Labor Demand

Labor Economics

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Labor Economics: Outline

- Labor Supply
- Labor Demand
- Equilibrium in Labor Market

- *et cetera*

Labor Demand Model: Firms

Firm's role in:

- Labor Market
  - "consumes" labor
- Capital Market
  - "consumes" capital
- Product (output) Market
  - supplies its output

Labor Demand Model: Firms

Markets are competitive:

- firms are "price takers".

Competitive Markets Assumptions:

- Firms can hire at a constant wage rate w
  - unlimited labor hours (*L*)
- Firms can rent at a constant rental rate r
  - unlimited amounts of capital (*K*)
- Firms can sell at a constant price p
  - unlimited amounts of a single good (q).

Production Function

Function:

$$q=f(L,K)$$

More output with more inputs:

$$MP_L = \frac{\partial f(L,K)}{\partial L} > 0$$

Marginal Product of Labor (MP_L) is the change in output resulting from hiring an additional worker, holding constant the quantities of all other inputs.

Marginal Product and Average Product

- **Average Product of Labor** (AP_L) is the amount of output produced by the typical worker.

$$AP_L = q/L$$

- **Marginal Product of Capital** (MP_K) is the change in output resulting from one-unit increase in the capital stock, holding constant the quantities of all other inputs.

$$MP_K = \frac{\partial f(L, K)}{\partial K} > 0$$

Marginal Product and Average Product

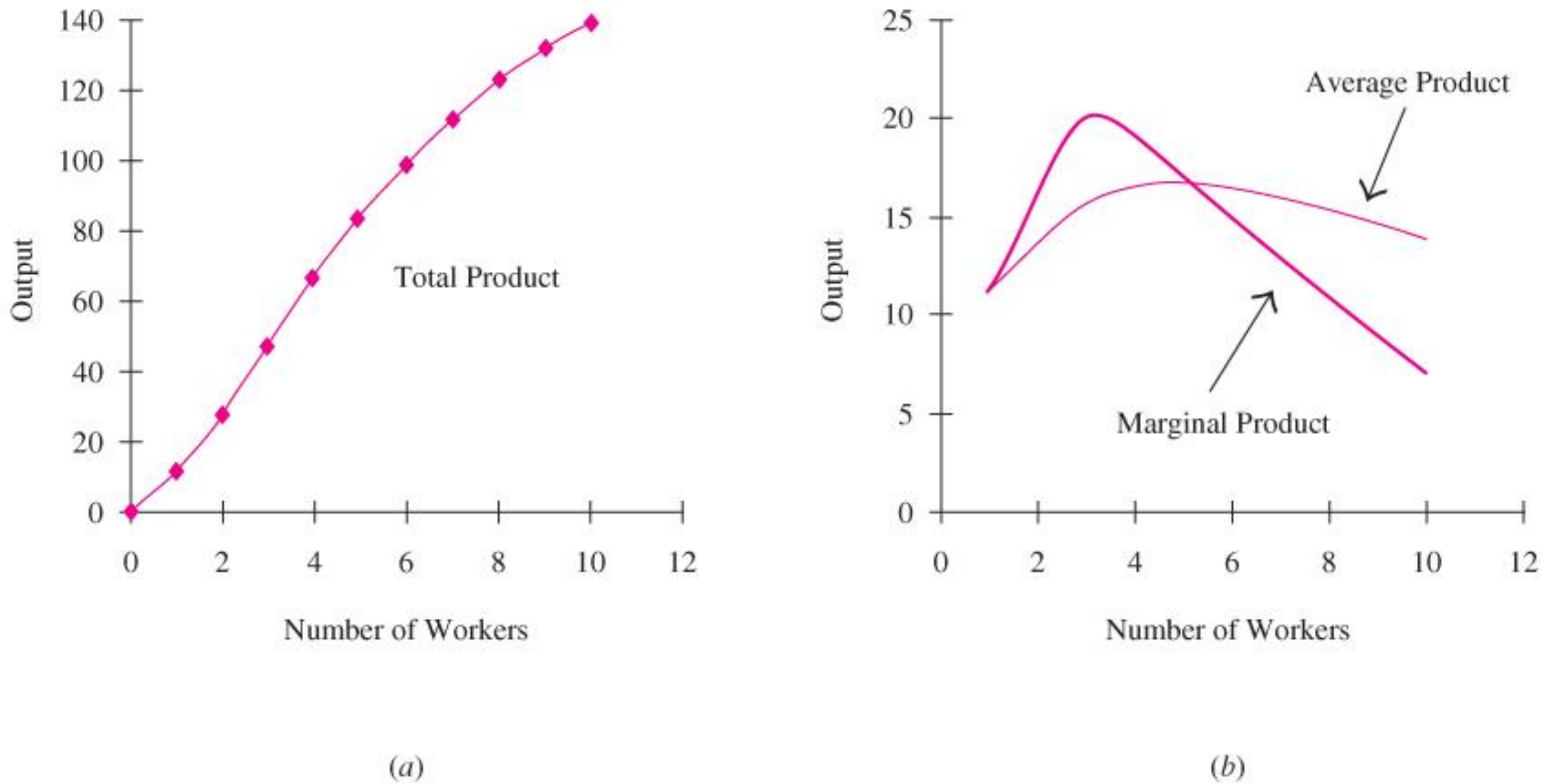
TABLE 3-1 **Calculating the Marginal and Average Product of Labor (Holding Capital Constant)**

Number of Workers Employed	Output (Units)	Marginal Product (Units)	Average Product (Units)	Value of Marginal Product ($)	Value of Average Product ($)
0	0	—	—	—	—
1	11	11	11.0	22	22.0
2	27	16	13.5	32	27.0
3	47	20	15.7	40	31.3
4	66	19	16.5	38	33.0
5	83	17	16.6	34	33.2
6	98	15	16.3	30	32.7
7	111	13	15.9	26	31.7
8	122	11	15.3	22	30.5
9	131	9	14.6	18	29.1
10	138	7	13.8	14	27.6

Note: The calculations for the value of marginal product and the value of average product assume that the price of the output is $2.

Graphical Interpretation

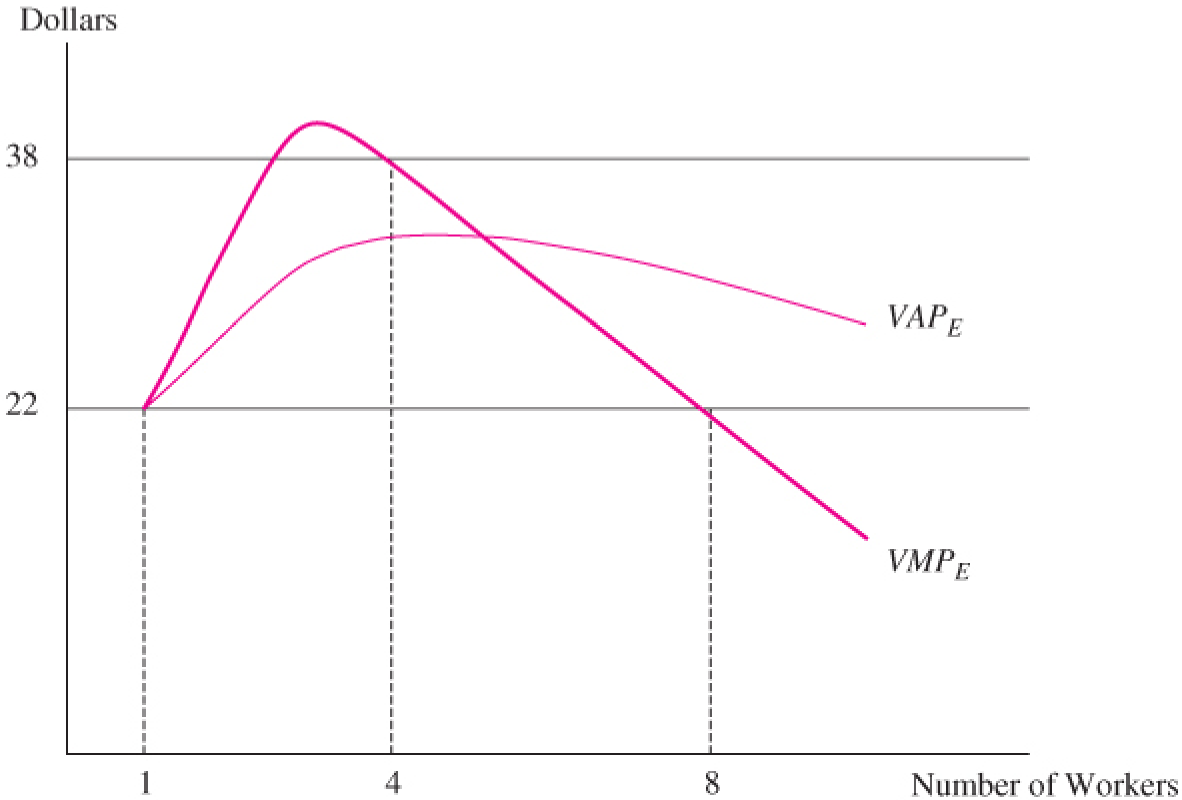
FIGURE 3-1 The Total Product, the Marginal Product, and the Average Product Curves
(*a*) The total product curve gives the relationship between output and the number of workers hired by the firm (holding capital fixed). (*b*) The marginal product curve gives the output produced by each additional worker, and the average product curve gives the output per worker.



SR: How many workers should the firm hire?

FIGURE 3-2 **The Firm's Hiring Decision in the Short Run**

A profit-maximizing firm hires workers up to the point where the wage rate equals the value of marginal product of labor. If the wage is $22, the firm hires eight workers.



The Employment Decision

- Firm's problem:

$$\max_{L} \; pf(L,\overline{K}) - wL - r\overline{K}$$

- Solution:

1. Partial derivative with respect to L

$$p\frac{\partial f(L,K)}{\partial L} = w$$

Problem

Suppose the production function is given by

$$F(L) = 6L^{2/3}$$

How many units of labor will the firm hire, if the cost per unit of labor is 12 and the price of output is 6?

Firm's problem

- Hire labor so that
- the value of marginal product is equal to the wage.

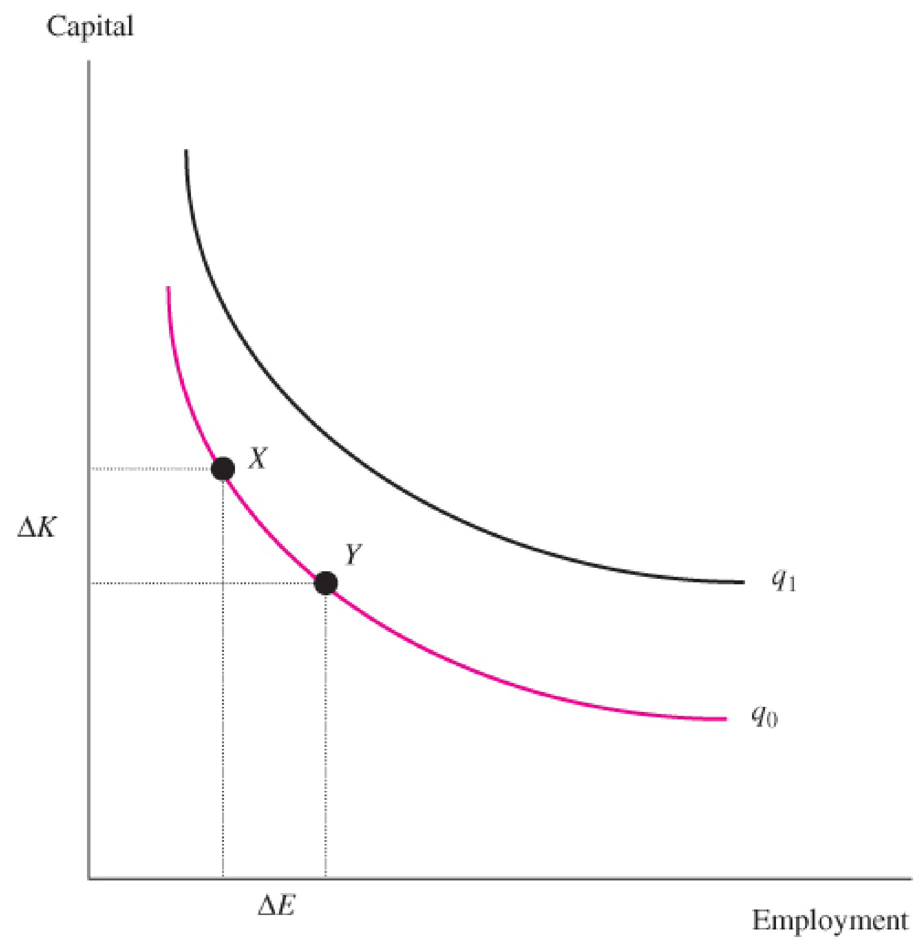
- … and how much capital to rent?

The Employment Decision in the LR

Isoquants:

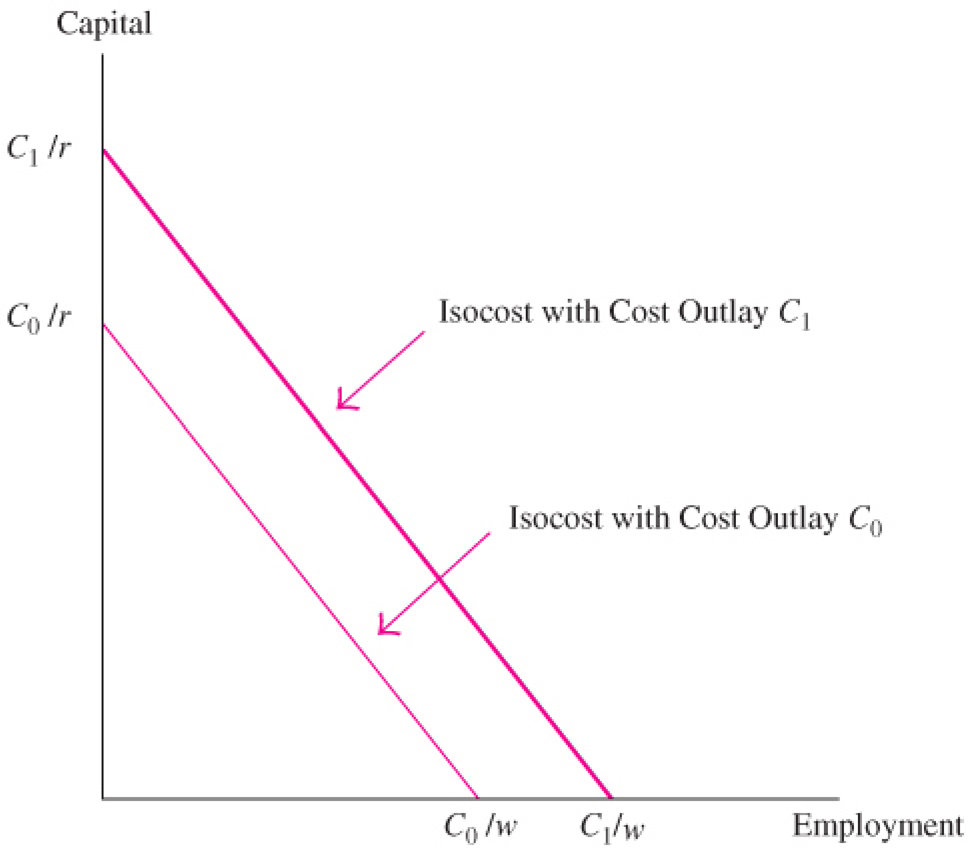
Similar to ICs (MRS): the slope of the isoquant at any given point is the *marginal rate of technical substitution*

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



Isocosts

Isocost line: equally costly combinations of L and K.



$$C = wL + rK$$

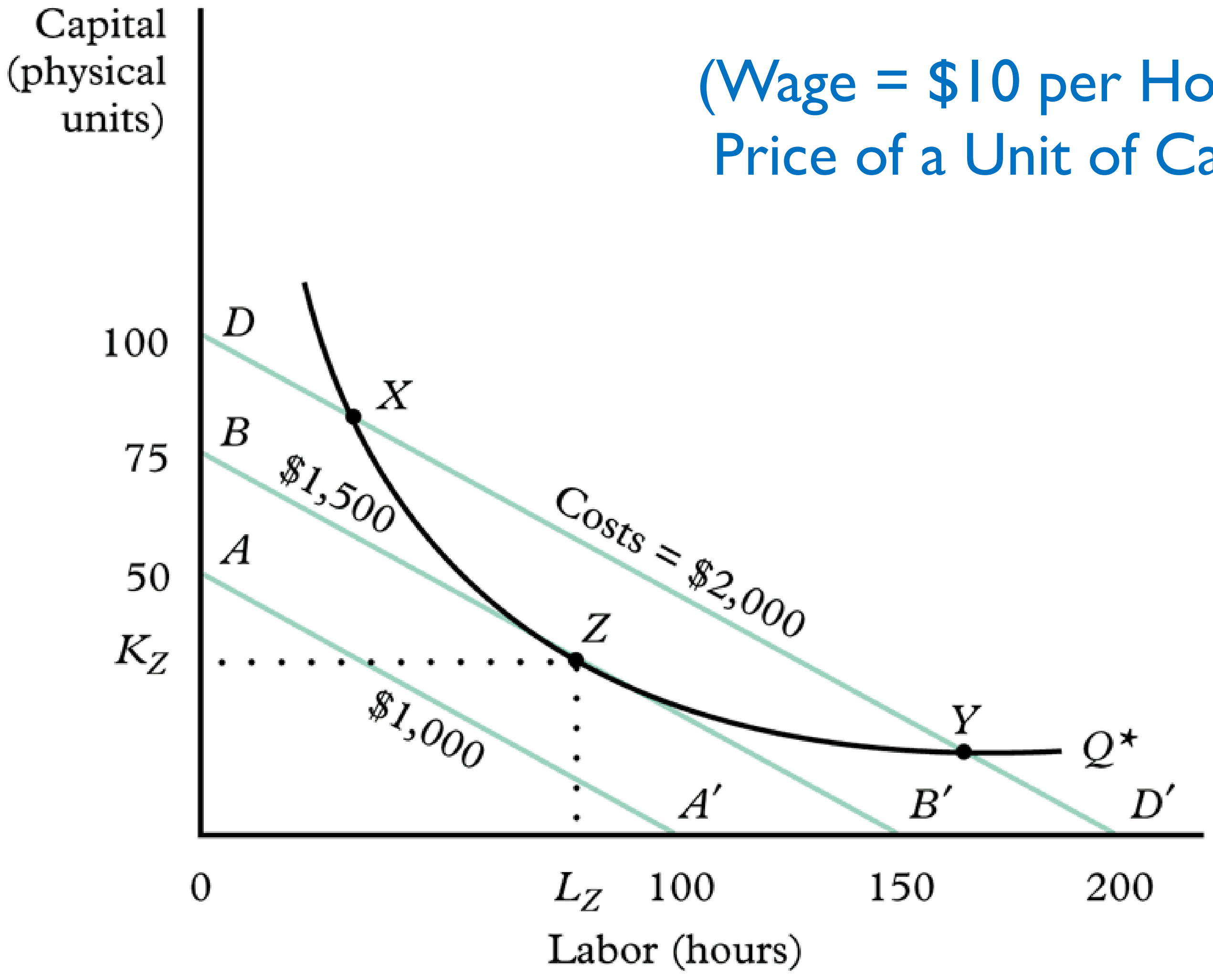
$C_1 > C_0$

Slope of isocost:

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

Cost Minimization: graph

(Wage = $10 per Hour;
Price of a Unit of Capital = $20)



Cost Minimization

$$\min_{L,K} \; wL + rK \;\text{ s.t. }\; f(L,K) = q$$

- **Solution:**

the slope of isoquant = *the slope of isocost*

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

Profit Maximization

$$\pi = pq - wL - rK$$

Firms CHOOSE L and K to $max\ \pi$,

but NOT CHOOSE prices (w and r) and output (q).

$$\max_{L,K}\ pq - wL - rK \quad \text{s.t.} \quad q = f(L,K)$$

$$\max_{L,K}\ pf(L,K) - wL - rK$$

The Employment Decision

$$\max_{L,K} \; pf(L,K) - wL - rK$$

- Deriving first order conditions:

1. Partial derivative with respect to L

$$p\frac{\partial f(L,K)}{\partial L} = w$$

2. Partial derivative with respect to K

$$p\frac{\partial f(L,K)}{\partial K} = r$$

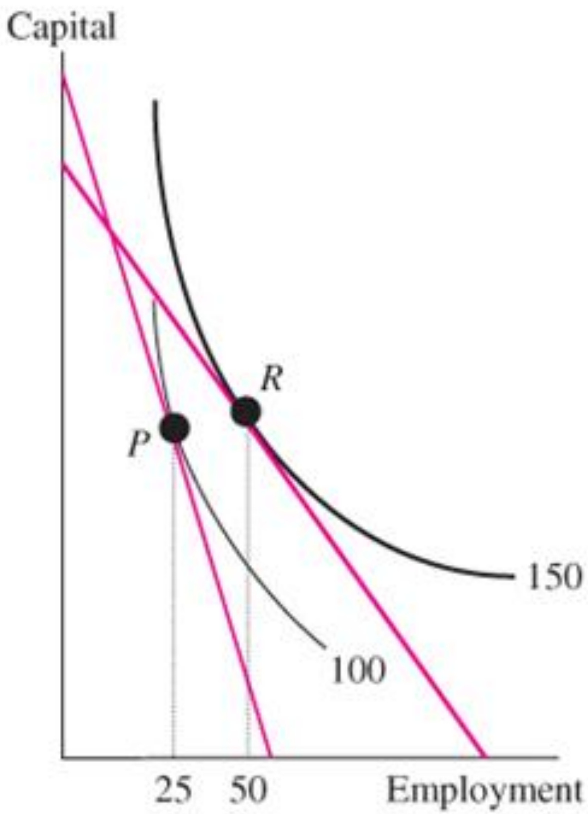
3. Solve two equations for two unknowns:

$L^*(w,r,p), K^*(w,r,p) \Rightarrow q^* = f(L^*(w,r,p), K^*(w,r,p))$

Changes in cost of inputs: $w \downarrow$

?

Changes in cost of inputs: $w\downarrow$

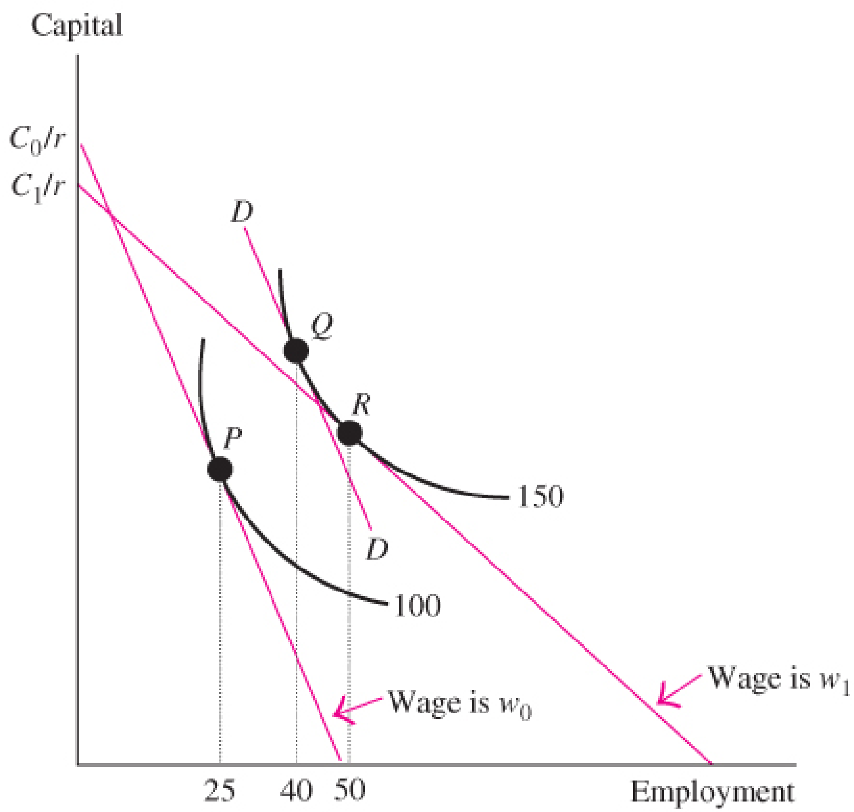


(b) Firm's Hiring Decision

- Two simultaneous changes
  - in capital labor ratio
  - production size

Substitution and Scale Effects

FIGURE 3-12 **Substitution and Scale Effects**
A wage cut generates substitution and scale effects. The scale effect (the move from point *P* to point *Q*) encourages the firm to expand, increasing the firm's employment. The substitution effect (from *Q* to *R*) encourages the firm to use a more labor-intensive method of production, further increasing employment.



Elasticity of Substitution

The *elasticity of substitution* indicates how easily firms can change their input mix as relative input prices change.

$$\sigma = \frac{\%\Delta(K/L)}{\%\Delta(w/r)} \text{ or } \sigma = \frac{\partial(K/L)}{\partial(w/r)} \cdot \frac{w/r}{K/L}$$

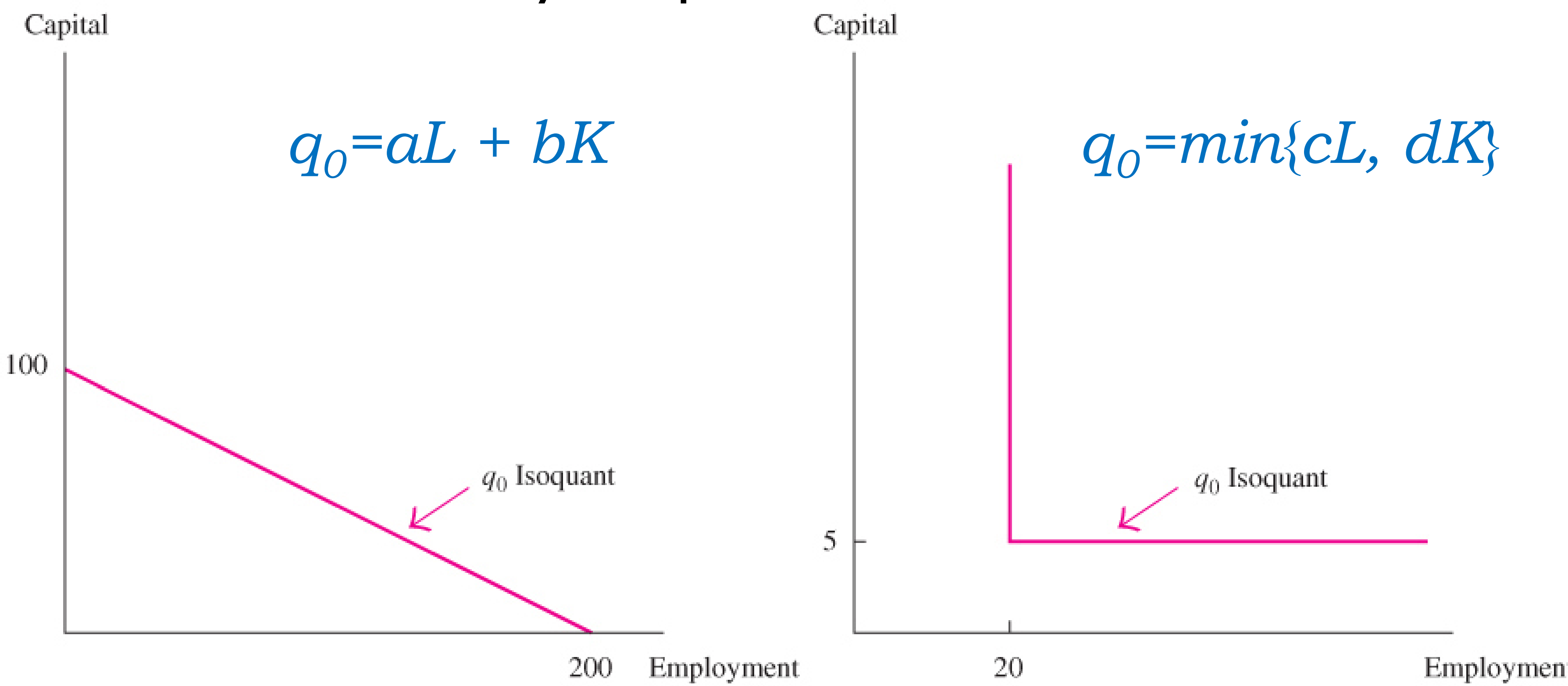
Note: for profit maximization w/r=MRTS $\Rightarrow$

$$\sigma = \frac{\%\Delta(K/L)}{\%\Delta(MRTS)} \text{ or } \sigma = \frac{\partial(K/L)}{\partial(MRTS)} \cdot \frac{MRTS}{K/L}$$

$\sigma \geq 0$: higher values of σ indicate that the firm can more easily substitute inputs as the relative input prices change.

Elasticity of Substitution

- σ is determined by the production function!



(*a*) Perfect Substitutes   (*b*) Perfect Complements

Elasticity of Labor Demand

The *elasticity of demand is defined as* the percentage change in quantity resulting from a percentage change in price.

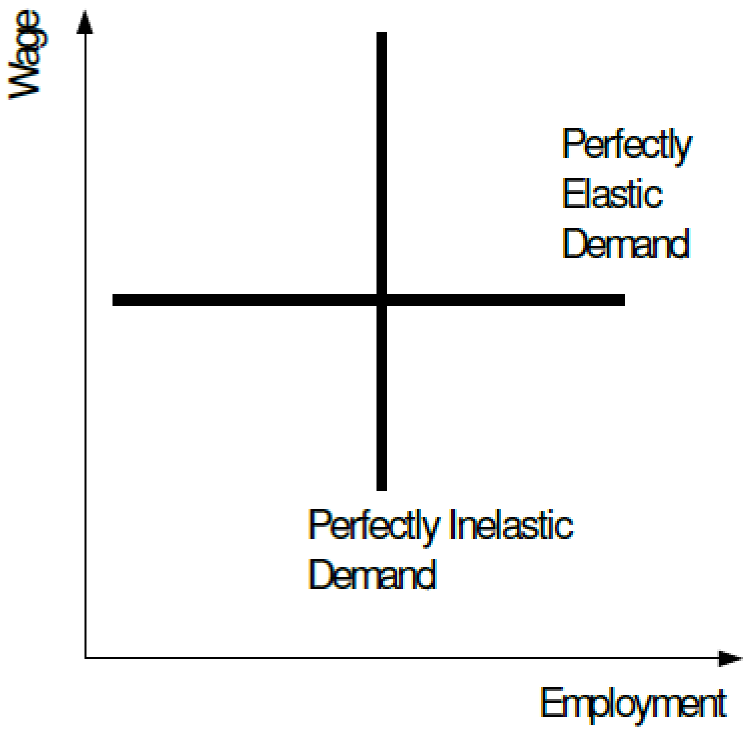
$$\varepsilon = \frac{\%\Delta L^*(w,r,p)}{\%\Delta w} \quad \text{or} \quad \varepsilon = \frac{\partial L^*(w,r,p)}{\partial w} \cdot \frac{w}{L^*}$$

- It is a measure of how responsive employment is to a change in the wage.

Elasticity of Labor Demand

- $\varepsilon = 0$ perfectly inelastic demand;
- $-1 < \varepsilon < 0$ inelastic demand;
- $\varepsilon = -1$ unit elastic labor demand;
- $\varepsilon < -1$ elastic labor demand;
- $\varepsilon = -\infty$ perfectly elastic demand.

Elasticity of Labor Demand



- Perfectly inelastic demand:

  $$\partial L/\partial w \cdot w/L = 0$$

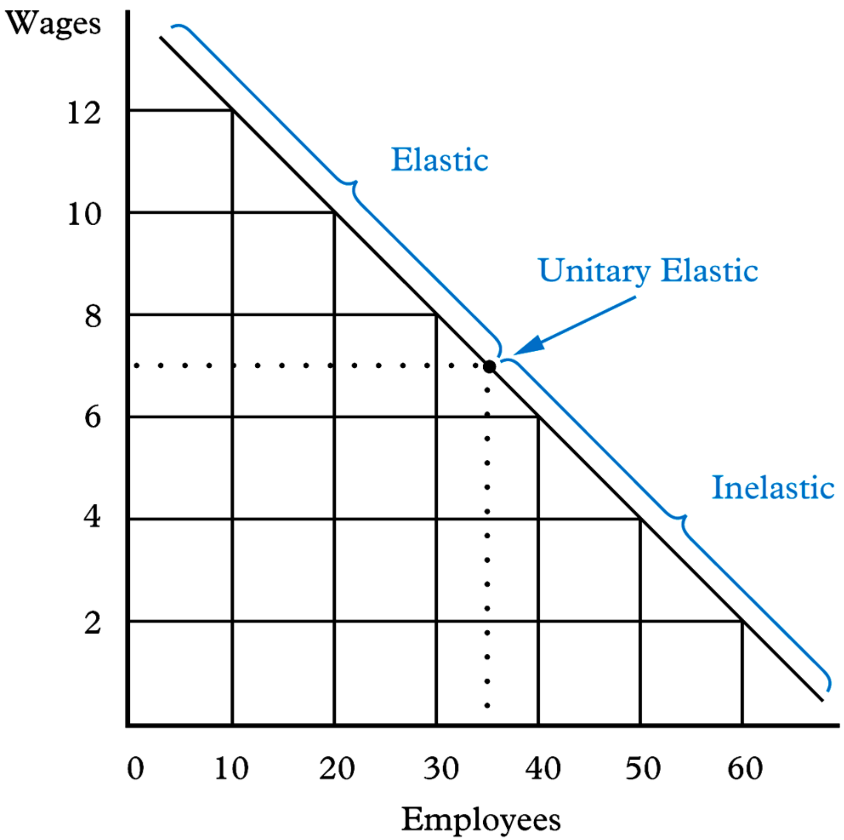
- Same employment is demanded at any wage.

- Perfectly elastic demand:

  $$\partial L/\partial w \cdot w/L = -\infty$$

- No labor is demanded above market wage.

Elasticity of Labor Demand



- **Inelastic demand**

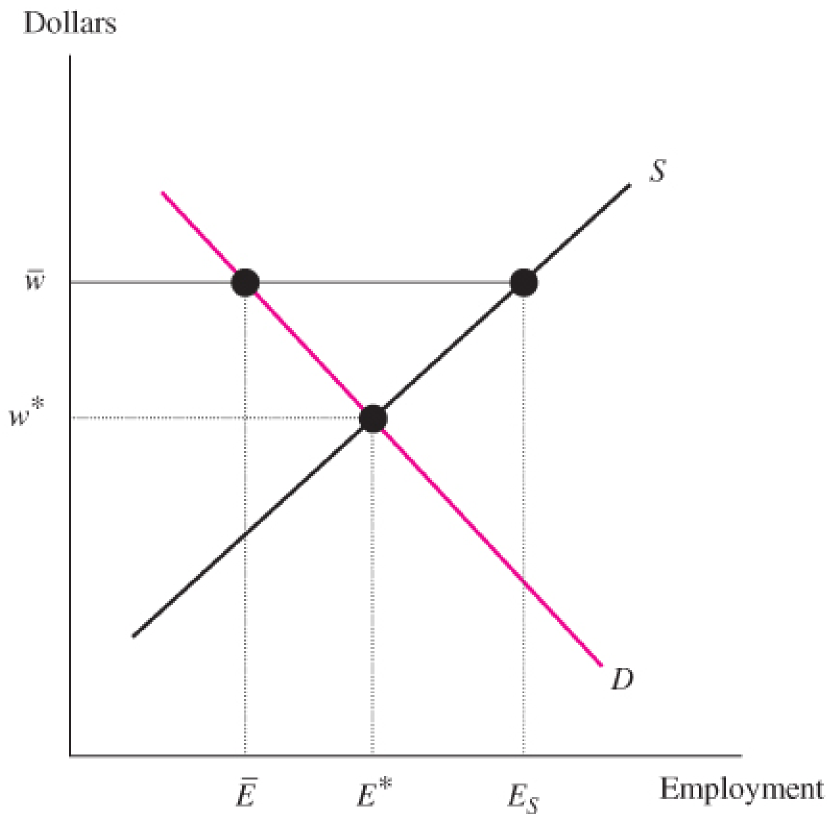
  $-1 < \partial L/\partial w \cdot w/L < 0$
- % Δ in L **<** % Δ in w.
- **Elastic demand**

  $\partial L/\partial w \cdot w/L < -1$
- % Δ in L **>** % Δ in w.
- **Unit Elastic demand**

  $\partial L/\partial w \cdot w/L = -1$
- % Δ in L **=** % Δ in w.

Policy Application: Minimum wage

FIGURE 3-19 **The Impact of the Minimum Wage on Employment**
A minimum wage set at $\overline{w}$ forces employees to cut employment (from E^* to $\overline{E}$). The higher wage also encourages ($E_S - E^*$) additional workers to enter the market. The minimum wage, therefore, creates unemployment.



Policy Application: Minimum wage

- If the labor demand **elasticity** with respect to wages is **low**, the **employment effects** of min wages are **low**.

Extreme cases:

- If labor demand is perfectly inelastic?
- If labor demand is perfectly elastic?

Reality? somewhere between extreme cases