Elasticity

February 1, 2007

Reading: Chapter 5

Definition

General

Y depends on X

How much does Y change when X changes? How responsive is Y to a change in X?

Suppose X changes from 8 to 10 which makes Y change from 30 to 34. \( \Delta Y = 34 - 30 = 4 \) and \( \Delta X = 10 - 8 = 2 \).

Measure of response: \( \frac{\Delta Y}{\Delta X} = \frac{4}{2} = 2 \).

Measure affected by scale of measurement.

So responsiveness measured by elasticity:

\[
\frac{\% \text{ change in } Y}{\% \text{ change in } X} = \frac{\frac{4}{20} \times 100}{\frac{2}{8} \times 100} = \frac{4}{5} = 0.8
\]

Called X elasticity of Y.

Price elasticity of Demand

In microeconomics most common elasticity in price elasticity of demand or quantity demanded.

The price elasticity of demand is the ratio of the percent change in the quantity demanded to the percent change in the price.

Convention: put minus sign in front, to make it positive.

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

Why study it? Examples of uses:

How to set price or quantity
Tax incidence

Measurement

Using the Midpoint Method to Calculate Elasticities

\[
\% \text{ change in quantity demanded} = \frac{\text{Change in } Q}{\text{Average value of } Q} \times 100
\]

\[
\% \text{ change in price} = \frac{\text{Change in } P}{\text{Average value of } P} \times 100
\]

Price elasticity of demand

\[
\text{Price elasticity of demand} = \frac{\frac{Q_2 - Q_1}{Q_1 + Q_2}}{\frac{P_2 - P_1}{P_1 + P_2}}
\]

Note minus sign

Using initial prices and quantities

% change in Y

% change in X

\( \frac{\Delta Y}{\Delta X} \)

\Delta Y

\Delta X

\% change in Y

\% change in X

\( \frac{\% \text{ change in } Y}{\% \text{ change in } X} \)

\( \frac{\text{Change in } Q}{\text{Average value of } Q} \times 100 \)

\( \frac{\text{Change in } P}{\text{Average value of } P} \times 100 \)

\( \frac{\frac{Q_2 - Q_1}{Q_1 + Q_2}}{\frac{P_2 - P_1}{P_1 + P_2}} \)
Measurement
Graphical interpretation of point elasticity

Elasticity at point E
Elasticity = EB/AE

Elasticity
= \frac{(\Delta Q/Q)(\Delta P/P)}{= \frac{P}{Q}(\Delta P/\Delta Q)}
= \frac{(OG/0H)(EB/HB)}{= HB/0H}
= \frac{EB/AE}{

Elasticity can change on a curve
Elasticity measured for a given price

Interpretation
Different elasticity magnitudes

Inelastic demand:
Price elasticity of demand < 1

Elastic demand:
Price elasticity of demand > 1

Problem with measuring price elasticity of demand:
quantity demanded depends on price as well as other variables

Some Estimated Price Elasticities of Demand

<table>
<thead>
<tr>
<th>Good</th>
<th>Price elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inelastic demand</td>
<td>Elasticity of demand &lt; 1</td>
</tr>
<tr>
<td>Eggs</td>
<td>0.1</td>
</tr>
<tr>
<td>Beef</td>
<td>0.4</td>
</tr>
<tr>
<td>Stationary</td>
<td>0.5</td>
</tr>
<tr>
<td>Gasoline</td>
<td>0.5</td>
</tr>
<tr>
<td>Elastic demand</td>
<td>Elasticity of demand &gt; 1</td>
</tr>
<tr>
<td>Housing</td>
<td>1.2</td>
</tr>
<tr>
<td>Restaurant meals</td>
<td>2.3</td>
</tr>
<tr>
<td>Airline travel</td>
<td>2.4</td>
</tr>
<tr>
<td>Foreign travel</td>
<td>4.1</td>
</tr>
</tbody>
</table>
Interpretation
Elasticity and revenue

1. **A price effect:** After a price increase, each unit sold sells at a higher price, which tends to raise revenue.

2. **A quantity or sales effect:** After a price increase, fewer units are sold, which tends to lower revenue.

Interpretation
Elasticity and revenue, cont.

- If demand for a good is **elastic**, an increase in price reduces total revenue. (Quantity effect > Price effect).

- If demand for a good is **inelastic**, a higher price increases total revenue. (Price effect > Quantity effect).

- If demand for a good is **unit-elastic**, an increase in price does not change total revenue. (Quantity effect = Price effect).

Interpretation
Factors Determining Price Elasticity of Demand

- **Whether Close Substitutes Are Available**
- **Whether the Good Is a Necessity or a Luxury**
- **Time for adjustment**

Interpretation
Other Demand Elasticities

**Cross-Price Elasticity**

- Substitutes – negative elasticity
- Complement – positive elasticity

**Income Elasticity of Demand**

- Normal Goods – positive elasticity
- Inferior Goods – negative elasticity
Price Elasticity of Supply

The price elasticity of supply is a measure of the responsiveness of the quantity of a good supplied to the price of that good.

\[
\text{Price elasticity of supply} = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}
\]

More elastic - flatter curve
Less elastic - steeper curve

Factors determining supply elasticity
- The Availability of Inputs
- Time for adjustment

Application
Revenue maximization
- With linear demand curve revenue maximized by
  - setting price 0A
  - or quantity 0B
- Ticket price
- How much oil to pump

Applications
Tax incidence