**Elasticity** is easiest to understand with an example, a rubber band. A **more elastic** rubber band means that we can stretch the band further than with a **less elastic** rubber with the same amount of force. If a red rubber band can be stretched further than a yellow rubber band with the same amount of force, we say that the red rubber band is more elastic.

Formally, elasticity in Economics is defined as responsiveness. **Price elasticity of demand** measures the responsiveness of demand to changes in price. **Price elasticity of supply** measures the responsiveness of supply to changes in price. **Income elasticity of demand** measures the responsiveness of demand to changes in income. As a rule, **X elasticity of Y** refers to the responsiveness of Y to changes in X. Here are a few elasticities to keep in mind.

<table>
<thead>
<tr>
<th>Elasticity</th>
<th>What Is Measured</th>
<th>How It Is Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price Elasticity of Demand</td>
<td>Responsiveness of Demand to Changes in Price</td>
<td>%Change in $Q_d$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Change in $P$</td>
</tr>
<tr>
<td>Price Elasticity of Supply</td>
<td>Responsiveness of Supply to Changes in Price</td>
<td>%Change in $Q_s$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Change in $P$</td>
</tr>
<tr>
<td>Income Elasticity of Demand</td>
<td>Responsiveness of Demand to Changes in Income</td>
<td>%Change in $Q_d$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Change in $I$</td>
</tr>
<tr>
<td>Cross-Price Elasticity of Demand</td>
<td>Responsiveness of Demand of One To Changes in Price of the Other</td>
<td>%Change in $Q^{ow}_d$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Change in $P^{ow}$</td>
</tr>
<tr>
<td>Wage Elasticity of Labour Demand</td>
<td>Responsiveness of Labour Demand to Changes in Wage</td>
<td>%Change in $L_d$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Change in $W$</td>
</tr>
<tr>
<td>Wage Elasticity of Labour Supply</td>
<td>Responsiveness of Labour Supply to Changes in Wage</td>
<td>%Change in $L_s$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Change in $W$</td>
</tr>
<tr>
<td>Interest Rate Elasticity of Savings</td>
<td>Responsiveness of Savings to Changes in Interest Rate</td>
<td>%Change in $L_F$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Change in $r$</td>
</tr>
<tr>
<td>Interest Rate Elasticity of Borrowing</td>
<td>Responsiveness of Borrowings to Changes in Interest Rate</td>
<td>%Change in $L_{FD}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Change in $r$</td>
</tr>
</tbody>
</table>

* Note that $Q_d$ stands for Quantity demanded, $Q_s$ for Quantity supplied and LF for Loanable Funds.

<table>
<thead>
<tr>
<th>Midpoint Percentage Formula for Quantity</th>
<th>( \frac{Q_2 - Q_1}{(Q_2 + Q_1)/2} \times 100% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midpoint Percentage Formula for Price</td>
<td>( \frac{P_2 - P_1}{(P_2 + P_1)/2} \times 100% )</td>
</tr>
</tbody>
</table>
There is a connection between elasticity in a rubber band and elasticities in Economics. The amount of force used to stretch a rubber band is analogous to the amount of change in price for price elasticities. A more elastic rubber band allows the band to be stretched further than a less elastic rubber band with the same amount of force. A more elastic demand, for example, allows the quantity demanded to change more than a less elastic demand with the same percentage of price change. In general, an unspecified elasticity refers to price elasticity.

Here is a real example. Consider the demand for gasoline. The demand for gasoline is relatively price inelastic compared to demands for most goods and services. It is because the demand for gasoline is not as price sensitive as going to the movies, for example. While entertainment may be an optional activity, driving to and from work may not be an optional activity. Therefore, the quantity demanded for gasoline does not react as much as the quantity demanded for movie tickets to price changes. If a movie ticket price increases from $10 to $12, we may not go see a movie. If gasoline price increases from $1.00/L to $1.20/L, we probably would not stop driving.

Recall that X elasticity of Y refers to the responsiveness of Y to changes in X. More specifically, elasticity is a numerical measure that allows us to estimate how much Y will change by (in percentage terms) if we know how much X will change by (in percentage terms). There are two components to elasticity, sign and size. If it is positive (+), that tells us that Y will increase if we know that X will increase and that Y will decrease if we know that X will decrease. If it is negative (-), that tells us that Y will decrease if we know that X will increase and that Y will increase if we know that X will decrease.

Without looking at the sign, if elasticity is bigger than 1, we say it is elastic and that Y will change more in percentage terms than the change in X in percentage terms. Without looking at the sign, if elasticity is smaller than 1, we say it is inelastic and that Y will change less in percentage terms than the change in X in percentage terms.
A meta study conducted in the United States by Brons et al. (2008) estimates the short run price elasticity of demand for gasoline to be roughly -0.34 and long run price elasticity of demand to be -0.84. The first thing to note is that the price elasticities of demand for gasoline in the short run and the long run are both negative. The negative sign tells us that the quantity demanded for gasoline moves in the opposite direction to the price of gasoline. If gasoline price increases, quantity demanded for gasoline falls both in the short run and in the long run. If gasoline price decreases, quantity demanded for gasoline increases both in the short run and in the long run.

The size of the elasticities tells us if the demand is price elastic or price inelastic. Without looking at the sign, the short run price elasticity of demand for gasoline, 0.34, is a smaller number than 1. Thus, we say that the short run elasticity of demand for gasoline is inelastic. Without looking at the sign, the long run price elasticity of demand for gasoline, 0.84, is a smaller number than 1. Thus, we say that the long run elasticity of demand for gasoline is inelastic. Now, compare 0.34 with 1 and 0.84 with 1. 0.84 is closer to 1 than 0.34. Thus, we say that the long run elasticity of demand for gasoline is less inelastic than the short run elasticity of demand for gasoline.

With a 1% increase in the price of gasoline, we expect the short run demand for gasoline to fall by roughly 0.34% (1% × -0.34) and the long run demand for gasoline to fall by roughly 0.84% (1% × -0.84). In the short run, demand for gasoline is less price sensitive than in the long run. Generally, this holds true. While in the short run, defined as a period of a year or less, consumers have limited options for reacting to price changes, in the long run, they have more options for reacting to price changes. If consumers feel that the price of gasoline has increased too much, they may decide to invest in a hybrid vehicle or an electric vehicle in the long run. For most goods and services, consumers have more options to choose from in the long run than in the short run. This is why long run elasticities are almost always less inelastic or more elastic than the short run elasticities.

So far, we have looked at inelastic and elastic relationships. There are special cases of these relationships called perfectly inelastic or zero elasticity relationship and perfectly elastic or infinite elasticity relationship. Perfectly elastic demand for a good, for example, is so price sensitive that the smallest change in price will result in a world of difference for quantity demanded for the good. A small increase in price will result in quantity demanded of zero. A small decrease in price will result in quantity demanded of infinity. Perfectly inelastic demand for a good, for example, is so price insensitive that the largest change in price will result in zero difference for quantity demanded for the good. A large increase in price will result in the exact same quantity demanded as before the price increase. A large decrease in price will result in the exact same quantity demanded as before the price decrease.
Price elasticities in particular have profound implications for price setting behaviour for firms. The optimal price or the revenue maximizing price for firms is the price at which the price elasticity of demand is unit elastic. The reason is that if the demand of a good is elastic at a certain price, firms can reduce the price to increase revenue. A 1% decrease in the price results in a greater than 1% increase in the quantity demanded. Thus, when the demand of a good is elastic at a certain price, firms can and will reduce the price because the increase in quantity demanded more than offsets the decrease in the price. Similarly, if the demand of a good is inelastic at a certain price, firms can increase the price to increase revenue. A 1% increase in the price results in a less than 1% decrease in the quantity demanded. Thus, when the demand of a good is inelastic at a certain price, firms can and will increase the price because the increase in price more than offsets the decrease in the quantity demanded.

Price elasticities have profound implications also for government tax policies. An efficient tax policy is one that does not provide an incentive for economic agents to make a suboptimal decision. By definition, taxing a good or service whose demand is inelastic has less of an impact on the choices that economic agents make than taxing a good or service whose demand is elastic. This is because if a government starts taxing a good whose demand is elastic, economic agents will react to the tax imposition with fewer quantities demanded. This is in contrast to a good whose demand is inelastic because economic agents will not react as much to the tax imposition. Thus, a government looking to introduce a tax must be mindful of the impact the tax will have.
Practice Problems

1. What does price elasticity of demand measure?
   a) Responsiveness of price to changes in demand
   b) Responsiveness of demand to changes in price
   c) Responsiveness of price to changes in supply
   d) Responsiveness of supply to changes in supply

2. What does wage elasticity of labour supply measure?
   a) Responsiveness of wage to changes in labour supply
   b) Responsiveness of population to changes in labour supply
   c) Responsiveness of labour supply to changes in population
   d) Responsiveness of labour supply to changes in wage

3. Interpret the sign and size of price elasticity of demand -5.3.
   a) Inverse relationship between price and demand; Elastic
   b) Inverse relationship between price and demand; Inelastic
   c) Positive relationship between price and demand; Elastic
   d) Positive relationship between price and demand; Inelastic

4. Interpret the sign and size of price elasticity of supply 0.28.
   a) Inverse relationship between price and supply; Elastic
   b) Inverse relationship between price and supply; Inelastic
   c) Positive relationship between price and supply; Elastic
   d) Positive relationship between price and supply; Inelastic

5. Describe the shape of a perfectly elastic demand curve.
   a) Vertical
   b) Horizontal
   c) Diagonal
   d) None of the above

6. Describe the shape of a demand curve with zero elasticity.
   a) Vertical
   b) Horizontal
   c) Diagonal
   d) None of the above

7. Long run demand for a good is:
   a) More price elastic than short run demand for the good
   b) More price inelastic than short run demand for the good
   c) Less price inelastic than short run demand for the good
   d) Both A and C
8. How do firms use price elasticity to set prices for normal goods?
   a) They set price such that the elasticity at that price is greater than 1.
   b) They set price such that the elasticity at that price is less than 1.
   c) They set price such that the elasticity at that price is less than -1.
   d) They set price such that the elasticity at that price is equal to -1.

9. If the demand for a good is price inelastic, a 1% increase in price leads to?
   a) A more than 1% increase in quantity demanded
   b) A less than 1% decrease in quantity demanded
   c) A more than 1% decrease in quantity demanded
   d) Exactly 1% decrease in quantity demanded

10. On which of the following should the government tax if it wants to affect consumption choices the least?
    a) Elastic good
    b) Unit elastic good
    c) Inelastic good
    d) All of the above

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**Answers**

1. B
2. D
3. A
4. D
5. B
6. A
7. D
8. D
9. B
10. C