Frank and Bernanke Chapter Problems

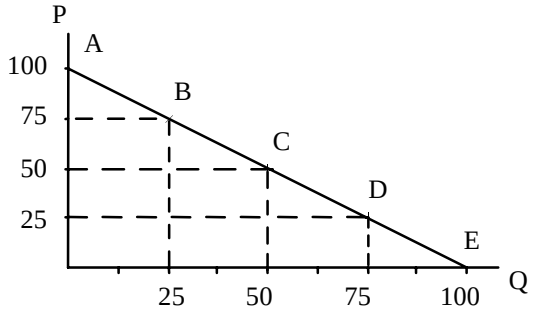
Note from Professor Salemi: I have included the key to all end-of-chapter problems. Some of these problems concern material I have not emphasized and that is not testable.

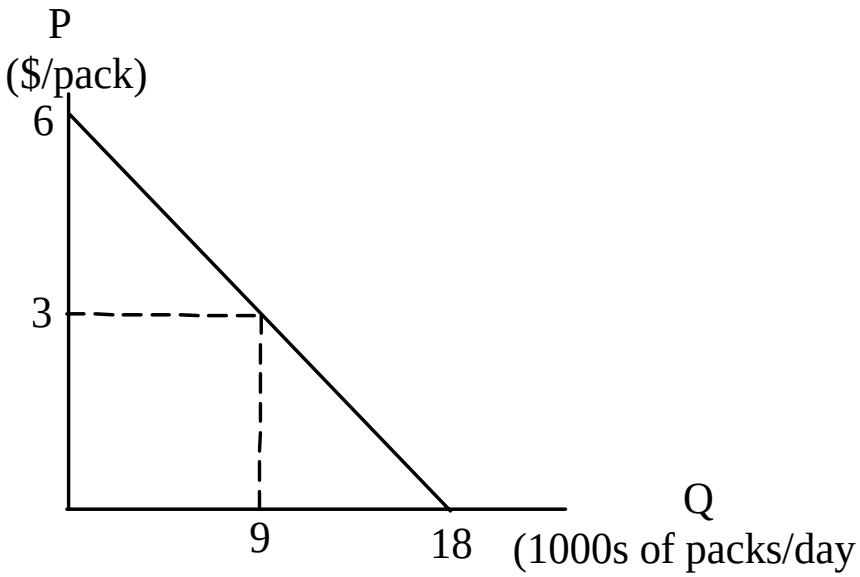
Chapter 4: Elasticity
Answers to Problems

1. For the demand curve shown, the slope is 1 so (1/slope) is also 1. The absolute value of the price elasticity of demand at any point on this demand curve is thus the ratio (P/Q) at that point.

A	infinity
B	3
C	1
D	1/3
E	0

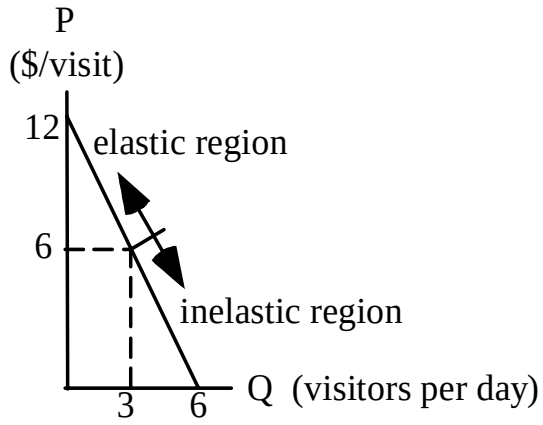
2.a.





b. Use the formula: elasticity = (P/Q) (1/slope). When P = 3, Q = 9 and 1/slope is 3. So elasticity = 3(3/9) = 1.0.
c. If the price increases from $3 to $4, revenue will fall from $27,000 to $24,000.
d. Using the same formula as in b, elasticity = (2/12)x(3) = 0.5.
e. If the price increases from $2 to $3, revenue will rise from $24,000 to $27,000.

3. To maximize revenue from the sale of tickets price should be set at the midpoint of the demand curve, p = $6/visit.



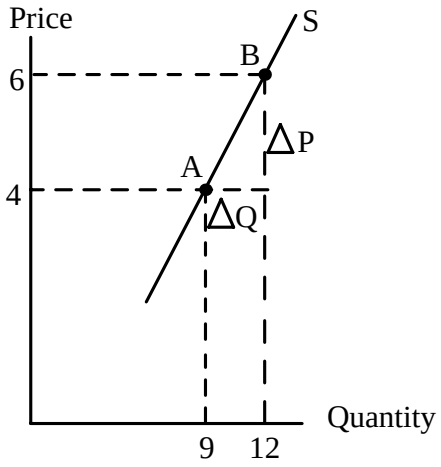
4. The price elasticity of a good generally increases with the number of substitutes it has. It is easier to substitute a Ford or Toyota for a Chevrolet than it is to substitute a motorcycle or a skateboard for a car. Thus the market demand curve for cars is likely to be less elastic with respect to price than the market demand curve for Chevrolets.

5. The more income a person has, the smaller a given expenditure will be as a proportion of her overall budget, and hence the less likely she will be to respond dramatically to a price change. Thus senior executives, the most highly paid of the three groups, should have the least price-

elastic demand curves. Students, the least well paid, should have the most price-elastic demand curves.

6. The cross-price elasticity is (percent change in Q_{syrup}/percent change in P_{milk}) = -4/2 = -2. Since this cross elasticity is negative, the two are complements.

7. The expression for supply elasticity is (P/Q)x(1/slope). Since the slope of this supply curve is $\Delta P/\Delta Q$ = 2/3, the elasticity of supply at A is (4/9)x(3/2)=2/3. The elasticity at B is (6/12)x(3/2)=3/4.



8. The inputs required to produce each slice of pizza cost a total of $1.20, and this marginal cost is constant. The supply curve of pizza is thus a horizontal line at P = $1.20.

9. The absolute value of the slope of this demand curve is 1/3, so plugging in the P and Q values at point A into the formula elasticity = (1/slope)P/Q, we have elasticity at A = 3(4/6) = 2. A one percent price increase will thus translate into a two percent decrease in the quantity demanded. Total expenditure, which was PQ, will thus now be (1.01P)x(.98Q), which is approximately equal to .99Q. So total expenditure will decline by about one percent.

10. What government officials failed to take into account was that people don't demand electricity for its own sake, but rather as a means to accomplish other ends, such as producing cooler air for their homes. By requiring people to buy more efficient air conditioners, the government effectively reduced the price of buying cooler air. If the demand for cool air is sufficiently elastic with respect to its price, people may buy enough more of it than before that they end up using more electricity.

Chapter 7: Efficiency and Exchange

Answers to Problems

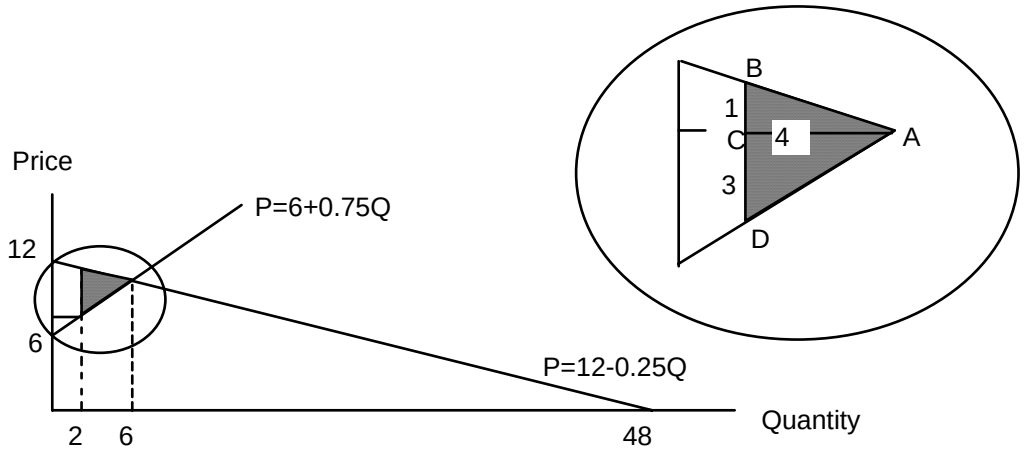
1a. Consumer surplus is the triangular area between the demand curve and the price line. Its area is equal to 0.5bh, where b is the base of the triangle and h is the height. The base is 6 units and the height is 1.5 units, measured in dollars. Therefore, consumer surplus is 0.5($1.50/unit)(6 units/wk), or $4.50 per week.

b. Producer surplus is the triangular area between the supply curve and the price line. Using the base-height formula, it is (0.5)($4.50/unit)(6 units/wk), or $13.50 per week.

c. The maximum weekly amount that consumers and producers together would be willing to pay to trade in used DVDs is the sum of gains from trading in used DVDs—namely, the total economic surplus generated per week, which is $18 per week.

2a. At a price of $7.50, the quantity supplied per week = 2. The quantity demanded at this price is 18 per week, which implies a weekly shortage of 16 used DVDs.

b. The weekly economic surplus lost as a result of the price ceiling is the area of the dark-shaded triangle in the diagram, or the sum of the areas of the two triangles ABC and ACD. Using the information given in the graph, this amount is calculated as (0.5)(4)(1) + (0.5)(4)(3) = $8/wk.



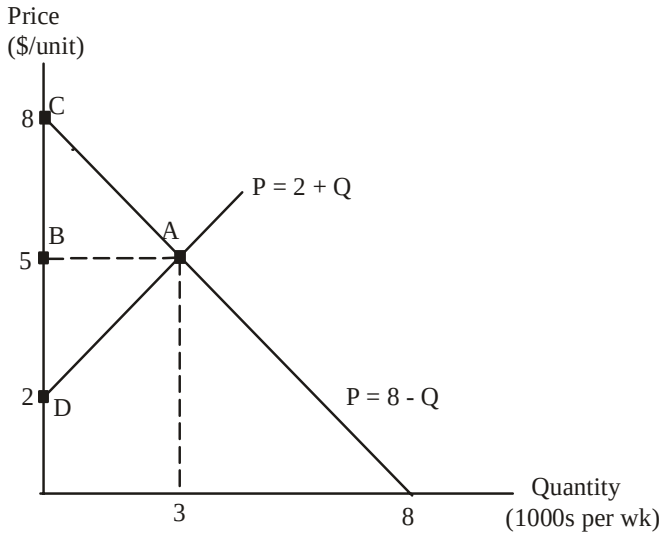
3a. When there is no charge for the tour, the surplus enjoyed by someone who takes it equals his or her reservation price for the tour. If the warden operates the tour on a first-come-first

served basis, Faith, Penny, and Fran will be turned away. The combined consumer surplus when the four who arrive first take the tour is $20 + $14 + $30 + $15=$79.

b. An offer of $15 compensation generates 3 volunteers to return another day: Fran, Jack and Jon. The four who go on the tour receive a total consumer surplus of $40 + $30 + $20 + $17=$107. The warden pays $45 in compensation payments to the three volunteers, which causes him a loss in economic surplus of $45 that is exactly offset by the gain in economic surplus to the three volunteers. Total economic surplus from the tour operation is now $107—$28 higher than before.

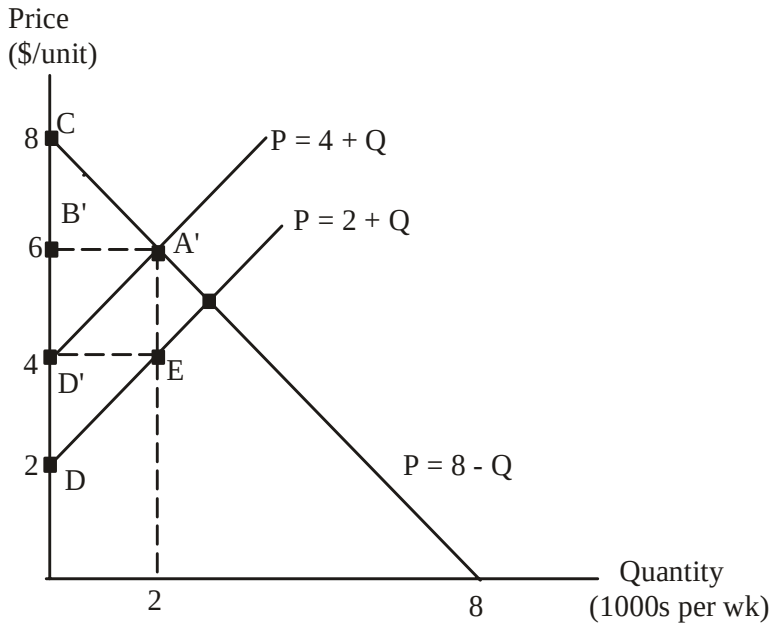
c. The compensation policy is more efficient than the first-come-first-served policy because it establishes a market for a scarce resource that would otherwise be allocated by non-market means. People who choose not to miss the tour that day are paying an opportunity cost of $15 not to miss it. Therefore, only those people to whom the tour is worth more than $15 will actually take it.

d. Suppose the Warden auctions off the right to take the tour by steadily increasing the tour price by $1 increments until only 4 people are willing to pay. The auction will stop when the price reaches $16, and Faith, Penny, Herman, and Kate will be the four remaining. The warden will collect $64 from the auction. He can then give refunds to Herman and Kate, who would have gotten to go for free under the first-come-first-served scheme, so they will be just as well off as before. He can give $16 to Jack, which is $1 more than enough to compensate him for not getting to go. And he can give $15 to Jon, which is also $1 more than enough to compensate him. That leaves the warden with $1, so he too is better off than before. Faith is $1 better off than before, and Penny is $24 better off than before. All others are exactly as well off as before.4a. The equilibrium price is $5 and the equilibrium quantity is 3,000 units per week. The consumer surplus is the area between the demand curve and the price line—triangle ABC in the diagram—which is $4,500/wk. The producer surplus generated is the area of triangle ABD, which is $4,500/wk. Therefore, the total economic surplus is $9,000/wk.



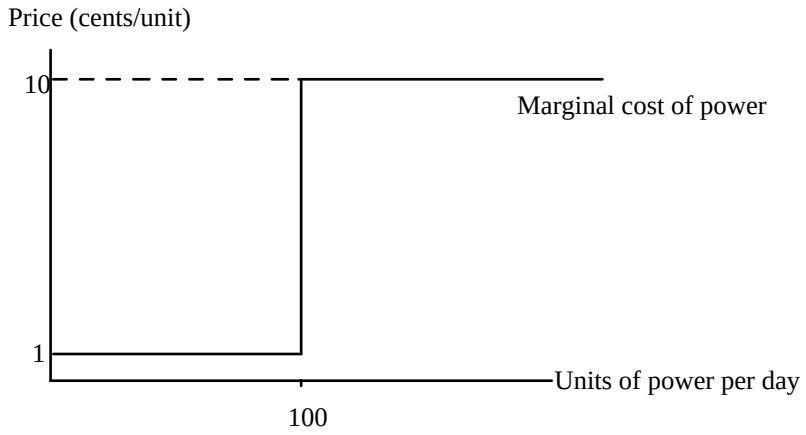
b. The tax shifts the vertical intercept of the supply curve up by $2 to $4. The new equilibrium price and quantity are $6 and 2,000 respectively. The tax revenue is $2(2,000), or $4,000/wk. Consumer surplus is now the area of the triangle A'B'C, which is $2,000/wk.

Net of the $2 tax, sellers receive a price of $4 per unit. Their surplus is the area of the triangle D'ED, which is $2,000/wk. The tax revenue collected is ($2/unit)(2,000 units/wk) = $4,000/wk. Counting the revenue from the tax as part of total economic surplus, the new total economic surplus is thus $2,000/wk + $2,000/wk + $4,000/wk = $8,000/wk, or $1,000/wk less than without the tax.



5. Profit is the difference between the company's total revenue and its total cost. Producer surplus is the difference between total revenue and the firm's reservation price for the quantity it sells. So the question boils down to whether the firm's total cost of producing a given quantity is the same as its reservation price for selling that quantity. Its reservation price is, by definition, the lowest total dollar amount for which it could sell that quantity and still be no worse off than before. That dollar amount is the sum of the respective marginal costs of producing each unit. So producer surplus is the difference between total revenue and the sum of all marginal costs incurred. That is not the same as profit, which is total revenue minus the sum of not only all marginal costs incurred, but also fixed costs.

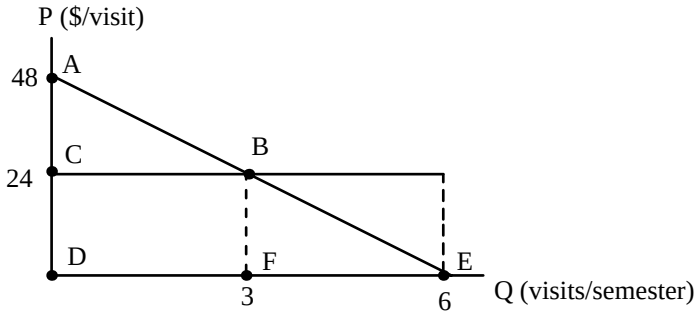
6a. The marginal cost curve for electric power in Charlotte would look like this:



b. The city should charge 10 cents per unit since that is the marginal cost when residents use at least 100 units/day, which they will if the city charges 10 cents or less. It should charge 10 cents per unit to all users, even those who are receiving their power from the hydroelectric facility, since if those users were to cut their consumption, they would free up hydroelectric capacity, which could then be used to serve others who are currently receiving their power from the more costly steam generator.

7. The winter demand (D_W in the diagram) can be served entirely by the underground spring, so the price should be 2 cents per hundred gallons in the winter months. Water must be drawn from the lake to meet demand in the summer months (D_S in the diagram), so the price should be 4 cents per hundred gallons in summer.

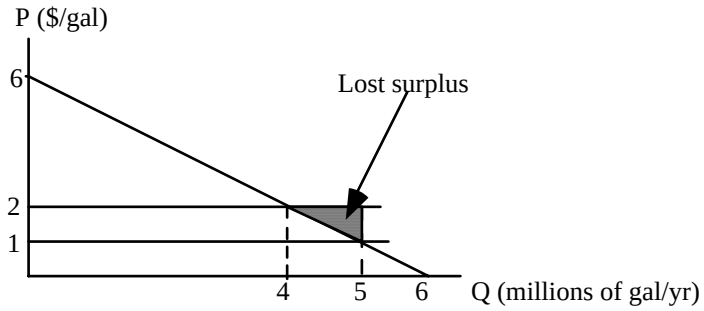
8a. As shown by the demand curve in the following diagram, Phil would make three more visits per semester to the walk-in clinic at a price of 0 than he would at a price of $24/visit. Phil's total expenditure on medical care (insurance premiums plus payments for office visits) will thus differ by the cost of those three extra visits, namely $72/semester. Since policy A has to reimburse the cost of 6 visits, its premium will be 6($24)=$144/semester greater than policy B's.



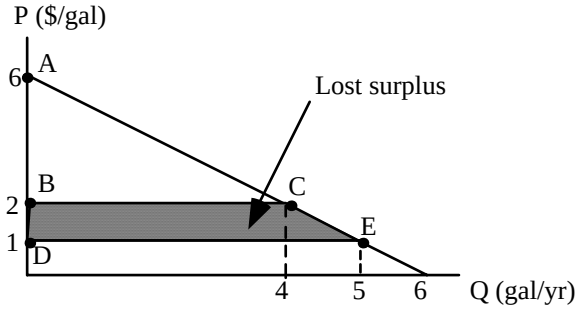
b. The value to Phil of the three extra visits he would take under policy A is given by the area of triangle BFE, which is $36/semester. Since that is less than his extra expense under policy A, he will choose policy B.

c. If his alternative were to switch to policy A at a price of $72/semester more than the current price of B, Phil would pay up to $36/semester for the right to continue buying policy B at its current price.

9. At a price of $1/gal, Islandians will consume 5 million gallons of oil per year. The true marginal cost of oil for the nation is the international price, which is $2/gal. If Islandians had been charged this price they would have consumed only 4 million gal/yr. The lost surplus from consuming the larger amount of oil is the cumulative difference between the cost of the oil and the most they would have been willing to pay for it. This difference is the area of the shaded triangle in the diagram, or $500,000/yr.



10a. The demand curve is as shown in the diagram.



b. With the subsidy, each family receives consumer surplus equal to the area of triangle ADE. Without the subsidy, consumer surplus equals the area of triangle ABC. The difference is the area BCED, which equals $4.50/yr.
c. The government's oil subsidy per family is ($1/gal)(5 gal/yr)=$5/yr. So the government could cut each family's taxes by $5/yr by not subsidizing oil.
d. The family's net gain would be the $5 it saves in taxes minus the $4.50 it loses in consumer surplus from its heating oil purchases, or $0.50/yr.
e. The aggregate gain from the tax cut and removal of the subsidy is $500,000/yr, the same as the loss in total consumer surplus that resulted from the subsidy.

Chapter 8
The Quest for Profit and the Invisible Hand

Answers to Problems

1a. False: the maxim tells us that there are no unexploited economic opportunities when the market is in long-run equilibrium.
b. False: firms in long-run equilibrium have to make an accounting profit in order to cover the opportunity cost of resources supplied by their owners.
c. True: These firms can earn economic profits until other firms adopt their innovations. As the innovations spread, the industry supply curve will shift down, causing the market price of the good to fall and eroding the short-term economic profit.

2. The reason these firms' shares are valuable is that once their products have established a market niche, the firms will cease to give them away. The anticipated future profits of such companies lead investors to bid for their shares now.

3a. John's accounting profit is his revenue minus his explicit costs, or $750 per week.
b. Yes: his opportunity cost of his labor to run the café is $1,000 - $275, or $725 per week. Adding this implicit cost to the explicit costs implies that the café is making an economic profit of $25 per week. And since $25>0, John should stay in business.
c. John's opportunity cost rises by $100, to $825 per week. The café is thus now making an economic loss of $75 per week.
d. The accounting profit would now be $1,750/yr. The answer to part b. would not change. If John had $10,000 of his own to invest in the café, he would forgo $1,000/yr in interest by not putting the money in a savings account. That amount is an opportunity cost that must be included when calculating economic profit.
e. To earn a normal profit, the café would have to cover all its implicit and explicit costs. The opportunity cost of John's time is $1,000/yr, whereas the café's accounting profit is only $750/yr. Thus, the café would have to earn additional revenues of $250/yr to make a normal profit.

4a. Jacobs will earn $600,000/yr, the normal salary for a designer plus the economic rent he collects for his special talent. 5/6 of his salary is economic rent.
b. If Jacobs's employer withholds some of the additional revenue it takes in as a result of hiring him, some other advertising company will offer him a higher salary and still manage to earn an economic profit. Bidding for Jacobs will continue until firms are indifferent between paying him $600,000 and hiring any other designer for $100,000.

5. Assuming that all tofu firms initially earn zero economic profit, the innovation will cause one tofu factory's costs to fall. The firm that owns the factory will make an economic profit in the short run, because the market price of tofu will not change. As other firms adopt the innovation, they too will make an economic profit. This economic profit will attract new firms into the industry, and so the supply curve for tofu will begin to shift to the right, causing the

market price of tofu to fall. The decline in price will continue as more firms enter, until there is no more economic profit to be made.

6. If the import licenses were free and could not be transferred, owners of each license would make an economic profit of $20,000/yr. When the annual interest rate is 10 percent, the most a buyer will be willing to pay for a stream of economic profits of $20,000/yr is the amount of money she would have to put into a savings account to earn that much interest each year. This sum of money is $200,000. If the import licenses are auctioned, they will sell for this price, and the government will earn an economic rent of $200,000 per license. The buyers of the licenses will make no economic profit.

7a. A cotton farmer would make a short-run economic profit of $60,000 revenue- $10,000 rent - $4,000 marketing cost - $6,000 opportunity cost, or $40,000/yr. In the long run, factory workers would want to move into cotton farming, and would thereby bid up the rent on cotton farms. The rent would continue to rise until it reached $50,000 per farm. At that point the incentive to leave a factory job would no longer exist, because cotton farmers would again be making zero economic profit.

b. Landowners would reap the long-term benefits of the scheme. Their income would rise by $40,000/yr. per 120-acre plot.

8. The question you should ask is: How much money would your friend need to put in the bank at 20 percent interest to generate annual earnings of $30,000? To find out, simply let X denote that amount in the equation X(.2) = $30,000 and solve: X = $30,000/.2 = $150,000.

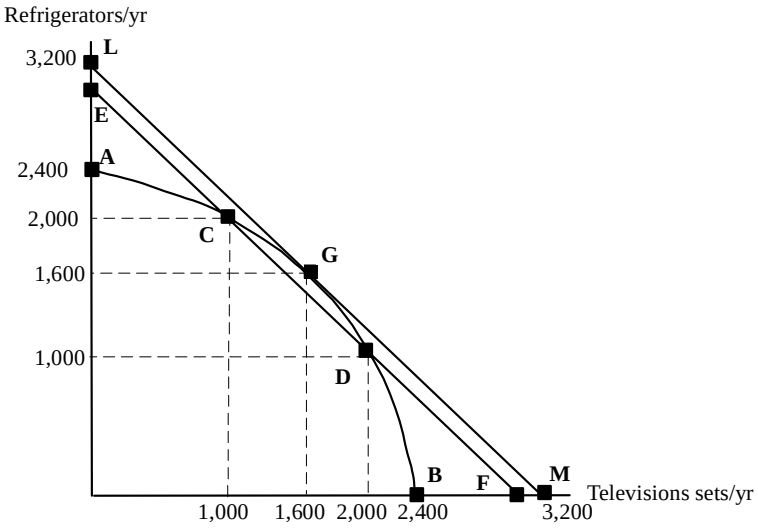
9. If you pay $X for the orchard, the opportunity cost of your investment is (0.10)($X)/yr. The opportunity cost of your time is $10,000/yr. The highest value of X for which you would be willing to own and manage the orchard is the value that yields zero economic profit. To find that value, solve $25,000/yr – (.10)($X)/yr - $10,000/yr = 0: X = $150,000/yr.

10a. The most Louisa would be willing to pay in experimental costs is $500,000. She could charge all 100,000 patrons $5 more, but only for one night. After the first night, other producers would figure out the recipe and compete the price back down to $5 per plate.

b. With a patent that lasts one year, Louisa would be willing to pay up to $182.5 million dollars ($500,000/day)(365 days/year). She could charge an additional $5 per meal each night of the year before the other producers could copy her recipe.

Chapter 28
International Trade

Problems



1. The maximum number of television sets this country can produce each year is 2,400. The maximum number of refrigerators is also 2,400.

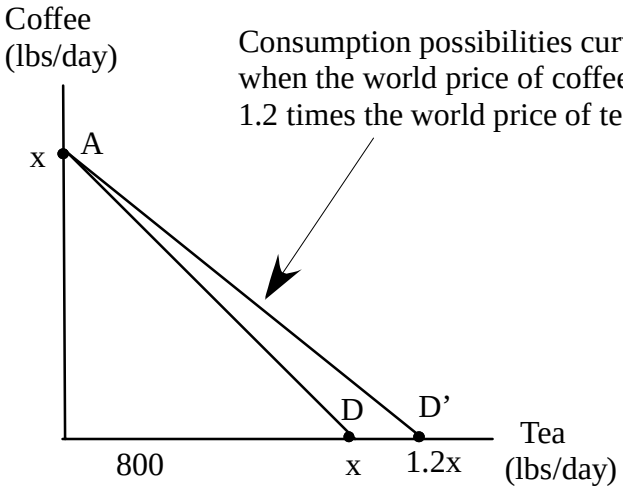
2. The absolute value of the slope of the consumption possibilities line is the price of television sets divided by the price of refrigerators, which is 1.0. A shown in the diagram, a line with this slope is tangent to the PPC at point G. The annual sale of 1,600 televisions and 1,600 refrigerators at $500 each yields revenue of $1,600,000/yr. Thus the country could consume a maximum of ($1,600,000/yr)/($500/set) = 3,200 television sets per year. Similarly, it could consume a maximum of 3,200 refrigerators per year. Doubling the price of both goods would double the revenue from the sale at point G but would have no effect on the consumption possibilities line.

3. Starting at point G, if the country sells 600 television sets per year, it will receive $600,000/yr, which would enable it to buy an additional 600 refrigerators per year, for a total of 2,200. For the same reason, the country could afford to consume 1,000 television sets and 2,200 refrigerators. But it could not consume 1,000 televisions and 2,500 refrigerators.

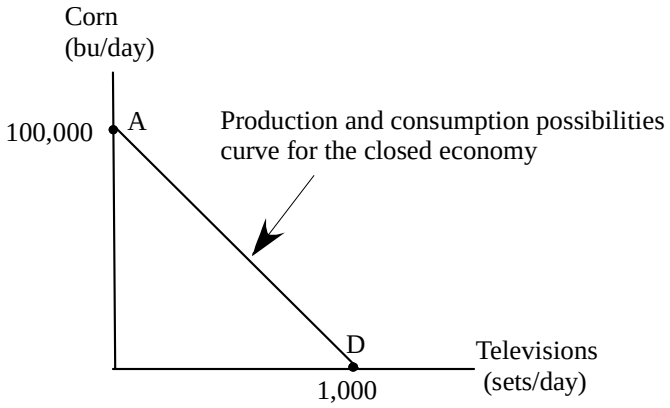
4. The absolute value of the slope of the consumption possibilities line would again be 1.0 and it would again be tangent to the PPC at point G. So the country should again produce 1,600 units of each good per year.

5. Now the absolute value of the slope of the consumption possibilities line is $1000/$1200 = 0.833 < 1.0. So now the tangency will occur to the left of point G. The country should produce more than 1,600 refrigerators each year and fewer than 1,600 televisions. There is no way to be sure how the country will change its consumption of the two goods.

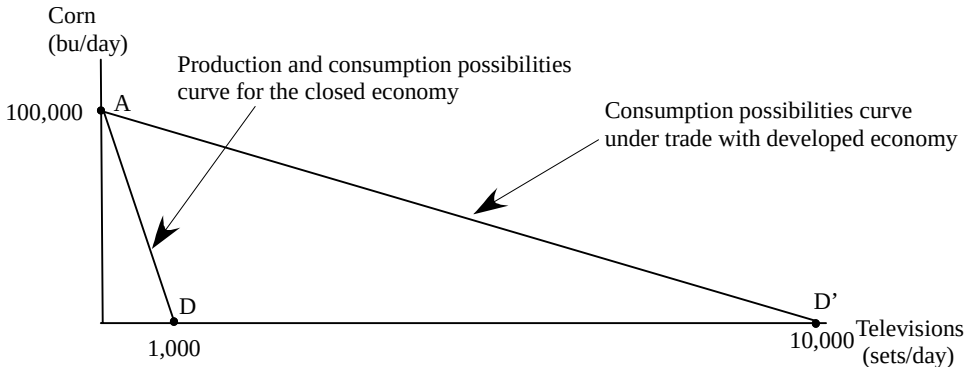
6. The economy's production possibilities curve is AD in the diagram. Since coffee is the more expensive good and the country is equally productive in each good, it should specialize completely in coffee production. The x pounds per day of coffee it produces can be sold for an amount that would enable the country to purchase a maximum of 1.2x pounds of tea per day. Line AD' in the diagram is the economy's consumption possibilities curve.



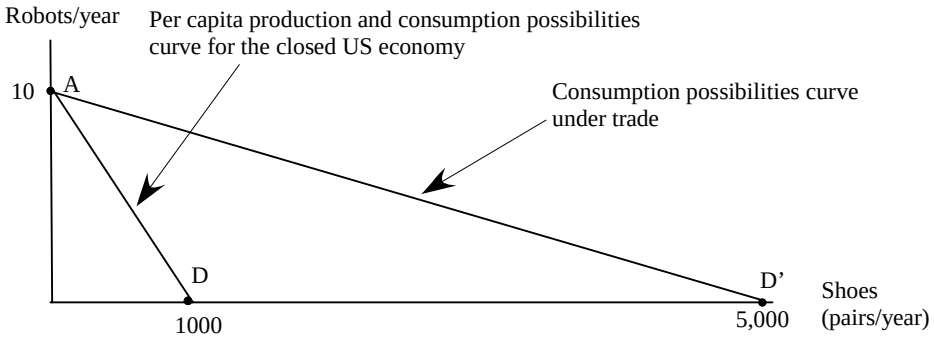
7.a. The is line AD, whose slope is 100 bushels of corn per television set. The slope is the opportunity cost of producing an additional television set. The opportunity cost of producing a bushel of corn is the reciprocal of AD, or $1/100^{th}$ of a television set. In the closed economy, AD is also the consumption possibilities set.



b. Since the other economy is much larger, the relative prices for the two goods will be determined by the opportunity costs of producing the two goods there. Thus the price of a television set will be ten bushels of corn. Under free trade with the developed economy, the consumption possibilities curve will be line AD'. This new opportunity greatly expands the range of consumption possibilities for the developing economy.

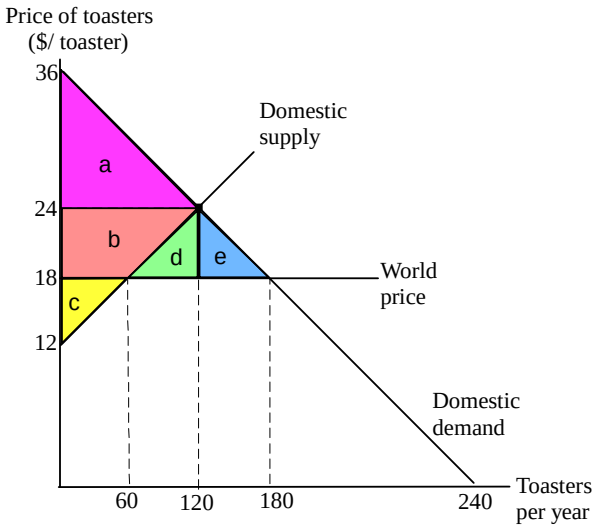


8.a. In per-capita terms the US production possibilities curve is the line AD. Once the US can trade with the rest of the world, its best bet is to specialize in robot production. The 10 robots a US worker can produce in a day will sell for a total of $50,000, which is enough to buy 5,000 pairs of shoes at the world price of $10/pair. The new consumption possibilities curve for each worker will be line AD'.

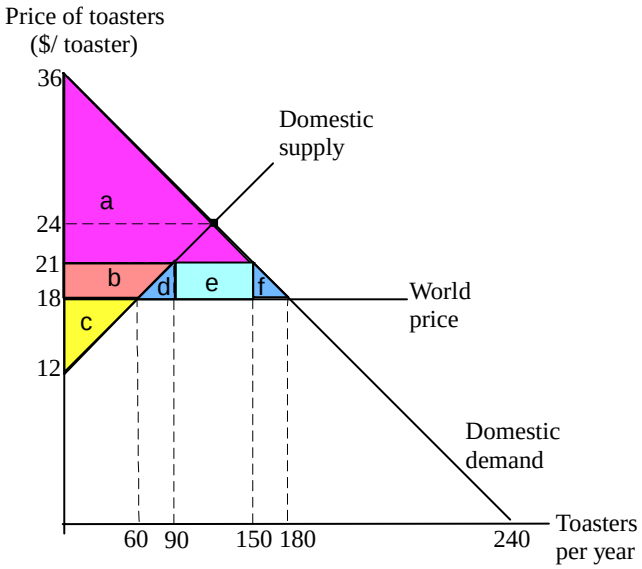


b. Foreign workers will earn $5,000/yr.
c. American workers will import shoes and export robots.
d. An American worker will earn $50,000/yr, enough to buy either 10 robots or 5,000 pairs of shoes or any other combination on the consumption possibilities curve AD'.
e. The American worker benefits by being able to trade with low cost producers of shoes.
f. Opening the country to trade would stimulate demand for robot producers and reduce demand for shoe producers. Shoe producers might thus suffer losses while attempting to make the transition to producing robots.

9. Producer surplus before trade was the sum of areas b and c, or $720/yr. Consumer surplus was the area a, also $720/yr. After trade at the world price of $18, consumer surplus becomes the sum of the areas a, b, d, and e, or $1,620/yr, a gain of $900/yr. Producer surplus becomes area c, or $180/yr, a reduction of $540/yr. The net change in total economic surplus is thus $360/yr.



10. Before the tariff, consumer surplus was the sum of the areas a, b, d, e, and f, a total of $1,620/yr. After the tariff, consumer surplus falls to the area a, which is $1,125/yr, a reduction of $495/yr. Before the tariff, producer surplus was area c, or $180/yr. After the tariff, producer surplus rises to the sum of areas c and b, or $405/yr, a gain of $225/yr. The government gains area e, or $180/yr, in revenue from the tariff. The net effect of the tariff is thus to reduce total economic surplus by $90/yr.



Chapter 9
Monopoly and Other Forms of Imperfect Competition

I. Answers to Problems

1. As shown in the following table, Volvo's greater production volume gives it substantially lower average production cost, and this advantage helps explain why Volvo's market share has in fact been growing relative to Saab's.

	Saab	Volvo
annual production	50,000	200,000
fixed cost	$1,000,000,000	$1,000,000,000
variable cost	$500,000,000,	$2,000,000,000
total cost	$1,500,000,000	$3,000,000,000
Average cost per car	$30,000	$15,000

2a. False. The *industry* demand curve is downward sloping in both cases, but from the individual perfectly competitive firm's point of view, the demand curve is horizontal. Because the individual firm is too small to affect the market price, it can sell as many units as it wishes at that price.

b. True. If they try to charge a higher price they will lose all their business; if they try to charge a lower price, they will not be maximizing profit.

c. True. This is the essential feature of natural monopoly.

3. The answer is c. The monopolist chooses the output level at which marginal revenue equals marginal cost and then charges a price consistent with demand at that level of output. Since price always exceeds marginal revenue, price is greater than marginal cost. There is no shortage: at the output chosen, demand and supply coincide. And the monopolist has no reason to maximize marginal revenue (which would require producing zero units of output).

4. The answer is a. The demand curve and the marginal revenue curve would coincide, because the monopolist would sell each successive unit of output at exactly its reservation price, so that unit would generate revenue identical to the reservation price. The final unit of output would be sold at a price equal to marginal cost, so e is wrong: the outcome would be socially efficient. Because two or more consumers might have the same reservation price, c is wrong.

5. To charge different prices to different customers for essentially similar products with similar costs of production, the seller must create a hurdle to separate customers with high reservation prices from those with lower reservation prices. This hurdle often involves a minor difference in quality. For example, a well-known mail-order firm sells down-filled comforters with a plain stitch pattern at a lower price than slightly warmer comforters with a fancier stitch pattern. The price differential is about 100 percent.

6. The socially desirable price to charge is the one at which the marginal benefit to consumers equals the marginal cost of production. However, natural monopolies are usually characterized by very large fixed costs and relatively low marginal costs. The high fixed

costs mean that average cost is greater than marginal cost, so that charging a price equal to marginal cost implies economic losses. An example is the London Underground, which incurred huge fixed costs tunneling, laying railway line, building stations and acquiring rolling stock. However, this transport system incurs virtually no additional cost when an additional passenger travels from Heathrow airport to Trafalgar Square. Charging a price equal to the marginal cost would thus fail to cover the average cost of a ride.

One way the London Underground deals with this problem is by offering a railcard that entitles customers to unlimited travel within a certain period. With this card, the marginal cost to the consumer of an additional journey is zero.

7a. To answer this question, we need a table of George's total and marginal revenue:

Customer	Reservation price ($/photo)	Total revenue ($/day)	Marginal revenue ($/photo)
			50
A	50	50	
			42
B	46	92	
			34
C	42	126	
			26
D	38	152	
			18
E	34	170	
			10
F	30	180	
			2
G	26	182	
			-6
H	22	176	

Since marginal cost = $12, George will set a price consistent with serving only the first five customers. That price is the reservation price of the fifth customer, $34. His profit will be $170 - $60, or $110 per day.

b. The consumer surplus = $(50 + 46 + 42 + 38 + 34) - $170, or $40 per day.

c. The socially efficient number is 8, since each customer has a reservation price that exceeds the marginal cost of production.

d. George will produce 8 portraits, and his economic profit will be $(50 +….+22) - $96, or $192 per day.

e. No consumer surplus will be generated.

f. The ability to offer a rebate coupon allows George to divide his market into two sub-markets. The table of total and marginal revenue for the list-price sub-market is as follows:

Customer	Reservation price ($/photo)	Total revenue ($)	Marginal revenue ($/photo)
			50
A	50	50	
			42
B	46	92	
			34
C	42	126	
			26
D	38	152	
			18
E	34	170	

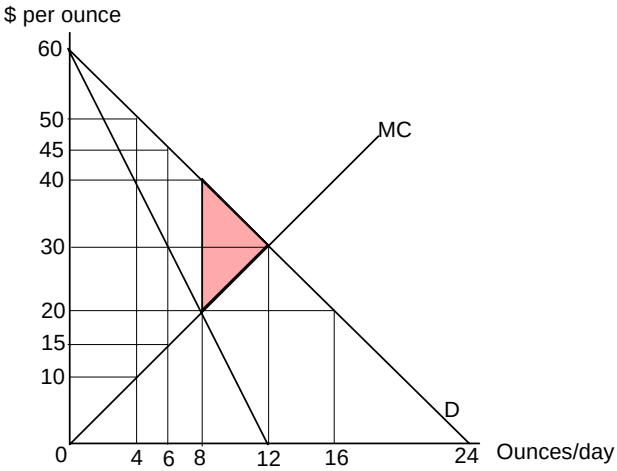
George should set the price at $34 and sell 5 photos per day in this market. In the discount-price sub-market, the table of total and marginal revenue is as follows:

Customer	Reservation price ($/photo)	Total revenue ($/day)	Marginal revenue ($/photo)
			30
F	30	30	
			22
G	26	52	
			14
H	22	66	

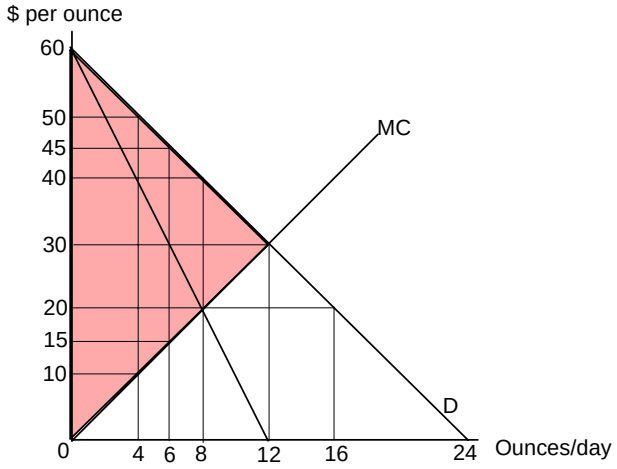
The discount price should be $22; George should sell three photos in this market.

g. George's economic profit is now $34(5) + $22(3) - $96, or $140. The consumer surplus is $(50+46+42+38+34) - $170, plus $(30+26+22) - $66, or $52.

8. The profit-maximizing quantity is Q*=8, the quantity for which MR=MC. The socially optimal quantity in this market is Q**=12, the quantity for which MC = demand. The increase in total economic surplus that results when Q increases from 8 to 12 is the area of the shaded triangle, or $40/day.



9. A perfectly discriminating monopolist would sell each unit for exactly the buyer's reservation price, so the marginal revenue curve and the demand curve become the same. Serena will thus produce and sell 12 ounces per week. Buyers get no consumer surplus. Total surplus is equal to producer surplus, which the area of the shaded triangle below, $360/day.



10.

Price	$1	$.90	$.80	$.70	$.60	$.50	$.40	$.30	$.20	$.10
Quantity	1	2	3	4	5	6	7	8	9	10
Total Revenue	$1	$1.80	$2.40	$2.80	$3.00	$3.00	$2.80	$2.40	$1.80	$1
Marginal Revenue	$1	$.80	$.60	$.40	$.20	$0	$-.20	$-.40	$-.60	$-.80

a. See the table.
b. MR=MC at a price of $.60.
c. Profit=5*(.6 - .2)=$2. Consumer surplus = ($1 - $0.60)+ ($0.90 - $0.60)+($0.80 - $0.60)+($0.70 - $0.60)=$1.
d. She should set P = MC; therefore P = $.20.
e. She would charge persons A through I their respective reservation prices. Doing so would earn her a profit of $3.60, which is the same as the total economic surplus in part (d).

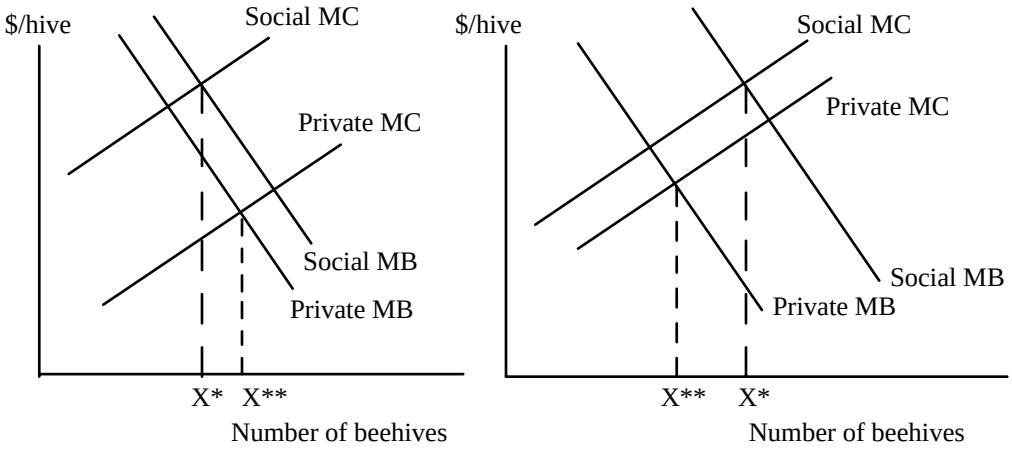
Chapter 11: Externalities and Property Rights

II. Answers to Problems

1a. True. Consider that if the marginal cost of the pollution curbed in plant A were higher than that in plant B, pollution emissions could be transferred from plant B to plant A, lowering the total cost.

b. True. An example is the excessive use of pesticides on crops. This activity reduces the amount of insect damage to crops, and thus lowers the farmer's production cost. However, the pesticide runoff pollutes waterways, imposing a negative externality on recreational users of those waters.

2. All parts. The socially optimal number of beehives could be greater or less than the privately optimal number, depending on the magnitude of the social marginal cost relative to the private marginal cost, as well as the magnitude of the social marginal benefit relative to the private marginal benefit. If the negative externality is negligible and the positive externality is large, the result is shown in the right panel of the diagram, in which the socially optimal number of beehives, X*, exceeds the privately optimal number, X**. However, if the negative externality is large relative to the positive externality, the result is shown in the left panel, in which the socially optimal number, X*, is smaller than the privately optimal number, X**.



3. The equilibrium quantity of boom box rentals is found by solving $5 + 0.1Q = 20 – 0.2Q$ for $Q_{pvt} = 50$ units per day. To find the socially optimal number of rentals we first find the Social MC curve by adding the $3 per unit noise cost to the Private MC curve to get Social MC = $8 + 0.1Q$. Equating Social MC to demand, we have $8 + 0.1Q = 20 – 0.2Q$, which solves for $Q_{soc} = 40$ units per day, or 10 less than the equilibrium number.

4. Imposition of this tax would shift the Private MC curve upward by $3 per unit, making it identical to the Social MC curve. The socially optimal number of boom boxes would be rented, resulting in an overall increase in efficiency in this market.

5. The most efficient outcome is for Jones to emit smoke, because the total daily surplus in that case will be $600, compared to only $580 when Jones does not emit smoke. Since Smith has the right to insist that Jones emit no smoke, Jones will have to compensate Smith for not exercising that right. If Jones pays Smith $30, each will be $10 better off than if Smith had forced Jones not to emit smoke

6. John and Karl stand to save $200/mo in rental payments by living together. The lowest-cost accommodation to the dirty dish problem is for John to leave his dirty dishes in the sink. Under that arrangement, the maximum monthly rent Karl would be willing to pay to share an apartment with John is $350 - $175 = $175/mo. That amount would leave John with a remaining monthly rent bill of $325, which generates a social surplus of $25/mo. If John splits this surplus evenly with Karl, John ends up paying $337.50/mo and Karl pays $162.50. Thus both will be better off sharing.

7. Adding an additional $30/mo to the cost of the shared living arrangement makes the total cost of sharing $205/mo. Because that amount exceeds the $200/mo saved by joint living, the two should live separately.

8a. Since Barton's monthly payoff without soundproofing is $50 more than with it, his natural inclination is not to install soundproofing. Statler would have to pay Barton at least $50 to induce Barton to install it, but since soundproofing is worth only $40/mo to Statler, Statler will not do so. Since the joint payoff is $230 without soundproofing and $220 with it, their choice is socially efficient.

b. Barton will not install soundproofing. Instead, he will pay Statler $40/mo to compensate for the noise damage. As in part a, this solution is socially efficient.

c. No; the same result obtained in both a and b.

9a. Barton will now install and maintain soundproofing, because doing so is cheaper than compensating Statler at a rate of $60/mo for the noise nuisance. This outcome is socially efficient.

b. Barton will not install soundproofing. The noise costs Statler $60/mo, so in the absence of transaction costs, Statler would be willing to pay up to that amount to induce Barton to install soundproofing. However, if he must also pay a $15 fee for this transaction, it is not worthwhile. Thus, no soundproofing will be installed, and the outcome will be socially inefficient.

c. If Statler has the legal right to peace, then installing and maintaining the soundproofing than will be cheaper for Barton than to pay Statler $60 compensation for noise damage. So this time, the outcome is socially efficient.

d. The difference is due to the presence of the negotiation costs, which in part b outweigh the gains from adopting the most efficient accommodation to the noise problem. No agreement was necessary in part c, because the law placed the burden of accommodation on Barton.

10. The following table shows the total village income from grazing llamas, together with the marginal village income from the activity.

Number of llamas on the commons	Price per 2-year-old llama ($)	Income per llama ($/yr.)	Total village income ($/yr.)	Marginal income ($/yr.)
				22
1	122	22	22	
				14
2	118	18	36	
				12
3	116	16	48	
				8
4	114	14	56	
				4
5	112	12	60	
				-6
6	109	9	54	

a. Three llamas will be sent onto the commons. The resulting net village income will be $48 from the llamas plus $45 from government bonds, or $93.

b. The socially optimal number is only one llama. Villagers send three instead, because in deciding whether or not to send a llama, each villager ignores the impact of his or her llama's presence on the other llamas' fleece quality. The total village income at the socially optimal number of one llama is $22 from the llama and $75 from government bonds, or $97.

c. If a single villager could control access to the commons, she would send only a single llama, which she could sell after one year for $22 more than she paid for it. If the land were free, the owner would thus earn $22 per year by raising one llama per year on it, or $7 more than she would have earned had she used her $100 to buy a bond. The price of the land will be bid up until it owning the land is no better than putting the same amount in the bank at 15 percent interest. That price is the amount of money that would yield $7 per year if deposited at 15 percent interest: $0.15X = \$7$, or $X = \$46.67$. The new owner will graze one llama. Total village income will be the same as in part b.