5

VICARIOUS PROBLEM SOLVING: APPLICATIONS OF THE THEORY OF CHOICE

Chapter Summary

Many intriguing puzzles about the consumer are explored in this chapter. Among the many questions asked are the following. If the government wants to subsidize low-income families, which payment scheme would be more efficient: lump-sum payments, payments-in-kind, or per-unit subsidies? What is the profit-maximizing pricing scheme for consumer durables? How can the waste from the tragedy of the commons be transformed into surplus or profits? How do consumers choose between work and leisure? How can the welfare of an individual be measured in a changing economic environment?

Lump Sum Versus Excise Taxes

When the government wants to collect taxes, it can chose to levy a fixed, **lump-sum tax** per individual, or it can impose an **excise tax** on every unit of a particular good purchased. Given that the aim of the government is to collect some specific revenue, the consumer would prefer that a lump-sum tax be used because it leaves the consumer at a higher level of utility. Alternatively, if the individual's utility level is held constant, the government can collect more revenue by using a lump-sum tax. This same result also holds for comparing lump-sum subsidies and per-unit subsidies or cash payments and payments-in-kind.

Compensating Variation, Equivalent Variation, and Consumer Surplus

To measure the benefits to consumers from a change in a policy, such as a price decrease for good 1, three measures have been proposed. **Compensating variation** is the maximum amount of money that an individual is willing to pay to consume good 1 at the lower price. **Equivalent variation** is the minimum amount of compensation required to induce an individual to forfeit the opportunity of purchasing good 1 at the lower price. Although these measures are accurate benefit measures, their calculation requires knowledge of consumers' preferences. For this reason, **consumer surplus,** the area under the demand curve between the original price and the new lower price, is a practical measure that is commonly used. In the absence of an income effect, that is, when indifference curves are "vertically parallel," the three measures are identical.

Two-Part Tariffs

The result that a lump-sum charge allows the individual to maintain a higher level of utility for a

given revenue suggests an optimal **two-part pricing scheme** in the case of **consumer capital goods.** These are items such as personal computers, refrigerators, and plane trips, which are of indirect value in and of themselves but which are used to produce a valued good or service. When a consumer capital good requires a complementary good, such as entry into squash clubs and court time or cameras and film, then a profit-maximizing firm selling these products will charge the marginal cost of producing the complementary good for that good and will charge the **reservation price** for the consumer capital good. The reservation price is the maximum price that makes the individual indifferent between buying the product and doing without it. Similarly, for constant profits of the firm, the consumer would prefer this pricing arrangement to one in which the firm extracts some profit from the complementary good.

Time and Wealth

When we examined the problem of the consumer in Chapter 4, we took the consumer's income as given. But where did that income come from? This question brings us to the choice problem between income and leisure, or time spent working and time spent doing other things. This problem can be reduced to one in which a consumer maximizes utility between income and leisure, subject to an income–time constraint; that is, the income earned and the income forgone in leisure must equal the "full wealth" or total potential wealth that could be earned. The solution to this problem is the **supply curve** of labor for an individual.

Many consumption goods require time as well as money. For example, concert tickets cost money and take time to use and eating a meal costs money and time to enjoy. When analyzing problems with such goods, we must consider the **full price** of the good, that is, the money price plus the **opportunity cost** of time spent consuming that good.

Tragedy of the Commons

The importance of introducing time into the consumer problem is most evident in the **tragedy of the commons.** In this problem, there is a limited supply of a good that is "everybody's property," such as clean air, forest lands, fish, and racquetball courts. Time and effort are wasted in attempts to get some of the good. Perhaps the money price is low — it may even be zero in the case of university racquetball court facilities — but the opportunity cost of the time spent standing in line for hours can be extremely large. Thus, the first-come, first-served method of allocation involves a real resource cost in the form of wasted time. Institutional methods of allocation can avoid this problem. For example, suppose that a money price equivalent to the value of time spent in lineups was charged for the common property good. This would reduce the excess demand for the good and at the same time eliminate the wastage of valuable time.

Index Numbers

Although we cannot observe individuals' indifference curves, we can sometimes infer changes in a consumer's welfare between two periods by simply observing the consumer's purchases and the market data in those periods. The procedure goes like this. If yesterday's bundle can be afforded today but is not chosen and today's bundle was not affordable yesterday, then you must be better off today. This implies that the **Paasche quantity index** must exceed 1 for the consumer to be better off today. Alternatively, if today's bundle was affordable yesterday but was not chosen and yesterday's bundle is not affordable today, then one must be worse off today. This is the same as saying that the **Laspeyres quantity index** must be less than 1 for yesterday's welfare to be higher.

An individual's change in welfare can also be measured with price and income indexes. In particular, if the **Laspeyres price index** is less than the **income index** (today's income divided by yesterday's income), then the consumer is better off today. If the **Paasche price index** is greater than the income index, then the individual is worse off today compared with yesterday.

Intertemporal Choice

The final topic of the chapter deals with **intertemporal choices.** Individuals and firms often have to make decisions that will affect future

utility or profits, such as what type of investment to make, whether or not to take out a mortgage, or what type of bonds to sell. To simplify the issues, assume that individuals can borrow and lend at the same rate of interest. Thus, one dollar invested today at an interest rate of i is worth $(1 + i)^t$ dollars t periods into the future. Alternatively, the **present value** of receiving $(1 + i)^t$ dollars t periods from now is simply one dollar. Firms sell **bonds** to the public to borrow money. Bonds are sold at some price, with promises to pay the purchaser a fixed sum of money in each of a fixed number of periods. A bond that has no maturity date is known as a **consol.**

Key Words

Bond
Compensating variation
Consol
Consumer capital
Consumer surplus
Equivalent variation
Income index
Intertemporal choice
Laspeyres index
Lump-sum versus excise taxes
Paasche index
Present value
Price indices
Quantity indices
Reservation price
Supply of labor
Tragedy of the commons
Two-part tariffs

Case Study: The Energy Crisis in the United States

The oil embargo in 1973 resulted in an energy crisis in the United States. In the mid-1970s, the United States was importing nearly half its oil from the Organization of Petroleum Exporting Countries (OPEC). Although Americans eventually began to reduce their oil consumption in response to rising prices (by driving smaller cars and by switching from oil to natural-gas heating), the short-run or immediate response was not large. The oil shortage became a national crisis.

A For several years after the embargo, gasoline was rationed. Effectively, only so much gasoline was available at the pumps. Long lines formed, many people were turned away without full tanks, and on several occasions, violence broke out in the lines. Analyze this rationing scheme. Let G^0 and G' be the preembargo and postembargo (fixed) supplies of gasoline. Assume that every gallon of gasoline requires q minutes of queuing time.

B Consider an alternative rationing scheme in which the government places a per-unit tax t on every unit of gasoline, but then gives the consumer a *lump-sum* rebate equal to tg_{-1}, where g_{-1} equals the pretax consumption level of gasoline. Under this scheme, consumers pay higher prices by t cents in the *current* year, then receive t cents back on every gallon of gasoline purchased in the *previous* year. Would this scheme be effective in decreasing the consumption of gasoline? Explain. Does the effectiveness of this program depend on its being a one-shot, unanticipated policy? Why or why not?

Exercises

Multiple-Choice

Choose the correct answer to each question. There is only one correct answer to each question.

1 Suppose that a certain bundle of goods costs \$200 in year 0 and \$250 in year 1. Then, if an individual actually spends \$250 in year 1, and his preferences have not changed, which of the following is correct?

a He is no worse off in year 1.
b He must be better off in year 0.
c He cannot be better off in year 1.
d He is equally well off in the two years.
e None of the above.

2 In Figure 5.1, the consumer chooses bundle A when the budget line is CC and bundle B when the budget line is DD. If the consumer's preferences have not changed, then which of the following is correct?

a Points in area F are preferred to bundle A.
b Points in area COC are inferior to bundle A.
c Points in the shaded region are inferior to bundle B.
d All of the above are true.
e Only **b** and **c** are true.

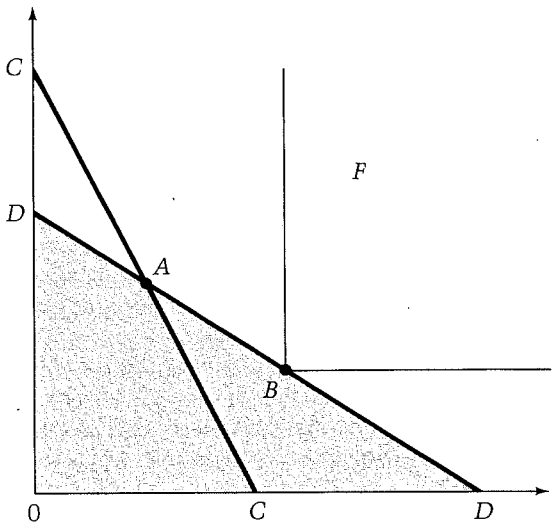

FIGURE 5.1

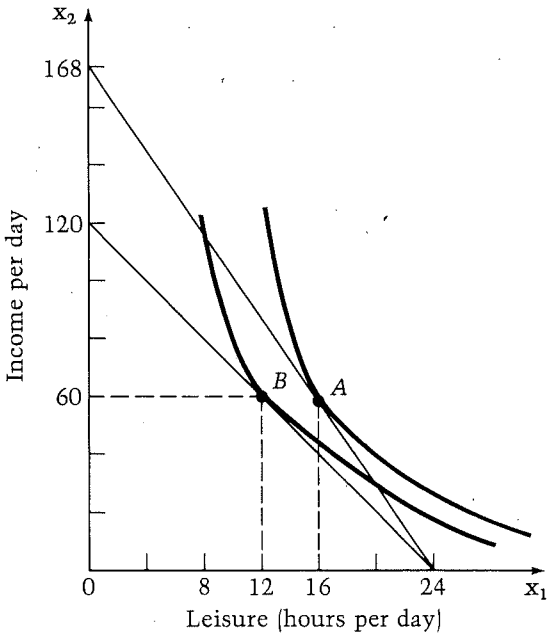

FIGURE 5.2

3 The supply curve of labor will be backward-bending in which of the following cases?

a If leisure is an inferior good

b If the substitution and income effects from an increase in the wage rate reinforce each other

c If an increase in the wage rate results in an increase in the amount of labor supplied on the market

d If the reduction in leisure due to an increase in the opportunity cost of leisure is less than the increase in leisure due to the corresponding increase in real income

e If none of the above is true

Use Figure 5.2 to answer questions **4** and **5.**

4 A utility-maximizing individual

a Is indifferent between the two income–leisure bundles *A* and *B* because they contain the same amount of income.

b Will choose to earn $120 income if the wage rate drops to $5 per hour.

c Is facing a wage rate of $7 when choosing bundle *A*.

d Only **b** and **c** are true.

e None of the above is true.

5 If the individual's wage falls from $7 to $5, which of the following is correct?

a The person will tend to consume less leisure owing to the substitution effect.

b The person will tend to take more leisure because of the income effect.

c The person is on the backward-bending portion of the labor supply curve.

d Leisure is an inferior good.

e None of the above is true.

6 Suppose that a tax of $1 on every unit of a good 1 is replaced by a lump-sum tax of $5. Under the per-unit tax, the individual consumed 5 units of good 1. Then, which of the following statements is true?

a The individual would not reduce his consumption of good 1.

b The individual would be worse off under this tax than under the first tax.

c The individual would consume less good 1 under the lump-sum tax.

d The individual would not be able to afford the same bundle of good 1 and everything else chosen under the per-unit tax.

e None of the above is true.

Refer to Figure 5.3 of an individual's utility-maximizing bundle of good 1, and to the composite good before and after a tax is imposed on that good, to answer questions **7** and **8.**

7 After a per-unit tax is placed on good 1,

a The consumer purchases less of the composite good.

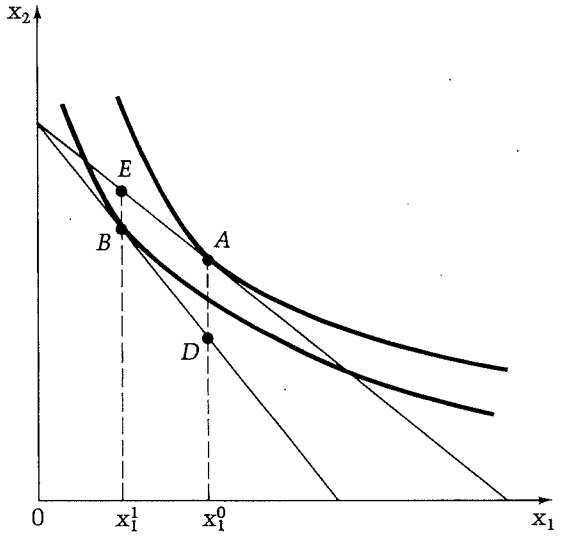

FIGURE 5.3

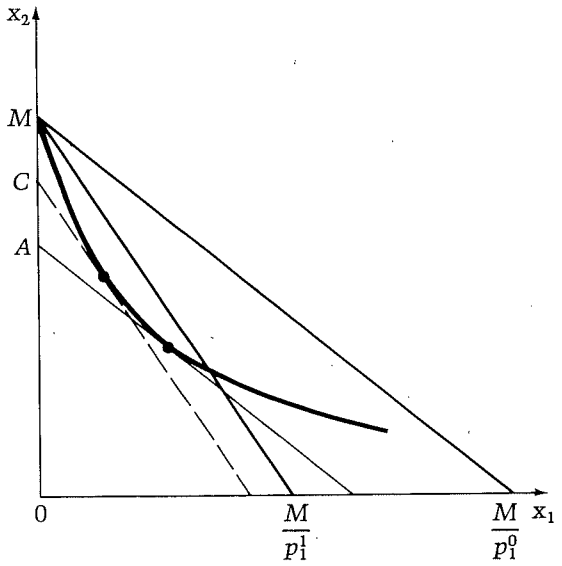

FIGURE 5.4

b The consumer chooses bundle A to maximize utility.

c The government collects AD tax revenues from this individual.

d The government collects BE tax revenues from this individual.

e None of the above is true.

8 If the government replaces the per-unit tax on good 1 with a lump-sum tax that leaves the individual at the same utility level as under the per-unit tax, then

a The government would collect fewer taxes than under the per-unit tax.

b The individual would consume less good 1 than under the per-unit tax.

c The individual would consume more good 1 than under the per-unit tax.

d Only **a** and **b** are true.

e Only **a** and **c** are true.

9 Figure 5.4 illustrates William Whiz's indifference curves for floppy disks for his personal computer, good 1, and all other goods, good 2. William's income is M. The same firm produces personal computers and floppy disks.

a If the price of the floppy disks is p_1^0, then the maximum price that William is willing to pay for the computer is distance MA.

b If the price of the floppy disks is p_1^1, then the maximum price that William is willing to pay for the computer is MC.

c The maximum price that William is willing to pay for the computer increases with a decrease in the price of the floppy disks.

d All of the above are true.

e Only **a** and **c** are true.

10 For a reduction in the price of a normal good,

a Consumer surplus overestimates consumers' true willingness to pay for the price reduction.

b Consumer surplus underestimates consumers' true willingness to pay for the price reduction.

c The quantity demanded of the good at the lower price along the compensated demand curve is larger than that quantity along the ordinary demand curve.

d The quantity demanded of the good will fall.

e None of the above is true.

True-False

11 If your current consumption bundle could have been bought 10 years ago for one-half of its current costs but your income 10 years ago was one-half of your current income and your tastes have not changed, then you must be equally well off compared with 10 years ago.

12 If the Laspeyres price index indicates your cost of living has increased but there has been no

change in your disposable income, then you must be worse off than prior to the cost-of-living increase.

13 If the Paasche price index indicates your cost of living has increased but there has been no change in your disposable income, then you must be worse off than before the cost-of-living increase.

14 If the government wants to increase its revenue through a tax on some good, then it can collect more revenue through a lump-sum tax than through a per-unit tax that would leave the individual at the same level of utility.

15 Suppose that a consumer is willing to purchase f^* units of film at price p^*. Then, the maximum price that the consumer is willing to pay for the camera is the consumer surplus received from the f^* units of film if the income effect is zero.

16 Assume that an individual works 5 hours per day and earns \$50 per day. If the government increases the income tax rate from 0% to 20%, then the individual will certainly increase his work hours to $6\frac{1}{4}$ to keep his income at the same level.

17 The supply curve for labor will be backward-bending if the substitution effect from an increase in the wage rate is smaller than the income effect when leisure is a normal good.

18 At low wages, the income effect for an increase in the wage is likely to dominate the substitution effect because the individual will want to increase her income by working more to offset the low wages.

19 Since you enjoy driving to the country so much every week, the "price" of your country trips is only the transportation expenses you incur per trip.

20 The higher the interest rate, the higher will be the price of the consol on the bond market.

Short Problems

21 Figure 5.5 shows the budget constraints faced by an individual in 1985 and 1986. Points A and B are the respective bundles of goods chosen in the two years. Can you say if the individual is better or worse off in 1986 compared with 1985? Explain.

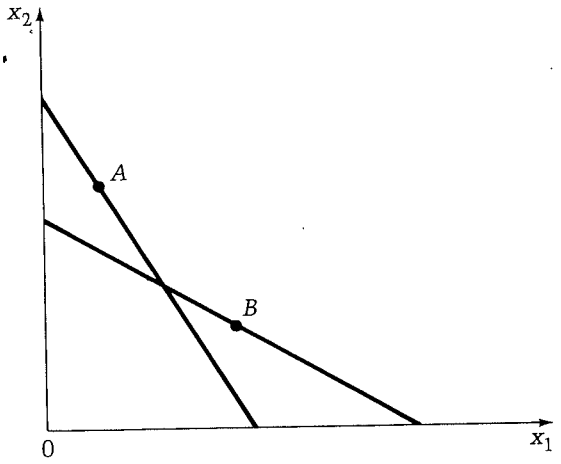

FIGURE 5.5

22 An individual consumes only two goods, good 1 and good 2. He spends all his income on these two goods. His consumption of good 1 and good 2 and the prices he faced in 1985 and 1986 are as follows:

	P_1	P_2	x_1	x_2
1985	10	15	20	10
1986	8	20	30	9

a In which period is he better off? Why?

b If you knew the indifference curves, show how you could calculate exactly how much income he needs in 1985 to reach the 1986 level of utility.

23 An individual can purchase housing either in the private housing market, in which she can buy any amount of housing she pleases at the market price, or in the public housing market, in which she is offered a particular amount of housing at a price lower than the private market price. Will she necessarily choose the public housing? If she does, will she consume more housing than she would have purchased on the private market? Explain.

24 At the University of Toronto, squash courts are allocated on a first-come, first-served basis.

Starting at 7:30 A.M., avid squash players can begin their attempts at reserving a squash court for the following day. A new squash plan has been recently introduced. For $100, a squash membership can be purchased, allowing the holder to book a court 1 week in advance. Only 300 of these memberships are available. Analyze this pricing scheme. Why was this membership offered? Why were only a limited number of memberships available?

25 The market for personal-computer (PC) software is very competitive. Active development of software is encouraged by IBM's liberal policy on providing information on its computer systems. Why might IBM be indifferent between facing competition in the software market rather than simply producing the software itself?

26 On an indifference curve diagram, illustrate the compensating variation and consumer surplus from a reduction in the price of a good with a zero income effect.

27 If Susan is offered a bond that will pay her $1000 in 3 year's time, and the current interest rate is 10%, then what price will she be willing to pay for the bond?

Long Problems

28 An individual has to choose between two jobs. The first job pays an hourly wage rate w_1 and requires him to work exactly 6 hours per day. The second job pays a lower hourly wage rate w_2, but he can work as many hours at this job as he likes. The two jobs are identical in all other characteristics, such as responsibility and boredom. In three separate diagrams, show the following:

a An individual who prefers the job paying w_1

b An individual who prefers the job paying w_2

c An individual who is indifferent between the two jobs

29 A worker is currently earning $6 per hour and is working 40 hours per week.

a Use indifference curves and budget constraints for the labor–leisure trade-off to illustrate this worker's optimizing decision.

b If the worker is offered an overtime wage of $9 per hour for all hours worked over 40, will she increase her hours worked? Explain, using a diagram.

30 Consider a society with no income taxes. The government decides to impose an income tax equal to 20% of all earnings.

a Use an income–leisure graph to illustrate the effect of this tax on the budget constraint of a representative individual. Assume that the individual has no nonlabor income.

b Suppose that leisure is a normal good. Will the tax necessarily result in a decline in work time? Explain, using your diagram. Show the substitution and income effects for this change in the tax rate.

31 Reingard recently hit it lucky in a New York lottery. Her winnings are paid in $1000 *annual* increments for as long as she lives. She also earns $250 per month teaching at a New York university. Assume Reingard spends all of her annual earnings, and she cannot borrow against her future earnings.

a Draw a diagram of her utility-maximizing choice between leisure and all other goods. Given that Reingard lives a long and happy life, what is the present value of her stream of income earnings from the lottery ticket winnings?

b Suppose that her wage increases to $350 per month. Show the new optimum.

c Suppose that her lottery earnings increase by $600 per year. Show the new optimum.

d If Reingard is indifferent between a wage or lottery earnings increase, in which case, **b** or **c**, will Reingard work more? Explain.

32 A recent Berkeley graduate buys only three commodities—good 1, good 2, and good 3—with his income. In his initial job location in Atlanta, he purchased the following quantities each month at the prices indicated.

	Atlanta	
	Quantity	***Price ($)***
Good 1	100	5
Good 2	200	8
Good 3	50	4

He is offered a new job in New York City at a substantially higher salary, $3200 per month.

The prices of goods 1, 2, and 3 in the new city are as follows.

New York City	
Good	***Price ($)***
Good 1	6
Good 2	10
Good 3	8

Is he worse off if he takes the job because of the higher prices, or do you need more information to tell? Explain.

33 A consumer spends his income on compact discs (CDs) and all other goods, good 2. CDs cost $20 per unit and the consumer's income is $300.

a Draw the consumer's budget constraint and show the optimum for a consumer who buys a positive amount of good 2 and CDs. Let the quantities of CDs and good 2 be x_1 and x_2, respectively.

b Now assume that a CD company offers him the following deal. For a membership fee of $100, he can buy all the CDs he wants for $10 each. Draw the new budget constraint under this offer.

c Under the offer, show that anyone buying more than 10 CDs before the plan is introduced will join the plan, but anyone buying less than 10 CDs may or may not join the plan.

d Draw an indifference curve diagram showing that if an individual is indifferent between joining and not joining the plan, then she would spend more money on CDs and purchase more CDs under the plan.

34 The Smiths, a family of four, spend $1000 out of their $6000 annual income on food. After conducting a thorough study, a government agency decides that $3000 is the minimum money required to provide proper nutrition for a family of four. Deciding that the Smiths cannot afford to pay more than $1000 for food out of their current income, the agency decides to make a gift to them each year of $2000 worth of food stamps, which may be used *only* on food.

a On a diagram, draw the Smiths' budget constraints before and after the gift of food stamps. Assuming convex indifference curves, show the optimum before and after the gift. *Hint:* Measure food and all other goods in dollars. According to your diagram, has the government succeeded in its objective of ensuring that the Smiths get proper nutrition, that is, $3000 worth of food? Explain.

b Suppose that, instead of the food stamp program, the government gives the Smith family a cash subsidy of $2000 that can be spent on anything they wish. On the diagram you drew for **34a**, show the new budget constraint and the optimum. Is the government any closer to achieving its objective? Explain.

35 Laura earns $10,000 per year. She spends her income on education and composite commodity good 2. A unit of education costs $500 (think of a unit of education as one class). A unit of good 2 costs $1.

a Suppose that Laura maximizes utility subject to her budget constraint by consuming 8 units of education and spending $6000 on everything else. Indicate Laura's optimum on an indifference curve–budget constraint diagram. Now suppose that the government wants to subsidize Laura's education. It has three policies to choose among:
(1) Pay some portion of the price of each unit of education purchased.
(2) Give an equivalent cash subsidy.
(3) Give an equivalent subsidy-in-kind (that is, give Laura a voucher, or units of education).

b Suppose that the government decides to follow policy (1) by paying $250 per unit of education purchased by Laura. Redraw your diagram for **35a**, and show the new bundle of education and the composite commodity that Laura will choose under this government program. Indicate on the diagram the amount of money that the government is spending under this program. Will this program result in a shift in or a movement along the demand curve? Explain.

c Now suppose that instead of the per-unit subsidy, the government follows policy (2) and gives Laura a cash subsidy equal to the money spent under the program in **35b**. Redraw the diagram from **35b** and show the effect of this new policy on Laura's choice of education and good 2. Will Laura be better or worse off under this program than under program (1) analyzed in **b**? Explain. Will this program result in a shift in or a movement along the demand curve? Explain.

d Finally, suppose that instead of the per-unit subsidy in **35b** or the cash subsidy in **35c**, the government gives an education voucher as in policy (3). That is, the government spends the same amount of money as it did in **b** and **c** but "pays" Laura in units of education. Show on a diagram Laura's choice of education and good 2, and compare it to her choice under the cash-subsidy program in **c**. Is Laura better or worse off under this voucher program than under the cash subsidy program discussed in **c**? Explain. Will this program result in a shift in or a movement along the demand curve? Explain.

e What have you learned from this exercise?

36 Figure 5.6 is the ordinary demand curve of a representative consumer for bread. Assume that bread is a normal good and that the individual is currently consuming at a rate of 3 loaves per week at a per-unit price of $1. Because of a new computer-operated dough kneader, the cost of producing bread falls, and the equilibrium price drops to $0.50 per loaf. The government wants to determine the impact of the machine on consumer welfare and concludes that each individual has experienced an increase in welfare of *ABCD*.

a Would you agree that *ABCD* is the accurate measure of welfare? Why or why not?

b Draw the compensated-demand curve and indicate the change in the compensating variation due to the change in the price of bread.

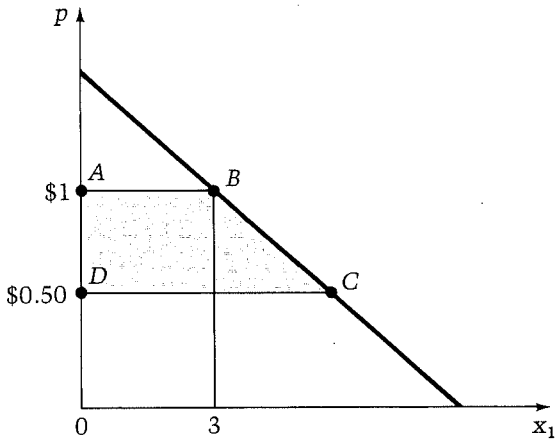

FIGURE 5.6

Answers to Chapter 5

Case Study

A Suppose that there are N identical consumers. Let the initial budget constraint facing the individual be given by Ma in Figure A5.1; G^0/N is demanded. Now suppose that the oil embargo reduces supply to G'. The resulting queuing raises the total price of gas (price plus waiting costs), such that the consumer purchases bundle C.

The new total price of 1 gallon of gasoline is equal to the price paid at the pump plus the cost of waiting q minutes, hence, the cost of waiting q minutes can be measured by the change in the slope of the budget constraint. The value of the total queuing time is equal to the distance CD in the diagram.

Alternatively, a tax equal to the value of the queuing time could be placed on each gallon of gasoline. Suppose that each gallon requires q units of time, and w is the opportunity cost per unit of time. Then the tax $t = wq$ will cause each individual to choose point C in Figure A5.1. Although the individual is not better or worse off, the time spent working instead of queuing gener-

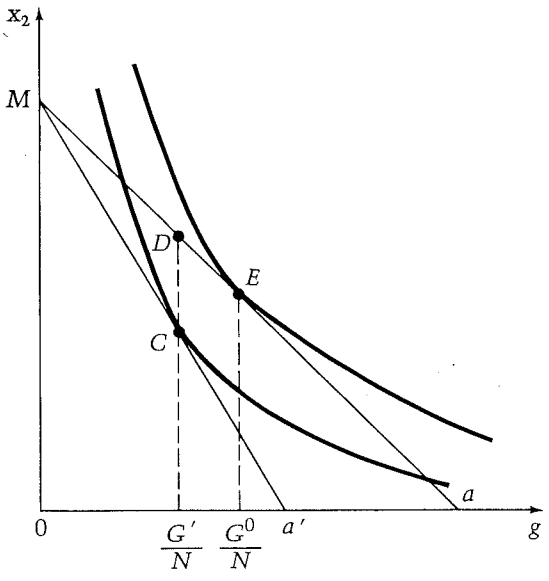

FIGURE A5.1

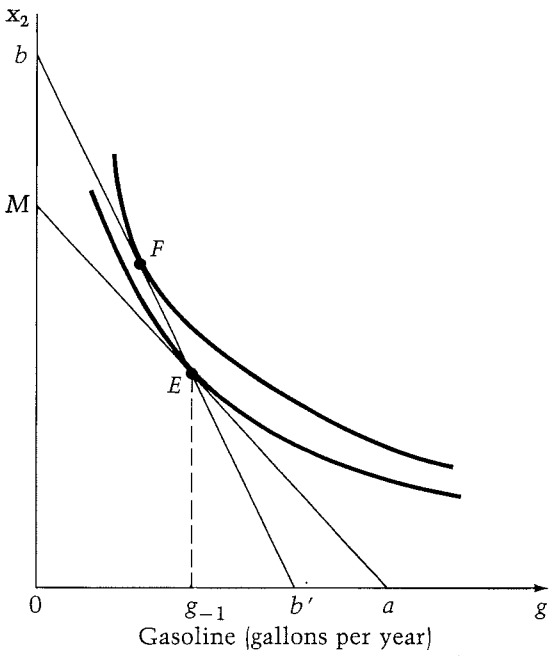

FIGURE A5.2

ates income, which is collected by the government as taxes.

B Yes, the consumers would cut back consumption. To see this, suppose that last year's budget constraint is given by Ma, or

$$x_2 + p_g g = M$$

and last year's utility-maximizing bundle is E in Figure A5.2. The tax-rebate plan would change the budget line to

$$x_2 + (p_g + t)g = M + tg_{-1}$$

where g_{-1} is last year's consumption of gasoline. Note that the budget line under the tax-rebate plan passes through last year's bundle E with a steeper slope (that is, last year's bundle E is attainable). As shown in the Figure, the consumer would choose bundle F and purchase less gasoline.

The preceding answer assumes that the consumer is not aware that her actions could affect the lump-sum subsidy received. On the contrary, if the consumer realizes that any tax paid this year will be refunded next year, she may not adjust her actions in response to the tax.

Multiple-Choice

1 a	**2** d	**3** d	**4** c	**5** c
6 a	**7** d	**8** c	**9** d	**10** a

True-False

11 F	**12** F	**13** T	**14** T	**15** T
16 F	**17** T	**18** F	**19** F	**20** F

Short Problems

21 We cannot say because bundle A is not affordable in 1986 and bundle B is not affordable in 1985. Two possible sets of preferences are illustrated in Figure A5.3. In Figure A5.3*a*, the individual is better off in 1985; in Figure A5.3*b*, the individual is better off in 1986.

22 a To determine the period in which the individual is better off, calculate the Laspeyres and Paasche price indices and the expenditure index.

$$L = \frac{8 \times 20 + 20 \times 10}{10 \times 20 + 15 \times 10} = \frac{160 + 200}{200 + 150}$$

$$= \frac{360}{350} = 1.03$$

$$P = \frac{8 \times 30 + 20 \times 9}{10 \times 30 + 15 \times 9} = \frac{240 + 180}{300 + 135} = \frac{420}{435}$$

$$= 0.966$$

$$E = \frac{8 \times 30 + 20 \times 9}{10 \times 20 + 15 \times 10} = \frac{240 + 180}{200 + 150} = \frac{420}{350}$$

$$= 1.2$$

Since $E > L > P$, the cost of living has increased less than the increase in income; the individual is better off in 1986.

b The budget line for 1985 is $350 = 10x_1 + 15x_2$. The budget line for 1986 is $420 = 8x_1 + 20x_2$. The two budget lines are illustrated in Figure A5.4. The income needed in 1985 to reach the utility level in 1986 is found by shifting the 1985 budget line until it is tangent to the indifference curve reached in 1986. Thus, CD represents the income necessary in 1985 to reach the same utility level in 1986.

23 Assume that if the individual buys housing in the private market, her budget line is AB shown in Figure A5.5. If she buys public housing, *only* point D on budget line AC is attainable. Figure

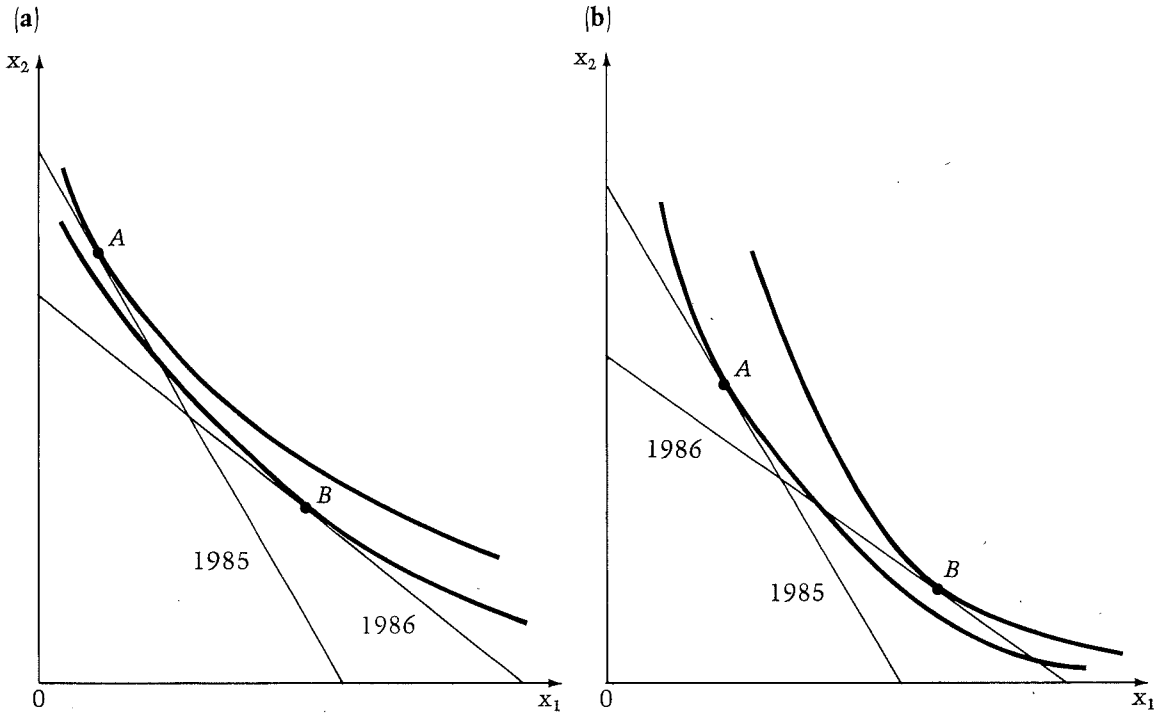

FIGURE A5.3

A5.5*a* shows the case in which public housing is not preferred. The utility-maximizing bundle in the private market is *E*, which is on a higher indifference curve than the one through *D*. If public housing is chosen, the individual will not necessarily consume more housing. Figure A5.5*b* shows a case in which public housing is preferred but less housing is consumed than if housing were purchased in the private market.

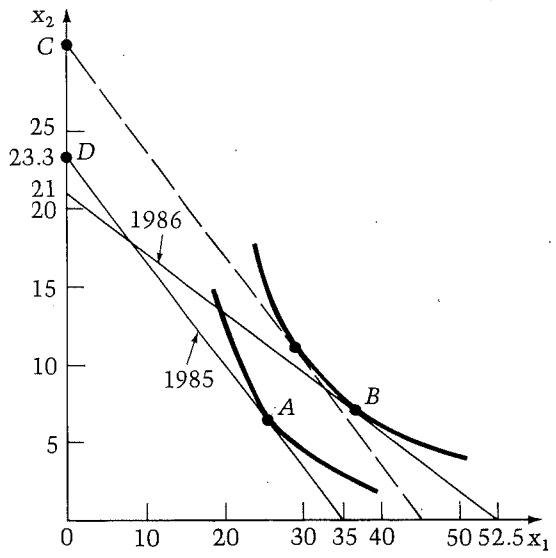

FIGURE A5.4

24 Without the membership policy, the demand for squash courts would exceed the capacity. The rationing mechanism of first-come, first-served was inefficient because valuable time was wasted. The membership was a way for the university to recover some of the cost savings of individuals' time. Only a limited number were offered for distributional reasons. Realizing that many students may not be able to afford the membership, the university allowed a limited number of memberships (probably purchased by the wealthier faculty members) so individuals with a lower opportunity cost of time (probably students) could still make squash reservations with their time.

25 Software is a complementary component of computers. If the market for software is competitive, the software will be sold at the marginal cost of production. This enables IBM to sell the

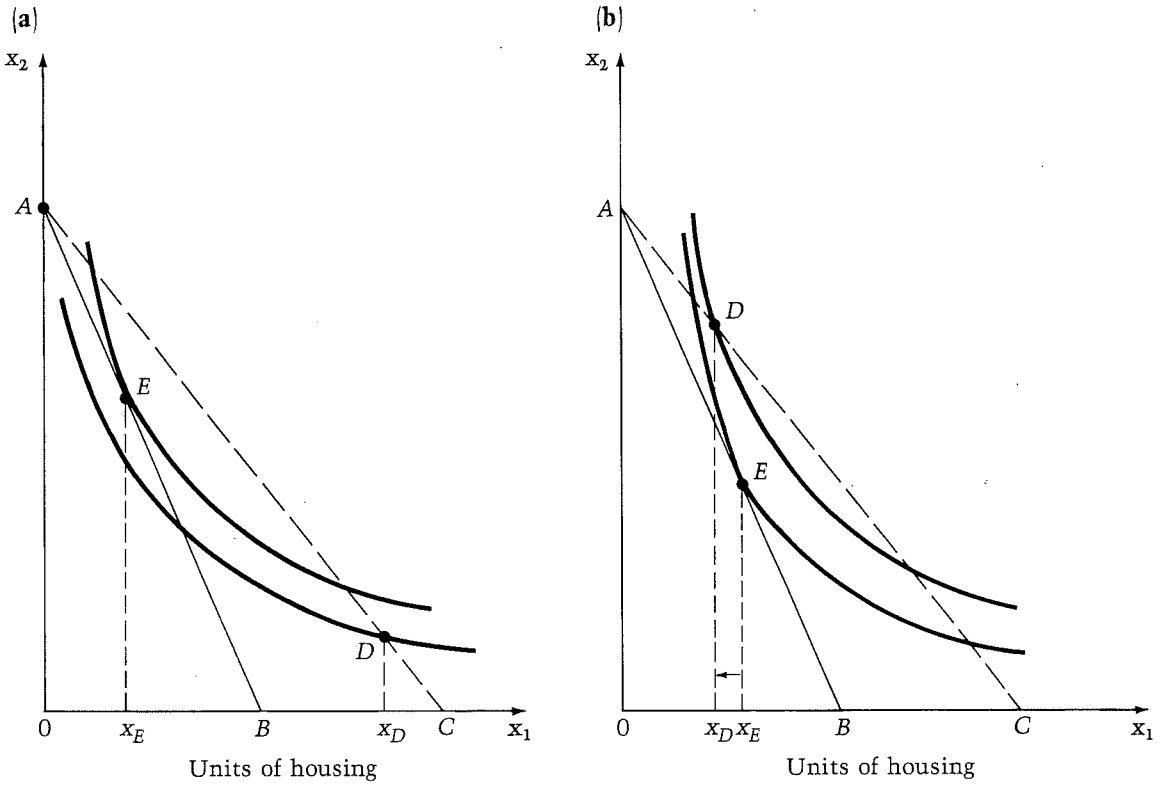

FIGURE A5.5

computers at a price equal to the consumer surplus from the use of the low-cost software. This pricing policy is the profit-maximizing pricing policy that IBM would want to follow if it sold *both* the computers and the software.

26 Let the price of good 1 fall from p_1^0 to p_1^1 as shown in Figure A5.6. The substitution effect is x_1^0 to x_1^1. The income effect is zero; hence, the substitution effect equals the total effect. In this case, the consumer surplus equals the compensating variation. Both measures give the maximum amount of money the individual is willing to give up to experience the price reduction. This amount of money, when it is given up, will leave the individual on the original indifference curve I_1. The compensating variation and consumer surplus in this case, are given by $M - M'$.

27 $$PV = \frac{\$1000}{(1+i)^t} = \frac{\$1000}{(1+0.1)^3} = 751.3$$

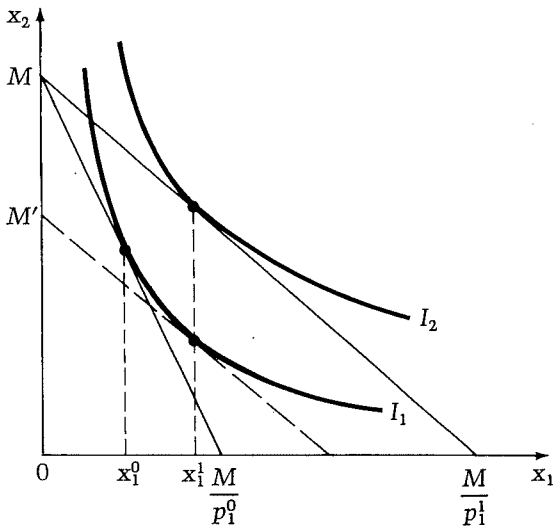

FIGURE A5.6

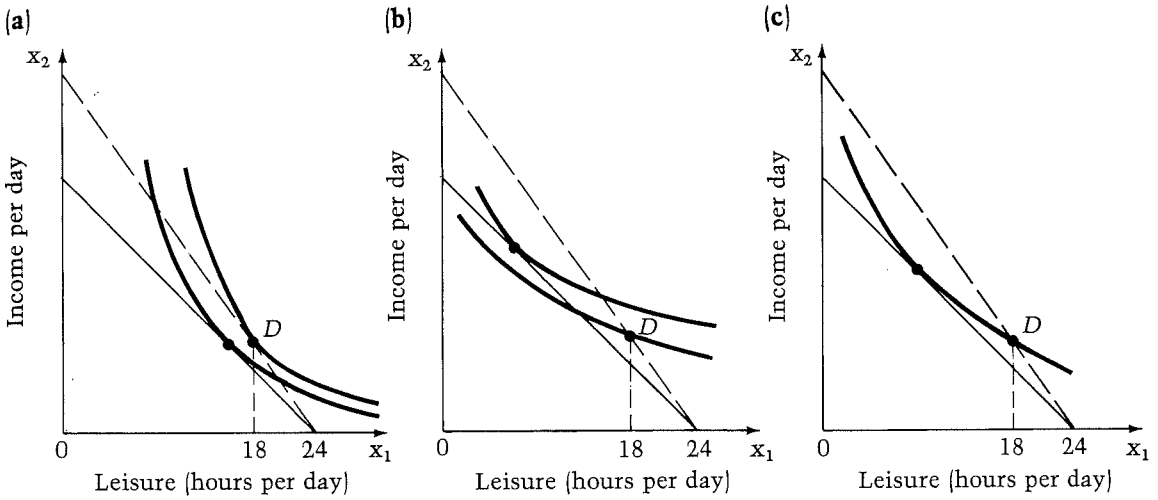

FIGURE A5.7

Long Problems

28 In each of the cases shown in Figure A5.7, the flatter income line represents the combination of income earned and leisure attainable when the wage rate is w_2. Point D on the dotted line indicates the *only* income–leisure combination that is attainable when the wage rate is w_1 and the individual can work only 6 hours.

29 a The maximum amount of money that the individual can earn in one week if she takes 0 hours of leisure is $24 \times 7 \times \$6 = \$1008$. The income line is AB in Figure A5.8.

b If the individual is offered \$9 per hour for all hours over 40 hours, then her income line will get steeper for less than 128 hours of leisure. At maximum, the individual can earn: $40 \times \$6 + 128 \times \$9 = \$1392$. The new and the old income lines are in Figure A5.9. The individual will increase her hours of work.

30 a Let w be the daily wage rate for an individual. The income line without the tax is given by DE in Figure A5.10. The effect of the 20% tax is

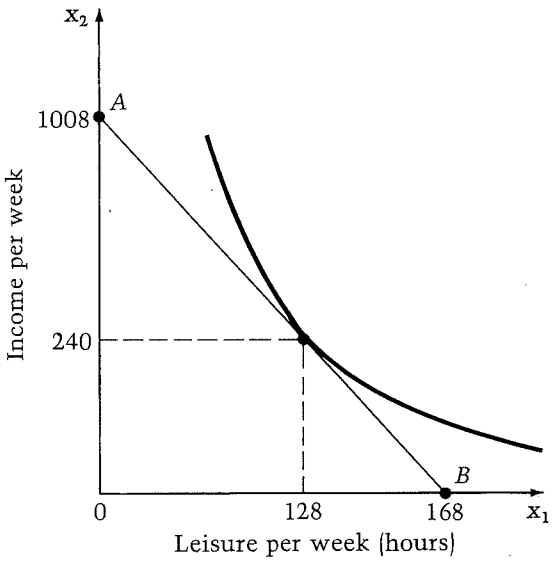

FIGURE A5.8

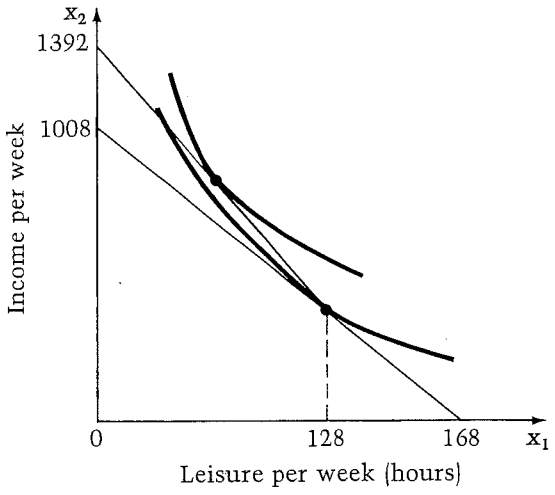

FIGURE A5.9

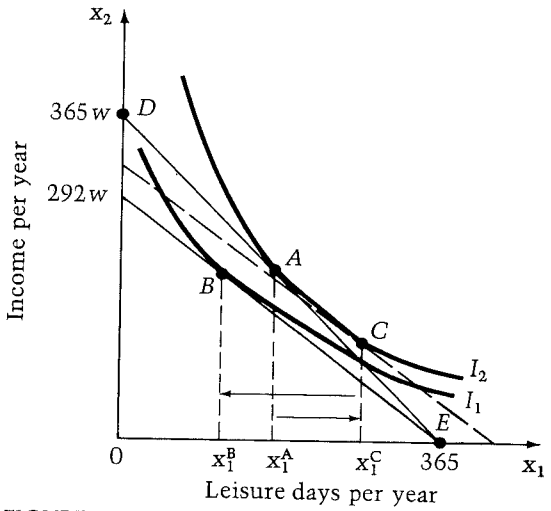

FIGURE A5.10

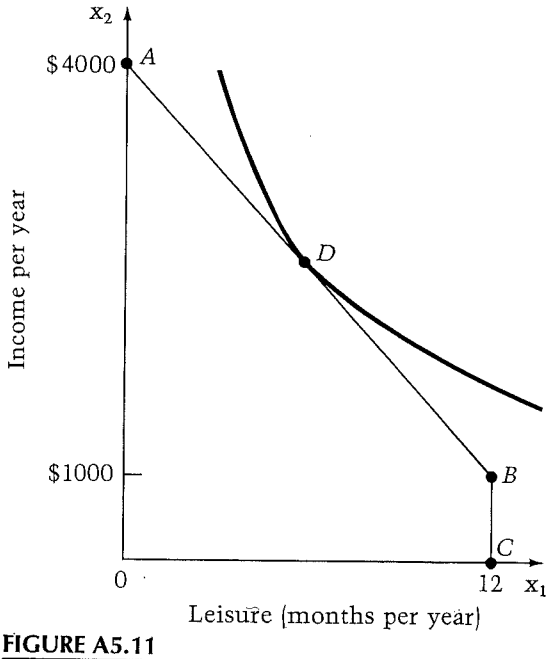

FIGURE A5.11

to pivot the income line inward. The maximum income that can be earned is $0.8 \times 365w = 292w$.

b If leisure is a normal good, the tax will not necessarily result in a decline in work time, as shown in Figure A5.10. The tax lowers the effective wage, resulting in an increase in leisure because of the substitution effect from x_1^A to x_1^C. The decline in real income decreases leisure from x_1^C to x_1^B. If the income effect outweighs the substitution effect, less leisure will be taken.

31 a Since Reingard earns $250 per month, her *maximum* annual income is $3000. She also receives $1000 per year from her lottery earnings, so her yearly budget line is *ABC*. Point *D* in Figure A5.11 indicates her utility-maximizing bundle. The present value of her stream of income from the lottery is $1000/0.08 = $12,500.

b If her wage rises to $350 per month, the slope of the budget line increases to $350 (from $250). Maximum income from teaching is now $350 × 12 = $4200. The new utility-maximizing point is given by *E* in Figure A5.12*a*.

c If her lottery winnings increase by $600, the income line shifts upward, but the slope of the income line stays the same. The new utility-maximizing point is given by *F* in Figure A5.12*b*.

d If Reingard is indifferent between the two income increases, as shown in Figure A5.12*c*, she will choose to work more when the opportunity cost of leisure is higher: that is, when the wage is higher.

32 The Laspeyres price index can be used to determine if he is better off in New York than in Atlanta. If the Laspeyres price index (based on the Atlanta bundle of goods) is less than the expenditure index (New York income divided by Atlanta income), then he is definitely better off in New York:

$$L = \frac{6 \times 100 + 10 \times 200 + 8 \times 50}{5 \times 100 + 8 \times 200 + 4 \times 50}$$

$$= \frac{600 + 2000 + 400}{500 + 1600 + 200} = \frac{3000}{2300} = 1.3$$

$$E = \frac{3200}{2300} = 1.39$$

Since $E > L$, he is better off in New York.

33 a The utility-maximizing bundle is given by *A* in Figure A5.13*a*.

b The new plan is shown in Figure A5.13*b*. The maximum number of CDs that can be purchased is 20; the maximum income that can be spent on everything else is $200.

c The two budget lines intersect at $x_1 = 10$. To see this, write the two budget lines:

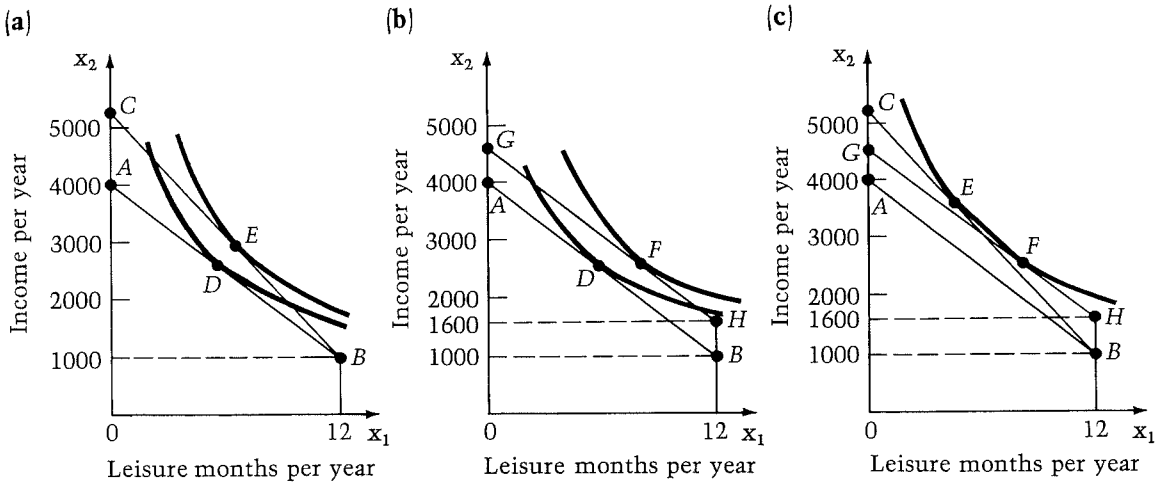

FIGURE A5.12

$$300 = x_2 + 20x_1 \quad \text{and} \quad 200 = x_2 + 10x_1$$

Substitute the second budget line into the first one:

$$300 = 200 - 10x_1 + 20x_1$$
$$x_1 = 10$$

As shown in Figure A5.14*a*, an individual buying more than 10 CDs will join the plan because a higher level of utility can be achieved. Individuals buying less than 10 CDs may or may not benefit from the plan. An individual who benefits from the plan is shown in Figure A5.14*b*.

d Figure A5.15 shows the individual to be indifferent between joining and not joining the plan. Comparison of point *B*, the utility-maximizing bundle under the plan, with point *A* indi-

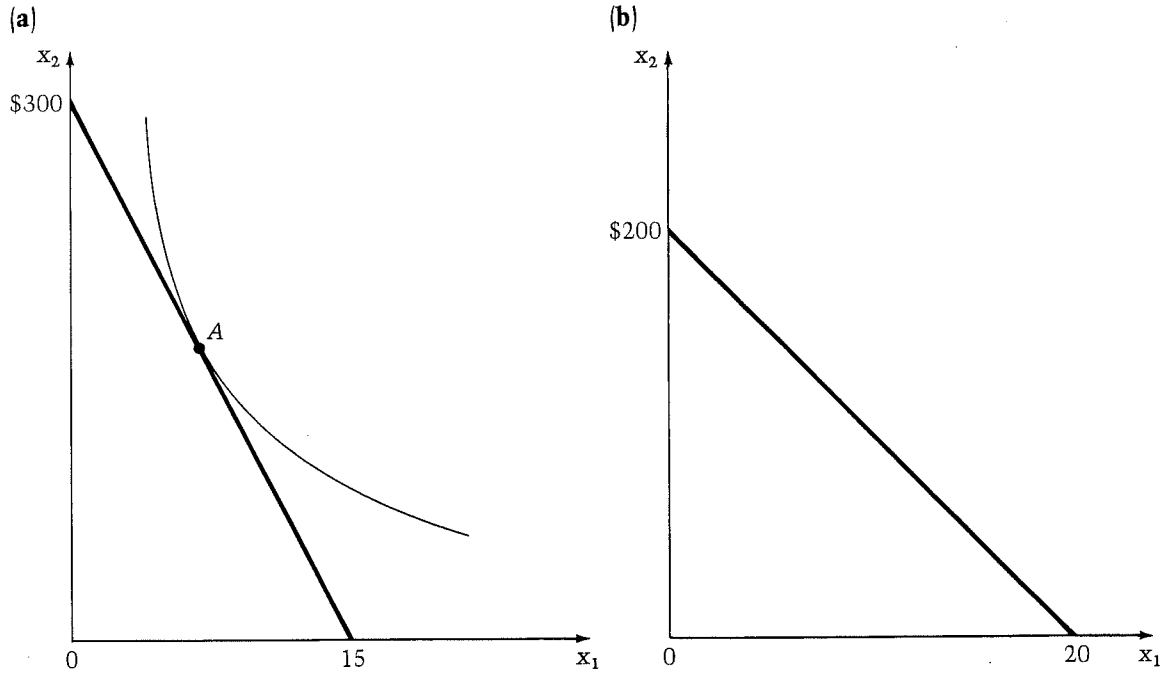

FIGURE A5.13

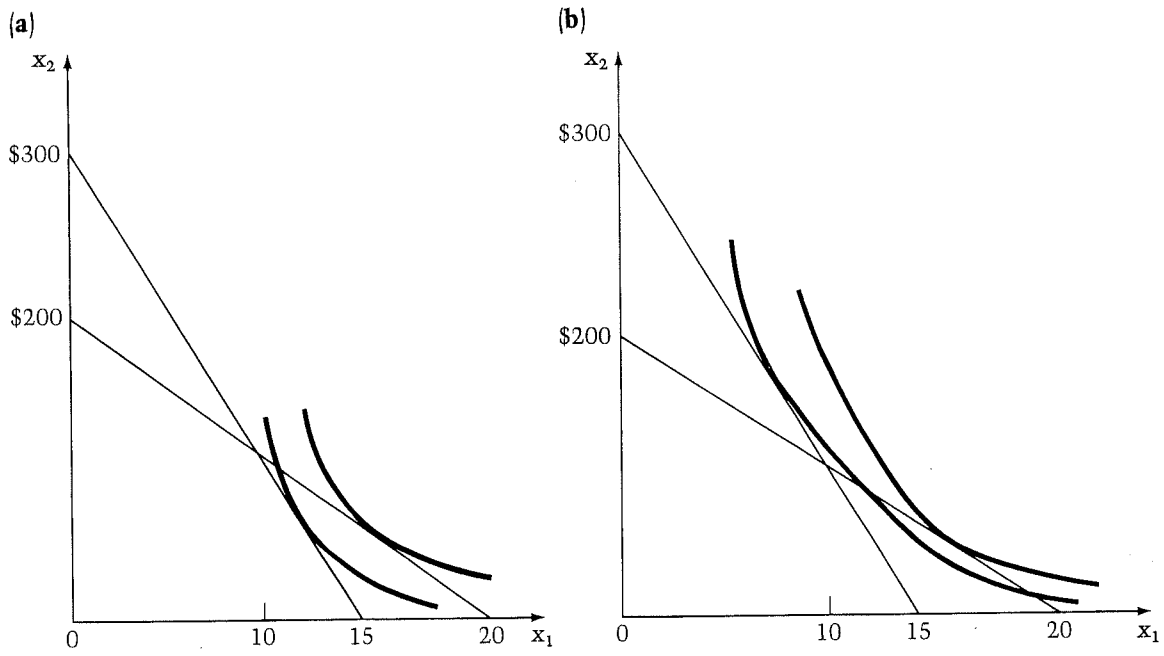

FIGURE A5.14

cates that the individual would purchase more CDs under the plan and have less money to spend on everything else.

34 a The original budget line is *AB* in Figure A5.16. The budget line with the $2000 food voucher is *BCD*. Before the voucher, they consume the bundle given by point *E*; after the voucher, they consume the bundle given by point *C*. The way the indifference curves are drawn (they don't have to look that way), the Smiths spend only $2000 on food under the voucher.

b If the government gives a cash subsidy of $2000, the Smiths may choose to spend some of

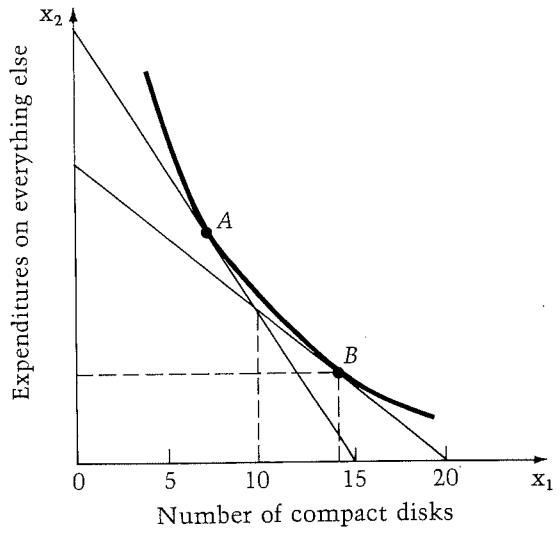

FIGURE A5.15

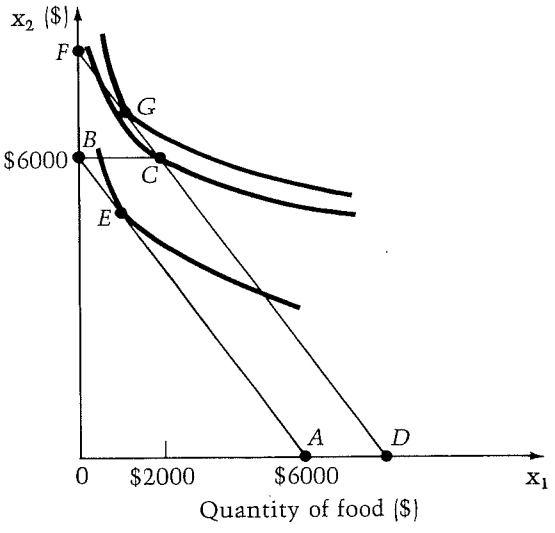

FIGURE A5.16

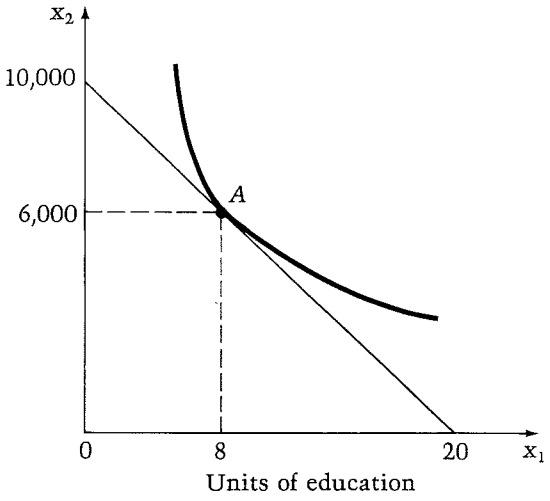

FIGURE A5.17

it on other goods. As shown in the figure, the budget line under the cash subsidy is *FD*. The Smiths choose point *G* on the budget line. In this case, the government is not closer to achieving its objectives; however, the Smiths are certainly better off.

35 a Laura's utility-maximizing bundle is given by point *A* in Figure A5.17.

b Under the per-unit subsidy, the budget line pivots outward as shown in Figure A5.18*a*. The government spends *BN*, the difference between the two budget lines at the utility-maximizing bundle *B*. This program will shift the demand

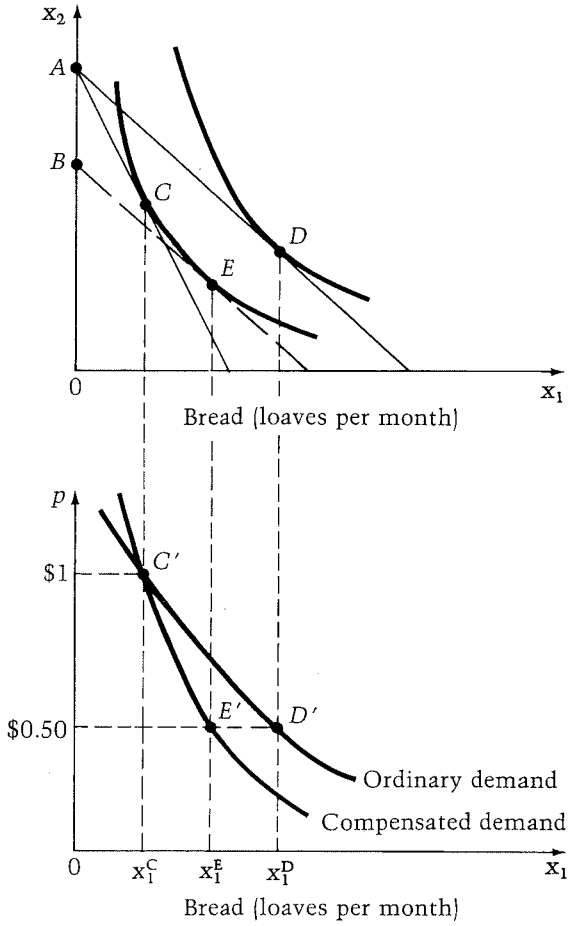

FIGURE A5.19

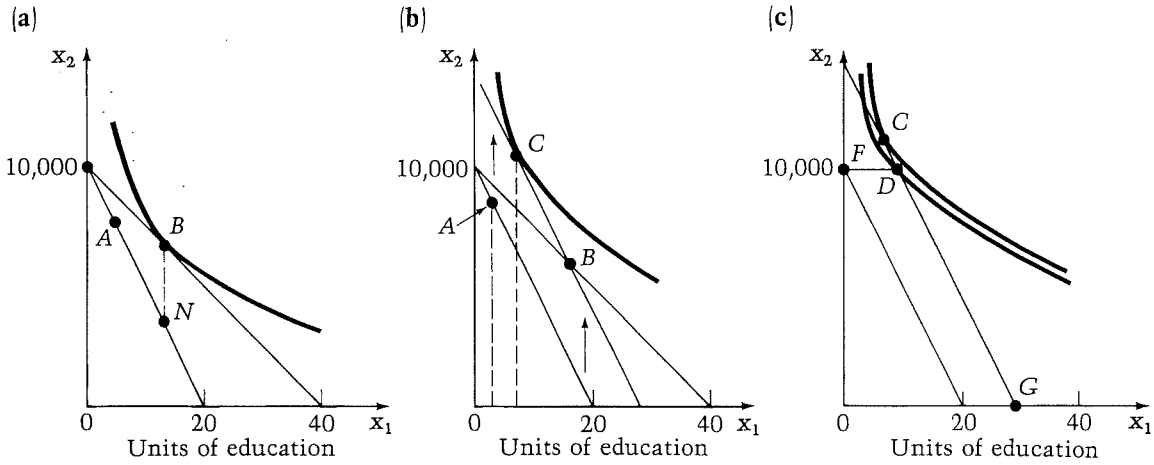

FIGURE A5.18

curve for education to the right; at every price, more units of education will be demanded.

c If the government gives a lump-sum subsidy equal to the amount spent on the program in **35b**, then the budget line will be a parallel increase in the original budget line with slope $p_1/p_2 = 500$ through point *B*. Laura chooses bundle *C* on a higher indifference curve, as shown in Figure A5.18*b*. The program will shift the demand curve for education to the right.

d Under the voucher scheme, the budget line will be the same as in **35c** except that bundles with more than 10,000 units of good 2 are not attainable. The new budget line is *FDG*. If Laura's bundle *C* in **35c** is as shown in Figure A5.18*c* then Laura will be worse off under the voucher scheme than under the cash subsidy. The best she can do is to consume bundle *D* under the voucher program. This program will shift the demand curve for education to the right.

e A lump-sum payment (cash subsidy) is more efficient than either a per-unit subsidy or a voucher. That is, given that the government spends the same amount of money on the individual in all cases, the recipient can be made no worse off and is usually better off with a cash subsidy than under the other two schemes.

36 a No. *ABCD* overestimates the true willingness to pay because bread is a normal good. That is, if the consumer surplus were actually taken away from the consumer, the individual would purchase less bread as a result of this income effect.

b The compensated demand curve is derived in Figure A5.19 for a decrease in the price of bread from \$1 to \$0.50. Bundles *C* and *D* are points on the ordinary demand curve; bundles *C* and *E* are points on the compensated demand curve. After the income effect is removed, the individual purchases x_1^E units of bread rather than x_1^D units at a price of \$0.50. The compensating variation is given by the vertical distance *AB* in the figure.