

THE ELASTICITY OF SUPPLY AND DEMAND

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ELASTICITY: A MEASURE OF RESPONSE

Imagine that you are the manager of the public transportation system for a large metropolitan area. Operating costs for the system have soared in the last few years, and you are under pressure to boost revenues. What do you do?

Economists use a measure of responsiveness called **ELASTICITY**. Elasticity is the ratio of the percentage change in a dependent variable to a percentage change in an independent variable. If the dependent variable is y, and the independent variable is x, then the elasticity of y with respect to a change in x is given by:

 $e_y = (\% \text{ change in } y) / (\% \text{ change in } x)$

A variable such as y is said to be more elastic (responsive) if the percentage change in y is large relative to the percentage change in x. It is less elastic if the reverse is true.

THE PRICE ELASTICITY OF DEMAND

To show how responsive quantity demanded is to a change in price, we apply the concept of elasticity. The **price elasticity of demand** for a good or service, e_D , is the percentage change in quantity demanded of a particular good or service divided by the percentage change in the price of that good or service, all other things unchanged.

 $e_D = rac{\% \ change \ in \ quantity \ demanded}{\% \ change \ in \ price}$

Because the price elasticity of demand shows the responsiveness of quantity demanded to a price change, assuming that other factors that influence demand are unchanged, it reflects movements along a demand curve.

NB:

A. With a downward-sloping demand curve, price and quantity demanded move in opposite directions, so the price elasticity of demand is **ALWAYS NEGATIVE**.

A positive percentage change in price implies a negative percentage change in quantity demanded, and vice versa.

Sometimes you will see the absolute value of the price elasticity measure reported. In essence, the minus sign is ignored because it is expected that there will be a negative (inverse) relationship between quantity demanded and price.

B. Be careful not to confuse elasticity with slope.

The **slope** of a line is the change in the value of the variable on the vertical axis divided by the change in the value of the variable on the horizontal axis between two points.

Elasticity is the ratio of the percentage changes.

The slope of a demand curve, for example, is the ratio of the change in price to the change in quantity between two points on the curve. The price elasticity of demand is the ratio of the percentage change in quantity to the percentage change in price.

COMPUTING THE PRICE ELASTICITY OF DEMAND

Finding the price elasticity of demand requires that we first compute percentage changes in price and in quantity demanded. We calculate those changes between two points on a demand curve.



We measure the percentage change between two points as the change in the variable divided by the average value of the variable between the two points.

- the percentage change in quantity between points A and B is computed relative to theaverage of the quantity values at points A and B: (60,000 + 40,000)/2 = 50,000. The percentage change in quantity, then, is 20,000/50,000, or 40%.
- the percentage change in price between points A and B is based on the average of the two prices: (\$0.80 + \$0.70)/2 = \$0.75, and so we have a percentage change of -0.10/0.75, or -13.33%.
- 3) The price elasticity of demand between points A and B is thus $e_{D} = 40\%/(-13.33\%) = -3.00$.

ARC ELASTISITY

This measure of elasticity, which is based on percentage changes relative to the average value of each variable between two points, is called **ARC ELASTICITY**. The arc elasticity method has the advantage that it yields the same elasticity whether we go from point A to point B or from point B to point A. It is the method we shall use to compute elasticity.

For the arc elasticity method, we calculate the price elasticity of demand using the average value of price, P^{av} , and the average value of quantity demanded, Q^{av} . The change in quantity between two points is ΔQ and the change in price is ΔP . So we can write the formula for the price elasticity of demand as

$$\mathbf{e}_{\mathbf{D}} = \frac{\Delta Q/Q^{av}}{\Delta P/P^{av}}$$

IN OUR CASE

The price elasticity of demand between points A and B is thus:



With the arc elasticity formula, the elasticity is the same whether we move from point A to point B or from point B to point A. If we start at point B and move to point A, we have:

$$e_D = \frac{\frac{-20\,000}{\frac{60\,000+40\,000}{2}}}{\frac{\$0,10}{\frac{\$0,70+\$0,80}{2}}} = \frac{-40\%}{13,33\%} = -3,00$$

The fact that arc elasticities are approximate suggests an important practical rule in calculating arc elasticities: we should consider only small changes in independent variables. We cannot apply the concept of arc elasticity to large changes.

PRICE ELASTICITIES ALONG A DEMAND CURVE

which we are measuring it. For any linear demand curve, the absolute value of the price elasticity of demand will fall as 0.90 20,000 we move down and to the right (40,000+60,000)/2 $e_{\rm D} = -3.00$ 0.80 -3.00en= -0.10along the curve. $(0.70 \pm 0.80)/2$ 0.70 B per ride 0.60 20,000 $e_{\rm D} = -1.00$ 0.55 (90,000+110,000)/2 0.50 Price -0.100.45 D 0.40 (0.55+0.45)/2 $e_{\rm D} = -0.33$ 0.30 20.000 0.20 (140,000+160,000)/2 0.33 -0.100.10 (0.30 + 0.20)/2100 110 120 130 140 150 160 170 180 190 20 30 80 90 40 60 200 Quantity of rides per day (in thousands)

On a linear demand curve, the price elasticity of demand varies

depending on the interval over

The price elasticity of demand varies between different pairs of points along a linear demand curve. The lower the price and the greater the quantity demanded, the lower the absolute value of the price elasticity of demand.

THE PRICE ELASTICITY OF DEMAND AND CHANGES IN TOTAL REVENUE

Total revenue is the price per unit times the number of units sold

TR_(price \$0.8)=0.80*40,000=32,000 per day The reduction in fare **increases** total revenue. TR_(price \$0.1)=0.7*60,000=60,000 per day

However, if the initial price had been \$0.30 and the transit authority reduced it by \$0.10 to \$0.20, total revenue would *decrease* from \$42,000 (\$0.30 times 140,000) to \$32,000 (\$0.20 times 160,000).

So it appears that the impact of a price change on total revenue depends on the initial price and, by implication, the original elasticity.

ELASTIC, UNIT ELASTIC, AND INELASTIC DEMAND

To determine how a price change will affect total revenue, economists place price elasticities of demand in three categories, based on their absolute value.

If the absolute value of the price elasticity of demand is greater than 1 ($e_D > 1$), demand is termed **price elastic**

If it is equal to 1 ($e_D = 1$), demand is **unit price** elastic.

And if it is less than 1 (**e**_D<1), demand is price **inelastic**.





CONSTANT PRICE ELASTICITY OF DEMAND CURVES

The demand curve in Panel (a) is perfectly inelastic. The demand curve in Panel (b) is perfectly elastic. Price elasticity of demand is -1.00 all along the demand curve in Panel (c), whereas it is -0.50 all along the demand curve in Panel (d).



DETERMINANTS OF THE PRICE ELASTICITY OF DEMAND

Availability of Substitutes (The availability of close substitutes tends to make the demand more price elastic. If a good has no close substitutes, its demand is likely to be somewhat less price elastic.)

Importance in Household Budgets (One reason price changes affect quantity demanded is that they change how much a consumer can buy; a change in the price of a good or service affects the purchasing power of a consumer's income and thus affects the amount of a good the consumer will buy. This effect is stronger when a good or service is important in a typical household's budget.)

Time (depends in large part on how much time we allow for a response. the absolute value of the price elasticity of demand will be greater when more time is allowed for consumer responses.)

SUMMARY

The price elasticity of demand measures the responsiveness of quantity demanded to changes in price; it is calculated by dividing the percentage change in quantity demanded by the percentage change in price.

Demand is price inelastic if the absolute value of the price elasticity of demand is less than 1; it is unit price elastic if the absolute value is equal to 1; and it is price elastic if the absolute value is greater than 1.

Demand is price elastic in the upper half of any linear demand curve and price inelastic in the lower half. It is unit price elastic at the midpoint.

When demand is price inelastic, total revenue moves in the direction of a price change. When demand is unit price elastic, total revenue does not change in response to a price change. When demand is price elastic, total revenue moves in the direction of a quantity change.

The absolute value of the price elasticity of demand is greater when substitutes are available, when the good is important in household budgets, and when buyers have more time to adjust to changes in the price of the good.

INCOME ELASTICITY OF DEMAND

The **income elasticity of demand** (e_{γ}) as the percentage change in quantity demanded at a specific price divided by the percentage change in income that produced the demand change, all other things unchanged:

 $e_Y = rac{\% \ change \ in \ Q \ demanded}{\% \ change \ in \ income}$

Because income elasticity of demand reports the responsiveness of quantity demanded to a change in income, all other things unchanged (including the price of the good), it reflects a shift in the demand curve at a given price. Remember that price elasticity of demand reflects movements *along* a demand curve in response to a change in price.

INCOME ELASTICITY OF DEMAND

A **positive income elasticity** of demand means that income and demand move in the same direction—an increase in income increases demand, and a reduction in income reduces demand. (a good whose demand rises as income rises is called a **normal good**)

If a good or service is inferior, then an increase in income reduces demand for the good. That implies a **negative income elasticity** of demand.



CROSS PRICE ELASTICITY OF DEMAND

The demand for a good or service is affected by the prices of related goods or services.

The **cross price elasticity of demand** ($e_{A, B}$) uses to describe the responsiveness of demand for a good or service to a change in the price of another good or service. It equals the percentage change in the quantity demanded of one good or service at a specific price divided by the percentage change in the price of a related good or service.

 $e_{A,B} = \frac{\% change in Q demanded of good A}{\% change in P of good B}$

CROSS PRICE ELASTICITY OF DEMAND

Cross price elasticities of demand define whether two goods are **substitutes**, **complements**, or **unrelated**.

 If two goods are substitutes, an increase in the price of one will lead to an increase in the demand for the other – the cross price elasticity of demand is positive.

If two goods are **complements**, an increase in the price of one will lead to a reduction in the demand for the other – the cross price elasticity of demand is **negative**.

If two goods are **unrelated**, a change in the price of one will not affect the demand for the other – the cross price elasticity of demand is **zero**



SUMMARY

The income elasticity of demand reflects the responsiveness of demand to changes in income. It is the percentage change in quantity demanded at a specific price divided by the percentage change in income, ceteris paribus.

Income elasticity is positive for normal goods and negative for inferior goods.

The cross price elasticity of demand measures the way demand for one good or service responds to changes in the price of another. It is the percentage change in the quantity demanded of one good or service at a specific price divided by the percentage change in the price of another good or service, all other things unchanged.

Cross price elasticity is positive for substitutes, negative for complements, and zero for goods or services whose demands are unrelated.

PRICE ELASTICITY OF SUPPLY

Price elasticity of supply as the ratio of the percentage change in quantity supplied of a good or service to the percentage change in its price, all other things unchanged

eS = % change in quantity supplied

% change in price

Because price and quantity supplied usually move in the same direction, the price elasticity of supply is usually positive. The larger the price elasticity of supply, the more responsive the firms that supply the good or service are to a price change.



Supply is price elastic if the price elasticity of supply is greater than 1

unit price elastic if it is equal to 1,

price **inelastic** if it is less than 1.

A vertical supply curve is **perfectly inelastic**; its price elasticity of supply is zero. (The supply of Beatles' songs is perfectly inelastic because the band no longer exists.)

A horizontal supply curve is **perfectly elastic**; its price elasticity of supply is infinite. It means that suppliers are willing to supply any amount at a certain price.



SUMMARY

The price elasticity of supply measures the responsiveness of quantity supplied to changes in price. It is the percentage change in quantity supplied divided by the percentage change in price. It is usually positive.

Supply is price inelastic if the price elasticity of supply is less than 1; it is unit price elastic if the price elasticity of supply is equal to 1; and it is price elastic if the price elasticity of supply is greater than 1. A vertical supply curve is said to be perfectly inelastic. A horizontal supply curve is said to be perfectly elastic.

The price elasticity of supply is greater when the length of time under consideration is longer because over time producers have more options for adjusting to the change in price.

When applied to labor supply, the price elasticity of supply is usually positive but can be negative. If higher wages induce people to work more, the labor supply curve is upward sloping and the price elasticity of supply is positive. In some very high-paying professions, the labor supply curve may have a negative slope, which leads to a negative price elasticity of supply.