Measurement and Interpretation of Elasticities

Chapter 2 +

What Are Elasticities?

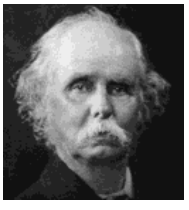
- Measure of the relationship between two variables

$$\text{Elasticity} = \frac{\text{Percentage change in y}}{\text{Percentage change in x}}$$

- Elastic vs. inelastic
- Arc vs. point

Alfred Marshall

- Popularized concepts
  - Changed the name and face of economics
- Quirks
- Elasticities



Elasticities of Demand

- Own-price elasticity of demand
  - responsiveness of changes in quantity associated with a change in the goods own price
- Income elasticity of demand
  - responsiveness of changes in quantity associated with a change in income
- Cross-price elasticity of demand
  - responsiveness of changes in quantity associated with a change in price of another good

Own-Price Elasticity of Demand

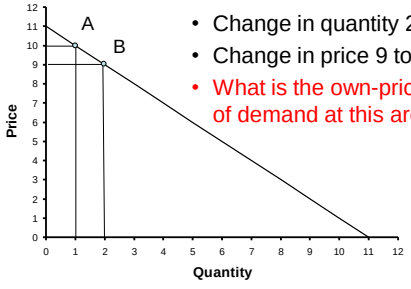
$$\textbf{Own-price Elasticity} = \frac{\text{Percentage change in quantity}}{\text{Percentage change in own price}}$$

$$\text{Own-price elasticity} = \frac{(Q_A - Q_B)/[(Q_A + Q_B)/2]}{(P_A - P_B)/[(P_A + P_B)/2]}$$

$$= \frac{\frac{\Delta Q}{\overline{Q}}}{\frac{\Delta P}{\overline{P}}} = \frac{\Delta Q}{\Delta P} \bullet \frac{\overline{P}}{\overline{Q}}$$

- Interpretation -- 1% increase in price leads to a x% change in quantity purchased over this arc

Own-Price Elasticity



- Consumer bundle B to A
- Change in quantity 2 to 1
- Change in price 9 to 10
- What is the own-price elasticity of demand at this arc?

Math Details

- Recall change in quantity = 2 to 1 and price 9 to 10

$$\frac{\%\ \text{change in quantity}}{\%\ \text{change in own price}} = \frac{(1-2)/[(1+2)/2]}{(10-9)/[(10+9)/2]} = \frac{-0.667}{0.105} = -6.33$$

- or

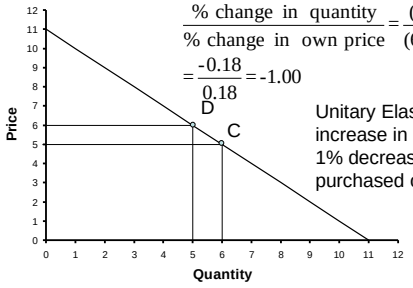
$$\frac{\Delta Q}{\Delta P} \bullet \frac{\bar{P}}{\bar{Q}} = \frac{(1-2)}{(10-9)} \bullet \frac{(10+9)/2}{(1+2)/2} = \frac{-1}{1} \bullet \frac{9.5}{1.5} = -6.33$$

- Interpretation -- 1% increase in price leads to a 6.33% decrease in quantity purchased over this arc

Own-Price Elasticity

- Bundles C to D

$$\frac{\%\ \text{change in quantity}}{\%\ \text{change in own price}} = \frac{(5-6)/[5+6)/2]}{(6-5)/[(6+5)/2]} = \frac{-0.18}{0.18} = -1.00$$



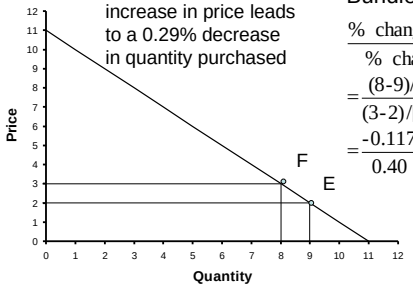
Unitary Elasticity -- 1% increase in price leads to a 1% decrease in quantity purchased over this arc

Own-Price Elasticity

Interpretation -- 1% increase in price leads to a 0.29% decrease in quantity purchased

- Bundles E to F

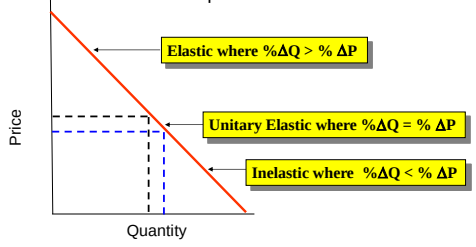
$$\frac{\%\ \text{change in quantity}}{\%\ \text{change in price}} = \frac{(8-9)/[8+9)/2]}{(3-2)/[(3+2)/2]} = \frac{-0.117}{0.40} = -0.294$$



Own-Price Elasticity Cont.

- Generally elasticities vary over the curve
- Negative – law of demand
- Linear demand curve - specific

$$\frac{\Delta Q}{\Delta P} \bullet \frac{\overline{P}}{\overline{Q}}$$

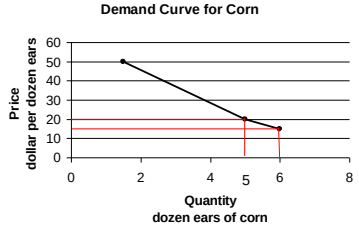


Own-Price Elasticity

If value of the elasticity coefficient is	Demand is said to be	%Δ in quantity is
Less than -1.0	Elastic	Greater than %Δ in price
Equal to -1.0	Unitary elastic	Same as %Δ in price
Greater than -1.0	Inelastic	Less than %Δ in price

Use - example

- What is arc elasticity for corn between the prices of $15 (6 corn) and $20 (5 corn) / dozen?



Use Cont.

- Calculation of arc elasticity
  - % change in Price = (20-15)/[(20+15)/2] = 0.28
  - % change in Q = (5-6)/[(5+6)/2] = -0.18
  - Own-price elasticity = -0.18/(0.28) = -0.63
- Elastic or inelastic
  - Why?
- Goal is to increase revenues. The current price is $17.50 / dozen, should you increase or decrease price?

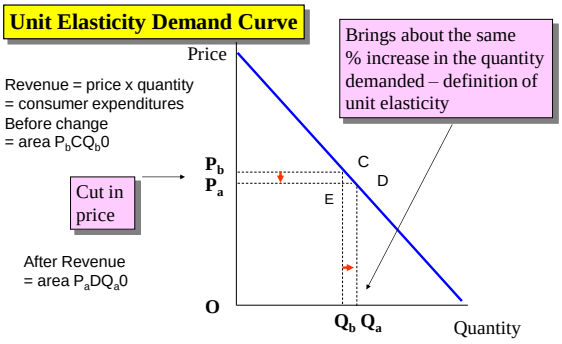
Revenue Implications - Know

Own-price elasticity is	Cutting the price will	Increasing the price will
Elastic	**Increase revenue**	**Decrease revenue**
Unitary elastic	**No change in revenue**	**No change in revenue**
Inelastic	**Decrease revenue**	**Increase revenue**

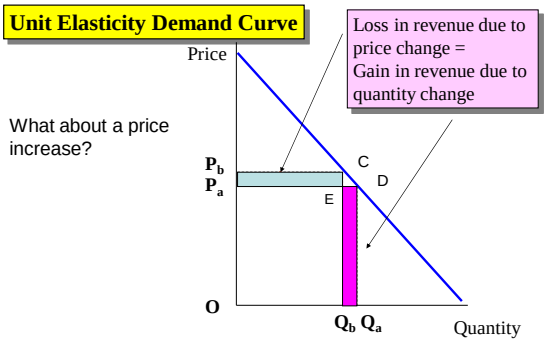
Use Cont.

- Necessary information from earlier calculations
  - Price increase from 15 to 20
  - Quantity decreases from 6 to 5
  - Own-price elasticity = -0.18/(0.28) = -0.63
- Current price $17.50 with Q = 5.5
- Goal is to increase revenues
  - Current TR = 17.5 x 5.5 = 96.25
  - Increase price TR = 20 x 5 = 100
  - Decrease price TR = 15 x 6 = 90

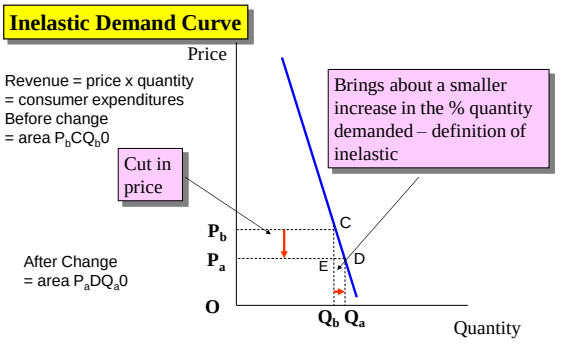
Revenue Implications – Why?



Revenue Implications – Why?

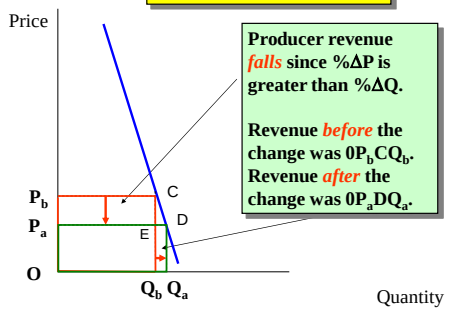


Revenue Implications – Why?



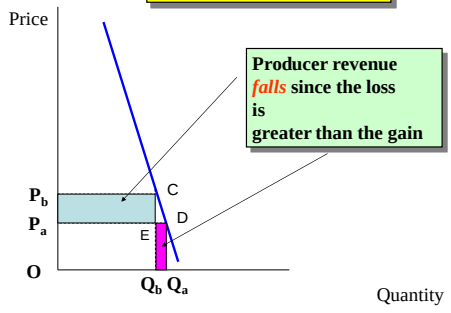
Revenue Implications – Why?

Inelastic Demand Curve



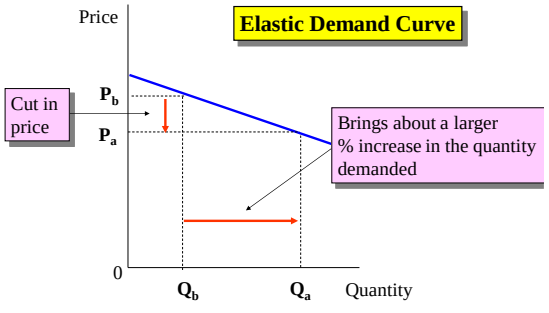
Revenue Implications – Why?

Inelastic Demand Curve

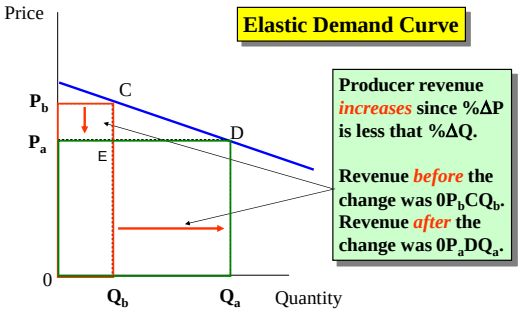


Revenue Implications

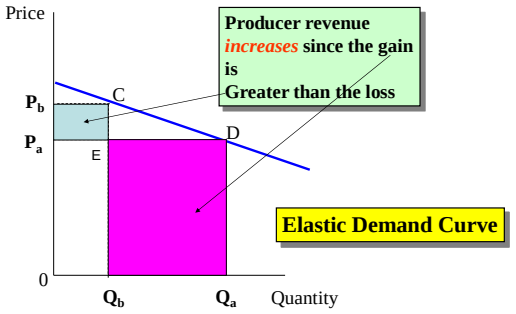
Elastic Demand Curve



Revenue Implications



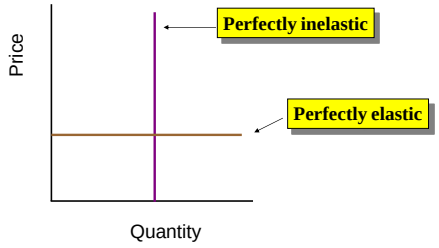
Revenue Implications



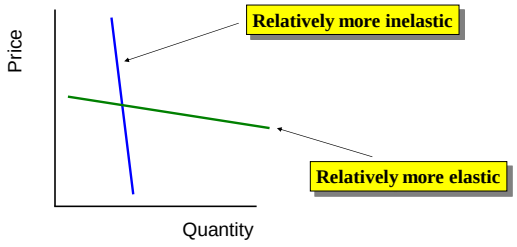
Revenue Implications - Know

Own-price elasticity is	Cutting the price will	Increasing the price will
Elastic	Increase revenue	Decrease revenue
Unitary elastic	No change in revenue	No change in revenue
Inelastic	Decrease revenue	Increase revenue

Relative Elasticities

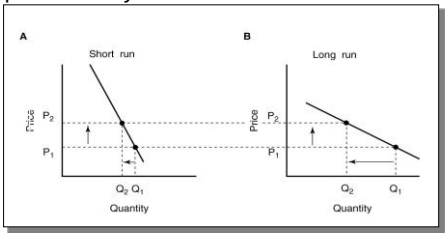


Relative Elasticities

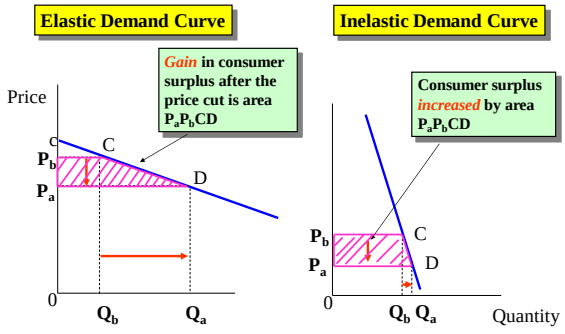


Long vs. Short-Run

- Demand curves tend to be more elastic (flatter) over time as consumers adjust to changing prices – Why?



Consumer Surplus



Income Elasticity of Demand

Income Elasticity of Demand = $\dfrac{\text{Percentage change in quantity}}{\text{Percentage change in income}}$

Income elasticity = $\dfrac{(Q_A - Q_B)/[(Q_A + Q_B)/2]}{(I_A - I_B)/[(I_A + I_B)/2]}$

$$= \frac{\frac{\Delta Q}{\bar{Q}}}{\frac{\Delta I}{\bar{I}}} = \frac{\Delta Q}{\Delta I} \bullet \frac{\bar{I}}{\bar{Q}}$$

- Interpretation -- 1% increase in income leads to a x% change in quantity purchased over this arc

Income Elasticity Example

- Income and Corn
  - Income change 200 to 400
  - Corn quantity change 5 to 9
- What is arc income elasticity of demand?

$$\frac{\%\ change\ in\ quantity}{\%\ change\ in\ income} = \frac{(9-5)/[9+5)/2]}{(400-200)/[(400+200)/2]} = \frac{0.57}{0.66} = 0.85$$

Interpretation?

Interpreting the Income Elasticity of Demand - Know

If the income elasticity is	The good is classified as
Greater than 1.0	A luxury *and* a normal good
Less than 1.0 but greater than 0.0	A necessity *and* a normal good
Less than 0.0	An inferior good!

Cross-Price Elasticity of Demand

$$\text{Cross-price Elasticity of Demand} = \frac{\text{Percentage change in quantity of good C}}{\text{Percentage change in price D}}$$

$$\text{Cross -price elasticity} = \frac{(Q_{CA} - Q_{CB})/[(Q_{CA}+Q_{CB})/2]}{(P_{DA} - P_{DB})/[(P_{DA}+P_{DB})/2]}$$

$$= \frac{\frac{\Delta Q_C}{\bar{Q}_C}}{\frac{\Delta P_D}{\bar{P}_D}} = \frac{\Delta Q_C}{\Delta P_D} \bullet \frac{\bar{P}_D}{\bar{Q}_C}$$

- Interpretation -- 1% increase in price of good D leads to a x% change in quantity purchased of good C over this arc

Cross-Price Elasticity Example

- Steak quantity and corn price
  - Corn price change from $20 to $15 / dozen
  - Steak quantity changes from 2.5 to 2.75 pounds
- What is arc cross-price elasticity of demand for steak?

$$\frac{\%\text{ change in quantity}_{\text{steak}}}{\%\text{ change in corn price}} = \frac{(2.75-2.5)/[(2.75+2.5)/2]}{(15-20)/[(15+20)/2]} = \frac{0.1}{-0.28} = -0.33$$

Interpretation?

Interpreting the Cross Price Elasticity of Demand - Know

If the cross price elasticity is	The goods are classified as
Positive	Substitutes
Negative	Complements
Zero	Independent

Stimulus Bill Example

- 2009 Stimulus Bill
  - Included a up to a $1500 tax credit for insulation and energy efficient windows, doors, HVAC units
- What is a tax credit?
- Why pass the bill and potential economic effects? - nonpolitical

Stimulus Bill Insulation

- Assume you have calculated the following elasticities for insulation
  - Income elasticity of demand = 1.2
  - Own-price elasticity = -0.4
  - Cross price elasticity with lumber = -0.02
  - Cross price elasticity with energy = 0.09
  - Assume tax credit decreases insulation price by 30%
- What is the effect of the stimulus bill given these elasticities? Recession has decreased incomes by 10%

Stimulus Bill Insulation

- Decrease in insulation sales – recession
  - -10% x 1.2 = -12% - decrease in insulation sales
- Increase in insulation sales – stimulus bill
  - -30% x -0.4 = 12% - increase in insulation sales
- Change in lumber sales – stimulus bill
  - -30% x -0.02 = 0.6% - increase in lumber sales
- Change in energy use – stimulus bill
  - -30% x 0.09 = -2.7% - decrease in energy use

Costs of the Bill

- Decrease in tax revenues – insulation tax credit
- Increase in tax revenues – increase in insulation sales
- Increase in tax revenues – increase in lumber sales
- Decrease in tax revenues – decrease in energy use
- Environmental / other
- Overall ?

Price Flexibility of Demand

- *Price flexibility* is the reciprocal of own price elasticity
  - Price flexibility = 1/(own price elasticity)

$$\textbf{Price Flexibility of Demand} = \frac{\text{Percentage change in price}}{\text{Percentage change in quantity}}$$

- Rearrange

  % Δ price = price flexibility x % Δ quantity

Price Flexibility Use Example

- If the calculated elasticity is -0.25, then the *price flexibility = 1/(-0.25)= - 4.0*
- Useful concept to producers to help form price expectations
- Example USDA projects an additional 2% of supply will come on the market, what happens to price.

If supply increases by 2%, price would fall by 8%!

%ΔPrice = price flexibility x %ΔQuantity
= - 4.0 x (+2%)
= - 8%

Revenue Implications – Demand Elasticity and Changes in Supply

Own-price elasticity is	Increase in supply will	Decrease in supply will
Elastic	Increase revenue	Decrease revenue
Unitary elastic	No change in revenue	No change in revenue
Inelastic	Decrease revenue	Increase revenue

Characteristic of agriculture

Summary - Know

- Know how to interpret all three elasticities
- Know how to interpret a price flexibility
- Understand revenue implications for producers if prices are cut (raised)
- Understand the welfare implications for consumers if prices are cut (raised)