Chapter 4 Individual and Market Demand

Read Pindyck and Rubinfeld (2013), Chapter 4

CHAPTER 4 OUTLINE

4.1 Individual Demand
4.2 Income and Substitution Effects
4.3 Market Demand
4.4 Consumer Surplus
4.5 Network Externalities
**4.1 Individual Demand**

- **Price Changes**

**FIGURE 4.1 EFFECT OF PRICE CHANGES**

A reduction in the price of food, with income and the price of clothing fixed, causes the consumer to choose a different market basket.

In panel (a), the baskets that maximize utility for various prices of food (point A, $2; B, $1; D, $0.50) trace out the price-consumption curve.

Part (b) gives the demand curve, which relates the price of food to the quantity demanded. (Points E, G, and H correspond to points A, B, and D, respectively).

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**4.1 Individual Demand**

**EFFECT OF PRICE CHANGES**

- **price-consumption curve**
  Curve tracing the utility-maximizing combinations of two goods as the price of one changes.

- **individual demand curve**
  Curve relating the quantity of a good that a single consumer will buy to its price.
The individual demand curve has two important properties:

1. The level of utility that can be attained changes as we move along the curve.

2. At every point on the demand curve, the consumer is maximizing utility by satisfying the condition that the marginal rate of substitution (MRS) of food for clothing equals the ratio of the prices of food and clothing.

**Figure 4.2**

**EFFECT OF INCOME CHANGES**

An increase in income, with the prices of all goods fixed, causes consumers to alter their choice of market baskets.

In part (a), the baskets that maximize consumer satisfaction for various incomes (point A, $10; B, $20; D, $30) trace out the income-consumption curve.

The shift to the right of the demand curve in response to the increases in income is shown in part (b). (Points E, G, and H correspond to points A, B, and D, respectively.)
**4.1 INCOME CHANGES**

**income-consumption curve**

Curve tracing the utility-maximizing combinations of two goods as a consumer's income changes.

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**• Normal versus Inferior Goods**

**FIGURE 4.3 AN INFERIOR GOOD**

An increase in a person’s income can lead to less consumption of one of the two goods being purchased.

Here, hamburger, though a normal good between A and B, becomes an inferior good when the income-consumption curve bends backward between B and C.
Engel Curves

• **Engel curve** Curve relating the quantity of a good consumed to income.

**FIGURE 4.4**

ENGEL CURVES

Engel curves relate the quantity of a good consumed to income.

In (a), food is a normal good and the Engel curve is upward sloping.

In (b), however, hamburger is a normal good for income less than $20 per month and an inferior good for income greater than $20 per month.

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**EXAMPLE 4.1 CONSUMER EXPENDITURES IN THE UNITED STATES**

We can derive Engel curves for groups of consumers. This information is particularly useful if we want to see how consumer spending varies among different income groups.

**TABLE 4.1** ANNUAL U.S. HOUSEHOLD CONSUMER EXPENDITURES

<table>
<thead>
<tr>
<th>INCOME GROUP (2009 $)</th>
<th>LESS THAN $10,000</th>
<th>10,000–19,999</th>
<th>20,000–29,999</th>
<th>30,000–39,999</th>
<th>40,000–49,999</th>
<th>50,000–69,999</th>
<th>70,000 AND ABOVE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXPENDITURES ($)</strong> ON:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entertainment</td>
<td>1,041</td>
<td>1,025</td>
<td>1,504</td>
<td>1,970</td>
<td>2,008</td>
<td>2,611</td>
<td>4,733</td>
</tr>
<tr>
<td>Owned Dwelling</td>
<td>1,880</td>
<td>2,083</td>
<td>3,117</td>
<td>4,038</td>
<td>4,847</td>
<td>6,473</td>
<td>12,306</td>
</tr>
<tr>
<td>Rented Dwelling</td>
<td>3,172</td>
<td>3,359</td>
<td>3,228</td>
<td>3,296</td>
<td>3,295</td>
<td>3,295</td>
<td>2,977</td>
</tr>
<tr>
<td>Health Care</td>
<td>1,222</td>
<td>1,917</td>
<td>2,536</td>
<td>2,684</td>
<td>2,937</td>
<td>3,454</td>
<td>4,393</td>
</tr>
<tr>
<td>Food</td>
<td>3,429</td>
<td>3,529</td>
<td>4,415</td>
<td>4,737</td>
<td>5,384</td>
<td>6,420</td>
<td>9,761</td>
</tr>
<tr>
<td>Clothing</td>
<td>799</td>
<td>927</td>
<td>1,080</td>
<td>1,225</td>
<td>1,336</td>
<td>1,608</td>
<td>2,850</td>
</tr>
</tbody>
</table>
EXAMPLE 4.1 CONSUMER EXPENDITURES IN THE UNITED STATES

Average per-household expenditures on rented dwellings, health care, and entertainment are plotted as functions of annual income. Health care and entertainment are normal goods, as expenditures increase with income. Rental housing, however, is an inferior good for incomes above $30,000.

FIGURE 4.5 ENGEL CURVES FOR U.S. CONSUMERS

INDIVIDUAL DEMAND

Substitutes and Complements

Recall that:

Two goods are *substitutes* if an increase in the price of one leads to an increase in the quantity demanded of the other.

Two goods are *complements* if an increase in the price of one good leads to a decrease in the quantity demanded of the other.

Two goods are *independent* if a change in the price of one good has no effect on the quantity demanded of the other.
A fall in the price of a good has two effects:

1. Consumers will tend to buy more of the good that has become cheaper and less of those goods that are now relatively more expensive.

2. Because one of the goods is now cheaper, consumers enjoy an increase in real purchasing power.

**Substitution Effect**

- substitution effect  Change in consumption of a good associated with a change in its price, with the level of utility held constant.

**Income Effect**

- income effect  Change in consumption of a good resulting from an increase in purchasing power, with relative prices held constant.

**Total Effect of a change in price** = Substitution Effect + Income Effect
A decrease in the price of food has both an income effect and a substitution effect.

The consumer is initially at $A$, on budget line $RS$. When the price of food falls, consumption increases by $F_1F_2$ as the consumer moves to $B$.

The substitution effect $F_1E$ (associated with a move from $A$ to $D$) changes the relative prices of food and clothing but keeps real income (satisfaction) constant.

The income effect $EF_2$ (associated with a move from $D$ to $B$) keeps relative prices constant but increases purchasing power. Food is a normal good because the income effect $EF_2$ is positive.
4.2 INCOME AND SUBSTITUTION EFFECTS

Substitution Effect

- **substitution effect**  Change in consumption of a good associated with a change in its price, with the level of utility held constant.

Income Effect

- **income effect**  Change in consumption of a good resulting from an increase in purchasing power, with relative prices held constant.

The total effect of a change in price

Total Effect \( (F_1F_2) = \text{Substitution Effect} (F_1E) + \text{Income Effect} (EF_2) \)

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4.2 INCOME AND SUBSTITUTION EFFECTS

Income Effect: Inferior Good

Figure 4.7

Income and Substitution Effects: Inferior Good

The consumer is initially at \( A \) on budget line \( RS \). With a decrease in the price of food, the consumer moves to \( B \). The resulting change in food purchased can be broken down into a substitution effect, \( F_1E \) (associated with a move from \( A \) to \( D \)), and an income effect, \( EF_2 \) (associated with a move from \( D \) to \( B \)).

In this case, food is an inferior good because the income effect is negative. However, because the substitution effect exceeds the income effect, the decrease in the price of food leads to an increase in the quantity of food demanded.

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4.2 INCOME AND SUBSTITUTION EFFECTS

A Special Case: The Giffen Good

- **Giffen good** Good whose demand curve slopes upward because the (negative) income effect is larger than the substitution effect.

Figure 4.8

**Upward-Sloping Demand Curve: The Giffen Good**

When food is an inferior good, and when the income effect is large enough to dominate the substitution effect, the demand curve will be upward-sloping. The consumer is initially at point A, but, after the price of food falls, moves to B and consumes less food. Because the income effect $E_F_2$ is larger than the substitution effect $F_1E$, the decrease in the price of food leads to a lower quantity of food demanded.

6. Suppose that a consumer spends a fixed amount of income per month on the following pairs of goods: (see a-d)

If the price of one of the goods increases, explain the effect on the quantity demanded of each of the goods. In each pair, which are likely to be complements and which are likely to be substitutes?

a) tortilla chips and salsa
b) tortilla chips and potato chips
c) travel by bus and travel by subway
d) movie tickets and gourmet coffee
4.3 Market Demand

- **market demand curve** Curve relating the quantity of a good that all consumers in a market will buy to its price.

**From Individual to Market Demand**

<table>
<thead>
<tr>
<th>TABLE 4.2 DETERMINING THE MARKET DEMAND CURVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) PRICE ($)</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

**From Individual to Market Demand**

The market demand curve is obtained by summing our three consumers’ demand curves $D_A$, $D_B$, and $D_C$.

At each price, the quantity of coffee demanded by the market is the sum of the quantities demanded by each consumer.

At a price of $4$, for example, the quantity demanded by the market (11 units) is the sum of the quantity demanded by $A$ (no units), $B$ (4 units), and $C$ (7 units).
From Individual to Market Demand

Two points should be noted:

1. The market demand curve will shift to the right as more consumers enter the market.
2. Factors that influence the demands of many consumers will also affect market demand.

The aggregation of individual demands into market becomes important in practice when market demands are built up from the demands of different demographic groups or from consumers located in different areas.

Elasticity of Demand

Denoting the quantity of a good by \( Q \) and its price by \( P \), the price elasticity of demand is

\[ E_p = \frac{\Delta Q/Q}{\Delta P/P} = \frac{P}{Q} \left( \frac{\Delta Q}{\Delta P} \right) \]  

(4.1)

Inelastic Demand

When demand is inelastic, the quantity demanded is relatively unresponsive to changes in price. As a result, total expenditure on the product increases when the price increases.

Elastic Demand

When demand is elastic, total expenditure on the product decreases as the price goes up.
Elasticity of Demand

**Isoelastic Demand**

- **Isoelastic demand curve**
  - Demand curve with a constant price elasticity.

Figure 4.11

**Unit-Elastic Demand Curve**

When the price elasticity of demand is \(-1.0\) at every price, the total expenditure is constant along the demand curve $D$.

![Diagram showing unit elasticity of demand curve](image)

**Table 4.3**

<table>
<thead>
<tr>
<th>Demand</th>
<th>If Price Increases, Expenditures</th>
<th>If Price Decreases, Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inelastic</td>
<td>Increase</td>
<td>Decrease</td>
</tr>
<tr>
<td>Unit Elastic</td>
<td>Are unchanged</td>
<td>Are unchanged</td>
</tr>
<tr>
<td>Elastic</td>
<td>Decrease</td>
<td>Increase</td>
</tr>
</tbody>
</table>

**Speculative Demand**

- **Speculative demand**
  - Demand driven not by the direct benefits one obtains from owning or consuming a good but instead by an expectation that the price of the good will increase.
9. The ACME Corporation determines that at current prices the demand for its computer chips has a price elasticity of -2 in the short run, while the price elasticity for its disk drives is -1.

a) If the corporation decides to raise the price of both products by 10%, what will happen to its sales? To its sales revenue?

b) Can you tell from the available information which product will generate the most revenue? If yes, why? If not, what additional information do you need?

Ans. No. Although we know the elasticities of demand, we do not know the prices or quantities sold, so we cannot calculate the revenue for either product. We need to know the prices of chips and disk drives and how many of each ACME sells.

EXAMPLE 4.3 THE AGGREGATE DEMAND FOR WHEAT

Domestic demand for wheat is given by the equation

\[ Q_{DD} = 1430 - 55P \]

where \( Q_{DD} \) is the number of bushels (in millions) demanded domestically, and \( P \) is the price in dollars per bushel.

Export demand is given by

\[ Q_{DE} = 1470 - 70P \]

where \( Q_{DE} \) is the number of bushels (in millions) demanded from abroad.

To obtain the world demand for wheat, we set the left side of each demand equation equal to the quantity of wheat. We then add the right side of the equations, obtaining

\[ Q_{DD} + Q_{DE} = (1430 - 55P) + (1470 - 70P) = 2900 - 125P \]
EXAMPLE 4.3  THE AGGREGATE DEMAND FOR WHEAT

The total world demand for wheat is the horizontal sum of the domestic demand $AB$ and the export demand $CD$. Even though each individual demand curve is linear, the market demand curve is kinked, reflecting the fact that there is no export demand when the price of wheat is greater than about $21 per bushel.

EXAMPLE 4.4  THE DEMAND FOR HOUSING

There are significant differences in price and income elasticities of housing demand among subgroups of the population.

<table>
<thead>
<tr>
<th>GROUP</th>
<th>PRICE ELASTICITY</th>
<th>INCOME ELASTICITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single individuals</td>
<td>-0.10</td>
<td>0.21</td>
</tr>
<tr>
<td>Married, head of household age less than 30, 1 child</td>
<td>-0.25</td>
<td>0.06</td>
</tr>
<tr>
<td>Married, head age 30–39, 2 or more children</td>
<td>-0.15</td>
<td>0.12</td>
</tr>
<tr>
<td>Married, head age 50 or older, 1 child</td>
<td>-0.08</td>
<td>0.19</td>
</tr>
</tbody>
</table>

In recent years, the demand for housing has been partly driven by speculative demand. Speculative demand is driven not by the direct benefits one obtains from owning a home but instead by an expectation that the price will increase.
EXAMPLE 4.5  THE LONG-RUN DEMAND FOR GASOLINE

Would higher gasoline prices reduce gasoline consumption? Figure 4.13 provides a clear answer: Most definitely.

**FIGURE 4.13**
GASOLINE PRICES AND PER CAPITA CONSUMPTION IN 10 COUNTRIES

The graph plots per capita consumption of gasoline versus the price per gallon (converted to U.S. dollars) for 10 countries over the period 2008 to 2010. Each circle represents the population of the corresponding country.

4.4  CONSUMER SURPLUS

- **consumer surplus**: Difference between what a consumer is willing to pay for a good and the amount actually paid.

Consumer Surplus and Demand

*Figure 14.3*

**Consumer Surplus**

Consumer surplus is the total benefit from the consumption of a product, less the total cost of purchasing it.

Here, the consumer surplus associated with six concert tickets (purchased at $14 per ticket) is given by the yellow-shaded area.
4.4 CONSUMER SURPLUS

Consumer Surplus and Demand

Figure 14.4

For the market as a whole, consumer surplus is measured by the area under the demand curve and above the line representing the purchase price of the good.

Here, the consumer surplus is given by the yellow-shaded triangle and is equal to $1/2 \times (\$20 - \$14) \times 6500 = \$19,500.

Consumer Surplus and Demand

When added over many individuals, it measures the aggregate benefit that consumers obtain from buying goods in a market.

When we combine consumer surplus with the aggregate profits that producers obtain, we can evaluate both the costs and benefits of alternative market structures and public policies.

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EXAMPLE 4.6 THE VALUE OF CLEAN AIR

Although there is no actual market for clean air, people do pay more for houses where the air is clean than for comparable houses in areas with dirtier air.

FIGURE 4.16 VALUING CLEANER AIR

The yellow-shaded triangle gives the consumer surplus generated when air pollution is reduced by 5 parts per 100 million of nitrogen oxide at a cost of $1000 per part reduced.

The surplus is created because most consumers are willing to pay more than $1000 for each unit reduction of nitrogen oxide.
13. Suppose you are in charge of a toll bridge that costs essentially nothing to operate. The demand for bridge crossings $Q$ is given by $P = 15 - \frac{1}{2}Q$.

a) Draw the demand curve for bridge crossings.
b) How many people would cross the bridge if there were no toll?
c) What is the loss of consumer surplus associated with a bridge toll of $5$?
d) The toll-bridge operator is considering an increase in the toll to $7$. At this higher price, how many people would cross the bridge? Would the toll-bridge revenue increase or decrease? What does your answer tell you about the elasticity of demand?
e) Find the lost consumer surplus associated with the increase in the price of the toll from $5$ to $7$.

4.5 Network Externalities

- network externality When each individual’s demand depends on the purchases of other individuals.

A positive network externality exists if the quantity of a good demanded by a typical consumer increases in response to the growth in purchases of other consumers. If the quantity demanded decreases, there is a negative network externality.

Positive Network Externalities

- bandwagon effect Positive network externality in which a consumer wishes to possess a good in part because others do.
**Figure 4.17**

**POSITIVE NETWORK EXTERNALITY**

With a positive network externality, the quantity of a good that an individual demands grows in response to the growth of purchases by other individuals.

Here, as the price of the product falls from $30 to $20, the bandwagon effect causes the demand for the good to shift to the right, from $D_{40}$ to $D_{60}$.

**Figure 4.18**

**NEGATIVE NETWORK EXTERNALITY: SNOB EFFECT**

The snob effect is a negative network externality in which the quantity of a good that an individual demands falls in response to the growth of purchases by other individuals.

Here, as the price falls from $30,000 to $15,000 and more people buy the good, the snob effect causes the demand for the good to shift to the left, from $D_2$ to $D_6$.

**Negative Network Externalities**

- **snob effect** Negative network externality in which a consumer wishes to own an exclusive or unique good.
EXAMPLE 4.7 FACEBOOK

By early 2011, with over 600 million users, Facebook became the world’s second most visited website (after Google). A strong positive network externality was central to Facebook’s success.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>FACEBOOK USERS (MILLIONS)</th>
<th>HOURS PER USER PER MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>12</td>
<td>&lt;1</td>
</tr>
<tr>
<td>2007</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>2008</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>2009</td>
<td>350</td>
<td>5.5</td>
</tr>
<tr>
<td>2010</td>
<td>500</td>
<td>7</td>
</tr>
</tbody>
</table>

Network externalities have been crucial drivers for many modern technologies over many years.

11. Suppose the income elasticity of demand for food is 0.5 and the price elasticity of demand is –1.0. Suppose also that Felicia spends $10,000 a year on food, the price of food is $2, and that her income is $25,000.

a) If a sales tax on food caused the price of food to increase to $2.50, what would happen to her consumption of food? (Hint: Since a large price change is involved, you should assume that the price elasticity measures an arc elasticity, rather than a point elasticity.)

b) Suppose that Felicia gets a tax rebate of $2500 to ease the effect of the sales tax. What would her consumption of food be now?

c) Is she better or worse off when given a rebate equal to the sales tax payments? Draw a graph and explain.
c. Is she better or worse off when given a rebate equal to the sales tax payments? Draw a graph and explain.

**Ans.**
Felicia is better off after the rebate. The amount of the rebate is enough to allow her to purchase her original bundle of food and other goods. Recall that originally she consumed 5000 units of food.

When the price went up by fifty cents per unit, she needed an extra (5000)(0.50) = $2500 to afford the same quantity of food without reducing the quantity of the other goods consumed. This is the exact amount of the rebate. However, she did not choose to return to her original bundle. We can therefore infer that she found a better bundle that gave her a higher level of utility. In the graph below, when the price of food increases, the budget line pivots inward. When the rebate is given, this new budget line shifts out to the right in a parallel fashion. The bundle after the rebate is on that part of the new budget line that was previously unaffordable, and that lies above the original indifference curve. It is on a higher indifference curve, so Felicia is better off after the rebate.