CHAPTER 5
Applying Consumer Theory

CHAPTER OUTLINE

5.1 Deriving Demand Curves
5.2 How Income Changes Shift Demand Curves
   A Rise in Income Shifts the Demand Curve
   Consumer Theory and Income Elasticities
5.3 Effects of a Price Change
   Income and Substitution Effects with a Normal Good
   Income and Substitution Effects with an Inferior Good
5.4 Cost of Living Adjustments
   Inflation Indexes
   Effects of Inflation Adjustments
5.5 Deriving Labor Supply Curves
   Labor-Leisure Choice
   Income and Substitution Effects
   Shape of the Labor Supply Curve
   Income Tax Rates and Labor Supply

TEACHING TIPS

This chapter contains a great deal of important material, and requires several classes to cover effectively. I find that covering the price consumption curve, Engel curve, and the derivation of demand curves usually takes me about one 70-minute period. The material is not intuitively difficult, but students need to be clear about these concepts in order to have the substitution and income effect material make sense. You may want to spread the presentation of the substitution and income effects over more than one period, because students will benefit from having some time to process the first run through, as well as refer back to the book.

When presenting the substitution and income effects, try to set up the presentation such that the class can take good quality notes on the graphs. When students come in for help on this material, you might go through their notes with them. What you are likely to discover is that hurriedly drawn indifference curves and freehand wobbly budget constraints have led to a graph that looks almost nothing like the one you put on the board. They may have the imaginary budget line drawn so that it intersects the original point of tangency, which leaves them with no substitution effect. To minimize this problem, in addition to reminding them to bring in a protractor and colored pencils to take notes with, I do the following: The first time I demonstrate the separation of the total effect into the two component effects, I replicate an example that is in the text (such as the beer and wine example in Figure 5.5). I tell the class that I am doing this, but ask them to take notes as they normally would rather than just watch me and look at the book. This way, if they make errors in note taking, they can refer to the text to see the correct graph. The other thing that can be helpful is to supply them with pre-drawn indifference curves, as this is where most of the trouble occurs. For example, if they draw their curves much differently than yours when you are demonstrating the separation of income and substitution effects for an inferior good, theirs may not turn out to be inferior. Another possibility is to give the class coordinates of points that make up the needed indifference curves.

If your students have a strong calculus background and you have the time, the Slutsky equation is presented on the Web site for the text (www.awl.com/perloff). Perhaps most important is that the class see the relevance of separating out the effects of the price change. The examples in the text, especially the extended example of the CPI substitution bias, can work to motivate understanding. You could also show the separation for a price increase in the context of a sin tax, but not until you are comfortable that separations for price decreases are well understood.
The inclusion of the labor supply curve and the labor leisure trade-off in this chapter is another good way to make the point of the importance of the substitution and income effects. Although it has been extended and refined in recent years by the inclusion of home production effects, Ashenfelter and Heckman's paper (Econometrica, January, 1974) on the income and substitution effects of family income is a nice empirical test of this concept. Briefly, they found that women treat increases in their husband’s income as a pure income effect (i.e., they “purchase” more leisure by reducing work hours), but husbands do not react to an increase in their wife’s income (indicating an income effect of zero). Students are likely to have their own opinions on the validity of this result in today's labor market, which can lead to a lively discussion.

The effect of income taxes on labor supply is also a good discussion topic. The text describes the attempts by the Kennedy and Reagan administrations to increase both work effort and tax receipts by decreasing marginal tax rates at the highest levels. If there is time, you might point out the normative nature of “fair” marginal tax rates, and that while a primary issue for individuals is fairness, another important aspect of the setting of tax rates is how they may affect work effort and thus revenues. It may be the case that in order to construct tax proportions that the majority feels is fair, rates would have to be higher than another scheme judged to be almost as fair but with lower rates and greater work effort.

As an extension of this section, you may want to discuss in class or assign as homework question #7 in the Additional Problems section below. This question requires the students to construct a piece-wise linear budget line due to changes in the marginal tax rate as hours worked increases.

### ADDITIONAL APPLICATION

**Rats Treat Quinine Solution as a Giffen Good**

Economists have long sought empirical confirmation of the Giffen good phenomenon—the occurrence of a negative income effect so large that it overwhelms the substitution effect, creating a positively sloped demand curve. Battalio, Kagel, and Kogut (1991) used a novel experimental procedure to demonstrate that, within a certain income range, the Giffen phenomenon can occur at the individual level.

The authors began by providing six rats with the opportunity to consume liquid in the form of root beer, a quinine solution (0.1 gram per liter), and water. The rats strongly preferred root beer to water and water to quinine solution. Given these preferences, root beer was chosen as the normal good and quinine was intended to serve as the Giffen good. In the experiment, the rats could “purchase” each liquid by pressing on a wall-mounted lever (one for root beer, one for quinine) in their cage. Income was controlled by fixing the number of presses that would produce liquid. The rats could allocate their total presses across the two levers in whatever proportion they chose.

The authors first searched for an income range in which quinine was strongly inferior (a necessary condition for producing the Giffen phenomenon). They then imposed income-constant price changes at these income levels to demonstrate the Giffen effect. The quinine price was changed by altering the amount received per lever press. As the price went up, less quinine was received per press.

Of the six rats tested, three produced a Giffen response, and three did not. Not surprisingly, the Giffen-response-producing rats were the same three that had treated quinine as a strongly inferior good in the income range that was tested. The other three rats, for whom quinine was not strongly inferior, did not exhibit the Giffen phenomenon.

The authors concluded that the Giffen good is observed rarely for two reasons. First, it is difficult empirically to generate (or to observe in human experience) the “initial conditions of strong inferiority that the

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Further, when the responses were averaged across rats to produce a market effect, the effect was not significantly different from zero. Thus, although some individuals did exhibit the Giffen phenomenon in a specific income range, the heterogeneity of preferences and income levels across individuals makes the observation of the Giffen phenomenon at the market level extremely unlikely.

1. The authors were able to demonstrate this result only at very low income levels. Why would this be so?
2. Does this experiment reinforce or weaken the theory of choice?

DISCUSSION QUESTIONS

1. What kind of experiment could a firm conduct to determine the demand curve it faces?
2. Suppose the government wants to discourage consumption of some good (such as cigarettes or liquor). How effective will specific taxes and lump sum taxes (a pure reduction in income) be in reducing consumption? What type of information do you need to answer this question?
3. How can the firm use the information contained in an Engel Curve and government forecasts of income to predict future demand?
4. Are you aware of any Giffen goods? What types of goods might these be?
5. Should the government try to pick the marginal tax rate so as to maximize government revenue?
6. Think of several goods that, at your current income levels, you would consider normal, others that you would consider inferior. Try to determine the defining characteristics of normal and inferior goods by evaluating your list. What do the two groups have in common? How are they different from each other?

ADDITIONAL QUESTIONS AND MATH PROBLEMS

1. Suppose the government wants to increase the ability of families to pay for college education. Would a $500 income tax rebate differ from a $500 tax credit for tuition reimbursement? Explain.

2. True, False or Uncertain; explain your answer. When income rises and the price of \( x \) falls, the consumer will always buy more units of \( x \).

3. A consumer faces prices for hot dogs and hamburgers of $1 each. Consumption of the two commodities at various weekly income levels are shown below.
   a) Use the information to sketch the income consumption curve on a graph.
   b) Draw the Engel curves for hot dogs and hamburgers.

<table>
<thead>
<tr>
<th>Income</th>
<th>Hot Dogs</th>
<th>Hamburgers</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>15</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
   c) What is the income elasticity of hot dogs for this consumer as income increases from $10 to $15?

4. Draw a graph with arcade games on the horizontal axis and newspapers on the vertical axis. Joe has $10 per week to allocate between these commodities. The price of newspapers is $.50. At the initial price for arcade games of $.25, Joe purchases 10 newspapers and plays 20 games. When the price of games increases to $.50, Joe purchases 8 newspapers and plays 12 games. When the price of games increases again to $.75, Joe buys 5 papers and plays 10 games.
   a) Use this information to draw the utility maximizing points on a graph.
   b) Draw the price-consumption curve.
   c) Draw the individual demand curve for arcade games.
   d) Use the information given to calculate Joe’s elasticity of demand for arcade games between $.25 and $.50, and between $.50 and $.75.
5. Sarah allocates her income of $5.00 between the consumption of donuts and coffee. Her tastes and preferences are indicated by the indifference curves shown in Figure 5.1. The price of donuts is $.50 each. Initially the price of coffee is $1.00 per cup. Subsequently, the price of coffee falls to $.50 per cup. On the graph below, show the initial utility maximizing position, the new utility maximizing position, and separate the income and substitution effects. For Sarah, is coffee a normal or inferior good?

![Figure 5.1](image)

6. What would the value of the substitution effect be for two goods that are perfect complements? Use a graph to demonstrate your answer.

7. The basic labor supply model presented in this chapter assumes that wage income is untaxed. Suppose instead that a set of marginal tax rates was imposed such that at a wage of $10/hour, the first 5 hours of labor were untaxed, the next 10 hours of labor were taxed at a 20 percent rate, and all labor thereafter was taxed at a 50% rate. Show on a graph how this would affect the budget line. How might this alter work effort?

ANSWERS TO ADDITIONAL QUESTIONS AND MATH PROBLEMS

1. Yes. A $500 reduction in income taxes would represent a pure income effect, providing families with additional disposable income that could be spent on anything (including, but not necessarily college). A $500 tax credit for tuition reimbursement would be a price change, and so would involve both a substitution and an income effect, but would only be received if the family spent at least $500 on tuition. All families will be as well or better off with the tax cut as they would with the tuition tax credit (see Chapter 4).

2. False. In order to make predictions using economic theory, it is best to change only one parameter at a time. In this case income rises and price falls. If the good is inferior, the effects will be in opposite directions.

3. a) See Figure 5.2.
   b) See Figures 5.3 and 5.4.
   c) \( \xi = \frac{3}{5}(10/3) = 2 \)
4. (a) See Figure 5.5.
   (b) See Figure 5.5.
   (c) See Figure 5.6.
   (d) \( \varepsilon_1 = (8/-.25)(.25/20) = -0.4 \). \( \varepsilon_2 = (2/-.25)(.50/12) = -0.3 \).

5. To separate the income and substitution effects, draw the imaginary budget line \( I^* \). In this case, because the income effect partly offsets the substitution effect, coffee is an inferior good. See Figure 5.7.
6. Because the indifference curves are L-shaped, the substitution effect is zero. When the imaginary budget line is drawn tangent to the original indifference curve, it passes through the same point as the original tangency. Thus, there is only an income effect.

7. When the marginal taxes are imposed, the budget constraint becomes non-linear. Beginning at 0 hours of labor (24 hours of leisure), until labor supply is equal to 5 hours, the slope of the budget line is $-w$, the wage rate. Thereafter the after-tax rate drops to $8, reducing the slope of the budget line, shown as line segment TR in Figure 5.8. This rate is in effect from the sixth through the fifteenth hour worked. Thereafter the net wage fall to $5 per hour, again reducing the slope (segment RP). The dashed line shows the wage line without the tax. The effect of the tax is to reduce the price of leisure, but also to reduce the ability to buy leisure. Depending on whether the income effect or the substitution effect is dominant, the individual may work more or less. In Figure 5.8 the indifference curves shown result in the individual reducing work effort from $H_1$ to $H_2$, and increasing leisure (substitution effect dominant).

Figure 5.8

![Diagram showing the effect of taxes on labor supply and income]

Money, income per day

<table>
<thead>
<tr>
<th>Hours worked per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>$H_1$</td>
</tr>
<tr>
<td>$H_2$</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

Pre-tax budget line

Time constraint

$H_1$

$H_2$

$I_1$

$I_2$