Price Flexibility Coefficient, Other
Demand Elasticities

10/13/09
Review From 10/08/09

- Identify the four factors that affect the own-price elasticity of demand ... and know if it results in the elasticity being more or less elastic
  - Availability of substitutes
  - Proportion of budget spent on item
  - Time horizon (adjustment period)
  - Degree of Necessity

- Understand the relationship of changes in price on total revenue, given elastic vs inelastic demand

- Be able to apply the concept of price elasticity of demand for real-world situations
Total Revenue Changes for a Given Price Change

Inelastic Demand

Elastic Demand

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### Relationship of Price Elasticity of Demand to Changes in Total Revenue

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Total Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elastic</strong></td>
<td>Increase</td>
<td>Decrease</td>
</tr>
<tr>
<td></td>
<td>Decrease</td>
<td>Increase</td>
</tr>
<tr>
<td><strong>Inelastic</strong></td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td></td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
</tbody>
</table>

**Note that for:**
- Elastic Demand, Price and Revenue Move in the **OPPOSITE** Direction
- Inelastic Demand, Price and Revenue Move in the **SAME** Direction

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Total Revenue Changes for a Given Price Change

**Inelastic Demand**
- Price: $P_1$ to $P_2$
- Quantity: $Q_1$ to $Q_2$
- Gain in Revenue

**Elastic Demand**
- Price: $P_1$ to $P_2$
- Quantity: $Q_1$ to $Q_2$
- Loss in Revenue

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Application of Demand Elasticities:

- U.S. Tobacco Leaf/Industry
- Soft Drinks
- Snack Foods

For copies of illustrative slides go to class website for slides on 10/08/09
Application of Demand Elasticities to Taxing Foods/Beverages

- WSJ - soda tax: http://online.wsj.com/article/SB124208505896608647.html#printMode
- NEJM I: http://content.nejm.org/cgi/content/full/360/18/1805
- NEJM: http://content.nejm.org/cgi/content/full/NEJMhpr0905723
- Mercatus:
  - http://www.mercatus.org/PublicationDetails.aspx?id=27272
  - http://www.mercatus.org/PublicationDetails.aspx?id=27916
“A tax of 1 cent per ounce of beverage would increase the cost of a 20-oz soft drink by 15 to 20%. The effect on consumption can be estimated through research on price elasticity (i.e., consumption shifts produced by price). The price elasticity for all soft drinks is in the range of –0.8 to 1.0. (Elasticity of –0.8 suggests that for every 10% increase in price, there would be a decrease in consumption of 8%, whereas elasticity of 1.0 suggests that for every 10% increase in price, there would be a decrease in consumption of 10%.) … With the use of a conservative estimate that consumers would substitute calories in other forms for 25% of the reduced calorie consumption, an excise tax of 1 cent per ounce would lead to a minimum reduction of 10% in calorie consumption from sweetened beverages, or 20 kcal per person per day, a reduction that is sufficient for weight loss and reduction in risk (unpublished data).“

Total Revenue Changes for a Given Price Change: Cigarettes vs Sodas

Inelastic Demand = -0.2

Inelastic Demand = -0.8

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Other Applications – Taxing Snack Foods and a “Fat Tax”


Price Volatility in Ag Markets

- Most agricultural commodities and food items tend to exhibit a very inelastic demand schedule ... which leads to volatile/ flexible prices, relative to changes in quantities.

- Sometimes ag economists (and farmers) are more interested in how quantity changes affect prices (price flexibility coefficient) than how price changes affect quantity (own-price elasticity of demand).
Price Flexibility Coefficient

- Percentage Change in Price Given a 1% Change in Quantity
- Approximated by the Inverse of the Elasticity of Demand
- Inelastic Demand Characterizes More Flexible Prices Via a Larger Price Flexibility Coefficient

\[ E_{PFC} = \frac{P_2 - P_1}{P_1} \cdot \frac{Q_2 - Q_1}{Q_1} = \frac{\% \text{ Change in } P}{\% \text{ Change in } Q} = \frac{1}{\varepsilon_D} \]
Price Flexibility Coefficients: Interpretation

- If the own-price elasticity of demand is -0.5 (-1/2), then the price flexibility coefficient is $\frac{1}{-0.5} = -2$ which is interpreted as:

  Each 1% increase in quantity leads to a 2% decline in price, holding all other factors constant.
Price Response for a Given Quantity Change

Inelastic Demand $|\varepsilon| < 1$

Elastic Demand $|\varepsilon| > 1$

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Movements vs Shifts in the Demand Curve

- So far in evaluating point (or arc) elasticities of demand and price flexibility coefficients we have been analyzing either the quantity responsiveness (with own-price elasticities) or the price responsiveness (with price flexibility coefficients) along a given demand curve, holding all other factors constant.

- Recall our demand shifters:
  - Changes in the prices of substitutes or compliments
  - Changes in income
  - Changes in tastes and preferences
  - Changes in the size or composition of the population

- Now we are going to analyze the direction of the shift AND how responsive quantity is to changes in one of these demand shifters
Measuring the Effects of Demand Shifters on Quantity Demanded

**A Change in Quantity Demand**

**A Change in Demand**
### Demand Shifters/ Direction of the Shift

<table>
<thead>
<tr>
<th>Demand Shifter</th>
<th>Direction of the Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of Substitutes</td>
<td>Shifts Demand to the <strong>right</strong></td>
</tr>
<tr>
<td></td>
<td>Shifts Demand to the <strong>left</strong></td>
</tr>
<tr>
<td>Price of Complements</td>
<td>Shifts Demand to the <strong>left</strong></td>
</tr>
<tr>
<td></td>
<td>Shifts Demand to the <strong>right</strong></td>
</tr>
<tr>
<td>Income (Normal Good)</td>
<td>Shifts Demand to the <strong>right</strong></td>
</tr>
<tr>
<td></td>
<td>Shifts Demand to the <strong>left</strong></td>
</tr>
<tr>
<td>Population Size or Composition</td>
<td>Shifts Demand to the <strong>right</strong></td>
</tr>
<tr>
<td></td>
<td>Shifts Demand to the <strong>left</strong></td>
</tr>
<tr>
<td>Tastes and Preferences</td>
<td>Shifts Demand to the <strong>varies</strong></td>
</tr>
</tbody>
</table>
Cross-Price Elasticity

Measures how the quantity demanded of one commodity responds to changes in the price of another commodity, holding all other factors constant.

\[
\varepsilon_{ij} = \frac{\Delta Q_i}{\Delta P_j} \cdot \frac{P_j}{Q_i} = \frac{Q_{i(2)} - Q_{i(1)}}{Q_{i(1)}} \cdot \frac{P_j}{P_{j(2)} - P_{j(1)}} = \frac{\% \text{ Change In } Q_i}{\% \text{ Change In } P_j}
\]

- Substitutes: \( E_{ij} > 0 \)
- Complements: \( E_{ij} < 0 \)
- Independent: \( E_{ij} = 0 \)

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Cross-Price Elasticity

\[
\varepsilon_{IJ} = \frac{\frac{Q_I(2) - Q_I(1)}{Q_I(1)}}{\frac{P_J(2) - P_J(1)}{P_J(1)}} = \frac{\% \text{ Change in } Q_I}{\% \text{ Change in } P_J}
\]

Assume the price of the jth commodity increases from $0.75 to $1.00, which causes the quantity of the ith commodity to increase from 10 to 15. What is the cross-price elasticity for the ith commodity? Are commodities i and j substitutes or compliments?
Cross-Price Point Elasticity of Demand

\[ \varepsilon_{IJ} = \frac{Q_{I(2)} - Q_{I(1)}}{Q_{I(1)}} \frac{Q_{I(1)}}{P_{J(2)} - P_{J(1)}} \frac{P_{J(2)} - P_{J(1)}}{P_{J(1)}} \]

<table>
<thead>
<tr>
<th>Price of Pizza ($)</th>
<th>Price of Hamburgers ($)</th>
<th>Quantity of Pizzas</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>55</td>
</tr>
</tbody>
</table>

What is the Cross-Price Elasticity of Demand for a given change in the Price of Hamburgers w.r.t. the Quantity of Pizza?
Cross Price Elasticity for Pizza

Assume:

\[ Q_{\text{Pizza}} = 40 - 2.0P_{\text{Pizza}} + 5P_{\text{HB}} - 2P_{\text{Beer}} + 0.0008 \text{Inc} \]

Assume:

- $P_{\text{pizza}} = $10.00
- $P_{\text{HB}} = $4.00
- $P_{\text{Beer}} = $5.00
- $\text{INC} = $25,000

What is the cross price elasticity for pizza with respect to the changes in hamburger prices?

\[ \varepsilon_{Q_{\text{PIZZA}},P_{\text{HB}}} = \frac{\triangle Q_{\text{PIZZA}}}{\triangle P_{\text{HB}}} \times \frac{P_{\text{HB}}}{Q_{\text{PIZZA}}} = \]

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Cross Price Elasticity for Pizza

Assume:

\[ Q_{\text{Pizza}} = 40 - 2.0P_{\text{Pizza}} + 5 P_{\text{HB}} - 2 P_{\text{Beer}} + 0.0008 \text{ Inc} \]

Assume:

\[
\begin{align*}
P_{\text{Pizza}} &= $10.00 \\
P_{\text{HB}} &= $4.00 \\
P_{\text{Beer}} &= $5.00 \\
\text{INC} &= $25,000
\end{align*}
\]

\[
\varepsilon_{Q_{\text{PIZZA}}, P_{\text{HB}}} = \frac{5 \times \frac{4.00}{50}}{4.00} = 0.4
\]

What is the cross price elasticity for pizza with respect to the changes in hamburger prices?
Interpretation

Each 1% increase in the price of hamburgers results in a 0.4% increase in the quantity demanded for pizza.

Each 10% increase in the price of hamburgers results in a 4.0% increase in the quantity demanded for pizza.
Income Elasticity

Measures the responsiveness of quantity demanded (Q) to income (INC), changes, holding all other factors constant.

\[ \varepsilon_{INC} = \frac{\frac{Q_2 - Q_1}{Q_1}}{\frac{INC_2 - INC_1}{INC_1}} = \frac{\text{% Change In Q}}{\text{% Change In INC}} \]

- **Normal Good**: \( INC > 0 \) (e.g. beef, sports tix, computers)
- **Inferior Good**: \( INC < 0 \) (e.g. Ramen noodles, generic items)

Assume income increases from $25,000 to $30,000, which causes quantity purchased to increase from 50 to 54. What is the income elasticity? Is this a normal or inferior good?
Income Elasticity for Pizza

\[ Q_{\text{Pizza}} = 40 - 2.0P_{\text{Pizza}} + 5P_{\text{HB}} - 2P_{\text{Beer}} + 0.0008 \text{Inc} \]

Assume:
- \( P_{\text{pizza}} = $10.00 \)
- \( P_{\text{HB}} = $4.00 \)
- \( P_{\text{Beer}} = $5.00 \)
- \( \text{INC} = $25,000 \)

What is the income elasticity for pizza?

\[ \varepsilon_{\text{INC}} = \frac{\triangle Q_{\text{PIZZA}}}{\triangle \text{INC}} \cdot \frac{\text{INC}}{Q_{\text{PIZZA}}} \]

\[ 0.00008 \times \frac{25,000}{50} = 0.40 \]
## Income Elasticities for Some Foods - Table 4.3 Schrimper

<table>
<thead>
<tr>
<th>Food</th>
<th>Income Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>.39</td>
</tr>
<tr>
<td>Pork</td>
<td>.66</td>
</tr>
<tr>
<td>Chicken</td>
<td>.08</td>
</tr>
<tr>
<td>Turkey</td>
<td>-.13</td>
</tr>
<tr>
<td>Eggs</td>
<td>.29</td>
</tr>
<tr>
<td>Cheese</td>
<td>.42</td>
</tr>
<tr>
<td>Milk</td>
<td>.12</td>
</tr>
<tr>
<td>Butter</td>
<td>.54</td>
</tr>
<tr>
<td>Margarine</td>
<td>-.34</td>
</tr>
<tr>
<td>Sugar</td>
<td>.01</td>
</tr>
<tr>
<td>Coffee</td>
<td>.82</td>
</tr>
</tbody>
</table>

**USDA Elasticity Data Base**


Source: Huang, AJAE, 1996b

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Journal Entry # 11


- Answer the 5 questions -- turn in with the rest of the set on 10/27/09