Managerial Economics

M.Com. IV Sem.

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Elasticity Of Demand

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5.2 Price Elasticity of Demand

The concept of price elasticity of demand is a numerical measure of the extent to which quantity demanded responds to a change in price, other determinants of demand being kept constant.

Example: If the price of cigarettes fell by 20% and the price of salt fell by 20%, the increase in quantity demanded due to equal changes in prices would be different for salt and cigarettes. Thus salt and cigarettes are said to have a different price elasticity of demand.

Price elasticity of demand, e_p, measures the degree to which the quantity demanded responds to a change in price when all other factors that influence demand such as tastes or income are kept constant. In the example, it is extremely likely that the percentage increase in quantity demanded would be much more for cigarettes than for salt, even though the percentage decreases in price are the same. Thus price elasticity of demand allows us to compare the sensitivity of the demand for various goods for the same changes in price. From the definition:

$$e_p = (-)\frac{\%\ change\ in\ quantity\ demanded}{\%\ change\ in\ price}$$

Let us consider a commodity X. If its price rose, then the percentage change in price would be positive (since the new price is greater than the old price) and the denominator in the expression for e_p would be positive. However, the quantity demanded would fall and the percentage change in quantity demanded would be negative. Hence the numerator in the expression would be negative.

Thus, for most goods as quantity demanded and price have an inverse relationship, cetris paribus, e_p is always likely to be negative.

Caution However by placing a minus sign in the formula we make e_p positive. The reason is that we want to equate "more elastic" with "more responsive". For example, let two commodities X and Y have elasticities of + 10 and +0.5 (calculated after multiplying by (–1) in accordance with the formula). The demand for commodity X is more responsive to price changes than is the demand for commodity Y, and X has a larger elasticity since +10 is greater than +0.5. Hence "more elastic" is equated with "more responsive". However, if we did not multiply by (–1), the two elasticities would be –10 and –0.5. Since –0.5 is greater than –10 we would be likely to say that Y has a greater elasticity than X (when in fact it is the other way round). Hence without multiplying by (–1) we would not be able to substitute "more elastic" for "more responsive".

A review of the basic formula of elasticity will show that it follows from the definition of price elasticity.

$$e_p = (-)\frac{\%\ change\ in\ quantity\ demanded}{\%\ change\ in\ price}$$

where,

% change in quantity demanded= $\frac{new\ quantity - old\ quantity}{old\ quantity} \times 100$

% change in price= $\frac{New\ price - Old\ price}{Old\ price} \times 100$

Let P = Old price

Q = Old quantity

Δ Q = New quantity – Old quantity

Δ P = New price – Old price

$$e_{p = (-)} \frac{\Delta Q}{Q} \times 100 \ / \frac{\Delta P}{P} \times 100 = (-) \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

Task Given the following data, calculate the price elasticity of demand when (a) price increases from ₹ 5.00 per unit to ₹ 8.00 per unit and (b) the price falls from ₹ 8.00 per unit to ₹ 5.00 per unit.

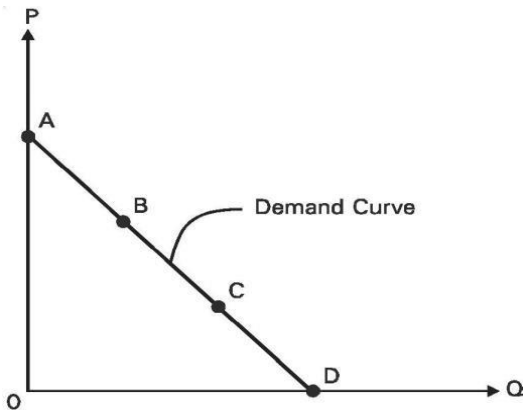
P_x (per unit)	6	5	4	3	2	1
Qx	200	350	600	850	900	1200

The price elasticity of a straight line demand curve varies from infinity at the price axis to zero at the quantity axis.

Consider a straight line demand curve cutting both the axes as shown in Figure 5.5. Elasticity of demand, e_p, is defined as the numerical measure of the degree to which quantity demanded responds to a change in price ceteris paribus.

$E_{p= (-)} \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$

Figure 5.5



Now the slope of the demand curve is dP/dQ (since the demand curve is a straight line and the slope of a straight line is given by change in Y divided by change in X).

Hence the term dQ/dP in the expression for e_p is the reciprocal of the slope of the demand curve.

Since the slope of a straight line is the same throughout, the reciprocal of the slope will also be the same throughout. Thus, for any straight line demand curve, the elasticity at any point is a function of (depends upon) the P/Q ratio.

At the price axis, Q = 0 and P/Q is undefined, but as we let q approach zero, without ever reaching it, the ratio p/q increase without limit. In other words, e_p approaches infinity as q approaches 0. Thus, e_p is infinity at the price axis.

At the quantity axis, P = 0 and P/Q is zero. Thus $e_p = 0$ at the quantity axis.

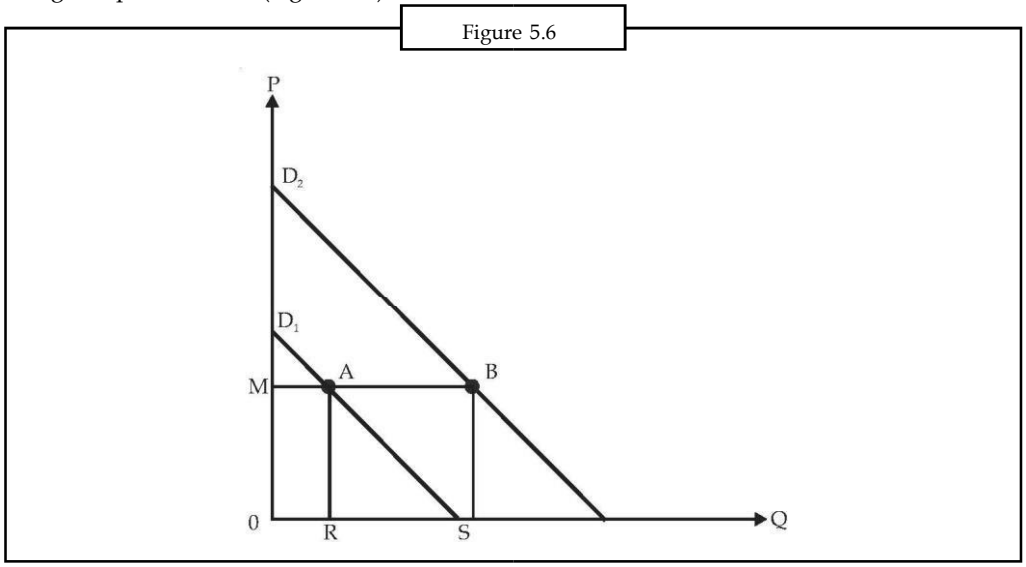
By a similar reasoning we conclude that as we move down a demand curve, the p/q ratio falls steadily as p keeps decreasing and q keeps increasing. Hence the coefficient of elasticity is greater at a higher point (point B) than at a lower point (point C) since the higher point will have a greater p/q ratio and dQ/dP is inconsequential.

Two parallel straight line demand curves have a different elasticity at each price.

Explain why the (proposition above) is true?

Let D_1 and D_2 be two parallel straight line demand curves, and let the (same) price at which their elasticities are being compared be OM (Figure 5.6).

Figure 5.6



Elasticity of demand, e_p, is defined as the numerical measure of the degree to which quantity demanded responds to a change in price, ceteris paribus. From the definition,

$$e_p = (-).\frac{dQ}{dP}.\frac{P}{Q}$$

Since the slope of a demand curve is dP/dQ, the term dQ/dP in the expression for e_p is the reciprocal of the slope of a demand curve. Also, as the two demand curves are parallel, it follows that their slopes and hence the reciprocals of their slopes are the same.

Thus at any given price level the elasticities of the straight line demand curves can be compared by comparing their corresponding quantities.

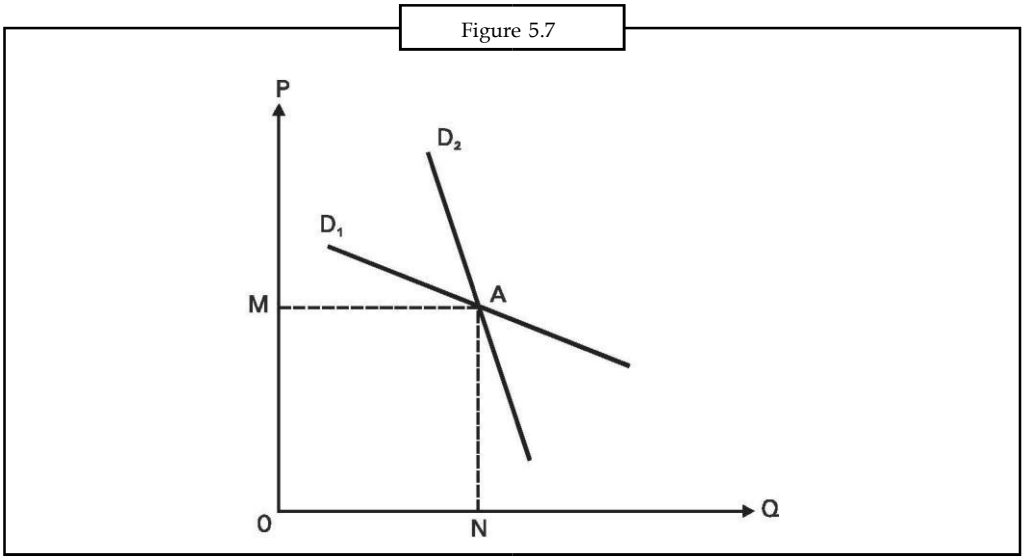
At point A (demand curve D_1) the quantity demanded is OR and at point B (demand curve D_2, but at the same price as A) the quantity demanded is OS. Since OS > OR the P/Q ratio is greater in the case of D_1. Hence point A has a higher elasticity than point B or the demand curve further away from the origin is less elastic at each price than the one closer to the origin.

The elasticities of two intersecting straight line demand curves can be compared at the point of intersection merely by comparing slopes, the steeper curve being less elastic.

Let two straight line demand curves, D_1 and D_2, having different slopes, intersect each other at A, as in Figure 5.7.

At the point of intersection, price (P) and quantity (Q) are the same for both demand curves. Hence the P/Q ratio is the same for both demand curves at the point of intersection (point).

Figure 5.7



Since the slope of a demand curve is dP/dQ, the term dP/dQ in the expression for e_p is the reciprocal of the slope. For both demand curves, since P/Q is the same, the elasticities can be compared by comparing dQ/dP.

As D_1 is steeper than D_2, dQ/dP for D_1 is less than that for D_2. (Remember that dQ/dP measures the reciprocal of the slope). Hence D_2 (the steeper curve) is less elastic than D_1.

Arc Elasticity

The geometrical method of measurement of price elasticity of demand is applicable only for infinitesimal changes in price. If price changes appreciably then we use the arc elasticity of demand. Arc elasticity is calculated with the help of the following formula:

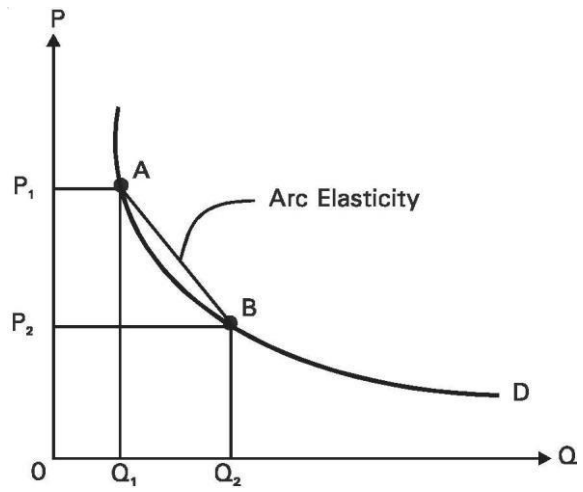
$$e_p = \frac{\Delta Q}{\Delta p} \cdot \frac{(P1+P2)/2}{(Q1+Q2)/2} = \frac{\Delta Q}{\Delta P} \cdot \frac{(P1+P2)/2}{(Q1+Q2)/2}$$

Where P_1 and Q_1 are initial price and quantity, P_2 and Q_2 are new price and quantity and ΔP and ΔQ are the changes in price and quantity respectively.

The arc elasticity is a measure of average elasticity, that is, the elasticity at the midpoint of the chord that connects the two points (A and B) on the demand curve defined by the initial and new price levels. The measure of arc elasticity is an approximation of the true elasticity of the section AB of the demand curve. The more convex to the origin the demand curve is, the poorer the linear approximation attained by the arc elasticity formula.

Caution It would be observed that the only difference between this formula and the point elasticity formula is in the use of the average quantities and average prices. A basic limitation of the point elasticity formula relates to the use of the base. If in Figure 5.8 we have to measure elasticity of demand between the points A and B by the percentage method, it is difficult to say which one of those will make a better base. The choice will be entirely arbitrary. The problem can be solved by using average prices and average quantities.

Figure 5.8



5.3 Income Elasticity

The income elasticity of demand (e_i) is similar to the concept of price elasticity of demand. Just as price determines price elasticity, so does income, another determinant of demand, determine income elasticity.

The income elasticity of demand is a numerical measure of the degree to which quantity demanded responds to a change in income, other determinants of demand being kept constant.

For example, let there be two goods, clothing and salt. Let the consumers income increase by 5%. Then the percentage change (increase) in quantity demanded would be different for clothing and different for salt (the percentage increase in quantity demanded for clothing is likely to be much higher than that for salt). Thus, clothing and salt are said to have a different income elasticity of demand. Thus, for the same percentage increase in income (i.e., 5%) the percentage increase in the quantity demanded for different goods is different. Income elasticity of demand provides us with a numerical measure of this difference.

Thus, income elasticity of demand allows us to compare the sensitivity of the demand for various goods for the same change in income. From the definition,

e_i = % change in quantity demanded/ % change in income

The income elasticity of a commodity may be positive (the usual or likely case) or negative, depending on whether the good is normal or inferior.

A normal good is one where a percentage increase in income ceteris paribus causes a percentage increase in quantity demanded and vice-versa. Thus for normal goods (e.g., clothing, cigarettes) income and quantity demanded vary in direct proportion ceteris paribus due to which the income elasticity of demand is positive.

An inferior good is one where a percentage increase in income ceteris paribus, causes a percentage decrease in quantity demanded and vice-versa. Thus for inferior goods (e.g., cheap whisky, artificial jewellery, imitation shoes, etc.) income and quantity demanded vary in an inverse proportion ceteris paribus due to which the income elasticity of demand is negative.

When $e_i = 1$, the good is said to have unitary income elasticity; when $e_i > 1$, the good is said to be income elastic, and so on. Remember when e_i is negative, the good is an inferior good.

5.4 Cross Elasticity of Demand

Caution The cross elasticity of demand (e_c) is a numerical measure of the degree to which quantity demanded of a good responds to changes in the prices of other commodities, the other determinants of demand being kept constant.

Let there be two goods X and Y. If the price of Y changes (increases or decreases), this may have an effect on the quantity demanded of good X. The concept of cross elasticity provides a numerical measure of the percentage change in quantity demanded due to a change in price of other commodities. It measure the degree to which quantity demanded is a function of the price of all other commodities. From the definition,

$$e_c = \frac{\text{\% change in quantity demanded of good X}}{\text{\% change in price of good Y}}$$

Example: If X and Y (say butter and bread) are complements, e_c will be negative. If the price of bread rose ceteris paribus, there would be a decrease in the quantity demanded of bread and a decrease in the quantity demanded of butter. Thus, for complements, a change in price of one good ceteris parbius causes the quantity demanded of the complements to move in the opposite direction. If there is a percentage increase in the price of bread, the denominator in the formula would be positive. Similarly, if there is a percentage decrease in the quantity of butter, the numerator in the formula would be negative. Hence, e_c is negative for complements.

If X and Y (say tea and coffee) are substitutes, e_c will be positive. If the price of coffee rose ceteris paribus, there would be a decrease in the quantity demanded of coffee and an increase in the quantity demanded of tea as consumers would readily "substitute" tea for coffee. Thus, for substitutes the price change of one good ceteris paribus causes the quantity demanded of the substitute to move in the same direction. If there is a percentage increase in the price of coffee, the denominator in the formula would be positive. Similarly, if there is a percentage increase in the quantity demanded of tea, the numerator in the formula would be positive. Hence, e_c is positive for substitutes.

The higher the numerical magnitude of cross elasticity, the greater is the degree of complementarity/substitution between the two goods. Thus, theoretically the value of cross elasticity ranges from minus infinity ($-\infty$) for perfect complements to plus infinity ($+\infty$) for perfect substitutes.

$$e_c = \frac{dQx}{Qx} \div \frac{dPx}{Px}$$

$$= \frac{dQx}{dPx} \cdot \frac{Px}{Qx}$$

Notes Applications of Elasticity

The concept of elasticity has a wide range of applications in economics. In particular, an understanding of elasticity is fundamental in understanding the response of supply and demand in a market.

Some common applications of elasticity include:

1. Effect of changing price on firm's revenues: If the demand for the product is price inelastic, the firm would not want to lower its price since that would reduce its total revenue, increase its total costs and this will give it lower profits.

2. Analysis of incidence of the tax burden and other government policies: In economics, tax incidence is the analysis of the effect of a particular tax on the distribution of economic welfare. Tax incidence is said to "fall" upon the group that, at the end of the day, bears the burden of the tax. The key concept is that the tax incidence or tax burden does not depend on where the revenue is collected, but on the price elasticity of demand (and price elasticity of supply). For example, a tax on orange farmers might actually be paid by owners of agricultural land or consumers of oranges.

3. Effect of international trade and terms of trade effects: Marshall-Lerner Condition gives a technical reason why a reduction in value of a nation's currency need not immediately improve its balance of payments. The condition states that, for

a currency devaluation to have a positive impact on trade balance, the sum of price elasticity of exports and imports (in absolute value) must be greater than 1.

4. Analysis of consumption and saving behavior: the way consumers respond to the change in prices or other determinants of demand, determines their consumption pattern and savings pattern. For example, a consumer purchases 2 bottles of cold drinks instead to 4, when price rose from ₹ 10 to ₹15. Other things remaining constant, he is saving more money than before.

5. If the elasticity of the firm's sales with reference to advertisement expenditure is positive and higher than for its expenditure on product quality and customer service, then the firms would find it more beneficial to concentrate its sales efforts on advertising rather than on product quality and customer service.

5.5 Summary

- Elasticity of demand tells the degree of responsiveness of consumer to a price change. It is measured as:

$$e_d = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

- The arc elasticity is a measure of average elasticity, that is, the elasticity at the midpoint of the chord that connects the two points (A and B) on the demand curve defined by the initial and new price levels.
- The income elasticity of demand is a numerical measure of the degree to which quantity demanded responds to a change in income, other determinants of demand being kept constant.
- The cross elasticity of demand is a numerical measure of the degree to which quantity demanded of a good responds to changes in the prices of other commodities, the other determinants of demand being kept constant.
- An understanding of elasticity is fundamental in understanding the response of supply and demand in a market.

5.6 Keywords

Arc elasticity: It computed if the data is discrete and therefore incremental change is measurable.

Cross elasticity: Degree to which demand for one product is affected by the price of another product.

Demand elasticity: Elasticity used to show the responsiveness of the quantity demanded of a good or service to a change in its price.

Elasticity: It measures the degree of responsiveness of demand/supply to change in price.

Point elasticity: It computed if demand function is continuous and therefore only marginal changes are calculable.

5.7 Self Assessment

1. Fill in the blanks:

   (a) Elasticity of demand measures responsiveness of demand of a commodity to ……., …… and ..... .

   (b) Such horizontal demand curves, where quantity demanded is infinitely responsive to price changes, are called ..... .

   (c) Demand curves which have an elasticity coefficient as 1 are called ..... .

   (d) All such demand curves where quantity demanded is totally unresponsive to changes in price are called ..... .

   (e) The demand is ..... in the long run.

2. State true or false for the following statements:

(a) If we go by the Law of Demand, the price elasticity for most goods would be negative.

(b) The price elasticity of a straight line demand curve varies from zero to infinity.

(c) When the income elasticity is equal to 1, the good is said to be income inelastic.

(d) When the income elasticity is negative, the good is an inferior good.

(e) For complementary goods, the cross elasticity will always be positive.

Answers: Self Assessment

1. (a) Price, income of consumers and price of other goods

(b) Perfectly elastic (c) Unit elastic

(d) Perfectly elastic (e) More elastic

2. (a) True (b) True (c) False

(d) True (e) False