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Supply and demand “elasticity”

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Elasticities

We have so far focused on specifying qualitative relationships between determinants of supply and demand and the actual quantity demanded and quantity supplied of a good. Although qualitative relationships provide meaningful information, they cannot measure the impact produced by a change in a particular determinant on the quantity demanded or supplied of a commodity. In the business world especially, we need to know the quantitative impact of a change in one determinant such as Price, income or the Price of inputs on the quantity demanded or quantity supplied of a commodity. Quantitative impacts are also often important in the public policy arena.

For instance, when considering an increase in the sales tax on cigarettes, government decision makers may be concerned about the magnitude of the effect of the tax on the quantity of cigarettes demanded by smokers (perhaps, in particular, by teenage smokers).

Elasticities measure the magnitude of the responsiveness of any variable (such as quantity demanded and quantity supplied) to a change in particular determinants.

Price Elasticity of demand

Even though we assume that all market demand curves have negative slopes (implying that at a lower Price a greater quantity will be purchased), the degree of responsiveness varies widely from one commodity to another. A reduction in the Price of cigarettes may lead to an infinitesimal increase in purchases, while a reduction in airplane fares may produce a veritable explosion in air travel. The law of demand tells us to expect some increases in quantity demanded, but not how much.

The Price elasticity of demand is a measure of how sensitive quantity demanded is to a change in a product's Price. It can be defined as the percentage change in quantity demanded divided by the percentage change in Price. The ratio will always be negative for any downward-sloping demand curve. For example, if a 10 percent Price increase brings about a 20 percent reduction in quantity demanded, the Price elasticity of demand is -20 percent/+10 percent, or -2.0. Economists usually drop the minus sign on the understanding that Price and quantity demanded always move in different directions and simply refer to the elasticity as being, in this case 2.0.

Price elasticity of demand provides a quantitative measure of the Price responsiveness of quantity demanded along a demand curve. The higher the numerical value of the elasticity, the larger the effect of a Price change on quantity. If the elasticity is only 0.2, then a 10 percent Price increase will reduce quantity demanded by just 2 percent:

$$2 \text{ percent} / 10 \text{ percent} = 0.2$$

Alternatively, if the elasticity is 4.0, a 10 percent rise will reduce quantity demanded by 40 percent:

$$40 \text{ percent} / 10 \text{ percent} = 4.0$$

If the Price elasticity of demand exceeds 1.0, then demand is said to be elastic. Elasticity is greater than 1.0 whenever the percentage change in quantity demanded is greater than the percentage change in Price, implying that the quantity demanded is relatively responsive to a Price change. If the Price elasticity of demand is less than 1.0, then demand is said to be inelastic. Elasticity is less than 1.0 whenever the percentage change in quantity demanded is less than percentage change in Price, implying that quantity demanded is relatively unresponsive to a Price change. When the Price elasticity of demand is equal to 1.0, then demand is said to be unit elastic, or of unitary elasticity. Unitary elasticity occurs whenever the percentage changes in Price and quantity demanded are equal.

Whether demand is elastic, unit elastic or inelastic determines how a Price change will affect total expenditure on the product. Total expenditure equals Price times quantity, or $P \times Q$. A change in Price affects these terms in offsetting ways. A higher Price increases the P term but reduces the Q term (Quantity demanded is lower at a higher Price). The net effect on total expenditure, therefore, depends on the relative size of the two changes. Put differently, the net effect on total expenditure depends on how responsive quantity is to the Price change; it depends on the Price elasticity of demand. If a 10 percent increase in Price reduces quantity by 10 percent (the unit elastic case), then total expenditure, $P \times Q$, remains unchanged. If a 10 percent increase in Price reduces quantity by more than 10 percent (the elastic demand case), then total expenditure will fall because of the sharper reduction in quantity purchased. Finally, if a 10 percent increase in Price reduces quantity by less than 10 percent (the inelastic demand case), then total expenditure will rise.

Calculating Price Elasticity of Demand

Calculating Price Elasticity of Demand from pair of Price- quantity points is frequently necessary. Suppose that we are given the followings Price – quantity values for gasoline (where quantity demanded is measured in gallons):

$$P1 = \$3.00$$

$$P2 = \$2.97$$

$$Qd1 = 1,000$$

$$Qd2 = 1,005$$

Our definition of Price elasticity of demand is the percentage change in quantity demanded divided by the percentage change in Price. This relationship is expressed as a formula, letting η (the greek letter eta) stand for Price elasticity of demand:

$$\eta = \frac{(\Delta Q_d / Q_d)}{(\Delta P / P)}$$

Here, $\Delta Q_d / Q_d$ is the percentage change in quantity demanded, and $\Delta P / P$ is the percentage change in Price. In applying this formula- called the point elasticity formula- we encounter an ambiguity. While ΔQ_d and ΔP are unambiguously determined (a 5 gallon change in quantity and a \$0.03 change in the per-gallon Price), what values should be used for Q_d and P ? If we enter the values for P_1 and Q_{d1} into the formula we obtain:

$$\frac{(\Delta Q_d / Q_{d1})}{(\Delta P / P_1)} = \frac{(5 / 1,000)}{(\$0.03 / \$3.00)} = 0.50$$

Alternatively, if we use P_2 and Q_{d2} , we obtain:

$$\frac{(\Delta Q_d / Q_{d2})}{(\Delta P / P_2)} = \frac{(5 / 1,005)}{(\$0.03 / \$2.97)} = 0.49$$

Because we are dealing with small changes in this case, which values we choose makes little quantitative difference. There is, however, a slight difference, and it reflects the fact that the percentage change between two prices depends on the direction of the change. If Price falls from \$3.00 to \$1.50 per gallon, this is referred to as a 50 percent decrease (a \$1.50 change in Price divided by the initial Price, \$3.00). Alternatively, if the Price rises from \$1.50 to \$3.00 per gallon, this is a 100 percent increase (a \$1.50 change in Price divided by the initial Price, \$1.50). Don't be sidetracked by this arithmetical obscurity. The important point is that some base Q_d and P must be employed in the formula, but for small changes in Q_d and P , which base is chosen makes no significant difference to the results.

There is substantial difference, however, when a large change in Price and quantity is involved. Suppose, for example, that we have the following values:

$P_1 = \$3.00$	$P_2 = \$1.50$
$Q_{d1} = 1,000$	$Q_{d2} = 2,000$

By inspection we see that total expenditure is \$3,000 (quantity demanded is once again being measured in gallons) at both prices, so we know that demand is unit elastic. Surprisingly, though, it

now makes a great deal of difference what base values of P and Qd we use if we try to apply the point elasticity formula:

$$(\Delta Qd/Qd1)/(\Delta P/P1) = (1,000/1,000)/(\$1.50/3.00) = 2.0 \text{ and}$$

$$(\Delta Qd/Qd2)/(\Delta P/P2) = (1,000/2,000)/(\$1.50/1.50) = 0.5$$

According to one calculation, Price elasticity of demand is 2.0; according to the other it is 0.50. Both are wrong, and the true value, unity, lies between these estimates. The basic problem in this case is that the elasticity of demand tends to vary from one point (one P1 Qd combination) to another on the demand curve, and for a large change in Price and quantity we need an average value over the entire range. Consequently, when we deal with large changes in Price and quantity, we should use the following arc elasticity formula:

$$\eta = \frac{\left[\frac{\Delta Qd}{(1/2)(Qd1 + Qd2)} \right]}{\left[\frac{\Delta P}{(1/2)(P1 + P2)} \right]}$$

Note that this formula differs from the point elasticity formula only in using the average of the two quantities, $(1/2)(Qd1+Qd2)$ and the average of the two prices, $(1/2)(P1 + P2)$.

Applying this formula to the preceding figures yields the true value of the elasticity over the entire range of prices considered:

$$\eta = \frac{\left[\frac{\Delta Qd}{(1/2)(Qd1 + Qd2)} \right]}{\left[\frac{\Delta P}{(1/2)(P1 + P2)} \right]}$$

$$\eta = \frac{\left[\frac{1000}{(1/2)(1000 + 2000)} \right]}{\left[\frac{\$1.50}{(1/2) (\$1.50 + \$ 3.00)} \right]} = \mathbf{1.0}$$

Thus, we have two formulas. The first Works well when small changes in P and Qd are involved because, in that case, which P and Qd are used makes Little difference. The second formula avoids the problema of having to pick one specific point by using the average values of Price and quantity demanded and should be used with large changes in Price and quantity demanded.

Glossary

Elasticity: Measures of the magnitude of the responsivenesses of any variable (such as quantity demanded or supplied) to a change in particular determinants).

Price elasticity of demand: A measure of how sensitive quantity demanded is to a change in a product's price.

Elastic: The situation in wich Price elasticity of demand excedes 1.0 or unity.

Inelastic: The situation in which Price elasticity of demand is less than 1.0 or unity.

Unit Elastic: The situation in which Price elasticity of demand equals 1.0 or unity.

Problems

1.- Suppose that the demand elasticity for cigarettes is igual to 2.0. If the demand elasticity for Camel cigarettes is equal to 6.0 must there be at least some cigarettes brands with a demand elasticity less than 2.0?

2.- If the Price of apples decrease by 2 percent and causes Apple consumption to increase 4 percent, the Price elasticity of demand is _____, indicating the demand is _____

- a) 0.5, inelastic
- b) 0.5 elastic
- c) 2, inelastic
- d) 2, elastic

3.- A family consumes 3 liters of milk every day at a rate of 18 pesos each. As result of information that milk is very healthy, the producers decided to raise the price to 25 pesos, so the family is able to buy 2 litres of milk a day.

Calculate

- a) The quantity consumed, by the family, of liters of milk in a period of 6 months, before and after the variation of the price.
- b) The price elasticity of demand.
- c) Indicates which type of elasticity is.

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Lectura



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