

Cooleconomics.com
Principles of Economics

Elasticity

Contents:

Demand and steepness

Supply and steepness

Elasticity

 introduction

 price elasticity of demand

 price elasticity of supply

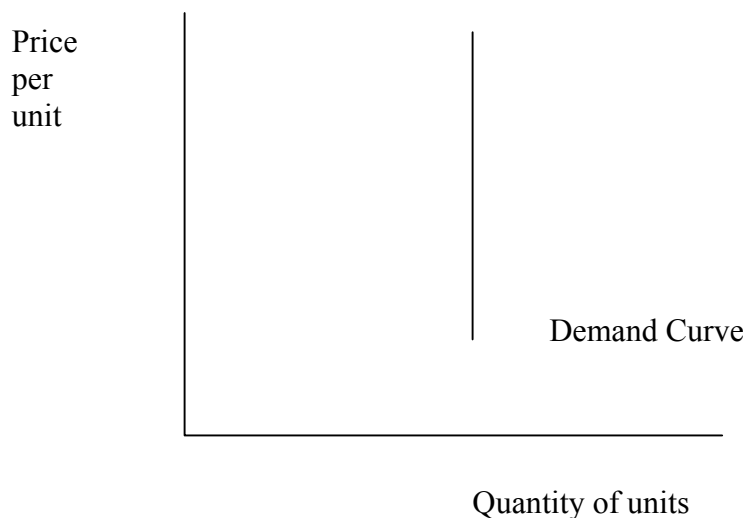
 income elasticity of demand

 cross elasticity of demand

DEMAND AND STEEPNESS

Why is one demand curve steeper than another? The steepness of a demand curve is a measure of the responsiveness of buyers to a change in the price of the product. The steeper a demand curve is, the less responsive buyers are to a change in price.

Consider, for example, the hypothetical extreme of a completely vertical demand curve:



These buyers do not change the quantity that they demand when the price changes. An approximate real world example is insulin; a diabetic needs it to survive, and will continue to buy the same quantity even if the price skyrockets.

Here are some things that affect steepness of a demand curve:

1. Number of substitutes for the product

If a product has few substitutes, then buyers have few options when the price of the product rises; hence they are likely to keep buying the product, though perhaps in slightly lower quantities. On the other hand, if a product has many substitutes, then it is easy for buyers to switch to other products when the product's price rises; hence a product with many substitutes will have a relatively flat demand curve.

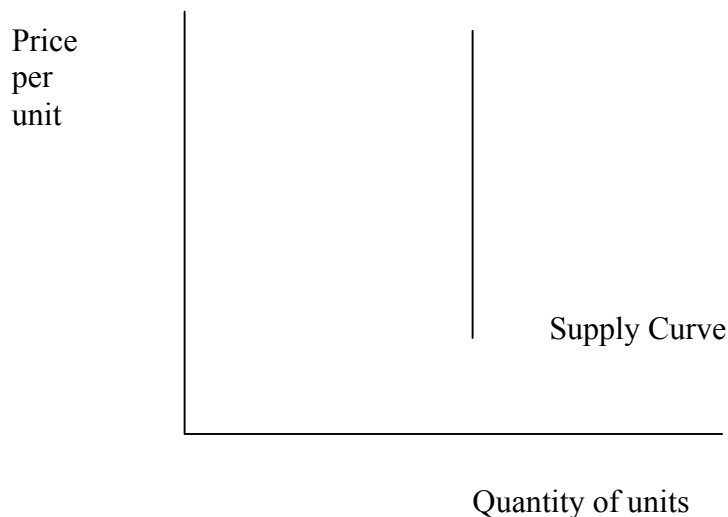
2. Time

Suppose gasoline prices skyrocket. Over the short term, you may be forced to buy almost as much gas as at lower prices, since you may need to drive to get to work, etc. Over a longer term, however, you could buy a more fuel efficient vehicle, and reduce your gas consumption by a larger amount. Conclusion: for most (not all) products, more time implies a flatter demand curve.¹

SUPPLY AND STEEPNESS

Why is one supply curve steeper than another? The steepness of a supply curve is a measure of the responsiveness of sellers to a change in the market price of the product. The steeper a supply curve is, the less responsive sellers are to a change in price.

Consider, for example, the hypothetical extreme of a completely vertical supply curve:



These sellers do not change the quantity that they sell when the price changes. An approximate real world example is harvested bananas; the bananas are already harvested, and sellers will want to sell them all regardless of the price they can get for them (because spoiled unsold bananas do not add to revenue).

¹ Goods which are *durable*—benefit the consumer for a few years—actually have steeper demand curves given more time. Suppose lawn mower prices skyrocket, for example. Over the short term buyers may delay acquisition of new mowers to replace old ones, hoping that prices will fall back down; this means a very flat demand curve. Over the long term, however, lawn mowers wear out, and buyers must replace them; this means a steeper demand curve.

Time is the most important thing that affects the steepness of a supply curve. Let us define and consider three time periods:

1. The Market Period

In the market period, sellers do not have enough time to alter that quantity of product available for sale. The banana example above is a market period example. The supply curve is *vertical* in the market period.

2. The Short Run

In the short run, sellers are able to alter the quantity supplied, but they have at least one fixed factor of production. Suppose a banana farm believes that bananas will fetch a high price next year. This is enough time for the banana farmer to spend a little more money to take extra special care of the banana trees, to ensure a slightly higher banana yield, taking advantage of the higher banana prices. But the banana farmer doesn't have enough time to plant new banana trees that will yield fruit next year. This is a short run example; the trees are the farmer's fixed resource.

The supply curve is steep, but not vertical, in the short run.

3. The Long Run

In the long run, sellers are able to alter the quantity supplied, and they have no fixed factors of production. Suppose a banana farm believes that bananas will fetch a high price in 10 years. This is enough time for the banana farmer to spend a more money planting extra banana trees, to ensure a massively higher banana yield in 10 years, taking great advantage of the higher banana prices. This is a long run example; the trees are the now a variable resource.

The supply curve is very flat in the long run; it may even be downward-sloping. (More on this in later notes.)

FROM STEEPNESS TO ELASTICITY

Sure, steepness is an indicator of the responsiveness of quantity to changes in price, but it's quite vague, ain't it? *Price elasticity* is a much more precise measure of this price/quantity relationship. We shall discuss price elasticity, and some other elasticities, in the next section of notes.

ELASTICITY

General: *Elasticity* is a ratio of the percentage change in one variable to the percentage change in another variable. We shall discuss four elasticities below:

(1) Price elasticity of demand =

percentage change in quantity demanded / percentage change in price

(2) Price elasticity of supply =

percentage change in quantity supplied / percentage change in price

(3) Income elasticity of demand =

percentage change in quantity demanded / percentage change in income

(4) Cross-price elasticity of demand =

percentage change in quantity demanded of good A / percentage change in price of good B

More about price elasticity of demand:

Example 1: Suppose a 10% price reduction in Coke causes a 5% increase in unit sales. Then the price elasticity of demand of coke is

$$5\% / -10\% = -.5$$

Example 2: Suppose a 2% increase in pretzel prices causes a 10% reduction in unit sales. Then the price elasticity of demand of pretzels is

$$-10\% / 2\% = -5$$

From the above examples we can note that:

Price elasticity of demand is almost always negative.

The closer the price elasticity of demand is to zero, the less responsive is demand to changes in price.

Calculating price elasticity of demand using the *midpoint* formula:

Example 3: Suppose the following points are on a hypothetical demand curve:

Point A: At a price of \$10 quantity demanded is 100

Point B: At a price of \$20 quantity demanded is 30

We can calculate the price elasticity of demand (E_d) for the segment of the demand curve between points A and B using the midpoint formula:²

$$E_d = \frac{Q_A - Q_B}{(Q_A + Q_B)/2} \div \frac{P_A - P_B}{(P_A + P_B)/2}$$

² Another formula which can be used to calculate elasticity—the *point* formula—is ignored in these notes and will be ignored on any exams.

$$= \frac{100 - 30}{(100 + 30)/2} \div \frac{10 - 20}{(10 + 20)/2}$$

$$= 1.076923076923 / -.6666666666 = -1.615384615386$$

So: $E_d = -1.615384615386$

Price Elasticity of demand and total revenue

Define *total revenue* (R) as the total dollar value of a firm's sales. For a firm that only produces one product (and sells all units at the same price per unit), this is equal to price times quantity:

$$R = PQ$$

A firm might want to know how changing its product's price affects its total revenue. Well, guess what? The value of the price elasticity of demand tells the firm something about how a price change will affect total revenue!!

If E_d is more negative than -1, then a higher price results in lower total revenue, and a lower price results in higher total revenue. Don't believe me? Check out example 3: raising the price from \$10 to \$20 causes total revenue to fall from \$1000 to 600; cutting the price from \$20 to \$10 causes total revenue to rise from \$600 to \$1000.

If E_d is between 0 and -1, then a higher price results in higher total revenue, and a lower price results in lower total revenue. In example 1, Coke revenue will rise if Coke's price is increased; Coke revenue will fall if Coke's price is reduced.

MORE ABOUT PRICE ELASTICITY OF SUPPLY

Example 4: Suppose a 10% price reduction in wheat causes a 5% reduction in wheat supply. Then the price elasticity of supply of wheat is

$$-5\% / -10\% = .5$$

Example 5: Suppose a 2% increase in milk prices causes a 10% increase in milk supply. Then the price elasticity of supply of milk is

$$10\% / 2\% = 5$$

From the above examples we can note that:

Price elasticity of supply is usually positive

The closer the price elasticity of supply is to zero, the less responsive is supply to changes in price.

Calculating price elasticity of supply using the *midpoint* formula:

Example 3: Suppose the following points are on a hypothetical supply curve:

Point A: At a price of \$10 quantity supplied is 30

Point B: At a price of \$20 quantity supplied is 100

We can calculate the price elasticity of demand (E_s) for the segment of the demand curve between points A and B using the midpoint formula:

$$E_s = \frac{Q_A - Q_B}{(Q_A + Q_B)/2} \div \frac{P_A - P_B}{(P_A + P_B)/2}$$

$$= \frac{30 - 100}{(30 + 100)/2} \div \frac{10 - 20}{(10 + 20)/2}$$

$$= -1.076923076923 / -.66666666666 = 1.615384615386$$

MORE ABOUT INCOME ELASTICITY OF DEMAND

Example 6: Suppose a 10% income reduction 5% reduction in steak demand. Then the income elasticity of demand of steak is

$$-5\% / -10\% = .5$$

Example 7: Suppose a 2% increase in income causes a 10% reduction in ramen noodles demand. Then the income elasticity of demand of ramen noodles is

$$-10\% / 2\% = -5$$

From the above examples we can note that:

Income elasticity of demand (E_I) may be a positive or negative number

Define a *normal good* as one whose demand is positively associated with income. E_I is positive for normal goods. (Steak is normal in example 6)

Define an *inferior good* as one whose demand is negatively associated with income. E_I is negative for inferior goods. (Ramen noodles are inferior in example 7)

MORE ABOUT **CROSS** ELASTICITY OF DEMAND

Example 8: Suppose a 10% increase in Coke prices causes a 5% increase in Pepsi demand. Then the cross elasticity of demand of Coke and Pepsi is

$$5\% / 10\% = .5$$

Example 9: Suppose a 2% increase in hot dog prices causes a 10% reduction in hot dog **bun** demand. Then the cross elasticity of demand between hot dogs and hot dog buns is

$$-10\% / 2\% = -5$$

From the above examples we can note that:

Cross elasticity of demand (E_C) may be a positive or negative number

Define *substitute* goods as those that serve roughly the same purpose to buyers. E_C is positive for substitute goods. (Coke and Pepsi are substitutes in example 8)

Define *complementary* goods as those that are often consumed together. E_C is negative for complementary goods. (Hot dogs and hot dog buns are complements in example 9)