Solutions and Activities
for
CHAPTER 1

WHY STUDY PUBLIC FINANCE?

Questions and Problems

1. **Many states have language in their constitutions that requires the state to provide for an "adequate" level of education spending. What is the economic rationale for such a requirement?**

   There are two economic rationales for government provision of a good or service: market failure and redistribution. A market failure argument for state provision of education would be that an educated population benefits society generally because, for example, well-educated individuals have better job prospects and are therefore less likely to commit crimes. Each person who receives an education receives a private benefit (e.g., higher wage rate) and also confers a positive externality on the community (e.g., lower crime rate). In the absence of public provision of education, self-interested people would acquire less-than-optimal levels of education because they would not take into account its external benefit. Public education can correct this market failure. An argument can also be made that public education is redistributive because it increases the human capital of all students regardless of their individual economic status.

2. **How has the composition of federal and state and local government spending changed over the past 40 years? What social and economic factors might have contributed to this change in how governments spend their funds?**

   Since 1960, there has been a marked shift of federal spending away from defense spending and toward spending on Social Security and health care. In 1960, defense spending accounted for approximately half of the federal budget, while Social Security and health care combined accounted for about 15% of the budget. In 2001, Social Security and health care spending each exceeded defense spending, which accounted for less than 20% of total federal spending.

   Health spending has also increased as a fraction of state and local spending, more than doubling over the last 40 years. Otherwise, the composition of the state and local spending has been relatively stable over that time.

   The increases in expenditures on Social Security and health care reflect the aging of the population. As the baby boom generation has aged, it has had a greater need for these kinds of spending. Furthermore, this generation has played an increasingly important role in the political process, which has allowed them to win increases in spending directed toward their interests.

   The relative decrease in defense spending may have been influenced by the collapse of the Soviet Union and the end of the cold war.

3. Some goods and services are provided directly by the government, while others are funded publicly but provided privately. What is the difference between these two mechanisms of public financing? Why do you think the same government would use one approach sometimes and the other approach at other times?

Direct public provision of a good or service occurs when the government itself produces the good or service. Police forces and military are examples of direct provision. Public financing of private provision of goods and services occurs when the government wishes to increase the provision of a good or service, but it does not want to directly involve itself in its provision. An example is when the government hires private companies to build or repair roads, or when the government purchases military aircraft from private companies instead of building them itself.

Public funding for private provision is appealing relative to direct public provision whenever the private market can produce the goods or services more efficiently than the government. This is likely to be the case where there is an existing market or industry for the good or service, especially when that market is competitive. When there is no existing market for a good or service provided by the government, or when that market is characterized by an imperfectly competitive industry, there may be a stronger case for direct provision (although it is important to recognize that direct provision can also suffer from efficiency failures). There may be national security concerns related to private provision of certain goods and services, especially those performed by the military and police forces. The government is more likely to provide these goods and services directly.

4. Why does redistribution cause efficiency losses? Why might society choose to redistribute resources from one group to another when doing so reduces the overall size of the economic pie?

Redistribution can cause efficiency losses if there are behavioral responses to the redistribution system. The government might raise money to fund redistribution by imposing a tax on labor income, and this might cause a reduction in the labor supply. Similarly, generous unemployment benefits might induce some who are out of work to remain unemployed. Despite these possible efficiency losses, we (collectively) choose to redistribute wealth. Some reasons for redistribution are that people have a taste or preference for a certain degree of economic equity; that the existence of a large or visible underclass is somewhat discomforting or threatening; that people are risk averse and so are willing to pay for a "safety net" in case they or their families ever need assistance; and that humans are naturally empathetic. In a country with many very poor people, redistribution from the few rich to the many poor may make the majority of people better off, even if it reduces the overall size of the pie. A democratic process may therefore lead to the occurrence of this sort of redistribution.

5. Consider the four basic questions of public finance listed in the chapter. Which of these questions are positive—questions that can be proved or disproved—and which are normative—questions of opinion? Explain your answer.

The four basic questions of public finance:

1. *When should the government intervene in the economy?* The word "should" suggests that this is a question about which opinion will vary, so it is normative.
2. *How might the government intervene?* This question is positive. It asks: How does the government actually intervene now, and how might it intervene in the future? One can check whether a government might intervene in a particular way directly by examining the behavior of existing and future governments.
3. *What is the effect of those interventions on economic outcomes?* Economic effects can be measured and thus are not a matter of opinion, so this question is positive.

4. *Why do governments choose to intervene in the way they do?* This is a factual (positive) question. It may be difficult to directly observe the answer, but one can potentially learn about the motivations behind a government's interventions by looking at patterns of behavior over time.

6. One rationale for imposing taxes on alcohol consumption is that people who drink alcohol impose negative spillovers on the rest of society—for example through loud and unruly behavior or intoxicated driving. If this rationale is correct, in the absence of governmental taxation, will people tend to consume too much, too little, or the right amount of alcohol?

People demand goods primarily on the basis of their own enjoyment of that good. They tend to underweight the impact of their consumption on the well-being of others. In the absence of taxes on alcohol, people will tend to consume too much of it. That is, they will tend to consume more than they would if they took the harm they cause others into account.

7. What is the role of the Congressional Budget Office? Why is independence and impartiality important when conducting empirical analyses?

The CBO provides economic analyses of proposed legislation, particularly estimates of the cost of proposed projects. To do this accurately and to provide the best possible advice to Congress, the CBO must carefully consider all the economic effects of a proposal. A politically motivated CBO might be tempted to understate some costs or overstate others in order to influence legislation.

8. In order to make college more affordable for students from families with fewer resources, a government has proposed allowing the student of any family with less than $50,000 in savings to attend public universities for free. Discuss the direct and possible indirect effects of such a policy.

This policy would make college cheaper for students from families with less than $50,000 in savings. There would be two direct effects of this policy. First, it would make the families of students who already intended to attend college better off if the families that were saving had less then $50,000 in savings. Second, it would probably encourage additional students from low-savings families to attend college. A potential indirect effect of this policy would be to reduce the savings of *other* families—families that were saving money for a college education but would stop doing so when they could anticipate getting a free ride if they don't save.

9. The country of Adventureland has two citizens, Bill and Ted. Bill has a private legal business. He earns $50 per hour. At a tax rate of 0%, Bill works 20 hours. At a 25% tax rate he works only 16 hours, and at a 40% tax rate he works only 8 hours per week. Ted works a manufacturing job. He works 20 hours per week and earns $6 per hour, regardless of the tax rate. The government is considering imposing an income tax of either 25% or 40% on Bill and using the revenues to make transfer payments to Ted. The accompanying table summarizes the three possible policies. Does either tax policy raise social welfare? Are either of the policies obviously less than optimal? Explain your answers.

Effects of Redistributive Policies in Adventureland			
	0%	**25%**	**40%**
Bill's Pre-Tax Income	$1,000	$800	$400
Bill's Taxes	0	$200	$160
Bill's Net Income	**$1,000**	**$600**	**$240**
Ted's Pre-Tax Income	$120	$120	$120
Ted's Transfer Payment	0	$200	$160
Ted's Net Income	**$120**	**$320**	**$280**

Whether or not the policies raise social welfare depends on the society's taste for redistribution. Indeed, either of the policies makes Ted better off and makes Bill worse off than the status quo of no taxes, so if society deems it sufficiently important to redistribute to Ted, then either policy would raise social welfare. If society cares about only the "size of the pie," however, then both policies would lower social welfare. Whenever society deems that improving Ted's income by $200 improves social welfare more than reducing Bill's income by $400 harms social welfare, the 25% tax policy raises social welfare and is the optimal policy. The 40% tax policy can never be optimal, since the 25% tax policy makes both Bill and Ted better off than the 40% tax policy.

Advanced Questions

10. In the United States, the federal government pays for a considerably larger share of social welfare spending (that is, spending on social insurance programs to help low-income, disabled, or elderly people) than it does for K–12 education spending. Similarly, state and local governments provide a larger share of education spending and a smaller share of welfare spending. Is this a coincidence, or can you think of a reason for why this might be so?

Local control is often considered more important for education than for other services because there may be regional variations in curriculum preferences—whether to teach the theory of evolution, for example. There may be fewer regional variations in preferences related to social programs, however, so people may be more willing to give up local control over these programs. Another possible explanation for federal control of social welfare programs is jurisdiction "shopping." If social insurance benefits varied substantially among states, people might move from one to another to avail themselves of more generous benefits.

11. The urban African-American community is decidedly split on the subject of school vouchers, with their leaders comprising some of the most vocal proponents and opponents of increased school competition. Why do you think this split exists?

This community contains a disproportionate number of poor families, with many students attending substandard schools. Proponents of the voucher system may believe that it will allow them to send their children to better schools or that competition will encourage their local schools to improve in order to retain students who would have a choice of schools under the voucher system. Opponents may view it as a threat to neighborhood schools, fearing that if students take their vouchers and leave, inner-city schools may become even more impoverished. Philosophically, some proponents believe that market competition can solve a wide variety of problems, while some opponents are suspicious of the market system—at least as applied in the context of education—possibly viewing it as an institution that favors those with more money to spend in the marketplace.

12. Many states have constitutional requirements that their budgets be in balance (or in surplus) in any given year, but this is not true for the U.S. federal government. Why might it make sense to allow for deficits in some years and surpluses in others?

Time-series graphs illustrate one striking reason to allow for deficits: during World War II the federal government spent far more than it took in. Like a family, a government sometimes faces unforeseen emergencies that require it to borrow. Had the United States been constrained by a balanced budget requirement at the time of World War II, the outcome of the war might have been very different. The family metaphor is relevant for a second reason:

borrowing allows an entity to pay over time for a durable good that is being consumed over time. It makes sense for most families to take out a mortgage to purchase a home, because that purchase delivers benefits over many years. Similarly, many government investments yield long-term benefits. Surpluses and deficits may also have beneficial macroeconomic effects, such as helping to stabilize a volatile economy.

13. Proper hygiene, such as regular hand-washing, can greatly limit the spread of many diseases. How might this suggest a role for public interventions? What kinds of public interventions might be possible? Suggest three distinct types of possible interventions.

Individuals tend to ignore the external costs they impose on others by failing to wash their hands frequently enough (or by failing to employ other sorts of hygienic practices). This suggests that they tend to wash their hands less than optimally and that there may therefore be a role for public interventions. One possible intervention would be a requirement that individuals wash their hands after using restrooms. (Such regulations are imposed for employees at businesses, for example.) A second possible intervention is public provision of hand-washing facilities. This would reduce the cost of hand-washing, thereby encouraging individuals to engage in that activity more frequently. A third possibility would be an advertising campaign to encourage hand-washing.

In-class Projects or Demonstrations

Federal Budget Shares and Positive vs. Normative Questions

1. How does the federal government allocate its budget?

On the first day of class (before most students have read the text), ask students individually or in small teams to allocate 100 "points" among the federal budget categories, showing the proportion of the budget they *think* is actually spent on each category. This is a positive question; initial guesses can be verified against the data in the text.

2. How "should" federal government dollars be spent?

After the first exercise, ask small groups of students to set an "ideal" budget (again based on 100 points so that their allocations can be easily translated into percentages), then require each team to justify its allocations. Part of this exercise forces students with differing priorities to negotiate over the 100 points. The exercise also encourages them to use economic theory to justify their allocations.

Students can investigate the effects of these decisions at www.budgetsim.org/nbs/shortbudget06.html.

Solutions and Activities
for
CHAPTER 2

THEORETICAL TOOLS OF PUBLIC FINANCE

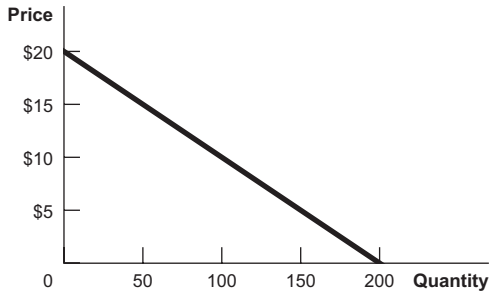
Questions and Problems

1. **The price of a bus trip is $1 and the price of a gallon of gas (at the time of this writing!) is $3. What is the relative price of a gallon of gas, in terms of bus trips? What happens when the price of a bus trip falls to 75¢?**

   A commuter could exchange 3 bus trips for 1 gallon of gas (both will cost $3), so the relative price of a gallon of gas is 3 bus trips. At 75¢ per bus trip, the relative price of a gallon of gas has increased to 3 ÷ 0.75 = 4 bus trips.

2. **Draw the demand curve $Q = 200 - 10P$. Calculate the price elasticity of demand at prices of $5, $10, and $15 to show how it changes as you move along this linear demand curve.**

   One way to sketch a linear demand function is to find the x (Q) and y (P) intercepts. $Q = 0$ when $P = \$20$. When $P = 0$, $Q = 200$.



   Solving for $P = \$5$, $Q = 200 - 10(5) = 200 - 50 = 150$.

   Similarly, solving for $P = \$10$, $Q = 200 - 10(10) = 100$.

   And solving for $P = \$15$, $Q = 200 - 150 = 50$.

   Price elasticity is the percent change in the quantity purchased divided by the percent change in price. To calculate these percentage changes, divide the change in each variable by its original value. Moving in $5 increments:

   As P increases from $5 to $10, Q falls from 150 to 100.
   Therefore, P increases by 100% (5/5) as Q falls by 33% (50/150).
   Elasticity = –0.33/1.00 = –0.33.

   As P increases from $10 to $15, Q falls from 100 to 50.
   P increases by 50% (5/10) as Q falls by 50% (50/100).
   Elasticity = –0.5/0.5 = –1.0.

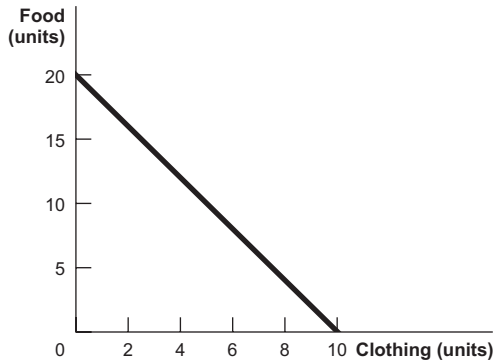
As P increases from \$15 to \$20, Q falls from 50 to 0.
P increases by 33% (5/15) and Q increases by 100% (50/50).
Elasticity is –1.0/0.33 = –3.03.

Even though the magnitude of the change remains the same (for every \$5 increase in price, the quantity purchased falls by 50), in terms of percentage change elasticity of demand increases in magnitude as price increases.

3. You have \$100 to spend on food and clothing. The price of food is \$5 and the price of clothing is \$10.

a. Graph your budget constraint.

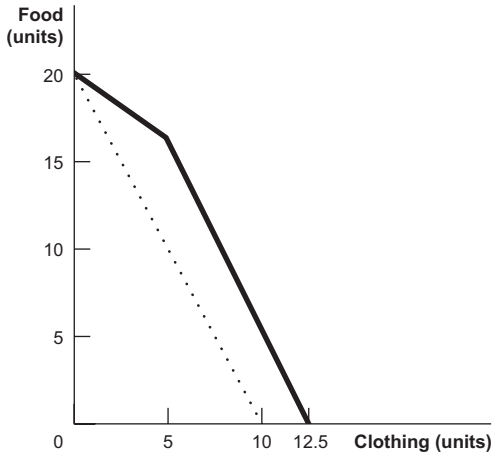
The food intercept (y in the accompanying figure) is 20 units. If you spend the entire \$100 on food, at \$5 per unit you can afford to purchase 100/5 = 20 units. Similarly, the clothing intercept (x) is 100/10 = 10. The slope, when food is graphed on the vertical axis, will be –2.



b. Suppose that the government subsidizes clothing such that each unit of clothing is half-price, up to the first 5 units of clothing. Graph your budget constraint in this circumstance.

This budget constraint will have two different slopes. At quantities of clothing less than or equal to 5, the slope will be –1 because 1 unit of food costs the same as 1 unit of clothing (\$5). At quantities of clothing greater than 5, the slope will be –2 (if graphed with food on the y-axis), parallel to the budget constraint in a. The point where the line kinks, (5,15), is now feasible. The new x-intercept (clothing intercept) is 12.5: if you purchase 5 units at \$5 per unit, you are left with \$75 to spend. If you spend it all on clothing at \$10 per unit, you can purchase 7.5 units, for a total of 12.5 units.

New budget constraint (bold) and original (dashed):

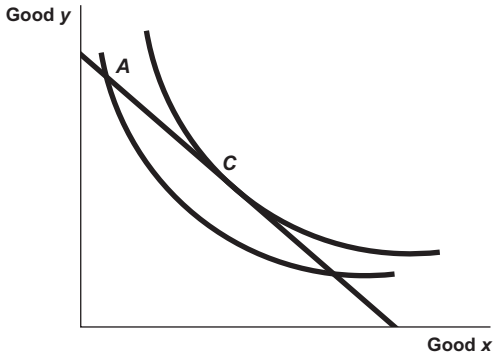


4. Use utility theory to explain why people ever leave all-you-can-eat buffets.

The theory of diminishing marginal utility predicts that the more people eat the less utility they gain from each additional unit consumed. The marginal price of an additional unit of food at an all-you-can-eat buffet is zero; rational consumers will eat only until their marginal utility gain from an additional bite is exactly zero. The marginal cost of remaining at the buffet is the value of the time spent on the best alternative activity. When the marginal benefit of that activity is greater than the marginal benefit of remaining at the buffet, diners will leave.

5. Explain why a consumer's optimal choice is the point at which her budget constraint is tangent to an indifference curve.

Consumers optimize their choice when they are on the highest possible indifference curve given their budget constraint. Suppose a consumer's choice is feasible (on the budget constraint) but not at a tangency, as at point *A* in the accompanying figure. Under these circumstances, the budget constraint must pass through the indifference curve where it intersects the chosen point. There must then be at least a segment of the budget constraint that lies above (up and to the right of) the indifference curve associated with that choice. Any choice on that segment would yield higher utility. Only when no part of the budget constraint lies above the indifference curve associated with a consumer's choice are no feasible improvements in utility possible. The single tangency point (*C* in the figure) is the only point at which this occurs.



6. Consider the utilitarian social welfare function and the Rawlsian social welfare function, the two social welfare functions described in Chapter 2.

a. Which one is more consistent with a government that redistributes from rich to poor? Which is more consistent with a government that does not do any redistribution from rich to poor?

The Rawlsian social welfare function is consistent with redistribution from the rich to the poor whenever utility is increasing in wealth (or income). The utilitarian social welfare function can also be consistent with a government that redistributes from the rich to the poor, for example, if utility depends only on wealth and exhibits diminishing marginal utility. However, the Rawlsian social welfare function weights the least-well-off more heavily, so it will generally prescribe more redistribution than the utilitarian social welfare function.

b. Think about your answer to a. Show that government redistribution from rich to poor can still be consistent with either of the two social welfare functions.

If utility depends only on wealth and exhibits diminishing marginal utility, and if efficiency losses from redistribution are small, then both the utilitarian and Rawlsian social welfare functions can be consistent with government redistribution. A simple example can

illustrate this point. Suppose that utility as a function of wealth is expressed as $v = \sqrt{w}$, and that a rich person has wealth of \$100 (yielding utility of 10) and a poor person has wealth of \$25 (yielding utility of 5). The sum of utilities is 10 + 5 = 15.

Tax the wealthy person \$19; their remaining wealth is \$81, yielding utility of 9. Give \$12 of the \$19 to the poor person; this yields wealth of 25 + 12 = \$37. The square root (utility) of 37 is greater than 6, so total utility is now greater than 15, even with the efficiency loss of \$7 (\$19 – \$12). Under the Rawlsian function, which considers only the least-well-off person's utility, social welfare has increased from 5 to greater than 6.

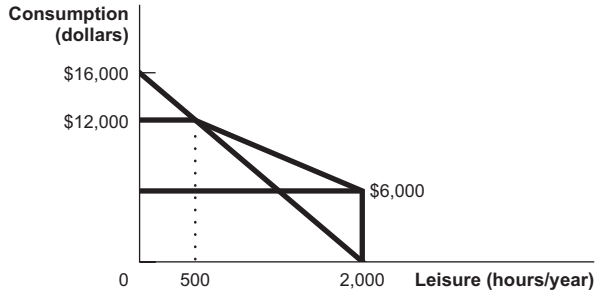
7. Since the free market (competitive) equilibrium maximizes social efficiency, why would the government ever intervene in an economy?

Efficiency is not the only goal of government policy. Equity concerns induce government to intervene to help people living in poverty, even when there are efficiency losses. In economic terms, a society that willingly redistributes resources has determined that it is willing to pay for or give up some efficiency in exchange for the benefit of living in a society that cares for those who have fewer resources. Social welfare functions that reflect this willingness to pay for equity or preference for equity may be maximized when the government intervenes to redistribute resources.

8. Consider an income guarantee program with an income guarantee of \$6,000 and a benefit reduction rate of 50%. A person can work up to 2,000 hours per year at \$8 per hour.

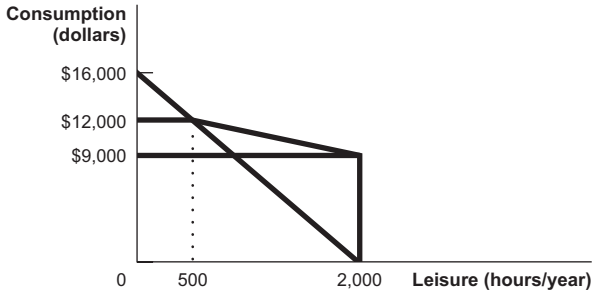
a. Draw the person's budget constraint with the income guarantee.

A person will no longer be eligible for benefits when he or she works 1,500 hours and earns \$12,000 (guarantee of \$6,000/50%).



b. Suppose that the income guarantee rises to \$9,000 but with a 75% reduction rate. Draw the new budget constraint.

Benefits will end under these conditions when earned income is \$9,000/.75 = \$12,000, just as shown in a. The difference is that the all-leisure income is higher, but the slope of the line segment from 500 hours of leisure to 2,000 hours of leisure is flatter.



c. Which of these two income guarantee programs is more likely to discourage work? Explain.

A higher income guarantee with a higher reduction rate is more likely to discourage work for two reasons. First, not working at all yields a higher income. Second, a person who works less than 1,500 hours will be allowed to keep much less of his or her earned income when the effective tax rate is 75%. With a 75% benefit reduction rate, the effective hourly wage is only $2 per hour (25% of $8).

9. A good is called *normal* if a person consumes more of it when her income rises (for example, she might see movies in theaters more often as her income rises). It is called *inferior* if a person consumes less of it when her income rises (for example, she might be less inclined to buy a used car as her income rises). Sally eats out at the local burger joint quite frequently. The burger joint suddenly lowers its prices.

a. Suppose that, in response to the lower burger prices, Sally goes to the local pizza restaurant less often. Can you tell from this whether or not pizza is an inferior good for Sally?

You cannot. Since Sally eats at the burger joint quite a bit, falling burger prices imply that she is richer. If this was the only effect, you could indeed conclude that pizza is an inferior good—Sally gets richer and buys less pizza. But there is also a substitution effect here: the relative price of pizza has gone up. This leads her to substitute away from pizza. If the substitution effect is bigger than the income effect for Sally, then she could respond in this way, even if pizza is a normal good.

b. Suppose *instead* that, in response to the lower burger prices, Sally goes to the burger joint less often. Explain how this could happen in terms of the income and substitution effects by using the concepts of normal and/or inferior goods.

The substitution effect says that when the relative price of burgers falls, Sally should consume more of them. Since she actually consumes less of them, the income effect must be working in the opposite direction, leading her to consume fewer burgers (and it must be stronger than the substitution effect). Since the fall of burger prices made Sally richer, burgers must be an inferior good for Sally. (Note: A good for which falling prices leads to reduced consumption is known as a Giffen good.)

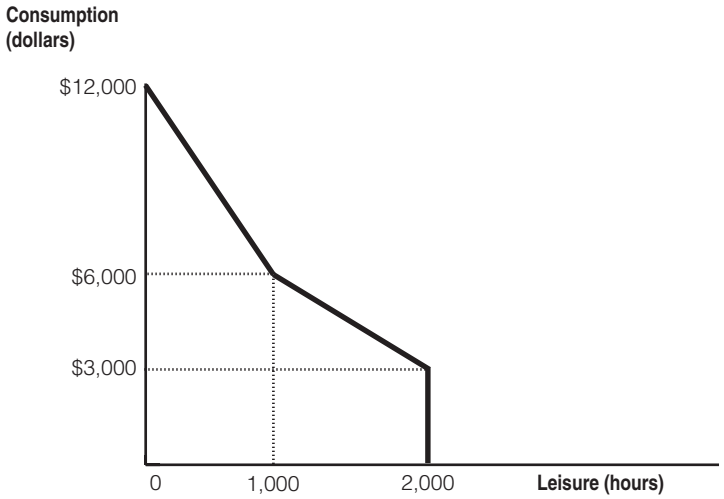
Advanced Questions

10. Consider an income guarantee program with an income guarantee of $3,000 and a benefit reduction rate of 50%. A person can work up to 2,000 hours per year at $6 per hour. Alice, Bob, Calvin, and Deborah work for 100, 333$^1/_3$, 400, and 600 hours, respectively, under this program.

The government is considering altering the program to improve work incentives. Its proposal has two pieces. First, it will lower the guarantee to $2,000. Second, it will not reduce benefits for the first $3,000 earned by the workers. After this, it will reduce benefits at a reduction rate of 50%.

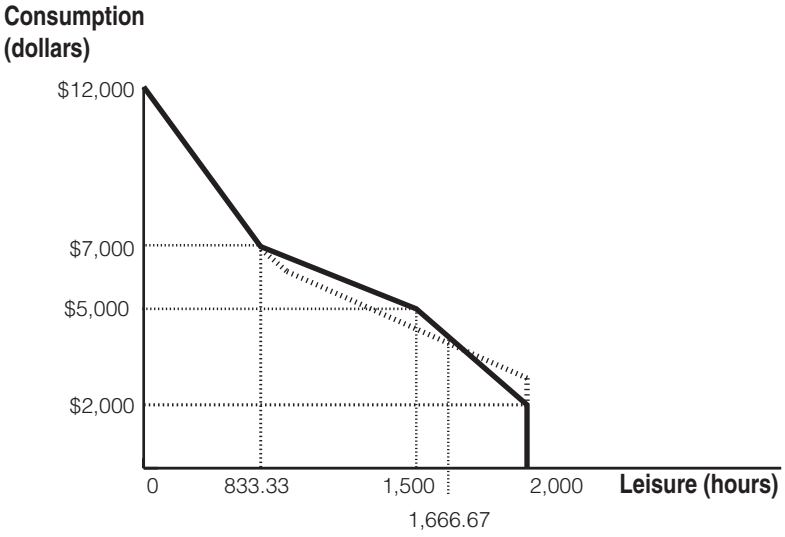
a. Draw the budget constraint facing any worker under the original program.

The budget constraint for the original program is depicted in the graph that follows. With zero hours worked (2,000 hours leisure), a worker gets to consume $3,000—the guaranteed income level. After 1,000 hours of work, the benefits have been reduced to zero (50% of $6,000 in income).



b. Draw the budget constraint facing any worker under the proposed new program.

The budget constraint for the proposed program is depicted in the following graph. At zero hours of work (2,000 hours of leisure), the worker now only gets to consume the lower $2,000 guarantee. She can work for up to 500 hours without any benefit reductions, so if she works for 500 hours, she gets to consume $5,000 (= $2,000 + $6/hr × 500 hrs) and has 1,500 hours of leisure. After working an additional 2,000/3 ≈ 666.67 hours, for a total of about 1,133.33 hours of work or 833.33 hours of leisure, she will be receiving no benefits. (Her benefits have been reduced by 50% × $6/hr × 2,000/3 hrs = 50% × $4,000 = $2,000.) The dashed line also depicts the original budget constraint.



c. Which of the four workers do you expect to work more under the new program? Who do you expect work less? Are there any workers for whom you cannot tell if they will work more or less?

Workers working fewer than 500 hours see their hourly wage effectively doubled under the plan. The substitution effect therefore tends to make Alice, Bob, and Calvin all work more. One can calculate that the two budget constraints cross at 333⅓ hours of

work, or 1,666.67 hours of leisure. The income effect is thus different for these three workers. Alice was working less than 333⅓ hours under the old policy, so the policy change effectively makes her poorer. She consumes less of all normal goods, including leisure, so this also makes her work more. We can unambiguously conclude that she will work more. Bob was working exactly 333⅓ hours, so he feels no income effect. We can conclude from the substitution effect alone that he too will work more. Calvin was working more than 333⅓ hours before, so this policy change effectively makes him richer. He will therefore tend to work less due to the income effect. We cannot tell if the substitution effect or the income effect is stronger, so we cannot tell if Calvin will work more or less. Finally, Deborah was working 600 hours before. Under both policies, the effective wage of someone working this many hours is $3/hr (since 50% of income is offset by reduced benefits). There is no substitution effect for her. As the graph shows, however, she experiences an increase in income. We conclude that she will work less.

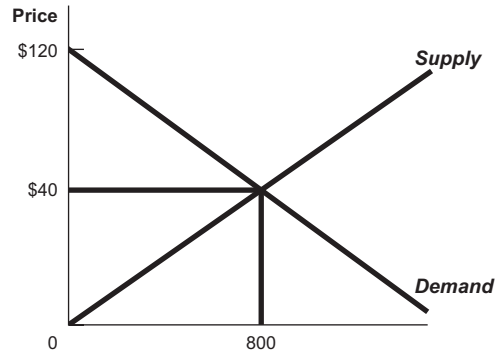
11. Consider a free market with demand equal to $Q = 1{,}200 - 10P$ and supply equal to $Q = 20P$.

a. What is the value of consumer surplus? What is the value of producer surplus?

The first step is to find the equilibrium price and quantity by setting quantity demanded equal to quantity supplied. Recall that the condition for equilibrium is that it is the price at which these quantities are equal.

From $Q = 1{,}200 - 10P$ and $Q = 20P$, substitute: $1{,}200 - 10P = 20P$.
Adding $10P$ to each side of the equation yields $1{,}200 = 30P$.
Dividing both sides by 30 yields $P = 40$. If $Q = 20P$, then in equilibrium
$Q = 20(40) = 800$.

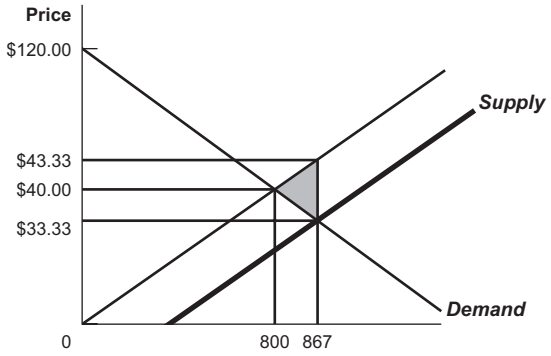
Consumer and producer surplus are determined by finding the areas of triangles; area is equal to ½ the base times the height.



The vertical intercept is the price at which quantity demanded is zero: $0 = 1{,}200 - 10P$. This solves to 120.

Consumer surplus = ½ (800)(120 – 40) = ½ (800)(80) = 32,000.
Producer surplus = ½ (800)(40) = 16,000.
Total surplus = 48,000.

b. Now the government imposes a $10 per unit subsidy on the production of the good. What is the consumer surplus now? The producer surplus? Why is there a deadweight loss associated with the subsidy, and what is the size of this loss?



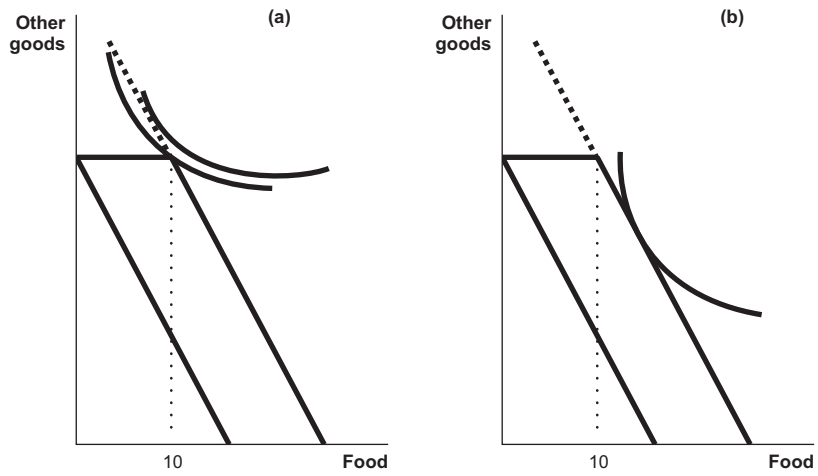
A subsidy in effect lowers the cost of producing a good, yielding the bold supply line. The new supply function is $Q = 20(P + 10)$ because the producer receives the price plus $10 when it produces. Solving for a new equilibrium,

$20P + 200 = 1{,}200 - 10P$.
$30P = 1{,}000$.
$P = \$100/3 \approx \$33.33$; $Q = 20\ (100/3 + 10) = 2{,}600/3 \approx 866.67$.
Consumer surplus = ½ (2600/3)(120-100/3) ≈ 37,555.56.
Producer surplus = ½ (100/3 + 10)(2,600/3) ≈ 18,777.78.
Cost of subsidy = 10(2600/3) ≈ 8,666.67.
Total surplus = consumer surplus + producer surplus – cost of subsidy ≈ 47,666.67, less than the original 48,000.

There is efficiency loss because trades are induced for which the actual resource cost (without the subsidy) is greater than consumer willingness to pay. The deadweight loss is the area of the triangle that encompasses these new trades (the shaded area in the graph, pointing to the original equilibrium): ½ (2,600/3 – 800)(10) ≈ 333.33.

12. Governments offer both cash assistance and in-kind benefits, such as payments that must be spent on food or housing. Will recipients be indifferent between receiving cash versus in-kind benefits with the same monetary values? Use indifference curve analysis to show the circumstances in which individuals would be indifferent and situations in which the form of the benefits would make a difference to them.

Generally recipients can attain a higher level of utility (they can choose a consumption bundle on a higher indifference curve) when they are given cash rather than a specific good. People who would purchase the same amount of food or housing as the in-kind grant provides would be indifferent between in-kind and cash benefits because they would use the cash to purchase the same items. However, people whose preferences would lead them to purchase less food or housing than the in-kind grant provides would prefer to receive cash. That way they could spend some of the cash on food or housing and the rest on the other goods they prefer. Suppose the government provides the first ten units of food at no cost. The person represented in panel (a) of the following graph would prefer cash. The indifference curve tangent to the extension of the new budget constraint identifies a consumption bundle that includes less than ten units of food. The person represented in panel (b) would choose the same point given cash or food. The optimal consumption bundle includes more than ten units of food.



13. Consider Bill and Ted, the two citizens in the country of Adventureland described in Problem 9 from Chapter 1. Suppose that Bill and Ted have the same utility function $U(Y) = Y^{1/2}$, where Y is consumption (which is equal to net income).

a. Rank the three tax policies discussed in Problem 9 from Chapter 1 for a utilitarian social welfare function. Rank the three for a Rawlsian social welfare function.

The utility function is increasing in income. Rawlsian social welfare is therefore equal to the utility of the individual with lower income. For 0% and 25% tax rates, Ted has the lower incomes ($120 and $320, respectively). For a 40% tax rate, Bill has the lower income ($240). Since $320 > $240 > $120, Rawlsian social welfare is highest under the 25% tax rate and lowest under the 40% tax rate. To compute utilitarian social welfare, we compare:

Utilitarian social welfare with a 0% tax = $1{,}000^{1/2} + 120^{1/2} \approx 42.58$
Utilitarian social welfare with a 25% tax = $600^{1/2} + 320^{1/2} \approx 42.38$
Utilitarian social welfare with a 40% tax = $240^{1/2} + 280^{1/2} \approx 32.33$

We see that the 0% tax rate is best.

b. How would your answer change if the utility function was instead $U(Y) = Y^{1/5}$?

This change does not affect the order of tax rates according to the Rawlsian social welfare function. To compute social welfare for the utilitarian social welfare function we compare:

utilitarian social welfare with 0% tax = $(1000)^{1/5} + 120^{1/5} \approx 6.59$.
utilitarian social welfare with 25% tax = $600^{1/5} + 320^{1/5} \approx 6.76$.
utilitarian social welfare with 40% tax = $240^{1/5} + 280^{1/5} \approx 6.08$.

We see that the 25% tax rate is best and the 40% tax rate is the worst.

c. Suppose that Bill and Ted instead have different utility functions: Bill's utility is given by $U^B(Y) = \frac{1}{4}Y^{1/2}$, and Ted's is given by $U^T(Y) = Y^{1/2}$. (This might happen, for example, because Bill has significant disabilities and therefore needs more income to get the same level of utility.) How would a Rawlsian rank the three tax policies now?

Since the two have different utility functions, it is no longer easy to see who is better off under each situation. Under the 0% tax policy, we see that Ted has utility $120^{1/2} \approx 10.95$ and Bill has utility $\frac{1}{4}\, 1{,}000^{1/2} \approx 7.91$. We see that Bill is worse off under this policy.

Since the other two tax policies make Bill worse off and Ted better off than the 0% policy, Bill's utility will be used to compute Rawlsian social welfare. Rawlsian social welfare is highest with 0% taxes and lowest with 50% taxes, the policies that make Bill the best and worst off, respectively.

Effects of Redistributive Policies in Adventureland			
	0%	**25%**	**40%**
Bill's Pre-Tax Income	$1,000	$800	$400
Bill's Taxes	0	$200	$160
Bill's Net Income	**$1,000**	**$600**	**$240**
Ted's Pre-Tax Income	$120	$120	$120
Ted's Transfer Payment	0	$200	$160
Ted's Net Income	**$120**	**$320**	**$280**

14. You have $3,000 to spend on entertainment this year (lucky you!). The price of a day trip (*T*) is $40 and the price of a pizza and a movie (*M)* is $20. Suppose that your utility function is $U(T,M) = T^{1/3}M^{2/3}$.

a. What combination of *T* and *M* will you choose?

This question can be solved by students who have taken calculus, following the approach described in the appendix to the chapter.

The constrained optimization problem can be written as

Max $T^{1/3}(M)^{2/3}$ subject to $\$3{,}000 = 40T + 20M$.

Rewriting the budget constraint as $M = 150 - 2T$ and substituting into the utility function gives

Max $T^{1/3}(150–2T)^{2/3}$.

Taking the derivative with respect to T and setting equal to zero gives

$1/3\ T^{–2/3}\ (150 – 2T)^{2/3} – 4/3\ T^{1/3}(150 – 2T)^{–1/3} = 0.$

Rearranging gives

$(150 – 2T) = 4T$, or $T = 150/6 = 25$.

Plugging back into the budget constraint gives

$M = 150–2\ (25) = 100.$

You take 25 trips and go on 100 movie-and-a-pizza outings.

b. Suppose that the price of day trips rises to $50. How will this change your decision?

The new constrained optimization problem can be written

Max $T^{1/3}(M)^{2/3}$ subject to $\$3{,}000 = 50T + 20M$.

Rewriting the budget constraint as $M = 150 – 2.5T$ and substituting into the utility function gives

Max $T^{1/3}(150 – 2.5T)^{2/3}$

Taking the derivative with respect to T and setting equal to zero gives

$1/3\ T^{–-2/3}\ (150 – 2.5T)^{2/3} – 5/3\ T^{1/3}(150 – 2.5T)^{–1/3} = 0.$

Rearranging gives

$(150 - 2.5T) = 5T$, or $T = 150/7.5 = 20$.

Plugging back into the budget constraint gives:

$M = 150 - 2.5(20) = 100$.

You now take 20 trips and go on 100 movie-and-a-pizza outings.

Solutions and Activities
for
CHAPTER 3

EMPIRICAL TOOLS OF PUBLIC FINANCE

Questions and Problems

1. **Suppose you are running a randomized experiment and you randomly assign study participants into control and treatment groups. After making the assignments, you study the characteristics of the two groups and find that the treatment group has a lower average age than the control group. How could this arise?**

   Random draws do not guarantee that the average of all demographic and other variables will be exactly the same for groups, although if the size of the groups is large, they should converge to the same value. One reason the average ages might differ in this experiment is that the samples are too small. Imagine tossing a coin 10 times. You would expect to get approximately 5 heads and 5 tails, but you would not assume that your coin was biased if you instead got 6 or 7 heads. However, if you tossed the coin a very large number of times and got heads in 60% or 70% of the tosses, you would tend to conclude that the coin was biased. The law of large numbers says that the more times a fair coin is tossed, the closer the percentage of heads will tend to be toward 50%. Similarly with the groups from the randomized experiment: it is possible for the average age of the treatment and control groups to be quite different if the sample size is small, but as the sample size gets larger, these differences should disappear.

2. **Why is a randomized trial the "gold standard" for solving the identification problem?**

   If participant assignment to the treatment group and the control group is truly random and the groups are large enough, it is statistically unlikely that membership in one group or the other will be biased in a way that is related to the question being studied. On average, the two groups will have the same characteristics. This would not be true if subjects were allowed to choose their own groups, because people with certain traits in common may be more or less likely to select a given group.

3. **What do we mean when we say that correlation does not imply causality? What are some of the ways in which an empirical analyst attempts to disentangle the two?**

   Correlation merely means that two events tend to occur together; causality means that one event causes the other. Correlation can occur when a third event causes both of the other events. For example, ice cream consumption and air-conditioning use tend to happen together. They are correlated, but their relationship is not causal. A third event, hot weather, causes the other two events. The point of much empirical work is to control for possible variables that might cause other events (that are not causally related) to occur together. Randomized trials, regression analysis of data that include control variables, and quasi-ex-periments are all ways to investigate causal relationships by controlling for other possible mechanisms that might influence the variables of interest.

4. A researcher conducted a cross-sectional analysis of children and found that average test performance of children with divorced parents was lower than average test performance of children of intact families. This researcher then concluded that divorce is bad for children's test outcomes. What is wrong with this analysis?

This is a clear example of using correlation to infer causality. Perhaps the causality is reversed: it could be that parents of children who perform poorly on tests feel stressed, which leads to higher divorce rates, or a third variable might explain both events: perhaps residence in a close-knit community both enhances scholastic performance and deters divorce. In either case, we would observe lower scores among children with divorced parents, but in neither case would the divorced parents be the *cause* of the lower scores. In assessing the results of any study, researchers should consider all possible explanations for what was observed and then control for alternative explanations.

5. A study in the *Annals of Improbable Research* once reported that counties with large numbers of mobile home parks had higher rates of tornadoes than did other counties. The authors conclude that mobile home parks cause tornado occurrences. What is an alternative explanation for this fact?

This conclusion illustrates another obvious confusion of correlation with causation. Perhaps tornadoes are more frequently reported for neighborhoods with mobile home parks because even a very small tornado will damage a mobile home, but tornadoes may not do damage (and thus go unreported) in a neighborhood with masonry or wood homes (the Three Little Pigs theory). Perhaps people who have more resources are better able to choose safer locations to live in, leaving "tornado alley" neighborhoods to mobile home residents. Tornadoes occur much more frequently in some parts of the country than in others; perhaps these areas also have a higher share of mobile home parks.

6. What are some of the concerns with conducting randomized trials? How can quasi-experiments potentially help here?

Randomized trials are expensive: the validity of each study relies on the law of large numbers, and the greater the number of participants needed, the more expensive the data. It may be possible to run trials only by recruiting voluntary participants for them. If the people who respond to recruiting efforts differ in some way from the rest of the population, the results of the experiments may be unrepresentative of effects on the population at large. Attrition can also pose problems. It may be impossible to prevent some participants in a study from leaving town or otherwise ceasing to participate. If this attrition is nonrandom, it can undermine the initial randomization of the experiment and lead to biased results. Human subject approval is required to subject people to experimental practices, since subjecting individuals to intrusive or dangerous procedures can raise serious ethical concerns. Quasi-experiments allow researchers to take advantage of naturally occurring changes. For example, tax laws change periodically. Researchers can observe behavior before and after a tax-law change to investigate its effects. In some instances, where every taxpayer in a jurisdiction is affected by a change, there are sufficient numbers of participants to create a valid experimental pool. And there is no need to divide the participants into control and treatment groups because the date of the change divides the sample. Similarly, some changes in laws affect one group of people but not another group; thus, the legal distinction may create a control (unaffected) group and a treatment (affected) group.

7. You are hired by the government to evaluate the impact of a policy change that affects one group of individuals but not another. Suppose that before the policy change, members of a group affected by the policy averaged $17,000 in earnings and members of a group unaffected by the policy averaged $16,400. After the policy change,

members of the affected group averaged $18,200 in earnings while members of the unaffected group averaged $17,700 in earnings.

a. How can you estimate the impact of the policy change? What is the name for this type of estimation?

The question here is one of differences in changes: both groups experienced a change in earnings, but it is not immediately obvious whether either group experienced a bigger change. The appropriate approach to estimate the impact on each group is called a difference-in-differences approach.

Treatment group difference: $18,200 – $17,000 = $1,200
Control group difference: $17,700 – $16,400 = $1,300

Thus, we estimate that the impact of the policy change was to lower earnings by $100.

b. What are the assumptions you have to make for this to be a valid estimate of the impact of the policy change?

The essential assumption you have to make is that trends in earnings would have been the same for the two groups had there been no policy change. If, for some reason, one group would have experienced larger income growth than the other in the absence of the policy change, then the difference in difference estimate will be biased.

8. Consider the example presented in the appendix to this chapter. Which coefficient estimates would be considered "statistically significant" or distinct from zero?

There are two ways to determine at a glance whether a coefficient is statistically distinct from zero. The first way is to consider whether zero falls in the range bounded by two standard errors less than the estimate and two standard errors greater than the estimate. The second way is to divide the coefficient estimate by the standard error. If the quotient is approximately two or greater, the estimate can be considered statistically significant. By these standards, the estimated coefficient for the indicator, or dummy, variable "Black" is not distinct from zero; neither are the estimated coefficients for living in a central city, another urban area, or a rural area. All of the other variables pass this test of statistical significance: White, High School Dropout, High School Graduate, Some College, Age, TANF, and the constant term.

9. A researcher wants to investigate the effects of education spending on housing prices, but she only has cross-sectional data. When she performs her regression analysis, she controls for average January and July temperatures. Why is she doing this? What other variables would you control for, and why?

This researcher has access to very limited data and would like to control for the characteristics of the location of the housing stock. Housing prices reflect, among other things, the desirability of house location, and the researcher thinks that climate must affect desirability. She is unable to use historical prices to look at changes in price for a single location over time because she has only cross-sectional data, so she must use the data she has to control for systematic differences. Examples of other variables she could include are: local unemployment rates, average population age, number of school-age children, etc.

10. It is commonly taught in introductory microeconomics courses that minimum wages cause unemployment. The federally mandated minimum wage is $5.15, but approximately 1/3 of states have higher state-mandated minimum wages. Why can't you test the "minimum wages cause unemployment" theory by simply comparing unemployment rates across states with different minimum wages? Can you think of a better way to test it?

The problem with this test is that all states are not the same. Different states have populations with different characteristics and different preferences. Some of these characteristics

may be related to both the choice of the state-level minimum wage and the unemployment level. For example, consider states with a large number of people who have taken an economics course. People in these states may be inclined to favor low minimum wages (based on what they were taught in their introductory micro class) and also may find it very easy to get a job (they have studied economics, after all!). This would lead us to observe a relationship between unemployment rates and minimum wages across states even without any of the direct causation suggested by economic theory.

A better way to test this would be to look at how unemployment rates *changed* after a new minimum wage law was passed in one state compared with the change in unemployment rates in a nearby state that did not change its law. This is the approach taken, for example, in Card and Krueger (1994).

Advanced Questions

11. Suppose that your friend Oscar has collected data and determined that towns with newly constructed high schools tend to have higher SAT scores than other towns. He tells you that he has proved that new high schools cause higher SAT scores. When you object that "correlation does not imply causation," he is ready with more data. He shows you convincing evidence that SAT scores tend to increase shortly after towns build new high schools, but that there is no tendency for new high schools to be built in towns that have recently seen large increases in SAT scores. Is this enough evidence to prove that new high schools cause higher SAT scores, or can you think of an alternative explanation for Oscar's data?

The timing evidence is certainly more convincing than simple correlations—and it strongly suggests that SAT scores do not cause new schools to be built. However, there are alternative explanations to the conclusion that new schools cause higher SAT scores. For example, consider a town that has recently experienced a wave of "yuppification"—a number of young, well-educated couples have recently moved to what was traditionally a more blue-collar town. As these new couples have children who begin to approach high school age, they may vote to raise taxes to build a new school for their children. Their children—the children of well educated parents—are likely to do well on their SATs. This story would thus lead to the pattern Oscar found in these towns: a new high school gets built shortly before the children of better-educated parents begin to take their SATs. But in this story, the new school does *not* cause better SAT scores.

12. Researchers often use panel data (multiple observations over time of the same people) to conduct regression analysis. With these data, researchers are able to compare the same person over time in order to assess the impacts of policies on individual behavior. How could this provide an improvement over cross-sectional regression analysis of the type described in the text?

Panel data sets allow researchers to control for attributes of a person that do not change over time. For example, it is particularly hard to obtain data about attitudes, preferences for leisure, familial or cultural values, and the like, but these traits are likely to be fairly stable in adults. Therefore a researcher can control for these unobservable, or unmeasurable, influences on behavior by using panel data. In effect, the researcher can hold the person's underlying preferences and attitudes constant while observing their responses to policy over time.

13. Suppose that your state announced that it would provide free tuition to high-achieving students graduating from high school starting in 2007. You decide to see whether this new program induces families with high-achieving children graduating in 2007 or later to purchase new cars. To test your findings, you use a "falsification

exercise": you observe the new-car-purchasing behavior of families with children graduating in 2006. Why is this a useful exercise?

Suppose that you had found large increases in new-car purchases amongst students graduating high school starting in 2007. While it is suggestive, this does not necessarily imply that the increases in new-car purchases are a result of the new program. There may be other reasons for increased new-car purchases that happened to occur at the same time—for example, a price war amongst car manufacturers. The "falsification exercise" can help to rule out many of these other explanations. For example, if the falsification exercise "works," you will not observe any change in the new-car purchases by families of 2006 graduates. This helps to rule out things like "price wars" that would affect families of 2006 graduates as well as families of 2007 graduates. It therefore makes you more confident that the increase in new-car purchases was a result of the policy, not of something else. Conversely, if the falsification exercise "fails" and you observe a similar increase in new-car purchases by families of 2007 graduates, you would have to re-think your results. The falsification exercise would suggest to you that something other than the policy was driving changes in car purchases. Either way, the falsification exercise helps you to better understand your results.

14. Your state introduced a tax cut in the year 1999. You are interested in seeing whether this tax cut has led to increases in personal consumption within the state.

You observe the following information:

Year	Consumption in your state
1994	300
1996	310
1998	320
2000	350

a. Your friend argues that the best estimate of the effect of the tax cut is an increase in consumption of 30 units, but you think that the true effect is smaller, because consumption was trending upward prior to the tax cut. What do you think is a better estimate?

Prior to the tax cut, there was a steady increase in consumption of 10 units every two years. If that trend had continued, and there had not been a tax cut, you might have predicted that consumption in 2000 would be 330. The actual consumption was 350, so an argument could be made that the additional increase of 20 units can be attributed to the tax cut, over and above the general trend.

b. Suppose that you find information on a neighboring state that did not change its tax policy during this time period. You observe the following information in that state:

Year	Consumption in neighboring state
1994	260
1996	270
1998	280
2000	300

Given this information, what is your best estimate of the effect of the tax cut on consumption? What assumptions are required for that to be the right estimate of the effect of the tax cut? Explain.

This new information suggests that growth in consumption would have been even greater than the past trend indicates even if there had been no tax cut. We can make use a difference in difference estimate, using the neighboring state as a control.

1998-2000 difference in consumption in your state: 30
1998-2000 difference in consumption in neighboring state: 20
Difference in difference estimate: 30-20=10

We therefore estimate that the tax cut increased consumption by 10 units.

For this estimate to be correct, it must be the case that the trends in the two states would have been the same except for the tax cut in your state. This is suggested by the common trends prior to the tax cut, but the common trend before doesn't guarantee that the common trend would have continued. Other consumption-affecting policy changes imposed at the same time as the tax cut, in either state, could make the estimates incorrect, for example. Or there may have been a sudden employment boom in the neighboring state that did not affect your state (a large company decided to build a new plant there, for example). The difference in difference estimate relies on no such sudden changes occurring in state-specific consumption trends.

Activities and Projects

Understanding and interpreting empirical data takes practice, as does identifying alternative explanations for apparent relationships among variables. Following are some ways of developing these skills:

1. Ask students to name several pairs of phenomena that are correlated, and then ask them to decide whether they are causally related and if so the direction of that causality. This task can be jump-started with some examples:
   - Wages and gender, race, or ethnicity
   - Crime rates and race or ethnicity, which could segue into a discussion of profiling
   - Geographic location and socioeconomic variables (for example, the prevalence of high-poverty states in the South)
2. Ask students to brainstorm possible explanations for puzzling correlations (possibly from pairs named in the previous exercise) and then to determine what evidence or data could be used to eliminate or bolster some of those explanations.
3. A number of articles in the labor economics literature use control variables in fairly transparent ways to explain the gender gap in wages. Examples from this literature could be used to illustrate empirical techniques. See, for example, "Trends in the Well-Being of American Women: 1970–1995" by Francine Blau, *Journal of Economic Literature* (March 1998).

Solutions and Activities
for
CHAPTER 4

TOOLS OF BUDGET ANALYSIS

Questions and Problems

1. **We say that a variable is *cyclical* if it increases with economic booms and declines with economic recessions. We say that a variable is *countercyclical* if the opposite is true. Which elements of the U.S. federal budget are cyclical and which are countercyclical? (To get a sense of the main elements of the budget, visit www.whitehouse.gov/omb/budget/fy2007/pdf/hist.pdf, Tables 2 [for revenues] and 3 [for expenditures].) For fun, you could also check out Nathan Newman and Anders Schneiderman's National Budget Simulator at www.budgetsim.org/nbs/shortbudget06.html, where you can experiment with what might happen to the federal budget under various taxation and spending scenarios.**

   Many categories of federal revenue are cyclical. For example, both the personal income tax and the corporate income tax tend to move with the economy: during a downturn, individuals and corporations have lower tax burdens, and during boom times their tax burdens increase. Revenue from excise and other taxes on consumption (such as import taxes and gift taxes) also increase during particularly prosperous (high consumption) times and decrease during downturns in the economy.

   In contrast, there are a number of expenditure categories that tend to be countercyclical. Examples include human services, which includes some income-support payments. These payments tend to rise during a recession, as more people become unemployed. Payments to bail out struggling companies or to honor insurance commitments (Federal Depository Insurance for banks, for example) also tend to increase during bad economic times.

2. **How have the major federal laws to promote balanced budgets lost their effectiveness over time?**

   The Gramm-Rudman-Hollings act was a major federal law designed to promote balanced budgets. It set annual targets for federal deficit spending and included a provision for automatic spending cuts if the targets were not met. In practice, the law was rendered ineffective because, for example, deficit targets were simply reset when it became clear that the targets were not going to be met.

   The Budget Enforcement Act tried to promote balanced budgets by setting caps on the amount of discretionary spending that could take place in future years. Recently, the caps have been avoided by making use of the provision in the law that allows for unlimited "emergency" spending beyond the cap. Such "emergency" spending has been used for financing spending for nonemergency purposes.

3. **Suggest one way in which generational imbalances might be understated and one way in which they might be overstated.**

   Calculated generational imbalances suggest that our current deficit will be balanced on the backs of future generations, to their detriment. These imbalances might be understated, in

which case they will be even worse than anticipated for the next generation, if assumptions about continued growth are too optimistic; if the actual interest rate is less than the assumed rate of 3.6%; or if future policies entail higher expenditures than anticipated.

The imbalances might be overstated if assumptions about continued growth are too pessimistic; if the actual interest rate is greater than the assumed rate; if the quality of life of future generations (possibly including their economic productivity) is enhanced by expenditures made today; or if demographic shifts or policy changes result in lower expenditures than anticipated.

4. What is the intuition behind the notion of Ricardian equivalence? How might you look for evidence to test the suggestion that people account for future generations' tax burdens by saving more today?

According to the theory of Ricardian equivalence, whenever there is a deficit, the current generation realizes that it is paying less in taxes than is being spent by the government. They realize that this will result in a heavier tax burden on future generations than there would be if they were paying enough taxes to balance the current budget. To reduce this intergenerational inequity, the current generation saves more than they would if their taxes were higher. This will mean that children will inherit the means to pay higher taxes later. If this theory were accurate, individuals would respond to lower taxes (for the same levels of government expenditures) by raising their savings rate. To investigate whether the theory is accurate, then, one could look at how private savings rates have changed when new tax cuts (or tax increases) were passed.

5. From 1962 to 1965, federal spending on non-defense-related education and training rose from $9.6 billion to $19.5 billion, while from 2002 to 2005, it rose from $196.0 billion to $232.1 billion. Given that the Consumer Price Index (in January) was 30.0 in 1962, 31.2 in 1965, 177.1 in 2002, and 190.7 in 2005, which period saw the larger increase in education and training spending?

Despite the large nominal numbers in the early part of this millennium, the real increase during the 1960s was greater, as illustrated in the following table:

	1962	1965	Difference	2002	2004	Difference
Nominal	$9.6b	$19.5b	$9.9b	$196.0b	$232.1b	$36.1b
CPI	30.0	31.2		177.1	190.7	
Real (divide by CPI/100)	$32b	$62.5b	$30.5b	$110.7b	$121.7b	$11.0b

6. Why does the Congressional Budget Office construct a cyclically adjusted budget deficit for the purposes of monitoring federal income and outlays?

A number of factors can cause short-run fluctuations in tax collections and expenditures; for example, an economic downturn can temporarily reduce tax collections while increasing expenditures on income-support programs. These fluctuations have only short-term effects on the budget, however, and given the nature of business cycles, they will be offset by economic growth cycles when tax revenues are temporarily high and social expenditures low. Removing these ups and downs from the deficit calculation provides a better long-term picture of revenues and expenditures.

7. The federal government is considering selling tracts of federally owned land to private developers and using the revenues to provide aid to victims of an earthquake in a foreign country. How would this policy affect the levels of federal revenues,

expenditures, and deficits under a cash accounting system? What would be different under a capital accounting system?

Under a cash accounting system, there would be no effect on the current level of the deficit. Revenue would increase by the amount of the sale, but the revenue increase would be exactly offset by the increased expenditures on foreign aid. A capital accounting system would recognize that the government has sold off a valuable asset. It would therefore regard the policy as increasing the overall deficit. The capital account deficit would be unchanged: the additional revenue from the sale would be offset by the decrease in the value of assets held by the government. The cash account would move towards deficit as a result of the increased consumption expenditures.

8. **A government is considering paving a highway with a newly developed "wear-proof" material. Paving the highway would cost $2 billion today, but it would save $300 million in maintenance costs for each of the next 10 years. Use the concept of present value to determine whether the project is worth undertaking if the government can borrow at an interest rate of 5%. Is it worth it if the interest rate is 0%? 10%? A politician says to you, "I don't care what the interest rate is. The project is clearly a good investment: it more than pays for itself in only 7 years, and all the rest is money in the bank." What's wrong with this argument, and why does the interest rate matter?**

As the following table shows, the project is worth undertaking at 0% and 5% interest, but it is not worth undertaking at 10%. The politician's argument is incorrect because it fails to take into account the interest the government must pay on the money borrowed to finance the project.

	$r = 0\%$	$r = 5\%$	$r = 10\%$
Initial Costs	–$2*b*	–$2*b*	–$2*b*
Savings, year 1	.3*b*	0.2857*b*	0.2727*b*
Savings, year 2	.3*b*	0.2721*b*	0.2479*b*
Savings, year 3	.3*b*	0.2592*b*	0.2254*b*
Savings, year 4	.3*b*	0.2468*b*	0.2049*b*
Savings, year 5	.3*b*	0.2351*b*	0.1863*b*
Savings, year 6	.3*b*	0.2239*b*	0.1693*b*
Savings, year 7	.3*b*	0.2132*b*	0.1539*b*
Savings, year 8	.3*b*	0.2031*b*	0.1400*b*
Savings, year 9	.3*b*	0.1934*b*	0.1272*b*
Savings, year 10	.3*b*	0.1842*b*	0.1157*b*
Net benefits	$1*b*	$316.5m	–$156.6m

9. **Table 4-1 in the textbook shows the remarkable difference across generations in their likely net tax payments to the federal government. What is responsible for these large intergenerational differences?**

The generational accounting used to generate Table 4-1 assumes that our current deficit will be paid for by future generations. Specifically, this accounting sets current plus future tax payments equal to the current debt plus future government consumption. Future tax payments will need to be sufficient to pay off the current deficit as well as to pay for the commitments the government has made to the current generation, including the commitment to make Social Security and Medicare payments when that generation retires. The baby boom generation will require high government expenditures when they retire. Those commitments plus current deficit spending (which benefits the current generation) mean that future tax payments will have to be high to keep this account in balance. Thus the tax burden of future generations will be greater than the benefits they are predicted to receive.

10. Is it necessarily inequitable for future generations to face higher taxes as a result of benefits that accrue to those living today? Explain.

There are some reasons why the apparent intergenerational inequity might not be as bad as it seems. First, many of the expenditures made today will yield benefits far into the future. Because future generations will benefit from these current expenditures, it is not unreasonable to ask them to shoulder some of the costs. Second, the historical trend is for future generations to live better lives (measured on some dimensions) than their parents' generation. Technological advances constantly improve productivity and increase real incomes. Therefore, future generations may be better able than the current generation to shoulder this debt.

11. Texbook Table 6.1 from the 2004 federal budget's historical tables (www.whitehouse.gov/omb/ budget/fy2007/pdf/hist.pdf) shows how the main categories of federal outlays have changed from 1940 to 2011 (projected). Where have the biggest changes over time occurred? Where are the biggest changes from 2006 to 2011 projected to occur?

The budget totals have increased enormously; outlays as a percent of GDP have increased by less (from approximately 10% immediately preceding World War II and a high of 43.7% five years later in 1944 to approximately 20% in recent decades). Defense spending was very high during and immediately following World War II: in 1945 almost 90% of federal outlays were for defense. Briefly during the mid-1950s defense spending accounted for more than 50% of all federal outlays. By the mid-1990s the percentage had fallen to less than 20% of total outlays, where it remains today. Interest payments increased until 2000, then fell briefly. They are now back on the rise and are expected to increase from 2005 to 2011. Grants to state and local governments have also increased and are also predicted to increase further. Payments to individuals, both indirect in the form of grants to state and local governments and direct, have accounted for an increasing share of the federal budget: in 1940 only 17.5% of the budget went to these items; that share fell to as low as 2% during World War II, then increased and remained in the 20–30% range from the late 1940s until the early 1970s (with a brief dip during the Korean War). In the 1970s payments to individuals surpassed defense expenditures and, as a share of the budget, have increased to more than 60% of outlays. By 2011, this category is predicted to represent 66.5% of the budget.

It is difficult to compare numbers that vary so much in magnitude over such a long period of time. Comparing the distribution of outlays can make it somewhat easier to see how some categories fare relative to others.

12. Consider a one-year project that costs $300,000, provides an income of $70,000 a year for five years, and costs $30,000 to dispose of at the very end of the fifth year. Assume that the first payment comes at the start of the year after the project is undertaken. Should the project be undertaken at a 0% discount rate? How about 2%? 5%? 10%?

To answer these questions, calculate the present discounted value as $P/(1 + r)^t$ where P is the dollar value, r is the discount rate, and t is the number of years until it is realized. Enter costs as negative numbers. This formula yields the following calculations:

	$r = 0\%$	$r = 2\%$	$r = 5\%$	$r = 10\%$
Initial Cost	–$300,000	–$300,000	–$300,000	–$300,000
Disposal Cost	–30,000	–27,171.92	–23,505.78	–18,627.64
Benefit, year 1	+70,000	+68,627.45	+66,666.67	+63,636.36
Benefit, year 2	+70,000	+67,281.81	+63,492.06	+57,851.24
Benefit, year 3	+70,000	+65,962.56	+60,468.63	+52,592.04
Benefit, year 4	+70,000	+64,669.18	+57,589.17	+47,810.94
Benefit, year 5	+70,000	+63,401.16	+54,846.83	+43,464.49
Net Benefits	**$20,000**	**$2,771.26**	**–$20,441.37**	**–$53,271.47**

Only when the flow of benefits is not discounted at all and when it is discounted at the low rate of 2% does this project make economic sense. When the stream of benefits faces a higher discount rate (5% and 10%), the project is no longer economically justified.

Advanced Questions

13. Several public interest watchdog groups point out "pork" in the federal budget—spending that they claim would have little or no national benefit but would benefit a small number of people in a geographically concentrated area. Why are these types of spending more likely to occur in the federal budgeting process than they would if they were each voted on individually?

Possible explanations include the following: It is easier to "hide" pork in large, multi-issue bills, where relatively small items may escape scrutiny.

These bills might contain a bit of pork for everyone, encouraging "logrolling" among representatives who have a very strong interest in benefiting their local constituents and see expenditures in other districts as having a minimal negative impact on the budget as a whole.

Special interest groups and lobbyists may push hard for their own pieces of the pork, while there is often little organized opposition to these items.

14. How do you think population growth affects the degree of "generational balance" in government finance?

If there is population growth over time, then debts incurred by the current generation will be spread out over more people in the future. The per capita burden on future generations will therefore be smaller than if there was no population growth. If this growth slows or stops, though, the per capita imbalance will worsen as there will be fewer people to pay off the debts from prior generations. On a per capita basis, then, a faster rate of population growth can be said to reduce the degree of "generational imbalance" (at least when the imbalance favors current generations at the expense of later generations).

15. How might large federal deficits affect future economic growth? How would your answer change if foreign confidence in the ability of the United States to repay its debts erodes?

When governments run deficits, they compete with private individuals to borrow loanable funds. With increased deficits, the total demand for loanable funds increases, driving up the rate of interest. The quantity of private investment in assets that improve economic productivity therefore falls. This is the basic theory of crowding out. If international investors/savers lose faith in the ability of the United States to repay its debt, the supply curve of loanable funds will become steeper: foreigners will supply additional loanable funds only if they receive higher interest rates to compensate them for what they perceive to be a riskier investment. This means that deficit spending will have larger effects on interest rates, and it will crowd out private investment to an even greater extent.

16. What is meant by dynamic scoring of the budget? Why does dynamic scoring potentially lead to more realistic estimates of the "true" effective size of a budget deficit? What are some methodological issues involved in dynamic scoring? You can read more about dynamic budget scoring in Chapter 5 of the Council of Economic Advisors 2004 *Economic Report of the President.* The Council of Economic Advisers' Web site is www.whitehouse.gov/cea, and at the time of this writing the Economic Report of the President could be found at www.gpoaccess.gov/eop/index.html.

Dynamic scoring allows budget predictions to incorporate changes in the economy in response to policy. Tax increases and tax cuts have direct effects on revenue collections, and

they also have indirect effects on collections because they can affect economic growth. For example, some argue that a tax cut will actually increase tax revenue because workers will have an incentive to work more when they are taxed less. If done correctly, dynamic scoring can improve estimates by accounting for ripple effects of policy changes. Most people agree that policy changes do not happen in a vacuum; when one aspect of the economy changes, other variables change in response. However, the magnitude of those changes is not precisely known, so predictions can vary. This might encourage policy makers to overstate or understate the effects of a policy.

17. Consider the same highway paving project from question 8. A second politician says to you, "At an interest rate of 6%, the project is a bad idea. Over 10 years, the project reduces maintenance costs by a total of $3 billion. But borrowing $2 billion for 10 years at a 6% interest rate means paying $1.58 billion in interest. The total cost of the project over 10 years is therefore $3.58 billion!" Use present value calculations to show that the project is, in fact, worth undertaking at 6% interest rate. What's wrong with the second politician's argument?

The net benefit of the project, in present value terms, is $208.0 million. (This can be computed using a table like the solution to question 8.) The politician's mistake is to count the interest on the initial expenditure ($(1.06)^{10} \times \$2b = \$3.58$) but not the interest on the $300m saved by the project in years 1–9.

18. The Budget Enforcement Act of 1990 created a PAYGO system prohibiting any policy changes which increased the estimated deficit in any year in the subsequent six-year period. Another type of possible PAYGO system would prohibit any policy changes which increase the present value of the deficit over the entire six-year period. Discuss the relative advantages and disadvantages of these "annual" and "cumulative" PAYGO systems.

Annual PAYGO systems can discourage cost-saving investments that require larger up-front payments. Under an annual PAYGO system, for example, a government cannot borrow money to pay to install an energy-saving technology in an office building, even if the technology would save more than enough in energy costs over the subsequent five years to justify the expenditure. A cumulative PAYGO system would allow a government to borrow money to finance such a project, but it would give the government flexibility to use creative accounting. A government could, for example, cut this year's taxes while "planning" to raise taxes in five years so that there would be no estimated increase in the total deficit over the six-year window. In five years, the government could then use the same sort of trick to keep taxes from rising to the previously "planned" level.

Projects and Demonstrations

Using the CPI

The difference between nominal and real values can be made salient for students by having them find out how their own wages have changed in real terms. Have their wages kept up with inflation? By going to the Bureau of Labor Statistics home page (http://www.bls.gov), they can try out different values over different time periods using the online Inflation Calculator.

Using a Spreadsheet Program to Calculate PDV

Questions 12 and 17 can be used to illustrate simple spreadsheet techniques. The following spreadsheet shows one way to calculate the discounted costs and benefits using Excel:

	PDV at 0%	Year	PDV at 2%	PDV at 5%	PDV at 10%
Discount factor			1.02	1.05	1.1
Immediate current cost	–$300,000		–$300,000	–$300,000	–$300,000
Disposal cost	–30,000.00	5	–27,171.92	–23,505.78	–18,627.64
Benefits, year 1	70,000.00	1	68,627.45	66,666.67	63,636.36
Benefits, year 2	70,000.00	2	67,281.81	63,492.06	57,851.24
Benefits, year 3	70,000.00	3	65,962.56	60,468.63	52,592.04
Benefits, year 4	70,000.00	4	64,669.18	57,589.17	47,810.94
Benefits, year 5	70,000.00	5	63,401.16	54,846.83	43,464.49
Total	**$20,000**		**$2,771.26**	**–$20,441.37**	**–$53,271.47**

The formula can be entered into the first calculated cell for a rate of 2% and then copied to the rest of the cells. Most students will appreciate the convenience of spreadsheets after seeing how easy this calculation is once the spreadsheet has been set up. Students may need to be instructed to use the dollar sign to "freeze" cell addresses.

	PDV at 0%	Year	PDV at 2%
Discount factor		1.02	
Immediate current cost	–300,000		–300,000
Disposal cost	–30,000	5	=+$B4/(D$2^$C4)

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 5

EXTERNALITIES: PROBLEMS AND SOLUTIONS

Questions and Problems

1. **Peterson, Hoffer, and Millner (1995) showed that air bag use has led to increases in car crashes. Despite this finding, the government mandates that new cars have airbags, rather than taxing their use. Is this policy a contradiction?**

   For the sake of argument, let us assume that the paper showed beyond a reasonable doubt that air bag use leads to more car crashes. Then the natural conclusion to reach, based on the analysis in this chapter, is that air bag use should be taxed: accidents impose negative externalities (on the people in the car you crash into!). This suggests that the policy of mandating air bags is undesirable. However, there may be other effects that make this policy reasonable. For example, note that some people who get into accidents have no medical insurance, and these individuals impose negative externalities on hospitals, which are required to provide them with free care. These externalities may be reduced by air bags, if they mitigate injuries caused by accidents. More plausibly: if air bags reduce the cost of injury, they may reduce insurance premiums for everybody—not just for the person with air bags. This reduction is a positive externality from air bag use that may offset the negative externality noted in the paper.

2. **When the state of Virginia imposed stricter regulations on air pollution in 2003, it also authorized an auction of pollution permits, allowing some plants to emit larger amounts of ozone-depleting chemicals than would otherwise be allowed, and some to emit less. Theory predicts that this auction will lead to a socially efficient allocation of pollution. Describe how this outcome would occur.**

   Assuming that the given level of pollution permits was set correctly, an auction would lead to a socially efficient allocation of permits across firms. Firms that would benefit the most from having the right to pollute—say, because it would be very costly for them to produce without polluting—would be the most willing to pay for the right. Therefore, those firms would bid more at the auction and would receive the permits. Firms that find it easy to adopt less-polluting technologies in their production process would be less willing to pay for the right to pollute and therefore would not bid as much at the auction and would not receive as many permits. This means that the permits would be allocated to the firms that cannot easily reduce pollution, while the firms that could most easily reduce emissions would do so instead of buying permits and continuing to pollute. This is the socially efficient outcome: pollution would be reduced, and it would be reduced most by firms that could most cheaply reduce it.

3. **Can an activity generate both positive and negative externalities at the same time? Explain your answer.**

   Sometimes externalities are in the eye (or nose or ear) of the beholder. If you like the music your roommate plays, you can free ride when he or she is playing music, enjoying a

positive externality. Your other roommate, though, who hates that kind of music, would experience a negative externality. Sometimes a positive externality becomes too much of a good thing. During the holiday season, some people construct elaborate displays that everyone can enjoy just by driving by them. But if too many people drive by every night, traffic congestion becomes a problem for those living in the neighborhood: for them, the holiday display creates a negative externality.

4. In the midwestern United States, where winds tend to blow from west to east, states tend to more easily approve new polluting industries near their eastern borders than in other parts of the state. Why do you think this is true?

When a state approves new polluting industries, it imposes an externality on neighboring "downwind" states. It is unlikely that downwind states have figured out a way to make upwind states fully internalize their externalities. States are therefore unlikely to fully take into account the costs they impose on other states by locating their polluting plants near their eastern borders. On the other hand, they will tend to take into account the pollution costs they would impose on themselves by locating their plants farther west. Hence, the private cost of installing plants in the eastern part of the states will tend to be smaller than the private cost of installing plants in the western part, and they are therefore more likely to approve new polluting industries near their eastern borders. Of course, there may be other, more important reasons for them to locate their polluting industries on the eastern border of their state. Possibly because of patterns of settlement (east to west), large cities in midwestern states tend to be located on the eastern borders of their states; examples include Detroit, Chicago, Milwaukee, and the Twin Cities. It may be that industrial plants tend to be located near such population (employment) centers.

5. Can government assignment and enforcement of property rights internalize an externality? Will this approach work as well as, better than, or worse than direct government intervention? Explain your answers and describe one of the difficulties associated with this solution.

The Coasian approach of assigning property rights and then allowing the affected parties to negotiate a solution can internalize an externality. If one party has a clear, enforceable right to engage in an activity that generates an externality, then the injured party or parties have an incentive to pay the externality generator to stop or curtail the activity. Similarly, if the injured parties have a right to be free of an externality but also have an enforceable right to sell the freedom, a person or firm that profits from generating the externality might be able to negotiate for the purchase of the right to operate. This might be better than government intervention when the number of affected people is small and there are no barriers to negotiation. Social norms or large power or wealth differentials, however, could deter negotiation. For example, a manufacturing firm might easily pay off residents of a poor neighborhood to acquire the right to dispose of toxic materials, which some people might regard as inequitable. Some other difficulties with this solution arise when there are too many affected parties to be able to negotiate a transaction, when one of the affected parties engages in the "holdout" strategy, and when it is difficult to identify the source of the externality.

6. In close congressional votes, many members of Congress choose to remain "undecided" until the last moment. Why might they do this? What lesson does this example teach about a potential shortcoming of the Coasian solution to the externality problem?

Members of Congress who remain undecided until the last moment may be engaging in a form of the holdout strategy. Suppose vote trading, or logrolling, is occurring with respect to a piece of legislation. The sponsor of the bill might offer his or her support for other bills in exchange for votes on this bill. As the call for the vote approaches, the sponsor may be willing to offer more to obtain the support needed to pass the bill, so remaining un-decided

increases a Congress member's negotiating strength. The situation in which legislators fail to commit their votes until the final hour is analogous to the holdout problem that exists with Coasian solutions that involve several parties. If the purchaser of the right to impose an externality needs to strike a deal with many sellers, each individual seller can delay settling to pressure the purchaser to increase the price.

7. Suppose that a firm's marginal production costs are given by $MC = 10 + 3Q$. The firm's production process generates a toxic waste, which imposes an increasingly large cost on the residents of the town where it operates: the marginal external cost associated with the Qth unit of production is given by $6Q$. What is the marginal private cost associated with the 10th unit produced? What is the total marginal cost to society associated with producing the 10th unit (the marginal social cost of the 10th unit)?

The marginal private cost is $10 + 3(10) = 40$. The external cost associated with the 10th unit is $6(10) = 60$. So the marginal social cost of producing the 10th unit is 100.

8. In two-car automobile accidents, passengers in the larger vehicle are significantly more likely to survive than are passengers in the smaller vehicle. In fact, death probabilities are decreasing in the size of the vehicle you are driving, and death probabilities are increasing in the size of the vehicle you collide with. Some politicians and lobbyists have argued that this provides a rationale for encouraging the sale of larger vehicles and discouraging legislation that would induce automobile manufacturers to make smaller cars. Critically examine this argument using the concept of externalities.

The evidence suggests that driving a larger vehicle imposes negative externalities on other drivers. (Or, viewed from the other direction, driving a smaller vehicle imposes positive externalities on other drivers.) Individuals probably take their own safety into account when selecting an automobile but probably do not fully take into account these externalities, which suggests that people choose vehicles that are larger than is socially optimal. The correct conclusion is that intervening to encourage the sale of smaller vehicles (or to discourage the sale of larger vehicles) can improve welfare—just the opposite of the proposed argument.

9. Why do governments sometimes impose quantity regulations that limit the level of negative-externality-inducing consumption? Why do governments sometimes impose price regulations by taxing this consumption?

If the government has perfect knowledge about the marginal benefits of consumption and the marginal damage caused by the externality, it can easily compute the socially optimal level of consumption. It can implement this level either by a tax on consumption or by regulating the total amount of consumption. When it is uncertain, for example, about the exact marginal consumption benefits, it will not be able to reach the socially optimal level of consumption anymore. What it needs to think about in this case is whether it is likely to cause more deadweight loss by getting the tax rate a little wrong or by getting the regulated quantity of consumption a little wrong. Suppose the government knows the entire curve of marginal damage caused by the externality at different levels of consumption. If it knows that this curve is relatively flat (i.e., doesn't depend strongly on the quantity of consumption), then using a tax to curtail consumption will tend to cause smaller deadweight losses than quantity regulations, so the government should use taxation to correct the externality. If, on the other hand, the marginal damage curve is very steep, then it will instead want to use quantity regulations.

There may also be a political component to these differences. Taxing consumption of a good that generates a negative externality—gasoline, for example—implies that wealthier individuals can purchase the right to generate the externality. Quantity restrictions may seem more equitable but may also be seen as violations of our freedoms.

10. Answer the following two questions for each of the following examples: (i) smoking by individuals; (ii) toxic waste production by firms; (iii) research and development by a high-tech firm; and (iv) individual vaccination against communicable illness.

a. Is there an externality? If so, describe it, including references to whether it is positive or negative, and whether it is a consumption or production externality.

i. Smoking by individuals generates negative consumption externalities by generating secondhand smoke.

ii. Toxic waste production by firms generates negative production externalities because the harm (or toxicity) is a by-product of the firm's production.

iii. Research and development by a high-tech firm generates positive production externalities when the results of that research expand the knowledge and productivity of all firms.

iv. Individual vaccinations generate positive consumption externalities by reducing the number of people in the population who have a communicable illness. When the number of infected people is reduced, the probability of catching the illness is reduced for everyone.

b. If there is an externality, does it seem likely that private markets will arise that allow this externality to be internalized? Why or why not?

i. The problem of secondhand smoke is unlikely to be solved by private markets. Smoke is widely dispersed, making it difficult to account for and negotiate with every affected person. In addition, the value of smoking a single cigarette is likely to be small relative to the transaction costs of negotiating the solution.

ii. The problem of toxic waste might be amenable to a private market solution. The generator can be easily identified, and a finite number of people in a localized town or community are likely to be affected. If local residents have property rights to restrict toxic waste production, it should be relatively easy for a firm which places a high value on the ability to produce toxic waste to compensate them in exchange for the right to pollute.

iii. A firm that purchases a patent or license is in some sense using a market mechanism to partially compensate the researching firm for its contribution to the knowledge base. However, it is hard to completely restrict or contain the flow of information. It is unlikely that a private market for intellectual property could completely internalize this externality.

iv. Private compensation for the reduced risk of exposure associated with vaccinations seems unlikely. It would be virtually impossible to identify the beneficiaries of increased vaccination rates.

Advanced Questions

11. Warrenia has two regions. In Oliviland, the marginal benefit associated with pollution cleanup is $MB = 300 - 10Q$, while in Linneland, the marginal benefit associated with pollution cleanup is $MB = 200 - 4Q$. Suppose that the marginal cost of cleanup is constant at $12 per unit. What is the optimal level of pollution cleanup in each of the two regions?

The optimal level of cleanup will occur when the marginal benefit just equals the marginal cost. In Oliviland, the marginal benefit is $300 - 10Q$; marginal cost is 12. Therefore, the equation to solve for Oliviland is $300 - 10Q = 12$, or $288 = 10Q$. The optimal level in Oliviland is equal to 28.8. For Linneland, the marginal benefit is $200 - 4Q$. Setting the benefit equal to 12 yields $200 - 4Q = 12$, or $188 = 4Q$. The optimal level in Linneland is equal to 47.

12. The private marginal benefit associated with a product's consumption is *PMB* = 360 – 4*Q* and the private marginal cost associated with its production is *PMC* = 6*Q*. Furthermore, the marginal external damage associated with this good's production is *MD* = 2*Q*. To correct the externality, the government decides to impose a tax of *T* per unit sold. What tax *T* should it set to achieve the social optimum?

Find the social optimum by setting $PMB = PMC + MD$ (= SMC):

$360 - 4Q = 8Q$, or $Q^* = 30$.

Setting a tax of T effectively increases the PMC by T per unit sold. The new equilibrium quantity solves

$$360 - 4Q = 6Q + T.$$

Setting $Q = 30$ and solving for T gives $T = 60$. A tax of $T = 60$ will achieve the social optimum.

13. Suppose that demand for a product is *Q* = 1,200 – 4*P* and supply is *Q* = –200 + 2*P*. Furthermore, suppose that the marginal external damage of this product is $8 per unit. How many more units of this product will the free market produce than is socially optimal? Calculate the deadweight loss associated with the externality.

To answer this question, first calculate what the free market would do by setting demand equal to supply:

$$1{,}200 - 4P = -200 + 2P, \text{ or } 1{,}400 = 6P.\ P \approx 233.33,$$
$$\text{so } Q_{\text{Free Market}} = 1{,}200 - 4(233.33) \approx 266.67.$$

The socially optimal level occurs when the marginal external cost is included in the calculation. Suppose the $8 externality were added to the price each consumer had to pay. Then demand would be $Q = 1{,}200 - 4(P + 8)$.

Solving for P, $1{,}200 - 4(P + 8) = -200 + 2P$, or $P = 228$.

Solving for Q, $1{,}200 - 4(228 + 8) = 1{,}200 - 944$. $Q_{\text{Social Opt}} = 256$, $10^2/_3$ units less than provided by the free market.

Deadweight loss is the area of a triangle of height 8 and width $10^2/_3$: $\frac{1}{2}(8 \times 10^2/_3) \approx 42.67$.

14. The marginal damage averted from pollution cleanup is *MD* = 200 – 5*Q*. The marginal cost associated with pollution cleanup is *MC* = 10 + *Q*.

a. What is the optimal level of pollution reduction?

Damage averted is the benefit, so solve by setting damage averted equal to the marginal cost:

$200 - 5Q = 10 + Q$, or $31^2/_3$.

b. Show that this level of pollution reduction could be accomplished through taxation. What tax per unit would generate the optimal amount of pollution reduction?

By setting a tax T on each unit of pollution, the government will induce the polluters to clean it up as long as the marginal cost of cleanup is less than or equal to the tax. So the total amount of pollution cleanup for a given tax will solve:

$$10 + Q^* = T.$$

To implement the social optimum of $31^2/_3$ units of pollution therefore requires a tax of $10 + 31^2/_3 = 41^2/_3$.

15. Two firms are ordered by the federal government to reduce their pollution levels. Firm *A*'s marginal costs associated with pollution reduction are *MC* = 20 + 4*Q*. Firm *B*'s marginal costs associated with pollution reduction are *MC* = 10 + 8*Q*. The marginal benefit of pollution reduction is *MB* = 400 – 4*Q*.

There are two ways of interpreting this question: the marginal benefit pollution reduction applies either to the *overall* level of pollution reduction (for the two firms combined) or to each firm separately. We offer answers for both.

a. What is the socially optimal level of each firm's pollution reduction?

In the first interpretation, the social optimum must solve

$MC^A = MC^B = MB,$ or $20 + 4\ Q^A = 10 + 8\ Q^B = 400 - 4\ (Q^A + Q^B)$

We can solve in two steps. First, setting $MC^A = MC^B$ and solving for Q^A in terms of QB gives

$Q^A = 2Q^B - 2.5.$

Next, setting $MC^B = MB$, plug in for Q^A in terms of Q^B and solve for Q^B:

$10 + 8Q^B = 400 - 4((2Q^B - 2.5) + Q^B)$

This gives $Q^B = 20$, and therefore $Q^A = 37.5$.

In the second interpretation, we set $MC = MB$ separately for each firm:

For firm A, $MC = MB$ when $20 + 4Q = 400 - 4Q$, or when $380 = 8Q$. $Q^A = 47.5$.
For firm B, it is $10 + 8Q = 400 - 4Q$, or $390 = 12Q$. $Q^B = 32.5$.
Total reduction is 80 units.

b. Compare the social efficiency of three possible outcomes: (1) require both firms to reduce pollution by the same amount; (2) charge a common tax per unit of pollution; (3) require both firms to reduce pollution by the same amount but allow pollution permits to be bought and sold.

Under the first interpretation:

1. The same total reduction could be achieved by requiring each firm to reduce pollution by 28.75 units. This would be less efficient than the social optimum, since it would be less costly for firm A to reduce pollution by more and for firm B to reduce pollution by less (since $MC^A < MC^B$ at 27.25 units).

2. A common tax could be used to achieve the social optimum. Setting a tax of 170 would lead firm A (respectively, B) to reduce pollution to the point where $MC^A = 170$ (respectively $MC^B = 170$). Solving gives $Q^A = 37.5$ and $Q^B = 20$.

3. Requiring both firms to reduce pollution by 27.25 units but allowing them to trade pollution permits can also be used to achieve the social optimum. The value to firm B of being able to produce 1 more unit of pollution (i.e., MC^B) is higher than the cost to firm A of reducing pollution by one unit (i.e., MC^B) when $Q^B = 27.25 = Q^A$, so both can gain by trading a unit of pollution permits. This continues to be true as long as $Q^A < 37.5$ and $Q^B > 20$—so they will trade until $Q^A = 37.5$ and $Q^B = 20$.

Under the second interpretation:

1. The same level of pollution reduction could be achieved by requiring both firms to reduce pollution by 40 units. Firm A stops reducing pollution before it has exhausted all reduction steps for which the marginal cost is less than the marginal benefit, but firm B takes some pollution reduction steps for which the marginal cost exceeds marginal benefit. This is not socially efficient.

2. A common tax would yield the same result: a tax designed to be optimal for firm A would be too low to induce firm B to reduce to the efficient quantity, and a tax designed to be optimal for firm B would induce firm A to reduce by too much.

3. If the firms started at the pollution reduction levels suggested in part (1), a pollution permit market would allow firm A to reduce its pollution by 7.5 more units and sell the permits to firm B, yielding the same result as in a.

16. One hundred commuters need to use a strip of highway to get to work. They all drive alone and prefer to drive big cars—it gives them more prestige and makes them feel safer. Bigger cars cost more per mile to operate, since their gas mileage is lower. Worse yet, bigger cars cause greater permanent damage to roads.

The weight of the car is w. Suppose that the benefits from driving are $4w$, while the costs are $(3/2)w^2$. The damage to roads is $(1/3)w^3$. Assume that individuals have utility functions of the form $U = x$, where x is the net benefits from driving a car of a given size.

Students who have taken calculus should be able to answer this question if they understand marginal to mean a partial derivative.

a. What car weight will be chosen by drivers?

If benefits are $4w$, marginal benefits are 4. Similarly, if costs are $(3/2)w^2$, marginal (private) cost is $3w$. Private individuals who do not consider external costs will set $MB = MC$, or $4 = 3w$ and choose a car that weighs $1\frac{1}{3}$.

b. What is the optimal car weight? If this differs from a, why?

Social optimality requires MB = total marginal costs. To measure total marginal costs, you need to include the damage to the roads, $(1/3)w^3$. The marginal damage is the first derivative of road damage with respect to weight, or w. Here the marginal external cost, the road damage, is w. Setting marginal benefits equal to total marginal costs gives the equation for optimality: $4 = 3w + w$. Solving for w, when both private and external costs are included, yields $w_{\text{social optimal}} = 1$.

The optimal car weight, when all costs are included, is less than the optimal weight chosen by individuals when they ignore the external costs they impose. The reason is that internalizing the externality would make decision makers take into account the external cost. When they do, weight costs them more.

c. Can you design a toll system that causes drivers to choose the optimal car weight? If so, then how would such a system work?

A toll just equal to the externality will internalize this externality. The marginal external cost was calculated to be w, the weight of the car, in 16b. Adding this cost to the private marginal cost of driving makes the total marginal cost of driving $4w$. Individual decision makers will reoptimize by setting private marginal benefit equal to the marginal cost they are now charged. Here it will be $4 = 4w$. A private decision maker will choose $w = 1$, the socially optimal weight. While this toll system would correct the externality, it is a strange sort of toll—it depends on the weight of the vehicle. Toll booths do not typically have scales built in, so this is hard to administer in practice. (Note that some tolls roads charge on the basis of the number of axles on the vehicle, but this only goes part-way towards a fully weight-dependent toll.)

17. Firms *A* and *B* each produce 80 units of pollution. The federal government wants to reduce pollution levels. The marginal costs associated with pollution reduction are $MC^A = 50 + 3Q^A$ for firm *A* and $MC^B = 20 + 6Q^B$ for firm *B*, where Q^A and Q^B are the quantities of pollution *reduced* by each firm. Society's marginal benefit from pollution reduction is given by $MB = 590 - 3Q^{tot}$, where Q^{tot} is the total reduction in pollution.

a. What is the socially optimal level of each firm's pollution reduction?

The social optimum requires $MB = MC^A = MC^B$. Setting $MC^A = MC^B$ and solving for Q^A in terms of Q^B,

$50 + 3Q^A = 20 + 6Q^B$, or $Q^A = 2Q^B - 10$.

Setting $MC^B = MB$, plugging in for Q^A in terms of Q^B, and solving for Q^B,

$20 + 6Q^B = 590 - 3Q^{tot} = 590 - 3(Q^A + Q^B) = 590 - 3((2Q^B - 10) + Q^B)$
$20 + 6Q^B = 620 - 9Q^B$
$15Q^B = 600 Q^B = 40$.

Plugging back in for Q^A gives $Q^A = 70$.

b. How much total pollution is there in the social optimum?

There was a total of 160 units before, and the social optimum has 40 + 70 = 110 units of pollution reduction, so the social optimum has 50 units of pollution.

c. Explain why it is inefficient to give each firm an equal number of pollution permits (if they are not allowed to trade them).

It would be inefficient for each firm to be give 25 units of pollution permits. Then each firm would have to reduce pollution by 55 units. The cost to firm *B* of the 55th unit of reduction was 350. The cost to firm *A* of reducing pollution by an *additional* unit (the 56th unit) would be 218. Hence, efficiency could be improved by having firm *B* produce 1 unit more pollution and having *A* produce 1 unit less: there would be no change in total pollution, but the total cost of abatement would go down by 132.

d. Explain how the social optimum can be achieved if firms are given equal numbers of pollution permits but are allowed to trade them.

Starting from the situation where each firm has 25 units of pollution, note that firm *A* would be willing to reduce pollution by another unit if it was paid 218 or more. Firm *B* would be willing to pay up to 350 to have another pollution permit. If permits were tradeable, both firms would benefit by firm *A* selling a pollution permit to firm *B* at some intermediate price. They would keep making profitable sales of this sort until the social optimum was reached and the cost of an additional unit of pollution reduction was the same for both firms.

e. Can the social optimum be achieved using a tax on pollution?

A tax could be used to achieve the same outcome: setting a tax of 260 would lead firm *A* to reduce pollution until $50 + 3Q^A = 260$, yielding $Q^A = 70$. It would lead firm *B* to reduce pollution until $20 + 6Q^B = 260$, yielding $Q^B = 40$. Hence, the tax would achieve the social optimum.

In-class Project

An in-class demonstration of externalities and Coase's solution is described in "The Paper River: A Demonstration of Externalities and Coase's Theorem," by Gail M. Hoyt, Patricia L. Ryan, and Robert G. Houston, Jr., *Journal of Economic Education* 30, no. 2 (Spring 1999), pp. 141–47. "The Paper River Revisited: A Common Property Externality Exercise," by Thomas P. Andrews, *Journal of Economic Education* 33, no. 4 (Fall 2002), pp. 327–32, adds some nice refinements.

In these experiments, "upstream producers" solve several multiplication problems in a short amount of time using small (approximately 1.5 in. × 2 in.) slips of paper and either a pen or a

pencil. I have used ten problems, each of which is a three-digit number multiplied by a two-digit number, with a time limit of 3 minutes. The upstream producers can buy either a pen or a pencil to do their calculations. The pen costs the firm 1 point and the pencil costs the firm 2 points (the pen is the cheaper technology). Two points are awarded for each correct answer, and the cost of the pen or pencil is subtracted to yield the upstream firm's total points for the round.

The "downstream firms" then make paper airplanes, earning two points for each airplane successfully completed in three minutes. The catch is that the airplanes must be made of clean paper. If the upstream firm uses a pen, the paper is ruined and cannot be used for airplane production. If the upstream firm uses a pencil, the downstream firm can erase the marks and reuse the paper. If the upstream firm conserves on paper use, the downstream firm can make airplanes without having to erase. By participating in this exercise over three or four rounds, students are able to negotiate toward an efficient solution, where "efficient" is defined as maximizing points.

This simulation can easily be completed in a one-hour class period. It helps to prepare several sets of ten math problems (each one a three-digit number multiplied by a two-digit number) ahead of time on transparencies and to prepare a separate transparency for each set showing the answers.

The original paper river experiment involved several separate pairs, each consisting of one upstream and one downstream producer. Negotiations were limited to agreements between the two firms. In the later version, the slips of paper were available to several producers of each type, demonstrating the difficulty of arriving at a Coasian solution when many parties are affected.

Solutions and Activities
for
CHAPTER 6

EXTERNALITIES IN ACTION: ENVIRONMENTAL AND HEALTH EXTERNALITIES

Questions and Problems

1. **Some people were concerned that the 1990 amendments to the Clean Air Act would generate "hot spots" of pollution—localized areas with very high concentrations of pollutants. Why might the amendments lead to such "hot spots"? Are these "hot spots" necessarily a bad thing from an overall social welfare perspective? Explain.**

   Trading of emissions permits generally does not address the spatial distribution of pollution sources. It is conceivable that the ages of factories tend to be about the same in similar areas: newer plants are found in recently settled areas; older plants are found in older cities. If the age of a plant correlates with its emissions reduction costs, which is also conceivable, demand for emissions permits might be high in some parts of the country, and these areas could become "hot spots." Whether this is a bad thing depends on the nature of the pollutants. If the effects of emissions are very local and the damage from exposure rises at an increasing rate (if twice the emissions cause more than double the damage), then concentration of the pollution would be bad. But if the damage from concentration does not follow this pattern, isolated hot spots might be a good thing—these small, concentrated areas could be quarantined, leaving the rest of the country fairly clean. In addition, the effects of some pollutants are readily dispersed. For these pollutants it would not matter that the sources are geographically concentrated.

2. **The National Institute on Drug Abuse describes six-year trends in teenage smoking, drinking, and other drug use on the Web at http://www.nida.nih.gov/infofax/hsyouthtrends.html. According to this site, for which age groups have the changes in the rates of teenage smoking and drinking been most pronounced?**

   The data indicate that the lifetime cigarette use rate among twelfth graders has fallen from 64.6% in 1999 to 50% in 2005, and that the drop between 2004 and 2005 was statistically significant (though it does not clearly indicate at what level of significance). Among tenth and eighth graders, lifetime cigarette use has fallen from 57.6% and 44.1%, respectively, to 38.8% and 25.9%, respectively, over the same time period. In absolute, percentage point terms, the fall in smoking rates over these periods was largest for tenth graders. In relative terms, however, the largest drop was among eighth graders, among whom the data indicate a 41.3% drop in lifetime use—(25.9 – 44.1)/41.1 = 41.3%. Similar trends hold for the other frequency-of-use categories, though for some the drop in use rate appears most pronounced among tenth as opposed to eighth graders.

The data also indicate that lifetime alcohol use fell uniformly across ages between 1999 and 2005. This drop was most pronounced among eighth graders, for whom it fell from 52.1% to 41.0% over that time period, with the fall between 2004 and 2005 statistically significant.

3. Think about the major ways in which acid rain causes damage, such as through forest erosion, property damage, reduced visibility, and adverse health outcomes. Which of these costs are highly localized and which are borne by society more broadly? Explain.

Acid rain generates widespread damage and costs because of the way it is dispersed; however, some of the damage is locally concentrated. Direct property damage (material and paint corrosion and deterioration, for example) implies discrete, local costs, as do instances of reduced visibility. Forest erosion, on the other hand, can generate indirect costs, including increased flooding, reduced soil stability, wildlife habitat reduction, and damage to recreational and aesthetic assets. These costs are broadly borne.

4. Many towns and cities on the northeast and west coasts have recently passed bans on smoking in restaurants and bars. What is the economic rationale behind these bans? Would there be similar rationales for banning smoking in automobiles? Apartment buildings? Houses?

The economic rationale for these bans is that smoking causes externalities, in particular through the health effects of secondhand smoke. The secondhand smoke externality does not apply in private automobiles, homes, or apartments. But there may be other externalities associated with smoking in these settings. Smoking while driving may increase the risk of an accident, which would potentially injure other drivers, passengers or pedestrians. Smoking in an apartment building may increase the risk of a fire, which would injure other residents in the building. Smoking in a private house also poses the risk of a fire, but if houses are sufficiently far apart, this may not impose significant externalities.

It is important to note that, even when there is an externality providing an economic rationale for banning smoking, the ban should not necessarily be imposed. Bans restrict freedom of choice, which is valuable to individuals, and therefore impose real costs as well as the benefits they may produce in terms of reducing externalities.

5. Think about the concerns about the original 1970 Clean Air Act described in the text. To what degree did the 1990 amendments to the act address these concerns? Explain your answer.

First, the provisions of the act applied only to new plants, creating an incentive for plant owners to continue using old, dirty plants to avoid compliance costs.

Second, the method of emissions reduction was dictated: plants had to use scrubbers rather than being allowed to use the most cost-effective technology. This removed incentives to develop new technologies or to use existing technologies that were more cost effective.

Third, compliance was costly, so firms had an incentive to find loopholes.

By establishing tradable allowances and removing the exemption for older plants, the 1990 amendments reduced some of these problems. The closing of the age-of-plant loophole gave firms an incentive to find the least-cost way to reduce pollution.

6. In which way could smoking exert a *positive* externality on others?

As described in the text, the reduction in expected lifetimes can deliver a positive externality. If smokers tend to die soon after their retirement, they will collect less in Social Security payments, leaving more money for nonsmokers. In addition, if smokers pay into group retirement plans that do not differentiate smoking behavior, then their reduced time of withdrawal from the plans will subsidize the longer-lived nonsmokers.

7. Some observers argue that since carbon dioxide and temperature levels have been much higher in Earth's history than they are today, the current concerns about the human contribution to global warming are overblown. How would you empirically test this argument?

There are two interpretations of this argument. First, it suggests an alternative explanation to human-caused global warming: since carbon dioxide levels and temperatures have been much higher in Earth's prehuman history than they are today, causes other than human action may be responsible. Second, it suggests that *even if* the current warming is human-caused, it is well within the bounds of historical norms and may therefore not be problematic. To test the first interpretation, researchers should ask: What was also true at other times when CO_2 levels and temperatures were high? Perhaps data on other atmospheric activity (sunspots?) would suggest nonhuman causes for the rising levels. Do the same causes exist today? Another thing to consider is whether the rates of increase of CO_2 and temperature levels today seem similar to the rates of increase in the past. Did CO_2 and temperature levels previously increase at the same rate at which they are currently increasing?

It will be difficult to answer these questions and thus to eliminate competing explanations for observed temperature and CO_2 levels. Data from early historic periods would have to be inferred from currently available sources, since recorded climate and atmospheric data for those periods are not available. This may therefore be an empirically challenging approach.

Testing the second interpretation is more difficult, but one could try to look at how previous periods of high temperatures differed from previous period of comparable temperatures. This would help in understanding the potential impacts on humans of rising temperatures and whether the impacts would be harmful.

8. Nordhaus and Boyer (2000) estimated that the United States would bear over 90% of the total world cost of achieving the Kyoto targets for greenhouse gas emission reductions. Explain how this can be, when the United States produces only about a quarter of the world's greenhouse gasses.

The United States relies on many coal-fired power plants, in part because it has large coal deposits (and relatively little oil and natural gas). There is no easy way to reduce emissions from these plants. Furthermore, the emissions targets were set to be 5% below 1990 emission levels. The United States experienced rapid growth through the 1990s, and it is predicted to have continued growth through 2010. This means that, in order to achieve emissions targets, the United States will have to reduce emissions by 30% relative to projected 2010 emissions. In countries that have experienced slower growth, the relative amount by which they must reduce emissions is much lower.

9. Evans, Farrelly, and Montgomery (1999) found evidence that workplace smoking bans substantially reduce overall rates of smoking, particularly for people with longer workweeks. Why should workplace smoking bans be particularly influential in affecting the behavior of people who work long hours?

People who cannot smoke at work have an externally imposed control on their behavior. Longer hours means this "commitment device" has more bite: people have to wait even longer for their smokes. Making it through a nine-hour day without a smoke might be just the impetus needed to get people to quit; six hours without a cigarette might not be long enough to have an impact.

10. Congressman Snitch argues that since obesity causes so many serious health problems, fatty foods should be regulated. Do you agree with him?

Arguments can be made both for and against regulation. Opponents might argue that this proposal is both too narrow and too broad. It is too narrow because it does not regulate all

foods that lead to obesity. Sugar is fat-free, but too much of it makes people fat. It is too broad because not all fat consumption leads to obesity. New research on "good fats" suggests that some fatty foods are a necessary part of a healthy diet. Furthermore, some naturally thin people eat fatty foods without getting fat. Opponents may also raise the free-choice argument: if there are no negative externalities, we should assume that the eater has weighed the costs and benefits of consuming that extra doughnut.

Proponents might argue that there are indeed external costs of obesity, such as health costs, increased insurance premiums, and shrinking airplane seats. There is an additional argument made in the text that "internalities" might need to be regulated because people have a difficult time making rational decisions when there are large temporal differences between realization of the benefits and the costs: gratification from doughnut consumption is immediate; the cost is delayed.

Advanced Questions

11. Why does Chay and Greenstone's (2003) approach to measuring the effects of acid rain reduce the identification problems associated with more "traditional" approaches?

Fortunately for the researchers, the Clean Air Act was not applied equally to all counties. That inequality essentially created a "control" group—counties that did not have levels high enough to warrant regulation—and an "experimental" group—nonattainment counties that were forced to reduce total suspended particulates. By comparing the two groups on one measure of health outcomes, changes in infant mortality, Chay and Greenstone isolated the effects of reduction in total suspended particulates.

12. Imagine that it is 1970, and your parents are in college, debating the merits of the Clean Air Act of 1970. Your father supports the act, but your mother says that since it only covers new plants, it might actually make the air dirtier.

a. What does your mother mean by her argument?

Your mother anticipated the incentive for owners to keep old plants in operation to take advantage of their exemption from the rules. If the old plants are dirtier than new ones would be, this loophole could lead to dirtier air.

b. How would you construct an empirical test to distinguish between your parents' hypotheses?

Chay and Greenstone compared improvements in particulate levels in counties that were regulated by the 1970 rules (the nonattainment counties) with improvements in exempted counties. A similar approach could be taken with plant closures.

You could compare data on new plant construction and old plant closures in nonattainment counties with data on plant construction and closures in exempted counties. If other potential explanations are controlled for, this comparison would help identify the extent to which the 1970 rules encouraged firms to keep old plants on line. Your mother's argument would be supported by a finding that old plants were closed more frequently in the nonattainment counties than in the exempt counties. Confounding effects would have to be considered. For example, demographic shifts could account for plant openings and closings, regardless of the application of the Clean Air Act. The empirical test would have to control for these effects. It would be difficult to know whether the demographic shift was in response to patterns of factory closing and construction brought on by the Clean Air Act.

13. Caffeine is a highly addictive drug found in coffee, tea, and some sodas. Unlike cigarettes, however, there have been very few calls to tax it, to regulate its consumption, or limit its use in public places. Why the difference? Can you think of any economic arguments for regulating (or taxing) it's use?

Unlike cigarettes, caffeine does not cause any obvious externalities (e.g., secondhand smoke). If we believe Becker and Murphy's rational addiction model, then addictiveness does not provide a motivation for regulating a good—only externalities do. On the other hand, if people have self-control problems, then "internalities" could potentially provide a motivation for taxing or otherwise regulating caffeine. This is particularly true for children, who tend to be short-sighted and may not fully appreciate the long-term consequences of caffeine addiction. This might be a reason to regulate sales of sodas containing caffeine in schools, for example.

14. When Wisconsin had lower drinking ages than its neighboring states, it experienced higher levels of alcohol-related crashes in its border counties than in other counties in its interior. What does this finding imply for the spillover effects of the policies of one state (or country) on other jurisdictions?

The evidence from Wisconsin suggests that people from nearby states who were old enough to drink in Wisconsin but not in their own state were driving to Wisconsin to drink. In this particular case, the older drinking ages in nearby states was imposing a negative externality on Wisconsin. (Of course, Wisconsin's lower drinking age may have been imposing a negative externality on nearby states as well.)

15. In Becker and Murphy's "rational addicts" model, smokers are perfectly aware of the potential for smoking to cause addiction, and they take this into account when deciding whether or not to smoke. Suppose a new technology—such as a nicotine patch—has just been invented which makes quitting smoking much easier (less costly) for an addict. If Becker and Murphy's model is correct, what effects would you expect this invention to have on people's smoking behavior? Would your answer be different for young people and older people?

Older people who are already addicted to smoking might suddenly find it worthwhile to quit, now that it is less costly to do so. This would lead to lower smoking rates. At the same time, people considering starting to smoke—particularly young people—would now find it less costly to become addicted to smoking because it would be easier to quit later. Since they take this cost into account when making their decisions, their smoking rates are likely to increase.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 7

PUBLIC GOODS

Questions and Problems

1. **We add the demands of *private* goods horizontally but add the demands of *public* goods vertically when determining the associated marginal benefit to society. Why do we do this and why are the procedures different for public and private goods?**

   The horizontal summation of private goods adds up the individual quantities demanded by each consumer, which we do because each consumer uses up the quantity he or she purchases. The vertical summation for public goods adds up each consumer's willingness to pay for each additional unit. Because the good is public, each consumer gets to consume each unit. This sum therefore gives the total social valuation of each additional unit—society's demand curve.

2. **The citizens of Balaland used to pave 120 miles of roadways per year. After the government of Balaland began paving 100 miles of roadways per year itself, the citizens cut back their paving to 30 miles per year, for a total number of roadway miles paved per year of only 130 miles. What might be happening here?**

   Private paving in Balaland is partially crowded out by the public paving. On their own, Balalanders chose to pave 120 miles of road, presumably their optimal number of miles when they were bearing the cost themselves. When the government began providing 100 miles of paved roadway, Balalanders chose a new optimal quantity. That new quantity is more than the original 120 because the cost borne by them is less, but the quantity is less than the original 120 plus the government's 100 because the marginal benefit of additional paved miles declines with each additional mile that is paved. If Balalanders strongly desire the first 120 miles of paving but get no additional utility from additional miles of paving, they would have paved only an additional 20 miles after the government paved 100. This would have been complete crowding out. However, by paving 100 miles for the citizens, the Balaland government made them richer. This income effect may have increased their demand for paved road miles to 130.

3. **Bill's demand for hamburgers (a private good) is $Q = 20 - 2P$ and Ted's demand is $Q = 10 - P$.**

   a. **Write down an equation for the social marginal benefit of the consumption of hamburgers.**

      The social marginal benefit from the Qth hamburger is the willingness of society to pay for the hamburger. To compute it, we first find the social demand curve for hamburgers by summing individual demands horizontally: $Q = (20 - 2P) + (10 - 3P) = 30 - 3P$. Inverting this gives $P = 10 - Q/3$. The willingness of society to pay for the Qth hamburger is thus $10 - Q/3$.

b. Now suppose that hamburgers are a *public* good. Write down an equation for the social marginal benefit of hamburger consumption.

For public goods, we don't add quantities horizontally; we add prices vertically. For Bill, $Q = 20 - 2P$; solving for P yields $P = 10 - 0.5Q$. For Ted, $Q = 10 - P$, so $P = 10 - Q$. Summing vertically, total $P = (10 - 0.5Q) + (10 - Q) = 20 - 1.5Q$.

4. People in my neighborhood pay annual dues to a neighborhood association. This association refunds neighborhood dues to selected home owners who do a particularly nice job in beautifying their yards.

a. Why might the neighborhood association provide this refund?

Neighbors who are good gardeners provide an external benefit to the entire neighborhood. Everyone's property values are a little higher when the neighborhood looks nice. The refund helps to compensate the gardeners for providing this public good and might induce other neighbors to beautify their lawns in hopes of receiving the refund.

b. At the most recent home owners' association meeting, home owners voted to end this practice because they felt that it was unfair that some people would not have to pay their share of the costs of maintaining the neighborhood. What is likely to happen to the overall level of neighborhood beautification? Explain.

Ending the refund program removes the private incentive to provide the positive externality. The benefits to gardening have declined but the costs have remained the same. Because maintaining a lawn is costly in terms of time and money, those who once received the refund but no longer do will cut back on their gardening efforts. When there is no compensation for providing the positive externality, people are likely to free ride on those who do provide it. However, it is unlikely that canceling the refund program would completely eliminate private provision of nice lawns and gardens. People who like to garden and receive private utility from doing so will continue to maintain their yards but at a level at which marginal private benefit just equals marginal private cost. This level will be less than the level at which marginal private benefit plus the refund equaled marginal private cost.

5. Zorroland has a large number of people who are alike in every way. Boppoland has the same number of people as Zorroland, with the same average income as Zorroland, but the distribution of incomes is wider. Why might Boppoland have a higher level of public good provision than Zorroland?

If average incomes are the same in the two locations but the distribution is wider in Boppoland, there are, as a matter of arithmetic, more wealthy (and more poor) people in Boppoland. Wealthy Boppos may have a fairly high willingness to pay for or provide public goods because the cost of provision is small relative to their incomes or because of the income effect on their demand for public goods.

6. Think about the rival and excludable properties of public goods. To what degree is *radio broadcasting* a public good? To what degree is a *highway* a public good?

Radio broadcasting is nonrival: airwaves can be consumed (listened to) simultaneously by many consumers with no deterioration in sound quality. Perhaps radio signals can be made excludable by the use of scramblers, much like the ones used for pay-per-view TV. Anyone who has driven during rush hour knows that highways are subject to congestion. At these times, highways are rival: additional cars reduce the utility everyone receives from driving. Highways can also be excludable through the use of tolls. In practice, however, most highways are not excludable: any (licensed) driver is allowed to use them.

7. Think of an example of a free rider problem in your hometown. Can you think of a way for your local government to overcome this problem?

Examples of free rider problems could include swimming pools that are congested on hot days, litter in public parks, holiday lighting or fireworks displays, public television and radio, and parent volunteer groups in schools.

Admission fees can reduce free riders at public facilities, schools could require all parents to serve on at least one school committee or provide some reward system for parents who volunteer, and taxes could be used to subsidize local public television and radio stations.

8. In order to determine the right amount of public good to provide, the government of West Essex decides to survey its residents about how much they value the good. It will then finance the public good provision by taxes on residents. Describe a tax system that would lead residents to underreport their valuations. Describe an alternative system that could lead residents to overreport their valuations.

If the taxes are based on reported valuations, residents have an incentive to reduce their stated valuation of the good so that they can pay lower taxes and free ride on the public good. If taxes can be levied on nonresidents—e.g., a "commuter" tax—then individuals will tend to overstate their valuations. Alternatively, a tax on only the wealthiest members of West Essex (e.g., a highly progressive income tax) might lead to overreporting, since the majority of individuals will bear very little of the cost of additional public goods provision.

9. Why is it difficult to empirically determine the degree to which government spending crowds out private provision of public goods?

In nonexperimental data it is difficult to isolate the effect of the public provision to determine the extent of crowding out. Government provision of a public good reflects, on some level, a political determination that citizens have a preference for that public good. But if citizens like that particular public good, then they may also receive a lot of individual utility from its provision. Because these preferences are correlated, an estimate of crowding out will be low: private provision will thrive alongside public provision. Experimental investigations of crowding out can isolate the effect, but these experiments typically take place in laboratory environments. They may therefore lack external validity: behavior in an artificial experiment may not mimic what people do in their day-to-day lives. Reasons for this include the use of undergraduate students as experiment participants; the relatively low dollar values for the experiment goods; and the lack of a realistic context in which experiment decisions are made—in most economic experiments, for example, the public good is not specifically named.

10. Think back to Chapter 5. Why can the public good provision problem be thought of as an externality problem?

Provision of public goods generates benefits for everyone, not just for those who provide the goods, so the benefits have the same characteristics as positive externalities. Overuse of public goods, because public goods are nonexcludable, can generate negative externalities, such as congestion.

Advanced Questions

11. Suppose 10 people each have the demand $Q = 20 - 4P$ for streetlights and 5 people have the demand $Q = 18 - 2P$ for streetlights. The cost of building each streetlight is 3. If it is impossible to purchase a fractional number of streetlights, how many streetlights are socially optimal?

Compute the social optimum by inverting the demand curves and summing to get the social demand: $P = (5 - Q/4) + (9 - Q/2) = 14 - 3Q/4$. Setting the result equal to the marginal

cost of 3 and solving for Q gives $3 = 14 - 3Q/4$, or $Q = 44/3 \approx 14.67$. This indicates that the social optimum is somewhere between 14 and 15. We need to figure out whether society is better off with 14 or 15 units. To do so, first compute the total social benefit (ignoring costs) from 14 and 15 units, respectively. This is the area underneath the social demand curve to the left of 14 and 15 units. Noting that the height of the demand curve at 14 and 15 units is $14 - 10.5 = 3.5$ and $14 - 11.25 = 2.75$, respectively, we compute

Area under social demand to the left of 14 units: $\frac{1}{2}(14 - 3.5)(14)+14(3.5) = 122.5$
Area under social demand to the left of 15 units: $\frac{1}{2}(14 - 2.75)(15)+15(2.75) = 125.625$

The total social cost of 14 units is $14(3) = 42$. Similarly, the total social cost of 15 units is 35. Hence, the total social surplus from 14 units is $122.5 - 42 = 80.5$, and the total social surplus from 15 units is $125.625 - 45 = 80.625$. For social welfare, 15 units is slightly better than 14 units.

12. Andrew, Beth, and Cathy live in Lindhville. Andrew's demand for bike paths, a public good, is given by $Q = 12 - 2P$. Beth's demand is $Q = 18 - P$, and Cathy's is $Q = 8 - P/3$. The marginal cost of building a bike path is $MC = 21$. The town government decides to use the following procedure for deciding how many paths to build. It asks each resident how many paths they want, and it builds the largest number asked for by any resident. To pay for these paths, it then taxes Andrew, Beth, and Cathy the prices a, b, and c per path, respectively, where $a + b + c = MC$. (The residents know these tax rates before stating how many paths they want.)

a. If the taxes are set so that each resident shares the cost evenly ($a = b = c$), how many paths will get built?

When taxes are set at $a = b = c = \text{MC}/3 = 7$, each resident faces an individual marginal cost of 7 per bike path. At this marginal cost, Andrew wants *no* bike paths, Beth wants 11, and Cathy wants 2.67. The government therefore builds 11 paths.

b. Show that the government can achieve the social optimum by setting the correct tax prices a, b, and c. What prices should it set?

The social optimum can be computed by reexpressing the demand curves for the three residents as $P = 6 - Q/2$, $P = 18 - Q$, and $P = 24 - 3Q$, respectively, and summing them to get marginal social benefit $MSB = 48 - 4.5\,Q$. Setting $MSB = MC$ and solving for Q gives $Q = 6$. We need to tax prices so that nobody will want more than 6 units (and someone will want exactly 6 units). Looking at Andrew's inverted demand curve, we see that he will want exactly 6 units at $a = 3$ (since then $a = 6 - 6/2$). Beth will want exactly 6 units at $b = 12$. And at $c = 6$, Cathy will want exactly 6 units. Since $3 + 12 + 6 = 21$, these tax rates are just enough to cover MC, and the social optimum is achieved. Note that with this tax system in place, the three residents are unanimous in the number of bike paths they desire.

13. The town of Springfield has two residents: Homer and Bart. The town currently funds its fire department solely from the individual contributions of these residents. Each of the two residents has a utility function over private goods (X) and total firefighters (M) of the form $U = 4 \times \log(X) + 2 \times \log(M)$. The total provision of firefighters hired, M, is the sum of the number hired by each of the two persons: $M = M_H + M_B$. Homer and Bart both have income of \$100, and the price of both the private good and a firefighter is \$1. Thus, they are limited to providing between 0 and 100 firefighters.

a. How many firefighters are hired if the government does not intervene? How many are paid for by Homer? By Bart?

Following the algorithm shown in the appendix, if each resident optimizes his own function, he will choose the number of firefighters that maximizes his own utility, taking into consideration the contribution by the other resident.

Private consumption, X, can be rewritten as $100 - M_{\text{Bart}}$ because all income not spent on firemen (M) can be spent on private goods.

The public good enjoyed by Bart can be rewritten as $M_{\text{Bart}} + M_{\text{Homer}}$ because public goods provided by either one are consumed by both.

Therefore, Bart's utility function can be rewritten as $U_{\text{Bart}} = 4 \times \log(100 - M_{\text{Bart}}) + 2 \times \log(M_{\text{Bart}} + M_{\text{Homer}})$.

Set $\delta U/\delta M_{\text{Bart}}$ equal to zero: $-4/(100 - M_{\text{Bart}}) + 2/(M_{\text{Bart}} + M_{\text{Homer}}) = 0$; $4/(100 - M_{\text{Bart}}) = 2/(M_{\text{Bart}} + M_{\text{Homer}})$.

Cross-multiply, $4(M_{\text{Bart}} + M_{\text{Homer}}) = 2(100 - M_{\text{Bart}})$, and expand: $4M_{\text{Bart}} + 4M_{\text{Homer}}\ 200 - 2M_{\text{Bart}}$.

Solving for M_{Bart} yields $M_{\text{Bart}} = (200 - 4M_{\text{Homer}})/6$.

The same procedure yields $M_{\text{Homer}} = (200 - 4M_{\text{Bart}})/6$.

These are response functions. They allow each resident to calculate his optimal M as a function of the contribution to M made by the other resident. Because the other resident's M carries a negative sign, the more one resident contributes, the less the other will.

Solving these response functions simultaneously is greatly eased by the fact that they are symmetric. At the solution, then, $M_{\text{Homer}} = M_{\text{Bart}}$, and hence $3M_{\text{Bart}} = 100 - 2\ M_{\text{Homer}} = 100 - 2\ M_{\text{Homer}}$. So $M_{\text{Bart}} = M_{\text{Homer}} = 20$.

b. What is the socially optimal number of firefighters? If your answer differs from a, why?

The socially optimal number is determined by adding each resident's marginal rate of substitution (placing the marginal utility for the public good in the numerator and for the private good in the denominator) and setting the result equal to the price ratio (1 here because both goods have the same price). Because Homer and Bart have the same utility functions, they will have the same marginal rates of substitution. Therefore, the socially optimum number of firefighters solves

$$MRS_{\text{Bart}} + MRS_{\text{Homer}} = 1.$$

Computing the MRS for each resident: $MU_M/MU_X = (2/M)/(4/[100 - M_i])$, where $M = M_{\text{Homer}} + M_{\text{Bart}}$, and $M_i = M_{\text{Bart}} = M_{\text{Homer}}$. The social optimum is then the solution to

$(2/M)/(4/[100 - M_{\text{Bart}}]) + (2/M)/(4/[100 - M_{\text{Homer}}]) = 1$ or
$[100 - M_{\text{Bart}}]/2M + [100 - M_{\text{Homer}}]/2M = 1$ or
$200 - (M_{\text{Bart}} + M_{\text{Homer}}) = 2M$ or
$200 - M = 2M$.

Hence, $M = 200/3$, and the social optimum is between 66 and 67 firefighters.

Intuitively, in the computation in a, we set the marginal utility of the last firefighter to each resident equal to the marginal utility of consumption for that resident. In b, we set the sum of the marginal utilities of the last firefighter—the social marginal utility of the firefighter—equal to the marginal utility of consumption for either resident. Since the social marginal utility of firefighters exceeds the individual marginal utilities of that firefighter, society optimally hires more than individuals would if they were acting alone.

14. The town of Musicville has two residents: Bach and Mozart. The town currently funds its free outdoor concert series solely from the individual contributions of these residents. Each of the two residents has a utility function over private goods (X) and total concerts (C) of the form $U = 3 \times \log(X) + \log(C)$. The total number of concerts given, C, is the sum of the number paid for by each of the two persons: $C = C_B + C_M$. Bach and Mozart both have income of 70, and the price of both the private good and a concert is 1. Thus, they are limited to providing between 0 and 70 concerts.

a. How many concerts are given if the government does not intervene?

Since the price of both commodities is 1, it is possible to solve by setting individual marginal utilities equal to each other. Following the algorithm in the appendix to this chapter, the quantity of private good can be expressed as $70 - C_i$; total public good is $2C_i$ (where C_i = each individual's contribution, and the contributions are equal because their utilities and incomes are equal).

This calculation yields $3/(70 - C_i) = 1/(2C_i)$, or $C_i = 10$. Each resident pays for 10 concerts; the total number of concerts is 20.

b. Suppose the government is not happy with the private equilibrium and decides to provide 10 concerts in addition to what Bach and Mozart may choose to provide on their own. It taxes Bach and Mozart equally to pay for the new concerts. What is the new total number of concerts? How does your answer compare to your answer to a? Have we achieved the social optimum? Why or why not?

At a price of 1, providing 10 concerts will cost 10. Thus, paying for the new concerts funded by the government will require a tax of 5 on each of the two residents. After-tax in-come for each has declined to 65; total provision is $2C_i + 10$. Therefore the equation is $3/(65 - C_i) = 1/(2C_i + 10)$, and each resident will provide 5 concerts. Those concerts, in addition to the 10 government-funded ones, yield 20, the same as in a. We do not achieve the social optimum or even come close to it because there is complete crowding out.

c. Suppose that instead an anonymous benefactor pays for 10 concerts. What is the new total number of concerts? Is this the same level of provision as in b? Why or why not?

In this case, income does not decline, but total provision is $2C_i + 10$. Solving $3/(70 - C_i) = 1/(2C_i + 10)$ yields $C_i \approx 5.7$. There is incomplete crowding out because the donated concerts increase each resident's wealth, allowing each to purchase more concerts.

15. Consider an economy with three types of individuals, differing only with respect to their preferences for monuments. Individuals of the first type get a fixed benefit of 100 from the mere existence of monuments, whatever their number. Individuals of the second and third type get benefits according to $B_{II} = 200 + 30M - 1.5M^2$ and $B_{III} = 150 + 90M - 4.5M^2$, where M denotes the number of monuments in the city. Assume that there are 50 people of each type. Monuments cost \$3,600 each to build. How many monuments should be built?

The marginal benefit for type I individuals is 0 (if $M > 0$).

The marginal benefit for type II individuals is $30 - 3M$.

The marginal benefit for type III individuals is $90 - 9M$.

The marginal cost is \$3,600.

Aggregating marginal benefits and setting them equal to marginal cost yields $50(30 - 3M) + 50(90 - 9M) = \$3{,}600$. $M = 4$.

In-class Activities and Demonstrations

One salient way to demonstrate the free rider effect is through an in-class simulation of effort level on a group project. Divide students into groups of six to eight. Each student chooses to exert a hypothetical effort level represented as an integer in the range 0 to 5. This effort level is a public good, as it increases the group's points. The private good is 5 minus the effort level, which represents the time, the effort, or the energy savings that the student keeps by not contributing to the group project.

Once students have secretly and anonymously written their chosen effort level on a slip of paper, one member of the group totals the effort. The total is the Group Effort.

In one treatment, the Group Effort is doubled and divided by the number of group members. This equal distribution of public points is added to any points the student may have kept as private goods.

In a second treatment, the instructor chooses a threshold group effort. If the total Group Effort does not meet the threshold (which should be set at an amount close to 2.5 times the number of students in the group), then no public points are earned. If the threshold is met, public points are calculated as for the first treatment.

Each student's individual score equals 5 – effort level + share of public points.

If the first treatment is played more than once, students will catch on that the person who contributes the least effort to the Group Effort earns the most points. This reinforces the idea that, given a budget constraint, resources that are not contributed to the public good benefit the individual, but resources contributed to the public good benefit everyone. It also demonstrates the conflict between what is best for an individual and what is socially optimal. If everyone contributes their maximum effort to the public, the maximum points are earned. But, of course, that's when the temptation to free ride is greatest.

This demonstration should also inspire discussion of why results might differ between the two treatments. Sometimes provision of a public good requires a minimum level of participation. Does setting a minimum change patterns of contribution?

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 8

COST-BENEFIT ANALYSIS

Questions and Problems

1. **A new public works project requires 200,000 hours of labor to complete.**

   a. **Suppose the labor market is perfectly competitive and the market wage is $15. What is the opportunity cost of the labor employed?**

   The workers could have earned $15(200,000) = $3,000,000 elsewhere. Since labor markets are competitive, this represents a reduction in the value the workers would have produced by working elsewhere. Hence, $3,000,000 is the opportunity cost of the labor employed here.

   b. **Suppose that there is currently unemployment among workers, and that there are some workers who would willingly work for $10 per hour. What is the opportunity cost of the labor employed? Does this vary depending on the fraction of would-be unemployed workers hired for the project?**

   The opportunity cost for the unemployed workers is only $10 per hour; for those who are employed at $15, it is $15 per hour. The higher the fraction of unemployed workers hired for this project, the lower the opportunity cost of labor. If half the workers are otherwise unemployed, labor costs are $15(100,000) + $10(100,000) = $2,500,000. If 90% of the workers are otherwise unemployed, labor costs are $15(20,000) + $10(180,000) = $2,100,000.

   c. **If your answers to a and b differ, explain why.**

   When employed workers are shifted into the public works project, they produce $15 less elsewhere. When unemployed workers are shifted into the public works project, there is no loss in production elsewhere. However, these workers lose the value of their leisure time, which we infer is equal to $10 per hour from the fact that they would be willing to work for this level of wages.

2. **How does the opportunity cost of a government purchase vary depending on whether the market for the purchased good is perfectly competitive or monopolistic?**

   The opportunity cost should be calculated as the resource cost of producing the input. In a perfectly competitive market, the price will equal the marginal resource cost. In a monopolistic market, the price will be greater than marginal cost. The opportunity cost and thus the figure used in a cost-benefit calculation should be the marginal cost. The additional price paid to a monopolist is a transfer to that firm, not a net benefit or cost.

3. **Two city councilors are debating whether to pursue a new project. Councilor Miles says it is only "worth it" to society if suppliers lower their costs to the city for the inputs to the project. Councilor Squeaky disagrees, and says it doesn't matter—society**

is no better off with these cost concessions than it would be without the concessions. Where do you stand? Explain.

Strictly speaking, if there are no efficiency costs associated with raising revenues, then Councilor Squeaky is correct. The true social cost of the project includes only the marginal cost of producing those inputs. If suppliers charge more than this for the inputs, the additional cost represents a transfer, but not a net cost or benefit. The costs suppliers offer to the city for the inputs to the project are thus irrelevant for whether the project is "worth it" to society or not in this case. Councilor Miles might be correct if there are efficiency costs associated with raising revenue, however.

4. **For your senior thesis, you polled your classmates, asking them, "How much would you be willing to pay to double the amount of parking on campus?" Based on their responses, you estimated that your fellow students were collectively willing to pay $12 million to double the amount of on-campus parking. What are some problems with this type of analysis?**

Survey willingness-to-pay figures can be suspect for several reasons. First, respondents may not have much experience with pricing this commodity, so they wouldn't have a good sense of what they really would be willing to pay if they actually had to pay for it. Second, respondents may have an incentive to either understate or overstate their true willingness to pay. They will understate it if they are concerned that the regents will raise their tuition to pay for the parking lot; they will overstate it if they want more parking but don't think they will actually have to pay for it. Third, you may need to consider your polled audience; if you had an unscientific sample, your results may be biased. For example, a senior polling his or her friends may have mostly asked students who will have graduated before the parking is expanded, and they may not place a high value on future parking. Or a dorm resident may have polled many students who do not drive and thus have little use for additional parking.

5. **Consider the Deacon and Sonstelie (1985) approach to valuing time described in the text on p. 202. Imagine that two cars are equivalent to one another in every way (such as gas mileage) except for gas tank size, and car A's tank has twice the gas capacity of car B's tank. Which driver is more likely to patronize a Chevron station mandated to lower prices below those of independent stations? Explain your answer.**

The total cost of purchasing gas at the Chevron station is the price of gas at that station plus the time cost for time spent waiting in line. Time costs are twice as high for the car with the smaller gas tank (car B), because the driver has to fill the tank twice as often. In effect, the driver of car A has lower costs than the driver of car B when patronizing the Chevron station and so is more likely to fill up there.

6. **A city government is considering building a new system of lighted bike paths. A councilor supporting their construction lists the following as potential benefits of the paths: (1) more enjoyable bike rides for current and future bikers, (2) reduced rush-hour automobile traffic from increases in bike commuting, and (3) the creation of 15 construction-related jobs. Can all of these actually be considered to be benefits? Explain.**

The first two can certainly be considered benefits. The third cannot generally be considered a benefit. If labor markets are perfectly competitive, then there is no such thing as the "creation" of jobs—the new government jobs merely crowd out jobs in other sectors of the economy. Even if labor markets are imperfectly competitive and the government hires workers who would otherwise have been unemployed, it is still not clear that this job creation can be considered a benefit. For example, consider an unemployed worker who gets $5 per hour in benefits from leisure. Proper accounting would consider the "true" social costs of hiring this worker to be the $5 per hour in foregone leisure. Any more money paid to the worker

would be neither a social benefit nor a social cost per se—it would be simply a transfer from the government to the worker. However, society might value the creation of this job if unemployment has significant externalities or if society values the redistribution associated with this transfer.

7. Suppose you prefer working 40 hours per week to 20 hours, and prefer working 32 hours per week to either 20 or 40 hours. However, you are forced to work either 20 hours or 40 hours per week. Is your hourly wage rate an accurate reflection of the value of your time? Explain.

Given the choice between 40 hours and 20 hours of work per week, you will choose to work 40 hours. However, because you cannot freely trade an hour of your time for the wage rate, the hourly rate does not reflect the value of your time very accurately. You would have preferred a 32-hour work week, so it must be that for the last 8 hours you work (in a 40-hour work week), your wage is less than the value of your time.

8. The city of Metropolita added a new subway station in a neighborhood between two existing stations. After the station was built, the average house price increased by $10,000 and the average commute time fell by 15 minutes per day. Suppose that there is one commuter per household, that the average commuter works 5 days a week, 50 weeks a year, and that the benefits of reduced commuting time apply to current and future residents forever. Assume an interest rate of 5%. Produce an estimate of the average value of time for commuters based on this information.

Letting V denote the value of an hour, the annual value of the time savings from the change can be written as (5 days/week × 50 weeks/year × .25 hours/day) × V, or 62.5 V per year. The present value of 62.5 V per year, forever, at a 5% discount rate, is 62.5 V / 0.05. The implication of the change in house prices is that households were willing to pay $10,000 to gain 15 minutes per commuting day, i.e., that the present value of the time savings is $10,000. Setting 62.5 V / 0.05 = $10,000 and solving gives V = $8.

9. One approach to calculating the value of life involves the use of compensating differential studies. What informational problems make these studies difficult to carry out?

Compensating wage differentials compensate workers for taking additional risks or tolerating less pleasant circumstances on the job. The wage premium that someone is willing to accept in exchange for an increased risk of loss of life might be used to estimate the value of life. Jobs differ in many ways, however, and wage differences are attributable to all those differences. For example, risky jobs are less likely to involve sitting in ergonomically correct desk chairs in climate-controlled offices, and the absence of those amenities might account for part of a higher wage paid to workers in riskier jobs. This presents an informational problem because a researcher would not be able to distinguish that part of the compensating wage differential that is attributable to increased risk and that part of the differential that is attributable to other amenities. The risk of nonfatal injuries might also be compensated for in the wage differentials, but that difference cannot be used to infer the value of life.

Estimating the value of life based on the willingness of a worker to accept a wage premium in exchange for increased risk on the job presents informational problems because a researcher will be unable to observe differences in risk attitudes. If workers who tend to be risk-takers are more likely to accept jobs with a high degree of risk, the compensating wage differential will reflect only the value to these workers and will therefore be overstated relative to the average worker.

Advanced Questions

10. The city of Gruberville is considering whether to build a new public swimming pool. This pool would have a capacity of 800 swimmers per day, and the proposed admission fee is $6 per swimmer per day. The estimated cost of the swimming pool, averaged over the life of the pool, is $4 per swimmer per day.

Gruberville has hired you to assess this project. Fortunately, the neighboring identical town of Figlionia already has a pool, and the town has randomly varied the price of that pool to find how price affects usage. The results from their study follow:

Swimming pool price per day	Number of swimmers per day
$8	500
$10	200
$4	1,100
$6	800
$2	1,400

a. If the swimming pool is built as planned, what would be the net benefit per day from the swimming pool? What is the consumer surplus for swimmers?

At an admission fee of $6, the city earns a profit of $2 per swimmer per day, or a total of $1,600 per day. Consumer surplus can be determined from the demand function. With every $2 increase in price, quantity demanded falls by 300. If you assume a linear demand function, quantity demanded will be zero at an admission price of $11.33. The triangle of consumer surplus is bounded by the quantity of 800 and the vertical distance of $11.33 – $6 = $5.33.

Consumer surplus = ½ (800 × 5.33) = $2,132. Total surplus ($1,600 + $2,132) is $3,732 per day.

b. Given this information, is an 800-swimmer pool the optimally sized pool for Gruberville to build? Explain.

If you assume that the cost per swimmer does not vary with the size of the pool, then this is not the optimal pool size. Optimality occurs where marginal cost equals marginal benefit. Since marginal cost is $4, the pool should set a price of $4 to swim. Then the marginal benefit to additional swimmers will be exactly $4 (the last swimmer was just willing to pay to get in). There will be 1,100 swimmers at this price, so the optimum pool size is thus 1,100. The town earns no profits on the pool, but the consumer surplus now becomes ½ (1,100 × 7.33) = $4,031.50 per day.

11. The U.S. Office of Management and Budget (OMB) recommends that the government use different discount rates for public investments than for the sale of government assets. For public investments, the OMB suggests a discount rate that reflects the historical pretax rate of return on private investments, while for the sale of government assets, the OMB recommends using the cost of government borrowing as a discount rate. Why might the OMB make this distinction?

To determine whether a new project is a good investment, the government should compare the returns on the project to the opportunity cost of the project. One way to measure opportunity costs is to look at the returns that would be generated by allowing society to undertake private sector investment with the resources intended for the project. This is what using the historical pretax returns on private sector investment as a discount rate does: it effectively compares the returns on the government project to (estimates of) the alternative returns in the private sector.

Sales of existing assets do not directly involve net social costs or benefits. The government effectively "trades" the existing asset for purchasing power (money), a transaction that has no direct effect on society. There is no social tradeoff involved in the decision about whether or not to sell an asset. There is a tradeoff to the government, however, since the additional revenue raised by the sale of the asset can be used to offset government borrowing. Using the cost of government borrowing is thus the natural discount rate to use for these considerations.

12. The city of Animaltown plans to build a new bridge across the river separating the two halves of the city for use by its residents. It is considering two plans for financing this bridge. Plan A calls for the bridge to be paid for out of tax revenues, allowing anyone to freely use the bridge. Plan B calls for imposing a toll of $6 for crossing the bridge, with the remainder of the cost to be paid out of tax revenues. City planners estimate a local demand curve for hourly use of the bridge to be $Q = 1{,}800 - 100P$. The bridge will be able to accommodate 2000 cars per hour without congestion. Which of the plans is more efficient, and why? How would your answer change if congestion was predicted on the bridge?

At a price of $6, the hourly use would be 1,800 – 100(6) = 1,200, well below the capacity of the bridge. If the bridge were free, hourly use would be 1,800. The consumer surplus triangle under Plan A would be ½ (18) × 1800 = 16,200, while under Plan B it would be lower, at ½ (18 – 6) × 1200 = 7200. Without congestion, the marginal cost of additional use of the bridge is presumably close to zero, this means that total surplus is higher under Plan A. Intuitively, the reason for this is simply that the efficient price of a good with zero marginal cost is zero—the bridge should be free if there is no marginal cost. If there was substantial congestion, there *would* be a positive social marginal cost of additional bridge use of the bridge, and Plan B might be more desirable.

13. You are trying to decide where to go on vacation. In country A, your risk of death is 1 in 10,000, and you'd pay $6,000 to go on that vacation. In country B, your risk of death is 1 in 20,000, and you'd pay $9,000 to go on that vacation. Supposing that you're indifferent between these two destinations, save for the differential risk of death, what does your willingness to pay for these vacations tell you about how much you value your life?

You are willing to pay $3,000 to change your risk from 0.01% to 0.005%, a change of 0.005%. In this situation, you are placing a value of $6 million (= $3000/.05) on your life. But people's perceptions and valuations of risk tend to be nonlinear and dependent on other considerations than that of the risk itself. These other considerations include remoteness of the risk, familiarity or experience with the source of risk, degree of control over the risk, and salience of the dangers, so this $6 million figure is only an approximation.

14. Jellystone National Park is located 10 minutes away from city A and 20 minutes away from city B. Cities A and B have 200,000 inhabitants each, and residents in both cities have the same income and preferences for national parks. Assume that the cost for an individual to go to a national park is represented by the cost of the time it takes her to get into the park. Also assume that the cost of time for individuals in cities A and B is $.50 per minute.

You observe that each inhabitant of city A goes to Jellystone ten times a year while each inhabitant of city B goes only five times a year. Assume the following: the only people who go to the park are the residents of cities A and B; the cost of running Jellystone is $1,500,000 a year; and the social discount rate is 10%. Also assume that the park lasts forever.

a. Compute the cost per visit to Jellystone for an inhabitant of each city.

A day at the park will cost a resident of city A $10 (10 minutes each way × $.50 per minute) and a resident of city B $20 (20 minutes each way × $.50 per minute).

b. Assuming that those two observations (cost per visit and number of visits per inhabitant of city A, and cost per visit and number of visits per inhabitant of city B) correspond to two points of the same linear individual demand curve for visits to Jellystone, derive that demand curve. What is the consumer surplus for inhabitants of each city? What is the total consumer surplus?

City A residents account for 2,000,000 visits at a price of $10; city B residents account for 1,000,000 visits at a price of $20. If the demand function is linear, every $10 price increase is associated with a decrease in quantity of 1,000,000 visits. Thus, the demand function is Price = $30 – 0.00001$Q$.

City A residents have a consumer surplus of ½ (2,000,000 × $20) = $20,000,000.

City B residents have a consumer surplus of ½ (1,000,000 × $10) = $5,000,000.

Total consumer surplus is $25,000,000.

c. There is a timber developer who wants to buy Jellystone to run his business. He is offering $100 million for the park. Should the park be sold?

Each year consumer surplus is $25 million and operating costs are $1.5 million, for a net benefit of $23.5 million. Applying the social discount rate of 10% yields a PDV of $235 million, much more than the timber developer's offer. The park should not be sold.

15. Imagine you are the governor of Massachusetts 15 years ago and need to decide if you should support the "Big Dig" highway and bridge construction project.

The Big Dig is estimated to take 7 years to complete. The project will require $45 million in construction materials per year and $20 million in labor costs per year. In addition, the construction will disrupt transportation within the city for the duration of the construction. The transportation disruption lengthens transport times for 100,000 workers by 30 hours a year. All workers are paid $15 per hour (assume that there are no distortions and that the wage reflects each worker's per-hour valuation of leisure).

The Big Dig, when finished, will ease transportation within the city. Each of the 100,000 workers will have their transport time reduced by 35 hours a year as compared to the preconstruction transport time. In addition, part of the Big Dig project involves converting the space formerly taken up by an elevated highway into a large park. The State of Massachusetts has determined that each worker will value the park at $40 per year. We will assume that no one else will use the park.

We also assume the government has a 5% discount rate and that the workers live forever. The benefits to the Big Dig begin in year 7, assuming the project begins in year 0 (i.e., the project runs for 7 years, from t = 0 to t = 6).

a. Should you, as the governor, proceed with the project? Formally show the cost-benefit analysis.

Costs during construction are as follows:

Year	Materials	Labor	Delay costs	Total	Total discounted to present
0	$45m	$20m	100,000×30×$15 = $45m	$110m	$110.00m
1	45m	$20m	45m	110m	110m/(1.05) = 104.76m
2	45m	$20m	45m	110m	110m/(1.05^2) = 99.77m
3	45m	$20m	45m	110m	95.02m
4	45m	$20m	45m	110m	90.50m
5	45m	$20m	45m	110m	86.19m
6	45m	$20m	45m	110m	82.08m
Total Costs					**$668.33m**

The value of the benefits for the park are \$40(100,000) = \$4 million per year, and the value of saved time is 100,000 × 35 × \$15 = \$52.5 million. The per-year benefit from the project is thus \$56.5 million, starting in year 7. The present value of the benefit, as of year 0, with a 5% discount rate is thus (\$56.5m/0.05)/(1.057) = \$803 million. Since this is bigger than the discounted costs, the project is worthwhile.

b. It occurs to you, after completing the calculation in part a, that it is possible the cost estimates are uncertain. If the construction materials estimate is \$45 million with 50% probability and \$100 million with 50% probability, should the project proceed? Assume that the government is risk neutral.

The new information suggests that the expected value of the materials cost is instead .5(\$45m) + .5(\$100m) = \$72.5 million per year for each of the first 7 years. The new total expected cost per year is \$72.5m + \$20m + \$45m = \$137.5m. Using Excel, where the cell formula for PDV is = A2/(1.05^B2):

Principal	Years	PDV
137.5	0	\$137.5
137.5	1	\$130.9524
137.5	2	\$124.7166
137.5	3	\$118.7777
137.5	4	\$113.1216
137.5	5	\$107.7348
137.5	6	\$102.6046
	Total	**\$835.4077**

Given the 50% probability that material costs will be \$100 million instead of the original estimate of \$45 million, the expected costs exceed the expected benefits and the project should not be undertaken.

Students who set up this project using a spreadsheet can see that it is easy to test varying assumptions without tedious recalculation.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 9

POLITICAL ECONOMY

Questions and Problems

1. **In a recent study, Americans stated that they were willing to pay $70 billion to protect all endangered species and also stated that they were willing to pay $15 billion to protect a single species. Which problem with Lindahl pricing does this demonstrate? Explain.**

   This illustrates the preference knowledge problem. Lindahl pricing requires an accurate measure of each individual's marginal willingness to pay, but people often do not have a good idea of their own marginal willingness to pay for things that are not ordinarily bought or sold in the market. Endangered species protection is an abstract concept, so it is unlikely that people had thought about their willingness to pay for it before being surveyed. At $15 billion per species, all endangered species could not be protected for $70 billion. It appears that the respondents either overstated their willingness to pay to preserve one species or understated their willingness to pay to preserve all endangered species.

2. **The preference revelation problem associated with Lindahl pricing becomes more severe as the number of people in society increases. Why do you think this is true?**

   The more people there are in a community, the easier it is to free ride. One reason is that it is less likely that anyone would detect a single free rider in a large community. Another reason is that by free riding, a person reduces the aggregate contribution to the public good, thus reducing the level of public good provision; in a large community, though, each individual's share is so small relative to the whole that free riding by a single individual does not significantly change the level of public good provision.

3. **Matsusaka (1995) showed that states that provide for voter initiatives tend to have smaller government growth than do states without such a provision. Why might this be so?**

   A natural conclusion might be that voter initiatives cause lower government growth. There is a natural causative channel for this conclusion, since voter initiatives have been particularly successful in capping tax increases. In states that have enacted measures that restrict the government's ability to raise taxes, governments have been forced to grow more slowly. In voter initiative states that have not passed tax reform measures, governments may have restrained their own growth out of fear of a voter initiative that would severely limit their ability to raise taxes.

   However, as discussed in Chapter 3, it is important not to confuse correlation with causation, even when there is a natural causative channel. An alternative explanation could be that citizens in some states have difference preferences than citizens in other states. If citizens who tend to like voter initiatives also tend to like small governments, then unobserved preferences could be the underlying cause for both smaller government growth and the presence of voter initiatives.

4. Major League Baseball used to use what is known as a 5-3-1 system to vote for the Most Valuable Player (MVP) in each league. Each voter gets to vote for three different players they consider worthy of the award. Their first-place candidate gets 5 points, their second-place candidate gets 3 points, and their third-place candidate gets 1 point. Points are then added up across all voters, and the player with the most total points wins the award. Suppose there are three voters—Neyer, Law, and Phillips—and five potential candidates for the award—Alex, David, Raffy, Manny, and Mario. The table below shows how each voter ranks the candidates. Raffy is embroiled in a substance abuse scandal. The "guilty" or "innocent" verdict will come out the day before voting, and a guilty verdict will ban him from being voted on as an MVP.

Rank	Neyer	Law	Phillips
Best	David	David	Raffy
Second Best	Alex	Alex	Alex
Third Best	Raffy	Raffy	Manny
Fourth Best	Manny	Manny	Mario
Fifth Best	Mario	Mario	David

a. Who will win the MVP if Raffy is found innocent?

If Raffy is found innocent, David gets 10 points (5 from Neyer and 5 from Law). Alex gets 9 points (3 from each voter), Raffy gets 7 points, and Manny gets 1 point. David wins the MVP.

b. Who will win the MVP if Raffy is found guilty?

If Raffy is found guilty, David still gets 10 points. But Alex now gets 11 points: 5 from Phillips and 3 each from Neyer and Law. So Alex wins the MVP.

c. What problem with consistent aggregation does this illustrate?

This illustrates a violation of the independence of irrelevant alternatives. Raffy wasn't going to win the competition either way, but the winner changes depending on whether he is in the competition or not.

5. Fletcher (2003) shows that when congressional districts are redrawn to include more elderly people, members of Congress become more likely to take pro-elderly positions in congressional votes. Why does the median voter model predict that this would be so?

Redistricting can change the distribution of voters in a district. When the distribution shifts, the median of the distribution shifts with it. In this case, there are now more voters at the end of the spectrum that prefers pro-elderly policies, and thus the median shifts toward more pro-elderly policies. The median voter model predicts that representatives will seek to satisfy the median voter in an effort to obtain the most votes, so the changes in congressional votes following the redistricting are perfectly consistent with the median voter theory.

6. Strattmann (1994) documented a condition of "logrolling" in Congress, in which members of Congress trade votes on one bill for votes on another. Is logrolling efficient, or should it be banned? Explain.

Logrolling is one way preference intensities can be expressed in the political process. When votes are traded, as in a market, legislators have an incentive to make political exchanges that benefit their constituents, and the greater the benefit the higher the "price," in terms of votes, the legislator may be willing to pay. Thus, it could be argued that this quasi-market increases efficiency. In practice, however, logrolling may result in more pork. Many public expenditures entail large benefits to small groups—for example, a new project may

disproportionately benefit the residents of an area where the project is located—while the costs are widely dispersed. As a result, a member of Congress may be willing to vote for the pet projects of many other members in order to obtain votes for his own project, resulting in more pork.

7. A problem with the median voter outcome is that it does not take into account intensity of preferences. Suppose that the government decided to give multiple votes to people with strong preferences, pro or con. Does this solve the problem? Why or why not?

This does not necessarily solve the problem of preference intensities. For example, consider a vote involving a simple "yes" or "no" decision (as opposed to one with multiple options). If individuals are multiple votes on this issue, they will not divide the votes between "yes" and "no" in proportion to their preferences. Instead, they will simply cast all of their votes in favor the position they prefer, regardless of their preference intensity. There will be no change in the outcome of the vote.

Giving individuals multiple votes may help to solve the problem of preference intensities when individuals can decide to split those votes across various different initiatives. A person with strong opinions about education but only mild preferences about building bike paths could cast all of her votes for her favorite school councilor, for example, and none of her votes for whether to build a bike path. This sort of mechanism has its own problems, however: it provides strong incentives for strategic voting, for example.

8. When local telephone companies wish to raise the rates they charge to phone customers, they must first argue their case at a public hearing before a regulatory body. How does the free rider problem explain why telephone companies are usually successful in getting permission to raise their rates?

The telephone companies have a strong incentive to expend resources lobbying for higher rates. Because a rate increase is valuable to each of those companies, no individual company will risk trying to free ride on another telephone company's efforts. Individual consumers, however, do not stand to lose a substantial amount of money from a rate increase, so each individual has less of an incentive to be involved in the issue. The large number of consumers, together with the small potential individual gain from lobbying against rate hikes, increases the likelihood that nobody will oppose the rate increases.

9. Figlio (1999) found that legislators are more likely to mirror their constituents' preferences during election years than in earlier years of their terms. This is particularly true for relatively inexperienced legislators. Why might this be the case?

Reelection concerns loom largest as elections approach, so legislators may be more conscious of their constituents' concerns at this time. In addition, the press and opposition candidates are more likely to report controversial votes during an election year, so legislators may feel more pressure to mirror constituent preferences during an election year. Inexperienced legislators may have come to Congress with their own ideologies and platforms, but they realize, as reelection time approaches, that they need to be more pragmatic about earning another term, and thus they give more consideration to their constituents' preferences. Experienced legislators, on the other hand, realize that they are always campaigning for the next election and thus are more attentive to their constituents' preferences throughout their terms.

10. Every year, the World Bank rates countries on the basis of their quality of governance, along a number of different dimensions (such as political stability, government effectiveness, and the rule of law). These indices are on the Web at http://www.worldbank.org/wbi/governance/govdata2002. Identify some countries where the quality of

governance has improved from 1996 to the present. What does this improvement portend for future economic growth in these countries?

Among the twenty most populous countries, Russia, Turkey, and Mexico showed the most improvement in political stability; Ethiopia and Iran showed the most improvement in corruption control. Since investment and thus economic growth requires stability, protection of property rights, and some degree of trust, one would expect healthier economic growth in the countries where the levels of these conditions are high or are improving.

Advanced Questions

11. Alfie, Bill, and Coco each value police protection differently. Alfie's demand for the public good is $Q = 55 - 5P$, Bill's demand is $Q = 80 - 4P$, and Coco's demand is $Q = 100 - 10P$. If the marginal cost of providing police protection is $13.5, what is the socially optimal level of police provision? Under Lindahl pricing, what share of the tax burden would each of the three people pay?

To answer these questions, first rewrite each demand so that P is expressed as a function of Q:

Alfie: $P_A = 11 - 0.2Q$; Bill: $P_B = 20 - 0.25Q$; Coco: $P_C = 10 - 0.1Q$.

Adding each person's willingness to pay yields $P_A + P_B + P_C = 41 - 0.55Q$. The left-hand side gives the marginal social benefit of providing the Qth unit of the good. Setting this marginal benefit equal to the marginal cost gives the socially optimum level of provision:

$41 - 0.55Q = 13.5$, or $Q = 50$

When $Q = 50$, Alfie's marginal benefit is $11 - 0.2(50) = 1$. Similarly, Bill's marginal benefit is $20 - 0.25(50) = 7.5$, and Coco's is $10 - 0.1(50) = 5$. Hence, Alfie's share of the tax burden under Lindahl pricing is $1/13.5 \approx 7.4\%$, and Bill and Coco's shares are approximately 55.6% and 37%, respectively.

12. Carrboro has three equal-sized groups of people: (1) type A people consistently prefer more police protection to less; (2) type B people prefer high levels of police protection to low levels and they prefer low levels to medium levels; (3) type C people prefer medium levels to low levels, which they in turn prefer by a modest amount to high levels.

a. Which types of people have single-peaked preferences? Which have multipeaked preferences?

Types A and C have single-peaked preferences, with peaks at "high" and "medium" respectively. Type B has multiple-peaked preferences, with peaks at "high" and "low" and a dip at "medium."

b. Will majority voting generate consistent outcomes in this case? Why or why not?

Majority voting does not usually generate consistent outcomes when some voters have preferences that fail to be single peaked. But they do happen to generate consistent outcomes in this case. If "high" and "low" are the two options on the ballot, "high" will win, since types A and B will vote for it. Similarly "high" wins when "high" and "medium" are the two options on the ballot. When "low" and "medium" are on the ballot, "medium" wins, since types A and C will vote for it. Finally, when all three are on the ballot, types A and B will both vote for "high," which will therefore win. Notice that there are no cycles, so the voting outcomes are, in fact, consistent. The decisions coincide with those that would be made by a society that prefers "high" to "medium" and "medium" to "low."

13. In business, there is a tension between the principals (stockholders) and agents (managers). The managers may choose policies that increase short-term profitability (and their bonuses) at the expense of long-term profitability. Describe why the same types of problems may exist in government as well, where elected officials are the agents and voters are the principals.

To stay in office, elected officials must be reelected, which tends to make them place a high value on short-term benefits. Just as a manager is pressed to show profitability in each annual report to stockholders, elected officials must demonstrate successes to the voters in each election year. Projects or policies that yield benefits far into the future may not help a candidate's bid for reelection, particularly if voters assess issues and performance from a short-term perspective.

14. Voters rarely get to choose the exact level of spending on a public good. Instead, they are provided with two options—a proposed spending level posed by the government and a default (or "reversion") level that would be enacted if the proposal were rejected by voters. The Leviathan theory suggests that governments will select intentionally large proposed spending levels and default levels that are well below the desired level of spending. Why is this behavior consistent with a size-maximizing government?

According to the theory of a size-maximizing government, bureaucrats have a strong incentive to maximize their output and thus their budgets. Bureaucrats who are interested in keeping and expanding their positions as well as their budgets prefer a larger government, but taxpayers dislike high levels of expenditure. By setting default levels that are very low, voters are forced to choose between the high expenditure levels favored by governments and very low spending levels. Many of the services provided by the government are perceived by citizens as essential, such as police and fire protection, public education, and highway maintenance. The possibility that the government will revert to a small, default level of public spending carries the threat that these essential services will not be provided. When the government threatens its citizens with denial of essential services or severe reductions in popular programs, the citizens are forced to choose between the reductions and the alternative—spending at a higher level than they might have preferred. Given this choice, voters will approve the proposed high budget because they would be worse off with a budget that is substantially smaller than what they preferred. When faced with a binary choice, voters will pick the option they prefer, so they have to find the big budget proposal only *slightly* preferable to the reversion for the big budget to pass. The worse the reversion budget, the greater increase in spending the government can get away with.

15. Refer to Table 4-1, which reports the composition of the U.S. generational accounts. Why might the political system in the United States have led to this pattern of intergenerational transfers?

Table 4-1 indicates that the current elderly are receiving much more in transfers over their lifetimes than they paid or will pay in taxes, leaving future generations to pay much more in taxes than they receive in transfers. The current elderly have substantially more political power than unborn generations and generations as yet too young to vote. They therefore have the ability to increase their current and promised future transfer payments without raising their tax burden, leaving that burden to fall on future generations who currently have no political voice.

In-class Exercise

Supply each student with one of the following lists, making sure that equal numbes of students receive each list.

	List 1	**List 2**	**List 3**
Favorite candidate	Chris	Pat	Terry
Second favorite	Pat	Terry	Chris
Least favorite	Terry	Chris	Pat

Try several different voting mechanisms—including majority voting, pairwise voting, and sequential elimination, or runoff—and have one student keep track of the results. In the first round of voting, tell students that they must vote their true preferences. Initial voting can be conducted using a show of hands.

In another round of voting, try a Borda count: Allow each student to cast 2 votes for his or her favorite candidate and a single vote for his or her second-favorite candidate. This initial public voting establishes baseline information about the distribution of preferences in the class.

After the initial rounds of voting, instruct the students that they may vote strategically in order to assure the election of their favorite candidate. Physically separating each group into “parties” according to the given preferences can facilitate coalition building and vote trading. A public roll call (or show of hands) can be expected to lead to different results than those retained from secret balloting.

Some possible discussion questions: If your objective is to have your own candidate win, is it always best to vote your true preferences? Does public voting increase or decrease voting efficiency relative to voting via a secret ballot?

Solutions and Activities
for
CHAPTER 10

STATE AND LOCAL GOVERNMENT EXPENDITURES

Questions and Problems

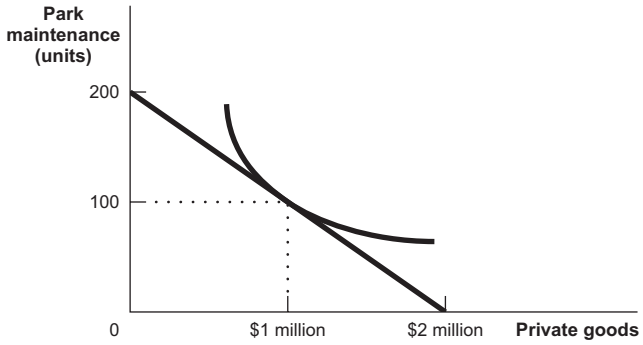
1. The (identical) citizens of Boomtown have $2 million to spend either on park maintenance or private goods. Each unit of park maintenance costs $10,000.

a. Graph Boomtown's budget constraint.

Boomtown can afford up to $2 million of the private good or up to 200 units ($2 million/$10,000) of park maintenance, with a constant trade-off of 1 unit of the private good for every $10,000 of the public good. The budget constraint, depicted in the graph in b, is the line segment connecting ($2 million, 0) and (0, 200 units).

b. Suppose that Boomtown chooses to purchase 100 units of park maintenance. Draw the town's indifference curve for this choice.

Boomtown's indifference curve must be tangent to the budget constraint at the point ($1 million, 100 units), as shown in the following figure.

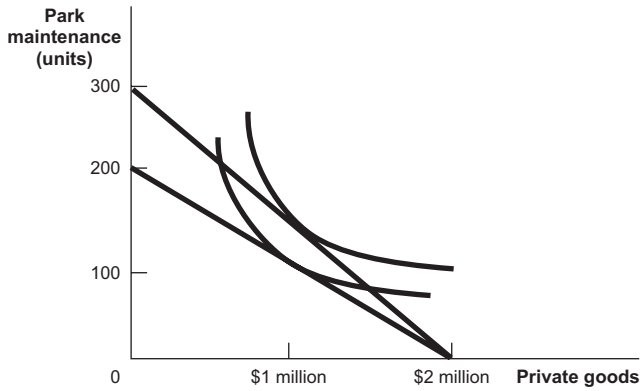


c. Now suppose that the state government decides to subsidize Boomtown's purchase of park maintenance by providing the town with 1 unit of maintenance for every 2 units the town purchases. Draw the new budget constraint. Will Boomtown purchase more or fewer units of park maintenance? Will Boomtown purchase more or fewer units of the private good? Illustrate your answer, and explain.

This policy does not change the quantity of private goods Boomtown can afford. But for every 2 units of park maintenance Boomtowners now purchase they acquire a total of 3 units. So if they spend all their money on park maintenance, they can get a total of 300 units of park maintenance. The budget constraint thus rotates around the point ($2 million, 0) and intersects the vertical axis at (0, 300 units), as shown in the figure on the next page.

The subsidy has both an income and a substitution effect. The income effect occurs because Boomtown can now afford to buy more of each good than the original choice of

($1 million, 100 units). Assuming both are normal goods, this will lead Boomtown to choose more private goods as well as more park maintenance. The substitution effect occurs because the subsidy makes park maintenance cheaper in terms of private goods. This will make Boomtown purchase more park maintenance and fewer private goods. We therefore know that Boomtown will purchase more park maintenance, but it is unclear whether the town will purchase more or fewer private goods. In the following illustration, they choose to purchase more private goods, but the graph could be drawn the other way as well.



2. Why does the Tiebout model solve the problems with preference revelation that are present with Lindahl pricing?

The problems with preference revelation with Lindahl pricing arise from the fact that an individual who reports lower preferences for a public good lowers the provision of that public good by only a small amount (since the total provision is average across all members of the community) but lowers his taxes by a large amount (since his taxes are based on his reported preferences). In other words, individuals have an incentive to free ride on the provision of others. In the Tiebout model everyone in each jurisdiction ends up with the same preferences, and the Lindahl prices can therefore be set *equal* for each resident. This means that taxes are no longer specific to an individual's report. When an individual reports lower preferences for the public good, he lowers the provision by a small amount, but he also lowers his taxes by a small amount (and lowers everyone else's taxes by the same amount). This removes the incentive to free ride and solves the problems with preference revelation.

3. Some have argued that diversity in communities and schools leads to positive externalities. What implications does this view have for the efficiency of a Tiebout equilibrium? What implications does it have for government policy?

If diversity in communities and schools leads to positive externalities, then the sorting into homogenous communities implied by the Tiebout model may be inefficient. When considering where to locate, families will fail to take into account the positive externalities they would provide by living in a community where they would enhance diversity. They will therefore have a tendency to locate themselves in overly homogeneous communities. If this view is correct, there may be scope for welfare improving government diversity-enhancing interventions. One example of such an intervention could be to offer subsidies for building low-income housing in wealthy communities.

4. Brunner, Sonstelie, and Thayer (2003) studied how home ownership and community income influenced votes on a proposed initiative in California to allow children to ob-

tain their locally funded education at any public or private school rather than being districted to their local school. Think about how public services such as education are capitalized into house prices. Why would renters in high-income communities be more likely than owners to support this school choice plan? Why would the reverse be true in low-income communities?

One of the major reasons for differences in housing prices across towns is differences in school quality across towns. Towns with good schools have relatively inflated housing prices and towns with bad schools have relatively deflated housing prices. The California initiative would have uncoupled the link between town of residence and schools. It therefore would have tended to level housing prices across townships, raising prices in towns with bad schools and lowering prices in towns with good schools. This would benefit homeowners in towns with bad schools—who would see the value of their property increase—and harm homeowners in towns with good schools. Similarly, it would tend to benefit renters in towns with good schools—who would see their rent decrease—and harm renters in towns with bad schools.

5. **Think about two public goods—public schools and food assistance for needy families. Consider the implications of the Tiebout model. Which of the goods is more efficiently provided locally? Which is more efficiently provided centrally? Explain.**

The Tiebout model relies on a strong link between taxes paid and benefits received. This link is stronger for public schools than it is for food assistance. Taxpayers with children and those who perceive the positive externality of an educated populace will be willing to pay taxes in exchange for quality public education. In addition, much of the benefit of this expenditure is enjoyed locally. Local provision is likely to be relatively efficient. Many taxpayers will not perceive any benefit from paying for food assistance that is given to only a few, so they will not support this public good or they will move away from communities that provide it. Furthermore, the provision of food assistance may lead to in-migration of needy families, reducing the community's ability to continue to provide this assistance. Under these conditions, food assistance is more efficiently provided centrally.

6. **Describe the externalities argument for distributing money from one community to another. Provide an example of this kind of redistribution based on externalities.**

Many of the effects of public good provision are not confined to the community providing the good. A public good that generates benefits for the surrounding communities will be underprovided relative to the efficient level if the community in which the good is physically located must pay the entire cost of provision. Examples include public parks enjoyed by residents of surrounding communities, public safety and law enforcement, public education, and fireworks displays. At the national level, federal block grants and matching grants to state and local governments are two mechanisms for redistributing public goods among communities. An example of redistribution at the state level involves the use of equalization formulas to redistribute public education revenues among communities. Poor education systems are thought to impose negative externalities on society, for example by increasing crime rates relative to what they would be with well-educated individuals. Funding equalization was intended to level the playing field, increasing the level of education in towns with weak school systems and therefore reducing these negative externalities. Prior to the institution of equalization, children in wealthier communities (where local property taxes raised more money) attended better-funded schools. Funding equalization was intended to level the educational playing field.

7. The state of Minnegan is considering two alternative methods of funding local road construction, matching grants and block grants. In the case of the matching grant, Minnegan will spend $1 for every $1 spent by localities.

a. What is the price of an additional dollar of local spending in each case?

The "price" of spending $1 on road construction is reduced to 50¢ by the matching grant. The other 50¢ of the $1 spent comes from the matching grant. The block grant would not change the relative price of road construction. Since block grant money can be used to purchase anything, the price, or opportunity cost, of $1 worth of road construction is still $1.

b. Which of the two methods do you think would lead to higher levels of local spending on roads? Explain your answer.

Both grants will increase spending through the income effect: Minnegan is wealthier with either and is likely to spend more money on several projects, including roads. The matching grant reduces the relative cost of road construction, however, so in addition to the income effect, the substitution effect will induce more road building. The matching grant is more likely to lead to higher levels of spending on roads.

8. The state of Massachusetts recently ran an advertising campaign for the state lottery that claimed, "Even when you lose, you win." The gist of the advertisement was that lottery revenue was used for particularly good ends like education. Suppose that lottery revenues are indeed earmarked for education. How would traditional economic theory evaluate the claim behind the ad campaign? How would an economist who believed in the flypaper effect evaluate it?

Traditional theory would suggest that the earmarking of lottery revenues for education is largely irrelevant. Simply saying that this revenue is used for that purpose does not mean that spending on education would be any different if the revenue was instead raised by another source such as taxation. That is, lottery revenue spending on education may simply crowd out other education spending, leading to no increase in total spending on education. If the flypaper effect is true, however, earmarks matter; according to the flypaper effect, money "sticks" where it is sent, so earmarking particular funds for education will have a much smaller crowding-out effect on other sources of education spending.

9. Why does California's school finance equalization policy have a high associated marginal tax price? Explain.

One provision of California's equalization policy is that there can be no more than a $200 difference in per-pupil spending among school districts. If a school district raises revenue that would cause its expenditures to exceed the lowest district's expenditures plus $200, that additional revenue would have to be handed over to the state for redistribution. This is essentially a 100% marginal tax rate. This 100% marginal tax rate translates into an effectively infinite tax price since no matter how much more a town "spends" on education through increased taxes, it sees no increase in local funding.

Advanced Questions

10. Rhode and Strumpf (2003) evaluated a century of historical evidence to investigate the impact of changes in moving costs within the Tiebout model.

a. What does the Tiebout model predict should happen to the similarity of residents within a community as the costs of moving fall?

The Tiebout model predicts that communities will become more homogeneous with increased mobility. Moving costs are a barrier to complete sorting in Tiebout's model;

when those costs fall, people are expected to more easily move to locations where the residents have the same preferences for public goods.

b. Rhode and Strumpf found that while mobility costs have steadily fallen, the differences in public good provision across communities have fallen as well. Does Tiebout sorting explain this homogenization of public good provision, or must other factors have played a larger role? Explain.

The Tiebout model does not predict homogeneity across communities; in fact, the Tiebout model allows for substantial variance across communities, predicting homogeneity only within each separate community. There may be some towns with very high levels of public good provision and some towns in which very little is publicly provided. Reduced mobility costs would enhance this kind of sorting. Other factors, such as increased mobility itself (as costs have fallen), may have increased homogeneity generally in the population. As people move more and are exposed to more national media, regional or cultural differences in attitudes and preferences might diminish.

11. The state of Delaland has two types of town. Type A towns are well-to-do, and type B towns are much poorer. Being wealthier, type A towns have more resources to spend on education; their demand curve for education is $Q = 100 - 2P$, where P is the price of a unit of education. Type B towns have a demand curve for education that is given by $Q = 100 - 5P$.

a. If the cost of a unit of education is $15 per unit, how many units of education will the two types of town demand?

Type A towns will demand $Q = 100 - 2(15) = 70$ units of education, while type B towns will demand $Q = 100 - 5(15) = 25$ units of education.

b. In light of the large discrepancies in educational quality across their two types of town, Delaland decides to redistribute from type A towns to type B towns. In particular, type A towns by $5 for each unit of education they provide, and they give type B towns $5 for each unit of education they provide. What are the new tax prices of education in the two towns? How many units of education do the towns now purchase?

To buy a unit of education, a type A town now has to pay the $15 cost plus $5 in taxes. The tax price of education is thus $20 for type A towns. Type B towns have to pay only $10 for a unit of education since the state will pay the other $5; they have a tax price of $10. At these new prices, type A towns will demand $Q = 100 - 2(20) = 60$ and type B towns will demand $Q = 100 - 5(10) = 50$ units of education.

c. Delaland wants to completely equalize the units of education across towns by taxing type A towns for each unit of education they provide and subsidizing type B towns for each unit of education they provide. It wants to do this in such a way that the taxes on type A towns are just enough to finance the subsidies on type B towns. If there are 4 type A towns for every 5 type B towns, how big a tax should Delaland levy on type A towns? How big a subsidy should they provide to type B towns?

The state wants to equalize the units of education in the two types of town. Call the level at which they equalize spending Q^*. Let T denote the per-unit tax on type A towns, and let S denote the per-unit subsidy on type B towns. For budget balance, we need $4Q^*T = 5\,Q^*S$, or $S = 0.8T$. With a unit tax of T, type A towns will demand a total of $Q^* = 100 - 2(15 + T)$ units of education; type B towns will demand $Q^* = 100 - 5(15 - S)$ with a unit subsidy of S. Setting these equal and using $S = 0.8T$,

$100 - 2(15 + T) = 100 - 5(15 - 0.8T)$ or
$30 + 2T = 75 - 4T$ or
$T = 45/6 = 7.5$

Hence, $T = 7.5$, and $S = 0.8T = 6$. With this tax and subsidy scheme, each town will demand 55 units of education.

12. The Individuals with Disabilities Education Act mandates that states and localities provide appropriate education for all students identified as having special needs. States have responded by funding special education using several different mechanisms. Two of these mechanisms are "census" approaches (in which states estimate how many children should have special needs based on student characteristics and allocate money to localities based on these predictions) and "marginal subsidy" approaches (in which states pay localities a percentage of the amount of money that the localities say they spend on special education).

a. It has been found that the marginal subsidy approach leads to more students being classified by their localities as needing special education than does the census approach. Why might this be the case?

It is costly to classify a student as "special needs." Under a census system, classifying an additional student as "special needs" does not change the funding for their locality, so the district bears the entire marginal cost of providing the appropriate education for the student. Under a "marginal subsidy" system, the state bears some of the additional cost associated with classifying an additional student as "special needs," thus lowering the marginal cost of provided the appropriate education for him or her. Since they have a lower marginal cost of classifying additional students as "special needs," we expect that localities will increase the number of students so classified under the marginal subsidy system.

b. Suppose that you analyze cross-sectional data on the level of subsidy and the number of students enrolled in special education. You find that, in cross-section, states that reimburse localities the most for their special education students tend to have the highest rates of students enrolled in special education. Think of one possible problem with this analysis.

This analysis is meant to suggest that higher reimbursement rates *cause* higher special education enrollment. The problem with this analysis is emphasized in Chapter 3: correlation does not imply causation. An alterative explanation for the observed relationship between reimbursement rates and enrollment, for example, could be that the quality of special education varies by state. Teachers in states with high-quality programs might be more likely to refer students to the programs. At the same time, high-quality programs probably would be more costly as well, so state states with high-quality programs might also be more likely to provide higher reimbursement rates for enrollment in these programs.

13. As described in the text, Fischel (1989) argued that California's *Serrano v. Priest* school finance equalization induced voters to limit property taxes in California. Following this argument, would an alternative school finance equalization that produced increased spending for low-wealth communities using state funds be more, less, or equally likely to induce a property tax limitation in California? Explain.

One aspect of Fischel's argument is that wealthy Californians were willing to pay higher property taxes for their own local schools but were not willing to pay higher property taxes to support nonlocal schools. Property taxes are assessed at the local level, and residents appear to prefer to see the money spent at the local level as well. The use of state funds to equalize school finance would make a property tax limitation less likely. If state funds were

spent on school finance, local taxes could be used to finance local public goods. Residents would see more clearly the tax–benefit link. Knowing that property taxes would be used for local benefits would make residents less likely to set limits on increasing property taxes.

14. There are two types of residents in Brookline and Boston, professors and students. Professors have an income of $Y = 200$; students have an income of $Y = 100$. Both Brookline and Boston provide road repair services for their citizens. Professors value road repair more than students because they have nicer cars. In fact, the value of road repair to each individual takes the form $(Y \times R)/10 - R^2/2$. The *per-resident* cost of road repair is $5R$.

a. What is the marginal value of road repair for each type of individual? What is the marginal cost to each type of individual?

For professors, the value of road repair is $20R - R^2/2$; marginal value is the first derivative of this expression with respect to R: $20 - R$. For students, the marginal value is $10 - R$. The per-resident cost of road repair is $5R$, so marginal cost is 5.

b. How much do professors want to spend on road repair? How much do students want to spend?

Professors want to spend on road repair to the point where marginal cost equals marginal benefit, or where $20 - R = 5$. Hence, professors want road repairs in the quantity $R = 15$; each professor will want to spend $5(15) = 75$. Similarly, students want road repairs in the quantity $R = 5$; each student will want to spend $5(5) = 25$.

c. Assume that residents are distributed as follows:

	Brookline	Boston
Professors	**50**	**25**
Students	**25**	**50**

If each town uses majority voting to determine how much road repair to provide, how much will each town provide? Are any residents unsatisfied with the amount of road repair?

Brookline will provide 15 units because more than half of its residents are professors; Boston will provide 5 units of road repair because more than half of its residents are students. The 25 students in Brookline are unsatisfied. They do not value road repair highly enough to justify (pay for) that level of provision. The professors in Boston are also unsatisfied. They would prefer and would be willing to pay for more road repair.

d. Now assume that professors and students are able to migrate between Brookline and Boston. Which residents will choose to move? What will the equilibrium distribution of residents be? Are any residents unsatisfied with the amount of road repair now? Is the provision of road repair efficient? Why or why not?

Students will move to Boston and professors will move to Brookline. The equilibrium distribution of residents has perfectly homogeneous communities of 75 people. Each type of resident is paying his or her marginal benefit, and that marginal benefit equals the marginal cost of provision. This provision is efficient and achieves the Lindahl result.

e. Consider again the premigration equilibrium. The State of Massachusetts decides to pass a law about road repair. It requires that professors in the state must contribute 75 units toward road repair in the town where they live; students must contribute 25 units toward road repair in the town where they live. How much road

repair will there be in each town under the new regime? Will any residents want to move and, if so, where and why?

In Brookline, in the premigration period, there were 50 professors and 25 students. The total contributions to road repair under the new state law are 50(75) + 25(25) = 4,375.

Because total cost = $5R \times$ population, the quantity of road repair is $4{,}375/(5 \times 75) = 11.67$. In Boston, total contributions are 25(75) + 75(25) = 3,750. The quantity of road repair is $3{,}750/(5 \times 75) = 10$. Everyone is unhappy. Both towns provide too much road repair for the students and too little for the professors. Brookline's quantity is just a bit better from the professors' perspective than Boston's, so the professors might choose to move there. If they do, as more professors move to Brookline, *R* would increase there and fall in Boston (because the mix of professors and students in each place would change). Eventually, types would sort and reach the efficient result shown in d. However, the difference between 11.67 and 10 is fairly small, perhaps not enough to start the sorting process in that direction.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Advanced In-class Demonstration

This demonstration illustrates a simple migration model with implications for stability. The simulation has students voting with their feet to maximize their utility, as in the Tiebout model.

Each student has the same simple utility function. Positive network externalities yield a benefit equal to a constant times the size of the community. Congestion yields a cost equal to the size of the community squared. Only two communities can form, town A and town B, and every student must move to one community or the other. It is easiest if students are allowed to migrate one at a time.

For the first round, the constant equals the class size. For example, in a class of 30, each person's utility is 30(population of Town_i) – population of $\text{Town}_i{}^2$. Start everyone in town A. The utility of each will be 0 according to the formula. The first mover to town B will have utility of 29, so he will move. Similarly, the second person will move: comparing utility at town size of 29 ($U = 29$) with utility at town size of 2 ($U = 56$) will induce a move to town B. Eventually students will arrive at a stable equilibrium population distribution of half in each town.

In round two, set the constant equal to the class size *minus* ten. Students again migrate starting from town A. Clearly the first ten will quickly move. So will the eleventh, even though utility in the new town has started to fall. A stable equilibrium will be reached at half in each town.

In round three, the constant is the class size *plus* ten. Even if the class starts with a 50-50 distribution between the towns, there will be migration. They should eventually find a stable equilibrium in which everyone is living in one town but individual utility is only 300.

Class discussion can include comparison of optimal population size with a stable equilibrium population size, the efficiency and equilibrium implications of the Tiebout model when the number of towns is "too small" to allow optimization, and possible explanations for the existence of large metropolitan areas even if many of the residents would prefer a smaller city size.

In the second and third rounds, the first movers may try to keep newcomers out because their entry drove down every resident's utility. This can lead to a discussion about how real-world communities accomplish this.

Following is an Excel spreadsheet example for a class size of 30.

Town size	30n–n^2	20n–n^2	40n–n^2
1	29	19	39
2	56	36	76
3	81	51	111
4	104	64	144
5	125	75	175
6	144	84	204
7	161	91	231
8	176	96	256
9	189	99	279
10	200	100	300
11	209	99	319
12	216	96	336
13	221	91	351
14	224	84	364
15	225	75	375
16	224	64	384
17	221	51	391
18	216	36	396
19	209	19	399
20	200	0	00
21	189	–21	399
22	176	–44	396
23	161	–69	391
24	144	–96	384
25	125	–125	375
26	104	–156	364
27	81	–189	351
28	56	–224	336
29	29	–261	319
30	0	–300	300

Solutions and Activities
for
CHAPTER 11

EDUCATION

Questions and Problems

1. **State and federal governments actively support education at the primary, secondary, and collegiate levels. But they *mandate* education at the primary and secondary levels, while merely provide subsidies and loan guarantees at the collegiate level. Of the key rationales for public provision of education described in section 11.1 of the text, which do you think underpins this differential treatment?**

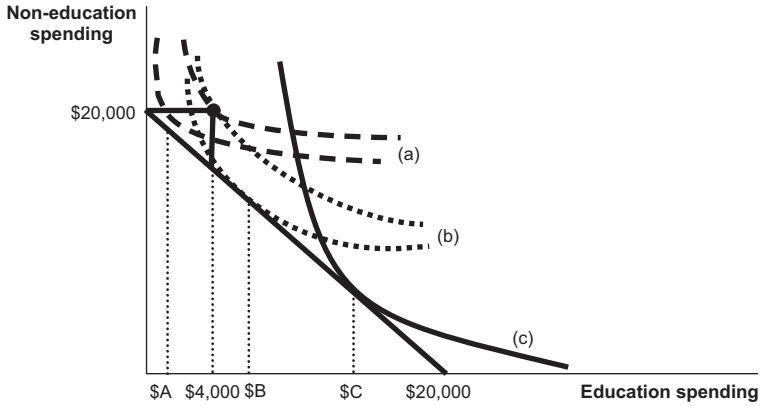
   The text describes five rationales for public provision of education: *productivity gains*; an *educated citizenry*, *credit market failures*, *family decision making*, and *redistribution*. Each provides a reason that education is likely to be underprovided without government intervention, but most of them do not provide a reason to *mandate* education. For example, the government can solve credit market failures by offering loan guarantees while letting students choose whether to get educated or not. Similarly, the government could address the positive externalities associated with productivity gains or having an educated citizenry by subsidizing education without mandating it. Finally, the government could redistribute to poorer families by using progressive taxation or simply by offering free education without mandating it.

   The one rationale that does suggest mandating education is family decision making. If the government believes that parents are likely to make the wrong decisions for their children and fail to provide them with an education—even if they are strongly encouraged to do so by loan guarantees, subsidies, or free education—it may feel it necessary to *require* that the parents send their children to school. This rationale applies to children under their parent's supervision—to children at the primary and secondary education levels. By the time students are old enough to attend college, parents play a much smaller role in making decisions for them, so the importance of this rationale is reduced.

2. **Consider two metropolitan areas, one that has many small school districts and one that has only a few large school districts. How are the efficiency and equity effects of introducing a voucher system likely to differ across these two areas?**

   One of the major arguments for introducing a voucher system is that it will improve competition in education and therefore make schools more efficient. Introducing a voucher system is therefore more likely to improve efficiency in areas that currently suffer from an absence of competition. Metropolitan areas with many small school districts already achieve a significant degree of competition via the Tiebout mechanism: since it is easy to move to a neighboring district, potential students can "vote with their feet," and there is a therefore a substantial degree of interdistrict competition. The Tiebout mechanism works less well in metropolitan areas with only a few large school districts, so introducing vouchers is more likely to improve efficiency.

3. Suppose that a family with one child has $20,000 per year to spend on private goods and education, and further suppose that all education is privately provided. Draw this family's budget constraint. Suppose now that an option of free public education with spending of $4,000 per pupil is introduced to this family. Draw three different indifference curves corresponding to the following three situations: (a) a free public education would increase the amount of money that is spent on the child's education; (b) a free public education would decrease the amount of money that is spent on the child's education; and (c) a free public education would not affect the amount of money spent on the child's education.



The family with indifference curves labeled (a) was consuming very little education prior to the introduction of the public education program ($A). When the public education program is introduced, they move into the public education system; their consumption of education increases to $4,000 and their consumption of other goods goes up to $20,000. The family with indifference curves (b) was consuming slightly more than $4,000 in education prior to the introduction of public education ($B). When the system is introduced, this family also moves into the public education system. The move involves a reduction in their education spending, but the large increase in their spending on other goods (since they no longer have to pay for the education out of pocket) more than compensates them, and they are better off. Finally, the family with indifference curve (c) is unaffected by the introduction of public education. They value education highly enough that the increase in non-education spending they could achieve by switching to the new public education system is not enough to compensate them for the reduction in spending from $C to $4,000. (Note: Another less interesting but possible answer to (c) is a family that happened to consume *exactly* $4,000 prior to public education.)

4. Empirical evidence suggests that better-educated adults donate more to charity than do less-educated adults with similar income levels. Why might this evidence justify public subsidization of education? What potential biases may make it difficult to interpret this empirical relationship?

This evidence would justify public subsidization of education for some of the same reasons education is already publicly subsidized. First, contributions to charity are often contributions to a public good. Thus, education indirectly increases the provision of goods that are underprovided by private markets. Second, some charities engage in redistributive activities; this observed phenomenon reinforces education's redistribution effects. Contributions to educational institutions or scholarship-granting agencies can offset the credit market failures that prevent students from being able to finance their education.

This justification for public subsidization of education relies on a particular interpretation of the empirical relationship: education causes increased charity. As emphasized in Chapter 3, however, one must be extremely careful in interpreting empirical relationships as indicative of causation. It could be, for example, that individuals who are more charitable also value their education more (for example, they like to read books and write papers more than others do) and therefore choose to get more education. Or it may be that charitable proclivities cause education, as individuals who wish to make charitable donations in the future feel that an education is important for informing them of where it is most important to make donations. If these stories are correct, then there is no charity-linked externality reason to subsidize education.

5. Some have argued that introducing a voucher system would be particularly good for two groups of students: those who are the *worst* off under the current system, and many of the students who are the *best* off under the current system. Why might this be the case?

The worst-off students under the current system are students who are stuck in underperforming schools. Vouchers would help these students by freeing them to find better options. Some students who are best-off under the current system already attend private schools. Under a voucher system, these students would potentially get a voucher which would allow them to attend the same school for less out-of-pocket money.

6. Several researchers have found evidence of sheepskin effects, in which the labor market return to twelfth grade is higher than the return to eleventh grade and the return to the fourth year of college is higher than the return to the third year of college. Why does this evidence of sheepskin effects bolster the screening explanation for the relationship between education and earnings?

Sheepskin effects suggest that some years of education are much more valuable than others. Specifically, when a sheepskin effect holds, the year immediately preceding graduation has the highest payoff in terms of earnings. One explanation for the education/earnings link is that education increases human capital by increasing skills and productivity. It seems unlikely, though, that productivity-enhancing skills are disproportionately gained in the last year of any degree program. On the other hand, staying through the last year does signal tenacity, a trait that employers value but one that is not directly observable. Thus, the high earnings associated with completing a degree are logically consistent with the screening theory but do not seem consistent with the productivity theory.

7. What are the advantages of comparing twins to investigate the relationship between education and earnings? What are the drawbacks of doing so?

Twins are likely to be similar in many ways. If identical, they share genetic predispositions. If raised together, they also share family influence. Thus, many variables are controlled for when comparing identical twins raised in the same household. Even nonidentical twins in the same household share some inherited traits and environmental influences. These similarities reduce the number of competing explanations for differences in earnings. Differences between twins are presumably caused by some variable other than genetics or environment. If education is the one observable trait that differs, then perhaps it is the one variable that explains differences in earnings. However, twins are not *exactly* alike; if they were, they would both have sought the same level of education. If there is a common explanation for one twin obtaining more education and being better paid on the job (for example, a more ambitious personality), then a researcher cannot attribute the entire earnings differential to education.

8. Suppose you want to evaluate the effectiveness of vouchers in improving educational attainment by offering a voucher to any student in a particular town who asks for one. What is wrong with simply comparing the educational performance of the students receiving vouchers with those who do not receive vouchers? What would be a better way to study the effectiveness of vouchers?

Comparing the educational performance of students who receive vouchers with the performance of students who do not does not provide much evidence of the effectiveness of vouchers because students who receive vouchers may differ from those students who do not in other ways. In this situation, there is an obvious way in which the two classes of students differ: some wanted vouchers and the others did not. The desire for vouchers may, for example, reflect greater motivation. Hence, if greater educational performance were observed among students receiving vouchers than among students who did not, one could not tell whether the performance difference was because of the vouchers or because of the difference in motivation. A better approach (empirically speaking) would be allow students to apply for vouchers and then randomly choose only half of the applicants to actually receive them. Comparing the two halves of applicants would produce an unbiased estimate of the causal effect of vouchers. (Of course, the effect of vouchers would be measured on those who applied for them; there would be no measure of how vouchers might affect other students.)

9. Seven in ten students who attend publicly funded universities leave the state after graduation, indicating that a very large fraction of states' investments in human capital bears fruit elsewhere. Why, then, might states still play such a large role in higher education financing?

If the goal of public provision of higher education is to provide states with a skilled workforce, then states might want to rethink their funding of higher education, given this degree of mobility. Perhaps state universities were established during a time of limited mobility, and the tradition has outlived its original justification. States may also subsidize higher education to offset individual families' failure to save enough for college or their inability to borrow for college, even though the investment in a college education is cost-effective. Thus, the state subsidy corrects this inefficiency or market failure.

Another explanation for continued state financing may be that an educated workforce is not the only rationale for state university funding. Some state universities bring prestige to the state through collegiate sports, for example, and research conducted at state universities can enhance the productivity of industries located in the state, or can lure new industries into the state. In addition, the leading medical facilities in some states serve as teaching hospitals for the state university medical school, and state governments turn to faculty at their universities to provide policy analysis. Thus, universities provide far more services to state residents than just educating their children.

10. The U.S. Department of Education regularly conducts the National Assessment of Educational Progress (also known as the "Nation's Report Card") to monitor student achievement in subjects such as reading, writing, and mathematics. Visit their data Web site at http://www.nces.ed.gov/nationsreportcard/). Compare the progress from 1998 to 2003 of students in your state with the progress of students in one other state. In which subject areas or grade levels has your state compared most favorably with the other state?

Answers to this question will depend on the states being compared. Another interesting exercise is to compare states that seem similar along other demographic dimensions with states that are very dissimilar. It is also informative to compare the chosen states to the national averages available at the same site.

Example: For fourth-grade math scores, the national public school average rose from 222 (out of a possible 500) in 1996 to 234 in 2003. These are very similar to scores reported

for the state of New York. Scores in California increased by more but were always less than the national average. Scores in New Mexico, a poor rural state, were low, and scores in Wisconsin, a wealthier state, were relatively high. Similarly, for fourth-grade reading scores, California and New Mexico reported lower-than-average scores; New York and Wisconsin reported above-average scores.

Average eighth-grade math scores increased nationally from 269 in 1996 to 276 in 2003. In California, scores were 6 points less than the national average in 1996 and 9 points less than the national average by 2003. In New Mexico, scores were just lower than in California in 1996 and did not improve. New York scores were slightly above the national average for the entire time period; scores were even higher in Wisconsin (although the increase in Wisconsin was just 1 point).

Reading scores in the eighth grade followed similar patterns: California and New Mexico reported lower-than-national-average scores; New York and Wisconsin reported above-average scores.

Advanced Questions

11. Many state constitutions explicitly require that states provide an "adequate" level of school funding. How might raising this level of "adequacy" actually lead to reduced overall levels of educational spending?

Public funding of education may crowd out private spending on education, particularly when public education is perceived to be a reasonable substitute for private education. If the public schools are of relatively low quality, parents who can afford to and who value their children's education will choose to reduce private consumption of other goods in order to send their children to private schools. As the quality of the public schools improves, however, parents will be less willing to make this trade-off. Because they gain so much, in terms of consumption of other goods, by switching from private schools to public schools, parents will be induced to move their children into the public school system, even if the public schools are not quite as good as the private schools. When public schools are perceived to be almost as good as private schools, parents will switch from private to public schools, reducing overall spending on education.

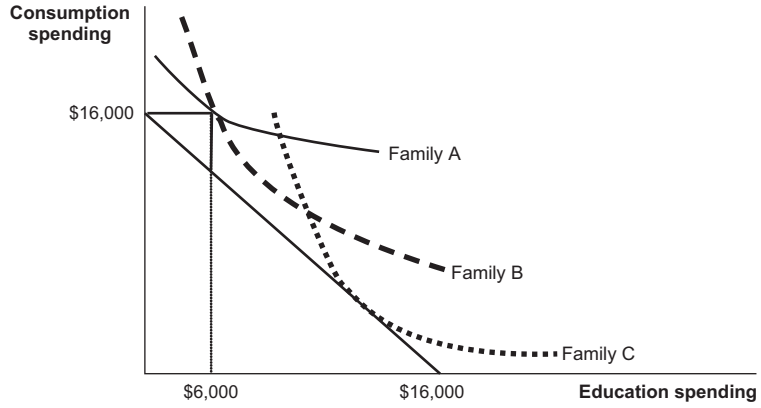
12. Epple and Romano (2003) described theoretical evidence that school vouchers will lead to "cream-skimming," where private schools will pick off the better students and leave public schools with lower-ability average students. They propose targeted vouchers, in which different-sized vouchers go to different groups of students, to combat this potential concern. How would you design a targeted voucher system that would lead to a reduced level of cream-skimming?

If all vouchers carry the same dollar value, schools will have an incentive to admit students who are the least costly to educate. High-need students will be a drain on the schools' resources, so these students may have a hard time gaining acceptance at private schools. To counter this tendency, vouchers could be issued in an amount that just equals the cost of educating the child who holds the voucher. School districts already routinely test children to determine eligibility for special programs, some of which are expensive to administer. This same mechanism could be used for targeting vouchers. Students who were qualified to receive costly interventions in pubic school would be given a voucher just sufficient to provide the same intervention in private schools. If the vouchers were calibrated to the cost of delivery of each program, schools would be indifferent (from a cost perspective) between admitting special-needs students and less-costly students. The onus would then be on the parents to ensure the appropriate intervention.

One important aspect of this plan is that the mix of students might affect the value of the schooling independent of the cost to educate a specific child. For example, the presence of easy-to-educate students might exert a positive influence on the harder-to-educate (and thus more costly) students by setting a good example, fostering a culture of achievement, and other positive peer effects. This positive externality associated with including in the mix easy-to-educate students would argue for somewhat more generous vouchers for those "good influence" students who choose to attend a school with heterogeneous students.

13. The town of Greenville has three families, each with one child, and each of which earns $20,000 per year (pre-tax). Each family is taxed $4,000 per year to finance the public school system in the town, which any family can then freely attend. Education spending is $6,000 per student in the public schools. The three families differ in their preferences for education. Though families A and B both send their children to the public school, family B places a greater value on education than family A. Family C places the greatest relative value on education and sends its child to private school.

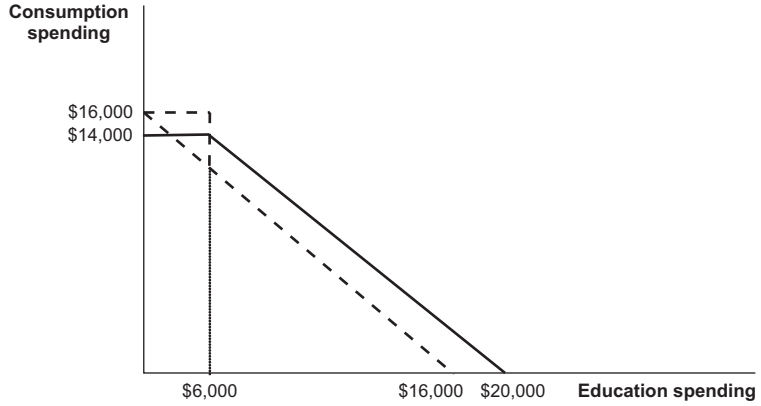
a. Graph the budget constraints facing each of the three families and draw a possible indifference curve which could correspond to the choice each family makes.



Note that family B's indifference curve is steeper than Family A's, reflecting their greater preference for education (even though they make the same choice).

The town is considering replacing its current system with a voucher system. Under the new system, each family would receive a $6,000 voucher for education, and families would still be able to send their children to the same public school. Since this would be more costly than the current system, they would also raise taxes to $6,000 per household to pay for it.

b. Draw the budget constraint the families would face under this system.



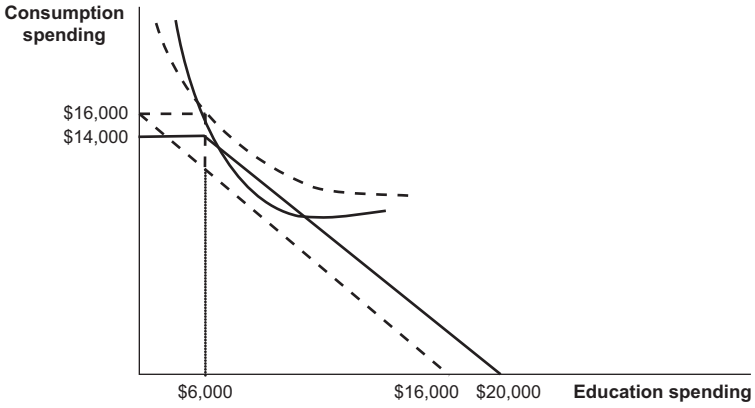
In the diagram, the budget constraint from a is shown with dashed lines and the new budget constraint is shown in solid lines. Since families are now taxed $6,000, they can afford only $14,000 in consumption spending if they attend public schools. If their entire $14,000 of disposable income is spent on education, they get a total of $20,000 in education.

Suppose that, when the new system is introduced, family A continues to send their child to public school, but family B now sends their child to private school (along with family C's child).

c. Explain how you know that family C is made better off and family A is made worse off by the voucher policy.

To see that family C is made better off is straightforward: there is a pure income effect for this family. Before, they were paying $4,000 in taxes and receiving no voucher. Now, they pay $2,000 more in taxes andt receive a $6,000 voucher. Because they were spending more than $6,000 on education before, this voucher is a good as cash to them, so they are effectively $4,000 richer. Family A is made worse off because they continue to get the same education as before but now they have $2,000 less of consumption goods because their taxes have gone up.

d. Show, using diagrams, that family B could be made better or worse off by the voucher policy.



The diagram indicates that, depending on how the indifference curve for B families is drawn, the policy can make them better or worse off. With the dashed indifference curve,

the new budget set lies entirely below the old indifference curve, and the family must be worse off. With the solid indifference curve, the family can be better off. Intuitively, there are two competing forces at work here. The first is that they would be poorer if they didn't change their choice—as a result of paying higher taxes. The second is that because they now get $6,000 in voucher funds that they can spend on either private education or public education, they can move to a private school without giving up the education subsidy. Which force has a bigger effect depends on their preferences.

e **14. Lazear (2001) noted that when one simply compares the performance of students in small and large class sizes, there is little difference, despite the presumption (and experimental evidence) that smaller class sizes improve performance. He argued that one reason for the absence of an observed relationship between class size and student outcomes is that schools may put more disruptive children in smaller classes. How would this practice bias the estimated effect of class size on student outcomes?**

Disruptive students are likely to do worse on tasks that require sitting still for a long period of time, such as taking standardized tests. Thus, there is a selection bias if disruptive students are disproportionately assigned to smaller classes (presumably to make them more manageable for the teacher). The easiest-to-control students in the larger classes are also the ones best able to tolerate long sitting periods, and thus their test scores are likely to be higher. If student outcomes are measured by performance on tests, the well-behaved students in the big classes will have better outcomes. Experimental evidence using randomly assigned classroom sizes would not have this selection bias element.

15. One way to structure a student loan repayment plan is to make it income-contingent—that is, to relate the amount that a student would have to repay in any given month to how much income he or she earns. How might the existence of such a plan alter a student's choice of college major?

Students would have less incentive to choose a major or program that leads to a high-paying job on graduation. Some students currently feel financial pressure to pick majors that will enable them to live comfortably while paying off large student loans. If the loan repayment plan were income-contingent, students would be able to choose majors based on their own preferences and strengths rather than their ability to repay the loans.

While this scheme would ease students' financial worries, it would not necessarily be efficient. It has been claimed that one of the rationales for subsidized student loans is to offset failures in the credit market. But a working credit market would not freely accommodate a student's wish to pursue a career in art rather than in business. A fully functioning credit market would lend more money to a student pursuing a lucrative major and would lend less to a student seeking a rewarding but low-paying career because the financial returns to these choices differ.

Students who choose lower-paying careers must be making a trade-off between money and other sources of utility. An income-contingent repayment plan would encourage students to choose lower-paying jobs because they would not have to bear the full cost of that choice.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 12

SOCIAL INSURANCE: THE NEW FUNCTION OF GOVERNMENT

Questions and Problems

1. **A number of Web sites, such as www.quickquote.com, offer instant quotes for term life insurance. Use one such Web site to compare the prices of $1 million 5-year term life policies for 50-year-old men and women. Explain the difference in quotes for men and women. Suppose the U.S. government were to pass a law requiring insurers to offer the same prices for men and women. What effect would you expect the law to have on prices and insurance coverage?**

   Annual premiums as of August 16, 2006, for "preferred plus" policies for nonsmokers in Vermont were $1150 per year for men and $760 per year for women. The higher price for men reflects their higher risk of death—a higher mortality rate. Passing a law equalizing prices across genders might be expected to lower prices for men and raise prices for women. This would presumably lead to more coverage for men and less coverage for women. Given that men represent the large majority of life insurance policy holders, we would probably see a larger movement in the prices of policies for women. This would potentially lead to a drastic reduction in their coverage. Such a law could potentially lead to the complete collapse of the market for women's life insurance, in which case men's prices would be unlikely to change.

2. **What is consumption smoothing? How does insurance help people smooth consumption?**

   Consumption smoothing refers to people's efforts to have approximately the same amount of consumption in all time periods, rather than having periods of high consumption and periods of low consumption. Insurance smoothes consumption by taking away a relatively small amount of money in each time period, in the form of insurance premiums, but paying a substantial amount of money in the event of a loss. Thus, the insured has slightly less consumption in all periods, and if he or she suffers a loss, the insurance company pays a benefit that allows the insured to maintain his or her original level of consumption.

3. **Suppose that you have a job paying $50,000 per year. With a 5% probability, next year your wage will be reduced to $20,000 for the year.**

   a. **What is your expected income next year?**

      The probability that your income next year will be $50,000 is .95; the probability that your income next year will be $20,000 is .05. Summing the expected values of the outcomes yields .95($50,000) + .05($20,000) = $47,500 + $1,000 = $48,500. This is your expected income next year.

b. Suppose that you could insure yourself against the risk of reduced consumption next year. What would the actuarially fair insurance premium be?

An actuarially fair premium would be one that exactly offset the expected value of the loss. In this case, the expected loss is \$50,000 – \$48,500 = \$1,500, so an actuarially fair premium would be \$1,500.

Another (equivalent) way to determine this premium is to calculate the expected value of the claims the insurance company would pay; here it is the probability of the loss occurring times the dollar value of the loss, or .05 (\$50,000 – \$20,000) = .05(\$30,000) = \$1,500.

A third (equivalent) way to determine the premium is to compute the expected profits to the insurance provider for any given premium P. Since the premium is surely paid and the insurance company pays you \$30,000 with a probability of 0.05, the expected profits are given by P – .05(\$30,000). Actuarially fair premiums are those that lead to zero expected profits; setting expected profits equal to zero and solving gives P = 0.05(\$30,000) = \$1,500 again.

4. Small companies typically find it more expensive, on a per employee basis, to buy health insurance for their workers, as compared with larger companies. Similarly, it is usually less expensive to obtain health insurance through an employer-provided plan than purchasing it directly from an insurance company—even if your employer requires you to pay the entire premium. Use the ideas from this chapter to explain these observations.

There are two explanations for these phenomena, discussed at more length in Chapter 15. The first is the problem of *asymmetric information*. A large company is likely to have many workers, some of whom are in good health and some of whom are in bad health. While there is substantial asymmetric information regarding the health status of any individual worker (the worker knows more than the insurance company), there is much less asymmetric information about the average of workers across a large company. Furthermore, because any given worker is a small portion of the total workforce, large employers have very little incentive to seek insurance *because* they know one of their workers is in bad health.

For small employers—and to an even greater extent for individuals—the asymmetric information problem is much worse. This is both because there are fewer workers to average across and because small companies may choose to seek insurance because one worker (say, the head of the company) is in particularly poor health. The greater riskiness of small companies and individuals leads insurance companies to require higher premium payments.

The second reason is *administrative costs*. The administrative costs of insurance are often fixed for the entire insurance pool, so the smaller the pool, the higher the cost per insured. This will raise insurance costs for small firms relative to large firms and and raise them even higher for individuals.

5. The problem of adverse selection in insurance markets means that it is generally a bad deal for companies to offer insurance at the same price for all potential customers. Why then do we observe some insurance companies (such as those selling "trip insurance" that refunds money to people who purchase trips that they are unable to take) do exactly this?

Adverse selection results from information asymmetry. In some markets, though, the insured has no better information about his or her risk exposure than does the insurer. If the event that would precipitate an insurance claim is completely unknown to and out of the control of the insured (for example, the outbreak of war in the destination country), then adverse selection will not operate, and insurers will charge a single premium to all customers.

Another reason for single-premium markets is that it is sometimes not worth it to an insurance company to collect the information necessary to tailor premiums to different risk groups. Auto insurance covers drivers over long periods of time, and the probability of a claim during any one period may be fairly high for some drivers. It is worth the time to find out who those drivers are likely to be. Trip insurance, on the other hand, covers a very short period of time with a low risk of a claim being made. A complicated schedule of risk categories may not pay off for the insurance company. Perhaps insurance companies set the premium high enough to cover the traveler who knows she is at a high risk for cancellation, realizing that they can't profitably serve the low-risk population.

6. Why might government provision of insurance lead to a larger number of insurance claims than private provision of insurance would?

An obvious reason is that some people will opt out of purchasing private insurance, so if the government insured everyone more people would be insured, leading to a larger number of claims. Very-low-risk people, who would have opted out of private insurance, and people who did not buy insurance because they knew that if they suffered a loss the government would not remain idle would be included in the insured pool. Some of them would file claims. And if government provision operated under a single-premium pricing system, frequent claimants would not be penalized by having to pay higher rates in the future, reducing the total cost of filing a claim.

7. Why does the government mandate individuals to purchase their own insurance in some cases—such as automobile liability insurance—but directly provide insurance to people in other situations—such as health insurance?

The text identifies five reasons for government intervention in insurance markets: *adverse selection, externalities, administrative costs, redistribution,* and *paternalism*. Neither the paternalism motivation (where the government intervenes to help individuals make the best decisions for themselves) nor the externalities motivation (where the government intervenes to make decisions take the externalities into account) provide any reason to use mandates instead of direct provision or vice versa. Either type of intervention can address these market failures. Similarly, both mandates and direct public provision can resolve the adverse selection problem, and there is no obvious reason that one will be better than the other along this dimension.

In contrast, redistributional concerns can argue in favor of mandates for some types of insurance and direct public provision (social insurance) for others. To see why, note that firms tend to charge higher premiums to individuals they can identify as having higher risks of accidents. In providing social insurance, the government can effectively pool different risk types together so that high-risk and low-risk individuals pay the same "premiums" (taxes) for social insurance. Hence, social insurance can make high-risk individuals better off than they would be with a mandate; similarly, it can make low-risk individuals worse off. This sort of redistribution may be more desirable in some contexts than others. In health insurance, for example, "high-risk" individuals are the people unlucky enough to be sick or injured. Redistributing toward these individuals may be normatively desirable. In contrast, the "high-risk" individuals in auto insurance markets are the reckless drivers. It may seem less desirable to redistribute away from the safe drivers toward the reckless ones. This provides a reason to use social insurance for health insurance but mandates for auto insurance.

Another potential reason to use social insurance instead of mandates is the administrative cost differences between private provision and direct public provision. Larger differences (in favor of public provision) argue in favor of using social insurance instead of mandates. It may be that differences in administrative costs are quite large for medical insurance (hence direct provision) and small for auto insurance (hence mandates).

8. Your professor is paid only nine months out of the year (really!!). Suppose that she were fired each spring and rehired each fall and thereby eligible for unemployment insurance benefits. (After all, all those students going away for the summer creates economic hardship for your university!) Do you think that would affect her consumption smoothing over the year, relative to what she does right now, when she is not fired annually? Explain your answer.

If professors are poor consumption smoothers, they might consume large amounts in the nine months when they are paid and be left with very little to consume during the summer months. In all likelihood, many professors are smarter than this: they are able to save a portion of their nine-month salary and use it to finance their summer consumption. This can allow them to perfectly smooth their consumption over the year even though their income varies over the year. The proposed system of "firing" professors each spring and rehiring them each fall so that they could collect unemployment insurance benefits would increase their annual income. This might increase the *level* of consumption for professors but it would not improve smoothing for the "smart" professors: they had smooth consumption before and will have (a higher level of) smooth consumption afterwards. Unemployment insurance is more helpful for consumption smoothing and expected utility when unemployment is unpredictable.

9. Currently, in order to receive workers' compensation, a claimant's injury claims must be verified by a physician of the claimant's choosing. Suppose that the workers' compensation policy changed so that only government-assigned physicians could verify injury claims. What is likely to happen to the rate of reported on-the-job injury? Explain.

Requiring government-designated physicians to verify claims could increase the cost of obtaining injury verification for some potential claimants and so, on the margin, deter them from filing claims. This deterrence would occur if some workers had identified private physicians who were relatively more willing to verify an injury claim. If workers knew that their claims were only marginally legitimate and might not be validated by the government physician, they may hesitate to report injuries. Alternatively, if the government-designated physicians were inconveniently located or had inconvenient hours, legitimate claims might go unreported. In either case, reported on-the-job injuries would decline even if actual injury rates remained the same.

10. Describe the dimensions along which moral hazard can exist. Can you think of ways in which the government can reduce the prevalence of moral hazard along each dimension?

Moral hazard exists because the presence of insurance can provide an incentive for people to change their behavior. Insurance makes riskier behavior less costly, both before and after the loss-inducing event occurs. There are three general pathways to moral hazard. The first is that insured people may be less careful and will not take all possible precautions to guard against a loss; since they have insurance to cover a loss, they will be less cautious. The second pathway involves the insured's response once a loss has occurred: because repairs or remedies are covered by insurance, there is little incentive to take steps to economize on repairs or to choose less-expensive remedies. The third pathway involves the provider's response to the insured's loss. The provider of collision repair, medical care, or fire cleanup, for example, knows that the purchaser is not as concerned about saving money as he would be if it were coming out of his own pocket; therefore, the provider has some incentive to either provide more service than is necessary or to inflate the charges of the services provided.

To combat moral hazard along the first dimension, the government could more actively screen claims, denying those for which the insured was at least partly responsible. It could

also raise premiums for individuals who have already filed claims, making each claim more expensive in terms of future premiums.

The second dimension of moral hazard could be reduced by setting fixed payment amounts or limits on services offered for a list of loss-inducing events. If a broken windshield only nets $\$x$ from the insurance company, the insured has an incentive to find a shop that will repair it for *less than x* and pocket the rest.

The third dimension could be reduced by restricting providers to a list of acceptable responses to each event. Tests, procedures, or services not on the list would not be covered by insurance.

Advanced Questions

11. Suppose you think that poorly educated families are less able to smooth consumption in the absence of unemployment insurance than are well-educated families. How would you empirically test this supposition? What types of data would you want to use?

A perfect data set for looking at this question would be longitudinal and would track a large set of individuals over time. It would include data on the education level and employment status of each worker and data on their (say) weekly consumption. Then one could simply look at how much consumption varies for a given individual between times the person is unemployed and times when the person is employed. Without data on consumption, one could potentially still test the theory by looking at wealth, income, and borrowing. This would potentially allow the researcher to infer consumption from changes in net wealth (and income) over time. (This would be complicated by the possibility of receiving unobserved assistance from family and friends when unemployed.)

12. There are two types of drivers on the road today. Speed Racers have a 5% chance of causing an accident per year, while Low Riders have a 1% chance of causing an accident per year. There are the same number of Speed Racers as there are Low Riders. The cost of an accident is $12,000.

a. Suppose an insurance company knows with certainty each driver's type. What premium would the insurance company charge each type of driver?

The insurance company expects to pay out $12,000 in claims to 5% of the Speed Racers it covers, so it must collect at least 0.05($12,000) = $600 from each one. Similarly, it must collect at least 0.01($12,000) = $120 from each Low Rider.

b. Now suppose that there is asymmetric information so that the insurance company does not know with certainty the driver's type. Would insurance be sold if

i. drivers self-reported their types to the insurance company?

Every individual would claim to be a Low Rider, but if the insurance company sold insurance to everyone for $120, it would lose money because of the presence of Speed Racers in the population. The insurance company would quickly increase premiums, but if it increased them by too much the Low Riders would leave the market. It cannot be determined here exactly how much more than $120 the Low Riders would tolerate, as their risk aversion is not specified. As more Low Riders chose not to purchase insurance, the pool of covered drivers would include a higher and higher proportion of Speed Racers, requiring the insurance company to increase premiums again to cover the claims.

ii. no information at all is known about individual driver's types?

The insurance company could offer a premium that averages the expected claims. In a population of half Low Riders and half Speed Racers, the pooling premium would be ($600 + $120)/2 = $360. The Low Riders would have to be extremely risk averse to be willing to pay $360 to cover an expected loss of $120. If they (the Low Riders) opted out of the market, the insurance company would be back to the adverse selection problem discussed above: an insured pool containing a high proportion of Speed Racers.

13. Your utility function is $U = \ln(2C)$ where C is the amount of consumption you have in any given period. Your income is $40,000 per year and there is a 2% chance that you will be involved in a catastrophic accident that will cost you $30,000 next year.

a. What is your expected utility?

Expected utility is the sum of the expected utility in each state. Assuming consumption of your entire income, when income is $40,000, utility is $\ln(80{,}000) \approx 11.30$; when income is $10,000, utility is $\ln(20{,}000) \approx 9.90$.

Therefore, expected utility is $98(11.30) + .02(9.90) \approx 11.262$.

b. Calculate an actuarially fair insurance premium. What would your expected utility be were you to purchase the actuarially fair insurance premium?

The insurance company would expect to pay $30,000 each year to 2% of its customers, so over the population it would pay 0.02($30,000) = $600 per person. So $600 would be an actuarially fair premium.

A person who purchased actuarially fair insurance would have utility in both states of $\ln(2(40{,}000 - 600)) \approx 11.275$.

c. What is the most that you would be willing to pay for insurance, given your utility function?

To answer this question, first go back to the original utility to determine how much money would yield the same utility as the expected utility of taking the risk. The wealth that would yield utility of 11.262 solves $\ln(2W) = .98\ln(80{,}000) + .02\ln(20{,}000)$, so $W = \exp(.98\ln(80{,}000) + .02\ln(20{,}000))/2 \approx \$38{,}906.20$. You are indifferent between the risky situation and certain wealth of $38,906.20 because they yield the same utility. Therefore, you should be willing to pay $40,000 – 38,906.20 = $1,093.80 for insurance.

14. Billy Joe has utility of $U = \ln(C)$, while Bobby Sue has utility of $U = \sqrt{C}$ Which person is more risk averse? Which person would pay the higher insurance premium to smooth consumption?

It is not obvious from looking at the two utility functions which is more risk averse. A numerical example is helpful. Consider starting from a wealth of 100 and having a 50% chance of losing 90. Billie Joe's expected utility is $\frac{1}{2}\ln(100) + \frac{1}{2}\ln(10) \approx 3.45$. The amount of (riskless) wealth Billie Joe would need to have to be just as well off solves $\ln(W_{BJ}) = \frac{1}{2}\ln(100) + \frac{1}{2}\ln(10)$, or $W_{BJ} \approx \$31.62$. Bobby Sue's expected utility is $\frac{1}{2}(100)^{.5} + \frac{1}{2}(10)^{.5} \approx 6.58$. The amount of (riskless) wealth Bobby Sue would need to have to be just as well off solves $(W_{BS})^{.5} = 6.58$, or $W_{BS} \approx 43.31$. This means that Billie Joe is more risk averse than Bobby Sue. To see this, note that the 50% risk of losing 90 is "like" losing 68.38 (100 – 31.62) for Billie Joe and like losing only 56.69 for Bobby Sue: the same risk hurts Billie Joe more. Equivalently, Billie Joe would be willing to pay up to a 68.38 to fully insure himself, while Bobby Sue would be willing to pay only up to 56.69.

15. Chimnesia has two equally sized groups of people: smokers and nonsmokers. Both types of people have utility $U = \ln(C)$, where C is the amount of consumption that people have in any period. So long as they are healthy, individuals will consume their en-

tire income of $15,000. If they need medical attention (and have no insurance), they will have to spend $10,000 to get healthy again, leaving them with only $5,000 to consume. Smokers have a 12% chance of requiring major medical attention, while nonsmokers have a 2% chance.

Insurance companies in Chimnesia can sell two types of policy. The "low deductible" (L-) policy covers all medical costs above $3,000, while the "high deductible" (H-) policy only covers medical costs above $8,000.

a. What is the actuarially fair premium for each type of policy and for each group?

The actuarially fair premium for selling an L-policy to smokers is given by $0.12($10,000 – $3,000) = .12($7,000) = $840, since this is the expected amount the insurance company has to pay for medical care. Similarly, the actuarially fair premium for selling an L-policy to nonsmokers is .02($7,000) = $140. The actuarially fair premiums for selling an H-policy to smokers and nonsmokers are $0.12($10,000 – $8,000) = $240 and .02($2,000) = $40, respectively.

b. If insurance companies can tell who is a smoker and who is a nonsmoker and charges the actuarially fair premiums for each policy and group, show that both groups will purchase the L-policy.

One can compute the expected utility of each group with each policy to answer this, but there is an easier way. Since both policies are actuarially fairly priced for each group, both groups will prefer the policy that is closer to full insurance—the L-policy.

Suppose that smoking status represents *asymmetric information*: each individual knows whether or not they are a smoker, but the insurance company doesn't.

c. Explain why it is impossible, at any prices, for both groups to purchase L-policies in this setting. Which groups, if any, do you expect to buy L-policies, and at what price?

With asymmetric information, companies can't offer one price to smokers and another to nonsmokers: if, for example, the price offered to nonsmokers is lower, smokers will simply pretend to be nonsmokers. Hence, if both groups purchase L-policies, they must both pay the same premium, and the premium must be at least ($840 + $140)/2 = $490 or the firm will lose money when it sells to both groups. (We use a to compute the average cost of claims.) But at this high premium, nonsmokers won't find it worthwhile to buy insurance. To wit, their utility from no insurance is

$$.98\ln(15{,}000) + .02\ln(15{,}000 - 10{,}000) \approx 9.594$$

and their utility from an L-policy with premium $490 is:

$$.98\ln(15{,}000 - 490) + .02\ln(15{,}000 - 490 - 10{,}000 + 7000) \approx 9.578.$$

The only group that would want L-policies at this (or higher) prices is smokers. And if only smokers are buying insurance, it must have a premium of at least $840 for firms to not lose money.

d. Show that it is possible for both groups to purchase insurance, with one group buying L-policies and one group buying H-policies.

Imagine offering a menu of two insurance policies: an $840 L-policy and a $40 H-policy. We know from c that nonsmokers prefer no policy to the high-priced L policy. Since a $40 H-policy is actuarially fair for them, we know they prefer this policy to no policy (they value insurance). Hence, when offered this menu, nonsmokers will choose the cheap H-policy. Firms will break even selling these policies to them.

On the other hand, smokers get expected utility .88ln(15,000 – 840) + .12ln(15,000 – 840 – 10,000 + 7,000) ≈ 9.530 from the L-policy and expected utility .88 ln(15,000 – 40) + .12 ln(15,000 – 40 – 10,000 + 2000) = 9.521 from the H-policy. Hence, when offered this menu of options, smokers will choose the high-priced L-policy. Firms will break even selling these policies to them, too.

16. The country of Adventureland's two citizens, Bill and Ted, both earn $1,000 per week working the same job at the same company. Bill and Ted each face some risk of being laid off due to bad market conditions next year, in which case they will have an income of only $250 from an alternative part-time job they would fall back on. There is a 10% probability that Bill will be laid off and a 30% probability that Ted will be laid off. Bill and Ted have the same utility function $U = \ln(C)$.

The government is considering providing some social unemployment insurance. In particular, they are considering two plans. The first would pay any worker who loses his job $100, and the second would pay any worker who loses his job $600. Both would be financed by collecting a tax from any worker who keeps his job.

a. Under each plan, how high would the government have to set the tax so that it would not expect to lose money on the plan?

Under the first plan, there is a 10% chance that the government will have to pay Bill $100 and a 30% chance that it will have to pay Ted $100. The expected cost is thus $40 = .1($100) + .3($100). Let T be the amount of tax it collects from workers who are not fired. There is a 90% chance that it will collect this tax from Bill and a 70% chance that it will collect this tax from Ted. The expected tax collection is $.9T + .7T = 1.6T$. Setting $1.6T =$ $40 and solving gives $T =$ $25. Similar calculations for the larger policy give $T =$ $150.

b. Assuming it sets the tax rate you found in a, compute the well-being of Bill and Ted under each of the plans. How do Bill and Ted rank the three possibilities (the two policies and the status quo)? Explain the pattern you see in terms of *redistribution* and *risk aversion*.

The following table reports the effects of the policies on the utilities of the two types.

Effects of Social Insurance Policies in Adventureland			
	No policy	**$100 policy**	**$600 policy**
Income with job	$1000	$975	$850
Income without job	$250	$350	$850
Bill's expected utility	6.769	6.780	6.745
Ted's expected utility	6.492	6.575	6.745

Both Bill and Ted like the $100 policy more than no policy, but Ted likes the $600 policy best of all while Bill finds it the worst. The intuition for this pattern is straightforward. Providing more social insurance has two effects: it *redistributes* from Bill to Ted, and it *provides insurance* against the risk of losing a job. Both effects benefit Ted, so more social insurance is better. Bill benefits from the insurance (he is risk averse) but loses from the redistribution. For small policies, the benefits of the first effect outweigh the costs of the second. For large policies, the second effect outweighs the first.

c. Which plan is best if the society has a utilitarian social welfare function? A Rawlsian social welfare function? (See Chapter 3 if you need a reminder about social welfare functions.)

Both a Rawlsian and a utilitarian would agree that the $600 policy (full social insurance) is best.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 13

SOCIAL SECURITY

Questions and Problems

1. **The government of Westlovakia has just reformed its social security system. This reform changed two aspects of the system: (1) It abolished its actuarial reduction for early retirement, and (2) it reduced the payroll tax by half for workers who continued to work beyond the early retirement age. Would the average retirement age for Weslovakian workers increase or decrease in response to these two changes, or can you tell? Explain your answer.**

   The first policy change, abolishing the actuarial reduction, would tend to lower the average retirement age. The actuarial reduction is intended to make workers approximately indifferent between retiring early and waiting until standard retirement age. With the reduction, early retirees have a smaller benefit over more years. Abolishing the reduction would make early retirement more attractive: the benefits would be just as high as if workers had waited, and they would be paid over more years. The second policy change would increase the return to working later in life and thus would tend to raise the average retirement age.

   The overall effect would depend on a number of factors. If people discount the future by enough (that is, have a high enough internal discount rate), they will tend to retire early: the benefit is immediate. People who have a lower discount rate will choose to work longer at the lower tax rate. A second factor that would influence the decision is the potential retiree's health status or personal (as opposed to statistical) life expectancy. Someone who believes he has a fairly high probability of living long and well late in life will be more likely to opt for later retirement. A third factor that will tend to increase the retirement age is that the early retirement effect is truncated at the age designated for eligibility: even people who choose to retire early will be able to retire only a few years earlier than before in order to benefit. People who choose to retire later may retire many years after the standard retirement age.

2. **When you called her last night, your grandmother confided that she is afraid to sell her home because doing so will affect her Social Security benefits. You told her that you'd call her back as soon as you read Chapter 13. Now that you've read it, what will you say to her about how her benefits will change when she sells her house?**

   Social Security benefits do not change with changes in the value of assets held by the beneficiary. The formula used to calculate benefits under Social Security is based on earned income only. Your grandmother's Social Security benefits will not be affected by the sale of her house.

3. **Congressman Snicker has proposed a bill that would increase the number of years of earnings counted when computing the Social Security Average Indexed Monthly Earnings amount from 35 to 40. What would be the effects of this policy change on the retirement behavior of workers? Would the Social Security trust fund balance increase or decrease? Why?**

Workers may work longer if their best 40 years counted rather than their best 35. Generally, you would expect earned income to increase over a worker's lifetime; thus, the last several years are likely to yield higher income than the first several years. Being able to count 5 more high-earning years would induce some workers to remain in the workforce to increase their calculated benefits; if they did not work longer, the 40 years might include some very low or zero-earning years (when the worker was in his or her twenties, possibly still in school).

The primary reason this bill would tend to increase the Social Security trust fund is because it would tend to reduce the Averaged Indexed Monthly Earnings and therefore the size of retiree benefits. Simply put, the 5 additional years of earnings history would be the *lowest* five years counted (or else they would have been counted in the original 35). This effect might be partially offset by workers tending to work more (high earnings) years. Of course, these additional years of work would also involve Social Security payroll taxes that would increase the trust fund.

4. Suppose the Social Security payroll tax was increased today to 16.4% to solve the 75-year fiscal imbalance in the program. Explain the effect of this change on the value of the Social Security program for persons of different ages, earning levels, and sexes.

An increase in the payroll tax would reduce the value of Social Security for younger workers relative to older workers. Older workers would benefit from having a more secure plan, and they wouldn't have to pay in at the higher rate for very long. Younger workers would have to pay the higher rate over many more years, and their benefit calculation would not increase (because the increase in taxes is meant to keep the current system solvent, not to increase benefits). The very-highest-earning workers would not be harmed as much as lower-earning workers because the payroll tax is not imposed on earnings above $94,200 (currently); however, their payroll tax burden would increase. Women generally benefit more from Social Security because they live longer than men. They are also more likely than men to have interrupted their careers to raise their families, so they tend to pay in less. They are also more likely to receive benefits as a surviving spouse. All these factors would continue to exist with a higher tax rate. The higher tax rate would be borne by the employed, not by those who receive benefits because of their survivor spouse status.

5. Senator Deal proposes to offer a choice to future retirees: if you retire before age 70, the benefits are calculated on the last 35 years of income; if you retire at age 73, however, you receive benefits calculated on only the last 15 years of income. Which option are high-income workers likely to choose? Low-income workers? Why?

A high-income worker may not benefit by much if he delays retirement until age 73, and he would lose three years of benefits. He is likely to choose the earlier retirement age. Assuming no major work interruptions, which is perhaps a more reasonable assumption for a high-wage earner than a low-wage earner, his benefits will be calculated based on his wage since he was in his mid-thirties. These are likely to be fairly-high-earning years, as they begin a decade after a person would have completed his education. Because of the regressive nature of benefit calculations, the higher wages of the last 15 years would yield a low marginal benefit. High-wage earners are also better able to save for retirement in other ways, so they may be able to afford retiring three years earlier.

Low-wage earners will be more likely to delay retirement until age 73. They would lose three years of benefits, but their benefits, once they do retire, will be higher if their income is higher in the last 15 years of work. This option will be particularly attractive if these workers had some low- or zero-earning years over the course of their working lives. In addition, calculated benefits are a higher percent of average monthly wage for these workers, so they stand to lose less by working more years.

6. Consider two households, the Smiths and the Joneses. The Smiths are a two-earner household: both Dick and Jane Smith work and earn the same amount each year. The Joneses are a one-earner household: Sally Jones works while Harry Jones is a homemaker and stay-at-home dad. Use the way spousal benefits are treated in the Social Security system to address the following:

a. How do the relative rates of return on Social Security payroll taxes compare for the two families?

All else equal, the Joneses will get a better return on their payroll tax contribution. This is because only Sally pays in to the Social Security system, but Harry is still entitled to a 50% spousal benefit (and a *full* spousal benefit if Sally dies first). Both the Smiths had payroll taxes withheld, and neither gets a free benefit like Harry. (This is complicated by the progressivity of the system for converting AIME into PIA, however.)

b. After the kids go off to college, Harry considers taking a small part-time job. How might the Social Security system of taxes and benefits affect his decision?

Harry will have to pay payroll taxes if he works, but his work is unlikely to increase his net Social Security benefit since he will be unlikely to earn enough to have a large enough personal Social Security benefit to make it worth taking his own benefit instead of half of his wife's. The payroll tax will tend to discourage him from working.

c. Suppose that both families have retired and have started to receive Social Security benefits. By what fraction will these benefits fall for each of these families if one member of the household dies? What implications does this have for relative consumption smoothing in these two households?

Total Social Security income will fall by 50% for the Smiths since the two Smiths originally had equal benefits and one of the two benefits is lost upon death. Total Social Security income will fall by only 1/3 for the Joneses. Prior to the death, they received 150% of Sally's benefit (Sally's benefit plus a 50% spousal benefit). After death, the survivor receives only 100% of Sally's benefit. The steeper drop-off for the Smiths may make it harder for them to consumption smooth.

7. Senator Dare suggests lowering Social Security benefits by reducing the rate at which Average Indexed Monthly Earnings are converted to the Primary Insurance Amount for future retirees. Senator Snow instead proposes reducing the rate at which benefits are indexed to inflation so that when the Consumer Price Index rises by one percentage point, Social Security benefits rise by less than one percent. Which proposal will be worse for current retirees? For future retirees?

Neither policy would directly help the elderly since both reduce their benefits. But since the conversion of Average Indexed Monthly Earnings into the Primary Insurance Amount occurs once and for all at the beginning of Social Security benefit receipt, it is reasonable to assume that Senator Dare's proposal wouldn't affect individuals who have already retired, and therefore it wouldn't harm them either. In fact, it might indirectly help current retirees insofar as it improved the solvency of Social Security and the assurance that their benefits will last their lifetimes. This policy would clearly harm future retirees.

Senator Snow's proposal would harm both current and future retirees by reducing their benefits. It would be particularly harmful for retirees who happen to retire during periods of high inflation, as the incomplete indexing would cause a relatively rapid decline in the real spending power of their benefits.

8. What are the political and economic ramifications of investing a large part of the Social Security trust fund in the stock market, as has been recently proposed?

Historically, stock market returns have been higher than the return on government bonds, so investing savings in the stock market might seem like a good idea. At the same time,

stocks do carry greater risks, at least somewhat (or completely, depending on who you believe!) offsetting this benefit. There are several possible economic ramifications of this policy. For example, it is possible that investing in stocks instead of government bonds would shift excess savings from the government to private firms. This would potentially be a boon for the economy, leading to higher investment and more rapid growth. The political ramifications are potentially more pernicious. The Social Security trust fund is large, and investing it in stocks would make the government a major shareholder of many corporations. If politicians had active control of which companies to invest in, this could lead to several kinds of abuses, including politicians using promises of investment (or threats of noninvestment) to exert control over private companies.

9. Prior to 1982 college-age children of deceased workers received college tuition subsidies as benefits of the Social Security program. Drawing on the lessons of Chapter 11, what do you think the rationale for such a program was?

Some of the justifications for public subsidization of education are credit market failures, redistribution, and to offset parental decision making that undervalues children's education. All three of these rationales would justify providing college tuition subsidies to children who have lost their parent(s). Parents are more likely than children to be able to borrow in order to send a child to school, as they have established credit histories and assets against which to borrow. A child who has lost a working parent loses the parent's access to credit markets. The subsidy makes up for the loss. In addition, children are likely to be poorer after the death of a working parent and thus less able to afford education. This subsidy would have redistributive effects to compensate for greater poverty. Finally, the parent may have died without providing for or before providing for, his or her child's education. This subsidy would correct that intrafamily allocation or would make the allocation that the parent would have made had he or she survived.

10. Dominitz, Manski, and Heinz (2003) present survey evidence suggesting that young Americans are extremely uncertain about the likelihood that they will receive any Social Security benefits at all. How might demographic trends in the United States contribute to this concern?

The most obvious trend in this regard is the aging of the baby boom generation. Young Americans are aware that, in a few years, the baby boom generation will become an extremely large body of retired people. Exacerbating the retiree population bulge is the fact that people live longer now than they have in the past. The baby boomers will be around for a long time, collecting their Social Security checks. In addition, family sizes are smaller. Baby boomers may have grown up with several siblings, but they had fewer children as adults. Therefore, there will be fewer workers contributing for each baby boomer collecting. Instead of running annual surpluses, the Social Security trust fund will soon be running annual deficits and will begin running out of money.

11. The Social Security Administration Web site has a link to a publication entitled Social Security Programs Throughout the World. The European version is online at http://www.ssa.gov/policy/docs/progdesc/ssptw/2004-2005/europe/index.html. Pick any two countries in Europe and compare the key attributes of their social security programs. Which of these two countries do you think will have the greater rate of early retirement? Why?

Responses to this question will obviously depend on the countries chosen. There are fairly wide variations in the ages at which retirees become eligible for benefits in different countries. Retirement age is lowest in Slovenia, as low as 58 for men and as low as 54 years and 8 months for women. Other Eastern European countries, such as Ukraine, Belarus, Russia, and Serbia, also have low ages of eligibility. These countries should see relatively low

rates of retirement prior to the local age of eligibility, because eligibility occurs at relatively young ages. In contrast, the Scandinavian countries of Denmark, Iceland, and Norway have the highest age of eligibility, 67. Holding health status equal across countries, countries in which eligibility occurs at older ages should experience higher rates of retirement prior to eligibility. It is difficult to generalize given the different currencies and complex structures of individual countries' rules. However, most countries generally provide an amount equal to a percent of average working wage. Some calculate it based on a fairly short window of working years; in Serbia, for example, the base is calculated using the best ten consecutive years.

Advanced Questions

12. Lalaland is an extremely stable country with 200,000 residents, half of whom are young workers and half of whom are retirees. At the end of each "year," the 100,000 retirees die, the 100,000 young workers retire, and 100,000 new young workers are born. Workers earn a total of $5,000 for the year. Lalaland operates a "pay as you go" social security system, where each current worker is taxed $2,500 and the revenue collected is used to pay a $2,500 pension to each retiree. The neighboring country, Gogovia, is larger and more dynamic. Gogovia has an active stock market that Lalalandians can invest in and earn a 10% rate of return. It also has an active banking sector, which will gladly lend the Lalalandian government money, charging them 10% interest per year.

Lalaland is considering moving to a system of personal accounts, where each Lalalander would take her $2,500 and invest it in Gogovian markets (and earn a much higher rate of return!). The government would borrow $250 million ($2,500 × 100,000) from Gogovian bankers to pay for current retirees. It would then tax retirees each year by just enough to pay the interest on this debt. Would this new system be better or worse for Lalaland?

The new system would be neither better nor worse for Lalanland. In fact, it is an entirely equivalent system. The interest due on the debt would be 10% × ($250m) = $25m, so taxes would have to be $25m/100,000 = $250 per retiree. This is exactly enough to offset the higher returns Lalalanders would earn in the stock market.

13. Does Social Security provide much benefit in terms of consumption smoothing over the retirement decision? Contrast Social Security with a different social insurance program, unemployment insurance, which provides income support for half a year to individuals who have lost their jobs. Do you think that unemployment insurance is likely to provide more or less consumption smoothing than Social Security?

Unemployment insurance smooths consumption over discrete, fairly brief, unanticipated interruptions in work; Social Security allows retirees to remain out of poverty after stopping work. Retirement is not a surprise. In the absence of Social Security (and even in its presence), people with foresight plan and save for retirement. Social Security payments alone are not enough to allow retirees to maintain their preretirement consumption level, but they do substantially reduce the number of retirees in poverty. The purpose of Social Security was not to allow retirees to maintain preretirement income (that is, to smooth consumption) but to help them avoid poverty. Unemployment insurance is much more explicitly aimed at consumption smoothing between employment spells. It allows people to maintain their standard of living over intermittent dips in income. Thus, Social Security provides less consumption smoothing than does unemployment insurance.

14. Edwards and Edwards (2002) describe evidence that following a social security reform in Chile that reduced the implicit tax on working in the formal sector, informal sector wages rose. What do you think is the mechanism at work here?

In equilibrium, prices and wages tend to equalize. In the case of Chile, if formal sector wages are particularly low, people will choose to work in the informal sector. One reason formal sector wages are low is that they are taxed. When tax rates are high, more people seek work in the untaxed, informal sector. However, when tax rates fall, as they did in Chile, the effective wages in the formal sector increase and people exit the untaxed sector to accept jobs in the formal sector. Wages in the informal sector must then increase to retain those employees who are tempted by higher after-tax wages elsewhere.

15. Suppose that you had information about the amount of private savings during the years before and after the introduction of the Social Security program. How might you carry out a difference-in-difference analysis of the introduction of the Social Security program on private savings?

How to apply differences-in-differences to examine private savings would depend on the nature of the data. If one had data on only *aggregate* private savings, one could evaluate the effects of introducing Social Security by comparing changes in the U.S. savings rate (the difference between savings before and savings after Social Security was introduced) to changes in, say, the Canadian savings rate. In particular, one would compute the difference in the U.S. and Canadian savings rates before and after the Social Security system was introduced and the date the difference between these two differences. The validity of this estimate would rely on there being no major contemporaneous changes that affected one country but not the other.

Better data would be on *individual* levels of private savings. Then one could use the fact that some individuals (for example, certain government employees) were and still are outside the Social Security system. One could thus compute the difference in savings rates before and after the introduction of Social Security for individuals (say, of a given age and income level) affected by Social Security. One could then compute a similar difference for similar individuals not affected by Social security. The difference between these differences would provide an estimate of the change in private savings that was due to the introduction of Social Security.

16. Suppose you find evidence that high school dropout workers are more likely to retire at age 62 than are college-educated workers. You conclude that these workers do so because they are more liquidity-constrained than are other workers. Can you think of alternative explanations for this finding?

One possible explanation is that less-well-educated workers are more likely to have jobs that are relatively more physically demanding and particularly difficult to continue after age 62. Similarly, the physical wear and tear of demanding jobs may leave these workers unable to comfortably work later in life. Another possible explanation is that these workers have already had their 35 best years: they began working at a younger age than college-educated workers and their upward mobility is constrained, so they will be unlikely to have high salaries later in life. Finally, higher education is correlated with better health; less-well-educated workers may retire fairly early if they anticipate having a reduced life expectancy.

17. Consider an economy that is composed of identical individuals who live for two periods. These individuals have preferences over consumption in periods 1 and 2 given by $U = \ln(C_1) + \ln(C_2)$. They receive an income of 100 in period 1 and an income of 50 in period 2. They can save as much of their income as they like in bank accounts, earning an interest rate of 10% per period. They do not care about their children, so they spend all their money before the end of period 2.

Each individual's lifetime budget constraint is given by $C_1 + C_2/(1 + r) = Y_1 + Y_2/(1 + r)$. Individuals choose consumption in each period by maximizing lifetime utility subject to this lifetime budget constraint.

a. What is the individual's optimal consumption in each period? How much saving does he or she do in the first period?

Individuals solve

max $U = \ln(C_1) + \ln(C_2)$ subject to $C_1 + C_2/(1.1) = 100 + 50/(1.1)$.

Rearrange the budget constraint $C_2 = 110 + 50 - 1.1C_1$ and plug into the maximand:

max $U = \ln(C_1) + \ln(160 - 1.1C^1)$.

Then take the derivative and set it equal to zero:

$1/C_1 = 1.1/(160 - 1.1C_1)$, or $2.2C_1 = 160$.

So $C_1 \approx 72.7$, and savings $100 - C_1 \approx 27.3$. The optimal consumption in the second period is then $50 + 1.1(100 - C_1) = 80$.

b. Now the government decides to set up a social security system. This system will take $10 from each individual in the first period, put it in the bank, and transfer it to him or her with interest in the second period. Write out the new lifetime budget constraint. How does the system affect the amount of private savings? How does the system affect national savings (total savings in society)? What is the name for this type of social security system?

Individuals now solve

max U = $\ln(C_1) + \ln(C_2)$ subject to $C_1 + C_2/(1.1) = 100 - 10 + (50+10(1.1))/(1.1)$.

Rearranging the budget constraint gives $C_2 = 160 - 1.1$C1 again—so the consumption levels are the same as in a. Since after-tax income is 10 lower in period 1, however, this means that private savings falls by 10 per individual. Total savings is unchanged, however, since the increased savings through the government exactly offsets the decreased private savings. This is an example of a funded social security system: the money needed for second period benefits is saved in the first period.

c. Suppose instead that the government uses the $10 contribution from each individual to start paying out benefits to current retirees (who did not pay in to a social security when they were working). It still promises to pay current workers their $10 (plus interest) back when they retire using contributions from future workers. Similarly, it will pay back future workers interest on their contributions using the contributions of the next generation of workers. An influential politician says: "This is a free lunch: we help out current retirees, and current and future workers will still make the same contributions and receive the same benefits, so it doesn't harm them, either." Do you buy this argument? If not, what is wrong with it?

The Senator makes it seem as if we can pay benefits to current retirees without ever paying for it, but there's (usually) no such thing as a free lunch, which makes us think someone is harmed by this policy. The key observation is that this policy lowers the national savings rate as compared with b. With lower national savings, the economy will grow less quickly, and future generations will, in fact, be worse off.

18. For each of the reforms listed, briefly discuss the pros and cons of the reform, paying attention in particular to efficiency implications (through potential behavioral responses to the change) and equity implications (who wins and who loses). [Note that all reforms are intended to save the system money, so you do not need to list this as a benefit.]

a. Increase the number of years used to calculate benefits from 35 to 40.

Increasing the number of years used to calculate benefits could lower benefits, because more low- or zero-earning years would be included in a retiree's average wage. To avoid this reduction in benefits, workers might choose to delay retirement so that they had 40 high-earning years included in the calculation. Workers who spent many years in col-

lege and graduate school might be most vulnerable, as they would have had fewer full-time working years by the time they reach retirement age. Similarly, workers who had some interruptions in their employment—to raise a family or to retrain for a new career, for example—also have to delay retirement to avoid inclusion of zero-wage or low-wage years.

b. Reduce benefits for beneficiaries with high asset levels (wealth).

Means-testing by considering asset levels would increase the redistributive nature of Social Security but would induce some perverse behavior. People might be able to increase their benefits by hiding assets by setting up trusts or other entities, for example. They might also change the timing of selling some of their assets to retain Social Security benefits, which distorts resource mobility, an efficiency concern. While this plan may appear to benefit the less wealthy at the expense of the wealthy elderly, it seems vulnerable to loopholes and evasive behavior.

c. Add new state and local government workers to the pool of covered workers (i.e., they pay payroll taxes now and receive benefits when they are old).

Broadening the tax base to include these workers would yield a net increase to the system. Current Social Security participants would, over their lifetimes, pay in more than they would withdraw. Therefore, increasing the number of workers covered would provide a net increase to the cash flow in the system. The new workers would stand to lose from this system relative to a plan in which they had their own retirement accounts (because with Social Security they would pay in more than they receive), but the Social Security system would benefit. This new rule might induce some to exit these jobs, but since most workers are covered by the system, they would have little choice as to where else to work to avoid this tax.

d. Gradually increase the normal retirement age (NRA) from 65 to 70 (under current laws, the NRA will gradually rise to 67 by 2022; the proposal is to speed up this process so that the NRA will be 70 by 2022).

Gradually increasing the normal retirement age will save the fund money by reducing the number of years during which retirees can collect. People who need to retire earlier for health or physical limitation reasons will be adversely affected. If they are able to, they may attempt to find less physically demanding work or they may increase private savings in order to be able to afford to retire earlier.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 14

UNEMPLOYMENT INSURANCE, DISABILITY INSURANCE, AND WORKERS' COMPENSATION

Questions and Problems

1. The unemployment insurance payroll tax is said to be partially experience-rated because the tax rate on earnings is higher for firms with a history of laying off workers. What is the rationale for making the payroll tax rate a function of a firm's layoff history?

Experience rating forces firms to bear some of the cost of laying off workers. In the absence of experience rating, firms would have an incentive to lay off and then rehire workers with greater frequency. Frequent layoffs and rehires without experience rating allows employees to benefit at no cost to the firm. To discourage firms from taking advantage of this implicit subsidy, experience rating increases their insurance premiums when layoffs occur. This disciplines firms to hire only when the long-term prognosis of success is good and to keep workers employed during seasonal, or other temporary, slack times.

2. Describe the effects of raising the maximum benefit level for unemployment insurance on the savings rate of high-income workers. How big are the consumption-smoothing benefits of this policy change likely to be? Are there other potential benefits of raising this maximum benefit level?

High-wage earners would receive more income in the event that they lost their job. This means that they would have to do less "precautionary" saving (savings for the purpose of consumption smoothing after these events). Although this policy would presumably improve consumption smoothing among high-income workers, the benefit is likely to be relatively small for at least two reasons. First, high-income workers presumably already had plenty of income and savings to prepare for temporary unemployment spells; they were probably able to consumption smooth quite well beforehand. Second, high-income workers are usually high-productivity workers; they probably find it relatively easy to find new jobs after becoming unemployed.

However, the fact that these workers have high productivity suggests another benefit of raising the maximum benefit. Insofar as their productivity is specific to a particular type of job, it may take higher-wage workers a relatively long time to find jobs that are good matches to their specific skills that lead to higher productivity. Generous unemployment insurance benefits would allow these productive workers to take more time to find jobs that are better matches—that is, jobs that do not waste their human capital.

3. Workers' compensation benefits vary across states and types of injuries. How can you employ this information to estimate the elasticity of injury with respect to workers' compensation benefits generosity?

Suppose that one had state-level data on the injury frequency. One could try to regress frequency of injuries on the level of workers' compensation benefits, but it would raise the

standard "correlation versus causation" problem: one wouldn't be able to tell whether the higher benefit levels caused frequency of injury, or whether there is some other reason for the relationship (for example, states with more risky industries have more injuries and are more generous because workers have more political power). Having variation in injury types would allow the researcher to include state and injury-type fixed effects in her regression of benefit level on injury frequency—to account for the possibility that injury reporting behavior is different in different states and for different injuries. The coefficient on "benefit level" could then be used to compute an elasticity of injury with respect to benefit level.

This approach would be better than just looking at across-state variation, but the approach could still have problems. One would have to worry about the possibility of benefits being high for some injuries (but not others) in some states because of something particular to that injury in that state. That is, one might still be worried about state- and injury-specific things that would lead to both higher workers' compensation levels for that injury in that state and higher injury rates for that injury in that state. A (hypothetical) example: states with textile industries have many losses of fingers and because of unionization have high compensation for finger loss but not for any other types of injuries.

4. The Organisation for Economic Co-operation and Development (OECD) compares net replacement rates for unemployed families of different types across countries. These data are available online through the "Statistics" link at http://www.oecd.org/els/social/workincentives. In which countries has the replacement rate provided by unemployment benefits increased the most over the 40 years? Has the replacement rate declined in any countries?

Portugal's gross replacement rate rose from 0% to 41% between 1961 and 2004. Italy, Finland, Denmark, Switzerland, and the Netherlands also saw dramatic increases in replacement rates over that time period. Japan's replacement rate has remained low, falling from 12% to 8% over that time, and the United Kingdom's replacement rate has fallen modestly as well, from 24% to 16%.

5. What does the empirical evidence on the consumption-smoothing benefits of unemployment insurance indicate about the degree to which individuals are, on average, insured against the income losses associated with unemployment?

Gruber (1997) found that people are *not* completely insured against unemployment income loss and so are unable to smooth their consumption during periods of unemployment. While unemployment insurance reduces the decline in consumption associated with unemployment, it does not allow for full consumption smoothing. In addition, unemployment insurance *does* crowd out other sources of savings and income. Gruber's study found that approximately 30% of unemployment benefits were used to shore up consumption during spells of unemployment, but that 70% of the benefits crowded out other sources of consumption smoothing.

6. Consider Meyer's (1989) study of the effects of unemployment benefits on unemployment spell durations. How does this study deal with the likelihood that unemployment spells and unemployment benefits may both increase during economic recessions?

It seems logical to assume that people will remain unemployed for longer periods of time during a recession as it is harder to find another job at these times. It also seems logical to assume that people will remain unemployed longer if their benefits are increased. To distinguish between the effect of a recession and the effect of increased benefits, Meyer used the difference-in-difference approach. Because the increase in benefits was greater for higher-wage earners, he compared the difference in unemployment duration among high-wage earners in a state without the benefit increase (Pennsylvania) with the difference in

unemployment duration among high-wage earners in New Jersey, where benefits had increased. The increase in duration in Pennsylvania established the recession effect. The extent to which unemployment duration was even longer in New Jersey could be attributable to the higher benefits. However, recessions don't affect states equally. The industrial mix in a given state can make it more or less vulnerable to recessions, so the recession effect in Pennsylvania may not have been exactly the same as the effect in New Jersey. To investigate that possibility, Meyers also compared unemployment duration in New Jersey among workers who did not receive increased benefits (the lower-wage workers) with those whose benefits had increased.

7. Gruber (2000) found evidence that the elasticity of labor supply with respect to disability insurance benefits is considerably smaller than the estimates of the elasticity of unemployment durations with respect to unemployment insurance benefits. Why might moral hazard be less of an issue in the disability insurance program than in the unemployment insurance program?

For moral hazard to be a significant problem, there must be informational asymmetry and the beneficiary must have substantial control over the triggering event (or the duration of the event). Several features of the disability insurance program reduce the likelihood of moral hazard. Certainly there is informational asymmetry: the claimant has better information about his or her true ability to work. However, the five-month waiting period before benefits begin reduces the incentive of the claimant to stretch the truth, and the requirement that the disability be certified by a state body reduces the informational asymmetry. Because disability is often a permanent condition, once it is determined to be legitimate, moral hazard with respect to duration is not a major factor.

One feature of unemployment insurance in particular makes it susceptible to moral hazard: the requirement that the recipient actively seek employment. This feature is very difficult to monitor and enforce. As a result, there is informational asymmetry about the extent to which the recipient seeks new employment and an opportunity for the recipient to be less than aggressive in a job search. Because the recipient determines the level of effort he expends in his job search, he has a large degree of control over the duration of the unemployment spell.

8. Governments typically provide disability insurance and unemployment insurance to workers. In contrast, governments typically *mandate* that firms provide workers' compensation insurance to their workers but do not provide the coverage. Why the difference? Why don't governments provide workers' compensation instead of mandating it?

By requiring firms to provide workers' compensation insurance for their workers, the government induces firms to internalize the costs of a risky work environment for their workers. A firm with a history of on-the-job injuries will find it extremely expensive to buy insurance. The firm therefore has an incentive to reduce on-the-job injuries. If the government provided workers' compensation insurance directly, employers would be less careful in making sure that their workers were not injured on the job (unless there was perfect experience rating). In other words, by requiring firms to purchase their own workers' compensation insurance, the government reduces moral hazard on the firm side and presumably makes workplaces substantially safer than if it picked up the tab for firms' carelessness.

9. In May 2004, the state of Vermont significantly reformed its workers' compensation system. One key provision of this reform was to reduce the window of time during which a claimant could file an initial workers' compensation claim. Will this help to reduce the degree of fraudulent use of the workers' compensation system? Explain.

Limiting the time between an injury and a claim could possibly reduce fraud. As mentioned in the text, some of the most difficult injuries to verify are soft-tissue injuries, such as

muscle strain. The precise moment of injury may be difficult to identify or the injury may be the cumulative result of small events or overuse. As a result, it is difficult to determine whether the injury happened at work or elsewhere. Allowing a worker to wait for a long period of time before reporting these kinds of injuries increases the worker's ability to characterize a nonwork injury as one that happened on the job. On the other hand, sometimes these kinds of injuries are not apparent until well after the fact, so this policy change could reduce the number of legitimate claims.

10. Senator Doppelganger has proposed rules that will make it easier for workers to apply for and receive disability benefits. What is this likely to do to rates of application for disability benefits? To the reported unemployment rate?

More people who lose a job or are unemployed for an extended period of time are likely to apply for (and receive) disability benefits than before, even if they have relatively minor injuries. Individuals who are receiving disability benefits are not considered to be looking for a job—indeed, if they could reasonably find a job, they are not even eligible for disability benefits. This rise in disability application and benefit receipts will thus tend to crowd out unemployment. Autor and Duggan (2003)[1] use a 1984 policy change that eased the receipt of disability benefits to argue that disability insurance can cause substantial unemployment crowd-out.

Advanced Questions

11. Are individuals more likely to maintain their pre-injury consumption levels after an easily preventable on-the-job injury than after a difficult-to-prevent on-the-job injury? Explain.

The occurrence of an easily preventable injury raises the suspicion of moral hazard. People who do not have savings or an alternative source of income during a time when they are unable to work may be more careful on the job; for them the cost of injury, in terms of reduced consumption, is high. Injuries suffered by these individuals are more likely to be ones that were difficult to prevent. These people will not be as able to maintain pre-injury consumption levels. People who have sufficient savings or other income to smooth consumption during out-of-work spells may not be quite as cautious, so they would be more likely to suffer easily preventable injuries. Once injured, they are also better able to maintain pre-injury consumption levels.

12. The empirical evidence on unemployment spell durations suggests that workers who leave unemployment earlier (that is, find or take a job sooner) have no higher post-unemployment wages than do workers who leave unemployment later. This result could be interpreted as evidence that the quality of the job match does not improve as the unemployment spell grows longer.

a. What does this interpretation of the evidence imply about the moral hazard costs of unemployment insurance?

Had the evidence indicated that longer unemployment durations led to better job matches, you might conclude that workers were truly exerting effort to find better matches during unemployment spells. Those who look longer find better jobs; those who take the first offer to come along have shorter spells. The fact that the evidence shows no better matches for those who take longer suggests that the longer duration was not spent looking

[1]Autor, David H. and Mark G. Duggan, "The Rise in the Disability Rolls and the Decline in Unemployment," *Quarterly Journal of Economics,* 2003, 118 (1 February), 157–205.

for better jobs. The longer unemployment duration may just have been due to moral hazard: the temptation to not even start to look or to look half-heartedly until the benefit period had almost run out. This interpretation suggests that longer benefit periods, by allowing delays in the job search, increase moral hazard costs.

b. An alternative explanation for this evidence is that workers with longer unemployment spells are less qualified than are workers with shorter unemployment spells. How could you empirically distinguish between this explanation and the explanation put forth in a?

The basic "alternative" argument put forth in a is that the well-qualified have an easier time finding jobs early, while the less-well-qualified take quite a bit longer because they have fewer good matches. This would mean that people who find jobs early would tend to have higher wages. Observing that people who get jobs later do not have higher wages could simply be a result of two offsetting effects: first, longer searches improve productivity for any given worker, and second, higher productivity workers tend to take jobs earlier. To try to rule out this alternative explanation of the data, the perfect approach would be to randomly assign some workers to short unemployment insurance durations and some workers to long unemployment insurance durations. If the interpretation in a is correct, both groups have the same wages when they find jobs, but the long-duration group would have longer durations. If the alternative explanation is correct, the longer-duration group would have both longer durations and higher wages.

13. The U.S. Department of Labor's Web site, http://workforcesecurity.doleta.gov/ unemploy/sigprojul2006.asp, includes a table of the major differences in unemployment insurance programs across states. At the time of this writing, the state of Kentucky had a much wider range in the payroll tax rates paid by different experience-rated firms than did Oregon. Which state's system subsidizes firms with high layoff rates to a greater degree? Explain.

These data suggest that Oregon does not engage in as accurate or refined experience rating of firms as Kentucky does. Imperfect experience rating means that firms with more frequent layoffs do not pay the entire cost of the layoffs. In this case, it seems that Oregon subsidizes high-layoff firms to a greater extent than does Kentucky. In Kentucky, a firm is likely to think twice before laying off workers, because when it does its workers' compensation premium will increase. Layoffs are costly to the firm. In Oregon, the number of layoffs necessary to jump into the next-higher premium bracket must be higher than in Kentucky. (Since there are fewer total brackets, they must span larger ranges.) As a result, some layoffs are "free" in the sense that the firm will not face a higher workers' compensation premium. The free layoffs generate workers who claim the benefit. Someone must be paying the benefits, and it is not the firm. Thus, the Oregon program subsidizes some firms who lay off workers.

14. You are hired by the presidential administration to review the unemployment insurance (UI) program, which currently replaces approximately 45% of a worker's wages for 26 weeks after she loses her job.

Consider two alternative reforms of the current UI system. The first is to experience rate firms fully, so that the taxes firms pay are set exactly equal to the benefits their workers receive (benefits remain at 45% of wages). The second is a system of individual full experience rating—the government would loan individuals 45% of their wages while unemployed, but they would have to pay this back when they get new jobs.

a. Contrast the effects of these alternative policies on unemployment durations and the likelihood of worker layoffs.

Perfect experience rating would put an end to the subsidization of the layoff/rehire pattern of some firms and thus would certainly reduce layoffs. This reduction could lead to increased unemployment duration, though. Perfect experience rating would probably shut down firms that are just on the margin of staying in business or firms with seasonal production. Under the current system, these firms can lay off and rehire quickly without bearing the full cost. Firms can retain the loyalty of their laid-off workers during slow times by allowing the government to subsidize their downtime and then rehire them as needed. Under the new proposal, firms that have seasonal operations or that need to close plants temporarily will face increased costs in the form of increased unemployment insurance premiums. If these costs force the firms out of business, their former employees will have to find new work, something that may take longer than just waiting for a callback from their old employers. Even if the firms did not go out of business, they might wait longer to call back former employees. With perfect experience rating, it may be cheaper for firms to lay off workers less frequently but for longer periods of time. In particular, a layoff of longer than 26 weeks would be cheaper for firms than two shorter layoff periods because the firms would not bear the cost of the 27th and later weeks.

The individual loan system completely shifts the burden of unemployment from the firms to the individual. If firms bear no cost associated with unemployment, they may be more willing to lay off (and hire) workers. Under a system of partial experience rating, firms have at least some incentive to keep workers on over short periods of slow production. Without this incentive, firms may lay off workers much faster at the beginning of a downturn. On the other hand, because the benefit is in the form of a loan, workers have substantial incentive to seek new employment as soon as possible, so the duration of unemployment should fall. Under this system, firms that are particularly seasonal or cyclical would suffer. They would be less able to hire back their original workers because the workers would have sought work elsewhere (either to reduce the time of the loan period or because they wanted more stable employment to avoid having to take loans in the future).

b. What are the consumption-smoothing properties of each alternative policy?

By reducing the number of cyclical and seasonal layoffs, the firm-level experience-rating system would tend to smooth consumption. However, the extent to which the system increased unemployment duration would undermine the consumption-smoothing benefits. Long unemployment spells are more difficult for a worker to smooth over. After 26 weeks, no benefits would be paid, and by that time any savings might have been depleted as well. The firm-level experience-rating system might enhance short-term consumption smoothing, but it would worsen long-term consumption smoothing.

The individual loan system could either help to smooth consumption or hurt consumption smoothing. On the one hand, by providing access to credit during the time of unemployment allows workers to transfer income from later (after they find a job) to their periods of unemployment. It therefore smoothes consumption across the unemployed and re-employed periods. On the other hand, it makes it more costly for a worker who has recently become unemployed to consume, since they know they will have to pay back the loan eventually. This means that they may choose to consume less after becoming unemployed than if they received cash benefits instead of loans. If so, there could be a larger drop-off in consumption after they become unemployed—less smoothing. (This effect would be at least partially offset by increasing saving prior to becoming unemployed.)

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 15

HEALTH INSURANCE I: HEALTH ECONOMICS AND PRIVATE HEALTH INSURANCE

Questions and Problems

1. **Matt is an employee at a large university, where he pays $120 per month in insurance premiums and his employer pays $300 per month. He finds that if he quits his job, the same quality of insurance would cost him $600 per month. Why is there a difference in the premium?**

   Matt's university employer presented a large pool of people to the insurance company. Insurance companies will insure a large pool of customers for less money than they will insure individuals for two reasons. First, the employees of such a large employer are unlikely to be any less healthy, on average, than any other group of people with the same distribution of age and gender. Since people are unlikely to select university employment based on their likelihood to use health insurance, the insurance company avoids the problem of adverse selection. Second, the law of large numbers predicts that the incidence of a large health insurance claim in this large population would be about what you would statistically expect in the population as a whole. Individuals or small groups, on the other hand, don't give insurance companies this risk-pooling advantage, and individuals who seek health insurance may be doing so because of adverse selection—that is, because they know they are in poorer-than-average health. As a result, the insurance company must charge Matt a higher premium if he quits.

2. **The U.S. Bureau of the Census reports trends over time in health insurance coverage, by race and sex, at http://www.census.gov/hhes/hlthins/www/historic/hihistt1.html. Which racial or ethnic group has seen the largest increase in its rate of health insurance coverage from 1987 to 2002? Is this increase largely coming from increases in the rates of government-provided insurance, employer-provided insurance, or privately purchased insurance?**

   The general trend in insurance coverage from 1987 to 2002 was that of an overall *decline* in the percent of people covered. The composition of coverage also changed, with an increase in the percent of people covered by government-provided insurance and a decrease in the percent covered by employer-provided plans. African Americans were the only racial group for which there was no overall decline in coverage rates over that time period; the percentage of Asian Americans who were uninsured increased by over 2.5 percentage points. The increase in uninsured white Americans was over 3 percentage points.

   Over that time period, a higher percentage of whites obtained government-provided insurance; among Asian Americans, employer-based coverage increased slightly and government-provided insurance decreased. Among African Americans, both government and total nongovernment insurance coverage stayed similar, but employer-provided coverage rose while privately purchased coverage declined.

3. Suppose the U.S. government gets rid of the tax exemption for employer-provided health insurance. Instead, the government provides a 20% subsidy on employer-provided health insurance, so that the employer only has to pay 80% of the cost of such policies. How might this policy change affect the type of workers to whom firms will offer health insurance? Which types of firms is this policy most likely to effect?

The current system provides a tax exemption for health insurance expenditures. This policy is most beneficial to high-income workers who would face particularly high tax rates if not for this treatment. It is less beneficial to workers facing low tax rates. The new policy would provide the same tax benefits provision for all workers. This might be expected to increase coverage among low-income workers and reduce coverage among high-income workers. This policy change might be particularly good at encouraging firms with many low-wage workers to begin to offer health insurance coverage.

4. Many privately purchased health insurance plans have stringent "preexisting conditions" exclusions, which deny coverage to insured persons for any health conditions that were known at the time of enrollment. Why does this exclusion reflect a market failure in the insurance market?

The market failure that leads to "preexisting conditions" clauses is adverse selection caused by informational asymmetry. Privately purchased plans, in contrast to group plans, are particularly susceptible to adverse selection. In a plan with just one purchaser, there is no law-of-large-numbers effect to drive claims to their statistical expected value, and the event that triggers the purchase of insurance is the decision of a person to buy it, not a person's employment. That decision could easily be motivated by a desire to obtain coverage because the insured knows that an adverse health event is likely. The decision to work for a particular employer is less likely to be motivated by the adverse selection component. The potential insured has much better information about his or her health status than does the insurer. Because the insurance company cannot know for sure whether a private purchaser is a high risk, it must protect itself from loss by including a preexisting condition clause. This strategy reduces the informational asymmetry.

5. What negative externalities arise when an individual does not have health insurance?

When someone does not have insurance, costs are imposed on those who do in several ways. First, many diseases are contagious. If contagious diseases go untreated because the infected person lacks insurance and thus cannot afford treatment, they will spread to the rest of the population. Second, emergency treatment is not denied to people who cannot afford to pay; therefore, uninsured people will go to hospitals and receive care. The cost of providing the care is borne by the insured patients. Third, uninsured care is often given in a hospital emergency room rather than a doctor's office. The resource costs of providing care in a hospital setting are much higher than in a doctor's office, so the care the uninsured do receive is more costly than the care they would have received if they had insurance. Inefficiently used hospital resources impose a social cost.

6. An individual's demand for physician office visits per year is $Q = 10 - (1/20)P$, where P is the price of an office visit. The marginal cost of producing an office visit is $120.

a. If individuals pay full price for obtaining medical services, how many office visits will they make per year?

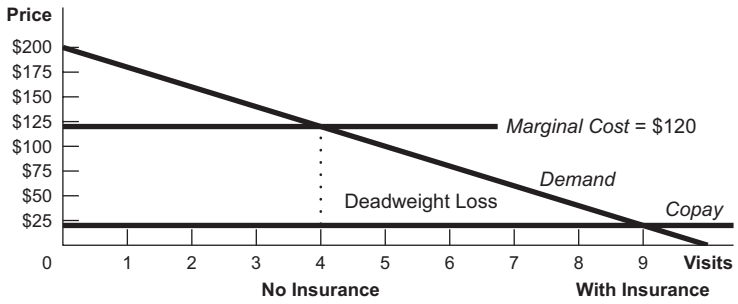
The solution to this question can be determined by setting the marginal benefit of a physician office visit equal to the marginal cost. To find the marginal benefit of a physician office visit, invert the demand function so that it is expressed in terms of price, or the dollar amount a patient is willing to pay: $Q = 10 - 0.05P$ yields $P = 200 - 20Q$. Setting demand equal to supply, or marginal cost, yields $200 - 20Q = 120$; $20Q = 80$. The patient will visit the doctor 4 times a year.

b. If individuals must pay only a $20 copayment for each office visit, how many office visits will they make per year?

When the price is only $20, the quantity demanded is 10 – 0.05(20) = 10 – 1 = 9.

c. What is the deadweight loss to society associated with not charging individuals for the full cost of their health care?

The deadweight loss triangle is bounded by a quantity difference of 5 (9 – 4) and a dollar difference of 100. The formula for the area of a triangle is ½ (base × height) = ½ (100 × 5) = $250, represented graphically,



7. Jack has three types of medical expenditures: contact lenses, prescription drugs for a condition he has, and accidents and acute illnesses (such as broken bones and pneumonia). He has been paying for all of his medical expenditures out of pocket and he is now considering purchasing health insurance. The different plans he is considering offer coverage for different types of expenditures. Describe the consumption-smoothing benefits and moral hazard costs of coverage for contact lenses, prescription drugs, and accidents and acute illnesses.

There are likely to be few consumption-smoothing benefits of health insurance coverage of expenses for contact lenses since contact lens use is completely predictable (and a small fraction of his income). The moral hazard effects of coverage for contact lenses are likely to be modest as well: Jack *might* consume some more contact lenses than he would if they were not covered by insurance, but there are only so many contact lenses he needs; furthermore, the coverage would probably limit the number he could purchase in a year. Prescription drugs for preexisting conditions are similar in both respects, with even lower moral hazard costs. However, prescription drug coverage more generally might also apply to future needs. This sort of coverage would have consumption-smoothing benefits as well as moral hazard costs since coverage might make doctors more likely to prescribe drugs for conditions that do not really need them (for example, to replace over-the-counter substitutes). Coverage for accidents and acute illnesses is likely to have the greatest consumption-smoothing benefits: Jack cannot easily consumption smooth in the event of a major injury without insurance. It is also likely to have low moral hazard costs since illnesses and acute injuries are relatively easy to verify.

8. As Figure 15-1 illustrates, the United States leads all OECD countries in health care expenditures, spending almost double the average OECD country's share of Gross Domestic Product on health care. But American health care outcomes are not dramatically better than those of other OECD countries. What could explain this disconnect between differential spending and differential outcomes?

With some exceptions, the other OECD countries are fairly compact and urban. Perhaps it is easier to provide medical care to people who are less spread out and have a more homogeneous lifestyle. Another factor to consider is that most other OECD countries are less ethnically diverse than the United States. The variety of ethnic and cultural backgrounds in the

United States, given that some illnesses are genetically correlated with ethnicity or race, may increase costs by increasing the number of health problems that U.S. providers must be prepared to address.

Another factor that contributes to this disparity is the free market system for health care. In the United States, people choose their level of care to a greater extent than in many other countries, where health care is nationalized and rationed by queuing rather than price. Procedures that would not be provided in some countries with nationalized health care systems are available in the United States—for a price. This system increases the costs by delivering care to people who would not have been treated in a nationalized system, but it may contribute to worse health statistics because some Americans cannot afford even basic care.

Finally, scientists in the United States engage in substantially more research and development, and U.S. patent protection on new drugs and other medical inputs allows firms to recover recover R&D costs when they sell their products in the United States. Other countries purchase these inputs for a lower price, free riding on the research carried out in the United States.

9. Senator Snead, making the case for universal, free health care, argues that people are not price sensitive to health care costs; when they need to go to the doctor, they go, regardless of the cost. Evaluate this argument in light of the empirical evidence on the price sensitivity of health care demand.

Senator Snead is incorrect in his claim that demand for health care is completely inelastic. The RAND Health Insurance Experiment conducted in the mid-1970s used a controlled experiment design in which people faced different levels of copayments. Those who had lower copays and thus lower out-of-pocket costs for medical care tended to use more medical care than those whose copays were higher. Furthermore, more doctor visits were not associated with better health outcomes. If the results of the study generalize well to nationally provided free universal health care, then universal, free health care would not necessarily improve health outcomes relative to a program that covered only catastrophic adverse health events, but it would increase usage.

10. Catastrophic injuries and illnesses account for two-thirds of total health care costs in the country of Gnut. The Gnuti government is deciding between two different universal health insurance programs: program *X* would pay for two-thirds of any health care expense that a Gnuti citizen incurred, while program *Y* would pay only for catastrophic illnesses and injuries, but would cover 100% of those costs. Which program is likely to better allow Gnuti citizens to smooth consumption? Which program is likely to cost the Gnuti government less? Explain your answers.

Coverage of 100% of the costs of catastrophic illnesses and injuries would be more effective at smoothing consumption, because catastrophic losses are the most difficult to save for or to self-insure against. Routine and nonemergency medical expenses do not present a consumption-smoothing problem; they are, by definition, expenses that tend to occur fairly regularly. In addition, the catastrophic coverage would probably be less expensive for the Gnuti government. If there were no behavioral response to either policy, the two policies would have equal costs: the catastrophic plan would cover 100% of all expenditures for catastrophic illnesses and injuries, while the other plan would cover two-thirds of all costs. However, covering routine health care costs would tend to increase utilization by more than covering catastrophic costs since spending for non-life-threatening events is more price-elastic.

11. You observe that states with higher income tax rates also tend to have higher rates of employer-provided health insurance. Is this a good test of the effects of tax policy on the demand for employer-provided health insurance? Explain.

Higher income tax rates do make employer-provided health insurance more attractive, because the higher the tax rate, the greater the value of spending a dollar on an untaxed ben-

efit. However, state income taxes may be correlated with other factors that are also correlated with employer-provided health insurance. For example, it may be that state income taxes are higher in states that are more urbanized and thus have more large employers. Larger companies, with more employees, can provide health coverage for a lower cost than can small companies because bigger companies can spread the risk of an expensive loss over more people. A better way to test this correlation would use differences in differences: look at whether firms change their health insurance offerings when tax laws change and then, if firms do change, compare the change with what happens at the same time in states where the laws have not changed.

12. Given that subsidized health care leads to increased health care usage, is this necessarily due to moral hazard? Explain.

Part of the increase in usage may be due to moral hazard, but some of it is probably due to the income effect. Subsidized health care increases a person's real income and would increase expenditure on health care even in the absence of moral hazard. Some people may have sincerely needed the care without the insurance; with it they can finally afford to obtain the care they need. Insurance also reduces the price of health care relative to other goods and services, so people may purchase more units of covered health care and fewer units of uncovered substitutes, such as nontraditional providers and over-the-counter remedies. This substitution is the moral hazard aspect of purchasing more covered care, while the income effect is an increase in usage that should not be characterized as moral hazard.

13. Your employer-provided health insurance coverage allows you to choose either a health maintenance organization—in which your doctor is paid the same amount by the insurance company when you select her as your physician, regardless of how many visits you make—or a preferred provider organization—in which your doctor is reimbursed by the insurance company based on the quantity of care provided—for your health benefits. In which organization would you expect to have an easier time getting an appointment to see your doctor? Explain.

A preferred provider organization (PPO) should be more willing to make appointments than an HMO. HMOs have an incentive to reduce the amount of care they give because appointments are just a cost to them; they receive no offsetting revenue. A PPO, in contrast, is reimbursed for at least some of the cost of each appointment, so appointments do not represent a total loss. In the aggregate, HMOs do best for a doctor when she has the largest number of enrollees, as the number of enrollees completely determines revenue, but all the enrollees must compete for a limited number of appointments. When a doctor is in a PPO, revenue is determined by the number of patient contacts. Thus, the doctor can enroll fewer patients but provide more care and still receive the same revenue as an HMO with many patients. In fact, depending on the reimbursement level, doctors in PPOs have an incentive to make sure all of their appointment times are filled.

Advanced Questions

14. Suppose the government of Orwellia decides to genetically test all individuals for the risk of major illness, and reports the results of these tests to potential insurers when people apply for individual health insurance coverage. Will healthy people find working for large firms more, less, or equally attractive than before this testing program began? How about unhealthy people? Explain.

Since insurers will now observe the outcome of a test, they will presumably charge more for sicker applicants and less for healthier ones. This will make it cheaper for healthy people

to buy private health insurance and it will make it more expensive for unhealthy people. Large firms tend to offer health insurance more frequently than small firms—this is one advantage to working at a large firm. Healthy people who can now buy private insurance more cheaply will find the relative benefits of working at a large firm reduced, and will be less likely to work there. For unhealthy people, just the opposite will occur: they will find working at large firms relatively more appealing. Note that this shift in worker types is likely to increase the cost for a large firm to buy health insurance.

15. The following question considers the possibility that employer-provided health insurance reduces job mobility—a phenomenon that has been termed job lock. Job lock prevents workers from transitioning to jobs in which their marginal productivity would be higher than at their current jobs.

Consider three workers with the following preferences:

$$U_{ij} = W_{ij} + (50 \times H_{ij})$$

$$U_{kj} = W_{kj} + (110 \times H_{kj})$$

$$U_{lj} = W_{lj} + (150 \times H_{lj})U_{lj}$$

where W_{ij} is the wage at job *j* for worker *i*, H_{ij} is an indicator variable (i.e., it takes on a value of one or zero) for whether or not employer-provided health insurance (EPHI) is offered to worker *i* at job *j*. Assume that there are no employee copayments for the insurance and that the labor market is perfectly competitive. Workers *i, k,* and *l* all have a marginal product of $200. There is an arbitrarily large number of firms in the economy, and they cannot offer worker-specific compensation packages. If they provide EPHI to one worker, they must provide it for all their workers. EPHI costs firms $100 per worker. Assume that there is full employment—all three workers will be employed.

a. What wage does each of these workers earn? Do they have EPHI? What is the compensating wage differential for EPHI (the labor-market-wide decrease in wages at a job that provides EPHI)?

Assume that each worker chooses to work at the firm that gives him or her the highest utility. Because it is a perfectly competitive market, firms pay a total compensation package of $200, the marginal product of each worker.

First consider the firms' options: they can either pay a wage of $200 and not offer insurance; or they can pay a wage of $100, and incur the $100 cost of insurance.

Now consider worker *i*: with insurance, he earns a wage of $100; the value of the insurance is 50 ×1, so total utility with insurance is 150. Without insurance, he earns a wage of $200. Worker *i* will choose the $200 wage and no insurance.

Consider worker *k*: with insurance, *k* earns a wage of $100; the value of the insurance is 110. Total utility at an insuring firm is 210, greater than the 200 that *k* would have at a firm with no insurance. Worker *k* chooses a wage of $100 plus insurance.

Consider worker *l*: With insurance, *l* has utility of 100 plus 150 = 250, quite a bit whigher than the 200 without insurance. Worker *l* chooses a wage of $100 plus insurance. The compensating wage differential is $100: workers at firms that provide health insurance receive $100 less in wages.

b. Now assume that there are two types of firms: type 1 and 2. Type 1's cost of providing EPHI is $200 per worker and type 2's cost of providing EPHI is $100. At which type of firm is each of the three workers employed? Why? Which workers have EPHI?

None of the workers value insurance enough to work for a firm that provides only insurance and no cash wage. Worker *i* continues to work for a firm that does not offer insurance. Workers *k* and *l* work for type 2 firms because their marginal utility from insurance, 110 and 150 respectively, is greater than the $100 wage reduction necessary for type 2 firms to provide the insurance.

c. Now assume that firms of type 1 develop a new technology that increases the marginal productivity of their workers to $230. At what firms do the workers work now? Are any of them suffering job lock?

Type 1 firms can now offer either of the following compensation packages: a $30 wage and a $200 health insurance package or a $230 wage without health insurance. Worker *i*, who doesn't much value health insurance, will find it optimal to work for a type 1 firm offering the higher $230 wage. Worker *k* will also find this optimal. His utility from this option is 230. His utility from a type 1 firm offering the $30 wage + health insurance package would be 30 + 110 = 140, and his utility from working for a type 2 firm (as before) is 210. Finally, worker *l* would not be affected by this innovation: his utility from the two new options would be 230 or 180, both of which are less than the utility of 250 he gets from working at a type 2 firms, where he gets insurance and a $100 wage.

There is a sense in which worker *k* suffers from job lock: he could have a higher productivity by working for firm 1, but he values insurance highly enough that he continues to work for firm 2. But this isn't necessarily "bad" job lock: yes, he would be more productive at a type 1 firm, but this would prevent him from getting health insurance efficiently. It would appear that in this toy world, social welfare is higher when job lock occurs.

16. The Consolidated Omnibus Budget Reconciliation Act of 1985 (COBRA) mandated that employers with over 20 employees allow workers who are separated from their job to purchase insurance through their health-insurance plan (if they offer one). How might you use this law to test for health-insurance-related job lock?

The passage of this law made it easier for workers at large firms to maintain coverage after leaving their jobs. This should reduce job lock for these workers. Workers in smaller firms were not affected by the law, so job lock should not have changed. One could use a difference-in-difference approach to test for job lock. This would involve comparing changes in the job separation rate from large firms after the passage of the law to changes in the job separation rate from small firms after the passage of the law. If job lock is a problem, we would see the former change by more than the latter (which would serve as the control group).

17. The country of Cheapland currently has a national health insurance system that reimburses citizens for 90% of all heath care costs incurred. Cheapland's government is considering a policy change that would provide medical care providers with a fixed reimbursement level for each diagnosed illness so that citizens would no longer bear any out-of-pocket expenses for medical care. In what ways will this policy change reduce moral hazard? In what ways will it increase it?

Cheapland might reduce provider-level moral hazard with this plan. Providers would not have an incentive to overtreat or overcharge after making a diagnosis because they would be unable to receive additional compensation. In fact, this policy might provide an incentive for providers to undertreat patients because they would receive the same reimbursement regard-

less of the amount of (costly) care they provide. On the other hand, the new policy might induce more people to seek medical care. Under the old plan, patients had to pay 10% of their costs; under the new plan, their marginal cost of treatment is zero. Hence, moral hazard on the part of the patients might increase. Another source of moral hazard could also arise: providers might deliberately overdiagnose (or change diagnoses based on its relative remuneration) to increase their reimbursement.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 16

HEALTH INSURANCE II: MEDICARE, MEDICAID, AND HEALTH CARE REFORM

Questions and Problems

1. **When your governor took office, 100,000 children in your state were eligible for Medicaid and 200,000 children were not. Now, thanks to a large expansion in Medicaid, 150,000 children are eligible for Medicaid and 150,000 children are not. Your governor boasts that, under her watch, "the number of children without access to health care fell by one-quarter." Is this a valid statement to make? Why or why not?**

   This governor has erroneously equated new eligibility with new access, which is not quite correct for two reasons. First, it is not certain that the 50,000 newly covered children did not have access prior to the change; they may have had privately provided insurance. Empirical studies have shown that Medicaid crowds out some private insurance when eligibility is expanded because Medicaid offers more generous benefits than most private health insurance plans. Second, eligibility does not assure access. If reimbursement rates for providers under Medicare are low, they may refuse to care for the newly eligible children.

2. **Explain why takeup rates—the fraction of eligible individuals who enroll in the program—are so much higher for Medicare than for Medicaid.**

   While Medicaid coverage is considerably more generous than Medicare coverage, there are several reasons that takeup rates are modest for Medicaid and nearly universal for Medicare. First, Medicaid is considered a welfare program designed to help the needy, so there is a stigma attached to it. Medicare is universal, so there is no such stigma. Second, while Medicaid offers generous benefits to enrollees, it has relatively low doctor reimbursement rates, so many doctors do not take Medicaid patients. People who wish to choose their doctor and be ensured of easy access to care may prefer not to go on Medicaid. These problems are much less severe with Medicare. Finally, once a person is eligible for Medicare, he or she is eligible forever. In contrast, eligibility for Medicaid can be transitory, and some individuals who know they are likely to lose their eligibility shortly—say, when they find a new job—may not find it worth the hassle of signing up.

3. **Describe the empirical evidence of the relationship between Medicaid expansions and improved children's health. How cost-effective have these Medicaid expansions been? Explain your answer.**

   Medicaid expansions have been successful and cost-effective in reducing infant mortality. There was an estimated 50% increase in preventive care, including early prenatal care, when Medicaid eligibility was expanded. The increase contributed to a large decrease in infant and child mortality. The decrease came at a cost of approximately $1 million per life saved, which is much less than the cost of other life-saving measures and well below most estimates of the statistical value of life.

4. Beginning in the mid 1980s, there was a large expansion in the Medicaid eligibility of children. How do you think this affected the job mobility of low- to middle-income parents? How could you test this?

This expansion should have increased job mobility. Prior to the policy change, many parents may have suffered from job lock where they felt that they were imperfectly matched to their job but couldn't easy quit to look for a new job for fear of losing insurance coverage for their children. Access to state-provided Medicaid would have eased this concern. One way to test this would be to see how job mobility changed as Medicaid was expanded. It is difficult to infer causality from time series analysis alone, however. For example, job mobility might have been expanding more generally over that time period. A better approach might be to compare the changes in job mobility of parents of newly eligible children to the changes in the job mobility of similarly aged workers without children.

5. What are the similarities between Medicare vouchers and education vouchers (described in Chapter 11)? What are the differences?

Some similarities between the two are that both types of vouchers allow recipients to use a fixed amount of money to shop for the service. Both respect consumer sovereignty: Who knows better than the consumer which provider is the best fit? Both use competition in the marketplace to encourage providers to provide high-quality service at a competitive price. Both provide the consumer with an incentive to shop around. These market interactions generate market prices, and prices in markets can efficiently signal value, willingness to pay, and cost to provide so that the government does not have to figure out reimbursement amounts.

The key difference between the two is in the effect of sorting in the marketplace. While sorting would occur in the educational voucher scenario, the consequences of sorting in the health care market are more dire. Healthy people would tend to pick the least-generous and thus lowest-cost plans because they would be able to pocket the difference. The least healthy would choose the most-generous, high-cost plans. Over time, these differences would become more polarized because the high-benefit/high-cost plans would have to increase their premiums even more given the adverse selection present in their pool of insureds. Ultimately, the least-healthy people would face such high premiums that they might be priced out of the market.

6. Is the rapidly expanding share of total GDP of the health sector in the United States necessarily evidence of wasteful health care spending? Why or why not?

It is almost impossible to meaningfully compare the cost of medical care today with the cost of care in the past because the service being delivered is so different. Spending has increased dramatically, but much of the spending increase has funded medical advances that have extended life expectancies, reduced suffering, and enhanced people's quality of life. Diseases that were once death sentences are now curable, and conditions that required lengthy hospital stays and painful treatment are now treated on an outpatient basis with much less discomfort. From an economic perspective, better treatment and faster recovery times mean less productivity loss due to illness or injury. Certainly there is some waste in the provision of health care, but there have been enormous advances. Perhaps it is worth tolerating some waste to achieve the advances.

7. Suppose the government decided to subsidize health insurance for the currently uninsured, requiring participants to pay half of their health insurance costs up to 10% of total family income.

a. How might this policy affect the use of medical care by the uninsured and their health?

This policy might reduce the number of uninsured people in the population by making

insurance more affordable. If the previously uninsured population were able to obtain insurance affordably, those who don't have insurance because they cannot afford it would obtain it. The 10% cap would reduce the problem of high premiums for individuals who purchase insurance separately from large employers or other risk-pooling entities, but it would not completely eliminate that problem. It is likely that if the previously uninsured bought insurance privately, it would be for a high premium because of the lack of risk pooling. Once insured, this population would face lower costs for medical care and so would be more likely to seek it. Although there seems to be little evidence that more generous benefits improve health outcomes relative to less generous benefits, the absence of any insurance at all is associated with worse health outcomes. Thus, to the extent people avail themselves of this opportunity, their health is likely to improve.

b. How might this policy affect the employer provision of health insurance?

This policy might dissuade employers from offering health insurance to employees because they would know that alternative coverage is available from the government. Large employers have a cost advantage in providing health insurance to their employees: they offer insurance companies large pools of enrollees who have not adversely selected coverage, they reduce administrative costs by covering many enrollees with a single contract, and because premiums are paid with pretax dollars, it is cheaper for employers to offer insurance than to increase wages by an equivalent dollar amount. If this policy crowded out employer provision, some of these sources of efficiency would be lost.

c. How might this policy affect hours of labor supplied by workers?

There are two ways this might discourage work. First, employer-provided health insurance is typically linked to full-time work requirements. This may provide a strong incentive for workers to take full-time jobs instead of part-time jobs. If workers can instead get government-subsidized health insurance while working only part-time, they may switch to part-time work. Second, consider a worker whose family income is below 20% of the cost of medical care. Then paying half of the cost of health insurance would lead them to spend more than 10% of their income on health insurance and, since the government limits the amount families pay to a maximum of 10% of family income, the government would have to contribute the difference. If the worker were to choose to work more, his family income would rise, so 10% of his income would be higher, and the government would contribute less for health insurance. Effectively, the 10% income limit forces low-income workers to spend some of their additional earnings on insurance that the government would have provided if they didn't work. This is like a tax on working, which discourages work.

8. Artie, Bella, and Carmen are Medicare Part D recipients. Artie currently has $1,000 in prescription drug costs each year. Bella and Carmen have $3,000 and $6,000, respectively. Each has a mild case of insomnia, and a new drug has just been introduced to treat their condition. It will cost $1,000 per year. Which of the three is most likely to take the new drug?

Medicare part D would cover 75% of the cost of the drug for Artie, since adding the new drug would increase his expenditures from $1,000 to $2,000. The drug would therefore cost him an additional $250 out of pocket each year. Bella would have to pay a full $1,000 out of pocket for the drug, since she is in the "donut hole" of coverage between $2,500 and $5,100 per year. Carmen is above the "donut hole" and would have to pay only $50 (5% of $1,000) for the drug. All else equal, then, Carmen would be the most likely to take it, then Artie, then Bella.

9. One disadvantage to a national health insurance system such as Canada's is that of "queuing"—people often need to wait long periods of time to receive desired treatments. What elements of a national health insurance system could lead to this situation?

Queuing is most likely to occur as a rationing device when demand for services outstrips supply. Markets correct these shortages by allowing prices to rise, encouraging entry by new suppliers or increased provision by existing suppliers. A national health system that capped expenditures and allowed only a fixed percentage increase in payments each year would not encourage entry of new providers, so the shortage would persist. Fixed-budget health insurance systems are also less able to introduce new techniques and products: first, the capital needed for research and development may not be available, and second, there is no reward for taking the risk inherent in research and development. In the United States, a company that successfully introduces a new drug or procedure can profit; in a nationalized system, the profit motive is eliminated. If these advances made medical care more efficient, the failure to provide them would result in longer wait times than would otherwise occur.

10. The fact that such a large fraction of U.S. health care costs is spent on people in their last six months of life has led many people to call the American health care system "wasteful." Why might this be an overgeneralization?

The argument implicit in saying that spending on the last six months wasteful is simple: it seems silly to spend huge sums of money on people who are dying anyway. However, it is crucial to note that doctors may not have known that the patients were dying when they treated them—they may not, in fact, be throwing money at a "sinking ship." An example is useful. Suppose that there is only one type of care ever needed: a $10,000 treatment for people with potentially fatal diseases that could kill them within 6 months. Suppose that this treatment has a 50% success rate: half of those who are treated live and half die. In this example, a full 50% of all medical costs are spent on treatment for people who die within the next 6 months. This is clearly not wasteful: the treatment had a 50% success rate, and the appearance of "waste" comes from focusing only on the unsuccessful treatments. Of course unsuccessful treatments look wasteful—but nobody knows in advance which will be successful, so the treatment itself is not.

Advanced Questions

11. In response to the State Children's Health Insurance Program in 1997, 37 states (including the District of Columbia) expanded Medicaid coverage to children in families below 200% of the poverty line, and even higher in some states.

a. In some of these states, the eligibility expansions have covered all children. How would you design a quasi-experimental analysis to evaluate the impact of these expansions?

As is the case with any program that varies by state, this situation offers the opportunity to compare coverage trends in the 14 states (51 minus 37) that did not expand coverage with trends in the 37 that did. As long as there weren't other trends that differed systematically between the 14 states and the 37 states, the trend in the 14 states can be used as a "control" for the 37 "treatment" states.

b. In other states, the eligibility expansions only covered certain age groups of children. How could you design a quasi-experimental analysis to evaluate the impact of these expansions? How could you make this more convincing than the evaluation in a? Explain.

A concern about the approach in a is that there may be systematic trend differences between the two types of states. Indeed, the states that chose to expand coverage may have done so because they had different trends. Using an "in-state" control to compare coverage trends of the unaffected age groups with the trends in the affected age groups may assuage these concerns. It would be particularly convincing to use both the across-state and within-state control groups. Suppose, for example, one could show that trends in the 14 "control" states and in the 37 "treatment" states were the same for the age groups that were unaffected by the change in the treatment states. This would provide strong evidence that the 14 states are a good control, and differences in coverage trends among affected age groups in these two types of states could be convincingly attributed to the coverage expansions.

12. After the Medicare program adopted the Prospective Payment System (PPS), researchers observed that people tended to receive less care for any given diagnosed condition.

a. One explanation for this finding is that the PPS provides incentives to provide lower levels of treatment for any given diagnosis. Why would PPS provide these incentives?

Under the Prospective Payment System, the government sets a fixed reimbursement amount based on a patient's diagnosis. As a result, the provider is paid that dollar amount regardless of the care given. Care that costs less than the fixed reimbursement amount yields surplus to the provider; care that costs more than the fixed reimbursement amount yields a loss to the provider. Thus, providers have an incentive to provide lower levels of care for a given initial diagnosis.

b. Another explanation for this finding is that PPS offers incentives for physicians to diagnose marginal health conditions as more serious than they are. Why would PPS provide these incentives?

The more serious the diagnosis, the higher the fixed reimbursement amount. Thus, if a provider can justify a more serious diagnosis, he or she will receive a higher reimbursement. Sometimes a provider cannot tell how complicated treatment will be when a patient first presents. A provider who is concerned that complications or contributing adverse factors will make treatment more expensive than the fixed reimbursement amount has an incentive to hedge the diagnosis up to cover the additional costs.

c. Since this reduction in quantity of care was not accompanied by a reduction in observable health outcomes, what, if anything, can you infer about the efficiency of the Medicare program *before* the policy change? Explain your answer.

If there was no deterioration in health outcomes when less care was delivered, it would seem that some of the pre-PPS care had little marginal benefit. This combination of findings (less care, no worse outcomes) is consistent with being in the "flat" part of the health effectiveness curve described in Chapter 15, and it implies that the Medicare program was less efficient prior to adoption of the PPS.

Arguing against this conclusion is the moral hazard discussed earlier. The PPS provides an incentive for providers to "diagnose up," so at every diagnosis level patients are slightly less sick than they were prior to adoption of the PPS. Thus, one could get outcomes that were no worse than before even with less cost within each diagnosis group.

13. One feature of Medicare coverage is that individuals are responsible for 20% of their Part B (primary physician) costs, without limit. Individuals have traditionally purchased Medi-gap policies that cover this gap by paying for the out-of-pocket costs not covered by Medicare. But some Medi-gap policies did not cover this 20% copayment.

Finkelstein (2002) studied the effects of a federal mandate that Medi-gap plans cover this 20% copayment. She found that this mandate would lead fewer individuals to buy Medi-gap coverage.

a. Why would the mandate lower the demand for Medi-gap coverage?

When Medi-gap coverage was forced to be more generous, companies that provided increased coverage had to increase their premiums. As a result, coverage was either no longer affordable or not worth the price to some of the people who had been purchasing it prior to the mandate. If it were the healthiest people who no longer opted for gap coverage, adverse selection would have put upward pressure on Medi-gap premiums, making them even higher.

b. What do you think would be the net effect of this policy on the costs of the Medicare program itself?

The decrease in Medi-gap enrollees should have reduced Medicare costs by making Medicare enrollees more price sensitive in their demand for health care. Empirical evidence suggests that generous coverage induces higher utilization, with little marginal improvement in outcomes, relative to less-generous coverage. Thus, some enrollees would tend to use less care given their copay obligations, and the system would save money. Offsetting this, but probably only partly, would be the fact that some people who previously had Medigap policies that did not cover the 20% copay would now have Medigap policies that did cover it. These individuals would find medical care cheaper at the margin and would increase their care and the cost of the Medicare program.

14. In 1981, the federal government passed a law that gave states permission to change the structure of their Medicaid program. States could now, if they wished, require Medicaid beneficiaries to enroll in a Medicaid "managed care organization" (MCO), as long as Medicaid recipients were offered a choice of several plans. Medicaid recipients would be required to receive their medical care only through their MCOs. The MCOs would receive fixed, regular payments from the state and, in return, would cover the medical expenses of their Medicaid enrollees.

a. Using what you know about Medicaid and managed care, explain several reasons why policy makers might support the requirement that Medicaid beneficiaries enroll in MCOs.

Managed care reduces the cost of providing care by capping payment based on the number of enrollees in the plan. Not only are costs reduced overall under this system, they are more predictable. Catastrophic events cost no more than regular coverage since reimbursement is per capita, not per treatment or diagnosis. Out-of-pocket costs to enrollees were also reduced, as they no longer had copay obligations, and coverage in some cases was expanded. Apparently, outcomes were no worse under this system, either. As a result, this move was politically popular as well as cost-saving.

b. Again, applying what you know about Medicaid and managed care, how do you think this requirement would affect the decision of people who are eligible to enroll in Medicaid? Be specific about which Medicaid eligibles are likely to change or not change their decision to enroll.

Medicaid provides "the best insurance money can't buy," but nevertheless people often choose not to enroll in Medicaid. One of the main explanations for this is the fact that it can be hard to find a doctor who will take Medicaid patients in some areas. If the MCOs were good at allowing (at least limited) access, individuals who were formerly not enrolling in Medicaid might now find it worth doing so. On the other hand, Medicaid eligibles who did not enroll for other reasons—for example, because they were in a brief

transition period and knew that they would not be eligible much longer—would not be likely to enroll simply because the MCO option was introduced.

c. How might this requirement affect overall access to care for Medicaid eligibles?

Managed care providers have an incentive to restrict access because they earn the same amount of money whether they provide no care at all or very comprehensive care. Since comprehensive care costs providers and no care doesn't, physicians may provide less access to care under the MCO plan. Furthermore, MCOs have an incentive to enroll as many participants as possible because each participant is a revenue source. As a result, more enrollees have to compete with each other for limited provider time and resources.

Offsetting this, the answer in b suggests that introducing MCOs is likely to attract individuals only insofar as it is better than traditional Medicaid, and the main weakness in traditional Medicaid is access to doctors. One might therefore think that MCOs would, in fact, enhance access to providers.

15. The current government-provided system in the country of Puceland provides free health insurance for all children but for no adults. There are two types of adults in Puceland: high earners and low earners. All the 100,000 high earners receive insurance coverage through their employer, but only half of the 100,000 low earners do. The remaining adults are uninsured.

You are hired to analyze the effectiveness of a proposed plan to offer coverage to all low earners. You have read the economics literature in Puceland and your best estimates are as follows: (1) only 80% of uninsured workers who are offered government health insurance will choose to enroll; (2) 60% of currently insured low earners work at firms that will drop insurance coverage for them after the policy change; the other 40% will remain in their current employer-provided plan; (3) 10% of high earners will choose to become low earners (at firms who do not offer health insurance) and take up the government insurance once they can get it.

a. Estimate the increase in the number of insured adults.

The 100,000 original high earners will remain insured, since the 10,000 (10%) who become low earners will still take up government insurance. Of low earners, 50% are currently uninsured, and 60% of the other 50% will lose their coverage through work when the program is introduced. Hence, 80% (= 50% + 50% × 60%) of low earners will get no employer-provided coverage once the policy change is enacted. About 80% of these 80% of low earners will actually take up government insurance, for a total of 64,000 low earners receiving government-provided insurance. An additional 20,000 low earners will remain covered through their employers (40% of 50,000). So there will be a total of 184,000 = 100,000 + 64,000 + 20,000 adults with coverage once the policy is put in place, an increase of 34,000 over the original 150,000.

b. Estimate the dollar cost per additionally insured adult. Why is it so much higher than $5,000?

The cost per additionally covered adult is ($5,000 × 74,000 workers)/34,000 or about $10,880 per additional adult. It costs more than $5,000 per adult because many of the 74,000 workers the government pays for are not newly insured—they were crowded out of employer-provided plans.

c. Suppose that, without access to any insurance, each adult has a 5% chance of dying in a given year. Access to government-provided health insurance reduces the chance to 3%, and access to employer-provided health insurance reduces it to 2%. If it costs the government $5,000 per year to provide health insurance to an adult, estimate the dollar cost of the program per life saved.

The total number of adults in employer-provided health plans is currently 150,000, with 50,000 uncovered workers. If the plan is enacted, 110,000 will be covered through their employer (10,000 fewer high earners and 30,000 = 60% × 50,000 fewer low earners); 74,000 will be covered through the government health plan; and 16,000 will have no coverage. The expected number of deaths without the policy change is

$$2\% \times 150{,}000 + 5\% \times 50{,}000 = 5500.$$

The expected number of deaths under the government plan is

$$2\% \times 110{,}000 + 5\% \times 16{,}000 + 3\% \times 74{,}000 = 5{,}220.$$

The policy change thus saves 280 lives. The total cost to the government is \$5,000 × 74,000 = \$370 million. Hence, \$370m/280 lives ≈ \$1.3 million/life is the cost per life saved.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 17

INCOME DISTRIBUTION AND WELFARE PROGRAMS

Questions and Problems

1. **As Table 17-2 shows, members of the poorest fifth of U.S. households have a much smaller share of total U.S. income than is typical in other developed countries. Does this mean that the poorest fifth of U.S. households are worse off in the United States than are the poorest fifth of households elsewhere? Why or why not?**

   The fact that the poorest quintile in the United States has a much smaller share of total U.S. income than does the poorest quintile in other countries establishes that the poorest fifth of households in the United States has very low relative wealth. As an absolute value, however, a small percent of U.S. total income is more than a larger percent of total income in many other countries. Thus, when measuring absolute levels of income, the poorest fifth of U.S. households is not worse off than the poorest fifth in other countries. There is evidence, though, that it is *relative* wealth, not absolute wealth, that determines well-being. Disparity in wealth (as would be the case in a country in which the lowest quintile had a very small share of total income) has been linked to worse health outcomes even when wealth levels are not low. People's perceptions of their own well-being may have more to do with how they compare to others than with their absolute income level.

2. **The U.S. federal government definition of poverty is the same in all communities around the country. Is this appropriate? Why or why not?**

   It is not appropriate to define the poverty line by the same dollar amount in all communities. The cost of living varies substantially across communities, across states, and among rural, suburban, and urban dwellers. One of the biggest contributors to this variance is the price of housing. Because housing (either rental or owned) tends to be such a large component of a family's budget, the disparity in prices means that very different amounts of money are needed to adequately support a family depending on where that family lives.

3. **Suppose there are two types of people in the country of Dipolia: unskilled people who value only food and skilled, lazy people who value only alcoholic drinks. The government of Dipolia is considering moving from a cash-welfare system to a food stamps system. The new system will provide the same benefit levels, but recipients will get stamps allowing them to buy food instead of cash. Explain how this change will affect the work efforts and utility levels of the two types of people in Dipolia. How would your answer differ if unskilled people valued both food and alcoholic drinks?**

   Under a cash-welfare system, skilled lazy people would face the trade-off between working and earning money to buy drinks and not working, enjoying more leisure, and receiving welfare to buy drinks. Depending on their productivity and their preferences, these workers may choose the latter. When the policy change is introduced, the trade-off changes: they can either work and earn money to buy drinks or they can not work and receive food. Since they do not like food, they are now more likely to choose to work; the labor supply of skilled

workers increases. Those who would have been on welfare before the change will be worse off as a result of the change since they can no longer be on welfare and drink. Unskilled workers faced the trade-off between working and earning money to buy food or being on cash welfare and using the cash to buy food. Depending on their productivity and preferences, they may or may not choose to be on welfare. When the policy change is introduced, there will be no change in their trade-off. They can either work or receive welfare for food. Their labor supply would not change.

On the other hand, if unskilled workers valued both food and alcohol, they could be made strictly worse off by the policy change, since they could no longer be able to purchase their optimal mix of goods.

4. Suppose that currently the government provides everyone with a guaranteed income of $12,000 per year, but this benefit level is reduced by $1 for each $1 of work income. The government is considering changing this policy so that the benefit level is reduced by $1 for every $2 of work income. What effect would this policy have on work effort? Explain your answer.

A dollar-for-dollar reduction in benefits is essentially a 100% tax rate, surely a substantial deterrent to working for many people. No worker who values leisure would ever take a job earning less than $12,000, since his effective wage is zero in that range. Similarly, it is unlikely that a worker would ever choose to earn slightly more than $12,000 since it would require substantial effort but increase his take-home pay to only slightly above the government guarantee. Hence, the government guarantee and the $1 for $1 benefit reduction system will lead to many potential workers choosing to supply no work effort. The new system will encourage these workers to increase their work effort by effectively reducing their tax rate by 50%.

The policy change will discourage the work effort of other workers. For workers who earned between $12,000 and $24,000 under the $1 for $1 reduction system, for example, the policy change will have two effects, both of which tend to reduce their effort. First, there is an income effect: these workers used to receive no support from the government, since the benefit reduction phased out at $12,000 in earned income. After the policy change, the benefit reduction doesn't phase out until $24,000. Hence, these workers begin to receive some government support after the policy change, increasing their total income. Since they value leisure, this income effect will lead them to reduce their work effort. Furthermore, because they now find themselves in the phase-out region, their effective tax rate increases to 50% (from 0%) under the policy change. This substitution effect also leads them to reduce work effort.

Furthermore, workers who earned slightly more than $24,000 before the policy change may also be induced to reduce—but never to increase—their work effort: the slower phase-out makes earning amounts between $12,000 and $24,000 more appealing. For example, a worker earning $25,000 under the old system could reduce pretax earnings to $23,000 and would now receive $500 in government support, making the reduction in work effort more appealing.

5. Senator Ostrich suggests that "in order to end poverty, all we need to do is pay everyone making less than the poverty line the difference between what they are earning and the poverty line." Ostrich argues that, based on the set of people currently below the poverty line, this would cost $98 billion per year. Why is Ostrich understating the costs of this program?

Eliminating poverty is more expensive than Senator Ostrich makes it out to be because he has not accounted for Okun's "leaky bucket" costs. There are costs to administer and monitor any program, including one as simple as Senator Ostrich's—an agency must deter-

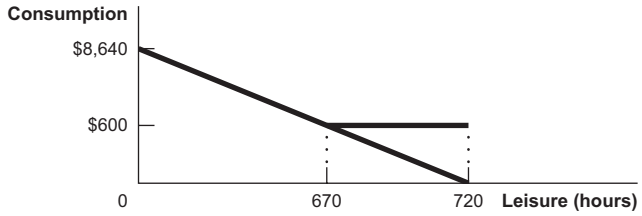
mine who is eligible, monitor eligibility, and distribute the benefits. A second "leaky bucket" cost is associated with the work-incentive effects imposed on those who will be taxed in order to raise that $98 billion. When income taxes increase, labor yields a lower net return, and consequently leisure costs less in terms of opportunity costs. These effects may result in reduced work hours among those who would be taxed to fund this program, reducing overall productivity. The third cost that must be considered is the incentive effects among potential recipients. The availability of benefits such as those proposed may induce some people to work less to qualify for the benefit. While this disincentive effect is different from the one associated with the nonbeneficiaries, it yields the same result: a decline in productivity. In addition, it makes the program more costly by making more people eligible for benefits.

6. An individual can earn $12 per hour if he or she works. Draw the budget constraints that show the monthly consumption–leisure trade-off under the following three welfare programs.

In each graph, assume that a person can work at most 24 hours per day times 30 days per month for a total of 720 hours. Thus, the axis intercepts, in the absence of any program, are 720 × $12 = $8,640 in consumption and 720 hours of leisure.

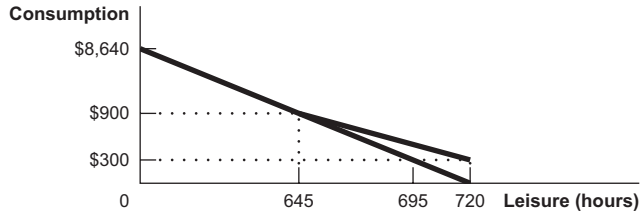
a. The government guarantees $600 per month in income and reduces the benefit by $1 for each $1 of labor income.

The equivalent of $600 of income is 50 hours of labor (at the $12 wage) or 720 – 50 = 670 hours of leisure.



b. The government guarantees $300 per month in income and reduces that benefit by $1 for every $3 of labor income.

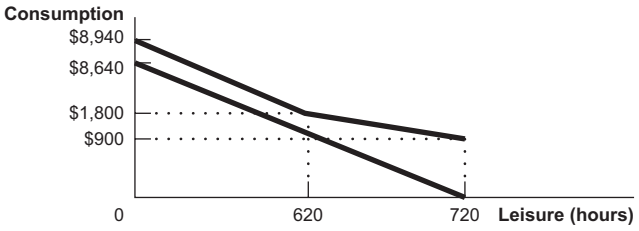
The equivalent of $300 of income is 25 hours of labor or 695 hours of leisure. The entire $300 guarantee would be eliminated after the recipient earned $900 or worked 900/12 = 75 hours, which yields 720 – 75 = 645 hours of leisure.



c. The government guarantees $900 per month in income and reduces that benefit by $1 for every $2 in labor income, until the benefit reaches $300 per month. After that point, the government does not reduce the benefit at all.

This program yields a wage rate of $6 per hour up to 100 hours of work per month. The reduction ends after $600 is deducted, which occurs at 100 hours per month (100 × 6

= $600). Wages are 100 × $12 = $1,200, plus benefits of $300, for total consumption of $1,500 and 720 – 100 = 620 hours of leisure. At greater than 100 hours, the new budget line parallels the baseline $12 per hour line but is $300 higher. As a result, the new *y*-intercept is $8,640 + $300 = $8,940.



7. Suppose that you wanted to test the hypothesis that welfare benefit generosity induces people to become single mothers.

a. Which population would you choose to study in answering this question?

The only population that would be able to engage in this moral hazard behavior would be women of childbearing and child-rearing age; thus, the population would include married and unmarried females from their teens through perhaps their fifties. While women in their late forties and older are unlikely to become mothers, they may become single in response to this generosity.

b. How would you use variation in welfare benefits to estimate the impact of welfare on single motherhood?

State-by-state variation in benefits allows for a quasi-experimental approach to this question. It would be even better if there were variation over time in some states so that a difference-in-difference approach could be used. In either approach, you could investigate relationships between benefit generosity and births to single women and between benefit generosity and divorce rates among couples with children. Positive correlations between these pairs of variables (that is, states with higher-than-average benefits also have relatively high single-mother birth rates and relatively high divorce rates among parents) would tend to support the hypothesis. It would be more convincing if other possible explanations did not differ between high- and low-benefit states. For example, if divorce rates generally were similar but parents were more likely to divorce in high-benefit states, it would suggest that parents were divorcing to obtain benefits.

c. How would you know whether welfare benefit generosity influences single motherhood?

You would not know for sure, but you could infer causality if the evidence described in b were very strong, both in terms of the size of the differences and the statistical significance of those differences. A difference-in-difference approach could help to eliminate general trends in single parenthood as an explanation.

8. Several recent studies have documented a "race to the bottom" in welfare benefit levels, whereby states respond to their neighbors' benefit reductions with reductions in their own welfare generosity. Why might a state respond to its neighbors' change in generosity?

If adjacent states have very dissimilar levels of generosity, some families might move from the less-generous state to the more-generous state, putting a larger burden on taxpayers of the generous state. Residents of the generous states may begin to resent those whom they see as "border hoppers," people who are taking advantage of their states' benefits, and they

will pressure their legislatures to reduce benefits. Thus, if one state lowers its benefits, surrounding states will be pressured to do the same.

9. The Earned Income Tax Credit (EITC) provides a cash subsidy for every $1 earned by those with incomes below $33,700 per year. How might the EITC raise an individual's overall work effort? How might the EITC lower an individual's work effort?

The EITC increases wages for some, increasing their return to working and thus increasing the cost of leisure; not only do these workers earn a wage, but they receive a bonus, in the form of the EITC, on top of that wage. Because the EITC is available only as a subsidy for earned income, it specifically rewards work effort, thus tending to increase it for those who qualify for the benefit. Offsetting this effect is an income effect that tends to reduce work effort. The EITC programs increases the total income of any worker with positive earnings less than $33,700. This increase in income will tend to lead them to enjoy more leisure time—to reduce their labor supply. A similar effect is possible for workers who would earn slightly more than $33,700 in the absence of the EITC. These workers may choose to work slightly less when the EITC is put in place so that they can qualify for some EITC benefits and enjoy more leisure.

10. An issue that arises when designing a welfare system is whether to make the benefits available to all low-income families with children or only to families headed by a single mother. Explain the trade-offs involved in this decision.

The advantage of targeting benefits to single mothers only is that it helps to circumvent the iron triangle. Single mothers are a group with particularly low earning capacities, and other families cannot become single-mother families easily (or at all). This means that this needy group can be targeted with relatively little moral hazard and hence lower costs. There are, however, some disadvantages. For example, this policy could increase the rate of single motherhood because it provides a monetary incentive for couples with children to break up, a potentially undesirable outcome. Also, in the absence of moral hazard, low income is the best indicator of need. This targeted policy leaves some other families who are in just as much need without support.

11. Consider the major changes in the welfare system that occurred in the 1996 welfare reform, described in section 17.5. Which of these changes are likely to reduce the number of people on welfare? Which of these changes are likely to increase the number of people on welfare?

Many of the changes in the welfare system have already reduced and may continue to reduce the number of people receiving welfare. The way welfare programs are now funded encourages states to reduce welfare payments. Under the old system, the federal government helped states pay their actual benefit costs. As a result, the old system gave more federal dollars to states that paid the most in benefits. Under the current reforms, states receive block grants from the federal government to help finance their welfare programs, allowing states to save money if they spend less in benefits: reducing benefits does not reduce the amount of federal money they receive. Since one way to reduce benefits paid is to move people off the program, this funding mechanism may encourage states to reduce their welfare population.

Time limits will also, almost by definition, reduce the number of people in the program. Once a person has exhausted her eligibility, she will be removed from the program, which reduces the number of beneficiaries. It is not clear, however, what happens to people when they lose eligibility this way as opposed to becoming ineligible because they were successful in finding a job.

Work or education and training requirements may reduce the number of beneficiaries for two reasons. First, effective training and work experience will allow participants to move

into better-paying jobs so that they do not need to be in the program. Second, requiring work or school may deter some people from taking advantage of the program because they may not want to meet these requirements. On the other hand, if training programs or related services, such as subsidized child care, are seen as additional benefits, some people may seek eligibility in order to obtain them, thus increasing the welfare rolls.

Some of the provisions of the reform are directly aimed at discouraging unwed motherhood, including requirements that teenagers stay in school and that mothers name the fathers of their children, and capping benefits so that additional children do not increase benefits. This reform seems less likely to reduce the number of welfare beneficiaries. Rates of single parenthood are increasing across age, race, and income levels, not just among poor teenagers. If this phenomenon is a real cultural shift, then welfare reform seems to be a very weak tool for stopping it. Furthermore, some women become single mothers because they lose a spouse or must leave an abusive one. Reforms that are tied to preserving these families will fail.

12. Congressman Snowball, having read Chapter 11 of this text, informs his colleagues that people who have higher levels of education have higher earnings capacities. He argues, based on Chapter 17, that one way to reduce the moral hazard of welfare is to pay larger benefits to those with limited earnings capacities. Therefore, according to Congressman Snowball, a way to accomplish this would be to provide large welfare payments to poorly educated Americans. Does this eliminate moral hazard?

This proposal shifts the moral hazard from deterring work effort to deterring education. Moral hazard is a risk whenever the condition or event that confers benefits is in the control of the potential recipient. Giving large welfare payments to people who drop out of high school seems like a very bad idea, because it would reward behavior that is completely in the control of the recipient. Furthermore, the behavior being encouraged is one that undermines productivity, so it would be bad for society as a whole. In addition, many of the individuals who would be able to change their behavior in order to take advantage of the benefit are teenagers: high school students who could drop out in order to be poorly educated Americans. They may be less able than adults to perceive the long-term costs of limiting their education.

Advanced Questions

13. The Women, Infants, and Children food assistance program provides needy families with easily identifiable coupons good for very specific types of food, although in most states the food stamp program provides recipients with an Electronic Benefit Transfer (EBT) card that looks and works very much like a standard debit card. Which program is more likely to surmount the problem of the iron triangle? Explain your answer.

The "iron triangle" is the problem faced by policy makers who wish to establish a program that (1) does not provide a disincentive to work, (2) redistributes income, and (3) does not increase costs. It is hard to imagine a program that cost effectively redistributes income without having a disincentive effect on work effort. But one potential solution to the iron triangle problem is to use ordeal mechanisms, such as food stamps, to make the program less attractive, particularly to those who do not need it as much. The Women, Infants, and Children (WIC) program appears to be better able than the EBT card program to do so.

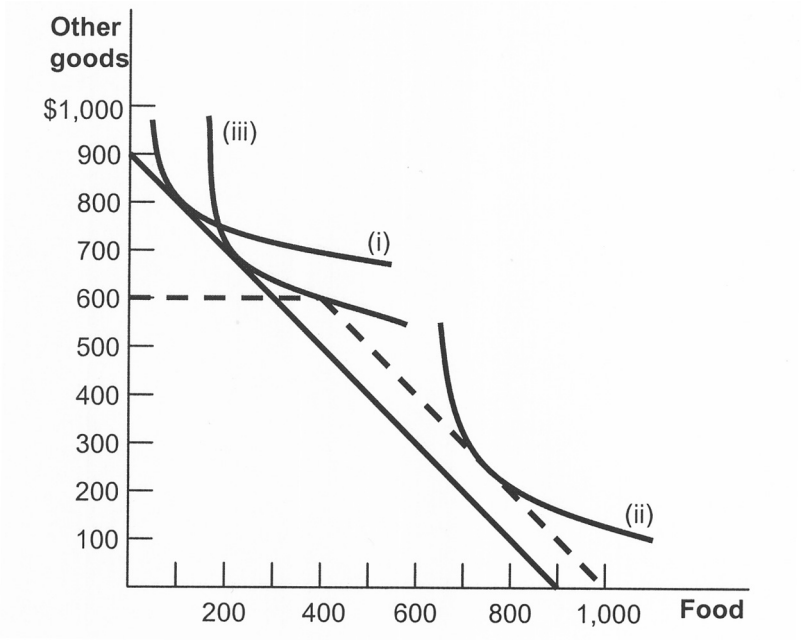
14. The Personal Responsibility and Work Opportunity Reconciliation Act of 1996 imposed limits on the amount of time that a family could receive cash welfare payments during its members' childhoods. Grogger and Michalopoulos (2003) found that these

time limits led to immediate reductions in the number of people receiving welfare benefits, even though nobody in the family had reached his or her time limit. Which group of families should be particularly sensitive to the introduction of these time limits: those with younger children or those with older children? Explain your answer.

You would expect that parents of younger children would be more concerned about "timing out" of welfare eligibility because they have a longer exposure time. Parents of older children may not be as worried about time limits because their children will be grown, or close to it, before the time limit sets in. In addition, because parents of younger children have many more years during which they may need assistance, they may wish to save some of those years of eligibility to use in the future.

15. Jackie spends her money on food and all other goods. Right now, she has an income of $600 per month. Compare two alternative welfare programs in which she could participate: program A would provide her with a monthly check of $300 and program B would provide her with $400 a month in credits that can be spent only on food.

a. Draw Jackie's budget constraints in each of these two cases.



The solid line in the figure shows Jackie's budget constraint with a $300 cash grant (program A). The grant, combined with her $600 income, allows her to buy $900 worth of food and other goods in any combination that totals $900. The dashed line shows Jackie's budget constraint with a $400 food subsidy (program B). Jackie has only $600 to spend on all other goods, but if she chooses to spend it all on food, she could buy $1,000 worth of food. More likely, Jackie will choose some combination along this line.

b. Draw representative indifference curves that would reflect each of these three scenarios (see the graph in a).

(i) Jackie prefers program A to program B.

The indifference curve labeled (i) is consistent with preferences that favor the cash grant over the subsidy.

(ii) Jackie prefers program B to program A.

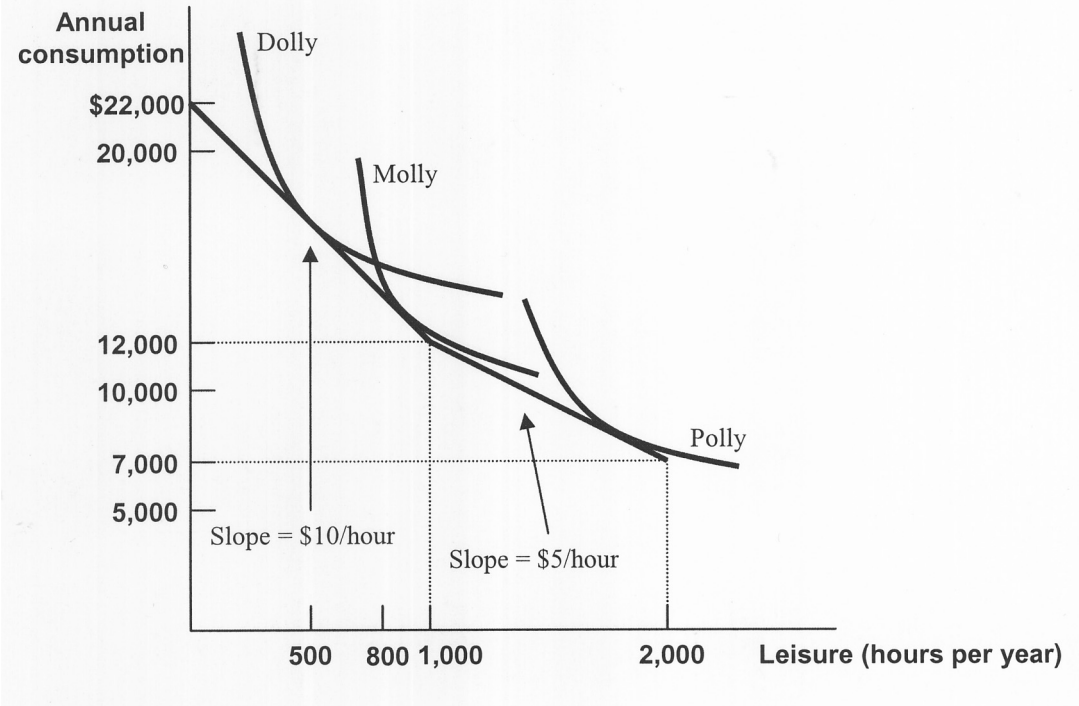
The curve labeled (ii) is consistent with preferences that favor the larger in-kind subsidy. The (ii) preferences are heavily weighted toward food: this person wishes to spend the lion's share of her budget on food, so a food subsidy of $400 is worth more to her than $300 in cash.

(iii) Jackie is indifferent between the two programs.

The indifference curve labeled (iii) indicates someone who is exactly indifferent between a $300 cash grant and a $400 in-kind subsidy. With the $300 check program, the individual with these preferences works more and gets to consume about $700 worth of "other goods" and less than $400 in food. The $400 food-only program induces the worker to consume only $600 of other goods and $400 in food. There is a trade-off between these two options: the latter option involves more total consumption, but the former option has a more desirable balance between the two types of good. The indifference curve indicates that the worker is indifferent to this tradeoff.

16. Polly, Molly, and Dolly are all single mothers. They each can earn $10 per hour working for up to 2,000 hours per year. Their government runs a welfare system that gives income benefits of $5,000 per year for single mothers with no income. The welfare benefits are reduced by $1 for every $2 in earned income. Currently, the government also provides free health care for children of single mothers with less than $25,000 in income. Each mother values this benefit at $2,000 per year. Under this system, Polly works 200 hours per year, Molly works 1,025 hours per year, and Dolly works 1,500 hours, so only Polly receives welfare.

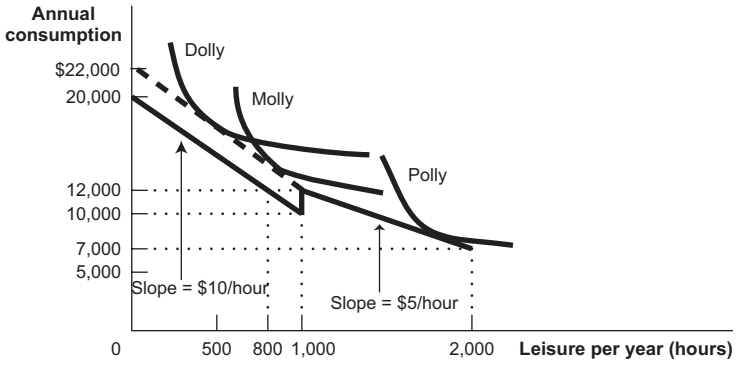
a. Draw the set of hours worked and consumption combinations that these mothers face (carefully labeling the slopes of the budget constraint). Draw a representative indifference curve for each mother.



b. In an effort to save money, the government decides to cut back on insurance provision. It dictates that to receive free health care for their children, single mothers will henceforth have to be on welfare. On a new set of axes, draw the new budget

constraint for the three mothers. Describe what will happen to the number of hours each mother works.

This policy change lowers the effective income of any mother not on welfare by $2,000, since it gets rid of $2,000 in medical insurance. This shifts the steeper portion of the budget constraint down to the dark line depicted in the following graph. Polly will be unaffected by this policy change since she was already on welfare. Molly will no longer find it optimal to earn $10,500 since she can get $12,000 worth of benefits by working just fewer than 1,000 hours and qualify for welfare and the $2,000 insurance benefit. By doing so, she would enjoy more consumption *and* more leisure. It is hypothetically possible that Molly would actually choose to work more than 1,200 hours after the change (e.g., with very strong preferences for more than $12,000 in income) but it is likely that she would reduce her hours worked to just below 1,000. Dolly, on the other hand, will certainly increase her labor supply in response to this policy change: since this policy change effectively makes her poorer, she consumes less leisure.



17. Consider the following welfare program, designed to ensure that needy people get adequate income to buy food. The government offers cash assistance to any worker earning more than $100 and less than $980, according to the following schedule.

Income	Cash Assistance Received
$100	$264
$200	$234
$300	$204
$400	$174
$500	$144
$600	$114
$700	$84
$800	$54
$900	$24
$980	$0

There are two types of consumption goods, food (*F*) and "other" goods (*X*), and people have utility functions

$$U = \tfrac{1}{3}\ln(F) + \tfrac{2}{3}\ln(X)$$

over these goods. The prices of food and other goods are both normalized to 1; therefore, the budget constraint is

$$F + X = Y$$

a. Determine the optimal levels of food and other-good consumption for an individual with earned income of $300.

A worker with $300 in earned income gets $204 in cash assistance for a total of $504. The worker's maximization problem is

$$\max \tfrac{1}{3}\ln(F) + \tfrac{2}{3}\ln(X) \text{ subject to } F + X = 504.$$

Rearranging the budget constraint gives $F = 504 - X$. Plugging this into the maximand, taking a derivative, and setting it to zero gives

$$-\tfrac{1}{3}\frac{1}{504 - X} + \tfrac{2}{3}\frac{1}{X} = 0, \text{ or } X = 2(504 - X).$$

Solving gives $X = 336$. Hence, $F = 168$.

b. Now consider replacing the cash-welfare program with a food stamps program. Instead of receiving the cash amount indicated in the table above, workers would receive an equal amount of stamps that they could spend only on food. Determine the optimum level of food and other-good consumption for the individual with $300 in earned income. Does this make the individual better or worse off than the cash welfare system?

One option is for the worker to consume $204 in food and $300 in other goods. As determined in a, the worker would *rather* consume $36 more in other goods and $36 less in food. But because he cannot exchange food stamps for other goods, he is best off consuming as many "other goods" as he can. Hence, $204 in food and $300 in other goods is his best option. This makes him worse off than in a; one can see this by computing utilities or simply by noting that he could have chosen this combination in a but did not.

c. Repeat a and b for an earned income of $900 and explain any differences in outcomes.

The worker's maximization problem is now:

$$\max -\tfrac{1}{3}\ln(F) + \tfrac{2}{3}\ln(X) \text{ subject to } F + X = 900 + 24.$$

Rearranging the budget constraint gives $F = 924 - X$. Plugging this into the maximand, taking a derivative, and setting it to zero gives:
and solving gives $X = 616$. Hence, $F = 308$.

$$-\tfrac{1}{3}\frac{1}{924 - X} + \tfrac{2}{3}\frac{1}{X} = 0, \text{ or } X = 2(924 - X).$$

Since 308 is more than 24, this combination of food and other goods is still possible when he receives $24 in food stamps instead of in cash. The worker can use the food stamps and an additional $284 of her income on food and achieve the same consumption and utility as if she would if she were given $24 in cash.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 18

TAXATION IN THE UNITED STATES AND AROUND THE WORLD

Questions and Problems

1. The nation of Fishkasar has a tax rate of 10% on the first 20,000 walops (the national currency) of taxable income, then 25% on the next 30,000 walops, then 50% on all taxable income above 50,000 walops. Fishkasar provides a 4,000-walop exemption per family member.

a. Jamil's family has three members and earns 50,000 walops per year. Calculate the family's marginal and average tax rates.

The first step is to compute Jamil's family's taxable income: before exemptions, its income is 50,000. It gets a 4,000-walop exemption for each of the three family members, for a total of 12,000 in exemptions. Hence, taxable income is 50,000 – 12,000 = 38,000. Since this is between 20,000 and 50,000, the family faces a 25% marginal tax rate.

To compute the average tax rate, first compute the total tax liability. The first 20,000 of taxable income is taxed at 10%. The next 18,000 is taxed at 25%. The total tax is thus $.1 \times 20{,}000 + .25 \times 18{,}000 = 2{,}000 + 4{,}500 = 6{,}500$. The average tax rate is thus $100\% \times 6{,}500/50{,}000 = 13\%$.

b. Boba's family has five members and earns 85,000 walops per year. Calculate the family's marginal and average tax rates.

Boba's family's taxable income is $85{,}000 - 5 \times 4{,}000 = 65{,}000$. This is greater than 50,000, so the family is in the 50% marginal tax bracket. The family's total tax liability is $.1 \times 20{,}000 + .25 \times 30{,}000 + .5 \times 15{,}000 = 17{,}000$. Its average tax rate is thus $100\% \times 17{,}000/85{,}000 = 20\%$.

c. Suppose that Fishkasar changed its tax code to a flat tax of 30% with an 8,000-walop per family member exemption. Would this change in the tax system make the system more progressive, more regressive, or neither?

The flattening of the marginal rate schedule tends to make this change less progressive. Indeed, the flat 30% marginal rate structure is not progressive at all: any two families with positive taxable income will face the same marginal tax rate, regardless of their income. On the other hand, the increase in the per-family-member exemption tends to make the average rates more progressive. For simplicity, consider two single-member households with incomes of 8,000 and 12,000 walops, respectively. Under the old system, the first would have an average tax rate of 400/8,000 = 5% and the second would have an average tax rate of $800/12{,}000 \approx 6.67\%$, so the tax is system was slightly progressive in this income range. Under the new system, the first would have no tax liability and hence a 0% average tax rate; the second would have an average tax rate of $30\% \times 4000/12{,}000 = 10\%$. So the new system is more progressive in this income range.

2. What is the rationale behind having an Alternative Minimum Tax?

The Alternative Minimum Tax (AMT) was a political response to publicized reports that, owing to loopholes and other provisions of the tax code, some very wealthy people were paying no income taxes. Some argue that wealthier taxpayers are better able to shield income from taxability because they can afford to hire accountants and are better positioned to sacrifice liquidity in some of their income. As a result, they can invest more of their income in ways that increase tax deductions. The AMT counters these advantages by requiring wealthy taxpayers to calculate their taxes based on an alternative schedule and to pay the taxes if they exceed the tax liability calculated under the regular schedule.

3. Suppose that the U.S. personal income tax system became a "flat tax" system, in which all taxpayers paid a certain percentage of their incomes in tax, and in which there are no exemptions or deductions. In which way(s) could this flat tax be more *regressive* than the present U.S. system? In which ways could it be more *progressive* than the present system?

On its face, this tax is more regressive than the current system because poorer taxpayers would pay exactly the same marginal tax rate as wealthier taxpayers. This system might be more progressive than it looks, however, given the elimination of exemptions and deductions. Wealthier taxpayers would lose their home interest deductions, tax-preferred savings mechanisms, and other benefits; wealthy entrepreneurs would lose their business expense deductions. The antiprogressive nature of tax deductions—the fact that deductions are more valuable to high-bracket taxpayers—would end. As a result, some wealthier taxpayers may be more harmed by this change than the less wealthy.

4. Why should casualty losses or large medical expenditures be fully tax-deductible only under certain circumstances?

The justification for allowing deductions for casualty losses or large medical expenditures is based on the idea that people should pay taxes based on their ability to afford them. According to the Haig-Simons definition of income, only income that increases a person's ability to consume should be taxed. Catastrophic losses reduce a person's ability to consume and so, out of fairness, should reduce their tax liability. In some cases, however, expenditures on medical care might represent utility-increasing consumption. A person who obtains nonessential medical care, such as cosmetic procedures, has actually increased consumption.

In some cases, casualty losses should not be fully deductible under the Haig-Simons measure either. Some casualty losses are not random but rather are part of the expected cost of living in a particular location. Parts of Florida are prone to hurricane damage; parts of California are susceptible to earthquake damage. Those are known risks and so tend to reduce the price of property in those locations. Thus, property owners in these areas have already had their consumption increased because their housing costs are lower than the costs of identical housing in low-risk locations. Realization of the known risk simply offsets the increased ability to consume.

Expenditures for medical care or casualty loss should be fully tax-deductible only when they are unexpected, not voluntary or controlled by the recipient, and do not increase consumption.

5. Many employers sponsor "cafeteria" plans. These plans allow employees to have some of their earnings put into an account that can be used for medical expenditures incurred in that tax year. The income put in this account is not considered part of the individual's tax base. In what ways is it desirable to exclude this income from the tax base? In what ways is it undesirable?

The Haig-Simons definition of income states that any benefits that increase the ability of an individual to consume should be included in taxable income. Most medical expenditures

probably fall into this category. (For an obvious example, the money in the account could be used to purchase designer eyeglasses. Even "real" medical goods such as sleep aids or heartburn medications are a form of consumption, however.) On the other hand, there are some medical expenditures that should not be included in taxable income, according to Haig-Simons. These include medical care for acute or chronic job-related injuries. For example, expenditures on treatment for repetitive strain injuries resulting from working a job should not be included in taxable income since these expenditures are required to bring well-being back up to the level it would have been without working the job.

Health-related expenses may also yield positive externalities, an additional reason to subsidize these expenditures. One way to subsidize them is to exclude them from income taxation, as is accomplished by cafeteria plans.

6. Professor Slither attended the Antarctic Economic Association meetings. She is able to fully deduct from her taxes the hotel expenses that she incurred, but can deduct only half of the meals expenses that she incurred. Why does the U.S. tax code make this distinction? Does this tax policy make sense, from a Haig-Simons perspective?

Business deductions for meals were the target of a lot of negative publicity, resulting in a political response to limit them. The perception was that people were wining and dining at the taxpayers' expense. A Haig-Simons perspective would consider business expenditures to be legitimate deductions from taxable income to the extent that they reduce the taxpayer's ability to voluntarily consume. Given this view, allowing full deductibility for hotel expenses but not meals makes some sense.

A person does not reduce his or her housing expenses by staying in a hotel on a business trip. The mortgage or the rent at home must still be paid, so this business expense is in addition to the individual's base consumption of housing and thus reduces his or her ability to consume. In addition, for many people, staying in a fancy hotel on a business trip can be a treat, increasing utility. To the extent that the hotel provides greater utility for the traveler than staying home would, perhaps it should be included. This, of course, would be impossible to calculate.

Meals, on the other hand, replace consumption that people would have had to provide if they were not on a trip. Because they would have had to eat regardless of the trip, this expense does not reduce other consumption dollar-for-dollar.

7. Ed and Wendy are a married couple with no children. Each earns $75,000 per year, and their combined household adjusted gross income is $150,000. John and Kristen also have $150,000 in combined household adjusted gross income and no children. However, Kristen earns all of the income; John does not work.

a. Use the 2006 tax rates for married couples filing jointly described in Chapter 18 to compute how much income tax each couple owes. Assume that both take the standard deduction.

Each family has an exemption of $3,300 per person, or $6,600 total. The standard deduction is $10,300 for married couples. Hence, each family has a taxable income of $150,000 – $6,600 – $10,300 = $133,100. They pay a 10% tax on the first $15,100, 15% on the next $46,200, 25% on the next $62,400, and 28% on the remainder ($9,400), for a total of $26,672.

b. Does either couple pay a "marriage tax?" Does either couple receive a "marriage benefit?" [Note: To answer this question, you will need to look up the 2006 tax rates for single individuals. These can be found on the IRS Web site http://www.irs.gov/formspubs.]

Ed and Wendy each earn $75,000. If they were single, they would have taxable income of $75,000 – $3,300 – $5,150 = $66,550. Referring to the 2006 income tax rate

schedule from the IRS, they would each pay a 10% tax rate on the first $7,550 of taxable income, 15% on the next $23,100, and 25% on the remainder ($35,900). Hence, they would each pay a tax of $13,195 for a total of $26,390. Ed and Wendy therefore pay a small marriage tax—their total tax liability would be slightly smaller if they were single.

If John and Kristen were single, only Kristen would pay any tax. Her taxable income would be $150,000 – $3,300 – $5,150 = $141,550. She would pay a 10% rate on the first $7,550, a 15% rate on the next $23,100, a 25% rate on the next $43,550, and a 28% rate on the remainder ($67,350). Her total tax would therefore be $33,965.50. Hence, John and Kristen receive a substantial marriage benefit.

8. Chapter 7 argued that private provision of public goods is inefficiently low, and that subsidization can help attain the optimal level of public goods. Why might offering tax breaks for public goods provision be an inefficient method of bringing about this goal?

Allowing a tax deduction for contributions to public goods reduces the price of providing the goods relative to the price of private consumer goods. This mechanism would tend to offset the natural tendency of private markets to underprovide public goods. The way this system works, however, does not assure that public goods will be privately provided efficiently. Each contributor decides which specific public good will be provided and to what extent. Because deductions are more valuable the higher the taxpayer's marginal tax rate, the public goods most preferred by high-earning taxpayers will be the ones provided by this system. There is no mechanism for assuring that public goods preferred by most taxpayers, as opposed to the wealthiest taxpayers, will be provided. Of course, we do not worry in private markets that the wealthiest have the most choice, but in those markets expenditures are not made with government-subsidized money.

9. Your roommate and you had identical high school grade point averages and SAT scores. In many respects, one would expect that you would be equally successful. But because you chose economics as a major and your roommate chose geology, you will be paying a larger amount of tax in the future than your roommate will because your income will be higher. Is this attribute of the tax code vertically equitable? Is it horizontally equitable?

Vertical equity requires that the person with the higher income pay the higher tax. If the economics major earns more than the geology major, then according to this principle the economics major should pay the higher tax. Horizontal equity requires that people with similar ability to pay should pay the same tax. In this case, measuring ability to pay solely by salary, they should pay different tax amounts. The difference in salaries, though, was generated solely by the choices the roommates made, presumably with information about the expected return to different majors.

An argument could be made that any difference in their salaries is attributable to compensating wage differentials: the lower-wage major receives nonmonetary satisfaction from his or her job sufficient to offset the monetary wage difference. In other words, total compensation to the two majors (monetary plus nonmonetary) must, by definition, be equal. Any difference in monetary wage is made up in nonmonetary amenities. That argument supports the claim that this difference in tax liability is inequitable, as taxes are levied only against monetary wages.

10. The government of Utopia plans to offer a transportation tax credit in which families receive a share of their expenditures on transportation to and from work or school as a reduction in their tax bill. Utopia is considering two forms of this tax credit, one that

is fully refundable and one in which the tax credit is limited to the amount of taxes the family pays. Which form of the tax credit is more progressive? Explain.

It is more progressive to allow for a refundable tax credit than to limit the credit to taxes actually paid. Unless a tax credit is fully refundable, families whose incomes are so low that they do not owe any income taxes do not receive the credit. Critics of refundable tax credits might claim that it isn't a tax refund if you haven't paid taxes in the first place, but this is not quite correct. Everyone pays some taxes, whether in the form of sales taxes when they purchase goods or in the form of increased prices when taxes are passed through to the consumer. Thus, a fully refundable tax credit sent to families who have not paid income taxes will offset other taxes they have paid.

11. Suppose that the government adopts a Haig-Simons comprehensive income definition. Will this make employers more likely or less likely to offer employer-provided pension plans or health insurance coverage? Why?

Adoption of the Haig-Simons definition would require inclusion of employer-provided benefits in taxable income because these benefits increase employees' ability to consume. Taxation of these benefits would make them less attractive to workers, so employers would not be able to substitute benefits for wages as easily as they do now. As a result, employers would be less likely to offer the benefits.

On the other hand, even if the benefits were taxed, employers may be able to provide them more efficiently—and thus, more cheaply—than employees could obtain them in private markets. If it were cheaper to obtain group health insurance through an employer than it would be to purchase private insurance in the market, even when the benefit is taxed, then workers might remain willing to trade off higher wages for more benefits. And the total cost of hiring a worker may be less for the firm offering the benefits, in which case some employers would still provide the benefits.

Advanced Questions

12. Your employer allows you to purchase a parking permit with "pretax dollars"—that is, you don't have to pay taxes on the money that you used to purchase this permit. Does allowing some people to purchase certain goods or services using pretax dollars increase or decrease equity in the U.S. tax system? Explain.

Allowing some people, but not everyone, to purchase goods with pretax dollars decreases equity in the tax system. These plans allow employees to have money deducted from their wages and placed into an account to be used for specified purposes. Money placed in these accounts is not included in taxable income, increasing the net income received by people whose firms use these accounts. Parking, medical copays, child care, and other expenses can be paid for with pretax money. These accounts allow people who use them to spend more money on other things and provide a subsidy for some of the expenses they do incur. Thus, some consumption is not included in the tax base, violating the Haig-Simons definition. Furthermore, horizontal equity is violated: people who have these plans at work pay less in taxes than do people who have the same income but do not have the plans.

13. Oregon has an income tax but no state sales tax, while Washington has no state income tax but does have a state sales tax. Oregon residents can deduct the state taxes they pay (the income tax payments) from their federal income taxes, while Washington residents cannot deduct the state taxes they pay (the sales tax payments). What are the equity implications of this difference?

Consider two people with the same earnings and spending patterns, one of whom lives in Washington and one of whom lives in Oregon. The income taxes paid in Oregon are de-

ductible from federal income taxes, but the sales taxes paid in Washington are not. Oregonians will therefore pay less federal tax, all else equal, than will Washingtonians. This is not horizontally equitable.

Partly offsetting this horizontal equity concern is the fact that people choose whether to live in Oregon or Washington, so the equity issues are less pressing than if taxes were inequitable based on some factor over which people have no choice. Furthermore, markets adjust for these differences. People know—or could know— this essential difference between the two states and the implications for federal tax deductibility when choosing where to live. Housing prices and other cost-of-living components may have been adjusted to account for this apparent inequity already. For example, if the absence of sales tax has made Oregon a more desirable state of residence, then that difference should already be reflected in higher housing prices in Oregon. If this is the case, then being able to deduct income taxes in Oregon may simply offset the difference in the cost of living there.

14. Suppose a researcher compared charitable contribution levels across counties and found that, all else equal, counties with higher home-ownership levels have higher levels of charitable contributions. Give an explanation of this finding that draws on the U.S. personal income tax code. Can you think of a reason this estimated relationship might not, in fact, be an effect of the tax code?

Charitable contributions are cheaper for households that itemize their tax deductions rather than taking the standard deduction since only itemizers get to take advantage of the tax deductibility of donations to charity. Filers with houses will typically have quite a bit of (deductible) mortgage interest and will therefore be more likely than non–home owners to itemize their deductions. This suggests that home owners would tend to find charitable contributions cheaper, on average, than renters, accounting for the observed relationship.

This relationship could be biased, however. Based on the "all else equal" statement, we can assume that the relationship is found even when taking into account things like education and income, but there may be other, unobservable factors that would lead to both relatively high levels of home ownership and high levels of charitable contributions in some counties and relatively low levels of both in other counties, even if the tax code did *not* have this feature. For example, some counties may have a large fraction of "transient" workers—workers who move frequently; other may have a more sedentary work force. Transient workers are less likely to purchase homes and are also less likely to be involved in the community to the point of making local charitable contributions. Nontransients are more likely both to own homes and make local charitable contributions. This would lead to the observed correlation between homes and contributions even if the tax code were not structured to induce this relationship.

15. You are interested in estimating the effects of tax breaks on the level of charitable contributions. How could observing changes over time in tax rates and associated charitable contribution levels help you to distinguish between marginal and inframarginal effects of the tax break?

Any time marginal tax rates change, the price of making a charitable contribution changes. In times of high marginal tax rates, it is relatively cheaper to make a contribution; in times of low marginal tax rates, the price of a charitable contribution is closer to the price of other goods. The issue of marginal versus inframarginal effects has to do with whether decreasing the price of giving actually encourages new contributions or simply makes existing levels of giving cheaper. The government would like to spend its money inducing new behavior (marginal effects); subsidizing behavior that would have occurred anyway (inframarginal effects) is wasting tax dollars.

Contributions made at the time of the lowest historical tax rates would indicate the extent to which people donate when the price of donating is fairly high. Comparing those con-

tributions with contributions made when the marginal tax rates were higher (and thus the price of giving was lower) would provide a measure of the price elasticity of charitable contributions. If charitable contributions went up substantially when marginal tax rates increased, you could conclude that contributions are price elastic. In that case, marginal effects would be large (although there would be some subsidization of contributions that would have happened anyway).

16. The largest tax break for most Americans is the mortgage interest tax deduction, which allows home owners to deduct from their taxable income the amount of money they pay in interest to finance their homes. This tax break is intended to encourage home ownership. Compare this tax deduction to a uniform tax credit for home ownership on equity and efficiency grounds.

The more expensive the home, the larger the mortgage; the larger the mortgage, the bigger the deduction. Compounding this effect is the tendency for wealthier people to live in larger, more expensive homes and face a higher marginal tax rate. Therefore, both the size and the marginal value of the mortgage deduction are higher for wealthier taxpayers. This is in direct contradiction to vertical equity.

Deductions favor high tax bracket taxpayers because they reduce the base on which taxes are calculated. Sometimes a deduction can drop the base to a lower tax bracket. Even if it doesn't reduce the taxpayer's marginal rate, it reduces the number of dollars to which that taxpayer's highest bracket applies.

In contrast, tax credits benefit all taxpayers equally by reducing the taxpayers' tax liability dollar for dollar. As a result, tax credits do not disproportionately benefit high tax bracket payers. In addition, making the credit uniform avoids the problem of providing the largest subsidies to those living in the fanciest homes.

On equity grounds, the tax credit appears to be preferred. Offsetting this benefit is the fact that housing prices vary significantly by geographic region. A credit that is generous in some parts of the country would be very small relative to housing prices in other areas.

The tax credit would seem to be better on efficiency grounds as well. The mortgage deduction as it is now implemented distorts consumption behavior in favor of more expensive homes. A uniform credit would continue to encourage home ownership at some basic level (which may be justified based on the positive externalities involved) but would not subsidize McMansions.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 19

THE EQUITY IMPLICATIONS OF TAXATION: TAX INCIDENCE

Questions and Problems

1. **Why do most analysts assume that payroll taxes in the United States are borne by workers rather than by employers?**

   The incidence of a tax depends on relative elasticities. The party who is least able to find a substitute or who has the least flexibility will bear the burden of a tax. Workers who are responsible for supporting families cannot readily change their labor supply in response to small changes in their net wages. Given this inelastic supply of labor, employers are able to shift the burden of payroll taxes to workers.

2. **The demand for rutabagas is $Q = 2{,}000 - 100P$ and the supply of rutabagas is $Q = -100 + 200P$. Who bears the *statutory* incidence of a $2 per unit tax on the sale of rutabagas? Who bears the *economic* incidence of this tax?**

   If the tax is on the sale of rutabagas, the buyer bears the statutory incidence, since the "sticker price" of rutabagas does not include the tax. Economic incidence is determined by relative elasticities. In this case, the quantity supplied is more responsive to a change in price, so the less elastic consumers will bear most of the economic incidence.

   To calculate the relative burdens, solve the equilibrium condition with and without the tax. Without the tax: $2{,}000 - 100P = -100 + 200P$. Price = $7.00. With the tax, the price the supplier receives is reduced by $2.00. The equilibrium condition is

   $$2{,}000 - 100P = 200(P - 2) - 100$$
   $$2{,}000 - 100P = 200P - 500$$
   $$2{,}500 = 300P, \text{ Price} = \$8.33.$$

   The consumers' tax burden = (posttax price – pretax price) + tax payments by consumers, here $\$8.33 - \$7.00 + 0 \approx \$1.33$.

   The producers' tax burden = (pretax price – posttax price) + tax payments by producers, here $\$7.00 - \$8.33 + \$2.00 \approx \$.67$. In this case the consumer bears a larger share of the tax burden than the producer.

3. **The demand for rutabagas is still $Q = 2{,}000 - 100P$ and the supply is still $Q = -100 + 200P$, as in Question 2. Governor Sloop decides that instead of imposing the $2 sales tax described in Question 2, the government will instead force stores to pay the tax directly. What will happen to the "sticker price" on rutabagas? How will the size of the consumer tax burden change?**

   As in Question 2, the sticker price for consumers when they bear the statutory burden of the $2 tax is $P \approx \$6.33$. (As in question 2, this is the solution to $2{,}000 - 100(P + 2) = -100 + 200P$.) The sticker price for consumers when firms pay the tax is the solution to $2{,}000 - 100(P') = -100 + 200(P' + 2)$, so the new sticker price is $P' \approx \$8.33$, or $2.00 more than the sticker price before. Consumers pay exactly the same net amount as before: before, they paid

the $6.33 sticker price plus a $2 tax, and now they pay $8.33 directly. The economic incidence of the tax is unchanged.

4. The demand for football tickets is $Q = 360 – 10P$ and the supply of football tickets is $Q = 20P$. Calculate the gross price paid by consumers after a per-ticket tax of $4. Calculate the after-tax price received by ticket sellers.

For this answer, it does not matter whether the tax is added to the price paid by the consumers or subtracted from the price the sellers keep. Adding it to the consumers' price yields demand of $360 – 10(P + 4)$, which is set equal to supply to yield the equilibrium after-tax price: $360 – 10P – 40 = 20P$.

Simplified, $320 = 30P$, so base price = $10.67 and price + tax = $14.67 paid by consumers.

Producers keep only $14.67 – $4 = $10.67.

Without the tax, $360 – 10P = 20P$; $360 = 30P$; the price paid by consumers and kept by sellers is $12.

5. The government is considering imposing taxes on the sellers of certain classes of products. The first tax they are considering is a tax on 2% milk. The second is a tax on all dairy products. The third is a tax on all food products. Which of these three taxes would you expect to have the largest impact on the sticker prices of the taxed products?

We expect food to have the highest sticker price increase, since the elasticity of demand for food is the lowest. The demand for 2% milk is likely to be quite elastic, since 1% milk and whole milk are close substitutes. Sellers of 2% milk will have a difficult time shifting the burden of the tax onto consumers, and the sticker price will be little changed. The demand for all dairy products will be somewhat elastic, since there are some substitutes available for these products: meats, soy and rice milk, and peanut butter can replace some dairy products in some parts of a person's diet, for example. But the demand for dairy products is less elastic than the demand for 2% milk, so consumers will see some rise in the sticker prices of dairy products. Finally, there are no good substitutes for "all food." Food is a necessity, so the demand for it is quite inelastic. Most of the tax burden will be shifted to consumers in the case of a tax on food, and consumers will see a significant increase in food sticker prices.

6. To finance a new health insurance program, the government of Millonia imposes a new $2 per hour payroll tax to be paid by employers.

a. What do you expect to happen to wages and the size of the workforce?

You might expect the new tax to reduce cash wages by the entire amount of the tax: labor supply tends to be inelastic, particularly in this case, in which the same tax will be imposed on every job in Millonia. Thus the size of the workforce will not change. Furthermore, the tax is being imposed to fund something that benefits the workers and their families, so workers may be willing to consider it a payment for health insurance rather than a cut in pay. But pay cuts are extremely unpopular and difficult to implement. Firms may think that the public will perceive a wage cut as a signal of poor economic strength, and workers are likely to complain bitterly. As a result, even though economic theory suggests that the workers, whose supply is inelastic, will bear the tax, employers may accept some of the burden. Thus, wages may fall but not by the full amount of the tax.

b. How will this answer change in markets where labor is inelastically demanded?

If demand for workers is inelastic, it is much more likely that firms will have to bear the tax incidence, so wages would not decrease. This might be the case if the workers have specialized training or there is a tight labor market. Either case would lead to a situa-

tion in which firms did not have substantial flexibility in their hiring, so the size of the workforce would remain the same.

7. You have determined that producers, rather than consumers, will bear the lion's share of the burden associated with a new tax. How does the elasticity of labor supply influence whether this tax burden will, in turn, be borne more by workers or by property owners?

The more elastic the labor supply is the more easily it will be able to escape the tax burden. If workers can easily move to an untaxed jurisdiction, a producer will not be able to shift the tax burden to them. Property owners may be less able to move to avoid the tax. In the extreme, if the property in question is fixed real estate, it will be immobile and completely inelastic. In that case, property owners will bear the entire tax burden. If the property in question is more mobile, such as investment in capital equipment, then over time it, too, is elastic and property owners will be able to avoid much of the tax burden. As always, the least elastic component is saddled with most of the tax burden.

8. Why can some taxes that appear to be regressive in terms of current income be thought of as progressive from a lifetime tax incidence perspective?

Incomes vary significantly over a person's lifetime, so looking at the progressivity or regressivity of a tax at just one point in time can obscure its true effect. For example, during any single year some young adults who are at the beginning of their careers will have low incomes but fairly high expected lifetime incomes. A high tax on their current low income (such as a consumption or sales tax on durable goods that people buy when they are first establishing their households or families) would seem regressive, because they are paying the tax now when they are young and poor. If these taxes on starting-out durables are considered over the longer time horizon of their lifetimes, however, they don't seem so regressive.

If it is true that people follow consumption-smoothing patterns over their lifetimes, such that they consume more than their income when young but less than their income during their peak earning years, then a consumption tax will seem more regressive in any single year than it is when considered over a lifetime. That is because the tax base—consumption—is high relative to income when income is low and low relative to income when income is high.

9. Consider a labor market in which workers are paid the minimum wage. When will it matter for tax incidence whether a payroll tax is imposed on workers or on employers?

Normally, the statutory imposition of a tax is irrelevant to the actual economic incidence because the party on whom legal liability rests will shift the burden if it can, and the less-elastic party will bear most of the burden of the tax. However, a tax imposed on employers cannot be shifted to workers earning the minimum wage; employers are legally constrained from lowering wages further, so they will bear the full burden. On the other hand, a tax imposed on workers will be at least partially shifted to employers if the demand for labor is inelastic. Therefore, minimum-wage employers with inelastic demand for labor are likely to share some of the burden of a tax imposed on employees. However, if the same tax were imposed on employers of minimum-wage workers, the employer would be forced to bear the entire burden.

10. Consider the changes over time in the U.S. effective tax rates presented in Table 19-1. How did the total effective tax burden change for the lowest and highest deciles of the population between 1979 and 2003? How did the composition of this burden across different types of taxes change over this period?

The lowest decile of the population has seen a decrease in its total tax burden from 8% to 4.8% over this time period. This decile's income tax burden fell from zero to –5.9% (re-

flecting the introduction of the Earned Income Tax Credit) and its corporate income tax burden fell from 1.1% to only 0.3%. At the same time, the lowest decile has seen an increase in its payroll tax and excise tax burdens.

The highest decile has also seen a decrease in its total tax burden, though it has been less substantial than the decline in the lowest decile (it fell from from 27.5% to 25%). Like the lowest decile, the highest decile has seen a decline in personal and corporate income tax burdens and an increase in payroll tax burden. Unlike the lowest decile, however, the highest decile has seen a small decline in their (already small) excise tax burden.

Advanced Questions

11. The elasticity of demand for maracas is –2.0 and the elasticity of supply is 3.0. How much will the price of maracas change with a per-unit tax of $2? Who bears the larger burden of the tax, consumers or producers?

Elasticity of supply has a greater magnitude than that for demand, so even before calculating specific amounts you can guess that consumers will bear the greater burden. To calculate specific burdens, use the expressions for ΔP given in the appendix, which is derived from the definitions of elasticity of demand and elasticity of supply.

When a tax is imposed on a consumer, the change in price (ΔP) will equal (elasticity of demand)/(elasticity of supply – elasticity of demand) × the tax.

Solving for the values given, $\Delta P = (-2/)(2) = -2/5(2) = -4/5$. The net-of-tax price paid by the consumers is the original price minus $.80 (4/5 of a dollar), so the total price increase paid by the consumer is $1.20. This outcome is consistent with our initial expectation: the consumer ends up bearing $0.20 more than half the total tax.

12. The government of Byngia has introduced a new tax on airline travel. Byngia has two types of travelers, business travelers and leisure travelers. Business travelers in Byngia have an elasticity of demand of –1.2, while Byngian leisure travelers have an elasticity of –3.0. Airlines can price discriminate among these groups; that is, they can charge different prices to the different types of fliers in the market. Which type of travel will bear the larger burden of the tax? Explain.

Business travelers will bear the larger burden of this tax because their demand is less price elastic than that of leisure travelers. Leisure travelers will choose other modes of transportation or perhaps not travel at all if they face an increase in prices. Business travelers often do not have a choice about whether to travel, and other modes of transportation are often not fast enough. With few substitutes, business travelers are price inelastic, so the airlines will be able to pass the tax burden to them.

There is one exception to this answer: if airlines have perfectly inelastic supply, then neither type of travelers will bear any burden.

13. Massive Products, Inc., is a monopolist whose cost of production is given by $10Q + Q^2$ (so its marginal cost curve—equivalently, its inverse supply curve—is given by $10 + 2Q$). Demand for Massive Products' massive products is $Q = 200 – 2P$.

a. What price will the monopolist charge, and what profits will the monopolist earn? What will consumer surplus be?

First we calculate the profit-maximizing quantity by setting marginal cost equal to marginal revenue. Marginal cost is $10 + 2Q$. Marginal revenue can be found by solving for the inverse demand curve, $P = 100 – \frac{1}{2}Q$ and noting that the marginal revenue curve has the same P-axis intercept and is twice as steeply sloped. Hence, marginal revenue is $100 – Q$. Setting $MR = MC$ and solving for Q,

$10 + 2Q = 100 - Q$, or $3Q = 90$, or $Q = 30$.

Therefore, the profit-maximizing quantity is 30, and the profit-maximizing price can be found from the inverse demand curve: $P = 100 - ½ (30) = \$85$. Profits are computed as the difference between total revenue and total cost, or $\$85 (30) - 10(30) - 30^2 = 2,550 - 1,200 = 1,350$.

Consumer surplus can be computed as the area of the triangle with width $Q = 30$ and height $100 - 85 = 15$ (the difference between the P-intercept of demand and the price paid). Computing, consumer surplus = ½ (30)(15) = 225.

b. How will the monopolist's price and profits change if a tax of $15 per unit is imposed on the buyers of the product?

Imposing a $15 tax on buyers will change their demand curve to $Q = 200 - 2(P+15)$, or $Q = 170 - 2P$, where P is the pretax ("sticker") price. The new inverse demand is $P = 85 - ½ Q$, and the new marginal revenue is $P = 85 - Q$. Setting equal to marginal cost and solving gives

$10 + 2Q = 85 - Q$, or $3Q = 75$, or $Q = 25$.

The profit-maximizing price is thus $P = 85 - ½ Q = \$72.50$. Profits are given by $\$72.50 (25) - 10(25) - 25^2 = 1,812 - 875 = 937.5$.

c. What is the deadweight burden of the tax?

To compute the deadweight burden of the tax, we look at the change in total surplus (including tax revenue as surplus). The after-tax consumer surplus can be computed from the new demand curve: ½ (25)(12.50) = 156.25, where 25 is the quantity purchased and 12.50 = 85 – 72.5 is the difference between the P-intercept of demand and the price paid. The tax revenue is 25(15) = 375. Hence, the deadweight burden of the tax is (1,350 + 225) – (937.5 + 156.25 + 375) = 1575 – 1468.75 = 106.25.

14. In which case will workers bear a larger share of the tax burden, when taxes are imposed in a single locality or when taxes are imposed throughout an entire state? Why will your answer differ between the short run and the long run?

Workers are relatively mobile in the short run, so a tax in a single locality will induce workers to seek jobs in nearby towns. A statewide tax will make it more difficult for workers to seek jobs since untaxed towns are farther away, reducing their supply elasticity. Thus, in the short run, workers bear a larger share of the tax burden when the tax increase is statewide. The physical assets of the employer will carry the tax burden in the short run if it is imposed in a single locality, but even those assets will migrate in the long run. In fact, investment capital may be even more mobile than labor in the long run, as some workers may not wish to leave their hometowns. Theoretically, you would expect the least-mobile physical capital (land) to bear the entire burden of these location-specific taxes once the mobile factors have adjusted to the change, and for workers to bear none of the burden.

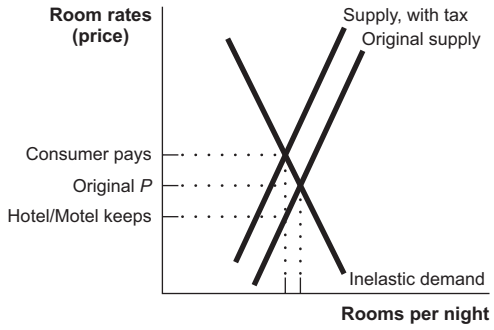
15. The city of Malaise is considering a 10% tax on the revenues of all hotels/motels inside the city limits. Although not completely different from hotels and motels in the nearby suburbs, the ones in Malaise have a distinct advantage in their proximity to the interesting sights and convention centers. So individuals will pay some premium to stay in Malaise rather than to stay nearby.

Furthermore, all land is used equally well by hotels/motels and other forms of business; any Malaise land not taken by a hotel/motel is readily absorbed by other forms of business.

Mayor Maladroit calls you in to advise him on the incidence of such a tax. He is particularly concerned with who will bear this tax in the short run (one month) and the long run (five years).

a. What is the incidence of the tax in the short run? Answer intuitively, and use a diagram if possible.

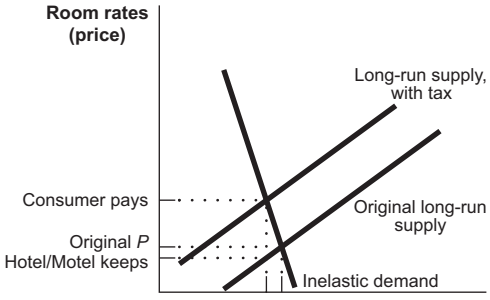
In the short run, the city hotels and motels will share the burden of the tax with their guests. From the description of the town, it appears that demand for lodging near the city center is relatively inelastic, so the businesses will be able to increase their rates without losing many customers. However, the supply of hotel and motel space is likely to be fairly inelastic too, particularly in the short run: it takes some time to convert hotels and motels to other uses, and vice versa. Graphically, both demand and supply will be steep:



In the short run, this tax yields very little quantity change but a significant price change.

b. What is the long-run incidence? Once again, use a diagram if possible.

In the long run, the number of hotel and motel rooms can be adjusted; thus, supply is more elastic. In the long run the tax incidence will fall primarily on the inelastically demanding guests. The price kept by the firms is close to the original price.



c. How would your analysis in b change if hotels/motels in the suburbs were perfect substitutes for those in Malaise? What would happen to tax revenues?

The availability of an untaxed substitute in the suburbs would make demand more price elastic. This elasticity would have two effects on the market. First, the firms would not be able to shift the lion's share of the tax burden to the consumers, because if they did, visitors to the area would simply stay in the suburbs. Second, the number of rooms rented would fall, so the revenue raised by this tax would decline relative to a.

Solutions and Activities
for
CHAPTER 20

TAX EFFICIENCIES AND THEIR IMPLICATIONS FOR OPTIMAL TAXATION

Questions and Problems

1. The market demand for super-sticky glue is $Q = 240 – 6P$ and the market supply is $Q = –60 + 4P$.

a. Calculate the deadweight loss of a tax of $4 per unit levied on producers of super-sticky glue.

Deadweight loss is calculated as the area of a triangle, the height of which is the dollar amount of the tax and the base of which is the change in quantity purchased resulting from the tax.

First, determine the change in quantity associated with this tax. Without the tax, equilibrium is $240 – 6P = –60 + 4P$, or $300 = 10P$. Equilibrium price is $30, so equilibrium quantity is $–60 + (4 \times 30) = 120 – 60 = 60$.

A tax levied on producers changes the supply function to $Q = –60 + 4(P – 4)$ because the price the producers can keep from any sale is reduced by $4. Recalculating equilibrium, $240 – 6P = –60 + 4P – 16$, or $316 = 10P$. Equilibrium price is $31.60, so equilibrium quantity is $240 – 6(31.60) = 50.4$.

The change in quantity is $60 – 50.4 = 9.6$, so the area of the deadweight triangle is $\frac{1}{2}(9.6)(4) = 19.2$.

b. How does deadweight loss change if the tax is levied on consumers of super-sticky glue?

Intuitively you would expect the deadweight loss to be exactly the same. The legal liability for the tax does not change the economic incidence of the tax.

In this case, the height of the triangle is still the $4 tax. When the tax increases the price a consumer must pay, the new demand function is $Q = 240 – 6(P + 4)$. The new equilibrium condition is $240 – 6P – 24 = –60 + 4P$, or $276 = 10P$.

Price is $27.60, and quantity is $–60(4 \times 27.60) = 50.4$, exactly the quantity that resulted when the tax was imposed on the producer.

2. The government of Washlovia wants to impose a tax on clothes dryers. In East Washlovia the demand elasticity for clothes dryers is –2.4 while in West Washlovia the demand elasticity is –1.7. Where will the tax inefficiency be greater? Explain.

The more elastic the demand, the more inefficient the tax; therefore, the tax will be less efficient in East Washlovia. Tax inefficiency is measured by the area of deadweight loss it generates. The height of the deadweight loss triangle will be the same in both areas, as it is the dollar amount of the tax. The base of the deadweight loss triangle, though, will differ, because it is the quantity change, or the quantity response, to the tax. Elasticity is a measure of quantity response to a price change: the higher the elasticity, the greater the quantity change

for a given price change. When demand is elastic, a price change will distort quantity demanded by relatively more than when it is inelastic, and it is this quantity distortion that causes inefficiency.

3. On a recent visit to Amsterdam, you noticed that houses facing the canals are tall, deep, and extremely narrow. Your host tells you that this is due to builders' desires to avoid taxes. Describe a tax system that would induce this kind of behavior.

Suppose the tax base, for property fronting on a canal, is the linear measure of frontage on that canal. In other words, property tax equals the tax rate times the number of feet of canal frontage. In some parts of the United States, lakefront property is described by its feet of frontage, as that is a particularly desirable aspect of the property, so this approach is not such a stretch. If property is taxed only on its canal frontage, then people have an incentive to reduce their tax liability by constructing buildings that minimize that measure. If the height and depth of the building do not figure into the tax base, then space obtained by building up and back will be less costly.

4. Suppose that the government of Michconsin imposes a tax on cheese curd production. When will the efficiency costs of the tax be greater, in the short run or in the long run, and why?

Both demand and supply elasticities are greater in the long run because consumers have more time to seek out or learn about substitutes and producers have more time to switch production to other goods to avoid the tax. Both of these long-run adjustments will result in a greater decrease in the quantity of cheese curds produced relative to the short-run decrease. Therefore, consistent with the rule that higher elasticity leads to greater inefficiency, the efficiency costs of this tax will be greater in the long run.

5. Bob's Bees is a small boutique honey manufacturer in Massachusetts. Bob's neighbor is Jon's Jams. The more honey Bob produces, the more jam Jon is able to produce; that is, there is a positive production externality.

a. Suppose that the government of Massachusetts imposes a new tax on jam and honey production. Will the deadweight loss of this tax be greater, smaller, or the same as if there were no production externality? Explain.

There are two reasons that the deadweight loss will be greater than if there were no externalities. First, the presence of the externality means that production is already distorted away from optimality. Since deadweight losses increase at an increasing rate with distortions, this makes deadweight losses from these taxes particularly large. Second, the presence of externalities will lead to an undesirable secondary effect of imposing taxes: the reduction in Bob's output will hurt the jam industry as well as causing deadweight losses in the honey market (and similarly for the tax on jams).

b. How would your answer change if the production externality were negative (perhaps because Bob's bees sting Jon's jam makers)?

A tax imposed on production that generates a negative externality corrects some of the inefficiency associated with the externality: not only is the deadweight loss not increased by the tax, but the tax offsets some of the preexisting inefficiency. Because Bob is not bearing the full cost of his production in the absence of the tax, he is overproducing honey. The tax will cause him to reduce production, so some of the negative externality will be corrected.

6. The city of Johnstown decides to build a new stadium to attract a basketball team from the city of Rosendale. One economic advisor suggests that the stadium should be financed by a 2-year sales tax of 10%, while another advisor suggests that the sta-

dium should be financed with a 20-year sales tax of 1%. Assume the interest rate is zero. Which approach will yield a more efficient outcome? Why?

The 20-year tax will be more efficient. As a general rule, a short-term, higher tax increase will impose more deadweight loss than a lower tax spread out over a longer period of time. This result follows from the fact that the efficiency loss of taxes increases at an increasing rate as the tax rate increases. A 1% tax is minimal, so distortions, in terms of otherwise beneficial transactions being deterred, are also minimal. In terms of the area of the deadweight loss triangle, transactions that would no longer take place are the ones closest to the nontax equilibrium. Because these transactions are so close to the nontax equilibrium, the total surplus they would have generated (the height of the deadweight loss triangle) is fairly small.

7. **You are a consultant to the government of Buttony. The government has decided to cut taxes on either apples, bananas, or cantaloupe, and it wants your input on which fruit would be the best choice for a tax cut. It provides you with the following information. What is your recommendation, and why?**

Good	Unit Price	Sales (thousands)	Unit tax	Marginal tax revenue (thousands of dollars per $1 additional tax)	Marginal deadweight loss (thousands of dollars per $1 additional tax)
Apples	$1	100	$0.10	20	5
Bananas	$2	100	$0.25	30	20
Cantaloupe	$4	50	$0.15	10	20

Taxes should be set so that the marginal deadweight burden per marginal dollar of revenue generated is equal across goods. This is not true in Buttony. The marginal deadweight burden per marginal dollar of revenue is much higher for cantaloupe ($20/10 = 2 > 20/30 > 5/20$) than for the other goods. Cutting taxes on cantaloupe would be the most efficient: for a given revenue reduction, cutting cantaloupe taxes would reduce the deadweight loss the most.

8. **Luxury goods often have much higher elasticities of demand than do goods purchased by a broad base of people. Why, then, are governments more likely to tax luxuries than these "staple" goods?**

While the Ramsey Rule would suggest taxing goods that are inelastically demanded, thus minimizing deadweight loss, there are other factors to consider; in particular, equity concerns are often inconsistent with this implication of optimal taxation. A tax on inelastically demanded staples such as food would be regressive. Poorer people would spend a higher proportion of their income on necessities, so they would bear a disproportional share of a tax on those items. Wealthy people are much more likely to purchase luxury items, so the direct effects of a tax on these goods would be progressive. (Indirect effects, like employment in the sectors that produce and service luxury goods, might not be as progressive.)

9. **Consider a social insurance program that is financed by a payroll tax. How does the incidence of this tax differ if the benefits of the insurance program are restricted to workers, rather than if benefits are available to all citizens? Under which circumstances will these differences be particularly large?**

A payroll tax is paid by firms that hire workers. Thus, a program in which the benefits are restricted to workers is one in which there is a strong tax–benefit linkage. In that case,

the tax causes firms to demand fewer workers at every wage, but the effect is offset by workers' willingness to accept lower wages because they benefit from the program funded by the payroll tax. Both of these effects exert downward pressure on wages, so the incidence of the tax is shifted to the workers in the form of lower wages rather than a reduction in the level of employment.

If the benefits funded by the tax were available to all citizens, there would be no corresponding shift in the supply of labor function (because there would be no additional benefit to being a worker), so deadweight loss would be greater but wages would not fall by as much. When a benefit is not tied to working status, workers do not bear as much of the incidence of the tax.

The difference is driven by the labor supply response to the benefit provided. If labor does not respond to a new benefit by lowering its wage demands, firms will be less able to pass the entire cost of the tax to workers in the form of reduced wages. On the other hand, if workers value the benefit funded by the payroll tax, they will be more willing to accept lower wages in exchange for receipt of the benefit. Thus, the differences between these two programs will be particularly large when the benefit is highly valued by workers, or when workers believe there is a high probability they will be the recipients of the benefit.

Advanced Questions

10. The market demand for stuffed rabbits is $Q = 2{,}600 - 20P$, and the government intends to place a $4 per bunny tax on stuffed rabbit purchases. Calculate the deadweight loss of this tax when:

a. Supply of stuffed rabbits is $Q = 400$.

The quantity before the tax is 400; the quantity after the tax is 400. When supply is always 400 rabbits, the deadweight loss of the bunny tax is ½ (4 × 0), or 0. There is no change in supply, so there is no deadweight loss.

b. Supply of stuffed rabbits is $Q = 12P$.

In this case, supply is not completely inelastic, so before-tax and after-tax quantities must be calculated.

Before tax: $2{,}600 - 20P = 12P$; $P = \$81.25$; $Q = 12 \times 81.25 = 975$.

After tax: $2{,}600 - 20P = 12(P - 4)$; $2{,}600 - 20P = 12P - 48$

$2{,}648 = 32P$; $P = 82.75$; $Q = 2{,}600 - (20 \times 82.75) = 945$.

The quantity change is 975 – 945 = 30, so the area of the deadweight loss triangle is ½ (30 × 4) = 60.

c. Explain why the deadweight loss calculations differ between a and b.

Deadweight loss is caused by changes in the equilibrium quantity. In a, because supply was perfectly inelastic, there was no change in quantity. When quantity does not change, the tax has caused no distortion. Thus, there is no deadweight loss, only a transfer of money from the seller to the government.

11. How is it possible for marginal tax rates to decline as income increases while average tax rates rise with income? How does the optimal tax system simulated by Gruber and Saez (2000) represent an optimal trade-off between equity and efficiency concerns?

A taxpayer's marginal tax rate is the rate paid on the last dollar of income; the average rate is calculated on the taxpayer's entire income. As long as marginal rates are above average rates, average rates will be increasing. The higher marginal (or last) rate will bring the

average up. This is behavior analogous to the behavior of cost functions, grade point averages, and all other phenomena for which both marginal and average functions are calculated. When the marginal unit is below the average, it brings the average down. When the marginal unit exceeds the average, it brings the average up. In the example given by Gruber and Saez (2000), it is true that marginal rates decline with income, but the rates are still greater than the average tax rate and so must bring the average tax rate up.

In the case of taxes, the marginal rate has the greatest effect on decision making: a rational worker will choose to decrease or increase labor time or effort on the basis of his marginal net wage, not his average wage. Thus, the marginal tax rate has important efficiency implications. If it is too high, it will discourage work. The work deterrence of an income tax is highest for high-income workers, as their marginal utility from additional income is low (by the concept of diminishing marginal utility of income). Thus, falling marginal tax rates for high-income earners reduces the efficiency loss of work deterrence. On the other hand, the fairness (or equity) concerns of a tax system would indicate lower average tax rates for poorer taxpayers. The system simulated by Gruber and Saez (2000) accomplishes that. Higher-income taxpayers face higher average tax rates than do lower-income taxpayers.

12. Gruber and Krueger (1991)[1] found that mandated increases in the costs of workers' compensation benefits in the 1970s and 1980s led to substantial wage offsets for workers. Some of the wage reductions they found were even larger than the total cost to firms of providing the additional benefits. What does this suggest about the deadweight loss from the implicit "benefit tax" involved in imposing these mandatory benefits?

Workers apparently valued the additional benefits provided by the increases in workers' compensation quite highly. This suggests that the deadweight loss from the imposition of this "tax" is likely to be small, relative to a tax that was not accompanied by a benefit. In fact, a complete wage offset suggests that workers' compensation insurance was a perfect substitute for wage income, in which case the deadweight loss would be zero.

13. Schmeezle and Schmoozle are two advisors for the government of Feldspar. Schmeezle says that since the elasticity of demand for granite countertops is –3 and the elasticity of demand for sinks is –1.5, taxes should be raised entirely from granite countertops. Schmoozle argues that it is better to levy taxes on both goods anyway. Which advisor should the Feldspar government listen to? Why?

Feldspar should take Schmoozle's advice. The marginal deadweight burden for the first bit tax on a good (in a competitive market) is zero, and the marginal deadweight burden increases as the tax size gets larger. To minimize the deadweight burden, the government would want to put small taxes on both goods. Schmeezle is also wrong for another reason: the demand for granite countertops is more elastic than the demand for sinks, so the tax on *sinks* should be bigger than the tax on countertops.

14. What is the theoretical justification for a so-called Laffer curve? Based on the empirical evidence described in the text, should the U.S. raise or lower its tax rates in order to increase tax revenues? Explain.

The Laffer curve illustrates the theory that work disincentives associated with high tax rates will offset the revenue gains the high rates might generate. According to this theory, at very low tax rates, workers will choose to work in order to generate income. These low taxes raise revenue because they are assessed on a large base. As tax rates increase, however, the

[1]Jonathan Gruber and Alan Krueger, "The Incidence of Mandated Employer-Provided Insurance: Lessons from Workers' Compensation Insurance," in *Tax Policy and the Economy*, D. Bradford, ed. (Cambridge, MA: MIT Press and NBER, 1991.)

tax base will eventually begin to shrink. The tax base is the number of hours workers choose to work times their wages. As taxes increase, workers cut back on hours worked, reducing the size of the tax base and ultimately the total tax revenue generated. When the tax rates are so high that this revenue reduction occurs, a government can raise more revenue by reducing tax rates, since the tax base would increase as a result of higher after-tax wages.

It is clear that a tax of zero will raise no revenue and that a 100% marginal tax rate will completely deter work. It is not completely clear, however, where in the wide range between zero and 100% the work deterrence effects of a high marginal tax rate offset the revenue generation of high taxes. The evidence cited in the text suggests that higher tax rates would increase tax revenues because the country is currently operating on the upward sloping portion of the Laffer curve.

15. The demand for snorkels in Berhama is given by $Q_S = 500 - 8P_S$ and the supply of snorkels in Berhama is given by $Q_S = 200 + 4P_S$. The demand for kayaks is given by $Q_k = 650 - 6P_k$ and the supply of kayaks is given by $Q_k = 50 + 1.5P_k$. Both goods are currently untaxed, but the government of Berhama needs to raise $5,000 (to finance a new lighthouse) by taxing snorkels and kayaks. What tax should it levy on each of the two goods?

If it puts a tax of τ_s on snorkels, the equilibrium price will solve $500 - 8P_s = 200 + 4(P_s - \tau_s)$, or $12P_s = 300 + 4\tau_s$, or $P_s = 25 + \tau_s/3$. The quantity of snorkels sold will be $Q_s = 500 - 8(25 + \tau_s/3) = 300 - 8\tau_s/3$. With no tax, 300 snorkels are sold. Hence, the deadweight burden of taxation is

$$DWL_s = 1/2\tau_s\, \Delta Q_s = 1/2\tau_s\, (8\tau_s/3).$$

The tax revenue from the snorkel tax is:

$$TR_s = \tau_s Q_s = 300\tau_s - 8\tau_s^2/3.$$

The marginal *DWL* is thus $8\tau_s/3$, and the marginal revenue is $300 - 16\tau_s/3$.

A similar exercise for kayaks yields

$$DWL_k = 1/2\tau_k\, \Delta Q_k = 1/2\tau_s\, (6\tau_k/5)$$

and

$$TR_k = \tau_k\, Q_k = 410\tau_k - 6\tau_k^2/5.$$

The marginal DWL is thus $6\tau_k / 5$, and the marginal revenue is $410 - 12\tau_k/5$.

The optimal taxes must equate the ratio of the marginal *DWL* to the marginal revenue:

$$\frac{8\tau_s/3}{300-16\tau_s/3} = \frac{6\tau_k/5}{410-12\tau_k/5}$$

or

$$(8\tau_s/3)410 - (8\tau_s/3)(12\tau_k/5) = (6\tau_s/3)(6\tau_k/5)$$

or

$$(3280/3)\tau_s = 360\tau_k.$$

Hence, $\tau_s/\tau_k = 1080/3280 = 135/410$ for an efficient tax. Setting taxes τ_k and $\tau_s = (135/410)\tau_k$ and yields total revenues

$$TR = 410\tau_k - 6\tau_k^2/5 + 300(135/410)\tau_k - 8\left((135/410)\tau_k\right)^2/3.$$

Setting this equal to the $5,000 in revenue they need to raise (and solving numerically) yields $\tau_k = 10.13$ and $\tau_s \approx 3.33$.

16. Suppose that a state mandates that both women and men be provided family leave by their employers following the birth of a child.

a. How would you empirically test how this policy change affected the relative wages of men and women in the state?

Because this is a state mandate, you could compare data from states that do not have the new provision with data from states that mandate family leave. The data set for states that mandate family leave would have to include data on wages and employment of men and women both before and after the mandate took effect. You would also want to include data for other possible explanations, including the educational attainment and marital and family status of each worker, age, employment history, and characteristics of the state that might affect wages, such as industrial mix and urbanization. The same data would be needed from states that did not adopt the mandate.

With these data, you could look at the change in wages and employment for men in states that adopted the policy, the change in wages and employment for women in states that adopted the policy, and the changes in wages and employment for the two groups in states that did not adopt a family leave policy. If changes in employment levels were approximately the same in the states regardless of the mandate, but wages fell by more in the states with the policy than they did in comparable states without the policy, you could conclude that the evidence was consistent with the tax–benefit linkage literature—namely, this mandate causes firms to offer lower wages in order to pay for the benefit and causes workers to accept lower wages in exchange for the benefit.

b. Based on the empirical evidence on group-specific employer mandates described in the text, what do you expect to happen to the relative wages of men and women in the state?

This mandate is similar to the maternity leave benefit discussed in the text. The results of that group-specific mandate were to lower wages by the full amount of the cost while having almost no effect on employment levels. These results suggest that a family leave mandate like the one discussed in b would result in little deadweight loss because there would be little change in employment levels but that the workers would bear the full incidence of the costs of the mandate.

17. The government of Granita is thinking about imposing a very small tax on one or more of the following goods: anvils, books, and cardigans. Anvils and books are both produced in competitive markets with constant marginal costs, while cardigans are produced by a monopoly with constant marginal costs. The elasticities of demand for the three goods are –3, –1.5, and –1. What good or goods should the government put the very small tax on if it wants to minimize the deadweight burden?

The government should tax both anvils and books but not cardigans. The marginal deadweight burden from a small tax on a competitively produced good is very small (limiting to zero at zero tax), so small taxes on both these goods is not very costly. Because the monopoly output is below the social optimum already, however, a small tax on cardigans would create more deadweight burden. Thus, equating the marginal deadweight burden across goods requires both taxing the competitively produced goods and subsidizing the monopoly sales.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 21

TAXES ON LABOR SUPPLY

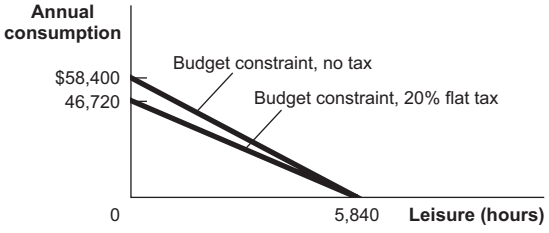
Questions and Problems

1. Suppose that for every hour you work you can earn $10 before taxes. Furthermore, suppose that you can work up to 16 hours per day, 365 days per year. Draw your annual budget constraint reflecting the consumption-leisure trade-off under the following income tax schemes.

To determine the *y*-intercept, calculate the total amount of income you could earn if you worked all hours possible at a wage of $10: 16 × 365 × $10 = $58,400. To determine the *x*-intercept, calculate the total hours from which you can choose labor or leisure: 16 × 365 = 5,840.

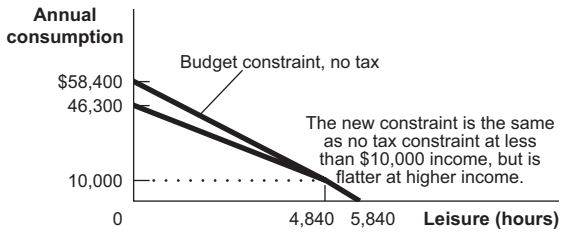
a. a flat income tax of 20% on all income earned

A flat rate of 20% changes the *y*-intercept to 16 × 365 × (80% × $10) = $46,720. The slope of the budget constraint changes from –10 to –8 because the after-tax wage is only $8 per hour.



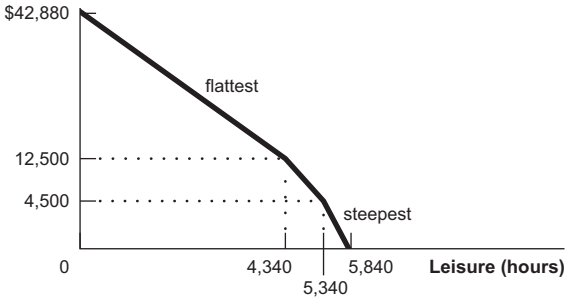
b. an income tax where you pay no tax on the first $10,000 earned and a tax of 25% on all income over $10,000

This budget constraint will have two segments: a slope of –10 at income less than $10,000 and labor less than 1,000 hours (4,840 hours or more of leisure). At income greater than $10,000 and leisure less than 4,840 hours, the slope of the budget constraint will be –7.5. The *y*-intercept is total possible income: $10,000 + 7.5(4,840) = $46,300.



c. an income tax where you pay 10% on the first $5,000 earned, 20% on the next $10,000 earned, and 30% thereafter

This budget constraint will have three segments: one with slope –9 at income of $5,000 or less (and leisure of 5,340 hours or more), one with slope –8 at income between $5,000 and $15,000, and one with slope –7 for income above $15,000 and leisure less than 4,840 hours. The *y*-intercept is 9(500) + 8(1,000) + 7(4,340) = $42,880.



2. For which group of workers is the substitution effect associated with a tax increase more likely to outweigh the income effect: primary earners or secondary earners? Explain.

A tax increase will reduce income, and through the income effect reduce the demand for leisure. Workers will respond by working more. The substitution effect works in the opposite direction: as income taxes increase, the relative price of leisure falls, so workers will tend to consume more leisure and work fewer hours. The empirical evidence suggests small elasticities of labor supply for primary earners and larger elasticities of labor supply for secondary earners. This suggests that the substitution effect outweighs the income effect for secondary earners but not for primary earners. This is reasonable, too, since secondary earners face a larger "cost" of working: their work displaces at-home work (for example, cleaning and childcare). Furthermore, the primary earner already provides substantial income for the household, so secondary income is less essential for many households.

3. Over time, more women have become the primary (or sole) wage earners in their households. How does this fact complicate the empirical analysis of the effects of taxation on women's labor supply?

Large shifts in the employment patterns of women make it difficult to isolate the effects of taxation. The major tax reforms of the 1980s coincided with changes in attitudes regarding working women. Women entered the labor force in large numbers and in professions that paid more than those traditionally held by women. Perhaps some of that change could be attributed to reductions in tax rates, but some of it must also be attributable to social changes. Because these changes in women's labor participation were occurring nationwide, and because the tax changes were also occurring at the federal level, there is no convenient control group against which to compare the treatment, or tax change. The total effect can be observed, but it is difficult to separate out the relative contributions of the competing explanations.

The movement of women towards becoming the primary wage earners in their households also complicates the empirical analysis of the effects of taxation on women's labor supply more directly. If women are secondary earners, their marginal tax rates are effectively determined by the earnings of their husbands. Changes in marginal tax rates, like the Tax Reform Act of 1986 (TRA '86), thus lead to changes in the marginal tax rates faced by women, and one could hope to use this variation to study women's labor supply. The problem with this approach is that it would require comparing women's labor supply before and after the tax change, and it would be impossible to tell how much of this change to attribute to the tax

change and how much to attribute to the changing role of women in the labor force. (This is where the difference-in-difference approach taken by Nada Eissa, as described in the text, can help. Her work "differenced out" the trend by comparing the changes in labor supply of women with very high-earning husbands and women with only moderately high-earning husbands, two groups that were differentially affected by TRA '86.)

4. What is likely to happen to overall labor supply if

a. the Earned Income Tax Credit (EITC) compensation rate increases from 30% to 50% for each dollar earned?

An increase in the EITC compensation rate is likely to increase labor supply. In principle, there are offsetting substitution and income effects. The higher compensation rate makes leisure relatively more expensive for workers, so the substitution effect leads workers to supply more labor. Offsetting this, the higher compensation rate makes workers richer, leading them to consume more leisure and supply less labor. Since the EITC applies only to low-income workers, however, the substitution effect is likely to dominate. In particular, some workers might not choose to work at all with the 30% compensation rate. They would face only the substitution effect, and it might be strong enough to induce some of them to enter the labor force.

b. the rate of reduction in the EITC phase-out period increases?

An increase in the rate of reduction of benefits under the EITC might reduce labor supply among some workers because it increases the effective marginal tax rate on earned income. Leisure becomes less expensive, so secondary workers in particular might find it less worthwhile to work relative to staying home. Empirical evidence regarding work incentives under the EITC, though, suggests that an increase in the steepness of the phase-out profile might not lead to a decrease in total labor supply. Entrance into the workforce is increased by the EITC, but marginal changes in hours worked would not seem to be as sensitive to the effects of the program. Once people are in the labor force they tend to stay in, even though the phase-out portion of the EITC program results in a high marginal tax rate.

5. The country of Akerlovia currently has a tax system that gives each citizen $5,000 in cash up front, exempts the first $10,000 in earned income from tax, and taxes all earned income over $10,000 at a 25% rate. It is considering replacing this system with an Earned Income Tax Credit system. The proposed new system would drop the $5,000 cash give-away and would instead subsidize the first $10,000 in earned income at a 50% rate. All income earned over $10,000 would still be taxed at the same 25% rate, and the EITC benefits would never be phased out. Describe the effects of this policy change on the labor supply of workers with various incomes.

This policy change has no effect on any worker with income over $10,000. Under either system, these workers get $5,000 from the government and they face a 25% marginal tax rate. It will encourage work among all other workers via both the income and substitution effects. At their original levels of work, these workers will be poorer under the new system: they will get less than $5,000 from the government, so the income effect will encourage them to work more (consume less leisure). Furthermore, an additional hour of work now yields a 50% larger increase in their take-home income than it did under the old system. Hence, the substitution effect also leads them to work more.

6. How does making child care costs tax-deductible reduce the "tax wedge" associated with the fact that market work is taxed but home work is not? Does making child care costs deductible increase or decrease social efficiency?

A parent who stays home to care for his or her children receives home production value for providing the service; a parent who works and hires a caregiver must pay the caregiver

for the service. In the absence of a deduction for child care costs, payment for nonparental child care is made with income on which tax has been assessed. Thus a parent who pays for child care must earn more than the caregiver's payment, before taxes, to pay the caregiver. Home-provided child care is "paid for" by forgoing untaxed wages, so the cost of home care is less than the cost of a hired caregiver. Making child care expenses tax-deductible would lead to greater social efficiency by eliminating this difference and thus reducing distortion.

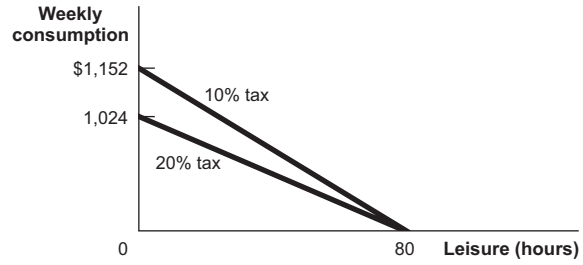
Because paying for child care makes working more expensive, it can cause a secondary worker in a family to choose home-produced child care over the labor force, even if that worker has higher productivity at work. For example, suppose a parent is choosing between earning $15 an hour at work (because that is the value of his marginal product) and staying home and caring for his children, which he values at $12 an hour. The market work apparently has higher value, but if the tax on the $15 is more than $3 per hour (a 20% rate), the worker will be better off staying home. If child care expenses were tax-deductible, the worker would choose to work, an activity that yields higher value in this example. In addition, because child care is a direct cost of employment, deducting it from income is consistent with the Haig-Simons comprehensive income measure.

7. Suppose that you can earn $16 per hour before taxes and can work up to 80 hours per week. Consider two income tax rates, 10% and 20%.

a. On the same diagram, draw the two weekly consumption–leisure budget constraints reflecting the two different tax rates.

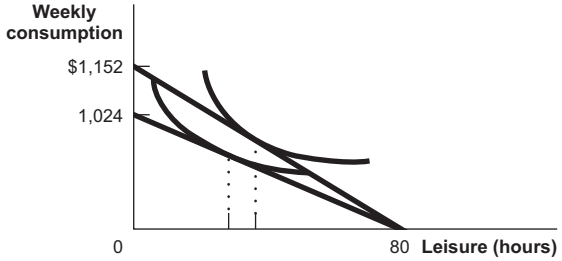
The maximum weekly consumption, in dollars, without a tax is 80 × $16 = $1,280.

A 10% tax reduces that amount to .9 × $1,280 = $1,152, and a 20% tax reduces it to .8 × $1,280 = $1,024. These give the *y*-intercepts of the budget constraints. The *x*-intercept, measuring leisure, is always 80 hours.



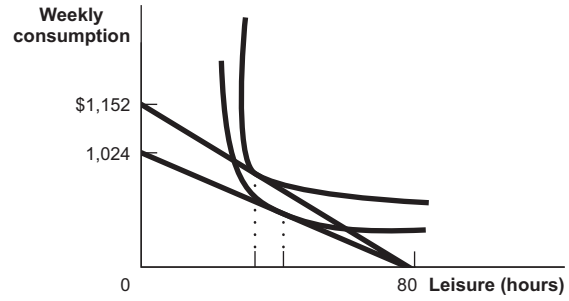
b. Draw a set of representative indifference curves such that the income effect of the tax increase outweighs the substitution effect.

When the income effect outweighs the substitution effect, a lower tax leads to more leisure because a higher income allows a person to acquire more of a normal good, in this case leisure:



c. Draw a set of representative indifference curves such that the substitution effect of the tax increase outweighs the income effect.

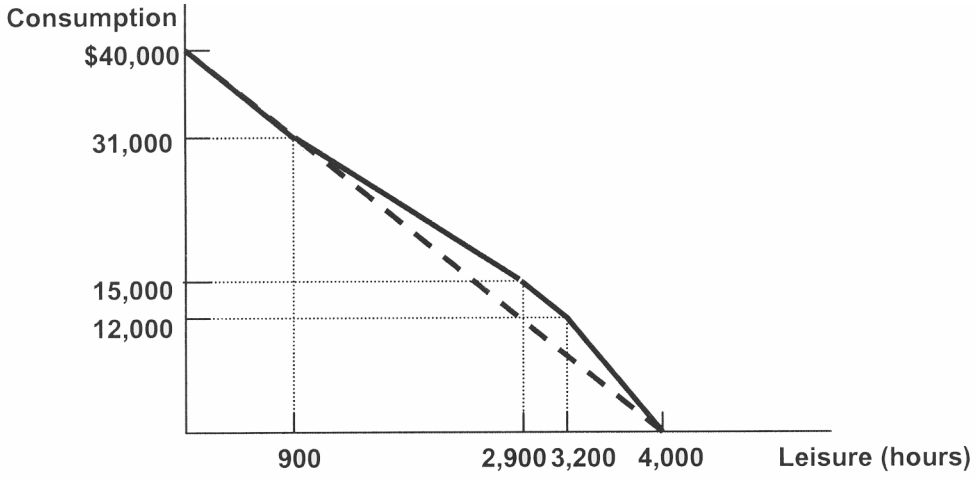
When the substitution effect outweighs the income effect, a lower tax leads to less leisure because leisure now has a higher opportunity cost (the higher after-tax wage):



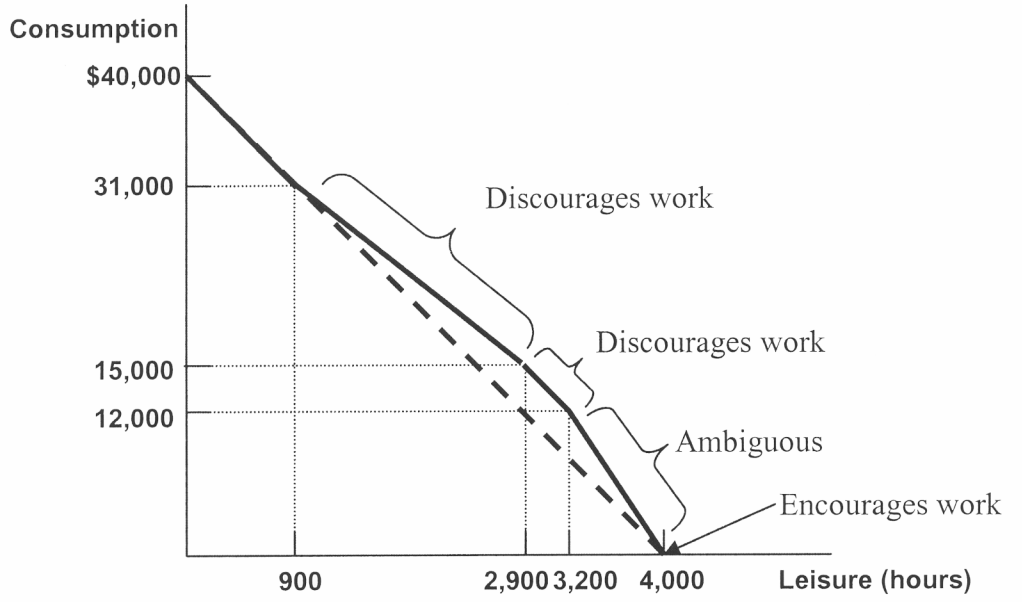
8. Suppose that the government introduces an Earned Income Tax Credit such that for the first $8,000 in earnings, the government pays 50¢ per dollar on wages earned. For the next $3,000 of earnings, the credit is held constant at $4,000, and after that point the credit is reduced at a rate of 20¢ per dollar earned. When the credit reaches zero, there is no additional EITC.

a. Draw the budget constraint that reflects this earned income tax credit for a worker who can work up to 4,000 hours per year at an hourly wage of $10 per hour.

The 50¢ cent subsidy applies to the first $8,000 of earnings, or the first 800 hours of work. This corresponds to 3,200 hours of leisure and a consumption of $12,000. The next $3,000 of earnings—300 hours of labor—is untaxed. Hence, at 2,900 hours of leisure, the worker gets a consumption of $15,000. The $4,000 EITC benefit is phased out gradually, disappearing after $20,000 in additional earnings. Hence, at 900 hours of leisure, the worker gets to consume $31,000.



b. Illustrate on your graph the portions of the budget constraint where the labor supply effects of the policy are positive, negative, or ambiguous, relative to the "no policy" status quo.



9. Congressman Pinkie proposes reducing the tax exemption for children in married families where only one parent works outside the home. Why would this proposal improve equity, from a Haig-Simons perspective?

When both parents in a family work, they generally spend money that has been taxed on child care and other home production activities. When one parent stays home from work, he or she can care for children and engage in other home production tasks without having to spend taxed income or having to pay taxes on the benefits. It is as if the benefits of home-produced goods and services are tax-free. A reduced tax exemption for children in families with a stay-at-home parent would eliminate this tax advantage. From a Haig-Simons perspective, it costs families more money to earn their income when both parents are working because they must spend money on child care and other services. The exemption compensates them for this extra cost.

Advanced Questions

10. Suppose that you estimate the following female labor supply relationship:

Labor supply$_i$ = –320 + 85(after-tax wage)$_i$ + 320(college graduate)$_i$ –120(married)$_i$, where labor supply is measured in annual hours worked and wages are expressed in hourly wages.

a. Interpret the coefficient on after-tax wages. What does this coefficient imply about the effect of increasing wages from $6 to $10 per hour on labor supply?

The coefficient on after-tax wages is positive, indicating that a higher after-tax wage increases labor supply. The magnitude of the effect is 85: for each dollar increase in after-tax wage, all else equal, a female will work 85 more hours per year. For a $4 increase (from $6 to $10), that translates to 4 × 85 = 340 hours.

b. What can we learn from this estimate about the income and substitution effects of wages on labor supply?

This estimate does not explicitly include a measure of nonlabor income. The approach described in the text subtracts the nonwage income effect from the wage effect to isolate

the substitution effect of wages on labor supply. That cannot be done here. The most we can confidently state is that the total of income and substitution effects is positive, so any negative effect on labor supply arising from the income effect is more than offset by the substitution effect. The substitution effect, which induces more work as leisure becomes more expensive, must be greater than the income effect, which induces less work as income increases.

c. How might this coefficient estimate be biased? Explain.

This estimate holds marital status and having a college degree constant. Given those controls, the coefficient of interest is +85, indicating that women who earn a higher wage work more hours. A number of other explanatory variables would have to be included to avoid bias. There is no control for family size or presence of children, and it may be the case that mothers are more likely to work part-time and to accept a lower hourly wage in exchange for work hour flexibility. It is also possible that the women who are earning the highest wages and working the longest hours are somehow different from other women, not just in presence of children but in chosen careers, in attitudes about working, or in ambition. Thus, there are a number of competing explanations for the observed correlation between wages and hours that this cross-sectional estimate cannot distinguish.

11. Why does the Earned Income Tax Credit exacerbate the marriage penalty for low-income workers? Suggest an alternative method of calculating the EITC that reduces this penalty.

The EITC exacerbates the marriage penalty by combining both spouses' incomes to determine eligibility for the credit. Two fairly low incomes can combine to equal a total family income high enough to place the family in the phase-out portion of the EITC. In that situation, adding a second income to the first puts the second income in the range of a very high marginal tax rate. This effect could result in a labor supply reduction for secondary earners in these families. To counter this effect, the EITC could be amended so that the average of the two spouses' salaries determined the family income, it could provide for a much longer plateau before phase-out for two-earner families, or it could be applied to *individual* incomes, regardless of marital status, rather than to family income.

12. The National Bureau of Economic Research's TAXSIM model (http://www.nber.org/~taxsim/taxsim-calc5) allows you to calculate tax liabilities for a given individual in different years. Go to this Web site and fill in the blanks to "construct" two individuals—a lower-income individual with $20,000 in income and a higher-income individual with $100,000 in income. Assume that both individuals are 45-year-old single parents of two children who do not own homes and have no child care expenses. Use the model to calculate these individuals' federal marginal tax rates and federal income tax liability in 1985, 1995, and 2005. Explain the pattern you find.

The following table summarizes the marginal tax rates for the three years and the two individuals.

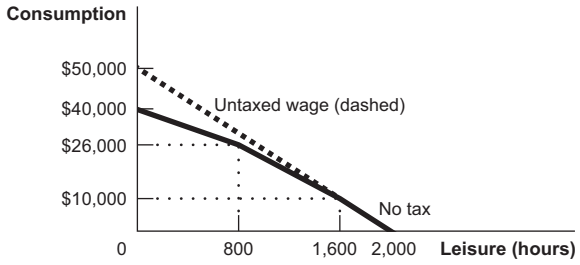
	$20,000 Income Individual		**$100,000 Income Individual**	
	MTR	**Tax Liability**	**MTR**	**Tax Liability**
1985	20.00%	$2,226	48.00%	$33,658
1995	35.22%	-$338	31.00%	$20,407
2005	31.06%	-$3,904	25.00%	$16,272

We see that the marginal tax rate for the lower-income individual was less than half the marginal tax rate for the higher-income individual in 1985. The marginal rate for the higher-income individual fell steadily, reflecting two things: first, marginal tax rates were reduced over this time period. Second, inflation eroded the real value of $100,000 over that 20-year period: $100,000 was much more income in 1985 than in 2005, so it consequently put the individual into a higher bracket in the earlier year. In 1995 and 2005, the marginal tax rate of the lower-income worker was higher than the marginal tax rate of the higher-income worker, and the total tax liability of the lower-income worker was negative. These two facts can both be explained by the introduction (and expansion) of the Earned Income Tax Credit. The low-income individual finds himself or herself in the phase-out portion of the EITC and is subjected to a high effective marginal tax rate.

13. You graduate from college and take a job at a consulting firm with a wage of $25 per hour. Your job is extremely flexible: you can choose to work any number of hours from 0 to 2,000 per year.

a. Suppose there is an income tax of the following form:
Income up to $10,000: no tax
Income from $10,000–$30,000: 20% tax rate
Income from $30,000 up: 30% tax rate
Draw a graph in hours worked/consumption space, showing your opportunity set with and without the tax system. With the tax system in place, are there any points that you are particularly unlikely to choose? Why or why not?

With an hourly wage of $25, the points of interest in the labor/leisure budget constraint will be $10,000 and 400 hours of labor (1,600 hours of leisure) and $30,000 and 1,200 hours of labor (800 hours of leisure). At leisure of more than 1,600 hours, the slope of the budget constraint is the wage of 25; between 1,600 and 800 hours of leisure, the slope is 80% of the wage, or 20; at less than 800 hours of leisure, the slope is 70% of the wage, or 17.5. The *y*-intercept will be $10,000 + .8($20,000) + .7($20,000) = $40,000.



There are no points that you are particularly unlikely to choose because there are no sharp discontinuities or perfectly flat portions of the budget constraint. A marginal tax rate of 1 (or even greater!) would completely discourage work, but there are no such tax rates in this system.

b. Say you choose to work 1,500 hours per year. What is your marginal tax rate? What is your average tax rate? Do these rates differ? Why or why not?

Working 1,500 hours per year would yield an income of 1,500 ≈ $25 = $37,500 and would put you in the highest tax bracket, with a marginal tax rate of 30%. To calculate the average tax rate, divide total taxes paid by income: the first $10,000 of income is untaxed; the next $20,000 of income is taxed at the rate of 20%, or $4,000; the remaining $7,500 is taxed at the rate of 30%, or $2,250.

Total taxes are $6,250. The average tax rate is 6,250/37,500 ≈ 16.66%. The marginal tax rate is higher than the average tax rate because the progressive structure of this tax system taxes the last dollar earned at the highest rate; the average tax rate includes the lower marginal rates paid on the first $30,000 of income.

c. Suppose that the two tax rates are increased to 25% and 50%. What is the likely effect on the labor supply of men? What is the likely effect on the labor supply of married women? Explain how the responses might differ between these groups, both in terms of underlying economic effects and in terms of the empirical evidence on labor supply responses.

The 25% rate is a slight increase over the current 20% rate; the 50% rate is 20 percentage points higher than the original tax rate for the higher bracket. The labor supply of men is generally thought to be inelastic: the empirical estimate of elasticity is approximately –0.1. This inelasticity suggests that the labor supply of men would be minimally affected by this change. The labor supply of married women, though, has been estimated to be much more elastic: a higher tax rate would tend to reduce their work hours by more. These predictions based on empirical evidence are supported by economic theory. Secondary earners (historically, married women) face high marginal tax rates even if they earn low wages, since the primary earner's income pushes the family into a higher tax bracket. This provides a strong disincentive to work, particularly if the secondary worker has home production alternatives such as child care.

e 14. Fligrenia's tax system has several tax brackets, ranging from a 0% marginal rate to a 50% marginal rate. The marginal tax rate paid by married couples under the current system is based on the last dollar earned by either spouse. Fligrenia is changing its tax system, however. Under the new system, the higher earner in a household will continue to be taxed as before (based on the marginal rate associated with total household income). The marginal rate for the lower earner will now be based on that worker's income only, however.

a. Which families do you expect to be most affected by this tax change, and why?

The tax change would most affect households with one high-earning primary worker and one low-earning secondary worker. Under the old system, the primary worker would earn enough to push the family up to a high marginal tax bracket, so the secondary worker would face high marginal taxes on his or her earnings. The new system would "fix" this, putting the secondary worker's earnings into a much lower bracket. This would potentially lead to a big response.

b. Describe a difference-in-difference analysis that could be used to estimate the effects of taxation on married female labor supply.

Secondary earner wives with similar earnings capacities (as measured, say, by their years of education) will be affected differently by the policy change depending on their husbands' earnings. Wives of lower-earning husbands can therefore serve as a natural control group for otherwise similar wives of higher-earning husbands, since the latter see a large drop in effective marginal tax rate, but the former see a more modest drop. Comparing differences in the labor supply responses of these two groups should provide a good estimate of the labor supply effects of taxes, even if other changes in employment patterns among married women are taking place in the economy (at least so long as the changes are not specific to wives of high-earning men).

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 22

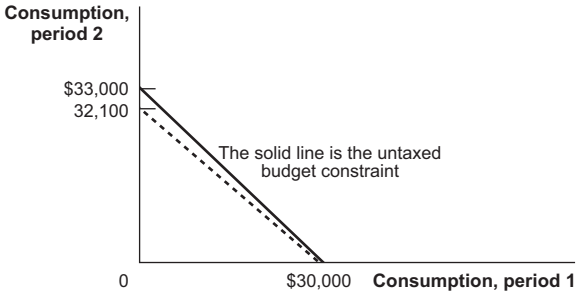
TAXES ON SAVINGS

Questions and Problems

1. **Suppose that a person lives for two periods, earning $30,000 in income in period 1, which she consumes or saves for period 2. What is saved earns interest of 10% per year.**

   a. Draw that person's intertemporal budget constraint.

   The *x*-axis intercept is consumption out of the entire earnings of period 1: $30,000. The *y*-axis intercept is income available in period 2 if the entire period 1 earnings were saved, earning interest at the rate of 10%. This amount is 30,000(1 + *r*) = $33,000.



   b. Draw that persons's intertemporal budget constraint if the government taxes interest at the rate of 30%.

   When interest is taxed at 30%, the *y*-axis intercept becomes 30,000(1 + 10%[1 – 30%]), or 30,000 × 1.07 = $32,100. This is shown as a dashed line in the figure in a.

2. **Suppose that the government increases its tax rate on interest earned. Afterward, savings increase. Which effect dominates, the income effect or the substitution effect? Explain.**

   An increase in the tax on interest earned makes individuals poorer, so the income effect would tend to reduce consumption. It also reduces the opportunity cost of consumption by reducing the value of savings, so the substitution effect would tend to increase consumption. Since savings increased when the tax rate on interest increased, the income effect was the dominant effect.

3. **Mallovia has two tax brackets. The first $20,000 in income is taxed at a 10% marginal rate, and income above $20,000 is taxed at a 30% marginal rate. All income—earned income and nominal interest, dividend, and capital-gains income—is treated the same. The threshold for the 30% rate is currently indexed for inflation, and the real interest rate is 5%.**

a. How does inflation affect the return to savings in Mallovia? Compare the likely savings rate when expected inflation is 10% with the likely savings rate when expected inflation is zero.

Inflation reduces the return to savings because Mallovia's tax system taxes nominal interest. A 10% inflation rate implies a 15% nominal interest rate. This entire 15% is taxed, even though only one-third of it represents a real return. However, the lower effective rate of return will only lower the savings rate if the substitution effect (the lower rate of return to savings) dominates the income effect (people need to save more to achieve a given level of well-being in retirement, for example).

b. How would your answer change if the threshold for the 30% rate were not indexed for inflation?

If the threshold were not indexed, inflation would lower the return to savings even more for some individuals. Without indexing, inflation will push some individuals into higher tax brackets when they get older. This means that their interest income will be taxed at a higher rate, reducing the rate of return. Again, this will further lower savings if the substitution effect dominates the income effect. Note, however, that for individuals with high enough savings rates that they would be in the 30% tax bracket anyway, the only effect of deindexing is an income effect—a higher percentage of their real income is taxed at the higher rate. This will increase their savings rate.

4. The government of Maupintania introduces a new insurance program that pays for 100% of unexpected catastrophic medical costs. Before this time, only low-income households had this benefit.

a. Describe an empirical test of the effects of this policy change on the savings of high-income households in Maupintania.

Extending this benefit to high-income households will affect precautionary savers, those who had been saving to smooth consumption in the event of an unforeseen medical emergency. If the government covers catastrophic medical costs, less precautionary savings is needed. Therefore, a simple empirical test would compare savings among high-income Maupintanians before and after the change in policy. However, if the researchers suspected that savings rates might be changing for reasons unrelated to the policy change they could use a difference-in-differences approach, comparing any changes in savings rates among high-income Maupintanians with changes in savings rates among low-income Maupintanians. So long as the non-policy-related changes in savings rates were similar across Maupintanians with low and high incomes, the changes in saving rate of the high-income residents over and above the change in savings rates of the low-income residents provide an unbiased measure of the effects of the policies.

b. What do you expect to happen to the overall rate of savings in Maupintania?

By eliminating one risk that precautionary savers might be saving for, this benefit is likely to reduce the overall rate of savings in Maupintania.

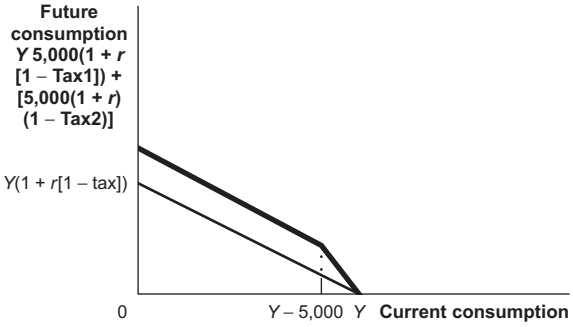
5. Shiz University has introduced a new plan that allows employees to automatically deduct after-tax money from their paychecks to be deposited in a pension plan. Why might people participate in this plan when there are no financial incentives to do so?

Since the money deposited is after-tax, there is no tax advantage to using this benefit, and because it restricts choice over use of the money, there would appear to be a disadvantage. A fully rational economic agent would not accept a constraint with no offsetting benefit. However, this plan would appeal to employees who know they need a commitment device to get them to save. Most people don't have perfect willpower, so although they may

know they are better off saving for retirement, they may also know they will find it hard to sacrifice current consumption. By agreeing to have the money deducted before they even receive it, these employees avoid temptation.

6. The government introduces a tax incentive program in which the first $5,000 of savings can be tax-deferred. Draw the resulting budget constraint that illustrates the trade-off between current and future consumption.

In this budget constraint, the first $5,000 saved gains more future-period consumption than does other savings, so the slope of that part of the budget constraint is steeper. Any tax that would have been paid on that amount can be invested by the taxpayer, increasing future consumption. Savings in excess of $5,000 is taxed immediately, reducing future consumption. In the following graph, *Y* denotes current income. Tax1 denotes tax assessed on the undeferred income; Tax2 is the tax paid on the amount deferred. The bold, kinked line illustrates the tax-deferred budget constraint.



7. Gale and Scholz (1994) estimate that increasing the contribution limits for Individual Retirement Accounts would have little effect on the overall rates of savings. Why do you think this might be the case?

Overall savings rates only increase when people take money from current consumption and invest it in savings. When people merely switch from non-IRA savings to IRA savings, the total savings rate is unaffected. One reason for Gale and Scholz's finding may be that the current IRA limits are so high that most people could not afford to reduce their current consumption further to invest more in retirement savings. Perhaps the only people who could or would increase IRA savings are the wealthy who already have substantial savings that could be moved to this less-liquid but tax-favored form of savings.

8. Discuss whether IRAs have increased savings in the United States in the past 15 years, paying attention to the fact that people vary along many dimensions and there are numerous definitions of savings. What can we learn by comparing the non-IRA assets of people who do and don't have IRAs? Can you suggest alternative means of estimating the impact of IRAs on savings?

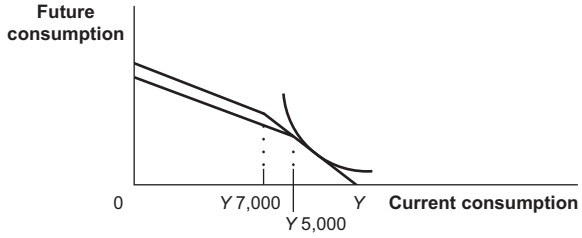
In the aggregate, IRAs have increased savings rather than merely reshuffling existing savings. However, there are definitely differences in saving behavior among taxpayers. People may save in IRAs as a response to tax preferences, or it may be that people who tend to save do so in a variety of investment instruments. An example provided in this chapter was that of 401(k) plans: people who had chosen employment at which 401(k) plans were offered differed in other savings-related ways from people who had chosen employment with firms that did not have 401(k) plans. Therefore, the non-401(k) group would not make a good control for considering responses among 401(k) holders. The same thing may be true of people with fully funded IRAs: they are likely to be different in other respects from non-IRA holders. For example, they may be better informed about tax advantages because of their education or career choices, or they may be the saving type.

Studying non-IRA assets may be one way to investigate a person's tendency to save. A taxpayer with plenty of non-IRA assets in addition to an IRA would appear to be someone who places a high value on saving for the future. Perhaps for this taxpayer the IRA had no effect on new savings: the money would have been saved anyway, so the tax preference did not induce any new behavior. In contrast, a taxpayer who does not have any other savings may well be someone who would not have saved in the absence of the IRA because there does not appear to be additional evidence of a preference for saving for the future. This inference is not completely convincing, however. The tax preference may have induced more savings in the person who was already saving, and the person with only an IRA might have intended to save exactly that amount for retirement and no more. Without an IRA, he would have saved it elsewhere.

The change in eligibility for IRAs might allow for a quasi-experimental approach to estimating the impact of IRAs on savings. High-income taxpayers who had been eligible for tax-deductible IRAs lost that deduction. It may provide insight to investigate any changes in their saving behavior before and after the policy change and compare their changes with the behavior of taxpayers who remained eligible for an IRA tax deduction.

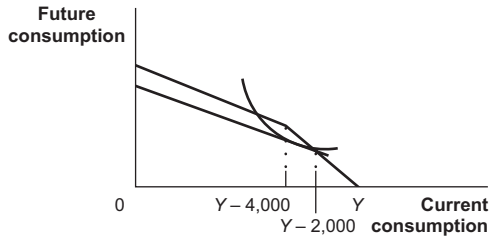
9. Two countries with comparable levels of income per capita each propose raising the amount of savings that can be tax-deferred by $2,000. In Wenti, the current maximum amount of savings that can be tax-deferred is $2,000, while in Schale, the current limit is $5,000. In which country are savings likely to rise by more? In which country is the inframarginal response likely to be greatest? Which savings incentive will likely cost its government the most? Explain.

Because income is similar in both communities (and assuming that tastes for saving are similar in both communities), it is likely that savings will increase by more in Wenti than in Schale. The current tax-deferred limit in Schale, at $5,000, may already be close to or more than the maximum amount taxpayers are willing or able to save in such an illiquid form. Given the stated similarities between the two countries, the current limit in Schale must exceed the savings rate of more people than the current limit in Wenti. Thus, more taxpayers in Schale are currently choosing an optimal combination of savings and current consumption that places them on the steep part of their intertemporal budget constraint. If that is the case, increasing the tax-deferred limit will not affect their behavior.



No indifference curve tangent to the higher budget constraint will yield greater utility than the one chosen when the tax-deferred limit was $5,000. Total savings won't change.

In contrast, the new limit in Wenti is only $4,000, an amount that is likely to be less than the maximum amount people are willing to save in such an illiquid form. This change in the budget constraint is more likely to induce new savings.



The effect in Wenti is ambiguous: indifference curves exist that would induce either more or less savings depending on whether the income effect dominates (less savings) or the substitution effect dominates (more savings).

The Wenti incentive is likely to induce a greater inframarginal response than the Schale plan because more taxpayers in Wenti will be able to move existing savings into a tax-deferred account. Any Wentian with savings in excess of $2,000 will be able to reshuffle at least some savings into the tax-deferred account, but a Schalean would have to have savings in excess of $5,000 in order to take advantage of this new limit. Because fewer Schaleans will be willing or able to avail themselves of this tax advantage, the Wenti plan will cost the government more in lost revenue.

10. Jack is a 48-year-old consultant who earns $480,000 per year. Hector is a 19-year-old college student who has just finished a summer job that paid him $5,000. Both are planning on putting some of their earnings into IRA accounts. Who should be more likely to use a Roth IRA instead of a traditional IRA?

Hector is more likely to use a Roth IRA. With a Roth IRA, individuals pay taxes on their income *now* and do not pay taxes later. With a traditional IRA, individuals pay taxes when they take the money out. For an individual facing a constant tax rate, it doesn't matter which vehicle they use. Hector, however, is likely to be in a lower tax bracket now than he will be when he retires, and Jack is probably in as high a tax bracket as he will ever be. Hence, Hector benefits more from paying the low tax now while Jack benefits more from deferring the tax until later.

Advanced Questions

11. Generational accounting techniques (recall Chapter 4) suggest that future income tax rates will be higher than current tax rates. How should this information affect the savings rate? How should it affect the relative appeal of Roth versus traditional tax-deferred IRAs?

Rising income taxes will reduce the return to savings, since the interest earnings will be taxed at a higher rate. This will increase savings rates if the substitution effect dominates the income effect, and it will reduce savings rates if the income effect dominates. Rising tax rates substantially reduce the returns to saving in tax-deferred traditional IRA accounts, since both the principal and the interest will be taxed at a higher rate. In contrast, returns to Roth IRAs are unaffected by future tax rates since there is no tax on withdrawals from Roth IRA accounts (the money is taxed only when it is put into the account). Assuming that the government keeps its word and does not tax withdrawals from Roth accounts, then rising tax rates will make Roth IRAs relatively more appealing.

12. In some cultures, when a member of the community who is ineligible for government-provided social insurance faces some adverse condition, the rest of the community lends that member money until his or her condition improves. In these cultures,

would you expect more or less buffer-stock savings than occurs in the United States? Explain.

A person who lives in a culture that follows a norm of assisting someone who has fallen on hard times would have less need for precautionary savings and thus would be likely to have lower savings rates. In a sense, these cultures informally pool risk. By accepting this norm, people have accepted an implicit duty to help their fellow members in exchange for the expectation that help would be given if they needed it. Perhaps people in the United States have accepted a norm of self-reliance: save for your own future needs and, to some extent, let the chips fall where they may. As a result, we must save for the proverbial rainy day.

13. Consider a model in which individuals live for two periods and have utility functions of the form $U = \ln(C_1) + \ln(C_2)$. They earn income of $100 in the first period and save S to finance consumption in the second period. The interest rate, r, is 10%.

a. Set up the individual's lifetime utility maximization problem. Solve for the optimal C_1, C_2, and S. (Hint: Rewrite C_2 in terms of income, C_1, and r.) Draw a graph showing the opportunity set.

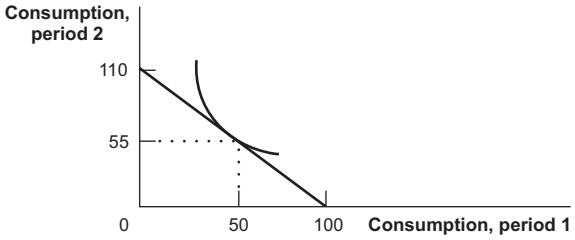
Consumption in the second period is savings from the first period plus interest. Savings is just income from the first period minus consumption during the first period: $C_2 = (100 - C_1)(1 + 0.1)$. The utility maximization problem is

$$\max \ln(C_1) + \ln(C_2) \text{ subject to the budget constraint.}$$

When the budget constraint is incorporated into the expression for C_2, as shown, the maximization problem is

$$\max \ln(C_1) + \ln((100 - C_1)(1.1)) = \max \ln(C_1) + \ln(110 - 1.1C_1).$$

Solving, the first-order condition is $1/C_1 = 1.1/(110 - 1.1C_1)$ or $110 - 1.1C_1 = 1.1C_1$.
$C_1 = 110/2.2 = 50$.
$C_1 = 50$, so savings is $100 - 50 = 50$.
$C_2 = S(1 + r) = 50(1.1) = 55$.



b. The government imposes a 20% tax on labor income. Solve for the new optimal levels of C_1, C_2, and S. Explain any differences between the new level of savings and the level in part a, paying attention to any income and substitution effects.

The 20% tax is imposed on the entire $100 earned in the first period. After-tax income is $100(1 – tax), but since it is only a tax on labor income, interest earned is not subject to additional tax. The new optimization problem is

$$\max \ln(C_1) + \ln(80 - C_1)(1.1) = \max \ln(C_1) + \ln(88 - 1.1C_1).$$

The first-order condition is $1/C_1 = 1.1/(88 - 1.1C_1)$.

Solving, $88 - 1.1C_1 = 1.1C_1$; $88 = 2.2C_1$.

$C_1 = 40$.

Savings = 80 – 40 = 40.

$C_2 = S(1 + r) = 40(1.1) = 44$.

The tax reduced current consumption and savings by reducing income; this is an income effect. Because it is a tax only on labor income, not on interest earned, the tax represents a parallel shift of the budget constraint, a pure income effect. The relative prices of C_1 and C_2 did not change, so there is no substitution effect.

c. Instead of the labor income tax, the government imposes a 20% tax on interest income. Solve for the new optimal levels of C_1, C_2, and S. (Hint: What is the new aftertax interest rate?) Explain any differences between the new level of savings and the level in a, paying attention to any income and substitution effects.

A tax on interest rather than on labor income changes computation of C_2 to include a tax of 20% on interest earned on savings:

$$C_2 = (100 - C_1)(1 + r) - .2(r(100 - C_1)).$$

The first component of this expression is just savings plus interest; the second component is 20% times the interest earned. This is equivalent to

$$C_2 = (100 - C_1)(1 + .8r) \text{ or } (100 - C_1)(1.08).$$

The maximization problem here is max $\ln(C_1) + \ln(108 - 1.08C_1)$; the first-order condition is $1/C_1 = 1.08/(108 - 1.08C_1)$.

$C_1 = 108/2.16 = 50$.

Savings = 100 – 50 = 50.

$C_2 = 50(1.08) = 54$.

In this case, the lower return to savings (because interest is taxed) changed the relative prices of C_1 and C_2: sacrificing C_1 yields less increase in C_2 than before the tax. However, this substitution effect (which would be expected to decrease savings) is exactly offset by the income effect: with the lower rate of return, the individual is worse off in period 2 for any given level of savings, leading him to reduce his consumption in period 1, thereby increasing saving.

14. Consider a model in which individuals live for two periods. There are two individuals, John and Jules, and both have utility functions of the form $U = \ln(C_1) + \ln(C_2)$. John earns \$100 in the first period and saves S to finance consumption in the second period. Jules will receive \$110 in the second period, and she borrows B to finance consumption in the first period. The interest rate r is 10%.

a. Set up each individual's lifetime utility maximization problem. Solve for the optimal C_1, C_2, and S (or B) for Jules and John. (Hint: Rewrite C_2 in terms of C_1, income, and r.)

For John, consumption in the second period is given by $C_2 = S(1+r) = (100 - C_1)(1 + 0.1)$ (i.e., the amount he saves plus interest). For Jules, consumption in the first period is financed entirely by borrowing, and she must pay back $(1+r)B$ in the second period. Hence, it must be that $C_2 = 110 - (1 + r)B = 110 - (1 + r)C_1$ for Jules. Rearranging (with $r = 0.1$), we calculate that $C_2 = (100 - C_1)(1 + 0.1)$. Hence, John and Jules have the same budget constraint. Since they have the same preferences as well, they will have the same consumption in each period. To find the consumption, use the relationship $C_2 = (100 - C_1)(1.1)$ in John's (or Jules's) maximization problem:

$$\max \ln(C_1) + \ln(1.1(100 - C_1))$$

Taking a derivative, setting it equal to zero, and rearranging gives

$$1/C_1 = 1.1/(1.1(100 - C_1)), \text{ or } 100 - C_1 = C_1, \text{ or } C_1 = 50.$$

Hence, $C_1 = 50$, $S = 50$, $C_2 = 50(1.1) = 55$, and $B = 50$.

b. The government now imposes a 20% tax on interest income. Solve for John's new optimum level of *S*. (Hint: What is the new after-tax interest rate?) Explain how your answer relates to the saving you found for John in a, paying attention to any income and substitution effects.

Writing the relationship between savings and second-period consumption for John is now slightly more complicated:

$$C_2 = S\,(1 + r) - 0.2rS = S(1+1 - 0.2)r) = S(1 + 0.8r).$$

Hence, $C_2 = (100 - C_1)(1.08)$. The maximization problem thus reads

$$\max \ln(C_1) + \ln(1.08(100 - C_1))$$

Taking a derivative, setting it equal to zero, and rearranging gives

$$1/C_1 = 1.08/(1.08(100 - C_1)), \text{ or } 100 - C_1 = C_1, \text{ or } C_1 = 50$$

just as in a. Savings and first-period consumption are the same as in a. (C_2 is now 54, lower than before.) Savings is unchanged in spite of the tax because of perfectly offsetting income and substitution effects. The substitution effect makes John want to save less and consume more in the first period (the rate of return is lower), but the income effect makes John poorer, so he consumes less in each period.

c. Suppose that the government also provides a 20% tax credit on interest, so if Jules borrows $10—and consequently owes $1 in interest—the government will give her $0.20 back. Solve for Jules's now-optimum level of *B*. Explain how your answer related to the borrowing you found in a, paying attention to any income and substitution effects.

For Jules, we now have

$$C_2 = 110 - [(1 + r)B - 0.2rB] = 110 - (1 + 0.8r)B = 110 - 1.08B.$$

(Note that this in not the same as John's part b budget constraint.) Her maximization problem reads

$$\max \ln(C_1) + \ln(110 - (1.08)C_1)).$$

Taking a derivative, setting it equal to zero, and rearranging gives

$$1/C_1 = 1.08/(110 - 1.08C_1), \text{ or } 110 - 1.08C_1 = 1.08C_1, \text{ or } C_1 \approx 50.93$$

This change leads Jules to borrow more and consume more than in a. (Note, however, that she has the same C_2 as in a.) We can understand this easily as well: the substitution effect makes her consume more in the first period (it is cheaper to borrow). The income effect makes her richer, since for any given first-period consumption, she has to pay less back and thus gets to consume more in the second period. Hence, the income effect also leads her to consume more.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 23

TAXES ON RISK TAKING AND WEALTH

Questions and Problems

1. **The tax system has a 50% tax rate on gains from risky investments, and also allows a deduction at a 50% rate of any losses from risky investments. Which tax policy would increase risk taking more: (a) allowing those deductions on any losses, or (b) limiting the deduction only to losses that offset other gains (no loss offset)?**

   Allowing an investor to use the deduction for losses to reduce taxes on other gains will provide an incentive for the investor to take more financial risk, because the government is bearing some of that risk—by protecting the investor against part of the loss. An investor has an incentive to take risks, particularly if he expects a large, otherwise taxable, gain from another source. If losses could not be used to offset gains, as in (a), the investor would bear a greater share of the risk of loss.

2. **The Job Growth and Tax Relief Reconciliation Act of 2003 (JGTRRA) reduced the rate at which capital gains are taxed, but it includes a "sunset" provision whereby the tax rate will return to its original level in 2009 (unless further action is taken by Congress). How is this sunset provision likely to affect capital gains tax realizations and revenues in 2008 and 2009?**

   Individuals with unrealized capital gains will have a strong incentive to realize the gains in 2008, before the tax rates rise again. Indeed, an investor who would anticipate realizing capital gains in 2009 has an incentive to realize the gains in December 2008 instead. This leads us to expect a "boom" in capital gains tax revenues in 2008 and a corresponding reduction in revenues in 2009. Offsetting this—but probably only partly—is the fact that the lower level of realizations in 2009 will be taxed at a higher rate.

3. **President Berry suggests changing the capital gains tax law such that taxes are assessed when the gains are accrued rather than when they are realized. Why would investors tend to oppose this policy change?**

   The most obvious reason that individuals would not want taxes to be levied on accrual rather than on realization is that it would increase their effective tax rate. When taxes are levied only on realization, investors gain the benefit of compounding: if, for example, they earn a 10% rate of capital gains each year and they hold the asset for two years, a realization-based tax allows them to earn a 10% return in the second year on both the initial investment and the 10% return from the first year. Taxing on an accrual basis would remove this advantage and increase the effective tax rate.

   In addition, accrued gains are those associated with increases in the value of an asset and thus are, in a sense, hypothetical. The asset is worth more, in terms of increasing the owner's ability to consume other things, only if it is sold. Investors would object to this policy change because they would not want to pay taxes on an increase in value that has not yet been realized. First, they may not have the cash on hand to pay the tax and thus may have to

sell, or liquidate, the asset before they intended to. The timing of the sale of assets should not be dictated by tax bill dates. Second, the accrued value of some assets may be hard to determine (unless of course they are sold). Finally, the accrued value of some assets fluctuates—a "paper" gain can be wiped out and regained repeatedly. Whether a tax is owed in any given tax year will depend on the date on which the value is determined.

4. Prior to 1997, many university professors who moved from expensive places like Boston or San Francisco to low-cost cities like Madison, Wisconsin, or Gainesville, Florida, tended to purchase extremely large houses upon their moves. This tendency was dramatically curtailed after 1997. What feature of the U.S. tax code encouraged this behavior?

For many taxpayers, their homes are their most valuable asset, and homes can experience significant appreciation. Generally, when appreciated assets are sold, the appreciation, or gain, is taxed as a capital gain. For homes, though, there was an exception if the gain was used to purchase a taxpayer's next home. Housing prices in Boston and San Francisco are very high, so the appreciation on houses in those cities is also high, even if the appreciation does not represent a large percentage; a small percentage of $1 million is still a large amount. To shelter the gains from taxation, home owners had to use them to buy another house; to invest large gains in houses in a low-cost housing market, the home buyers had to buy pretty big or fancy houses.

5. What is the empirical evidence on whether capital gains tax cuts lead to a permanent increase in capital gains realizations? What does this evidence imply for the prospects of lowering capital gains taxes as a long-term revenue-generation tool?

The empirical evidence indicates that lowering the tax rate on capital gains can induce a transient change in the realization of gains but not a permanent one. There was a temporary spike in sales of assets in 1986 because taxpayers knew that the tax rate would increase in 1987 (as shown in Figure 23-1). After the tax change in 1987, realized capital gains returned to their 1985 level, confirming that the spike in 1986 was temporary.

Lowering capital gains taxes, then, seems only to shift the timing of asset sales, not to generate more revenue in the long term. In fact, because tax changes are announced in advance, people can plan to realize gains in the year with the lowest tax rate, reducing tax revenues.

6. When I spend money on my children's consumption, this transfer is not taxed, but if I make a large direct gift to my children, it is taxed. Why does this represent a horizontal inequity inherent in transfer taxes? Can you think of any policy modifications that could reduce this inequity?

Horizontal equity requires that people with the same ability to pay taxes should pay the same amount in taxes. Whenever one taxpayer avoids taxation that another similarly situated taxpayer pays, it seems horizontally inequitable. Thus, when spending for the benefit of offspring is not taxed but an identical amount in the form of a cash gift is taxed, it violates horizontal equity. Two ways to address this problem would be to tax all expenditures (over some minimum amount) that benefit a taxpayer's children or to never tax any transfers to children. Taxing every child-benefiting transfer (educational expenses, family vacations, camp, musical instruments and lessons, soccer dues, prom dresses—the list is endless) would be an accounting nightmare. But not taxing any transfers to children would create asset-sheltering incentives; parents who wanted to appear assetless to college financial aid offices or to Medicare administrators could simply move all their assets into their children's names.

7. Senator Crawford, arguing in favor of capital gains tax cuts, says that reducing capital gains tax rates will stimulate entrepreneurial activity. Senator Long, arguing against

these tax cuts, suggests that they will encourage people to engage in riskier behavior and inefficient investment. Evaluate both senators' arguments.

Entrepreneurs are compensated by the increase in the value of their companies, which comes in the form of capital gains. Lowering the tax on capital gains may induce new investment and more entrepreneurial activity because the gains from the investment will have a higher net-of-tax return to the investor or entrepreneur. In addition, when capital gains are heavily taxed, people may keep their money in resources that are not particularly productive simply because selling those investments will trigger tax liability. Lowering the tax will contribute to resource mobility.

Senator Long knows that capital gains are essentially returns to risk taking. When taxes on capital gains are sufficiently less than taxes on other income, people will choose capital gain income over labor income; that is, they will choose the riskier but lower-taxed behavior.

8. When Bill died in 2006, he left his children $200,000 in cash (generated from labor earnings), a $1.1-million-dollar home he had purchased (with labor earnings) for $100,000 in 1980, and $1.2 million in stock that he had purchased (with labor earnings) for $200,000 in 1985. Evaluate the argument that the estate tax represents double taxation of Bill's income.

Bill's total estate is $2.5 million. The 2006 estate tax exemption is/was $2 million. So $500,000 of Bill's estate is taxed. Of his estate, $500,000 has "already been taxed" once—the $200,000 in cash and the $300,000 paid for the house and the stock. The $2 million in capital gains on the house and stock have not been taxed. Because of the "basis step-up at death" provision in the tax code, that $2 million will never be taxed. Think of dividing the $2.5 million estate—all of which was part of Bill's lifetime income in one way or another—into three pieces: the $500,000 that has already been taxed, the $500,000 that is taxed under the estate tax, and the $1.5 million that has not been and will never be taxed. This calls into question the validity of the argument that the estate tax represents double taxation of Bill's income.

9. Why does the property tax, as implemented in the United States, provide a disincentive for property owners to improve their property? How would a land tax alter these incentives?

The property tax is assessed on the value of land plus improvements, so the higher the value of the improvements is, the higher the tax is. A property tax increases the price of improvements or, similarly, reduces the net-of-tax return on making improvements. If only the land were taxed, owners would have an incentive to use the land as productively as possible because they would be able to keep more of the returns to productivity. Someone who wanted to use a given piece of land in a productive way would be more likely to acquire, improve, and use the parcel if he were not taxed on the improvements located on it. Furthermore, if someone were not using the land in its most productive way but had to pay taxes on the market value of the land, he or she would have an incentive to sell the property to someone who would put it to use.

10. The government of Lupostan introduced a policy in which all investments in college education and training are tax-deductible. Describe an empirical test of the effects of this policy on the level of human capital accumulation. What effects would you expect to find from such a policy?

You would expect this policy to increase investment in human capital. First, deductibility would make those investments less expensive relative to other investments, and the substitution effect would induce relatively more acquisition of education and training. Second, the tax deduction would increase income, and the income effect would tend to increase investment in everything, including human capital.

One test of the effects of this policy would compare education and training before and after the change in the tax. However, if other things were changing at the same time—if educational attainment were generally increasing, for example—this test would be biased. A differences-in-differences approach can potentially remove this bias. Noting that the benefits of tax-deductibility are bigger for households with higher tax rates and lower for households with lower tax rates, one can use the low-tax households as a "control group" for high-tax-rate households. Comparing the differences in education and training among high-tax households to the differences in education among low-tax households should provide a better estimate of the effects of the policy on encouraging education and savings than looking only at the first difference would.

Advanced Questions

11. Estoluania is considering replacing its progressive tax system with a flat tax that would raise equal revenue. How could this change encourage risk-taking behavior? How could it discourage risk-taking behavior?

The move to a flat tax would reduce the top marginal tax rate, thereby increasing the "upside" to risky investments. With more to gain from a risky investment, individuals might find these investments more appealing.

Under either tax system, the government provides "insurance" to investors by effectively sharing some of their risk: the government gets some of the benefit (more tax revenue) when the returns to a risky investment turn out to be high, and it bears some of the cost (reduced tax receipts) when returns are low. As in the Domar-Musgrave model described in the chapter, this risk sharing can lead to increases in risk-taking behavior relative to a no-tax world: an individual who wants to hold a portfolio with a certain level of risk must increase his or her exposure to risky assets when the government "insures" some of the risk. A similar argument applies when comparing a flat tax with a progressive tax. The latter provides more "insurance" than the former (it taxes gains more highly and losses less highly). It can therefore encourage individuals to take on more risk in order to achieve a given level of net after-tax risk in their portfolios. The movement to a flat tax may therefore reduce risk taking in Estoluania.

12. A researcher found that when the capital gains tax rate declined, the average bequest size fell as well. How does the tax treatment of capital gains in the United States explain this relationship?

A high capital gains tax rate creates a deterrent to selling assets. When an asset is sold, if there has been any appreciation in value—even if the appreciation is simply a result of general inflation—the seller of the asset must pay capital gains taxes on the difference between the original price and the sale price. One exception to this law occurs when the asset is part of an estate. When someone inherits an asset, the original value of the asset is changed, or stepped up, to the value on the date of inheritance. Thus, the amount of appreciation that is taxable starts over at zero. This exception creates a strong incentive to pass on an appreciated asset to heirs. When capital gains tax rates are lower, it is not so critical to leave an asset in an estate; the original owner is more likely to sell the asset and take the gain for himself. As a result, the size of the bequest will decrease.

13. Pamplovia raised its estate tax rate from 30% to 50%. However, it "grandfathered" in families whose householders were over 80 years old, allowing these families to be assessed the original 30% estate tax. How could you go about estimating the effects of estate tax rates in Pamplovia on the magnitude of bequests.

People who were 79 at the time of the change face a 50% estate tax; those just a year older face the 30% rate. This creates an opportunity to investigate the effect of the change in

tax rates by comparing the bequests of those who face a 30% rate and those who face a 50% rate. Seventy-nine-year-olds are not very different from eighty-year-olds, and so by comparing those two groups a researcher could estimate the effects of the tax rates. A more refined approach would use a difference-in-differences approach. The control group could be those who were 80 and 81 at the time of the tax change (all of whom face a 30% tax rate); the treatment group would be those who are 80 and 81 the following year: the 81-year-olds will still face a 30% tax rate, but the 80-year-olds face a 50% tax rate. The size of a person's estate may shrink between the ages of 80 and 81, but having people of both those ages in each group would allow researchers to control for the change. An economic recession or expansion may reduce the value of investments between the two years, but considering data from both years would allow researchers to control for business cycle effects. By using these controls the researcher would be able to isolate the change in bequest associated with the difference in estate tax rate.

14. In some states, a local government that reduces its tax base receives additional aid for local public good provision from the state government. Why will cities be more likely to offer tax breaks in this circumstance? Why are tax breaks in this case particularly bad for overall welfare?

A city would rather have the state government pay for local public goods than pay for them itself, because when the state pays the cost is spread over all state residents but the benefits are enjoyed primarily by the residents of that city. A city has an incentive to offer tax breaks to new industries to raise the employment and income level of its residents when the revenue lost from the tax breaks is made up for by state revenues (that is, with taxes paid by all state residents). This practice is individually rational for each city but collectively disastrous. As in any free rider situation, when everyone tries to free ride the entire group becomes worse off. In this example, each city competes with every other city to attract new businesses with tax breaks. When every city tries to pass the cost of its own tax breaks on to the state, the whole state suffers.

15. The Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA) lowered the top marginal rate for estate taxation, called for a gradual increase in the estate tax exemption (the amount of an estate that is untaxed) to $3.5 million, and called for a complete elimination of the tax in 2010. However, a sunset provision in the law implies that the estate tax will reappear again in 2011, with an exemption of only $1 million and at a higher marginal rate. How should this sunset provision affect the savings and charitable giving rates of the elderly prior to 2011 and subsequent to 2011?

For a wealthy individual who thinks she is likely to pass away before 2011 (and who values bequests), the high exemptions and complete repeal make the return to saving higher. As usual, this has offsetting substitution and income effects: the higher rate of return encourages additional savings, but this will be at least partially offset by the fact that a lower level of savings will still generate the same anticipated bequest. Assuming that the substitution effect dominates, however, we expect that the lower rates will encourage additional saving by these wealthy individuals. Similarly, an elderly individual who anticipates dying with a large estate may wish to make charitable donations to avoid some of the estate tax. The higher exemptions and lower rates will make these charitable donations less desirable, so they are likely to decline prior to 2011.

However, in 2011, any wealthy individuals who did not die will find themselves with larger estates (assuming they gave less to charity and saved more, as described) and facing high marginal tax rates on their estates when they do die. This will encourage charitable donations and consumption and discourage savings. In summary, then, we expect higher

savings and lower charitable giving prior to 2011 but a boom in charitable giving and a decrease in savings in 2011.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 24

CORPORATE TAXATION

Questions and Problems

1. **Gill Bates is the CEO of a large company. His compensation is based on current profitability. He is considering undertaking one of two investments available to the company: (a) one that yields profits of $500 million in each of the next 5 years and none thereafter and (b) one that yields annual profits of $300 million over 20 years. He selects the first investment. How could this example illustrate the agency problem?**

   Mr. Bates has traded long-term profitability for current profitability because he faces a shorter time horizon than does the company as a whole. The agency problem arises when an agent's incentives differ from the incentives of the entity for which he works. In this case, the long-term interests of the company would be served with the second investment, but Mr. Bates's immediate compensation will be higher under the first investment, so he has a strong incentive to seek higher short-term profits. In five years he may well be retired or employed by a different company, so choices that increase profitability far into the future will not benefit him personally.

2. **You are a manager of a company that just spent $80,000 to purchase a piece of equipment that is expected to function for six years. If you can borrow money at 7%, what is the present discounted value of the depreciation allowance under the following circumstances?**

   a. You can expense the investment.

   By expensing the investment, the company can take the entire $80,000 as a tax deduction immediately. The present discounted value of this option is the full $80,000.

   b. You depreciate using straight-line depreciation methods.

   The straight-line method allows a company to depreciate the cost of the equipment by equal amounts each year for the expected life of the equipment. In this case, the annual share of depreciation is $80,000/6 years ≈ $13,333.33.

   Over the six-year period and applying the rate of 7%, the calculation for present discounted value is $13{,}333.33 + 13{,}333.33/1.07 + 13{,}333.33/1.07^2 + 13{,}333.33/1.07^3 + \ldots + 13{,}333.33/1.07^5$, which yields 13,333.33 + 12,461.06 + 11,645.85 + 10,883.97 + 10,171.94 + 9,506.25 ≈ $68,002.63.

   c. You depreciate over four years using accelerated straight-line depreciation methods.

   Depreciating in equal amounts over four years yields $20,000 per year, or $20{,}000 + 20{,}000/1.07 + 20{,}000/1.07^2 + 20{,}000/1.07^3 \approx \$72{,}486.32$.

d. You depreciate using an augmented accelerated method in which half of the asset value is depreciated immediately and the other half is straight-line depreciated over the remaining three years.

Under this method, the calculation of present discounted value would be \$40,000 immediately plus 40,000/3 = 13,333 over each of the next three years. This yields \$40,000 + 12,461.06 + 11,645.85 + 10,883.97 = \$74,990.88.

Comparing the methods, it is clear that the faster the company can depreciate its investment, the greater the present discounted value of the depreciation allowance will be.

3. Suppose that new machines cost \$504, and the marginal benefit from new machines is $MB = 246 – 6K$, where K is the number of machines purchased. The depreciation rate is 15% and the dividend yield is 10%.

a. What amount of capital will you purchase? Why?

The rule to follow in determining the optimal investment is the same as for almost every rule in economics: set the marginal benefit equal to the marginal cost. In this case, the marginal cost is the sum of depreciation and required returns (dividends, here). For each machine, this cost is (0.15 + 0.1)\$504 = \$126. The marginal benefit is $246 – 6K$. Setting the two equal and solving for K yields $K = 20$.

b. What amount of capital would you purchase if there were a 25% tax rate on cash earnings minus labor costs?

The tax on earnings reduces the return to capital (the marginal benefit) by 25%. We now solve $126 = (1 – 0.25)(246 – 6K)$. Rearranging yields $K = (246 – 126/0.75)/6 = 13$. The tax thus reduces investment by 7 units.

4. Suppose that dividend yield is 6%, depreciation is 12%, and the corporate tax rate is 35%. What would be the marginal cost of each dollar of machinery investment under the following situations?

a. Firms are allowed to expense the machine.

When the firm can expense the machine (take the full deduction immediately), the cost of the investment is reduced by 35¢ cents for each dollar spent (because the firm saves 35¢ per dollar in taxes). Therefore, the marginal cost of the investment is the sum of depreciation and dividend yield, reduced by the tax benefit, or (depreciation + dividend) × (1 – .35) = (0.12 + 0.06)(0.65) = 0.117 per dollar.

b. There is an investment tax credit of 8%.

An investment tax credit reduces the cost of the investment even further. If the investment tax credit were included in the tax system described in a, the net cost to the firm would be (depreciation + dividend) × (1 – .35 – the ITC) = (0.12 + 0.06)(0.65 – .08) = (0.18)(0.57) = 0.1026 per dollar. (If the investment tax credit is put in place without expensing, the net cost would be .18(1 – .08) = .1656.)

5. Why has the effective capital gains tax rate tended to be substantially lower than the dividend tax rate in the United States? Given that this disparity exists, why do so many firms pay dividends?

Dividends are taxed as income as soon as they are received; capital gains are not taxed until the asset on which they accrue is sold. In addition, if the asset is passed to an heir, any accrued gains are never taxed because of the step up in basis of assets at the time of death. Even when capital gains are realized, they are taxed at a lower rate than the highest marginal tax assessed on ordinary income. The relative preference for capital gains over distributed dividends would suggest that firms should not distribute dividends, yet they do. One reason

may be that dividends serve as a very visible signal of a firm's profitability. A second reason may be that managers are persuaded to distribute earnings to shareholders to reduce the amount of discretionary spending available to the managers; getting the money out of the hands of the firm's managers and into the hands of the stockholders reduces the agency problem. Another reason may be historic: if a company has been distributing dividends and then stops, investors may lose confidence in the company.

6. Why are equity holders more likely than debt holders to want firms to engage in risky investments?

Risky investments increase the potential profits of a firm but also increase the risk that the firm will lose substantial sums of money and go bankrupt. Both equity holders and debt holders stand to lose if the firm goes bankrupt (and the equity holders stand to lose more, since debt holders get paid first!). However, so long as the firm does not go bankrupt and default on its debt, debt holders get no benefit from the firm making higher profits—they get the same return regardless of the actual profit level. They thus care only about making sure that the firm does not go bankrupt, and they therefore want the firm to be conservative with its investments. Equity holders reap the benefits of rising profits, so they are more likely to find a risky investment desirable.

7. You conducted a research study and found that corporations that finance their investments with a larger ratio of debt to equity tend to pay higher rates of interest to lenders. Why do you think this practice occurs?

One component of the interest rates charged by lenders is a risk premium: the higher the risk of default, the higher the interest rate charged to compensate the lender for taking the risk. A firm that has relatively more debt is relatively more risky for at least three reasons. First, payment on debt cannot be delayed, as can payment of dividends to stockholders. Thus, the more debt the company has, the higher its fixed costs. If a firm cannot pay its debts, it may be forced out of business. Second, if the firm were to become bankrupt, the debt holders would have first claim on the firm's assets. The more debt holders there are, the more prior claims there will be on assets that can be used to satisfy the debt. Third, a lender would have to wonder why the firm does not have a lot of equity. If the firm's owners, who presumably have substantial information about the firm's operations, are not risking very much of their own money (through ownership shares), then perhaps it is not a very good risk.

8. The government of Kapitalia changes its tax code to allow for more accelerated depreciation of assets. Would you expect firms to substitute production methods away from capital and toward labor, away from labor and toward capital, or neither? Explain.

Accelerated depreciation reduces the cost of investing in capital because the value of the tax deduction is available sooner. If capital and labor are substitutes, the reduced after-tax cost of capital will induce a firm to substitute the cheaper input, capital, for labor. However, if capital and labor are complements, as in a fixed-proportion technology firm, cheaper capital will cause an increase in both capital and labor.

9. Consider the psychological effects of dividend signaling. Which would seem a stronger signal of corporate health (or its absence): when a long-standing dividend payer stops paying dividends or when a firm that had not previously paid them begins to do so? Explain.

One argument holds that investors are more sensitive to losses than they are to gains. Ceasing dividend payments will be salient to dividend recipients and may be taken as a very strong signal that the company is in trouble. If investors have come to see the dividend as a

reliable and stable source of income, its absence will seem significant. On the other hand, receiving a dividend once, when none had been paid before, will not have quite as strong an effect. It may be seen as just a one-time windfall rather than a major and permanent change in the firm's health.

10. Suppose that all industrialized countries agreed to a compact specifying that the corporate income of multinational firms must be paid to the country where the parent is incorporated. What do you expect would happen to the number of multinational firms? Explain your reasoning.

If there were universal agreement to tax all profit immediately (not when repatriated) by each corporation's home country, there would not be any new and probably would be fewer multinational firms. This global approach, by which corporations pay taxes to their home countries on income regardless of where it is earned, is currently followed by the United States and several other OECD nations. In the United States, however, the foreign tax credit and other tax code provisions provide incentives for firms to establish subsidiaries in low-tax jurisdictions and to shift profit-generating activities to those jurisdictions. Arrangements in which subsidiaries are located purely for tax-reduction reasons would decline, but multinationals that exist for non-tax-related reasons (such as proximity to a natural resource) would continue to operate multinationally.

11. Suppose that the corporate income tax rate is 30%, the personal income tax rate on dividend income and the interest tax rate are both 35%, and the capital gains tax rate is 20%. Compare the after-tax returns on each dollar of corporate earnings under three investment financing strategies:

a. The corporation finances using debt.

When a corporation uses debt financing, it pays interest to bondholders and deducts the interest payments from its taxes. As a result, a dollar that is earned and then paid to bondholders as interest generates a tax deduction for the firm; no taxes will be owed on that dollar. However, the bondholder must pay 35¢ in taxes on the interest earned. Thus, the net gain to bondholders is 65¢.

b. The corporation finances by issuing equity but does not pay dividends.

When the corporation does not pay dividends, it pays corporate taxes of 30¢ on each dollar earned in profit. If those profits increase the value of the firm, the shareholders will eventually pay capital gains tax on the remaining 70¢, for a net gain of $(0.70)(1 - 0.20) = 56¢$.

c. The corporation finances by equity and pays all its income in dividends.

When the corporation pays dividends, it must first pay taxes on the dollar earnings and then the stockholders must pay taxes on the dividend. At the first step, the dollar of earnings is reduced by the corporate tax of 30% to 70¢. If the entire 70¢ were distributed in the form of dividends, the stockholders would pay a 35% tax on that amount. Thus, the net gain in this situation is $(0.70)(1 - 0.35) = 45.5¢$, the lowest after-tax return of the three financing possibilities.

12. Different states have different corporate tax rates. How could you use this to study the elasticity of corporate investment with respect to corporate tax rates? What would be the problems with this approach?

The natural approach suggested by this variation would be to compare how corporate investment varied across states with different tax rates. It would be important to control for firms' characteristics in this approach, since investment rates vary across industries and firms for reasons unrelated to the tax rates. Even if this were done, there would be potential problems with the estimation procedure. Suppose—as expected—you found that states with

higher taxes have lower investment rates. This is still not enough to show that the lower investment rates were caused by the higher taxes. You would have to rule out other possible explanations. Suppose, for example, that the reason some states have high tax rates is that they face a major statewide recession and need to raise revenue to meet their constitutional balanced budget requirements. The recession would also dampen investment, so you would see lower investment levels in states with high tax rates even if the lower investment rates were not caused by the high tax rates.

Advanced Questions

13. Megacola faces demand of $Q = 2{,}200 - 20P$. Its costs are constant at $5 per unit.

a. Show that Megacola will not change its behavior if the government introduces a 20% tax on its profits.

A tax on profits does not change the basic relationship between marginal cost and marginal revenue that identifies the optimal quantity.

In this example, profit is maximized when marginal revenue equals marginal cost of 5. First, express demand as a function of price: price = $110 - 0.05Q$.

Marginal revenue has the same intercept but twice the slope: $MR = 110 - 0.1Q$.

Setting $110 - 0.1Q = 5$ yields $Q = 1{,}050$ units.

Solving for price, $110 - 0.05(1{,}050) = \$57.50$.

At this price and quantity, the firm earns profits of $1{,}050(57.50 - 5) = \$55{,}125$.

Since we know that $55,125 is the maximum profit possible for this firm, we also know that 80% of this number is the maximum net-of-tax profit possible for this firm; 80% of any smaller profit would yield a smaller after-tax profit. Thus, taxing pure profit will not change the underlying calculation of profit-maximizing quantity.

b. Does the existence of firms such as Megacola strengthen or weaken the case for a corporate income tax? Explain.

Taxing Megacola on its economic profits does not appear to create a distortion in a, so it would seem to be a very efficient tax. In addition, it is progressive, as the firms with the most market power—those that are able to maintain positive economic profit in the long run—would be the ones who paid the most in taxes.

However, there are some good reasons to not use this approach. Although it may not distort Megacola's decision, it may distort the initial decision of Megacola to incorporate at all (as opposed to choosing some other business form) or to incorporate in this jurisdiction. Surely it will provide an incentive for Megacola to overstate its costs in order to reduce reported taxable profit. Finally, and perhaps most important, the tax will discourage Megacola from investing for the purposes of increasing future profits.

Finally, a more philosophical objection to corporate profits taxation is that corporations are really fictitious entities; ultimately, human beings pay taxes, so the incidence of the tax will fall on the owners of the corporation.

14. Suppose that the corporate tax rate is 25%, there is an investment tax credit of 10%, the depreciation rate is 5%, and dividend yield is 10%. The official depreciation schedule is such that the present discounted value of depreciation allowances is 40% of the purchase price of the machine.

a. Calculate the per-period marginal cost of each dollar that the firm spends on the machine.

In the absence of taxation, the marginal cost equals depreciation + dividend yield, here 5% + 10% = 15%. The corporate tax rate of 25% does not directly change the cost of

the investment, but the investment tax credit (10%) and the PDV of depreciation (40%) do. Depreciation generates a deduction from taxes, and thus lowers the cost of investment by the corporate tax rate × the PDV of depreciation, here 40% × 25% = 10%; the investment tax credit (ITC) lowers the cost by another 10%.

The final calculation for marginal cost is (depreciation + dividend yield)(1 – [corporate rate × PDV of depreciation] – ITC)(0.15)(1 – 0.10 – 0.10) = 0.15 × 0.80 = 12%.

b. If the marginal benefit per period is $MB = 40 – 0.6K$, where K is the number of dollars spent on the machine, what is the optimal amount of machinery purchased?

The after-tax per-period marginal benefit is $(40 – 0.6K) \times (1 – .25)$, or, multiplying through, $30 – .45K$. Setting the marginal benefit equal to the marginal cost of 0.12 gives $K = 66.40$.

c. How would your answer change if the investment tax credit increased to 20%?

Returning to the original expression, (depreciation + dividend yield)(1 – [corporate rate × PDV of depreciation] – ITC), and increasing the last element in the second parenthetical to 20%, (0.15)(1 – 0.10 – 0.20) = 0.15 × 0.70 = 10.5%.

Setting marginal benefit equal to marginal cost, $30 – .45K = .105$, and solving yields $K = 66.43$. The increase in the investment tax credit thus increases the optimal investment (admittedly not by very much!).

15. The legislature in Tuneria has just passed a new law which will provide a large investment tax credit in one year. What pattern of investment would you expect to see over the next two years? What implications would this have for estimates of the elasticity of investment with respect to investment tax credits?

One would naturally expect many firms to delay investments that they had intended to make this year for an additional year in order to receive the credit. If they do so, there will be a slump in investment this year and a large boom next year. Comparing the investment in the year before the investment tax credit was put in place to investment in the year after it was put in place would thus provide a misleading picture of the effects of the investment tax credit on investment decisions. This year-on-year change would reflect both retiming of a given level of planned investment and actual increases in overall investment levels.

16. Reducing corporate tax rates is often considered as a policy tool to enhance investment. How could the presence of tax loopholes diminish the relationship between corporate tax rates and corporate investment?

For corporate investment to be causally related to tax rates, it must be related to the effective tax rates actually paid, not statutory tax rates. When firms use loopholes to shelter some income from taxation or to overstate deductions or take them sooner rather than later, the effective tax rate is already lower than the stated rate. Reducing stated tax rates may not have a very large effect on actual behavior if firms are already avoiding tax liability through creative use of loopholes.

Suppose the stated corporate tax rates were lowered but some tax advantages, or loopholes, were phased out. In this case, reducing stated tax rates might not reduce effective tax rates at all and might have no effect on investment or even have an effect that is in the opposite direction of the one intended.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.

Solutions and Activities
for
CHAPTER 25

FUNDAMENTAL TAX REFORM

Questions and Problems

1. Why would reducing the number of tax brackets reduce the incentives for tax evasion?

Theoretically, evasion increases when the marginal benefit of evading taxes increases. Tax brackets increase the marginal benefit of evasion by providing opportunities for taxpayers to reduce the marginal tax rate they face; a taxpayer who is able to "hide" enough income can report a taxable income in a lower bracket. When there are many tax brackets, there are smaller ranges of taxable income within each bracket. As a result, on average, taxpayers have to hide less income in order to place themselves in a lower bracket—just a little bit of cheating will be sufficient. With fewer tax brackets and thus larger ranges of taxable income within each bracket, more taxpayers are unable or unwilling to hide sufficient income to move to a lower tax bracket, so the benefits of evasion are lower.

2. Describe the advantages of using a value-added tax instead of a sales tax.

In theory, the two tax systems are equivalent: it doesn't matter if the tax is levied all at once when final goods are sold to consumers, as it is under a sales tax system, or incrementally on the value added at each stage of production, as it is under a VAT. In practice, however, there are two principal advantages of the VAT. First, if the system is used to raise a large amount of revenue, a sales tax can provide much larger incentives to evade the tax than can a VAT. Because a sales tax is concentrated on sellers of final goods, they have a big incentive to exchange the good "under the table" for cash, fail to record the transaction, and avoid paying the tax. The VAT reduces the incentive by levying a tax on a smaller portion of the final sale price of the good. (Furthermore, it makes under-the-table transactions harder to hide, since sales of goods to retailers are recorded by their supplier.)

Second, the VAT avoids the "cascade" problem. The problem arises because it is not always easy to distinguish between "final goods" and "intermediate goods." In a pinch, a restaurant might purchase some of its ingredients at a local supermarket, for example. The supermarket treats the transaction as the sale of a final good and pays tax on the transaction, even though it is really an intermediate good. (This tax can be avoided with proper accounting, but in a pinch it might not actually be avoided.) The VAT system treats all sales the same way, regardless of whether the goods sold are ultimately final goods or intermediate goods. It therefore avoids this problem.

3. Compare the two tax systems illustrated in Table 25-5. Describe a taxpayer who would be better off with the existing system than with the flat-tax proposal. Describe a taxpayer who would be better off under the flat-tax system.

The existing system is better for taxpayers who have a greater ability to take advantage of deductions and other means of avoiding and evading taxes; the flat-tax system, by impos-

ing a lower rate on a broader definition of income, benefits taxpayers who cannot adjust their reported taxable income to reduce their tax liability. A taxpayer who benefits from the existing system is likely to be a home owner with a mortgage interest deduction. He may also own his own business, through which he can creatively account for losses and investments to shelter other income. He may even fail to report transactions that do not leave a paper trail, such as cash purchases.

The taxpayer who takes only the standard deduction and receives all of his income from an employer who withholds taxes from each paycheck cannot easily manipulate the current system. He is paying close to the statutory tax rate. A flat tax will lower the rate and remove deductions (which this taxpayer isn't taking anyway). Thus, this taxpayer will continue to pay the statutory rate, which is lower under the flat-tax system.

4. How would fundamental tax reform likely increase tax efficiency in the United States?

Depending on the exact nature of the fundamental reform, several sources of increased efficiency are likely. First, a simpler tax with fewer loopholes and fewer special treatments of various sources of income would make tax evasion more difficult and the detection of evasion simpler; thus, revenues would increase and expenditures on tax enforcement would fall. Second, a lower tax rate on a broader tax base would induce fewer behavioral distortions. A broader tax base provides fewer untaxed activities as substitutes for taxed activities; a lower tax rate reduces the incentive for people to change behavior in order to avoid taxes. Tax calculation and collection would be more efficient with increased tax simplicity. A complex tax system distorts productive resources toward activities with little inherent economic or productive value in order to obtain favorable tax treatment; tax reform would reduce this source of inefficiency.

5. Imagine that a $30,000 investment in a good is expected to return you $25,000, and your marginal tax rate is 30%. The government is considering an investment tax credit that reduces the price of the investment. How large would the percentage reduction in the price of the investment have to be for you to make this investment?

The $5,000 loss allows for a deduction worth the tax rate times the loss, in this case .3($5,000) = $1,500. An investment tax credit that generated an additional $3,500 in tax reduction would allow you to break even on this investment. Calculating backward, at a tax rate of 30%, the investment credit that would yield $3,500 in tax savings is ($3,500)/(0.30) = $11,666.67, approximately 40% of the original investment.

A 40% ITC would allow you to deduct $12,000 from your taxes (40% of the original amount of $30,000), saving you 30% of $12,000, or $3,600. A $5,000 loss would yield another deduction of 30%: 30% of $5,000 is $1,500. Total tax savings is $5,100, more than offsetting the $5,000 loss.

6. Tax evasion is particularly common for workers in professions like waiting tables and bartending, where tips make up a substantial fraction of compensation. Use economic theory to explain why this is the case.

Tips are often paid in cash. It is quite easy to hide this income by underreporting cash tips, and it is very difficult to verify small amounts of underreporting. (For proof, try asking a bartender if he prefers his tips in cash or credit!) When the likelihood of being caught for tax evasion is lower, economic theory tells us that individuals are more likely to evade taxes.

7. Describe the equity-efficiency trade-off associated with the Hall-Rabushka flat-tax proposal. How would this trade-off be affected by increasing the exemption level and the flat tax rate?

The Hall-Rabushka flat-tax proposal lowers the marginal tax rate faced by high-income

taxpayers reducing any disincentive to earn income that may be present under the current system. In addition, when high-income taxpayers face relatively low marginal rates, they will be less inclined to engage in convoluted transactions simply to avoid taxes and also less inclined to evade taxes. They may also save more because taxes paid on investment earnings would be lower. These aspects of the Hall-Rabushka proposal enhance efficiency. However, efficiency comes at a high equity cost: the taxpayers who would benefit most from this proposal are the richest ones. The flat tax significantly reduces vertical equity by removing much of the progressivity of our current tax rate structure.

This equity issue would be attenuated somewhat by increasing the exemption level and raising the tax rate. A higher exemption level would result in more low-income families paying no taxes, and a higher tax rate would increase the taxes paid by the wealthy. The net result would be lower taxes on average for people at the lower end of the income distribution (because a bigger fraction of their income would not be taxed) but higher taxes on other families; the higher tax rate would more than offset the benefit of the higher exemption. (Of course, the higher rate would also discourage work at higher tax rates, partly or fully offsetting the efficiency gains.)

8. The government of Tortunia increased its income tax rates by 20% in all tax brackets. The effect of this tax rate increase on total tax revenues works through several pathways. Describe whether you expect the higher tax rate to raise or lower tax revenues through each of the following pathways:

a. The direct effect of the tax rate increase

The direct effect of a tax rate increase is to raise more revenue. This effect is just the starting point of the analysis, though, because it assumes that the tax base will not change.

b. The effects of the tax rate increase on personal income

An increase in income tax rates will tend to decrease personal income by reducing the return to working and by reducing the return to saving. As a result, tax revenues may decline: even though the rate is higher, the base on which it is calculated would be expected to decrease.

c. The effects of the tax rate increase on tax evasion or tax avoidance

A higher tax rate will encourage taxpayers to seek ways of lowering the amount of tax they pay, through taking advantage of legal avoidance techniques such as sheltering income, through engaging in transactions that generate more deductions, or through illegal tax evasion. Increased evasion and avoidance will reduce tax revenues.

9. Why would an equitable transition from an income tax to a consumption tax undo some, if not all, of the efficiency gains associated with the introduction of a consumption tax?

The transition from an income tax to a consumption tax would be particularly harmful to older households. These households have already paid taxes on their earnings, and they would have to pay taxes again when they consume their accumulated savings. It would be quite expensive to write transition rules to exempt these households from the “extra” tax, and someone would have to pay for it. This would require raising tax rates on others, causing additional distortions and inefficiencies that could undo some or all of the efficiency gains of the new tax system.

Advanced Questions

10. Suppose that the world is populated by people who are identical in every dimension except for their savings behavior. People live for two periods, earning $500 in the first period and nothing in the second period. The income tax on labor earnings and interest income is 40% and the interest rate earned on savings is 8%. There are two types of people. "Hand-to-Mouth" consumers consume everything in the first period, and "Smoothers" split their consumption exactly equally between the two periods.

a. How much tax would Hand-to-Mouth consumers pay in each of the two periods? How much tax would Smoothers pay in each of the two periods?

Hand-to-Mouth consumers pay 40% taxes on their earnings, or $200 in the first period. Smoothers pay $200 in tax in the first period, leaving them with $300 to divide between the two periods. To determine how much they save to achieve perfectly smoothed consumption, let s be their savings. Then consumption in the first period is given by $C_1 = 300 - s$ and consumption in the second period is given by $C_2 = s(1 + 0.08)$. Setting $C_1 = C_2$ and solving for s gives $s \approx 144.23$. Taxes paid in the second period are thus $0.4(144.23 \times 0.08) \approx \$4.62$.

b. Suppose the income tax is replaced by an 80% consumption tax. In this system, for every $1 in consumption, the person is charged $0.80 in tax. How much tax will each type of consumer pay in each period now?

Under this tax system, the after-tax cost of $1 in consumption (in either period) is $1.80. Nonsavers would have a consumption of $\$500/\$1.80 \approx 277.78$ and would pay a tax of $\$500 - \$277.78 = \$222.22$. Savers would choose their savings to have equal consumption in both periods. Savings thus solves $(\$500 - s)/\$1.80 = (1.08s)/\$1.80$ or $(500 - s) = (1.08s)$ or $s \approx 240.38$, and savers' consumption in each period is $(1.08 \times 240.39)/\$1.80 \approx 144.23$, so their total tax in each period is $\$144.23 \times 0.8 \approx \$115.38$.

c. Compare the present value of the taxes paid by the two types of consumers under the two types of tax system. Which tax system is more equitable?

The present value of the taxes paid by Hand-to-Mouth consumers under the income tax system is $200. The present value of the taxes paid by Smoothers under the income tax system is $\$200 + \$4.62/1.08 \approx \$204.28$. In present value terms, Hand-to-Mouth consumers pay $222.22 in taxes under the consumption tax system. Smoothers pay a tax of $(\$144.23 + \$144.23/1.08) \times 0.8 = \$222.22$ in present value terms, exactly the same as the nonsavers. This consumption tax system treats the two types of consumers the same in present value terms and appears to be more equitable.

11. What is the difference between tax evasion and tax avoidance? How would you empirically distinguish the two phenomena?

Tax evasion is illegal: it is the failure to pay tax that is owed. Tax avoidance is legal: taxpayers are allowed to seek out and take advantage of provisions of the tax code that reduce their tax liability. Some taxpayers are more creative at tax avoidance than others, but if they stay within the provisions of the tax code and the judicial interpretations of that code, then what they do is technically legal and thus is avoidance rather than evasion.

The difference between evasion and avoidance is not always clear, as shown by differences in opinion among IRS auditors. Two auditors can review the same tax return and one can determine it to be compliant while the other finds evasion. If IRS auditors have a hard time distinguishing between the two, then researchers will be even more hard-pressed to distinguish evasion from avoidance when using data based on tax returns. Returns that have been determined in an IRS audit to be noncompliant could be assumed to involve tax

evasion rather than avoidance. Thus, imposition of fines, penalties, or in the extreme, prison, (but not interest for late payments) would indicate likely evasion.

12. Suppose that the tax rate is 30%. Suppose also that the probability of getting caught evading taxes is 10% plus an additional 2.5% for every $1,000 in tax evasion. (Hence, $P = 0.1 + 0.025X$, where X is the number of dollars (in thousands) of evasion.) Individuals who are caught evading taxes will be forced to pay the taxes they owe in addition to a $10,000 penalty. How much evasion will a risk-neutral taxpayer engage in? How would your answer change for a risk-averse taxpayer?

Letting X denote the number of thousands of dollars of evasion, the probability of getting caught is $(0.1 + 0.025X)$. The cost of evasion and getting caught is $10,000. So the expected cost of evasion, in thousands of dollars, is thus $10 \times (0.1 + 0.025X)$. The probability of not getting caught is $1 – (0.1 + 0.025X)$, so the expected benefit from evasion, again in thousands of dollars, is $X(0.90 – 0.025X)$.

We find the marginal costs and benefits by differentiating the costs and benefits with respect to X. The marginal cost of evasions is thus $MC = 0.25$ and the marginal benefit is $MB = 0.90 – 0.05X$. Setting them equal and solving yields $X = 13$ or about $13,000.

13. While proponents of tax simplification argue that a flat tax would be fairer, in other dimensions a flat tax reduces fairness in the tax system. Why is this so?

A flat tax seems fairer because it eliminates loopholes and other favorable tax treatments of income that tend to be more available to high-income taxpayers. It also reduces cheating, which enhances fairness. Arbitrary bracket cutoffs are eliminated with a flat tax, which also seems fair. Other aspects of the flat tax, though, reduce its fairness. First, the flatness of the tax renders the tax structure less progressive than the current increasing marginal rate structure. Vertical equity calls for higher-income taxpayers to pay a larger share of their income in taxes, but a flat tax would result in less progressivity than we currently have. Second, any change in a tax system will change the value of investment decisions made when the original system was in place. If the flat tax system eliminated the mortgage tax deduction, for example, many people would see the value of their most important asset—their house—fall. Finally, the flat tax would tax wage income and not dividend or interest income, violating the Haig-Simons notion of equity.

14. Istalia currently provides a tax credit for families who send their children to college. Faced with dire financial straits, Istalia decides to eliminate this tax credit but to continue to extend it to the families currently taking advantage of it. Given that such a process is inequitable and that it continues to drain revenues from the government, why is Istalia doing this?

Istalia is attempting to solve a transition issue. When tax regimes change, some people incur costs because decisions they made before the change are adversely affected. In Istalia, families began sending their children to college with the expectation that the tax credit would remain in place. Perhaps they budgeted with that assumption in mind. To find themselves suddenly unable to take a tax credit they had planned on seems unfair, so the government has decided that, for a short time, it can cover that transition cost. Future generations are on notice that this credit will not be available for them, so this transition issue will be fairly short-lived.

A second reason for the extension is that there may be substantial benefits from completing a degree once work on it has started. The efficiency costs of students failing to complete their education are high—those first years of college are in some sense wasted if students are forced to leave school before earning their degrees. Thus, extending the tax credit for students who are already attending college protects that initial investment.

15. Consider two consumption tax systems: (a) one in which all goods are taxed at the same rate and (b) another in which the "necessities" are not taxed and "luxuries" are taxed at a higher rate. Compare the equity and efficiency of these two systems.

Optimal tax theory would argue in favor of plan (a). This plan is a broad-based tax that is difficult to avoid, so it will not distort behavior significantly. Furthermore, given the tax's broad base, the rate can be relatively low to raise the same amount of revenue. Plan (b) violates most tenets of efficient taxation: it does not tax goods for which demand is inelastic (necessities), even though the Ramsey Rule indicates that taxes on necessities will generate the least deadweight loss. Plan (b) does tax luxuries, for which demand is likely to be elastic. Thus, this tax will distort behavior and generate substantial deadweight loss. Plan (a) is clearly more efficient.

However, plan (a) is regressive: poorer taxpayers will spend a higher percentage of their income on taxes than will wealthier taxpayers. That is because poorer taxpayers cannot afford to save or invest large portions of their income; they spend it on the goods they need. By consuming most of their income, poorer taxpayers are subjecting a high proportion of their income to the consumption tax. Plan (b) is not as regressive, because the kinds of goods that lower-income taxpayers purchase are not taxed but the kinds of goods purchased by higher-income taxpayers are taxed. Plan (b) is clearly more equitable.

16. When traveling on vacation recently in a country with a large consumption tax, I was presented with a deal: pay cash and get a 10% discount. Given that credit card transactions cost the merchant less than 2%, why did the merchant make me this offer? Would the merchant be more or less likely to make the offer if the country had a value-added tax instead? Explain.

The merchant probably made this offer as a means of tax evasion. When he accepts cash for a transaction, there is no paper trail, so he can avoid reporting the transaction to the authorities. While the direct cost of accepting a credit card may be only 2%, credit card transactions do leave a paper trail, so the merchant would have a harder time hiding those transactions from the tax collector. Thus, the total cost of accepting a credit card is 2% plus any tax owed on the sale.

A value-added tax might reduce cash discount offers by reducing the amount of tax owed by the merchant for each sale. With a value-added system, the merchant has to pay taxes only on the difference between the retail price to the tourist and the price the merchant paid to obtain the item. When there is less tax owed, there is less incentive to hide transactions.

Note: The e icon indicates a question that requires students to apply the empirical economics principles discussed in Chapter 3 and the Empirical Evidence boxes.