

Elasticity and Its Applications

Facts and Tools

1. For each of the following pairs, which of the two goods is more likely to be inelastically demanded and why? Table 5.1 should help:
 - a. Demand for tangerines vs. demand for fruit
 - b. Demand for beef next month vs. demand for beef over the next decade
 - c. Demand for Exxon gasoline at the corner of 7th and Grand vs. demand for gasoline in the entire city
 - d. Demand for insulin vs. demand for vitamins

Solution

1. a. Fruit is more inelastically demanded because the overall category of fruit has fewer good substitutes than any one item in that category.
- b. More inelastic over the next month because people are usually more stubborn (inelastic, inflexible) in the short run.
- c. Brand-named goods are more elastic than categories especially when there are very good substitutes for Exxon gasoline available at close distances.
- d. Insulin is probably more of a necessity; thus, demand for insulin from buyers is more inelastic than demand for vitamins for buyers of vitamins.
2. For each of the following pairs, which of the two goods is more likely to be elastically supplied? Table 5.3 should help:
 - a. Supply of apples over the next growing season vs. supply of apples over the next decade
 - b. Supply of construction workers in Binghamton, New York, vs. supply of construction workers in New York State
 - c. Supply of breakfast cereal vs. supply of food
 - d. Supply of gold vs. supply of computers

Solution

2. a. Supply of apples over the next decade is more elastic. If the price permanently rises, you can plant some trees or buy them from someone else or invest more in effective horticulture. The time horizon for the next growing season is too short to make such adjustments.
- b. Supply in Binghamton is more elastic because it draws on a smaller labor pool compared to the whole of New York State. If the wage rises or falls there, workers can move to Binghamton or leave Binghamton, respectively much easier than they could move to or leave from New York State.
- c. Supply of breakfast cereal is more elastic. If its price rises, firms can switch machines from making macaroni to making cereal more easily than transforming non-food-producing machines to food-producing machines.

- d. Supply of computers is more elastic. It's easier to adjust production of a manufactured good if its price rises or falls than to adjust production of a rare material. New gold is hard to find, but new computers are relatively easy to make.
- 3. Indicate whether the demand for the good would become more elastic or less elastic after each of the following changes. (Note that in each of these cases the demand curve may also shift inward or outward, but in this question we are interested in whether the demand becomes more or less elastic). Briefly justify your answer.
 - a. The demand curve for soap after wide understanding that bacteria and other organisms cause and spread disease
 - b. The demand curve for coal after the invention of nuclear power plants
 - c. The demand curve for cars as more employers allow employees to telecommute
 - d. The demand curve for a new television during an economic boom

Solution

- 3. a. More inelastic, because soap is viewed more as a necessity than a luxury
- b. More elastic, because nuclear power plants were a new substitute for coal power plants
- c. More elastic, because either (1) consumers see cars as less of a necessity and more as a luxury or (2) consumers see telecommuting as a new substitute for a car
- d. Inelastic, because as incomes rise televisions take up a smaller portion of an average person's budget
- 4. For each of the following, indicate if the supply for the good would become more elastic or less elastic as a result of each change and briefly justify your answer. (Once again, in each case the supply curve will also shift, but we are interested in changes in the elasticity.)
 - a. The supply curve for diamonds if a new process for *manufacturing* diamonds is created
 - b. The supply curve for food if pesticides and fertilizers were banned
 - c. The supply curve for plastic if a very large share of oil output was used to make plastic
 - d. The supply curve for nurses after several years of increasing wages in nursing

Solution

- 4. a. More elastic because mining more diamonds requires increasing costs per unit, but the number of diamond factories can be doubled while keeping all other things equal
- b. More inelastic, because with a shorter technological "menu," there are fewer ways to respond to a price change
- c. More inelastic, because increasing plastic production today will be accomplished by small decreases in other uses of oil, but if plastic production accounted for a larger share of oil production more plastic production would require getting more from the ground and that's more costly
- d. More elastic, because the additional time that passes allows more time to adapt including more nurses to be produced using education
- 5. Let's work out a few examples to get a sense of what elasticity of demand means in practice. Remember that in all of these cases, we're moving along a fixed demand curve—so think of supply increasing or decreasing while the demand curve is staying in the same place.
 - a. If the elasticity of demand for college textbooks is -0.1 , and the price of textbooks increases by 20%, how much will the quantity demanded change, and in what direction?
 - b. In your answer to part a, was your answer in percentages or in total number of textbooks?

- c. If the elasticity of demand for spring break packages to Cancun is -5 , and if you notice that this year in Cancun the quantity of packages demanded increased by 10%, then what happened to the price of Cancun vacation packages?
- d. In your college town, real estate developers are building thousands of new student-friendly apartments close to campus. If you want to pay the lowest rent possible, should you hope that demand for apartments is elastic or inelastic?
- e. In your college town, the local government decrees that thousands of apartments close to campus are uninhabitable and must be torn down next semester. If you want to pay the lowest rent possible, should you hope that demand for apartments is elastic or inelastic?
- f. If the elasticity of demand for ballpoint pens with blue ink is -20 , and the price of ballpoint pens with blue ink rises by 1%, what happens to the quantity demanded?
- g. What's an obvious substitute for ballpoint pens with blue ink? (This obvious substitute explains why the demand is so elastic.)

Solution

- 5. a. Recall that elasticity = (% change in quantity)/(% change in price). So $-0.1 = (\% \text{ change in quantity})/(20\%)$. That means that % change in quantity = $20\% \times (-0.1) = -2\%$. The quantity demanded falls by 2%.
 - b. This answer is in percentages.
 - c. $-5 = +(10\%)/(\% \text{ change in price})$, so % change in price = -2% . Prices fell by 2%.
 - d. You want demand to be elastic. If it is, then a rise in supply causes a big fall in the rental price.
 - e. You want demand to be inelastic. If it is, then a fall in supply causes only a small increase in the rental price.
 - f. Again, recall that elasticity = (% change in quantity)/(% change in price). So $-20 = (\% \text{ change in quantity})/(1\%)$. That means % change in quantity = -20% . Quantity demanded falls by 20%.
 - g. An obvious substitute is ballpoint pens with black ink.
- 6. It's an important tradition in the Santos family that they eat the same meal at their favorite restaurant every Sunday. By contrast, the Chen family spends exactly \$50 for their Sunday meal at whatever restaurant sounds best.
 - a. Which family has a more elastic demand for restaurant food?
 - b. Which family has a unit elastic demand for restaurant food? [*Hint: How would each family respond to an increase in food prices?*]

Solution

- 6. a and b. The Santos family commits themselves to demanding food from the same restaurant each week regardless of price. This results in a highly inelastic demand curve and thus a low elasticity. The Chen family on the other hand spends the same amount each week, so that a doubling of prices would result in half the amount of restaurant meals being eaten each week. The elasticity of demand for the Chen family must be unit elastic at that point of consumption. This can easily be seen with the midpoint formula for calculating elasticity: $[(\text{Change in } Q)/(\text{Average } Q)]/[(\text{Change in } P)/(\text{Average } P)]$. If the Chens bought ten \$5 meals and now buy five \$10 meals, elasticity equals $(-5/7.5)/(5/7.5)$, or -1 .
- 7. The U.S. Department of Agriculture (USDA) has been concerned that Americans aren't eating enough fruits and vegetables, and they've considered coupons and other subsidies to encourage people—especially lower-income people—to eat these healthier foods. Of course, if people's demand for fruits and vegetables is perfectly inelastic, then there's no point in giving out coupons (thought question: why?) If instead the demand is only somewhat elastic, there may be better ways to spend taxpayer dollars.

This is clearly a situation where you'd want to know the elasticity of fruit and vegetable demand: If people respond a lot to small changes in price, then government-funded fruit and vegetable coupons *could* make poorer Americans a lot healthier, which *might* save taxpayers money *if* they don't have to pay for expensive medical treatments for unhealthy eaters. There are a lot of links in this chain of reasoning—all of which are covered in more advanced economics courses—but the first link is whether people actually have elastic demand for fruits and vegetables. The USDA's Economic Research Service employs economists to answer these sorts of questions, and a recent report contained the following estimated elasticities (*Source*: Diansheng Dong and Bing-Hwan Lin, 2009. Fruit and vegetable consumption by low-income Americans: Would a price reduction make a difference? *Economic Research Report* 70, USDA).

Fruit	Elasticity of Demand
Apple	-0.16
Banana	-0.42
Grapefruit	-1.02
Grapes	-0.91
Orange	-1.14

- a. Based on these demand elasticity estimates, which fruit is most inelastically demanded? Which is most elastically demanded?
- b. For which of these fruits would a 10% drop in price cause an increase in total revenue from that sale of that fruit?
- c. If the government could offer “10% off” coupons for only three of these fruits, and it wanted to have the biggest possible effect on quantity demanded, which three fruits should get the coupons?
- d. Overall, the authors found that for the average fruit, the elasticity of demand was about -0.5. Is the demand for fruit elastic or inelastic?

- Solution**
7. a. Apples the most inelastically demanded, and oranges are most elastically demanded.
 b. For grapefruit and oranges, a fall in price would cause a rise in total revenue (absolute elasticity > 1).
 c. The most elastic: grapefruit, grapes, and oranges would create the biggest effect.
 d. Since the elasticity's absolute value is between 0 and 1, demand is inelastic.
 8. On average, old cars pollute more than newer cars. Therefore, every few years, a politician proposes a cash for clunkers program: The government offers to buy up and destroy old, high-polluting cars. If a cash for clunkers program buys 1,000 old, high-polluting cars, is this the same as saying that there are 1,000 fewer old, high-polluting cars on the road? Why or why not?

- Solution**
8. This is not the same: It's just another version of the slave redemption story or the gun buyback story. People will bring cars from out of state, from their backyard, or from the junkyard to sell to the government. Some of these cars were probably being driven very little, if at all. Such rarely used cars are just the ones you'd expect people to sell to the government.
 9. As we noted in the chapter, many economists have estimated the short-run and long-run elasticities of oil demand. Let's see if a rise in the price of oil hurts oil revenues in the long run. Cooper, the author cited in this chapter, found that in the United States, the long-run elasticity of oil demand is -0.5.
 - a. If the price of oil rises by 10%, how much will the quantity of oil demanded fall: by 5%, by 0.5%, by 2%, or by 20%?

- b. Does a 10% rise in oil prices increase or decrease total revenues to the oil producers?
- c. Some policymakers and environmental scientists would like to see the United States cut back on its use of oil in the long run. We can use this elasticity estimate to get a rough measure of how high the price of oil would have to permanently rise in order to get people to make big cuts in oil consumption. How much would the price of oil have to permanently rise in order to cut oil consumption by 50%?
- d. France has the largest long-run elasticity of oil demand (-0.6) of any of the large, rich countries, according to Cooper's estimates. Does this mean that France is better at responding to long-run price changes than other rich countries, or does it mean France is worse at responding?

Solution

- 9. a. Recall that elasticity = (% change in quantity)/(% change in price). So $-0.5 = (\% \text{ change in quantity})/(10\%)$. That means % change in quantity = -5% . Quantity demanded falls by 5%.
 - b. It will increase total revenues because the change is occurring along an inelastic point on the demand curve.
 - c. The price of oil would have to permanently rise by 100% to do this.
 - d. It means France is more responsive as more elastic means more flexible. One reason may be that France is also one of the countries that most uses nuclear power, making it a more viable substitute for oil.
- 10. Figure 5.3 and Table 5.2 both set out some important but tedious rules. Let's practice them, since they are quite likely to be on an exam. For each of the following cases, state whether the demand curve is relatively steep or flat, and whether a *fall* in price will raise total revenue or lower it. In this case note that we present the elasticity in terms of its absolute value.
 - a. Elasticity of demand = 0.2
 - b. Elasticity of demand = 2.0
 - c. Elasticity of demand = 10.0
 - d. Elasticity of demand = 1.1
 - e. Elasticity of demand = 0.9

Solution

- 10. a. Steep because the elasticity is inelastic; fall in revenue
- b. Flat because the elasticity is elastic; rise in revenue
- c. Flat because the elasticity is elastic; rise in revenue
- d. Flat because the elasticity is elastic; rise in revenue
- e. Steep because the elasticity is inelastic; fall in revenue
- 11. A lot of American action movies are quests to eliminate a villain. If in real-life villains are elastically supplied (like guns for buyback programs), should we care whether the hero captures a particular villain? Why or why not?

Solution

- 11. No, we shouldn't care. Once one villain is eliminated, another will quickly take his or her place if the supply of villains is elastic.

Thinking and Problem Solving

- 1. During the Middle Ages, the African city of Taghaza quarried salt in 200-pound blocks to be sent to the salt market in Timbuktu, in present-day Mali. Travelers report that Taghazans used salt instead of wood to construct buildings.

Compared with other towns without big salt mines, was the demand for *wood* more elastic or less elastic in Taghaza? How do you know?

- Solution** 1. The demand for wood was more elastic than in other places because substitutes for wood were easier to find in Taghaza than in other places.
2. Suppose that drug addicts pay for their addiction by stealing: So the higher the total revenue of the illegal drug industry, the higher the amount of theft. If a government crackdown on drug suppliers leads to a higher price of drugs, what will happen to the amount of stealing if the demand for drugs is elastic? What if the demand for drugs is inelastic?

- Solution** 2. If the demand for drugs is elastic, a higher price of drugs will mean less consumer expenditure on drugs. While some people will steal more to pay for the higher price, more than enough people to outweigh that will steal less as they move away from drugs in favor of other recreation. The overall amount of stealing will decrease. If the demand for drugs is inelastic, a higher price of drugs will mean greater consumer expenditure on drugs. Since the consumers get money for their addiction by stealing, the amount of stealing will increase.
3. Henry Ford famously mass-produced cars at the beginning of the twentieth century, starting Ford Motor Company. He made millions because mass production made cars cheap to make, and he passed some of the savings to the consumer in the form of a low price. Cars became a common sight in the United States thereafter. Keeping total revenue and its relationship with price in mind, do you expect the demand for cars to be elastic or inelastic given the story of Henry Ford?

- Solution** 3. Total revenue clearly went up for the Ford Motor Company as the price of cars decreased. Thus, the demand for cars was elastic.
4. In Chapter 10, you'll see that we recently purchased permits to pollute the air with sulfur dioxide (SO_2). We didn't use the permits: Instead, we threw them out. In other words, we bought permits for the same reason the government buys guns in gun buyback programs—to prevent what we bought from being used. As we discussed in the chapter, gun buyback programs have failed. So why is our plan to buy permits more likely to get SO_2 out of the air than the government's plan to get guns off the street?

- Solution** 4. The supply of guns to Washington, D.C., is close to perfectly elastic so every gun bought by the government is quickly replaced by a gun on the street. In contrast, the number of pollution permits is fixed so the supply is perfectly inelastic. When the supply is perfectly inelastic every permit bought by us is one less permit available to firms to pollute the air. Thus, our plan to reduce SO_2 is much more likely to work than the government's plan to reduce guns on the street. You just knew our plan was more likely to succeed, didn't you?
5. How might elasticities help to explain why people on vacation tend to spend more for food and necessities than the local population?

- Solution** 5. Tourists tend to be less familiar with a location than their hometown, causing them to be ignorant of the availability of substitutes at other stores or the quality of unknown brands within stores. Even knowing the existence of other stores may be insufficient because tourists highly value their time, making other stores no longer close substitutes.
6. In the short run the price elasticity of the demand and supply of electricity can be very low.

- a. How might revenue for the electricity industry change if one power plant were shut down for maintenance, reducing supply?
- b. If one power company owned many power plants, would it have a short-term incentive to keep all of its plants running, or could it have a short-term incentive to shut down a power plant now and then?

Solution

- 6. a. A shutdown of a power plant would shift the supply curve to the left, resulting in a large change in price relative to the reduction in the quantity sold. Total revenue would increase.
- b. The occasional shutdown could increase the revenues for the power company, so it will be sorely tempted to shut down some power plants now and again. We take up this issue in more detail in Chapter 11 when we look at California's electricity crisis.
- 7. Immigration is a fact of life in the United States. This will lead to a big boost in the labor supply. What field would you rather be in: A field where the demand for your kind of labor is elastic or a field where the demand for your kind of labor is inelastic?

Solution

- 7. I want to be in a field where the demand for my labor is elastic because a big increase in supply won't push down my wage much.
- 8. In the world of fashion, the power to imitate a trendy look is the power to make money. Stores like H&M and Forever 21 focus on imitating fashions wherever possible: As soon as they see that a new look is coming along, something people are willing to pay a high price for, they start cranking out that look. Do these imitation-centered stores make the supply of clothing more elastic or more inelastic? How can you tell?

Solution

- 8. They make the supply of clothing more elastic because a rise in price causes a much larger change in quantity supplied.
- 9. The relationship between elasticity of demand and total revenue can be a helpful shortcut, particularly if your professor likes to give multiple-choice exams. For each of the following examples, calculate how much money each consumer spends at the low price and at the high price, and decide whether the right answer for a question asking for the price elasticity of demand on a multiple-choice exam would be (a) -2.33 , (b) -1.17 , (c) -1.00 , or (d) -0.56 . Remember, if the consumer spends more money at the lower price, demand must be elastic. (*Warning:* Two of these will require a bit of guesstimation.)
 - a. When the price of a movie ticket rises from \$6 to \$8 for senior citizens, Gary (a senior citizen) decides to go to the movies every other day (15 times per month) instead of every day (30 times per month).
 - b. When the price of a large specialty coffee drink rises from \$3 to \$4, Martha reduces her weekly consumption from 7 to 5.
 - c. When $P_X = \$10.00$, $Q_X^D = 30$. When $P_X = \$7.50$, $Q_X^D = 40$.

Solution

- 9. a. At the low price, he spends \$180 per month, and at the high price, he spends \$120. Since he spends more at the low price, demand must be elastic: a or b. This is a huge increase (from \$120 to \$180), however, so the answer is probably a.
- b. At the low price, she spends \$21, and at the high price, she spends \$20. Since she spends more at the low price, demand must be elastic: a or b. However, this is a small increase (from \$20 to \$21), so the answer is probably b.
- c. At the low price, revenue is \$300. At the high price, revenue is \$300. Therefore, demand is unit elastic: c.

10. Let's practice the midpoint formula. Calculate the elasticity of demand for each of the following goods or services.

Good or Service	Beginning Price	Beginning Quantity	Ending Price	Ending Quantity	Elasticity of Demand
Daily movie ticket sales in Denver, Colorado	\$6	50,000	\$10	40,000	
Weekly milk sales at Loma Vista Elementary School	\$1	1,000	\$1.50	800	
Weekly round-trip ticket sales, New York to San Francisco	\$500	10,000	\$1,000	9,000	
Annual student enrollments, Upper Tennessee State University	\$6,000	40,000	\$9,000	39,000	

Solution 10.

Good or Service	Beginning Price	Beginning Quantity	Ending Price	Ending Quantity	Elasticity of Demand
Daily movie ticket sales in Denver, Colorado	\$6	50,000	\$10	40,000	$(-10,000/45,000) / (\$4/\$8) = -0.22/0.5 = -0.44$
Weekly milk sales at Loma Vista Elementary School	\$1	1,000	\$1.50	800	$(-200/900) / (\$0.5/\$1.25) = -0.44/0.4 = -1.1$
Weekly round-trip ticket sales, New York to San Francisco	\$500	10,000	\$1,000	9,000	$(-1,000/9,500) / (\$500/\$750) = -0.11/(0.67) = -0.16$
Annual student enrollments, Upper Tennessee State University	\$6,000	40,000	\$9,000	39,000	$(-1,000/39,500) / (\$3,000/\$7,500) = -0.025/0.4 = -0.063$

Challenges

1. In this chapter, we've emphasized that the elasticity of supply is higher in the long run than in the short run. In lots of cases, this is surely true: If you see that jobs pay more in the next state over, you won't move there the next week but you might move there next year. But sometimes the short-run elasticity will be *higher* than the long-run elasticity.

Austan Goolsbee found an interesting example of this when he looked at the elasticity of income of highly paid executives with respect to taxes. In 1993, then President Clinton passed a law raising income taxes. This tax hike was fully expected: He campaigned on it in 1992.

- a. What do you expect happened to executive income in the first year of the tax increases? What about in subsequent years?
Here's a hint: Top executives have a lot of power over when they get paid for their work: They can ask for bonuses a bit earlier, or they can cash out their stock options a bit earlier. Literally, this isn't their "labor supply," it's more like their "income supply."
(Source: Goolsbee, Austan. 2000. What happens when you tax the rich? Evidence from executive compensation. *Journal of Political Economy* 108(2): 352–378. For a book on the topic written by leading economists, see Joel Slemrod, ed. 2000. *Does Atlas Shrug?* Cambridge, MA: Harvard University Press.)
- b. Goolsbee estimated that the short-run elasticity of "income supply" for these executives was 1.4, while the long-run elasticity of "income supply" was 0.1. (Note: Goolsbee used a variety of statistical methods to look for these elasticities, and all came to roughly the same result.) If taxes pushed down their take-home income by 10%, how much would this cut the amount of income supplied in the short run? In the long run?
- c. You are a newspaper reporter. Your editor tells you to write a short story with this title: "Goolsbee's research proves that tax hikes make the rich work less." Make your case in one sentence.
- d. You are a newspaper reporter. Your editor tells you to write a short story with this title: "Goolsbee's research proves that tax hikes have little effect on work by the wealthy." Make your case in one sentence.
- e. Which story is more truthful?

Solution

1.
 - a. Income went down a lot in the first year of the tax increase because executives had pulled their income into the previous year when taxes were low. In the long run, however, executives have fewer options to move their income through time. Thus, as time continued, executive income returned to close to its previous level.
 - b. In the short run this would push down income by 14 percent, but in the long run it would only push it down by 1 percent.
 - c. In the first year of the Clinton tax increase executive income went down a lot. One could use this fact to argue that executives were responding to the tax by working a lot less.
 - d. A tax increase causes executives to move as much of their income as possible to a low-tax year, but even though income changes by a lot, executives continue to work about the same amount as before which is why income recovers in subsequent years.
 - e. Based on Goolsbee's research the story in part d is more truthful.
2. We saw that a gun buyback program was unlikely to work in Washington, D.C. If the entire United States ran a gun buyback program, would that be better at eliminating guns or worse? Why? What about if the gun buyback was also accompanied by a law making (at least some) guns illegal?

Solution

2. A national gun buyback would probably be more effective, since the supply of guns is more inelastic at the national level. It's harder to import guns from elsewhere to sell in the United States than to import guns from Maryland to sell in

Washington, D.C. There still is the important problem of people just selling use-less guns, long-forgotten guns, and so forth, but it weakens the problem of imports. If the gun buyback problem were accompanied by a law making it illegal to own (or produce more) guns, the program would likely be even more effective at getting guns off the street. Australia enacted just such a program in 1997. Economists Andrew Leigh and Christine Neill found that the program was successful at reducing the number of guns in Australia and that it reduced firearm deaths, especially firearm suicides.

3. Using the data from the ANWR example, what will be the percentage increase in quantity supplied if ANWR raises supply by 1%? No, this isn't a trick question, and the formula is already there in the chapter. Why isn't this number just 1%?

Solution

3. $E_d(\text{Shift in Supply})/(E_d + E_s) = 0.5 \times 1\%/(0.8) = 2.5\%/4 = 0.625\%$. This is the formula for a shift in equilibrium quantity caused by a shift in the supply curve. This is less than 1% because part of the effect of the rise in supply is a lower price. And that lower price reduces the quantity supplied by other suppliers, crowding them out.

To see this, notice that if the demand curve were vertical, then E_d would be 0. In this case, a rise in supply would push the price of oil down so much that other suppliers would reduce their quantity supplied by exactly the increase in ANWR supply, with no effect on equilibrium quantity. Our equation agrees with this intuition: The numerator would equal zero, so the quantity shift would equal zero.

At the other extreme, if demand were infinitely elastic—so people eat up all the oil at a given price—then there would be no price decline and the 1% ANWR increase would also be a 1% world increase. In terms of the equation, loosely speaking the result would be $(\text{infinity} \times 1\%)/(\text{infinity} + 0.3) = (\text{infinity} \times 1\%)/(\text{infinity}) = 1\%$. The infinities in the numerator and denominator cancel out, and all of the extra supply would go toward raising the equilibrium quantity of oil.