



$$y'_u \quad y = u^2 + 3\sqrt{u} - 1 \quad u = x^4 + 1 \quad y'_x =$$

$$= (u^2 + 3\sqrt{u} - 1)'_u (x^4 + 1)'_x = (2u + \frac{3}{2\sqrt{u}})'_u (4x^3)'_x$$

$$= (2x^4 + 2 + \frac{3}{2\sqrt{x^4 - 1}})'_u (4x^3)'_x$$

$$= (1 + \frac{2}{x})^{x+5} = ((1 + \frac{2}{x})^{\frac{x}{2}})^2 * (1 + \frac{2}{x})^5$$

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Preface

This book is a new type of intermediate microeconomics textbook. Previously, the choice was between books that use calculus to present formal theory dryly and with few, if any, applications to the real world and books that include applications but present theory using algebra and graphs only. This book uses calculus, algebra, and graphs to present microeconomic theory based on actual examples and then uses the theory to analyze real-world problems. My purpose is to show that economic theory has practical, problem-solving uses and is not an empty academic exercise.

This book shows how individuals, policymakers, and firms use microeconomic tools to analyze and resolve problems. For example, students learn that:

- individuals can draw on microeconomic theories when deciding whether to invest and whether to sign a contract that pegs prices to the government's measure of inflation;
- policymakers (and voters) can employ microeconomics to predict the impact of taxes, regulations, and other measures before they are enacted;
- lawyers and judges use microeconomics in antitrust, discrimination, and contract cases; and
- firms apply microeconomic principles to produce at least cost and maximize profit, select strategies, decide whether to buy from a market or to produce internally, and write contracts to provide optimal incentives for employees.

My experience in teaching microeconomics for the departments of economics at the Massachusetts Institute of Technology; the University of Pennsylvania; the University of California, Berkeley; the Department of Agricultural and Resource Economics at Berkeley; and the Wharton Business School has convinced me that students prefer this emphasis on real-world issues.

Changes in the Fourth Edition

In this edition, all the chapters were moderately to substantially revised and updated. In addition, this edition has two major new features on [Pearson MyLab Economics](http://www.myeconlab.com) (<http://www.myeconlab.com>): [Pearson MyLab Economics](#) Videos and a new online learning experience for the Solved Problems. Probably the most striking change to this edition is the addition of 17 color cartoons, which I claim (with a straight face) illustrate basic economic concepts.

Revised Chapters

Some of the major changes in the presentation of theories in the chapters include:

Supply and Demand. A major rewrite of Chapter 2 replaces the pork example with newly estimated coffee, corn, and oil examples. The discussion of elasticities uses new examples from recent papers.

Consumer Theory. Chapter 3 has a new section on finding an interior solution using a shortcut. The constant elasticity of substitution (CES) utility function is now the same as in the production chapter. Chapter 4 uses the estimated utility function from Chapter 3 to derive a demand curve. Chapter 5 underwent a substantial revision, particularly the sections on equivalent variation and compensating variation and the effects of taxes on labor supply.

Production and Costs. Chapters 6 and 7 have new estimated examples. Chapter 7 has a revised section on opportunity cost, a new section on short methods to minimize cost or maximize output, and a new discussion of the relationship between economies of scale and returns to scale.

Competition. Chapter 8 on the competitive firm is substantially rewritten, particularly the sections on perfect competition, profit maximization (especially shutdown conditions), the free entry and exit condition, and long-run market supply when input prices vary with output. Chapter 9 on the competitive market has a new introduction, uses a new estimated oil market model, and has an updated discussion of agricultural programs.

Monopoly. Some of the major revisions include the sections on regulation, monopsony, and networks. It also includes new material on the dominant firm-competitive fringe model.

Game Theory and Oligopoly. Chapter 13 has rewritten sections on dynamic games and auctions. Chapter 14's discussion of cartels is revised and updated.

Asymmetric Information. The first half of Chapter 18 is reorganized and rewritten.

New Online Features

Pearson has added a wide variety of new online features to support students and faculty in [Pearson MyLab Economics](#), which is a powerful online learning support system.

Pearson MyLab Economics Videos. This edition adds a set of [Pearson MyLab Economics Videos](#) that illustrate key points in the text. An icon shows which sections, figures, and game theory tables have [Pearson MyLab Economics Videos](#) by Tony Lima, a skilled and experienced professor. In the nearly 100 [Pearson MyLab Economics Videos](#), he slowly builds each figure, derives the equations, or analyzes the game, explaining the economics behind each step.

Pearson MyLab Economics Solved Problems. An icon identifies 36 of the most important Solved Problems for which online help is available. Using this resource, students learn how to solve economics problems by breaking them down into steps. In [Pearson MyLab Economics](#), the students solve the problem with hints rather than just read the step-by-step answer in the text. Each Solved Problem in the printed text has a similar problem online. Each Solved Problem in [Pearson MyLab Economics](#) and the eText also includes at least one additional graded practice exercise for students.

Applications

This edition has 117 Applications, of which 84% are new (35%) or revised (49%). The Applications in this edition use a balanced global outlook to illustrate the versatility of microeconomic theory. In addition, I've added 27 Application to [Pearson MyLab Economics](#), bringing the total number of additional Applications online to 218.

Challenges, Solved Problems, and End-of-Chapter Exercises

The Solved Problems (which show students how to answer problems using a step-by-step approach) and Challenges (which combine an Application with a Solved Problem) are very popular with students, so this edition increases the number by 8% to 111. After Chapter 1, each chapter starts with a Challenge (a problem based on an Application) and ends with its solution. In addition, many of the Solved Problems are linked to Applications. Each Solved Problem has at least one similar end-of-chapter exercise, which allows students to demonstrate that they've mastered the concept in the Solved Problem.

This edition has 744 end-of-chapter exercises, which is 5% more than in the last edition. Of the total, 27% are new or revised and updated. Select end-of-chapter exercise is available in [Pearson MyLab Economics](#). Students can click on the end-of-chapter exercise in the eText to go to [Pearson MyLab Economics](#) to complete the exercise online, get tutorial help, and receive instant feedback.

How This Book Differs from Others

This book differs from most other microeconomics texts in four main ways. First, it uses a mixture of calculus, algebra, and graphs to define economic theory. Second, it integrates estimated, real-world examples throughout the exposition, in addition to offering extended Applications. Third, it places greater emphasis on modern theories—such as industrial organization theories, game theory, transaction cost theory, information theory, contract theory, and behavioral economics—that are useful in analyzing actual markets. Fourth, it employs a step-by-step approach that demonstrates how to use microeconomic theory to solve problems and analyze policy issues.

Calculus

Microeconomic theory is primarily the study of maximizing behavior. Calculus is particularly helpful in solving maximization problems, while graphs help illustrate how to maximize. This book combines calculus, algebra, graphs, and verbal arguments to make the theory as clear as possible.

Modern Theories

The first half of the book (Chapters 2–10) examines competitive markets and shows that competition has very desirable properties. The rest of the book (Chapters 11–19) concentrates on imperfectly competitive markets—in which firms have market power (the ability to profitably set price above the unit cost of production), firms and consumers are uncertain about the future and have limited information, a market has an externality, or a market fails to provide a public good.

This book goes beyond basic microeconomic theory and looks at theories and applications from many important contemporary fields of economics. It extensively covers problems from resource economics, labor economics, international trade, public finance, and industrial organization. The book uses behavioral economics to discuss consumer choice, bandwagon effects on monopoly pricing over time, and the importance of time-varying discounting in explaining procrastination and in avoiding environmental disasters.

This book differs from other microeconomics texts by using game theory throughout the second half rather than isolating the topic in a single chapter. The book introduces game theory in Chapter 13, analyzing both static games (such as

the prisoners' dilemma) and multi-period games (such as collusion and preventing entry). Special attention is paid to auction strategies. Chapters 14, 16, 17, 18, and 19 employ game theory to analyze oligopoly behavior and many other topics. Unlike most texts, this book covers pure and mixed strategies and analyzes both normal-form and extensive-form games.

The last two chapters draw from modern contract theory to extensively analyze adverse selection and moral hazard, unlike other texts that mention these topics only in passing, if at all. The text covers lemons markets, signaling, shirking prevention, and revealing information (including through contract choice).

Actual Firms and Markets

To convince students that economics is practical and useful—not just a textbook exercise—this book presents theories using examples of real people and real firms based on actual data rather than artificial examples. These real economic stories are integrated into the formal presentation of many economic theories, discussed in Applications, and analyzed in what-if policy discussions.

Integrated Real-World Examples. This book uses real-world examples throughout the narrative to illustrate many basic theories of microeconomics. Students learn the basic model of supply and demand using estimated supply-and-demand curves for corn and coffee. They analyze consumer choice by employing estimated indifference curves between live music and music tracks. They learn about production and cost functions using estimates from a wide variety of firms. Students see monopoly theory applied to a patented pharmaceutical, Botox. They use oligopoly theories to analyze the rivalry between United Airlines and American Airlines on the Chicago–Los Angeles route and between Coke and Pepsi in the cola industry. They see Apple's monopoly pricing of iPads and learn about multimarket price discrimination through the use of data on how Warner Brothers sets prices for *Harry Potter and the Deathly Hallows Part 2* DVD across countries.

What-If Policy Analysis. This book uses economic models to probe the likely outcomes of changes in public policies. Students learn how to conduct what-if analyses of policies such as taxes, subsidies, barriers to entry, price floors and ceilings, quotas and tariffs, zoning, pollution controls, and licensing laws. The text analyzes the effects of taxes on virtually every type of market.

The book also reveals the limits of economic theory for policy analysis. For example, to illustrate why attention to actual institutions is important, the text uses three different models to show how the effects of minimum wages vary across types of markets and institutions. Similarly, the text illustrates that a minimum wage law that is harmful in a competitive market may be desirable in certain noncompetitive markets.

Applications. The text includes many Applications at the end of sections that illustrate the versatility of microeconomic theory. The Applications focus on such diverse topics as:

- the derivation of an isoquant for semiconductors, using actual data;
- how 3D printing affects firms' decisions about scale and its flexibility over time and is undermining movie studios;
- the amount by which recipients value Christmas presents relative to the cost to gift givers;
- why oil companies that use fracking are more likely to shut down;
- whether buying flight insurance makes sense;
- does going to college pay.

Step-by-Step Problem Solving

Many instructors report that their biggest challenge in teaching microeconomics is helping students learn to solve new problems. This book is based on the belief that the best way to teach this important skill is to demonstrate problem solving repeatedly and then to give students exercises to do on their own. Each chapter (after Chapter 1) provides several Solved Problems that show students how to answer qualitative and quantitative problems using a step-by-step approach. Rather than empty arithmetic exercises demanding no more of students than employing algebra or a memorized mathematical formula, the Solved Problems focus on important economic issues such as analyzing government policies and determining firms' optimal strategies.

One Solved Problem uses game theory to examine why Intel and AMD use different advertising strategies in the central processing unit (CPU) market. Another shows how a monopolistically competitive airline equilibrium would change if fixed costs (such as fees for landing slots) rise. Others examine why firms charge different prices at factory stores than elsewhere and when markets for lemons exist, among many other topics.

The Solved Problems illustrate how to approach the formal end-of-chapter exercises. Students can solve some of the exercises using graphs or verbal arguments, while others require math.

Alternative Organizations

Because instructors cover material in many different orders, the text permits maximum flexibility. The most common approach to teaching microeconomics is to cover some or all of the chapters in their given sequence. Common variants include:

- presenting uncertainty (Sections 16.1 through 16.3) immediately after consumer theory;
- covering competitive factor markets (Section 15.1) immediately after competition (Chapters 8 and 9);
- introducing game theory (Chapter 13) early in the course; and
- covering general equilibrium and welfare issues (Chapter 10) at the end of the course instead of immediately after the competitive model.

Instructors can present the material in Chapters 13–19 in various orders, although Section 16.4 should follow Chapter 15, and Chapter 19 should follow Chapter 18 if both are covered.

Many business school courses skip consumer theory (and possibly some aspects of supply and demand) to allow more time for the topics covered in the second half of the book. Business school faculty may want to place particular emphasis on game theory, strategies, oligopoly, and monopolistic competition (Chapters 13 and 14); capital markets (Chapter 15); uncertainty (Chapter 16); and modern contract theory (Chapters 18 and 19).

Pearson MyLab Economics

Pearson MyLab Economics's powerful assessment and tutorial system works hand-in-hand with the Fourth Edition of *Microeconomics: Theory and Applications with Calculus*. It includes comprehensive homework, quiz, test, and tutorial options, allowing students to test their knowledge and instructors to manage all assessment needs in one program. Students and instructors can register, create, and access all of

Pearson MyLab courses, regardless of discipline, from one convenient online location: <http://www.pearsonmylab.com>.

Key features in the [Pearson MyLab Economics](#) course for *Microeconomics: Theory and Applications with Calculus*, Fourth Edition, include the following resources for students and instructors:

- **Pearson eText.** The Pearson eText gives students access to their textbook anytime, anywhere. In addition to notetaking, highlighting, and bookmarking, the Pearson eText offers interactive and sharing features. Students actively read and learn, real-time data-graphs, animations, author videos, and more. Instructors can share comments or highlights, and students can add their own, for a tight community of learners in any class.
- **Pearson MyLab Economics Videos.** Key figures and concepts from the textbook are presented in step-by-step animations with audio explanations of the action. These new videos are linked from the eText and accessible through [Pearson MyLab Economics](#).
- **Pearson MyLab Economics Solved Problems.** Many students have difficulty applying economics concepts to solving problems. The goal of this digital resource is to help students overcome this hurdle by learning how to solve an economic problem by breaking it down into steps. Each Solved Problem in [Pearson MyLab Economics](#) and the eText also includes at least one additional graded practice exercise for students. These interactive tutorials help students apply basic problem-solving skills to homework, quizzes, and exams. The goal is for students to build skills they can use to analyze real-world economic issues they hear and read about in the news.
- **Additional Readings (Applications, Supplemental Material, and Solved Problems).** Additional Applications, Supplemental Material, and Solved Problems are available in [Pearson MyLab Economics](#). Appendices and Answers to Selected End-of-Chapter Exercises are also available on the Companion Web site at <http://www.pearsonglobaleditions.com/Perloff>.
- **NEW: Math Review Exercises in Pearson MyLab Economics.** [Pearson MyLab Economics](#) now offers a rich array of assignable and auto-graded exercises covering fundamental math concepts geared specifically to principles and intermediate economics students. Aimed at increasing student confidence and success, our new math skills review Chapter R is accessible from the assignment manager and contains over 150 graphing, algebra, and calculus exercises for homework, quiz, and test use.
- **Practice.** Algorithmically generated homework and study plan exercises with instant feedback ensure varied and productive practice that helps students improve their understanding and prepare for quizzes and tests. Exercises that require drawing figures encourage students to practice the language of economics.
- **Learning Resources.** Personalized learning aids such as Help Me Solve This problem walkthroughs, Teach Me explanations of the underlying concept, and figure Videos provide on-demand help when students need it most.
- **Study Plan.** Customized study plans show students which sections to study next, give easy access to practice problems, and provide an automatically generated quiz to prove mastery of the course material.
- **Digital Interactives.** Focused on a single core topic and organized in progressive levels, each interactive immerses students in an assignable and auto-graded activity. Digital Interactives are lecture tools for traditional, online, and hybrid courses, many incorporating real-time data, data displays, and analysis tools for rich classroom discussions.
- **Learning Catalytics.** Learning Catalytics™ is a “bring your own device” student engagement, assessment, and classroom intelligence system that lets learners use their smartphone, tablet or laptop to participate in and stay engaged in

lecture. It allows instructors to generate classroom discussion, guides lectures, and promotes peer-to-peer learning with real-time analytics. Now students can use any device to interact in the classroom, engage with content and even draw and share graphs. Instructors can divide classes into pairs or groups based on learners' response patterns, and learners with greater proficiency help motivate other learners while allowing instructors time to provide individualized and focused attention to learners who will benefit from it.

- **Current News Exercises.** These exercises provide a turnkey approach to assign gradable news-based exercises in [Pearson MyLab Economics](#). Every week, Pearson scours the news, finds a current article appropriate for a microeconomics course, creates an exercise around this news article, and then automatically adds it to [Pearson MyLab Economics](#).
- **Reporting Dashboard.** Faculty can view, analyze, and report learning outcomes clearly and easily using the Reporting Dashboard. It is available via the Gradebook and fully mobile-ready. The Reporting Dashboard presents student performance data at the class, section, and program levels in an accessible, visual manner.
- **LMS Integration.** Faculty can link from any LMS platform to access assignments, rosters, and resources, and synchronize MyLab grades with your LMS Gradebook. For students, a new direct, single sign-on provides easier access to all the personalized learning MyLab resources.
- **Mobile Ready.** Students and instructors can access multimedia resources and complete assessments from any mobile device.
- **Experiments in [Pearson MyLab Economics](#).** Flexible, easy-to-assign, auto-graded, and available in Single and Multiplayer versions, the Experiments in [Pearson MyLab Economics](#) make learning fun and engaging.

For more information, visit <http://www.myeconlab.com>.

Teaching Resources

Many useful teaching resources can be downloaded from the Instructor Resource Center, <http://www.pearsonglobaleditions.com/Perloff>, or the catalog page for *Microeconomics: Theory and Applications with Calculus*. The *Instructor's Resource Manual*, by Leonie Stone, State University of New York at Geneseo, has many useful and creative teaching ideas. It also offers additional Applications, as well as extra problems and answers, and it provides solutions for all of the end-of-chapter exercises.

The *Test Bank*, by Xin Fan, Hawaii Pacific University, features many different types of problems of varying levels of complexity, suitable for homework assignments and exams. The TestGen Files provide these test questions in a versatile, editable electronic format.

The book's PowerPoint® Presentation, written by James Dearden, Lehigh University, provides instructors with a set of comprehensive lecture slides. Embedded animated figures highlight the dynamic nature of microeconomics in action.

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 Kenny Bell, *University of California, Berkeley*
 Robert A. Berman, *American University*
 Douglas Blair, *Rutgers University*
 James Brander, *University of British Columbia*
 Jurgen Brauer, *Augusta State University*
 Margaret Bray, *London School of Economics*
 Helle Bunzel, *Iowa State University*
 Paul Calcott, *Victoria University of Wellington*

Lauren Calimeris, *University of Colorado at Boulder*
 Anoshua Chaudhuri, *San Francisco State University*
 Anthony Davies, *Duquesne University*
 James Dearden, *Lehigh University*
 Wayne Edwards, *University of Alaska, Anchorage*
 Susan Elmes, *Columbia University*
 Patrick M. Emerson, *Oregon State University*
 Eduardo Faingold, *Yale University*
 Rachael Goodhue, *University of California, Davis*
 Ron Goettler, *Carnegie Mellon University, Doha, Qatar*
 Thomas Gresik, *University of Notre Dame*

Barnali Gupta, *Miami University*
 Per Svejstrup Hansen, *University of Southern Denmark*
 Byoung Heon Jun, *Korea University*
 Rebecca Judge, *St. Olaf College*
 Johnson Kakeu, *Georgia Institute of Technology*
 Süleyman Keçeli, *Pamukkale University*
 Vijay Krishna, *University of North Carolina, Chapel Hill*
 Stephen Laueremann, *University of Michigan*
 Tony Lima, *Cal State East Bay*
 Urzo Luttmer, *Dartmouth University*
 Vikram Manjunath, *Texas A&M University*
 Carrie A. Meyer, *George Mason University*
 Joshua B. Miller, *University of Minnesota, Twin Cities*
 Stephen M. Miller, *University of Nevada, Las Vegas*
 Olivia Mitchell, *University of Pennsylvania*
 Jeffery Miron, *Harvard University*
 Shalah Mostashari, *Texas A&M University*
 Orgul Ozturk, *University of Southern Carolina*
 Alexandre Padilla, *Metropolitan State College of Denver*

Michael R. Ransom, *Brigham Young University*
 Alfonso Sánchez-Peñalver, *University of Massachusetts, Boston*
 Riccardo Scarpa, *University of Waikato, New Zealand*
 Burkhard C. Schipper, *University of California, Davis*
 Riccardo Scarpa, *University of Waikato*
 Galina A. Schwartz, *University of California, Berkeley*
 Steven Snyder, *Lehigh University*
 Barry Sopher, *Rutgers University*
 Ilya Sorvachev, *New Economic School, Russia*
 Stephen Snyder, *University of Pittsburgh*
 Scott Templeton, *Clemson University*
 Etku Unver, *Boston College*
 Ruth Uwaifo, *Georgia Institute of Technology*
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J.M.P.

Introduction

1

An Economist's Theory of Reincarnation: If you're good, you come back on a higher level. Cats come back as dogs, dogs come back as horses, and people—if they've been really good like George Washington—come back as money.

If each of us could get all the food, clothing, and toys we want without working, no one would study economics. Unfortunately, most of the good things in life are scarce—we can't all have as much as we want. Thus, scarcity is the mother of economics.

Microeconomics is the study of how individuals and firms make themselves as well off as possible in a world of scarcity, and the consequences of those individual decisions for markets and the entire economy. In studying microeconomics, we examine how individual consumers and firms make decisions and how the interaction of many individual decisions affects markets.

Microeconomics is often called *price theory* to emphasize the important role that prices play in determining market outcomes. Microeconomics explains how the actions of all buyers and sellers determine prices, and how prices influence the decisions and actions of individual buyers and sellers.

**In this chapter,
we discuss
three main topics**

1. **Microeconomics: The Allocation of Scarce Resources.** Microeconomics is the study of the allocation of scarce resources.
2. **Models.** Economists use models to make testable predictions.
3. **Uses of Microeconomic Models.** Individuals, governments, and firms use microeconomic models and predictions in decision making.

1.1 Microeconomics: The Allocation of Scarce Resources

Individuals and firms allocate their limited resources to make themselves as well off as possible. Consumers select the mix of goods and services that makes them as happy as possible given their limited wealth. Firms decide which goods to produce, where to produce them, how much to produce to maximize their profits, and how to produce those levels of output at the lowest cost by using more or less of various inputs such as labor, capital, materials, and energy. The owners of a depletable natural resource such as oil decide when to use it. Government decision makers decide which goods and services the government will produce and whether to subsidize, tax, or regulate industries and consumers to benefit consumers, firms, or government employees.

Trade-Offs

People make trade-offs because they can't have everything. A society faces three key trade-offs:

1. **Which goods and services to produce.** If a society produces more cars, it must produce fewer of other goods and services, because it has only a limited amount of *resources*—workers, raw materials, capital, and energy—available to produce goods.
2. **How to produce.** To produce a given level of output, a firm must use more of one input if it uses less of another input. For example, cracker and cookie manufacturers switch between palm oil and coconut oil, depending on which is less expensive.
3. **Who gets the goods and services.** The more of society's goods and services you get, the less someone else gets.

Who Makes the Decisions

The government may make these three allocation decisions explicitly, or the final decisions may reflect the interaction of independent decisions by many individual consumers and firms. In the former Soviet Union, the government told manufacturers how many cars of each type to make and which inputs to use to make them. The government also decided which consumers would get cars.

In most other countries, how many cars of each type are produced and who gets them are determined by how much it costs to make cars of a particular quality in the least expensive way and how much consumers are willing to pay for them. More consumers would own a handcrafted Rolls-Royce and fewer would buy a mass-produced Toyota Camry if a Rolls were not 14 times more expensive than a Camry.

How Prices Determine Allocations

Prices link the decisions about *which goods and services to produce, how to produce them, and who gets them*. Prices influence the decisions of individual consumers and firms, and the interactions of these decisions by consumers, firms, and the government determine price.

Interactions between consumers and firms take place in a **market**, which is an exchange mechanism that allows buyers to trade with sellers. A market may be a town square where people go to trade food and clothing, or it may be an international telecommunications network over which people buy and sell financial securities. Typically, when we talk about a single market, we are referring to trade in a single good or a group of goods that are closely related, such as soft drinks, movies, novels, or automobiles.

Most of this book concerns how prices are determined within a market. We show that the organization of the market, especially the number of buyers and sellers in the market and the amount of information they have, helps determine whether the price equals the cost of production. We also show that in the absence of a market (and market price), serious problems, such as high pollution levels, result.

APPLICATION

Twinkie Tax

Many American, Australian, British, Canadian, New Zealand, and Taiwanese jurisdictions are proposing a *Twinkie tax* on unhealthy fatty and sweet foods or a tax on sugary soft drinks to reduce obesity and cholesterol problems, particularly among children. One survey found that 45% of adults would support a 1¢ tax per pound on soft drinks, chips, and butter, with the revenues used to fund health education programs.

In recent years, many communities around the world debated (and some passed) new taxes on sugar-sweetened soft drinks. In 2014, Rosa DeLauro, a Connecticut Congressional representative, proposed a national soda tax. New beverage taxes went into effect in Mexico in 2014 and in Berkeley, California, in 2015. At least 34 states differentially tax soft drinks, candy, chewing gum, and snack foods such as potato chips. Today, many school districts throughout the United States ban soft drink vending machines. This ban discourages consumption, as would an extremely high tax. Britain's largest life insurance firm charges obese people higher premiums for life insurance policies.

New taxes will affect *which foods are produced*, as firms offer new low-fat and low-sugar products, and *how fast-foods are produced*, as manufacturers reformulate their products to lower their tax burden. These taxes will also influence *who gets these goods* as consumers, especially children, replace them with less expensive, untaxed products.¹

1.2 Models

Everything should be made as simple as possible, but not simpler. —Albert Einstein

To *explain* how individuals and firms allocate resources and how market prices are determined, economists use a **model**: a description of the relationship between two or more variables. Economists also use models to *predict* how a change in one variable will affect another variable.

APPLICATION

Income Threshold Model and China

According to an *income threshold model*, no one who has an income level below a threshold buys a particular consumer durable, which is a good that can be used for long periods, such as a refrigerator or car. The theory also holds that almost everyone whose income is above that threshold buys the durable.

If this theory is correct, we predict that, as most people's incomes rise above the threshold in less-developed countries, consumer durable purchases will increase from near zero to large numbers virtually overnight. This prediction is consistent with evidence from Malaysia, where the income threshold for buying a car is about \$4,000.

In China, incomes have risen rapidly and now exceed the threshold levels for many types of durable goods. As a result, many experts correctly predicted that the greatest consumer durable goods sales boom in history would take place there. Anticipating this boom, many companies have greatly increased their investments in durable goods manufacturing plants in China. Annual foreign direct investments (FDI) have gone from \$916 million a year in 1983 to \$120 billion in 2014, overtaking the United States as the world's largest recipient of FDI. In expectation

¹The sources for Applications are available at the back of the book.

of this growth potential, even traditional political opponents of the People's Republic—Taiwan, South Korea, and Russia—are investing in China.

Li Rifu, a 46-year-old Chinese farmer and watch repairman, thought that buying a car would improve the odds that his 22- and 24-year-old sons would find girlfriends, marry, and produce grandchildren. Soon after Mr. Li purchased his Geely King Kong for the equivalent of \$9,000, both sons met girlfriends, and his older son got married.

Four-fifths of all new cars sold in China are bought by first-time customers. An influx of first-time buyers was responsible for Chinese car sales increasing by a factor of 15 between 2000 and 2015. By 2010, China became the second largest manufacturer of motor vehicles. By 2014, China was producing more cars than the United States and Japan combined, as well as more than the entire European Union.

Simplifications by Assumption

We stated the income threshold model verbally, but we could have presented it graphically or mathematically. Regardless of how the model is described, an economic model is a simplification of reality that contains only reality's most important features. Without simplifications, it is difficult to make predictions because the real world is too complex to analyze fully.

By analogy, if the owner's manual accompanying a new DVD recorder had a diagram showing the relationships among all the parts in the recorder, the diagram would be overwhelming and useless. But a diagram that includes a photo of the buttons on the front of the machine, with labels describing the purpose of each, is useful and informative.

Economists make many *assumptions* to simplify their models.² When using the income threshold model to explain car-purchasing behavior in China, we assume that factors other than income, such as the vehicles' color choices, are irrelevant to the decision to buy cars. Therefore, we ignore the color of cars that are sold in China when we describe the relationship between average income and the number of cars that consumers want. If our assumption is correct, we make our auto market analysis simpler without losing important details by ignoring color. If we're wrong and these ignored issues are important, our predictions may be inaccurate.

Throughout this book, we start with strong assumptions to simplify our models. Later, we add complexities. For example, in most of the book, we assume that consumers know each firm's price for a product. In many markets, such as the New York Stock Exchange, this assumption is realistic. However, it is not realistic in other markets, such as the market for used automobiles, in which consumers do not know the prices that each firm charges. To devise an accurate model for markets in which consumers have limited information, in Chapter 16, we add consumer uncertainty about price into the model.

²An engineer, an economist, and a physicist are stranded on a deserted island with a can of beans but no can opener. How should they open the can? The engineer proposes hitting the can with a rock. The physicist suggests building a fire under the can to build up pressure and burst it open. The economist thinks for a while and then says, "Assume that we have a can opener. . . ."

Testing Theories

Blore's Razor: Given a choice between two theories, take the one which is funnier.

Economic *theory* is the development and use of a model to formulate *hypotheses*, which are predictions about cause and effect. We are interested in models that make clear, testable predictions, such as “If the price rises, the quantity demanded falls.” A theory stating that “People’s behaviors depend on their tastes, and their tastes change randomly at random intervals” is not very useful because it does not lead to testable predictions.



An alternative theory.

Economists test theories by checking whether predictions are correct. If a prediction does not come true, economists may reject the theory.³ Economists use a model until it is refuted by evidence or until a better model is developed.

A good model makes sharp, clear predictions that are consistent with reality. Some very simple models make sharp predictions that are incorrect, and other, more complex models make ambiguous predictions—in which any outcome is possible—that are untestable. The skill in model building is to chart a middle ground.

The purpose of this book is to teach you how to think like an economist, in the sense that you can build testable theories using economic models or apply existing models to new situations. Although economists think alike, in that they develop and use testable models, they often disagree. One may present a logically consistent argument that prices will go up in the next quarter. Another economist, using a different but equally logical theory, may contend that prices will fall in that quarter. If the economists are reasonable, they agree that pure

logic alone cannot resolve their dispute. Indeed, they agree that they’ll have to use empirical evidence—facts about the real world—to determine which prediction is correct.

Maximizing Subject to Constraints

Although one economist’s model may differ from another’s, a key assumption in most microeconomic models is that individuals allocate their scarce resources so as to make themselves as well off as possible. Of all the affordable combinations of goods, consumers pick the bundle of goods that gives them the most possible enjoyment. Firms try to maximize their profits given limited resources and existing technology. That resources are limited plays a crucial role in these models. Were it not for scarcity, people could consume unlimited amounts of goods and services, and sellers could become rich beyond limit.

³We can use evidence of whether a theory’s predictions are correct to refute the theory but not to prove it. If a model’s prediction is inconsistent with what actually happened, the model must be wrong, so we reject it. Even if the model’s prediction is consistent with reality, however, the model’s prediction may be correct for the wrong reason. Hence, we cannot prove that the model is correct—we can only fail to reject it.

As we show throughout this book, the maximizing behavior of individuals and firms determines society's three main allocation decisions: which goods are produced, how they are produced, and who gets them. For example, diamond-studded pocket combs will be sold only if firms find it profitable to sell them. The firms will make and sell these combs only if consumers value the combs at least as much as it costs the firm to produce them. Consumers will buy the combs only if they get more pleasure from the combs than they would from other goods they could buy with the same resources.

Many of the models that we examine are based on maximizing an objective that is subject to a constraint. Consumers maximize their well-being subject to a budget constraint, which says that their resources limit how many goods they can buy. Firms maximize profits subject to technological and other constraints. Governments may try to maximize the welfare of consumers or firms subject to constraints imposed by limited resources and the behavior of consumers and firms. We cover the formal economic analysis of maximizing behavior in Chapters 2–19 and review the underlying mathematics in the Calculus Appendix at the end of the book.

Positive Versus Normative

Those are my principles. If you don't like them I have others. —Groucho Marx

The use of models of maximizing behavior sometimes leads to predictions that seem harsh or heartless. For instance, a World Bank economist predicted that if an African government used price controls to keep the price of food low during a drought, food shortages would occur and people would starve. The predicted outcome is awful, but the economist was not heartless. The economist was only making a scientific prediction about the relationship between cause and effect: Price controls (cause) lead to food shortages and starvation (effect).

Such a scientific prediction is known as a **positive statement**: a testable hypothesis about matters of fact such as cause and effect relations. *Positive* does not mean that we are certain about the truth of our statement; it indicates only that we can test whether it is true.

If the World Bank economist is correct, should the government control prices? If government policymakers believe the economist's predictions, they know that the low prices will help consumers who are able to buy as much food as they want, and hurt both the food sellers and those who are unable to buy as much food as they want, some of whom may die from malnutrition. As a result, the government's decision of whether to use price controls turns on whether the government cares more about the winners or the losers. In other words, to decide on its policy, the government makes a value judgment.

Instead of making a prediction and testing it and then making a value judgment to decide whether to use price controls, government policymakers could make a value judgment directly. The value judgment could be based on the belief that “because people *should* have prepared for the drought, the government should not try to help them by keeping food prices low” or “people should be protected against price gouging during a drought, so the government should use price controls.”

These two statements are *not* scientific predictions. Each is a value judgment or **normative statement**: a conclusion as to whether something is good or bad. A normative statement cannot be tested because a value judgment cannot be refuted by evidence. It is a prescription rather than a prediction. A normative statement concerns what somebody believes should happen; a positive statement concerns what will happen.

Although a normative conclusion can be drawn without first conducting a positive analysis, a policy debate will be more informed if positive analyses are conducted first.⁴ Suppose your normative belief is that the government should help the poor. Should you vote for a candidate who advocates a higher minimum wage (a law that requires firms to pay wages at or above a specified level); a European-style welfare system (guaranteeing health care, housing, and other basic goods and services); an end to our current welfare system; a negative income tax (the less income a person receives, the more that person receives from the government); or job training programs? Positive economic analysis can be used to predict whether these programs will benefit poor people but *not* whether these programs are good or bad. Using these predictions and your value judgment, you decide for whom to vote.

Economists' emphasis on positive analysis has implications for what they study and even their use of language. For example, many economists stress that they study people's *wants* rather than their needs. Although people need certain minimum levels of food, shelter, and clothing to survive, most people in developed economies have enough money to buy goods well in excess of the minimum levels necessary to maintain life. Consequently, calling something a *need* in a wealthy country is often a value judgment. You almost certainly have been told by an elder that "you *need* a college education." That person was probably making a value judgment—"you *should* go to college"—rather than a scientific prediction that you will suffer terrible economic deprivation if you don't go to college. We can't test such value judgments, but we can test hypotheses such as "people with a college education earn substantially more than comparable people with only a high school education."

1.3 Uses of Microeconomic Models

Have you ever imagined a world without hypothetical situations?

Because microeconomic models *explain* why economic decisions are made and allow us to make *predictions*, they can be very useful for individuals, governments, and firms in making decisions. Throughout this book, we consider examples of how microeconomics aids in actual decision making. Here, we briefly look at some uses by individuals and governments.

Individuals use microeconomics to make purchasing and other decisions. Examples include considering inflation when choosing whether to rent an apartment (Chapter 4); determining whether going to college is a good investment (Chapter 15); deciding whether to invest in stocks or bonds (Chapter 16); determining whether to buy insurance (Chapter 16); and knowing whether you should pay a lawyer by the hour or a percentage of any award (Chapter 19).

Microeconomics can help citizens make voting decisions based on candidates' views on economic issues. Elected and appointed government officials use economic models in many ways. Recent administrations have placed increased emphasis on

⁴Some economists draw the normative conclusion that, as social scientists, we economists should restrict ourselves to positive analyses. Others argue that we shouldn't give up our right to make value judgments just like the next person (who happens to be biased, prejudiced, and pigheaded, unlike us).

economic analysis. Economic and environmental impact studies are required before many projects can commence. The President's Council of Economic Advisers and other federal economists analyze and advise national government agencies on the likely economic effects of all major policies.

Indeed, often governments use microeconomic models to predict the probable impact of a policy. We show how to predict the likely impact of a tax on the tax revenues raised (Chapter 2), the effects of trade policies such as tariffs and quotas on markets (Chapter 9), and whether San Francisco would earn more by raising the price for cable car rides (Chapter 11). Governments also use economics to decide how best to prevent pollution and global warming (Chapter 17).

Decisions by firms reflect microeconomic analysis. Firms price discriminate (charge individuals different prices) or bundle goods to increase their profits (Chapter 12). Strategic decisions concerning pricing, setting quantities, advertising, or entering into a market can be predicted using game theory (Chapter 13). An example in an oligopolistic market is the competition between American Airlines and United Airlines on the Chicago–Los Angeles route (Chapter 14). When a mining company should extract ore depends on interest rates (Chapter 15). A firm decides whether to offer employees deferred payments to ensure they work hard (Chapter 19).

SUMMARY

1. Microeconomics: The Allocation of Scarce Resources.

Microeconomics is the study of the allocation of scarce resources. Consumers, firms, and governments must make allocation decisions. A society faces three key trade-offs: which goods and services to produce, how to produce them, and who gets them. These decisions are interrelated and depend on the prices that consumers and firms face and on government actions. Market prices affect the decisions of individual consumers and firms, and the interaction of the decisions of individual consumers and firms determines market prices. The organization of the market, especially the number of firms in the market and the information consumers and firms have, plays an important role in determining whether the market price is equal to or higher than the cost of producing an additional unit of output.

2. Models. Models based on economic theories are used to answer questions about how some change,

such as a tax increase, will affect various sectors of the economy in the future. A good theory is simple to use and makes clear, testable predictions that are not refuted by evidence. Most microeconomic models are based on maximizing behavior. Economists use models to construct *positive* hypotheses concerning how a cause leads to an effect. These positive questions can be tested. In contrast, *normative* statements, which are value judgments, cannot be tested.

3. Uses of Microeconomic Models. Individuals, governments, and firms use microeconomic models and predictions to make decisions. For example, to maximize its profits, a firm needs to know consumers' decision-making criteria, the trade-offs between various ways of producing and marketing its product, government regulations, and other factors.