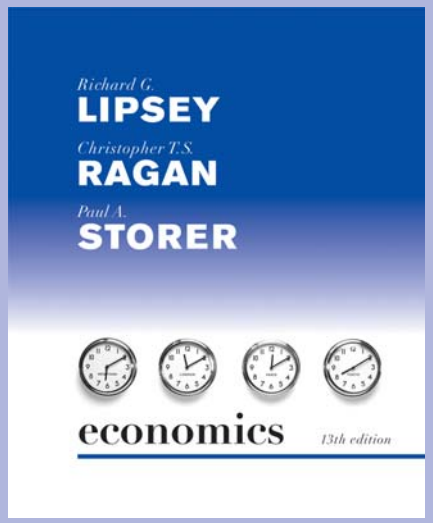
Chapter 4

Elasticity



In this chapter you will learn to

1. Explain the meaning of price elasticity of demand and how it is measured.
2. Describe the relationship between demand elasticity and total expenditure.
3. Explain the meaning of price elasticity of supply and how it is measured.
4. Explain why the effect of an excise tax on equilibrium price and quantity depends on relative demand and supply elasticities.
5. Explain how to measure the income elasticity of demand, and the meaning of normal and inferior goods.
6. Explain how to measure cross elasticity of demand, and the meaning of substitute and complement goods.

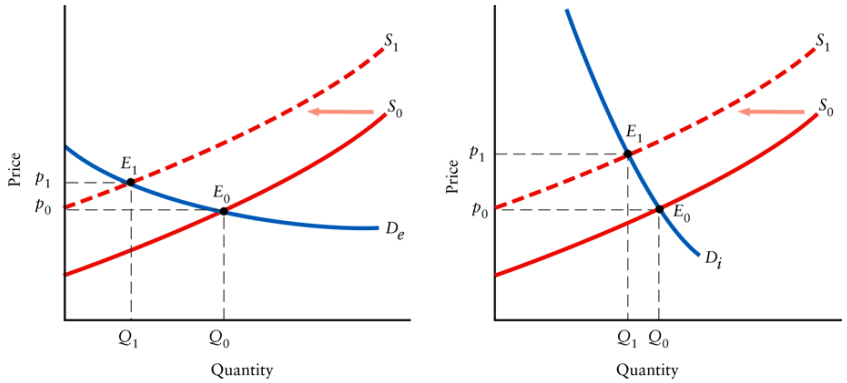
Price Elasticity of Demand

Demand is elastic when quantity demanded is relatively responsive to a change in the product's own price.

Demand is inelastic if quantity demanded is relatively unresponsive to changes in price.

Elasticity is related to the slope of the demand curve, but it is not exactly the same.

Figure 4.1 The Effects of a Supply Shift with Two Different Demand Curves



The Measurement of Price Elasticity

Elasticity (Greek letter eta: η) is defined as:

$$\eta = \frac{\textit{percentage change in quantity demanded}}{\textit{percentage change in price}}$$

$$\eta = \frac{\Delta Q^D/Q^D}{\Delta p/p}$$

Demand elasticity is negative, but economists emphasize the absolute value.

Elasticity measures the change in *p* and Q relative to some "base" values of p and Q.

The Use of Average Price and Quantity

Demand elasticity between point "0" and point "1" on some demand curve is:

$$\eta = \frac{(Q_1 - Q_0)/\bar{Q}}{(p_1 - p_0)/\bar{p}}$$

where $\bar{p}$ and $\bar{Q}$ are the average price and average quantity, respectively. Thus $p = (p_1+p_0)/2$ and $Q = (Q_1+Q_0)/2$. After a little simplifying, we get:

$$\eta = \frac{(Q_1 - Q_0)/(Q_1 + Q_0)}{(p_1 - p_0)/(p_1 + p_0)}$$

Table 4.1 Price Reductions and Corresponding Increases in Quantity Demanded for Three Products

Commodity	Reduction in Price	Increase in Quantity Demanded (per month)
Cheese	$2 per pound	7,500 pounds
T-shirts	$2 per shirt	25,000 shirts
CD players	$2 per CD player	500 CD players

Table 4.2 Price and Quantity Information Underlying Data of Table 4.1

Product	Unit	Original Price ($)	New Price ($)	Average Price ($)	Original Quantity	New Quantity	Average Quantity
Cheese	pound	5.00	3.00	4.00	116,250	123,750	120,000
T-shirts	shirt	17.00	15.00	16.00	187,500	212,500	200,000
CD players	player	81.00	79.00	80.00	9,750	10,250	10,000

Table 4.3 Calculation of Demand Elasticities

Product	(1) Percentage Decrease in Price	(2) Percentage Increase in Quantity	(3) Elasticity of Demand (2) ÷ (1)
Cheese	50.0	6.25	0.125
T-shirts	12.5	12.5	1.0
CD players	2.5	5.0	2.0

A Numerical Example of Price Elasticity

Product	Original Price	New Price	Average Price	Original Quantity	New Quantity	Average Quantity
Corona Beer (6-pack)	$9.00	$8.00	$8.50	2000	3000	2500

$$\eta = \frac{(3000 - 2000)/(3000 + 2000)/2}{(8 - 9)/(8 + 9)/2}$$

$$\eta = \frac{(1000)/(2500)}{(1)/(8.5)}$$

$$\eta = \frac{0.4}{0.1176} = 3.40$$

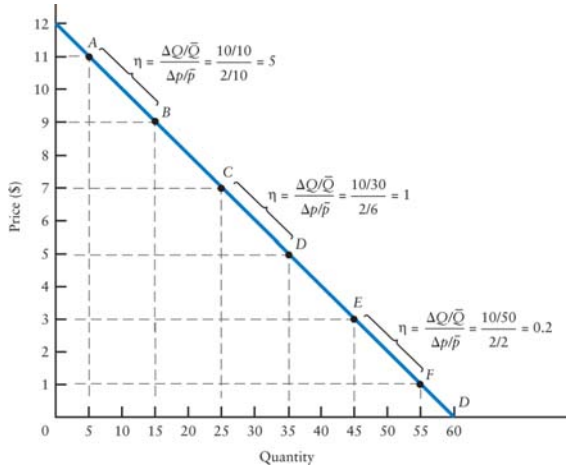
Interpreting Numerical Elasticities

Inelastic Demand ($\eta < 1$):
A given % change in *p* results in a smaller % change in Q^D.

Inelastic Demand ($\eta > 1$):
A given % change in *p* results in a larger % change in Q^D.

Inelastic Demand ($\eta = 1$):
A given % change in *p* results in the same % change in Q^D.

Figure 4.2 Elasticity along a Linear Demand Curve



What Determines Elasticity of Demand?

Demand elasticity tends to be high when there are many close substitutes.

The availability of substitutes is determined by:

- how specifically the product is defined
- whether the good is a necessity or a luxury
- the length of the time interval (short run vs. long run)

Figure 4.3 Three Demand Curves with Constant Elasticity

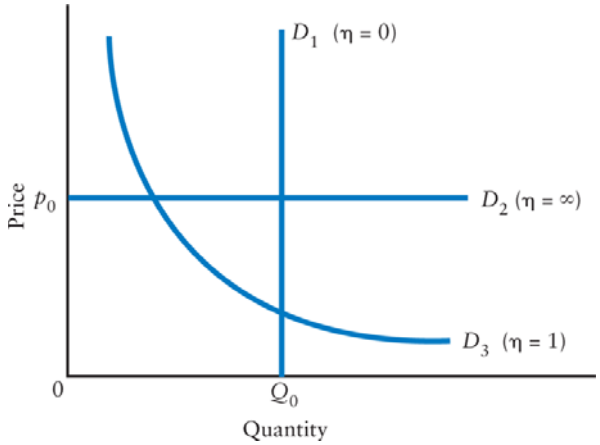
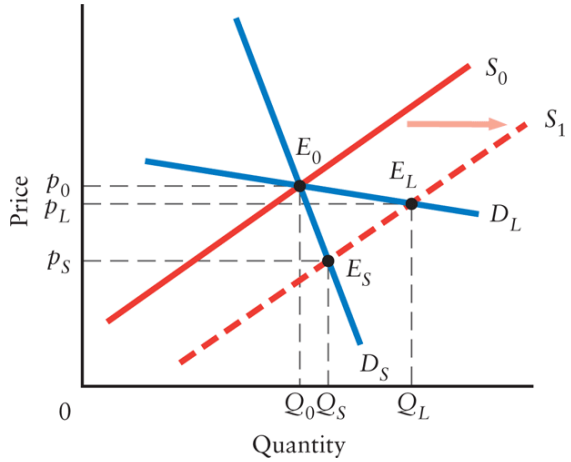


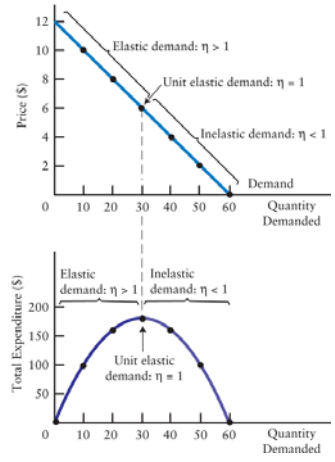
Figure 4.4 Short-Run and Long-Run Equilibrium Following an Increase in Supply



In the long run, demand is more elastic.

Figure 4.5 Total Expenditure and Quantity Demanded

Price ($)	Quantity Demanded	Expenditure ($)
12	0	0
10	10	100
8	20	160
6	30	180
4	40	160
2	50	100
0	60	0



Price Elasticity of Supply

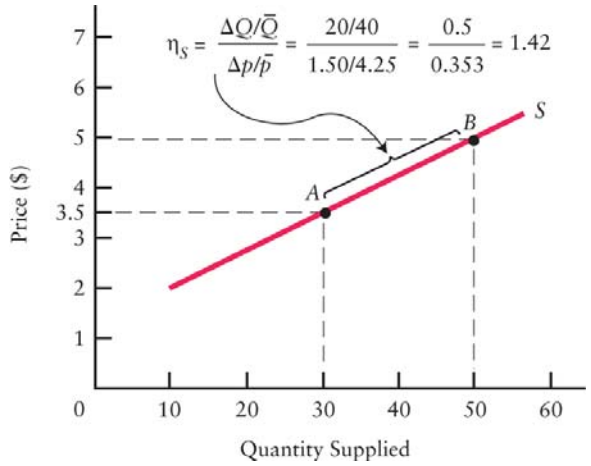
Price elasticity of supply measures the responsiveness of the quantity supplied to a change in the product's own price.

It is denoted by η_S and is defined as:

$$\eta_S = \frac{\textit{percentage change in quantity supplied}}{\textit{percentage change in price}}$$

$$\eta_S = \frac{\Delta Q^S/\bar{Q}^S}{\Delta p/\bar{p}}$$

Figure 4.6 Computing Price Elasticity of Supply



Determinants of Supply Elasticity

The elasticity of supply depends on how easily firms can increase output in response to an increase in the product's price.

This depends on:

- the technical ease of substitution in production
- the nature of production costs
- the time span (short run vs. long run)

Figure 4.7 Short-Run and Long-Run Equilibrium Following an Increase in Demand

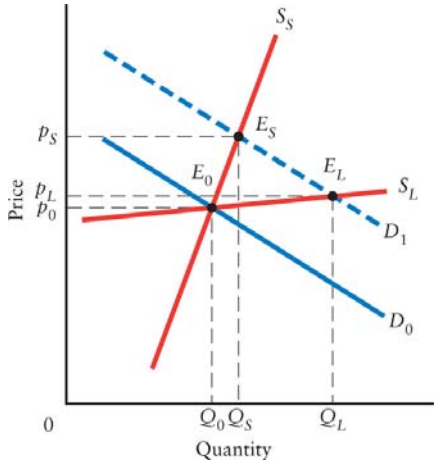
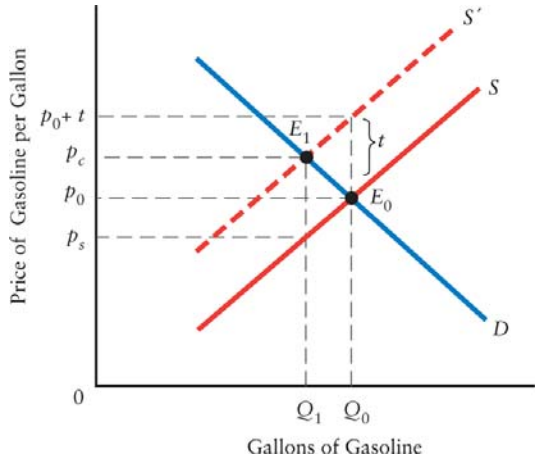


Figure 4.8 The Effect of a Gasoline Excise Tax

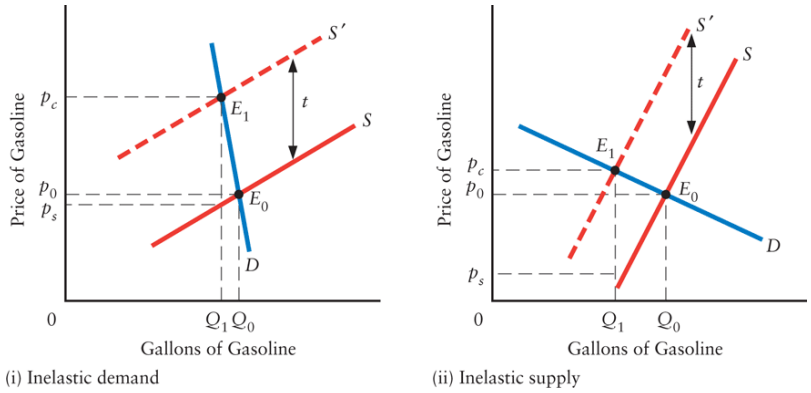


Tax Burden

The burden of an excise tax depends only on the relative elasticities of demand and supply.

- Inelastic demand: smaller burden for sellers and larger burden for buyers.
- Inelastic supply: smaller burden for buyers and larger burden for sellers.

Figure 4.9 Elasticity and the Incidence of an Excise Tax



Other Demand Elasticities

Income Elasticity of Demand

$$\eta_Y = \frac{\textit{percentage change in quantity demanded}}{\textit{percentage change in income}}$$

If $\eta_Y > 0$, the good is said to be normal.

If $\eta_Y < 0$, the good is said to be inferior.

Luxuries Versus Necessities?

The more necessary an item is in the consumption pattern of consumers, the lower its income elasticity.

Income elasticities for any one product also vary with the level of a consumer's income.

The distinction between luxuries and necessities also helps to explain differences in income elasticities between countries.

APPLYING ECONOMIC CONCEPTS 4.1

Who Really Pays for Payroll Taxes?

Cross Elasticity of Demand

$$\eta_{XY} = \frac{\textit{percentage change in quantity demanded of good } \boldsymbol{X}}{\textit{percentage change in price of good } \boldsymbol{Y}}$$

If $\eta_{XY} > 0$, then ***X*** and ***Y*** are <u>substitutes</u>.

If $\eta_{XY} < 0$, then ***X*** and ***Y*** are <u>complements</u>.

EXTENSIONS IN THEORY 4.1

The Terminology of Elasticity