

The background of the slide is an abstract composition of numerous overlapping triangles in various colors including yellow, orange, red, pink, purple, blue, and grey. A large, semi-transparent pink circle is positioned on the right side of the slide, partially overlapping the triangular pattern.

The Markets for the Factors of Production

EE 211

IN THIS CHAPTER

- 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

- Factors of production:
 - Inputs used to produce goods and services: labor, land, capital
 - Prices and quantities are determined by supply and demand in factor markets.
- Derived demand for a factor of production
 - A firm's demand for a factor of production is derived from its decision to supply a good in another market.

Two Assumptions

1. All markets are competitive
 - The typical firm is a price taker
 - In the market for the good it produces
 - And in the labor market (factors of production)
2. Firms care only about maximizing profits
 - Each firm's supply of output and demand for inputs are derived from this goal

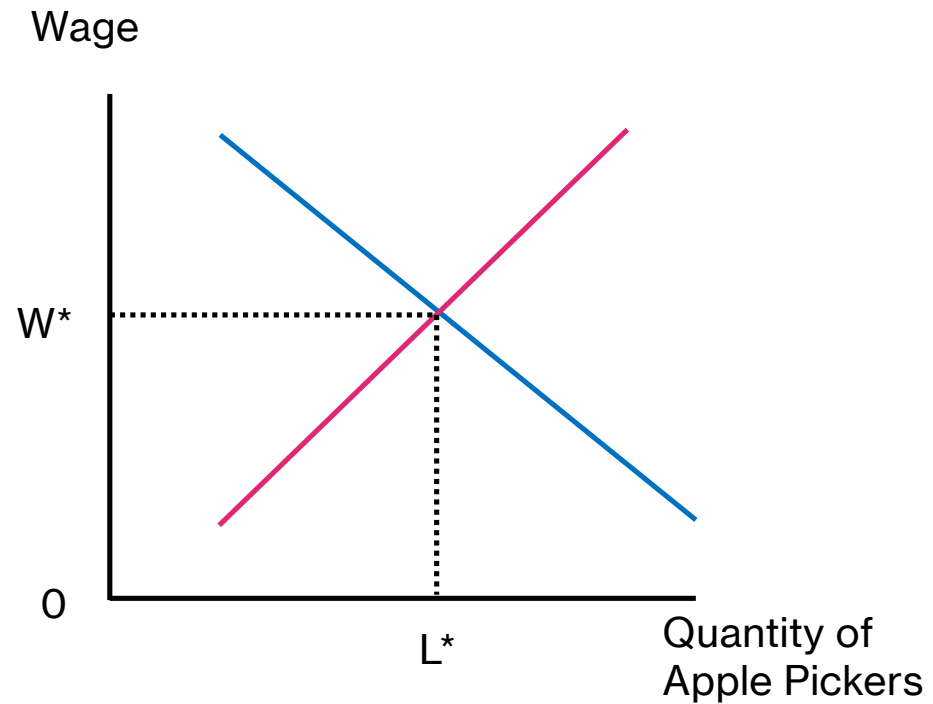
The Demand for Labor

- Labor demand is a derived demand
- Labor services are inputs into the production of other goods
- To understand labor demand, we focus on the firms that hire the labor and use it to produce goods for sale
- The link between the supply of goods and the demand for labor to produce them is crucial in determining equilibrium wages

(a) The Market for Apples



(b) The Market for Apple Pickers



- (a) Shows how the supply and demand for apples determine the price of apples
- (b) Shows how the supply and demand for apple pickers determine the wage of apple pickers.

Costs and Benefits of One More Worker

- Cost of hiring another worker:
 - The wage = the price of labor
- Benefit of hiring another worker:
 - Produce and sell more output, increasing revenue.
 - The size of this benefit depends on the **production function**: the relationship between the quantity of inputs used to make a good and the quantity of output of that good

The Production Function of the Marginal Product of Labor (MPL)

- The production function – the relationship between the quantity of inputs used to make a good and the quantity of output of that good
- **Marginal product of labor, $MPL = \Delta Q / \Delta L$**
 - The increase in the amount of output from an additional unit of labor
 - Where:
 - ΔQ = change in output
 - ΔL = change in labor
- **Diminishing marginal product**
 - The marginal product of an input declines as the quantity of the input increases

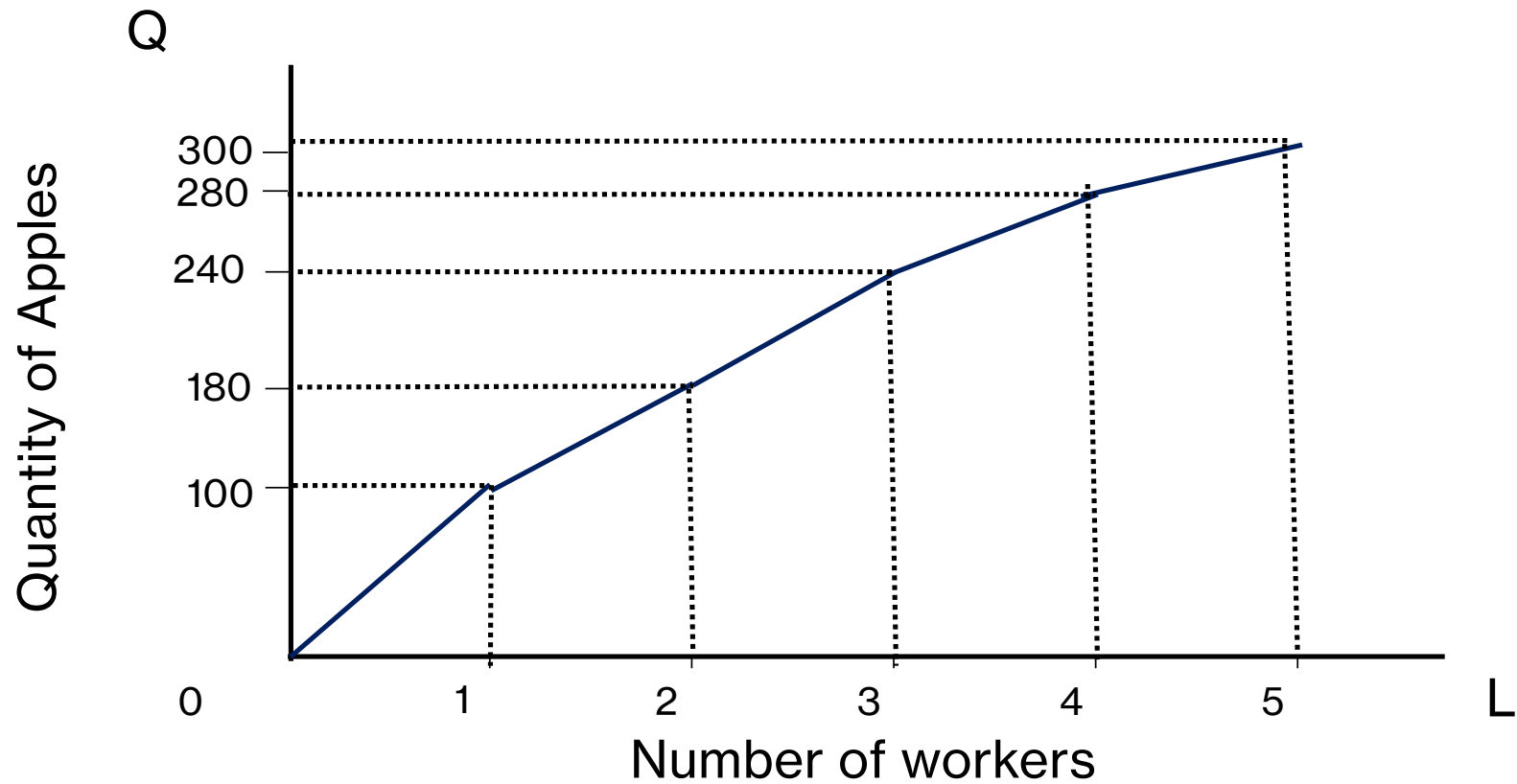
The Value of the Marginal Product

- 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 MPL, $VMPL = P \times MPL$
 - The marginal product of an input (labor) times the price of the output

How the competitive firm decides how much labor to hire

Labor (L)	Output (Q)	Marginal product of labor, $MPL = \Delta Q / \Delta L$	Value of the Marginal Product $VMPL = P \times MPL$ P=\$10 per bushel	Wage (w)	Marginal Profit $\Delta \text{profit} = VMPL - w$
0 workers	0 bushels				
		100 bushels	\$1,000	\$500	\$500
1	100				
		80	800	500	300
2	180				
		60	600	500	100
3	240				
		40	400	500	-100
4	280				
		20	200	500	-300
5	300				

The Production Function

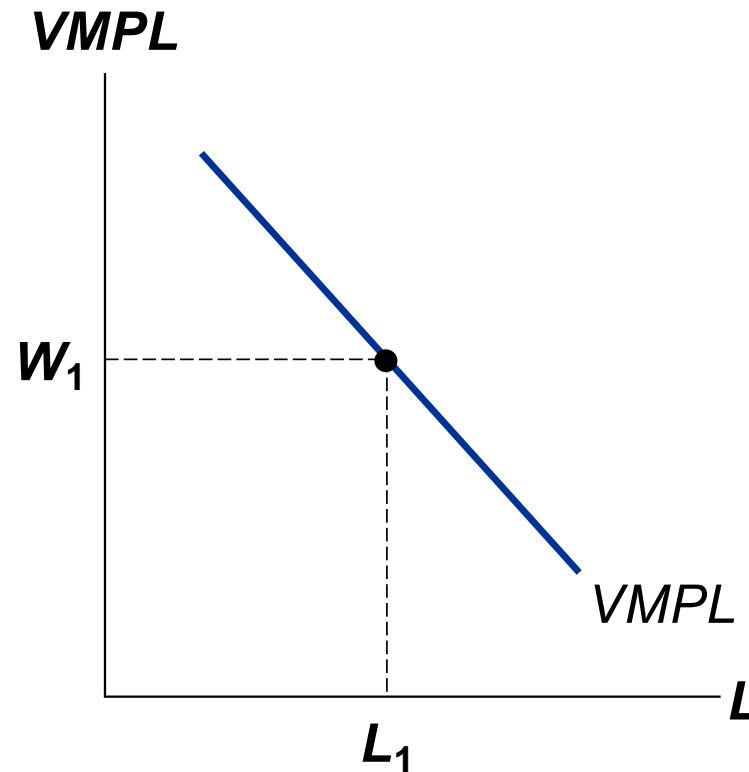


VMPL and labor demand

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.



What Causes the Labor-Demand Curve to Shift?

- Changes in the output price, P
 - An increase in P increases $VMPL (= P \times MPL)$ which is the D curve
- Technological change (affects MPL)
 - Can increase the MPL , increasing the demand for labor
- The supply of other factors of production (affects MPL)

EXAMPLE 1A: Xavier's Popcorn Truck

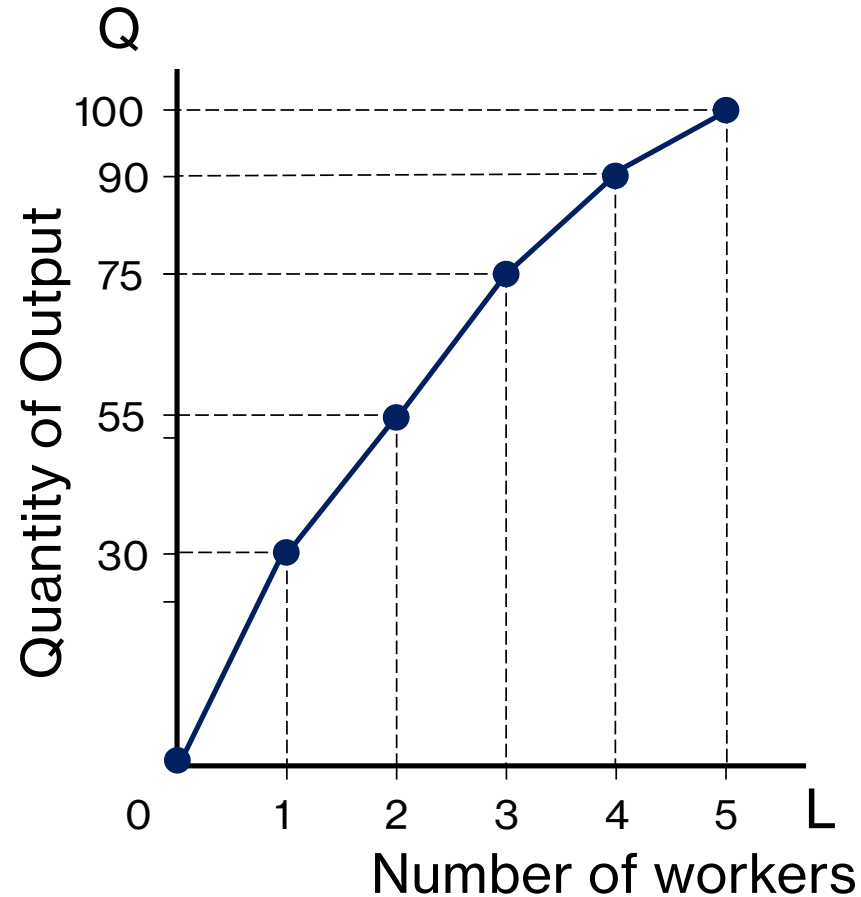
Xavier sells popcorn in a perfectly competitive market. He hires workers in a perfectly competitive labor market.

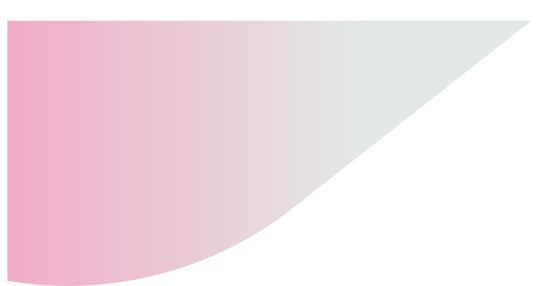
When deciding how many workers to hire, Xavier maximizes profits by thinking at the margin:

- If the benefit from hiring another worker exceeds the cost, Xavier will hire that worker.

EXAMPLE 1B: Xavier's Popcorn Production Function

L workers	Q buckets
0	0
1	30
2	55
3	75
4	90
5	100





Class exercise 1



Active Learning 1: Xavier's truck MPL and VMPL

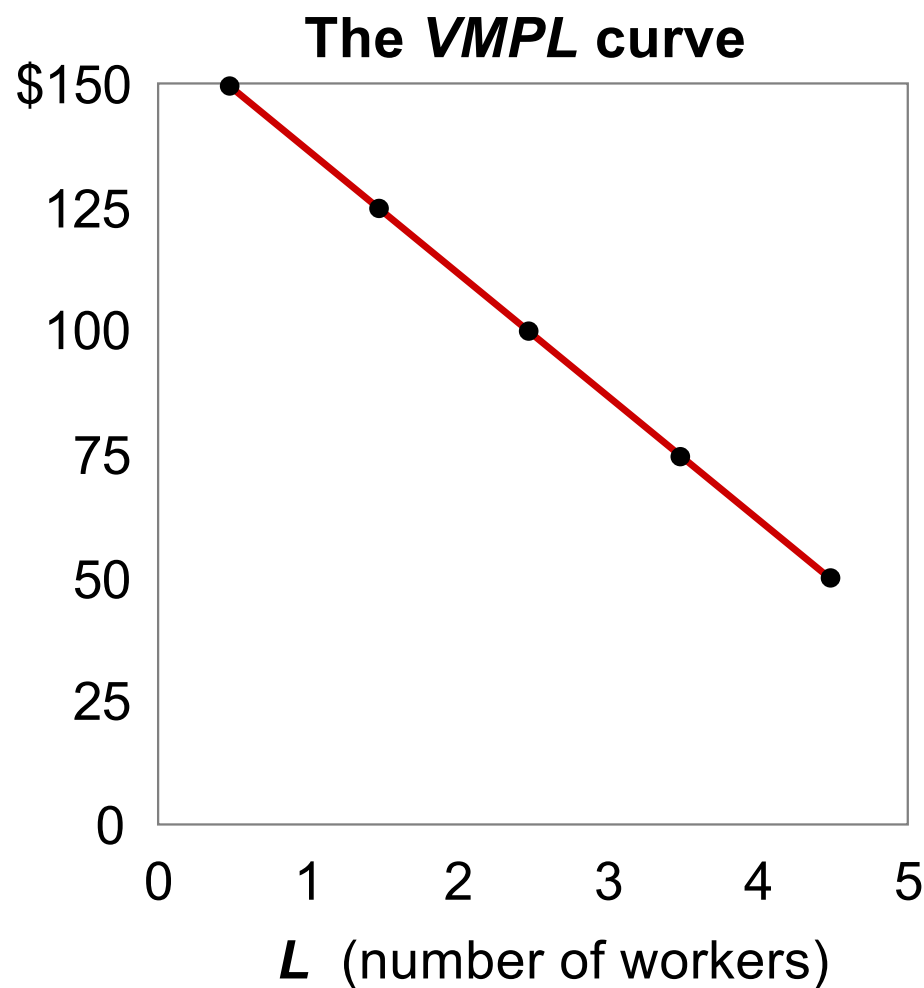
- Use the table given in Example 1B, which shows Xavier's popcorn truck input and output.
- The price of popcorn is $P = \$5$ per bucket of popcorn.
- A. Calculate MPL and $VMPL$, fill them in the blank spaces of the table.
- B. Then graph a curve with $VMPL$ on the vertical axis, L on horizontal axis.

Active Learning 1: Answers, A

L workers	Q buckets	MPL = $\Delta Q / \Delta L$	VMPL = $P \times MPL$
0	0		
1	30	30	150
2	55	25	125
3	75	20	100
4	90	15	75
5	100	10	50

Xavier's production function exhibits diminishing marginal product: *MPL* falls as *L* increases

Active Learning 1: Answers, B



Xavier's *VMPL* curve is downward sloping due to diminishing marginal product.

Example 1C: Xavier's labor demand

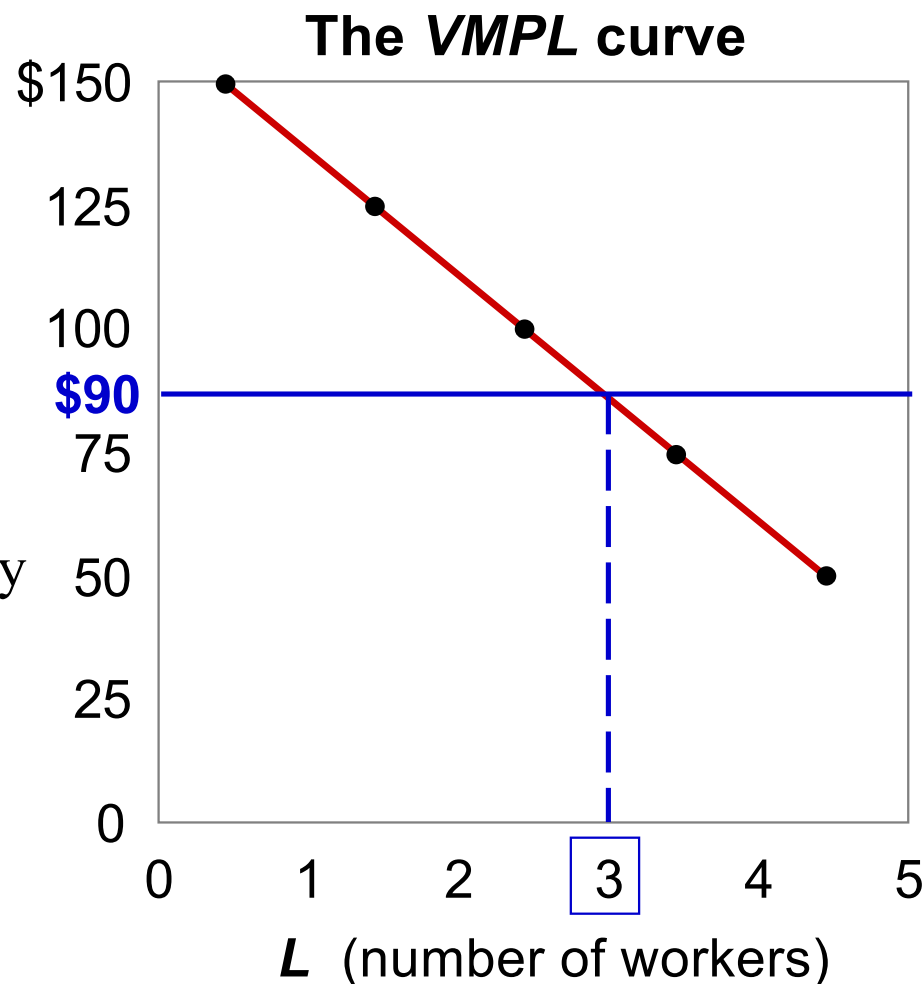
Suppose wage

$W = \$90/\text{day}$.

How many workers should Xavier hire?

Answer: $L = 3$

- At any smaller L : increase profit by hiring another worker
- At any larger L : increase profit by hiring one fewer worker.



Input Demand & Output Supply

- Marginal Cost (MC): cost of producing an additional unit of output

$$MC = \Delta TC / \Delta Q, \text{ where } TC = \text{total cost}$$

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

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.

The Supply of Labor

- Trade-off between work and leisure:
 - The more time you spend working, the less time you have for leisure.
- Wage
 - Is the opportunity cost of leisure
 - When wage increases, the opportunity cost of enjoying leisure goes up

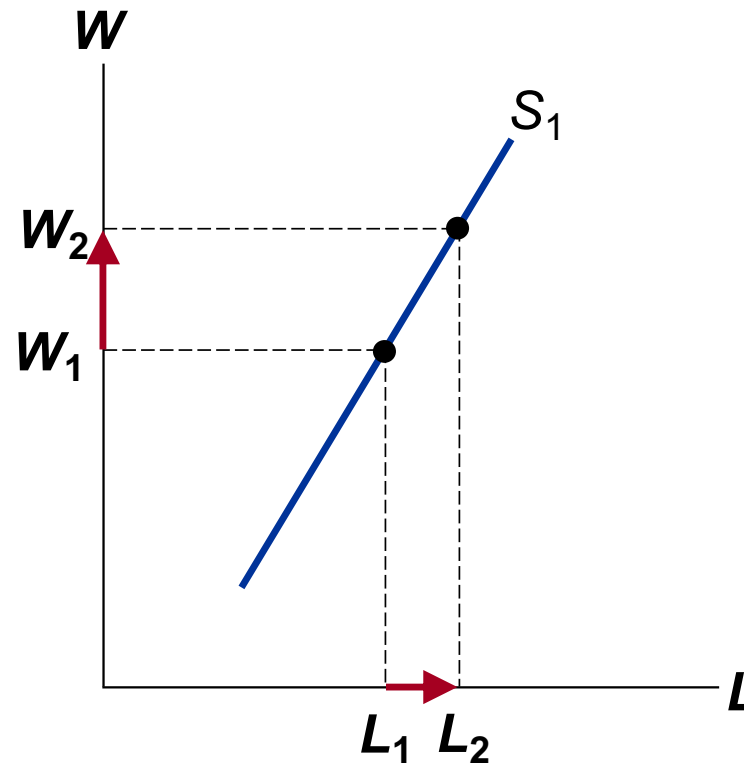


“I really didn’t enjoy working five days a week, fifty weeks a year for forty years, but I needed the money.”

The Labor Supply Curve

An increase in W
is an increase in the opportunity
cost of leisure.

People respond by taking less
leisure and by working more.



What Causes the Labor-Supply Curve to Shift?

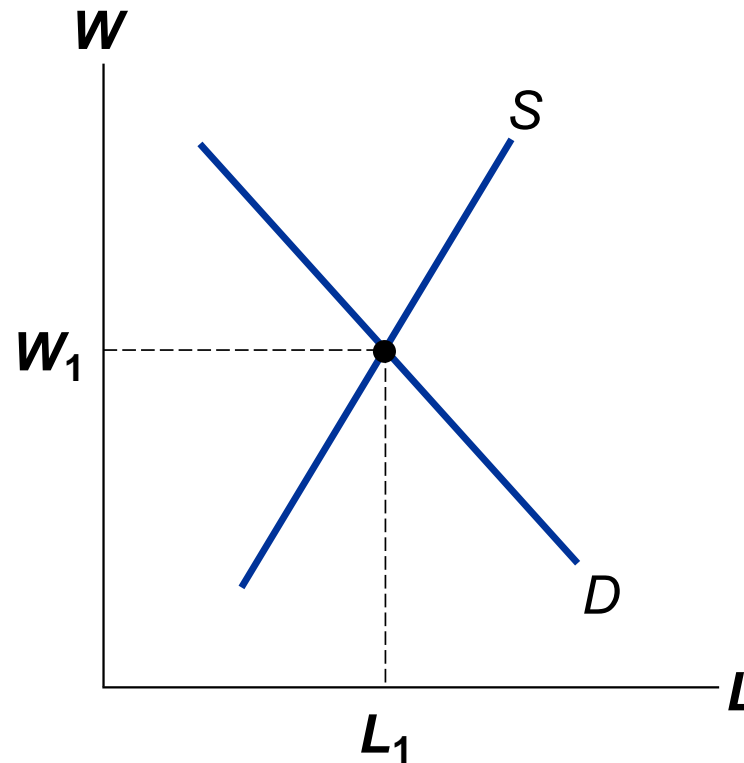
- **Changes in preferences**
 - Example: increase in labor force participation of women
- **Changes in alternative opportunities**
 - The supply of labor in any one labor market depends on the opportunities available in other labor markets
- **Immigration**
 - Movement of workers from region to region, or country to country

Equilibrium in the Labor Market

Wage: adjusts to balance S and D for labor.

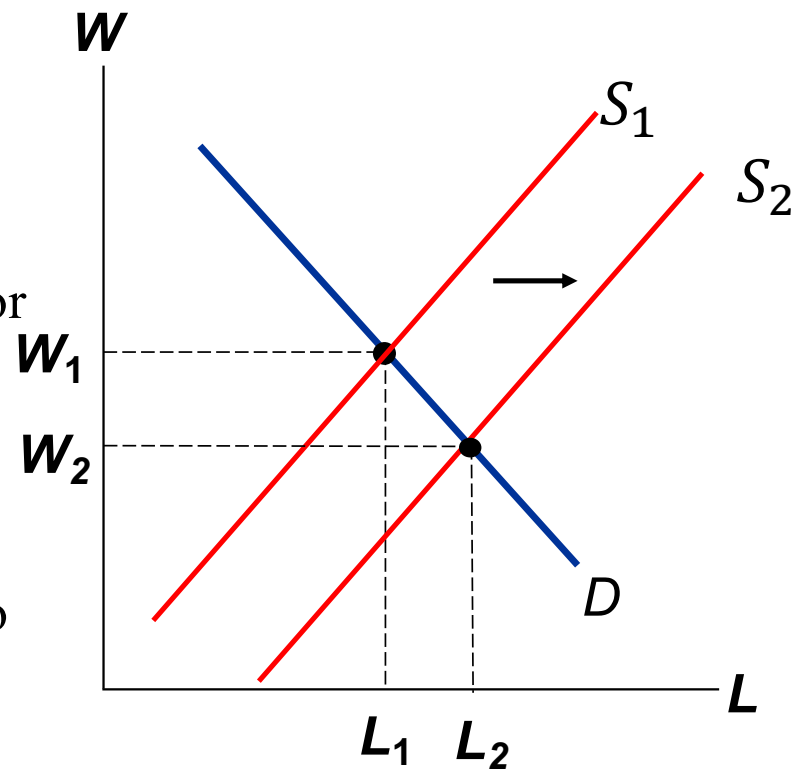
The wage always equals the value of the marginal product of labor ($VMPL$).

Any event that changes the S or D for labor must change the equilibrium wage and the $VMPL$ by the same amount.



Shift in Labor Supply

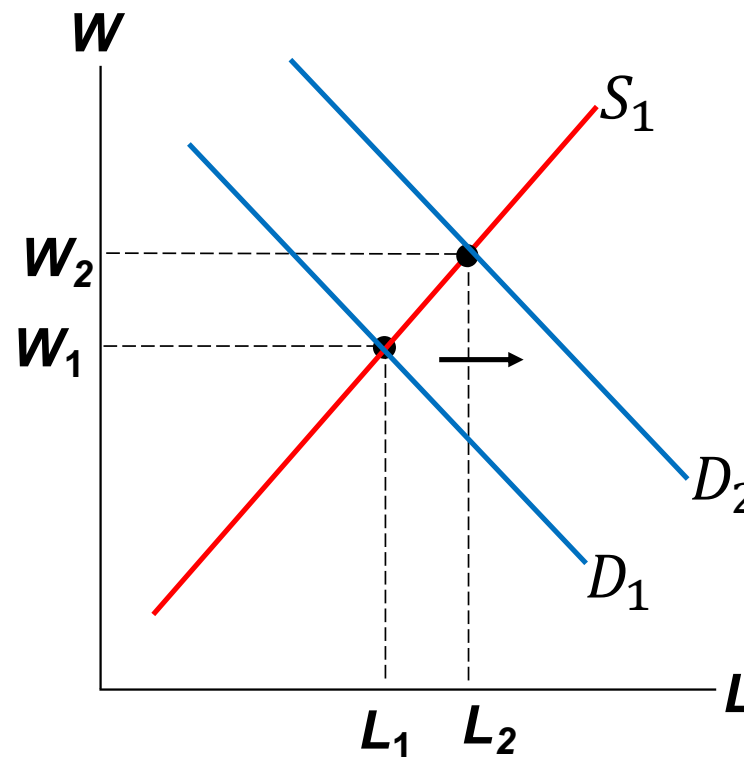
- Suppose that immigration increases the number of workers willing to pick apples.
- The supply of labor shifts to the right.
- At the initial wage W_1 , the quantity of labor supplied now exceeds the quantity demanded. This surplus of labor puts downward pressure on the wage of apple pickers, and the fall in the wage from W_1 to W_2 makes it profitable for firms to hire more workers.



- As the number of workers employed in each apple orchard rises, the marginal product of a worker falls, and so does the value of the marginal product.
- In the new equilibrium, both the wage and the value of the marginal product of labor are lower than they were before the influx of new workers.

Shift in Labor Demand

- Suppose an increase in the popularity of apples causes their price to rise.
- This price increase does not change the MPL of any given number of workers, but it does raise the value of marginal product.
- When demand for labor shifts to the right from D_1 to D_2 , the equilibrium wage rises from W_1 to W_2 and the equilibrium employment rises from L_1 to L_2 .



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.

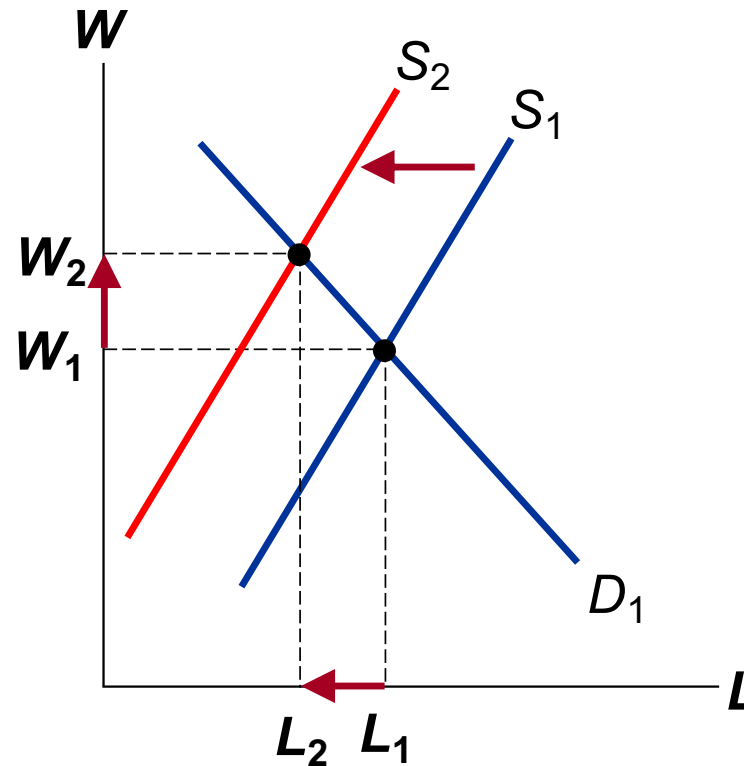
- A. Baby boomers who worked in the auto industry retire.
- B. Car buyers' preferences shift toward imported autos.
- C. Technological progress boosts worker productivity in the auto manufacturing industry.

Active Learning 2: Answers, A

The retirement of baby boomer auto workers shifts supply leftward.

- W rises, L falls.

The market for autoworkers

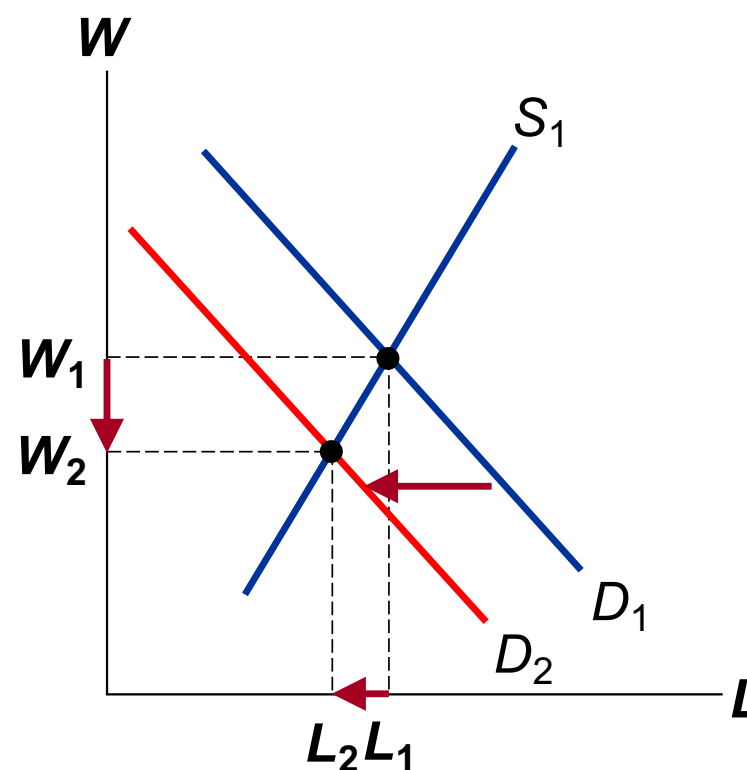


Active Learning 2: Answers, B

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

- At each L , $VMPL$ falls.
- Labor demand curve shifts left.
- W and L both fall.

The market for autoworkers

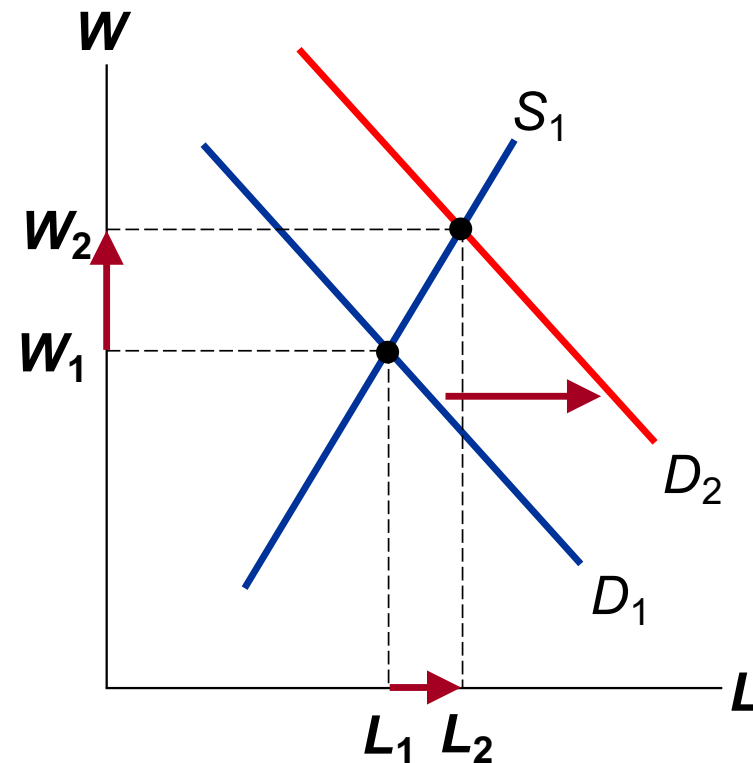


Active Learning 2: Answers, C

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

- $VMPL$ rises
- Labor demand curve shifts right.
- W and L increase.

The market for autoworkers



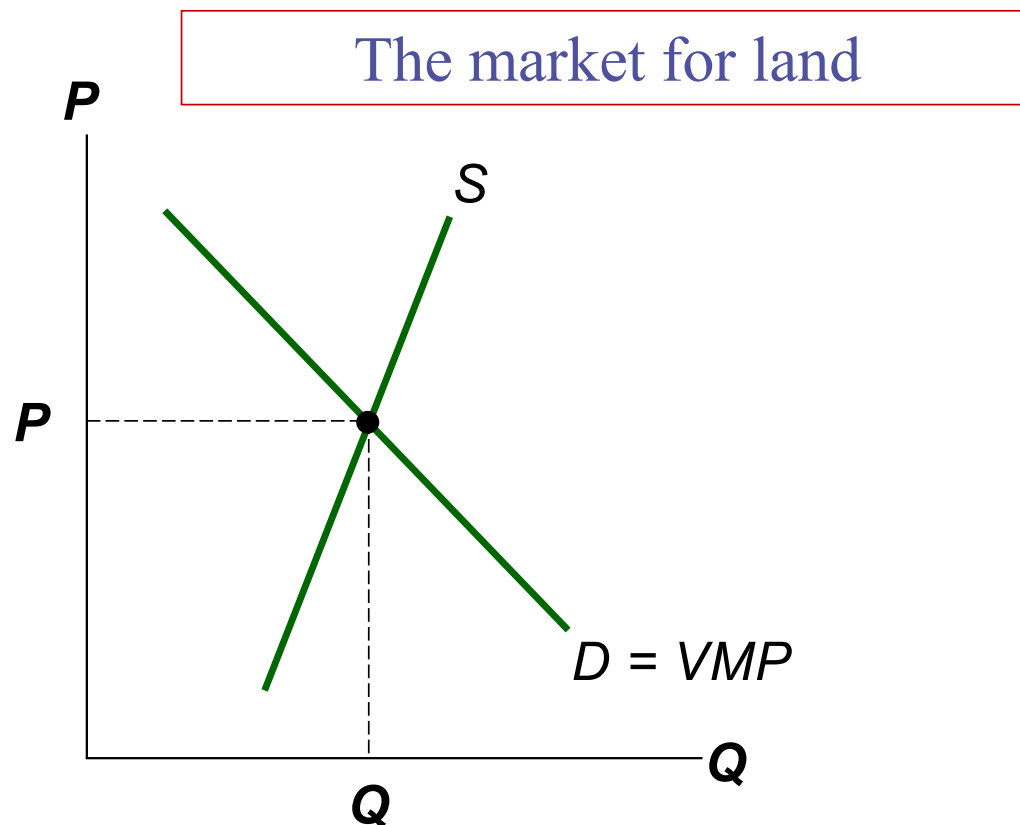
The Other Factors of Production: Land and Capital

- 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
 - Analogous to the determination of wages

How the Rental Price of Land is Determined

Firms increase the quantity of land to rent until the value of the marginal product (VMP) of land equals the land's rental price.

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

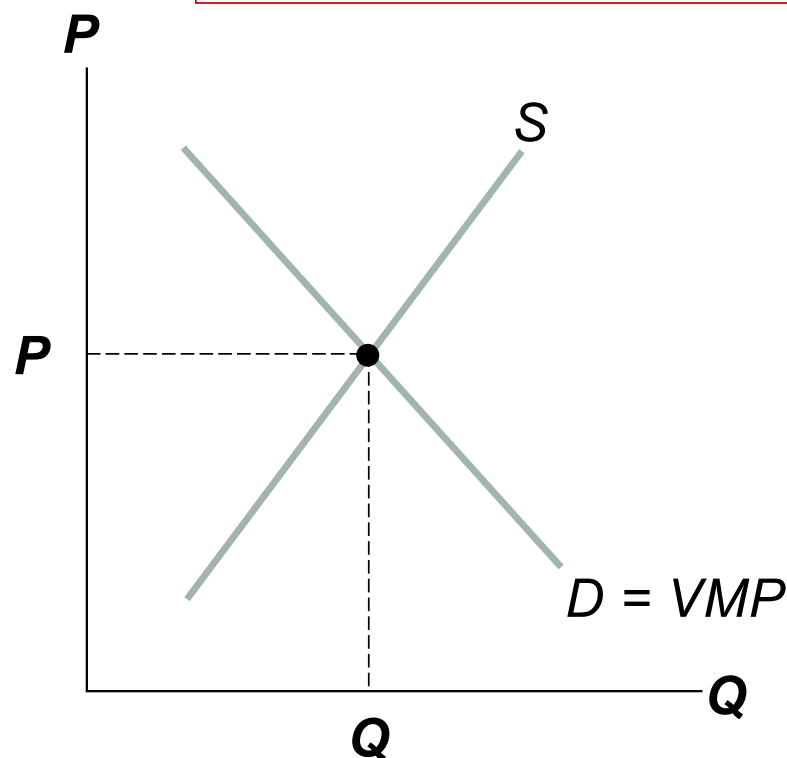


How the Rental Price of Capital is Determined

Firms increase the quantity of capital to rent until the value of the marginal product (VMP) of capital equals the capital's rental price.

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

The market 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

- 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

References

Mankiw, N.G., (2023) **Principles of Microeconomics**, 10th ed., Cengage, (ISBN-13: 978-981-5119-30-5)