

Price Elasticity of Demand Example Questions

Review:

First, a quick review of Price Elasticity of Demand from lecture on 02/19/09.

The definition of Price Elasticity of Demand (PED) is:

$$\text{Price Elasticity of Demand} = \frac{\text{Percentage Change in Quantity Demanded}}{\text{Percentage Change in Price}} = \frac{\% \Delta Q_D}{\% \Delta P}$$

In order to calculate the PED we need two points on the demand curve, (Q_{D_1}, P_1) and (Q_{D_2}, P_2) .

We use the midpoint formula, so:

$$PED = \frac{\frac{Q_{D_2} - Q_{D_1}}{\left(\frac{Q_{D_2} + Q_{D_1}}{2}\right)}}{\frac{P_2 - P_1}{\left(\frac{P_2 + P_1}{2}\right)}}$$

Once we have calculated the PED between two points on the demand curve, we can say if demand between those points is "elastic," "inelastic" or "unit elastic":

- Demand is "elastic" at a certain point if $PED < -1$
- Demand is "inelastic" at a certain point if $0 > PED > -1$
- Demand is "unit elastic" at a certain point if $PED = -1$

There are a number of factors that can determine if a demand curve will be more elastic, or more inelastic (we will talk more about these factors on Tuesday, 02/24/09):

Four Factors Affecting PED:

1. Availability of close substitutes
2. Necessities vs. luxuries
3. Definition of Market
4. Amount of time

When calculating different elasticities it is very important to keep in mind, what information you need to calculate a certain elasticity and what information you have available. Also, sometimes there is information that is not relevant to certain elasticities. Be sure you are aware of what information is necessary and what information is not. The following examples emphasize this point. The answers to these example problems are at the end of this handout.

Example 1: You are given market data that says when the price of pizza is \$4, the quantity demanded of pizza is 60 slices and the quantity demanded of cheese bread is 100 pieces. When the price of pizza is \$2, the quantity demanded of pizza is 80 slices and the quantity demanded of cheese bread is 70 pieces.

- Can the Price-Elasticity of Demand be calculated for either good?
- If so, calculate the PED.

Example 2: Consider the markets for widgets and cogs. You study survey data and observe that if widgets cost \$5, then 100 widgets are demanded. You also observe that if widgets cost \$3, then 150 cogs are demanded and if widgets cost \$4 then 100 cogs are demanded. If cogs cost \$2, then 125 cogs are demanded.

- Can the Price-Elasticity of Demand be calculated for either good?
- If so, calculate the PED.

Example 3: Consider the market for widgets and cogs (again). You study survey data and observe that if widgets cost \$5, then 100 widgets are demanded and 60 cogs are demanded. You also observe that if widgets cost \$3, then 200 widgets are demanded and 100 cogs are demanded. If cogs cost \$2, then 125 cogs are demanded.

- Can the Price-Elasticity of Demand be calculated for either good?
- If so, calculate the PED.

Answers to Example Questions

Example 1: You are given market data that says when the price of pizza is \$4, the quantity demanded of pizza is 60 slices and the quantity demanded of cheese bread is 100 pieces. When the price of pizza is \$2, the quantity demanded of pizza is 80 slices and the quantity demanded of cheese bread is 70 pieces.

- Can the Price-Elasticity of Demand be calculated for either good?

In order to calculate PED we need two (quantity, price) pairs for one good (two points along a certain good's demand curve). We are given this information for pizza. We are never given this information for cheese bread.

- If so, calculate the PED.

$$\text{PED} = \frac{\frac{Q_{D_2} - Q_{D_1}}{(Q_{D_2} + Q_{D_1})}}{\frac{P_2 - P_1}{(P_2 + P_1)}}$$

We need to use the formula, $\text{PED} = \frac{\frac{Q_{D_2} - Q_{D_1}}{(Q_{D_2} + Q_{D_1})}}{\frac{P_2 - P_1}{(P_2 + P_1)}}$.

We have two (quantity, price) pairs for pizza. Specifically, $(Q_{D_1}, P_1) = (60, \$4)$ and $(Q_{D_2}, P_2) = (80, \$2)$. Then, plugging these numbers into the above formula, we obtain:

$$\frac{\frac{80 - 60}{80 + 60}}{\frac{2}{2 - 4}} = \frac{\frac{20}{70}}{\frac{-2}{-2}} = \frac{2}{7} * \frac{-3}{2} = \frac{-3}{7}$$

Given this data, the PED is $\frac{-3}{7}$.

NOTE, that this tells us that given these two points, this demand curve for pizza is **inelastic**. We know this because the PED is between 0 and -1.

Example 2: Consider the market for widgets. You study survey data and observe that if widgets cost \$5, then 100 widgets are demanded. You also observe that if widgets cost \$3, then 150 cogs are demanded and if widgets cost \$4 then 100 cogs are demanded. If cogs cost \$2, then 125 cogs are demanded.

- Can the Price-Elasticity of Demand be calculated for either good?

In order to calculate PED we need two (quantity, price) pairs for one good (two points along a certain good's demand curve). We are not given this information for either widgets or cogs. We cannot calculate PED for either good in this case.

Example 3: Consider the market for widgets and cogs (again). You study survey data and observe that if widgets cost \$5, then 100 widgets are demanded and 60 cogs are demanded. You also observe that if widgets cost \$3, then 200 widgets are demanded and 100 cogs are demanded. If cogs cost \$2, then 125 cogs are demanded.

- Can the Price-Elasticity of Demand be calculated for either good?

In order to calculate PED we need two (quantity, price) pairs for one good (two points along a certain good's demand curve). We are given this information for widgets. We are never given this information for cogs.

- If so, calculate the PED.

$$\frac{\frac{Q_{D_2} - Q_{D_1}}{Q_{D_2} + Q_{D_1}}}{\frac{P_2 - P_1}{P_2 + P_1}}$$

We need to use the formula, $PED = \frac{\frac{Q_{D_2} - Q_{D_1}}{Q_{D_2} + Q_{D_1}}}{\frac{P_2 - P_1}{P_2 + P_1}}$.

We have two (quantity, price) pairs for widgets. Specifically, $(Q_{D_1}, P_1) = (100, \$5)$ and $(Q_{D_2}, P_2) = (200, \$3)$. Then, plugging these numbers into the above formula, we obtain:

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$$\frac{200 - 100}{200 + 100} = \frac{100}{150} = \frac{2}{3}$$
$$\frac{3 - 5}{3 + 5} = \frac{-2}{4} = \frac{-1}{2}$$
$$\frac{100}{150} * \frac{-4}{2} = \frac{2}{3} * \frac{-4}{2} = \frac{-4}{3}$$

Given this data, the PED is $\frac{-4}{3}$.

NOTE, that this tells us that given these two points, this demand curve for pizza is **elastic**. We know this because the PED is less than -1.

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Practice Questions and Answers from Lesson I-7: Elasticity

Practice Questions and Answers from Lesson I-7: Elasticity

The following questions practice these skills:

- ✓ Use the midpoint method for calculating percent change.
- ✓ Compute price elasticity of demand.
- ✓ Identify elastic and inelastic demand according to the price elasticity of demand.
- ✓ For elastic demand, apply the negative relation between price and revenue.
- ✓ For inelastic demand, apply the positive relation between price and revenue.
- ✓ Remember demand is more elastic when there are more substitutes or closer substitutes.
- ✓ Compute the price elasticity of supply.
- ✓ Compute cross-price elasticities of demand.
- ✓ Relate cross-price elasticities of demand to gross substitutes and gross complements.
- ✓ Identify elastic and inelastic portions of a linear demand curve.
- ✓ Compute income elasticity of demand.

Question: Amazon.com, the online bookseller, wants to increase its total revenue. One strategy is to offer a 10% discount on every book it sells. Amazon.com knows that its customers can be divided into two distinct groups according to their likely responses to the discount. The accompanying table shows how the two groups respond to the discount.

	Group A (sales per week)	Group B (sales per week)
Volume of sales before the 10% discount	1.55 million	1.50 million
Volume of sales after the 10% discount	1.65 million	1.70 million

- a. Using the midpoint method, calculate the price elasticities of demand for group A and group B.
- b. Explain how the discount will affect total revenue from each group.
- c. Suppose Amazon.com knows which group each customer belongs to when he logs on and can choose whether or not to offer the 10% discount. If Amazon.com wants to increase its total revenue, should discounts be offered to group A or to group B, to neither group, or to both groups?

Answer to Question:

- a. Using the midpoint method, the percent change in the quantity demanded by group A is

$$\frac{1.65 \text{ million} - 1.55 \text{ million}}{(1.55 \text{ million} + 1.65 \text{ million})/2} \times 100 = \frac{0.1 \text{ million}}{1.6 \text{ million}} \times 100 = 6.25\%$$

and since the change in price is 10%, the price elasticity of demand for group A is

Practice Questions and Answers from Lesson 1-7: Elasticity

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$$6.25\%/10\% = 0.625$$

Using the midpoint method, the percent change in the quantity demanded by group B is

$$\frac{1.7 \text{ million} - 1.5 \text{ million}}{(1.5 \text{ million} + 1.7 \text{ million})/2} \times 100 = \frac{0.2 \text{ million}}{1.6 \text{ million}} \times 100 = 12.5\%$$

and since the change in price is 10%, the price elasticity of demand for group B is

$$12.5\%/10\% = 1.25$$

b. For group A, since the price elasticity of demand is 0.625 (demand is inelastic), total revenue will decrease as a result of the discount. For group B, since the price elasticity of demand is 1.25 (demand is elastic), total revenue will increase as a result of the discount.

c. If Amazon.com wants to increase total revenue, it should definitely not offer the discount to group A and it should definitely offer the discount to group B.

Question: Do you think the price elasticity of demand for Ford sport-utility vehicles (SUVs) will increase, decrease, or remain the same when each of the following events occurs? Explain your answer.

- a. Other car manufacturers, such as General Motors, decide to make and sell SUVs.
- b. SUVs produced in foreign countries are banned from the American market.
- c. Due to ad campaigns, Americans believe that SUVs are much safer than ordinary passenger cars.
- d. The time period over which you measure the elasticity lengthens. During that longer time, new models such as four-wheel-drive cargo vans appear.

Answer to Question:

- a. The price elasticity of demand for Ford SUVs will increase because more substitutes are available.
- b. The price elasticity of demand for Ford SUVs will decrease because fewer substitutes are available.
- c. The price elasticity of demand for Ford SUVs will decrease because other cars are viewed as less of a substitute.
- d. The price elasticity of demand for Ford SUVs will increase over time because more substitutes (such as four-wheel-drive cargo vans) become available.

Question: The accompanying table gives part of the supply schedule for personal computers in the United States.

Price of computer	Quantity of computers supplied
\$1,100	12,000
\$900	8,000

a. Calculate the price elasticity of supply when the price increases from \$900 to \$1,100 using the midpoint method.

Practice Questions and Answers from Lesson I-7: Elasticity

- b. Suppose firms produce 1,000 more computers at any given price due to improved technology. As price increases from \$900 to \$1,100, is the price elasticity of supply now greater than, less than, or the same as it was in part a?
- c. Suppose a longer time period under consideration means that the quantity supplied at any given price is 20% higher than the figures given in the table. As price increases from \$900 to \$1,100, is the price elasticity of supply now greater than, less than, or the same as it was in part a?

Answer to Question:

- a. Using the midpoint method, the percent change in the quantity supplied is

$$\frac{12,000 - 8,000}{(12,000 + 8,000)/2} \times 100 = \frac{4,000}{10,000} \times 100 = 40\%$$

and the percent change in the price is

$$\frac{\$1,100 - \$900}{(\$1,100 + \$900)/2} \times 100 = \frac{\$200}{\$1,000} \times 100 = 20\%$$

The price elasticity of supply is therefore

$$40\%/20\% = 2.$$

b. The elasticity estimate would be lower. A price change from \$900 to \$1,100 is a 20% price change, just as calculated in part a. Previously, when the quantity supplied changed from 8,000 to 12,000, that was a 40% change in the quantity supplied. Now that the quantity supplied at each price is higher by 1,000, the same price change would imply a change in the quantity supplied from 9,000 to 13,000, which is a 36% change using the midpoint method. The new price elasticity of supply is $36\%/20\% = 1.8$, which is lower than in part a.

c. The elasticity estimate would be unchanged. The price increase from \$900 to \$1,100 is a 20% increase, just as calculated in part a. But now that all quantities are 20% higher, the quantity supplied increases from 9,600 to 14,400. Using the midpoint method, this is an increase of

$$\frac{14,400 - 9,600}{(14,400 + 9,600)/2} \times 100 = \frac{4,800}{12,000} \times 100 = 40\%$$

so that the price elasticity of supply is

$$40\%/20\% = 2$$

Therefore the price elasticity of supply is the same as in part a.

Question: The accompanying table lists the cross-price elasticities of demand for several goods, where the percent quantity change is measured for the first good of the pair, and the percent price

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Practice Questions and Answers from Lesson 1-7: Elasticity

change is measured for the second good.

Good	Cross-price elasticities of demand
Air-conditioning units and kilowatts of electricity	-0.34
Coke and Pepsi	+0.63
High-fuel-consuming sport-utility vehicles (SUVs) and gasoline	-0.28
McDonald's burgers and Burger King burgers	+0.82
Butter and margarine	+1.54

- Explain the sign of each of the cross-price elasticities. What does it imply about the relationship between the two goods in question?
- Compare the absolute values of the cross-price elasticities and explain their magnitudes. For example, why is the cross-price elasticity of McDonald's burgers and Burger King burgers less than the cross-price elasticity of butter and margarine?
- Use the information in the table to calculate how a 5% increase in the price of Pepsi affects the quantity of Coke demanded.
- Use the information in the table to calculate how a 10% decrease in the price of gasoline affects the quantity of SUVs demanded.

Answer to Question:

- A negative cross-price elasticity of demand implies that the two goods are gross complements. So air-conditioning units and kilowatts of electricity are gross complements, as are sport-utility vehicles and gasoline. A positive cross-price elasticity of demand implies that the two goods are gross substitutes. So Coke and Pepsi are gross substitutes, as are McDonald's and Burger King burgers as well as butter and margarine.
- The larger (and positive) the cross-price elasticity of demand is, the more closely the two goods are gross substitutes. Since the cross-price elasticity of butter and margarine is larger than the cross-price elasticity of McDonald's burgers and Burger King burgers, butter and margarine are closer gross substitutes than are McDonald's and Burger King burgers. Similarly, the greater (and negative) the cross-price elasticity of demand is, the more strongly the two goods are gross complements.
- A cross-price elasticity of 0.63 implies that a 1% increase in the price of Pepsi would increase the quantity of Coke demanded by 0.63%. Therefore, a 5% increase in the price of Pepsi would increase the quantity of Coke demanded by five times as much, that is, by $5 \times 0.63\% = 3.15\%$.
- A cross-price elasticity of -0.28 implies that a 1% fall in the price of gasoline would increase the quantity of SUVs demanded by 0.28%. Therefore, a 10% fall in the price of gasoline would increase the quantity of SUVs demanded by 10 times as much, that is, by $10 \times 0.28\% = 2.8\%$.

Question: What can you conclude about the price elasticity of demand in each of the following statements?

- "The pizza delivery business in this town is very competitive. I'd lose half my customers if I raised the price by as little as 10%."
- "I owned both of the two Jerry Garcia autographed lithographs in existence. I sold one on eBay for a high price. But when I sold the second one, the price dropped by 80%."
- "My economics professor has chosen to use the Krugman/Wells textbook for this class. I have no

Practice Questions and Answers from Lesson 1-7: Elasticity

choice but to buy this book."

d. "I always spend a total of exactly \$10 per week on coffee."

Answer to Question:

a. This statement says that a 10% increase in price reduces the quantity demanded by 50%. That is, the price elasticity of demand is $-50\% / 10\% = -5$

So demand is elastic.

b. The fact that it was necessary for price to drop by 80% in order to sell one more unit (an increase in quantity of 67%, using the midpoint method) indicates that the demand for Jerry Garcia autographed lithographs is inelastic.

c. There is no substitute available, so demand is inelastic. (Although, over time, as more used Krugman/Wells textbooks become available, the price elasticity of demand will increase.)

d. Demand is unit-elastic: no matter what the price of coffee is, the total revenue to the producer (which is my total expenditure on coffee) remains the same.

Question: The accompanying table shows the price and yearly quantity sold of souvenir T-shirts in the town of Crystal Lake according to the average income of the tourists visiting.

Price of T-shirt	Quantity of T-shirts demanded when the average tourist income is \$20,000	Quantity of T-shirts demanded when the average tourist income is \$30,000
\$4	3,000	5,000
\$5	2,400	4,200
\$6	1,600	3,000
\$7	800	1,800

a. Using the midpoint method, calculate the price elasticity of demand when the price of a T-shirt rises from \$5 to \$6 and the average tourist income is \$20,000. Also calculate it when the average tourist income is \$30,000.

b. Using the midpoint method, calculate the income elasticity of demand when the price of a T-shirt is \$4 and the average tourist income increases from \$20,000 to \$30,000. Also calculate it when the price is \$7.

Answer to Question:

a. Suppose the average tourist income is \$20,000. Using the midpoint method, the percent change in the quantity demanded is

$$\frac{1,600 - 2,400}{(1,600 + 2,400)/2} \times 100 = \frac{-800}{2,000} \times 100 = -40\%$$

and the percent change in the price is

Practice Questions and Answers from Lesson I-7: Elasticity

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$$\frac{\$6 - \$5}{(\$6 + \$5)/2} \times 100 = \frac{\$1}{\$5.5} \times 100 = 18.2\%$$

The price elasticity of demand is therefore

$$40\% / 18.2\% = 2.2$$

Now suppose the average tourist income is \$30,000. The percent change in the quantity demanded is

$$\frac{3,000 - 4,200}{(3,000 + 4,200)/2} \times 100 = \frac{-1,200}{3,600} \times 100 = -33.3\%$$

and the percent change in the price is

$$\frac{\$6 - \$5}{(\$6 + \$5)/2} \times 100 = \frac{\$1}{\$5.5} \times 100 = 18.2\%$$

The price elasticity of demand is therefore

$$33.3\% / 18.2\% = 1.8$$

b. Suppose the price of a T-shirt is \$4. Using the midpoint method, the percent change in the quantity demanded is

$$\frac{5,000 - 3,000}{(5,000 + 3,000)/2} \times 100 = \frac{2,000}{4,000} \times 100 = 50\%$$

and the percent change in income is

$$\frac{\$30,000 - \$20,000}{(\$30,000 + \$20,000)/2} \times 100 = \frac{\$10,000}{\$25,000} \times 100 = 40\%$$

The income elasticity of demand is therefore

$$50\% / 40\% = 1.25$$

Now suppose the price of a T-shirt is \$7. Using the midpoint method, the percent change in the quantity demanded is

$$\frac{1,800 - 800}{(1,800 + 800)/2} \times 100 = \frac{1,000}{1,300} \times 100 = 76.9\%$$

and the percent change in income is, as before,

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$$\frac{\$30,000 - \$20,000}{(\$30,000 + \$20,000)/2} \times 100 = \frac{\$10,000}{\$25,000} \times 100 = 40\%$$

The income elasticity of demand is therefore

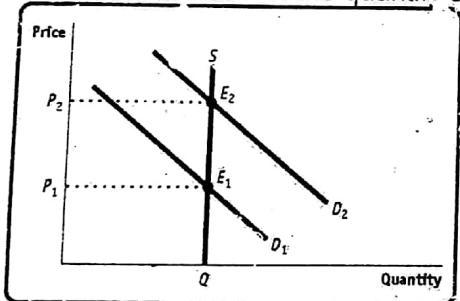
$$76.9\% / 40\% = 1.9$$

Question: In each of the following cases, do you think the price elasticity of supply is (i) perfectly elastic; (ii) perfectly inelastic; (iii) elastic, but not perfectly elastic; or (iv) inelastic, but not perfectly inelastic? Explain using a diagram.

- An increase in demand this summer for luxury cruises leads to a huge jump in the sales price of a cabin on the Queen Mary 2.
- The price of a kilowatt of electricity is the same during periods of high electricity demand as during periods of low electricity demand.
- Fewer people want to fly during February than during any other month. The airlines cancel about 10% of their flights as ticket prices fall about 20% during this month.
- Owners of vacation homes in Maine rent them out during the summer. Due to the soft economy this year, a 30% decline in the price of a vacation rental leads more than half of homeowners to occupy their vacation homes themselves during the summer.

Answer to Question:

- Supply is perfectly inelastic: the quantity of cabins on the Queen Mary 2 is fixed. As demand increases (a rightward shift in the demand curve), the price of a cabin on the Queen Mary 2 increases, without an increase in the quantity supplied. See the accompanying diagram.

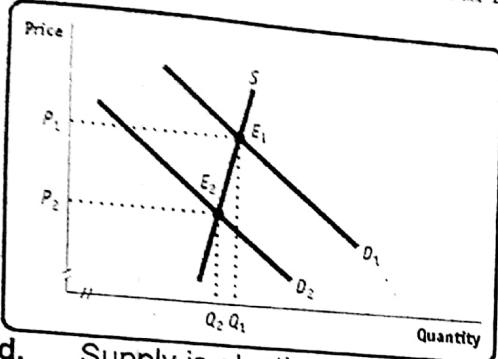


- Supply is perfectly elastic: As demand changes (for instance, as demand increases in times of high electricity demand), price does not change but the quantity supplied does change.

- Supply is inelastic: As price falls by 20%, the quantity supplied falls by 10%. This implies a price elasticity of supply of

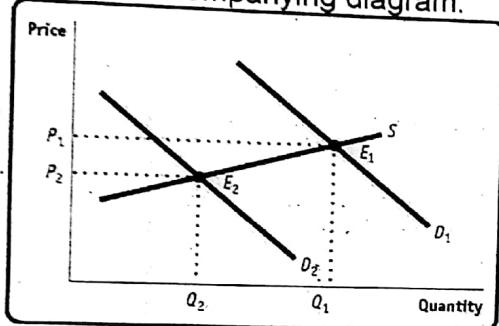
$$10\% / 20\% = 0.5$$

which is inelastic. See the accompanying diagram.



- d. Supply is elastic. As price falls by 30%, the quantity supplied falls by more than 50%. This implies a price elasticity of supply greater than $50\%/30\% = 1.7$.

See the accompanying diagram.

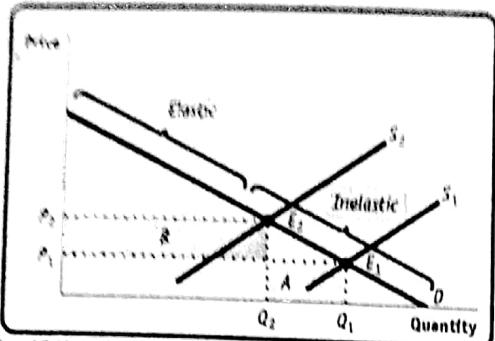


Question: Taiwan is a major world supplier of semiconductor chips. A recent earthquake severely damaged the production facilities of Taiwanese chip-producing companies, sharply reducing the amount of chips they could produce.

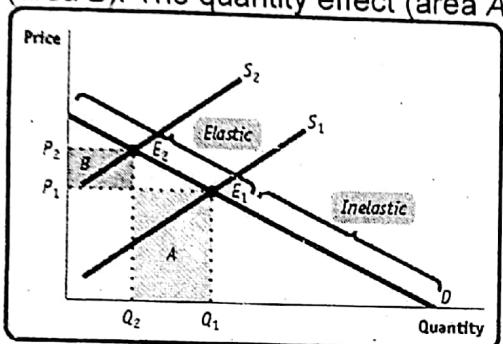
- a. Assume that the total revenue of a typical non-Taiwanese chip manufacturer rises due to these events. In terms of an elasticity, what must be true for this to happen? Illustrate the change in total revenue with a diagram, indicating the price effect and the quantity effect of the Taiwan earthquake on this company's total revenue.
- b. Now assume that the total revenue of a typical non-Taiwanese chip manufacturer falls due to these events. In terms of an elasticity, what must be true for this to happen? Illustrate the change in total revenue with a diagram, indicating the price effect and the quantity effect of the Taiwan earthquake on this company's total revenue.

Answer to Question:

- a. If the increase in price results in an increase in total revenue, then the price effect (which tends to increase total revenue) must outweigh the quantity effect (which tends to reduce total revenue). That is, demand must have been inelastic. In the accompanying diagram, as supply shifted leftward from S₁ to S₂, the fall in total revenue due to the quantity effect (area A) is outweighed by the gain in total revenue due to the price effect (area B).



- b. If the increase in price results in a fall in total revenue, then the quantity effect (which tends to reduce total revenue) must outweigh the price effect (which tends to increase total revenue). That is, demand must have been elastic. In the accompanying diagram, as supply shifted leftward from S_1 to S_2 , total revenue falls by the amount of the quantity effect (area A) but rises by the amount of the price effect (area B). The quantity effect (area A) is larger than the price effect (area B) so total revenue declines.



Question: There is a debate about whether sterile hypodermic needles should be passed out free of charge in cities with high drug use. Proponents argue that doing so will reduce the incidence of diseases, such as HIV/AIDS, that are often spread by needle sharing among drug users. Opponents believe that doing so will encourage more drug use by reducing the risks of this behavior. As an economist asked to assess the policy, you must know the following: (i) how responsive the spread of diseases like HIV/AIDS is to the price of sterile needles and (ii) how responsive drug use is to the price of sterile needles. Assuming that you know these two things, use the concepts of price elasticity of demand for sterile needles and the cross-price elasticity between drugs and sterile needles to answer the following questions.

- a. In what circumstances do you believe this is a beneficial policy?
b. In what circumstances do you believe this is a bad policy?

Answer to Question:

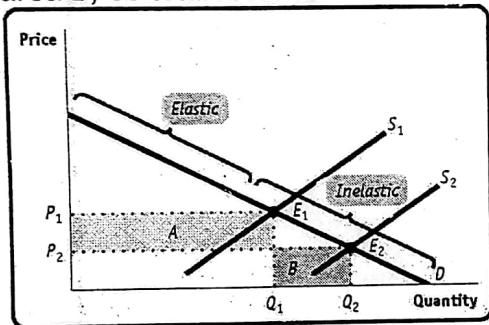
a. Handing out free needles lowers the price of needles to zero. First consider the demand for needles. The higher the price elasticity of demand for sterile needles, the greater the increase in the quantity of sterile needles demanded in response to a decrease in the price. And the greater the increase in the quantity of sterile needles demanded, the lower the spread of diseases like HIV/AIDS. Now consider the demand for drugs. Drugs and sterile needles are gross complements: as the price of sterile needles falls, the demand for drugs increases. This implies that the cross-price elasticity of demand between drugs and sterile needles is negative. The less negative (the closer to zero) the cross-price elasticity of demand between drugs and sterile needles, the less

responsive is the demand for drugs to the price of sterile needles. So the policy would be beneficial if the price elasticity of demand for sterile needles is high (elastic) and the cross-price elasticity of demand between drugs and sterile needles is negative and low (close to zero, that is, weakly complementary).

b. Similar reasoning as in part a implies that the policy would be a bad idea if the price elasticity of demand for sterile needles is low (inelastic) and the cross-price elasticity of demand between drugs and sterile needles is high and negative (strongly complementary).

Question: Worldwide, the average coffee grower has increased the amount of acreage under cultivation over the past few years. The result has been that the average coffee plantation produces significantly more coffee than it did 10 to 20 years ago. Unfortunately for the growers, however, this has also been a period in which their total revenues have plunged. In terms of an elasticity, what must be true for these events to have occurred? Illustrate these events with a diagram, indicating the quantity effect and the price effect that gave rise to these events.

Answer to Question: An increase in the amount of acreage that is cultivated results in a rightward shift in the supply of coffee. This reduces the price of coffee and increases the quantity demanded. If total revenue from coffee sales have decreased, this means that the price effect (which tends to lower total revenue) must have outweighed the quantity effect (which tends to increase total revenue). This implies that demand must be inelastic. As shown in the accompanying diagram, the price effect results in a loss of total revenue equal to the size of area A. The quantity effect (the quantity demanded increases as a result of the price fall) results in an increase in total revenue equal to the size of area B. Area A exceeds area B, so total revenue falls.



Question: The U.S. government is considering reducing the amount of carbon dioxide that firms are allowed to produce by issuing a limited number of tradable allowances for carbon dioxide (CO_2) emissions. In an April 25, 2007, report, the U.S. Congressional Budget Office (CBO) argues that "most of the cost of meeting a cap on CO_2 emissions would be borne by consumers, who would face persistently higher prices for products such as electricity and gasoline . . . poorer households would bear a larger burden relative to their income than wealthier households would." What assumption about one of the elasticities you learned about in this chapter has to be true for poorer households to be disproportionately affected?

Answer to Question: For poorer households to be disproportionately affected by an increase in energy prices, it is necessary that those households spend a larger share of their income on energy products than wealthier households. In other words, as income rises, the quantity of energy products

Practice Questions and Answers from Lesson I-7: Elasticity

demanded has to increase less than proportionately. So the CBO must think that the income elasticity of demand for energy products, although positive, is less than 1: energy products are income-inelastic. In fact, this is just what the CBO report says: "lower-income households tend to spend a larger fraction of their income than wealthier households do and . . . energy products account for a bigger share of their spending."

Question: According to a Honda press release on October 23, 2006, sales of the fuel-efficient four-cylinder Honda Civic rose by 7.1% from 2005 to 2006. Over the same period, according to data from the U.S. Energy Information Administration, the average price of regular gasoline rose from \$2.27 per gallon to \$2.57 per gallon. Using the midpoint method, calculate the cross-price elasticity of demand between Honda Civics and regular gasoline. According to your estimate of the cross-price elasticity, are the two goods gross complements or gross substitutes? Does your answer make sense?

Answer to Question: An increase in price from \$2.27 to \$2.57, using the midpoint method, is a percent increase of

$$\frac{\$2.57 - \$2.27}{(\$2.57 + \$2.27)/2} \times 100 = \frac{\$0.30}{\$2.42} \times 100 = 12.4\%$$

So the cross-price elasticity of demand is

$$7.1\% / 12.4\% = 0.6$$

Since the cross-price elasticity of demand between Honda Civics and regular gasoline is positive, your estimate says that the two are gross substitutes. This answer might seem perplexing because cars and gasoline are generally gross complements: you need gasoline to run a (gasoline-powered) car like a Honda Civic. So the complementary relationship between gas and cars implies that the cross-price elasticity between them is negative. But a Honda Civic adds another dimension to the comparison: it is a fuel-efficient car, not a gas-guzzler. And fuel-efficient cars and gas guzzlers are gross substitutes. So as gasoline prices rise, the demand for gas-guzzling cars falls and the demand for fuel-efficient cars (such as the Honda Civic), which are gross substitutes, rises. So the substitute nature between gas-guzzlers and Honda Civics implies a positive cross-price elasticity between gas and Honda Civics. Which effect is stronger? Clearly it is the substitution effect that is stronger, because the data show a positive cross-price elasticity.