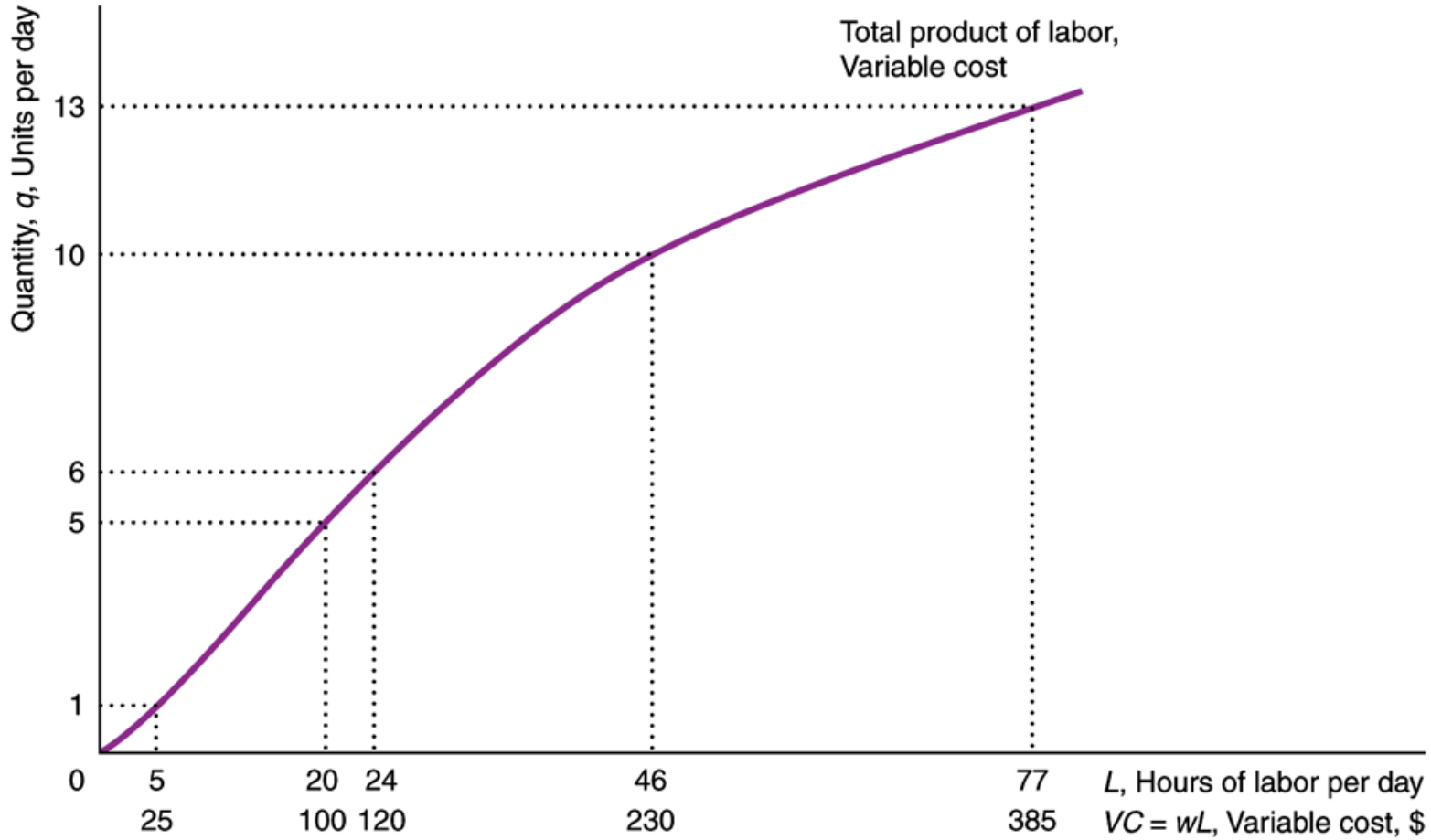


Figure 7.2 Variable Cost and Total Product of Labor



Shape of the Marginal Cost Curve

$$MC = \Delta VC/\Delta q.$$

- But in the short run,

$$\Delta VC = w.\Delta L \text{ (can you tell why?)}$$

  - Therefore,

$$MC = w.(\Delta L/\Delta q)$$

- The additional output created by every additional unit of labor is:

$$\Delta q/\Delta L = MP_L$$

  - Therefore,

$$MC = w/MP_L$$

Shape of the Average Cost Curves

$$AVC = VC/q.$$

- But in the short-run, with only labor as an input:

$$AVC = VC/q = wL/q$$

- *And since* $q/L = AP_L$*, then*

$$AVC = VC/q = w/APL_L$$

Application Short-Run Cost Curves for a Furniture Manufacturer

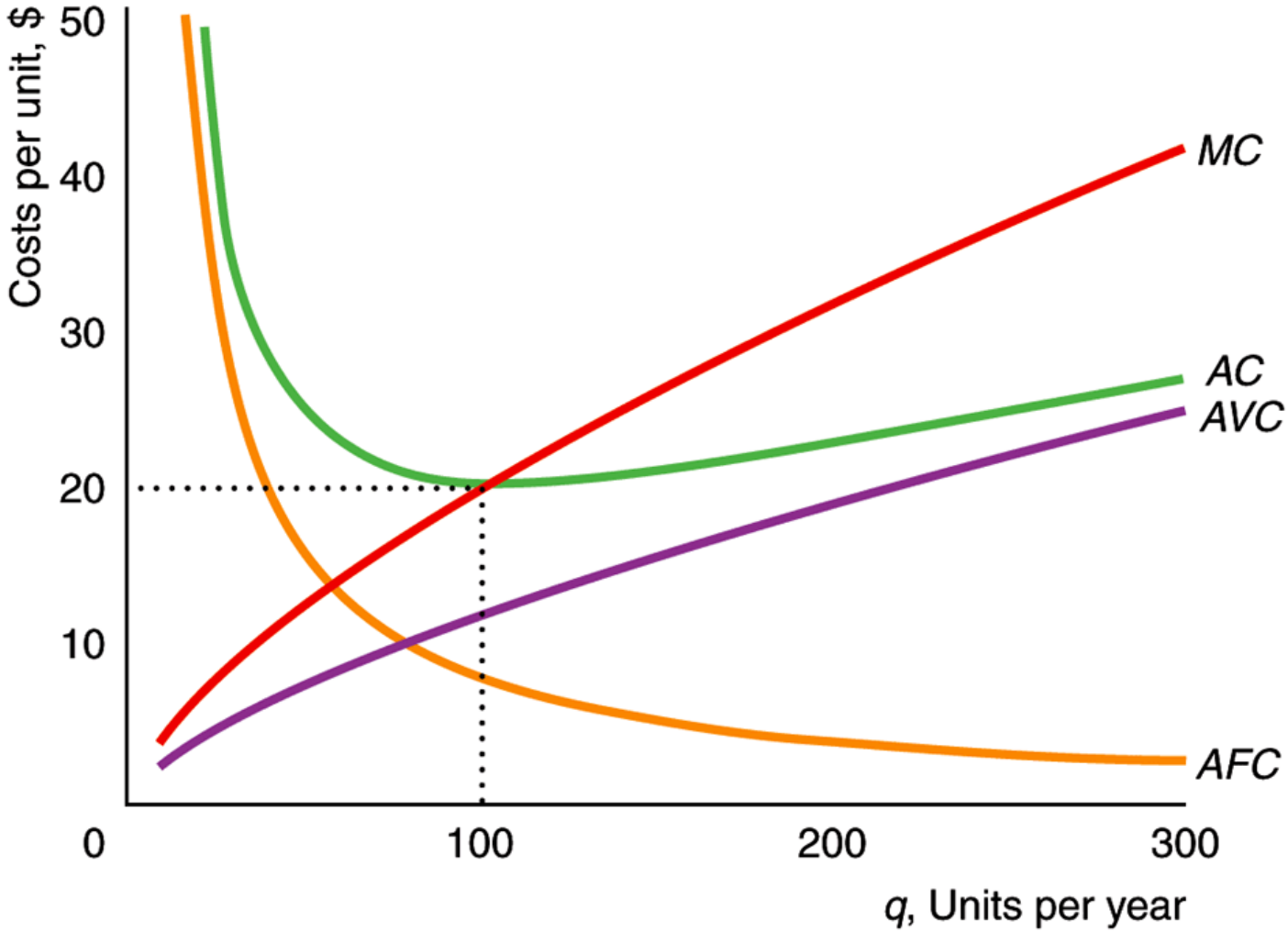
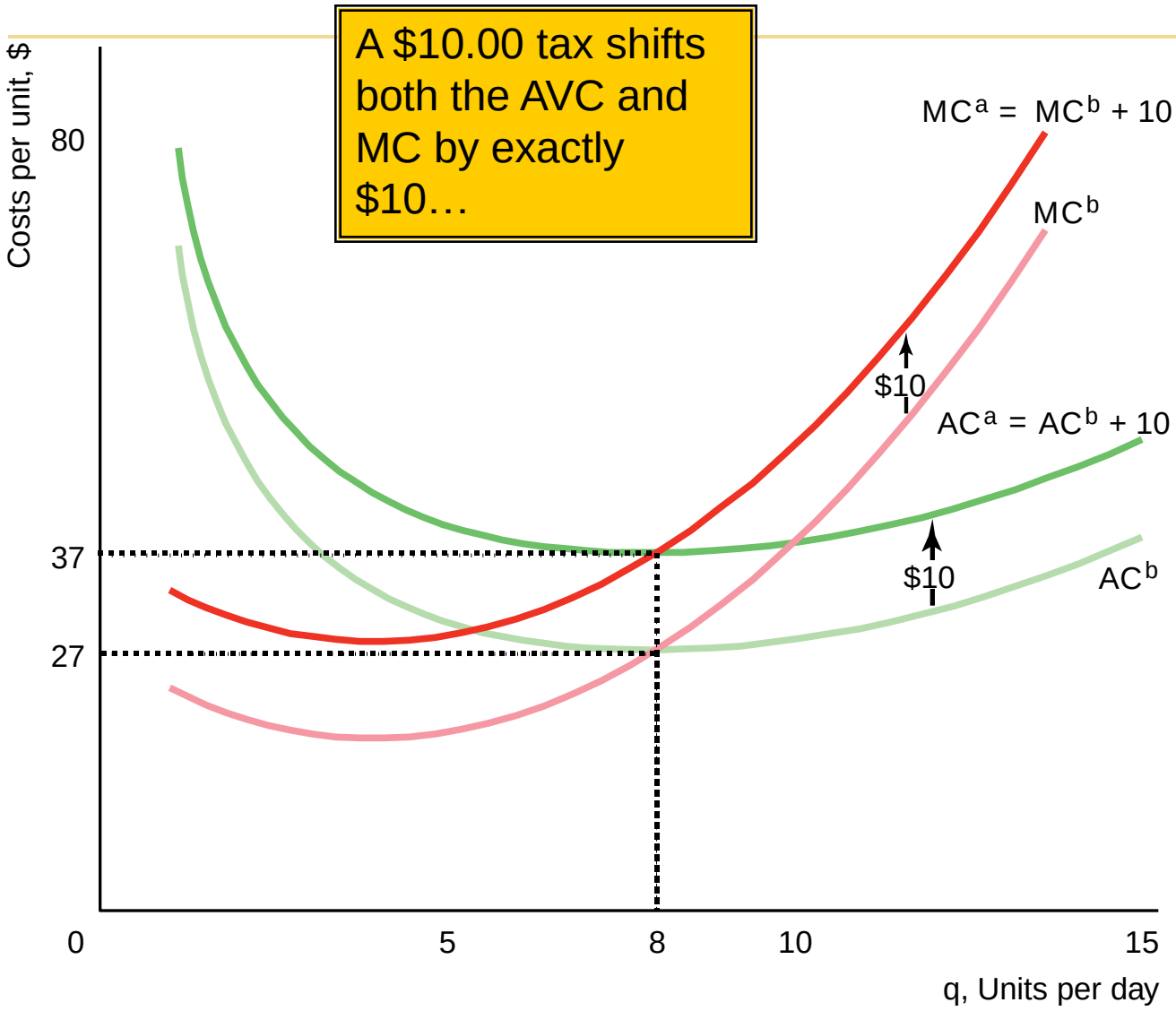


Table 7.2 Effect of a Specific Tax of $10 per Unit on Short-Run Costs

Q	AVC^b	$AVC^a = AVC^b + \$10$	$AC^b = C/q$	$AC^a = C/q + \$10$	MC^b	$MC^a = MC^b + \$10$
1	25	35	73	83	25	35
2	23	33	47	57	21	31
3	22	32	38	48	20	30
4	20.5	30.5	32.5	42.5	16	26
5	20	30	29.6	39.6	18	28
6	**20**	**30**	28	38	**20**	**30**
7	20.1	30.1	27	37	21	31
8	21	31	**27**	**37**	**27**	**37**
9	22	32	27.3	37.3	30	40
10	23	33	27.8	37.8	32	42
11	24.7	34.7	29.1	39.1	42	52
12	26.8	36.8	30.8	40.8	49	59

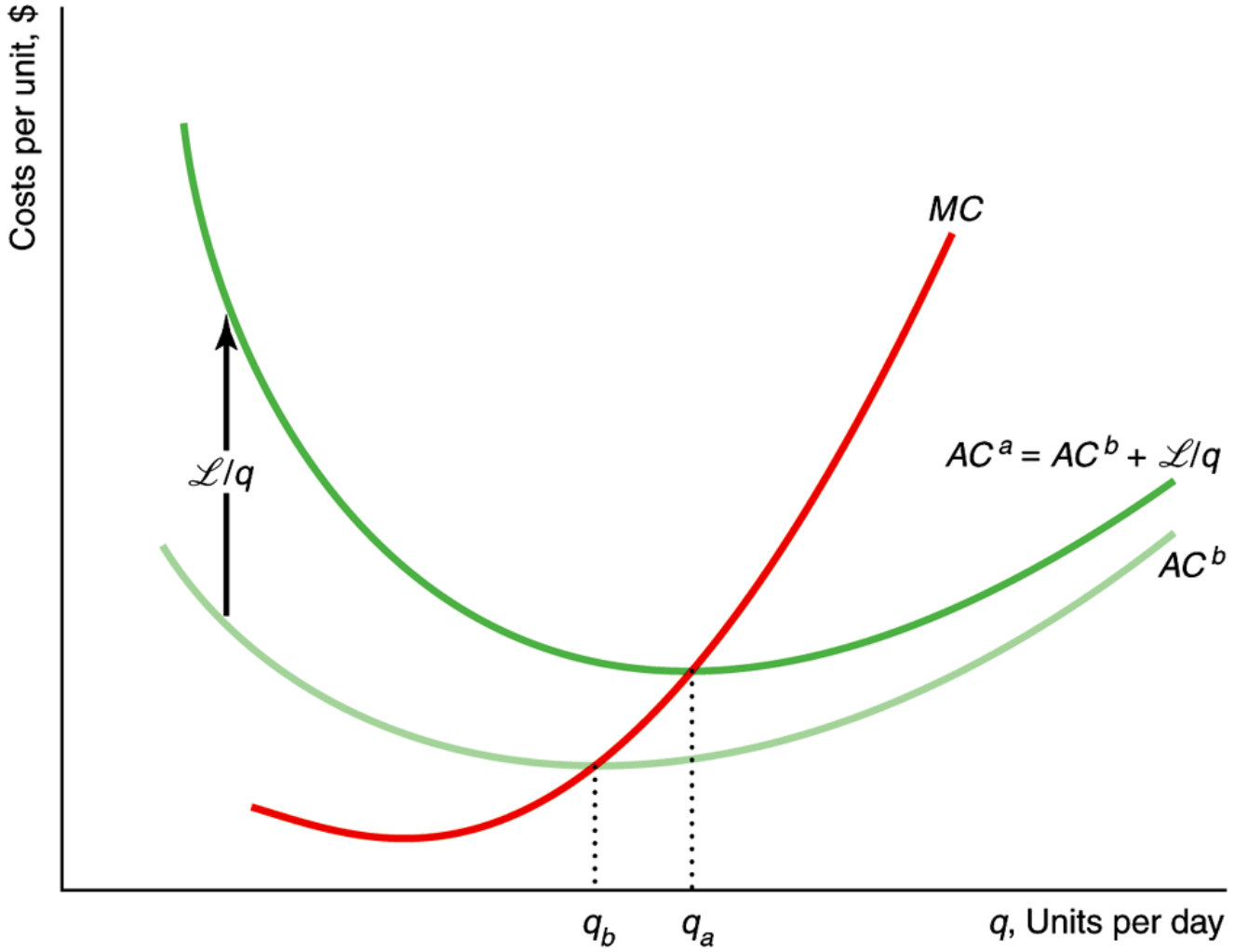
Figure 7.3 Effect of a Specific Tax on Cost Curves



Solved Problem 7.1

- What is the effect of a lump-sum franchise tax on the quantity at which a firm's after tax average cost curve reaches its minimum? (Assume that the firm's before-tax average cost curve is U-shaped.)

Solved Problem 7.1



Long-Run Costs

- Fixed costs are *avoidable* in the long run.
  - in the long $F = 0$.
  - As a result, the long-run total cost equals:

$$C = VC$$

Input Choice

- **isocost line -** all the combinations of inputs that require the same (*iso*-) total expenditure (*cost*).

- The firm's total cost equation is:

$$C = wL + rK.$$

Labor Costs

Capital Costs

Input Choice (Cont).

- The firm's total cost equation is:

$$C = wL + rK.$$

  - We get the Isocost equation by setting fixing the costs at a particular level:

$$\overline{C} = wL + rK.$$

  - And then solving for K (variable along y-axis):

$$K = \frac{\overline{C}}{r} - \frac{w}{r} L$$

Table 7.3 Bundles of Labor and Capital That Cost the Firm $100

Bundle	Labor, L	Capital, K	Labor Cost, $wL = \$5L$	Capital Cost, $rK = \$10K$	Total Cost, $wL + rK$
a	20	0	$100	$0	$100
b	14	3	$70	$30	$100
c	10	5	$50	$50	$100
d	6	7	$30	$70	$100
e	0	10	$0	$100	$100

Figure 7.4 A Family of Isocost Lines

For each extra unit of capital it uses, the firm must use two fewer units of labor to hold its cost constant.

Isocost Equation

$$K = \frac{\overline{C}}{r} - \frac{w}{r}L$$

Initial Values

$\overline{C} = \$100$

$w = \$5$

$r = \$10$

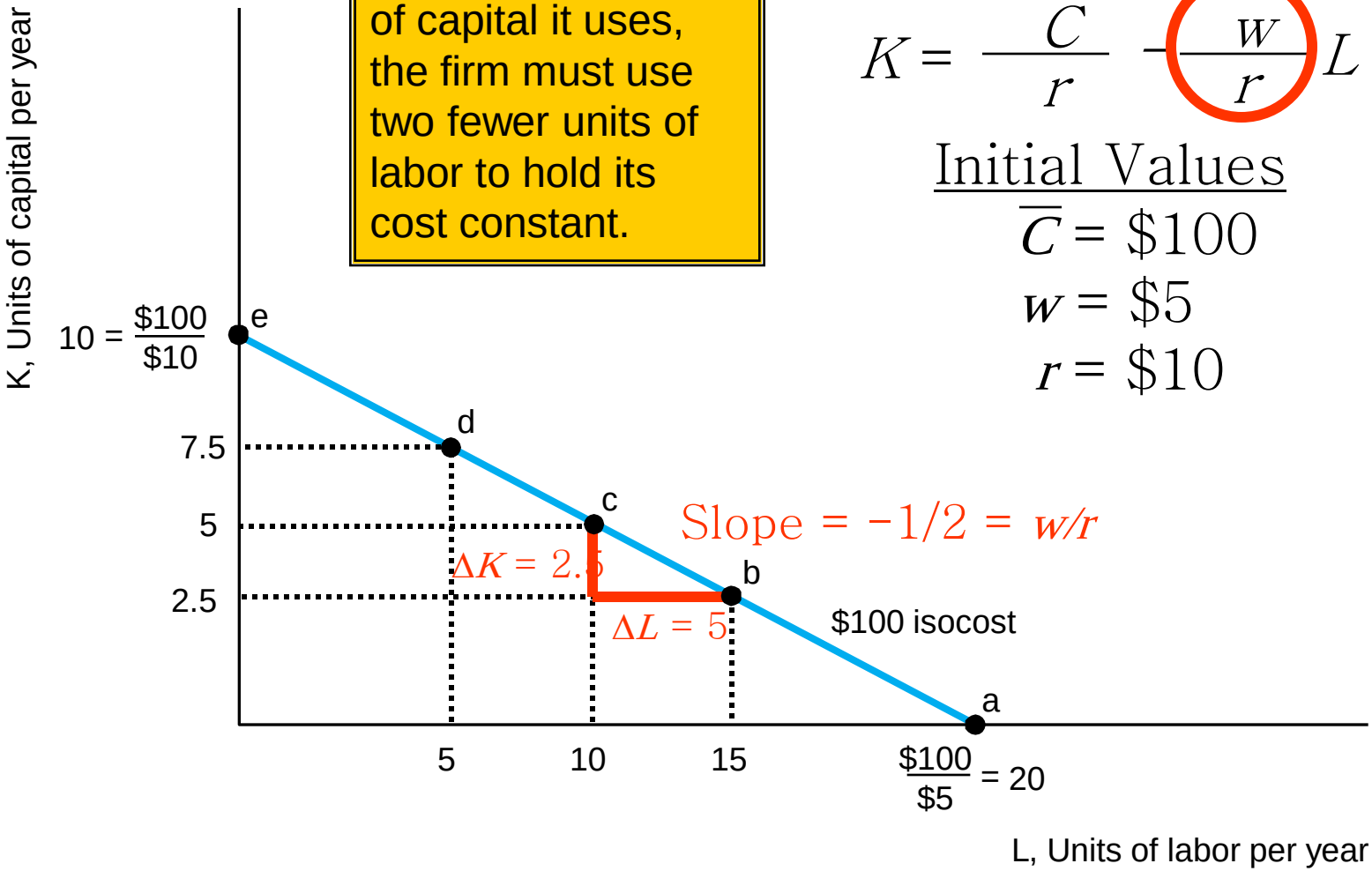


Figure 7.4 A Family of Isocost Lines

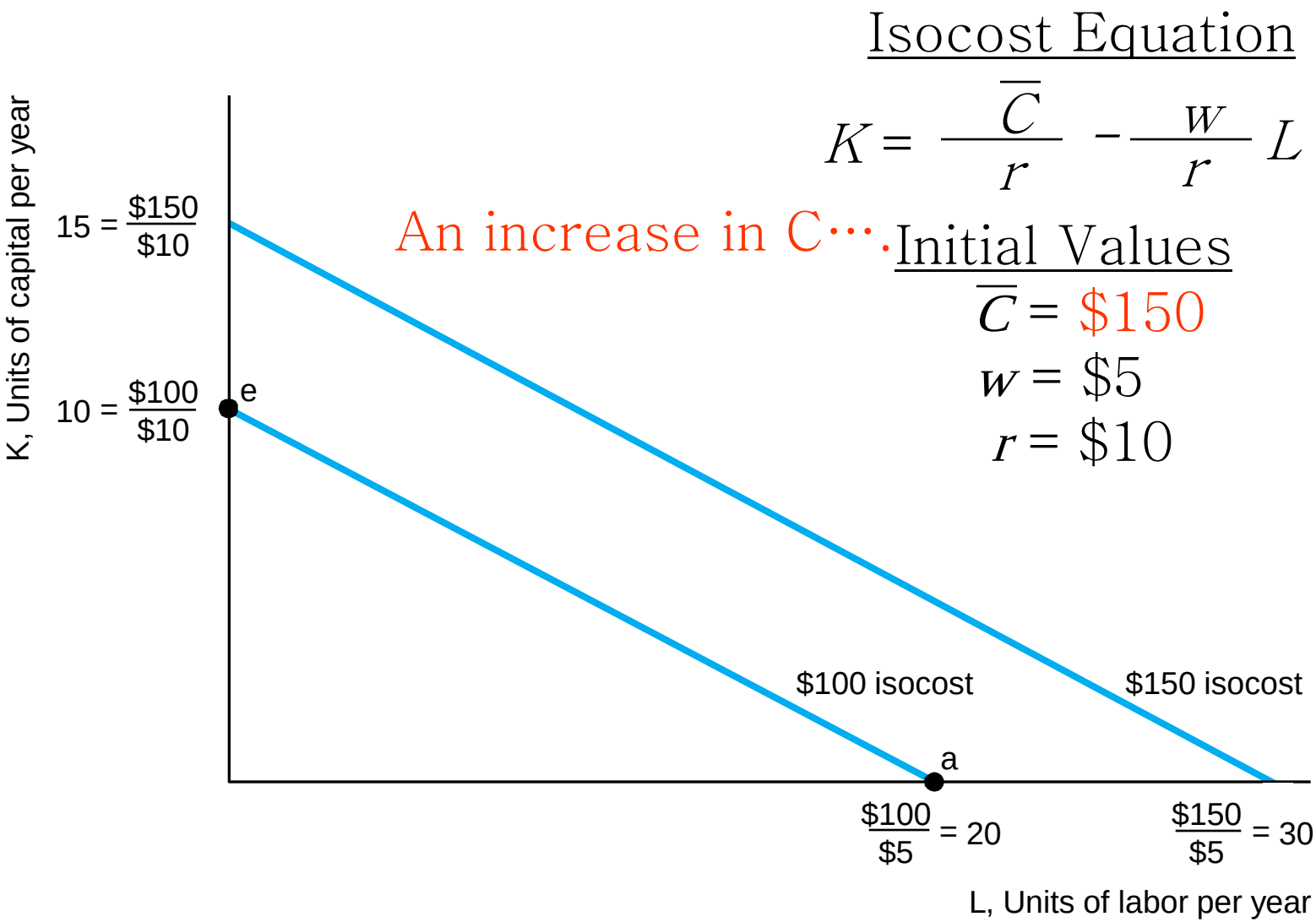
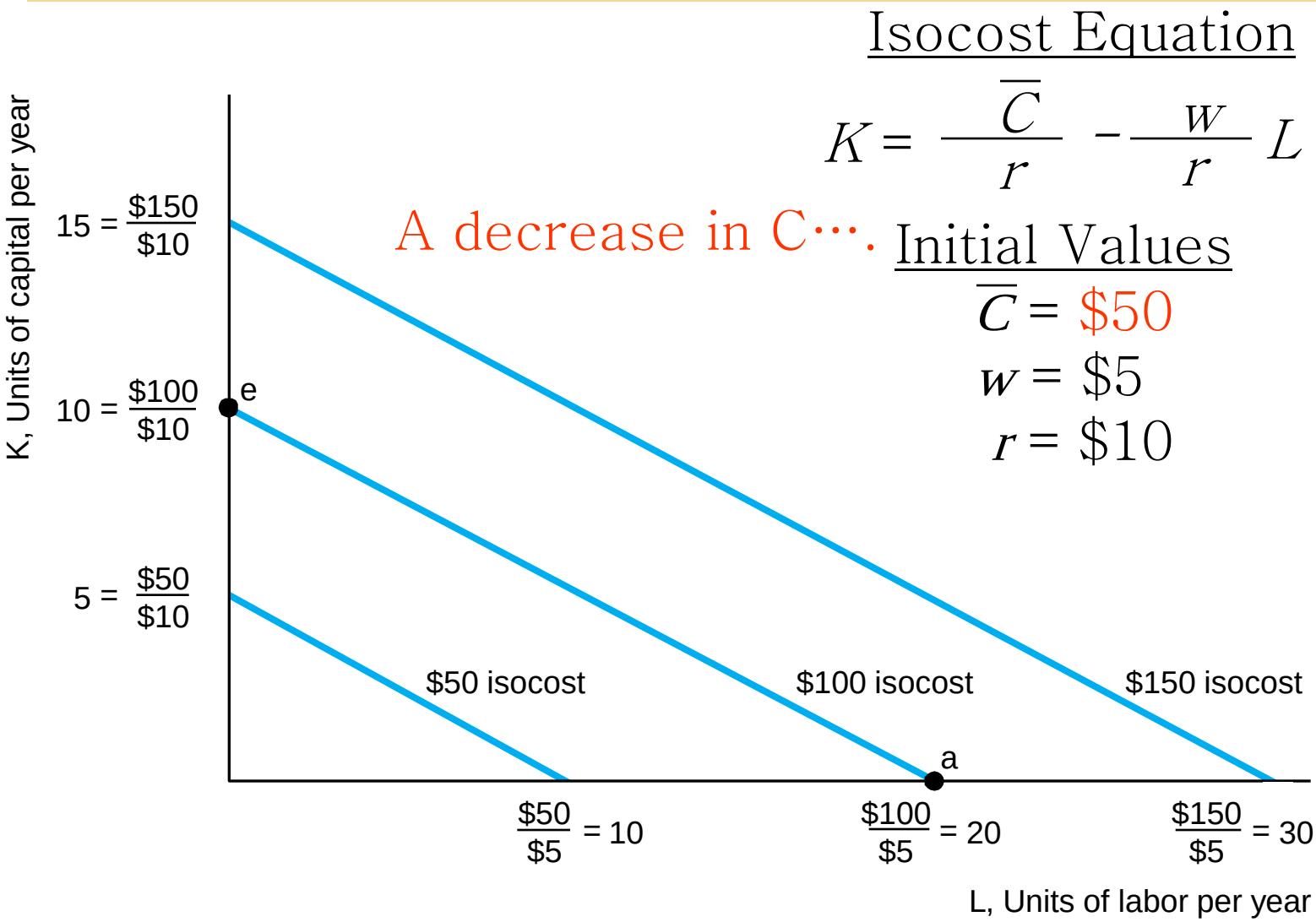


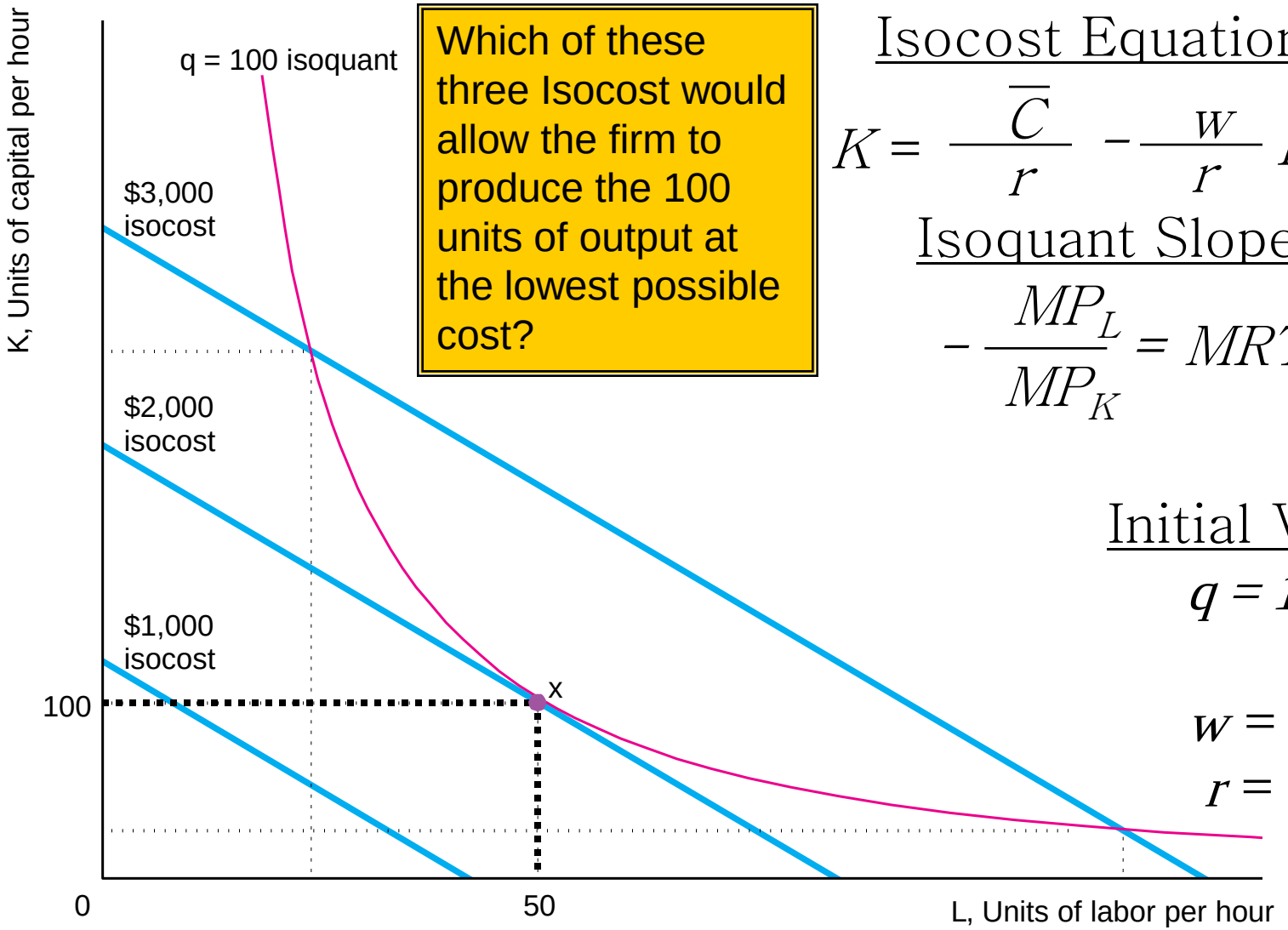
Figure 7.4 A Family of Isocost Lines



Combining Cost and Production Information.

- The firm can choose any of three equivalent approaches to minimize its cost:
  - **Lowest-isocost rule -** pick the bundle of inputs where the lowest isocost line touches the isoquant.
  - **Tangency rule -** pick the bundle of inputs where the isoquant is tangent to the isocost line.
  - **Last-dollar rule -** pick the bundle of inputs where the last dollar spent on one input gives as much extra output as the last dollar spent on any other input.

Figure 7.5 Cost Minimization



Which of these three Isocost would allow the firm to produce the 100 units of output at the lowest possible cost?

Isocost Equation

$$K = \frac{\overline{C}}{r} - \frac{w}{r} L$$

Isoquant Slope

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

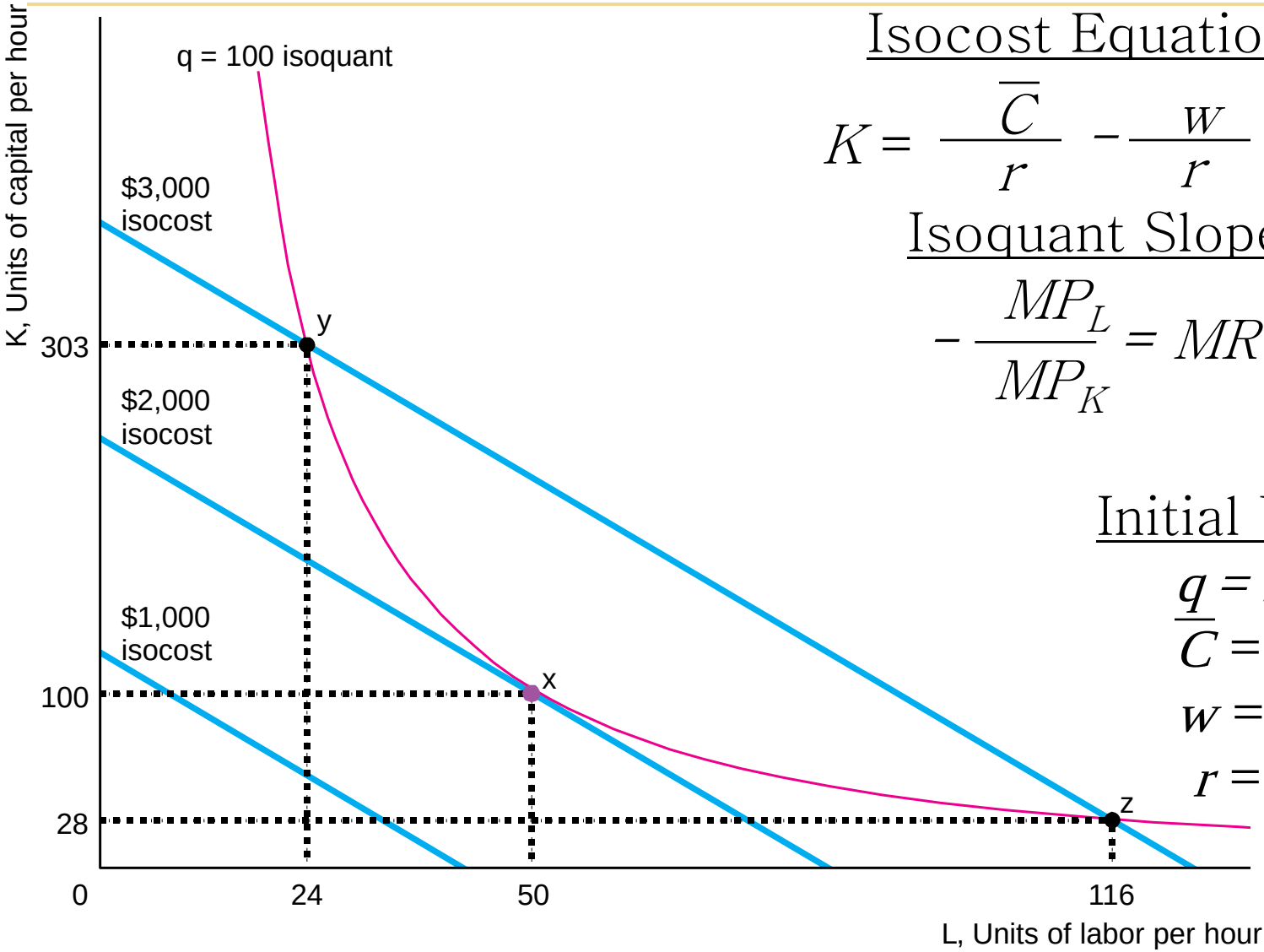
Initial Values

$q = 100$

$w = \$24$

$r = \$8$

Figure 7.5 Cost Minimization



Isocost Equation

$$K = \frac{\overline{C}}{r} - \frac{w}{r} L$$

Isoquant Slope

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

Initial Values

$\overline{q} = 100$

$\overline{C} = \$2{,}000$

$w = \$24$

$r = \$8$

Cost Minimization

- At the point of tangency, the slope of the isoquant equals the slope of the isocost. Therefore,

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

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

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

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

last-dollar rule: cost is minimized if inputs are chosen so that the last dollar spent on labor adds as much extra output as the last dollar spent on capital.

Figure 7.5 Cost Minimization

Initial Values

$q = 100$

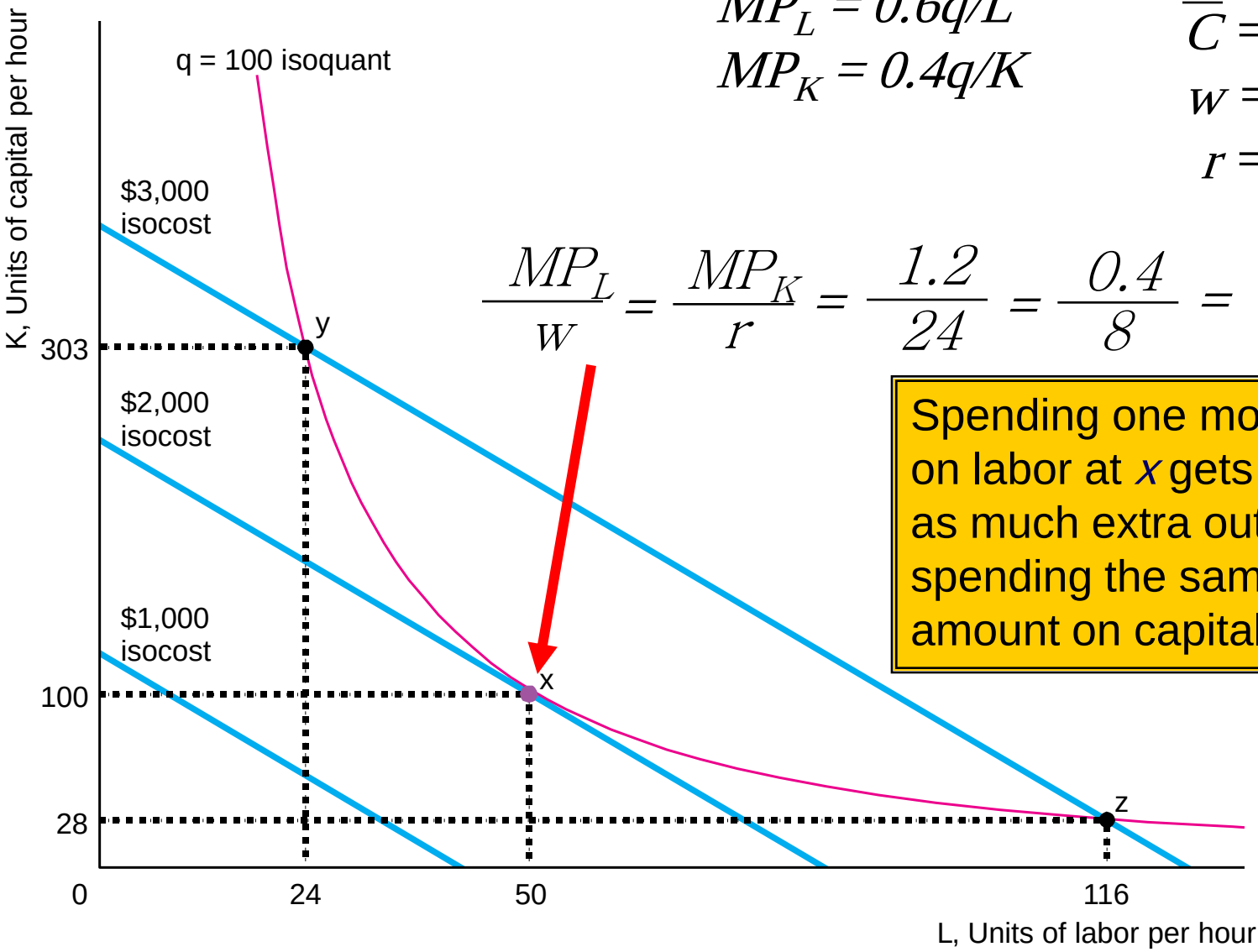
$\overline{C} = \$2{,}000$

$w = \$24$

$r = \$8$

$MP_L = 0.6q/L$

$MP_K = 0.4q/K$



$$\frac{MP_L}{w} = \frac{MP_K}{r} = \frac{1.2}{24} = \frac{0.4}{8} = 0.05$$

Spending one more dollar on labor at *x* gets the firm as much extra output as spending the same amount on capital.

Figure 7.5 Cost Minimization

Initial Values

$q = 100$

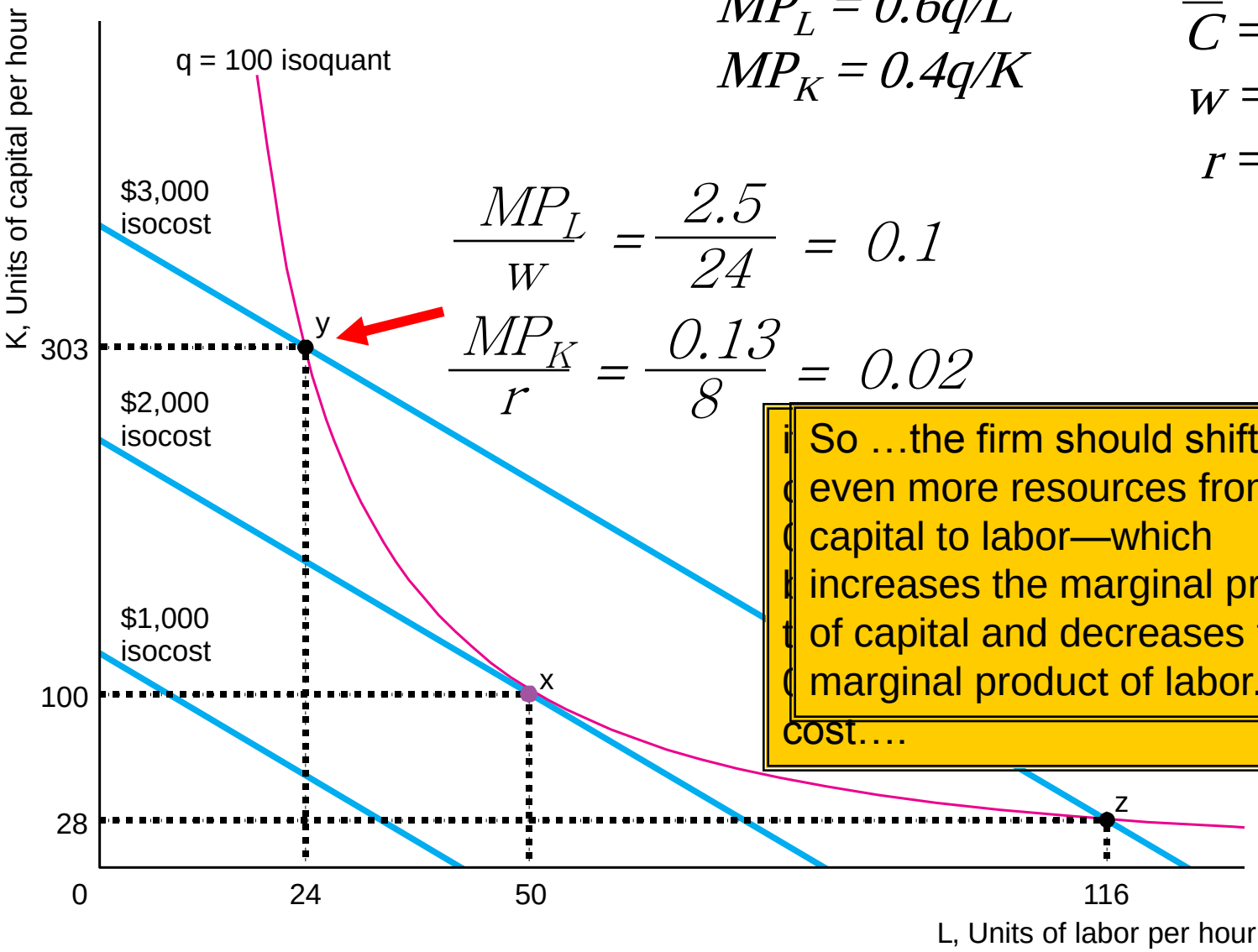
$\overline{C} = \$2{,}000$

$w = \$24$

$r = \$8$

$MP_L = 0.6q/L$

$MP_K = 0.4q/K$



$$\frac{MP_L}{w} = \frac{2.5}{24} = 0.1$$

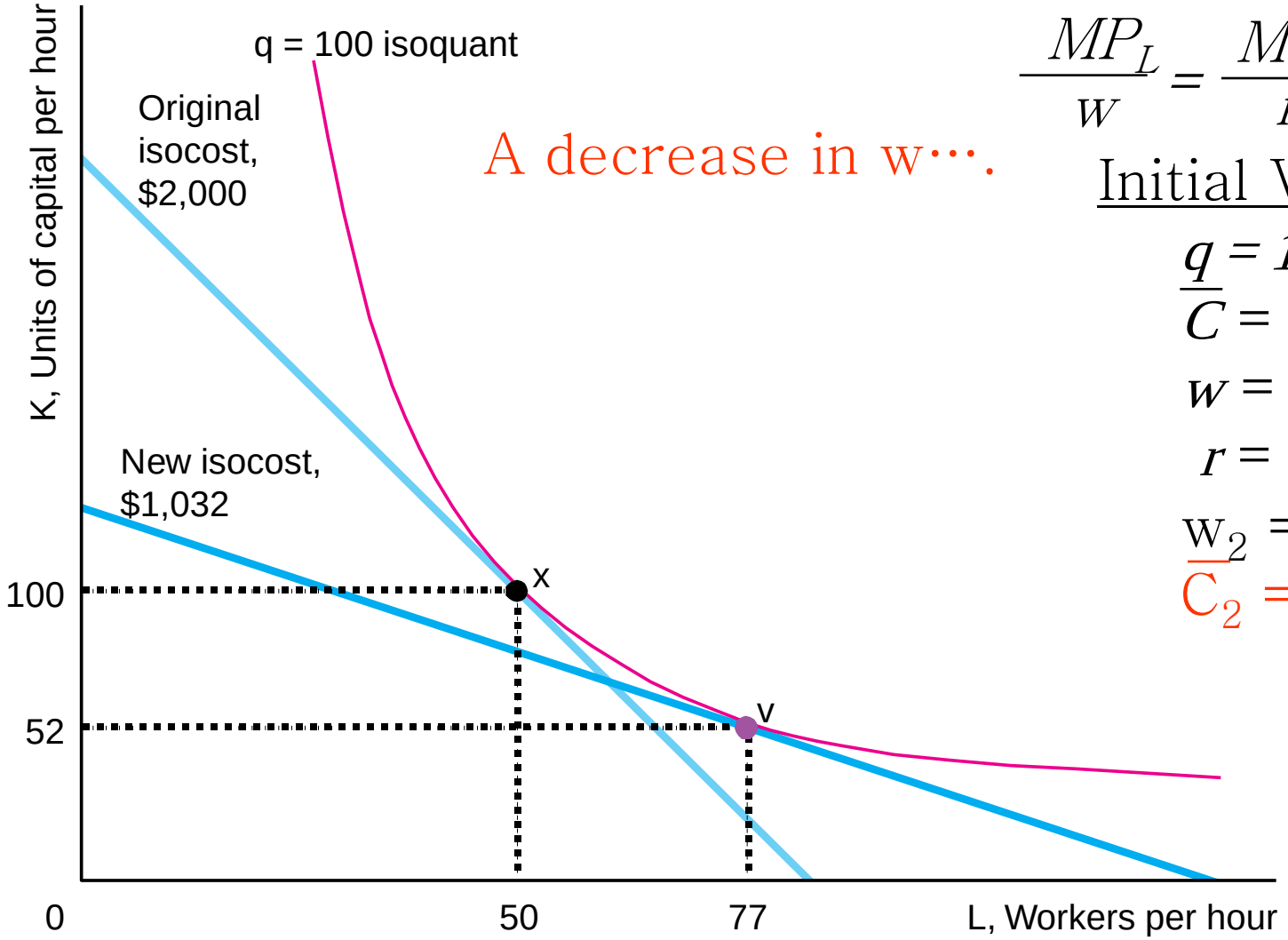
$$\frac{MP_K}{r} = \frac{0.13}{8} = 0.02$$

So …the firm should shift even more resources from capital to labor—which increases the marginal product of capital and decreases the marginal product of labor.

cost….

Figure 7.6 Change in Factor Price

Minimizing Cost Rule



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

Initial Values

$q = 100$

$C = \$2{,}000$

$w = \$24$

$r = \$8$

$w_2 = \$8$

$C_2 = \$1{,}032$

How Long-Run Cost Varies with Output

- **expansion path -** the cost-minimizing combination of labor and capital for each output level

Figure 7.7(a) Expansion Path

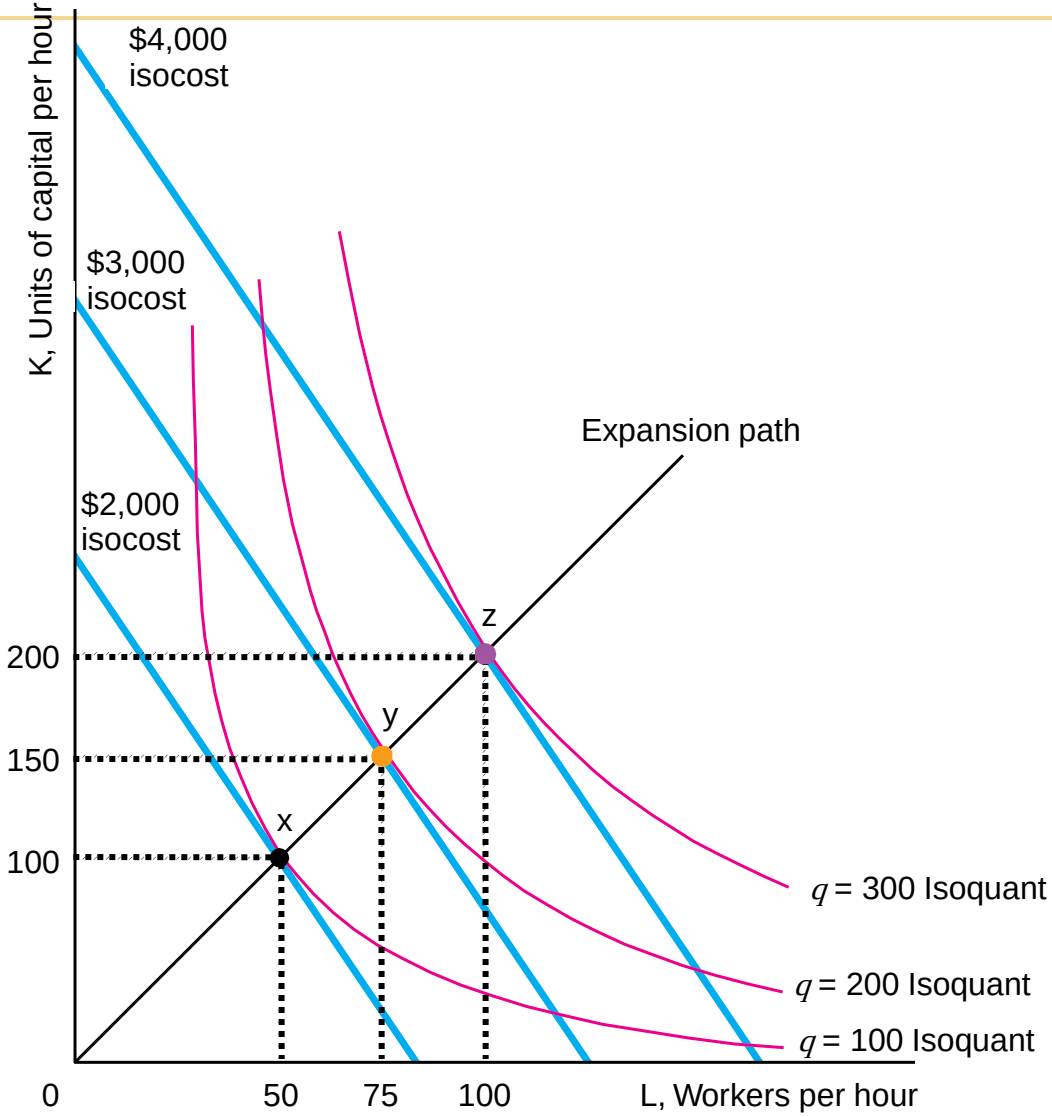
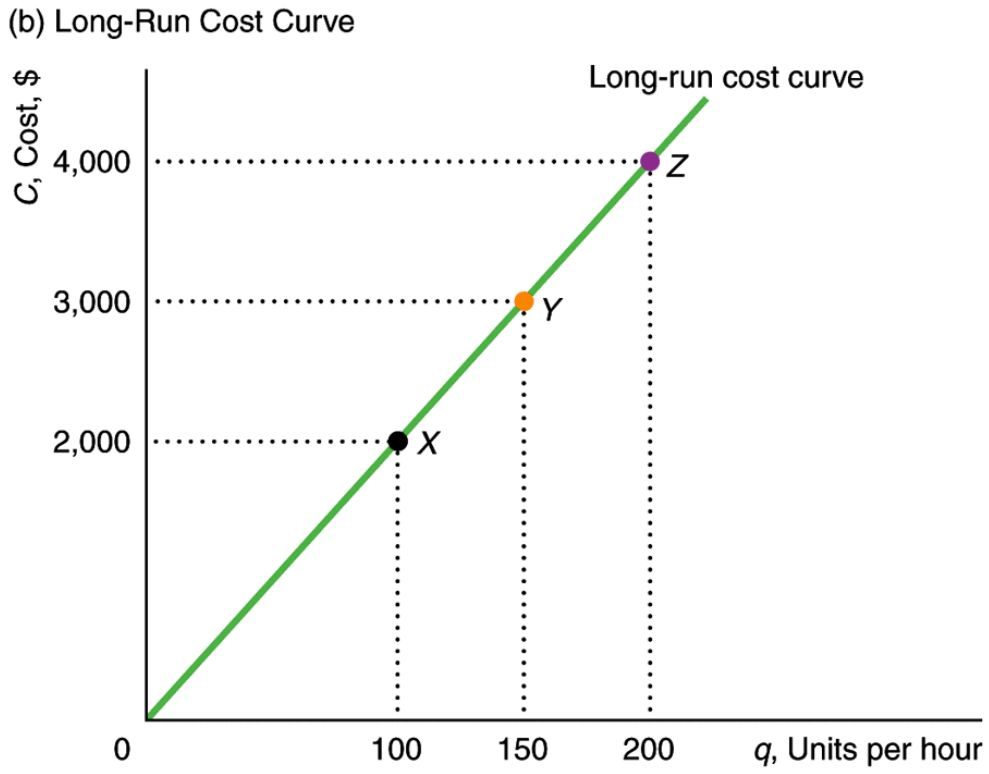


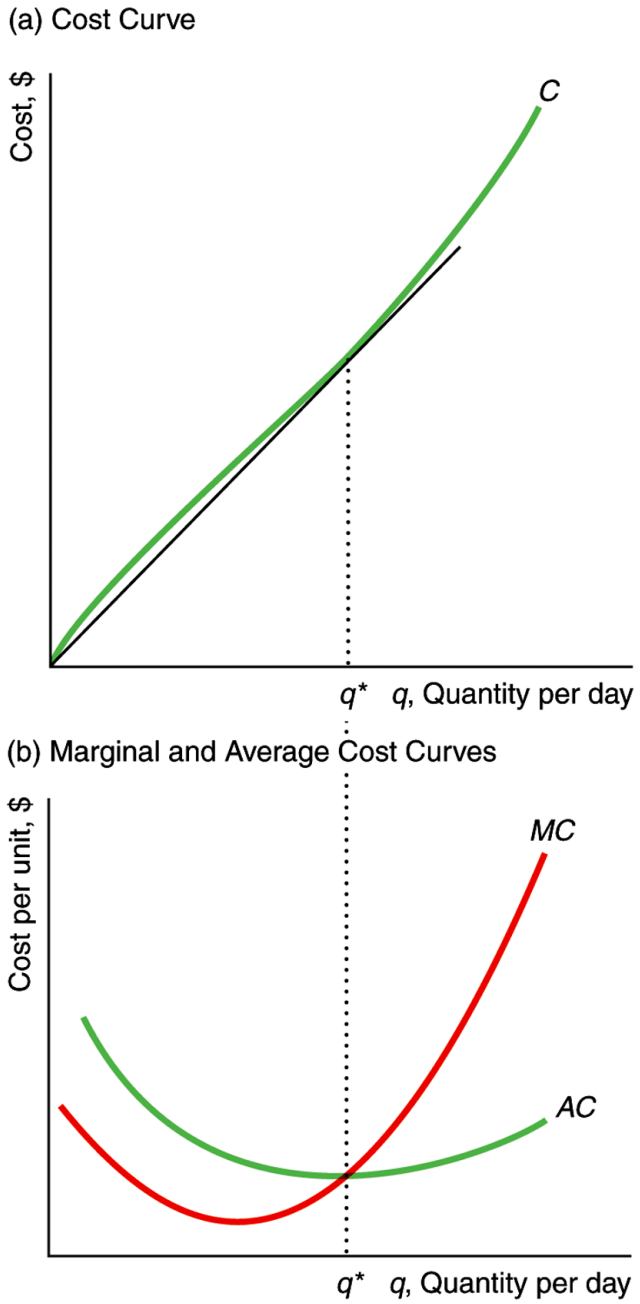
Figure 7.7(b) Expansion Path and Long-Run Cost Curve (cont'd)



Solved Problem 7.4

- What is the long-run cost function for a fixed-proportions production function (Chapter 6) when it takes one unit of labor and one unit of capital to produce one unit of output? Describe the long-run cost curve.

Figure 7.8 Long-Run Cost Curves



Economies of Scale

- **economies of scale -** property of a cost function whereby the average cost of production falls as output expands.
- **diseconomies of scale -** property of a cost function whereby the average cost of production rises when output increases.

Table 7.4 Returns to Scale and Long-Run Costs

Output, Q	Labor, L	Capital, K	Cost, $C = wL + rK$	Average Cost, $AC = C/q$	Returns to Scale
1	1	1	12	12	
3	2	2	24	8	Increasing
6	4	4	48	8	Constant
8	8	8	96	12	Decreasing

$w = r = \$6$ per unit.

Table 7.5 Shape of Average Cost Curves in Canadian Manufacturing

Scale Economies	Share of Manufacturing Industries, %
Economies of scale: initially downward-sloping *AC*	57
Everywhere downward-sloping *AC*	18
L-shaped *AC* (downward-sloping, then flat)	31
U-shaped *AC*	8
No economies of scale: flat *AC*	23
Diseconomies of scale: upward-sloping *AC*	14

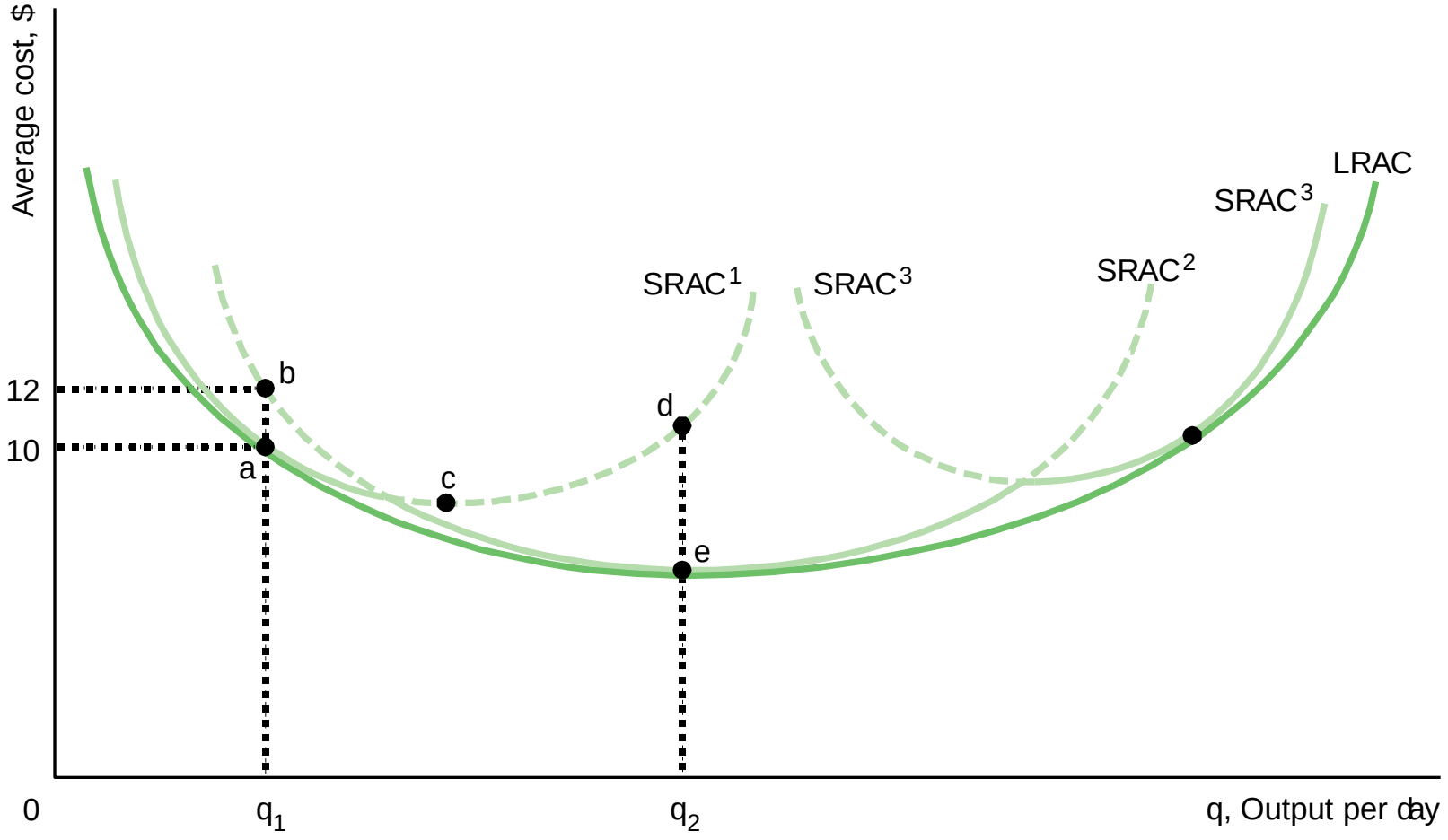
Source: Robidoux and Lester (1992).

Long-Run Average Cost

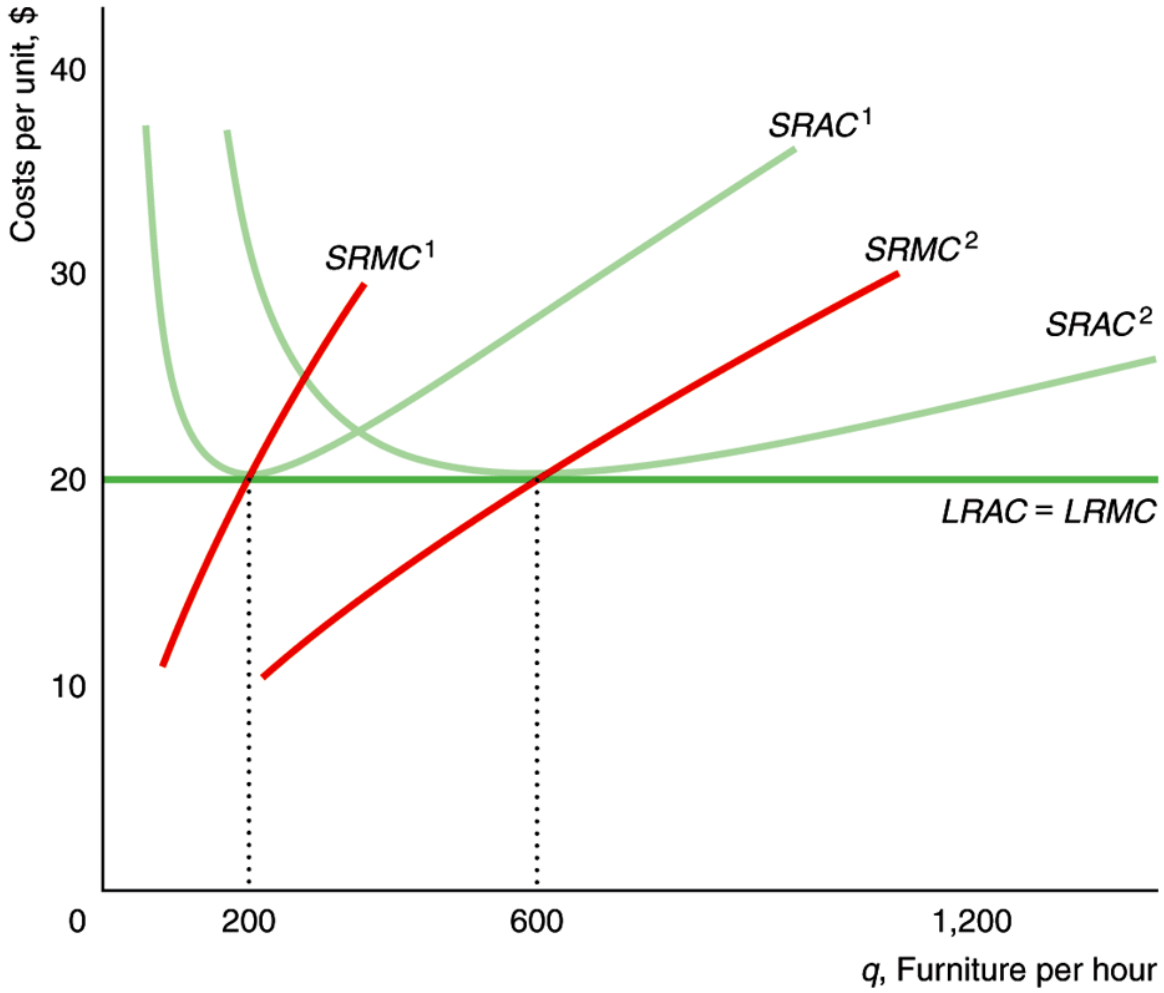
- In its long-run planning, a firm chooses a plant size and makes other investments so as to minimize its long-run cost on the basis of how many units it produces.
  - Once it chooses its plant size and equipment, these inputs are fixed in the short run.

    Thus, the firm's long-run decision determines its short-run cost.

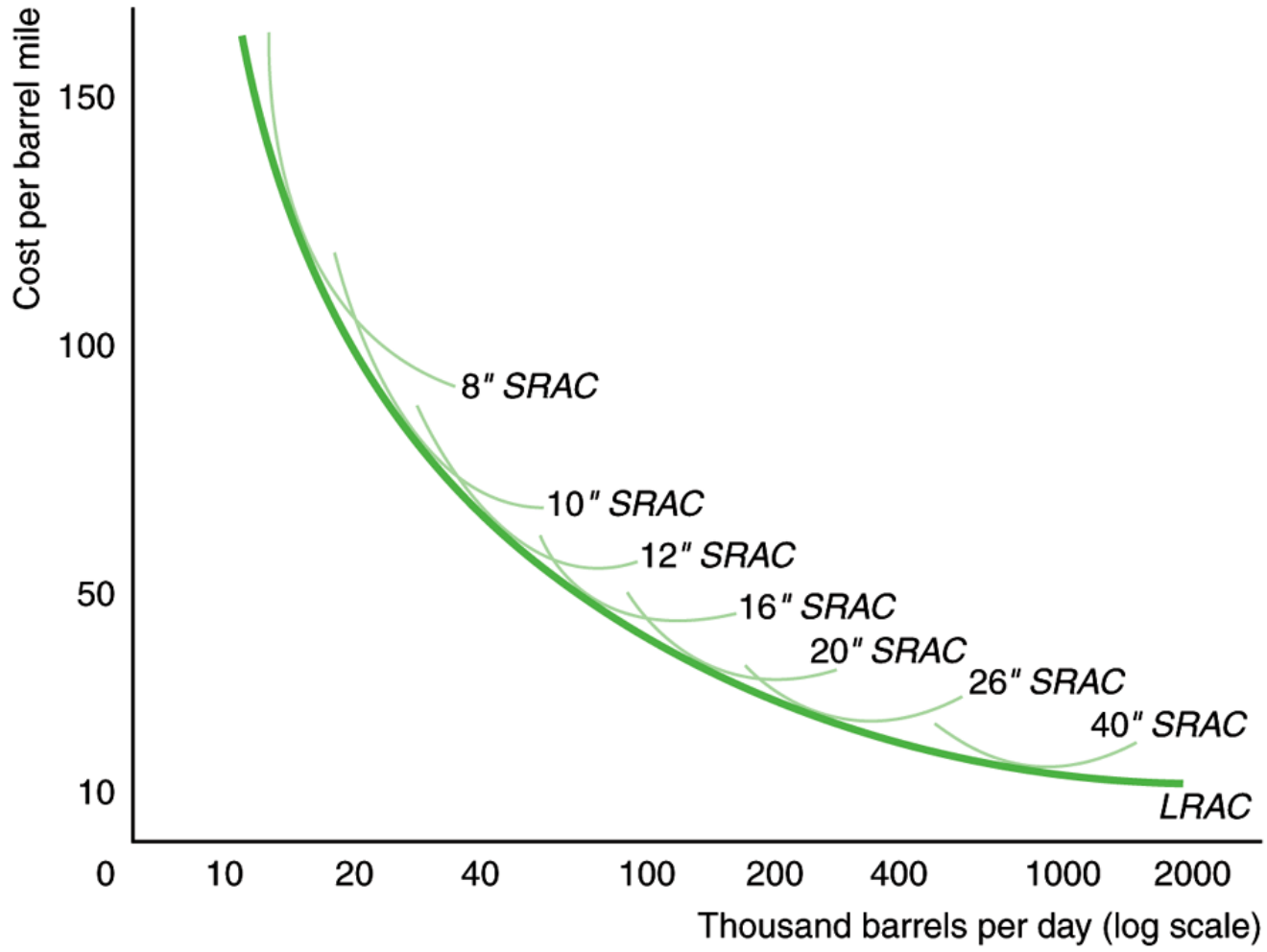
Figure 7.9 Long-Run Average Cost as the Envelope of Short-Run Average Cost Curves



Application Long-Run Cost Curves in Furniture Manufacturing and Oil Pipelines



Application Long-Run Cost Curves in Furniture Manufacturing and Oil Pipelines



Application Choosing an Ink-Jet or a Laser Printer

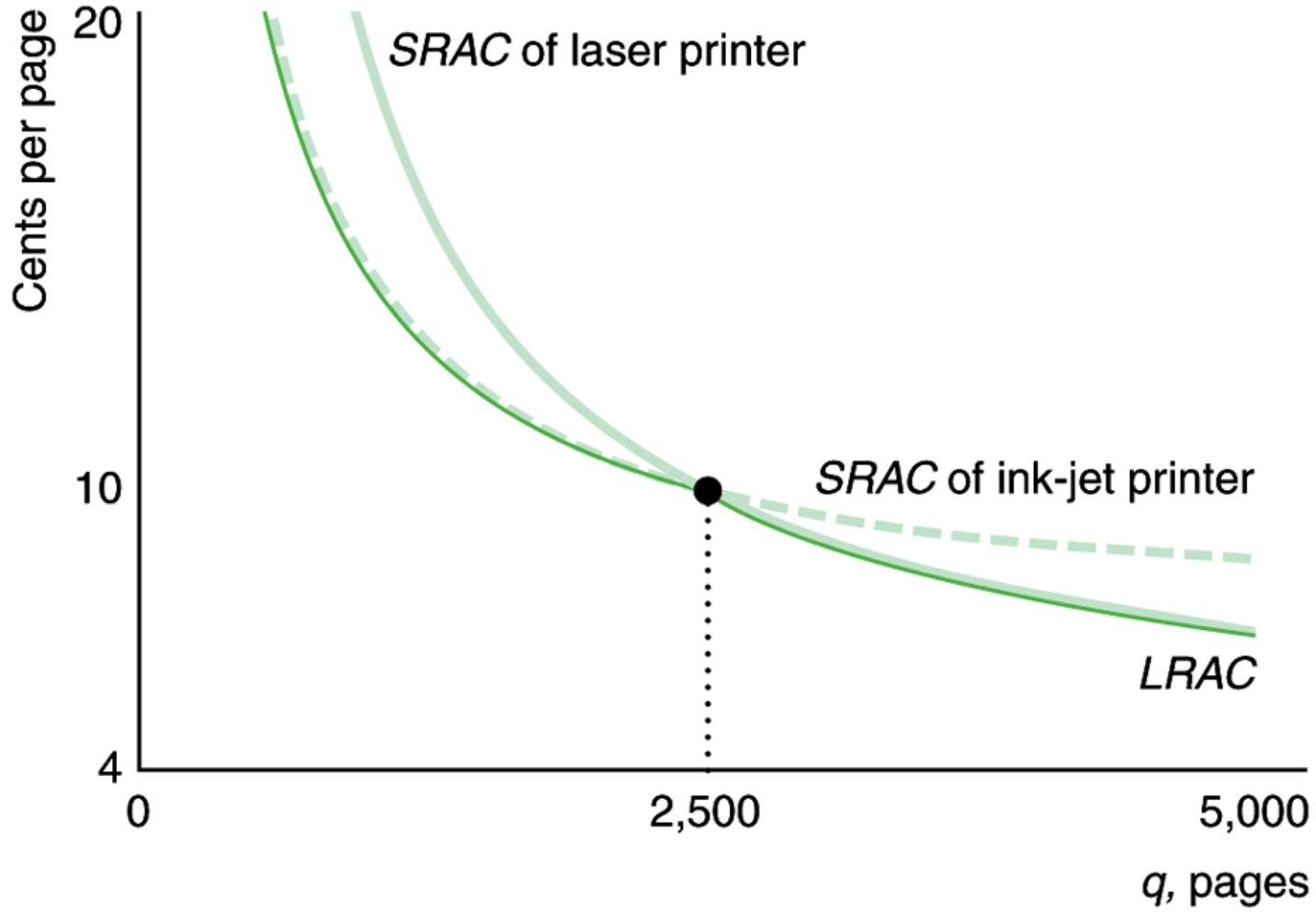
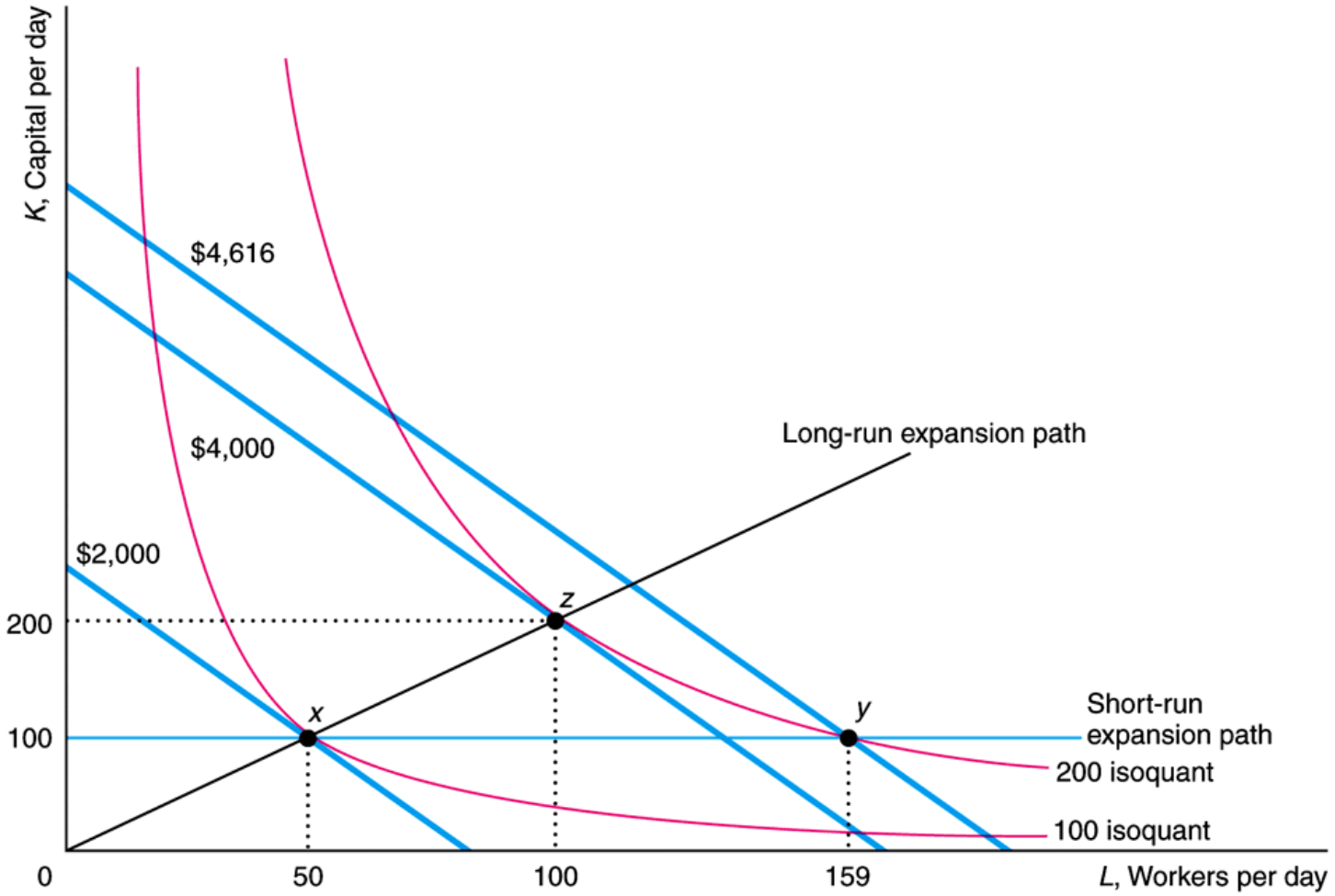


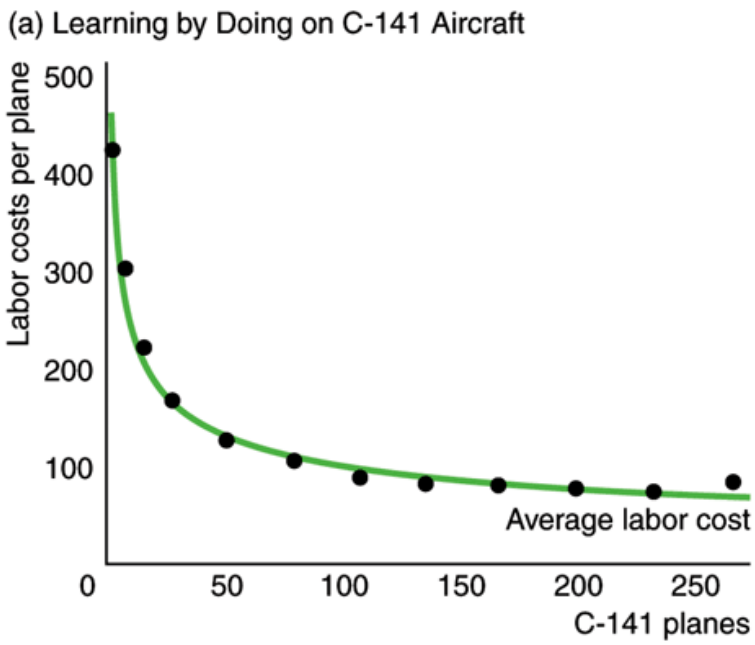
Figure 7.10 Long-Run and Short-Run Expansion Paths

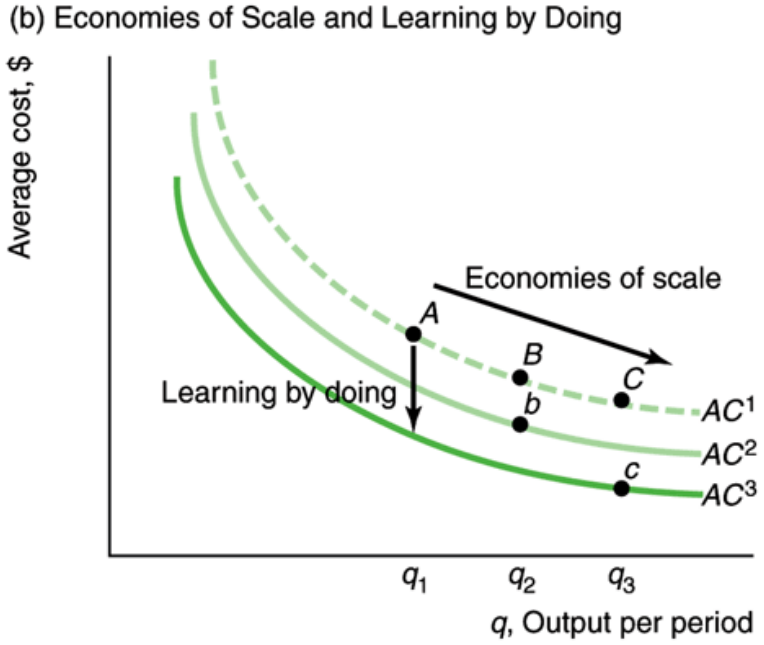


How Learning by Doing Lowers Costs

- **learning by doing -** the productive skills and knowledge that workers and managers gain from experience

Figure 7.11 Learning by Doing





Cost of Producing Multiple Goods

- **economies of scope -** situation in which it is less expensive to produce goods jointly than separately.

- **production possibility frontier -** the maximum amount of outputs that can be produced from a fixed amount of input

Figure 7.12 Joint Production