

CHAPTER  
R


18

# The Markets for the Factors of Production

PRINCIPLES OF  
**Microeconomics**

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**In this chapter,  
look for the answers to these  
questions:**

- What determines a competitive firm's demand for labor?
- How does labor supply depend on the wage? What other factors affect labor supply?
- How do various events affect the equilibrium wage and employment of labor?
- How are the equilibrium prices and quantities of other inputs determined?

# Factors of Production and Factor Markets

- **Factors of production:** the inputs used to produce goods and services.
  - Labor
  - Land
  - **Capital:** the equipment and structures used to produce goods and services.
- Prices and quantities of these inputs are determined by supply & demand in factor markets.

# Derived Demand

- Markets for the factors of production are like markets for goods & services, except:
- Demand for a factor of production is a **derived demand** – derived from a firm's decision to supply a good in another market.

# Two Assumptions

1. We assume all markets are competitive.  
The typical firm is a price taker
  - in the market for the product it produces
  - in the labor market
2. We assume that firms care only about maximizing profits.
  - Each firm's supply of output and demand for inputs are derived from this goal.

# Our Example: Farmer Jack

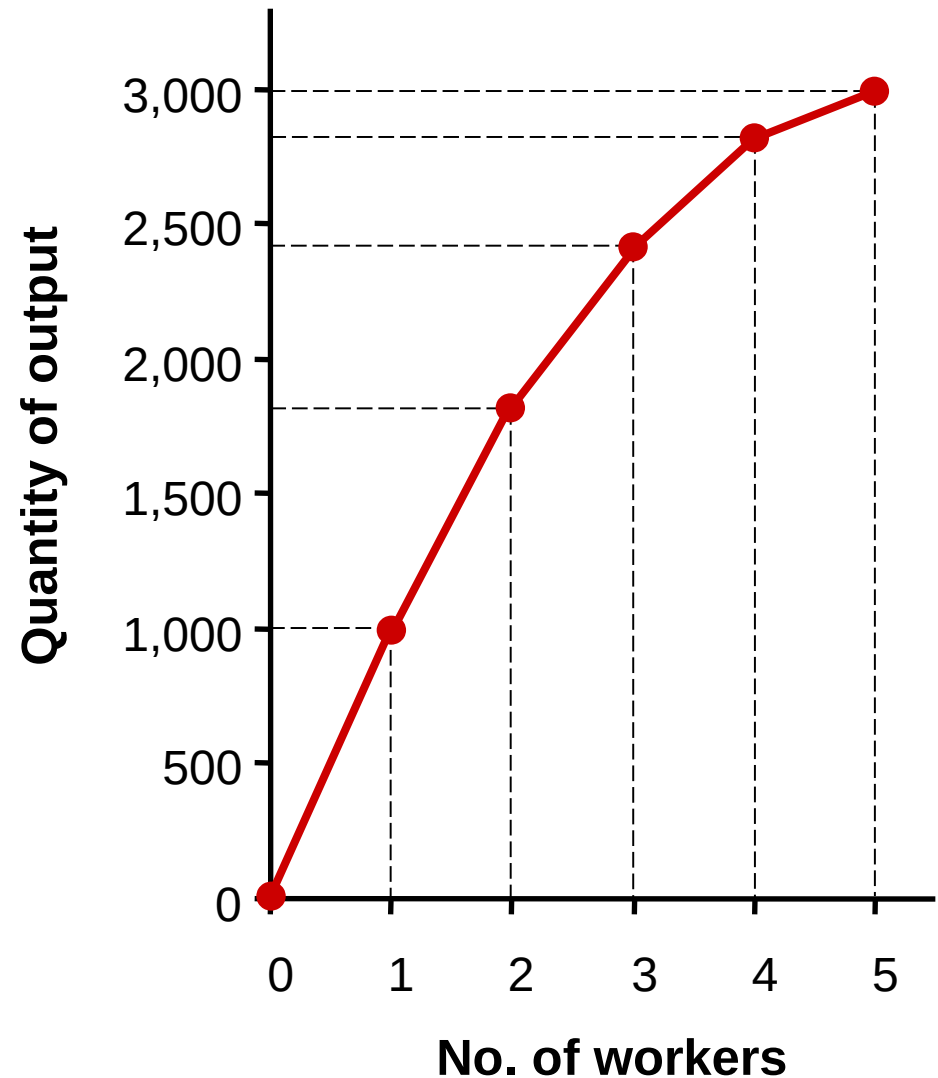
- Farmer Jack sells wheat in a perfectly competitive market.
- He hires workers in a perfectly competitive labor market.
- When deciding how many workers to hire, Farmer Jack maximizes profits by thinking at the margin:
  - If the benefit from hiring another worker exceeds the cost, Jack will hire that worker.

# Our Example: Farmer Jack

- Cost of hiring another worker:  
the wage – the price of labor
- Benefit of hiring another worker:  
Jack can produce more wheat to sell,  
increasing his revenue.
- The size of this benefit depends on Jack's **production function**: the relationship between the quantity of inputs used to make a good and the quantity of output of that good.

# Farmer Jack's Production Function

$L$ (no. of workers)	$Q$ (bushels of wheat per week)
0	0
1	1000
2	1800
3	2400
4	2800
5	3000





# Marginal Product of Labor (MPL)

- **Marginal product of labor:** the increase in the amount of output from an additional unit of labor

$$MPL = \frac{\Delta Q}{\Delta L}$$

where

$\Delta Q$  = change in output

$\Delta L$  = change in labor

# The Value of the Marginal Product

- Problem:
  - Cost of hiring another worker (wage) is measured in dollars
  - Benefit of hiring another worker (*MPL*) is measured in units of output
- Solution: convert *MPL* to dollars
- **Value of the marginal product:** the marginal product of an input times the price of the output  
$$VMPL = \text{value of the marginal product of labor}$$
$$= P \times MPL$$

## ACTIVE LEARNING 1

# Computing MPL and VMPL

$P = \$5/\text{bushel}$

Find *MPL*  
and *VMPL*,  
fill them in the  
blank spaces  
of the table

Then graph  
a curve with  
*VMPL* on the  
vertical axis,  
*L* on horiz axis

<i>L</i> (no. of workers)	<i>Q</i> (bushels of wheat)	<i>MPL</i>	<i>VMPL</i>
0	0		
1	1000		
2	1800		
3	2400		
4	2800		
5	3000		

# ACTIVE LEARNING 1

## Answers

Farmer Jack's production function exhibits

**diminishing marginal product**

MPL falls as L increases.

This property is very common.

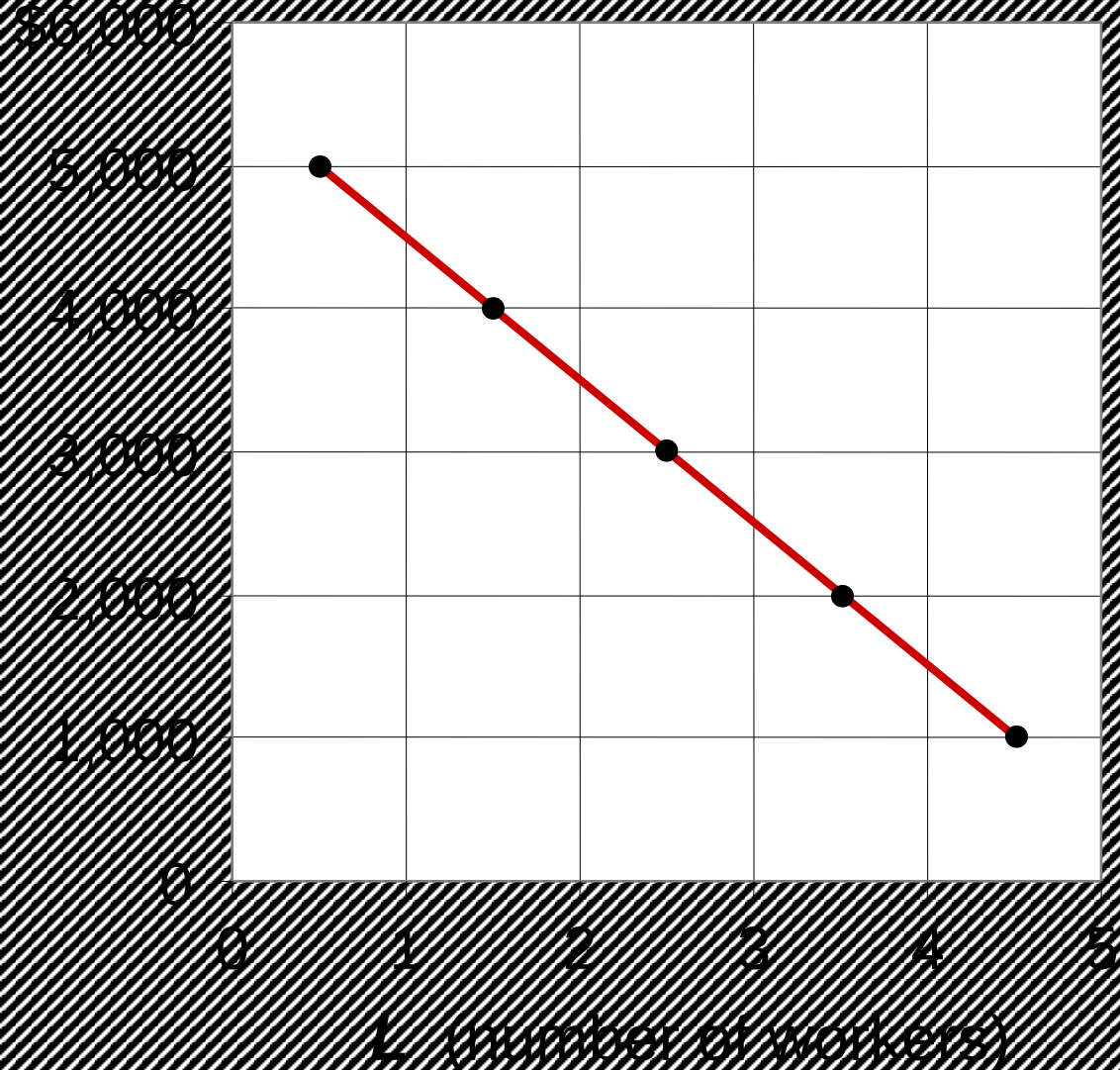
$L$ (no. of workers)	$Q$ (bushels of wheat)	$MPL = \Delta Q / \Delta L$	$VMPL = P \times MPL$
0	0		
1	1000	1000	\$5,000
2	1800	800	4,000
3	2400	600	3,000
4	2800	400	2,000
5	3000	200	1,000

# ACTIVE LEARNING 1

## Answers

Farmer Jack's VMPL curve is downward sloping due to diminishing marginal product.

The VMPL curve



# Farmer Jack's Labor Demand

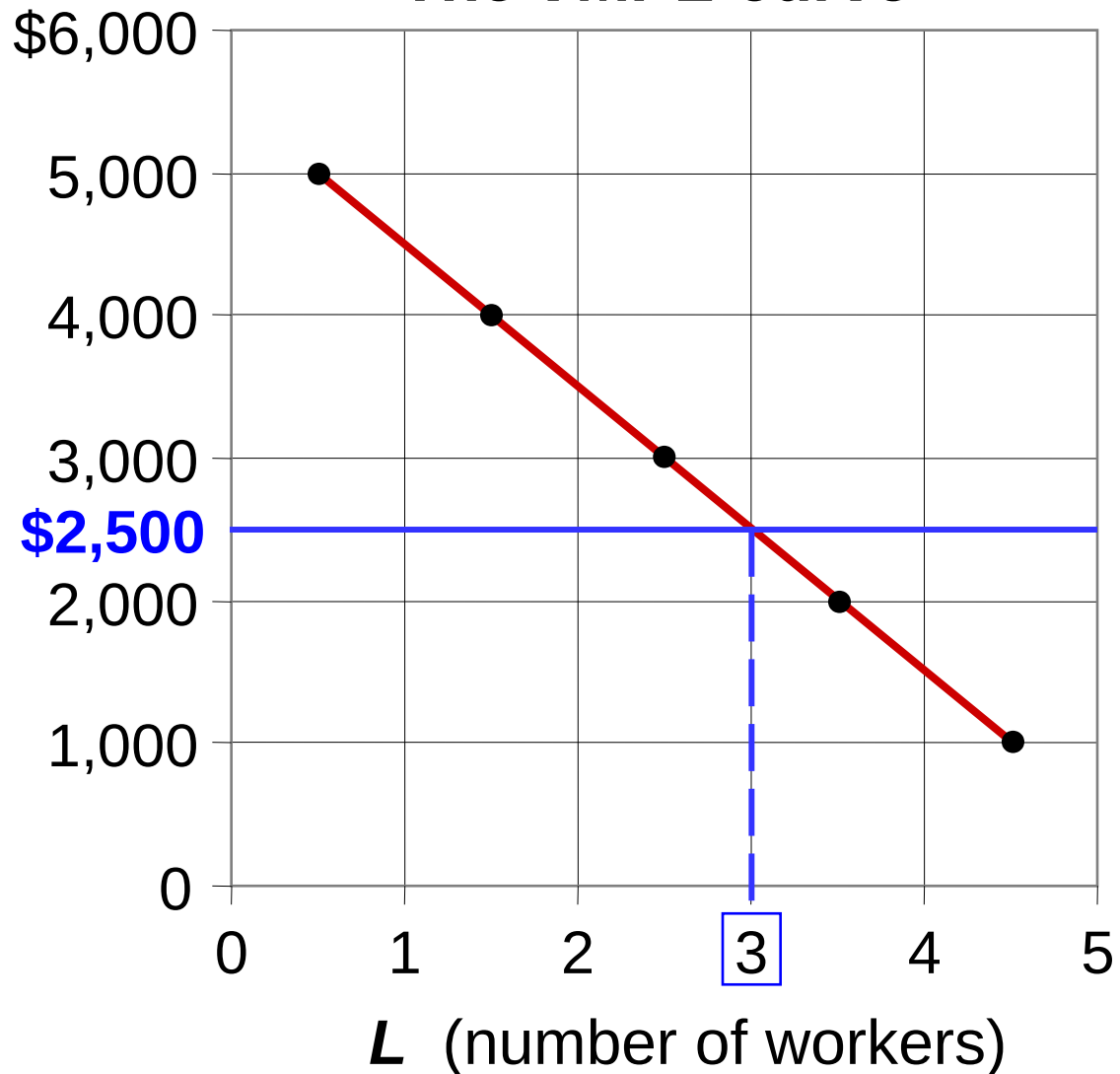
The VMPL curve

Suppose wage  
 $W = \$2500/\text{week}$ .

How many  
workers should  
Jack hire?

Answer:  $L = 3$

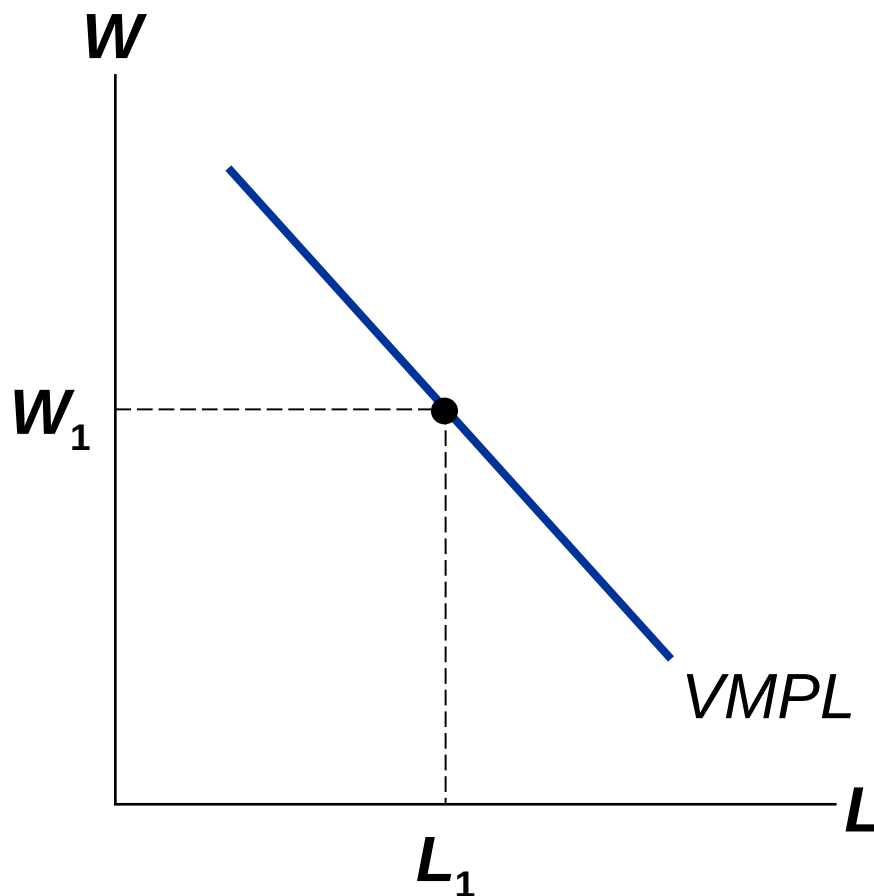
At any larger  $L$ ,  
can increase profit  
by hiring another  
worker.



# VMPL and Labor Demand

For any competitive, profit-maximizing firm:

- To maximize profits, hire workers up to the point where  $VMPL = W$ .
- The  $VMPL$  curve is the labor demand curve.

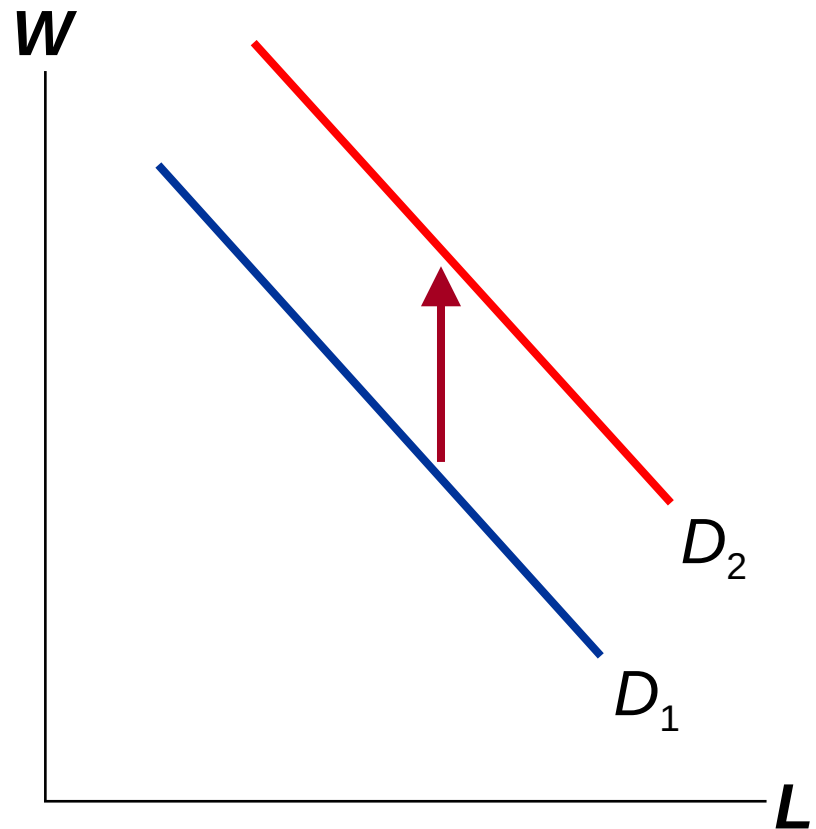


# Shifts in Labor Demand

Labor demand curve  
= *VMPL* curve.

$$VMPL = P \times MPL$$

Anything that  
increases *P* or  
*MPL* at each *L*  
will increase  
*VMPL* and shift  
labor demand curve  
upward.





# Things that Shift the Labor Demand Curve

- Changes in the output price,  $P$
- Technological change (affects  $MPL$ )
- The supply of other factors (affects  $MPL$ )
  - Example:  
If firm gets more equipment (capital), then workers will be more productive;  $MPL$  and  $VMPL$  rise, labor demand shifts upward.

# The Connection Between Input Demand & Output Supply

- Recall: **Marginal Cost ( $MC$ )**
  - = cost of producing an additional unit of output
  - =  $\Delta TC / \Delta Q$ , where  $TC$  = total cost
- Suppose  $W = \$2500$ ,  $MPL = 500$  bushels
- If Farmer Jack hires another worker,
  - $\Delta TC = \$2500$ ,  $\Delta Q = 500$  bushels
  - $MC = \$2500 / 500 = \$5$  per bushel
- In general:  $MC = W / MPL$

# The Connection Between Input Demand & Output Supply

- In general:  $MC = W/MPL$
- Notice:
  - To produce additional output, hire more labor.
  - As  $L$  rises,  $MPL$  falls...
  - causing  $W/MPL$  to rise...
  - causing  $MC$  to rise.
- Hence, *diminishing marginal product and increasing marginal cost are two sides of the same coin.*

# The Connection Between Input Demand & Output Supply

- The competitive firm's rule for demanding labor:

$$P \times MPL = W$$

- Divide both sides by  $MPL$ :

$$P = W/MPL$$

- Substitute  $MC = W/MPL$  from previous slide:

$$P = MC$$

- This is the competitive firm's rule for supplying output.

- Hence, *input demand and output supply are two sides of the same coin.*

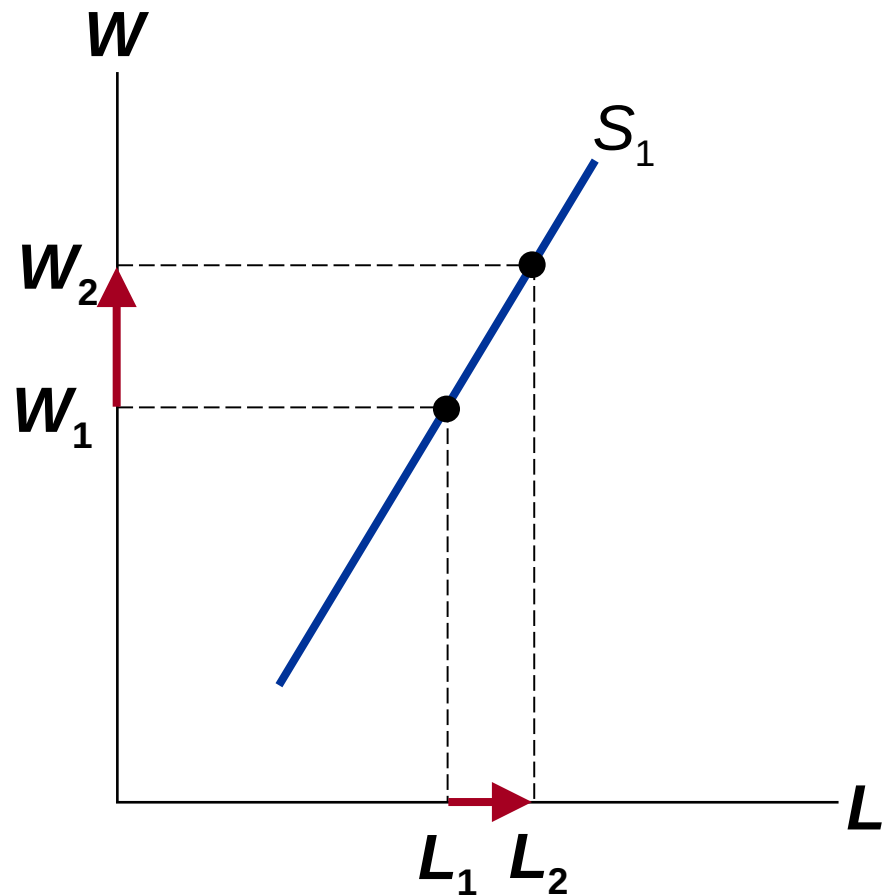
# Labor Supply

- Trade-off between work and leisure:  
The more time you spend working,  
the less time you have for leisure.
- The opportunity cost of leisure is the wage.

# The Labor Supply Curve

An increase in  $W$   
is an increase in the  
opp. cost of leisure.

People respond by  
taking less leisure  
and by working more.



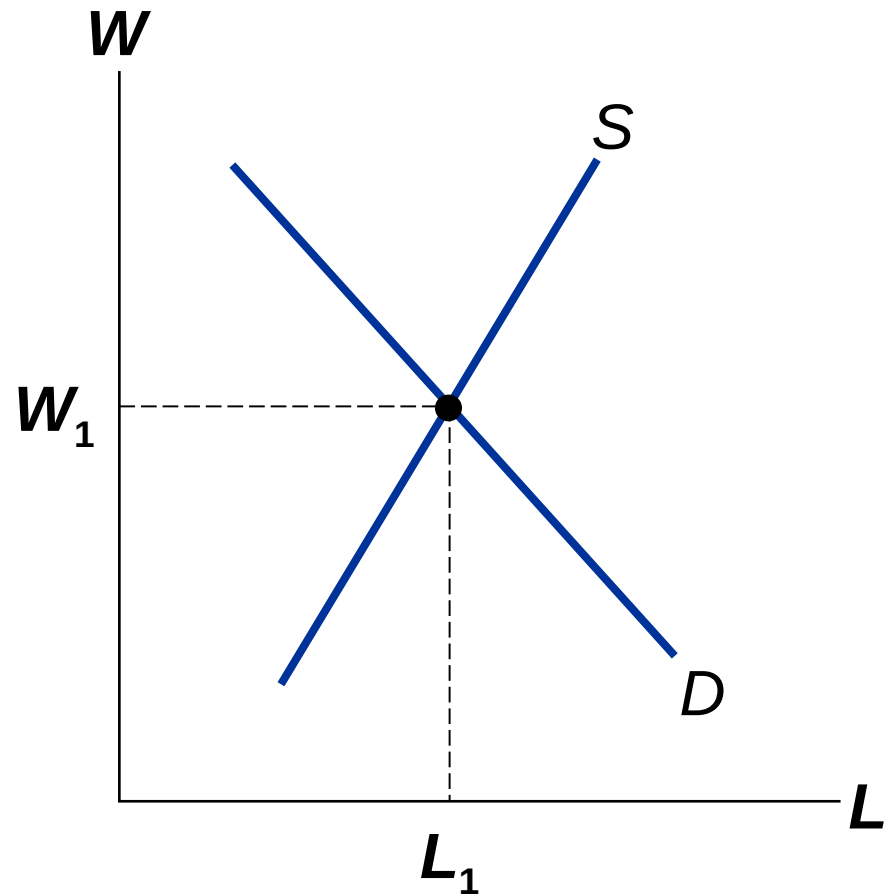
# Things that Shift the Labor Supply Curve

- Changes in tastes or attitudes regarding the labor-leisure trade-off
- Opportunities for workers in other labor markets
- Immigration

# Equilibrium in the Labor Market

The wage adjusts to balance supply and demand for labor.

The wage always equals  $VMPL$ .





## ACTIVE LEARNING 2

# Changes in labor-market equilibrium

In each of the following scenarios, use a diagram of the market for (domestic) auto workers to find the effects on their wage and employment.

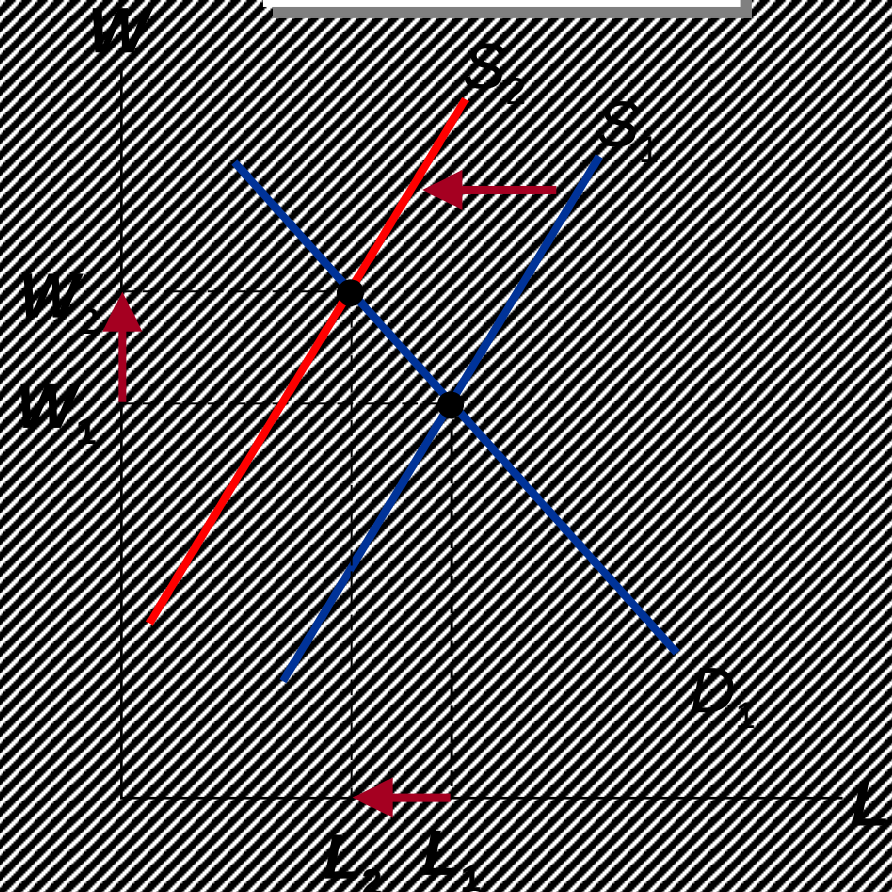
- A.** Baby Boomers who worked in the auto industry retire.
- B.** Car buyers' preferences shift toward imported autos.
- C.** Technological progress boosts productivity in the auto manufacturing industry.

# ACTIVE LEARNING 2

## Answers to A

The retirement of Baby Boomer auto workers shifts supply leftward.  
 $W$  rises,  $L$  falls.

The market for autoworkers



# ACTIVE LEARNING 2

## Answers to B

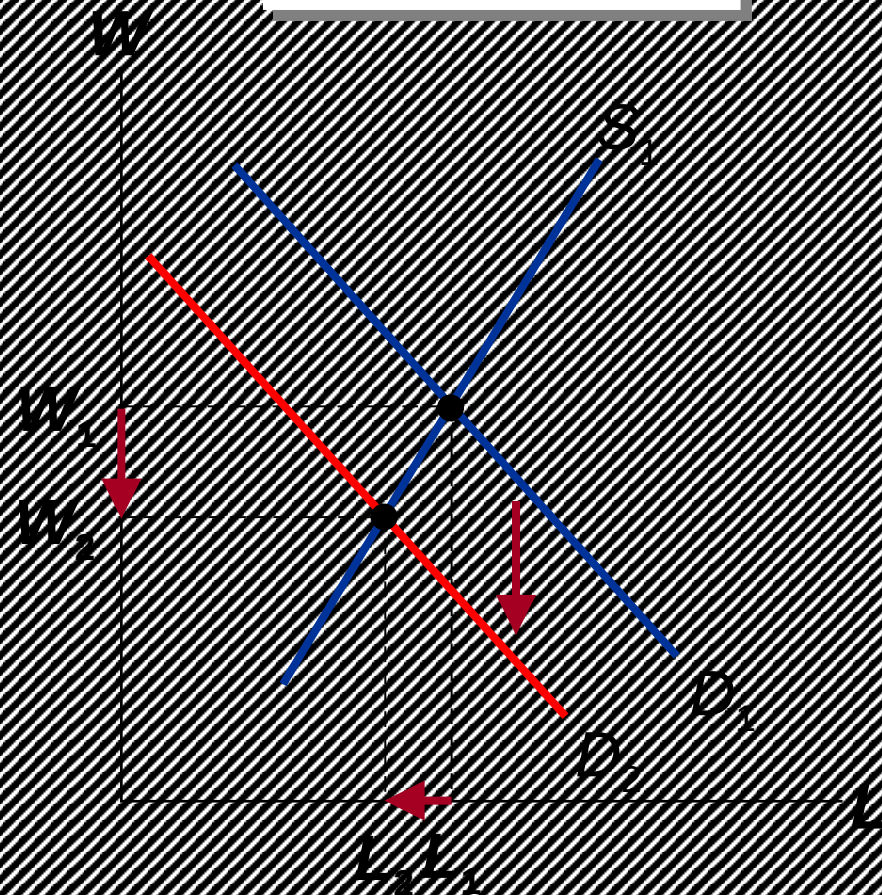
A fall in the demand for U.S. autos reduces  $P$ ,  
reduces  $P$ .

At each  $L$ ,  
VMPL falls.

Labor demand  
curve shifts down.

$W$  and  $L$  both fall.

The market for autoworkers



# ACTIVE LEARNING 2

## Answers to C

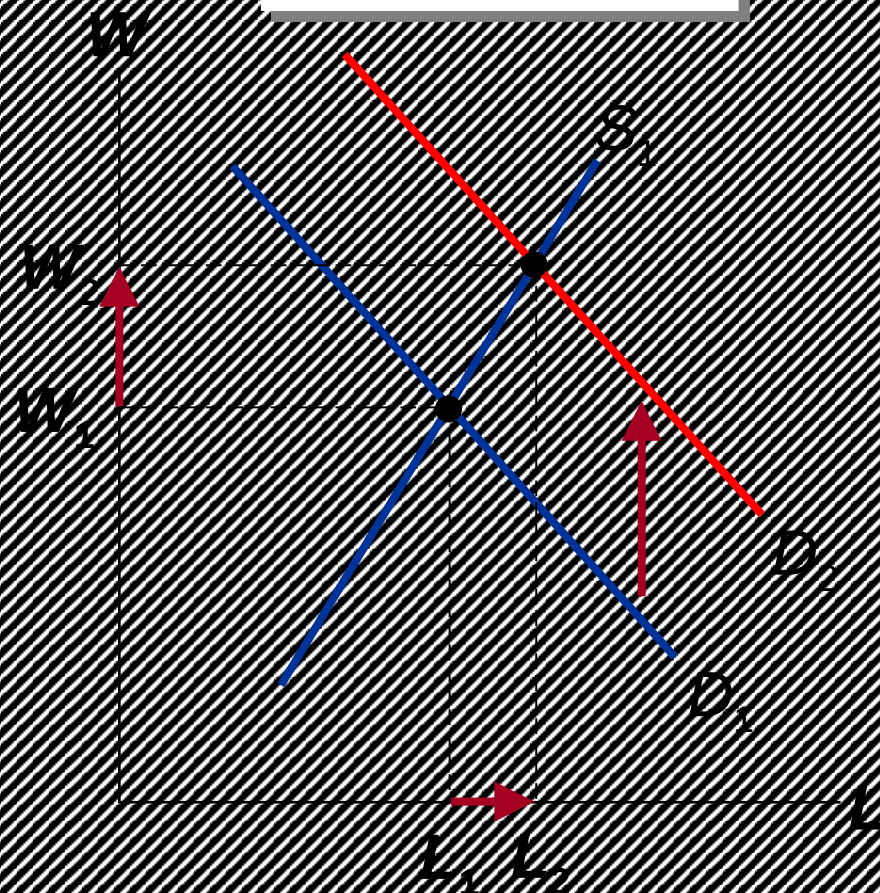
At each  $L$ ,

MPL rises due to  
tech. progress.

VMPL rises and  
labor demand curve  
shifts upward.

$W$  and  $L$  increase.

The market for  
autoworkers



# Productivity and Wage Growth in the U.S.

time period	growth rate of productivity	growth rate of real wages
1959-2006	2.1%	2.0%
1959-1973	2.8	2.8
1973-1995	1.4	1.2
1995-2006	2.6	2.5

Recall one of the Ten Principles:

*A country's standard of living depends on its ability to produce g&s.*

Our theory implies wages tied to labor productivity ( $W = VMPL$ ).

We see this in the data.

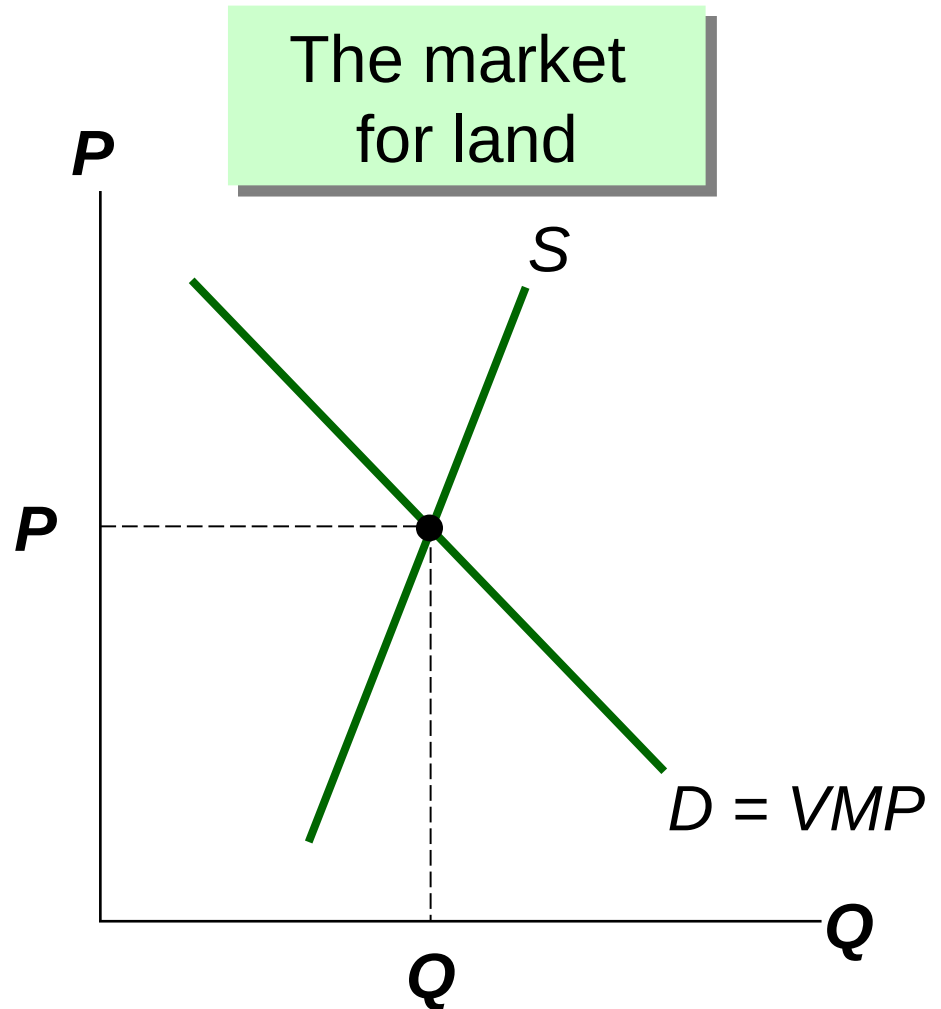
# The Other Factors of Production

- With land and capital, must distinguish between:
  - **purchase price** – the price a person pays to own that factor indefinitely
  - **rental price** – the price a person pays to use that factor for a limited period of time
- The wage is the rental price of labor.
- The determination of the rental prices of capital and land is analogous to the determination of wages...

# How the Rental Price of Land Is Determined

Firms decide how much land to rent by comparing the price with the value of the marginal product (*VMP*) of land.

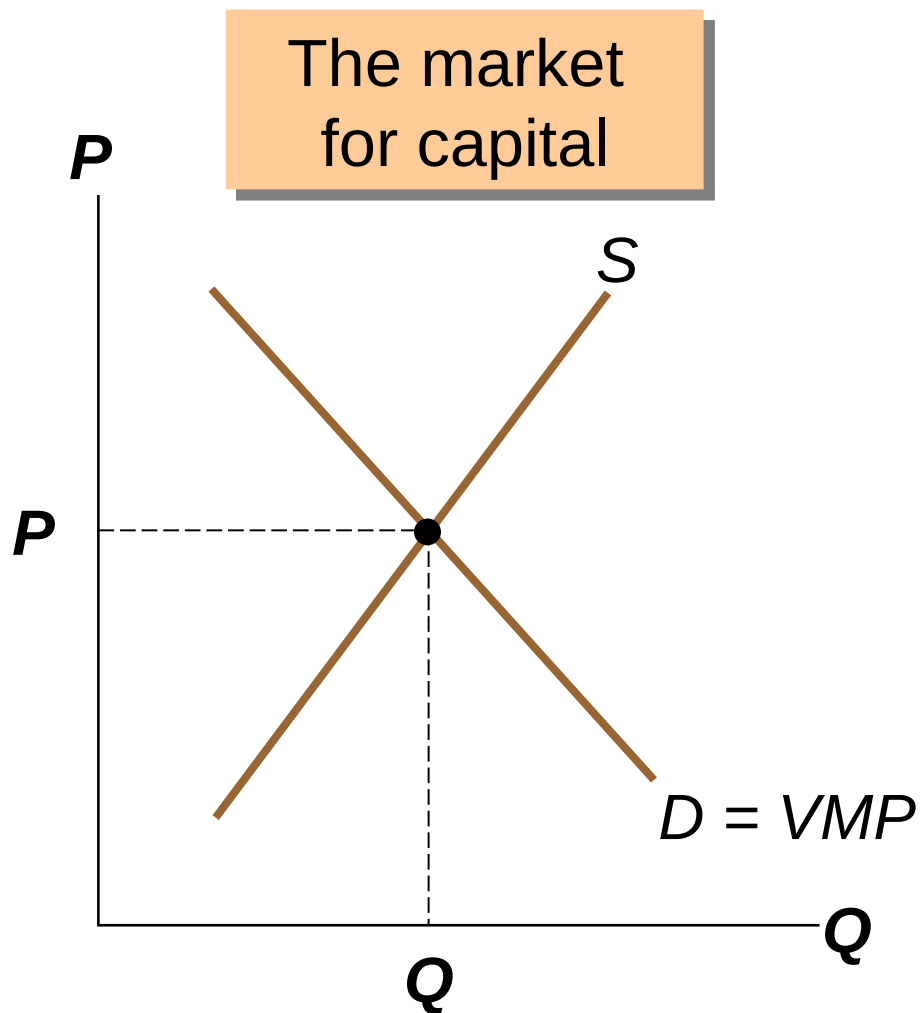
The rental price of land adjusts to balance supply and demand for land.



# How the Rental Price of Capital Is Determined

Firms decide how much capital to rent by comparing the price with the value of the marginal product (*VMP*) of capital.

The rental price of capital adjusts to balance supply and demand for capital.





# Rental and Purchase Prices

- Buying a unit of capital or land yields a stream of rental income.
- The rental income in any period equals the value of the marginal product (*VMP*).
- Hence, the equilibrium purchase price of a factor depends on both the current *VMP* and the *VMP* expected to prevail in future periods.

# Linkages Among the Factors of Production

- In most cases, factors of production are used together in a way that makes each factor's productivity dependent on the quantities of the other factors.
- Example: an increase in the quantity of capital
  - The marginal product and rental price of capital fall.
  - Having more capital makes workers more productive,  $MPL$  and  $W$  rise.

# CONCLUSION

- The theory in this chapter is called the **neoclassical theory of income distribution**.
- It states that
  - factor prices determined by supply and demand
  - each factor is paid the value of its marginal product
- Most economists use this theory a starting point for understanding the distribution of income.
- The next two chapters explore this topic further.

# CHAPTER SUMMARY



- The economy's income distribution is determined in the markets for the factors of production. The three most important factors of production are labor, land, and capital.
- A firm's demand for a factor is derived from its supply of output.
- Competitive firms maximize profit by hiring each factor up to the point where the value of its marginal product equals its rental price.

# CHAPTER SUMMARY



- The supply of labor arises from the trade-off between work and leisure, and yields an upward-sloping labor supply curve.
- The price paid to each factor adjusts to balance supply and demand for that factor. In equilibrium, each factor is compensated according to its marginal contribution to production.
- Factors of production are used together. A change in the quantity of one factor affects the marginal products and equilibrium earnings of all factors.