

# Chapter 5: Elasticity and applications

Discussion section 4

September 2023

# Outline

Elasticity captures an extremely intuitive concept:

How do you change your behavior in response to changing prices?

Let's refresh:

When does a consumer buy more of a good?

# Elasticity

- ① Its price is lower (law of demand)
- ② Incomes are higher (for normal goods)
- ③ Price of substitutes is higher
- ④ Price of complements is lower

The *elasticities of demand* will tell us just how big the change in demand is for these cases.

# Elasticity of demand

A good may have *elastic* or *inelastic* demand: demand responds a lot, or demand responds a little, in response to a price change.

What are some examples of inelastic goods?

Elastic goods?

Let's take a specific example: the Ford F-150. What factors will influence this product's elasticity of demand?

# Elasticity of demand

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

# Elasticity of demand

We have a simple equation to find the price elasticity of demand:

$$\text{Price elasticity of demand} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$$

Will this value be greater or less than 0? Why?

First, let's refresh the basics. If good A used to cost \$10, and now it costs \$14, what is the percentage change?

# Elasticity of demand

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%.

# Calculating elasticity

Consider two points on a demand curve:

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

Take our formula and calculate the price elasticity of demand:

- 1 Moving from point A to point B
- 2 Moving from point B to point A



## Calculating elasticity

① Moving from point A to point B:  $P_e = \frac{1/3}{-1/3} = -1$

② Moving from point B to point A:  $P_e = \frac{-1/4}{1/2} = -\frac{1}{2}$

Two different values! What gives?

You have \$100, and lose 10%. Tomorrow, you gain back 10%. How much do you have?

What can we do about this?

## Midpoint technique

Instead of taking the % change w.r.t. the original price, use an average of the two prices as your base, use an average of the two:

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

This is the formula we will use!

# Calculating elasticity

Let's return to our 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 % change for quantity?
- 4 What is the % change for price?

Then put it all together to get our new elasticity estimate.

# Calculating elasticity

- $P_A = 12$  and  $Q_A = 60$
  - $P_B = 8$  and  $Q_B = 80$
- 1 What is the new base price? \$10
  - 2 What is the new base quantity? 70
  - 3 What is the change for quantity?  $\frac{2}{7}$
  - 4 What is the change for price?  $\frac{2}{5}$

## Calculating elasticity

Whether we consider moving from A to B or from B to A, we get  $P_e = \frac{2/7}{2/5} = \frac{5}{7}$ .

Demand might be:

- Elastic
- Inelastic
- Unit elastic
- Perfectly elastic
- Perfectly inelastic

Group activity: draw a demand curve for each of these cases

# Types of elasticity

Demand might be:

- Elastic: price change of  $X\%$   $\rightarrow$  demand change greater than  $X\%$
- Inelastic: price change of  $X\%$   $\rightarrow$  demand change less than  $X\%$
- Unit elastic: price change of  $X\%$   $\rightarrow$  demand change of  $X\%$
- Perfectly elastic: price change has no impact on demand
- Perfectly inelastic: small price change has enormous impact on demand

# Total revenue

How do we know how much is spent on a good at the market equilibrium?

Total revenue = equilibrium price  $\times$  equilibrium quantity

How does elasticity interact with revenue? Think about how revenue changes when the price doubles from  $P_A$  to  $P_B = 2 * P_A$  when:

- Demand is elastic: quantity decreases by 75%
- Demand is inelastic: quantity decreases by 25%
- Demand is unit elastic

# Elasticity

Say we have a linear demand curve:

- Quantity demanded is 0 when price is 100
  - Quantity demanded is 12 when price is 4
- 1 Calculate the formula for the demand curve (slope and intercept) and draw graphically
  - 2 Is the elasticity constant? Why or why not?
  - 3 Pick a few example points, and use the midpoint formula to check the elasticity when:
    - 1 Price is close to 100
    - 2 Price is close to 0
    - 3 Price is around 50
  - 4 How will total revenue vary as price moves from 0 to 100?



# Different elasticities

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

In general, we can find the *X elasticity of Y* as:

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

Some important elasticities:

- Income elasticity of demand
- Cross-price elasticity of demand

# Different elasticities

Income elasticity of demand:

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

Cross-price elasticity of demand:

- Positive for substitutes, negative for complements
- CP elasticity of demand =  $\frac{\% \Delta \text{ of demand for good 1}}{\% \Delta \text{ of price of good 2}}$

# Supply elasticities

Firms will react to a change in price based on their *price elasticity of supply*.

The same ideas are in play. Firms may have supply that is:

- elastic
- inelastic
- unit elastic
- perfectly elastic
- perfectly inelastic

Let's draw a graph for each of these scenarios.

What is the formula for finding the price elasticity of supply?

# Supply elasticities

Firms may have supply that is:

- elastic: an  $X\%$  change in price  $\rightarrow < X\%$  change in supply
- inelastic: an  $X\%$  change in price  $\rightarrow > X\%$  change in supply
- unit elastic: an  $X\%$  change in price  $\rightarrow X\%$  change in supply
- perfectly elastic: any change in price  $\rightarrow$  enormous change in supply
- perfectly inelastic: any change in price  $\rightarrow$  no change in supply (perfectly vertical)

Of course our formula is:

$$\text{price elasticity of supply} = \frac{\% \Delta \text{ of supply}}{\% \Delta \text{ of price}}$$

# Elasticity examples

Let's use some intuition, and choose three products for which we think:

- 1 Demand is inelastic
- 2 Demand is elastic
- 3 Supply is inelastic
- 4 Supply is elastic

# Appliction

Let's think about the market for hotel rooms:

| <b>Price</b> | <b><math>Q_D</math> (Business)</b> | <b><math>Q_D</math> (Vacation)</b> | <b><math>Q_S</math> (Firms)</b> |
|--------------|------------------------------------|------------------------------------|---------------------------------|
| \$150        | 2,100                              | 1,000                              | 2,300                           |
| \$200        | 2,000                              | 800                                | 2,400                           |
| \$250        | 1,900                              | 600                                | 2,500                           |
| \$300        | 1,800                              | 400                                | 2,600                           |

Table: Market for airline tickets

Which group do you expect to be elastic? Inelastic? Why? Calculate the elasticities.

# Appliction

| <b>Business people</b> | <b>Vacationers</b> | <b>Firms</b> |
|------------------------|--------------------|--------------|
| 0.17                   | 0.78               | 0.15         |
| 0.23                   | 1.29               | 0.18         |
| 0.3                    | 2.2                | 0.22         |

Table: Elasticities for airline tickets

Was your intuition for the elasticities correct? When is this market in *equilibrium*?