Micro

ECON

McEachern   *2010-2011*

CHAPTER *7*

Production and

Cost in the Firm

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Cost and Profit

- **Producers: Maximize profit**
- **Opportunity cost**
  - **All resources have an opportunity cost**
- **Explicit costs**
  - **Payments for resources**
- **Implicit costs**
  - **Opportunity cost of resources owned by the firm / firm owners**
  - **No cash payment**

LO^1

Alternative Measures of Profit

- **Accounting profit**
  - **Total revenue minus explicit costs**
- **Economic profit**
  - **Total revenue minus all costs (implicit and explicit)**
    - **Opportunity cost of all resources**
- **Normal profit**
  - **"Accounting profit in excess of normal profit"**
    - **Accounting profit = Economic + Normal profit**

LO^1

Wheeler Dealer Accounts, 2010

Exhibit 1

Total revenue		$105,000
Less **explicit costs**:		
Assistant's salary	- $21,000	
Material and equipment	- $20,000	
Equals **accounting profit**		**$64,000**
Less **implicit costs**:		
Wanda's forgone salary	-$50,000	
Forgone interest on savings	- $1,000	
Forgone garage rental	- $1,200	
Equals **economic profit**		**$11,800**

Production in the Short Run

- **Variable resources**
  - **Can be varied quickly**
- **Fixed resources**
  - **Cannot be altered easily**
- **Short run**
  - **At least one resource is fixed**
- **Long run**
  - **No resource is fixed**

LO^2

Law of Diminishing Marginal Returns

- **Total product**
- **Production function**
  - **Relationship between amount of resources employed and total product**
- **Marginal product**
  - **Change in total product from an additional unit of resource**

LO²

Law of Diminishing Marginal Returns

- **Increasing marginal returns**
  - **Marginal product increases**
- **Diminishing marginal returns**
  - **Marginal product decreases**
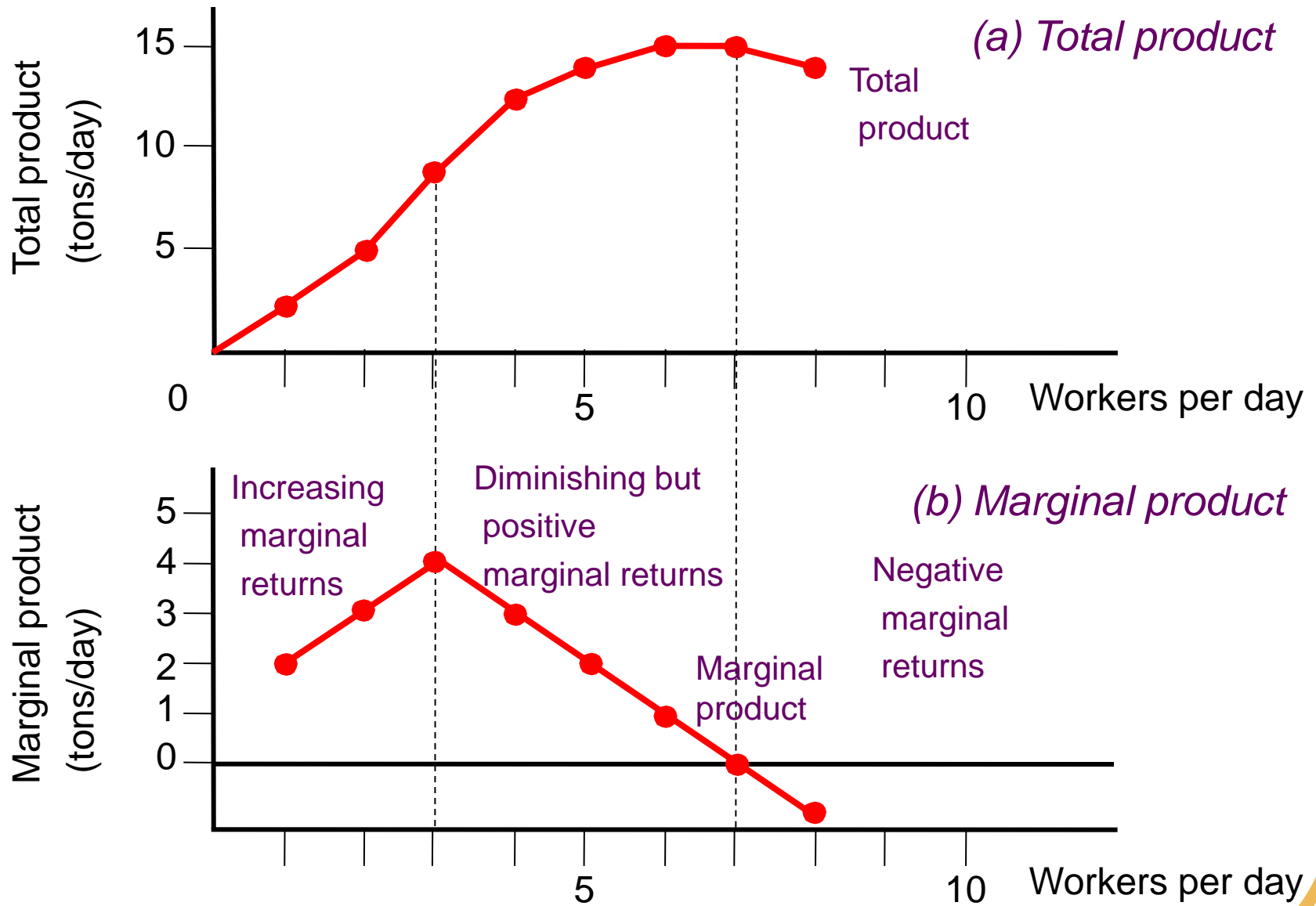- **Law of diminishing marginal returns**

LO²

The Short-Run Relationship Between Units of Labor and Tons of Furniture Moved

Units of the Variable Resource (worker-days)	Total Product (tons moved per day)	Marginal Product (tons moved per day)
0	0	—
1	2	2
2	5	3
3	9	4
4	12	3
5	14	2
6	15	1
7	15	0
8	14	−1

Marginal product increases as the firm hires each of the first three workers, reflecting increasing marginal returns. Then marginal product declines, reflecting diminishing marginal returns. Adding more workers may, at some point, actually reduce total product (as occurs here with an eighth worker) because workers start getting in each other's way.

Effects of an Increase in Demand

LO^2

Exhibit 3

(a) Total product

Total product (tons/day) — vertical axis: 5, 10, 15

Workers per day — horizontal axis: 0, 5, 10

Total product

(b) Marginal product

Marginal product (tons/day) — vertical axis: 0, 1, 2, 3, 4, 5

Workers per day — horizontal axis: 5, 10

Increasing marginal returns

Diminishing but positive marginal returns

Negative marginal returns

Marginal product

9

Costs in the Short Run

- **Fixed cost FC**
    - **For fixed resources**
- **Variable cost VC**
    - **For variable resources**
- **Total cost TC = FC + VC**
- **Marginal cost MC = △TC/△q**
    - **Change in TC to produce one more unit of output**

Costs in the Short Run

- **Changes in MC**
  - **Reflect changes in marginal productivity**
- **Increasing marginal returns**
  - **MC falls**
- **Diminishing marginal returns**
  - **MC increases**

Short-Run Total and Marginal Cost Data for Smoother Mover

(1) Tons Moved per day (q)	(2) Fixed Cost (FC)	(3) Workers per day	(4) Variable Cost (VC)	(5) Total Cost ($TC = FC + VC$)	(6) Marginal Cost ($MC = \Delta TC/\Delta q$)
0	$200	0	$ 0	$200	—
2	200	1	100	300	$ 50.00
5	200	2	200	400	33.33
9	200	3	300	500	25.00
12	200	4	400	600	33.33
14	200	5	500	700	50.00
15	200	6	600	800	100.00

First 3 workers: increasing marginal returns: MC declines

With the 4th worker: diminishing marginal returns: MC increases

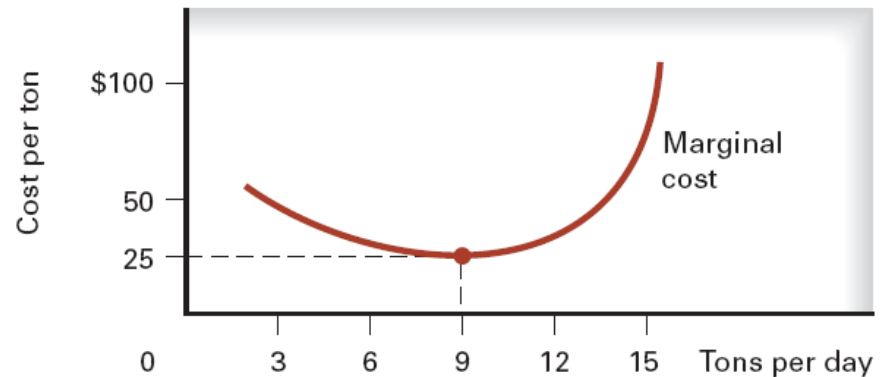# Total and Marginal Cost Curves for Smoother Mover

(a) Total cost curve
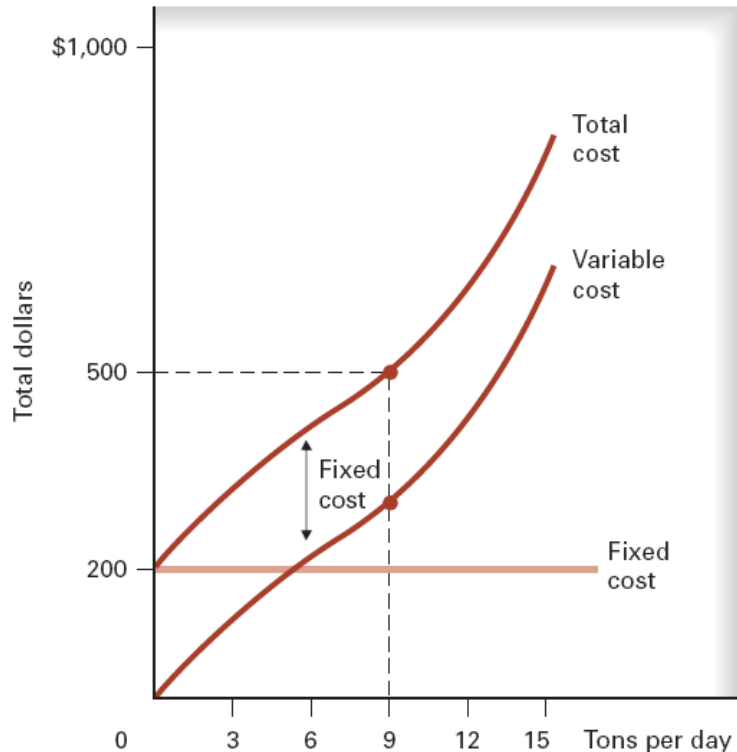
TC is the vertical sum of FC and VC

VC starts from origin; increases slowly at first; with diminishing returns, VC increases rapidly

FC = $200 at all levels of output

(b) Marginal cost curve

MC first declines: increasing marginal returns; then increases: diminishing marginal returns

Average Cost in the Short Run

- **Average variable cost AVC = VC/q**
- **Average total cost ATC = TC/q**
- **When MC < average cost**
  - **The marginal pulls down the average**
- **When MC > average cost**
  - **The marginal pulls up the average**
- **U-shape of average cost curves**
  - **Law of diminishing marginal returns**

# Short-Run Total, Marginal, and Average Cost Data for Smoother Mover

(1) Tons Moved per day (q)	(2) Variable Cost (VC)	(3) Total Cost (TC = FC + VC)	(4) Marginal Cost (MC = ΔTC/Δq)	(5) Average Variable Cost (AVC = VC/q)	(6) Average Total Cost (ATC = TC/q)
0	$ 0	$200	$ 0	$ —	∞
2	100	300	50.00	50.00	$ 150.00
5	200	400	33.33	40.00	80.00
9	300	500	25.00	33.33	55.55
12	400	600	33.33	33.33	50.00
14	500	700	50.00	35.71	50.00
15	600	800	100.00	40.00	53.33

MC first falls then increases (increasing then diminishing marginal returns)

As long as MC < AC, average cost declines

Once MC > AC, average cost increases

Average and Marginal Cost Curves
for Smoother Mover
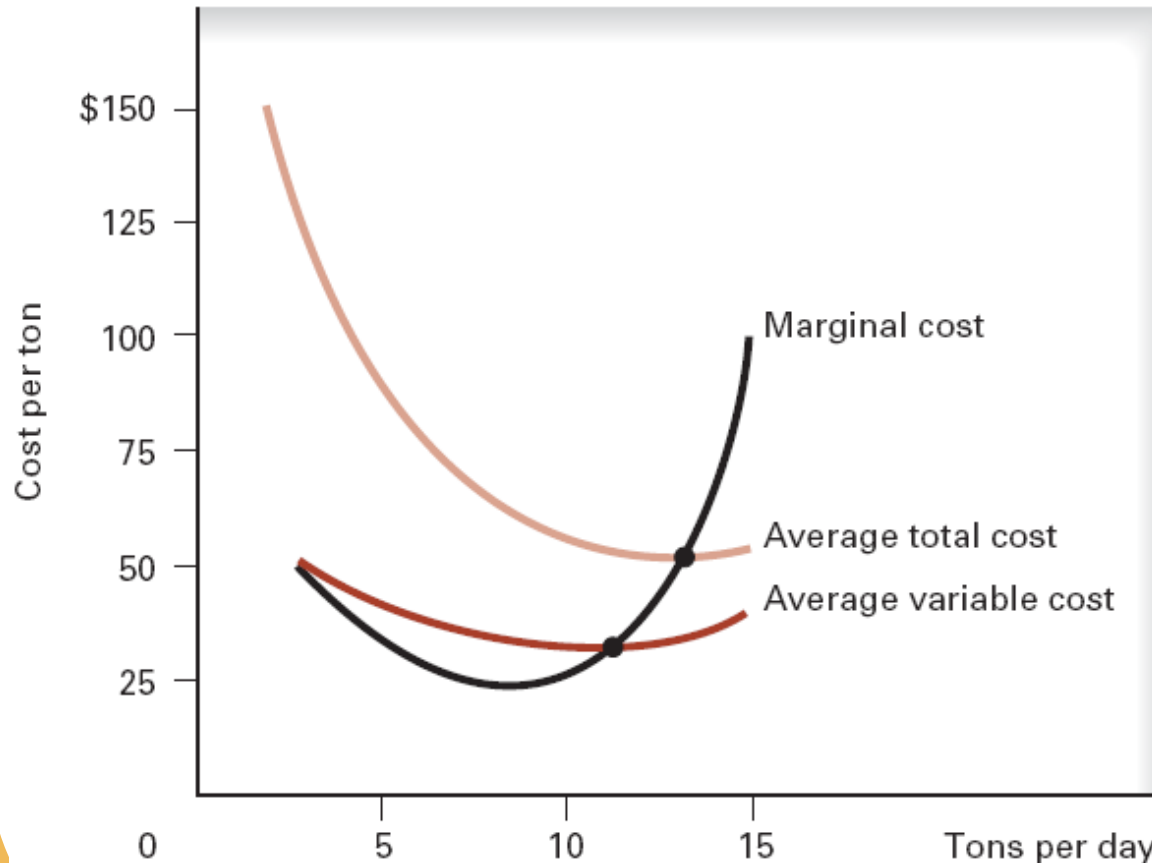
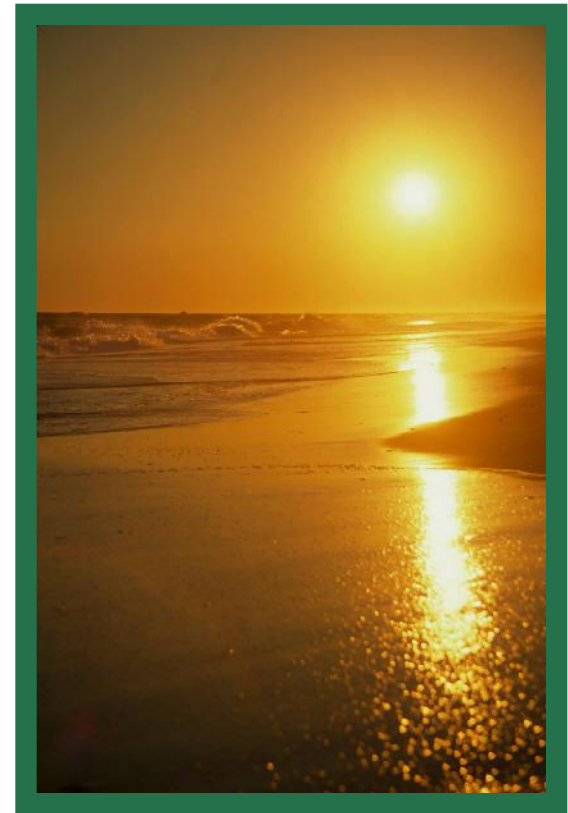When MC is above AVC (ATC), AVC (ATC) is increasing.

ATC and AVC: decline, reach low points, then rise.

When MC is below AVC (ATC), AVC (ATC) is falling

When MC = AVC (ATC), AVC (ATC) is at its minimum.

Costs in the Long Run

- **All resources can be varied**
- **Planning horizon**
- **Firms plan in the long run**
- **Firms produce in short run**

LO^4

Costs in the Long Run

- **U-shaped long-run average cost curve**
- **Economies of scale**
  - **LRAC falls as output expands**
- **Diseconomies of scale**
  - **LRAC increases as output expands**
- **Constant lung-run average cost**

LO⁴

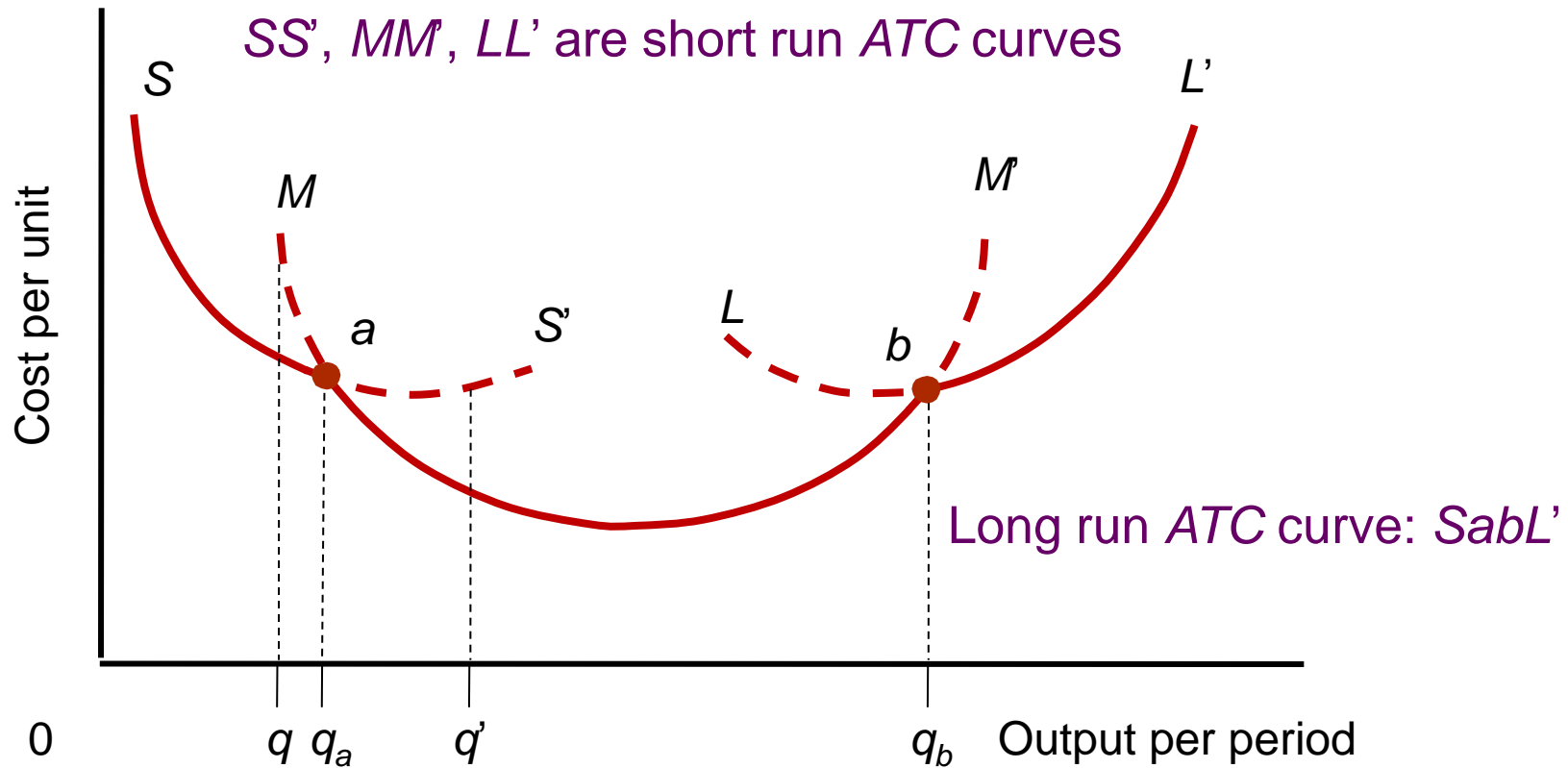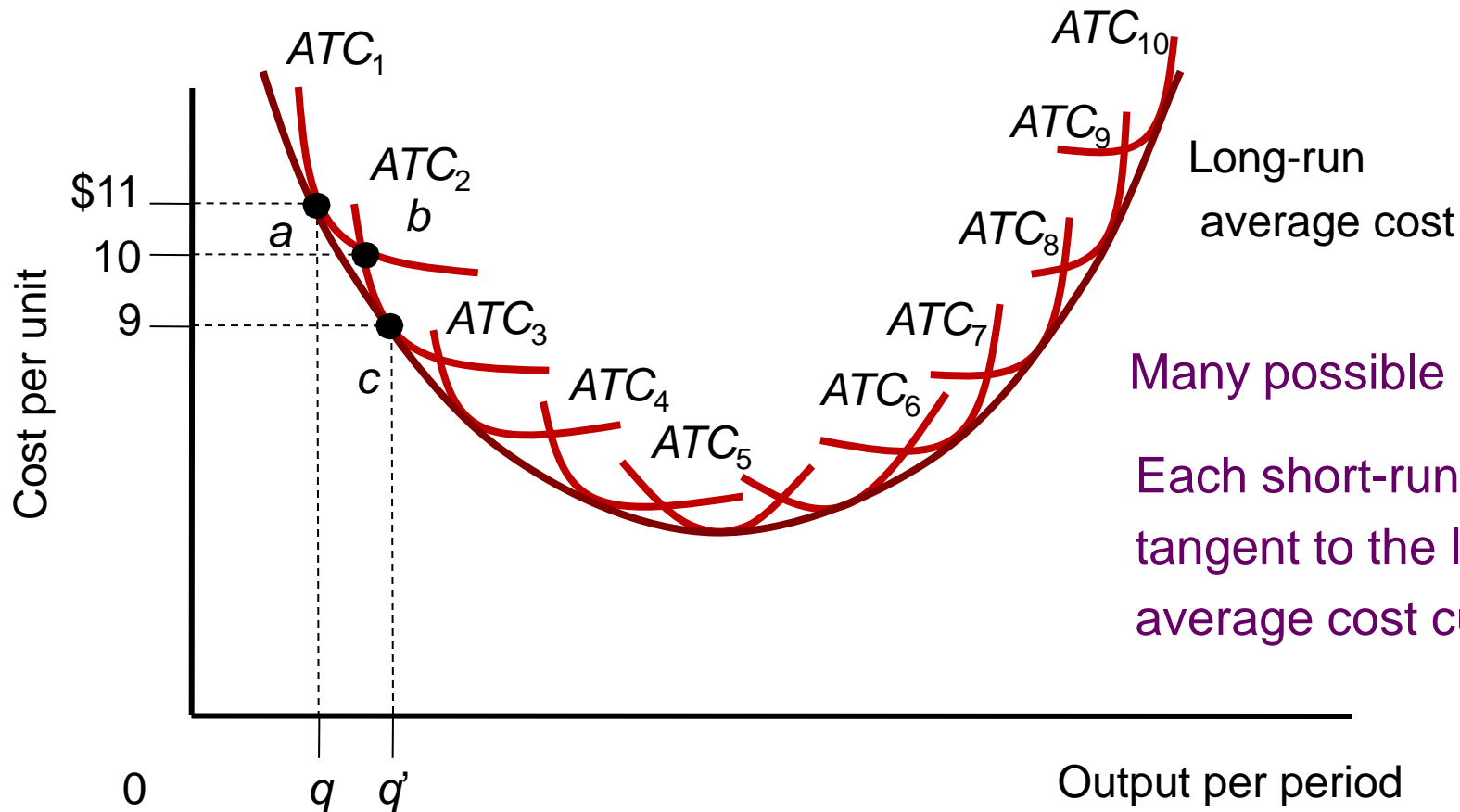# Short-Run Average Total Cost Curves Form the Long-Run Average Cost Curve, or Planning Curve

Exhibit 8

SS', *MM'*, *LL'* are short run *ATC* curves

Long run *ATC* curve: *SabL'*

Many Short-Run ATC Curves Form a Firm's LRAC Curve, or Planning Curve

Long-run average cost

Many possible plant sizes

Each short-run curve is tangent to the long run average cost curve

Each point of tangency represents the least cost way of producing that level of output

A Firm's Long-Run Average Cost Curve

Exhibit 10

Long-run average cost

Cost per unit

0   A   B   Output per period

Economies of scale   Constant average cost   Diseconomies of scale
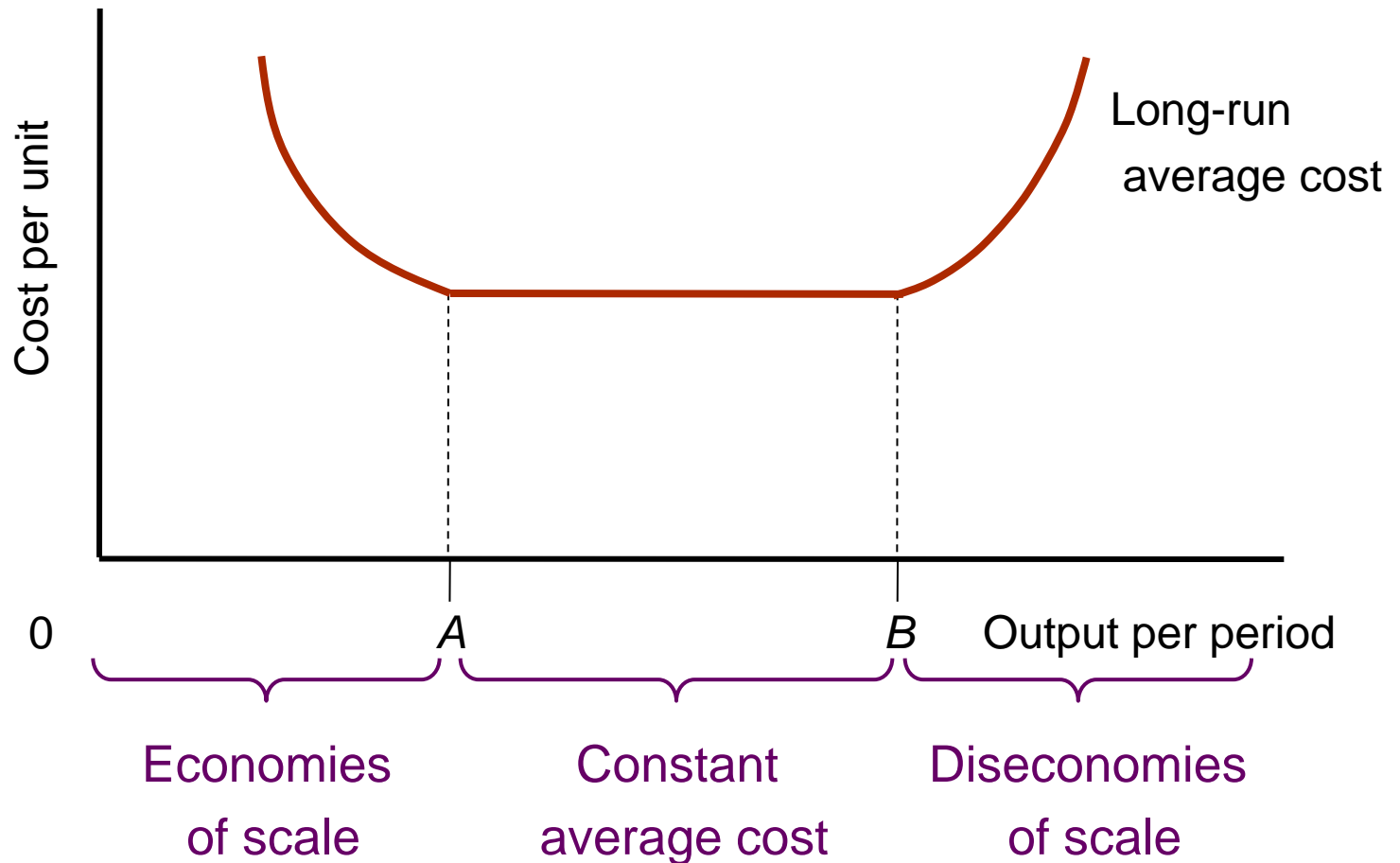
Scale Economies and Diseconomies at the Movies

Case Study

◆ **Movie theaters**

  ◆ **Economies of scale**

    ◆ **Decrease in LRAC as the number of screens initially increases**

  ◆ **Diseconomies of scale**

    ◆ **Adding even more screens**

    ◆ **Problems arise**

    ◆ **LRAC starts to increase**
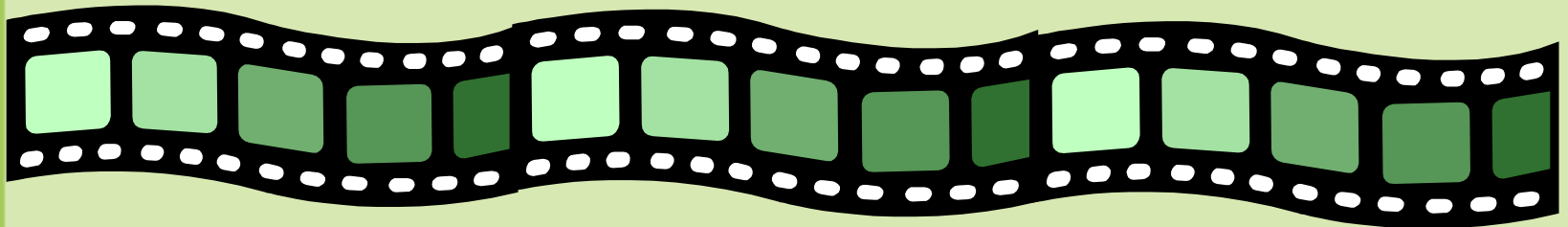
Economies and Diseconomies of Scale

- **Plant level**
  - **Particular location**
- **Firm level**
  - **Collection of plants**
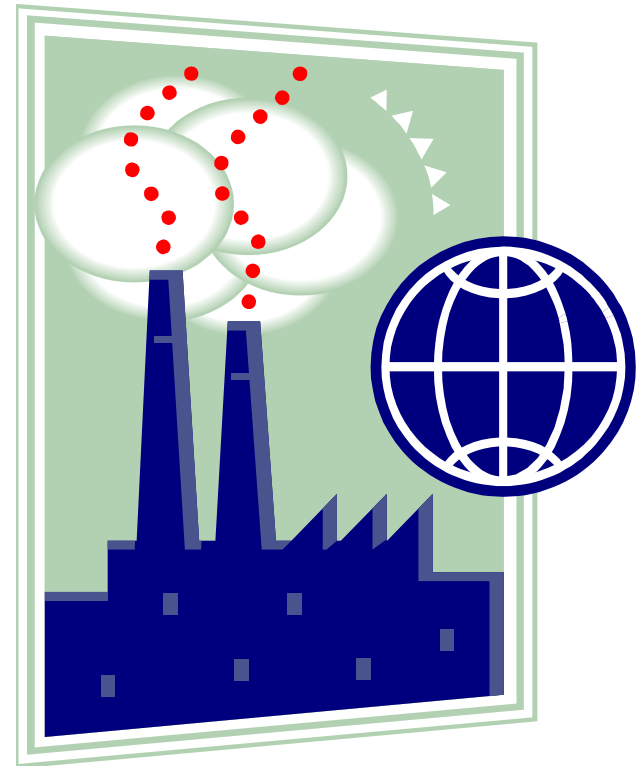
LO^4

Scale Economies and Diseconomies at McDonald's

Case Study

- ◆ **Economies of scale**
  - ◆ **At plant level**
    - ◆ **Specialization**
  - ◆ **At firm level**
    - ◆ **Sharing: information; technology**
- ◆ **Diseconomies of scale**
  - ◆ **At firm level**
    - ◆ **Uniform menu**

A Closer Look at Production and Cost

- **Production function**
- **Technologically efficient production**
- **Isoquant**
  - **All technologically efficient combinations of 2 resources**

Exhibit A

A Firm's Production Function Using Labor and Capital: Production per Month

Units of Capital employed per month	Units of Labor employed per month						
	1	2	3	4	5	6	7
1	40	90	150	200	240	270	290
2	90	140	200	250	290	315	335
3	150	195	260	310	345	370	390
4	200	250	310	350	385	415	40
5	240	290	345	385	420	450	475
6	270	320	375	415	450	475	495
7	290	330	390	435	470	495	510

A Closer Look at Production and Cost

- **Isoquants**
  - **Farther from origin: greater output rates**
  - **Negative slope**
  - **Don't intersect**
  - **Convex to the origin**

A Closer Look at Production and Cost

- **Marginal rate of technical substitution**
  - **MRTS**
  - **Slope of isoquant**
  - **MRTS = MP_L/MP_C**

Exhibit B

A Firm's Isoquants

Isoquants:
- negative slope
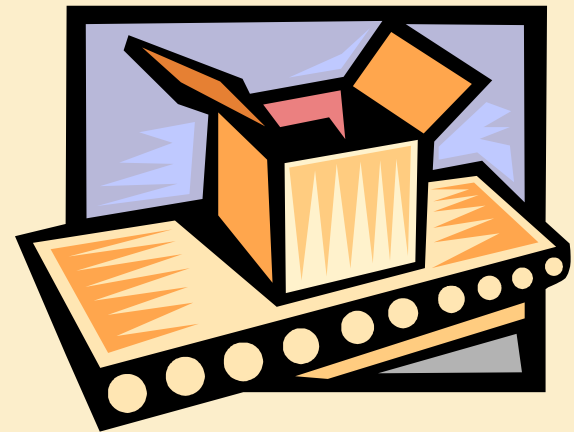- convex to the origin

Q_3: 475 units of output

Q_2: 415 units of output
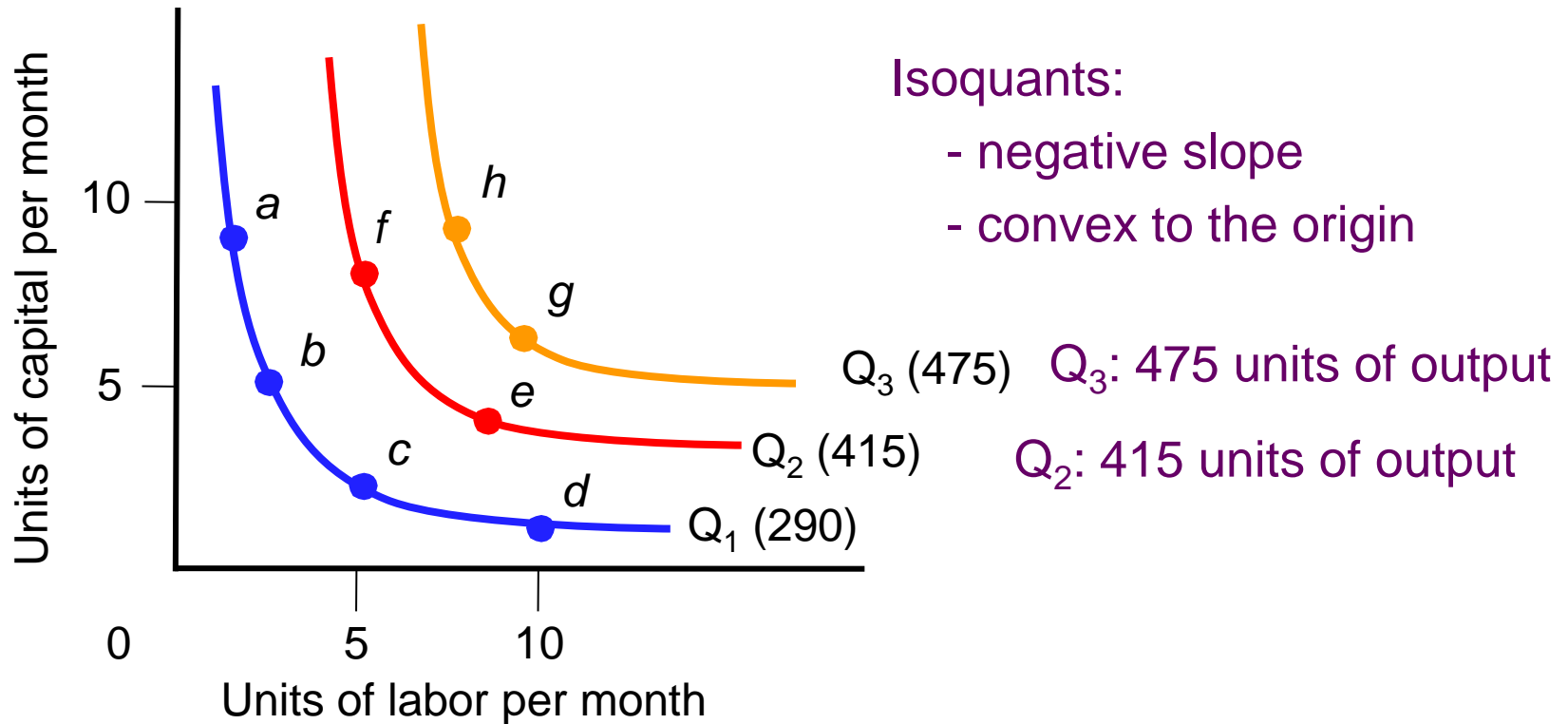
Q_1: all technologically efficient combinations of labor and capital that can be used to produce 290 units of output
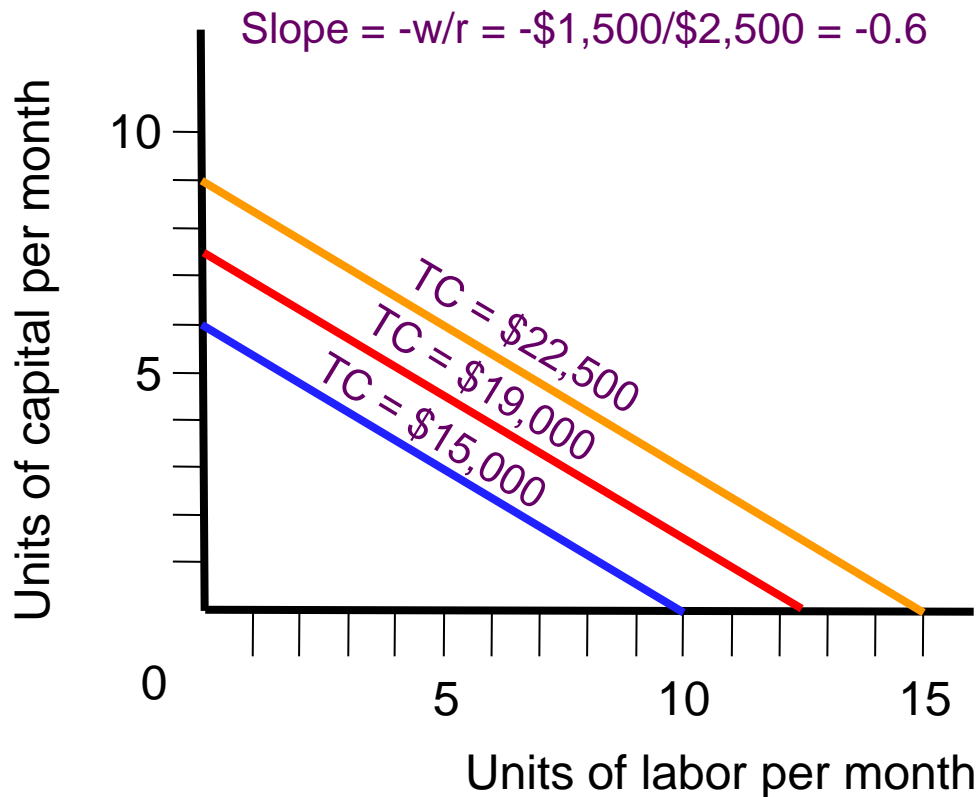
A Closer Look at Production and Cost

- **Isocost line**
  - **All combinations of capital and labor**
  - **Can be hired for a given total cost**
  - **Are parallel**
  - **Slope of isocost line**
    - **Negative**
    - **Price of labor divided by price of capital**

$$= -\frac{TC/r}{TC/w} = -\frac{w}{r}$$

Exhibit C

A Firm's Isocost Lines

Slope = -w/r = -$1,500/$2,500 = -0.6

Units of capital per month

10

5

TC = $22,500
TC = $19,000
TC = $15,000

0   5   10   15

Units of labor per month

Each isocost line

– Combinations of labor and capital that can be purchased for a given amount of total cost

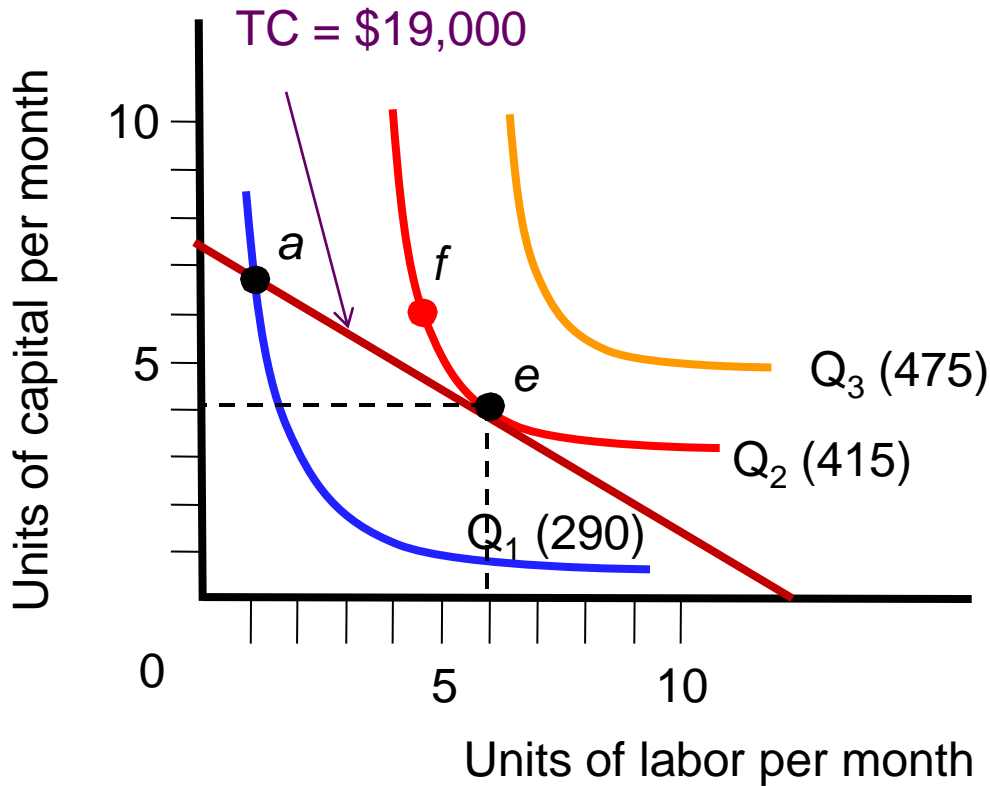– Slope is negative wage divided by the rental cost of capital

Higher costs: isocost lines farther from origin

A Closer Look at Production and Cost

- **Profit maximization**
- **Cost minimization**
- **Minimum cost to produce a given output**
  - **Tangency between isocost line and isoquant**
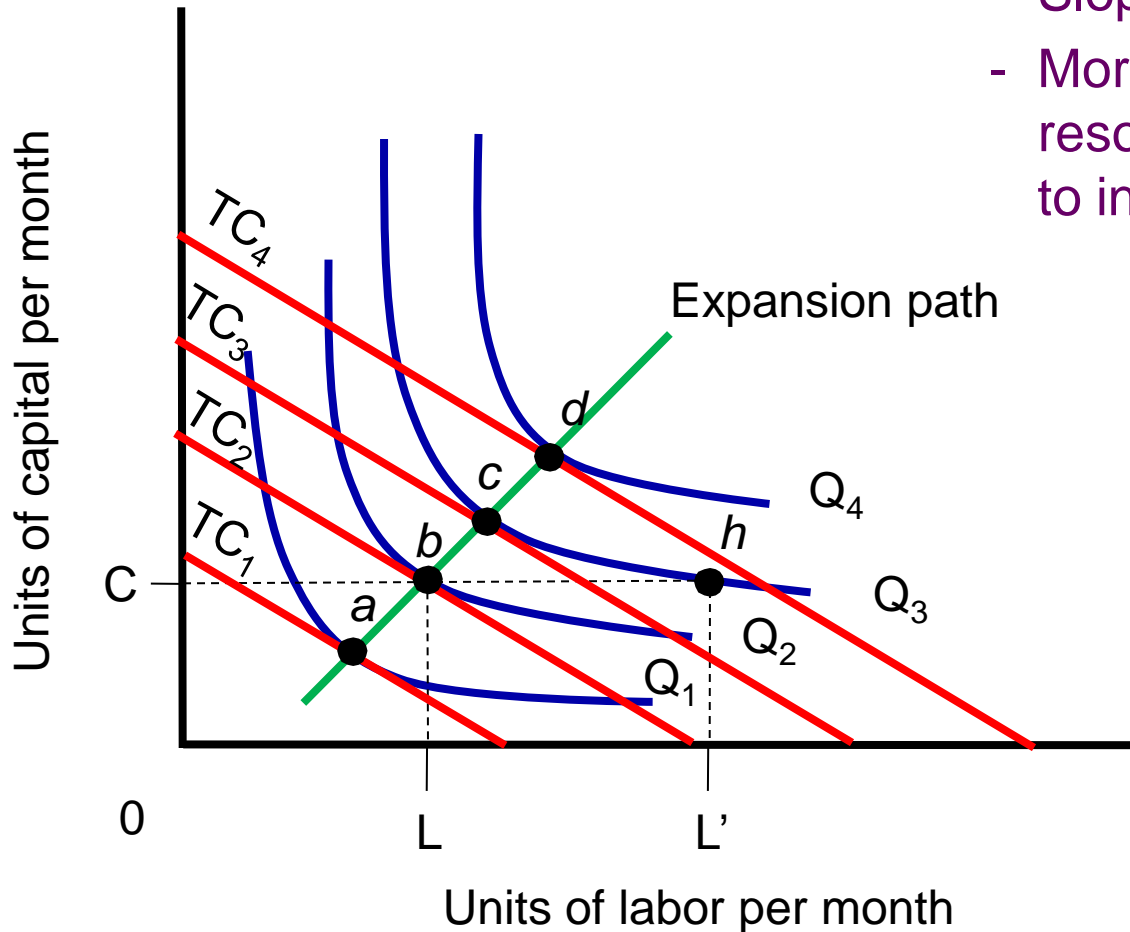   - **Slope = MRTS = w/r**
- **Expansion path**

A Firm's Optimal Combination of Inputs

TC = $19,000

e: isoquant Q_2 is tangent to the isocost line

Units of capital per month

Units of labor per month

Q_3 (475)

Q_2 (415)

Q_1 (290)

a

f

e

10

5

0

5

10

A Firm's Expansion Path

Expansion path
- Slopes up to the right
- More of both resources is needed to increase output

Units of capital per month

Expansion path

TC_4

TC_3

TC_2

TC_1

d

c

b

a

h

Q_4

Q_3

Q_2

Q_1

C

0

L

L'

Units of labor per month