

Price elasticity of demand



The price elasticity of demand measures the responsiveness of quantity demanded to a change in price, with all other factors held constant.

Definition

The price elasticity of demand, E_d is defined as the magnitude of:

proportionate change in quantity demanded

$$E_d = \frac{\text{proportionate change in quantity demanded}}{\text{proportionate change in price}}$$

proportionate change in price

Since the quantity demanded decreases when the price increases, this ratio is negative; however, the absolute value usually is taken and E_d is reported as a positive number.

Because the calculation uses proportionate changes, the answer is a unit-less number which does not depend on the units in which the price and quantity are expressed.

For example, consider a product which has E_d equal to be 0.5. Then, if the price is increased by 10%, a decrease of approximately 5% in quantity demanded would be observed.

In the above example, the word “approximately” is used as the exact result will depend on whether the initial value or the final value of price and quantity is used in the calculation. This is because for a linear demand curve the price elasticity varies as one moves along the curve. For small changes in price and quantity the difference between the two results often is negligible, but for large changes the difference may be more significant. To deal with this

issue, one can use the *arc* price elasticity of demand. This elasticity uses the average of the initial and final quantities and the average of the initial and final prices while calculating the proportionate change in each.

Mathematically, the arc price elasticity of demand can be written as:

$$Q_2 - Q_1$$

$$(Q_1 + Q_2) / 2$$

$$E_d = \frac{Q_2 - Q_1}{(Q_1 + Q_2) / 2}$$

$$P_2 - P_1$$

$$(P_1 + P_2) / 2$$

Where:

Q1 = Initial quantity

Q2 = Final quantity

P1 = Initial price

P2 = Final price

Elastic versus Inelastic

$$\underline{E > 1}$$

In this case, the quantity demanded is elastic, i. e. a small price change will cause a larger change in the quantity demanded. When $E_d = \text{infinity}$, this type of demand is called perfectly elastic. The demand curve in such a case would be horizontal i. e. parallel to the quantity axis. For products having a high price elasticity of demand, a price increase will result in a decrease in total revenue. This is because the revenue lost from the resulting decrease in quantity sold is more than the revenue gained from the price increase.

$E < 1$

In this case, the quantity demanded is relatively inelastic, i. e. a small change in price will cause even smaller change in quantity demanded. When $E_d = 0$, this is referred to as perfectly inelastic. The demand curve in this case would be vertical i. e. parallel to the price axis. For products in which quantity demanded is inelastic, a price increase will lead to a revenue increase. This is because, the revenue lost by the small decrease in quantity is less than the revenue gained from the higher price.

$E = 1$

In this case, the product is said to have unitary elasticity. Changes in price do not affect the total revenue as it is accompanied by equal change in quantity.

Factors that Affect the Price Elasticity of Demand

- Availability of substitutes: if there are many substitutes, the elasticity will be greater. The number of substitutes depends on how broadly the product is defined.

- Necessity or luxury: luxury products generally have greater elasticity. Some products that initially have a low degree of necessity are habit forming and hence can become necessities for some people.
- Proportion of the buyer's budget used by the item: products that consume a large part of the buyer's budget tend to have greater price elasticity.
- Time period: elasticity is generally greater over long period of time because consumers have more time to adjust their behaviour.
- Permanent or temporary change in price: a one-day sale will generate a different response than a permanent price decrease.
- Price points: depending on the point from where price is changed, decreasing the price from Rs. 200 to Rs. 190 may elicit a greater response than decreasing it from Rs. 190 to Rs. 180.

Durable Good

In economics, a durable good or a hard good is a good which has a low wear and tear, or in other words, it yields services or utility over a period of time rather than being completely used up in once. Most goods are therefore durable goods to a certain degree. These are goods that can last for a relatively long time, such as cars, refrigerators and mobiles. Perfectly durable goods never wear out. An example of such a good might be a brick.

Consumer durable goods include cars, appliances, business equipment, electronic equipment, home furnishings and fixtures, house-ware and accessories, photographic equipment, recreational goods, sporting goods, toys and games.

Durable goods are typically characterized by long inter-purchase times, which is the time between two successive purchases.

Durable goods along with nondurable goods and services together constitute the consumption of an economy.

The Indian Consumer Durables Industry can be segmented into three key groups-

White Goods

- Refrigerators

- Washing Machines

- Air Conditioners

- Speakers and Audio Equipments

Kitchen Appliances/Brown Goods

- Mixers

- Grinders

- Microwave Ovens

- Iron

- Electric Fans

- Cooking Range

- Chimneys

Consumer Electronics

- Mobile Phones
- Televisions
- MP3 Players
- DVD Players
- VCD Players

Several key trends are driving growth in the sector. They are-

Income growth and availability of financing

- Disposable income levels are rising and consumer financing has become easier

Increased affordability of products

- Advanced technology and increasing competition is narrowing the price gap and appliances which were once expensive are becoming cheaper

Increasing share of organised retail sector

- Urban and rural market are growing at the annual rates of seven percent to 10 per cent and 25 percent respectively with organised retail expected to garner about 15 per cent share by 2015 from the current 5 percent

Entry of heavyweight retail players is increasing competition

- Competitive evolution of organised retail due to the entry of heavyweight players like Croma, EZone and Reliance Digital is stimulating the demand through Exposure to experiences

Consumer Durables is one of the fastest growing industries in India. A strong growth is expected across all key segments-

Projected Growth Rates

| | |
|----------------------------------|--------|
| Colour TVs | 25-30% |
| Refrigerators | 18-22% |
| Washing Machines | 15-20% |
| Air Conditioners | 32-35% |
| Others (including VCDs and DVDs) | 35-40% |

(CONSUMER DURABLES December 2008)

Overall, the sector is a dynamic one, with significant growth opportunities-

Threat of New Entrants

- Most current players are global players
- New entrants will need to invest in Brand, Technology and Distribution

Supplier Power

- Indigenous supply base limited – most raw materials are imported

Competitive Rivalry

- Number of well established players, with new players entering
- Good technological capability
- Many untapped potential markets

Several global players are well established in the Consumer Durables sector in India, with competition from strong Indian players. Some of the key players in the sector in India include:

- Samsung
- Philips
- LG
- Whirlpool
- Nokia
- Sony

Table 2 Estimates of the Impact of Price, Income and Efficiency on Automobile and Appliance Sales

| Durable Good | Price Elasticity | Income Elasticity | Brand Price Elasticity | Implicit Discount Rate | Model | Data Time Periods |
|--------------|------------------|-------------------|------------------------|------------------------|--------|-------------------|
| Automobile | -1.07 | 3.08 | - | - | Linear | Short |

| | | | | | | |
|-------------------------|--------|------|---|-----|-------------------------------------|------------------------------------|
| s1 | | | | | Regression, stock adjustment | run |
| Automobile s1 | -0.36 | 1.02 | - | - | Linear Regression, stock adjustment | Long run |
| Clothes Dryers2 | -0.14 | 0.26 | - | - | Cobb-Douglas, diffusion | 194 7- 196 1 Mixe d |
| Room Air Conditioner s2 | -0.378 | 0.45 | - | - | Cobb-Douglas, diffusion | 194 6- 196 2 Mixe d |
| Dishwasher s2 | -0.42 | 0.79 | - | - | Cobb-Douglas, diffusion | 194 7- 196 8 Mixe d |
| Refrigerator s3 | -0.37 | - | - | 39% | Logit probability, survey data | 199 7 Short run |

| | | | | | | | |
|------------------------|---|---|--------|-------|---------------------------------|-------|-----------|
| Various4 | - | - | -1.769 | - | Multiplicative regression | - | Mixed |
| | | | | | | 194 | |
| Room Air Conditioners5 | - | - | -1.72 | - | Non-linear diffusion | 9-196 | Short run |
| | | | | | | 1 | |
| | | | | | | 196 | |
| Clothes Dryers5 | - | - | -1.32 | - | Non-linear diffusion | 3-197 | Short run |
| | | | | | | 0 | |
| Room Air Conditioners6 | - | - | - | 20% | Qualitative choice, survey data | - | - |
| Household Appliances7 | - | - | - | 37%10 | Assorted | - | - |

Sources: S. Hymens. 1971; P. Golder and G. Tellis, 1998; D. Revelt and K. Train, 1997;

Variables describing the market for refrigerators, clothes washers, and dishwashers

In this section variables that appear to account for refrigerator, clothes washer and dishwasher shipments, including physical household/appliance variables, and economic variables.

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Physical Household/Appliance Variables

Several variables influence the sale of refrigerators, clothes washers and dishwashers. The most important for explaining appliance sales trends are the annual number of new households formed (housing starts) and the number of appliances reaching the end of their operating life (replacements). Housing starts influence sales because new homes are often provided with, or soon receive, new appliances, including dishwashers and refrigerators. Replacements are correlated with sales because new appliances are typically purchased when old ones wear out. In principle, if households maintain a fixed number of appliances, shipments should equal housing starts plus appliance replacements.

Economic variables

Appliance price, appliance operating cost and household income are important economic variables affecting shipments. Low prices and costs encourage household appliance purchases and a rise in income increases householder ability to purchase appliances. In principle, changes in economic variables should explain changes in the number of appliances per household.

During the 1980–2002 study period, annual shipments grew 69 percent for clothes washers, 81 percent for refrigerators and 105 percent for dishwashers. This rising shipments trend is explained in part by housing starts, which increased 6 percent and by appliance replacements, which rose between 49 percent and 90 percent, depending on the appliance, over the period

Physical Household/Appliance VariablesShipments¹Housing Starts²Replacements³

| | (millions) | | | (millions) | | | (millions) | | |
|-----------------|------------|-------|--------|------------|-------|--------|------------|------|--------|
| Appliance | 1980 | 2002 | Change | 1980 | 2002 | Change | 1980 | 2002 | Change |
| Refrigerators | 5.124 | 9.264 | 81% | 1.723 | 1.822 | 6% | 3.93 | 5.84 | 49% |
| Clothes Washers | 4.426 | 7.492 | 69% | 1.723 | 1.822 | 6% | 3.66 | 5.50 | 50% |
| Dishwashers | 2.738 | 5.605 | 105% | 1.723 | 1.822 | 6% | 1.99 | 3.79 | 90% |

LONG RUN IMPACTS

Price elasticities over short and long time periods, also referred to as short run and long run price elasticities. The price elasticity of demand is significantly different over the short run and long run for automobiles.

Because forecasts of shipments and national impacts due to standards is over a 30-year time period, consideration must be given as to how the *relative* price elasticity is affected once a new standard takes effect.

Elasticity of demand changes in the years following a purchase price change.

With increasing years after the price change, the price elasticity becomes more inelastic until it reaches a terminal value around the tenth year after the price change.

Change in Price Elasticity of Demand for Automobiles following a Purchase Price Change

Years Following Price Change

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| | 1 | 2 | 3 | 5 | 10 | 20 | |
|---|---|---|---|-------|-------|-------|-------|
| Price Elasticity of Demand | | | | -1.20 | -0.93 | -0.75 | -0.55 |
| | | | | | | | -0.42 |
| Relative Change in Elasticity to 1st year | | | | 1.00 | 0.78 | 0.63 | 0.46 |
| | | | | | | | 0.35 |
| | | | | | | | 0.33 |

Change in *Relative* Price Elasticity for Home Appliances following a Purchase Price Change

Years Following Price Change

| | 1 | 2 | 3 | 5 | 10 | 20 | |
|---|---|---|---|-------|-------|-------|-------|
| Relative Change in Elasticity to 1st year | | | | 1.00 | 0.78 | 0.63 | 0.46 |
| | | | | | | | 0.35 |
| | | | | | | | 0.33 |
| Relative Price Elasticity | | | | -0.34 | -0.26 | -0.21 | -0.16 |
| | | | | | | | -0.12 |
| | | | | | | | -0.11 |