

# Managerial Economics

WILLIAM F. SAMUELSON  
STEPHEN G. MARKS

8th  
Edition



WILEY

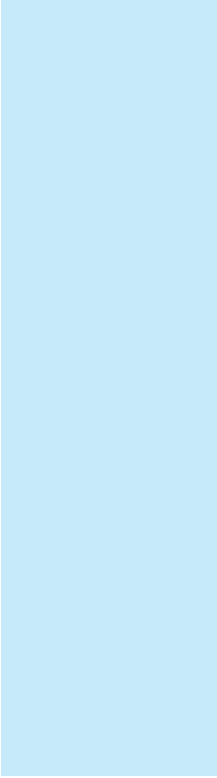


EIGHTH EDITION

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*To Our Families*

*W. F. S*

*S. G. M*

EIGHTH EDITION

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**William F. Samuelson**

*Boston University*

**Stephen G. Marks**

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**WILEY**

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# P R E F A C E

The last 25 years have witnessed an unprecedented increase in competition in both national and world markets. In this competitive environment, managers must make increasingly complex business decisions that will determine whether the firm will prosper or even survive. Today, economic analysis is more important than ever as a tool for decision making.

## OBJECTIVES OF THIS BOOK

The aims of this textbook are to illustrate the central decision problems managers face and to provide the economic analysis they need to guide these decisions. It was written with the conviction that an effective managerial economics textbook must go beyond the “nuts and bolts” of economic analysis; it should also show how practicing managers use these economic methods. Our experience teaching managerial economics to undergraduates, MBAs, and executives alike shows that a focus on applications is essential.

## KEY FEATURES

### Managerial Decision Making

The main feature that distinguishes *Managerial Economics*, Eighth Edition, is its consistent emphasis on managerial decision making. In a quest to explain economics per se, many current texts defer analysis of basic managerial decisions such as optimal output and pricing policies until later chapters—as special applications or as relevant only to particular market structures. In contrast, decision making is woven throughout every chapter in this book. Each chapter begins with a description of a real managerial problem that challenges students to ponder possible choices and is concluded by revisiting and analyzing the decision in light of the concepts introduced in the chapter. Without exception, the principles of managerial economics are introduced and analyzed by extended decision-making examples. Some of these examples include pricing airline seats (Chapter 3), competing as a commercial day-care provider (Chapter 7), fighting global warming (Chapter 11), choosing between risky research and development projects (Chapter 12), and negotiating David Letterman’s *Late Show* contract (Chapter 15). In addition to reviewing important concepts, the summary at the end of each chapter lists essential decision-making principles.

The analysis of optimal decisions is presented early in the book. Chapter 2 introduces and analyzes the basic profit-maximization problem of the firm. Chapter 3 begins with a traditional treatment of demand and goes on to apply demand analysis to the firm’s optimal pricing problem. Chapters 5 and 6 take a closer look at production and

cost as guides to making optimal managerial decisions. The emphasis on decision making continues throughout the remainder of the book because, in our view, this is the best way to teach managerial economics. The decision-making approach also provides a direct answer to students' perennial question: How and why is this concept useful? A list of real-world applications used throughout the text appears on the inside of the front cover.

## New Topics

At one time, managerial economics books most closely resembled intermediate microeconomics texts with topics reworked here and there. Due to the advance of modern management techniques, the days when this was sufficient are long past. This text goes far beyond current alternatives by integrating the most important of these advances with the principal topic areas of managerial economics. Perhaps the most significant advance is the use of game theory to illuminate the firm's strategic choices. Game theoretic principles are essential to understanding strategic behavior. An entire chapter (Chapter 10) is devoted to this topic. Other chapters apply the game-theoretic approach to settings of oligopoly (Chapter 9), asymmetric information and organization design (Chapter 14), and negotiation (Chapter 15).

A second innovation of the text is its treatment of decision making under uncertainty. Managerial success—whether measured by a particular firm's profitability or by the international competitiveness of our nation's businesses as a whole—depends on making decisions that involve risk and uncertainty. Managers must strive to envision the future outcomes of today's decisions, measure and weigh competing risks, and determine which risks are acceptable. Other managerial economics textbooks typically devote a single, short chapter to decision making under uncertainty after devoting a dozen chapters to portraying demand and cost curves as if they were certain.

Decision making under uncertainty is a prominent part of *Managerial Economics*, Eighth Edition. Chapter 12 shows how decision trees can be used to structure decisions in high-risk environments. Chapter 13 examines the value of acquiring information about relevant risks, including competing in high-risk auction and procurement settings. Subsequent chapters apply the techniques of decision making under uncertainty to topics that are on the cutting edge of managerial economics: organization design and negotiation.

A third innovation is the expanded coverage of international topics and applications. In place of a stand-alone chapter on global economic issues, we have chosen to integrate international applications throughout the text. For instance, early applications in Chapters 2 and 3 include responding to exchange-rate changes and multinational pricing. Comparative advantage, tariffs and quotas, and the risks of doing international business are additional applications taken up in later chapters. In all, 14 of the 16 chapters contain international applications. In short, our aim is to leave the student with a first-hand appreciation of business decisions within the global economic environment.

A fourth innovation is the inclusion of end-of-chapter spreadsheet problems. In the last 25 years, spreadsheets have become the manager's single most important quantitative tool. It is our view that spreadsheets provide a natural means of modeling managerial



decisions. In their own way, they are as valuable as the traditional modeling approaches using equations and graphs. (This admission comes from a long-ago college math major who first saw spreadsheets as nothing more than “trivial” arithmetic and a far cry from “true” programming.) Optimization is one hallmark of quantitative decision making, and with the advent of optimizer tools, managers can use spreadsheets to model problems and to find and explore profit-maximizing solutions. A second hallmark is equilibrium analysis. Again, spreadsheet tools allow immediate solutions of what otherwise would be daunting sets of simultaneous equations.

Spreadsheets offer a powerful way of portraying economic decisions and finding optimal solutions without a large investment in calculus methods. We have worked hard to provide a rich array of spreadsheet problems in 14 of the 15 principal chapters. Some of these applications include optimal production and pricing, cost analysis with fixed and variable inputs, competitive market equilibrium in the short and long runs, monopoly practices, Nash equilibrium behavior, identifying superior mutual fund performance, and the welfare effects of externalities. In each case, students are asked to build and analyze a simple spreadsheet based on an example provided for them. In addition, a special appendix in Chapter 2 provides a self-contained summary of spreadsheet optimization. In short, using spreadsheets provides new insights into managerial economics and teaches career-long modeling skills.

## Organization, Coverage, and Level

This textbook can be used by a wide range of students, from undergraduate business majors in second-level courses to MBA students and executive program participants. The presentation of all topics is self-contained. Although most students will have taken an economics principles course in their recent, or not so recent, past, no prior economic tools are presumed. The presentations begin simply and are progressively applied to more and more challenging applications. Each chapter contains a range of problems designed to test students’ basic understanding. A number of problems explore advanced applications and are indicated by an asterisk. Suggested references at the end of each chapter direct students to extensions and advanced applications of the core topics presented in the chapter.

Although this text has many unique features, its organization and coverage are reasonably standard. All of the topics that usually find a home in managerial economics are covered and are in the usual sequence. As noted earlier, the analytics of profit maximization and optimal pricing are presented up front in Chapter 2 and the second part of Chapter 3. If the instructor wishes, he or she can defer these optimization topics until after the chapters on demand and cost. In addition, the book is organized so that specific chapters can be omitted without loss of continuity. In the first section of the book, Chapters 4 and 5 fit into this category. In the second section of the book, Chapters 7, 8, and 9 are core chapters that can stand alone or be followed by any combination of the remaining chapters. The book concludes with applications chapters, including chapters on decision making under uncertainty, asymmetric information, negotiation, and linear programming that are suitable for many broad-based managerial economics courses.

Analyzing managerial decisions requires a modest amount of quantitative proficiency. In our view, understanding the *logic* of profit-maximizing behavior is more important than mathematical sophistication; therefore, *Managerial Economics*, Eighth Edition, uses only the most basic techniques of differential calculus. These concepts are explained and summarized in the appendix to Chapter 2. Numerical examples and applications abound throughout all of the chapters. In our view, the best way for students to master the material is to learn by example. Four to six “Check Stations”—mini-problems that force students to test themselves on their quantitative understanding—appear throughout each chapter. In short, the text takes a quantitative approach to managerial decision making without drowning students in mathematics.

## THE EIGHTH EDITION

While continuing to emphasize managerial decision making, the Eighth Edition of *Managerial Economics* contains several changes.

First, we have extensively revised and updated the many applications in the text. Analyzing the pricing of Amazon’s Kindle; using regression analysis to estimate box-office revenues for film releases; assessing the impact of OPEC’s oil cartel; judging the government’s antitrust case against Microsoft; or weighing the challenges of corporate governance in the aftermath of the financial crisis—these are all important and timely economic applications.

Second, we have highlighted and expanded an applications feature called *Business Behavior*. The rapidly growing area of behavioral economics asks: How does actual decision making behavior and practice compare with the prescriptions of economics and decision analysis? In many cases, the answer is that decisions rely on psychological responses, heuristic methods, and bounded rationality as much as on logic and analysis. In almost every chapter, we take deliberate time to provide an assessment (based on cutting-edge research findings) of real-world decision-making behavior, noting the most common pitfalls to avoid.

Throughout the text, we have included a wide range of end-of-chapter problems, from basic to advanced. Each chapter also contains a wide-ranging discussion question designed to frame broader economic issues. We have also updated each chapter’s suggested bibliographic references, including numerous Internet sites where students can access and retrieve troves of economic information and data on almost any topic.

The Eighth Edition examines the economics of information goods, e-commerce, and the Internet—topics first introduced in previous editions. While some commentators have claimed that the emergence of e-commerce has overturned the traditional rules of economics, this text takes a more balanced view. In fact, e-commerce provides a dramatic illustration of the power of economic analysis in analyzing new market forces. Any analysis of e-commerce must consider such issues as network and information externalities, reduced marginal costs and transaction costs, pricing and revenue sources, control of standards, e-commerce strategies, product versioning, and market segmentation, to name just a few topics. E-commerce applications appear throughout the text in Chapter 3 (demand), Chapter 6 (cost), Chapters 7 and 9 (competitive effects), and Chapter 14 (organization of the firm).

Finally, the Eighth Edition is significantly slimmer than earlier editions. Inevitably, editions of textbooks grow longer and longer as authors include more and more concepts, applications, and current examples. By pruning less important material, we have worked hard to focus student attention on the most important economic and decision-making principles. In our view, it is better to be shorter and clearer than to be comprehensive and overwhelming. Moreover, most of the interesting examples have not been lost, but rather have been moved to the Samuelson and Marks website at [www.wiley.com/college/samuelson](http://www.wiley.com/college/samuelson), where they can be accessed by instructors and students.

## ANCILLARY MATERIALS

**Study Guide** The student study guide is designed to teach the concepts and problem-solving skills needed to master the material in the text. Each chapter contains multiple-choice questions, quantitative problems, essay questions, and mini-cases.

**Instructor’s Manual, Test Bank, and PowerPoints** The Instructor’s Manual includes suggestions for teaching managerial economics, additional examples to supplement in-text examples, suggested cases, references to current articles in the business press, anecdotes, follow-up on text applications, and answers to the back-of-chapter problems. The test bank contains over 500 multiple-choice questions, quantitative problems, essay questions, and mini-cases.

**Respondus Test Bank** The test bank is available electronically in Respondus format on the book companion site.

**Online Chapter** Chapter 17 is now available on the book companion site at [www.wiley.com/college/samuelson](http://www.wiley.com/college/samuelson).

All instructor materials are available by accessing Wiley’s website at [www.wiley.com/college/samuelson](http://www.wiley.com/college/samuelson)

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**Wiley’s E-Text** for *Managerial Economics, 8th edition* takes learning from traditional to cutting edge by integrating inline interactive multimedia with market-leading content. This exciting new learning model brings textbook pages to life—no longer just a static e-book, the E-Text enriches the study experience with dynamic features:

- **Interactive Tables and Graphs** allow students to access additional rich layers and “hot areas” of explanation by manipulating slider controls or clicking on embedded “hotspots” incorporated into select tables and graphs

- **Practice Quizzes** allow students to practice as they read and thereby receive instant feedback on their progress
- **Audio-Enhanced Graphics** provide further explanations for key graphs in the form of short audio clips.

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# CHAPTER 1

## Introduction to Economic Decision Making

*The crucial step in tackling almost all important business and government decisions begins with a single question: What is the alternative?*

ANONYMOUS

- LO#1.** Describe seven different kinds of decisions that managers face.
- LO#2.** Outline the six steps in the decision-making process.
- LO#3.** Contrast decision making in the private and public sectors.

Decision making lies at the heart of most important business and government problems. The range of business decisions is vast: Should a high-tech company undertake a promising but expensive research and development program? Should a petrochemical manufacturer cut the price of its best-selling industrial chemical in response to a new competitor's entry into the market? Should management of a food products company launch a new product after mixed test-marketing results?

Likewise, government decisions range far and wide: Should the Department of Transportation impose stricter rollover standards for sports utility vehicles? Should a city allocate funds for construction of a harbor tunnel to provide easy airport and commuter access? These are all economic decisions. In each case, a sensible analysis of what decision to make requires a careful comparison of the advantages and disadvantages (often, but not always, measured in dollars) of alternative courses of action.

**Managerial economics** is the analysis of major management decisions using the tools of economics. Managerial economics applies many familiar concepts from economics—demand and cost, monopoly and competition, the allocation of resources, and economic trade-offs—to aid managers in making better decisions. This book provides the framework and the economic tools needed to fulfill this goal.

In this chapter, we begin our study of managerial economics by stressing decision-making applications. In the first section, we introduce seven decision examples, all of which we will analyze in detail later in the text. Although these examples cover only some applications of economic analysis, they represent the breadth of managerial economics and are intended to whet the reader's appetite. Next, we present a basic model of the decision-making process as a framework in which to apply economic analysis. This model proposes six steps to help structure complicated decisions so that they may be clearly analyzed.

After presenting the six steps, we outline a basic theory of the firm and of government decisions and objectives. In the concluding section, we present a brief overview of the topics covered in the chapters to come.

## SEVEN EXAMPLES OF MANAGERIAL DECISIONS

The best way to become acquainted with managerial economics is to come face to face with real-world decision-making problems. The seven examples that follow represent the different kinds of decisions that private- and public-sector managers face. All of them are revisited and examined in detail in later chapters.

The examples follow a logical progression. In the first example, a global carmaker faces the most basic problem in managerial economics: determining prices and outputs to maximize profit. As we shall see in Chapters 2 through 6, making decisions requires a careful analysis of revenues and costs.

The second example highlights competition between firms, the subject of Chapters 7 through 10. Here, three large office supply chains are battling for market share in a multitude of regional markets. Each is trying to secure a monopoly, but when rivals build superstores in the same city, they frequently get caught up in price wars.

The next two examples illustrate public-sector decisions: The first concerns funding a public project, the second is a regulatory decision. Here, a shift occurs both in the decision maker—from private to public manager—and in the objectives. As we argue in Chapter 11, government decisions are guided by the criterion of benefit–cost analysis rather than by profit considerations.

The final three examples involve decision making under uncertainty. In the fifth example, the failure of BP to identify and manage exploration risks culminated in the 2010 explosion of its *Deepwater Horizon* drilling rig in the Gulf of Mexico. In the next example, a pharmaceutical company is poised between alternative risky research and development (R&D) programs. Decision making under uncertainty is the focus of Chapters 12 and 13. In the final example, David Letterman and two rival television networks are locked in a high-stakes negotiation as to which company will land his profitable late-night show. Competitive risk in the context of negotiation is taken up in Chapter 15.

### Multinational Production and Pricing

Almost all firms face the problem of pricing their products. Consider a US multinational carmaker that produces and sells its output in two geographic regions. It can produce cars in its home plant or in its foreign subsidiary. It sells cars in the domestic market and in the foreign market. For the next year, it must determine the prices to set at home and abroad, estimate sales for each market, and establish production quantities in each facility to supply those sales. It recognizes that the markets for vehicles at home and abroad differ with respect to demand (i.e., how many cars can be sold at different prices). Also, the production facilities have different costs and capacities. Finally, at a cost, it can ship vehicles from the home facility to help supply the foreign market, or vice versa. Based on the available information, how can the company determine a profit-maximizing pricing and production plan for the coming year?



For the last 25 years, three giant office supply chains—Staples, Office Depot, and Office Max—have engaged in a cutthroat retail battle. In major city after major city, the rivals have opened superstores, often within blocks of each other.

This ongoing competition raises a number of questions: How do the chains assess the profitability of new markets? Where and when should each enter new markets? What if a region's office-supply demand is sufficient to support only one superstore? What measures might be taken by an incumbent to erect entry barriers to a would-be entrant? In view of accelerating office supply sales via the Internet, can mega bricks-and-mortar office supply stores survive?

As chief city planner of a rapidly growing Sun Belt city, you face the single biggest decision of your tenure: whether to recommend the construction of a new harbor bridge to connect downtown with the surrounding suburbs located on a northern peninsula. Currently, suburban residents commute to the city via a ferry or by driving a long-distance circular route. Preliminary studies have shown that there is considerable need and demand for the bridge. Indeed, the bridge is expected to spur economic activity in the region as a whole. The projected cost of the bridge is \$75 million to \$100 million. Toll charges on commuting automobiles and particularly on trucks could be instituted to recoup a portion of the bridge's costs. But, if bridge use falls short of projections, the city will be saddled with a very expensive white elephant. What would you recommend?

Environmental regulations have a significant effect on business decisions and consumer behavior. Charles Schultze, former chairperson of the President's Council of Economic Advisers, describes the myriad problems associated with the regulations causing electric utilities to convert from oil to coal.

Petroleum imports can be conserved by switching [utilities] from oil-fired to coal-fired generation. But barring other measures, burning high-sulfur Eastern coal substantially increases pollution. Sulfur can be "scrubbed" from coal smoke in the stack, but at a heavy cost, with devices that turn out huge volumes of sulfur wastes that must be disposed of and about whose reliability there is some question. Intermittent control techniques (installing high smoke stacks and turning off burners when meteorological conditions are adverse) can, at a lower cost, reduce local concentrations of sulfur oxides in the air, but cannot cope with the growing problem of sulfates and widespread acid rainfall. Use of low-sulfur Western coal would avoid many of these problems, but this coal is obtained by strip mining. Strip-mine reclamation is possible but substantially hindered in large areas of the West by lack of rainfall. Moreover, in some coal-rich areas the coal beds form the underlying aquifer, and their removal could wreck adjacent farming or ranching economies. Large coal-burning plants might be located in remote areas far from highly populated urban centers in order to minimize the human effects of pollution. But such areas are among the few left that are unspoiled by pollution, and both environmentalists and the residents (relatively few in number compared to

### Market Entry

### Building a New Bridge

### A Regulatory Problem

those in metropolitan localities but large among the voting populations in the particular states) strongly object to this policy. Fears, realistic or imaginary, about safety and accumulation of radioactive waste have increasingly hampered the nuclear option.<sup>1</sup>

Schultze's points apply directly to today's energy and environmental trade-offs. Actually, he penned this discussion in 1977! Important questions persist. How, when, and where should the government intervene to achieve and balance its energy and environmental objectives? How would one go about quantifying the benefits and costs of a particular program of intervention?

### BP and Oil Exploration Risks

BP (known as British Petroleum prior to 2001) is in the business of taking risks. As the third largest energy company in the world, its main operations involve oil exploration, refining, and sale. The risks it faces begin with the uncertainty about where to find oil deposits (including drilling offshore more than a mile under the ocean floor), mastering the complex, risky methods of extracting petroleum, cost-effectively refining that oil, and selling those refined products at wildly fluctuating world prices. In short, the company runs the whole gamut of risk: geological, technological, safety, regulatory, legal, and market related.

Priding itself on 17 straight years of 100 percent oil reserve replacement, BP is an aggressive and successful oil discoverer. But the dark side of its strategic aspirations is its troubling safety and environmental record, culminating in the explosion of its *Deepwater Horizon* drilling rig in the Gulf of Mexico in April 2010. This raises the question: What types of decisions should oil companies like BP take to identify, quantify, manage, and hedge against the inevitable risks they face?

### An R&D Decision

A five-year-old pharmaceutical company faces a major research and development decision. It already has spent a year of preliminary research toward producing a protein that dissolves blood clots. Such a drug would be of tremendous value in the treatment of heart attacks, some 80 percent of which are caused by clots. The primary method the company has been pursuing relies on conventional, state-of-the-art biochemistry. Continuing this approach will require an estimated \$100 million additional investment and should lead to a commercially successful product, although the exact profit is highly uncertain. Two of the company's most brilliant research scientists are aggressively advocating a second R&D approach. This new biogenetic method relies on gene splicing to create a version of the human body's own anticlotting agent and is considerably riskier than the biochemical alternative. It will require a \$200 million investment and has only a 20 percent chance of commercial success. However, if the company accomplishes the necessary breakthroughs, the anti-clotting agent will represent its first blockbuster, genetically engineered drug. If successful, the method will entail minimal production costs and generate annual profits two to five times greater than a biochemically based drug would. Which method should the firm choose for its R&D investment?

<sup>1</sup>C. L. Schultze, *The Public Use of Private Interest* (Washington, DC: The Brookings Institution, 1977), 9–10.

In January 1993, David Letterman made it official—he would be leaving *Late Night* on NBC for a new 11:30 P.M. show on CBS beginning in the fall. A tangled web of negotiations preceded the move. In 1992, NBC chose the comedian Jay Leno, instead of Letterman, to succeed Johnny Carson as the host of *The Tonight Show* in an effort to keep its lock on late-night programming. Accordingly, CBS, a nonentity in late-night television, saw its chance to woo David Letterman.

After extensive negotiations, CBS offered Letterman a \$14 million salary to do the new show (a \$10 million raise over his salary at NBC). In addition, Letterman's own production company would be paid \$25 million annually to produce the show. But, NBC was unwilling to surrender Letterman to CBS without a fight. The network entered into secret negotiations with Letterman's representative, Michael Ovitz, exploring the possibility of dumping Leno and giving *The Tonight Show* to Letterman.

One group of NBC executives stood firmly behind Leno. Another group preferred replacing Leno to losing Letterman to CBS. In the end, NBC offered *The Tonight Show* to Letterman—but with the condition that he wait a year until Leno's current contract was up. David Letterman faced the most difficult decision of his life. Should he make up and stay with NBC or take a new path with CBS? In the end, he chose to leave.

The Letterman negotiations raise a number of questions. How well did Michael Ovitz do in squeezing the most out of CBS on behalf of Letterman? In its negotiations, what (if anything) could NBC have done differently to keep its star?

## SIX STEPS TO DECISION MAKING

The examples just given represent the breadth of the decisions in managerial economics. Different as they may seem, each decision can be framed and analyzed using a common approach based on six steps, as Figure 1.1 indicates. With the examples as a backdrop, we will briefly outline each step. Later in the text, we will refer to these steps when analyzing managerial decisions.

### Step 1: Define the Problem

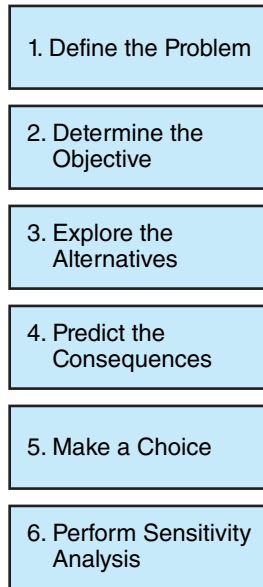
What is the problem the manager faces? Who is the decision maker? What is the decision setting or context, and how does it influence managerial objectives or options?

Decisions do not occur in a vacuum. Many come about as part of the firm's planning process. Others are prompted by new opportunities or new problems. It is natural to ask, what brought about the need for the decision? What is the decision all about? In each of the examples given earlier, the decision problem is reasonably well defined. In practice, however, managerial decisions do not come so neatly packaged; rather, they are messy and poorly defined. Thus, problem definition is a prerequisite for problem management. In fact, the decision in the fourth example—the conversion of utilities to coal—raises interesting issues concerning problem definition. How narrowly does one define the problem? Is the crux of the problem minimizing pollution from utilities? Presumably,

**FIGURE 1.1**

## The Basic Steps in Decision Making

The process of decision making can be broken down into six basic steps.



cost is also important. Thus, the problem involves determining how much pollution to clean up, by what means, and at what cost. Or is the problem much broader: reducing US dependence on foreign energy sources? If so, which domestic energy initiatives (besides or instead of utility conversion to coal) should be undertaken?

A key part of problem definition involves identifying the context. The majority of the decisions we study take place in the private sector. Managers representing their respective firms are responsible for the decisions made in five of the examples. By contrast, the third and fourth examples occur in the public sector, where decisions are made at all levels of government: local, state, and national. The recommendation concerning construction of a new bridge is made by a city agency and must be approved by the state government. Similarly, the chain of decisions accompanying the conversion of utilities from oil to coal involves numerous public-sector authorities. As one might imagine, the larger the number of bodies that share policy responsibility and the pursuit of different goals, the greater is the likelihood that decision-making problems and conflicts will occur.

**Step 2: Determine the Objective**

What is the decision maker's goal? How should the decision maker value outcomes with respect to this goal? What if he or she is pursuing multiple, conflicting objectives?

When it comes to economic decisions, it is a truism that “you can’t always get what you want.”<sup>2</sup> But to make any progress at all in your choice, you have to know what you want. In most private-sector decisions, **profit** is the principal objective of the firm and the usual barometer of its performance. Thus, among alternative courses of action, the manager will select the one that will maximize the profit of the firm. Attainment of maximum profit worldwide is the natural objective of the multinational carmaker, the drug company, and the management and shareholders of Staples, Office Depot, Office Max, BP, NBC, and CBS.

The objective in a public-sector decision, whether building a bridge or regulating a utility, is broader than the private-sector profit standard. The government decision maker should weigh all benefits and costs, not solely revenues and expenses. According to this benefit-cost criterion, the bridge in the fourth example may be worth building even if it fails to generate a profit for the government authority. In turn, regulating the production decisions of the utility depends on a careful comparison of benefits (mainly in the form of energy conservation and independence) and costs (in dollar and environmental terms).

In practice, profit maximization and benefit-cost analysis are not always unambiguous guides to decision making. One difficulty is posed by the timing of benefits and costs. Should a firm (the drug company, for example) make an investment (sacrifice profits today) for greater profits 5 or 10 years from now? Are the future benefits to commuters worth the current capital expense of building the bridge? Both private and public investments involve trade-offs between present and future benefits and costs.

Uncertainty poses a second difficulty. In some economic decisions, risks are minimal. For instance, a fast-food chain might know that it can construct a new outlet in 75 days at a cost of \$75 per square foot. The cost and timing of construction are not entirely certain, but the margin of error is small enough to be safely ignored. In contrast, the cost and date of completing a mammoth petrochemical plant are highly uncertain (due to unanticipated design changes, cost overruns, schedule delays, government regulations, and the like). At best, the plant owners may be able to estimate a range of cost outcomes and completion dates and assess probabilities for these possible outcomes.

The presence of risk and uncertainty has a direct bearing on the way the decision maker thinks about his or her objective. Both BP and the pharmaceutical company seek to maximize company profit, but there is no simple way to apply the profit criterion to determine their best actions and strategies. BP might pay \$50 million to acquire a promising site it believes is worth \$150 million and find, after thorough drilling and exploration, that the site is devoid of oil or natural gas. Similarly, the drug company cannot use the simple rule of “Choose the method that will yield the greater profit,” because the ultimate profit from either method cannot be pinned down ahead of time. There are no profit guarantees; rather, the drug company faces a choice between two risky research options. Similarly, public programs and regulatory policies generate future benefits and costs that cannot be predicted with certainty.

<sup>2</sup>Many readers will recognize this quote as a lyric penned by Mick Jagger of the Rolling Stones. What many may not know is that Jagger briefly attended the London School of Economics before pursuing the path to rock stardom.

### Step 3: Explore the Alternatives

What are the alternative courses of action? What are the variables under the decision maker's control? What constraints limit the choice of options?

After addressing the question, "What do we want?" it is natural to ask, "What are our options?" Given human limitations, decision makers cannot hope to identify and evaluate all possible options. Still, attractive options should not be overlooked or, if discovered, not mistakenly dismissed. Moreover, a sound decision framework should be able to uncover options in the course of the analysis.

In our examples, the main work of problem definition has already been carried out, greatly simplifying the identification of decision options. In the first example, the carmaker is free to set prices at home and abroad. These prices will largely determine the numbers of vehicles the firm can expect to sell in each market. It still remains for the firm to determine a production plan to supply its total projected sales; that is, the firm's other two decision variables are the quantities to produce in each facility. The firm's task is to find optimal values of these four decision variables—values that will generate a maximum level of profit.

In the other examples, the decision maker faces a choice from a relatively small number of alternatives. But even when the choices are limited, there may be more alternatives than first meet the eye. BP faces a myriad of choices as to how and where to explore for oil, how to manage its wells and refineries, and how to sell its petroleum products. Similarly, the utilities example illustrates the way in which options can multiply. There, the limitations and repercussions of the "obvious" alternatives lead to a wider consideration of other choices, which, unfortunately, have their own side effects.

The drug company might appear to have a simple either/or choice: pursue the biochemical R&D program or proceed with the biogenetic program. But there are other alternatives. For instance, the company could pursue both programs simultaneously. This strategy means investing resources and money in both but allows the firm to commercialize the superior program that emerges from the R&D competition.

Most managerial decisions involve more than a once-and-for-all choice from among a set of options. Typically, the manager faces a sequence of decisions from among alternatives. For instance, in the battle for David Letterman, each side had to formulate its current negotiation stance (in light of how much value it might expect to get out of alternative deals). How aggressive or conciliatory an offer should it make? How much can it expect the other side to concede? Thus, a commonly acknowledged fact about negotiation is that the main purpose of an opening offer is not to have the offer accepted (if it were, the offer probably was far too generous); rather, the offer should direct the course of the offers to follow. To sum up, in view of the myriad uncertainties facing managers, most ongoing decisions should best be viewed as *contingent* plans.

### Step 4: Predict the Consequences

What are the consequences of each alternative action? Should conditions change, how would this affect outcomes? If outcomes are uncertain, what is the likelihood of each? Can better information be acquired to predict outcomes?

Depending on the situation, the task of predicting the consequences may be straightforward or formidable. Sometimes elementary arithmetic suffices. For instance, the simplest profit calculation requires only subtracting costs from revenues. The choice between two safety programs might be made according to which saves the greater number of lives per dollar expended. Here the use of arithmetic division is the key to identifying the preferred alternative.

In more complicated situations, however, the decision maker often must rely on a model to describe how options translate into outcomes. A **model** is a simplified description of a process, relationship, or other phenomenon. By deliberate intent, a model focuses on a few key features of a problem to examine carefully how they work while ignoring other complicating and less important factors. The main purposes of models are to explain and to predict—to account for past outcomes and to forecast future ones.

The kinds of predictive models are as varied as the decision problems to which they are applied. Many models rest on economic relationships. Suppose the multinational carmaker predicts that a 10 percent price cut will increase unit sales by 15 percent in the foreign market. The basis for this prediction is the most fundamental relationship in economics: the demand curve. Staples' decision of when and how to enter a new market depends on predictions of demand and cost and of how its rivals might be expected to respond. These elements may be captured with a model of competitive behavior among oligopolists.

Other models rest on statistical, legal, and scientific relationships. The construction and configuration of the new bridge (and its likely environmental impact) and the plan to convert utilities to coal depend in large part on engineering predictions. Evaluations of test-marketing results rely heavily on statistical models. Legal models, interpretations of statutes, precedents, and the like are pertinent to predictions of a firm's potential patent liability and to the outcome in other legal disputes. Finally, the drug company's assessment of the relative merits of competing R&D methods rests on scientific and biological models.

A key distinction can be drawn between deterministic and probabilistic models. A **deterministic model** is one in which the outcome is certain (or close enough to a sure thing that it can be taken as certain). For instance, a soft-drink manufacturer may wish to predict the numbers of individuals in the 10-to-25 age group over the next five years. There are ample demographic statistics with which to make this prediction. Obviously, the numbers in this age group five years from now will consist of those who today are between ages 5 and 20, minus a predictable small number of deaths. Thus, a simple deterministic model suffices for the prediction. However, the forecast becomes much less certain when it comes to estimating the total consumption of soft drinks by this age group or the market share of a particular product brand. The share of a particular drink will depend on many unpredictable factors, including the advertising, promotion, and price decisions of the firm and its competitors, as well as consumer preferences. As the term suggests, a **probabilistic model** accounts for a range of possible future outcomes, each with a probability attached.

## Step 5: Make a Choice

After all the analysis is done, what is the preferred course of action? For obvious reasons, this step (along with step 4) occupies the lion's share of the analysis and discussion