After studying this chapter, you will be able to:

- Define economics and distinguish between microeconomics and macroeconomics
- Explain the two big questions of economics
- Explain the key ideas that define the economic way of thinking
- Explain how economists go about their work as social scientists and policy advisers

1 WHAT IS ECONOMICS?

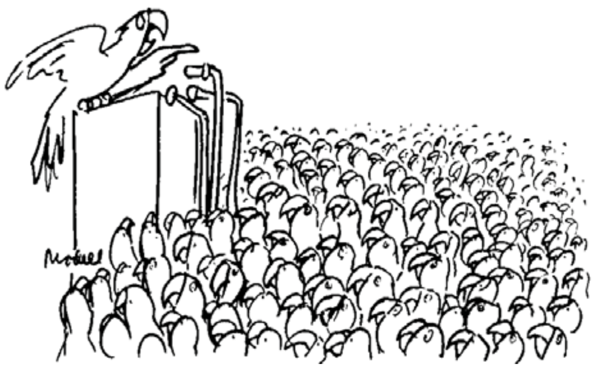
You are studying economics at a time of extraordinary challenge and change. The United States, Europe, and Japan, the world's richest nations, are still not fully recovered from a deep recession in which incomes shrank and millions of jobs were lost. Brazil, China, India, and Russia, poorer nations with a combined population that dwarfs our own, are growing rapidly and playing ever-greater roles in an expanding global economy.

The economic events of the past few years stand as a stark reminder that we live in a changing and sometimes turbulent world. New businesses are born and old ones die. New jobs are created and old ones disappear. Nations, businesses, and individuals must find ways of coping with economic change.

Your life will be shaped by the challenges that *you* face and the opportunities that *you* create. But to face those challenges and seize the opportunities they present, you must understand the powerful forces at play. The economics that you're about to learn will become your most reliable guide. This chapter gets you started. It describes the questions that economists try to answer and the ways in which they think as they search for the answers.

Definition of Economics

A fundamental fact dominates our lives: We want more than we can get. Our inability to get everything we want is called **scarcity**. Scarcity is universal. It confronts all living things. Even parrots face scarcity!



Not only do I want a cracker—we all want a cracker!

Think about the things that *you* want and the scarcity that *you* face. You want to live a long and healthy life. You want to go to a good school, college, or university. You want to live in a well-equipped, spacious, and comfortable home. You want the latest smart phone and a faster Internet connection for your laptop or iPad. You want some sports and recreational gear—perhaps some new running shoes, or a new bike. And you want more time, much more than is available, to go to class, do your homework, play sports and games, read novels, go to the movies, listen to music, travel, and hang out with your friends.

What you can afford to buy is limited by your income and by the prices you must pay. And your time is limited by the fact that your day has 24 hours.

You want some other things that only governments provide. You want to live in a peaceful and secure world and safe neighborhood and enjoy the benefits of clean air, lakes, and rivers.

What governments can afford is limited by the taxes they collect. Taxes lower people's incomes and compete with the other things they want to buy.

What everyone can get—what *society* can get—is limited by the productive resources available. These resources are the gifts of nature, human labor and ingenuity, and all the previously produced tools and equipment.

Because we can't get everything we want, we must make *choices*. You can't afford *both* a laptop *and* an iPhone, so you must *choose* which one to buy. You can't spend tonight *both* studying for your next test *and* going to the movies, so again, you must *choose* which one to do. Governments can't spend a tax dollar on *both* national defense *and* environmental protection, so they must *choose* how to spend that dollar.

Your choices must somehow be made consistent with the choices of others. If you choose to buy a laptop, someone else must choose to sell it. Incentives reconcile choices. An **incentive** is a reward that encourages an action or a penalty that discourages one. Prices act as incentives. If the price of a laptop is too high, more will be offered for sale than people want to buy. And if the price is too low, fewer will be offered for sale than people want to buy. But there is a price at which choices to buy and sell are consistent.

> **Economics** is the social science that studies the *choices* that individuals, businesses, governments, and entire societies make as they cope with *scarcity* and the *incentives* that influence and reconcile those choices.

The subject has two parts:

- Microeconomics
- Macroeconomics

Microeconomics is the study of the choices that individuals and businesses make, the way these choices interact in markets, and the influence of governments. Some examples of microeconomic questions are: Why are people downloading more movies? How would a tax on e-commerce affect eBay?

Macroeconomics is the study of the performance of the national economy and the global economy. Some examples of macroeconomic questions are: Why is the U.S. unemployment rate so high? Can the Federal Reserve make our economy expand by cutting interest rates?

REVIEW QUIZ

1. List some examples of the scarcity that you face.
2. Find examples of scarcity in today's headlines.
3. Find an illustration of the distinction between microeconomics and macroeconomics in today's headlines.

You can work these questions in Study Plan 1.1 and get instant feedback.

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Two Big Economic Questions

Two big questions summarize the scope of economics:

- How do choices end up determining *what*, *how*, and *for whom* goods and services are produced?
- Can the choices that people make in the pursuit of their own *self-interest* also promote the broader *social interest*?

What, How, and For Whom?

Goods and services are the objects that people value and produce to satisfy human wants. *Goods* are physical objects such as cell phones and automobiles. *Services* are tasks performed for people such as cell-phone service and auto-repair service.

What? What we produce varies across countries and changes over time. In the United States today, agriculture accounts for 1 percent of total production, manufactured goods for 22 percent, and services (retail and wholesale trade, health care, and education are the biggest ones) for 77 percent. In contrast, in China today, agriculture accounts for 11 percent of total production, manufactured goods for 49 percent, and services for 40 percent. Figure 1.1 shows these numbers and also the percentages for Brazil, which fall between those for the United States and China.

What determines these patterns of production? How do choices end up determining the quantities of cell phones, automobiles, cell-phone service, auto-repair service, and the millions of other items that are produced in the United States and around the world?

How? Goods and services are produced by using productive resources that economists call **factors of production**. Factors of production are grouped into four categories:

- Land
- Labor
- Capital
- Entrepreneurship

Land The "gifts of nature" that we use to produce goods and services are called **land**. In economics, land is what in everyday language we call *natural resources*. It includes land in the everyday sense together with minerals, oil, gas, coal, water, air, forests, and fish.

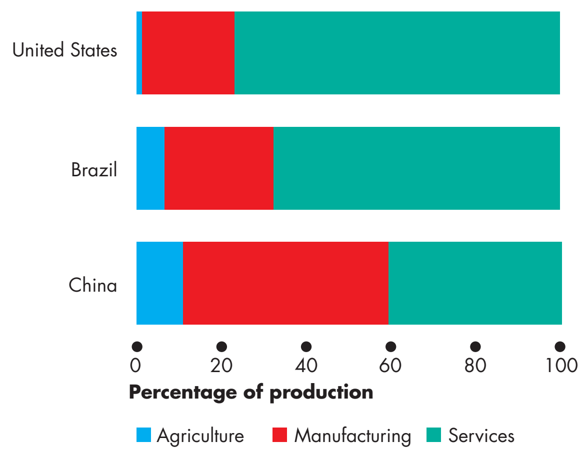
Our land surface and water resources are renewable and some of our mineral resources can be recycled. But the resources that we use to create energy are nonrenewable—they can be used only once.

Labor The work time and work effort that people devote to producing goods and services is called **labor**. Labor includes the physical and mental efforts of all the people who work on farms and construction sites and in factories, shops, and offices.

The *quality* of labor depends on **human capital**, which is the knowledge and skill that people obtain from education, on-the-job training, and work experience. You are building your own human capital right now as you work on your economics course, and your human capital will continue to grow as you gain work experience.

Human capital expands over time. Today, 87 percent of the adult population of the United States have completed high school and 29 percent have a college or university degree. Figure 1.2 shows these measures of the growth of human capital in the United States over the past century.

FIGURE 1.1 What Three Countries Produce



Agriculture and manufacturing is a small percentage of production in rich countries such as the United States and a large percentage of production in poorer countries such as China. Most of what is produced in the United States is services.

Source of data: CIA Factbook 2010, Central Intelligence Agency.

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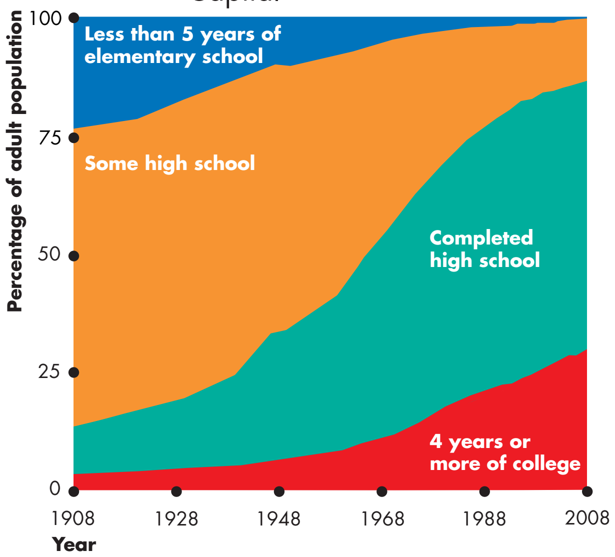
FIGURE 1.2 A Measure of Human Capital



In 2008 (the most recent data), 29 percent of the population had 4 years or more of college, up from 2 percent in 1908. A further 58 percent had completed high school, up from 10 percent in 1908.

Source of data: U.S. Census Bureau, *Statistical Abstract of the United States*, 2010.

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Capital The tools, instruments, machines, buildings, and other constructions that businesses use to produce goods and services are called **capital**.

In everyday language, we talk about money, stocks, and bonds as being "capital." These items are *financial* capital. Financial capital plays an important role in enabling businesses to borrow the funds that they use to buy physical capital. But because financial capital is not used to produce goods and services, it is not a productive resource.

Entrepreneurship The human resource that organizes labor, land, and capital is called **entrepreneurship**. Entrepreneurs come up with new ideas about what and how to produce, make business decisions, and bear the risks that arise from these decisions.

What determines the quantities of factors of production that are used to produce goods and services?

For Whom? Who consumes the goods and services that are produced depends on the incomes that people earn. People with large incomes can buy a wide range of goods and services. People with small incomes have fewer options and can afford a smaller range of goods and services.

People earn their incomes by selling the services of the factors of production they own:

- Land earns **rent**.
- Labor earns **wages**.
- Capital earns **interest**.
- Entrepreneurship earns **profit**.

Which factor of production earns the most income? The answer is labor. Wages and fringe benefits are around 70 percent of total income. Land, capital, and entrepreneurship share the rest. These percentages have been remarkably constant over time.

Knowing how income is shared among the factors of production doesn't tell us how it is shared among individuals. And the distribution of income among individuals is extremely unequal. You know of some people who earn very large incomes: Angelina Jolie earns $10 million per movie; and the New York Yankees pays Alex Rodriguez $27.5 million a year.

You know of even more people who earn very small incomes. Servers at McDonald's average around $7.25 an hour; checkout clerks, cleaners, and textile and leather workers all earn less than $10 an hour.

You probably know about other persistent differences in incomes. Men, on average, earn more than women; whites earn more than minorities; college graduates earn more than high-school graduates.

We can get a good sense of who consumes the goods and services produced by looking at the percentages of total income earned by different groups of people. The 20 percent of people with the lowest incomes earn about 5 percent of total income, while the richest 20 percent earn close to 50 percent of total income. So on average, people in the richest 20 percent earn more than 10 times the incomes of those in the poorest 20 percent.

Why is the distribution of income so unequal? Why do women and minorities earn less than white males?

Economics provides some answers to all these questions about what, how, and for whom goods and services are produced and much of the rest of this book will help you to understand those answers.

We're now going to look at the second big question of economics: Can the pursuit of self-interest promote the social interest? This question is a difficult one both to appreciate and to answer.

Can the Pursuit of Self-Interest Promote the Social Interest?

Every day, you and 311 million other Americans, along with 6.9 billion people in the rest of the world, make economic choices that result in *what*, *how*, and *for whom* goods and services are produced.

Self-Interest A choice is in your **self-interest** if you think that choice is the best one available for you. You make most of your choices in your self-interest. You use your time and other resources in the ways that make the most sense to you, and you don't think too much about how your choices affect other people. You order a home delivery pizza because you're hungry and want to eat. You don't order it thinking that the delivery person needs an income. And when the pizza delivery person shows up at your door, he's not doing you a favor. He's pursuing his self-interest and hoping for a good tip.

Social Interest A choice is in the **social interest** if it leads to an outcome that is the best for society as a whole. The social interest has two dimensions: efficiency and equity (or fairness). What is best for society is an efficient and fair use of resources.

Economists say that **efficiency** is achieved when the available resources are used to produce goods and services at the lowest possible cost and in the quantities that give the greatest possible value or benefit. We will make the concept of efficiency precise and clear in Chapter 2. For now, just think of efficiency as a situation in which resources are put to their best possible use.

Equity or fairness doesn't have a crisp definition. Reasonable people, both economists and others, have a variety of views about what is fair. There is always room for disagreement and a need to be careful and clear about the notion of fairness being used.

The Big Question Can we organize our economic lives so that when each one of us makes choices that are in our self-interest, we promote the social interest? Can trading in free markets achieve the social interest? Do we need government action to achieve the social interest? Do we need international cooperation and treaties to achieve the global social interest?

Questions about the social interest are hard ones to answer and they generate discussion, debate, and disagreement. Let's put a bit of flesh on these questions with four examples.

The examples are:

- Globalization
- The information-age economy
- Climate change
- Economic instability

Globalization The term *globalization* means the expansion of international trade, borrowing and lending, and investment.

Globalization is in the self-interest of those consumers who buy low-cost goods and services produced in other countries; and it is in the self-interest of the multinational firms that produce in low-cost regions and sell in high-price regions. But is globalization in the self-interest of the low-wage worker in Malaysia who sews your new running shoes and the displaced shoemaker in Atlanta? Is it in the social interest?

Economics in Action

Life in a Small and Ever-Shrinking World

When Nike produces sports shoes, people in Malaysia get work; and when China Airlines buys new airplanes, Americans who work at Boeing in Seattle build them. While globalization brings expanded production and job opportunities for some workers, it destroys many American jobs. Workers across the manufacturing industries must learn new skills, take service jobs, which are often lower-paid, or retire earlier than previously planned.

The Information-Age Economy The technological change of the past forty years has been called the *Information Revolution*.

The information revolution has clearly served your self-interest: It has provided your cell phone, laptop, loads of handy applications, and the Internet. It has also served the self-interest of Bill Gates of Microsoft and Gordon Moore of Intel, both of whom have seen their wealth soar.

But did the information revolution best serve the social interest? Did Microsoft produce the best possible Windows operating system and sell it at a price that was in the social interest? Did Intel make the right quality of chips and sell them in the right quantities for the right prices? Or was the quality too low and the price too high? Would the social interest have been better served if Microsoft and Intel had faced competition from other firms?

Climate Change Climate change is a huge political issue today. Every serious political leader is acutely aware of the problem and of the popularity of having proposals that might lower carbon emissions.

Every day, when you make self-interested choices to use electricity and gasoline, you contribute to carbon emissions; you leave your carbon footprint. You can lessen your carbon footprint by walking, riding a bike, taking a cold shower, or planting a tree.

But can each one of us be relied upon to make decisions that affect the Earth's carbon-dioxide concentration in the social interest? Must governments change the incentives we face so that our self-interested choices are also in the social interest? How can governments change incentives? How can we encourage the use of wind and solar power to replace the burning of fossil fuels that brings climate change?

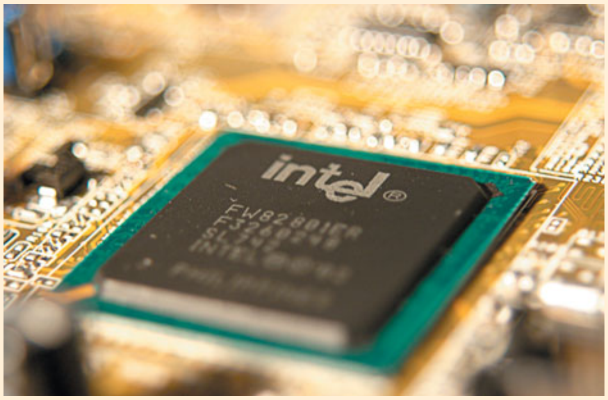
Economics in Action

Chips and Windows

Gordon Moore, who founded the chip-maker Intel, and Bill Gates, a co-founder of Microsoft, held privileged positions in the *Information Revolution*.

For many years, Intel chips were the only available chips and Windows was the only available operating system for the original IBM PC and its clones. The PC and Apple's Mac competed, but the PC had a huge market share.

An absence of competition gave Intel and Microsoft the power and ability to sell their products at prices far above the cost of production. If the prices of chips and Windows had been lower, many more people would have been able to afford a computer and would have chosen to buy one.



Economics in Action

Greenhouse Gas Emissions

Burning fossil fuels to generate electricity and to power airplanes, automobiles, and trucks pours a staggering 28 billions tons—4 tons per person—of carbon dioxide into the atmosphere each year.

Two thirds of the world's carbon emissions comes from the United States, China, the European Union, Russia, and India. The fastest growing emissions are coming from India and China.

The amount of global warming caused by economic activity and its effects are uncertain, but the emissions continue to grow and pose huge risks.

Economic Instability The years between 1993 and 2007 were a period of remarkable economic stability, so much so that they've been called the *Great Moderation*. During those years, the U.S. and global economies were on a roll. Incomes in the United States increased by 30 percent and incomes in China tripled. Even the economic shockwaves of 9/11 brought only a small dip in the strong pace of U.S. and global economic growth.

But in August 2007, a period of financial stress began. A bank in France was the first to feel the pain that soon would grip the entire global financial system.

Banks take in people's deposits and get more funds by borrowing from each other and from other firms. Banks use these funds to make loans. All the banks' choices to borrow and lend and the choices of people and businesses to lend to and borrow from banks are made in self-interest. But does this lending and borrowing serve the social interest? Is there too much borrowing and lending that needs to be reined in, or is there too little and a need to stimulate more?

When the banks got into trouble, the Federal Reserve (the Fed) bailed them out with big loans backed by taxpayer dollars. Did the Fed's bailout of troubled banks serve the social interest? Or might the Fed's rescue action encourage banks to repeat their dangerous lending in the future?

Banks weren't the only recipients of public funds. General Motors was saved by a government bailout. GM makes its decisions in its self-interest. The government bailout of GM also served the firm's self-interest. Did the bailout also serve the social interest?

Economics in Action

A Credit Crunch

Flush with funds and offering record low interest rates, banks went on a lending spree to home buyers. Rapidly rising home prices made home owners feel well off and they were happy to borrow and spend. Home loans were bundled into securities that were sold and resold to banks around the world.

In 2006, as interest rates began to rise and the rate of rise in home prices slowed, borrowers defaulted on their loans. What started as a trickle became a flood. As more people defaulted, banks took losses that totaled billions of dollars by mid-2007.

Global credit markets stopped working, and people began to fear a prolonged slowdown in economic activity. Some even feared the return of the economic trauma of the *Great Depression* of the 1930s when more than 20 percent of the U.S. labor force was unemployed. The Federal Reserve, determined to avoid a catastrophe, started lending on a very large scale to the troubled banks.

REVIEW QUIZ

1. Describe the broad facts about *what*, *how*, and *for whom* goods and services are produced.
2. Use headlines from the recent news to illustrate the potential for conflict between self-interest and the social interest.

You can work these questions in Study Plan 1.2 and get instant feedback. myeconlab

We've looked at four topics and asked many questions that illustrate the big question: Can choices made in the pursuit of self-interest also promote the social interest? We've asked questions but not answered them because we've not yet explained the economic principles needed to do so.

By working through this book, you will discover the economic principles that help economists figure out when the social interest is being served, when it is not, and what might be done when it is not being served. We will return to each of the unanswered questions in future chapters.

The Economic Way of Thinking

The questions that economics tries to answer tell us about the *scope of economics,* but they don't tell us how economists *think* and go about seeking answers to these questions. You're now going to see how economists go about their work.

We're going to look at six key ideas that define the *economic way of thinking*. These ideas are

- A choice is a *tradeoff.*
- People make *rational choices* by comparing *benefits* and *costs.*
- *Benefit* is what you gain from something.
- *Cost* is what you *must give up* to get something.
- Most choices are "*how-much*" choices made at the *margin.*
- Choices respond to *incentives.*

A Choice Is a Tradeoff

Because we face scarcity, we must make choices. And when we make a choice, we select from the available alternatives. For example, you can spend Saturday night studying for your next economics test or having fun with your friends, but you can't do both of these activities at the same time. You must choose how much time to devote to each. Whatever choice you make, you could have chosen something else.

You can think about your choices as tradeoffs. A **tradeoff** is an exchange—giving up one thing to get something else. When you choose how to spend your Saturday night, you face a tradeoff between studying and hanging out with your friends.

Making a Rational Choice

Economists view the choices that people make as rational. A **rational choice** is one that compares costs and benefits and achieves the greatest benefit over cost for the person making the choice.

Only the wants of the person making a choice are relevant to determine its rationality. For example, you might like your coffee black and strong but your friend prefers his milky and sweet. So it is rational for you to choose espresso and for your friend to choose cappuccino.

The idea of rational choice provides an answer to the first question: *What* goods and services will be produced and in what quantities? The answer is those that people rationally choose to buy!

But how do people choose rationally? Why do more people choose an iPod rather than a Zune? Why has the U.S. government chosen to build an interstate highway system and not an interstate high-speed railroad system? The answers turn on comparing benefits and costs.

Benefit: What You Gain

The **benefit** of something is the gain or pleasure that it brings and is determined by **preferences**—by what a person likes and dislikes and the intensity of those feelings. If you get a huge kick out of "Guitar Hero," that video game brings you a large benefit. And if you have little interest in listening to Yo Yo Ma playing a Vivaldi cello concerto, that activity brings you a small benefit.

Some benefits are large and easy to identify, such as the benefit that you get from being in school. A big piece of that benefit is the goods and services that you will be able to enjoy with the boost to your earning power when you graduate. Some benefits are small, such as the benefit you get from a slice of pizza.

Economists measure benefit as the most that a person is *willing to give up* to get something. You are willing to give up a lot to be in school. But you would give up only an iTunes download for a slice of pizza.

Cost: What You *Must* Give Up

The **opportunity cost** of something is the highest-valued alternative that must be given up to get it.

To make the idea of opportunity cost concrete, think about *your* opportunity cost of being in school. It has two components: the things you can't afford to buy and the things you can't do with your time.

Start with the things you can't afford to buy. You've spent all your income on tuition, residence fees, books, and a laptop. If you weren't in school, you would have spent this money on tickets to ball games and movies and all the other things that you enjoy. But that's only the start of your opportunity cost. You've also given up the opportunity to get a job. Suppose that the best job you could get if you weren't in school is working at Citibank as a teller earning $25,000 a year. Another part of your opportunity cost of being in school is all the things that you could buy with the extra $25,000 you would have.

As you well know, being a student eats up many hours in class time, doing homework assignments, preparing for tests, and so on. To do all these school activities, you must give up many hours of what would otherwise be leisure time spent with your friends.

So the opportunity cost of being in school is all the good things that you can't afford and don't have the spare time to enjoy. You might want to put a dollar value on that cost or you might just list all the items that make up the opportunity cost.

The examples of opportunity cost that we've just considered are all-or-nothing costs—you're either in school or not in school. Most situations are not like this one. They involve choosing *how much* of an activity to do.

How Much? Choosing at the Margin

You can allocate the next hour between studying and instant messaging your friends, but the choice is not all or nothing. You must decide how many minutes to allocate to each activity. To make this decision, you compare the benefit of a little bit more study time with its cost—you make your choice at the **margin**.

The benefit that arises from an increase in an activity is called **marginal benefit**. For example, your marginal benefit from one more night of study before a test is the boost it gives to your grade. Your marginal benefit doesn't include the grade you're already achieving without that extra night of work.

The *opportunity cost* of an *increase* in an activity is called **marginal cost**. For you, the marginal cost of studying one more night is the cost of not spending that night on your favorite leisure activity.

To make your decisions, you compare marginal benefit and marginal cost. If the marginal benefit from an extra night of study exceeds its marginal cost, you study the extra night. If the marginal cost exceeds the marginal benefit, you don't study the extra night.

Choices Respond to Incentives

Economists take human nature as given and view people as acting in their self-interest. All people—you, other consumers, producers, politicians, and public servants—pursue their self-interest.

Self-interested actions are not necessarily *selfish* actions. You might decide to use your resources in ways that bring pleasure to others as well as to yourself. But a self-interested act gets the most benefit for *you* based on *your* view about benefit.

The central idea of economics is that we can predict the self-interested choices that people make by looking at the *incentives* they face. People undertake those activities for which marginal benefit exceeds marginal cost; and they reject options for which marginal cost exceeds marginal benefit.

For example, your economics instructor gives you a problem set and tells you these problems will be on the next test. Your marginal benefit from working these problems is large, so you diligently work them. In contrast, your math instructor gives you a problem set on a topic that she says will never be on a test. You get little marginal benefit from working these problems, so you decide to skip most of them.

Economists see incentives as the key to reconciling self-interest and social interest. When our choices are *not* in the social interest, it is because of the incentives we face. One of the challenges for economists is to figure out the incentives that result in self-interested choices being in the social interest.

Economists emphasize the crucial role that institutions play in influencing the incentives that people face as they pursue their self-interest. Laws that protect private property and markets that enable voluntary exchange are the fundamental institutions. You will learn as you progress with your study of economics that where these institutions exist, self-interest can indeed promote the social interest.

REVIEW QUIZ

1. Explain the idea of a tradeoff and think of three tradeoffs that you have made today.
2. Explain what economists mean by rational choice and think of three choices that you've made today that are rational.
3. Explain why opportunity cost is the best forgone alternative and provide examples of some opportunity costs that you have faced today.
4. Explain what it means to choose at the margin and illustrate with three choices at the margin that you have made today.
5. Explain why choices respond to incentives and think of three incentives to which you have responded today.

You can work these questions in Study Plan 1.3 and get instant feedback. myeconlab

Economics as Social Science and Policy Tool

Economics is both a social science and a toolkit for advising on policy decisions.

Economist as Social Scientist

As social scientists, economists seek to discover how the economic world works. In pursuit of this goal, like all scientists, economists distinguish between positive and normative statements.

Positive Statements A *positive* statement is about what *is*. It says what is currently believed about the way the world operates. A positive statement might be right or wrong, but we can test it by checking it against the facts. "Our planet is warming because of the amount of coal that we're burning" is a positive statement. We can test whether it is right or wrong.

A central task of economists is to test positive statements about how the economic world works and to weed out those that are wrong. Economics first got off the ground in the late 1700s, so it is a young science compared with, for example, physics, and much remains to be discovered.

Normative Statements A *normative* statement is about what *ought to be*. It depends on values and cannot be tested. Policy goals are normative statements. For example, "We ought to cut our use of coal by 50 percent" is a normative policy statement. You may agree or disagree with it, but you can't test it. It doesn't assert a fact that can be checked.

Unscrambling Cause and Effect Economists are particularly interested in positive statements about cause and effect. Are computers getting cheaper because people are buying them in greater quantities? Or are people buying computers in greater quantities because they are getting cheaper? Or is some third factor causing both the price of a computer to fall and the quantity of computers bought to increase?

To answer such questions, economists create and test economic models. An **economic model** is a description of some aspect of the economic world that includes only those features that are needed for the purpose at hand. For example, an economic model of a cell-phone network might include features such as the prices of calls, the number of cell-phone users, and the volume of calls. But the model would ignore cell-phone colors and ringtones.

A model is tested by comparing its predictions with the facts. But testing an economic model is difficult because we observe the outcomes of the simultaneous change of many factors. To cope with this problem, economists look for natural experiments (situations in the ordinary course of economic life in which the one factor of interest is different and other things are equal or similar); conduct statistical investigations to find correlations; and perform economic experiments by putting people in decision-making situations and varying the influence of one factor at a time to discover how they respond.

Economist as Policy Adviser

Economics is useful. It is a toolkit for advising governments and businesses and for making personal decisions. Some of the most famous economists work partly as policy advisers.

For example, Jagdish Bhagwati of Columbia University, whom you will meet on pp. 52–54, has advised governments and international organizations on trade and economic development issues.

Christina Romer of the University of California, Berkeley, is on leave and serving as the chief economic adviser to President Barack Obama and head of the President's Council of Economic Advisers.

All the policy questions on which economists provide advice involve a blend of the positive and the normative. Economics can't help with the normative part—the policy goal. But for a given goal, economics provides a method of evaluating alternative solutions—comparing marginal benefits and marginal costs and finding the solution that makes the best use of the available resources.

REVIEW QUIZ

1. Distinguish between a positive statement and a normative statement and provide examples.
2. What is a model? Can you think of a model that you might use in your everyday life?
3. How do economists try to disentangle cause and effect?
4. How is economics used as a policy tool?

You can work these questions in Study Plan 1.4 and get instant feedback. myeconlab

SUMMARY

Key Points

Definition of Economics (p. 2)

- All economic questions arise from scarcity—from the fact that wants exceed the resources available to satisfy them.
- Economics is the social science that studies the choices that people make as they cope with scarcity.
- The subject divides into microeconomics and macroeconomics.

Working Problem 1 will give you a better understanding of the definition of economics.

Two Big Economic Questions (pp. 3–7)

- Two big questions summarize the scope of economics:

  1. How do choices end up determining *what*, *how*, and *for whom* goods and services are produced?
  2. When do choices made in the pursuit of *self-interest* also promote the *social interest*?

Working Problems 2 and 3 will give you a better understanding of the two big questions of economics.

The Economic Way of Thinking (pp. 8–9)

- Every choice is a tradeoff—exchanging more of something for less of something else.
- People make rational choices by comparing benefit and cost.
- Cost—*opportunity cost*—is what you must give up to get something.
- Most choices are "how much" choices made at the *margin* by comparing marginal benefit and marginal cost.
- Choices respond to incentives.

Working Problems 4 and 5 will give you a better understanding of the economic way of thinking.

Economics as Social Science and Policy Tool (p. 10)

- Economists distinguish between positive statements—what is—and normative statements—what ought to be.
- To explain the economic world, economists create and test economic models.
- Economics is a toolkit used to provide advice on government, business, and personal economic decisions.

Working Problem 6 will give you a better understanding of economics as social science and policy tool.

Key Terms

Benefit, 8
Capital, 4
Economic model, 10
Economics, 2
Efficiency, 5
Entrepreneurship, 4
Factors of production, 3
Goods and services, 3
Human capital, 3
Incentive, 2
Interest, 4
Labor, 3
Land, 3
Macroeconomics, 2
Margin, 9
Marginal benefit, 9
Marginal cost, 9
Microeconomics, 2
Opportunity cost, 8
Preferences, 8
Profit, 4
Rational choice, 8
Rent, 4
Scarcity, 2
Self-interest, 5
Social interest, 5
Tradeoff, 8
Wages, 4

STUDY PLAN PROBLEMS AND APPLICATIONS

myeconlab You can work Problems 1 to 6 in MyEconLab Chapter 1 Study Plan and get instant feedback.

Definition of Economics (Study Plan 1.1)

1. Apple Inc. decides to make iTunes freely available in unlimited quantities.
   a. Does Apple's decision change the incentives that people face?
   b. Is Apple's decision an example of a microeconomic or a macroeconomic issue?

Two Big Economic Questions (Study Plan 1.2)

2. Which of the following pairs does not match?
   a. Labor and wages
   b. Land and rent
   c. Entrepreneurship and profit
   d. Capital and profit
3. Explain how the following news headlines concern self-interest and the social interest.
   a. Starbucks Expands in China
   b. McDonald's Moves into Salads
   c. Food Must Be Labeled with Nutrition Data

The Economic Way of Thinking (Study Plan 1.3)

4. The night before an economics test, you decide to go to the movies instead of staying home and working your MyEconLab Study Plan. You get 50 percent on your test compared with the 70 percent that you normally score.
   a. Did you face a tradeoff?
   b. What was the opportunity cost of your evening at the movies?
5. **Costs Soar for London Olympics**
   The regeneration of East London, the site of the 2012 Olympic Games, is set to add extra £1.5 billion to taxpayers' bill.
   Source: *The Times*, London, July 6, 2006
   Is the cost of regenerating East London an opportunity cost of hosting the 2012 Olympic Games? Explain why or why not.

Economics as Social Science and Policy Tool (Study Plan 1.4)

6. Which of the following statements is positive, which is normative, and which can be tested?
   a. The United States should cut its imports.
   b. China is the largest trading partner of the United States.
   c. If the price of antiretroviral drugs increases, HIV/AIDS sufferers will decrease their consumption of the drugs.

ADDITIONAL PROBLEMS AND APPLICATIONS

myeconlab You can work these problems in MyEconLab if assigned by your instructor.

Definition of Economics

7. **Hundreds Line up for 5 p.m. Ticket Giveaway**
   By noon, hundreds of Eminem fans had lined up for a chance to score free tickets to the concert.
   Source: *Detroit Free Press*, May 18, 2009
   When Eminem gave away tickets, what was free and what was scarce? Explain your answer.

Two Big Economic Questions

8. How does the creation of a successful movie influence *what*, *how*, and *for whom* goods and services are produced?
9. How does a successful movie illustrate self-interested choices that are also in the social interest?

The Economic Way of Thinking

10. Before starring in *Iron Man*, Robert Downey Jr. had appeared in 45 movies that grossed an average of $5 million on the opening weekend. In contrast, *Iron Man* grossed $102 million.
    a. How do you expect the success of *Iron Man* to influence the opportunity cost of hiring Robert Downey Jr.?
    b. How have the incentives for a movie producer to hire Robert Downey Jr. changed?
11. What might be an incentive for you to take a class in summer school? List some of the benefits and costs involved in your decision. Would your choice be rational?

Economics as Social Science and Policy Tool

12. Look at today's *Wall Street Journal*. What is the leading economic news story? With which of the big economic questions does it deal and what tradeoffs does it discuss or imply?
13. Provide two microeconomic statements and two macroeconomic statements. Classify your statements as positive or normative. Explain why.

APPENDIX

Graphs in Economics

After studying this appendix, you will be able to:

- Make and interpret a scatter diagram
- Identify linear and nonlinear relationships and relationships that have a maximum and a minimum
- Define and calculate the slope of a line
- Graph relationships among more than two variables

Graphing Data

A graph represents a quantity as a distance on a line. In Fig. A1.1, a distance on the horizontal line represents temperature, measured in degrees Fahrenheit. A movement from left to right shows an increase in temperature. The point 0 represents zero degrees Fahrenheit. To the right of 0, the temperature is positive. To the left of 0 the temperature is negative (as indicated by the minus sign). A distance on the vertical line represents height, measured in thousands of feet. The point 0 represents sea level. Points above 0 represent feet above sea level. Points below 0 represent feet below sea level (indicated by a minus sign).

In Fig. A1.1, the two scale lines are perpendicular to each other and are called *axes*. The vertical line is the *y*-axis, and the horizontal line is the *x*-axis. Each axis has a zero point, which is shared by the two axes and called the *origin*.

To make a two-variable graph, we need two pieces of information: the value of the variable *x* and the value of the variable *y*. For example, off the coast of Alaska, the temperature is 32 degrees—the value of *x*. A fishing boat is located at 0 feet above sea level—the value of *y*. These two bits of information appear as point *A* in Fig. A1.1. A climber at the top of Mount McKinley on a cold day is 20,320 feet above sea level in a zero-degree gale. These two pieces of information appear as point *B*. On a warmer day, a climber might be at the peak of Mt. McKinley when the temperature is 32 degrees, at point *C*.

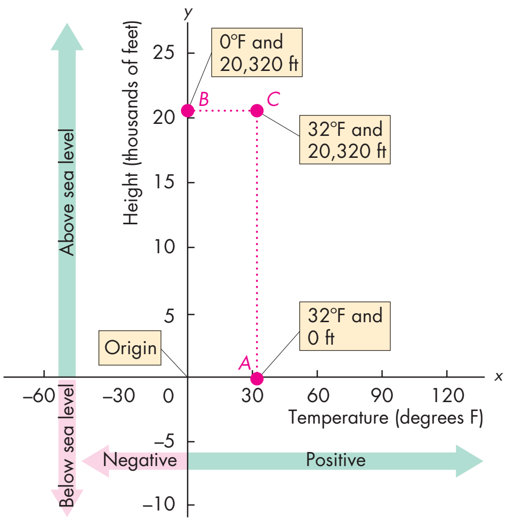
We can draw two lines, called *coordinates*, from point *C*. One, called the *x*-coordinate, runs from *C* to the vertical axis. This line is called "the *x*-coordinate" because its length is the same as the value marked off on the *x*-axis. The other, called the *y*-coordinate, runs from *C* to the horizontal axis. This line is called "the *y*-coordinate" because its length is the same as the value marked off on the *y*-axis.

We describe a point on a graph by the values of its *x*-coordinate and its *y*-coordinate. For example, at point *C*, *x* is 32 degrees and *y* is 20,320 feet.

A graph like that in Fig. A1.1 can be made using any quantitative data on two variables. The graph can show just a few points, like Fig. A1.1, or many points. Before we look at graphs with many points, let's reinforce what you've just learned by looking at two graphs made with economic data.

Economists measure variables that describe *what*, *how*, and *for whom* goods and services are produced. These variables are quantities produced and prices. Figure A1.2 shows two examples of economic graphs.

FIGURE A1.1 Making a Graph



Graphs have axes that measure quantities as distances. Here, the horizontal axis (*x*-axis) measures temperature, and the vertical axis (*y*-axis) measures height. Point *A* represents a fishing boat at sea level (0 on the *y*-axis) on a day when the temperature is 32°F. Point *B* represents a climber at the top of Mt. McKinley, 20,320 feet above sea level at a temperature of 0°F. Point *C* represents a climber at the top of Mt. McKinley, 20,320 feet above sea level at a temperature of 32°F.

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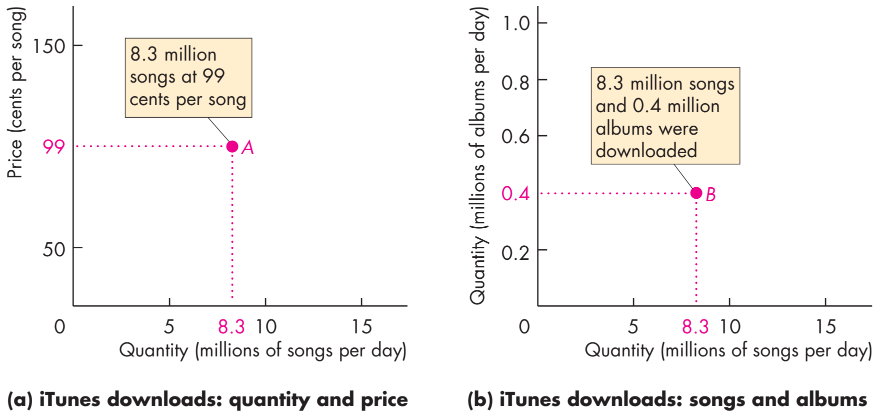
FIGURE A1.2 Two Graphs of Economic Data



The graph in part (a) tells us that in January 2010, 8.3 million songs per day were downloaded from the iTunes store at a price of 99 cents a song.

The graph in part (b) tells us that in January 2010, 8.3 million songs per day and 0.4 million albums per day were downloaded from the iTunes store.

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Figure A1.2(a) is a graph about iTunes song downloads in January 2010. The *x*-axis measures the quantity of songs downloaded per day and the *y*-axis measures the price of a song. Point *A* tells us what the quantity and price were. You can "read" this graph as telling you that in January 2010, 8.3 million songs a day were downloaded at a price of 99¢ per song.

Figure A1.2(b) is a graph about iTunes song and album downloads in January 2010. The *x*-axis measures the quantity of songs downloaded per day and the *y*-axis measures the quantity of albums downloaded per day. Point *B* tells us what these quantities were. You can "read" this graph as telling you that in January 2010, 8.3 million songs a day and 0.4 million albums were downloaded.

The three graphs that you've just seen tell you how to make a graph and how to read a data point on a graph, but they don't improve on the raw data. Graphs become interesting and revealing when they contain a number of data points because then you can visualize the data.

Economists create graphs based on the principles in Figs. A1.1 and A1.2 to reveal, describe, and visualize the relationships among variables. We're now going to look at some examples. These graphs are called scatter diagrams.

Scatter Diagrams

A **scatter diagram** is a graph that plots the value of one variable against the value of another variable for a number of different values of each variable. Such a graph reveals whether a relationship exists between two variables and describes their relationship.

The table in Fig. A1.3 shows some data on two variables: the number of tickets sold at the box office and the number of DVDs sold for eight of the most popular movies in 2009.

What is the relationship between these two variables? Does a big box office success generate a large volume of DVD sales? Or does a box office success mean that fewer DVDs are sold?

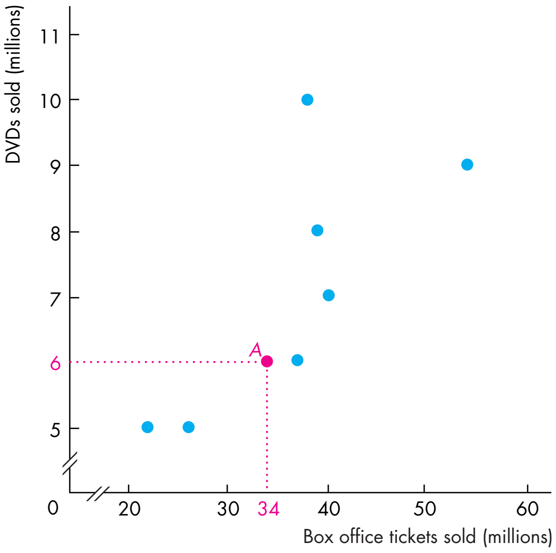
We can answer these questions by making a scatter diagram. We do so by graphing the data in the table. In the graph in Fig. A1.3, each point shows the number of box office tickets sold (the *x* variable) and the number of DVDs sold (the *y* variable) of one of the movies. There are eight movies, so there are eight points "scattered" within the graph.

The point labeled *A* tells us that Star Trek sold 34 million tickets at the box office and 6 million DVDs. The points in the graph form a pattern, which reveals that larger box office sales are associated with larger DVD sales. But the points also tell us that this association is weak. You can't predict DVD sales with any confidence by knowing only the number of tickets sold at the box office.

Figure A1.4 shows two scatter diagrams of economic variables. Part (a) shows the relationship between income and expenditure, on average, during a ten-year period. Each point represents income and expenditure in a given year. For example, point *A* shows that in 2006, income was $31 thousand and expenditure was $30 thousand. This graph shows that as income increases, so does expenditure, and the relationship is a close one.

FIGURE A1.3 A Scatter Diagram

Movie	Tickets (millions)	DVDs (millions)
Twilight	38	10
Transformers: Revenge of the Fallen	54	9
Up	39	8
Harry Potter and the Half-Blood Prince	40	7
Star Trek	34	6
The Hangover	37	6
Ice Age: Dawn of the Dinosaurs	26	5
The Proposal	22	5



The table lists the number of tickets sold at the box office and the number of DVDs sold for eight popular movies. The scatter diagram reveals the relationship between these two variables. Each point shows the values of the two variables for a specific movie. For example, point *A* shows the point for *Star Trek*, which sold 34 million tickets at the box office and 6 million DVDs. The pattern formed by the points shows that there is a tendency for large box office sales to bring greater DVD sales. But you couldn't predict how many DVDs a movie would sell just by knowing its box office sales.

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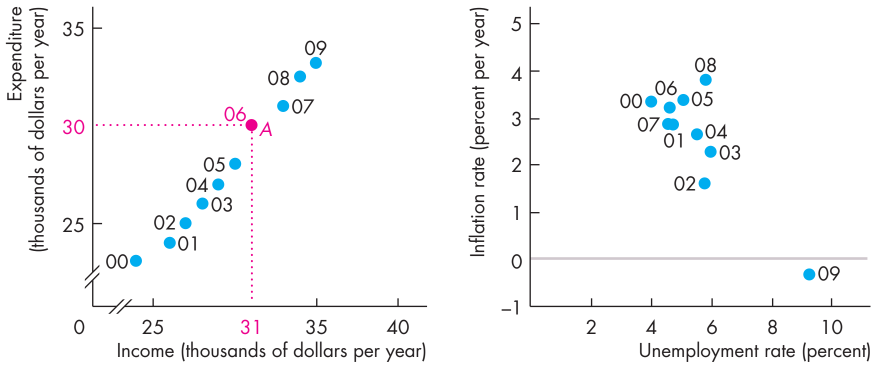
Figure A1.4(b) shows a scatter diagram of U.S. inflation and unemployment during the 2000s. Here, the points for 2000 to 2008 show no relationship between the two variables, but the high unemployment rate of 2009 brought a low inflation rate that year.

You can see that a scatter diagram conveys a wealth of information, and it does so in much less space than we have used to describe only some of its features. But you do have to "read" the graph to obtain all this information.

FIGURE A1.4 Two Economic Scatter Diagrams



(a) Income and expenditure

(b) Unemployment and inflation

The scatter diagram in part (a) shows the relationship between income and expenditure from 2000 to 2009. Point *A* shows that in 2006, income was $31 (thousand) on the *x*-axis and expenditure was $30 (thousand) on the *y*-axis. This graph shows that as income rises, so does expenditure and the relationship is a close one.

The scatter diagram in part (b) shows a weak relationship between unemployment and inflation in the United States during most of the 2000s.

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Breaks in the Axes The graph in Fig. A1.4(a) has breaks in its axes, as shown by the small gaps. The breaks indicate that there are jumps from the origin, 0, to the first values recorded.

The breaks are used because the lowest values of income and expenditure exceed $20,000. If we made this graph with no breaks in its axes, there would be a lot of empty space, all the points would be crowded into the top right corner, and it would be difficult to see whether a relationship exists between these two variables. By breaking the axes, we are able to bring the relationship into view.

Putting a break in one or both axes is like using a zoom lens to bring the relationship into the center of the graph and magnify it so that the relationship fills the graph.

Misleading Graphs Breaks can be used to highlight a relationship, but they can also be used to mislead—to make a graph that lies. The most common way of making a graph lie is to put a break in the axis and either to stretch or compress the scale. For example, suppose that in Fig. A1.4(a), the *y*-axis that measures expenditure ran from zero to $35,000 while the *x*-axis was the same as the one shown. The graph would now create the impression that despite a huge increase in income, expenditure had barely changed.

To avoid being misled, it is a good idea to get into the habit of always looking closely at the values and the labels on the axes of a graph before you start to interpret it.

Correlation and Causation A scatter diagram that shows a clear relationship between two variables, such as Fig. A1.4(a), tells us that the two variables have a high correlation. When a high correlation is present, we can predict the value of one variable from the value of the other variable. But correlation does not imply causation.

Sometimes a high correlation is a coincidence, but sometimes it does arise from a causal relationship. It is likely, for example, that rising income causes rising expenditure (Fig. A1.4a) and that high unemployment makes for a slack economy in which prices don't rise quickly, so the inflation rate is low (Fig. A1.4b).

You've now seen how we can use graphs in economics to show economic data and to reveal relationships. Next, we'll learn how economists use graphs to construct and display economic models.

Graphs Used in Economic Models

The graphs used in economics are not always designed to show real-world data. Often they are used to show general relationships among the variables in an economic model.

An *economic model* is a stripped-down, simplified description of an economy or of a component of an economy such as a business or a household. It consists of statements about economic behavior that can be expressed as equations or as curves in a graph. Economists use models to explore the effects of different policies or other influences on the economy in ways that are similar to the use of model airplanes in wind tunnels and models of the climate.

You will encounter many different kinds of graphs in economic models, but there are some repeating patterns. Once you've learned to recognize these patterns, you will instantly understand the meaning of a graph. Here, we'll look at the different types of curves that are used in economic models, and we'll see some everyday examples of each type of curve. The patterns to look for in graphs are the four cases in which

- Variables move in the same direction.
- Variables move in opposite directions.
- Variables have a maximum or a minimum.
- Variables are unrelated.

Let's look at these four cases.

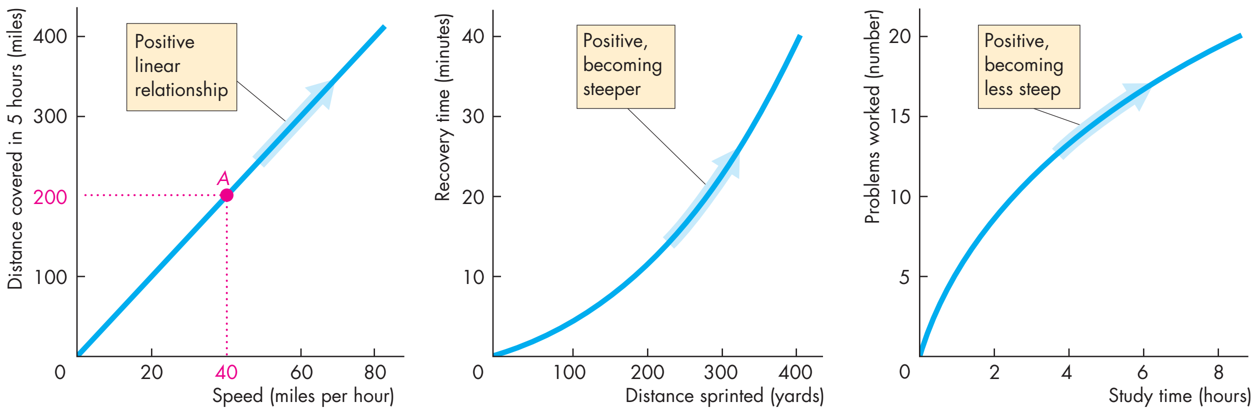
Variables That Move in the Same Direction

Figure A1.5 shows graphs of the relationships between two variables that move up and down together. A relationship between two variables that move in the same direction is called a **positive relationship** or a **direct relationship**. A line that slopes upward shows such a relationship.

Figure A1.5 shows three types of relationships: one that has a straight line and two that have curved lines. All the lines in these three graphs are called curves. Any line on a graph—no matter whether it is straight or curved—is called a *curve*.

A relationship shown by a straight line is called a **linear relationship**. Figure A1.5(a) shows a linear relationship between the number of miles traveled in

FIGURE A1.5 Positive (Direct) Relationships



(a) Positive linear relationship **(b) Positive, becoming steeper** **(c) Positive, becoming less steep**

Each part shows a positive (direct) relationship between two variables. That is, as the value of the variable measured on the *x*-axis increases, so does the value of the variable measured on the *y*-axis. Part (a) shows a linear positive relationship—as the two variables increase together, we move along a straight line.

Part (b) shows a positive relationship such that as the two variables increase together, we move along a curve that becomes steeper.

Part (c) shows a positive relationship such that as the two variables increase together, we move along a curve that becomes flatter.

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5 hours and speed. For example, point *A* shows that we will travel 200 miles in 5 hours if our speed is 40 miles an hour. If we double our speed to 80 miles an hour, we will travel 400 miles in 5 hours.

Figure A1.5(b) shows the relationship between distance sprinted and recovery time (the time it takes the heart rate to return to its normal resting rate). This relationship is an upward-sloping one that starts out quite flat but then becomes steeper as we move along the curve away from the origin. The reason this curve becomes steeper is that the additional recovery time needed from sprinting an additional 100 yards increases. It takes less than 5 minutes to recover from sprinting 100 yards but more than 10 minutes to recover from 200 yards.

Figure A1.5(c) shows the relationship between the number of problems worked by a student and the amount of study time. This relationship is an upward-sloping one that starts out quite steep and becomes flatter as we move along the curve away from the origin. Study time becomes less productive as the student spends more hours studying and becomes more tired.

Variables That Move in Opposite Directions

Figure A1.6 shows relationships between things that move in opposite directions. A relationship between variables that move in opposite directions is called a **negative relationship** or an **inverse relationship**.

Figure A1.6(a) shows the relationship between the hours spent playing squash and the hours spent playing tennis when the total time available is 5 hours. One extra hour spent playing tennis means one hour less spent playing squash and vice versa. This relationship is negative and linear.

Figure A1.6(b) shows the relationship between the cost per mile traveled and the length of a journey. The longer the journey, the lower is the cost per mile. But as the journey length increases, even though the cost per mile decreases, the fall in the cost is smaller the longer the journey. This feature of the relationship is shown by the fact that the curve slopes downward, starting out steep at a short journey length and then becoming flatter as the journey length increases. This relationship arises because some of the costs are fixed, such as auto insurance, and the fixed costs are spread over a longer journey.

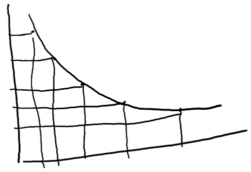
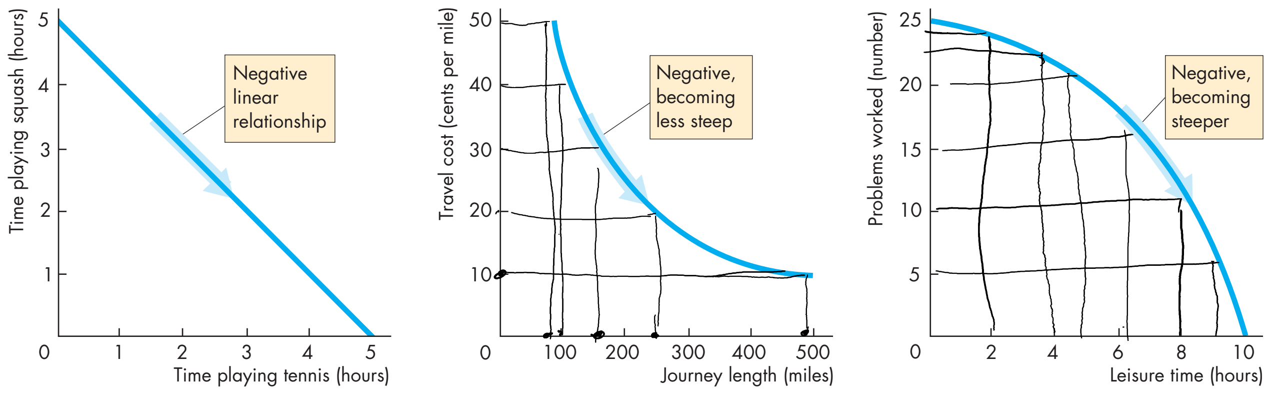


FIGURE A1.6 Negative (Inverse) Relationships



(a) Negative linear relationship **(b) Negative, becoming less steep** **(c) Negative, becoming steeper**

Each part shows a negative (inverse) relationship between two variables. Part (a) shows a linear negative relationship. The total time spent playing tennis and squash is 5 hours. As the time spent playing tennis increases, the time spent playing squash decreases, and we move along a straight line.

Part (b) shows a negative relationship such that as the journey length increases, the travel cost decreases as we move along a curve that becomes less steep.

Part (c) shows a negative relationship such that as leisure time increases, the number of problems worked decreases as we move along a curve that becomes steeper.

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Figure A1.6(c) shows the relationship between the amount of leisure time and the number of problems worked by a student. Increasing leisure time produces an increasingly large reduction in the number of problems worked. This relationship is a negative one that starts out with a gentle slope at a small number of leisure hours and becomes steeper as the number of leisure hours increases. This relationship is a different view of the idea shown in Fig. A1.5(c).

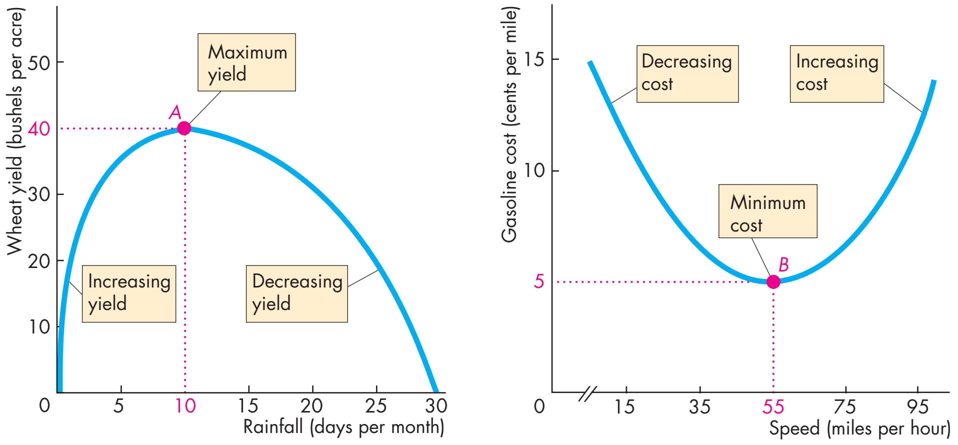
Variables That Have a Maximum or a Minimum

Many relationships in economic models have a maximum or a minimum. For example, firms try to make the maximum possible profit and to produce at the lowest possible cost. Figure A1.7 shows relationships that have a maximum or a minimum.

Figure A1.7(a) shows the relationship between rainfall and wheat yield. When there is no rainfall, wheat will not grow, so the yield is zero. As the rainfall increases up to 10 days a month, the wheat yield increases. With 10 rainy days each month, the wheat yield reaches its maximum at 40 bushels an acre (point *A*). Rain in excess of 10 days a month starts to lower the yield of wheat. If every day is rainy, the wheat suffers from a lack of sunshine and the yield decreases to zero. This relationship is one that starts out sloping upward, reaches a maximum, and then slopes downward.

Figure A1.7(b) shows the reverse case—a relationship that begins sloping downward, falls to a minimum, and then slopes upward. Most economic costs are like this relationship. An example is the relationship between the cost per mile and speed for a car trip. At low speeds, the car is creeping in a traffic snarl-up. The number of miles per gallon is low, so the cost per mile is high. At high speeds, the car is traveling faster than its efficient speed, using a large quantity of gasoline, and again the number of miles per gallon is low and the cost per mile is high. At a speed of 55 miles an hour, the cost per mile is at its minimum (point *B*). This relationship is one that starts out sloping downward, reaches a minimum, and then slopes upward.

FIGURE A1.7 Maximum and Minimum Points



(a) Relationship with a maximum

(b) Relationship with a minimum

Part (a) shows a relationship that has a maximum point, *A*. The curve slopes upward as it rises to its maximum point, is flat at its maximum, and then slopes downward.

Part (b) shows a relationship with a minimum point, *B*. The curve slopes downward as it falls to its minimum, is flat at its minimum, and then slopes upward.

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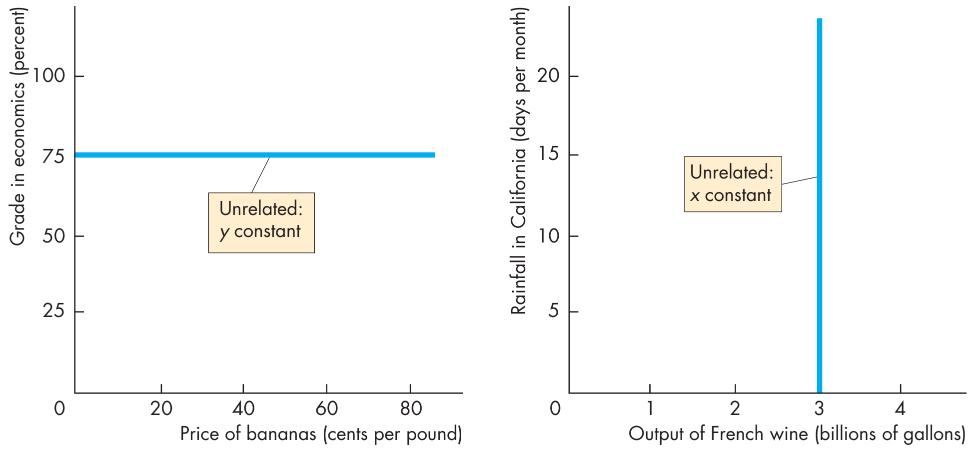
Variables That Are Unrelated

There are many situations in which no matter what happens to the value of one variable, the other variable remains constant. Sometimes we want to show the independence between two variables in a graph, and Fig. A1.8 shows two ways of achieving this.

In describing the graphs in Fig. A1.5 through Fig. A1.7, we have talked about curves that slope upward or slope downward, and curves that become less steep or steeper. Let's spend a little time discussing exactly what we mean by *slope* and how we measure the slope of a curve.

FIGURE A1.8 Variables That Are Unrelated



(a) Unrelated: *y* constant

(b) Unrelated: *x* constant

This figure shows how we can graph two variables that are unrelated. In part (a), a student's grade in economics is plotted at 75 percent on the *y*-axis regardless of the price of bananas on the *x*-axis. The curve is horizontal.

In part (b), the output of the vineyards of France on the *x*-axis does not vary with the rainfall in California on the *y*-axis. The curve is vertical.

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The Slope of a Relationship

We can measure the influence of one variable on another by the slope of the relationship. The **slope** of a relationship is the change in the value of the variable measured on the *y*-axis divided by the change in the value of the variable measured on the *x*-axis. We use the Greek letter Δ (*delta*) to represent "change in." Thus Δy means the change in the value of the variable measured on the *y*-axis, and Δx means the change in the value of the variable measured on the *x*-axis. Therefore the slope of the relationship is

$$\text{Slope} = \frac{\Delta y}{\Delta x}.$$

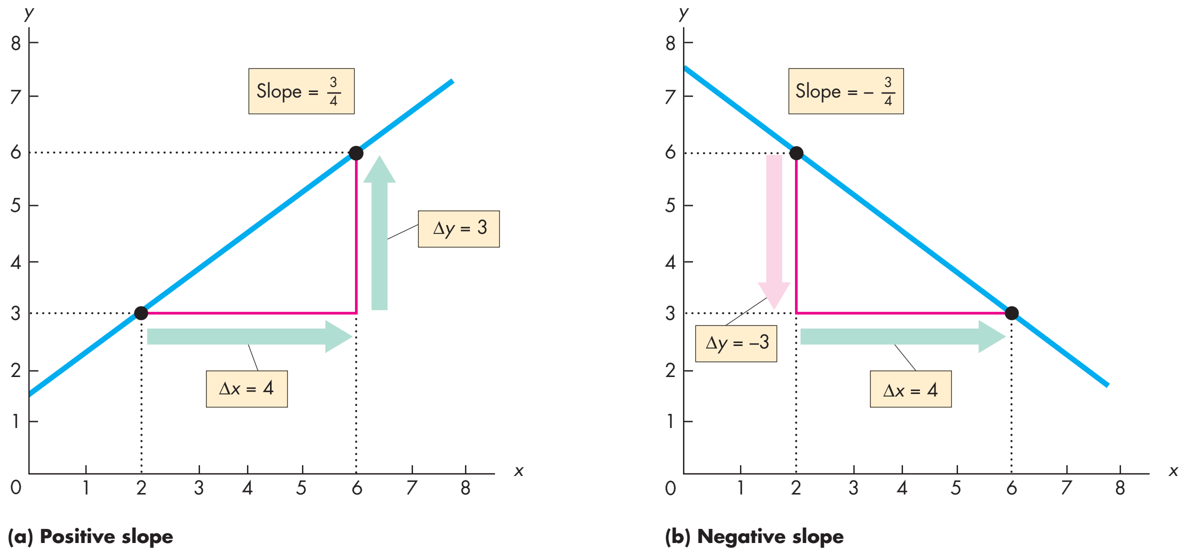
If a large change in the variable measured on the *y*-axis (Δy) is associated with a small change in the variable measured on the *x*-axis (Δx), the slope is large and the curve is steep. If a small change in the variable measured on the *y*-axis (Δy) is associated with a large change in the variable measured on the *x*-axis (Δx), the slope is small and the curve is flat.

We can make the idea of slope clearer by doing some calculations.

The Slope of a Straight Line

The slope of a straight line is the same regardless of where on the line you calculate it. The slope of a straight line is constant. Let's calculate the slope of the positive relationship in Fig. A1.9. In part (a),

FIGURE A1.9 The Slope of a Straight Line



To calculate the slope of a straight line, we divide the change in the value of the variable measured on the *y*-axis (Δy) by the change in the value of the variable measured on the *x*-axis (Δx) as we move along the line.

Part (a) shows the calculation of a positive slope. When *x* increases from 2 to 6, Δx equals 4. That change in *x* brings about an increase in *y* from 3 to 6, so Δy equals 3. The slope ($\Delta y/\Delta x$) equals 3/4.

Part (b) shows the calculation of a negative slope. When *x* increases from 2 to 6, Δx equals 4. That increase in *x* brings about a decrease in *y* from 6 to 3, so Δy equals –3. The slope ($\Delta y/\Delta x$) equals –3/4.

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when x increases from 2 to 6, y increases from 3 to 6. The change in x is +4—that is, Δx is 4. The change in y is +3—that is, Δy is 3. The slope of that line is

$$\frac{\Delta y}{\Delta x} = \frac{3}{4}.$$

In part (b), when x increases from 2 to 6, y decreases from 6 to 3. The change in y is *minus* 3—that is, Δy is –3. The change in x is *plus* 4—that is, Δx is 4. The slope of the curve is

$$\frac{\Delta y}{\Delta x} = \frac{-3}{4}.$$

Notice that the two slopes have the same magnitude (3/4), but the slope of the line in part (a) is positive (+3/+4 = 3/4) while that in part (b) is negative (–3/+4 = –3/4). The slope of a positive relationship is positive; the slope of a negative relationship is negative.

The Slope of a Curved Line

The slope of a curved line is trickier. The slope of a curved line is not constant, so the slope depends on where on the curved line we calculate it. There are two ways to calculate the slope of a curved line: You can calculate the slope at a point, or you can calculate the slope across an arc of the curve. Let's look at the two alternatives.

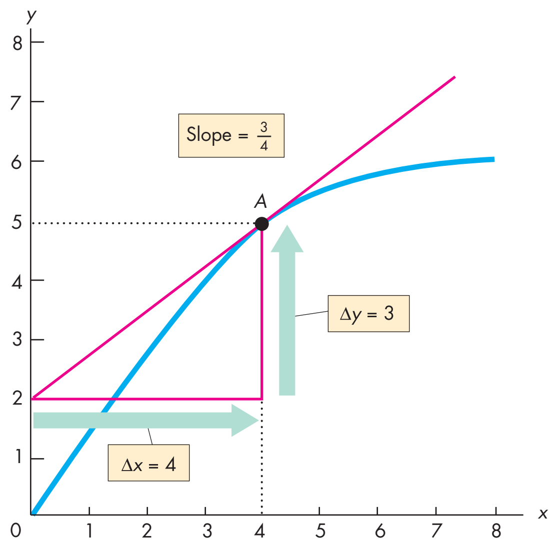
Slope at a Point To calculate the slope at a point on a curve, you need to construct a straight line that has the same slope as the curve at the point in question. Figure A1.10 shows how this is done. Suppose you want to calculate the slope of the curve at point A. Place a ruler on the graph so that the ruler touches point A and no other point on the curve, then draw a straight line along the edge of the ruler. The straight red line is this line, and it is the tangent to the curve at point A. If the ruler touches the curve only at point A, then the slope of the curve at point A must be the same as the slope of the edge of the ruler. If the curve and the ruler do not have the same slope, the line along the edge of the ruler will cut the curve instead of just touching it.

Now that you have found a straight line with the same slope as the curve at point A, you can calculate the slope of the curve at point A by calculating the slope of the straight line. Along the straight line, as x increases from 0 to 4 (Δx is 4) y increases from 2 to 5 (Δy is 3). Therefore the slope of the straight line is

$$\frac{\Delta y}{\Delta x} = \frac{3}{4}.$$

So the slope of the curve at point A is 3/4.

FIGURE A1.10 Slope at a Point



To calculate the slope of the curve at point A, draw the red line that just touches the curve at A—the tangent. The slope of this straight line is calculated by dividing the change in y by the change in x along the red line. When x increases from 0 to 4, Δx equals 4. That change in x is associated with an increase in y from 2 to 5, so Δy equals 3. The slope of the red line is 3/4, so the slope of the curve at point A is 3/4.

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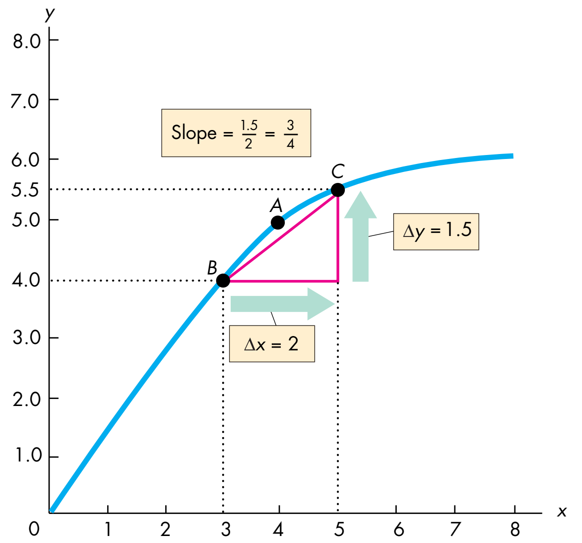
Slope Across an Arc An arc of a curve is a piece of a curve. Fig. A1.11shows the same curve as in Fig. A1.10, but instead of calculating the slope at point A, we are now going to calculate the slope across the arc from point B to point C. You can see that the slope of the curve at point B is greater than at point C. When we calculate the slope across an arc, we are calculating the average slope between two points. As we move along the arc from B to C, x increases from 3 to 5 and y increases from 4.0 to 5.5. The change in x is 2 (Δx is 2), and the change in y is 1.5 (Δy is 1.5).

FIGURE A1.11 Slope Across an Arc



To calculate the average slope of the curve along the arc *BC*, draw a straight line from point *B* to point *C*. The slope of the line *BC* is calculated by dividing the change in *y* by the change in *x*. In moving from *B* to *C*, the increase in x is 2 (Δx equals 2) and the change in y is 1.5 (Δy equals 1.5). The slope of the line *BC* is 1.5 divided by 2, or 3/4. So the slope of the curve across the arc *BC* is 3/4.

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Therefore the slope is

$$\frac{\Delta y}{\Delta x} = \frac{1.5}{2} = \frac{3}{4}.$$

So the slope of the curve across the arc *BC* is 3/4.

This calculation gives us the slope of the curve between points *B* and *C*. The actual slope calculated is the slope of the straight line from *B* to *C*. This slope approximates the average slope of the curve along the arc *BC*. In this particular example, the slope across the arc *BC* is identical to the slope of the curve at point *A*, but the calculation of the slope of a curve does not always work out so neatly. You might have fun constructing some more examples and a few counter examples.

You now know how to make and interpret a graph. So far, we've limited our attention to graphs of two variables. We're now going to learn how to graph more than two variables.

Graphing Relationships Among More Than Two Variables

We have seen that we can graph the relationship between two variables as a point formed by the *x*- and *y*-coordinates in a two-dimensional graph. You might be thinking that although a two-dimensional graph is informative, most of the things in which you are likely to be interested involve relationships among many variables, not just two. For example, the amount of ice cream consumed depends on the price of ice cream and the temperature. If ice cream is expensive and the temperature is low, people eat much less ice cream than when ice cream is inexpensive and the temperature is high. For any given price of ice cream, the quantity consumed varies with the temperature; and for any given temperature, the quantity of ice cream consumed varies with its price.

Figure A1.12 shows a relationship among three variables. The table shows the number of gallons of ice cream consumed each day at two different temperatures and at a number of different prices of ice cream. How can we graph these numbers?

To graph a relationship that involves more than two variables, we use the *ceteris paribus* assumption.

Ceteris Paribus

Ceteris paribus (often shortened to *cet par*) means "if all other relevant things remain the same." To isolate the relationship of interest in a laboratory experiment, a scientist holds everything constant except for the variable whose effect is being studied. Economists use the same method to graph a relationship that has more than two variables.

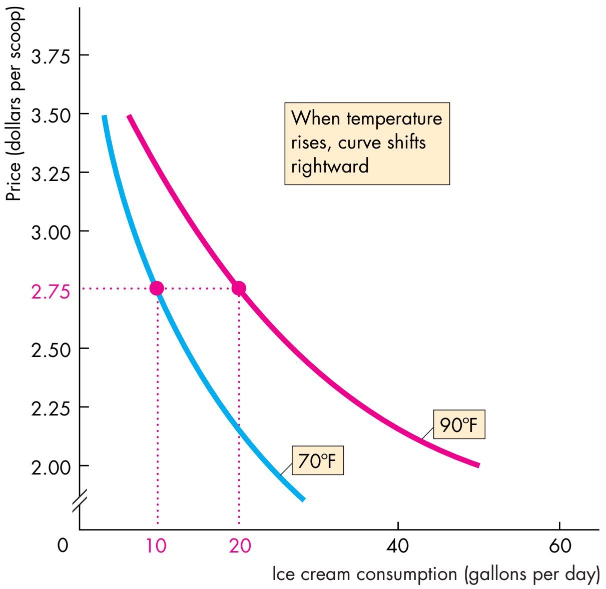
Figure A1.12 shows an example. There, you can see what happens to the quantity of ice cream consumed when the price of ice cream varies but the temperature is held constant.

The curve labeled 70°F shows the relationship between ice cream consumption and the price of ice cream if the temperature remains at 70°F. The numbers used to plot that curve are those in the first two columns of the table. For example, if the temperature is 70°F, 10 gallons are consumed when the price is \$2.75 a scoop and 18 gallons are consumed when the price is \$2.25 a scoop.

The curve labeled 90°F shows the relationship between ice cream consumption and the price of ice cream if the temperature remains at 90°F. The

FIGURE A1.12 Graphing a Relationship Among Three Variables

Price (dollars per scoop)	Ice cream consumption (gallons per day)	
	70°F	90°F
2.00	25	50
2.25	18	36
2.50	13	26
2.75	**10**	**20**
3.00	7	14
3.25	5	10
3.50	3	6



Ice cream consumption depends on its price and the temperature. The table tells us how many gallons of ice cream are consumed each day at different prices and two different temperatures. For example, if the price is $2.75 a scoop and the temperature is 70°F, 10 gallons of ice cream are consumed.

To graph a relationship among three variables, the value of one variable is held constant. The graph shows the relationship between price and consumption when temperature is held constant. One curve holds temperature at 70°F and the other holds it at 90°F.

A change in the price of ice cream brings a movement along one of the curves—along the blue curve at 70°F and along the red curve at 90°F.

When the temperature *rises* from 70°F to 90°F, the curve that shows the relationship between consumption and price *shifts* rightward from the blue curve to the red curve.

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numbers used to plot that curve are those in the first and third columns of the table. For example, if the temperature is 90°F, 20 gallons are consumed when the price is $2.75 a scoop and 36 gallons are consumed when the price is $2.25 a scoop.

When the price of ice cream changes but the temperature is constant, you can think of what happens in the graph as a movement along one of the curves. At 70°F there is a movement along the blue curve and at 90°F there is a movement along the red curve.

When Other Things Change

The temperature is held constant along each of the curves in Fig. A1.12, but in reality the temperature changes. When that event occurs, you can think of what happens in the graph as a shift of the curve. When the temperature rises from 70°F to 90°F, the curve that shows the relationship between ice cream consumption and the price of ice cream shifts rightward from the blue curve to the red curve.

You will encounter these ideas of movements along and shifts of curves at many points in your study of economics. Think carefully about what you've just learned and make up some examples (with assumed numbers) about other relationships.

With what you have learned about graphs, you can move forward with your study of economics. There are no graphs in this book that are more complicated than those that have been explained in this appendix.

MATHEMATICAL NOTE

Equations of Straight Lines

If a straight line in a graph describes the relationship between two variables, we call it a linear relationship. Figure 1 shows the *linear relationship* between a person's expenditure and income. This person spends \$100 a week (by borrowing or spending previous savings) when income is zero. Out of each dollar earned, this person spends 50 cents (and saves 50 cents).

All linear relationships are described by the same general equation. We call the quantity that is measured on the horizontal axis (or x-axis) x, and we call the quantity that is measured on the vertical axis (or y-axis) y. In the case of Fig. 1, x is income and y is expenditure.

A Linear Equation

The equation that describes a straight-line relationship between x and y is

$$y = a + bx.$$

In this equation, a and b are fixed numbers and they are called *constants*. The values of x and y vary, so these numbers are called *variables*. Because the equation describes a straight line, the equation is called a *linear equation.*

The equation tells us that when the value of x is zero, the value of y is a. We call the constant a the y-axis intercept. The reason is that on the graph the straight line hits the y-axis at a value equal to a. Figure 1 illustrates the y-axis intercept.

For positive values of x, the value of y exceeds a. The constant b tells us by how much y increases above a as x increases. The constant b is the slope of the line.

Slope of Line

As we explain in the chapter, the *slope* of a relationship is the change in the value of y divided by the change in the value of x. We use the Greek letter Δ (delta) to represent "change in." So Δy means the change in the value of the variable measured on the y-axis, and Δx means the change in the value of the variable measured on the x-axis. Therefore the slope of the relationship is

$$\text{Slope} = \frac{\Delta y}{\Delta x}$$

To see why the slope is b, suppose that initially the value of x is x_1, or \$200 in Fig. 2. The corresponding value of y is y_1, also \$200 in Fig. 2. The equation of the line tells us that

$$y_1 = a + bx_1. \quad (1)$$

Now the value of x increases by Δx to $x_1 + \Delta x$ (or \$400 in Fig. 2). And the value of y increases by Δy to $y_1 + \Delta y$ (or \$300 in Fig. 2).

The equation of the line now tells us that

$$y_1 + \Delta y = a + b(x_1 + \Delta x). \quad (2)$$

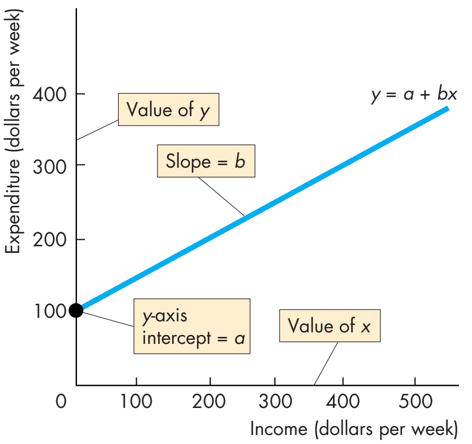


Figure 1 Linear relationship

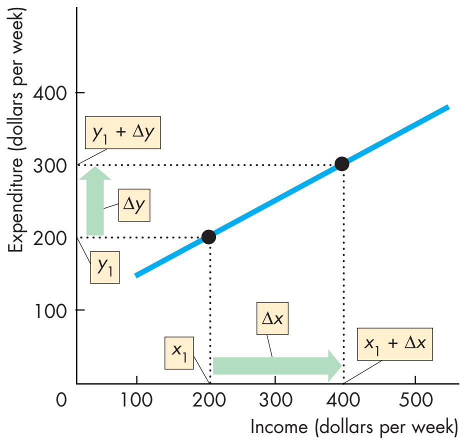


Figure 2 Calculating slope

To calculate the slope of the line, subtract equation (1) from equation (2) to obtain

$$\Delta y = b\Delta x \qquad (3)$$

and now divide equation (3) by Δx to obtain

$$\Delta y/\Delta x = b.$$

So the slope of the line is b.

Position of Line

The y-axis intercept determines the position of the line on the graph. Figure 3 illustrates the relationship between the y-axis intercept and the position of the line. In this graph, the y-axis measures saving and the x-axis measures income.

When the y-axis intercept, a, is positive, the line hits the y-axis at a positive value of y—as the blue line does. Its y-axis intercept is 100. When the y-axis intercept, a, is zero, the line hits the y-axis at the origin—as the purple line does. Its y-axis intercept is 0. When the y-axis intercept, a, is negative, the line hits the y-axis at a negative value of y—as the red line does. Its y-axis intercept is –100.

As the equations of the three lines show, the value of the y-axis intercept does not influence the slope of the line. All three lines have a slope equal to 0.5.

Positive Relationships

Figure 1 shows a positive relationship—the two variables x and y move in the same direction. All positive relationships have a slope that is positive. In the equation of the line, the constant b is positive. In this example, the y-axis intercept, a, is 100. The slope b equals $\Delta y/\Delta x$, which in Fig. 2 is 100/200 or 0.5. The equation of the line is

$$y = 100 + 0.5x.$$

Negative Relationships

Figure 4 shows a negative relationship—the two variables x and y move in the opposite direction. All negative relationships have a slope that is negative. In the equation of the line, the constant b is negative. In the example in Fig. 4, the y-axis intercept, a, is 30. The slope, b, equals $\Delta y/\Delta x$, which is –20/2 or –10. The equation of the line is

$$y = 30 + (-10)x$$

or

$$y = 30 - 10x.$$

Example

A straight line has a y-axis intercept of 50 and a slope of 2. What is the equation of this line?
The equation of a straight line is

$$y = a + bx$$

where a is the y-axis intercept and b is the slope.
So the equation is

$$y = 50 + 2x.$$

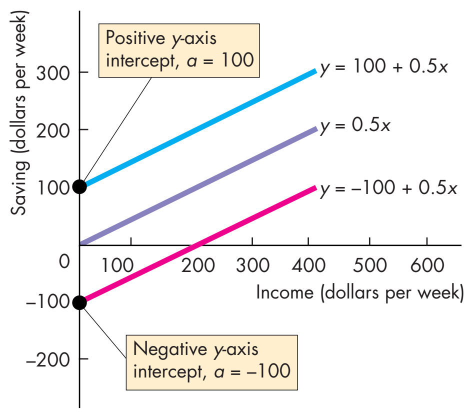


Figure 3 The *y*-axis intercept

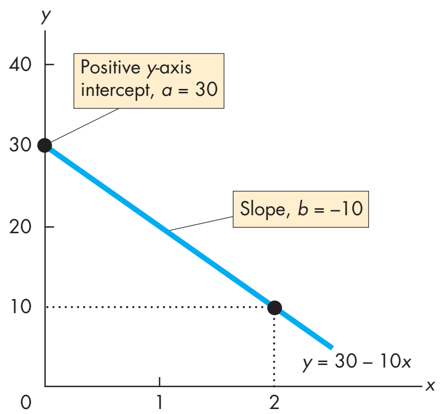


Figure 4 Negative relationship

REVIEW QUIZ

1. Explain how we "read" the three graphs in Figs A1.1 and A1.2.
2. Explain what scatter diagrams show and why we use them.
3. Explain how we "read" the three scatter diagrams in Figs A1.3 and A1.4.
4. Draw a graph to show the relationship between two variables that move in the same direction.
5. Draw a graph to show the relationship between two variables that move in opposite directions.
6. Draw a graph to show the relationship between two variables that have a maximum and a minimum.
7. Which of the relationships in Questions 4 and 5 is a positive relationship and which is a negative relationship?
8. What are the two ways of calculating the slope of a curved line?
9. How do we graph a relationship among more than two variables?
10. Explain what change will bring a *movement along* a curve.
11. Explain what change will bring a *shift* of a curve.

You can work these questions in Study Plan 1.A and get instant feedback. myeconlab

SUMMARY

Key Points

Graphing Data (pp. 13–16)

- A graph is made by plotting the values of two variables *x* and *y* at a point that corresponds to their values measured along the *x*-axis and the *y*-axis.
- A scatter diagram is a graph that plots the values of two variables for a number of different values of each.
- A scatter diagram shows the relationship between the two variables. It shows whether they are positively related, negatively related, or unrelated.

Graphs Used in Economic Models (pp. 16–19)

- Graphs are used to show relationships among variables in economic models.
- Relationships can be positive (an upward-sloping curve), negative (a downward-sloping curve), positive and then negative (have a maximum point), negative and then positive (have a minimum point), or unrelated (a horizontal or vertical curve).

The Slope of a Relationship (pp. 20–22)

- The slope of a relationship is calculated as the change in the value of the variable measured on the *y*-axis divided by the change in the value of the variable measured on the *x*-axis—that is, $\Delta y/\Delta x$.
- A straight line has a constant slope.
- A curved line has a varying slope. To calculate the slope of a curved line, we calculate the slope at a point or across an arc.

Graphing Relationships Among More Than Two Variables (pp. 22–23)

- To graph a relationship among more than two variables, we hold constant the values of all the variables except two.
- We then plot the value of one of the variables against the value of another.
- A *cet par* change in the value of a variable on an axis of a graph brings a movement along the curve.
- A change in the value of a variable held constant along the curve brings a shift of the curve.

Key Terms

Ceteris paribus, 22
Direct relationship, 16
Inverse relationship, 17
Linear relationship, 16
Negative relationship, 17
Positive relationship, 16
Scatter diagram, 14
Slope, 20

STUDY PLAN PROBLEMS AND APPLICATIONS

myeconlab You can work Problems 1 to 11 in MyEconLab Chapter 1A Study Plan and get instant feedback.

Use the following spreadsheet to work Problems 1 to 3. The spreadsheet provides data on the U.S. economy: Column A is the year, column B is the inflation rate, column C is the interest rate, column D is the growth rate, and column E is the unemployment rate.

	A	B	C	D	E
1	1999	2.2	4.6	4.8	4.2
2	2000	3.4	5.8	4.1	4.0
3	2001	2.8	3.4	1.1	4.7
4	2002	1.6	1.6	1.8	5.8
5	2003	2.3	1.0	2.5	6.0
6	2004	2.7	1.4	3.6	5.5
7	2005	3.4	3.2	3.1	5.1
8	2006	3.2	4.7	2.7	4.6
9	2007	2.8	4.4	2.1	4.6
10	2008	3.8	1.4	0.4	5.8
11	2009	–0.4	0.2	–2.4	9.3

1. Draw a scatter diagram of the inflation rate and the interest rate. Describe the relationship.
2. Draw a scatter diagram of the growth rate and the unemployment rate. Describe the relationship.
3. Draw a scatter diagram of the interest rate and the unemployment rate. Describe the relationship.

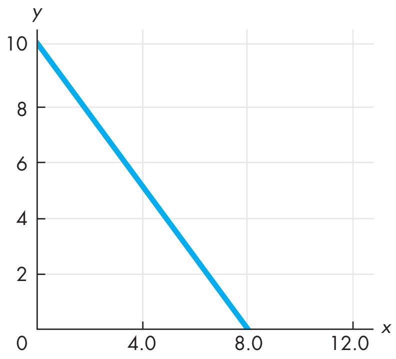
Use the following news clip to work Problems 4 to 6.

***Clash of the Titans* Tops Box Office With Sales of $61.2 Million:**

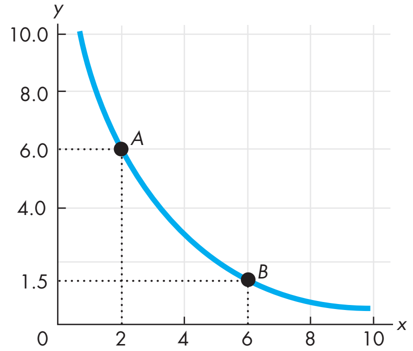
Movie	Theaters (number)	Revenue (dollars per theater)
Clash of the Titans	3,777	16,213
Tyler Perry's Why Did I Get Married	2,155	13,591
How To Train Your Dragon	4,060	7,145
The Last Song	2,673	5,989

Source: Bloomberg.com, April 5, 2010

4. Draw a graph of the relationship between the revenue per theater on the y-axis and the number of theaters on the x-axis. Describe the relationship.
5. Calculate the slope of the relationship between 4,060 and 2,673 theaters.
6. Calculate the slope of the relationship between 2,155 and 4,060 theaters.
7. Calculate the slope of the following relationship.



Use the following relationship to work Problems 8 and 9.



8. Calculate the slope of the relationship at point A and at point B.
9. Calculate the slope across the arc AB.

Use the following table to work Problems 10 and 11. The table gives the price of a balloon ride, the temperature, and the number of rides a day.

Price (dollars per ride)	Balloon rides (number per day)		
	50°F	70°F	90°F
5	32	40	50
10	27	32	40
15	18	27	32

10. Draw a graph to show the relationship between the price and the number of rides, when the temperature is 70°F. Describe this relationship.
11. What happens in the graph in Problem 10 if the temperature rises to 90°F?

ADDITIONAL ASSIGNABLE PROBLEMS AND APPLICATIONS

myeconlab You can work these problems in MyEconLab if assigned by your instructor.

Use the following spreadsheet to work Problems 12 to 14. The spreadsheet provides data on oil and gasoline: Column A is the year, column B is the price of oil (dollars per barrel), column C is the price of gasoline (cents per gallon), column D is U.S. oil production, and column E is the U.S. quantity of gasoline refined (both in millions of barrels per day).

	A	B	C	D	E
1	1999	24	118	5.9	8.1
2	2000	30	152	5.8	8.2
3	2001	17	146	5.8	8.3
4	2002	24	139	5.7	8.4
5	2003	27	160	5.7	8.5
6	2004	37	190	5.4	8.7
7	2005	49	231	5.2	8.7
8	2006	56	262	5.1	8.9
9	2007	86	284	5.1	9.0
10	2008	43	330	5.0	8.9
11	2009	76	241	4.9	8.9

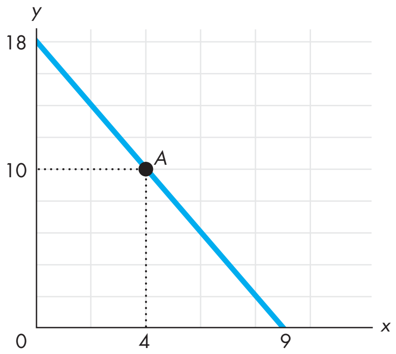
12. Draw a scatter diagram of the price of oil and the quantity of U.S. oil produced. Describe the relationship.
13. Draw a scatter diagram of the price of gasoline and the quantity of gasoline refined. Describe the relationship.
14. Draw a scatter diagram of the quantity of U.S. oil produced and the quantity of gasoline refined. Describe the relationship.

Use the following data to work Problems 15 to 17.

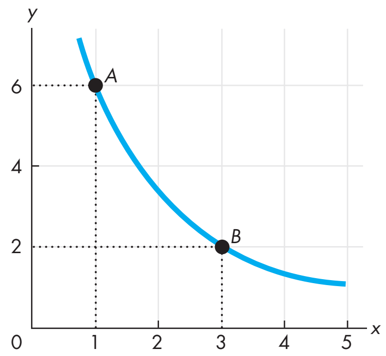
Draw a graph that shows the relationship between the two variables *x* and *y*:

x	0	1	2	3	4	5
y	25	24	22	18	12	0

15. a. Is the relationship positive or negative?
    b. Does the slope of the relationship become steeper or flatter as the value of *x* increases?
    c. Think of some economic relationships that might be similar to this one.
16. Calculate the slope of the relationship between x and y when x equals 3.
17. Calculate the slope of the relationship across the arc as x increases from 4 to 5.
18. Calculate the slope of the curve at point A.



Use the following relationship to work Problems 19 and 20.



19. Calculate the slope at point A and at point B.
20. Calculate the slope across the arc *AB*.

Use the following table to work Problems 21 to 23. The table gives information about umbrellas: price, the number purchased, and rainfall in inches.

Price (dollars per umbrella)	Umbrellas (number purchased per day)		
	0 inches	1 inch	2 inches
20	4	7	8
30	2	4	7
40	1	2	4

21. Draw a graph to show the relationship between the price and the number of umbrellas purchased, holding the amount of rainfall constant at 1 inch. Describe this relationship.
22. What happens in the graph in Problem 21 if the price rises and rainfall is constant?
23. What happens in the graph in Problem 21 if the rainfall increases from 1 inch to 2 inches?