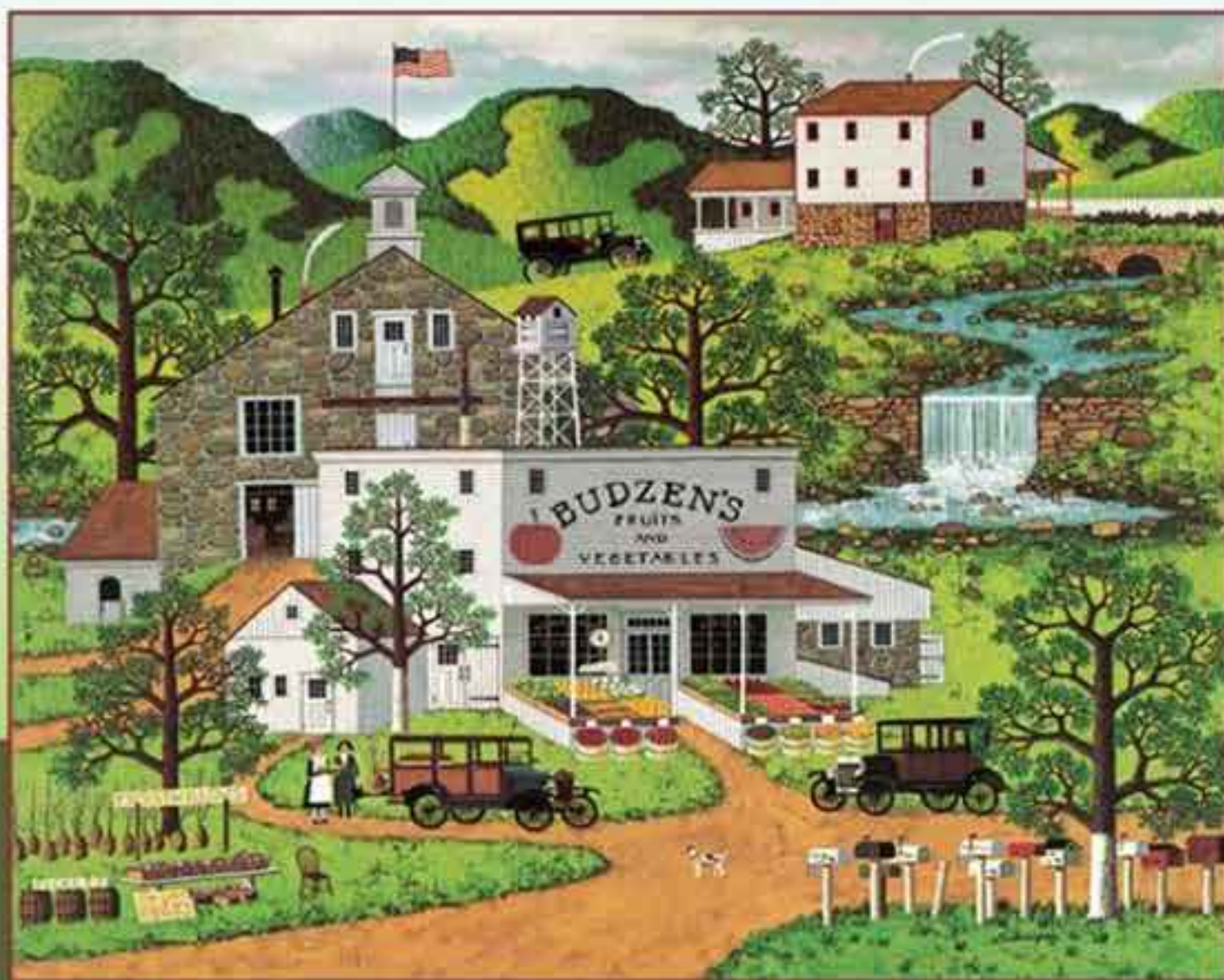NINTH EDITION

PRICE THEORY
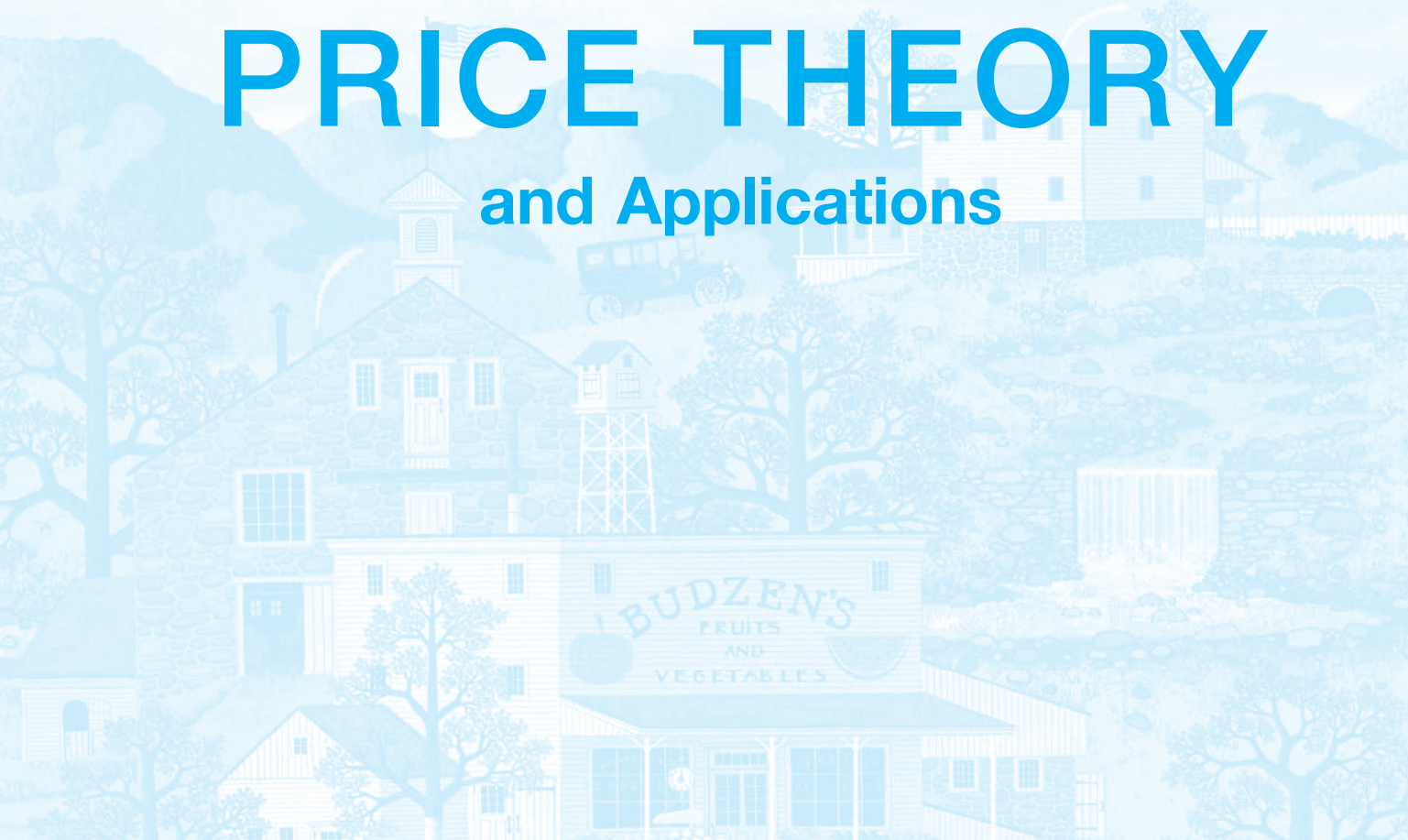## AND APPLICATIONS

STEVEN E. LANDSBURG

PRICE THEORY

and Applications

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and Applications

NINTH EDITION

Steven E. Landsburg

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About the Author

Steven E. Landsburg is a Professor of Economics at the University of Rochester. His articles have appeared in the *Journal of Political Economy*, the *Journal of Economic Theory*, and many other journals of economics, mathematics, and philosophy. He is the author of six books, including *More Sex Is Safer Sex: The Unconventional Wisdom of Economics* (Free Press/Simon and Schuster 2006) and * *The Big Questions: Tackling the Problems of Philosophy with Ideas from Mathematics, Economics and Physics* (Free Press/Simon and Schuster 2009). He has written regularly for *Slate* magazine and *Forbes*, and occasionally for the *New York Times*, the *Washington Post*, *The Wall Street Journal*, and dozens of other publications. He blogs regularly at www.ThebigQuestions.com/blog.

Dedication:
To the Red-Headed Snippet

Brief Contents

Contents

Preface

To the Student

Price theory is a challenging and rewarding subject. The student who masters price theory acquires a powerful tool for understanding a remarkable range of social phenomena. How does a sales tax affect the price of coffee? Why do people trade? What happens to ticket prices when a baseball player gets a raise? How does free agency affect the allocation of baseball players to teams? Why might the revenue of orange growers increase when there is an unexpected frost—and what may we infer about the existence of monopoly power if it does?

Price theory teaches you how to solve similar puzzles. Better yet, it poses new ones. You will learn to be intrigued by phenomena you might previously have considered unremarkable. When rock concerts predictably sell out in advance, why don't the promoters raise prices? Why are bank buildings fancier than supermarkets? Why do ski resorts sell lift tickets on a per-day basis rather than a per-ride basis?

Throughout this book, such questions are used to motivate a careful and rigorous development of microeconomic theory. New concepts are immediately illustrated with entertaining and informative examples, both verbal and numerical. Ideas and techniques are allowed to arise naturally in the discussion, and they are given names (like "marginal value") only after you have discovered their usefulness. You are encouraged to develop a strong economic intuition and then to test your intuition by submitting it to rigorous graphical and verbal analysis.

I think that you will find this book inviting. There are neither mathematical demands nor prerequisites and no lists of axioms to memorize. At the same time, the level of economic rigor and sophistication is quite high. In many cases, I have carried analysis beyond what is found in most other books at this level. There are digressions, examples, and especially problems that will challenge even the most ambitious and talented students.

Using This Book

This is a book about how the world works. When you finish the first chapter, you will know how to analyze the effects of sales and excise taxes, and you will have discovered the surprising result that a tax on buyers and a tax on sellers have exactly the same effects. When you finish the second chapter, you will understand why oranges, on average, taste better in New York than in Florida. In each succeeding chapter, you will be exposed to new ideas in economics and to their surprising consequences for the world around you.

To learn what price theory is, dig in and begin reading. The next few paragraphs give you a hint of what it's all about.

Price theory, or *microeconomics*, is the study of the ways in which individuals and firms make choices, and the ways in which these choices interact with each other. We assume that individuals have certain well-defined preferences and limits to their behavior. For example, you might enjoy eating both cake and ice cream, but the size

of your stomach limits your ability to pursue these pleasures; moreover, the amount of cake that you eat affects the amount of ice cream you can eat, and vice versa.

In predicting behavior, we assume that individuals behave *rationally*, which is to say that they make themselves as well-off as possible, as measured by their own preferences, and within the limitations imposed on them. While this assumption (like any assumption in any science) is only an approximation to reality, it is an extraordinarily powerful one, and it leads to many profound and surprising conclusions.

Price theory is made richer by the fact that each individual's choices can affect the opportunities available to others. If you decide to eat all of the cake, your roommate cannot decide to eat some too. An *equilibrium* is an outcome in which each person's behavior is compatible with the restrictions imposed by everybody else's behavior. In many situations, it is possible to say both that there is only one possible equilibrium and that there are good reasons to expect that equilibrium to actually come about. This enables the economist to make predictions about the world.

Thus, price theory is most often concerned with two sorts of questions: those that are positive and those that are normative. A positive question is a question about what *is* or *will be*, whereas a normative question is a question about what *ought to be*. Positive questions have definite, correct answers (which may or may not be known), whereas the answers to normative questions depend on values.

For example, suppose that a law is proposed that would prohibit any bank from foreclosing on any farmer's mortgage. Some positive questions are as follows: How will this law affect the incomes of bankers? How will it affect the incomes of farmers? What effect will it have on the number of people who decide to become farmers and on the number of people who decide to start banks? Will it indirectly affect the average size of farms or of banks? Will it indirectly affect the price of land? How will it affect the price of food and the well-being of people who are neither farmers nor bankers? and so forth. The following is a normative question: Is this law, on balance, a good thing?

Economics can, at least in principle, provide answers to the positive questions. Economics by itself can never answer a normative question; in this case your answer to the normative question must depend on how you feel about the relative merits of helping farmers and helping bankers.

Therefore, we will be concerned in this book primarily with positive questions. However, price theory is relevant in the consideration of normative questions as well. This is so in two ways. First, even if you are quite sure of your own values, it is often impossible to decide whether you consider some course of action desirable unless you know its consequences. Your decision about whether to support the anti-foreclosure law will depend not only on your feelings about farmers and bankers, but also on what effects you believe the law will have. Thus, it can be important to study positive questions even when the questions of ultimate interest are normative ones.

For another example, suppose that you have decided to start recycling newspapers to help preserve large forests. One of your friends tells you that in fact recycling leads to *smaller* forests because it lowers the demand for trees and induces paper companies to do less planting. Whether or not your friend is correct is a positive question. You might want the answer to that positive question before returning to the normative question: Should I continue to recycle?

The second way in which price theory can assist us in thinking about normative questions is by showing us the consequences of consistently applying a given normative criterion. For example, if your criterion is "I am always for anything that will benefit farmers, provided that it does not drive any bankers out of business," the

price theorist might be able to respond, "In that case, you must support such-and-such law, because I can use economic reasoning to show that such-and-such law will indeed benefit farmers without driving any bankers out of business." If such-and-such law does not sound like a good idea to you, you might want to rethink your normative criterion.

In the first seven chapters of this book, you will receive a thorough grounding in the positive aspects of price theory. You will learn how consumers make decisions, how firms make decisions, and how these decisions interact in the competitive marketplace. In Chapter 8, you will examine the desirability of these outcomes from the viewpoints of various normative criteria. Chapter 9 rounds out the discussion of the competitive price system by examining the role of prices as conveyors of information. In Chapters 10 through 14, you will learn about various situations in which the competitive model does not fully apply. These include conditions of monopoly and oligopoly, and circumstances in which the activities of one person or firm affect others involuntarily (e.g., factories create pollution that their neighbors must breathe).

The first 14 chapters complete the discussion of the market for goods, which are supplied by firms and purchased by individuals. In Chapters 15 through 17 you will learn about the other side of the economy: the market for inputs to the production process (such as labor) that are supplied by individuals and purchased by firms. In Chapter 17, you will study the market for the productive input called *capital* and examine the way that individuals allocate goods across time, consuming less on one day so that they can consume more on another.

Chapter 18 concerns a special topic: the role of risk.

Chapter 19 provides an overview of what economics in general, and price theory in particular, is all about. Most of the discussion in that final chapter could have been included here. However, we believe that the discussion will be more meaningful *after* you have seen some examples of price theory in action, rather than before. Therefore, we make the following suggestion: Dip into Chapter 19. Not all of it will make sense at this point, but much of it will. After you have been through a few chapters of the book, dip into Chapter 19 again. Even the parts you understood the first time will be more meaningful now. Later on—say, after you have finished Chapter 7—try it yet again. You will get the most from the final chapter if you read it one last time, thoroughly, at the end of the course.

Features

This book provides many tools to help you learn. Here are a few hints on how to use them.

Exhibits

Most of the exhibits have extensive explanatory captions that summarize key points from the discussion in the text.

Exercises

Exercises are sprinkled throughout the text. They are intended to slow you down and make sure that you understand one paragraph before going on to the next. If you cannot do an exercise quickly and accurately, you have probably missed an important point. In that case, it is wise to pause and reread the preceding few

paragraphs. Answers to all of the exercises are provided in Appendix B at the back of the book.

Dangerous Curves

The dangerous curve symbol appears periodically to warn you against the most common misunderstandings. Passages marked with this symbol describe mistakes that students and theorists often make and explain how to avoid them.

Marginal Glossary

Each new term is defined in bold in the text and in the margin, where you can easily find it. All of the definitions in the margin glossary are gathered in alphabetical order in the Glossary at the back of the book.

Chapter Summaries

The summaries at the end of each chapter provide concise descriptions of the main ideas. You will find them useful in organizing your study.

Blog Tie-ins

I blog regularly at www.TheBigQuestions.com/blog, often on topics related to the material in this textbook. Perusing that blog is one good way to find additional applications of the course material. Of course there are many other excellent economics blogs on the Internet. Two other blogs that frequently cover material related to this book are at gregmankiw.blogspot.com and www.econlog.econlib.org

Review Questions

The Review Questions at the end of each chapter test to see whether you have learned and can repeat the main ideas of the chapter.

Numerical Exercises

About half of the chapters have Numerical Exercises at the end. By working these, you apply economic theory to data to make precise predictions. For example, at the end of Chapter 7, you are given some information about the costs of producing kites and the demand for kites. Using this and the theory that you have learned, you will be able to deduce the price of kites, the number of kites sold by each firm, and the number of firms in the industry.

Problem Sets

The extensive Problem Sets at the end of each chapter occupy a wide range of difficulty. Some are quite straightforward. Others are challenging and open-ended and give you the opportunity to think deeply and creatively. Often, problems require additional assumptions that are not explicitly stated. Learning to make additional assumptions is a large part of learning to do economics. In some cases there will be more than one correct answer, depending on what assumptions you made. Thus, in answering problems you should always spell out your reasoning very carefully. This

is particularly important in "true or false" problems, where the quality of your explanations will usually matter far more than your conclusion.

About one third of the problems are discussed in Appendix C at the end of the book. These problems are indicated by a shaded box around the problem number. The discussions in Appendix C range from hints to complete answers. In many cases, the answer section lists only conclusions without the reasoning necessary to support them; your instructor will probably require you to provide that reasoning.

If your instructor allows it, you will learn a lot by working on problems together with your classmates. You may find that you and they have different answers to the same problem, and that both you and they are equally sure of your answers. In attempting to convince each other, and in trying to pinpoint the spot at which your thinking diverged, you will be forced to clarify your ideas and you will discover which concepts you need to study further. Now, you are ready to begin.

To the Instructor

One advantage of teaching the same course every semester is that you constantly discover new ways to help students understand and enjoy the subject. I've taught price theory 50 times now, and am eager to share the best of my recent discoveries.

The eighth edition of this book, like the seven that preceded it, was well received by both students and instructors. I've therefore continued to preserve the book's basic structure and the many features that have been recognized as highlights—the clarity of the writing, the careful pedagogy (including "Dangerous Curve" signals to warn students of common misunderstandings), the lively examples, and the wide range of exercises and problems.

At the same time, I've continued my practice of rewriting several sections for even greater clarity. In this edition, the biggest changes have come in Chapter 3, on indifference curves, and in Chapter 8, on welfare economics. In both cases, much of the core material has been (I think) substantially improved. The applications near the end of Chapter 3 (including optimal taxation and revealed preference) are now broken down into bite-sized pieces that I expect will be easier for students to digest. In Chapter 8, among many other innovations, I've highlighted four different ways of thinking about deadweight loss (FIRST as the excess of losses to losers over gains to winners, SECOND as the social value of forgone production, THIRD as the margin of victory in an election between policy choices in which voters are granted numbers of votes proportional to their stakes in the outcome, AND FOURTH as measures of forgone opportunities for Pareto improvements). Of course each of these four notions serves to reinforce the others. In Chapter 9 (on knowledge and information), I've replaced a somewhat dated example about alternative energy sources with a more contemporary discussion of the local foods movement. The antitrust section in Chapter 11 now contains a discussion of the dispute between Apple and Amazon, which serves to illustrate several concepts at once—including resale price maintenance and implicit collusion. Of course many other examples have been updated throughout the book; Polaroid cameras have been replaced by Amazon Kindles. And individual sections and paragraphs have been tightened up (or in some cases expanded with additional examples) throughout.

But I'll repeat here what I said in the previous edition: While I am very pleased with these improvements and innovations, I have not tampered with the fundamental structure and content of the book, which I expect will be as satisfactory to the next generation of students as it was to the previous. The standard topics of intermediate price theory are covered in this edition, and in the previous versions. I have retained all of the book's unique features, of which the following are the most important.

Use of Social Welfare as a Unifying Concept

Consumers' and producers' surplus are introduced in Chapter 8, immediately following the theory of the competitive. There they are used to analyze the effects of various forms of market interference. Thereafter, most new concepts are related to social welfare and analyzed in this light.

The Economics of Information

Chapter 9 (Knowledge and Information) surveys the key role of prices in disseminating information and relates this to their key role in equilibrating markets. Section 9.1 emphasizes the price system's remarkable success in this regard while Section 9.3 surveys some of its equally remarkable failures. Section 9.2 studies information in financial markets.

Treatment of Theory of the Firm

It is often difficult for students to understand the importance of production functions, average cost curves, and the like until after they have been asked to study them for several weeks. To remedy this, Chapter 5 (The Behavior of Firms) provides an overview of how firms make decisions, introducing the general principle of equating marginal costs with marginal benefits and relating this principle back to the consumer theory that the student has just learned.

Having seen the importance of cost curves, students may be more motivated to study their derivation in Chapter 6 (Production and Costs). The material on firms is presented in a manner that gives a lot of flexibility to the instructor. Those who prefer the more traditional approach of starting immediately with production can easily skip Chapter 5 or postpone it until after Chapter 6. Chapter 6 itself has been organized to rigorously separate the short-run theory (in Section 6.1) from the long-run theory (in Section 6.2). Relations between the short and the long run are thoroughly explored in Section 6.3. Instructors who want to defer the more difficult topic of long-run production will find it easy to simply cover Section 6.1 and then move directly on to Chapter 7.

Extended Analysis of Market Failures, Property Rights, and Rules of Law

This is the material of Chapter 13, which I have found to be very popular with students. The theory of externalities is developed in great detail, using a series of extended examples and illustrated with actual court cases. Section 13.4 (The Law and Economics) analyzes various legal theories from the point of view of economic efficiency.

Relationships to Macroeconomics

The topic coverage provides a solid preparation for a rigorous course in macroeconomics. In addition, several purely "micro" topics are illustrated with "macro" applications. (None of these applications is central to the book, and all can be skipped easily by instructors who wish to do so.) There are sections on information, intertemporal decision making, labor markets in general equilibrium, and rational expectations. In the chapter on interest rates, there is a purely microeconomic analysis of the effects of federal deficits, including Ricardian Equivalence, the hypotheses necessary for it to hold, and the consequences of relaxing these hypotheses. (This material has been extensively rewritten and simplified for this edition.) The section on rational expectations, in Chapter 18, is presented in the context of a purely micro problem, involving agricultural prices, but it includes a discussion of "why economists make wrong predictions" with a moral that applies to macroeconomics.

Other Nontraditional Topics

There are extensive sections devoted to topics excluded from many standard intermediate textbooks. Among these are alternative normative criteria, efficient asset markets, contestable markets, antitrust law, mechanisms for eliciting private information about the demand for public goods, human capital (including the external effects of human capital accumulation), the role of increasing returns in economic growth, the Capital Asset Pricing Model, and the pricing of stock options. The book concludes with a chapter on the methods and scope of economic analysis (titled What Is Economics?), with examples drawn from biology, sociology, and history.

Supplements

The *Instructor's Manual* contains the following features in each chapter: general discussion, teaching suggestions, suggested additional problems, and solutions to all of the end-of-chapter problems in the textbook. The *Manual* can be downloaded by instructors from the text Web site.

The *Test Bank*, prepared by Brett Katzman, Kennesaw State University, Kennesaw, GA, offers true/false questions, multiple-choice questions, and essay questions for each chapter. It has been significantly expanded for this edition.

The *Study Guide*, prepared by William V. Weber, Eastern Illinois University, Charleston, IL, has chapters that correspond to the textbook. Each chapter contains key terms, key ideas, completion exercises, graphical analyses, multiple-choice questions, questions for review, and problems for analysis. Artwork from the text is reprinted in the *Study Guide*, with ample space to take notes during classroom discussion.

PowerPoint® slides of exhibits from the text are also available for classroom use, and can be accessed at the text Web site. *PowerPoint* slides incorporating lecture *j* notes and exhibits, also available on the Web site, were prepared by Raymonda Burgman, DePauw University, Greencastle, IN.

Text Web Site

The text Web site is located at **http://www.cengage.com/economics/landsburg**. On the *Price Theory* Web site are several of the text supplements, teaching resources,

and learning resources. In addition, easy access is provided to the EconNews, EconDebate, EconData, and EconLinks Online features at the South-Western Economics Resource Center.

Acknowledgments

I first learned economics at the University of Chicago in the 1970s, which means that I learned most of it, directly or indirectly, from Dee McCloskey. Generations of Chicago graduate students were infected by Dee's enthusiasm for economics as a tool for understanding the world, and the members of one generation communicated their exuberance to me. They, and consequently I, learned from Dee that the world is full of puzzles—not the abstract or technical puzzles of formal economic theory, but puzzles like: Could the advent of free public education cause less education to be consumed?

We learned to see puzzles everywhere and to delight in their solutions. Later, I had the privilege to know Dee as a friend, a colleague, and the greatest of my teachers. Without Dee, this book would not exist. The exuberance that Dee personifies is endemic at Chicago, and I had the great good fortune to encounter it every day. I absorbed ideas and garnered examples in cafeterias, the library's coffee lounge, and especially in all-night seminars at Jimmy's Woodlawn Tap. Many of those ideas and examples appear in this book, their exact sources long forgotten. To all who contributed, thank you.

Among the many Chicago students who deserve explicit mention are Craig Hakkio, Eric Hirschhorn, and Maury Wolff, who were there from the beginning. John Martin and Russell Roberts taught me much and contributed many valuable suggestions specifically for this book. Ken Judd gave me a theory of executive compensation. Dan Gressell taught me the two ways to get a chicken to lay more eggs.

I received further education, and much encouragement, from the Chicago faculty. I thank Gary Becker, who enticed me to think more seriously about economics; Sherwin Rosen, who had planted the seeds of all this years before; and José Scheinkman, who listened to my ideas even when they were foolish. Above all, Bob Lucas can have no idea of how grateful I have been for his many gracious kindnesses. I remember them all, and value his generosity as I value the inspiration of his intellectual depth, honesty, and rigor.

Since leaving Chicago, my good fortune in colleagues followed me to Iowa and Cornell, and especially to Rochester, where this book was written. There is no faculty member in economics at Rochester who did not contribute to this book in one way or another. Some suggested examples and problems; others helped me learn material that

I had thought I understood until I tried to write about it; and many did both. I should name them all, but have space for only a few. William Thomson taught me about mechanisms for revealing the demand for public goods and suggested that they belonged in a book at this level. Walter Oi contributed more entertaining ideas and illustrations than I can remember and told me how Chinese bargemen were paid. Ken McLaughlin dazzled me with insights on pretty much a daily basis. And the late Alan Stockman started teaching me both economics and the joys of economics from the day I met him until the day he died.

I must also mention the contributions of the daily lunch group at the Hillside Restaurant, where no subject is off limits and no opinion too outrageous for

consideration. The daily discussions about how society is or should be structured were punctuated by numerous tangential discussions of how various ideas could best be presented in an intermediate textbook. I thank especially Stockman, McLaughlin, Mark Bils, John Boyd, Jim Kahn, Marvin Goodfriend (the first inductee into the Hillside Hall of Fame), and various part-time members.

Harold Winter's extensive written criticism of Chapter 11 led to substantial improvements. His many contributions specifically for this edition are acknowledged above and gratefully acknowledged again here. Wendy Betts gave me the epigram for Section 9.3.

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Steven E. Landsburg

Supply, Demand, and Equilibrium

Many books begin by telling you, at some length, what price theory is. This book begins by showing you. We'll jump right in, develop some simple tools, and use them to solve some problems.

How do air bags cause accidents? What determines the price of beef? When car dealers are taxed, how much of the tax gets "passed on" to buyers through higher prices? Are those buyers better or worse off than if they'd been taxed directly?

By the time you've finished this chapter, you'll know how to tackle these questions, and you'll have a good sense of what price theory is all about. It's time to dig in.

1.1 Demand

When the price of a good goes up, people generally consume less (or at least not more) of it. This statement, called the **law of demand**, is usually summarized as

When the price goes up, the quantity demanded goes down.

Economists believe that the law of demand is always (or nearly always) true. We believe this primarily on the basis of observations. In Chapter 4, we'll see that the law of demand follows logically from certain more fundamental assumptions about human behavior, which gives us yet another reason to believe it.

Law of demand

The observation that when the price of a good goes up, people will buy less of that good.

Demand versus Quantity Demanded

As an example, suppose that the good in question is coffee. The number of cups of coffee that you choose to purchase on a typical day might be given by a table like this:

Price (¢/cup)	Quantity (cups/day)
20	5
30	4
40	2
50	1

We say that when the price is 20¢ per cup, your **quantity demanded** is 5 cups per day. When the price is 30¢ per cup, your quantity demanded is 4 cups per day, and so on. Notice that the price is measured *per cup,* and the quantity is measured in *cups per day.* If we had selected different units of measurement, we would have had different entries in the table. For example, if we measured quantity in cups per week, the numbers in the right-hand column would be 35, 28, 14, and 7. To speak meaningfully about demand, we must specify our units and use them consistently.

Quantity demanded

The amount of a good that a given individual or group of individuals will choose to consume at a given price.

Demand

A family of numbers that lists the quantity demanded corresponding to each possible price.

The information in the table is collectively referred to as your **demand** for coffee. Notice the difference between *demand* and *quantity demanded*. Quantity demanded is a number, and it changes when the price does. Demand is a whole family of numbers, listing the quantities you would demand in a variety of hypothetical situations. (More precisely, demand is a *function* that converts prices to quantities.) The demand table asserts that if the price of coffee were 50¢ per cup, then you would buy 1 cup per day. It does not assert that the price of coffee actually is, or ever has been, or will be, 50¢ per cup.

If the price of coffee rises from 30¢ to 40¢ per cup, then your quantity demanded falls from 4 cups to 2 cups. However, your demand for coffee is unchanged, because the same table is still in effect. It remains true that if the price of coffee were 20¢ per cup, you would be demanding 5 cups per day; if the price of coffee were 30¢ per cup, you would be demanding 4 cups per day; and so on. The sequence of "if statements" is what describes your demand for coffee.

A change in price leads to a change in quantity demanded. A change in price does *not* lead to a change in demand.

Demand Curves

No table can present a complete picture of the demand for coffee. Our table does not tell us, for example, how much coffee you will purchase when the price is 22¢ per cup, or 33½¢. Therefore, we usually represent demand by a graph. We plot price on the vertical axis and quantity on the horizontal, always specifying our units.

Exhibit 1.1 provides an example. There, the information in your demand table for coffee has been translated into the black points in the graph. The curve through the points is called your **demand curve** for coffee. It fills in the additional information corresponding to prices that do not appear in the table. If we were to fill in enough rows of the table (and only space prevents us from doing so), then the demand table and the demand curve in Exhibit 1.1 would convey exactly the same information. The demand curve is a picture of your demand for coffee.

Demand curve

A graph illustrating demand, with prices on the vertical axis and quantities demanded on the horizontal axis.

Dangerous Curve

Because demand is a function that converts price (the independent variable) to quantity (the dependent variable), a mathematician would be inclined to plot price on the horizontal axis and quantity on the vertical. In economics, we do exactly the opposite, for good reasons that will be explained in Chapter 7.

Because the demand curve is a picture of demand, every statement that we can make about demand can be "seen" in the curve. For example, consider the law of demand: "When the price goes up, the quantity demanded goes down." This fact is reflected in the downward slope of the demand curve. It is important to remember both of these statements:

When the price goes up, the quantity demanded goes down.

and

Demand curves slope downward.

But it is even more important to recognize that these two statements are just two different ways of saying the same thing and to understand *why* they are just two different ways of saying the same thing.

| EXHIBIT **1.1** | **The Demand Curve** |

Price per cup (¢)

Price (¢/cup)	Quantity (cups/day)
20	5
30	4
40	2
50	1
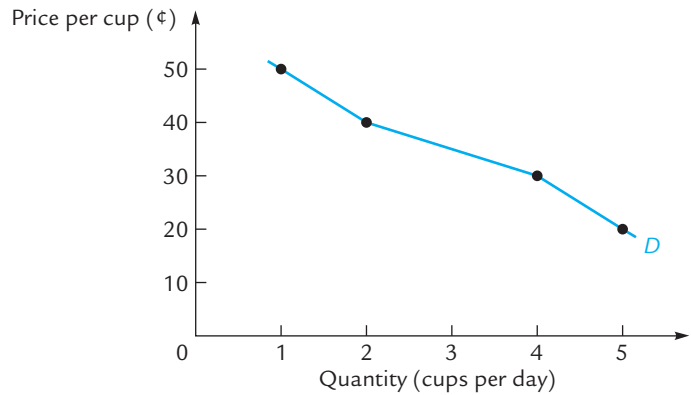
The demand table shows how many cups of coffee you would buy per day at each of several prices. The black points in the graph correspond precisely to the information in the table. The curve connecting the points is your demand curve for coffee. It conveys more information than the table because it shows how many cups of coffee you would buy at intermediate prices like 22¢ or 33½¢ per cup. If the table were enlarged to include enough intermediate prices, then the table and the graph would convey exactly the same information.

Example: The Demand for the Mona Lisa

Leonardo da Vinci only painted the Mona Lisa once. But if the original Mona Lisa were available for, say, $1.50, I'd want more than one of them—I think I'd probably hang one in my office, one in my living room, and perhaps one beside my bathroom mirror. So if the price of the Mona Lisa were $1.50, my quantity demanded would be 3. The point with those coordinates is on my Mona Lisa demand curve.

This example is meant to illustrate that points on the demand curve have *nothing to do* with the actual price of the Mona Lisa or the quantity of Mona Lisas that are actually available. My demand curve shows how many Mona Lisas I would *want* at various prices, not how many I *could get*.

Changes in Demand

We've seen that a change in price does not cause a change in demand. But a change in anything *other* than price *can* cause a change in demand. Suppose, for example, that your doctor has advised you to cut back on coffee for medical reasons. You might then choose to buy coffee according to a different table, such as this:

Price (¢/cup)	Quantity (cups/day)
20	3
30	2
40	1
50	0

Now your rule for deciding how many cups of coffee to purchase at different prices has changed—and this rule is just what we have called *demand*.

A change in *quantity demanded* is represented by a movement along the demand curve, from one point to another. But a change in *demand* is represented by a shift

EXHIBIT 1.2   Shifting the Demand Curve

TABLE A. Your Original Demand for Coffee

Price (¢/cup)	Quantity (cups/day)
20	5
30	4
40	2
50	1

TABLE B. Your New Demand for Coffee after Medical Advice to Cut Back

Price (¢/cup)	Quantity (cups/day)
20	3
30	2
40	1
50	0
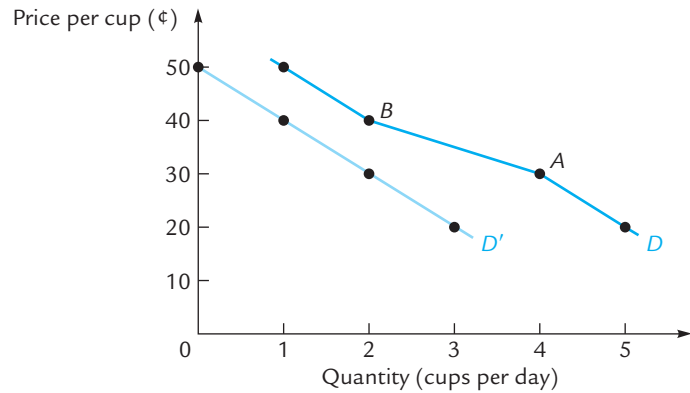
Your original demand curve for coffee is the curve labeled *D*. A change in price, say from 30¢ per cup to 40¢ per cup, would cause a movement along the curve from point *A* to point *B*. A change in something other than price, such as a doctor's suggestion that caffeine is bad for your health, can lead to a change in demand, represented by a shift to an entirely new demand curve. In this case the doctor's advice leads to a fall in demand, which is represented by a leftward shift of the curve.

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of the entire curve, as in Exhibit 1.2, which shows the same curve *D* that we met in Exhibit 1.1. After you receive medical advice to reduce your caffeine intake, your demand curve might shift to the curve labeled *D′*. Because you now want fewer cups of coffee at any given price, the new demand curve lies to the left of (and consequently below) the old demand curve. We describe this situation as a **fall in demand**.

The opposite situation, a **rise in demand**, results in a rightward shift of the demand curve. If you enrolled in a class that required a lot of late-night studying, you might experience a rise in your demand for coffee.

There are many other possible reasons for a shift in demand. If the price of tea were to fall, you might decide to drink more tea and less coffee. The amount of coffee you would choose to buy at any given price would go down. This is an example of a fall in demand. On the other hand, if your aunt gives you a snazzy new coffee maker for your birthday, your demand for coffee might rise.

Fall in demand

A decision by demanders to buy a smaller quantity at each given price.

Rise in demand

A decision by demanders to buy a larger quantity at each given price.

A change in anything *other* than price can lead to a change in demand.

Exercise 1.1 If the price of donuts were to fall, what do you think would happen to your demand for coffee? Does a fall in the price of a related good always affect your demand in the same way, or does it depend on what related good we are talking about?

Exercise 1.2 How might a rise in your income affect your demand for coffee?

Effect of a Sales Tax

One thing that could change your demand for coffee is the imposition of a sales tax.[1] Suppose that a new law requires you to pay a tax of 10¢ per cup of coffee that you buy. What happens to your demand curve?

Before we can begin to think about how a sales tax affects your demand curve, we have to decide what the word *price* means in a world with sales taxes. If a cup of coffee carries a price tag of "50¢ plus tax" and the tax is a nickel, should we say that the price is 50¢ or should we say that the price is 55¢? It doesn't matter which choice we make, but it *does* matter that we make a choice and stick with it. In this book, we will consistently use the word *price* to mean the pretax price, so that the price of that cup of coffee is 50¢. We think of the sales tax as something that you pay *in addition* to the market price. Therefore, a new sales tax is a change in something other than price, and can affect the location of the demand curve.

A sales tax makes buying coffee less desirable; at any given (pretax) price, you now want to buy less coffee than before. Your demand curve shifts to the left and downward. In fact, we can even figure out how far it shifts.

Suppose your demand for coffee in a world without taxes is given by the table in Exhibit 1.1. Let's figure out your demand in a world where coffee is taxed at 10¢ per cup. If the (pretax) price of coffee is 10¢, what will it actually cost you to acquire a cup of coffee? It will cost you 10¢ plus 10¢ tax—a total of 20¢. How many cups of coffee do you choose to buy when they cost you 20¢ apiece? According to the table in Exhibit 1.1, you will buy 5.

Now we can begin to tabulate your demand for coffee in a world with taxes. We know that, with taxes, if the price of coffee is 10¢ per cup, you will choose to buy 5 cups per day. This is the first row of your new demand table:

Price (¢/cup)	Quantity (cups/day)
10	5

We can continue in this way. When the price of coffee is 20¢, the actual cost to you will be 30¢. We know from Exhibit 1.1 that you will then choose to buy 4 cups. Thus, we can fill in another row of our table:

Price (¢/cup)	Quantity (cups/day)
10	5
20	4

If we complete the argument at other prices, we finally arrive at your new demand for coffee, which is shown in Exhibit 1.3. Compare the entries in the two demand tables of that exhibit. Notice that the same quantities appear in each but the corresponding prices are all 10¢ lower in the new demand schedule (Table B). What can we conclude about the demand curves that illustrate these tables? For every point on the original demand curve (D), a corresponding point on the new demand curve (D') represents the same quantity but a price that is lower by 10¢. This corresponding point lies a vertical distance exactly 10¢ below the original point.

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[1] In this book we will use the phrase *sales tax* to refer to a tax that is paid to the government by consumers. Some other texts use this phrase in a different way.

| EXHIBIT **1.3** | **The Effect of a Sales Tax on Demand** |

TABLE A. Demand for Coffee without Tax

Price (¢/cup)	Quantity (cups/day)
20	5
30	4
40	2
50	1

TABLE B. Demand for Coffee with a Sales Tax of 10¢ per Cup

Price (¢/cup)	Quantity (cups/day)
10	5
20	4
30	2
40	1

If the price of coffee is 10¢ per cup and there is a sales tax of 10¢, then it will actually cost you 20¢ to acquire a cup of coffee. Table A shows that under these circumstances you would purchase 5 cups per day. This is recorded in the first row of Table B. The other rows in that table are generated in a similar manner.

The rows of Table B contain the same quantities as the rows of Table A, but the corresponding prices are all 10¢ lower. Another way to say this is that each point on the new demand curve lies exactly 10¢ below a corresponding point on the original demand curve. Therefore, the new demand curve lies exactly 10¢ below the original demand curve in vertical distance. The sales tax causes the demand curve to shift downward parallel to itself by the amount of the tax.
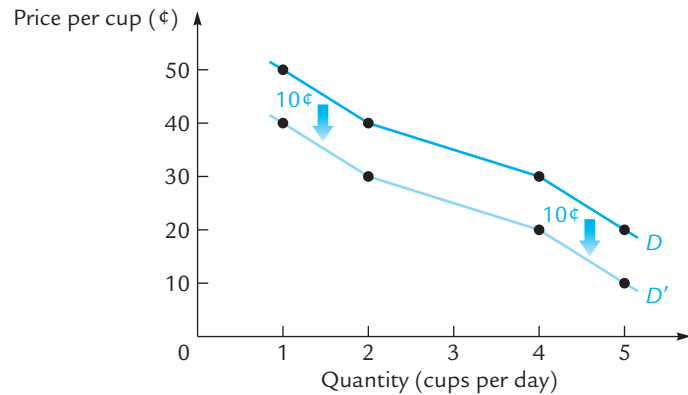
In summary, the sales tax causes each point of the demand curve to shift downward by the vertical distance 10¢. Because each point shifts downward the same distance, we can say that the demand curve shifts downward parallel to itself by the vertical distance 10¢. This gives us a precise prediction of how a sales tax affects demand.

A sales tax causes the demand curve to shift downward parallel to itself by the amount of the tax.

Exercise 1.3 How would demand be affected by a sales tax of 5¢ per item? How would it be affected by a subsidy under which the government pays 10¢ toward each cup of coffee purchased?

Exercise 1.4 How would demand be affected by a percentage sales tax—say, a tax equal to 10% of the price paid?

Market Demand

Until now we have been discussing your demand for coffee or the demand by some individual. We can just as well discuss the demand for coffee by some *group* of individuals. We can speak of the demand by your family, your city, your country, or the

entire world. The quantity associated with a given price is the total number of cups per day that the group members would demand.

Of course, because we can speak of a group's *demand* for coffee, we can speak of that group's *demand curve* as well. And, of course, this demand curve slopes downward.

The Shape of the Demand Curve

All demand curves slope downward, but some slope more steeply than others. The two panels of Exhibit 1.4 illustrate two possible demand curves for shoes. Both slope downward, but one slopes downward far more steeply than the other. If the demand curve looks like panel *A*, a small change in the price of shoes will lead to a small change in the quantity of shoes demanded. If the demand curve looks like panel *B*, a small change in the price of shoes will lead to a much larger change in the quantity of shoes demanded.

Often, people want to know the slopes of particular demand curves. If you owned a shoe store, you would be very interested in knowing whether a small price rise would drive away only a few customers or a great many. This is the same thing as asking whether the demand curve for your shoes is very steep or very flat.[2]

To help resolve such questions, economists have developed a variety of statistical techniques known collectively as **econometrics**. These techniques allow us (among other things) to estimate the slopes of various demand curves on the basis of direct observations in the marketplace. In this book we will not study any econometrics,

Econometrics

A family of statistical techniques used by economists.

EXHIBIT **1.4**   **The Shape of the Demand Curve**

The two panels depict two possible demand curves for shoes. In panel *A*, a given change in price (say from $4 per pair to $5 per pair) leads to a small change in quantity demanded (from 20 pairs of shoes per week to 18 pairs per week). In panel *B*, the same change in price leads to a large change in quantity demanded (from 20 pairs per week to 8 pairs per week).

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[2] The simplest measure of a demand curve's steepness is its slope. An alternative measure, more widely used in economics, is its *elasticity*. The *elasticity* is the ratio (percentage change in quantity)/(percentage change in price) between any two points. In panel *A* of Exhibit 1.4, where the price rises from $4 to $5 (a 25% increase), the quantity falls from 20 to 18 (a 10% decrease). Thus, the elasticity is −10%/25%, or −4. We will have more to say about elasticity in Chapter 4.

but it is important for you to know that the techniques exist and work tolerably well. In many circumstances, economists can estimate the slopes of demand curves with considerable accuracy.

Example: The Demand for Murder

Many economists have applied the successful techniques of econometrics to the study of demand curves for a variety of interesting "goods" that were previously viewed as outside the realm of economic analysis. Consider, for example, the demand curve for murder.

Murder is an activity that some people choose to engage in for a variety of reasons. We can view murder as a "good" for these people, and the commission of murder as the act of consuming that good. The price of consuming the good is paid in many forms. One of these forms is the risk of capital punishment.

This means that we can draw a demand curve for murder, plotting the probability of capital punishment on the vertical axis and the quantity of murders committed on the horizontal axis. We can ask how steep this demand curve is, which is the same thing as asking whether a small increase in the probability of capital punishment will lead to a small or a large decrease in the number of murders committed. In other words, measuring the slope of this demand curve is the same thing as measuring the deterrent effect of capital punishment.

Now, on the one hand, the deterrent effect of capital punishment is something about which there is much discussion and much interest. On the other hand, the slope of a demand curve is something that economists know how to measure.

Over the past 25 years, Professor Isaac Ehrlich has repeatedly measured the slope of the demand curve for murder, using essentially the same techniques that economists use to measure the slope of the demand curves for shoes, coffee, and other consumer goods. His results have been striking. The demand curve for murder appears to be remarkably flat; that is, a small increase in the price of murder leads to a large decrease in the quantity of murders committed. In fact, Ehrlich estimates that over the period 1935–1969 (a period in which executions were more common than they are today, making the statistical tests more reliable), one additional execution in the United States would have prevented, on average, about eight murders per year.[3]

This is a remarkable example of an application of economics to a positive question: "What is the deterrent effect of capital punishment?" It is emphatically *not* an answer to the related normative question: "Is capital punishment a good thing?" It is entirely possible to believe Ehrlich's results and still oppose capital punishment on ethical grounds; in fact, Ehrlich himself opposes capital punishment. However, knowing the answer to the positive question is undoubtedly helpful in thinking about the normative one. The size of the deterrent effect of the death penalty will certainly affect our assessment of its desirability, even though our assessment depends on many other things as well.

Example: The Demand for Reckless Driving

Reckless driving is another good that people choose to "consume." For this consumption they pay a price, partly by risking death in an accident. When that price

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[3] Ehrlich's first pathbreaking study was "The Deterrent Effect of Capital Punishment: A Question of Life and Death," *American Economic Review* 65 (1975), 397–417. His most recent contribution is "Sensitivity Analysis of the Deterrence Hypothesis: Let's Keep Econ in Econometrics" (with Z. Liu), *Journal of Law and Economics* XLII (1999), 455–487. Other researchers have reached somewhat different conclusions. You can find an excellent summary of the literature at http://www.cjlf.org/deathpenalty/dpdeterrence.htm.

is reduced—say, by the installation of safety equipment in cars—we should expect the quantity of reckless driving to increase.

This implies that safety devices like air bags could lead to either an increase or a decrease in the number of driver deaths. With an air bag, an individual accident is less likely to be fatal. But for exactly that reason, people will drive more recklessly and therefore will have more accidents. Whether the number of driver deaths decreases, increases, or remains constant depends on the size of that response; in other words, it depends on whether the demand curve for reckless driving is steep or flat.

When Professors Steven Peterson, George Hoffer, and Edward Millner investigated this question,[4] they found that air bags had almost no effect on the number of driver deaths; in fact, if anything, giving a driver an air bag makes him slightly *more* likely to die in an accident. With the air bag, the driver chooses to engage in enough additional reckless driving to completely offset the safety advantages of the air bag itself.

Does that mean drivers don't benefit from air bags? No, it just means they choose to take their benefits in a form other than safety. They get to drive faster, more aggressively, and more recklessly with only a slight increase in their chance of being killed. The real losers are pedestrians and other drivers, who participate in the additional accidents without sharing the safety features of the air bag.

If you find these results difficult to believe, try this experiment. Pick ten friends and read sentence 1 to five of them and sentence 2 to the other five:

1. "If you give a driver an air bag, he'll drive more recklessly."
2. "If you take away a driver's air bag, he'll drive more carefully."

Chances are, the five friends who hear sentence 1 will find it implausible and the five who hear sentence 2 will find it obvious. But the two sentences say exactly the same thing in different words, so your friends' instincts can't all be right. The instinct to disbelieve sentence 1 is an interesting fact about psychology; the fact that the sentence is nevertheless true is an interesting fact about economics.

The Wide Scope of Economics

The ideas of economics can be applied to every aspect of human behavior. In addition to the demand curves for murder and reckless driving, economists have measured the demand curves for "goods" as diverse as racial discrimination, love, children, religious activity, and cannibalism. Economic theory has yielded startling new insights in political science, sociology, philosophy, and law. The broad applicability of economic reasoning will be a recurring theme in this book.

1.2 Supply

The law of demand states that "when the price goes up, the quantity demanded goes down." The **law of supply** states that "when the price goes up, the quantity supplied goes up." By **quantity supplied** we mean the quantity of some good that a specified individual or group of individuals wants to supply to others per specified unit of time.

Law of supply

The observation that when the price of a good goes up, the quantity supplied goes up.

Quantity supplied

The amount of a good that suppliers will provide at a given price.

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[4] Steven P. Peterson, George E. Hoffer, and Edward L. Millner, "Are Drivers of Airbag Equipped Cars More Aggressive: A Test of the Peltzman Hypotheses?" *Journal of Law and Economics* 38 (1995), 251–265. Thirty years earlier, Professor Sam Peltzman found similar results for the effects of seat belts, collapsible steering wheels, penetration-resistant windshields, dual braking systems, and padded dashboards. See S. Peltzman, "The Effects of Automobile Safety Regulation," *Journal of Political Economy* 83 (1975), 677–725.