Chapter 5: Elasticity and applications

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Outline

Elasticity is an intuitive concept:

How do consumers change their behavior in response to changing prices or income?

We have different notions of elasticity, namely *price elasticity* and *income elasticity*... we will start by discussing price elasticity.

Price elasticity

We can consider price elasticity of *supply* and *demand*

- **Price elasticity of demand**: how much Q_D for a good responds to a change in the price of that good.
- **Price elasticity of supply**: how much Q_S for a good responds to a change in the price of that good.

Price Elasticity

A consumer or seller may be price **elastic** or **inelastic** for a particular good:

Elastic:

Quantity demanded/supplied responds *a lot* to changes in price.

Example: Travel

Inelastic:

Quantity demanded/supplied respond *little* to changes in price.

Example: Insulin

Elasticity Influences

What factors will influence a good's elasticity?

1. **Availability of close substitutes**: other kinds of trucks, cars, bikes, etc.
2. **Necessities vs. luxuries**: do you need it for work? For fun?
3. **Market definition**: Are we considering the market for Ford F150s? For pickup trucks? For motor vehicles?)
4. **Time horizon**: In the short run, maybe we need a pickup; in the long-run, maybe we retool our lives to accomadate a different car or no car at all

Calculating elasticity

We have a simple equation to find an elasticity:

$$X \text{ Elasticity of } Y = |\frac{\%\Delta X}{\%\Delta Y}|$$

The price elasticity of demand is calculated as follows:

$$\textit{Price} \text{ elasticity of demand} = |\frac{\%\Delta Q_D}{\%\Delta P}|$$

Calculating Elasticity

First, we need to know how to calculate the percent change of a price or quantity:

If good A used to cost \$10, and now it costs \$14, what is the percentage change?

$$\frac{\text{Change in price}}{\text{Original price}} * 100\% = \frac{\$14 - \$10}{\$10} * 100\% = 40\%$$

In our elasticity formula, we do not need to worry about multiplying by 100%.

Price elasticity of demand

Consider two points along a demand curve:

- A: price is $P_A = 12$ and quantity demanded is $Q_A = 60$
- B: $P_B = 8$ and $Q_B = 80$

We can use our formula to calculate the price elasticity of demand of:

1. Moving from A to B
2. Moving from B to A

Calculating price elasticity of demand

1. Moving from A to B: $P_e = \left|\frac{\frac{80-60}{60}}{\frac{8-12}{12}}\right| = \left|\frac{\frac{1}{3}}{-\frac{1}{3}}\right| = |-1| = 1$
2. Moving from B to A: $P_e = \left|\frac{\frac{60-80}{80}}{\frac{12-8}{8}}\right| = \left|\frac{-\frac{1}{4}}{\frac{1}{2}}\right| = \left|-\frac{1}{2}\right| = \frac{1}{2}$

** We get two different price elasticities! What gives?? **

The midpoint method

To avoid problems caused by calculating elasticities using different bases (as we saw in the previous example), we can use the midpoint method.

The midpoint method:

Use the average of the two points as the base in percentage calculations:

$$\text{Price elasticity of demand} = \frac{\frac{Q_2 - Q_1}{(Q_2 + Q_1)/2}}{\frac{P_2 - P_1}{(P_2 + P_1)/2}}$$

This is the formula we will use in this class!

The midpoint method

Using the midpoint method with our previous example:

- $P_A = 12$ and $Q_A = 60$
- $P_B = 8$ and $Q_B = 80$

1. What is the new base price?
2. What is the new base quantity?
3. What is the percent change for quantity demanded?
4. What is the percent change for price?

The midpoint method

Using the midpoint method with our previous example:

- $P_A = 12$ and $Q_A = 60$
- $P_B = 8$ and $Q_B = 80$

1. What is the new base price?
   - $\frac{P_A + P_B}{2} = \frac{12+8}{2} = \$10$
2. What is the new base quantity?
3. What is the percent change for quantity demanded?
4. What is the percent change for price?

The midpoint method

Using the midpoint method with our previous example:

- $P_A = 12$ and $Q_A = 60$
- $P_B = 8$ and $Q_B = 80$

1. What is the new base price?
   - $\frac{P_A + P_B}{2} = \frac{12+8}{2} = \$10$
2. What is the new base quantity?
   - $\frac{Q_A + Q_B}{2} = \frac{60+80}{2} = 70$
3. What is the percent change for quantity demanded?

4. What is the percent change for price?

The midpoint method

Using the midpoint method with our previous example:

- $P_A = 12$ and $Q_A = 60$
- $P_B = 8$ and $Q_B = 80$

1. What is the new base price?
   - $\frac{P_A + P_B}{2} = \frac{12+8}{2} = \$10$
2. What is the new base quantity?
   - $\frac{Q_A + Q_B}{2} = \frac{60+80}{2} = 70$
3. What is the percent change for quantity demanded?
   - $\frac{80-60}{70} = \frac{2}{7}$
4. What is the percent change for price?

The midpoint method

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   - $\frac{80-60}{70} = \frac{2}{7}$
4. What is the percent change for price?
   - $\frac{12-8}{10} = \frac{2}{5}$

The midpoint method

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3. What is the percent change for quantity demanded?
   - $\frac{80-60}{70} = \frac{2}{7}$
4. What is the percent change for price?
   - $\frac{12-8}{10} = \frac{2}{5}$

Whether we move from A to B or B to A we get $P_e = \frac{2/7}{2/5} = \frac{5}{7}$

The point method

We can also calculate the elasticity of demand at a particular point on the demand curve:

$$\text{Price elasticity of Demand} = \left|\frac{\Delta Q_D}{\Delta P}\right| \times \frac{P}{Q_D}$$

- $\frac{\Delta Q_D}{\Delta P}$ is the reciprocal slope of the demand curve at the point (Q_D, P)
  - (The slope of the demand curve is $\frac{\Delta P}{\Delta Q_D}$)

Let's do an example...

The point method

Imagine we are given the following demand equation and point on the curve:

- Demand equation: $P = -\frac{1}{2}Q + 10$
- Point A: $Q_D = 80 \quad P = 8$

What is the price elasticity of demand at point A on the demand curve?

$$\begin{aligned}
\text{Price elasticity of demand} &= \frac{1}{|\text{slope}|} \times \frac{P}{Q_D} \\
&= \frac{1}{|-\frac{1}{2}|} \times \frac{8}{80} \\
&= |-2| \times \frac{1}{10} \\
&= |-\frac{1}{5}| \\
&= \frac{1}{5}
\end{aligned}$$

Cases of elasticity of demand

Demand might be:

- **Elastic**: price change of $X\%$ $\rightarrow$ demand change greater than $X\%$
  - Elasticity > 1
- **Inelastic**: price change of $X\%$ $\rightarrow$ demand change less than $X\%$
  - Elasticity < 1
- **Unit elastic:** price change of $X\%$ $\rightarrow$ demand change of $X\%$
  - Elasticity $= 1$
- **Perfectly inelastic**: price change has no impact on demand
  - Elasticity $= 0$
- **Perfectly elastic:** small price change has enormous (infinite!) impact on demand
  - This one is tricky...

Let's draw them!

Revenue

The total revenue of a firm depends on the price and quantity sold of their products:

$$\text{Total revenue} = P \times Q$$

So, when a firm increases or decreases their prices P, the associated change in quantity sold Q will determine their change in total revenue.

What does total revenue look like on a graph?

Revenue

In order to determine the change in Q caused by the change in P, we must use the price elasticity of demand...

When demand is inelastic:

If price increases, total revenue increases

When demand is elastic:

If price increases, total revenue decreases

When demand is unit elastic:

Total revenue remains constant when price changes

Revenue

Let's say the price of a coffee at Starbucks initially was P_A, but has just doubled to $P_B = 2 \times P_A$.

How will total revenue change when:

1. Demand is elastic: quantity decreases by 75%
2. Demand is inelastic: quantity decreases by 25%
3. Demand is unit elastic

Different Elasticities

We have focused on the *Price elasticity of demand*, but there are others.

Income elasticity of demand:

- Positive for normal goods, negative for inferior goods
- income elasticity of demand $= |\frac{\%\ \Delta Q_D}{\%\ \Delta\ \text{Income}}|$

Cross-price elasticity of demand:

- Positive for substitutes, negative for complements
- CP elasticity of demand $= |\frac{\%\ \Delta Q_{D1}}{\%\ \Delta P_2}|$

Price elasticity of supply

We use a very similar formula:

$$\text{Price elasticity of supply} = \left|\frac{\%\ \Delta Q_S}{\%\ \Delta P}\right|$$

Firms may have supply that is:

- **Elastic**: an X% change in price $\rightarrow >$ X% change in supply
  - Elasticity > 1
- **Inelastic:** an X% change in price $\rightarrow <$ X% change in supply
  - Elasticity < 1
- **Unit elastic:** an X% change in price $\rightarrow$ X% change in supply
  - Elasticity $= 1$
- **Perfectly inelastic**: any change in price $\rightarrow$ no change in supply
  - Elasticity $= 0$
- **Perfectly elastic**: any change in price $\rightarrow$ enormous change in supply
  - This one is tricky...