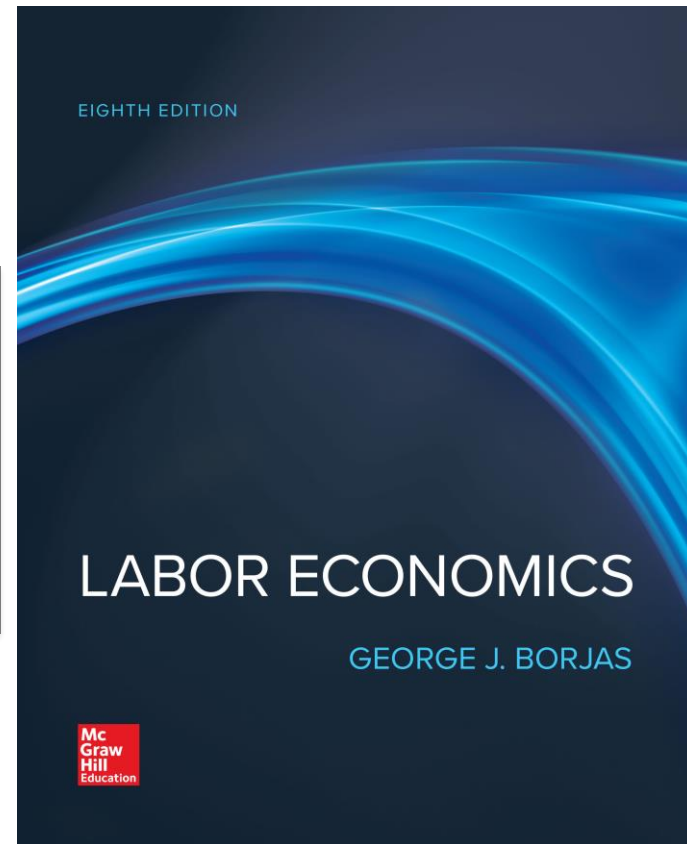# Chapter 3

Labor Demand

"The laborer is worthy of his hire."
-The Gospel of St. Luke

Introduction

Firms hire workers because consumers want to purchase a variety of goods and services.

Demand for workers is derived from the wants and desires of consumers.

Central questions: how many workers are hired and what are they paid?

The Firm's Production Function

Describes the technology that the firm uses to produce goods and services.

The firm's output can be produced by a variety of capital–labor combinations.

The marginal product of labor is the change in output resulting from hiring an additional worker, holding constant the quantities of other inputs.

The marginal product of capital is the change in output resulting from employing one additional unit of capital, holding constant the quantities of other inputs.

The Total Product, the Marginal Product, and the Average Product Curves
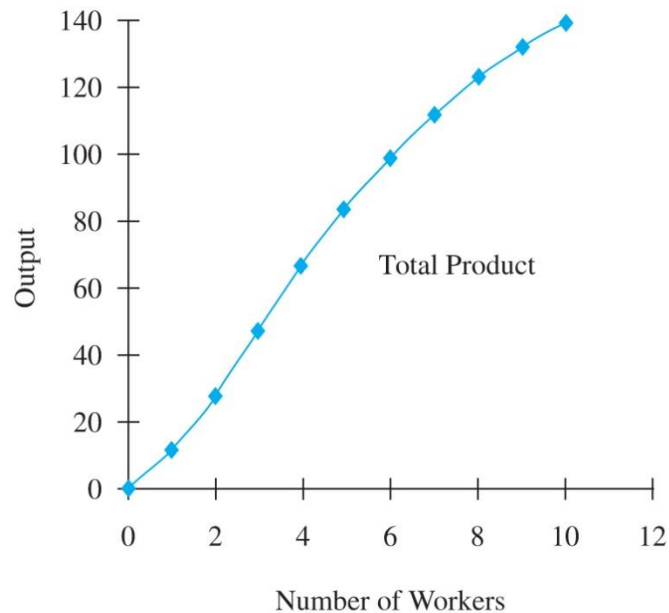
(a)
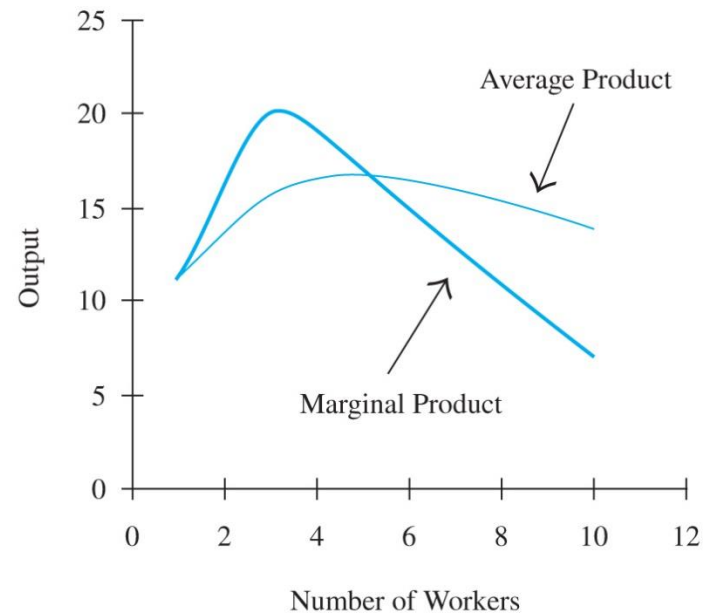
(b)

The total product curve gives the relationship between output and the number of workers hired by the firm (holding capital fixed). The marginal product curve shows the output produced by each additional worker, and the average product curve shows output per worker.

Profit Maximization

Objective of the firm is to maximize profits.

The profit function is:

- Profits = $pq - wE - rK$

  - Total Revenue = pq

  - Total Costs = $(wE + rk)$

Perfectly competitive firms cannot influence prices of output or inputs.

Short Run Hiring Decision

Value of Marginal Product of Employment (VMP_E) is the marginal product of labor times the dollar value of the output.

VMP_E indicates the dollar benefit derived from hiring an additional worker, holding capital constant.

Value of Average Product of Employment is the dollar value of output per worker.

The Firm's Hiring Decision in the Short-Run

Dollars

38

22

1   4   8   Number of Workers

VAP_E

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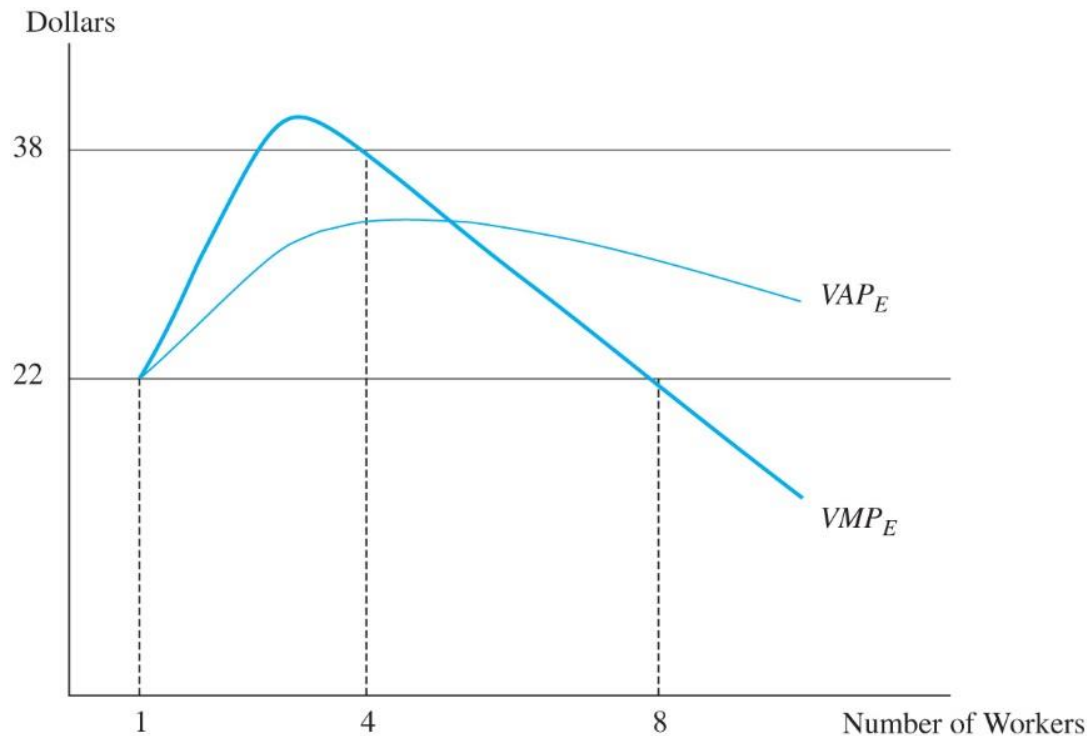
A profit-maximizing firm hires workers up to the point where the wage rate equals the value of marginal product of labor. If the wage is $22, the firm hires eight workers.

Labor Demand Curve

The demand curve for labor indicates how many workers the firm hires for each possible wage, holding capital constant.

The labor demand curve is downward sloping. This reflects the fact that additional workers are costly and alter average production due to the Law of Diminishing Returns.

The Short-Run Demand Curve for Labor
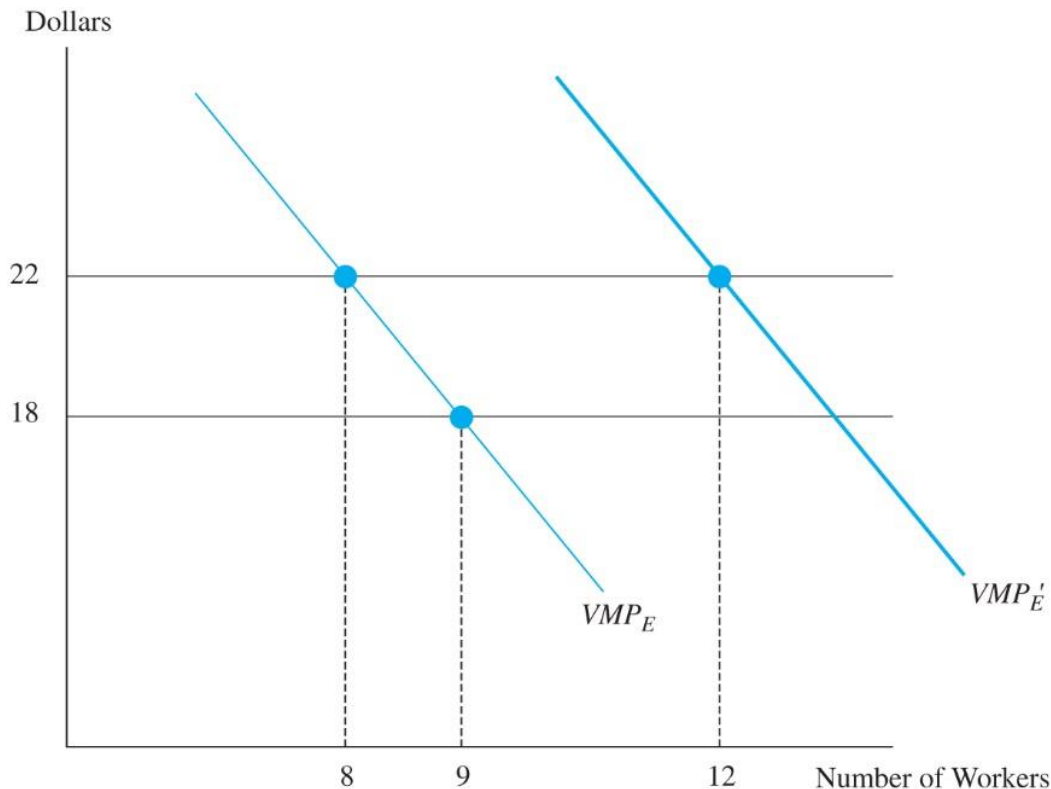
Because marginal product eventually declines, the short-run demand curve for labor is downward sloping. A drop in the wage from $22 to $18 increases the firm's employment. An increase in the price of the output shifts the value of marginal product curve upward (to the right), and increases employment.

Maximizing Profits: Two Rules

The profit maximizing firm should produce up to the point where the cost of producing an additional unit of output (marginal cost) is equal to the revenue obtained from selling that output (marginal revenue).

Marginal Productivity Condition: hire labor up to the point where the value of marginal product equals the added cost of hiring the worker (i.e., the wage).

The Mathematics of Marginal Productivity Theory

The cost of producing an extra unit of output:

- $MC = w \times (1 / MP_E)$

The condition: produce to the point where MC = P (for the competitive firm, $P = MR$)

- $W \times (1 / MP_E) = P$

Critiques of Marginal Productivity Theory

A common criticism is that the theory bears little relation to the way that employers make hiring decisions.
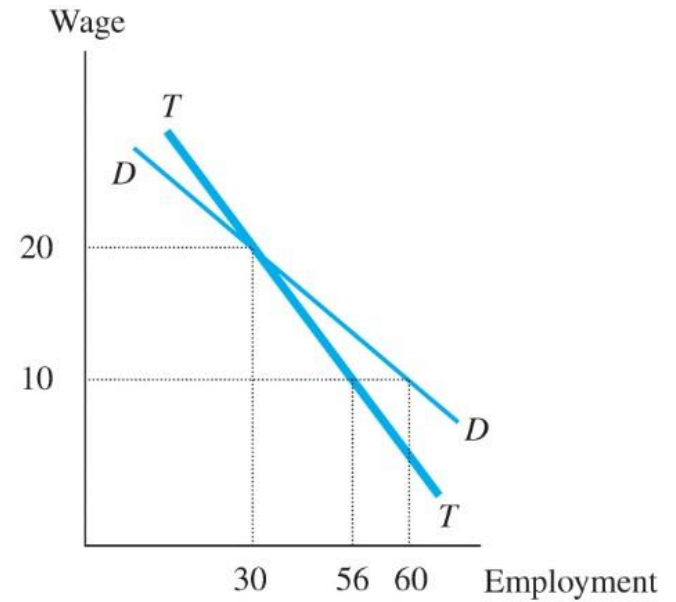
Another criticism is that the assumptions of the theory are not very realistic.

However, employers act as if they know the implications of marginal productivity theory (hence, they try to make profits and remain in business).
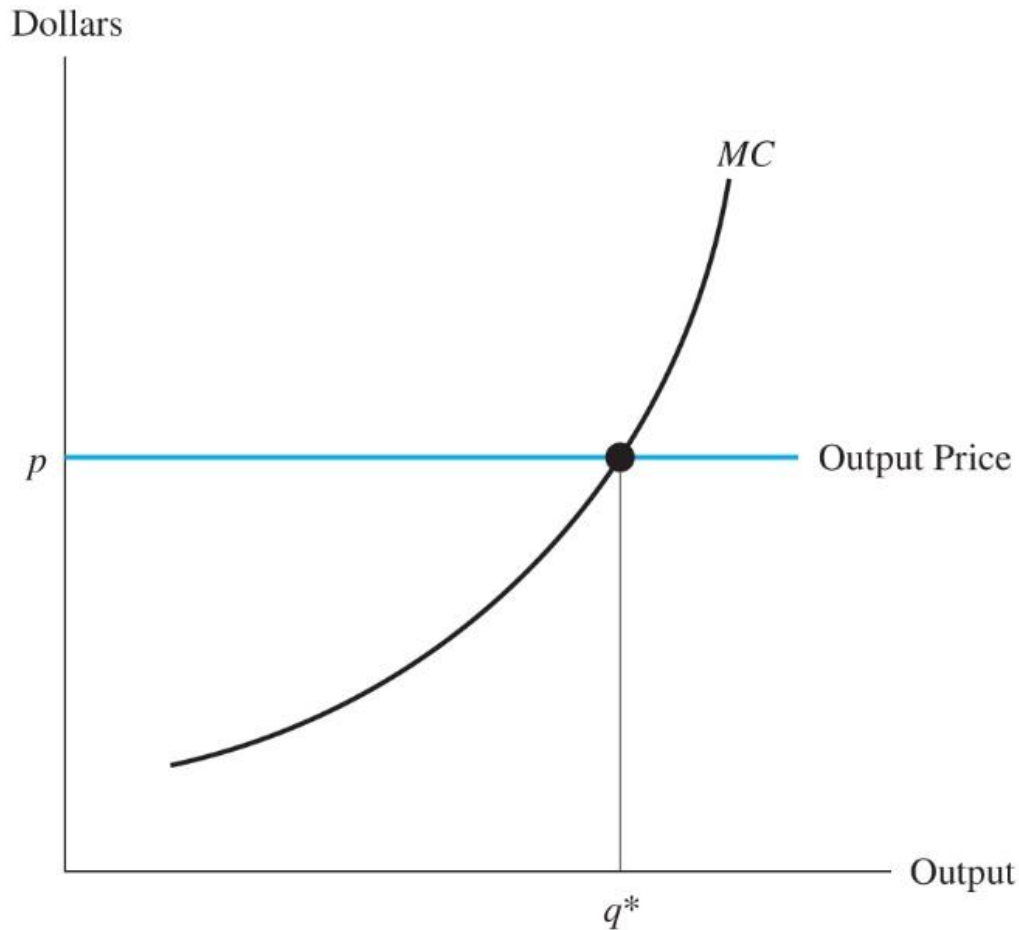
The Short-Run Demand Curve for the Industry
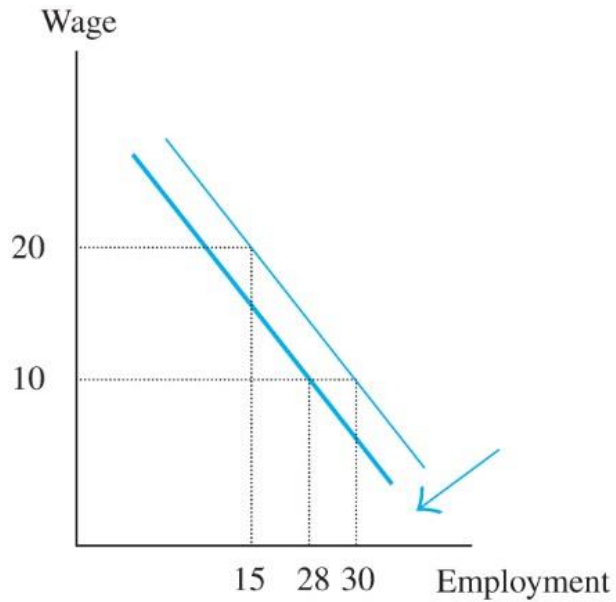
(a) Individual Firms

(b) Industry

The Firm's Output Decision

A profit-maximizing firm produces up to the point where the output price equals the marginal cost of production.

The Employment Decision in the Long Run

In the long run, the firm maximizes profits by choosing how many workers to hire AND how much plant and equipment to invest in.

Isoquant curves describe the possible combinations of labor and capital that produce the same level of output

Isoquant Curves
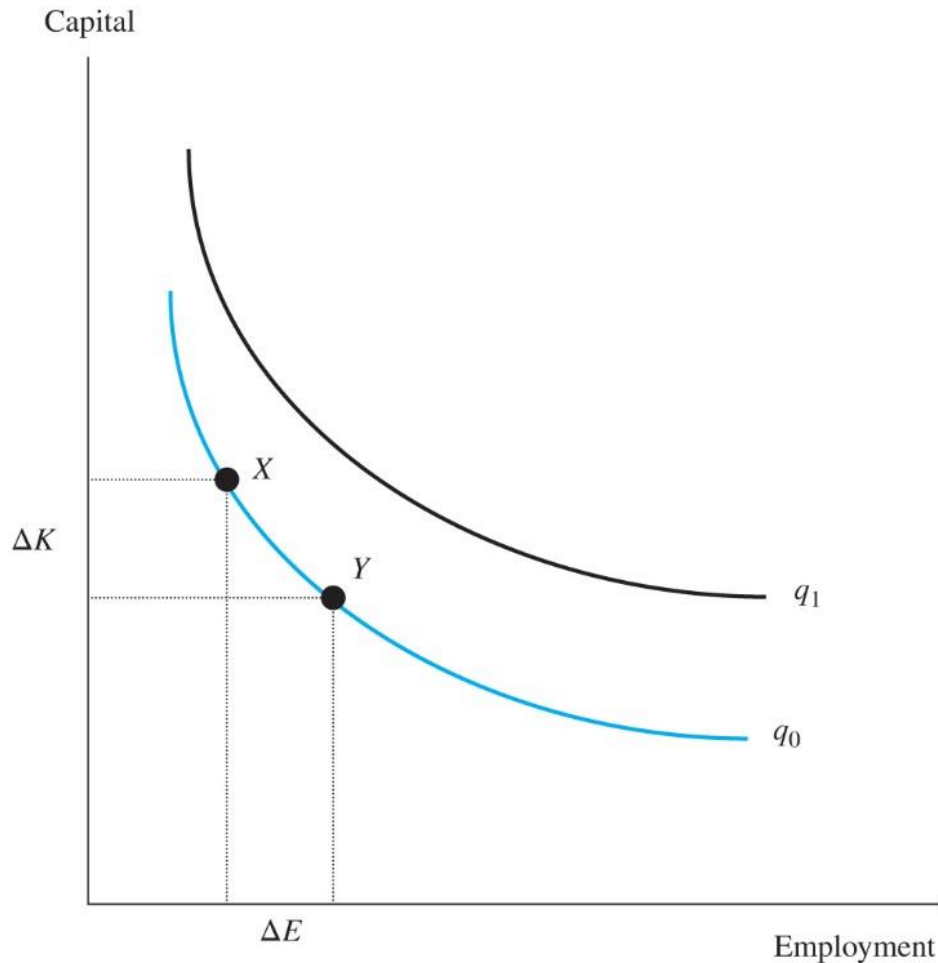
All capital-labor combinations that lie on a single isoquant produce the same level of output. The input combinations at points *X* and *Y* produce q_0 units of output. Combinations of input bundles that lie on higher isoquants must produce more output.
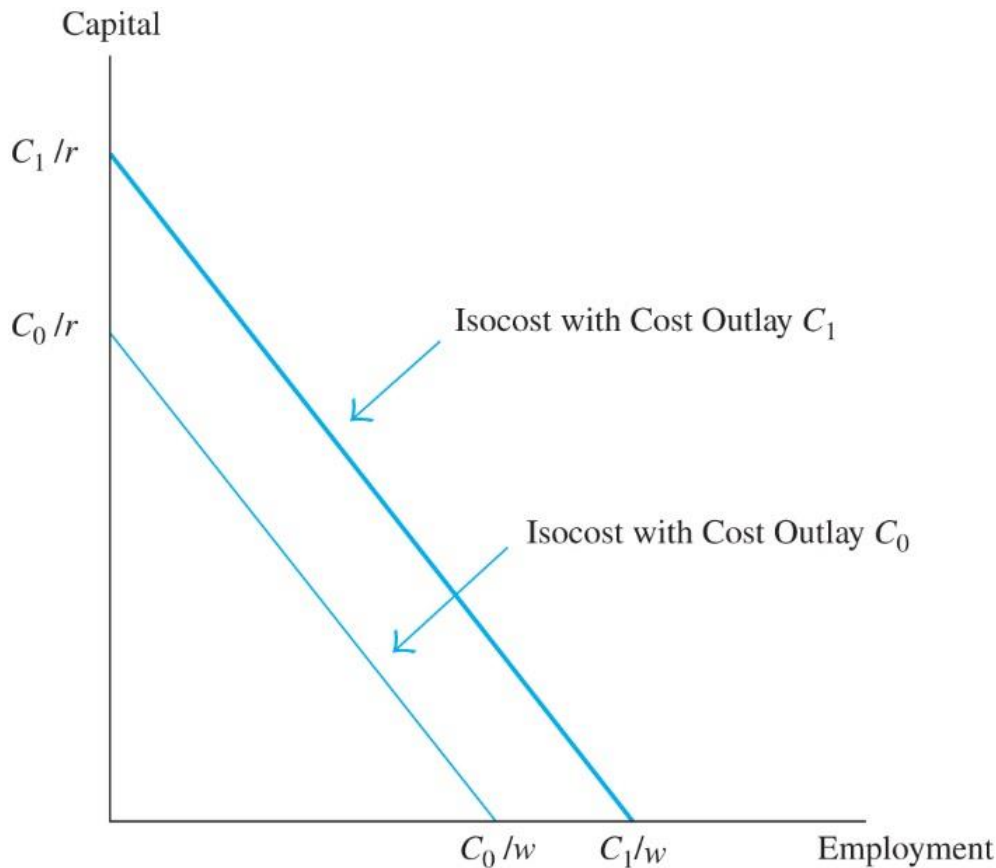
Isocost Lines

The isocost line indicates all labor–capital bundles that exhaust a specified budget for the firm.

Isocost lines indicate equally costly combinations of inputs.

Higher isocost lines indicate higher costs.

Isocost Lines

Capital

C_1/r

C_0/r

Isocost with Cost Outlay C_1

Isocost with Cost Outlay C_0

C_0/w C_1/w Employment

All capital-labor combinations that lie on a single isocost curve are equally costly. Capital-labor combinations that lie on a higher isocost curve are more costly. The slope of an isoquant equals the ratio of input prices (-*w/r*).

19

The Firm's Optimal Combination of Inputs
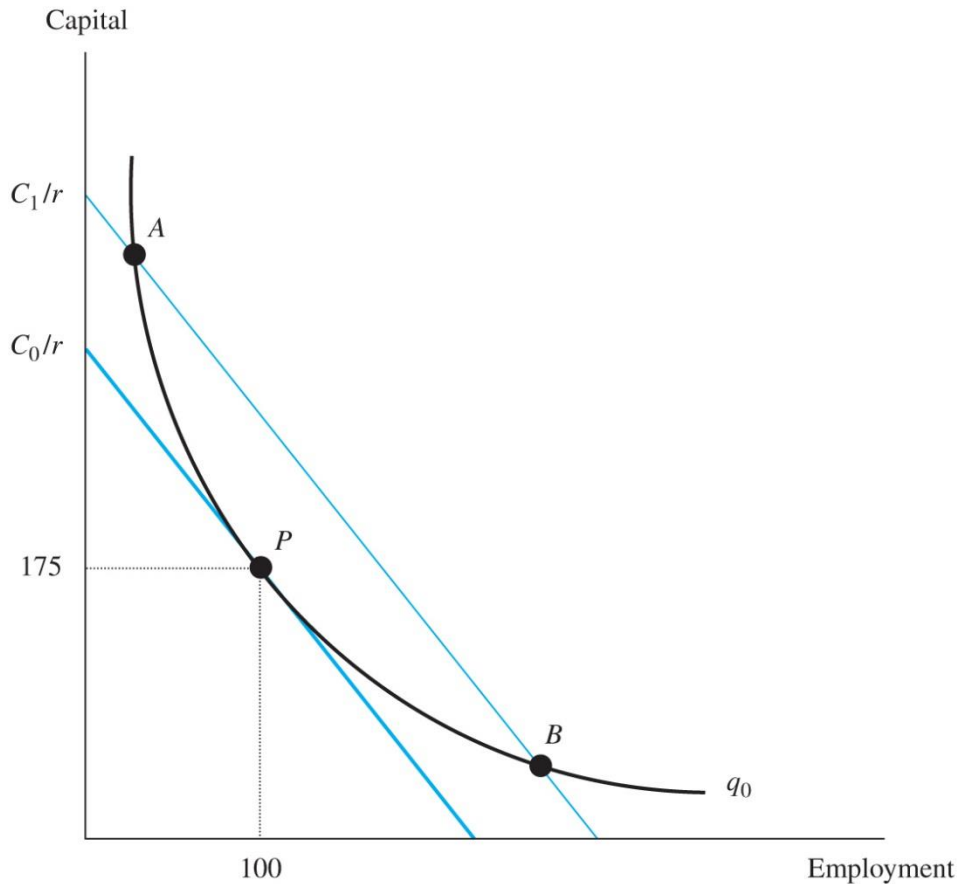
A firm minimizes the cost of producing q_0 units of output by using the capital-labor combination at point *P*, where the isoquant is tangent to the isocost. All other capital-labor combinations (such as those given by points *A* and *B*) lie on a higher isocost curve.

Cost Minimization

Profit maximization implies cost minimization.

The firm chooses the least-cost combination of capital and labor.

This least-cost choice is where the isocost line is tangent to the isoquant.

Marginal rate of substitution equals the ratio of input prices, w/r, at the least-cost choice.

Long Run Demand for Labor

When the wage drops, two effects arise.

- The firm takes advantage of the lower price of labor by expanding production (the scale effect).

- The firm takes advantage of the wage change by rearranging its mix of inputs, by employing more labor and less of other inputs, even if holding output constant (the substitution effect)

# The Impact of a Wage Reduction Holding Costs Constant
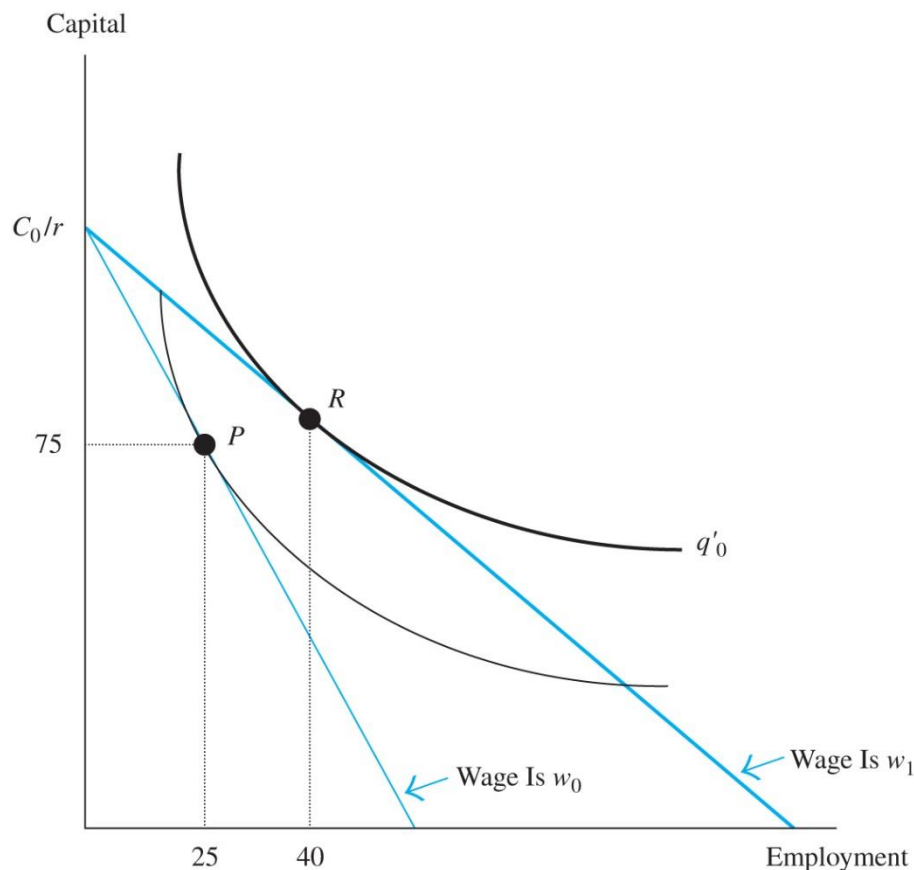
A wage reduction flattens the isocost curve. If the firm were to hold the initial cost outlay constant at C_0 dollars, the isocost would rotate around C_0 and the firm would move from point P to point R. A profit-maximizing firm, however, will not generally want to hold the cost outlay constant when the wage changes.

The Impact of a Wage Reduction on the Output and Employment of a Profit-Maximizing Firm

(a) Firm's Output Decision

(b) Firm's Hiring Decision
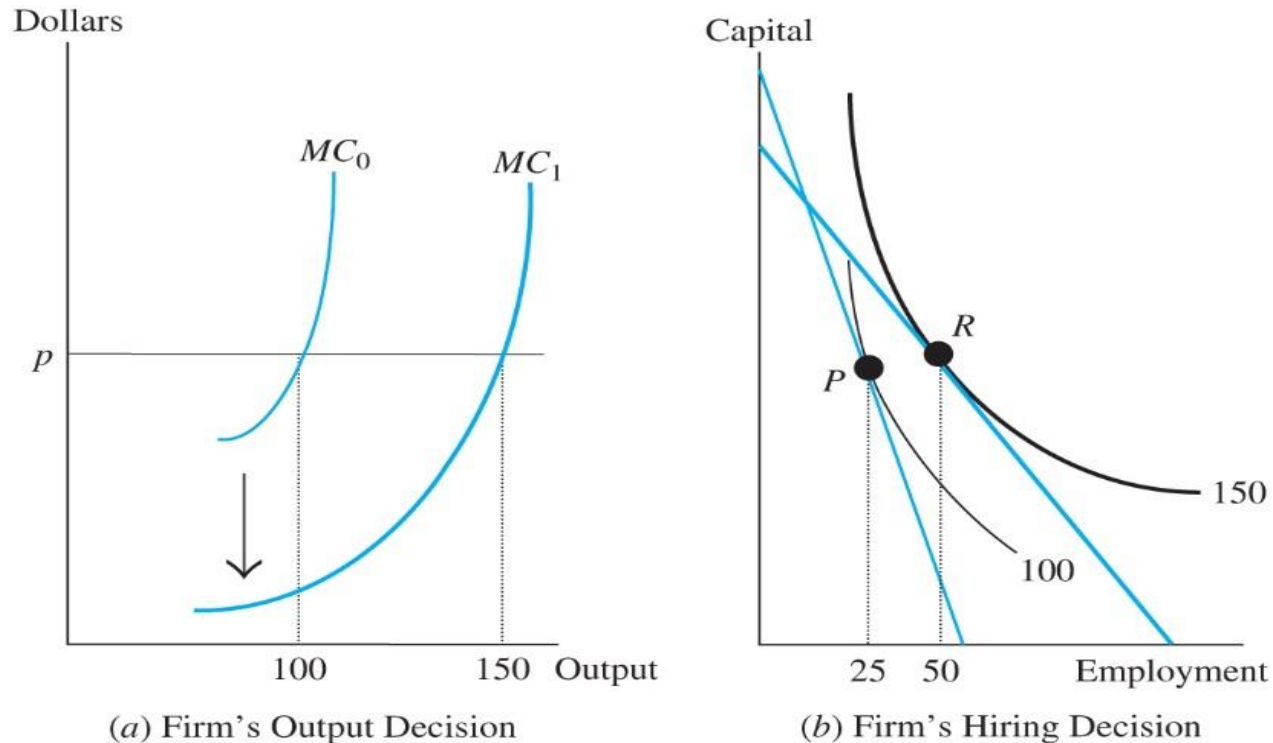
- A wage cut reduces the marginal cost of production and encourages the firm to expand (from producing 100 to 150 units).

- The firm moves from point *P* to point *R*, increasing the number of workers hired from 25 to 50.

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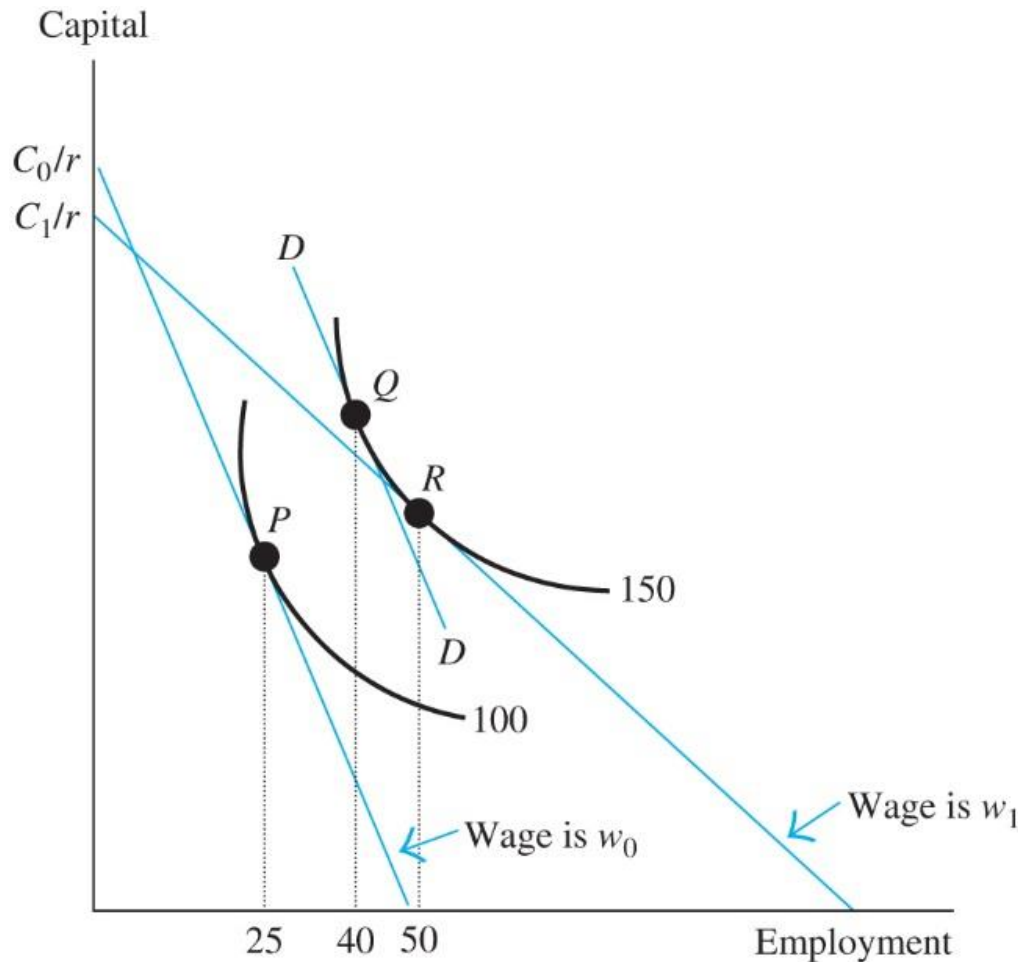
A wage cut generates substitution and scale effects. The scale effect (from *P* to *Q*) encourages the firm to expand, increasing the firm's employment. The substitution effect (from *Q* to *R*) encourages the firm to use a more labor-intensive method of production, further increasing employment.

Two Special Cases of Isoquants
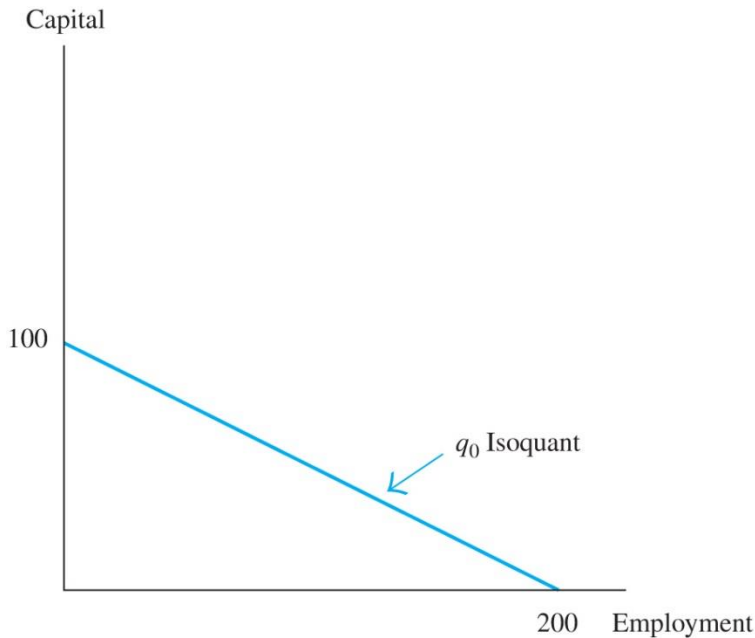
(a) Perfect Substitutes
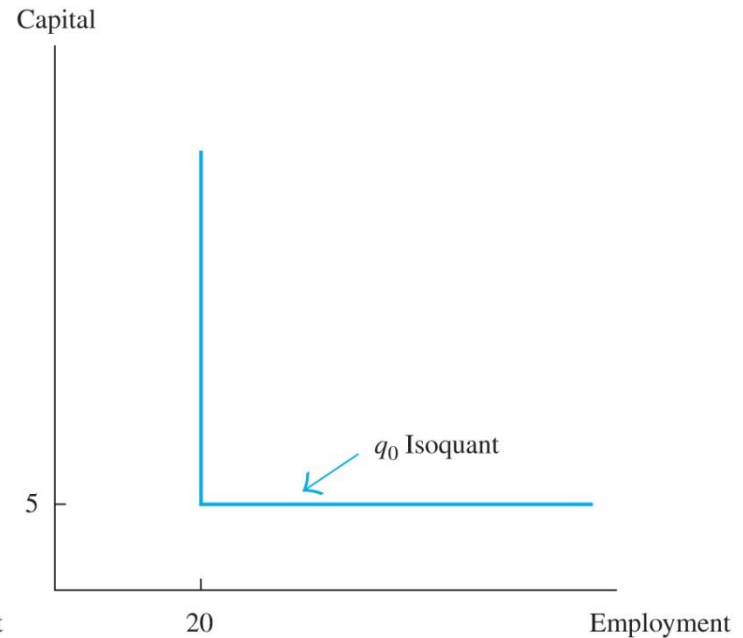
(b) Perfect Complements

Capital and labor are perfect substitutes if the isoquant is linear (so that two workers can always be substituted for one machine). The two inputs are perfect complements if the isoquant is right-angled. The firm then gets the same output when it hires 5 machines and 20 workers as when it hires 5 machines and 25 workers.

Elasticity of Substitution

The elasticity of substitution is the percentage change in the capital to labor ratio given a percentage change in the price ratio (wages to real interest).

- Formula: %Δ(K/L) ÷ %Δ(w/r).

- Interpret a particular elasticity of substitution number as the percentage change in the capital–labor ratio given a 1% change in the relative price of labor to capital

Elasticity of Substitution

Example:

If the elasticity of substitution is 5, then a 10% increase in the ratio of wages to the price of capital would result in the firm increasing its capital-to-labor ratio by 50%.

The Short- and Long-Term Demand Curves for Labor

Dollars

Short-Run Demand Curve

Long-Run Demand Curve

Employment
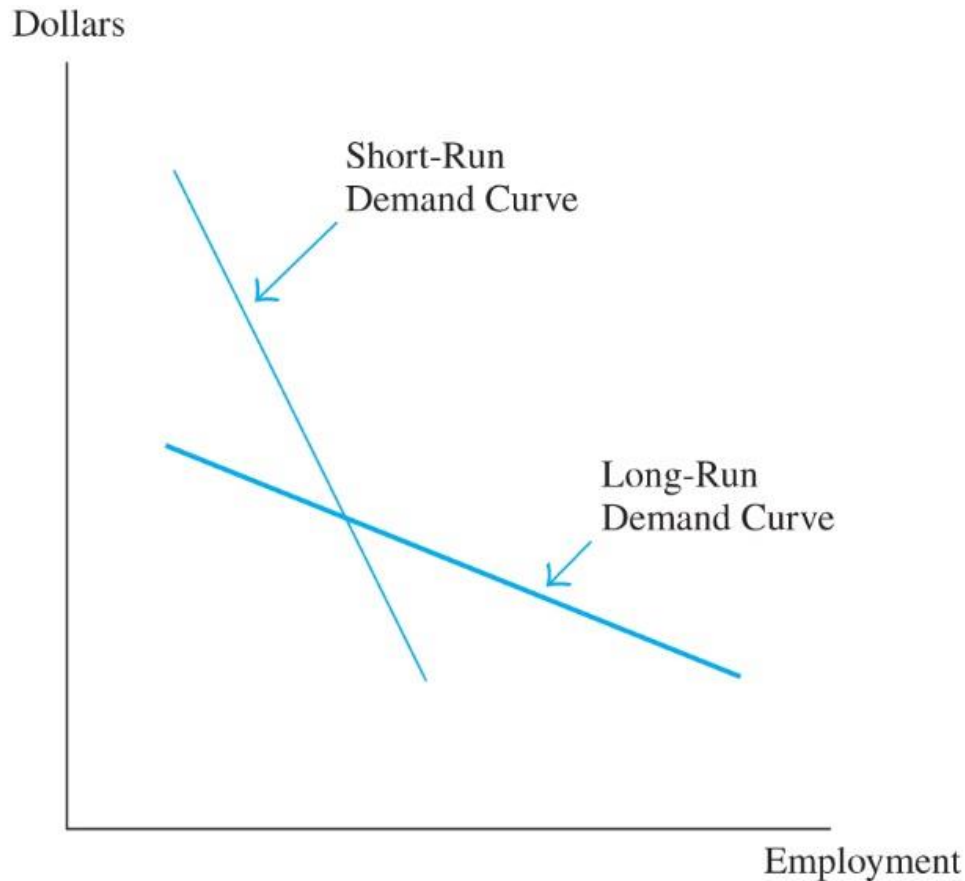
In the long run, the firm can take full advantage of the economic opportunities introduced by a change in the wage. As a result, the long-run demand curve is more elastic than the short-run demand curve.

Marshall's Rules

Labor Demand is more elastic when:

- The elasticity of substitution is greater.

- The elasticity of demand for the firm's output is greater.

- Labor's share in total costs of production is greater.

- The elasticity of supply of other factors of production such as capital is greater.

Factor Demands When There Are Several Inputs

There are many different inputs.

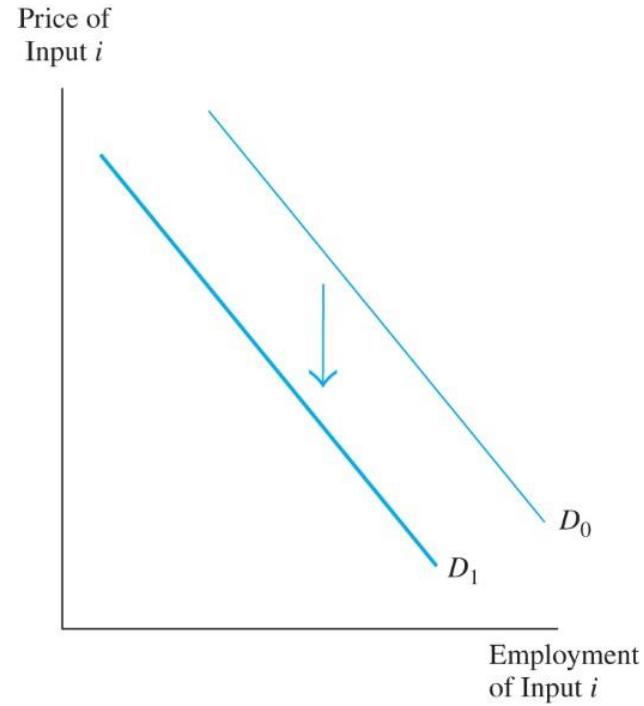- Skilled and unskilled labor

- Old and young

- Old and new machines

Cross-elasticity of factor demand.

- Percent change in x_i ÷ Percent change in w_j

- If cross-elasticity is positive, the two inputs are said to be substitutes in production.

# The Demand Curve for a Factor of Production Affected by the Prices of Other Inputs
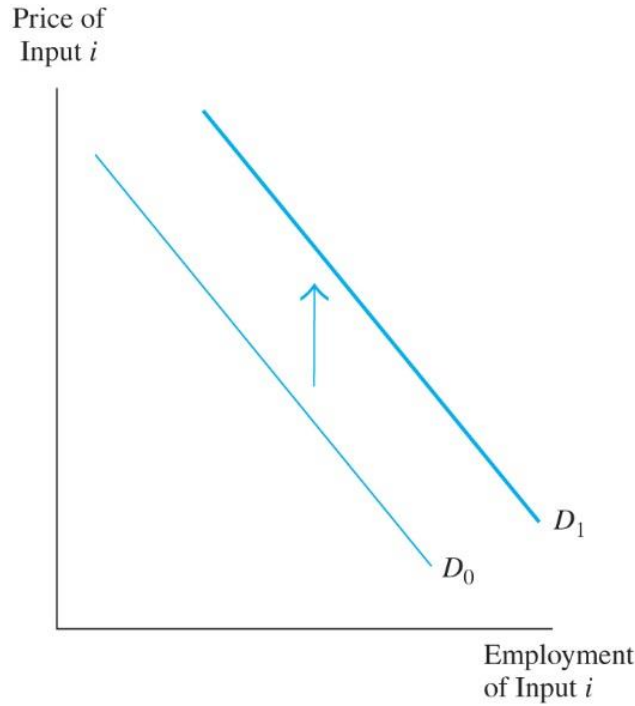
(a) inputs are i and j are substitutes

(b) inputs i and j are complements

The labor demand curve for input i shifts when the price of another input changes. (a) If the price of a substitutable input rises, the demand curve for input i shifts up. (b) If the price of a complement rises, the demand curve for input i shifts down.

Labor Market Equilibrium
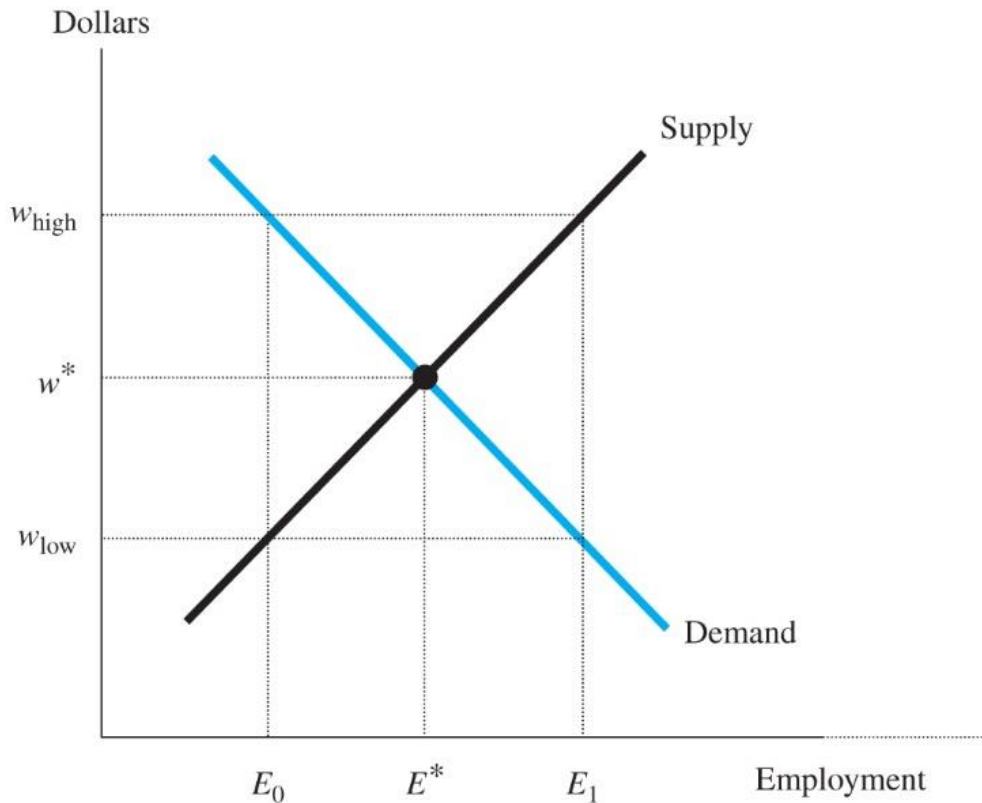
In a competitive labor market, equilibrium is attained at the point where supply equals demand. The market-clearing wage is *w** at which *E** workers are employed.

Application: The Employment Effects of Minimum Wages

The unemployment rate is higher the higher the minimum wage and the more elastic are the labor supply and demand curves.

The benefits of the minimum wage accrue mostly to workers who are not at the bottom of the distribution of permanent income.
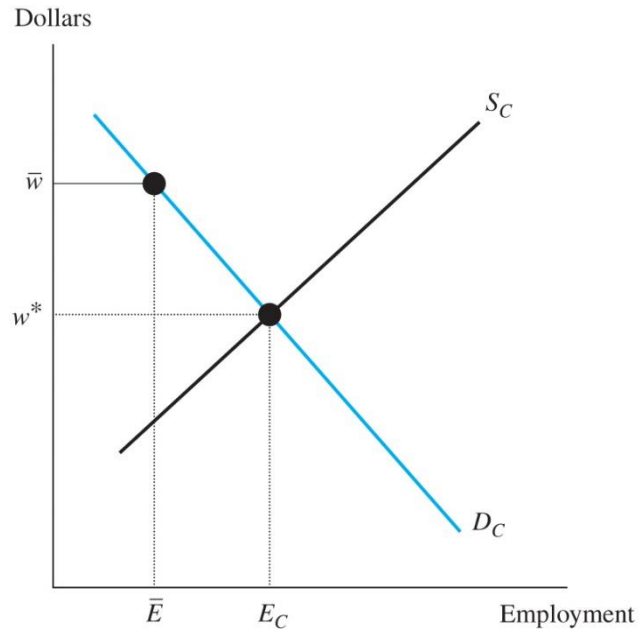
The Impact of the Minimum Wage on Employment
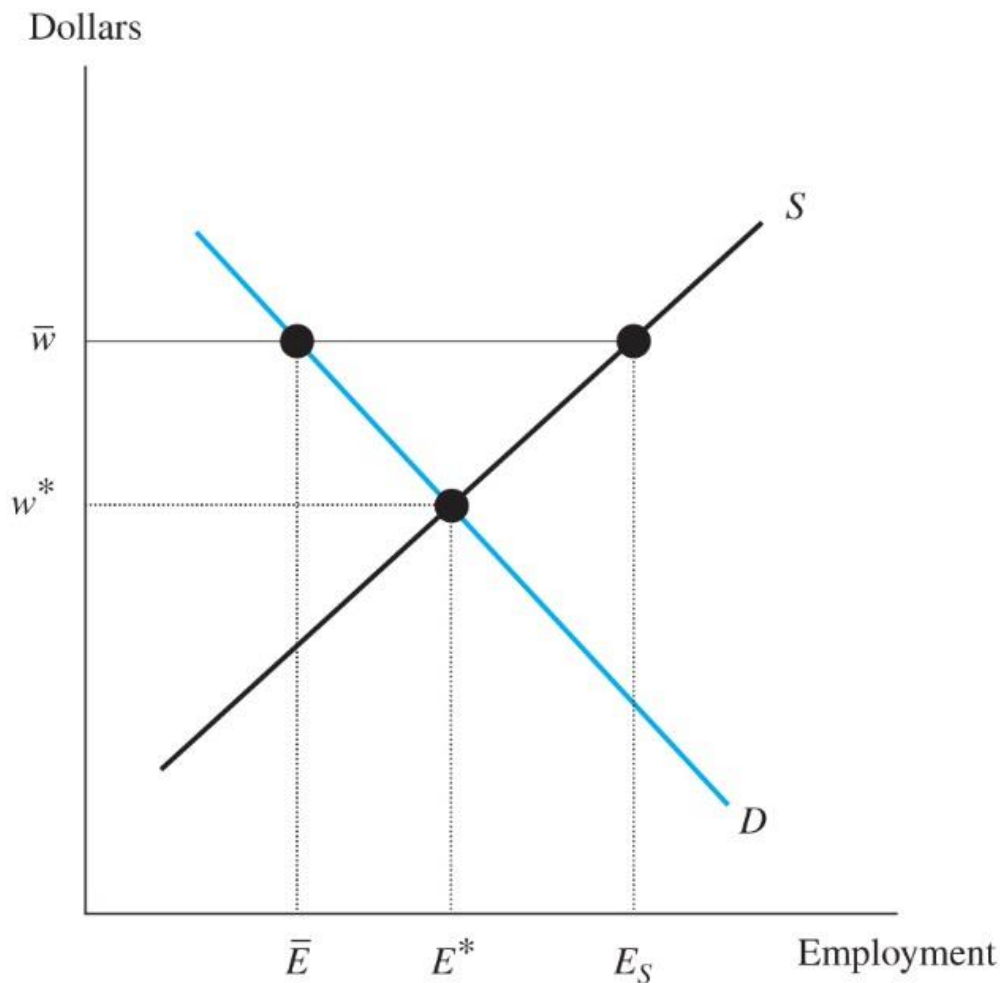
A minimum wage set at w^- results in employers cutting employment from E^* to E^-. The higher wage also encourages $E_S - E^*$ workers to enter the market. Thus, under a minimum wage, $E_S - E^-$ workers are unemployed.
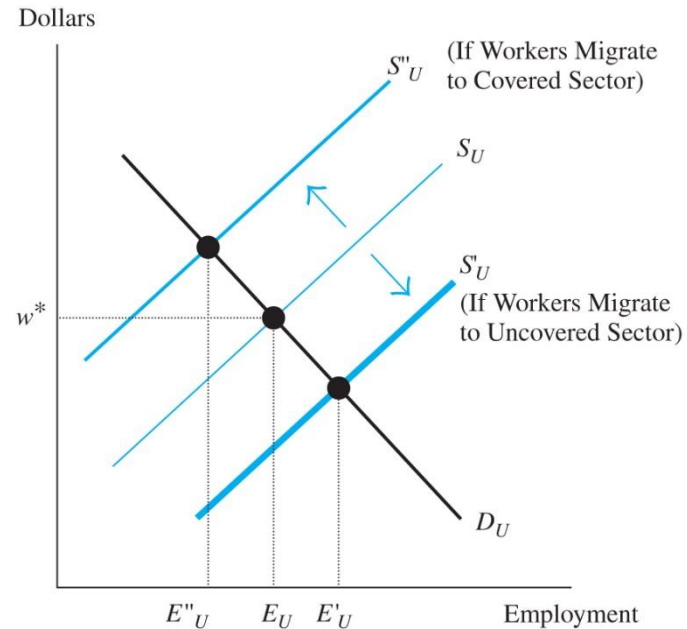
Minimum Wages in the United States, 1938-2011
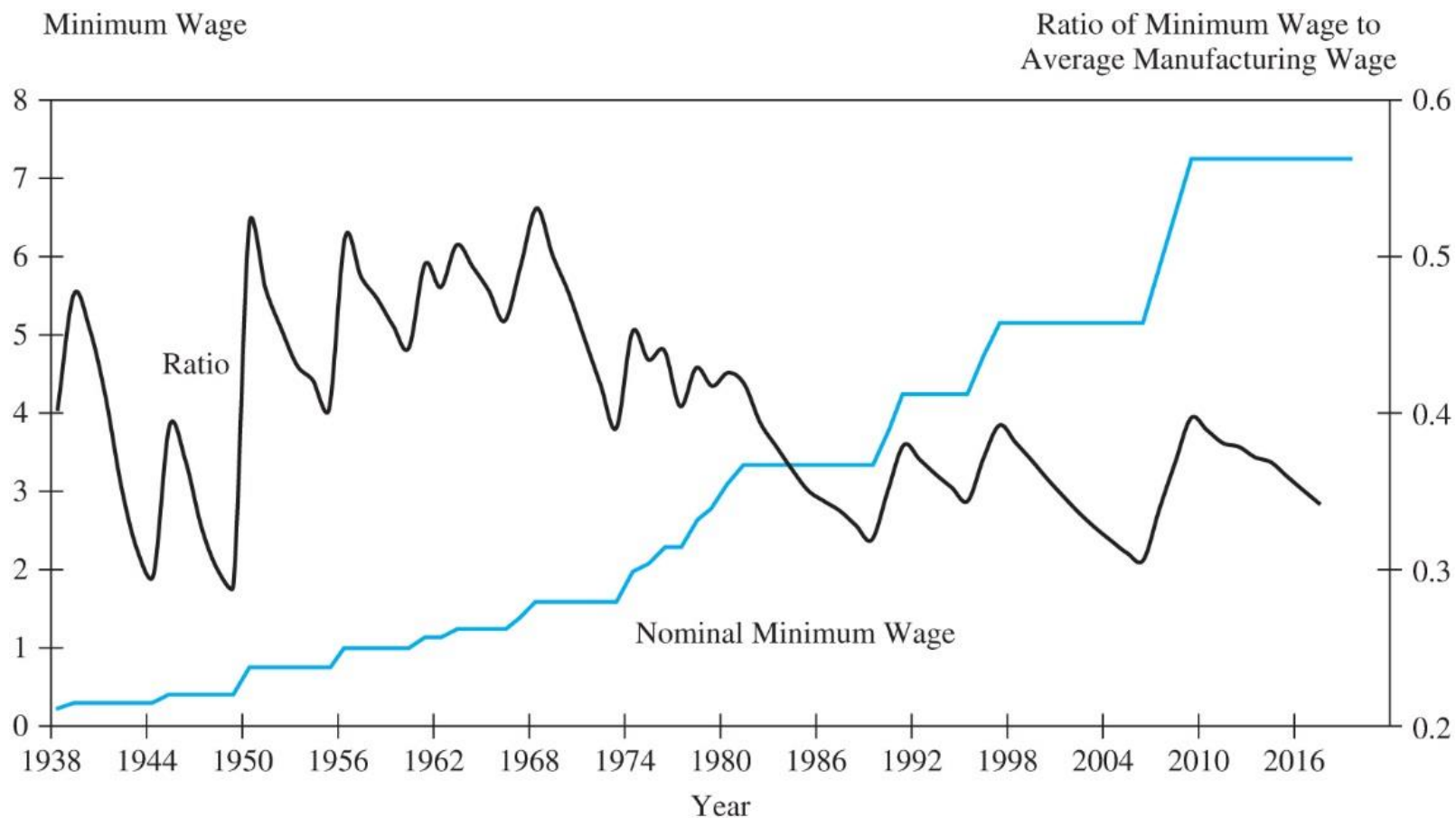
The Impact of Minimum Wages on the Covered and Uncovered Sectors

*(a)* Covered Sector   *(b)* Uncovered Sector

If the minimum wage applies only to jobs in the covered sector, the displaced workers might move to the uncovered sector, shifting the supply curve to the right and reducing the uncovered sector's wage. If it is easy to get a minimum wage job, workers in the uncovered sector might quit their jobs and wait in the covered sector until a job opens up, shifting the supply curve in the uncovered sector to the left and raising the uncovered sector's wage.

Estimating Labor Demand

One can identify the slope of the labor demand curve, which can be used to calculate the elasticity of labor demand, when the supply curve shifts.
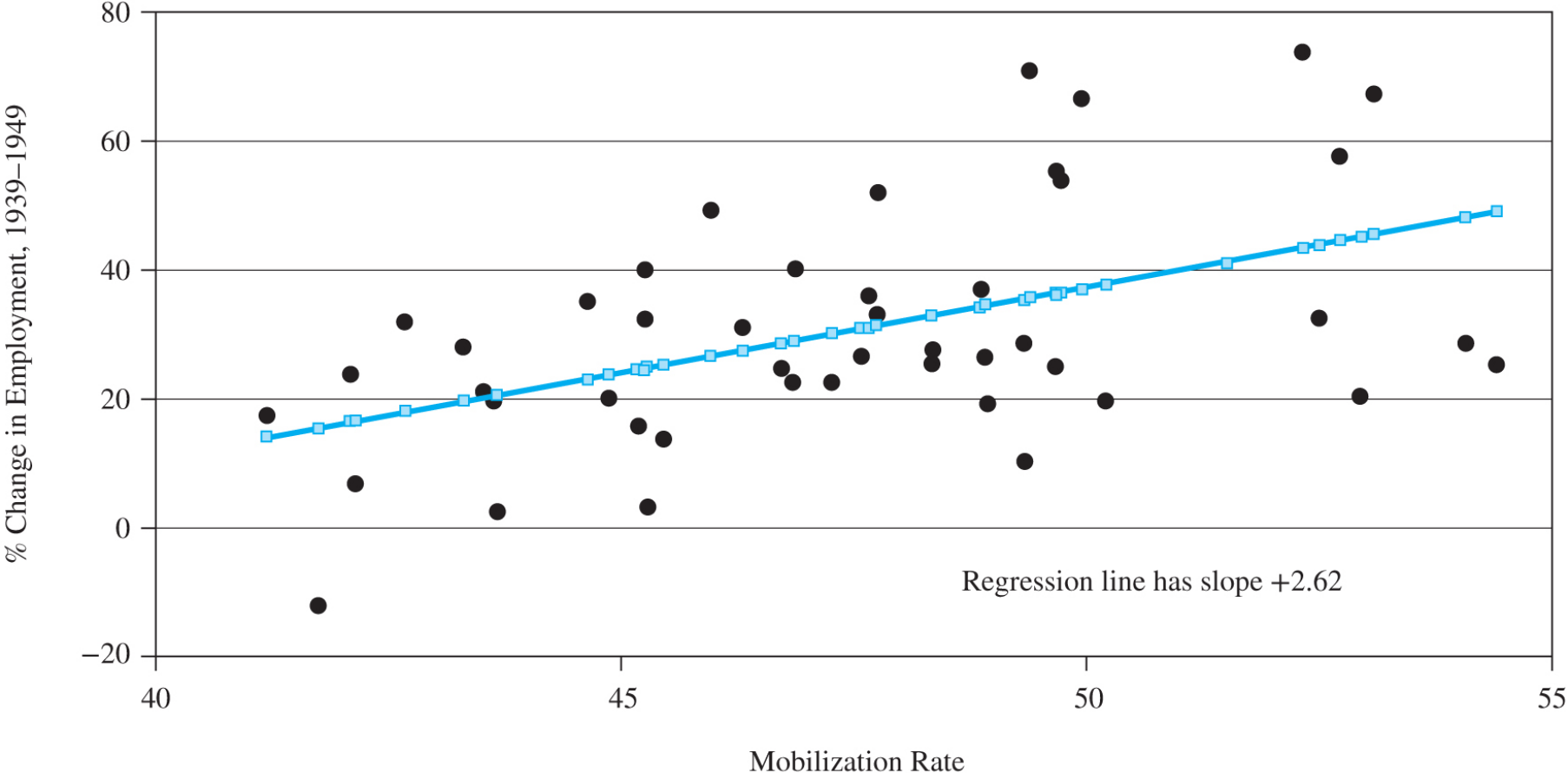
Problem: Must make sure the labor demand curve is not also changing.

Problems with Estimating Labor Demand
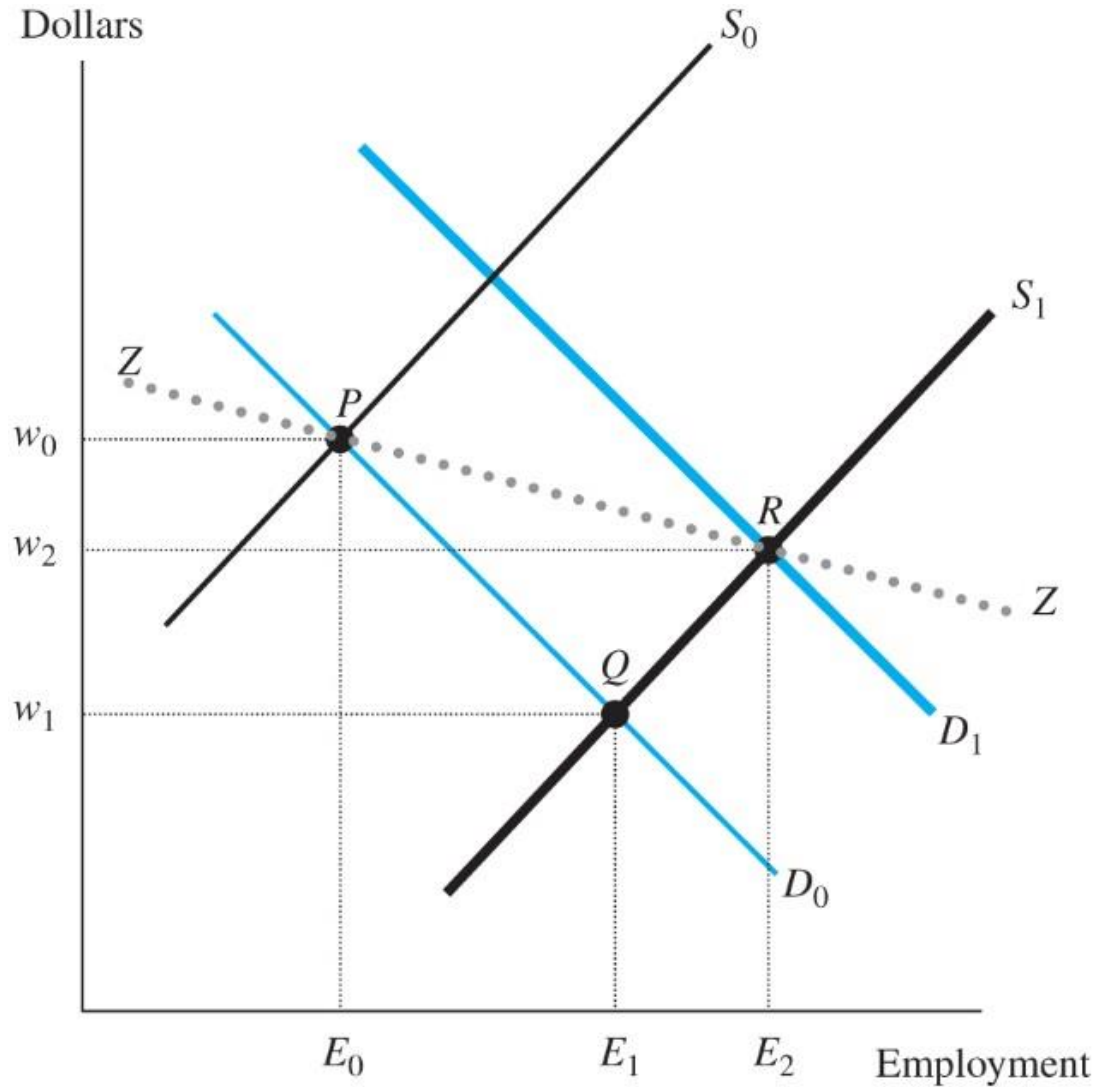
The Impact of Wartime Mobilization of Men on Female Labor Supply

(*a*) Mobilization Rate and Changes in Female Employment, by State

Regression line has slope +2.62

The Impact of Wartime Mobilization of Men on Female Wages

(b) Mobilization Rate and Changes in Female Wages, by State

Regression line has slope −2.58