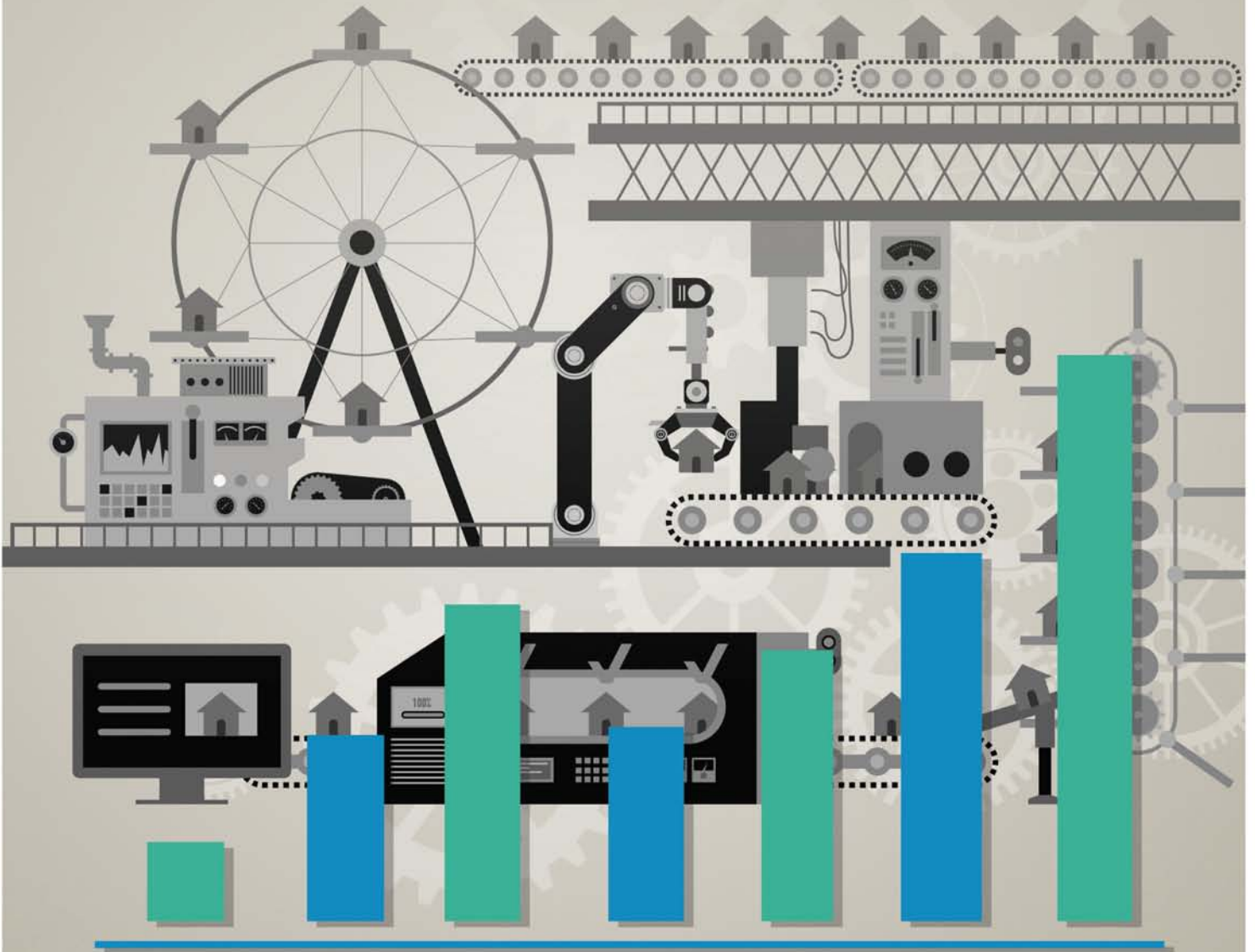


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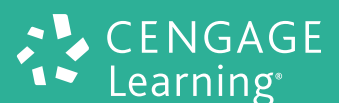
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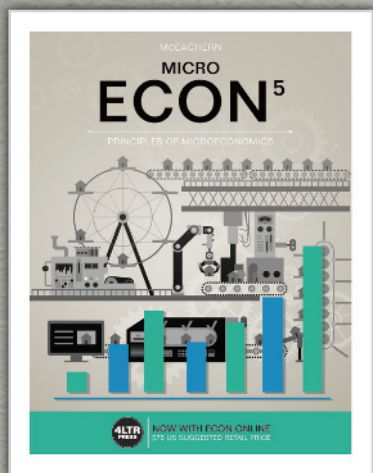


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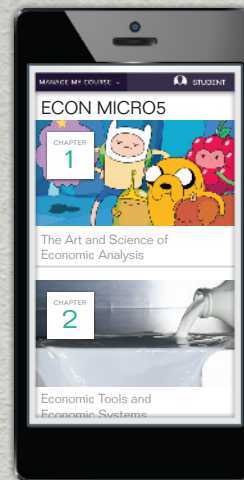




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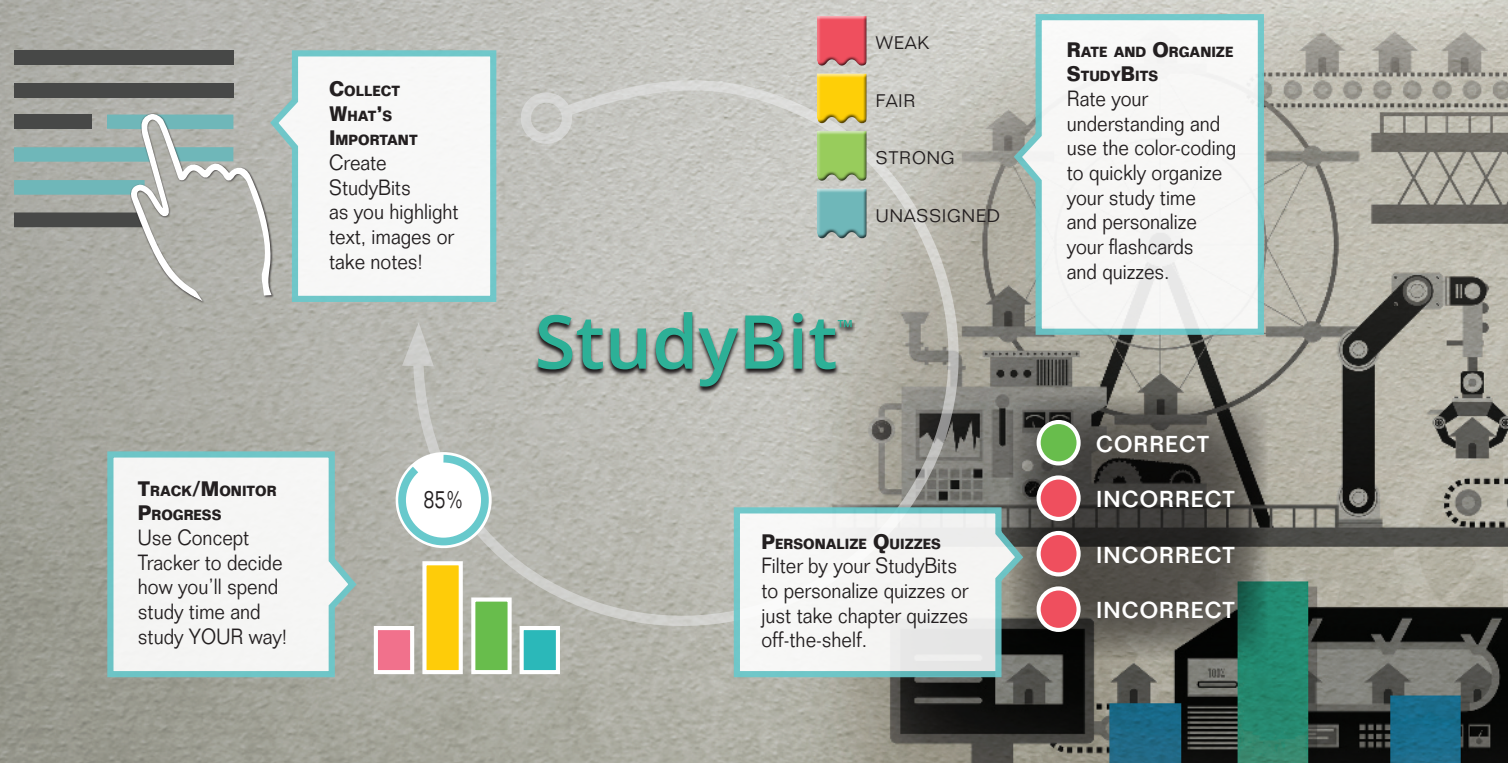
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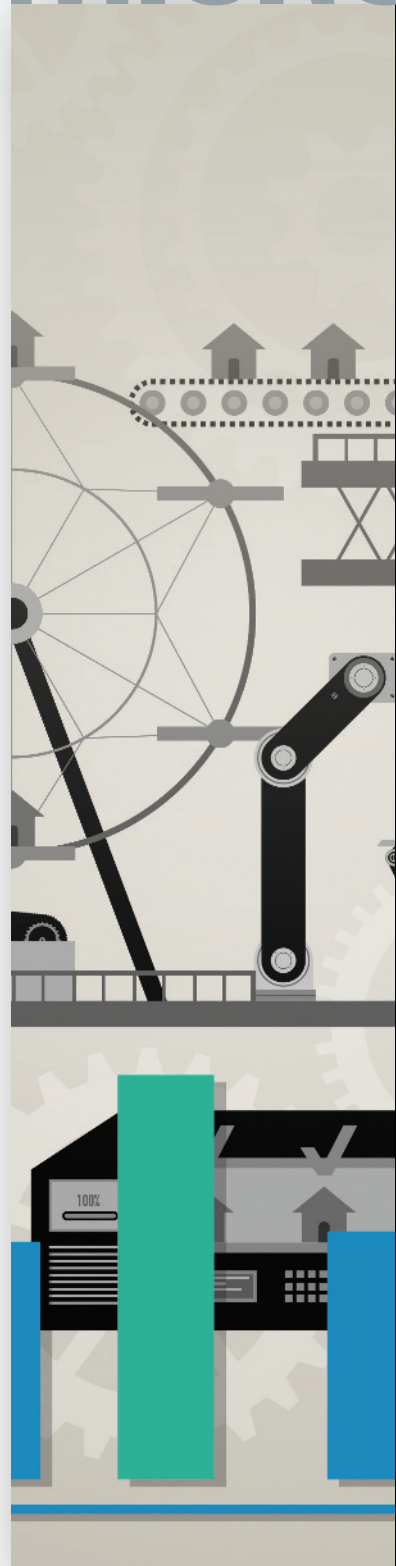
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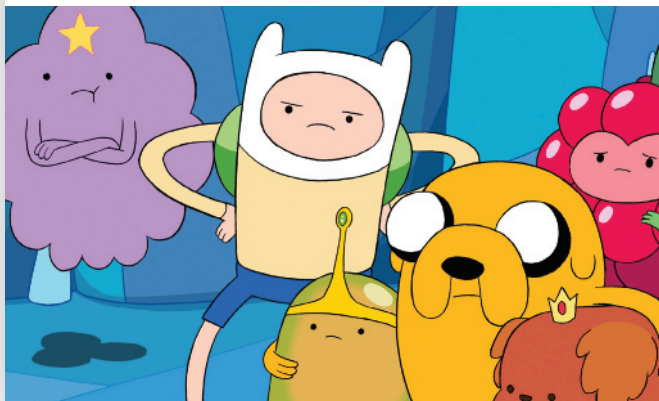
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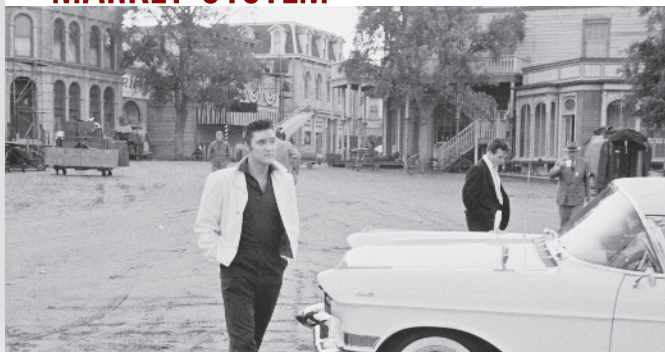
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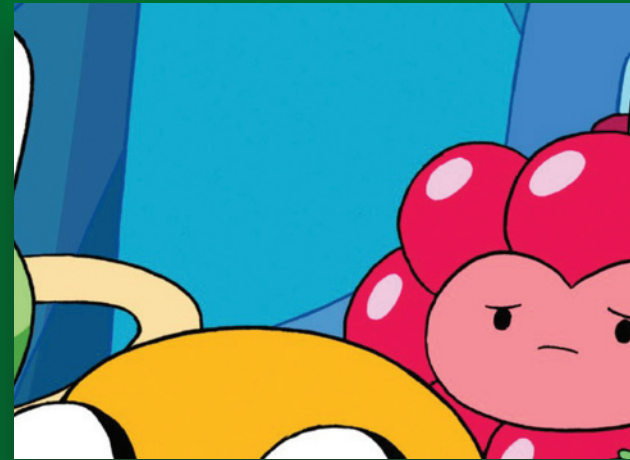
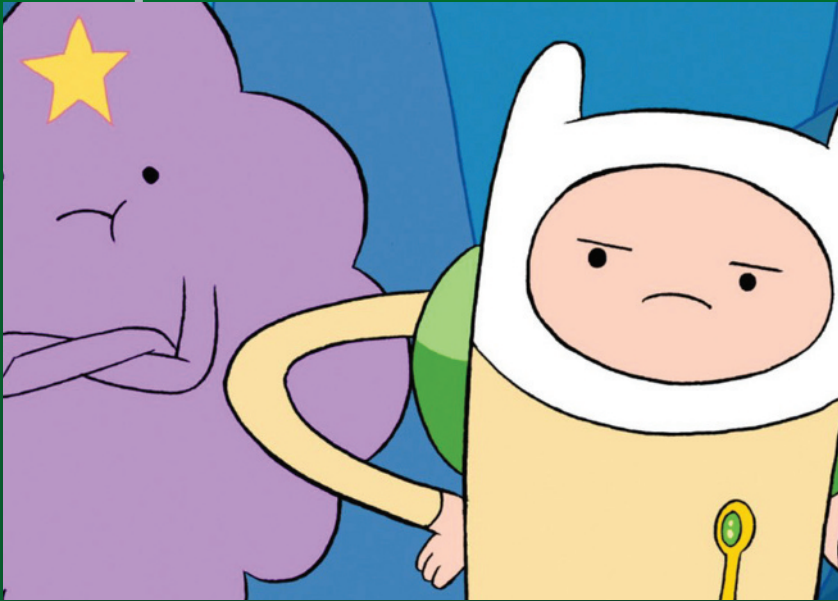
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# 1

# The Art and Science of Economic Analysis



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## LEARNING OUTCOMES

After studying this chapter, you will be able to...

- 1-1 Explain the economic problem of scarce resources and unlimited wants
- 1-2 Describe the forces that shape economic choices
- 1-3 Explain the relationship between economic theory and economic reality
- 1-4 Identify some pitfalls of economic analysis
- 1-5 Describe several reasons to study economics

After finishing this chapter go to **PAGE 15** for **STUDY TOOLS**

### Topics discussed in Chapter 1 include

- The economic problem
- The scientific method
- Marginal analysis
- Normative versus positive analysis
- Rational self-interest
- Some pitfalls of economic thinking



- ▶ Why are comic-strip and TV characters like those in *Adventure Time*, *The Simpsons*, and *Family Guy* missing a finger on each hand?
- ▶ Why do the kids on *South Park* have hands that look like mittens? And where is *Dilbert's* mouth?
- ▶ Which college majors pay the most? In what way are people who pound on vending machines relying on theory?

- ▶ Why is a good theory like a California Closet?
- ▶ What's the big idea with economics?

Finally, how can it be said that in economics “what goes around comes around”? These and other questions are answered in this chapter, which introduces the art and science of economic analysis.

You have been reading and hearing about economic issues for years—unemployment, inflation, poverty, recessions, federal deficits, college tuition, airfares, stock prices, computer prices, smartphone prices, gas prices. When explanations of such issues go into any depth, your eyes may glaze over and you may tune out, the same way you do when a weather forecaster tries to explain high-pressure fronts colliding with moisture carried in from the coast.

What many people fail to realize is that economics is livelier than the dry accounts offered by the news media. Economics is about making choices, and you make economic choices every day—choices about whether to get a part-time job or focus on your studies, live in a dorm or off campus, take a course in accounting or one in history, get married or stay single, pack a lunch or buy a sandwich. You already know much more about economics than you realize. You bring to the subject a rich personal experience, an experience that will be tapped throughout the book to reinforce your understanding of the basic ideas.

“Why are comic-strip and TV characters like those in *Adventure Time*, *The Simpsons*, and *Family Guy* missing a finger on each hand?”

1-1

## THE ECONOMIC PROBLEM: SCARCE RESOURCES, UNLIMITED WANTS

Would you like a new car, a nicer home, a smarter phone, tastier meals, more free time, a more interesting social life, more spending money, more leisure, more sleep? Who wouldn't? But even if you can satisfy some of these desires, others keep popping up. *The problem is that although your wants, or desires, are virtually unlimited, the resources available to satisfy these wants are scarce.* A resource is *scarce* when it is not freely available—that is, when its price exceeds zero. Because resources are scarce, you must choose from among your many wants, and whenever you choose, you must forgo satisfying some other wants. The

problem of scarce resources but unlimited wants exists to a greater or lesser extent for each of the 7.4 billion people on earth. Everybody—cab driver, farmer, brain surgeon, dictator, shepherd, student, politician—faces the problem. For example, a cab driver uses time and other scarce resources, such as the taxi, knowledge of the city, driving skills, and gasoline, to earn income. That income, in turn, buys housing, groceries, clothing, trips to Disney World, and thousands of other goods and services that help satisfy some of the driver's unlimited wants. **Economics** examines how people use their scarce resources to satisfy their unlimited wants. Let's pick apart the definition, beginning with resources, then goods and services, and finally focus on the heart of the matter—economic choice, which results from scarcity.

**economics** The study of how people use their scarce resources to satisfy their unlimited wants

## 1-1a Resources

**Resources** are the inputs, or factors of production, used to produce the goods and services that people want. *Goods and services are scarce because resources are scarce.* Resources sort into four broad categories: labor, capital, natural resources, and entrepreneurial ability.

**resources** The inputs, or factors of production, used to produce the goods and services that people want; consist of labor, capital, natural resources, and entrepreneurial ability

**labor** The physical and mental effort used to produce goods and services

**capital** The buildings, equipment, and human skills used to produce goods and services

**natural resources** All gifts of nature used to produce goods and services; includes renewable and exhaustible resources

**entrepreneurial ability** The imagination required to develop a new product or process, the skill needed to organize production, and the willingness to take the risk of profit or loss

**entrepreneur** A profit-seeking decision maker who starts with an idea, organizes an enterprise to bring that idea to life, and assumes the risk of the operation

**wages** Payment to resource owners for their labor

**interest** Payment to resource owners for the use of their capital

**rent** Payment to resource owners for the use of their natural resources

**profit** Reward for entrepreneurial ability; sales revenue minus resource cost

**good** A tangible product used to satisfy human wants

**Labor** is human effort, both physical and mental. Labor includes the effort of the cab driver and the brain surgeon. Labor itself comes from a more fundamental resource: *time*. Without time we can accomplish nothing. We allocate our time to alternative uses: We can *sell* our time as labor, or we can *spend* our time doing other things, like sleeping, eating, studying, playing sports, going online, attending class, watching TV, or just relaxing with friends.

**Capital** includes all human creations used to produce goods and services. Economists often distinguish between physical capital and human capital. *Physical capital* consists of factories, tools, machines, computers, buildings, airports, highways, and other human creations used to produce goods and services. Physical capital includes the cab driver's taxi, the surgeon's scalpel, and the building where your economics class meets (or, if you are taking this course online, your computer and online connectors). *Human capital* consists of the knowledge and skill people acquire to increase their productivity, such as the cab driver's knowledge of city streets, the surgeon's knowledge of human anatomy, and your knowledge of economics.

**Natural resources** include all *gifts of nature*, such as bodies of water, trees, oil reserves, minerals, even animals. Natural resources can be divided into renewable resources and exhaustible resources. A *renewable resource* can be drawn on indefinitely if used conservatively. Thus, timber is a renewable resource if felled trees are replaced to regrow a steady supply. The air and rivers are renewable resources if they are allowed sufficient time to cleanse themselves of any pollutants. More generally, biological resources like fish, game, livestock, forests, rivers, groundwater, grasslands, and soil are renewable if managed properly. An *exhaustible resource*—such as oil or coal—does not renew itself and so is available in a limited amount. Once burned, each barrel of oil or ton of coal is gone forever. The world's oil and coal deposits are exhaustible.

A special kind of human skill called **entrepreneurial ability** is the talent required to dream up a new product or find a better way to produce an existing one, organize production, and assume the risk of profit or loss. This special skill comes from an entrepreneur. An **entrepreneur** is a profit-seeking decision maker who starts with an idea, organizes an enterprise to bring that idea to life, and then assumes the risk of operation. An entrepreneur pays resource owners for the opportunity to employ their resources in the firm. Every firm in the world today, such as Ford, Microsoft, Google, and Facebook, began as an idea in the mind of an entrepreneur.

Resource owners are paid **wages** for their labor, **interest** for the use of their capital, and **rent** for the use of their natural resources. Entrepreneurial ability is rewarded by **profit**, which equals the *revenue* from items sold minus the *cost* of the resources employed to make those items. Sometimes the entrepreneur suffers a loss. Resource earnings are usually based on the *time* these resources are employed. Resource payments therefore have a time dimension, as in a wage of \$10 *per hour*, interest of 6 percent *per year*, rent of \$600 *per month*, or profit of \$10,000 *per year*.

## 1-1b Goods and Services

Resources are combined in a variety of ways to produce goods and services. A farmer, a tractor, 50 acres of land, seeds, and fertilizer combine to grow the good: corn. One hundred musicians, musical instruments, chairs, a conductor, a musical score, and a music hall combine to produce the service: Beethoven's *Fifth Symphony*. Corn is a **good** because it is something you can see, feel, and touch; it requires scarce resources to produce; and it satisfies human wants. The book you are now holding, the chair you are sitting in, the clothes you are



Scarcity means you must choose among options.

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wearing, and your next meal are all goods. The performance of the *Fifth Symphony* is a **service** because it is intangible, yet it uses scarce resources to satisfy human wants. Lectures, movies, concerts, phone service, wireless connections, yoga lessons, dry cleaning, and haircuts are all services.

Because goods and services are produced using scarce resources, they are themselves scarce. A *good or service is scarce if the amount people desire exceeds the amount available at a zero price*. Because we cannot have all the goods and services we would like, we must continually choose among them. We must choose among more pleasant living quarters, better meals, nicer clothes, more reliable transportation, faster computers, smarter phones, and so on. Making choices in a world of **scarcity** means we must pass up some goods and services. But not everything is scarce. In fact, some things we would prefer to have less of. For example, we would prefer to have less garbage, less spam e-mail, fewer telemarketing calls, and less pollution. Things we want none of even at a zero price are called *bads*, the opposite of goods.

A few goods and services seem *free* because the amount available at a zero price exceeds the amount people want. For example, air and seawater often seem free because we can breathe all the air we want and have all the seawater we can haul away. Yet, despite the old saying “The best things in life are free,” most goods and

services are scarce, not free, and even those that appear to be free come with strings attached. For example, *clean* air and *clean* seawater have become scarce. *Goods and services that are truly free are not the subject of economics. Without scarcity, there would be no economic problem and no need for prices.*

Sometimes we mistakenly think of certain goods as free because they involve no apparent cost to us. Napkins seem to be free at Starbucks. Nobody stops you from taking a fistful. Supplying napkins, however, costs the company millions each year and prices reflect that cost. Some restaurants make special efforts to keep napkin use down—such as packing them tightly into the dispenser or making you ask for them. And Starbucks recently reduced the thickness of its napkins.

You may have heard the expression “There is no such thing as a free lunch.” *There is no free lunch because all goods and services involve a cost to someone.*

The lunch may seem free to you, but it draws scarce resources away from the production of other goods and services, and whoever provides a free lunch often expects something in return. A Russian proverb makes a similar point but with a bit more bite: “The only place you find free cheese is in a mousetrap.” Albert Einstein once observed, “Sometimes one pays the most for things one gets for nothing.”

## 1-1c Economic Decision Makers and Markets

There are four types of decision makers in the economy: households, firms, governments, and the rest of the world. Their interaction determines how an economy’s resources are allocated. *Households* play the starring role. As consumers, households demand the goods and services produced. As resource owners, households supply labor, capital, natural resources, and entrepreneurial ability to firms, governments, and the rest of the world. *Firms, governments, and the rest of the world* demand the resources that households supply and then use these resources to supply the goods and services that households demand. The rest of the world

**service** An activity, or intangible product, used to satisfy human wants

**scarcity** Occurs when the amount people desire exceeds the amount available at a zero price



includes foreign households, foreign firms, and foreign governments that supply resources and products to U.S. demanders and demand resources and products from U.S. suppliers.

**Markets** are the means by which buyers and sellers carry out exchange at mutually agreeable terms. By bringing together the two sides of exchange, markets determine price, quantity, and quality. Markets are often physical places, such as supermarkets, department stores, shopping malls, yard sales, flea markets, and swap meets. But markets also include other mechanisms by which buyers and sellers communicate, such as classified ads, radio and television ads, telephones, bulletin boards, online sites, and face-to-face bargaining. These market mechanisms provide information about the quantity, quality, and price of products offered for sale. Goods and services are bought and sold in **product markets**. Resources are bought and sold in **resource markets**. The most important resource market is the labor, or job, market. Think about your own experience looking for a job,

and you'll already have some idea of that market.

### 1-1d A Simple Circular-Flow Model

Now that you have learned a bit about economic decision makers and markets, consider how all these interact. Such a picture is conveyed by the **circular-flow model**, which describes the flow of resources, products, income, and revenue among economic decision makers. The simple circular-flow model focuses on the

#### Exhibit 1

#### The Simple Circular-Flow Model for Households and Firms

Households earn income by supplying resources to resource markets, as shown in the lower portion of the model. Firms demand these resources to produce goods and services, which they supply to product markets, as shown in the upper portion of the model. Households spend their income to demand these goods and services. This spending flows through product markets as revenue to firms.



primary interaction in a market economy—that between households and firms. Exhibit 1 shows households on the left and firms on the right; please take a look.

Households supply labor, capital, natural resources, and entrepreneurial ability to firms through resource markets, shown in the lower portion of the exhibit. In return, households demand goods and services from firms through product markets, shown on the upper portion of the exhibit. Viewed from the business end, firms demand labor, capital, natural resources, and entrepreneurial ability from households through resource markets, and firms supply goods and services to households through product markets.

The flows of resources and products are supported by the flows of income and expenditure—that is, by the flow of money. So let's add money. The demand and supply of resources come together in resource markets to determine what firms pay for resources. These resource

prices—wages, interest, rent, and profit—flow as *income* to households. The demand and supply of products come together in product markets to determine what households pay for goods and services. These expenditures on goods and services flow as *revenue* to firms. Resources and products flow in one direction—in this case, counterclockwise—and the corresponding payments flow in the other direction—clockwise. What goes around comes around. Take a little time now to trace the logic of the circular flows.

## 1-2 THE ART OF ECONOMIC ANALYSIS

An economy results as millions of individuals attempt to satisfy their unlimited wants. Because their choices lie at the heart of the economic problem—coping with scarce resources but unlimited wants—these choices deserve a closer look. Learning about the forces that shape economic choices is the first step toward understanding the art of economic analysis.

### 1-2a Rational Self-Interest

A key economic assumption is that individuals, in making choices, rationally select what they perceive to be in their best interests. By *rational*, economists mean simply that people try to make the best choices they can, given the available time and information. People may not know with certainty which alternative will turn out to be the best. They simply select the alternatives they *expect* will yield the most satisfaction and happiness. In general, **rational self-interest** means that each individual tries to maximize the expected benefit achieved with a given cost or to minimize the expected cost of achieving a given benefit. Thus, economists begin with the assumption that people look out for their self-interest. For example, a physician who owns a pharmacy prescribes 8 percent more drugs on average than a physician who does not own a pharmacy.<sup>1</sup> A physician who owns a nuclear scanner (used to look inside the human body) is seven times more likely to recommend a scan than a physician who does not own a nuclear scanner.<sup>2</sup> And as one more example of self-interest, the *USA Today* weekly football poll asks coaches to list the top

1. Brian Chen, Paul Gertler, and Chuh-Yuh Yang, "Moral Hazard and Economies of Scope in Physician Ownership of Complementary Medical Services," NBER Working Paper 19622 (November 2013).

2. Sandeep Jouhar, *Doctored: The Disillusionment of an American Physician*, (Farrar, Straus, and Giroux, 2014), p. 96.

25 teams in the country. It is no surprise that coaches distort their selections to favor their own teams and their own conferences. And, to make their own records look better, coaches inflate the rankings of teams they have beaten.<sup>3</sup>

Rational self-interest should not necessarily be viewed as blind materialism, pure selfishness, or greed. We all know people who are tuned to radio station WIIFM (What's In It For Me?). For most of us, however, self-interest often includes the welfare of our family, our friends, and perhaps the poor of the world. Even so, our concern for others is influenced by our personal cost of that concern. We may readily volunteer to drive a friend to the airport on Saturday afternoon but are less likely to offer a ride if the flight leaves at 6:00 A.M. When we donate clothes to an organization such as Goodwill Industries, they are more likely to be old and worn than brand new. People tend to give more to charities when their contributions are tax deductible and when contributions garner social approval in the community (as when contributor names are made public or when big donors get buildings named after them).<sup>4</sup> Managers donate more company funds to charitable causes when they own less of the company (and, thus, when their personal cost of contributing is lower).<sup>5</sup> TV stations are more likely to donate airtime for public-service announcements during the dead of night than during prime time (which is why, 80 percent of such announcements air between 11:00 P.M. and 7:00 A.M.). In Asia, some people burn money to soothe the passage of a departed loved one. But they burn fake money, not real money.

The notion of self-interest does not rule out concern for others; it simply means that concern for others is influenced by the same economic forces that affect other economic choices. *The lower the personal cost of helping others, the more help we offer.* We don't like to think that our behavior reflects our self-interest, but it usually does. As Jane Austen wrote in *Pride and Prejudice*, "I have been a selfish being all my life, in practice, though not in principle."

3. Matthew Kotchen and Matthew Potoski, "Conflicts of Interest Distort Public Evaluations: Evidence from the Top 25 Ballots of NCAA Football Coaches," *Journal of Economic Behavior & Organization*, 107 (November 2014): 51–63.

4. Dean Karlan and Margaret McConnell, "Hey Look at Me: The Effect of Giving Circles on Giving," *Journal of Economic Behavior & Organization* (forthcoming).

5. Ing-Haw Cheng, Harrison Hong, and Kelly Shue, "Do Managers Do Good with Other People's Money?" NBER Working Paper No. 19432 (September 2013).

**rational self-interest**  
Each individual tries to maximize the expected benefit achieved with a given cost or to minimize the expected cost of achieving a given benefit

## 1-2b Choice Requires Time and Information

Rational choice takes time and requires information, but time and information are themselves scarce and therefore valuable. If you have any doubts about the time and information needed to make choices, talk to someone who recently purchased a home, a car, or a personal computer. Talk to a corporate official trying to decide whether to introduce a new product, sell online, build a new factory, or buy another firm. Or think back to your own experience in choosing a college. You probably talked to friends, relatives, teachers, and guidance counselors. You likely used school catalogs, college guides, and Web sites. You may have even visited some campuses to meet the admissions staff and anyone else willing to talk. The decision took time and money, and it probably involved aggravation and anxiety.

Because information is costly to acquire, we are often willing to pay others to gather and digest it for us. College guidebooks, stock analysts, travel agents, real estate brokers, career counselors, restaurant critics, movie reviewers, specialized Web sites, and *Consumer Reports* magazine attest to our willingness to pay for information that improves our choices. As we'll see next, *rational decision makers continue to acquire information as long as the additional benefit expected from that information exceeds the additional cost of gathering it.*

## 1-2c Economic Analysis Is Marginal Analysis

Economic choice usually involves some adjustment to the existing situation, or status quo. Amazon.com must decide whether to add a new line of products. The school superintendent must decide whether to hire another teacher. Your favorite jeans are on sale, and you must decide whether to buy another pair. You are wondering whether to carry an extra course next term. You just finished lunch and are deciding whether to order dessert.

Economic choice is based on a comparison of the *expected marginal benefit* and the *expected marginal cost* of the action under consideration. **Marginal** means incremental, additional, or extra. Marginal refers to a change in an economic variable, a change in the status quo. *A rational decision maker changes the status quo if the expected marginal benefit from the change exceeds*



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When deciding whether to order dessert, ask yourself, “is the marginal benefit higher than the marginal cost?”

*the expected marginal cost.* For example, Amazon.com compares the marginal benefit expected from adding a new line of products (the additional sales revenue) with the marginal cost (the additional cost of the resources required). Likewise, you compare the marginal benefit you expect from eating dessert (the additional pleasure or satisfaction) with its marginal cost (the additional money, time, and calories).

Typically, the change under consideration is small, but a marginal choice can involve a major economic adjustment, as in the decision to quit school and find a job. For a firm, a marginal choice might mean building a plant in Mexico or even filing for bankruptcy. By focusing on the effect of a marginal adjustment to the status quo, the economist is able to cut the analysis of economic choice down to a manageable size. Rather than confront a bewildering economic reality head-on, the economist begins with a marginal choice to see how this choice affects a particular market and shapes the economic system as a whole. Incidentally, to the noneconomist, *marginal* usually means relatively inferior, as in “a movie of marginal quality.” Forget that meaning for this course and instead think of *marginal* as meaning incremental, additional, or extra.

## 1-2d Microeconomics and Macroeconomics

Although you have made thousands of economic choices, you probably seldom think about your own

**marginal** Incremental, additional, or extra; used to describe a change in an economic variable



economic behavior. For example, why are you reading this book right now rather than doing something else? **Microeconomics** is the study of your economic behavior and the economic behavior of others who make choices about such matters as how much to study and how much to party, how much to borrow and how much to save, what to buy and what to sell. Microeconomics examines individual economic choices and how markets coordinate the choices of various decision makers. Microeconomics explains how price and quantity are determined in individual markets—the market for breakfast cereal, sports equipment, or used cars, for instance.

You have probably given little thought to what influences your own economic choices. You have likely given even less thought to how your choices link up with those made by millions of others in the U.S. economy to determine economy-wide measures such as total production, employment, and economic growth. **Macroeconomics** studies the performance of the economy as a whole. Whereas microeconomics studies the individual pieces of the economic puzzle, as reflected in particular markets, macroeconomics puts all the pieces together to focus on the big picture. Macroeconomics sees the forest, not the trees; the beach, not the grains of sand; and the Rose Bowl parade float, not the individual flowers that shape and color that float.

The national economy usually grows over time, but along the way it sometimes stumbles, experiencing *recessions* in economic activity, as reflected by a decline in production, employment, and other aggregate measures. **Economic fluctuations** are the rise and fall of economic activity relative to the long-term growth trend of the economy. These fluctuations, or *business cycles*, vary in length and intensity, but they usually involve the entire nation and often other nations too. For example, the U.S. economy now produces more than four times as much as it did in 1960, despite experiencing eight recessions since then, including the Great Recession of 2007–2009.

**TO REVIEW:** The art of economic analysis focuses on how people use their scarce resources in an attempt to satisfy their unlimited wants. Rational self-interest guides

“A good theory helps us understand a messy and confusing world.”

individual choice. Choice requires time and information and involves a comparison of the expected marginal benefit and the expected marginal cost of alternative actions. Microeconomics looks at the individual pieces of the economic puzzle; macroeconomics fits the pieces together to form the big picture.

1-3

## THE SCIENCE OF ECONOMIC ANALYSIS

Economists use scientific analysis to develop theories, or models, that help explain economic behavior. An **economic theory**, or **economic model**, is a simplification of economic reality that *is used to make predictions about cause and effect in the real world*. A theory, or model, such as the circular-flow model, captures the important elements of the problem under study but need not spell out every detail and interrelation. In fact, adding more details may make a theory more unwieldy and, therefore, less useful. For example, a wristwatch is a model that tells time, but a watch festooned with extra features is harder to read at a glance and is therefore less useful as a time-telling model. The world is so complex that we must simplify it to make sense of things. Store mannequins simplify the human form (some even lack arms and heads). Comic strips and cartoons simplify a character's anatomy—leaving out fingers (in the case of *Adventure Time*, *The Simpsons*, and *Family Guy*) or a mouth (in the case of *Dilbert*), for instance. You might think of economic theory as a stripped-down, or streamlined, version of economic reality.

A good theory helps us understand a messy and confusing world. Lacking a theory of how things work, our thinking can become cluttered with facts, one piled on another, as in a messy closet. You could think of a good theory as a closet organizer for the mind. A good theory offers a helpful guide to sorting, saving, and understanding information.

**microeconomics** The study of the economic behavior in particular markets, such as that for computers or unskilled labor

**macroeconomics** The study of the economic behavior of entire economies, as measured, for example, by total production and employment

**economic fluctuations** The rise and fall of economic activity relative to the long-term growth trend of the economy; also called business cycles

**economic theory, or economic model** A simplification of reality used to make predictions about cause and effect in the real world





A good theory can act like a closet organizer for your mind, helping you understand a messy and confusing world.

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### 1-3a The Role of Theory

Most people don't understand the role of theory. Perhaps you have heard, "Oh, that's fine in theory, but in practice it's another matter." The implication is that the theory in question provides little aid in practical matters. People who say this fail to realize that they are merely substituting their own theory for a theory they either do not believe or do not understand. They are really saying, "I have my own theory that works better."

All of us employ theories, however poorly defined or understood. Someone who pounds on the Pepsi machine that just ate a quarter has a crude theory about how that machine works. One version of that theory might be, "The quarter drops through a series of *what-chamacallits*, but sometimes it gets stuck. If

I pound on the machine, then I can free up the quarter and send it on its way." Evidently, this theory

**variable** A measure, such as price or quantity, that can take on different values at different times

is widespread enough that people continue to pound on machines that fail to perform (a real problem for the vending machine industry and one reason newer machines are fronted with glass). Yet, if you were to ask these mad pounders to explain their "theory" about how the machine works, they would look at you as if you were crazy.

### 1-3b The Scientific Method

To study economic problems, economists employ a process called the *scientific method*, which consists of four steps, as outlined in Exhibit 2.

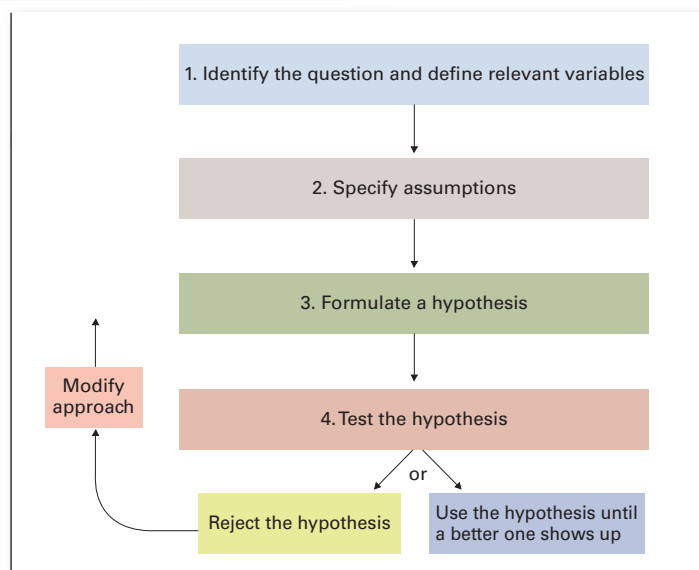
#### Step One: Identify the Question and Define Relevant Variables

The scientific method begins with curiosity: Someone wants to answer a question. Thus, the first step is to identify the economic question and define the variables relevant to a solution. For example, the question might be, "What is the relationship between the price of Pepsi and the quantity of Pepsi purchased?" In this case, the relevant variables are price and quantity. A **variable** is a measure that can take on different values at different

#### Exhibit 2

#### The Scientific Method: Step-by-Step

The steps of the scientific method are designed to develop and test hypotheses about how the world works. The objective is a theory that predicts outcomes more accurately than the best alternative theory. A hypothesis is rejected if it does not predict as accurately as the best alternative. A rejected hypothesis can be modified or reworked in light of the test results.



times. The variables of concern become the elements of the theory, so they must be selected with care.

## Step Two: Specify Assumptions

The second step is to specify the assumptions under which the theory is to apply. One major category of assumptions is the **other-things-constant assumption**—in Latin, the *ceteris paribus* assumption. The idea is to identify the variables of interest and then focus exclusively on the relationships among them, assuming that nothing else important changes—that other things remain constant. Again,

suppose we are interested in how the price of Pepsi influences the amount purchased. To isolate the relation between these two variables, we assume that there are no changes in other relevant variables such as consumer income, the average daytime temperature, or the price of Coke.

We also make assumptions about how people behave; these are called **behavioral assumptions**. The primary behavioral assumption is rational self-interest. Earlier we assumed that each decision maker pursues self-interest rationally and makes choices accordingly. Rationality implies that each consumer buys the products expected to maximize his or her level of satisfaction. Rationality also implies that each firm supplies the products expected to maximize the firm's profit. These kinds of assumptions are called behavioral assumptions because they specify how we expect economic decision makers to behave—what makes them tick, so to speak.

## Step Three: Formulate a Hypothesis

The third step in the scientific method is to formulate a **hypothesis**, which is a theory about how key variables relate to each other. For example, one hypothesis holds that if the price of Pepsi goes up, other things constant, then the quantity purchased declines. The hypothesis becomes a prediction of what happens to the quantity purchased if the price increases. *The purpose of this hypothesis, like that of any theory, is to help make predictions about cause and effect in the real world.*



If the price of your favorite soft drink rose, would you buy less of it?

## Step Four: Test the Hypothesis

In the fourth step, by comparing its predictions with evidence, we test the validity of a hypothesis. To test a hypothesis, we must focus on the variables in question, while carefully controlling for other effects assumed not to change. The test leads us either to (1) reject the hypothesis, or theory, if it predicts worse than the best alternative theory, or (2) use the hypothesis, or theory, until a better one comes along. If we reject the hypothesis, we can try to go back and modify our approach in light of the results. Please spend a moment now reviewing the steps of the scientific method in Exhibit 2.

### 1-3c Normative Versus Positive

Economists usually try to explain how the economy works. Sometimes they concern themselves not with how the economy *does* work but how it *should* work. Compare these two statements: “The U.S. unemployment rate is 5.6 percent,” and “The U.S. unemployment rate should be lower.” The first, called a **positive economic statement**, is an assertion about economic reality that can be supported or rejected by reference to the facts. Positive economics, like physics or biology, attempts to understand the world around us as it is. The second, called a **normative economic statement**, reflects an opinion. And an opinion is merely that—it cannot be shown to be true or false by reference to the facts. Positive statements concern what *is*; normative statements concern what, in someone's opinion, *should be*. Positive statements need not necessarily be true, but they must

#### other-things-constant assumption

The assumption, when focusing on the relation among key economic variables, that other variables remain unchanged; in Latin, *ceteris paribus*

#### behavioral assumption

An assumption that describes the expected behavior of economic decision makers—what motivates them

**hypothesis** A theory about how key variables relate

**positive economic statement** A statement that can be proved or disproved by reference to facts

**normative economic statement** A statement that reflects an opinion, which cannot be proved or disproved by reference to the facts

be subject to verification or refutation by reference to the facts. Theories are expressed as positive statements such as “If the price of Pepsi increases, then the quantity demanded decreases.”

Most of the disagreement among economists involves normative debates—such as the appropriate role of government—rather than statements of positive analysis. To be sure, many theoretical issues remain unresolved, but economists generally agree on most fundamental theoretical principles—that is, about positive economic analysis. For example, in a survey of 464 U.S. economists, only 6.5 percent disagreed with the statement “A ceiling on rents reduces the quantity and quality of housing available.” This is a positive statement because it can be shown to be consistent or inconsistent with the evidence. In contrast, there was much less agreement on normative statements such as “The distribution of income in the United States should be more equal.” Half the economists surveyed “generally agreed,” a quarter “generally disagreed,” and a quarter “agreed with provisos.”<sup>6</sup>

Normative statements, or value judgments, have a place in a policy debate such as the proper role of government, provided that statements of opinion are distinguished from statements of fact. In such policy debates, you are entitled to your own opinion, but you are not entitled to your own facts.

### 1-3d Economists Tell Stories

Despite economists’ reliance on the scientific method for developing and evaluating theories, economic analysis is as much art as science. Formulating a question, isolating the key variables, specifying the assumptions, proposing a theory to answer the question, and devising a way to test the predictions all involve more than simply an understanding of economics and the scientific method. Carrying out these steps requires good intuition and the imagination of a storyteller. Economists explain their theories by telling stories about how they think the economy works. To tell a compelling story, an economist relies on case studies, anecdotes, parables, the personal experience of the listener, and supporting data. Throughout this book, you’ll hear stories that bring you closer to the ideas under consideration. These stories, such as the

one about the Pepsi machine, breathe life into economic theory and help you personalize abstract ideas.

6. Richard M. Alston et al., “Is There a Consensus among Economists in the 1990s?” *American Economic Review*, 82 (May 1992): 203–209, Table 1.

### 1-3e Predicting Average Behavior

The goal of economic theory is to predict the impact of economic events on economic choices and, in turn, the effect of these choices on particular markets or on the economy as a whole. Does this mean that economists try to predict the behavior of particular consumers or producers? Not necessarily, because a specific individual may behave in an unpredictable way. But the unpredictable actions of numerous individuals tend to cancel one another out, so the *average behavior* of groups can be predicted more accurately. For example, if the federal government cuts personal income taxes, certain households might save the entire tax cut. On average, however, household spending would increase. Likewise, if Burger King cuts the price of Whoppers, the manager can better predict how much sales will increase than how a specific customer coming through the door will respond. *The random actions of individuals tend to offset one another, so the average behavior of a large group can be predicted more accurately than the behavior of a particular individual.* Consequently, economists tend to focus on the average, or typical, behavior of people in groups—for example, as average taxpayers or average Whopper consumers—rather than on the behavior of a specific individual.

## 1-4 SOME PITFALLS OF FAULTY ECONOMIC ANALYSIS

Economic analysis, like other forms of scientific inquiry, is subject to common mistakes in reasoning that can lead to faulty conclusions. Here are three sources of confusion.

### The Fallacy That Association Is Causation

In the past two decades, the number of physicians specializing in cancer treatment increased sharply. At the same time, the incidence of some cancers increased. Can we conclude that physicians cause cancer? No. To assume that event A caused event B simply because the two are associated in time is to commit the **association-is-causation fallacy**, a common error. The fact that one event precedes another or that the two events occur simultaneously does not necessarily mean that one causes the other. Remember: Association is not necessarily causation.

**association-is-causation fallacy** The incorrect idea that if two variables are associated in time, one must necessarily cause the other





Anna Omelchenko/Fotolia

Standing at a concert can help you see better... unless everyone else stands up too! This is an example of the fallacy of composition.

## The Fallacy of Composition

Perhaps you have been to a rock concert where everyone stands to get a better view. At some concerts, most people even stand on their chairs. But even standing on chairs does not improve your view if others do the same, unless you are quite tall. Likewise, arriving early to buy concert tickets does not work if many have the same idea. Earning a college degree to get a better job does not work as well if everyone earns a college degree. These are examples of the **fallacy of composition**, which is an erroneous belief that what is true for the individual, or the part, is also true for the group, or the whole.

## The Mistake of Ignoring the Secondary Effects

In many cities, public officials have imposed rent controls on apartments. The primary effect of this policy, the effect that policy makers focus on, is to keep rents from rising. Over time, however, fewer new apartments get built because renting them becomes less profitable. Moreover, existing rental units deteriorate because owners have plenty of customers anyway. Thus, the quantity and quality of housing may decline as a result of what appears to be a reasonable measure to keep rents from rising. The mistake was to ignore the **secondary effects**, or the unintended consequences, of the policy. Economic actions have secondary effects that often turn out to be more important than the primary effects. Secondary effects may develop more slowly and may not be immediately obvious, but good economic analysis tries to anticipate them and take them into account.

## 1-5 IF ECONOMISTS ARE SO SMART, WHY AREN'T THEY RICH?

Why aren't economists rich? Well, some are, earning over \$25,000 per appearance on the lecture circuit. Others top \$2 million a year as consultants and expert witnesses.<sup>7</sup> Economists have been appointed to federal cabinet posts, as secretaries of commerce, defense, labor, state, and treasury, for example, and to head the U.S. Federal Reserve System. Economics is the only social science and the only business discipline for which the prestigious Nobel Prize is awarded, and pronouncements by economists are reported in the media daily. A 2015 journal article argued that "the superiority of economists" gives them considerable influence over economic policy.<sup>8</sup> And *The Economist*, a widely respected news weekly from London, has argued that economic ideas have influenced policy "to a degree that would make other social scientists drool."<sup>9</sup>

The economics profession thrives because its models usually do a better job of making economic sense out of a confusing world than do alternative approaches. But not all economists are wealthy, nor is personal wealth the goal of the discipline. In a similar vein, not all doctors are healthy (some even smoke), not all carpenters live in perfectly built homes, not all marriage counselors are happily married, and not all child psychologists have well-adjusted children. Still, those who study economics do reap financial rewards.

Earlier in the chapter, you learned that economic choice involves comparing the expected marginal benefit and the expected marginal cost. Surveys show that students go to college because they believe a college diploma is the ticket to better jobs and higher pay. Put another way, for nearly two-thirds of U.S. high school graduates, the expected marginal benefit of college apparently exceeds the expected marginal cost. The cost of college will be discussed in the next chapter; the focus here is on the benefits of college, particularly expected earnings.

Among college graduates, all kinds of factors affect earnings, such as general

### fallacy of composition

The incorrect belief that what is true for the individual, or part, must necessarily be true for the group, or the whole

### secondary effects

Unintended consequences of economic actions that may develop slowly over time as people react to events

7. As reported by George Anders, "An Economist's Courtroom Bonanza," *Wall Street Journal*, 19 March 2007.

8. Marion Fourcade, Etienne Ollion, and Yann Algan, "The Superiority of Economists," *Journal of Economic Perspectives*, 29 (Winter 2015): 89–114.

9. "The Puzzling Failure of Economics," *The Economist*, 23 August 1997, p. 11.





Robert Nickelsberg/Alamy

As more people get college degrees, the advantage it gives you in the labor market gets smaller. (Don't worry, it's still worth it.)

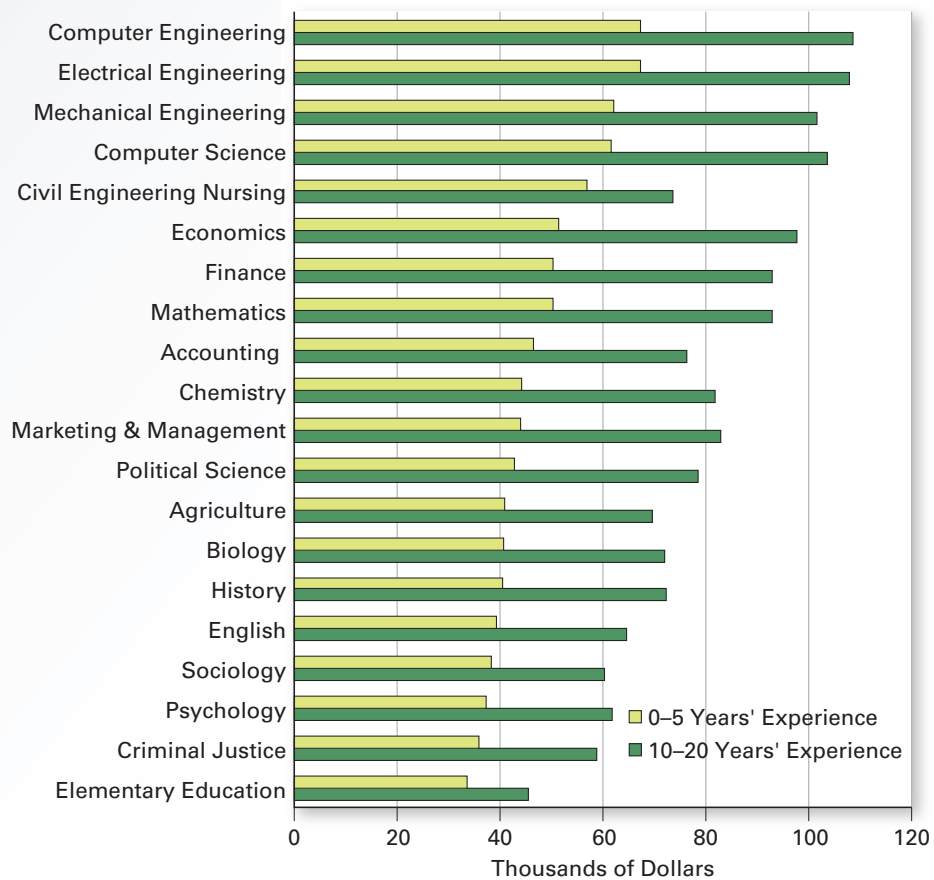
ability, effort, occupation, college attended, college major, highest degree earned, appearance, and, yes, luck. PayScale.com collects real-time information on annual pay from its 10 million users. To isolate the effects of a college major on earnings, only workers with a bachelor's as their highest degree are included in the results. Exhibit 3 shows the median earnings in 2015 by major for two groups of college graduates: (1) those with 0 to 5 years of job experience and (2) those with 10 to 20 years of job experience. Majors are listed from the top down by the median annual pay of those with between 0 and 5 years of experience, identified by the light green bars. The top pay of \$67,300 went to those who had majored in computer engineering; indeed, the top four slots went to engineering and

computer majors. Nursing ranked fifth and economics ranked sixth out of the twenty majors listed. Economics had a median pay of \$51,400, or 24 percent below the top pay. Elementary education majors held the bottom spot of \$33,600, which was only half the top pay.

The dark green bars show the median pay by major for those with 10 to 20 years of job experience. Again, those who had majored in computer engineering led the field with \$108,600, an increase of 61 percent over the pay of newer graduates with that degree. Economics majors with 10 to 20 years of job experience saw a 90 percent increase to \$97,700. While economics majors with 0 to 5 years experience were paid 25 percent less than the top paying major, among those with at least a decade of job experience, the median pay for economics majors moved up to within 10 percent of the top pay. In fact, economics majors saw their median pay grow more in dollar terms and in percentage terms than did any other major listed. This suggests that those who

### Exhibit 3

#### Median Annual Pay by College Major



Sources: Median pay data for 2015 were found at <http://www.payscale.com/best-colleges/degrees.asp>. For a survey of employment opportunities, go to the U.S. Labor Department's Occupational Outlook Handbook at <http://www.bls.gov/oco/>.

study economics acquire skills that appreciate with experience. The bump in median pay based on experience for the 19 other majors averaged 67 percent. Elementary education remained the lowest paying major among those with 10 to 20 years of experience. Note that the majors ranked toward the top of the list tend to be more quantitative and analytical. The selection of a relatively more challenging major such as engineering or economics may send a favorable signal to future employers. Nursing majors ranked high right out of school, thanks to strong demand for health care. But nurses with 10 to 20 years of experience earned only 29 percent more than those with only 0 to 5 years of experience. This was the slowest growth rate among the 20 majors.

Incidentally, Exhibit 3 ranks only 20 majors, but Payscale.com ranks 207 majors in all. Median pay for economics majors ranked them in the top 10 percent of that larger group of majors.

Remember, the survey was limited to those whose highest degree was the baccalaureate, so it excluded the many economics majors who went on to pursue graduate studies in law, business administration, economics, public administration, journalism, and other fields (a different study found that lawyers with undergraduate degrees in economics earned more on average than lawyers with other majors).

A number of world leaders majored in economics, including three of the last seven U.S. presidents; Prime Minister Stephen Harper of Canada; billionaire and former president of Chile, Sebastian Pinera (who earned a Ph.D. in economics from Harvard); Turkey's first female prime minister, Tansu Ciller (who earned a Ph.D. in economics from the University of Connecticut); Italy's former prime minister, Mario Monti (who earned a Ph.D. in economics from Yale); Greece's former prime minister, Lucas Papademos (who earned a Ph.D. in economics from MIT); U.S. Supreme Court justices Stephen Breyer and Anthony Kennedy; and former justice Sandra Day O'Connor. Other notable economics majors include billionaire Donald Trump, former Hewlett-Packard president (and billionaire) Meg Whitman, former head of Microsoft (and billionaire) Steve Ballmer, CNN founder (and billionaire) Ted Turner, financial guru (and billionaire) Warren Buffett, Walmart founder (and billionaire) Sam Walton, and Scott Adams, creator of *Dilbert*, the mouthless wonder.

## 1-6 FINAL WORD

This textbook describes how economic factors affect individual choices and how all these choices come together to shape the economic system. Economics is not the whole

story, and economic factors are not always the most important. But economic considerations have important and predictable effects on individual choices, and these choices affect the way we live.

Yes, economics is a challenging discipline, but it is also an exciting and rewarding one. The good news is that you already know a lot about economics. To use this knowledge, however, you must cultivate the art and science of economic analysis. You must be able to simplify the world to formulate questions, isolate the relevant variables, and then tell a persuasive story about how these variables relate.

An economic relation can be expressed in words, represented as a table of quantities, described by a mathematical equation, or illustrated as a graph. The appendix to this chapter introduces graphs. You may find a detailed reading of this appendix unnecessary. If you are already familiar with relations among variables, slopes, tangents, and the like, you can probably just browse. But if you have little recent experience with graphs, you might benefit from a more careful reading with pencil and paper in hand.

The next chapter introduces key tools of economic analysis. Subsequent chapters use these tools to explore economic problems and to explain economic behavior that may otherwise seem puzzling. You must walk before you can run, however, and in the next chapter, you will take your first wobbly steps.

## STUDY TOOLS 1

### READY TO STUDY? IN THE BOOK, YOU CAN:

- Work the Problems at the end of the chapter.
- Rip out the chapter review card for a handy summary of the chapter and key terms.

### ONLINE AT CENGAGEBRAIN.COM YOU CAN:

- Collect StudyBits while you read and study the chapter.
- Quiz yourself on key concepts.
- Prepare for tests with chapter flash cards as well as flash cards that you create.
- Watch videos to explore economics further.

# CHAPTER 1 PROBLEMS

Your instructor can access the answers to these problems online at <http://cengagebrain.com>.

## 1-1 Explain the economic problem of scarce resources and unlimited wants

1. *(Definition of Economics)* What determines whether or not a resource is scarce? Why is the concept of scarcity important to the definition of economics?

## 1-2 Describe the forces that shape economic choices

2. *(Rational Self-Interest)* Discuss the impact of rational self-interest on each of the following decisions:
  - a. Whether to attend college full time or enter the workforce full time
  - b. Whether to buy a new textbook or a used one
  - c. Whether to attend a local college or an out-of-town college
3. *(Rational Self-Interest)* If behavior is governed by rational self-interest, why do people make charitable contributions of time and money?
4. *(Marginal Analysis)* The owner of a small pizzeria is deciding whether to increase the radius of delivery area by one mile. What considerations must be taken into account if such a decision is to increase profitability?
5. *(Time and Information)* It is often costly to obtain the information necessary to make good decisions. Yet your own interests can be best served by rationally weighing all options available to you. This requires informed decision making. Does this mean that making uninformed decisions is irrational? How do you determine how much information is the right amount?

## 1-3 Explain the relationship between economic theory and economic reality

6. *(Role of Theory)* What good is economic theory if it can't predict the behavior of a specific individual?

## 1-4 Identify some pitfalls of economic analysis

7. *(Pitfalls of Economic Analysis)* Review the discussion of pitfalls in economic thinking in this chapter. Then identify the fallacy, or mistake in thinking, in each of the following statements:
  - a. Raising taxes always increases government revenues.
  - b. Whenever there is a recession, imports decrease. Therefore, to stop a recession, we should increase imports.
  - c. Raising the tariff on imported steel helps the U.S. steel industry. Therefore, the entire economy is helped.
  - d. Gold sells for about \$1,200 per ounce. Therefore, the U.S. government could sell all the gold in Fort Knox at \$1,200 per ounce to reduce the national debt.
8. *(Association Versus Causation)* Suppose I observe that communities with lots of doctors tend to have relatively high rates of illness. I conclude that doctors cause illness. What's wrong with this reasoning?

## 1-5 Describe several reasons to study economics

9. *(Studying Economics)* According to the text, economics majors on average make more money than most other majors and have more job opportunities. Are these the primary motivations one might have for studying economics? What are your motivations for studying economics?

# APPENDIX

## A1-1 UNDERSTANDING GRAPHS

Take out a pencil and a blank piece of paper. Go ahead. Put a point in the middle of the paper. This is your point of departure, called the **origin**. With your pencil at the origin, draw a straight line off to the right. This line is called the **horizontal axis**. The value of the variable  $x$  measured along the horizontal axis increases as you move to the right of the origin. Now mark off this line from 0 to 20, in increments of 5 units each. Returning to the origin, draw another line, this one straight north. This line is called the **vertical axis**. The value of the variable  $y$  measured along the vertical axis increases as you move north of the origin. Mark off this line from 0 to 20, in increments of 5 units each.

Within the space framed by the two axes, you can plot possible combinations of the variables measured along each axis. Each point identifies a value measured along the horizontal, or  $x$ , axis *and* a value measured along the vertical, or  $y$ , axis. For example, place point  $a$  in your graph to reflect the combination where  $x$  equals 5 units and  $y$  equals 15 units. Likewise, place point  $b$  in your graph to reflect 10 units of  $x$  and 5 units of  $y$ . Now compare your results with points shown in Exhibit A-1.

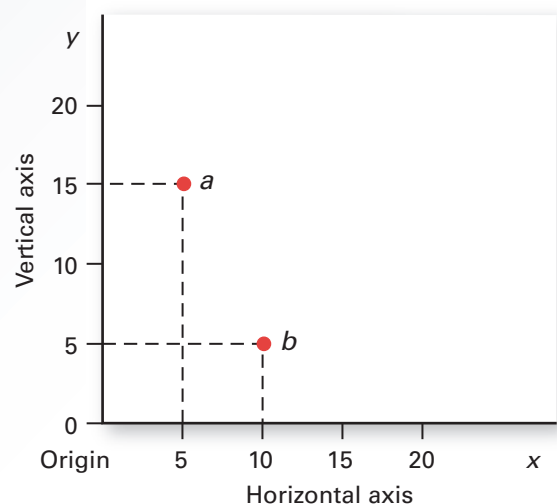
A **graph** is a picture showing how variables relate, and a picture can be worth a thousand words. Take a look at Exhibit A-2, which shows the U.S. annual unemployment rate since 1900. The year is measured along the horizontal axis and the unemployment rate is measured as a percentage along the vertical axis. Exhibit A-2 is a *time-series graph*, which shows the value of a variable, in this case the percent of the labor force unemployed, over time. If you had to describe the information presented in Exhibit A-2, the explanation could take many words. The picture shows not only how one year compares to the next but also how one decade compares to another and how the unemployment rate trends over time. The sharply higher unemployment rate during the Great Depression of the 1930s is unmistakable. *Graphs convey information in a compact and efficient way.*

This appendix shows how graphs express a variety of possible relations among variables. Most graphs of interest in this book reflect the relationship between two economic variables, such as the unemployment rate and the year, the price of a product and the quantity demanded,

### Exhibit A-1

#### Basics of a Graph

Any point on a graph represents a combination of values of two variables. Here point  $a$  represents the combination of 5 units of variable  $x$  (measured on the horizontal axis) and 15 units of variable  $y$  (measured on the vertical axis). Point  $b$  represents 10 units of  $x$  and 5 units of  $y$ .



or the price of production and the quantity supplied. Because we focus on just two variables at a time, we usually assume that other relevant variables remain constant.

One variable often depends on another. The time it takes you to drive home depends on your average speed. Your weight depends on how much you eat. The amount of Pepsi you buy depends on the price. A *functional relation* exists between two variables when the value of one variable *depends* on the value of another variable.

**origin** on a graph depicting two-dimensional space, the zero point

**horizontal axis** line on a graph that begins at the origin and goes to the right and left; sometimes called the  $x$  axis

**vertical axis** line on a graph that begins at the origin and goes up and down; sometimes called the  $y$  axis

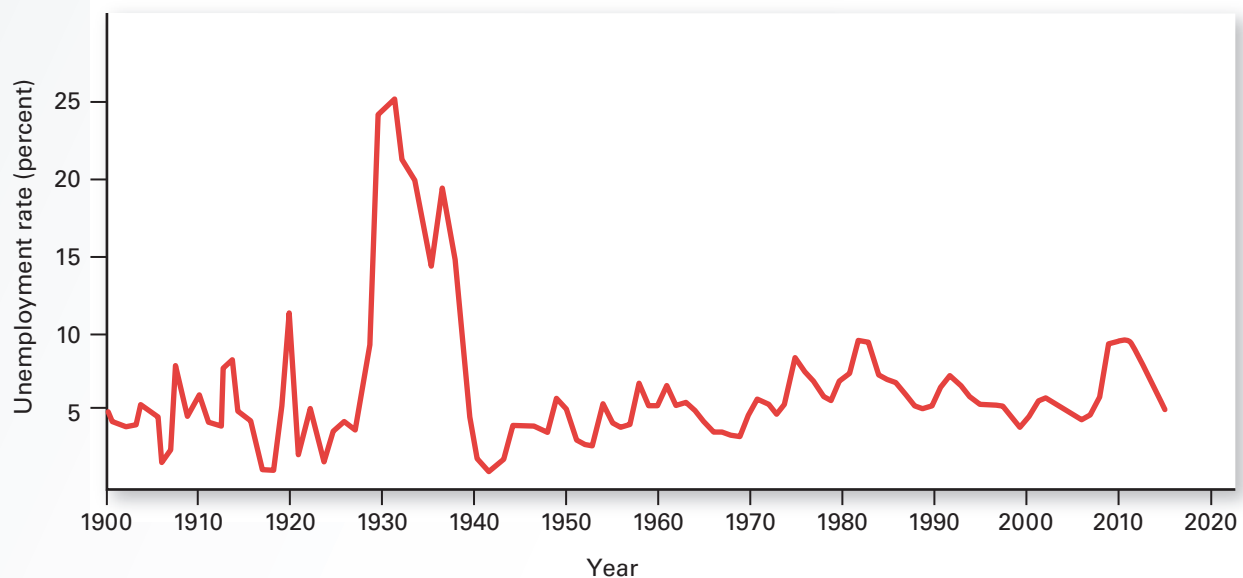
**graph** a picture showing how variables relate in two-dimensional space; one variable is measured along the horizontal axis and the other along the vertical axis



### Exhibit A-2

#### U.S. Unemployment Rate Since 1900

A time-series graph depicts the behavior of some economic variable over time. Shown here are U.S. unemployment rates since 1900.



Source: *Historical Statistics of the United States, 1970*; and *Economic Report of the President, February 2015*.

The value of the **dependent variable** depends on the value of the **independent variable**. The task of the economist is to isolate economic relations and determine the direction of causality, if any. Recall that one of the pitfalls of economic thinking is the erroneous belief that association is causation. We cannot conclude that, simply because two events relate in time, one causes the other. There may be no relation between the two events.

### A1-1a Drawing Graphs

Let's begin with a simple relation. Suppose you are planning to drive across the country and want to figure out how far you will travel each day. You plan to average 50 miles per hour. Possible combinations of driving time and distance traveled per day appear in Exhibit A-3. One column lists the hours driven per day, and the next column lists the number of miles traveled per day, assuming an average speed of 50 miles per hour. The

**dependent variable** a variable whose value depends on that of the independent variable

**independent variable** a variable whose value determines that of the dependent variable

### Exhibit A-3

#### Schedule Relating Distance Traveled to Hours Driven

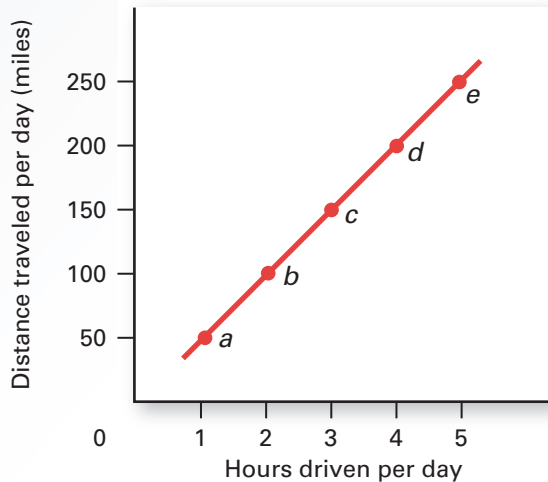
	Hours Driven per Day	Distance Traveled per Day (miles)
a	1	50
b	2	100
c	3	150
d	4	200
e	5	250

distance traveled, the *dependent* variable, depends on the number of hours driven, the *independent* variable. Combinations of hours driven and distance traveled are shown as *a*, *b*, *c*, *d*, and *e*. Each combination is represented by a point in Exhibit A-4. For example, point *a* shows that if you drive for 1 hour, you travel 50 miles. Point *b* indicates that if you drive for 2 hours, you travel 100 miles. By connecting the points, or possible combinations, we create a line running upward and to the right. This makes sense because, the longer you drive, the farther you travel. Assumed constant along this line is your average speed of 50 miles per hour.

### Exhibit A-4

#### Graph Relating Distance Traveled to Hours Driven

Points a through e depict different combinations of hours driven per day and the corresponding distances traveled. Connecting these points creates a graph.



Types of relations between variables include the following:

1. As one variable increases, the other increases—as in Exhibit A-4; this is called a **positive**, or **direct**, **relation** between the variables.
2. As one variable increases, the other decreases; this is called a **negative**, or **inverse**, **relation**.
3. As one variable increases, the other remains unchanged; the two variables are said to be *independent*, or *unrelated*.

One of the advantages of graphs is that they easily convey the relation between variables. We do not need to examine the particular combinations of numbers; we need only focus on the shape of the curve.

#### A1-1b The Slope of a Straight Line

A more precise way to describe the shape of a curve is to measure its slope. The **slope of a line** indicates how much the vertical variable changes for a given increase in the horizontal variable. Specifically, the slope between any two points along any straight line is the vertical change between these two points divided by the horizontal increase, or

$$\text{Slope} = \frac{\text{Change in the vertical distance}}{\text{Increase in the horizontal distance}}$$

Each of the four panels in Exhibit A-5 indicates a vertical change, given a 10-unit increase in the horizontal variable. In panel (a), the vertical distance increases by 5 units when the horizontal distance increases by 10 units. The slope of the line is therefore  $5/10$ , or  $0.5$ . Notice that the slope in this case is a positive number because the relation between the two variables is positive, or direct. This slope indicates that for every 1-unit increase in the horizontal variable, the vertical variable increases by  $0.5$  units. The slope, incidentally, does not imply causality; the increase in the horizontal variable does not necessarily *cause* the increase in the vertical variable. The slope simply measures the relation between an increase in the horizontal variable and the associated change in the vertical variable.

In panel (b) of Exhibit A-5, the vertical distance declines by 7 units when the horizontal distance increases by 10 units, so the slope equals  $-7/10$ , or  $-0.7$ . The slope in this case is a negative number because the two variables have a negative, or inverse, relation. In panel (c), the vertical variable remains unchanged as the horizontal variable increases by 10, so the slope equals  $0/10$ , or  $0$ . These two variables are not related. Finally, in panel (d), the vertical variable can take on any value, although the horizontal variable remains unchanged. Again, the two variables are not related. In this case, any change in the vertical measure, for example a 10-unit change, is divided by 0, because the horizontal value does not change. Any change divided by 0 is mathematically undefined, but as the line tilts toward vertical, its slope gets incredibly large. For practical purposes, we will assume that the slope of this line is not undefined but infinitely large.

#### A1-1c The Slope, Units of Measurement, and Marginal Analysis

The mathematical value of the slope depends on the units measured on the graph. For example, suppose copper tubing costs \$1 a foot. Graphs depicting the relation between total cost and quantity purchased are shown in Exhibit A-6. In panel (a), the total cost increases by \$1 for each 1-foot increase in the amount of tubing purchased. Thus, the slope equals  $1/1$ , or 1. If the cost per foot remains the same but units are

**positive relation (direct relation)** occurs when two variables increase or decrease together; the two variables move in the same direction

**negative relation (inverse relation)** occurs when two variables move in opposite directions; when one increases, the other decreases

**slope of a line** a measure of how much the vertical variable changes for a given increase in the horizontal variable; the vertical change between two points divided by the horizontal increase