Microeconomics
Topic 5: "Discuss factors that determine demand and supply elasticity. Explain how demand and supply elasticity affect tax policy and the consequences of business decisions."

Reference: Gregory Mankiw's *Principles of Microeconomics*, 2nd edition, Chapter 5.

Elasticity in General

Elasticity measures the percent change in one economic variable when there is a 1% change in a different economic variable. There are many different elasticities; here we'll look at the price elasticity of demand and the price elasticity of supply.

Price Elasticity of Demand

The price elasticity of demand measures how consumers respond to a price change. The price elasticity of demand is the percentage change in quantity demanded of a good divided by the percentage change in the price of that same good (and you must take the absolute value of the whole thing). Price elasticity of demand is often symbolized by e_d. Δ is the Greek letter delta and means the change in something, so $\%\Delta Q_d$ means the percentage change in quantity demanded.

The price elasticity of demand is $e_d = \left| \frac{\% \ \Delta Q_d}{\% \ \Delta P} \right|$

The absolute value just means that you always express the price elasticity of demand as a positive number. (Note: Some economics textbooks do not take the absolute value, which means that price elasticity of demand is negative because price and quantity move in opposite directions.) Elasticity e_d can range from 0 to infinity. Elasticity has to be defined as a percentage change, so that we can compare elasticities across different goods. You would not want to compare a one-dollar change in the price of a house to a one-dollar change in the price of a fish sandwich. You wouldn't notice a $1 change in the price of a house, but you would notice a $1 change in the price of a sandwich. It is better to use percentages in making the comparison.

Calculating Price Elasticity of Demand: The Midpoint or Arc Method

A common method for calculating the elasticity of demand is the arc method, where you calculate the elasticity over an arc (section) of the demand curve. Mankiw calls this the "midpoint method." Let's say you want to find the elasticity of a section of the demand curve, and the endpoints of the section are (P_1, Q_1) and (P_2, Q_2). Using this method, you calculate the percentage change in quantity demanded by taking the change in quantity demand divided by the average quantity over the part of the demand curve you are looking at:

$$\%\,\Delta Q_d = \frac{\Delta Q}{\frac{Q_1 + Q_2}{2}}$$

You find the percentage change in price the same way:

$$\%\,\Delta P = \frac{\Delta P}{\frac{P_1 + P_2}{2}}$$

Now you can find the price elasticity of demand.

$$e_d = \left|\frac{\%\Delta Q_d}{\%\Delta P}\right| = \left|\frac{\frac{\Delta Q}{\frac{Q_1 + Q_2}{2}}}{\frac{\Delta P}{\frac{P_1 + P_2}{2}}}\right|$$

Here's an example. Suppose that when the price of a product is $6, the quantity demanded is 2. When the price goes down to $4, the quantity demanded is 6. Find the price elasticity of demand.

$$e_d = \left|\frac{\%\Delta Q_d}{\%\Delta P}\right| = \left|\frac{\frac{\Delta Q}{\frac{Q_1 + Q_2}{2}}}{\frac{\Delta P}{\frac{P_1 + P_2}{2}}}\right| = \left|\frac{\frac{2-6}{\frac{2+6}{2}}}{\frac{6-4}{\frac{6+4}{2}}}\right| = \left|\frac{\frac{-4}{4}}{\frac{2}{5}}\right| = \frac{5}{2} = 2.5$$

It doesn't matter which Q you call Q_1 or which P you call P_1. The important thing is to mind your Ps and Qs, and not get them mixed up (don't use a Q where you are supposed to use a P).

Ranges of Elasticity

If the price elasticity of demand comes out greater than 1 (as in the example above), then consumers are very responsive to price changes. In this case, a price increase of 1% makes consumers cut back the amount they buy by more than 1%; a price decrease of 1% makes consumers increase the amount they buy by more than 1%. In this situation, consumers are flexible in the amount they buy when it comes to price changes; we say they have an elastic demand.

If the price elasticity of demand comes out less than 1, then consumers are very inflexible with respect to price changes. A price increase of 1% makes consumers cut back the amount they buy, but only by a little, less than 1%; a price decrease of 1% makes

consumers buy more, but only by a little, less than 1%. In this situation, consumers are inflexible when it comes to price changes; we say they have an inelastic demand.

If the price elasticity of demand comes out equal to 1, then the percent changes in price and quantity demanded are equal. A price increase of 1% makes consumers cut back the amount they buy by 1%; a price decrease of 1% makes consumers buy 1% more. In this situation, demand is called unit elastic.

$e_d > 1$ means demand is elastic.
$e_d = 1$ means demand is unit elastic.
$e_d < 1$ means demand is inelastic.

Relationship Between Elasticity and Revenue (or Consumers' Expenditures)

Elasticity is important in determining whether a change in the price of a good will increase or decrease the total revenues of firms selling the good. In this discussion, keep in mind that revenues are not the same as profits. Maximizing revenues is not the same thing as maximizing profits. When you just look at revenues, you are ignoring costs.

Suppose $e_d = 5$, so demand is elastic. This tells the seller that if they lower prices 1%, the quantity demanded will increase by 5%. A seller can increase revenue by lowering prices when demand is elastic, because the increase in revenue from consumers buying more of the good will exceed the decrease in revenue from each consumer paying a lower price. On the other hand, if the seller increases prices, revenues will fall.

Note: Ignoring sales tax, revenues are equal to consumers' expenditures. Therefore, a question about elasticity could ask you about either revenue or consumers' expenditures, since they are considered the same in this context. This means that for $e_d = 5$, a fall in price will increase both revenue and consumers' expenditures.

If $e_d = 1$, a small change in price will keep revenue (and consumer expenditures) the same. However, for a big change in price, the elasticity will actually change from 1. (This will be explained in more detail below).

Now say $e_d = 0.25$, so that demand is inelastic. The seller can increase revenue (and consumer expenditures) by raising price. The seller can increase prices by 1%, and consumers will only buy 0.25% less, so revenue will increase. If the seller decreased prices, revenue would decrease. In this situation, the seller should increase prices to increase revenues.

If demand is inelastic, why not keep increasing prices forever? The answer is that elasticity will change. Elasticity is not constant along a demand curve. In other words, elasticity is not the same as the slope. (The slope is always the same along a straight-line demand curve.) The bottom part of a demand curve tends to be inelastic, and the top tends to be elastic. Also, a steeper demand curve tends to be more inelastic, and a flatter demand curve tends to be more elastic.

Determinants of the Price Elasticity of Demand

These are several factors that can cause the price elasticity of demand to change or to be different for different goods.

1. The existence of substitutes. If you can easily switch from one good to another, the price elasticity of demand for either good tends to be elastic. The price elasticity of demand for Pepsi will be elastic because you can buy Coca-Cola instead. If there are no good substitutes, the price elasticity of demand tends to be inelastic.

2. Necessities vs. Luxuries. If you think something is a necessity, your demand will tend to be more inelastic; for something you think is a luxury, your demand will tend to be more elastic.

3. Definition of the market. Demand for Fords is more elastic than demand for cars in general. Why? There are more substitutes for Fords than for cars in general. If the price of a Ford goes up, you can just buy some other kind of car. If the price of all cars goes up, maybe you can buy a truck or a motorcycle instead, but that's not really the same as a car. This is why the elasticity of demand for Fords will be higher than that of all cars in general. The way you define the market affects how the elasticity will turn out. In general, the broader the market, the lower the elasticity of demand.

4. Time period under consideration. The longer the time period you look at, the more elastic demand will become. This is because you will have more time to find substitutes.

Price Elasticity of Supply

The price elasticity of supply measures how firms react to a price change. It's easy because it's similar to the price elasticity of demand, except now we're looking at what firms do. It is the percentage change in quantity supplied divided by the percentage change in price. You don't have to take the absolute value because it is always positive anyway (since a supply curve is upward sloping).

$$e_s = \frac{\% \Delta Qs}{\% \Delta P}$$

You can use the arc or midpoint method to calculate e_s just as with the price elasticity of demand. Also, the ranges are just like those for the price elasticity of demand:

$e_s > 1$ means supply is elastic.
$e_s = 1$ means supply is unit elastic.
$e_s < 1$ means supply is inelastic.

Elasticity and Excise Taxes

An excise tax is a tax on one good. The most common excise taxes in the U.S. today are taxes on gasoline, cigarettes, and liquor. These three goods all have one thing in common: they all tend to have inelastic demand. When excise taxes are placed on these goods, the sellers can pass most of the tax on to the consumers, because consumers' demand is inelastic. When the price goes up, consumers will only cut back the quantity they buy a little. They end up spending more on the good. If the taxed good had elastic demand, the sellers would only be able to pass a small part of the excise tax on to consumers, because if the price went up too much, consumers would dramatically cut back the quantity they buy.

In general, the burden of a tax is carried by the group that is most inelastic. If demand is more inelastic than supply, consumers will pay most of the tax. If supply is more inelastic than demand, producers will pay most of the tax. This is true regardless of who "officially" pays the tax. Even if a cigarette tax officially has to be paid by cigarette companies, consumers pay most of the tax because demand for cigarettes is relatively inelastic.