Elasticity and Its Application

Goals

In this chapter you will

Learn the meaning of the elasticity of demand

Examine what determines the elasticity of demand

Learn the meaning of the elasticity of supply

Examine what determines the elasticity of supply

Apply the concept of elasticity in three very different markets

Outcomes

After accomplishing these goals, you should be able to

Calculate the price and income elasticity of demand

Distinguish between the price elasticity of demand for necessities and luxuries

Calculate the price elasticity of supply

Distinguish between an inelastic and elastic supply curve

Demonstrate the impact of the price elasticity of demand on total revenue

Strive for a Five

This chapter introduces the topic of elasticity, which is tested on the AP microeconomics test. Some important ideas from this chapter include elasticity of:

- Supply
- Demand
- Income
- Cross price or mid- point elasticity of demand

Key Terms

- *Elasticity*—A measure of the responsiveness of the quantity demanded or quantity supplied to one of its determinants.
- *Price elasticity of demand*—A measure of how much the quantity demanded of a good responds to a change in the price of that good.
- *Elastic*—When the quantity demanded or supplied responds substantially to a change in one of its determinants.
- *Inelastic*—When the quantity demanded or supplied responds only slightly to a change in one of its determinants.
- *Total revenue*—The amount paid by buyers and received by sellers of a good computed as $P \times Q$.
- *Income elasticity of demand*—A measure of how much the quantity demanded of a good responds to a change in consumers' income.
- *Cross-price elasticity of demand*—A measure of how much the quantity demanded of one good responds to a change in the price of another good.
- *Price elasticity of supply*—A measure of how much the quantity supplied of a good responds to a change in the price of that good.
- *Normal good*—A good characterized by a positive income elasticity.
- *Inferior good*—A good characterized by a negative income elasticity.

Chapter Overview

Context and Purpose

Chapter 5 is the second chapter of a three-chapter sequence that deals with supply and demand and how markets work. Chapter 4 introduced supply and demand. Chapter 5 shows how much buyers and sellers respond to changes in market conditions. Chapter 6 will address the impact of government policies on competitive markets.

The purpose of Chapter 5 is to add precision to our supply and demand model. We introduce the concept of elasticity, which measures the responsiveness of buyers and sellers to changes in economic variables such as prices and income. The concept of elasticity allows us to make quantitative observations about the impact of changes in supply and demand on equilibrium prices and quantities.

Chapter Review

Introduction   In Chapter 4, we learned that an increase in price reduces the quantity demanded and increases the quantity supplied in a market. In this chapter, we will develop the concept of elasticity so that we can address how much the quantity demanded and the quantity supplied responds to changes in market conditions such as price.

The Elasticity of Demand

To measure the response of demand to its determinants, we use the concept of elasticity. Price elasticity of demand measures how much the quantity demanded responds to a change in the price of that good, computed as the percentage change in quantity demanded divided by the percentage change in price.

If the quantity demanded changes substantially from a change in price, demand is *elastic*. If the quantity demanded changes little from a change in price, demand is *inelastic*. Whether a demand curve tends to be price elastic or inelastic depends on the following:

■ *Availability of close substitutes:* The demand for goods with close substitutes is more sensitive to changes in prices and, thus, is more price elastic.

■ *Necessities versus luxuries:* The demand for necessities is inelastic while the demand for luxuries is elastic. Because one cannot do without a necessity, an increase in the price has little impact on the quantity demanded. However, an increase in price greatly reduces the quantity demanded of a luxury.

■ *Definition of the market:* The more narrowly we define the market, the more likely there are to be close substitutes and the more price elastic the demand curve.

■ *Time horizon:* The longer the time period considered, the greater the availability of close substitutes and the more price elastic the demand curve.

The formula for computing the price elasticity of demand is:

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

Because price elasticity of demand is always negative, it is customary to drop the negative sign.

When we compute price elasticity between any two points on a demand curve, we get a different answer depending on our chosen starting point and our chosen finishing point if we take the change in price and quantity as a percent of the starting value for each. To avoid this problem, economists often employ the *midpoint method* to calculate elasticities. With this method, the percentage changes in quantity and price are calculated by dividing the change in the variable by the *average* or midpoint value of the two points on the curve, not the starting point on the curve. Thus, the formula for the price elasticity of demand using the midpoint method is:

$$\text{Price elasticity of demand} = \frac{(Q_2 - Q_1)/\left[(Q_2 + Q_1)/2\right]}{(P_2 - P_1)/\left[(P_2 + P_1)/2\right]}.$$

If price elasticity of demand is greater than one, demand is elastic. If elasticity is less than one, demand is inelastic. If elasticity is equal to one, demand is said to have unit elasticity. If elasticity is zero, demand is perfectly inelastic (vertical). If elasticity is infinite, demand is perfectly elastic (horizontal). In general, the flatter the demand curve, the more elastic. The steeper the demand curve, the more inelastic.

Total revenue is the amount paid by buyers and received by sellers, computed simply as price times quantity. The elasticity of demand determines the impact of a change in price on total revenue:

■ If demand is price inelastic (less than one), an increase in price increases total revenue because the price increase is proportionately larger than the reduction in quantity demanded.

■ If demand is price elastic (greater than one), an increase in price decreases total revenue because the decrease in the quantity demanded is proportionately larger than the increase in price.

■ If demand is unit price elastic (exactly equal to one), a change in price has no impact on total revenue because the increase in price is proportionately equal to the decrease in quantity.

Along a linear demand curve, price elasticity is not constant. When price is high and quantity low, price elasticity is large because a change in price causes a larger *percentage* change in quantity. When price is low and quantity high, price elasticity is small because a change in price causes a smaller *percentage* change in quantity.

There are additional demand elasticities. The income elasticity of demand is a measure of how much the quantity demanded responds to a change in consumers' income, computed as the percentage change in quantity demanded divided by the percentage change in income or:

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

For *normal goods*, income elasticity is positive. For *inferior goods*, income elasticity is negative. Within the group of normal goods, necessities like food have small income elasticities because the quantity demanded changes little when income changes. Luxuries have larger income elasticities.

The cross-price elasticity of demand is a measure of the response of the quantity demanded of one good to a change in the price of another good, computed as the percentage change in the quantity demanded of one good divided by the percentage change in the price of another good or:

$$\text{Cross-price elasticity of demand} = \frac{\text{Percentage change in quantity demanded of good 1}}{\text{Percentage change in the price of good 2}}$$

The cross-price elasticity of demand is positive for *substitutes* and negative for *complements*.

The Elasticity of Supply

Price elasticity of supply measures how much the quantity supplied responds to a change in the price of that good, computed as the percentage change in quantity supplied divided by the percentage change in price.

If the quantity supplied changes substantially from a change in price, supply is *elastic*. If the quantity supplied changes little from a change in price, supply is *inelastic*. Supply is more elastic when the sellers have greater flexibility to change the amount of a good they produce in response to a change in price. Generally, the shorter the time period considered, the less flexibility the seller has in choosing how much to produce and the more inelastic the supply curve.

The formula for computing the price elasticity of supply is:

$$\text{Price elasticity of supply} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

If price elasticity of supply is greater than one, supply is elastic. If elasticity is less than one, supply is inelastic. If elasticity is equal to one, supply is said to have unit elasticity. If elasticity is zero, supply is perfectly inelastic (vertical). If elasticity is infinite, supply is perfectly elastic (horizontal). In general, the flatter the supply curve, the more elastic. The steeper the supply curve, the more inelastic.

Price elasticity of supply may not be constant along a given supply curve. At low quantities, a small increase in price may stimulate a large increase in quantity supplied because there is excess capacity in the production facility. Therefore, price elasticity is large. At high quantities, a large increase in price may cause only a small increase in quantity supplied because the production facility is at full capacity. Therefore, price elasticity is small.

Three Applications of Supply, Demand, and Elasticity

■   *The market for agricultural products:* Advances in technology have shifted the supply curve for agricultural products to the right. The demand for food, however, is generally inelastic (steep) because food is inexpensive and a necessity. As a result, the rightward shift in supply has caused a great reduction in the equilibrium price and a

small increase in the equilibrium quantity. Thus, ironically, technological advances in agriculture reduce total revenue paid to farmers as a group.

■ *The market for oil:* In the 1970s and early 1980s, the Organization of Petroleum Exporting Countries (OPEC) reduced the supply of oil in order to raise its price. In the short run, the demand for oil tends to be inelastic (steep) because consumers cannot easily find substitutes. Thus, the decrease in supply raised the price substantially and increased total revenue to the producers. In the long run, however, consumers found substitutes and drove more fuel-efficient cars causing the demand for oil to become more elastic, and producers searched for more oil causing supply to become more elastic. As a result, while the price of oil rose a great deal in the short run, it did not rise much in the long run.

■ *The market for illegal drugs:* In the short run, the demand for illegal addictive drugs is relatively inelastic. As a result, drug interdiction policies that reduce the supply of drugs tend to greatly increase the price of drugs while reducing the quantity consumed very little, and thus, total revenue paid by drug users increases. This need for additional funds by drug users may cause drug-related crime to rise. This increase in total revenue and in crime is likely to be smaller in the long run because the demand for illegal drugs becomes more elastic as time passes. Alternatively, policies aimed at reducing the demand for drugs reduce total revenue in the drug market and reduce drug-related crime.

Conclusion

The tools of supply and demand allow you to analyze the most important events and policies that shape the economy.

Helpful Hints

1. An easy way to remember the difference between the terms elastic and inelastic is to substitute the word *sensitivity* for elasticity. For example, price elasticity of demand becomes price *sensitivity* of demand. If the quantity demanded is sensitive to a change in price (demand is relatively flat), demand is elastic. If the quantity demanded is insensitive to a change in price (demand is relatively steep), demand is inelastic. The same is true for the price elasticity of supply. If the quantity supplied is sensitive to a change in price, supply is elastic. If the quantity supplied is insensitive to a change in price, supply is inelastic.

2. Although elasticity and slope are similar, they are not the same. Along a straight line, slope is constant. Slope (rise over run) is the same anywhere on the line and is measured as the change in the dependent variable divided by the change in the independent variable. Elasticity, however, is measured as the *percent* change in the dependent variable divided by the *percent* change in the independent variable. This value changes as we move along a line, because a one-unit change in a variable is a larger percentage change when the initial values are small as opposed to when they are large. In practice, however, it is still reasonable to suggest that flatter curves tend to be more elastic and steeper curves tend to be more inelastic.

3. The term "elasticity" is used to describe how much the quantity stretches (or changes) in response to some economic event such as a change in price or income. If the quantity stretches a great deal in response to a change in price or income, it is considered elastic. This mental picture should also help you remember how to calculate an elasticity—in the numerator, you will always find the percent change in quantity, and in the denominator, you will always find the percent change in the variable that is the source of the change in quantity.

Self-Test

Multiple-Choice Questions

1. In general, *elasticity* is a measure of
   a. the extent to which advances in technology are adopted by producers.
   b. the extent to which a market is competitive.
   c. how fast the price of a good responds to a change in demand or a change is supply.
   d. how much buyers and sellers respond to changes in market conditions.
   e. how much supply and demand respond to changes in each other.

2. The price elasticity of demand measures
   a. buyers' responsiveness to a change in the price of a good.
   b. the extent to which demand increases as additional buyers enter the market.
   c. how much more of a good consumers will demand when incomes rise.
   d. the movement along a supply curve when there is a change in demand.
   e. buyers' responsiveness to a change in the price of a related good.

3. Other things equal, the demand for a good tends to be more inelastic, the a. fewer the available substitutes.
   b. longer the time period considered.
   c. more the good is considered a luxury good.
   d. more narrowly defined is the market for the good.
   e. more the available substitutes.

4. For a particular good, a 3 percent increase in price causes a 10 percent decrease in quantity demanded. Which of the following statements is most likely applicable to this good?
   a. The relevant time horizon is short.
   b. The good is a necessity.
   c. The market for the good is broadly defined.
   d. There are many close substitutes for this good.
   e. The good is an inferior good.

Figure 5-1
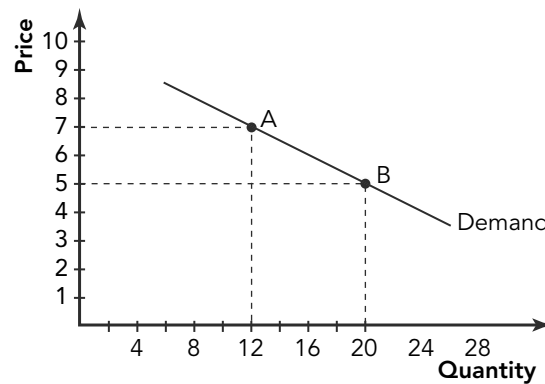
5. **Refer to Figure 5-1**. Suppose the point labeled B is the "halfway point" on the
   demand curve and it corresponds to a price of $5.00. Then, between prices of $4.99
   and $5.01, the price elasticity of demand is
   a.   less than 1 but greater than zero.
   b.   equal to 1.
   c.   greater than 1.
   d.   equal to zero.
   e.   Any of the above could be correct, depending on the quantities demanded at
   prices of $4.90 and $5.10.

Figure 5-2
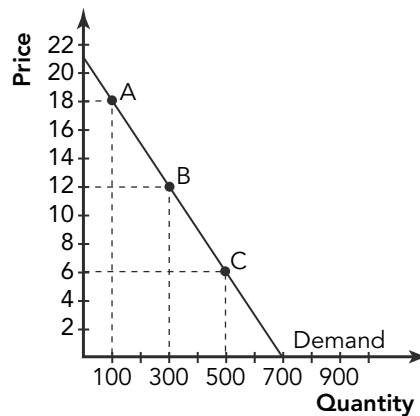
6. **Refer to Figure 5-2**. If the price decreased from $18 to $6,
   a.   total revenue would increase by $1,200, and demand is elastic between points A
        and C.
   b.   total revenue would increase by $800, and demand is elastic between points A and
        C.
   c.   total revenue would decrease by $1,200, and demand is inelastic between points A
        and C.
   d.   total revenue would decrease by $800, and demand is inelastic between points A
        and C.
   e.   total revenue would increase by $1,200, and demand is inelastic between points A
        and C.

7. You are in charge of the local city-owned golf course. You need to increase the revenue generated by the golf course in order to meet expenses. The mayor advises you to increase the price of a round of golf. The city manager recommends reducing the price of a round of golf. You realize that
   a. the mayor thinks demand is elastic, and the city manager thinks demand is inelastic.
   b. both the mayor and the city manager think that demand is elastic.
   c. both the mayor and the city manager think that demand is inelastic.
   d. the mayor thinks demand is inelastic, and the city manager thinks demand is elastic.
   e. both the mayor and the city manager think that demand is unit elastic.

8. Assume that a 4 percent decrease in income results in a 6 percent increase in the quantity demanded of a good. The income elasticity of demand for the good is
   a. negative and therefore the good is an inferior good.
   b. negative and therefore the good is a normal good.
   c. positive and therefore the good is an inferior good.
   d. positive and therefore the good is a normal good.
   e. positive and therefore the good is a substitute good.

9. Last month, sellers of good Y took in $100 in total revenue on sales of fifty units of good Y. This month, sellers of good Y raised their price and took in $120 in total revenue on sales of forty units of good Y. At the same time, the price of good X stayed the same, but sales of good X increased from twenty units to forty units. We can conclude that goods X and Y are
   a. substitutes, and have a cross-price elasticity of 0.60.
   b. complements, and have a cross-price elasticity of 0.60.
   c. substitutes, and have a cross-price elasticity of 1.67.
   d. complements, and have a cross-price elasticity of 1.67.
   e. both inferior goods.

10. A key determinant of the price elasticity of supply is the
    a. number of close substitutes for the good in question.
    b. definition of the market.
    c. length of the time period.
    d. extent to which buyers alter their quantities demanded in response to changes in their incomes.
    e. elasticity of demand.

11. A decrease in supply will cause the largest increase in price when
    a. both supply and demand are inelastic.
    b. both supply and demand are elastic.
    c. demand is elastic and supply is inelastic.
    d. demand is inelastic and supply is elastic.
   e. demand is unit elastic and supply is unit elastic.

Free Response Questions

1. You own a small-town movie theatre. You currently charge $5 per ticket for everyone who comes to your movies. Your friend who took an economics course in college tells you that there may be a way to increase your total revenue. Given the demand curves shown, answer the following questions.
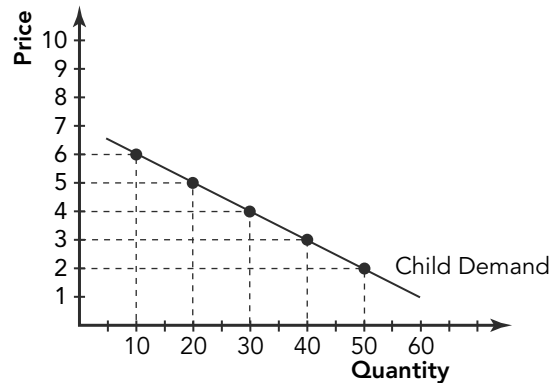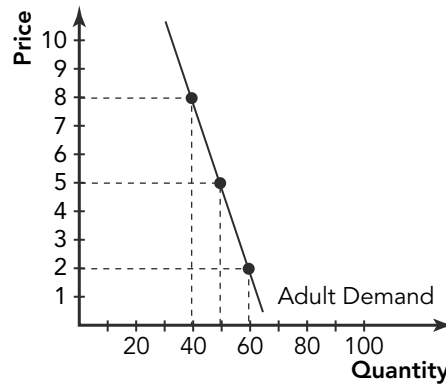
   a. What is your current total revenue for both groups?
   b. The elasticity of demand is more elastic in which market?
   c. Which market has the more inelastic demand?
   d. What is the elasticity of demand between the prices of $5 and $2 in the adult market? Is this elastic or inelastic?
   e. What is the elasticity of demand between $5 and $2 in the children's market? Is this elastic or inelastic?
   f. Given the graphs and what your friend knows about economics, he recommends you increase the price of adult tickets to $8 each and lower the price of a child's ticket to $3. How much could you increase total revenue if you take his advice?

2. Use the graph shown to answer the following questions. Put the correct letter(s) in the blank.
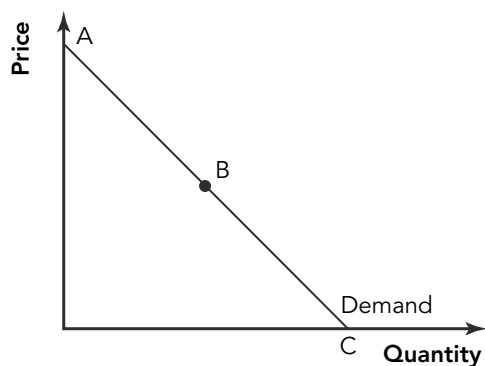
a. The elastic section of the graph is represented by section from _____.
b. The inelastic section of the graph is represented by section from _____.
c. The unit elastic section of the graph is represented by section _____.
d. The portion of the graph in which a decrease in price would cause total revenue to fall would be from _____.
e. The portion of the graph in which a decrease in price would cause total revenue to rise would be from _____.
f. The portion of the graph in which a decrease in price would not cause a change in total revenue would be _____.
g. The section of the graph in which total revenue would be at a maximum would be _____.
h. The section of the graph in which elasticity is greater than 1 is _____.
i. The section of the graph in which elasticity is equal to 1 is _____.
j. The section of the graph in which elasticity is less than 1 is _____.

Solutions

Multiple-Choice Questions

1. d   TOP: Price elasticity of demand
2. a   TOP: Price elasticity of demand
3. a   TOP: Price elasticity of demand
4. d   TOP: Price elasticity of demand
5. b   TOP: Midpoint method/ Price elasticity of demand
6. b   TOP: Elastic demand
7. a   TOP: Total revenue/ Price elasticity of demand
8. d   TOP: Total revenue/ Price elasticity of demand
9. a   TOP: Income elasticity of demand
10. c   TOP: Cross-price elasticity of demand
11. c   TOP: Price elasticity of supply
12. a   TOP: Price elasticity of demand / Price elasticity of supply

Free Response Questions

1. a.   Total revenue from children's tickets is $100 and from adult tickets is $250. Total revenue from all sales would be $350.
   b.   The demand for children's tickets is more elastic.
   c.   The adult ticket market has the more inelastic demand.
   d.   The elasticity of demand between $5 and $2 is 0.26, which is inelastic.
   e.   The elasticity of demand between $5 and $2 is 1.0, which is unit elastic.
   f.   Total revenue in the adult market would be $320. Total revenue in the children's market would be $120, so total revenue for both groups would be $440. $440 – $350 is an increase in total revenue of $90.

   TOP: Price elasticity of demand/ Total revenue

2. a.   A to B
   b.   B to C
   c.   B
   d.   B to C
   e.   A to B
   f.   B
   g.   B
   h.   A to B
   i.   B
   j.   B to C

   TOP: Price elasticity of demand/ Total revenue