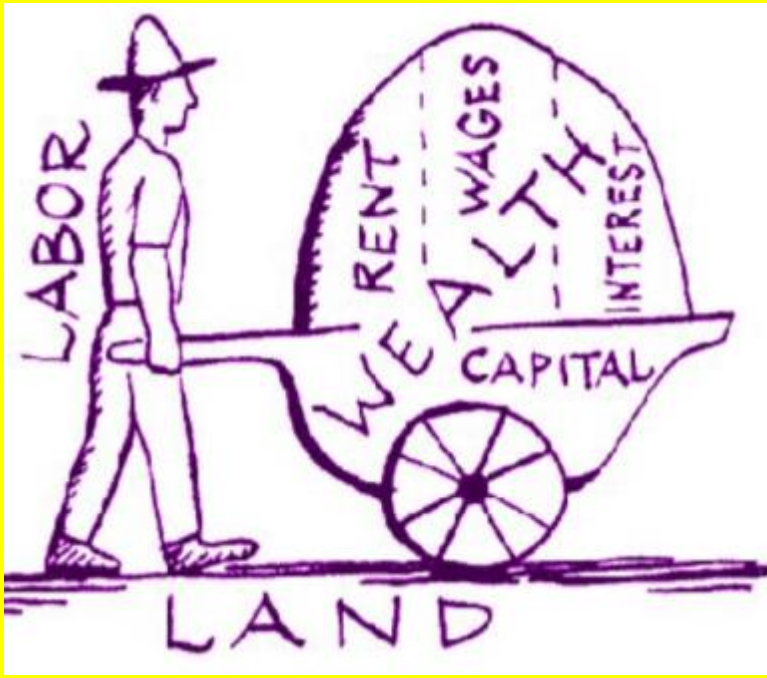
Factors of Production and Factor Markets

- **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 and demand in factor markets.



Derived Demand

- Markets for the factors of production are like markets for goods and 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.
- How much will I make from this?

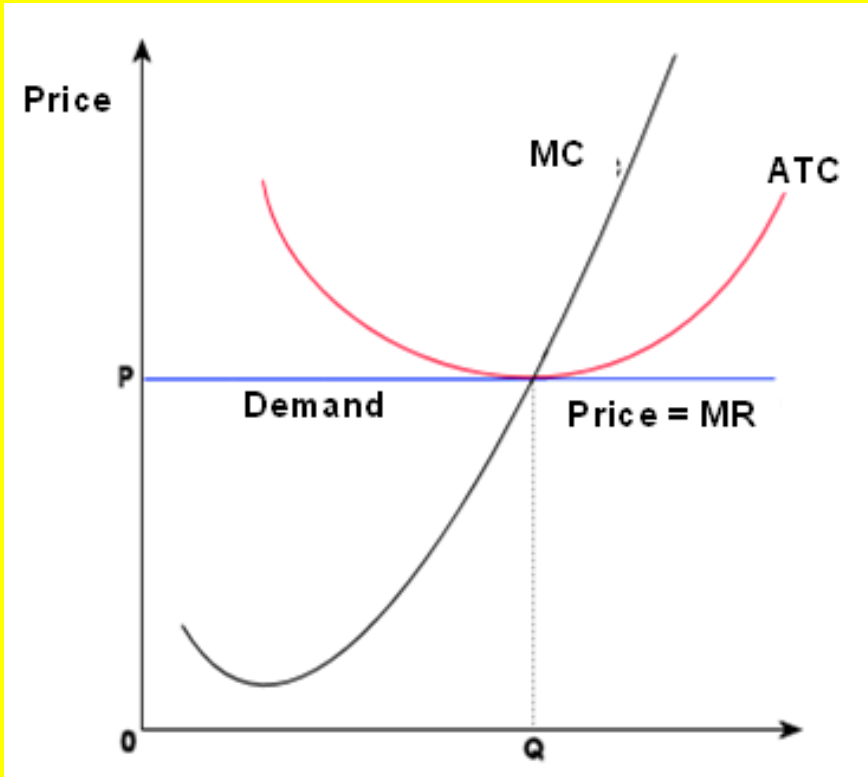
The demand for new bricks is derived from the demand for the final output of the construction industry- when there is a boom in the building industry, so the market demand for bricks will increase

Two Assumptions

1. We assume all markets are competitive.

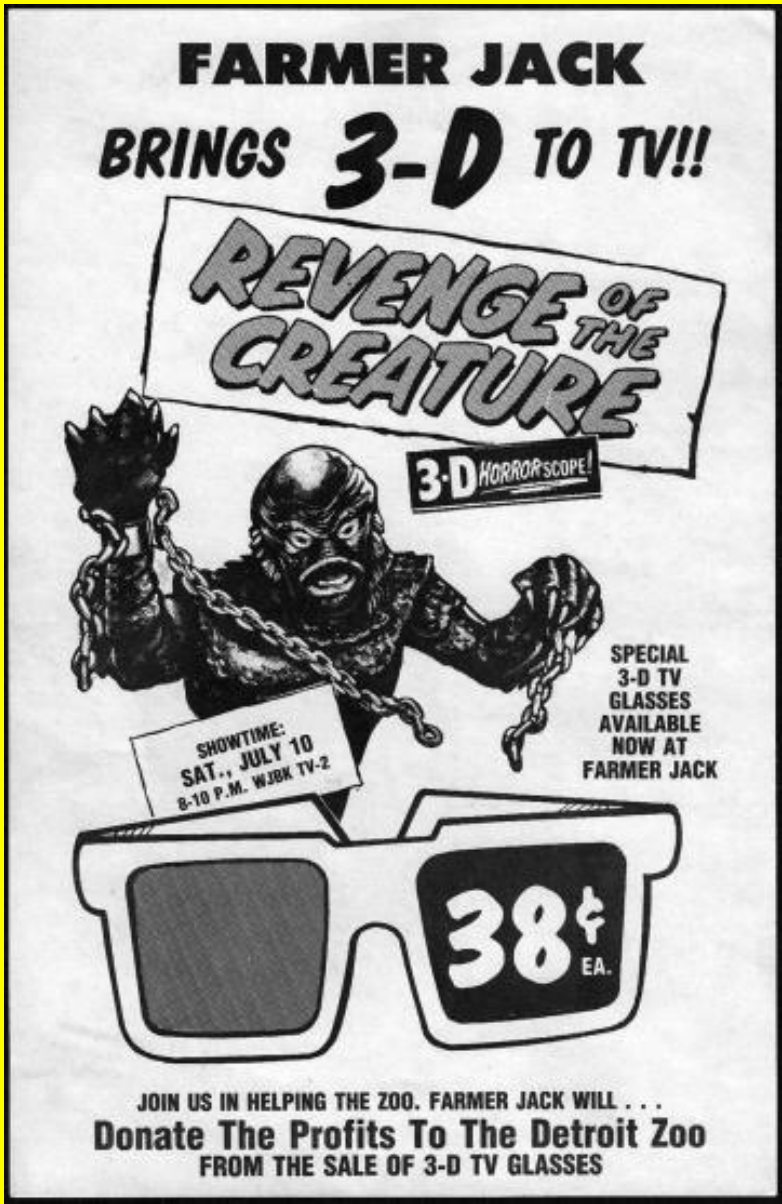
   The typical firm is a price taker
   - in the market for the product it produces
   - in the labor market

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.



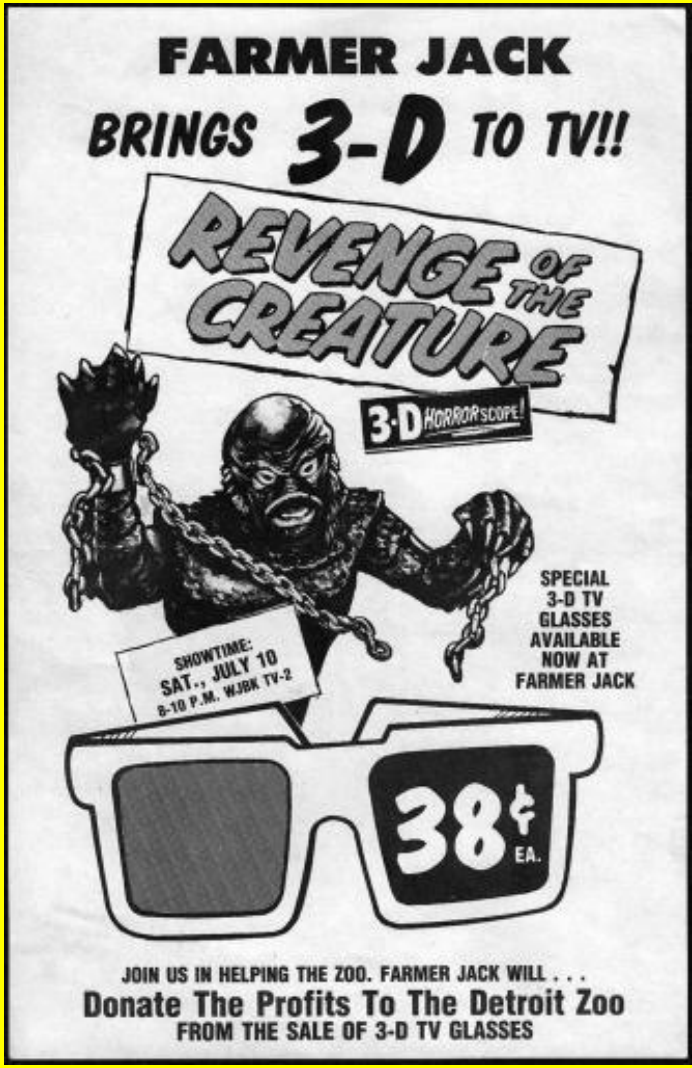
Our Example: Farmer Jack

- 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.



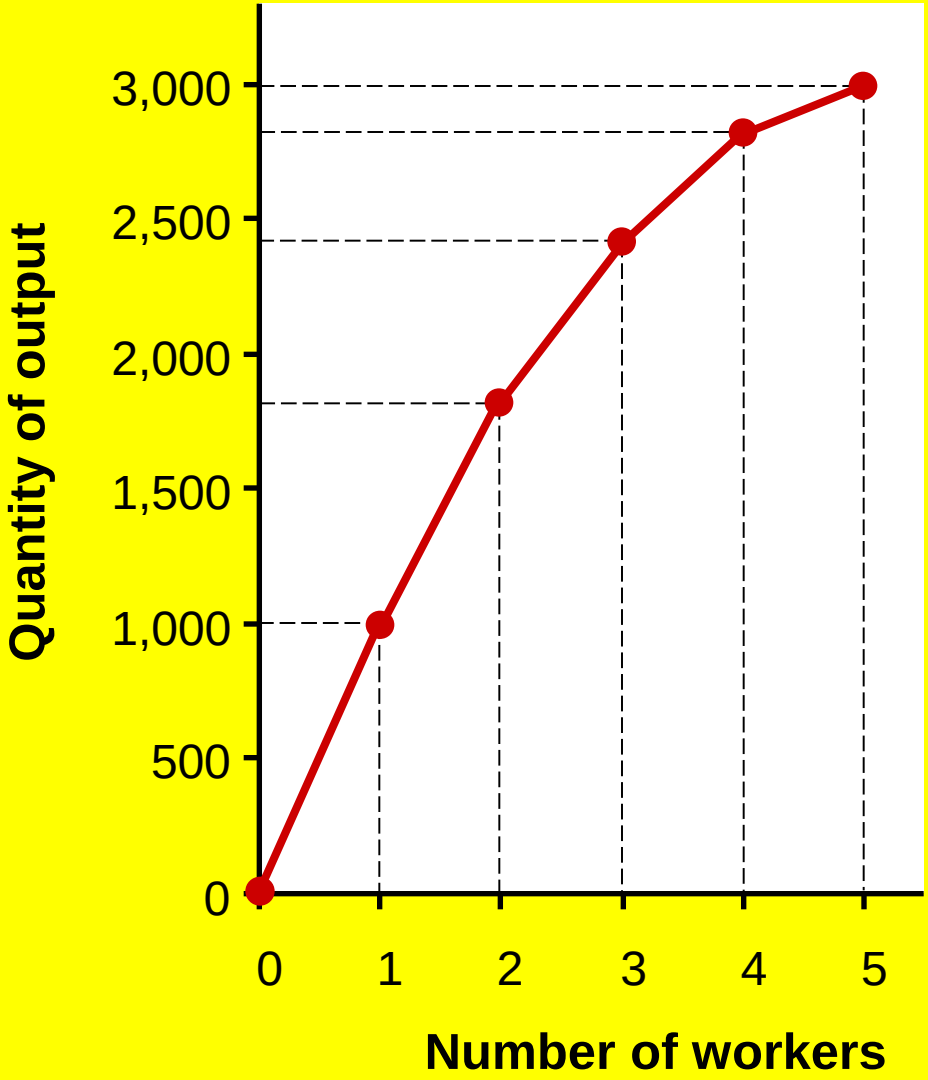
Our Example: Farmer Jack

- 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 (number 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

ΔQ = change in output

ΔL = change in labor

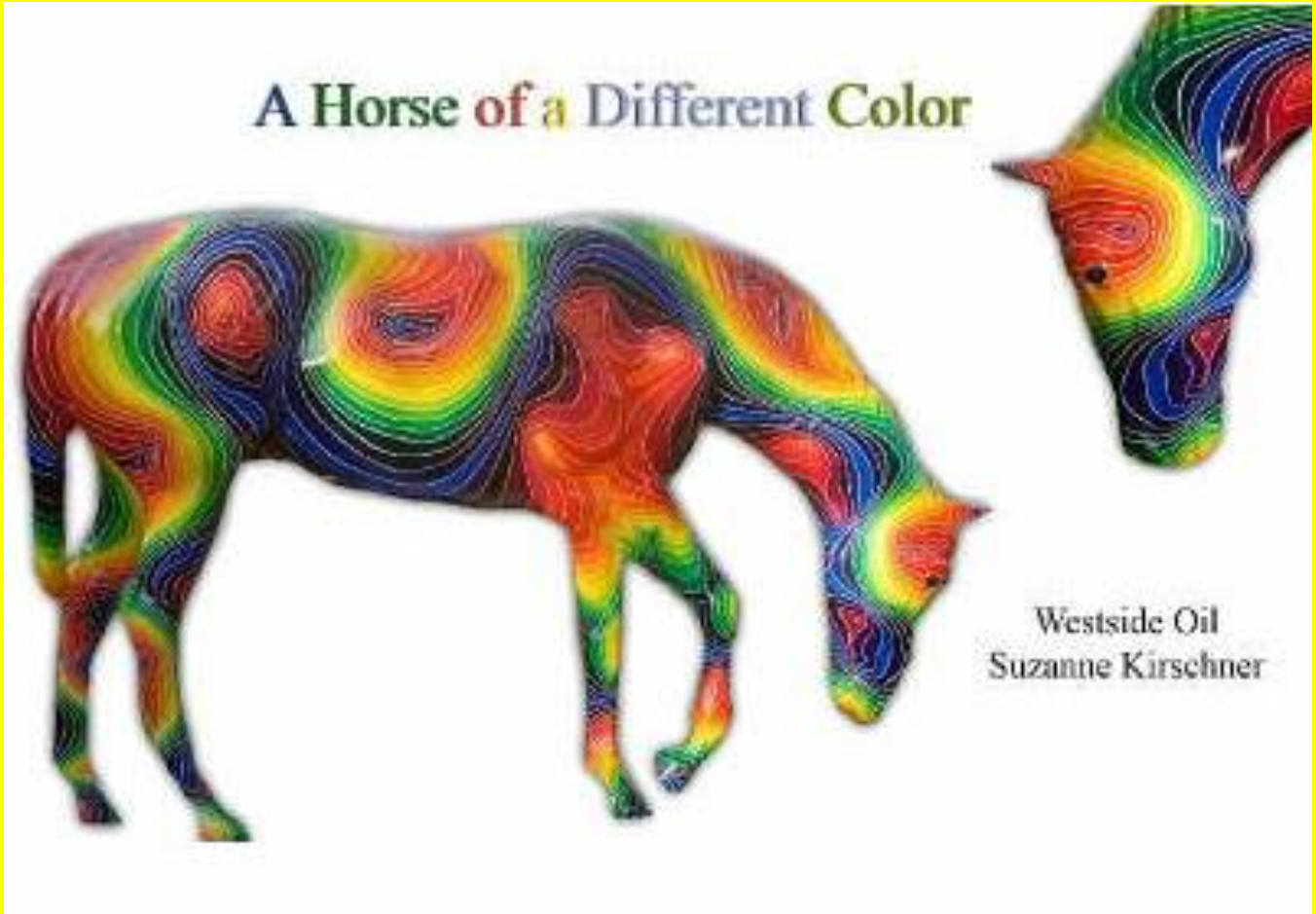
The Marginal Revenue Product

- 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 = value of the marginal product of labor (marginal revenue = *P* x *MPL)*

Same concept, different names

Value of Marginal Product =
Marginal Revenue Product of Labor



ACTIVE LEARNING 1

Computing MPL and MRPL (VMPL)

P = $5/bushel.

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

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

L (no. of workers)	***Q*** (bushels of wheat)	*MPL*	*MRPL*
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.

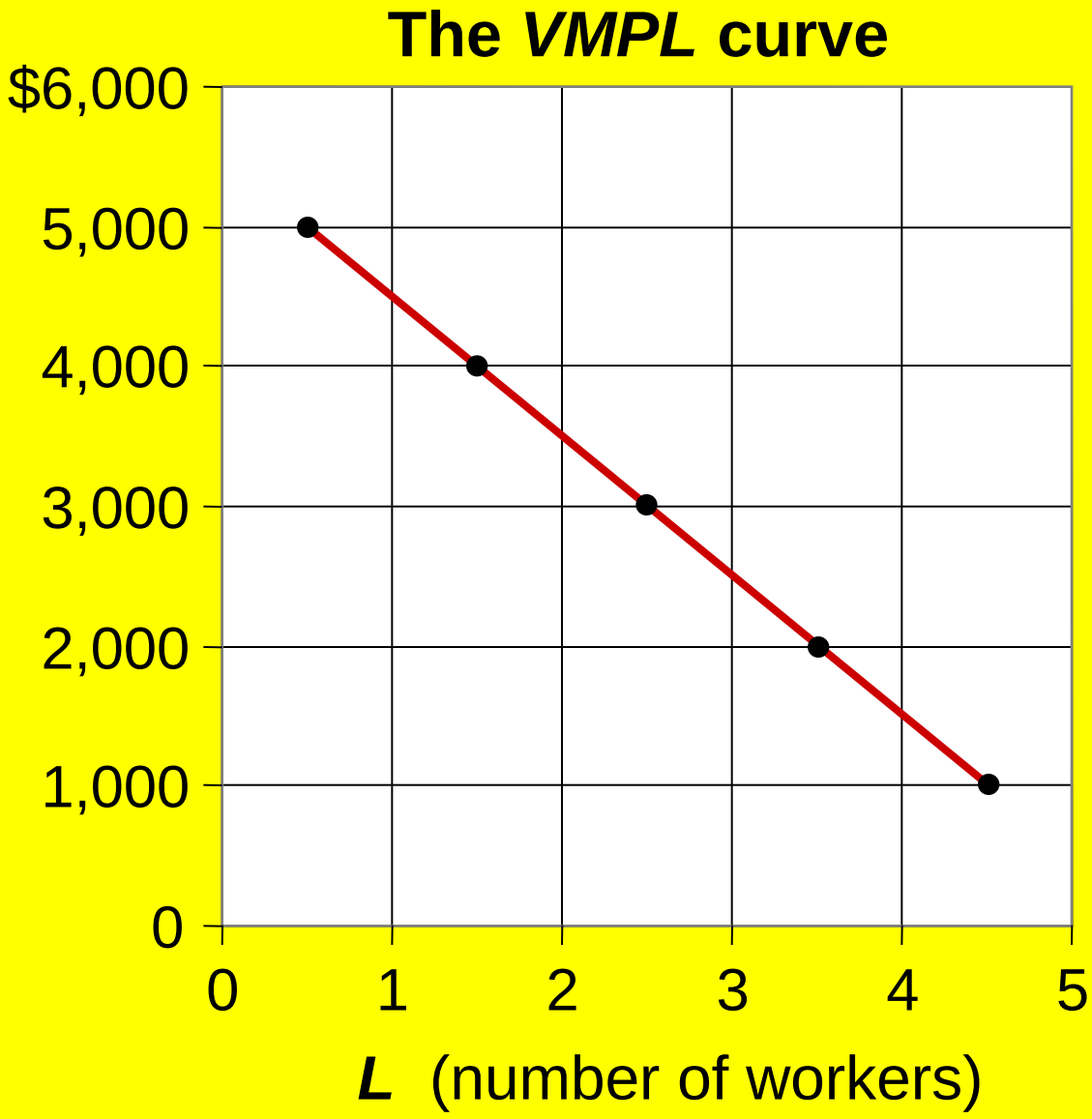
This property is very common.

L (no. of workers)	***Q*** (bushels of wheat)	*MPL* = Δ***Q***/Δ***L***	*MRPL*= ***P*** x *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.



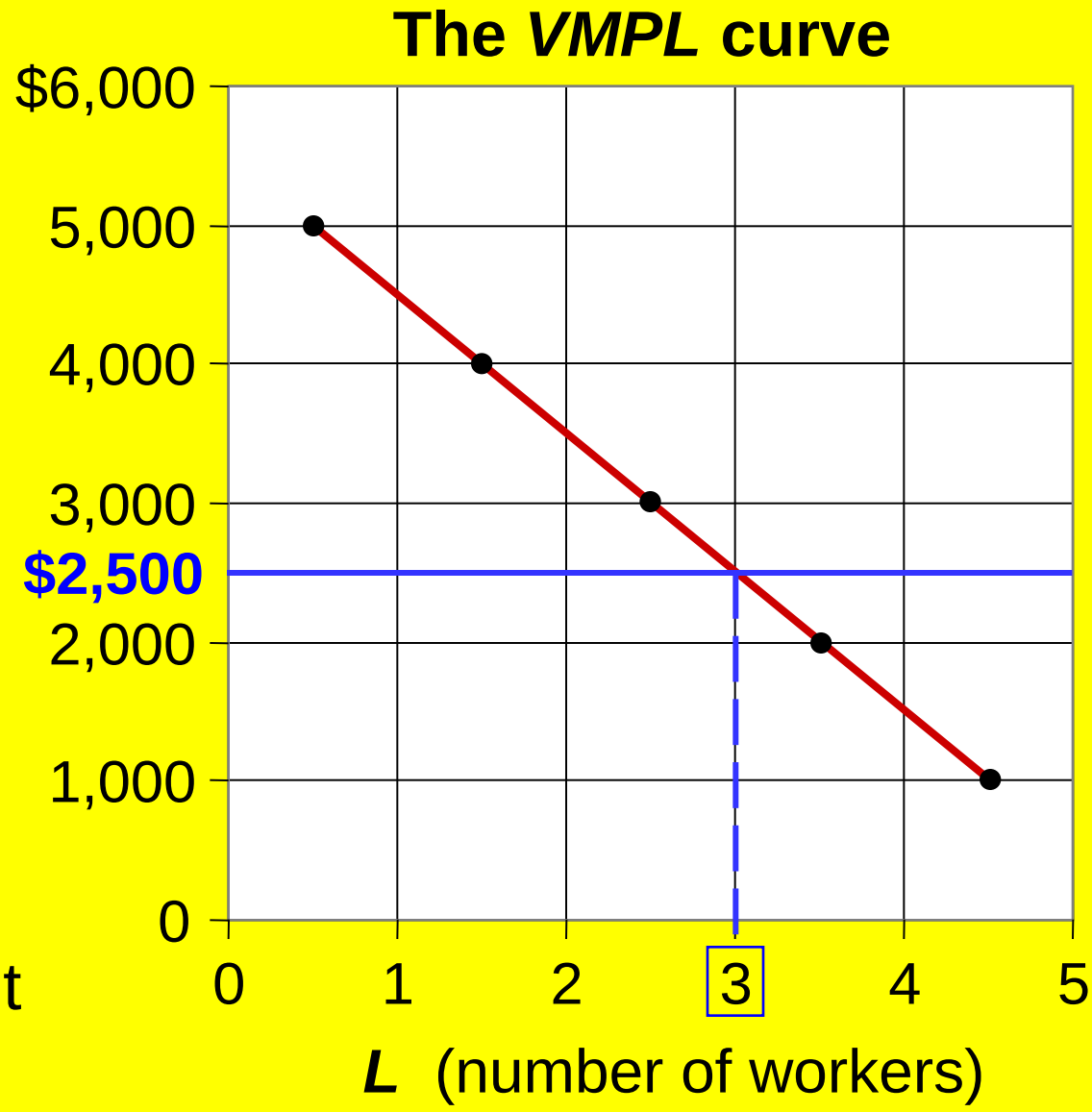
Farmer Jack's Labor Demand

Suppose wage
W = \$2500/week.

How many workers should Jack hire?

Answer: L = 3
At any larger L, can increase profit by hiring one fewer worker.

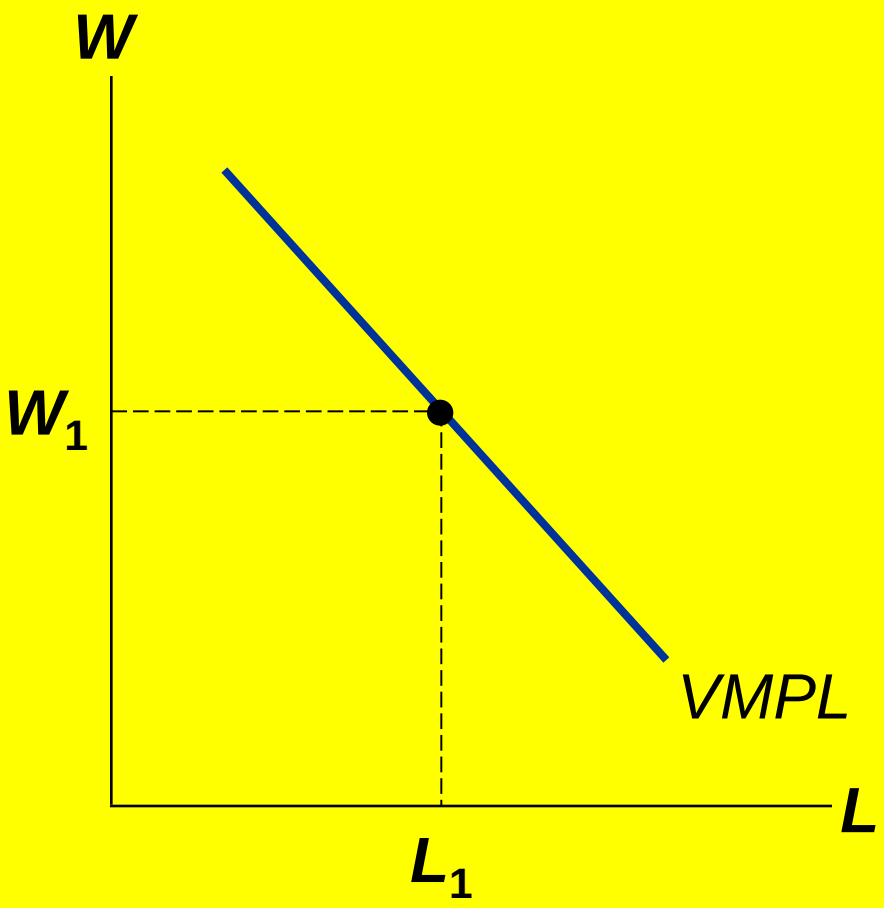
At any smaller L, can increase profit by hiring another worker.



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.

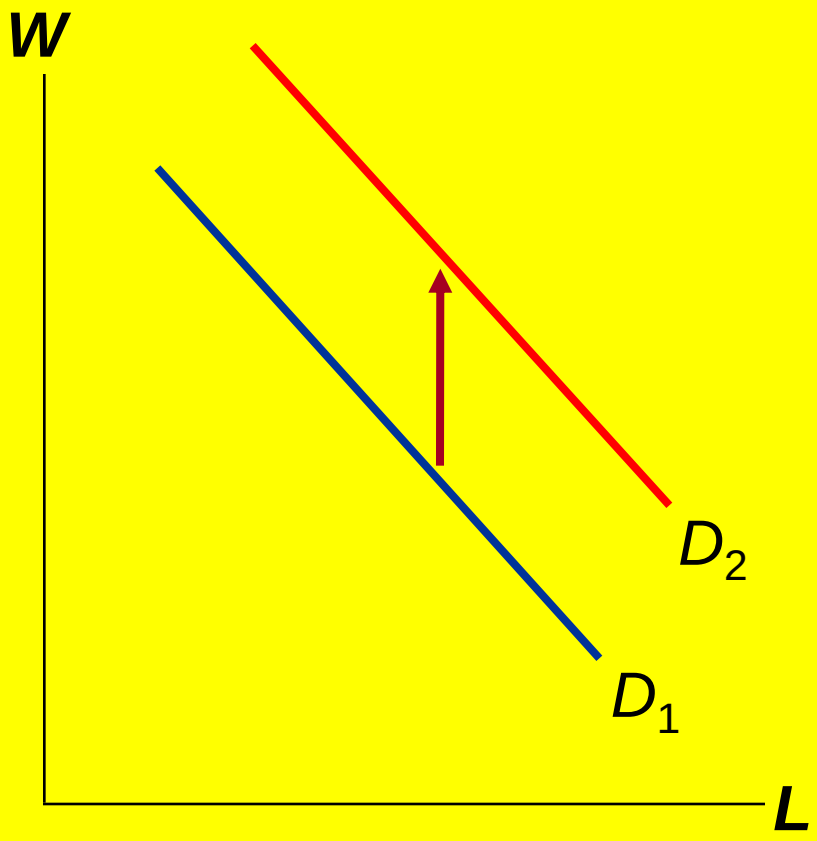


Shifts in Labor Demand

Labor demand curve = *VMPL* curve.

VMPL = *P* x *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 and Output Supply

- Recall: **Marginal Cost (*MC*)**

  = cost of producing an additional unit of output

  = Δ***TC***/Δ***Q***, where *TC* = total cost

- Suppose *W* = \$2500, *MPL* = 500 bushels

- If Farmer Jack hires another worker,

  Δ***TC*** = \$2500, Δ***Q*** = 500 bushels

  MC = \$2500/500 = \$5 per bushel

- In general: $MC = W/MPL$

The Connection Between Input Demand and 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 and 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.*

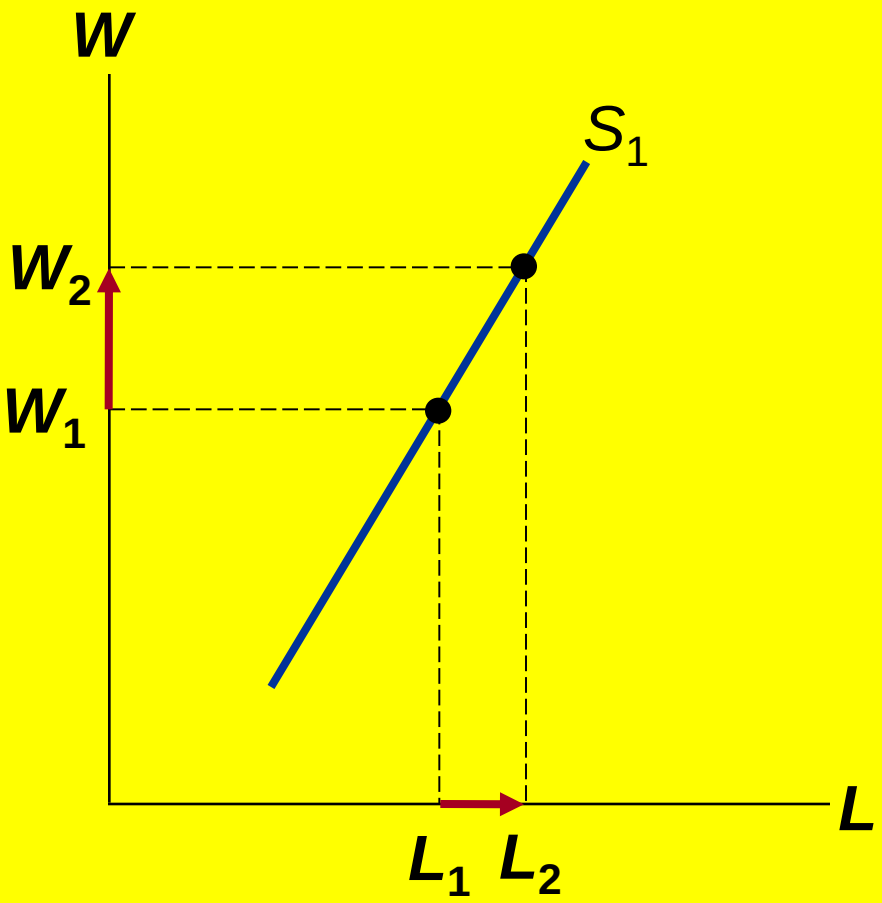
Labor Supply

- 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.



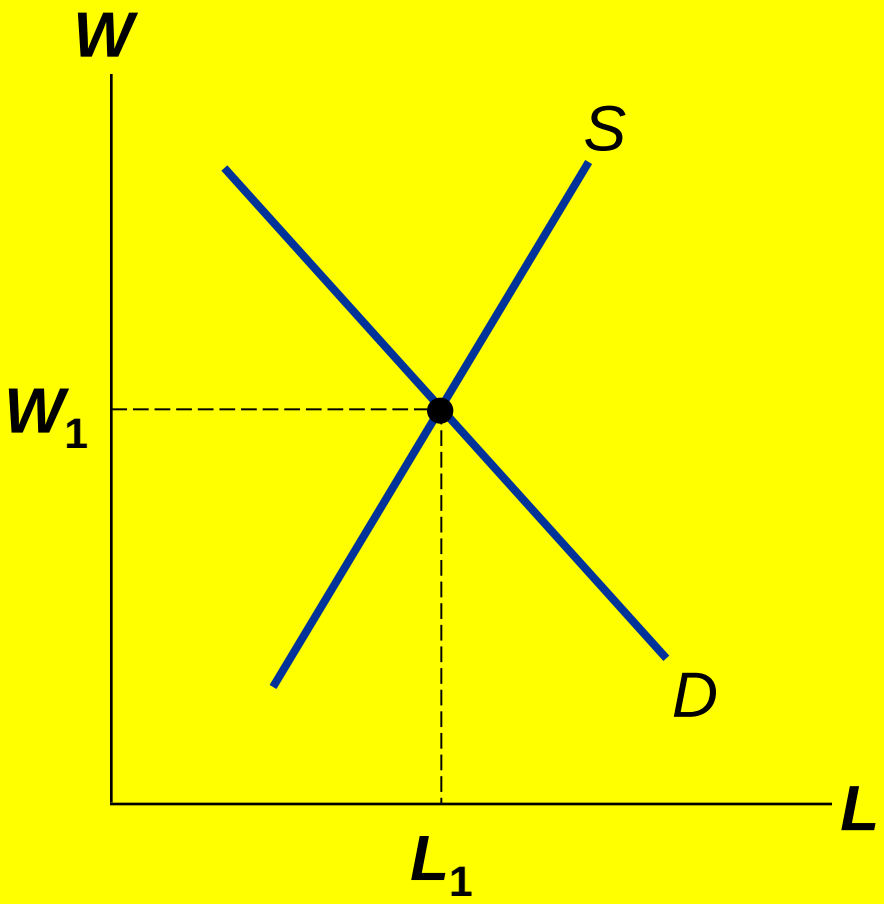
Things that Shift the Labor Supply Curve

- 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.

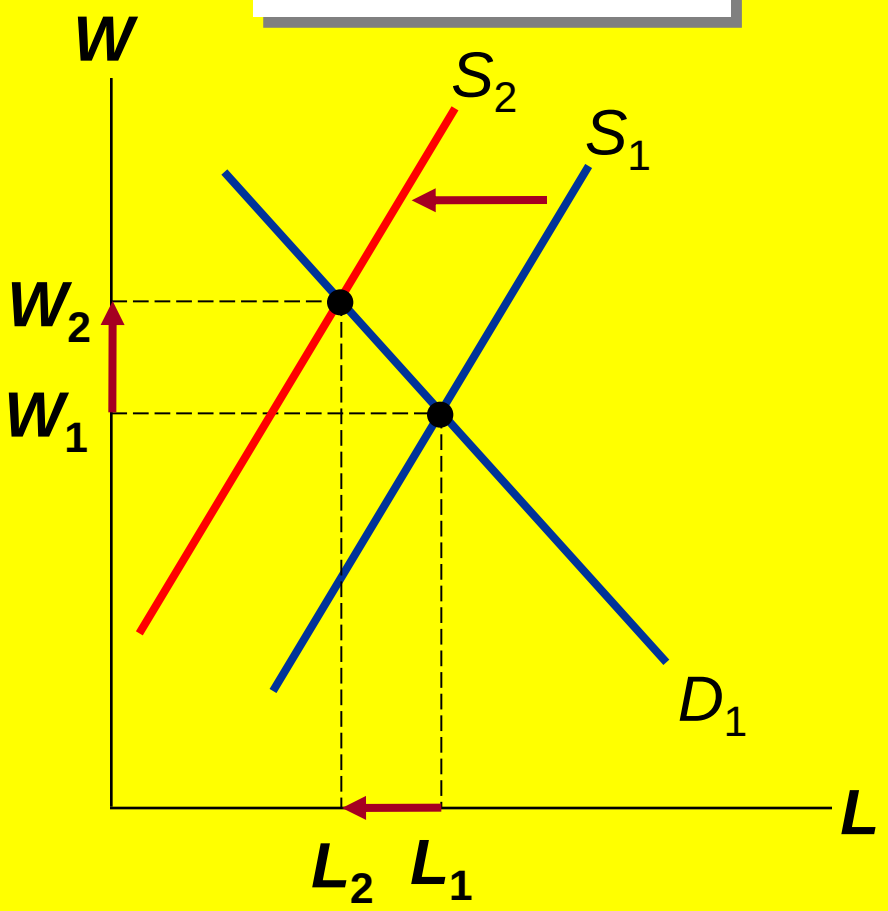
C. Technological progress boosts productivity in the auto manufacturing industry.

ACTIVE LEARNING 2

Answers to A

The retirement of Baby Boomer auto workers shifts supply leftward.

W rises, *L* falls.



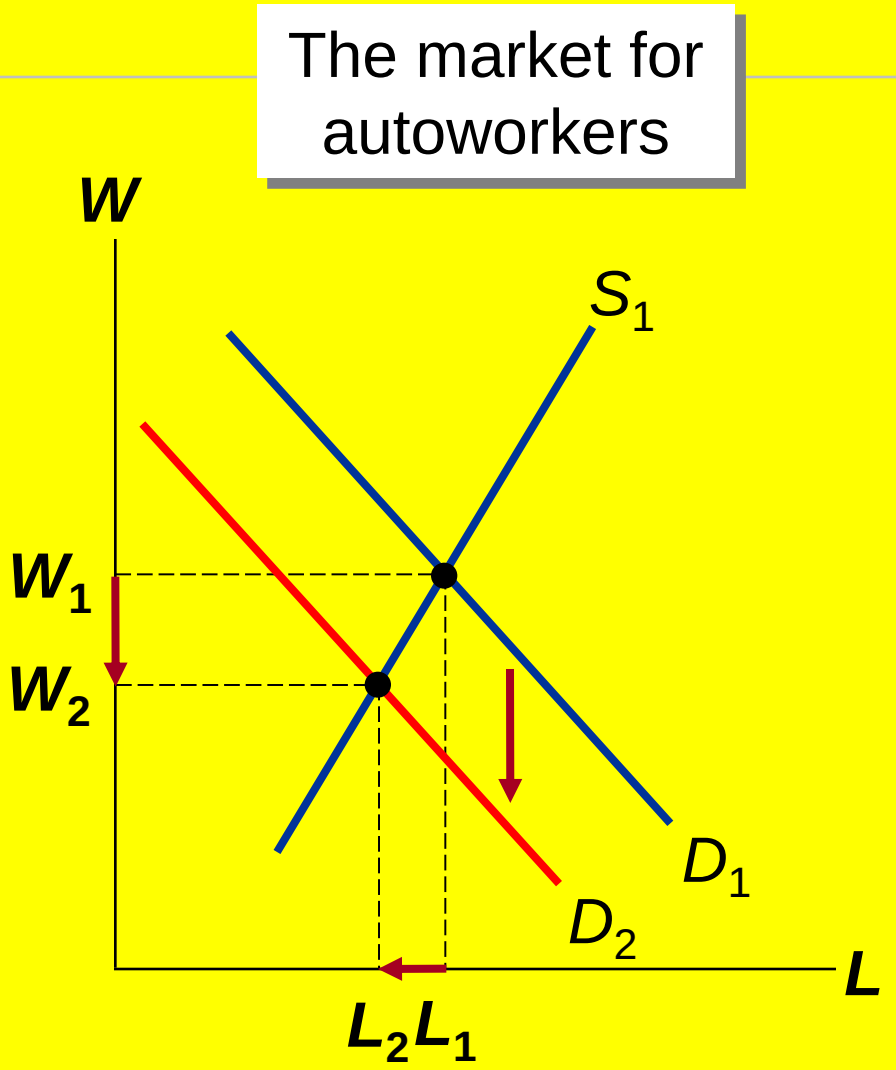
ACTIVE LEARNING 2
Answers to B

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

At each *L*, *VMPL* falls.

Labor demand curve shifts down.

W and *L* both fall.

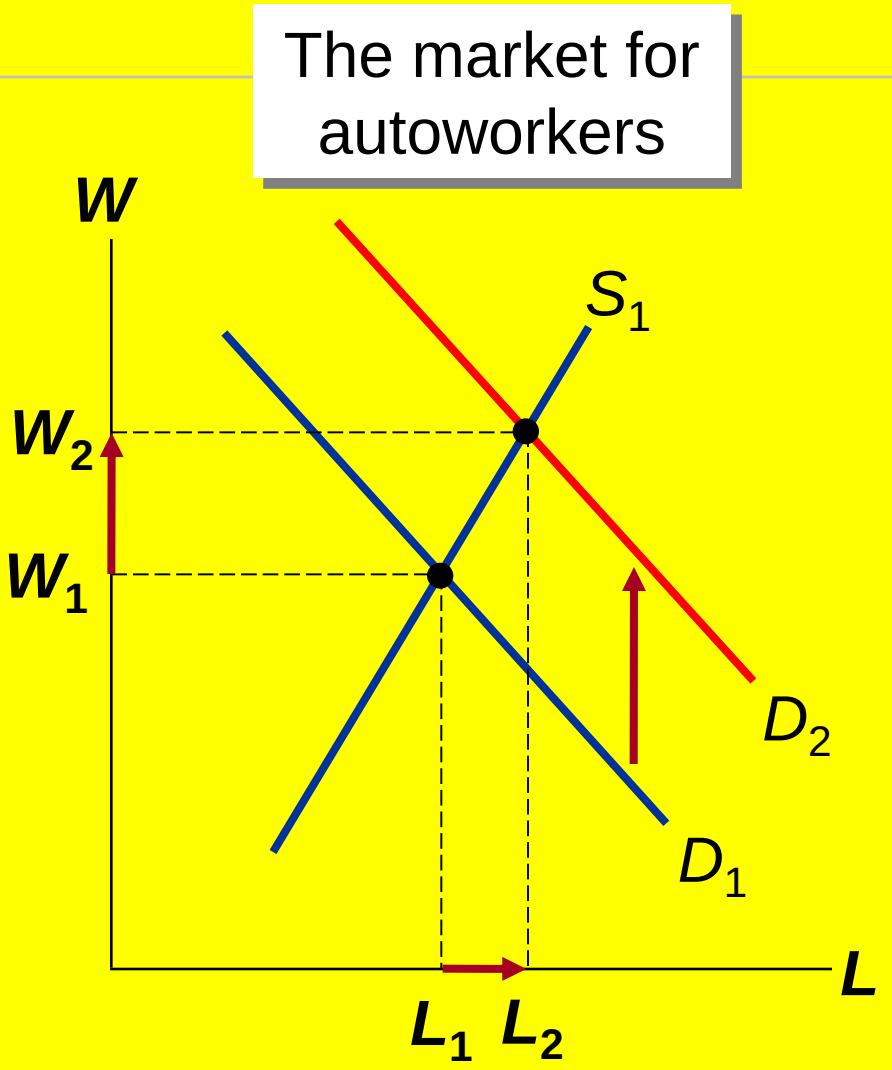


ACTIVE LEARNING 2
Answers to C

At each *L*,
MPL rises due to tech. progress.

VMPL rises and labor demand curve shifts upward.

W and *L* increase.



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.

14. Suppose that a large number of unskilled workers enter a nation's labor market. If the labor market is competitive, the number of unskilled workers hired and the wage rate will most likely change in which of the following ways?

	Number of Unskilled Workers Hired	Wage Rate
(A)	Increase	Increase
(B)	Increase	Decrease
(C)	Increase	Not change
(D)	Decrease	Increase
(E)	Decrease	Decrease

58. Which of the following will happen in the labor market if the price of the good produced by the workers decreases?

(A) The marginal product of labor will increase.
(B) The marginal product of labor will decrease.
(C) The marginal revenue product of labor will increase.
(D) The marginal revenue product of labor will decrease.
(E) The demand curve for labor will shift to the right.

Number of Workers	Hourly Wage	Marginal Factor Cost	Marginal Revenue Product
10	$5.00		
11	5.10	$6.10/hr	$8.70/hr
12	5.20	6.30/hr	7.60/hr
13	5.30	6.50/hr	6.50/hr
14	5.40	6.70/hr	5.40/hr
15	5.50	6.90/hr	4.30/hr

28. According to the information in the table above, the twelfth worker would increase the hourly profit by

(A) $0.20
(B) $1.10
(C) $1.30
(D) $2.40
(E) $5.20

30. Which of the following tends to increase the gap in earnings between skilled and unskilled workers over time?

(A) An increase in the demand for unskilled workers relative to skilled workers
(B) An increase in the supply of skilled workers relative to unskilled workers
(C) A decrease in the demand for unskilled workers relative to skilled workers
(D) A decrease in both the demand for and the supply of skilled workers
(E) An increase in both the demand for and supply of unskilled workers

54. When marginal product exceeds average product, which of the following must be true?

(A) Average product is increasing.
(B) Average product is decreasing.
(C) Marginal product is increasing.
(D) Total product is decreasing.
(E) Total product is at its maximum.

58. Marginal revenue product is defined as the

(A) change in income that occurs when an individual works additional hours
(B) change in total revenue that occurs when one additional unit of the good is produced
(C) change in total revenue that occurs when one additional unit of an input is employed
(D) total revenue divided by the quantity of labor employed
(E) change in total cost that occurs when one additional unit of an input is employed

43. A firm's demand curve for labor is equal to a segment of its

(A) average variable cost curve
(B) total revenue curve
(C) marginal cost curve
(D) marginal revenue product curve
(E) average product curve

36. Technological advances will lead to

(A) an increase in marginal utility
(B) a decrease in average total costs
(C) a decrease in net exports
(D) an increase in marginal costs
(E) diseconomies of scale