CHAPTER 7

Consumer Choice and Elasticity

The most famous law in economics, and the one economists are most sure of, is the law of demand. On this law is built almost the whole edifice of economics.

—*David R. Henderson*[1]

A thing is worth whatever a buyer will pay for it.

—*Publilius Syrus, first century B.C.*[2]

Chapter Focus

- **What are the fundamental postulates underlying consumer choice?**
- **How does the law of diminishing marginal utility help explain the law of demand?**
- **How do the demand curves of individuals translate into a market demand curve?**
- **What is demand elasticity? What does it measure? Why is it important?**

[1]David R. Henderson, "Demand," in *The Concise Encyclopedia of Economics*, ed. David R. Henderson, http://www.econlib.org/library/CEE.html.

[2]Quoted in Michael Jackman, ed., *Macmillan Book of Business and Economic Quotations* (New York: Macmillan, 1984), 150.

The statement of David Henderson highlights the central position of the law of demand in economics. As Publilius Syrus noted more than 2,000 years ago, demand reflects the willingness of individuals *to* pay for what is offered in the market. In this section, we begin our examination of microeconomic markets for specific products with an analysis of the demand side of markets. In essence we will be going "behind" the market demand curve to see how it is made up of individual consumer demands and what factors determine the choices of individual consumers.[3]

FUNDAMENTALS OF CONSUMER CHOICE

Each of us must decide how to allocate our limited income among the many possible things we could purchase. The prices of goods, *relative to each other,* are very important determining factors. If your favorite cereal doubled in price, would you switch to a different brand? Would your decision be different if all cereals, not just yours, doubled in price? Your choice ***between*** brands of cereal will be affected only by the change in relative prices. If the prices of all cereals rose by a proportional amount, you might quit purchasing cereal, but this would not give you a strong reason to switch to a different brand. Relative prices measure opportunity cost. If cereal is *$5* per box when movie tickets are $10, you must give up two boxes of cereal to purchase a movie ticket.

Several fundamental principles underlie the choices of consumers. Let's take a closer look at the key factors influencing consumer behavior.

1. Limited income necessitates choice. Because of scarcity, we all have limited incomes. The limited nature of our income requires us to make choices about which goods we will and will not buy. When more of one good or service is bought, we must buy less of some other goods if we are to stay within our budget.

2. Consumers make decisions purposefully. The goals that underpin consumer choice can usually be met in alternative ways. If two products cost the same, a consumer will choose to buy the one expected to have the higher benefit. On the other hand, if two products yield equal benefits, the consumer will choose to buy the cheaper one. Fundamentally, we assume that consumers are rational—that they are able to weigh the costs and benefits of alternative choices.

3. One good can be substituted for another. Consumers can achieve utility—that is, satisfaction—from many different alternatives. Either a hamburger or a taco might satisfy your hunger, while going either to a movie or to a football game might satisfy your desire for entertainment. With $600, you might either buy a new TV set or take a short vacation. No single good is so precious that some of it will not be given up in exchange for a large enough quantity of other goods. Even seemingly unrelated goods are sometimes substituted one for another. For example, high water prices in Southern California have led residents there to substitute cactus gardens and flow constrictor shower heads for the relatively more expensive water. In Montana, where household electricity in recent years cost nearly twice as much as in nearby Washington, people substitute natural gas, fuel oil, insulation, and wool sweaters for the relatively more expensive electricity.

4. Consumers must make decisions without perfect information, but knowledge and past experience will help. In Chapter 1, we noted that information is costly to acquire. Asking family and friends, searching through magazines such as *Consumer Reports,* and contacting your local Better Business Bureau are all ways of gathering information about products and potential sellers. The time and effort consumers spend acquiring information will be directly related to the value derived from it. Predictably,

[3]You may want to review the section on demand in Chapter 3 before proceeding with this chapter.

consumers will spend more time and money to inform themselves when they are buying "big ticket" items such as automobiles or air-conditioning systems than when they are buying pencils or paper towels.

While no one has perfect foresight, experience — your own and that of others — will help you make better-informed choices. You have a pretty good idea of what to expect when you buy a cup of coffee at your favorite restaurant or ten gallons of gasoline at a service station you patronize regularly. Your expectations might not always be fulfilled precisely the same way every time (for example, the coffee may be stronger than expected or the gasoline may make your car's engine knock), but even then, you will gain valuable information that will help you project the outcome of future choices more accurately.

5. The law of diminishing marginal utility applies: as the rate of consumption increases, the marginal utility derived from consuming additional units of a good will decline. Utility is a term economists use to describe the subjective personal benefits that result from taking an action. The law **of diminishing marginal utility** states that the **marginal** (or additional) **utility** derived from consuming successive units of a product will eventually decline as the rate of consumption increases. For example, the law says that even though you might like ice cream, your marginal satisfaction from additional ice cream will eventually decline as you eat more and more of it. Ice cream at lunchtime might be great. An additional helping for dinner might also be good. However, after you have had it for lunch and dinner, another serving as a midnight snack will be less attractive. When the law of diminishing marginal utility sets in, the additional utility derived from still more units of ice cream declines.

Law of diminishing marginal utility
The basic economic principle that, as the consumption of a product increases, the marginal utility derived from consuming more of it (per unit of time) will eventually decline.

Marginal utility
The additional utility, or satisfaction, derived from consuming an additional unit of a good.

The law of diminishing marginal utility explains why, even if you really like a certain product, you will not spend your entire budget on it. As you increase your consumption of any good, including those that you like a lot, the utility you derive from each additional unit will become smaller and smaller and eventually it will be less than the cost of the unit. At that point, you will not want to purchase any more units of the good.

MARGINAL UTILITY, CONSUMER CHOICE, AND THE DEMAND CURVE OF AN INDIVIDUAL

The law of diminishing marginal utility helps us understand the law of demand and the shape of the demand curve. The height of an individual's demand curve at any specific unit is equal to the maximum price the consumer would be willing to pay for that unit — its **marginal benefit** to the consumer — given the number of units he or she has already purchased. Although marginal benefit is measured in dollars, the dollar amount reflects the opportunity cost of the unit in terms of other goods forgone. If a consumer is willing to pay, at most, $5 for an additional unit of the product, this indicates a willingness to give up, at most, $5 worth of other goods. ***Because a consumer's willingness to pay for a unit of a good is directly related to the utility derived from consuming the unit, the law of diminishing marginal utility implies that a consumer's marginal benefit, and thus the height of the demand curve, falls with the rate of consumption.***

Marginal benefit
The maximum price a consumer will be willing to pay for an additional unit of a product. It is the dollar value of the consumer's marginal utility from the additional unit, and therefore it falls as consumption increases.

Exhibit 1 shows this relationship for a hypothetical consumer Jones, relative to her weekly consumption of frozen pizza. Because of the law of diminishing marginal utility, each additional pizza consumed per week will generate less marginal utility for Jones than the previous pizza. For this reason, Jones's maximum willingness to pay — her marginal benefit — will fall as the quantity consumed increases. In addition, the steepness of Jones's demand curve, or its responsiveness to a change in price — its elasticity — is a reflection of how rapidly Jones's marginal utility diminishes with additional consumption. An individual's demand curve for a good whose marginal value declines more rapidly will be steeper.

Given what we now know about a consumer's maximum willingness to pay for additional units of a good, we are now in a position to discuss the choice of how many units the consumer will choose to purchase at various prices. ***At any given price, consumers***

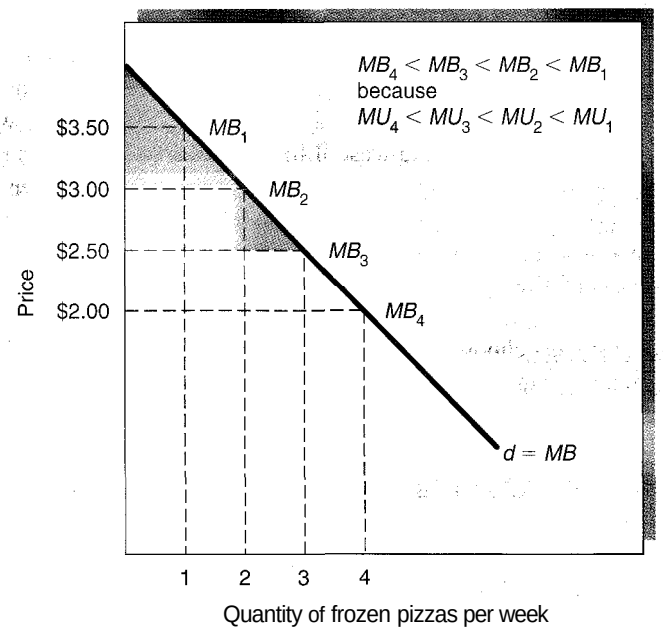


EXHIBIT 1
Diminishing Marginal Utility and the Individual's Demand Curve

An individual's demand curve, Jones's demand for frozen personal pizzas in this case, reflects the law of diminishing marginal utility. Because marginal utility *(MU)* falls with increased consumption, so does the consumer's maximum willingness to pay—marginal benefit (*MB*). A consumer will purchase until *MB = Price,* so at a price of $2.50 per pizza, Jones would purchase three pizzas and receive a consumer surplus shown by the shaded triangle.

will purchase all units of a good for which their maximum willingness to pay—their marginal benefit—is greater than the price. They will stop at the point where the next unit's marginal benefit would be less than the price. Although there are some problems related to dividing up certain kinds of goods (for example, it is hard to purchase half a car), we can generally say that a consumer will purchase all units of a good up to the point where the marginal benefit from it equals the price of the good ($MB = P$).

Returning to Exhibit 1, if the price of frozen pizza were $2.50, Jones would purchase three frozen pizzas per week.[4] Remember from Chapter 3 that consumer surplus is defined as the difference between the maximum price the consumer is willing to pay and the price actually paid. Jones's maximum willingness to pay for the first unit is $3.50, which, at a price of $2.50, generates $1.00 of consumer surplus for Jones. When a consumer has purchased all units to the point where $MB = P$, total consumer surplus is maximized. It is shown by the total triangular area under the demand curve that lies above the price. Total consumer surplus for Jones is shown as the shaded area in Exhibit 1.

Within this framework, how would a consumer respond to a decline in the price of a good? The consumer will increase purchases to the point where marginal benefit diminishes to the level of the new lower price. If marginal utility declines rapidly with consumption, the consumer will expand his or her purchases only slightly. If marginal utility declines less rapidly, it will take a larger expansion in purchases to reach this point. If the price were to rise, the consumer would cut back on purchases, eliminating those for which marginal benefit were now less than the price. This link between marginal benefit and maximum willingness to pay is the basis for the law of diminishing marginal utility, which underlies a person's demand curve for a product. The shape and steepness of the curve, for example, depends upon his or her marginal utility.

[4]Jones would certainly purchase the second unit because $MB > P$ For the third unit, $MB = P$ so Jones would be indifferent to buying the unit or not purchasing it For a good that is easily divisible, say, pounds of roast beef, the consumer would continue purchasing up to 2.9999 pounds. Thus, economist? are comfortable with simply concluding thdt the consumer will purchase this final unit, implying that Jones w.ll purchase three frozen pizzas

Consumer Equilibrium with Many Goods

The last time you were at the mall, you probably saw something, perhaps a nice billfold, that you liked. After all, there are many things we would like—many different alternatives that would give us utility. Next, you looked at the price tag: "Fifty dollars, wow! That's too much." What you were really saying was, "I like the billfold, but not as much as the $50 worth of other goods that I would have to give up for it." Consumer choice is a constant comparison of value relative to price. Consider another example: perhaps you prefer steak to less costly hamburger. Even if you do, your happiness might be better served if you were to buy the hamburger and then spend the extra money you saved on something else.

The idea that consumers choose among products by comparing their relative marginal utility (MU) to price (P) can be expressed more precisely. A consumer with a limited amount of income to spend on a group of products is not likely to do the following math, but will act as though he or she had, and will end up with

$$\frac{MU_A}{P_A} = \frac{MU_B}{P_B} = \ldots = \frac{MU_n}{P_n}$$

In this formula, MU represents the marginal utility derived from the last unit of a product, and P represents the price of the good. The subscripts $A, B, \ldots, n$ indicate the different products available to the consumer. ***This formula implies that the consumer will maximize his or her satisfaction (or total utility) by ensuring that the last dollar spent on each commodity yields an equal degree of marginal utility. Alternatively stated, the last unit of each commodity purchased should provide the same marginal utility per dollar spent on it.*** Thus, if the price of a gallon of ice cream is twice as high as the price of a liter of Coke, a consumer will purchase these items to the point where the marginal utility of the last gallon of ice cream is twice as high as the marginal utility of the last liter of Coke.

Perhaps the best way to grasp this point is to think about what happens when your ratios of marginal utility to price are not equal for two goods. Suppose that you are at a local restaurant eating buffalo chicken wings and drinking Coke. For simplicity, assume that a large Coke and an order of wings each costs $2. With your $10 budget, you decide to purchase four orders of wings and one large Coke. When you finish your Coke, there are still lots of wings left. You have already eaten so many wings, though, that those remaining do not look as attractive. You could get more utility with fewer wings and another Coke, but it is too late. You have not spent your $10 in a way that gets you the most for your money. Instead of satisfying the above condition, you find that the marginal utility of wings is lower than the marginal utility of a Coke, and because they both have the same price ($2), this implies that

$$\frac{MU_{wings}}{P_{wings}} < \frac{MU_{Coke}}{P_{Coke}}$$

If you had purchased fewer wings and more Coke, your total utility would have been higher. Spending more on Coke would have lowered its marginal utility, decreasing the value of the right side of the equation. Simultaneously, spending less on wings would have raised the marginal utility of wings, increasing the value of the left side of the equation. You will maximize your utility—and get the most "bang for the buck" from your budget—when you make these values (the ratios) equal.

The equation can also be used to illustrate the law of demand. Beginning with a situation in which the two sides were equal, suppose that the price of wings increased. It would lower the value of MU/P for wings below the MU/P for Coke. In response, you would reallocate your budget, purchasing fewer of the more costly wings and more Coke. Thus, we have the law of demand—as the price of wings rises, you will purchase less of them. When people try to spend their money in a way that gives them the greatest amount of satisfaction, the consumer decision-making theory outlined here is difficult to question. In the next section, we will take the theory a little further.

Price Changes and Consumer Choice

The demand curve or schedule shows the amount of a product that consumers are willing to buy at alternative prices during a specific time period. The law of demand states that the amount of a product bought is inversely related to its price. We have seen how the law of demand can be derived from fundamental principles of consumer behavior. Now, we go further and distinguish two different phenomena underlying a consumer's response to a price change. First, as the price of a product declines, the lower opportunity cost will induce consumers to buy more of it—even if they have to give up other products. This tendency to substitute a product that has become cheaper for goods that are now relatively more expensive is called the **substitution** effect of a price change.

Substitution effect
That part of an increase (decrease) in amount consumed that is the result of a good being cheaper (more expensive) in relation to other goods because of a reduction (increase) in price.

Second, if a consumer's money income is fixed, a reduction in the price of a product will increase his or her real income—the amount of goods and services he or she is able to purchase with that fixed amount of money income. If your rent were to decline by $100 per month, for example, that would allow you to buy more of a number of other goods. This increase in your real income has the same effect as if the rent had remained the same but your income had risen by $100 per month. As a result, this second way in which a price change affects consumption is called the **income effect.** Typically, consumers will respond to the income effect by buying more of the cheaper product and other products as well because they can better afford to do so. Substitution and income effects generally work in the same direction—in other words, in the same way; they both cause consumers to purchase more of a good as its price falls and less of a good as its price rises. (Both the income and substitution effects are derived graphically in the addendum to this chapter, titled "Consumer Choice and Indifference Curves.")[5]

Income effect
That part of an increase (decrease) in amount consumed that is the result of the consumer's real income being expanded (contracted) by a reduction (rise) in the price of a good.

Time Costs and Consumer Choice

You may have heard the saying that "time is money." It is certainly true that time has value and that this value can sometimes be measured in dollars. As we have learned, the monetary price of a good is not always a complete measure of its cost to the consumer. Consuming most goods requires not only money, but time as well; and time, like money, is scarce to the consumer. So a lower time cost, like a lower money price, will make a product more attractive. For example, patients in a dentist's office would prefer a shorter wait before receiving care. One study showed that dental patients are willing to pay more than $5 per minute saved to shorten their time spent in waiting rooms.[6] Similarly, commodities such as automatic dishwashers, prepared foods, air travel, and taxi service are demanded mainly for the time savings they offer. People are often willing to pay relatively high money prices for goods that help them save time.

Time costs, unlike money prices for goods, differ among individuals. They are higher for persons with higher wage rates, for example. Other things being equal, high-wage consumers choose fewer time-intensive (and more time-saving) commodities than people with lower time costs and wages. For example, high-wage consumers are overrepresented among airplane and taxicab passengers but underrepresented among television watchers, chess players, and long-distance bus travelers. Can you explain why? You can, if you understand how both money and time costs influence the choices of consumers.

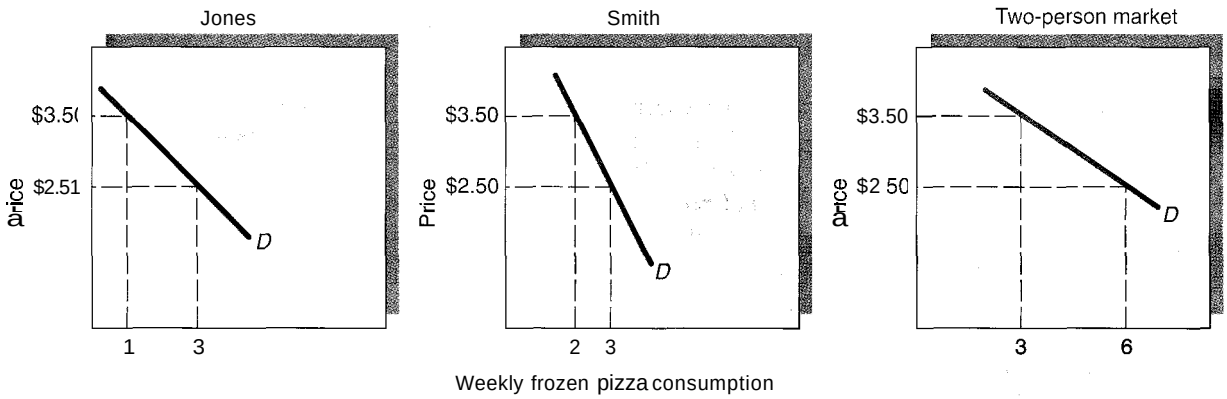
Failure to account for time costs can lead to bad decisions. For example, which is cheaper for consumers: (1) waiting in line three hours to purchase a $25 concert ticket or (2) buying the same ticket for $40 without standing in line? A consumer whose time is worth more than $5 per hour will find that $40 without the wait in line is less costly. As you can see, time costs matter. For example, when government-imposed price ceilings (discussed in Chapter 4) create shortages, rationing by waiting in line is frequently used. For many consumers, the benefit of the lower price due to the ceiling will be largely, if not entirely, offset by their increased time cost of having to wait in line.

[5]The substitution effect will always work in this direction. The income effect, however, may work in the reverse direction for some types of goods known as inferior goods. These will be addressed later in this chapter.

[6]Rexford E. Santerre and Stephen P. Neun, *Health Economics: Theories, insights and Industry Studies* (Orlando, Fla.: Harcourt, 2000), 113.

EXHIBIT 2
Individual and Market Demand Curves

The market demand curve is merely the horizontal sum of the individual demand curves. It will slope downward to the right just as individual demand curves do



MARKET DEMAND REFLECTS THE DEMAND OF INDIVIDUAL CONSUMERS

The market demand schedule is the relationship between the market price of a good and the amount demanded by all the individuals in the market area. Because individual consumers purchase less at higher prices, the amount demanded in a market area as a total is also inversely related to price.

Exhibit *2* shows the relationship between individual demand and market demand for a hypothetical two-person market. The individual demand curves for both Jones and Smith are shown. Jones and Smith each consume three frozen pizzas per week at a price of $2.50. The amount demanded in the two-person market is six pizzas. If the price rises to $3.50 per pizza, the amount demanded in the market will fall to three pizzas, one demanded by Jones and two by Smith. ***The market demand is simply the horizontal sum of the individual demand curves of consumers—in this case, Smith and Jones.***

In the real world, however, there can be millions of consumers in a market. But the relationship between the demand curves of individuals and the market demand curve will still be just like the one shown in Exhibit 2. At any given price, the amount purchased in the market will be the sum of the amounts purchased by each consumer in the market. Furthermore, the total amount demanded in the market will decline as price increases because individual consumers will purchase fewer units at the higher prices. The market demand curve reflects the collective choices of the individual consumers.

ELASTICITY OF DEMAND

Price elasticity of demand
The percentage change in the quantity of a product demanded divided by the percentage change in the price that caused the change in quantity. The price elasticity of demand indicates how responsive consumers are to a change in a product's price.

Although it is important to recognize that consumers will buy less of a product as its price increases, for many purposes, it is also important to know whether the increase will lead to a large or small reduction in the amount purchased. Economists have designed a tool called the price elasticity of demand to measure this sensitivity of amount purchased in response to a change in price. The equation for the **price elasticity of demand** is as follows:

$$\text{Price elacticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}} = \frac{\%\Delta Q}{\%\Delta P}$$

This ratio is often called the *elasticity coefficient.* To express it more briefly, we use the notation $\%\Delta Q$ to represent percentage change in quantity and %AP to represent percentage change in price. (The Greek letter delta *[A]* means "change in.") The law of demand states that an increase in a product's price lowers the quantity of it purchased, whereas a decrease in price raises it. Because a change in price causes the quantity demanded to change in the opposite direction, the price elasticity coefficient is always negative, although economists often ignore the sign and use the absolute value of the coefficient.

To see how the concept of elasticity works, suppose that the price of the Ford Explorer rises 10 percent, while other prices remain the same. Ford could expect Explorer sales to fall substantially—perhaps 30 percent—as sport-utility vehicle (SUV) buyers respond by switching to other SUVs whose prices have not changed. This strong response by buyers means that the demand for the Explorer is elastic.

Now consider a different situation. Suppose that, because of a new tax, the price of not only the Explorer *but of all new SUVs* rises 10 percent. In this case, consumers' options are much more limited. They can't simply switch to a cheaper close substitute as they could when the price of the Explorer alone rose. They might either simply pay the extra money for a new SUV or settle for a used SUV instead. Because of this, the 10 percent rise in the price of all new SUVs will lead to a smaller consumer response, perhaps a 5 percent decline in sales of new SUVs.

To calculate the elasticity coefficient for the Explorer in our example above, we begin with the 30 percent decline in quantity demanded and divide by the 10 percent rise in the price that caused the decline. Thus, the elasticity of demand for the Explorer would be:

$$\frac{\%\Delta Quantity}{\%\Delta Price} = \frac{-30\%}{+10\%} = -3$$

(or 3.0 if we ignore the minus sign). This means that the percentage change in quantity demanded is three times the percentage change in price.

To calculate the demand elasticity for *all* SUVs (our second example), we see that the percentage change in quantity, 5 percent, divided by the percentage change in price, 10 percent, gives us $-1/2$, or -0.5. When it comes to the price elasticity of demand for all SUVs, the percentage change in quantity demanded (using our hypothetical numbers) is only half the percentage change in price, not three times the percentage change in price as it was with the Explorer.

Often, we will have to derive the percentage change in quantity and price. If you know the quantities that will be purchased at two different prices, you can then derive the percentage change in both the price and the quantity. For example, suppose that a price change from P_0 to P, causes a change in quantity demanded from Q, to Q,. The change in quantity demanded would therefore be Q, – Q,. To calculate the percentage change in quantity, we divide the actual change by the midpoint (or average) of the two quantities.[7] Although it is often easy to find the midpoint without a formula (halfway between \$4 and \$6 is \$5), it can also be found as $(Q, + Q_1)/2$. Finally, because 0.05 is simply 5 percent, we multiply by 100. Thus, we can express the percentage change in quantity demanded as:

$$\frac{Q_0 - Q_1}{(Q_0 + Q_1)/2} \times 100$$

Similarly, when the change in price is $P_0 - P_1$, the *percentage* change in price is

$$\frac{P_0 - P_1}{(P_0 + P_1)/2} \times 100$$

Dividing the resulting percentage change in quantity by the percentage change in price gives us the elasticity.

[7]This formula uses the average of the starting point and the ending point of the change so that it will give the same result whether we start from the lower or the higher price. This arc elasticity formula is not the only way to calculate elasticity, but it is the most frequently used.

There is a more direct way to compute elasticity using this same sort of approach. Dividing the percentage change in quantity by the percentage change in price and simplifying yields the following:

$$\frac{(Q_0 - Q_1)/(Q_0 + Q_1)}{(P_0 - P_1)/(P_0 + P_1)}$$

(Because each term is multiplied by 100 and the denominator of each term contains a 2, these factors cancel out of the final expression.)

A numerical example will help you understand this. Suppose that Trina's Cakes can sell fifty specialty cakes per week at $7 each, or it can sell seventy specialty cakes at $6 each per week. The percentage difference in quantity is the difference in the quantity demanded ($50 - 70 = -20$) divided by the midpoint (60) times 100. The result is a -33.33 percent change in quantity ($-20 \div 60 \times 100 = -33.33$).

Now that we've calculated the percentage change in quantity demanded of cakes, let's calculate the percentage change in the price. The percentage change in price is the difference in the two prices ($\$7 - \$6 = \$1$) divided by the midpoint price ($6.50) times 100, or a 15.38 percent change in price ($1 \div 6.5 \times 100 = 15.38$). Dividing the percentage change in quantity by the percentage change in price ($-33.33 \div 15.38$) gives an elasticity coefficient of -2.17. Alternatively, we could have expressed this directly as:

$$\frac{[(50 - 70)/(50 + 70)]}{[(7 - 6)/(7 + 6)]} = \frac{-20/120}{1/13} = \frac{-1/6}{1/13} = \frac{-13}{6} = -2.17$$

The same result is obtained either way. The elasticity of 2.17 (ignoring the sign) indicates that the percentage change in quantity is just over twice the percentage change in price.

The elasticity coefficient lets us make a precise distinction between elasticity and inelasticity. When the elasticity coefficient is greater than 1 (ignoring the sign), as it was for the demand for Trina's Cakes, demand is elastic. When it is less than 1, demand is inelastic. Demand is said to be of *unitary elasticity* if the price elasticity is exactly 1.

Graphic Representation of Price Elasticity of Demand

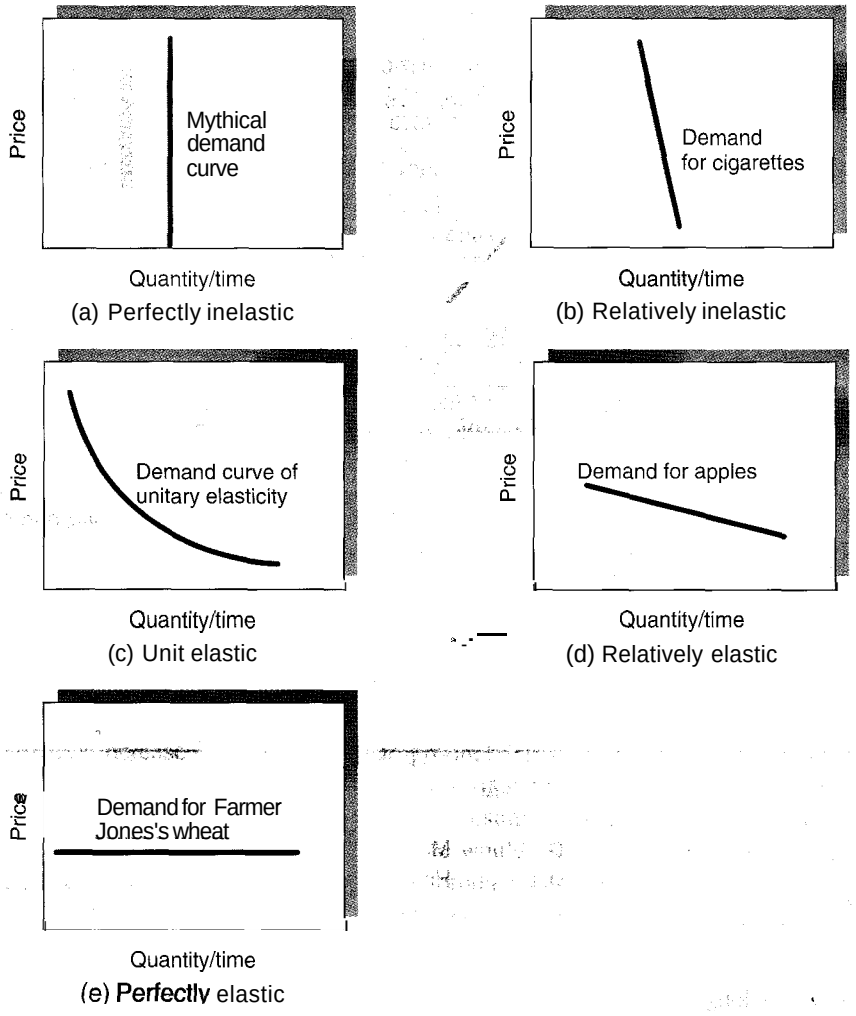
Exhibit 3 presents demand curves of varying elasticity. A demand curve that is completely vertical is said to be *perfectly inelastic*. In the real world, such demand is nonexistent because the substitutes for a good become more attractive as the price of that good rises. Moreover, because of the income effect, we should expect that a higher price will always reduce the quantity demanded, other things remaining the same. (Unlike our falling rent example earlier in the chapter, this example can be thought of as a "negative" income effect. When the price of a good rises, it leaves you with less overall buying power, not more.) Still, the (mythical) perfectly inelastic demand curve is shown in part (a) of Exhibit 3.

The more inelastic the demand, the steeper the demand curve *over any specific price range*. As you can see, the demand for cigarettes (shown in part b of Exhibit 3) is highly inelastic; a big change in price doesn't change quantity demanded much. People who crave nicotine will be very willing to pay the higher price. On the other hand, the demand for apples (shown in part d) is relatively elastic. People will find it easy to switch to oranges or bananas, for example, if the price of apples skyrockets.

When demand elasticity is unitary, as part (c) shows, a demand curve that is convex to the origin will result. When a demand curve is completely horizontal, an economist would say that it is *perfectly elastic*. Demand for the wheat marketed by a single wheat farmer, for example, would approximate perfect elasticity (part e).

Because elasticity is a relative concept, the elasticity of a straight line demand curve will differ ut each point along the demand curve. As **Exhibit 4** shows, the elasticity of a straight-line demand curve (one with a constant slope) will range from highly elastic to highly inelastic. In this exhibit, when the price rises from $10 to $11, sales decline from 20 to 10. According to the formula, the price elasticity of demand is -7.0. Demand is very elastic in this region. In contrast, demand is quite inelastic in the $1 to $2 price range. As

EXHIBIT 3
Price Elasticity of Demand



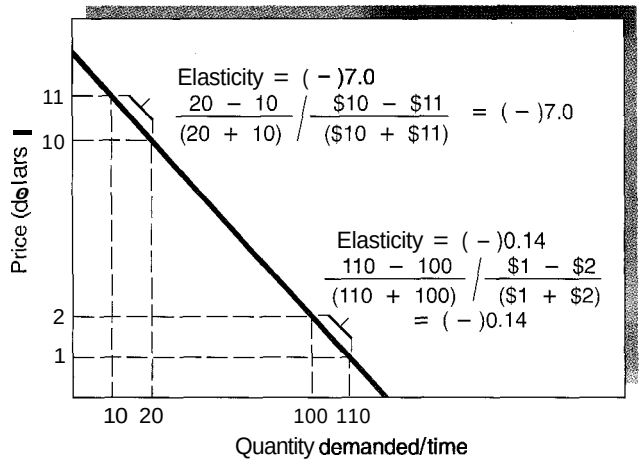
(a) Perfectly inelastic: Despite an increase in a product's price, consumers still purchase the same amount of it. Substitution and income effects prevent this from happening in the real world, though.
(b) Relatively inelastic: A percentage increase in a product's price results in a smaller percentage reduction in its sales. The demand for cigarettes has been estimated to be highly inelastic.
(c) Unit elastic: The percentage change in quantity demanded of a product is equal to the percentage change in its price. A curve with a decreasing slope results. Sales revenue (price times quantity sold) is constant.
(d) Relatively elastic: A percentage increase in a product's price leads to a larger percentage reduction in purchases of it. When good substitutes are available for a product (as in the case of apples), the amount of it purchased will be highly sensitive to price changes.
(e) Perfectly elastic: Consumers will buy all of Farmer Jones's wheat at the market price, but none will be sold above the market price.

the price increases from $1 to $2, the amount demanded declines from 110 to 100. The ten-unit change in quantity is the same, but it is a smaller *percentage* change. And the $1 change in price is the same, but it is now a larger *percentage* change. The elasticity of demand in this range is only −0.14; demand in this example is highly inelastic.

How Large Are the Demand Elasticities of Various Products?

Economists have estimated the price elasticity of demand for many products. As **Exhibit 5** shows, the elasticity of demand varies substantially among products. The demand is highly inelastic for several products — salt, toothpicks, matches, light bulbs, and newspapers, for example — in their normal price range. On the other hand, the demand curves for fresh tomatoes, Chevrolet automobiles, and fresh green peas are highly elastic. The demand for movies, housing, private education, radios, and television sets is near 1.0 (unitary).

EXHIBIT 4
Slope of the Demand Curve Versus Price Elasticity



With this straight line (constant slope) demand curve, demand is more elastic in the high price range. The formula for elasticity shows that, when price rises from $1 to $2 and quantity falls from 110 to 100, demand is inelastic. A price rise of the same magnitude (but of a smaller percentage), from $10 to $11 leads to a decline in quantity of the same size (but of a larger percentage), so that elasticity is much greater. (Price elasticities are negative, but economists often ignore the sign and look only at the absolute value.)

EXHIBIT 5
Estimated Price Elasticity of Demand for Selected Products

INELASTIC		APPROXIMATELY UNITARY ELASTICITY	
Salt	− 0.1	Movies	− 0.9
Matches	− 0.1	Housing, owner occupied, long run	− 1.2
Toothpicks	− 0.1	Shellfish, consumed at home	− 0.9
Airline travel, short run	− 0.1	Oysters, consumed at home	− 1.1
Gasoline, short run	− 0.2	Private education	− 1.1
Gasoline, long run	− 0.7	Tires, short run	− 0.9
Residential natural gas, short run	− 0.1	Tires, long run	− 1.2
Residential natural gas, long run	− 0.5	Radio and television receivers	− 1.2
Coffee	− 0.25	**ELASTIC**	
Fish (cod), consumed at home	− 0.5	Restaurant meals	− 2.3
Tobacco products, short run	− 0.45	Foreign travel, long run	− 4.0
Legal services, short run	− 0.4	Airline travel, long run	− 2.4
Physician services	− 0.6	Fresh green peas	− 2.8
Dental services	− 0.7	Automobiles, short run	− 1.2–1.5
Taxi, short run	− 0.6	Chevrolet automobiles	− 4.0
Automobiles, long run	− 0.2	Fresh tomatoes	− 4.6

Sources: Hendrick S Houthakker and Lester D. Taylor, Consumer Demand *in* the United States, *1929-1970* (Cambridge, Mass : Harvard University Press, 1966, 1970); Douglas R. Bohi, Analyzing Demand *Behavior* (Baltimore: Johns Hopkins University Press, 1981); Hsaing-tai Cheng and Oral Capps Jr , "Demand for Fish," *American* Journal *of Agricultural* Economics, August 1988; U.S. Department *of* Agriculture; and Rexford E. Santerre and Stephen P. Neun, Health *Economics: Theories,* Insights and *Industry* Studies (Orlando, Fla.. Harcourt, 2000).

Why Do the Price Elasticities of Demand Vary?

The primary determinants of a product's price elasticity of demand are the availability of good substitutes and to some extent the share of the typical consumer's total budget expended on a product. Let's consider each of these factors.

Availability of Substitutes ***The most important determinant of the price elasticity of demand is the availability of substitutes. When good substitutes for a product are available, a price increase induces many consumers to switch to other products. Demand is elastic.*** For example, if the price of felt tip pens increases, many consumers will switch to pencils, ballpoint pens, or (for children) crayons. If the price of apples increased, consumers might substitute oranges, bananas, peaches, or pears.

When good substitutes are unavailable, the demand for a product tends to be inelastic. Medical services are an example. When we are sick, most of us find witch doctors, faith healers, palm readers, and aspirin to be highly imperfect substitutes for the services of a physician. Not surprisingly, the demand for physician services is inelastic.

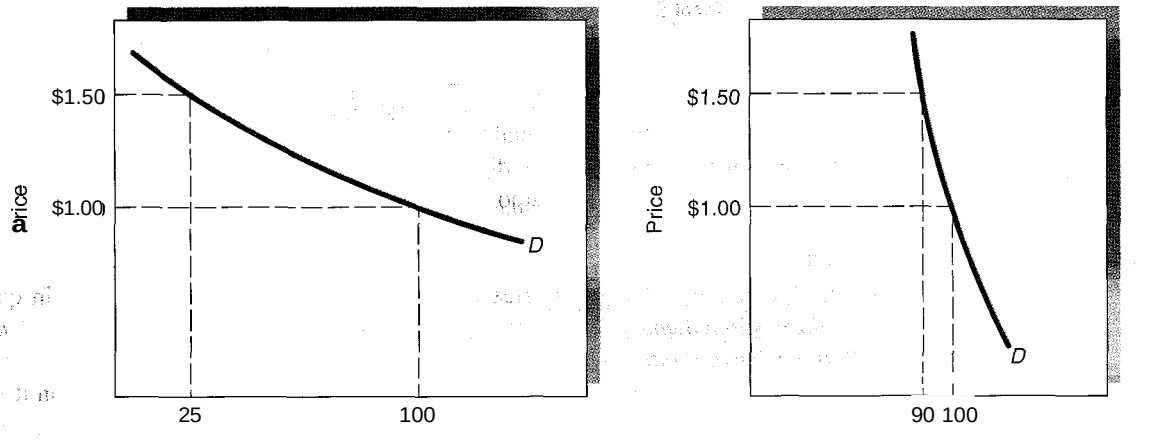
The availability of substitutes increases as the product class becomes more specific, thus increasing price elasticity. For example, as Exhibit 5 shows, the price elasticity of Chevrolets, a narrow product class, exceeds that of the broad class of automobiles in general. If the price of Chevrolets alone rises, many substitute cars are available. But if the prices of all automobiles rise together, consumers have fewer good substitutes.

Product's Share of the Consumer's Total Budget If the expenditures on a product are quite small relative to the consumer's budget, the income effect will be small even if there is a substantial increase in the price of the product. This will make demand less elastic. Compared to one's total budget, expenditures on some commodities are minuscle. Matches, toothpicks, and salt are good examples. Most consumers spend only $1 or $2 per year on each of these items. A doubling of their price would exert little influence on a family's budget. Therefore, even if the price of such a product were to rise sharply, consumers will still not find it worthwhile to spend much time and effort looking for substitutes.

Exhibit 6 provides a graphic illustration of both elastic and inelastic demand curves. In part (a), the demand curve for ballpoint pens is elastic because there are good

EXHIBIT 6
Inelastic and Elastic Demand

As the price of ballpoint pens (a) rose from $1.00 to $1.50, the quantity purchased plunged from 100,000 to 25,000. The percentage reduction in quantity is larger than the percentage increase in price. Thus, the demand for the pens is elastic. In contrast, an increase in the price of cigarettes from $1.00 to $1.50 results in only a small reduction in the number purchased (b). Because the demand for cigarettes is inelastic, the percentage reduction in quantity is smaller than the percentage increase in price.



substitutes — for example, pencils and felt tip pens. Therefore, when the price of the pens increases from $1.00 to $1.50, the quantity purchased of them declines sharply from 100,000 to only 25,000. The calculated price elasticity equals −3.0. The fact that the absolute value of the coefficient is greater than 1 confirms that the demand for ballpoint pens is elastic over the price range shown.

Part (b) of Exhibit 6 shows the demand curve for cigarettes. Because most smokers do not find other products to be a good substitute, the demand for cigarettes is highly inelastic. If a unit of six cigarettes is worth a dollar, a substantial increase in price (from $1.00 to $1.50) leads to only a small reduction in the quantity demanded. The price elasticity coefficient is −0.26, substantially less in absolute value than 1, confirming that the demand for cigarettes is inelastic. *(Exercise:* Use the price elasticity formula to verify the values of these elasticity coefficients.)

Time and Demand Elasticity

As changing market conditions raise or lower the price of a product, both consumers and producers will respond. However, the response will not be instantaneous, and it is likely to become larger over time. ***In general, when the price of a product increases, consumers will reduce their consumption by a larger amount in the long run than in the short run. Thus, the demand for most products will be more elastic in the long run than in the short run. This relationship between elasticity and the length of the adjustment period is sometimes referred to as the second law of demand.***

The first law of demand says that buyers will respond predictably to a price change, purchasing more when the price is lower than when the price is higher, if other things remain the same. The second law of demand says that the response of buyers will be greater after they have had time to adjust more fully to a price change.

HOW DEMAND ELASTICITY AND PRICE CHANGES AFFECT TOTAL EXPENDITURES (OR REVENUES) ON A PRODUCT

By looking at demand elasticity, we can determine changes in total consumer spending on a product when its price changes. We can do this in three different ways: by looking at (1) changes in an individual's total spending, using the demand elasticity from his or her demand curve for the product, (2) changes in the total combined spending of all consumers, using the elasticity from the total market demand curve, or (3) changes in total consumer spending on the product, using the demand curve facing that firm that produces it. In other words, this third method allows us to look at elasticity based not on what consumers spend, but on what the producer receives from selling the product.

Total expenditures (or revenues) simply amount to the price of the product times the number of units of it purchased (or sold).

Total Expenditures	=	Price	x	Quantity
?	−	↑	x	↓
?	−	↓	x	↑

Because total expenditures are equal to the price times the quantity, and because the price and the quantity move in opposite directions, the net effect of a price change on the total spending on a product depends upon whether the (percentage) price change or the (percentage) quantity change is greater.

When demand is inelastic, the price elasticity coefficient is less than 1. This means that the percentage change in price is greater than the percentage change in quantity. ***Therefore, when demand is inelastic, the change in the price will dominate and, as a result, the price and total expenditures will change in the sume direction.*** In other words, when the price of an inelastic product (say, cigarettes) increases, spending on it will increase, too — and vice versa. On the other hand, when demand is elastic, the change in quantity will be greater than the change in the price. ***As a result, the impact of the change in quantity will dominate, and therefore the price and expenditures will move in oppo-***

EXHIBIT 7
Demand Elasticity and How Changes in Price Affect Total Consumer Expenditures or a Firm's Total Revenue

Price Elasticity of Demand	Numerical Elasticity Coefficient (in absolute value)	Impact of raising Price on Total Consumer Expenditures or a Firm's Total Revenue	Impact of Lowering price on Total Consumer Expenditures or a Firm's Total Revenue
Elastic	1 to ∞	decrease	increase
Unit Elastic	1	unchanged	unchanged
Inelastic	0 to 1	increase	decrease

site directions. In other words, when the price of an elastic product (say, a ballpoint pen) increases, spending on it will decrease—and vice versa.

When demand elasticity is unitary, the change in quantity demanded will be equal in magnitude to the change in price. With regard to their impact on total expenditures, these two effects will exactly offset each other. ***Thus, when price elasticity of demand is equal to 1, total expenditures will remain unchanged as price changes.***

Exhibit 7 summarizes the relationship between changes in the price of a product and changes in total spending on it when demand is elastic, inelastic, and unit elastic. The demand curves shown in Exhibit 6 can also be used to show the link between elasticity and changes in total spending. In the case of cigarettes (part b), the price elasticity of demand for the price increase from $1.00 to $1.50 is 0.26, indicating that demand is inelastic. This increase in cigarette prices leads to an increase in spending on the product from $100 million ($1.00 × 100 million units) to $135 million ($1.50 × 90 million units). If the change had occurred in the opposite direction, with the price falling from $1.50 to $1.00, total expenditures would have declined.

The price elasticity of demand for a ballpoint pen when its price increases from $1.00 to $1.50 (part a of Exhibit 6) is 3.0, indicating that demand is elastic. This increase in the price of ballpoint pens lowers total consumer spending on the product from $100,000 ($1.00 × 100,000 pens) to $37,500 ($1.50 × 25,000 pens). If the change had occurred in the opposite direction, with the price falling from $1.50 to $1.00, total expenditures would have risen.

You can see how important it is for business decision makers to understand the concept of elasticity. When a firm increases the price of its product, its revenues may rise, fall, or remain the same. If the demand for the firm's product is inelastic, the higher price will expand the firm's total revenue. However, if the demand for the firm's product is elastic, a price increase will lead to substantially lower sales and a decline in total revenue. In the case of unitary elasticity, the price increase will leave total revenue unchanged.

Beyond the price elasticity of demand, two other elasticity relationships are important in any given market. We therefore end this chapter with a brief discussion of income elasticity of demand and price elasticity of supply.

INCOME ELASTICITY

Increases in consumer income will increase the demand (the quantity demanded at each price) for most goods. Income elasticity tells us how responsive the demand for a product is to income changes. **Income elasticity** is defined as:

$$\text{Income elasticity} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

As **Exhibit 8** shows, although the income elasticity coefficients for products vary from one good to another, they are normally positive. In fact, the term **normal good** refers to any good with a positive income elasticity of demand. Some normal goods have lower

Income elasticity
The percentage change in the quantity of a product demanded divided by the percentage change in consumer income that caused the change in quantity demanded. It measures the responsiveness of the demand for a good to a consumer's change in income.

Normal good
A good that has a positive income elasticity. so that, as consumer income rises, demand for the good rises, too.

EXHIBIT 8
Estimated Income Elasticity of Demand for Selected Products

LOW-INCOME ELASTICITY		HIGH-INCOME ELASTICITY	
Margarine	−0.20	Private education	2.46
Fuel	0.38	New cars	2.45
Electricity	0.20	Recreation and amusements	1.57
Fish (haddock)	0.46	Alcohol	1.54
Food	0.51		
Tobacco	0.64		
Hospital care	0.69		

Sources: Hendrick S. Houthakker and Lester D. Taylor, Consumer Demand in the *United* States, *1929–1970* (Cambridge, Mass : Harvard University Press, 1966); L. Taylor, "The Demand for Electricity' A Survey," Bell Journal *of Economics* (Spring 1975); F. W. Bell, "The Pope and the Price of Fish," American *Economic* Review 58 (December 1968); and Rexford E. Santerre and Stephen P. Neun, Health Economics: Theories, *Insights* and Industry *Studies* (Orlando, Fla.: Harcourt, 2000).

income elasticities than others, however. In general, goods that people regard as "necessities" will have low income elasticities (between 0 and 1). Significant quantities are purchased even at low incomes, and, as income increases, spending on these items will increase by less than a proportional amount. It is understandable that items such as fuel, electricity, bread, tobacco, economy clothing, and potatoes have a low income elasticity.

Goods that consumers regard as "luxuries" generally have a high (greater than 1) income elasticity. For example, private education, new automobiles, recreational activities, donations to environmental groups, swimming pools, and vacation air travel are all highly income elastic. As the consumer's income increases, the demand for these goods expands even more rapidly, and therefore spending on these items increases as a proportion of income.

A few commodities, such as margarine, low-quality meat cuts, and bus travel, actually have a negative income elasticity. Economists refer to goods with a negative income elasticity as **inferior goods. As** income expands, the demand for inferior goods will decline. Conversely, as income declines, the demand for inferior goods will increase.

Inferior good
A good that has a negative income elasticity, so that, as consumer income rises, the demand for the good falls.

PRICE ELASTICITY OF SUPPLY

Price elasticity of supply
The percentage change in quantity supplied, divided by the percentage change in the price that caused the change in quantity supplied.

The **price elasticity of supply** is the percentage change in quantity supplied, divided by the percentage change in the price causing the supply response. Because this measures the responsiveness of sellers to a change in price, it is analogous to the price elasticity of demand. However, the price elasticity of supply will be positive because the quantity producers are willing to supply is directly related to price. Like demand elasticity, time plays a role once again. Supply elasticities will be greater when suppliers have a longer time to respond to a price change. In the next two chapters, we will discuss more fully the factors that determine supply elasticity. For now, it is important simply to recognize the concept of supply elasticity and the fact that suppliers (like buyers) will be more responsive to a price change when they have had more time to adjust to it.

LOOKING AHEAD

Market demand indicates how strongly consumers desire a good or service. In the following chapter, we will turn to a firm's costs of production—costs that arise because resources are demanded for alternative uses. These two topics—consumer demand and the cost of production—are central to understanding how markets work and the conditions necessary for the efficient allocation of resources.