

18

The Markets for the Factors  
of Production

PRINCIPLES OF  
MICROECONOMICS  
FOURTH CANADIAN EDITION

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PowerPoint® Slides  
by Ron Cronovich  
Canadian adaptation by Marc Prud'Homme

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

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

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Factors of Production and Factor Markets

- Factors of production:** the inputs used to produce goods and services.
  - labour
  - 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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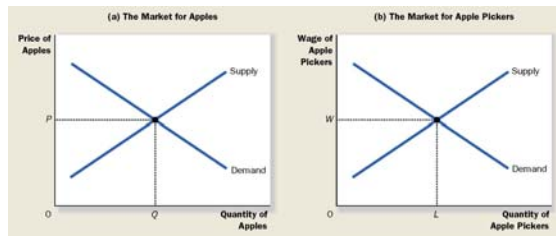
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**FIGURE 18.1: The Versatility of Supply and Demand**



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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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4

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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 labour 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 wheat in a perfectly competitive market.
- He hires workers in a perfectly competitive labour 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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6

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### Our Example: Farmer Jack

- Cost of hiring another worker:  
the wage – the price of labour
- 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.

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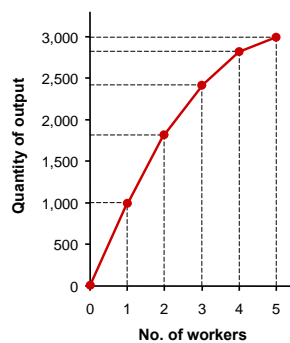
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### Farmer Jack's Production Function

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



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8

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### Marginal Product of labour (MPL)

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

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

where

$\Delta Q$  = change in output

$\Delta L$  = change in labour

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9

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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 labour
  - $= P \times MPL$

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### 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.

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

11

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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 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

12

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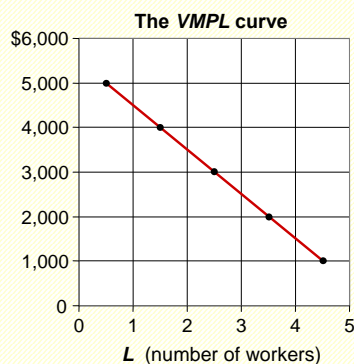
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### ACTIVE LEARNING 1: Answers

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



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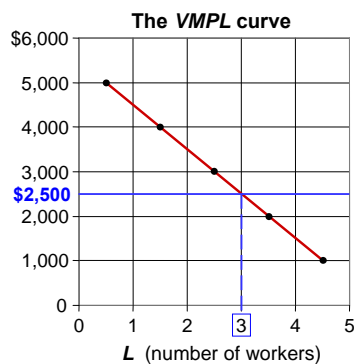
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### Farmer Jack's labour Demand

Suppose wage  $W = \$2500/\text{week}$ .  
How many workers should Jack hire?

Answer:  $L = 3$

At any smaller  $L$ , Jack can increase profit by hiring another worker.  
At any larger  $L$ , Jack can increase profit by hiring one fewer worker.



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14

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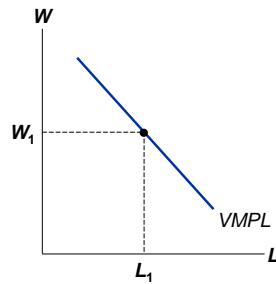
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### VMPL and labour Demand

For any competitive, profit-maximizing firm:

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



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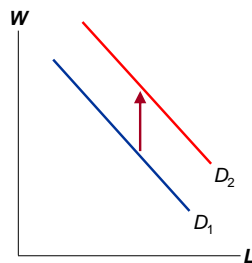
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### Shifts in labour Demand

labour demand curve  
=  $VMPL$  curve.

$$VMPL = P \times MPL$$

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



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16

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### Shifts in the Labour Demand Curve

- Changes in the output price
  - An increase in the price of the output rises the VMP and increases labour demand.
- Technological change (affects  $MPL$ )
  - Technological progress rises the  $MPL$  and thus increases the demand for labour.
  - But labour-saving technological change can move the labour supply curve to the left.
- The supply of other factors (affects  $MPL$ )
  - If firms acquire more equipment (capital), then workers will be more productive;  $MPL$  and  $VMPL$  rise, labour demand shifts upward.

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17

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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,  
 $\Delta TC = \$2500$ ,  $\Delta Q = 500$  bushels  
 $MC = \$2500/500 = \$5$  per bushel
- In general:  $MC = W/MPL$

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18

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### The Connection Between Input Demand & Output Supply

- In general:  $MC = W/MPL$
- Notice:
  - To produce additional output, hire more labour.
  - 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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19

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### The Connection Between Input Demand & Output Supply

- The competitive firm's rule for demanding labour:  
 $P \times MPL = W$
- 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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20

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## Labour Supply

- People face trade-offs, including a trade-off between work and leisure: The more time you spend working, the less time you have for leisure.
- The cost of something is what you give up to get it. The opportunity cost of leisure is the wage.



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21

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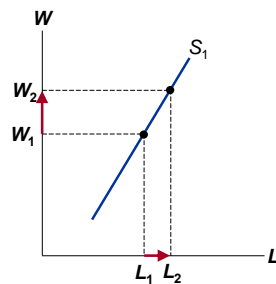
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## The Labour Supply Curve

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

People respond by taking less leisure and by working more.



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22

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## Things that Shift the Labour Supply Curve

- Changes in tastes or attitudes regarding the labour-leisure trade-off.
  - Increases in the participation rate of women in the labour force.
- Opportunities for workers in other labour markets
  - More and better employment opportunities in the high-tech industry results in a higher labour supply in that industry but reduces the availability of workers in the other industries.
- Immigration
  - When more immigrants enter the country the supply of labour increases.

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23

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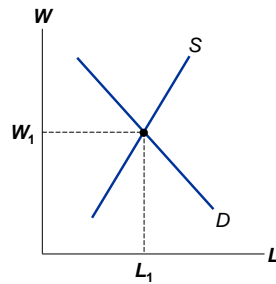
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## Equilibrium in the Labour Market

The wage adjusts to balance supply and demand for labour.

The wage always equals *VMPL*.



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24

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## ACTIVE LEARNING 2:

### Changes in labour-market equilibrium

In each of the following scenarios, use a diagram of the market for auto workers to find the effects on the wage and number of auto workers employed.

- A. Baby Boomers in the auto industry retire.
- B. Widespread recalls of North American autos shift car buyers' demand towards foreign-made autos.
- C. Technological progress boosts productivity in the auto manufacturing industry.

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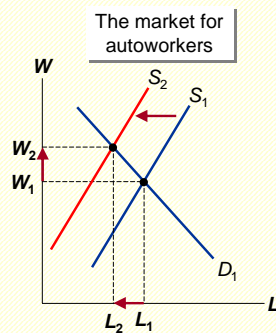
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## ACTIVE LEARNING 2A:

### Answers

The retirement of Baby Boomer auto workers shifts supply leftward.

$W$  rises,  $L$  falls.



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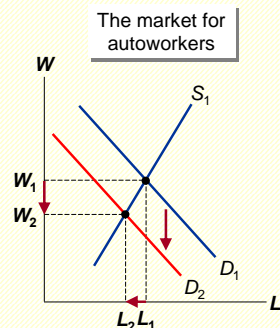
### ACTIVE LEARNING 2B: Answers

A fall in the demand for North American autos reduces  $P$ .

At each  $L$ ,  $VMPL$  falls.

Labour demand curve shifts down.

$W$  and  $L$  both fall.



27

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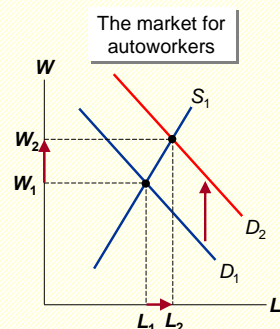
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### ACTIVE LEARNING 2C: Answers

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

$VMPL$  rises and labour demand curve shifts upward.

$W$  and  $L$  increase.



28

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### Productivity and Wage Growth in Canada

time period	growth rate of productivity	growth rate of real wages
1961-1999	1.9%	1.7%
1961-1973	3.2%	3.6%
1974-1999	1.2%	0.8%

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 labour productivity ( $W = VMPL$ ).

We see this in the data.




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**TABLE 18.3: Productivity and Wage Growth around the World, 1980–1992**

Country	Growth Rate of Productivity	Growth Rate of Real Wages
South Korea	8.5	7.9
Hong Kong	5.5	4.9
Singapore	5.3	5.0
Indonesia	4.0	4.4
Japan	3.6	2.0
India	3.1	3.4
United Kingdom	2.4	2.4
Canada	1.8	0.0
United States	1.7	0.5
Brazil	0.4	-2.4
Mexico	-0.2	-3.0
Argentina	-0.9	-1.3
Iran	-1.4	-7.9

Source: World Development Report 1994, Infrastructure for Development. Copyright © 1994 by The International Bank for Reconstruction and Development/The World Bank. Reprinted with permission.

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30

### 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 labour.
- The determination of the rental prices of capital and land is analogous to the determination of wages...

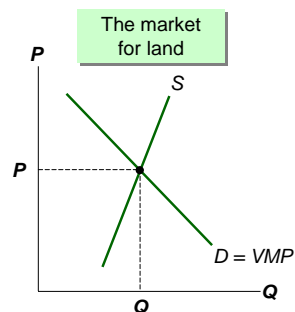
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31

### 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.



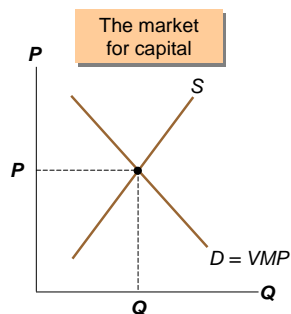
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### How the Rental Price of Capital Is Determined

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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33

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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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34

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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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35

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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 a starting point for understanding the distribution of income.
- The next two chapters explore this topic further.

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36

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## 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 labour, 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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37

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## CHAPTER SUMMARY

- The supply of labour arises from the trade-off between work and leisure, and yields an upward-sloping labour 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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38

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# End: Chapter 18

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