II

THE BUILDING BLOCKS OF DEMAND AND SUPPLY

The next four chapters describe and analyze the basic building blocks with which economists analyze markets and their two essential elements, buyers (consumers) and sellers (producers). As in a piece of machinery, all the parts of a market operate simultaneously together, so there is no logical place to begin the story. Furthermore, the heart of the story is not found in the individual components, but in the way they fit together. The four central microeconomics chapters start off with the separate components, but then assemble them into a working model of how firms determine price and output simultaneously. Then Chapter 9 deals with stocks and bonds as tools that help business firms obtain the finances they need to operate and as earnings opportunities for potential investors in firms.

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Consumer Choice: Individual and Market Demand

CHAPTER 6
Demand and Elasticity

CHAPTER 7
Production, Inputs, and Costs: Building Blocks for Supply Analysis

CHAPTER 8
Output, Price, and Profit: The Importance of Marginal Analysis

CHAPTER 9
Investing in Business: Stocks and Bonds

5

CONSUMER CHOICE: INDIVIDUAL AND MARKET DEMAND

Everything is worth what its purchaser will pay for it.

PUBLILIUS SYRUS (1ST CENTURY B.C.)

You are about to start a new year in college, and your favorite clothing store is having a sale. So you decide to stock up on jeans. How do you decide how many pairs to buy? How is your decision affected by the price of the jeans and the amount of money you earned in your summer job? How can you get the most for your money? Economic analysis provides some rational ways to make these decisions. Do you think about your decision as an economist would, either consciously or unconsciously? Should you? By the end of the chapter, you will be able to analyze such purchase decisions using concepts called "utility" and "marginal analysis."

Chapter 4 introduced you to the idea of supply and demand and the use of supply and demand curves to analyze how markets determine prices and quantities of products sold. This chapter will investigate the underpinnings of the demand curve, which, as we have already seen, shows us half of the market picture.

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PUZZLE: *Why Shouldn't Water Be Worth More Than Diamonds?*

When Adam Smith lectured at the University of Glasgow in the 1760s, he introduced the study of demand by posing a puzzle. Common sense, he said, suggests that the price of a commodity must somehow depend on what that good is worth to consumers—on the amount of *utility* that the commodity offers. Yet, Smith pointed out, some cases suggest that a good's utility may have little influence on its price.

Smith cited diamonds and water as examples. He noted that water has enormous value to most consumers; indeed, its availability can be a matter of life and death. Yet water often sells at a very low price or is even free of charge, whereas diamonds sell for very high prices even though few people would consider them necessities. We will soon be in a position to see how marginal analysis, the powerful method of analysis introduced in this chapter, helps to resolve this paradox.


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SCARCITY AND DEMAND

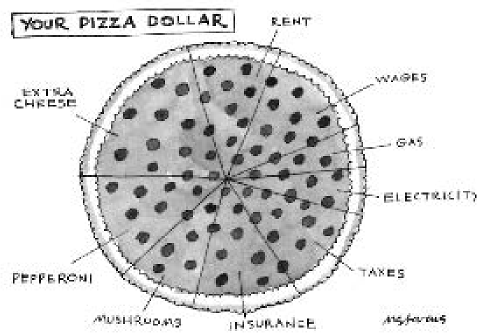
When economists use the term "demand," they do not mean mere wishes, needs, requirements, or preferences. Rather, "demand" refers to actions of consumers who, so to speak, put their money where their mouths are. "Demand" assumes that consumers *can* pay for the goods in question and that they are also *willing* to pay out the necessary money. Some of us may, for example, dream of owning a racehorse or a Lear jet, but only a few wealthy individuals can turn such fantasies into effective demands.

Any individual consumer's choices are subject to one overriding constraint that is at least partly beyond that consumer's control: The individual has only a limited income available to spend. This scarcity of income is the obvious reason why less affluent consumers demand fewer computers, trips to foreign countries, and expensive restaurant meals than wealthy consumers do. The scarcity of income affects even the richest of all spenders—the government. The U.S. government spends billions of dollars on the armed services, education, and a variety of other services, but governments rarely, if ever, have the funds to buy everything they want.

Because income is limited (and thus is a scarce resource), any consumer's purchase decisions for different commodities must be *interdependent.* The number of movies that Jane can afford to see depends on the amount she spends on new clothing. If John's parents have just sunk a lot of money into an expensive addition to their home, they may have to give up a vacation trip. Thus, no one can truly understand the demand curves for movies and clothing, or for homes and vacation trips, without considering demand curves for alternative goods.

The quantity of movies demanded, for example, probably depends not only on ticket prices but also on the prices of clothing. Thus, a big sale on shirts might induce Jane to splurge on several, leaving her with little or no cash to spend on movies. So, an analysis of consumer demand that focuses on only one commodity at a time leaves out an essential part of the story. Nevertheless, to make the analysis easier to follow, we begin by considering products in isolation. That is, we employ what is called "partial analysis," using a standard simplifying assumption. This assumption requires that all other variables remain unchanged. Later in the chapter and in the appendix, we will tell a fuller story.

UTILITY: A TOOL TO ANALYZE PURCHASE DECISIONS



In the American economy, millions of consumers make millions of decisions every day. You decide to buy a movie ticket instead of a paperback novel. Your roommate decides to buy two tubes of toothpaste rather than one tube or three tubes. How do people make these decisions?

Economists have constructed a simple theory of consumer choice based on the hypothesis that each consumer spends her or his income in the way that yields the greatest amount of satisfaction, or *utility*. This seems to be a reasonable starting point, because it says only that people do what they prefer. To make the theory operational, we need a way to measure utility.

A century ago, economists envisioned utility as an indicator of the pleasure a person derives from consuming some set of goods, and they thought that utility could be measured directly in some kind of psychological units (sometimes called *utils*) after somehow reading the consumer's mind. Gradually, they came to realize that this was an unnecessary and, perhaps, impossible task. How many utils did you get from the last movie you saw? You probably cannot answer that question because you have no idea what a util is. Neither does anyone else.

But you may be able to answer a different question like, "How many hamburgers would you give up to get that movie ticket?" If you answer "three," no one can say how many utils you get from seeing a film, but they can say that you get more from the movie than from a single hamburger. When economists approach the issue in this manner, hamburgers, rather than the more vague "utility," become the unit of measurement. They can say that the utility of a movie (to you) is three hamburgers.

Early in the twentieth century, economists concluded that this indirect way of measuring consumer benefit gave them all they needed to build a theory of consumer choice. One can measure the benefit of a movie ticket by asking how much of some other commodity (like hamburgers) you are willing to give up for it. Any commodity will do for this purpose, but the simplest, most commonly used choice, and the one that we will use in this book, is money.[1]

The Purpose of Utility Analysis: Analyzing How People *Behave*, Not What They *Think*

Here, a very important warning is required: Money (or hamburgers, for that matter) can be a very imperfect measure of utility. The reason is that measuring utility by means of money is like measuring the length of a table with a rubber yardstick. The value of a dollar changes—sometimes a great deal—depending on circumstances. For example, if you win $10 million in the lottery, an additional dollar can confidently be expected to add much less to your well-being than it would have one week earlier. After you hit the jackpot, you may not hesitate to spend $9 on a hamburger, whereas before you would not have spent more than $3. This difference does not mean that you now love hamburgers three times as much as before. Consequently, although we use

[1] Note to Instructors: You will recognize that, although not using the terms, we are distinguishing here between neoclassical *cardinal utility* and *ordinal utility*. Moreover, throughout the book, *marginal utility in money terms* (or *money marginal utility*) is used as a synonym for the *marginal rate of substitution* between money and the commodity.

money as an indicator of utility in this book, it should not be taken as an indicator of the consumer's psychological attitude toward the goods he or she buys.

So why do we use the concept of money utility? There are two good reasons. First, we do know how to approach *measuring* it (see next section), but we do not know how to measure what is going on inside the consumer's mind. Second, and much more important, it is extremely useful for analyzing demand behavior—what consumers will spend to buy some good, even though it is *not* a good indicator of what is going on deep inside their brains.

Total Versus Marginal Utility

The **total utility** of a quantity of a good to a consumer (measured in money terms) is the maximum amount of money that he or she is willing to give up in exchange for it.

Thus, we define the **total monetary utility** of a particular bundle of goods to a particular consumer as *the largest sum of money that person will voluntarily give up in exchange for those goods.* For example, imagine that you love pizza and are planning to buy four pizzas for a party you are hosting. You are, as usual, a bit low on cash. Taking this into account, you decide that you are willing to buy the four pies if they cost up to $52 in total, but you're not willing to pay more than $52. As economists, we then say that the *total utility* of four pizzas to you is $52, the maximum amount you are willing to spend to have them.

The **marginal utility** of a commodity to a consumer (measured in money terms) is the maximum amount of money that she or he is willing to pay for *one more unit* of that commodity.

Total monetary utility (from which we will drop the word "monetary" from here on) measures your dollar evaluation of the benefit that you derive from your total purchases of some commodity during some selected period of time. *Total* utility is what really matters to you. But to understand which decisions most effectively promote total utility, we must make use of a related concept, **marginal** (monetary) **utility.** This concept is not a measure of the amount of benefit you get from your purchase decision but, rather, provides *a tool* with which you can analyze how much of a commodity that you must buy to make your total utility as large as possible. Your marginal utility of some good, X, is defined as *the addition to total utility that you derive by consuming one more unit of X.* If you consumed two pizzas last month, marginal utility indicates how much additional pleasure you would have received by increasing your consumption to three pizzas. Before showing how marginal utility helps to find what quantity of purchases makes total utility as large as possible, we must first discuss how these two figures are calculated and just what they mean.

Table 1 helps to clarify the distinction between marginal and total utility and shows how the two are related. The first two columns show how much *total* utility (measured in money terms) you derive from various quantities of pizza, ranging from zero to eight per month. For example, a single pizza pie is worth (no more than) $15 to you, two are worth $28 in total, and so on. The *marginal* utility is the *difference* between any two successive total utility figures. For example, if you have consumed three pizzas (worth $40.50 to you), an additional pie brings your total utility to $52. Your marginal utility is thus the difference between the two, or $11.50.

Remember: Whenever we use the terms *total utility* and *marginal utility*, we define them in terms of the consumer's willingness to part with *money* for the commodity, not in some unobservable (and imaginary) psychological units.

TABLE 1

Your Total and Marginal Utility for Pizza This Month

(1) Quantity (Q) Pizzas per Month	(2) Total Utility (TU)	(3) Marginal Utility (MU) = ($\Delta TU/\Delta Q$)	(4) Point in Figure 1
0	$0.00		
		$15.00	*A*
1	15.00		
		13.00	*B*
2	28.00		
		12.50	*C*
3	**40.50**		
		11.50	*D*
4	**52.00**		
		8.00	*E*
5	60.00		
		5.00	*F*
6	65.00		
		3.00	*G*
7	68.00		
		0.00	*H*
8	68.00		

Note: Each entry in Column (3) is the difference between successive entries in Column (2). This is what is indicated by the zigzag lines.

The "Law" of Diminishing Marginal Utility

With these definitions, we can now propose a simple hypothesis about consumer tastes:

The more of a good a consumer has, the less *marginal* utility an additional unit contributes to overall satisfaction, if all other things remain unchanged.

Economists use this plausible proposition widely. The idea is based on the assertion that every person has a *hierarchy* of uses for a particular commodity. All of these uses are valuable, but some are more valuable than others. Take pizza, for example. Perhaps you consider your *own* appetite for pizza first—you buy enough pizza to satiate your own personal taste for it. But pizza may also provide you with an opportunity to satisfy your social needs. So instead of eating all the pizza you buy, you decide to have a pizza party. First on your guest list may be your boyfriend or girlfriend. Next priority is your roommate, and, if you feel really flush, you may even invite your economics instructor! So, if you buy only one pizza, you eat it yourself. If you buy a second pizza, you share it with your friend. A third is shared with your roommate, and so on.

The point is: Each pizza contributes something to your satisfaction, but each *additional* pizza contributes less (measured in terms of money) than its predecessor because it satisfies a lower-priority use. This idea, in essence, is the logic behind the **"law" of diminishing marginal utility,** which asserts that the more of a commodity you already possess the smaller the amount of (marginal) utility you derive from acquisition of yet another unit of the commodity**.**

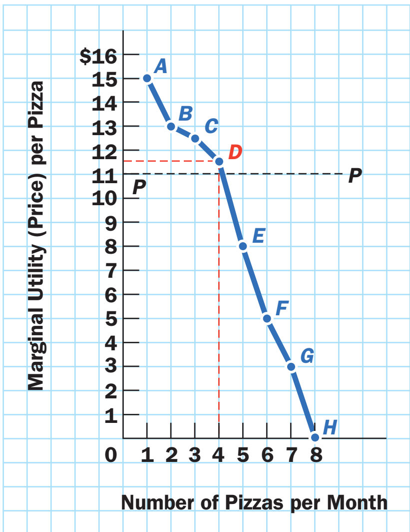
The **"law" of diminishing marginal utility** asserts that additional units of a commodity are worth less and less to a consumer in money terms. As the individual's consumption increases, the marginal utility of each additional unit declines.

The third column of Table 1 illustrates this concept. The marginal utility (abbreviated MU) of the first pizza is $15; that is, you are willing to pay *up to* $15 for the first pie. The second is worth no more than $13 to you, the third pizza only $12.50, and so on, until you are willing to pay only $5 for the sixth pizza (the MU of that pizza is $5).

Figure 1, a marginal utility curve, shows a graph of the numbers in the first and third columns of Table 1. For example, point *D* indicates that the MU of a fourth pizza is $11.50. So, at any higher price, you will not buy a fourth pizza.

FIGURE 1

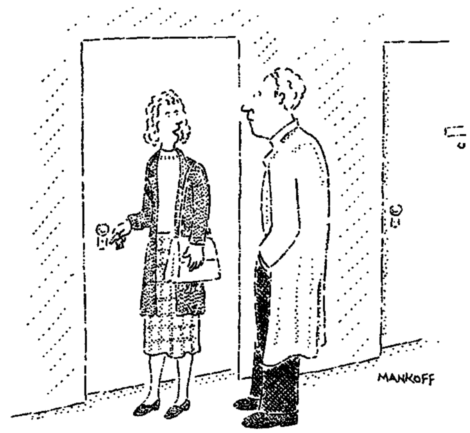
A Marginal Utility (or Demand) Curve: Your Demand for Pizza This Month



Note that the curve for marginal utility has a negative slope; it also illustrates how marginal utility diminishes as the quantity of the good rises. Like most laws, however, the "law" of diminishing marginal utility has exceptions. Some people want even more of some good that is particularly significant to them as they acquire more, as in the case of addiction. Stamp collectors and alcoholics provide good examples. The stamp collector who has a few stamps may consider the acquisition of one more to be mildly amusing. The person who has a large and valuable collection may be prepared to go to the ends of the earth for another stamp. Similarly, an alcoholic who finds the first beer quite pleasant may find the fourth or fifth to be absolutely irresistible. Economists generally treat such cases of increasing marginal utility as anomalies. For most goods and most people, marginal utility declines as consumption increases.

Table 1 illustrates another noteworthy relationship. Observe that as someone buys more and more units of the commodity—that is, as that person moves further down the table—the *total* utility numbers get larger and larger, while the *marginal* utility numbers get smaller and smaller. The reasons should now be fairly clear. The marginal utility numbers keep declining, as the "law" of diminishing marginal utility tells us they will. But *total* utility keeps rising so long as marginal utility remains positive. A person who owns ten compact disks, other things being equal, is better off (has higher total utility) than a person who possesses only nine, as long as the MU of the tenth CD is positive. In summary:

As a rule, as a person acquires more of a commodity, total utility increases and marginal utility from that good decreases, all other things being equal. In particular, when a commodity is very scarce, economists expect it to have a high marginal utility, even though it may provide little total utility because people have so little of the item.



"It's been fun, Dave, but I think we're entering the diminished marginal utility phase of our relationship."

Using Marginal Utility: The Optimal Purchase Rule

Now let us use the concept of marginal utility to analyze consumer choices. Consumers must always choose among the many commodities that compete for their limited supply of dollars. How can you use the idea of utility to help you understand the purchase choices permitted by those dollars that best serve your preferences?

You can obviously choose among many different quantities of pizza, any of which will add to your total utility. But which of these quantities will yield the greatest net benefits? If pizza were all that you were considering buying, in theory the choice would involve a simple calculation. We would need a statistical table that listed all of the alternative numbers of pizzas that you may conceivably buy. The table should indicate the *net* utility that each possible choice yields. That is, it should include the total utility that you would get from a particular number of pizzas, minus the utility of the other purchases you would forego by having to pay for them—their opportunity cost. We could then simply read your optimal choice from this imaginary table—the number of pizzas that would give you the highest net utility number.

Even in theory, calculating optimal decisions is, unfortunately, more difficult than that. No real table of net utilities exists; an increase in expenditure on pizzas would mean less money available for clothing or movies, and you must balance the benefits of spending on each of these items against spending on the others. All of this means that we must find a more effective technique to determine optimal pizza purchases (as well as purchases of clothing, entertainment, and other things). That technique is **marginal analysis.**

Marginal analysis is a method for calculating optimal choices—the choices that best promote the decision maker's objective. It works by testing whether, and by how much, a small change in a decision will move things toward or away from the goal.

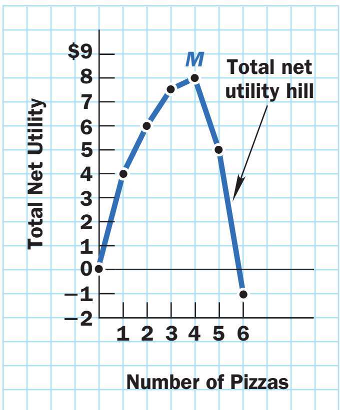
To see how marginal analysis helps consumers determine their optimal purchase decisions, first recall our assumption that you are trying to maximize the total *net* utility you obtain from your pizza purchases. That is, you are trying to select the number of pies that maximizes the total utility the pizzas provide you *minus the total utility you give up with the money you must pay for them.*

We can compare the analysis of the optimal decision-making process to the process of climbing a hill. First, imagine that you consider the possibility of buying only one pizza. Then suppose you consider buying two pizzas, and so on. If two pizzas give you a higher total net utility than one pizza, you may think of yourself as moving higher up the total net utility hill. Buying more pizzas enables you to ascend that hill higher and higher, until at some quantity you reach the top—*the optimal purchase quantity.* Then, if you buy any more, you will have overshot the peak and begun to descend the hill.

Figure 2 shows such a hill and describes how your total net utility changes when you change the number of pizzas you buy. It shows the upward-sloping part of the hill, where the number of purchases has not yet brought you to the top. Then it shows the point (*M*) at which you have bought enough pizzas to make your net utility as large as possible (the peak occurs at four pizzas). At any point to the right of *M*, you have overshot the optimal purchase. You are on the downward side of the hill because you have bought more than enough pizzas to best serve your interests; you have bought too many to maximize your net utility.

FIGURE 2

Finding Your Optimal Pizza Purchase Quantity: Maximizing Total Net Utility



Total Net Utility equals Total Utility minus Total Expenditure (Price X Quantity)

How does marginal analysis help you to find that optimal purchase quantity, and how does it warn you if you are planning to purchase too little (so that you are still on the ascending portion of the hill) or too much (so that you are descending)? The numerical example in Table 1 will help reveal the answers. The marginal utility of, for example, a third pizza is $12.50. This means that the total utility you obtain from three pizzas ($40.50) is exactly $12.50 higher than the total utility you get from two pizzas ($28). As long as marginal utility is a positive number, the more you purchase, the more total utility you will get.

That shows the benefit side of the purchase. But such a transaction also has a debit side—the amount you must pay for the purchase. Suppose that the price is $11 per pizza. Then the marginal *net* utility of the third pizza is marginal utility minus price, $12.50 minus $11, or $1.50. This is the amount that the third pizza adds to your total net utility. (See the third and fourth lines of Table 1.) So you really *are* better off with three pizzas than with two.

We can generalize the logic of the previous paragraph to show how marginal analysis solves the problem of finding the optimal purchase quantity, given the price of the commodity being purchased.

IDEAS FOR BEYOND THE FINAL EXAM

RULE 1: If marginal net utility is positive, the consumer must be buying too small a quantity to maximize total net utility. Because marginal utility exceeds price, the consumer can increase total net utility further by buying (at least) one more unit of the product. In other words, since marginal net utility (which is marginal utility minus price) tells us how much the purchase of an additional unit raises or lowers total net utility, a positive marginal net utility means that total net utility is still going uphill. The consumer has not yet bought enough to get to the top of the hill.

RULE 2: No purchase quantity for which marginal net utility is a negative number can ever be optimal. In such a case, a buyer can get a higher total net utility by cutting back the purchase quantity. The purchaser would have climbed too far on the net utility hill, passing the topmost point and beginning to descend.

This leaves only one option. The consumer cannot be at the top of the hill if marginal net utility (MU − *P*) is greater than zero—that is, if MU is greater than *P*. Similarly, the purchase quantity cannot be optimal if marginal net utility at that quantity (MU − *P*) is less than zero—that is, if MU is less than *P*. The purchase quantity can be optimal, giving the consumer the highest possible total net utility, only if:

Marginal net utility = MU − *P* = 0; that is, if MU = *P*

Consequently, the hypothesis that the consumer chooses purchases to make the largest net contribution to total utility leads to the following *optimal purchase rule:*

It always pays the consumer to buy more of any commodity whose marginal utility (measured in money) exceeds its price, and less of any commodity whose marginal utility is less than its price. When possible, the consumer should buy a quantity of each good at which price (*P*) and marginal utility (MU) are exactly equal—that is, at which

MU = *P*

because only these quantities will maximize the *net total utility* that the consumer gains from purchases, given the fact that these decisions must divide available money among all purchases.[2]

Notice that, although the consumer really cares about maximizing total *net* utility (and marginal utility is not the goal), we have used marginal analysis as a *guide* to the optimal purchase quantity. Marginal analysis serves only as an analytic method—as a means to an end. This goal is maximization of total net utility, not marginal utility or marginal net utility. In Chapter 8, after several other applications of marginal analysis, we will generalize the discussion to show how thinking "at the margin" allows us to make optimal decisions in a wide variety of fields besides consumer purchases.

Let's briefly review graphically how the underlying logic of the marginal way of thinking leads to the optimal purchase rule, MU = *P*. Refer back to the graph of marginal utilities of pizzas (Figure 1). Suppose that Paul's Pizza Parlor currently sells pizzas at a price of $11 (the dashed line *PP* in the graph). At this price, five pizzas (point *E*) is *not* an optimal purchase because the $8 marginal utility of the fifth pizza is less than its $11 price. You would be better off buying only four pizzas because that choice would save $11 with only a $8 loss in utility—a net gain of $3—from the decision to buy one less pizza.

[2] Economists can equate a dollar price with marginal utility only because they measure marginal utility in money terms (or, as they more commonly state, because they deal with the marginal rate of substitution of money for the commodity). If marginal utility were measured in some psychological units not directly translatable into money terms, a comparison of *P* and MU would have no meaning. However, MU could also be measured in terms of any commodity other than money. (Example: How many pizzas are you willing to trade for an additional ticket to a basketball game?)

You should note that, in practice, there may not exist a number of pizzas at which MU is *exactly* equal to *P*. In our example, the fourth pizza is worth \$11.50, whereas the fifth pizza is worth \$8—neither of them is *exactly* equal to their \$11 price. If you could purchase an appropriate (in-between) quantity (say, 4.38 pizzas), then MU would, indeed, exactly equal *P*. But Paul's Pizza Parlor will not sell you 4.38 pizzas, so you must do the best you can. You buy four pizzas, for which MU comes as close as possible to equality with *P*.

The rule for optimal purchases states that you should not buy a quantity at which MU is higher than price (points like *A*, *B*, and *C* in Figure 1) because a larger purchase would make you even better off. Similarly, you should not end up at points *E*, *F*, *G*, and *H*, at which MU is below price, because you would be better off buying less. Rather, you should buy four pizzas (point *D*), where $P = \text{MU}$ (approximately). Thus, marginal analysis leads naturally to the rule for optimal purchase quantities.

The decision to purchase a quantity of a good that leaves marginal utility greater than price cannot maximize total net utility, because buying an additional unit would add more to total utility than it would increase cost. Similarly, it cannot be optimal for the consumer to buy a quantity of a good that leaves marginal utility less than price, because then a reduction in the quantity purchased would save more money than it would sacrifice in utility. Consequently, the consumer can maximize total net utility only if the purchase quantity brings marginal utility as close as possible to equality with price.

Note that price is an objective, observable figure determined by the market, whereas marginal utility is subjective and reflects consumer tastes. Because individual consumers lack the power to influence the price, they must adjust purchase quantities to make their subjective marginal utility of each good equal to the price given by the market.

From Diminishing Marginal Utility to Downward-Sloping Demand Curves

We will see next that the marginal utility curve and the demand curve of a consumer who maximizes total net utility are one and the same. The two curves are identical. This observation enables us to use the optimal purchase rule to show that the "law" of diminishing marginal utility implies that demand curves typically slope downward to the right; that is, they have negative slopes.[3] To do this, we use the list of marginal utilities in Table 1 to determine how many pizzas you would buy at any particular price. For example, we see that at a price of \$8, it pays for you to buy five pizzas, because the MU of the fifth pizza ordered is \$8. Table 2 gives several alternative prices and the optimal purchase quantity corresponding to each price derived in just this way. (To make sure you understand the logic behind the optimal purchase rule, verify that the entries in the right column of Table 2 are, in fact, correct.) This *demand schedule* appears graphically as the *demand curve* shown in Figure 1. This demand curve is simply the blue marginal utility curve. This is true, because at any given price, the consumer will find it best to buy the quantity at which marginal utility is equal to the given price. So at any given quantity of the commodity, the price at which it will be bought will equal its marginal utility. That is, at each quantity, the curve tells us the price at which it will be bought, so it is a demand curve. But the curve also tells us the marginal utility at any such quantity, so it is also a marginal utility curve. You can also see its negative slope in the graph, which is a characteristic of demand curves.

TABLE 2

List of Optimal Quantities of Pizza for You to Purchase at Alternative Prices

Price	Quantity of Pizzas Purchased per Month
\$ 3.00	7
5.00	6
8.00	5
11.50	**4**
12.50	3
13.00	2
15.00	1

Note: For simplicity of explanation, the prices shown have been chosen to equal the marginal utilities in Table 1. In-between prices would make the optimal choices involve fractions of pizzas (say, 2.6 pizzas).

[3] If you need to review the concept of slope, refer to the Chapter 1 Appendix discussion on graphic analysis.

Let's examine the logic underlying the negatively sloped demand curve a bit more carefully. If you are purchasing the optimal number of pizzas, and then the price falls, you will find that your marginal utility for that product is now *above* the newly reduced price. For example, Table 1 indicates that at a price of $12.50 per pizza, you would optimally buy three pizzas, because the MU of the fourth pizza is only $11.50. If price falls below $11.50, it then pays to purchase more—it pays to buy the fourth pizza because its MU now exceeds its price. The marginal utility of the next (fifth) pizza is only $8. Thus, if the price falls below $8, it would pay you to buy that fifth pizza. So, the lower the price, the more the consumer will find it advantageous to buy, which is what is meant by saying that the demand curve has a negative slope.

Note the critical role that the "law" of diminishing marginal utility plays here. If *P* falls, a consumer who wishes to maximize total utility must buy more, to the point that MU falls correspondingly. According to the "law" of diminishing marginal utility, the only way to do this is to increase the quantity purchased.

Although this explanation is a bit abstract, we can easily rephrase it in practical terms. We have noted that individuals put commodities to various uses, each of which has a different priority. For you, buying a pizza for your date has a higher priority than using the pizza to feed your roommate. If the price of pizzas is high, it makes sense for you to buy only enough for the high-priority uses—those that offer high marginal utilities. When price declines, however, it pays to purchase more of the good—enough for some lower-priority uses. The same general assumption about consumer psychology underlies both the "law" of diminishing marginal utility and the negative slope of the demand curve. They are really two different ways of describing consumers' assumed attitudes.

Do Consumers Really Behave "Rationally" and Maximize Utility?

It may strike you that this chapter's discussion of the consumer's decision process—equating price and marginal utility—does not resemble the thought processes of any consumer you have ever met. Buyers may seem to make decisions much more instinctively and without any calculation of marginal utilities or anything like them. That is true—yet it need not undermine the pertinence of the discussion.

When you give a command to your computer, you actually activate some electronic switches and start some operations in what is referred to as *binary code*. Most computer users do not know they are having this effect and do not care. Yet they are activating binary code nevertheless, and the analysis of the computation process does not misrepresent the facts by describing this sequence. In the same way, if a shopper divides her purchasing power among various purchase options in a way that yields the largest possible utility for her money, she *must* be following the rules of marginal analysis, even though she is totally unaware of this choice.

A growing body of experimental evidence, however, has pointed out some persistent deviations between reality and the picture of consumer behavior provided by marginal analysis. Experimental studies by groups of economists and psychologists have turned up many examples of behavior that seem to violate the optimal purchase rule. For instance, one study offered two groups of respondents what were really identical options, presumably yielding similar marginal utilities. Despite this equality, depending on differences in some irrelevant information that was also provided to the respondents, the two groups made very different choices.

> One group of subjects received the information in parentheses, and the other received the information in brackets. . . .
>
> [*Problem 1*]. Imagine that you are about to purchase . . . a calculator for ($15)[$125]. The calculator salesman informs you that the calculator you wish to buy is on sale for ($10)[$120] at the other branch of the store, located a 20-minute drive away. Would you make the trip to the other store?
>
> The responses to the two versions of this problem were quite different. When the calculator cost $125 only 29 percent of the subjects said they would make the trip, whereas 68 percent said they would go when the calculator cost only $15.

SOURCE: Courtesy of Texas Instruments Incorporated.

Thus, in this problem *both* groups were really being told they could save $5 on the price of a product if they took a 20-minute trip to another store. Yet, depending on an irrelevant fact, whether the product was a cheap or an expensive model, the number of persons willing to make the same trip to save the same amount of money was very different. The point is that human purchase decisions are affected by the environment in which the decision is made, and not only by the price and marginal utility of the purchase.

SOURCE: Richard H. Thaler, *Quasi Rational Economics* (New York: Russell Sage Foundation, 1992), pp. 148–150.

CONSUMER CHOICE AS A TRADE-OFF: OPPORTUNITY COST

We have expressed the optimal purchase rule as the principle guiding a decision about how much of *one* commodity to buy. However, we have already observed that the scarcity of income lurking in the background turns every decision into a trade-off. Given each consumer's limited income, a decision to buy a new car usually means giving up some travel or postponing furniture purchases. The money that the consumer gives up when she makes a purchase—her expenditure on that purchase—is only one measure of the true underlying cost to her.

IDEAS FOR BEYOND THE FINAL EXAM

HOW MUCH DOES IT REALLY COST? **The real cost is the *opportunity cost* of the purchase—the commodities that she must give up as a result of the purchase decision. This opportunity cost calculation has already been noted in one of our *Ideas for Beyond the Final Exam*—we must always consider the real cost of our purchase decisions, which take into account how much of *other* things they force us to forgo. Any decision to buy implies some such trade-off because scarcity constrains all economic decisions. Although their dilemmas may not inspire much pity, even billionaires face very real trade-offs: Invest $200 million in an office building, or go for the $300 million baseball team?**

This last example has another important implication. The trade-off from a consumer's purchase decision does not always involve giving up another *consumer good*. This is true, for example, of the choice between consumption and saving. Consider a high school student who is deciding whether to buy a new car or to save the money to pay for college. If he saves the money, it can grow by earning interest, so that the original amount plus interest earned will be available to pay for tuition and board three years later. A decision to cut down on consumption now and put the money into the bank means that the student will be wealthier in the future because of the interest he will earn. This, in turn, will enable the student to afford more of his college expenses at the future date when those expenses arise. So the opportunity cost of a new car today is the forgone opportunity to save funds for the future. We conclude:

From the viewpoint of economic analysis, the true cost of any purchase is the opportunity cost of that purchase, rather than the amount of money that is spent on it.

The opportunity cost of a purchase can be either higher or lower than its price. For example, if your computer cost you $1,800, but the purchase required you to take off two hours from your job that pays $20 per hour, the true cost of the computer—that is, the opportunity cost—is the amount of goods you could have bought with $1,840 (the $1,800 price plus the $40 in earnings that the purchase of the computer required you to give up). In this case, the opportunity cost ($1,840, measured in money terms) is higher than the price of the purchase ($1,800). (For an example in which price is higher than opportunity cost, see Test Yourself Question 4 at the end of the chapter.)

Consumer's Surplus: The Net Gain from a Purchase

The optimal purchase rule, MU (approximately) = P, assumes that the consumer always tries to maximize the money value of the total utility from the purchase *minus* the amount spent to make that purchase.[4] Thus, any difference between the price consumers *actually* pay for a commodity and the price they would be *willing* to pay for that item represents a net utility gain in some sense. Economists give the name **consumer's surplus** to that difference—that is, to the net gain in total utility that a purchase brings to a buyer. The consumer is trying to make the purchase decisions that maximize

Consumer's surplus is difference between the value to the consumer of the quantity of Commodity *X* purchased and the amount that the market requires the consumer to pay for that quantity of *X*.

Consumer's surplus = Total utility (in money terms) − Total expenditure

[4] Again, in practice, the consumer can often only approximately equate MU and P.

Thus, just as economists assume that business firms maximize total profit (equal to total revenue minus total cost), they assume that consumers maximize consumer's surplus, that is, the difference between the total utility of the purchased commodity and the amount that consumers spend on it.

The concept of *consumer's surplus* seems to suggest that the consumer gains some sort of free bonus, or *surplus*, for every purchase. In many cases, this idea seems absurd. How can it be true, particularly for goods whose prices seem to be outrageous?

We hinted at the answer in Chapter 1, where we observed that both parties must gain from a voluntary exchange or else one of them will refuse to participate. The same must be true when a consumer makes a *voluntary* purchase from a supermarket or an appliance store. If the consumer did not expect a net gain from the transaction, he or she would simply not bother to buy the good. Even if the seller were to "overcharge" by some standard, that would merely reduce the size of the consumer's net gain, not eliminate it entirely. If the seller is so greedy as to charge a price that wipes out the net gain altogether, the punishment will fit the crime: The consumer will refuse to buy, and the greedy seller's would-be gains will never materialize. The basic principle states that every purchase that is not on the borderline—that is, every purchase except those about which the consumer is indifferent—must yield *some* consumer's surplus.

But how large is that surplus? At least in theory, it can be measured with the aid of a table or graph of marginal utilities (Table 1 and Figure 1). Suppose that, as in our earlier example, the price of a large pizza is $11 and you purchase four pizzas. Table 3 reproduces the marginal utility numbers from Table 1. It shows that the first pizza is worth $15 to you, so at the $11 price, you reap a net gain (surplus) of $15 minus $11, or $4, by buying that pizza. The second pizza also brings you some surplus, but less than the first one does, because the marginal utility diminishes. Specifically, the second pizza provides a surplus of $13 minus $11, or $2. Reasoning in the same way, the third pizza gives you a surplus of $12.50 minus $11, or $1.50. It is only the fourth serving—the last one that you purchase—that offers little or no surplus because, by the optimal purchase rule, the marginal utility of the last unit is approximately equal to its price.

We can now easily determine the total consumer's surplus that you obtain by buying four pizzas. It is simply the sum of the surpluses received from each pizza. Table 3 shows that this consumer's total surplus is

$$\$4 + \$2 + \$1.50 + \$0.50 = \$8$$

This way of looking at the optimal purchase rule shows why a buyer must always gain some consumer's surplus if she buys more than one unit of a good. Note that the price of each unit remains the same, but the marginal utility diminishes as more units are purchased. The last unit bought yields only a tiny consumer's surplus because MU (approximately) = *P*. But all prior units must have had marginal utilities greater than the MU of the last unit because of diminishing marginal utility.

We can be more precise about the calculation of the consumer's surplus with the help of a graph showing marginal utility as a set of bars. The bars labeled *A*, *B*, *C*, and *D* in Figure 3 come from the corresponding points on the marginal utility curve (demand curve) in Figure 1. The consumer's surplus from each pizza equals the marginal utility of that pizza minus the price you pay for it. By representing consumer's surplus graphically, we can determine just how much surplus you obtain from your entire purchase by measuring the area between the marginal utility curve and the horizontal line representing the price of pizzas—in this case, the horizontal line *PP* represents the (fixed) $11 price.

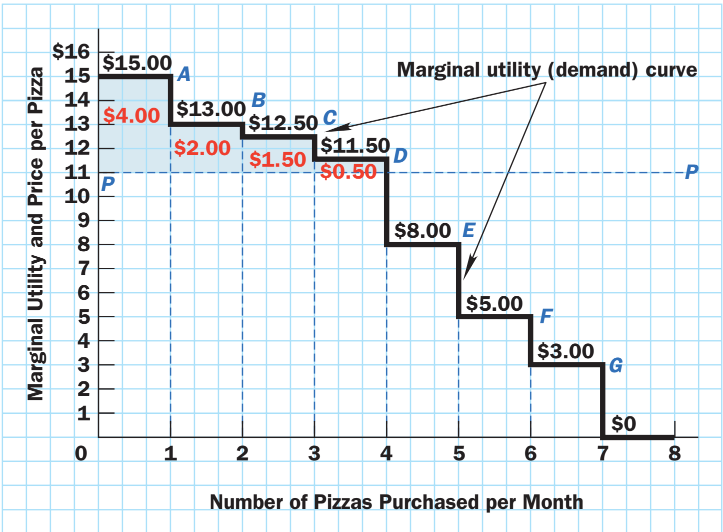
TABLE 3

Calculating Marginal Net Utility (Consumer's Surplus) from Your Pizza Purchases

Quantity	Marginal Utility	Price	Marginal Net Utility (Surplus)
0			
1	$15.00	$11.00	$4.00
2	13.00	11.00	2.00
3	12.50	11.00	1.50
4	11.50	11.00	0.50
Total			$8.00

FIGURE 3

Graphic Calculation of Consumer's Surplus



In Figure 3, the bar whose upper-right corner is labeled *A* represents the $15 marginal utility you derive from the first pizza; the same interpretation applies to the bars *B*, *C*, and *D*. Clearly, the first serving that you purchase yields a consumer's surplus of $4, indicated by the shaded part of bar *A*. The height of that part of the bar is equal to the $15 marginal utility minus the $11 price. In the same way, the next two shaded areas represent the surpluses offered by the second and third pizzas. The fourth pizza has the smallest shaded area because the height representing marginal utility is (as close as you can get to being) equal to the height representing price. Sum up the shaded areas in the graph to obtain, once again, the total consumer's surplus ($4 + $2 + $1.50 + $0.50 = $8) from a four-pizza purchase.

The consumer's surplus derived from buying a certain number of units of a good is obtained graphically by drawing the person's demand curve as a set of bars whose heights represent the marginal utilities of the corresponding quantities of the good, and then drawing a horizontal line whose height is the price of the good. The sum of the heights of the bars above the horizontal line—that is, the area of the demand (marginal utility) bars above that horizontal line—measures the *total* consumer's surplus that the purchase yields.

Resolving the Diamond–Water Puzzle

We can now use marginal utility analysis to analyze Adam Smith's paradox (which he was never able to explain) that diamonds are very expensive, whereas water is generally very cheap, even though water seems to offer far more utility. The resolution of the diamond–water puzzle is based on the distinction between marginal and total utility.

The *total* utility of water—its role as a necessity of life—is indeed much higher than that of diamonds. But price, as we have seen, is not related directly to *total* utility. Rather, the optimal purchase rule tells us that price tends to equal *marginal* utility. We have every reason to expect the marginal utility of water to be very low, whereas the marginal utility of a diamond is very high.

Given normal conditions, water is comparatively cheap to provide, so its price is generally quite low. Consumers thus use correspondingly large quantities of water. The principle of diminishing marginal utility, therefore, pushes down the marginal utility of water for a typical household to a low level. As the consumer's surplus diagram (Figure 3) suggests, this also means that its *total* utility is likely to be high.

In contrast, high-quality diamonds are scarce (partly because a monopoly keeps them so). As a result, the quantity of diamonds consumed is not large enough to drive down the MU of diamonds very far, so buyers of such luxuries must pay high prices for them. As a commodity becomes more scarce, its *marginal* utility and its market price rise, regardless of the size of its *total* utility. Also, as we have seen, because so little of the commodity is consumed, its *total* utility is likely to be comparatively low, despite its large *marginal* utility.

Thus, like many paradoxes, the diamond–water puzzle has a straightforward explanation. In this case, all one has to remember is that:

Scarcity raises price and *marginal* utility, but it generally reduces *total* utility. And although total utility measures the benefits consumers get from their consumption, it is marginal utility that is equal (approximately) to price.

Income and Quantity Demanded

Our application of marginal analysis has enabled us to examine the relationship between the *price* of a commodity and the quantity that will be purchased. But things other than price also influence the amount of a good that a consumer will purchase. As an example, we'll look at how quantity demanded responds to changes in *income*.

To be concrete, consider what happens to the number of ballpoint pens a consumer will buy when his real income rises. It may seem almost certain that he will buy more ballpoint pens than before, but that is not necessarily so. A rise in real income can either increase or decrease the quantity of any particular good purchased.

Why might an increase in income lead a consumer to buy fewer ballpoint pens? People buy some goods and services only because they cannot afford anything better. They may purchase used cars instead of new ones. They may use inexpensive ballpoint pens instead of finely crafted fountain pens or buy clothing secondhand instead of new. If their real incomes rise, they may then drop out of the used car market and buy brand-new automobiles or buy more fountain pens and fewer ballpoint pens. Thus, a rise in real income will reduce the quantities of cheap pens and used cars demanded. Economists have given the rather descriptive name **inferior goods** to the class of commodities for which quantity demanded falls when income rises.

An **inferior good** is a commodity whose quantity demanded falls when the purchaser's real income rises, all other things remaining equal.

The upshot of this discussion is that economists cannot draw definite conclusions about the effects of a rise in consumer incomes on quantity demanded. But for most commodities, if incomes rise and prices do not change, quantity demanded will increase. Such an item is often called a *normal good*.

FROM INDIVIDUAL DEMAND CURVES TO MARKET DEMAND CURVES

So far in this chapter, we have studied how *individual demand curves* are obtained from the logic of consumer choice. But to understand how the market system works, we must derive the relationship between price and quantity demanded *in the market as a whole*—the **market demand curve.** It is this market demand curve that plays a key role in the supply-demand analysis of price and output determination that we studied in Chapter 4.

A **market demand curve** shows how the total quantity of some product demanded by *all* consumers in the market during a specified period of time changes as the price of that product changes, holding all other things constant.

Market Demand as a Horizontal Sum

If each individual pays no attention to other people's purchase decisions when making his or her own, we can easily derive the market demand curve from consumers' individual demand curves: As we will see next, we simply *add* the individual consumers' demand curves, as shown in Figure 4. The figure gives the individual demand curves *DD* and *ZZ* for two people, Alex and Naomi, and the total (market) demand curve, *MM*. Alex and Naomi are both consumers of the product.

We can derive this market demand curve in the following straightforward way:

Step 1: Pick any relevant price, say, $10.

Step 2: At that price, determine Alex's quantity demanded (9 units) from his demand curve in Panel (a) of Figure 4 and Naomi's quantity demanded (6 units) from her demand curve in Panel (b) of Figure 4. Note that these quantities are indicated by the line segment labeled *AA* for Alex and that labeled *NN* for Naomi.

Step 3: Add Naomi's and Alex's quantities demanded at the $10 price (segment *AA* + segment *NN* = 9 + 6 = 15) to yield the total quantity demanded by the market at that price. This gives segment *CC*, with total quantity demanded equal to 15 units, in Panel (c) of Figure 4. Notice that the addition constitutes a *horizontal* movement in the graph because we are adding quantities purchased and those quantities are measured by horizontal distances from the zero point of the graph.

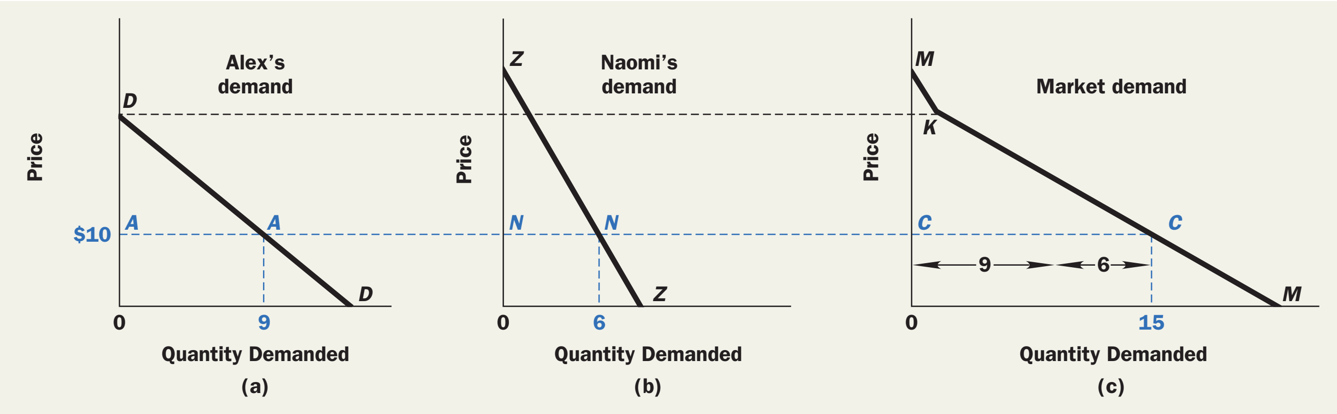


FIGURE 4

The Relationship Between Total Market Demand and the Demand of Individual Consumers Within That Market

Now repeat the process for each alternative price to obtain other points on the market demand curve until the shape of the entire curve *MM* appears. (The sharp angle at point *K* on the market curve occurs because that point corresponds to the price at which Alex, whose demand pattern is different from Naomi's, first enters the market. At any higher price, only Naomi is willing to buy anything.) That is all there is to the adding-up process. (Question: What would happen to the market demand curve if, say, another consumer entered the market?)

The "Law" of Demand

The **"law" of demand** states that a lower price generally increases the amount of a commodity that people in a market are willing to buy. Therefore, for most goods, market demand curves have negative slopes.

Just as for the case of an individual's demand curve, we expect the total quantity demanded by the market to move in the opposite direction from price. Economists call this relationship the **"law" of demand.**

Notice that we have put the word *law* in quotation marks. By now you will have observed that economic laws are not always obeyed, and we shall see in a moment that the "law" of demand is not without exceptions. But first let us see why the "law" usually holds.

Earlier in this chapter, we explained that individual demand curves usually slope downward because of the "law" of diminishing marginal utility. If individual demand curves slope downward, then the preceding discussion of the adding-up process implies that market demand curves must also slope downward. This is just common sense; if every consumer in the market buys fewer pizzas when the price of pizza rises, then the total quantity demanded in the market must surely fall.

But market demand curves may slope downward even if individual demand curves do not, because not all consumers are alike. Consider two examples where the individual's demand curve does not slope downward. If a bookstore reduces the price of a popular novel, it may draw many new customers, but few of the customers who already own a copy will buy a second one, despite the reduced price. Similarly, true devotees of pizza may maintain their pizza purchases unchanged even if prices rise to exorbitant levels, whereas others would not eat pizza even if you gave it to them free of charge. But the market prices of books and pizzas can still have a negative slope. As the price of pizza rises, less enthusiastic pizza eaters may drop out of the market entirely, leaving the expensive pie to the more devoted consumers. Thus, the quantity demanded declines as price rises, simply because higher prices induce more people to give up pizza completely. And for many commodities, lower prices encourage new customers to come into the *market* (for example, new book buyers) , and it is these "fair weather" customers (rather than the negative slope of *individual* demand curves) that can be most important for the "law" of demand.

This is also illustrated in Figure 4, in which only Naomi will buy the product at a price higher than *D*. At a price lower than *D*, Alex will also purchase the product. Hence, below point *K*, the market demand curve lies farther to the right than it would have if Alex had not entered the market. Put another way, a rise in price from a level below *D* to a level above *D* would cut quantity demanded for two reasons: (1) because Naomi's demand curve has a negative slope and (2) because it would drive Alex out of the market.

We conclude, therefore, that the "law" of demand stands on fairly solid ground. If individual demand curves slope downward, then the market demand curve surely will, too. Furthermore, the market demand curve may slope downward, even when individual demand curves do not.

Exceptions to the "Law" of Demand

Some exceptions to the "law" of demand have been noted. One common exception occurs when people judge quality on the basis of price—they perceive a more expensive commodity as offering better quality. For example, many people buy name-brand aspirin, even if right next to it on the drugstore shelf they see an unbranded, generic aspirin with an identical chemical formula, selling at half the price. The consumers who do buy the name-brand aspirin may well use comparative price to judge the relative qualities of different brands. They may prefer Brand *X* to Brand *Y because X* is slightly more expensive. If Brand *X* were to reduce its price below that of Brand *Y*, consumers might assume that it was no longer superior and actually reduce their purchases of *X*.

Another possible cause of an upward-sloping demand curve is snob appeal. If part of the reason for purchasing a $300,000 Rolls-Royce is to advertise one's wealth, a decrease in the car's price may actually reduce sales, even if the quality of the car remains unchanged. Other types of exceptions have also been noted by economists. But, for most commodities, it seems quite reasonable to assume that demand curves have negative slopes, an assumption that is supported by the data.

This chapter has begun to take us behind the demand curve, to discuss how it is determined by the preferences of individual consumers. Chapter 6 will explore the demand curve further by examining other things that determine its shape and the implications of that shape for consumer behavior.

SUMMARY

1. Economists distinguish between **total and marginal utility**. Total utility, or the benefit a consumer derives from a purchase, is measured by the maximum amount of money he or she would give up to obtain the good. Rational consumers seek to maximize (net) total utility, or **consumer's surplus**: the total utility derived from a commodity minus the value of the money spent in buying it.
2. Marginal utility is the maximum amount of money that a consumer is willing to pay for an *additional* unit of a particular commodity. *Marginal* utility is useful in calculating the set of purchases that maximizes net *total* utility. This illustrates one of our *Ideas for Beyond the Final Exam.*
3. The **"law" of diminishing marginal utility** is a psychological hypothesis stating that as a consumer acquires more and more of a commodity, the marginal utility of additional units of the commodity decreases.
4. To maximize the total utility obtained by spending money on Commodity *X*, given the fact that other goods can be purchased only with the money that remains after buying *X*, the consumer must purchase a quantity of *X* such that the price equals (or approximately equals) the commodity's marginal utility (in monetary terms).
5. If the consumer acts to maximize utility, and if her marginal utility of some good declines when she purchases larger quantities, then her demand curve for the good will have a negative slope. A reduction in price will induce her to purchase more units, leading to a lower marginal utility.
6. Abundant goods tend to have low prices and low marginal utilities regardless of whether their total utilities are high or low. That is why water can have a lower price than diamonds despite its higher total utility.
7. An **inferior good**, such as secondhand clothing, is a commodity of which consumers buy less when they get richer, all other things held equal.
8. Consumers usually earn a surplus when they purchase a commodity voluntarily. This means that the quantity of the good that they buy is worth more to them than the money they give up in exchange for it. Otherwise they would not buy it. That is why consumer's surplus is normally positive.
9. As another of our *Ideas for Beyond the Final Exam*, "How much does it really cost?", tells us, the true economic cost of the purchase of a commodity, *X*, is its opportunity cost—that is, the value of the alternative purchases that the acquisition of *X* requires the consumer to forgo. The

money value of the opportunity cost of a unit of good X can be higher or lower than the price of X.

10. A rise in a consumer's income can push quantity demanded either up or down. For normal goods, the effect of a rise in income raises the quantity demanded; for inferior goods, which are generally purchased in an effort to save money, a higher income reduces the quantity demanded.

11. The demand curve for an entire market is obtained by taking a horizontal sum of the demand curves of all individuals who buy or consider buying in that market. This sum is obtained by adding up, for each price, the quantity of the commodity in question that every such consumer is willing to purchase at that price.

KEY TERMS

Total utility 80

Marginal utility 80

The "law" of diminishing marginal utility 81

Marginal analysis 82

Consumer's surplus 86

Inferior good 89

Market demand curve 89

The "law" of demand 90

TEST YOURSELF

1. Which gives you greater *total* utility, 12 gallons of water per day or 20 gallons per day? Why?
2. At which level do you get greater *marginal* utility: 12 gallons per day or 20 gallons per day? Why?
3. Which of the following items are likely to be normal goods for a typical consumer? Which are likely to be inferior goods?
   a. Expensive perfume
   b. Paper plates
   c. Secondhand clothing
   d. Overseas trips
4. Emily buys an air conditioner that costs $600. Because the air in her home is cleaner, its use saves her $150 in curtain cleaning costs over the lifetime of the air conditioner. In money terms, what is the opportunity cost of the air conditioner?
5. Suppose that strawberries sell for $2 per basket. Jim is considering whether to buy zero, one, two, three, or four baskets. On your own, create a plausible set of total and marginal utility numbers for the different quantities of strawberries (as we did for pizza in Table 1) and arrange them in a table. From your table, calculate how many baskets Jim would buy.
6. Draw a graph showing the consumer's surplus Jim would get from his strawberry purchase in Test Yourself Question 5 and check your answer with the help of your marginal utility table.
7. Consider a market with two consumers, Jasmine and Jim. Draw a demand curve for each of the two consumers and use those curves to construct the demand curve for the entire market.

DISCUSSION QUESTIONS

1. Describe some of the different ways you use water. Which would you give up if the price of water were to rise a little? If it were to rise by a fairly large amount? If it were to rise by a very large amount?
2. Suppose that you wanted to measure the marginal utility of a commodity to a consumer by directly determining the consumer's psychological attitude or strength of feeling toward the commodity rather than by seeing how much money the consumer would give up for the commodity. Why would you find it difficult to make such a psychological measurement?
3. Some people who do not understand the optimal purchase rule argue that if a consumer buys so much of a good that its price equals its marginal utility, she could not possibly be behaving optimally. Rather, they say, she would be better off quitting while she was ahead, or buying a quantity such that marginal utility is much greater than price. What is wrong with this argument? (*Hint:* What opportunity would the consumer then miss? Is it maximization of marginal or total utility that serves the consumer's interests?)
4. What inferior goods do you purchase? Why do you buy them? Do you think you will continue to buy them when your income is higher?

APPENDIX *Analyzing Consumer Choice Graphically: Indifference Curve Analysis*

The consumer demand analysis presented in this chapter, although correct as far as it goes, has one shortcoming: By treating the consumer's decision about the purchase of each commodity as an isolated event, it conceals the fact that consumers must *choose* among commodities because of their limited budgets. The analysis so far does not explicitly indicate the hard choice behind every purchase decision—the sacrifice of some goods to obtain others.

The idea is included implicitly, of course, because the purchase of any commodity involves a trade-off between that good and money. If you spend more money on rent, you have less to spend on entertainment. If you buy more clothing, you have less money for food. But to represent the consumer's *choice* problem explicitly, economists have invented two geometric devices, the *budget line* and the *indifference curve*, which are described in this appendix.

GEOMETRY OF AVAILABLE CHOICES: THE BUDGET LINE

Suppose, for simplicity, that only two commodities are produced in the world: cheese and rubber bands. The decision problem of any household is then to allocate its income between these two goods. Clearly, the more it spends on one, the less it can have of the other. But just what is the trade-off? A numerical example will answer this question and introduce the graphical device that economists use to portray the trade-off.

Suppose that cheese costs $2 per pound, boxes of rubber bands sell at $3 each, and a consumer has $12 at his disposal. He obviously has a variety of choices, as displayed in Table 4. For example, if he buys no rubber bands, the consumer can go home with six pounds of cheese, and so on. Each of the combinations of cheese and rubber bands that the consumer can afford can be shown in a diagram in which the axes measure the quantities purchased of each commodity. In Figure 5, pounds of cheese are measured along the vertical axis, the number of boxes of rubber bands is measured along the horizontal axis, and a labeled point represents each of the combinations enumerated in Table 4. This budget line *AE* shows the possible combinations of cheese and rubber bands that the consumer can buy with $12 if cheese costs $2 per pound and a box of rubber bands costs $3. For example, point *A* corresponds to spending everything on cheese; point *E* corresponds to spending everything on rubber bands. At intermediate points on the budget line (such as *C*), the consumer buys some of both goods (at *C*, two boxes of rubber bands and three pounds of cheese), which together use up the $12 available.

If a straight line connects points *A* through *E*, the blue line in the diagram, it traces all possible ways to divide the $12 between the two goods. For example, at point *D*, if the consumer buys three boxes of rubber bands, he will have enough money left to purchase only 11/2 pounds of cheese. This is readily seen to be correct from Table 4. Line *AE* is therefore called the **budget line.**

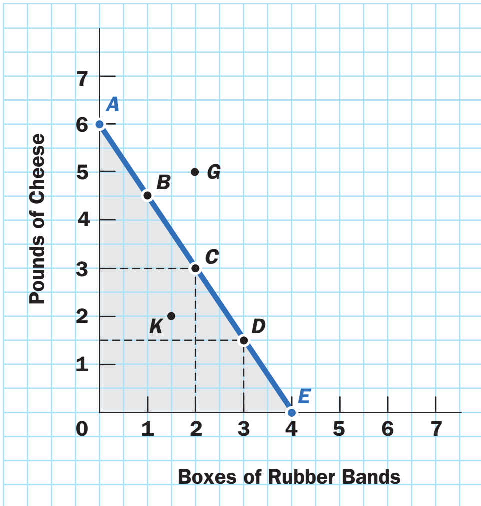
The **budget line** for a household graphically represents all possible combinations of two commodities that it can purchase, given the prices of the commodities and some fixed amount of money at its disposal.

TABLE 4

Alternative Purchase Combinations for a $12 Budget

Boxes of Rubber Bands (at $3 each)	Expenditure on Rubber Bands	Remaining Funds	Pounds of Cheese (at $2 each)	Label in Figure 5
0	$0	$12	6	*A*
1	3	9	4.5	*B*
2	6	6	3	*C*
3	9	3	1.5	*D*
4	12	0	0	*E*

FIGURE 5 A Budget Line



Properties of the Budget Line

Let us now use *r* to represent the number of boxes of rubber bands purchased by the consumer and *c* to indicate the amount of cheese that he acquires. Thus, at $2 per pound, he spends on cheese a total of $2 times the number of pounds of cheese bought, or $2*c*. Similarly, the consumer spends $3*r* on rubber bands, making a total of

\$2*c* plus \$3*r*; which must equal \$12 if he spends the entire \$12 on the two commodities. Thus, $2c + 3r = 12$ is the equation of the budget line. It is also the equation of the straight line drawn in the diagram.[5]

Note also that the budget line represents the *maximum* amounts of the commodities that the consumer can afford. Thus, for any given purchase of rubber bands, it indicates the greatest amount of cheese that his money can buy. If the consumer wants to be thrifty, he can choose to end up at a point *below* the budget line, such as *K*. Clearly, then, the choices he has available include not only those points on the budget line, *AE*, but also any point in the shaded triangle formed by that line and the two axes. By contrast, points above the budget line, such as *G*, are not available to the consumer, given his limited budget. A bundle of five pounds of cheese and two boxes of rubber bands would cost \$16, which is more than he has to spend.

Changes in the Budget Line

The position of the budget line is determined by two types of data: the prices of the commodities purchased and the income at the buyer's disposal. We can complete our discussion of the graphics of the budget line by examining briefly how a change in either prices or income affects the location of that line.

Obviously, any increase in the income of the household increases the range of options available to it. Specifically, *increases in income produce parallel shifts in the budget line*, as shown in Figure 6. The reason is simple: An increase in available income of, say, 50 percent, if spent entirely on these two goods, would permit the consumer's family to purchase exactly 50 percent more of *either* commodity. Point *A* in Figure 5 would shift upward by 50 percent of its distance from the origin, whereas point *E* would move to the right by 50 percent.[6] Figure 6 shows three such budget lines corresponding to incomes of \$9, \$12, and \$18, respectively.

Finally, we can ask what happens to the budget line when the price of some commodity changes. In Figure 7, when the price of the rubber bands *decreases*, the budget line moves outward, but the move is no longer parallel because the point on the cheese axis remains fixed. Once again, the reason is fairly straightforward. A 50 percent reduction in the price of rubber bands (from \$3.00 to \$1.50) permits the consumer to buy twice as many boxes of rubber bands with his \$12 as before: Point *E* moves rightward to point *H*, where the buyer can obtain eight boxes of rubber bands. However, since the price of cheese has not changed from point *A*, the amount of cheese that can be bought for \$12 is unaffected. This gives the general result that *a reduction in the price of one of the two commodities swings the budget line outward along the axis representing the quantity of that item while leaving the location of the other end of the line unchanged.* Thus a fall in the price of rubber bands from \$3.00 to \$1.50 swings the price line from *AE* to blue line *AH*. This happens because at the higher price,

FIGURE 6 The Effect of Income Changes on the Budget Line

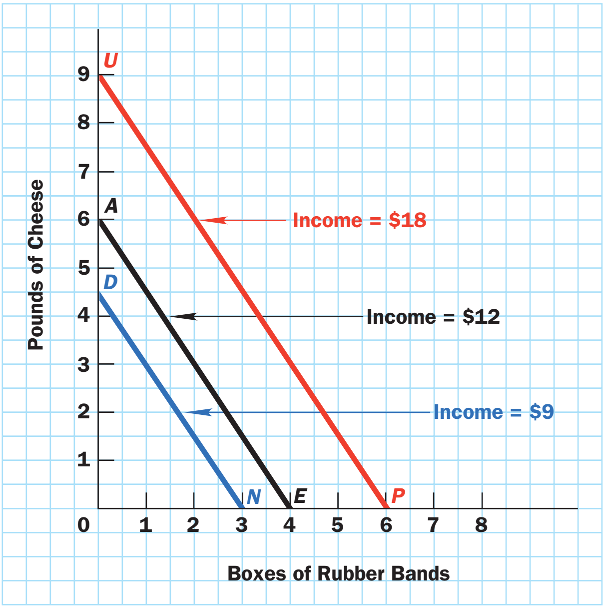
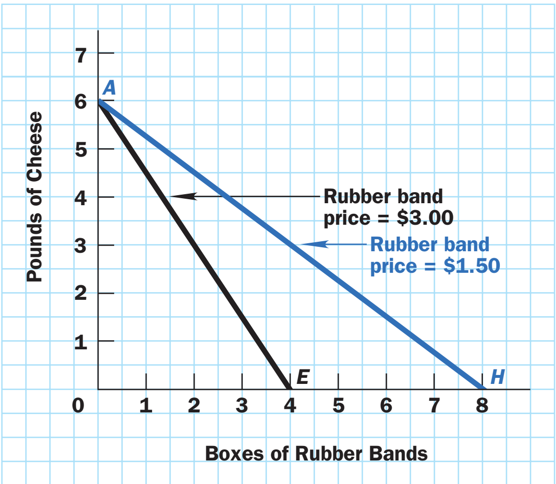


FIGURE 7 The Effect of Price Changes on the Budget Line



[5] You may have noticed one problem that arises in this formulation. If every point on the budget line, *AE*, is a possible way for the consumer to spend his money, he must be able to buy *fractional* boxes of rubber bands. Perhaps the purchase of 1½ boxes can be interpreted to include a down payment of \$1.50 on a box of rubber bands to be purchased on the next shopping trip!

[6] An algebraic proof is simple. Let *M* (which is initially \$12) be the amount of money available to the consumer's household. The equation of the budget line can be solved for *c*, obtaining $c = -(3/2)r + M/2$. This equation corresponds to a straight line with a slope of $-3/2$ and a vertical intercept of $M/2$. A change in *M*, the quantity of money available, will not change the *slope* of the budget line; rather, it will lead to parallel shifts in that line.

$12 buys only four boxes of rubber bands, but at the lower price, it can buy eight boxes.

WHAT THE CONSUMER PREFERS: PROPERTIES OF THE INDIFFERENCE CURVE

The budget line indicates what choices are *available* to the consumer, given the size of his income and the commodity prices fixed by the market. Next, we must examine the consumer's *preferences* to determine which of these available possibilities he will choose.

After much investigation, economists have determined what they believe to be the minimum amount of information they need about a purchaser in order to analyze his choices. Economists need know only how a consumer *ranks* alternative bundles of available commodities, deciding which bundle she likes better, but making no effort to find out *how much* more she likes the preferred bundle. Suppose, for instance, that the consumer can choose between two bundles of goods, Bundle *W*, which contains three boxes of rubber bands and one pound of cheese, and Bundle *T*, which contains two boxes of rubber bands and three pounds of cheese. The economist wants to know for this purpose only whether the consumer prefers *W* to *T* or *T* to *W*, or whether he is *indifferent* about which one he gets. Note that the analysis requires no information about the *degree* of preference—whether the consumer is wildly more enthusiastic about one of the bundles or just prefers it slightly.

Graphically, the preference information is provided by a group of curves called **indifference curves** (Figure 8).

> An **indifference curve** is a line connecting all combinations of the commodities that are equally desirable to the consumer.

Any point on the diagram represents a combination of cheese and rubber bands. (For example, point *T* on indifference curve I_b represents two boxes of rubber bands and three pounds of cheese.) Any two points on the same indifference curve (for example, *S* and *W*, on indifference curve I_a) represent two combinations of the goods that the consumer likes equally well. If two points, such as *T* and *W*, lie on different indifference curves, the consumer prefers the one on the higher indifference curve.

But before we examine these curves, let us see how to interpret one. A single point on an indifference curve says nothing about preferences. For example, point *R* on curve I_a simply represents the bundle of goods composed of four boxes of rubber bands and 1/2 pound of cheese. It does *not* suggest that the consumer is indifferent between 1/2 pound of cheese and four boxes of rubber bands. For the curve to indicate anything, one must consider at least two of its points—for example, points *S* and *W*. An indifference curve, by definition, represents all such combinations that provide equal utility to the consumer.

We do not know yet which bundle, among all of the bundles he can afford, the consumer will choose to buy; this analysis indicates only that a choice between certain bundles will lead to indifference. Before using indifference curves to analyze the consumer's choice, one must examine a few of its properties. Most important is the fact that:

> As long as the consumer desires *more* of each of the goods in question, *every* point on a higher indifference curve (that is, a curve farther from the origin in the graph) will be preferred to *any* point on a lower indifference curve.

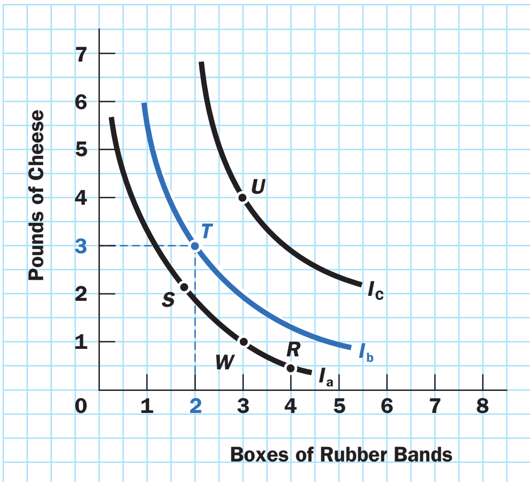
In other words, among indifference curves, *higher is better*. The reason is obvious. Given two indifference curves, say, I_b and I_c in Figure 8, the higher curve will contain points lying above and to the right of some points on the lower curve. Thus, point *U* on curve I_c lies above and to the right of point *T* on curve I_b. This means that the consumer gets more rubber bands *and* more cheese at *U* than at *T*. Assuming that he desires both commodities, the consumer must prefer *U* to *T*.

Because every point on curve I_c is, by definition, equal in desirability to point *U*, and the same relation holds for point *T* and all other points along curve I_b, the consumer will prefer *every* point on curve I_c to *any* point on curve I_b.

This at once implies a second property of indifference curves: *They never intersect*. This is so because if an indifference curve, say, I_b, is anywhere above another indifference curve, say, I_a, then I_b must be above I_a everywhere, because every point on I_b is preferred to every point on I_a.

Another property that characterizes the indifference curve is its *negative slope*. Again, this holds only if the

FIGURE 8 Three Indifference Curves for Cheese and Rubber Bands



consumer wants more of both commodities. Consider two points, such as *S* and *R*, on the same indifference curve. If the consumer is indifferent between them, one point cannot represent more of *both* commodities than the other point. Given that point *S* represents more cheese than point *R* does, *R* must offer more rubber bands than *S* does, or the consumer would not be indifferent about which he gets. As a result, any movement toward the point with the larger number of rubber bands implies a decrease in the quantity of cheese. The curve will always slope downhill toward the right, giving a negative slope.

A final property of indifference curves is the nature of their curvature—the way *they round toward the axes.* They are drawn "bowed in"—they flatten out (they become less and less steep) as they extend from left to right. To understand why this is so, we must first examine the economic interpretation of the slope of an indifference curve.

THE SLOPES OF INDIFFERENCE CURVES AND BUDGET LINES

In Figure 9, the average slope of the indifference curve between points *M* and *N* is represented by *RM/RN*.

> The **slope of an indifference curve,** referred to as the marginal rate of substitution (MRS) between the commodities, represents the maximum amount of one commodity that the consumer is willing to give up in exchange for one more unit of another commodity.

RM is the quantity of cheese that the consumer gives up in moving from *M* to *N*. Similarly, *RN* is the increased number of boxes of rubber bands acquired in this move. Because the consumer is indifferent between bundles *M* and *N*, the gain of *RN* rubber bands must just suffice to compensate him for the loss of *RM* pounds of cheese. Thus, the ratio *RM/RN* represents the terms on which the consumer is just willing—*according to his own preference*—to trade one good for the other. If *RM/RN* equals 2, the consumer is willing to give up (no more than) two pounds of cheese for one additional box of rubber bands.

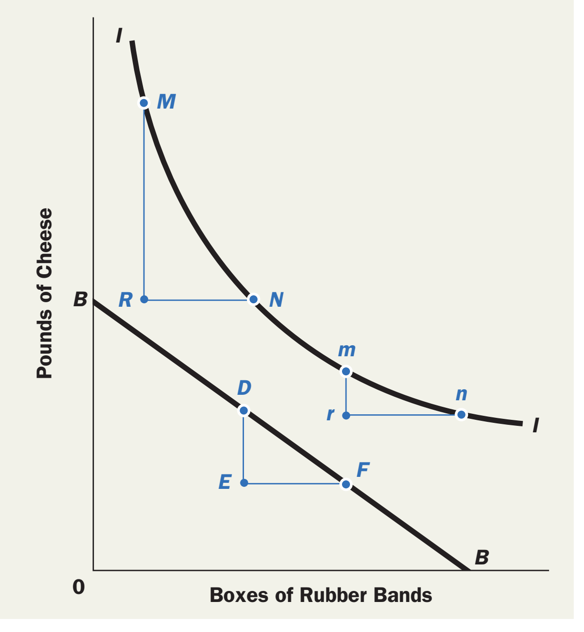
The **slope of the budget line,** *BB*, in Figure 9 is also a rate of exchange between cheese and rubber bands. But it no longer reflects the consumer's subjective willingness to trade. Rather, the slope represents the rate of exchange that *the market* offers to the consumer when he gives up money in exchange for cheese and rubber bands. Recall that the budget line represents all commodity combinations that a consumer can get by spending a fixed amount of money. The budget line is, therefore, a curve of constant expenditure. At current prices, if the consumer reduces his purchase of cheese by amount *DE* in Figure 9, he will save just enough money to buy an additional amount, *EF*, of rubber bands, because at points *D* and *F* he is spending the same total number of dollars.

> The **slope of a budget line** is the amount of one commodity that the market requires an individual to give up to obtain one additional unit of another commodity without any change in the amount of money spent.

The slopes of the two types of curves, then, are perfectly analogous in their meaning. The slope of the indifference curve indicates the terms on which the *consumer* is willing to trade one commodity for another, whereas the slope of the budget line reports the *market* terms on which the consumer can trade one good for another.

It is useful to carry our interpretation of the slope of the budget line one step further. Common sense suggests that the market's rate of exchange between cheese and rubber bands should be related to their prices, *pc* and *pr*, and it is easy to show that this is so. Specifically, the slope of the budget line is equal to the ratio of the prices of the two commodities. To see why, note that if the consumer gives up one box of rubber bands, he has *pr* more dollars to spend on cheese. But the quantity of cheese this money will enable him to buy is *inversely* related to its price; that is, the lower the price of cheese, the more cheese that money can buy—each dollar permits him to buy 1/*pc* pounds of cheese. So the additional *pr* dollars the consumer has available when he forgoes the purchase of one box of rubber bands permit him to buy *pr* times 1/*pc* = *pr*/*pc* more pounds of cheese. Thus, the slope of the budget line, which indicates how much additional cheese the consumer can buy when he gives up one box of rubber bands, is *pr*/*pc*.

FIGURE 9 Slopes of a Budget Line and an Indifference Curve



Before returning to our main subject, the study of consumer choice, we pause briefly and use our interpretation of the slope of the indifference curve to discuss the third of the properties of the indifference curve—its characteristic curvature—which we left unexplained earlier. The shape of indifference curves means that the slope decreases with movement from left to right. In Figure 9, at point *m*, toward the right of the diagram, the consumer is willing to give up far less cheese for one more box of rubber bands (quantity *rm*) than he is willing to trade at point *M*, toward the left. This situation occurs because at *M* the consumer initially has a large quantity of cheese and few rubber bands, whereas at *m* his initial stock of cheese is low and he has many rubber bands. In general terms, the curvature premise on which indifference curves are usually drawn asserts that consumers are relatively eager to trade away some part of what they own of a commodity of which they have a large amount but are more reluctant to trade away part of the goods of which they hold small quantities. This psychological premise underlies the curvature of the indifference curve.

We can now use our indifference curve apparatus to analyze how the consumer chooses among the combinations that he can afford to buy—that is, the combinations of rubber bands and cheese shown by the budget line. Figure 10 brings together in the same diagram the budget line from Figure 5 and the indifference curves from Figure 8.

Tangency Conditions

Because, according to the first of the properties of indifference curves, the consumer prefers higher curves to lower ones, he will go to the point on the budget line that lies on the highest indifference curve attainable. This will be point *T* on indifference curve I_b. He can afford no other point that he likes as well. For example, neither point *K* below the budget line nor point *W* on the budget line puts the consumer on such a high indifference curve. Further, any point on an indifference curve above I_b, such as point *U*, is out of the question because it lies beyond his financial means. We end up with a simple rule of consumer choice:

Consumers will select the most desired combination of goods obtainable for their money. The choice will be that point on the budget line at which the budget line is tangent to an indifference curve.

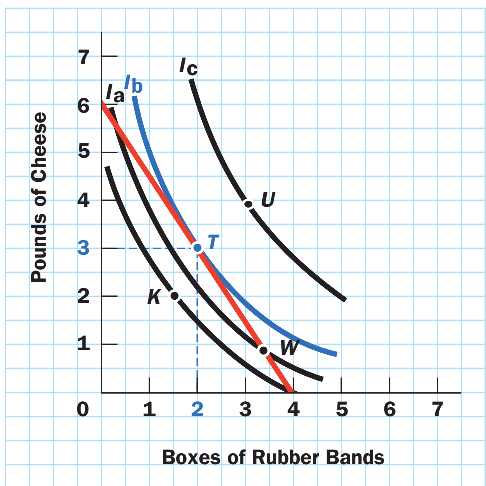
We can see why only the point of tangency, *T* (two boxes of rubber bands and three pounds of cheese), will give the consumer the largest utility that his money can buy. Suppose that the consumer were instead to consider buying 3½ boxes of rubber bands and one pound of cheese. This would put him at point *W* on the budget line and on the indifference curve I_a. But then, by buying fewer rubber bands and more cheese (a move upward and to the left on the budget line), he could get to another indifference curve, I_b, that would be higher and therefore more desirable without spending any more money. It clearly does not pay to end up at *W*. Only the point of tangency, *T*, leaves no room for further improvement.

At a point of tangency, where the consumer's benefits from purchasing cheese and rubber bands are maximized, the slope of the budget line equals the slope of the indifference curve. This is true by the definition of a point of tangency. We have just seen that the slope of the indifference curve is the marginal rate of substitution between cheese and rubber bands, and that the slope of the budget line is the ratio of the prices of rubber bands and cheese. We can therefore restate the requirement for the optimal division of the consumer's money between the two commodities in slightly more technical language:

Consumers will get the most benefit from their money when they choose combinations of commodities whose marginal rates of substitution equal the ratios of their prices.

It is worth reviewing the logic behind this conclusion. Why is it not advisable for the consumer to stop at a point such as *W*, where the marginal rate of substitution (slope of the indifference curve) is less than the price ratio (slope of the budget line)? By moving upward and to the left from W along his budget line, he can instead take advantage of market opportunities to obtain a commodity bundle that he likes better. This will always be true, for example, if the amount of cheese the consumer is *personally* willing to exchange for a box of rubber bands (the slope of the indifference curve) is greater than the amount of cheese for which the box of rubber bands trades *on the market* (the slope of the budget line).

FIGURE 10 Optimal Consumer Choice

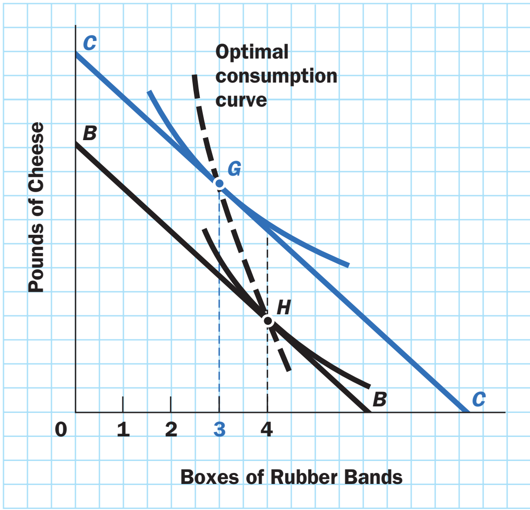


Consequences of Income Changes: Inferior Goods

Now consider what happens to the consumer's purchases after a rise in income. We know that a rise in income produces a parallel outward shift in the budget line, such as the shift from *BB* to *CC* in Figure 11. The quantity of rubber bands demanded rises from three to four boxes, and the quantity demanded of cheese increases as well. This change moves the consumer's equilibrium from tangency point *T* to tangency point *E* on a higher indifference curve.

A rise in income may or may not increase the demand for a commodity. In Figure 11, the rise in income does lead the consumer to buy more cheese *and* more rubber bands, but indifference curves need not always be positioned in a way that yields this sort of result. In Figure 12, as the consumer's budget line rises from *BB* to *CC*, the tangency point moves leftward from *H* to *G*. As a result, when his income rises, the consumer actually buys *fewer* rubber bands. This implies that for this consumer rubber bands are an *inferior good*.

FIGURE 12 Effects of a Rise in Income When Rubber Bands Are an Inferior Good



Consequences of Price Changes: Deriving the Demand Curve

Finally, we come to the main question underlying demand curves: How does a consumer's choice change if the price of one good changes? We explained earlier that a reduction in the price of a box of rubber bands causes the budget line to swing outward along the horizontal axis while leaving its vertical intercept unchanged. In Figure 13, we depict the effect of a decline in the price of rubber bands on the quantity of rubber bands demanded. As the price of rubber bands falls, the budget line swings from *BC* to *BD*. The tangency points, *T* and *E*, also move in a corresponding direction, causing the quantity demanded to rise from two to three boxes. The price of rubber bands has fallen and the quantity demanded has risen, so the demand curve for rubber bands has a negative slope. The desired purchase of rubber bands increases from two to three boxes, and the desired purchase of cheese also increases, from three pounds to $3\frac{3}{4}$ pounds.

The demand curve for rubber bands can be constructed directly from Figure 13. Point *T* shows that the consumer will buy two boxes of rubber bands when the price of a box is \$3.00. Point *E* indicates that when the price falls to \$1.50, quantity demanded rises to three boxes of rubber

FIGURE 11 Effects of a Rise in Income When Neither Good Is Inferior

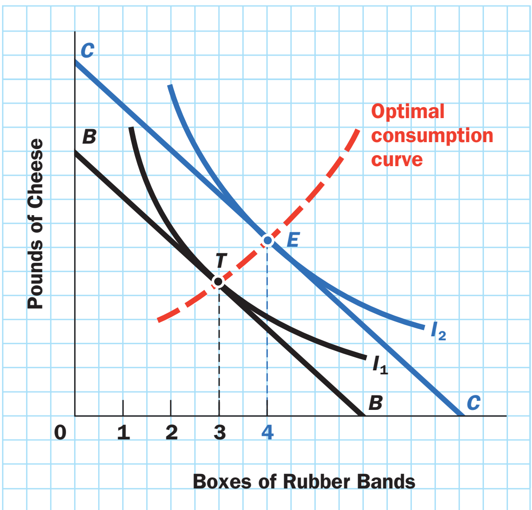
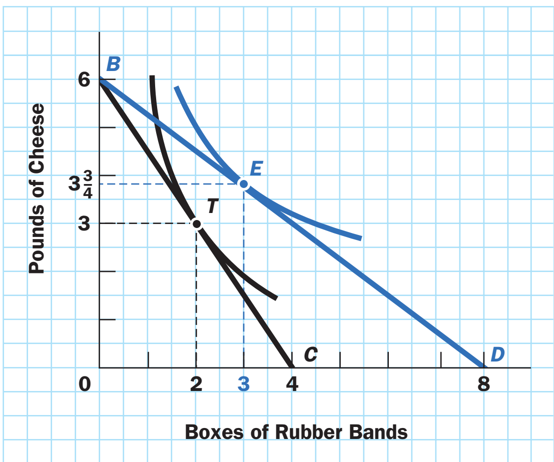


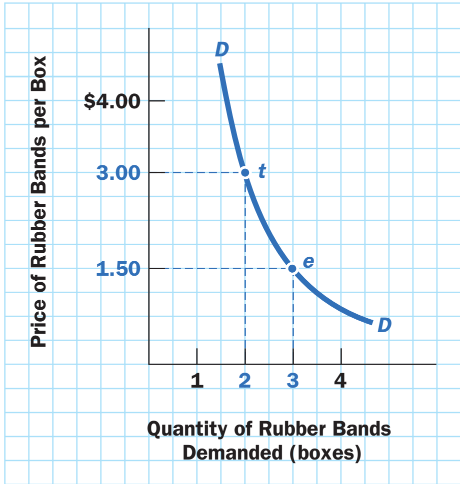
FIGURE 13 Consequences of Price Changes



bands.[7] These two pieces of information are shown in Figure 14 as points *t* and *e* on the demand curve for rubber bands. By examining the effects of other possible prices for rubber bands (other budget lines emanating from point *B* in Figure 13), we can find all the other points on the demand curve in exactly the same way. The demand curve is derived from the indifference curve by varying the price of the commodity to see the effects of all other possible prices.

The indifference curve diagram also brings out an important idea that the demand curve does not show. A change in the *price of rubber bands* also has consequences for the *quantity of cheese demanded* because it affects the amount of money left over for cheese purchases. In the example illustrated in Figure 13, the decrease in the price of rubber bands increases the demand for cheese from 3 to 3¾ pounds.

FIGURE 14 **Deriving the Demand Curve for Rubber Bands**



[7] How do we know that the price of rubber bands corresponding to the budget line *BD* is $1.50? Because the $12.00 total budget will purchase at most eight boxes (point *D*), the price per box must be $12.00/8 = $1.50.

SUMMARY

1. Indifference curve analysis permits economists to study the interrelationships of the demands for two (or more) commodities.
2. The basic tools of indifference curve analysis are the consumer's **budget line** and **indifference curves.**
3. A budget line shows all combinations of two commodities that the consumer can afford, given the prices of the commodities and the amount of money the consumer has available to spend.
4. The budget line is a straight line whose slope equals the ratio of the prices of the commodities. A change in price changes the **slope of the budget line.** A change in the consumer's income causes a parallel shift in the budget line.
5. Two points on an indifference curve represent two combinations of commodities such that the consumer does not prefer one combination over the other.
6. Indifference curves normally have negative slopes and are "bowed in" toward the origin. The **slope of an indifference curve** indicates how much of one commodity the consumer is willing to give up to get an additional unit of the other commodity.
7. The consumer will choose the point on her budget line that gets her to the highest attainable indifference curve. Normally this will occur at the point of tangency between the two curves. This point indicates the combination of commodities that gives the consumer the greatest benefits for the amount of money she has available to spend.
8. The consumer's demand curve can be derived from her indifference curve.

KEY TERMS

Budget line 93

Indifference curve 95

Slope of an indifference curve (marginal rate of substitution) 96

Slope of a budget line 96

TEST YOURSELF

1. John Q. Public spends all of his income on gasoline and hot dogs. Draw his budget line under several conditions:
   a. His income is $80, and one gallon of gasoline and one hot dog each cost $1.60.
   b. His income is $120, and the two prices remain the same.
   c. His income is $80, hot dogs cost $1.60 each, and gasoline costs $2.00 per gallon.
2. Draw some hypothetical indifference curves for John Q. Public on a diagram identical to the one you constructed for Test Yourself Question 1.
   a. Approximately how much gasoline and how many hot dogs will Mr. Public buy?
   b. How will these choices change if his income increases to $120? Is either good an inferior good?
   c. How will these choices change if gasoline price rises to $2.00 per gallon?
3. Explain the information that the *slope* of an indifference curve conveys about a consumer's preferences. Use this relationship to explain the typical U-shaped curvature of indifference curves.