Introduction to

# BEHAVIORAL ECONOMICS

DAVID R. JUST

WILEY

# Introduction to Behavioral Economics

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## NONECONOMIC FACTORS THAT SHAPE ECONOMIC DECISIONS

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WILEY

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*To Vibeka, Liam, Alex and Caden for the inspiration and education they have lovingly provided me.*

# Brief Contents

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# Preface

With the popularity of books such as *Nudge* or *Predictably Irrational*, we have seen a corresponding increase in interest among undergraduate students and professional students in behavioral economics. These concepts have great appeal to interested students because they are presented in the popular media as—at once—both novel and rooted in common sense or intuition. In my experience teaching behavioral economics I find that with each new irrational behavior I introduce, students are drawn in by the puzzle: why would someone would behave in such a way. This suspense makes them all the more engaged when it is time for the reveal—the behavioral explanation that makes the behavior intuitive. Over the first years of instructing I came to enjoy the in class response of the students to each of the anomalies, and especially those I could demonstrate with their own behavior in an in-class experiment. It wasn't until later that I realized just how important this class was. An alumnus of my class then employed gainfully on Wall Street, sought me out while visiting campus to tell me how the principles I had taught changed his career and how he viewed his life. He cited how several of the behavioral models in the class were now very important in determining a winning strategy, and encouraged me to drive this message home with the current crop of students. This was the first of many interactions with students having similar stories.

## Who Should Use this Book

The primary audience for this book is juniors and seniors in economics and business programs who want to know how the theories of economics stack up against reality. The book may also be appropriate for some graduate programs. The book assumes that students have had a course in intermediate microeconomics. Most students of behavioral economics are not primarily seeking training as experimental economists or academic researchers in general. Rather they are lead by a desire to (1) learn to avoid the common pitfalls of irrational behavior, and (2) increase the profitability of employers by learning to take advantage of consumer behavior or (3) more accurately model or predict market outcomes. The current set of textbooks exploring areas of behavioral economics focus primarily on the research experiments that have fueled the discipline. These experiments hold an important place in training any behavioral economist. However, the proper audience for this book is interested in experiments more as a set of examples of the broader principles of behavior. This is a basic textbook on behavioral economics focusing on the broader principles of behavior. Behavioral economic principles are illustrated using real world examples, examples from the experimental literature as well as experiential examples in the form of laboratory exercises. While presenting

experimental and real world examples are useful, a key to helping students understand behavioral economics is to put them in a position to experience the effects themselves. Thus, the instructions provided with the instructor's edition provides a set of classical classroom experiments that complement the material in this text.

Some pieces of the text require a calculus background. However, an attempt has been made to isolate these sections within Advanced Concept Boxes so that they may be easily skipped if necessary. Exercises related to these advanced sections are marked with a ¤. The overwhelming majority of behavioral economics can be described in simple language, graphs, examples and a few simple equations. Thus I have attempted to create a text that is flexible enough to be useful for a wide variety of audiences. Economics instructors, for example, may desire a more rigorous treatment of the mathematical models than many business instructors. Separate sections of each chapter focus on the modeling of behavior from an individual choice perspective, and on the implications of behavior from a profit-maximizing firm perspective. Economics training tends to focus attention on the individual choice model and implications for public policy and markets. Business teaching tends to focus on how firms profit motives can best be met given the behavior of individuals.

In addition to discussion of applications, significant space is devoted to management and policy implications. Behavioral economics has only recently begun to take seriously the potential impacts of behavioral theory on welfare economics and policy. Yet the contributions of Matthew Rabin and others have been substantial and influential. One important point of debate includes the role of government in helping individuals avoid mistakes in judgment. This has lead to heated debate about whether we can determine what is a mistake and what is simply an expression of preferences. Further, ethical issues can be raised when firms seek to take advantage of behavioral anomalies. Is it ethical to use auction mechanisms that are known to elicit winning bids that exceed the winner's willingness to pay? Should the government step in to regulate firms that take advantage of behavioral anomalies? These issues will be touched upon throughout the book, while the final chapter focuses attention of these issues in a much more thorough and rigorous discussion.

## Philosophy

Behavioral economics seeks to explain common and systematic deviations from the behavior implied by rational economic models. These deviations are called behavioral anomalies. In order to appreciate what is and is not an anomaly, the student needs to have some basic understanding of the rational economic model taught in core economics classes. Indeed, I have found my own course in behavioral economics to be very useful in cementing a student's understanding of the basics of consumer, producer and elementary game theory concepts. In order to underscore the contrast between rational and irrational, each chapter contains sections that describe the standard economic model that is relevant to the behavior being explored. Advanced economics students who already appreciate these concepts will be able to make quick work of these sections and focus more attention on the deviations described. These deviations are called behavioral anomalies, and can often be explained or understood through the marriage of rational economic models with basic psychological principles.

Currently, most who teach behavioral economics have either resorted to using collections of academic papers (published anthologies or their own selections), or popular books written for a lay audience as text books. This creates two very distinct problems. The first is an issue of level. Using a collection of papers often requires students to have a deeper understanding than can be expected of an advanced undergraduate while using books for a lay audience can leave the reader with only a superficial understanding. An organized text can help bridge this gap, building a deeper treatment on a foundation of basic principles. The second issue is organization into topics. Many behavioral and experimental economics books are organized by topics, and present many diverse experiments with conflicting results together. While this is a reasonable approach for a reference text, it can be confusing for the first-time reader. While anomalies and experiments are very diverse, the behavioral principles that have been used to explain the anomalies can be categorized into a few over-arching behavioral principles (e.g., status quo bias, overconfidence, representativeness, loss aversion, etc.). This book is organized by behavioral principles. My approach more closely mirrors the approach of typical undergraduate microeconomics textbooks. By focusing on over-arching principles, students will more easily see how to apply the principles in new contexts. I have intentionally chosen the most simple of anomalies for presentation within the first few chapters of the book allowing students to ease into the world of behavioral models through somewhat familiar concepts like the sunk cost fallacy. These are followed by some of the more difficult or confusing concepts that require greater effort to master intuitively.

## A Short Word on Experiments

Behavioral economics has long been tied to experimental economics due to the direct evidence experimental techniques have provided of decision heuristics and other non-rational decision-making. For this reason, many outside of the field of experimental economics or the field of behavioral economics believe the two are one in the same. Rather, experimental economics is a tool that is extremely useful in ferreting out behavioral phenomena. While experimental and experiential evidence is important in learning behavioral economic concepts, experimental techniques are not. An intricate understanding of experimental concepts (e.g., payoff dominance or internal validity) is no more central to learning behavioral economics than econometric techniques are to understanding intermediate microeconomics.

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# Rationality, Irrationality, and Rationalization

# 1

If economics is the study of how scarce resources are allocated given unlimited wants, **behavioral economics** may be said to focus more specifically on how scarce decision resources are allocated. Standard microeconomic modeling supposes that people make decisions with the sole purpose of making themselves better off. Behavioral economics often focuses on how people systematically deviate from the best possible decisions and what it will mean for the allocation of scarce resources. Behavioral economics is the study of how *observed* human behavior affects the allocation of scarce resources. Although the majority of microeconomic theory has focused on developing a unifying theory of behavior based on how one can logically obtain one's goal (e.g., through utility maximization) or the market forces one is likely to encounter, behavioral economics may more rightly be termed the odds and ends of economic theory. We often refer to the standard model of an economic decision maker as the **rational choice model** or simply **rational model**.

To the extent that people are observed to behave according to the rational model, behavioral economics does not deviate from standard microeconomic analysis. Were this all that was ever observed, behavioral economics would not have any use as a subdiscipline (and this would be a very short book indeed). Fortunately for us, economists have often noted a set of systematic deviations from the rational model that are either difficult to explain or model through an appeal to economic theory or that outright violate the standard economic model. We call any such deviations a **behavioral anomaly** or simply an **anomaly**. In such a situation, economic models might not be appropriate by themselves. In this case, behavioral economists seek to explain behavior by augmenting the rational choice model with principles developed in the fields of psychology, sociology, or, to a lesser extent, anthropology. Unfortunately, because behavioral economics draws from a disparate set of disciplines, there is no unifying theory of behavioral economics. Rather, the tools of behavioral economics are an eclectic and diverse set of principles that must be applied with care. Some theories are appropriate for some circumstances, but none apply generally to all decisions. This presents a challenge for the student first embarking on the journey to becoming a behavioral economist. Unlike the rest of economics, there is no single key to understanding behavioral economics. Rather, the student is responsible for learning to use a number of diverse tools that may be loosely grouped by the particular failings in rational choice theory they seek to address.

Because behavioral economics focuses so much on how people deviate from the rational choice model, it is important that the beginning student first have a clear understanding of this

model and its roots. Rightly, this is the first theory that a behavioral economist seeks to apply when describing individual behavior. It is only when using a rational model becomes impractical or inaccurate that behavioral economists seek alternative explanations. Nonetheless, these alternative explanations may be very important depending on the purpose of the modeling exercise. For example, if, as an individual, you discover that you systematically make decisions that are not in your best interest, you may be able to learn to obtain a better outcome. In this way, behavioral economics tools may be employed therapeutically to improve personal behavior and outcomes. Alternatively, if a retailer discovers that customers do not fully understand all relevant product information, the retailer might improve profits by altering the types and availability of product information. In this case, behavioral economics tools may be employed strategically to take advantage of the behavior of others. An economics researcher might also be interested in finding general theories of decision making that can be applied and tested more broadly. In this case, behavioral economics tools may be applied academically. The motivation for employing behavioral economics, be it therapeutic, strategic, or academic, in large part determines the types of models and phenomena that are important to the interested student. To this end, we employ three types of economic models: rational, behavioral, and procedurally rational. Throughout this book, we use these distinctions in discussing the uses and applications for behavioral economic modeling.

Finally, the roots and history of behavioral economics are inextricably linked to experimental economics. Although this text tries to avoid becoming one on experimental methods, it is important to discuss some of the basics of experimental economics, why it is so useful in behavioral economics, and what this might mean for the wider use of behavioral economic concepts.

## Rational Choice Theory and Rational Modeling

Behind every rational model is the notion that people are making optimal decisions given their access to information or the other constraints that they might face in their decisions. The most common rational models used in economics are the utility-maximization model and the profit-maximization model. The utility-maximization model assumes that the person has preferences over choices that can be expressed as a utility function. This function represents the level of enjoyment or welfare the person receives for a set of choices, often thought of as a bundle of goods that can be consumed. For example, a typical model presented in a course on microeconomics might suppose that one can consume two goods measured by the quantities $x_1$ and $x_2$. The person's decision problem could then be represented as

$$\max_{x_1, x_2} U(x_1, x_2) \tag{1.1}$$

subject to a budget constraint

$$p_1 x_1 + p_2 x_2 \leq y, \tag{1.2}$$

where $U(x_1, x_2)$ is the utility obtained from consuming amounts $x_1$ and $x_2$, $p_1$ is the price of good 1, $p_2$ is the price of good 2, and $y$ is the total budget that can be spent. The consumer's problem in equations 1.1 and 1.2 is to find the consumption bundle $(x_1, x_2)$ that maximizes his utility without exceeding his budget constraint. It is generally assumed that utility increases as either $x_1$ or $x_2$ increases. Further, the underlying preferences are assumed to be **complete** and **transitive**. By complete, we mean that given any two possible consumption bundles, $(\hat{x}_1, \hat{x}_2)$ and $(\tilde{x}_1, \tilde{x}_2)$, the consumer prefers bundle 1, $(\hat{x}_1, \hat{x}_2)$, prefers bundle two, $(\tilde{x}_1, \tilde{x}_2)$, or is indifferent between the two. No possible pair of bundles exists for which the consumer has no preference. By transitive, we mean that given any three bundles, if the consumer prefers $(\hat{x}_1, \hat{x}_2)$ to $(\tilde{x}_1, \tilde{x}_2)$, and the consumer prefers $(\tilde{x}_1, \tilde{x}_2)$ to $(\overline{x}_1, \overline{x}_2)$, then the consumer cannot prefer $(\overline{x}_1, \overline{x}_2)$ to $(\hat{x}_1, \hat{x}_2)$. Information about the consumer's preferences over consumption bundles is coded in the utility function by assigning a higher utility number to any bundle that is preferred or by assigning an equal number to any bundles to which the consumer is indifferent.

The decision problem can be represented as in Figure 1.1. The consumer can only consume any point in the triangle with sides formed by the $x_1$ axis, the $x_2$ axis, and the budget constraint, which is the straight downward-sloping line found by solving the budget constraint for the quantity of good 2 as a function of the amount of good 1, $x_2 = (y - p_1x_1)/p_2$. Preferences are represented in Figure 1.1 by indifference curves, a collection of consumption bundles such that each point in the set results in the same level of utility. Figure 1.1 depicts three indifference curves, each curving to the southeast as one moves down the $x_2$ axis. Indifference curves that are farther to the northeast of the figure represent higher levels of consumption of both goods and thus represent a higher level of utility. The assumption of complete and transitive preferences implies that these indifference curves cannot intersect one another. The intersection of two different indifference curves would require the intersection point to result in two different levels of utility.

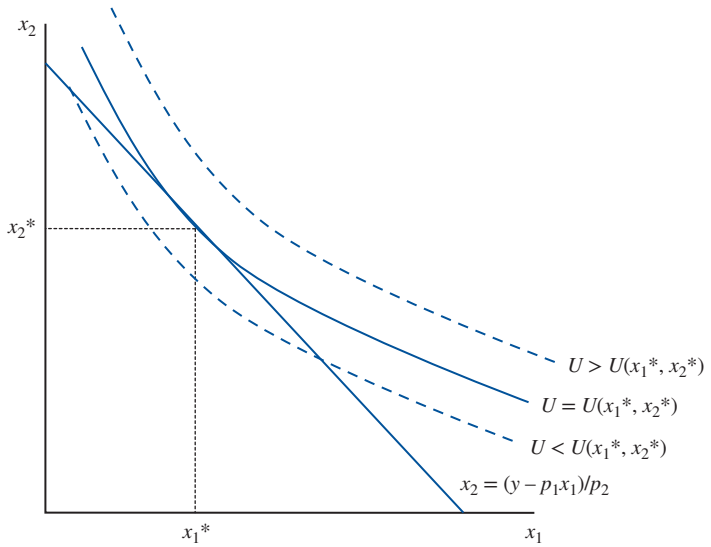


FIGURE 1.1
Utility Maximization

For a full discussion of the utility maximization model, the reader is referred to Nicholson and Snyder or Varian. The consumer problem is to maximize utility by finding the northeastern-most indifference curve that has at least one point that satisfies the budget constraint. This can occur at the intersection of the budget constraint with the $x_1$ axis (where $x_1 = y/p_1$ and $x_2 = 0$), where the budget constraint intersects the $x_2$ axis (where $x_1 = 0$ and $x_2 = y/p_2$), or at a point such as $(x_1^*, x_2^*)$ in Figure 1.1, where the indifference curve is tangent to the budget constraint. We call this third potential solution an internal solution, and the first two are referred to as corner solutions. Internal solutions are the most commonly modeled solutions given the mathematical convenience of determining a tangency point and the triviality of modeling single-good consumption. The set of tangency points that are traced out by finding the optimal bundle while varying the total budget is called the **income expansion path**. It generally reflects increasing consumption as income increases for any normal good, and it reflects decreasing consumption for any inferior good.

To find the solution to the utility-maximization problem, we must define the concept of marginal utility. The marginal utility of $x_1$, which we denote $\partial U(x_1, x_2)/\partial x_1$, is the amount of utility gained by increasing consumption of $x_1$, or the slope of the utility curve with respect to $x_1$. The marginal utility of $x_2$, denoted $\partial U(x_1, x_2)/\partial x_2$, is the utility gained from increasing consumption of $x_2$, or the slope of the utility curve with respect to $x_2$. An internal solution to the utility maximization problem occurs where the ratio of the marginal utilities is equal to the ratio of prices:

$$\frac{\frac{\partial}{\partial x_1} U(x_1^*, x_2^*)}{\frac{\partial}{\partial x_2} U(x_1^*, x_2^*)} = \frac{p_1}{p_2}. \tag{1.3}$$

Note that $-p_1/p_2$ is the slope of the budget constraint. The slope of an indifference curve is equal to $-\frac{\partial U(x_1, x_2)}{\partial x_1} / \frac{\partial U(x_1, x_2)}{\partial x_2}$. Thus, any point solving equation 1.3 yields a point on the indifference curve with the same slope as the budget constraint. If in addition that point is on the budget constraint, $p_1 x_1^* + p_2 x_2^* = y$, then we have found the optimal consumption bundle. The Advanced Concept box at the end of this chapter presents a mathematical derivation of this concept for the interested reader.

## Rationality and Demand Curves

If we know the functional form for the utility function we can find the marginal utility function. Then we can solve the system of equations 1.2 and 1.3 for a set of two demand functions, $x_1^*(p_1, p_2, y)$ and $x_2^*(p_1, p_2, y)$, that represent the amount of good 1 and good 2 that will make the consumer as well off as he can possibly be given the prices for the goods and the allocated budget. This model implies a set of relationships between prices and quantities based on the assumption of a utility function and its relationship to the quantity consumed. In particular, one may derive the law of demand—that as the price of a good increases, a consumer will purchase less of that good—which may be useful in pricing and marketing goods. This model makes several assumptions about the structure of the problem that are common among nearly all utility-maximization problems.

Foremost among these assumptions is the notion that the consumer has a set of well-understood and stable preferences over the two goods. However, simple introspection can lead us to question even the most basic of these assumptions. If consumers have a well-defined and stable set of preferences over goods, then what role can advertising serve other than to inform the customer about the availability or characteristics of a product? Were this the case, advertisements for well-known products should not be terribly effective. However, marketers for well-known products continue to buy advertising, often providing ads that yield no new information to the consumer. Further, consumers are often faced with goods with which they are unfamiliar or have not considered purchasing, and thus they might have incomplete preferences.

The utility-maximization model assumes that consumers know how their choice will result in a particular outcome. It seems reasonable that consumers choosing to buy four apples would know that the result would be their consuming four apples at some point in the future; but they might not know how many contain worms or have irregularities in taste or texture. In fact, consumers seldom face decisions with completely certain outcomes even for the simplest actions. In some cases, the consumer might not even be certain of the possible choices available. In an unfamiliar restaurant, diners might not fully read the menu to know the full range of possible choices. Even if they do, they might not be aware of the menu of the neighboring ice cream parlor and consider only the dessert possibilities at the restaurant.

Finally, the model assumes that consumers have the ability to determine what will make them better off than any other choice and that they have the ability to choose this option. The notion that the consumer can identify the best outcome before making a choice seems counter to human experience. Students might believe they should have studied more or at a different time in the semester, and people often feel that they have overeaten. Where exams and food consumption are repeated experiences, it seems strange that a person would not be able to eventually identify the correct strategy—or lack the ability to choose that strategy. Nonetheless, it happens. Perhaps this is due to an inability to execute the correct strategy. Maybe the spirit is willing but the flesh is weak. Rational models of consumer choice rely heavily on complete and transitive preferences, as well as on the ability of the consumer to identify and execute those preferences. If any of these assumptions were violated, the rational model of consumer choice would struggle to describe the motivation for individual behavior.

Even so, these violations of the underlying assumptions might not matter, depending on how we wish to use the model. There are two primary lines of argument for why we might not care about violations. First, if these assumptions are violated, we may be able to augment the model to account for the discrepancy resulting in a new model that meets the conditions of rationality. For example, if the consumer is uncertain of the outcomes, we may be able to use another rational-based model that accounts for this uncertainty. This would involve assuming preferences over the experience of uncertainty and modeling the level of uncertainty experienced with each good, such as the expected utility model discussed in later chapters, and supposing again that consumers optimize given their constraints and preferences. A second argument notes that a model is designed to be an abstraction from the real world. The whole point of a model is to simplify the real-world relationships to a point that we can make sense or use of it. Thus, even if the assumptions of our model are violated, consumers might behave as if they are

maximizing some utility function. Paul Samuelson once compared this as-if approach to a billiards player who, although he does not carry out the mathematical calculations, behaves as if he can employ the physics formulas necessary to calculate how to direct the desired ball into the desired hole. This as-if utility function, once estimated, may be useful for predicting behavior under different prices or budgets or for measuring the effects of price changes. Even if it is only an approximation, the results may be close enough for our purposes.

In truth, the adequacy of the model we choose depends tremendously on the application we have in mind. If we wish primarily to approximate behavioral outcomes, and the variation from the behavior described by the model is not substantial for our purpose, the rational model we have proposed may be our best option. Our reference to a deviation from rational behavior as an anomaly suggests that substantial deviations are rare, and thus rational theory is probably adequate for most applications. If the variations are substantial, then we might need to consider another approach. It is true that many of the applications of behavioral economics could be modeled as some sort of rational process. For example, a consumer might use a rule of thumb to make some decisions because of the costs involved in making a more-deliberate and calculated choice. In this case, the consumer's cognitive effort might enter the utility function leading to the observed heuristic. The consumer, though not at the best consumption choice given unlimited cognitive resources, is still the best off he or she can be given the cognitive costs of coming upon a better consumption choice. On occasion this is a successful strategy for dealing with an observed behavior. More often than not, however, it leads to an unwieldy model that, although more general, is difficult to use in practice. Occam's razor, the law of research that states that we should use as few mechanisms as possible to explain a relationship, might compel us to use a nonrational approach to modeling some economic behavior.

If instead, we are interested in the motivation of the decision maker, rather than simply approximating behavior under a narrow set of circumstances, the as-if approach might not be useful. For example, using mathematical physics to describe a pool player's shots might yield relatively accurate descriptions of the players' strategy until the pool table is tilted 15 degrees. At this point, the pool player is dealing with an unfamiliar circumstance and could take some significant time learning to deal with the new playing surface before our model might work again.

The need for a simple model drove classical economists to abstract from real behavior by assuming that all decision makers act as if they are interested only in their own well-being, with full understanding of the world they live in, the cognitive ability to identify the best possible choices given their complete and logical preferences, and the complete ability to execute their intended actions. Such omniscience might seem more befitting a god than a human being. Nineteenth-century economists dubbed this ultrarational being *Homo economicus*, noting that it was a severe but useful abstraction from the real-world behavior of humans. Although no one ever supposed that individual people actually possessed these qualities, nearly the whole of economic thought was developed based on these useful abstractions. As theory has developed to generalize away from any one of the superhuman qualities of *Homo economicus*, the term has become more of a derisive parody of traditional economic thought. Nonetheless, there is tremendous use in this, absurd though it is, starting point for describing human behavior.

In addition to the utility model, microeconomic theory also hinges very heavily on the notion that firms make decisions that will maximize their profit, defined as revenues minus costs. This is actually a somewhat stronger assumption than utility maximization because it generally specifies a relationship between a choice variable and the assignment of profit, which is generally observable. Alternatively, utility is not observable, and thus it can have an arbitrary relationship to choice variables. For example, a common profit-maximization model may be written as

$$\max_x pf(x) - rx - C, \tag{1.4}$$

where $x$ is the level of input used in the production process, $p$ is the price the firm receives for output, $f(x)$ is a production function representing the level of output as a function of input, $r$ is the input price, and $C$ is the fixed cost of operation. To find the solution to equation 1.4, we must define the marginal revenue and the marginal cost functions. Revenue in equation 1.4 is given by $pf(x)$. Marginal revenue, denoted $\partial(pf(x))/\partial x = p \times \partial f(x)/\partial x$, is the additional amount of revenue (price times quantity sold) that is received by increasing the input, or the slope of the revenue function. Here, $\partial f(x)/\partial x$ is the slope of the production function. The marginal cost is the additional cost of increasing the amount of input used, $r$. The profit-maximization problem is generally solved where the marginal revenue from adding an additional input is equal to the marginal cost of production so long as rent, $pf(x) - rx$, is great enough to cover the fixed cost of operation. Otherwise the firm will not produce because they would lose money by doing so. Marginal cost is equal to marginal revenue where $p\,\partial f(x^*)/\partial x = r$, or in other words at the point where a line tangent to the production function has a slope of $r/p$. This is the point depicted in Figure 1.2, where $\varphi$ is an arbitrary constant required to satisfy tangency.

The profit-maximization model generally employs assumptions that are similar to *Homo economicus* assumptions in scope and scale. However, unlike people, firms face

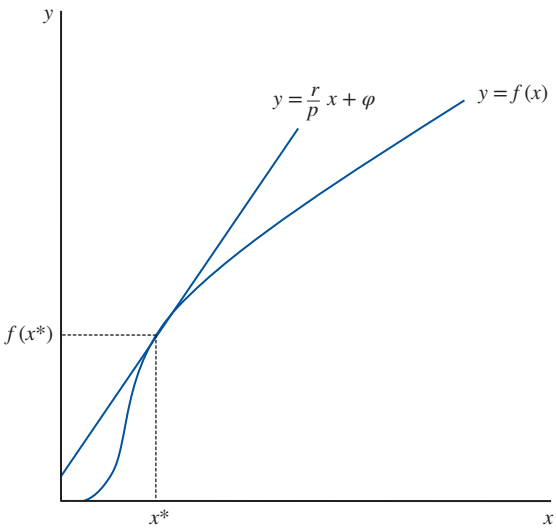


FIGURE 1.2
Profit Maximization

competitive pressures from others such that they disappear or cease to operate if they continually make bad decisions while their competitors make better decisions. A systematic error in judgment may be considered as an added cost to production or a competitive disadvantage. Because of this, in the context of a competitive industry, many have argued that behavioral economics has no place because firms that fail to maximize profit will be driven from the marketplace by smarter firms. Moreover, many behaviors that are rational under the utility-maximization model are not admissible under profit maximization. The models allow for differences in taste but not for differences in the measurement of profit. Thus those whose preferences get in the way of profit maximization may also be pushed out of the market by competitive pressures. This places a heavier burden on behavioral economists to prove the existence of behavior that is inconsistent with profit maximization by firms in cases where they believe profit is not truly the only motive.

Importantly, analysis using a rational model limits the scope of benevolent policy. By assuming that people have made the best choice possible, only policies that deal in interpersonal effects of economic behavior may improve an individual's well-being. Thus, a person who decides to smoke cigarettes, or, in a more extreme case, jump off of a bridge, cannot be made better off by a government that wishes to stop them. The rational model assumes these people knowingly chose the outcome that would make them the best off they could be. However, a secondhand smoker, who unwillingly inhales the smoke of nearby smokers, may be made better off if a policymaker limits the ability of others to smoke. In general, the rational model cannot suggest ways to abridge the choice of an individual to make that individual better off. In this sense, the rational model is not therapeutic.

## Bounded Rationality and Model Types

Although many of the important concepts in behavioral economics precedes him by many years, the current incarnation of behavioral economics owes much to the work of Herbert Simon. Simon first described the notion of *bounded rationality*. Specifically, this is the notion that whereas people might have a desire to find the optimal decision, they have limits on their cognitive abilities, limits on access to information, and perhaps limits on other necessary resources for making decisions. Because of these limitations, rather than optimize, people seek to simplify their decision problem by narrowing the set of possible choices, by narrowing the characteristics of outcomes that they might consider, or by simplifying the relationships between choices and outcomes. Thus, instead of optimizing by making the best overall choice, a boundedly rational person instead optimizes using some simplified decision framework. Naturally, this simplified decision framework depends directly on the particular decision resources available to that person. Hence, the proximity of the individual decision to the rational optimum depends not only on the structure of the problem and the information available but also on the characteristics of the person making the decision. Hence, education, experience, emotion, time pressure, stress, or the need to make multiple decisions at once might play directly into the accuracy of the individual decision maker. The decision mechanism may be termed a *heuristic*, or a simple general rule that may

be used to approximate the solution to the utility or profit-maximization problem. The heuristic most likely results in a close approximation of the true optimum under most circumstances. It is this ability to approximate the optimal choice that makes it useful to the decision maker. However, there may be some circumstances under which the differences are substantial and observable.

Economists have taken several approaches to modeling boundedly rational behavior. Two primary approaches are of particular importance. The first approach is a **behavioral model**. A behavioral model seeks to simply describe observed behavior. In some cases, it augments a rational model of behavior with some function or appendage that describes the observed deviations from rational decision making. One advantage of such a model is that it is based in empirical observations, and it is thus extremely accurate in the context in which observations were made. Additionally, behavioral models can be used to describe *any* type of behavior, because they are not based on any particular assumptions about the underlying motivations of the individual. For this same reason, however, behavioral models might not be the best tool for many jobs. Because the model is observation based, it is only as accurate as the observations taken. Thus, if we changed the decision context substantially, the model might no longer be appropriate. For example, we might repeatedly observe someone with two food objects placed in front of him: an apple on the left and a lemon on the right. Suppose each time we observe a choice, the person chooses the apple. One behavioral model might suggest the person always chooses the object on the left. If we then used this model to predict what would happen if a lemon were placed on the left and an apple on the right, we would be disappointed if the individual were actually choosing the object that delivered a preferred taste.

The downfall of the behavioral model is that it does not tell us *why*, only *what*. Thus, we cannot generalize the behavioral model to various contexts and decisions. To do this, we would need to understand the actual decision mechanism underlying the decision. Additionally, because the behavioral model does not yield the individual motivation for decisions, it provides an inappropriate instrument for trying to help someone to make better decisions. By simply describing the types of behavior observed, a behavioral model does not provide any rationale for how someone may be made better off. Thus again, our model might describe what behaviors or conditions are associated with deciding to smoke. However, this alone does not tell us if the person would be better off if the choice to smoke were removed by some policymaker. Alternatively, a behavioral model may be very appropriate for making predictions in highly similar contexts. For example, a firm marketing a product may derive and estimate a behavioral model of consumer purchases for the product. So long as the underlying decision problems of the consumers remain the same, the behavioral model may be very accurate and appropriate for their particular marketing efforts.

An alternative approach is to attempt to model the motivation for the decision mechanism. We call this a *procedurally rational model*. A person is procedurally rational if his or her decision is the result of logical deliberation. This deliberation might include misperceptions or other constraints, but the process by which the decision is arrived at itself is reasoned. Thus, a procedural rational model attempts to provide a reasoned decision mechanism that might not always arrive at the correct choice owing to misperceptions, limits on cognitive ability, or other constraints on decision resources. Given the decision motivations are properly modeled, a procedurally rational model may