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Principles of
Economics
Sixth Edition

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The Markets for the Factors of Production

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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?

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1

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.

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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.

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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.

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Our Example: Farmer Jack

- Farmer Jack sells vegetables 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.

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Our Example: Farmer Jack

- Cost of hiring another worker:
  the wage – the price of labor
- Benefit of hiring another worker:
  Jack can produce more vegetables 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.

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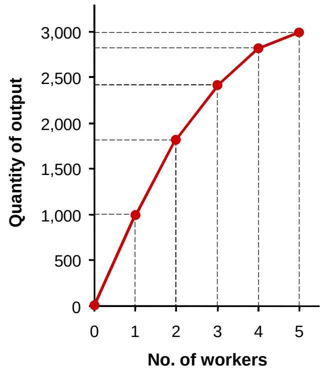
Farmer Jack's Production Function

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



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Marginal Product of Labor (MPL)

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

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

where
  $\Delta \boldsymbol{Q}$ = change in output
  $\Delta \boldsymbol{L}$ = change in labor

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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 = value of the marginal product of labor
  = *P* x *MPL*

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ACTIVE LEARNING 1

Computing MPL and VMPL

P = $5/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.

L (no. of workers)	***Q*** (bushels of veggie)	*MPL*	*VMPL*
0	0		
1	1000		
2	1800		
3	2400		
4	2800		
5	3000		

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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 veggie)	*MPL* = $\Delta \boldsymbol{Q}/\Delta \boldsymbol{L}$	*VMPL* = ***P*** x *MPL*
0	0		
1	1000	1000	$5000
2	1800	800	4000
3	2400	600	3000
4	2800	400	2000
5	3000	200	1000

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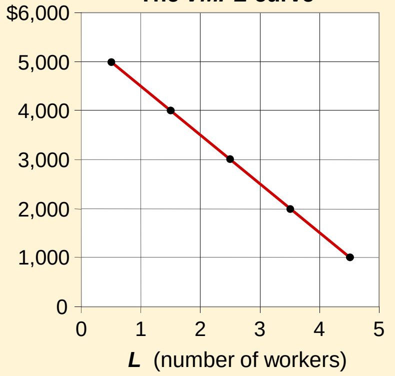
ACTIVE LEARNING 1

Answers

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

The *VMPL* curve



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Farmer Jack's Labor Demand

Suppose wage *W* = $2500/week.

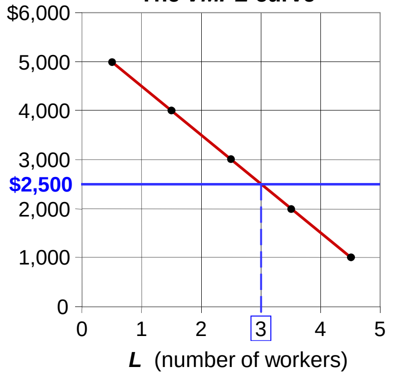
How many workers should Jack hire?

Answer: ***L*** = 3

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

At any larger *L*, can increase profit by hiring fewer workers.

The *VMPL* curve



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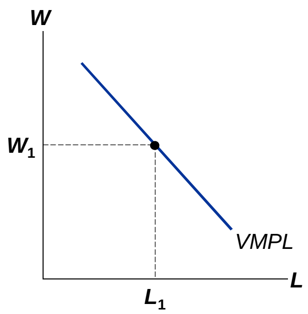
VMPL and Labor Demand

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.



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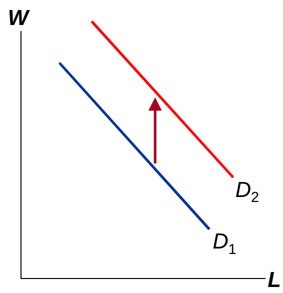
Shifts in Labor Demand

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.



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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.

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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,
  ΔTC = $2500, ΔQ = 500 bushels
  MC = $2500/500 = $5 per bushel
- In general: $\boxed{MC = W/MPL}$

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The Connection Between Input Demand & Output Supply

- In general: $\boxed{MC = W/MPL}$
- 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.*

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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.*

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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.

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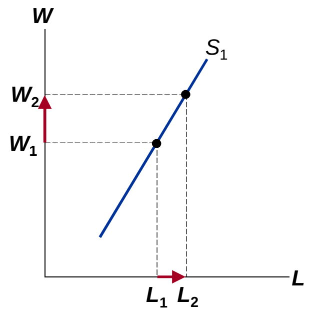
The Labor Supply Curve

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

People respond by taking less leisure and by working more.



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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

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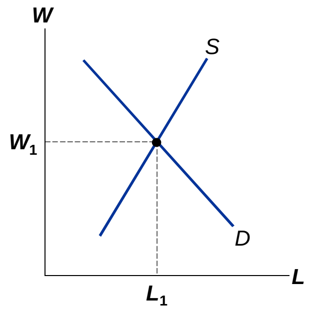
Equilibrium in the Labor Market

The wage adjusts to balance supply and demand for labor.

The wage always equals *VMPL*.



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ACTIVE LEARNING 2

Changes in labor-market equilibrium

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

A. Baby boomers who worked in the high-tech industry retire.

B. International high-tech corporate buyers' preferences shift toward MIC instead of MIT.

C. Technological progress boosts productivity in the high-tech manufacturing industry.

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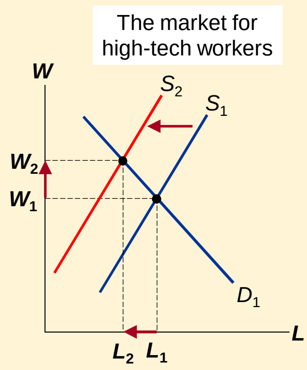
ACTIVE LEARNING 2

Answers to A

The retirement of baby boomer high-tech workers shifts supply leftward.

W rises, *L* falls.



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ACTIVE LEARNING 2

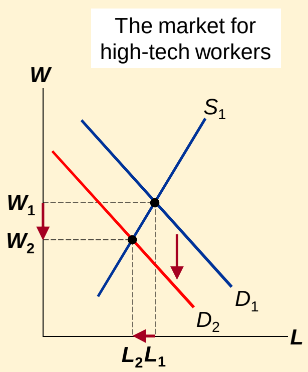
Answers to B

A fall in the demand for Made-in-Taiwan (MIT) reduces *P*.

At each *L*, *VMPL* falls.

Labor demand curve shifts down.

W and *L* both fall.



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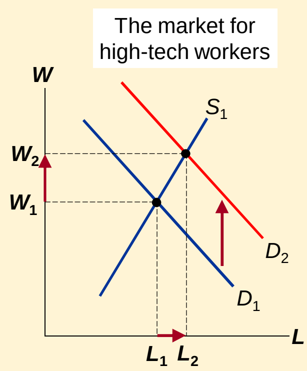
ACTIVE LEARNING 2

Answers to C

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

VMPL rises and labor demand curve shifts upward.

W and *L* increase.



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Productivity and Wage Growth in the U.S.

time period	growth rate of productivity	growth rate of real wages
1959–2009	2.1%	1.9%
1959–1973	2.8	2.8
1973–1995	1.4	1.2
1995–2009	2.6	2.3

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.

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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…

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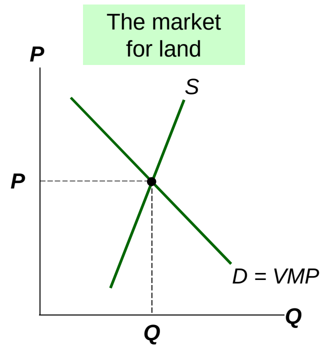
How the Rental Price of Land Is Determined

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.



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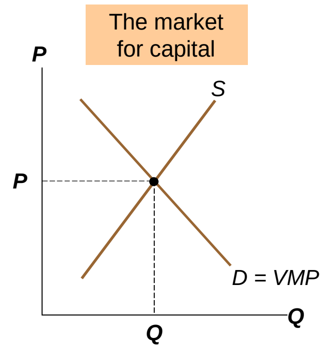
How the Rental Price of Capital Is Determined

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.



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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.

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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.

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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 as a starting point for understanding the distribution of income.
- The next two chapters further explore income distribution and related issues.

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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.

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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.

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Factor Markets

- Labor Market: Yet “another” market
- Derived Demand: W = P * MPL = VMPL
- Output Supply = Input Demand:
  - MC = P = W / MPL
- Labor Supply: Work vs. Leisure
- Other Factors: Land, Capital, etc.
- Homework: Mankiw, Ch. 18, pp.394-396, Problems 3, 6, 7, 9, 10, 11

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