CHAPTER 9

THE COMPETITIVE FIRM AND MARKET SUPPLY CURVES

Now that we've discussed the concept of opportunity costs, comparative advantage, and diminishing marginal products, we're ready to discuss the competitive firm. By "competitive" economists refer to a highly stylized set of conditions that describe a certain market structure. Normally when we hear the word competitive we think of rivalry. A competitive race is one where one racer is up against several others, and the winner is determined by the relative speed of each racer. This is not what a competitive market means. A competitive market is characterized by several features. First, all firms are *price takers*. A price taking firm is one that has no impact on its price, in part because it is so small relative to the size of the market. The wheat farmer in Saskatchewan or Nebraska can produce all of the wheat he wants, but his output is such a small contribution to the world supply of wheat he has no impact on the price of wheat. Whatever the world price of wheat is, the individual farmer simply takes it as given. Second, all competitive firms ignore their rivals, and make output decisions based only on prices. Since any individual firm has no impact on price, every firm simply ignores the actions of other firms in the industry. If one farmer decides to plant his back forty in corn rather than wheat this year, his neighbors simply ignore this action in deciding how much land they should plant in wheat or corn. Finally, and this is related to the other two features, there is no strategic behavior on the part of firms. Since every firm has no impact on price, they don't waste time thinking "if I plant the back forty on corn, then my neighbor will think I know something about the wheat market, and he'll plant corn. But I don't want him to plant corn, I want him to plant soybeans, so perhaps I should pretend I'm planting soy, ..." Owners of competitive price taking firms don't think this way.

The Competitive Firm: *each firm is price taking, ignores its rivals output decisions, and doesn't engage in strategic behavior.*

To say that a firm is price taking is to say something very specific about its demand curve. As far as the firm is concerned, its demand curve is flat and just equal to the price. This is shown in figure 9-1. The price for the product is determined in the market for this commodity, and the firm simply takes this price as given and assumes it can sell all it wants at that price. If the firm were to charge just a penny more than this price, then no one would buy from the firm and the quantity demanded would be zero. If the firm charged a penny less than the market price the world would beat a path to the firm's door. This means the elasticity of demand for the price taking firm is infinity. In other words, consumers think of one competitive firm as being a perfect substitute for every other price taking firm in that industry.

When a firm considers the market price as its demand curve, then the demand curve is also equal to the marginal and average revenue for the firm. Marginal revenue is the change in total revenue divided by the change in output. Average revenue is the total revenue divided by the level

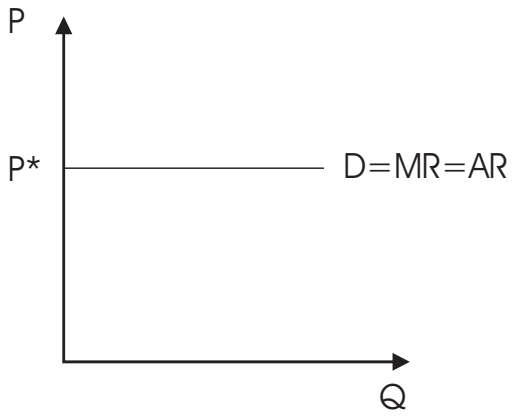

Figure 9-1
The Demand for A Perfectly Competitive Firm

of output. When the price of the good is fixed, then both the marginal and average revenue just equal the price. For every unit that is sold the total revenue simply increases by the price. We can show this with a simple example in Table 9-1. In the table the price of the good is \$10. When the firm sells one unit its revenues are \$10; when it sells two units revenues are \$20, and so on. Every time output changes by one unit, the total revenue changes by \$10. Hence the marginal revenue is also \$10. Likewise, when output is 7, total revenue is \$70. Therefore average revenue is \$70/7=\$10.

Marginal Revenue: a change in total revenue divided by a change in output: $\frac{\Delta TR}{\Delta Q}$

Average Revenue: total revenue divided by total output: $\frac{TR}{Q}$

For a price taking firm the demand curve is the price, the marginal revenue, and the average revenue.

9.1 The Profit Maximizing Level of Output

Let's suppose that a competitive firm has a production function for producing shoes as discussed in the last chapter, and that its level of capital is fixed at one unit. Furthermore, let's suppose that the price of this fixed capital input is zero, so that the firm has zero fixed costs. All of the costs the firm has are variable costs that result from changes in the amount of labor used to produce shoes.

Quantity	Price	Total Revenue	Marginal Revenue	Average Revenue
1	10	10		10
			10	
2	10	20		
			10	10
3	10	30		
			10	10
4	10	40		
			10	10
5	10	50		
			10	10
6	10	60		
			10	10
7	10	70		
			10	10
8	10	80		

Table 9-1
The Relationship Between Total, Marginal, and Average Revenue

The firm is a price taker and faces a price of $10 for every pair of shoes it sells. How many pairs of shoes should the firm make and sell if it wants to maximize its profits?

First we should note that the firm's profit is equal to the total revenue minus the total costs. Total costs are equal to the total variable costs plus the total fixed costs. Hence we can write profit as:

$$\text{Profit} = TR - TC.$$

Since we are going to assume that all variable costs are *avoidable* and all fixed costs are *sunk*, then the *rent* a firm earns is equal to total revenue minus the total variable costs. We can write rent as:

$$\text{Rent} = TR - TVC.$$

The distinction between rent and profit is confusing and important. The easiest way to understand it is to remember that rent is equal to the sunk costs of the firm in equilibrium. Rent is the amount of money that could be taken away from the firm, and the firm would continue to produce. In the shoe example we've started, the sunk costs are zero ... at least initially.

Our shoe example is shown in Figure 9-2, where the upward sloping marginal cost curve intersects the U-shaped average variable cost curve at its minimum point. The profit maximizing level of output is where the marginal cost equals the price.

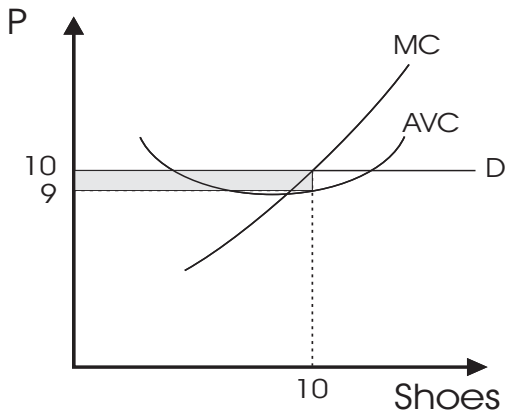

Figure 9-2
The Competitive Firm's Optimal Output

Profits are maximized when marginal cost equals price.

In the our shoe case this happens when 10 pairs of shoes are produced. Had the firm produced fewer than 10 pairs of shoes, say 9 pairs, then the marginal revenue of shoes would be greater than the marginal cost. This means the firm makes a positive contribution to profit by producing the 10th pair of shoes. Since the firm wants to maximize profit, it produces 10 pairs of shoes rather than 9. If the firm produced more than 10 pairs of shoes, say 11, then the marginal costs would be greater than the marginal revenue, meaning that the 11th pair of shoes lowers profits. Hence, 10 pairs of shoes maximizes the profits of the firm, and this occurs where marginal revenue equals marginal costs.

Notice when the firm produces 10 pairs of shoes, the average variable cost (AVC) of 10 shoes is \$9. This means that each pair of shoes costs \$9 (remember there are no fixed costs). Since the average revenue is \$10, the firm makes a profit of \$1 per pair of shoes, or \$10 profit. This is shown as the grey area in Figure 9-2.

Figure 9-2 is drawn under the assumption that the price of capital is zero. Suppose that the price of capital rises to \$10, so that the cost of one unit of capital is \$10. This cost eliminates the profit of the firm because the variable cost (VC) of \$90, plus the \$10 fixed cost (FC) just equals the \$100 of revenue the firm makes when it produces 10 pairs of shoes. This result is shown in Figure 9-3.

Several technical things need to be noted in Figure 9-3. First, notice that the average total cost curve (AC) lies above the average variable cost (AVC) curve. This is because the difference between the two is the average fixed cost (AFC).[1] Since AFC is just the FC divided by output, the larger

[1] This is a little confusing, but keep in mind that its just arithmetic. Since $TC = VC + FC$, if

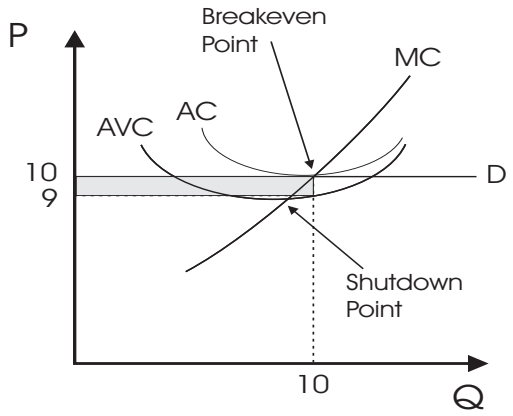

Figure 9-3
Profits with Fixed and Variable Costs

the output is the smaller AFC is. Hence the difference between the AVC and the AC curves gets smaller and smaller as the number of shoes produced increases.

Second, notice that the MC curve again intersects the AC curve at the minimum point. Furthermore, the AC at 10 pairs of shoes is \$10, which is equal to the price, which tells us that the firm is earning zero profits. In fact, from our definition of profits and rents, we see now that the grey area in Figure 9-3 is no longer profit but rent. The distinction is important. If the price of shoes were to fall, say to \$9.25, the firm would lose money. The \$9.25 would cover the labor costs of producing the shoes, but the firm would not make enough money to cover the fixed costs of capital. Would the firm stay in business? At first glance you might think, no. Why would a firm stay in business if it loses money. However, keep in mind that the fixed cost is *sunk*. There's nothing the firm can do to get this money back. So as long as the firm covers its variable costs, the firm stays in business. When the time comes to reinvest in the capital (e.g., update equipment), if the firm still cannot meet this expense, then the firm will go out of business. If the price of shoes falls below the minimum AVC point, then the firm goes out of business because it can avoid incurring the labor costs. As long as the firm earns a rent it will stay operating. Hence the minimum point of the AC curve is called the *break even point* because profit is zero there, and the minimum point of the AVC curve is called the *shutdown point* because at this point the rent is zero.

Breakeven point: the minimum of the AC curve.

Shutdown point: the minimum of the AVC curve.

Since output is zero if the price falls below the shutdown point, and since the firm produces a quantity determined by P=MC above this point, the supply curve of the individual firm is the marginal cost curve above the AVC minimum point.

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we divide the equation by the level of output we get $AC = AVC + AFC$.

The firm supply curve is the MC curve above the shutdown point (min AVC).

This is shown in Figure 9-4. Notice that since the supply curve lies above the AVC curve, it always lies on the upward sloping part of the MC curve. This means that supply curves are always upward sloping. Increases in prices for the firm's product always leads the firm to produce more.

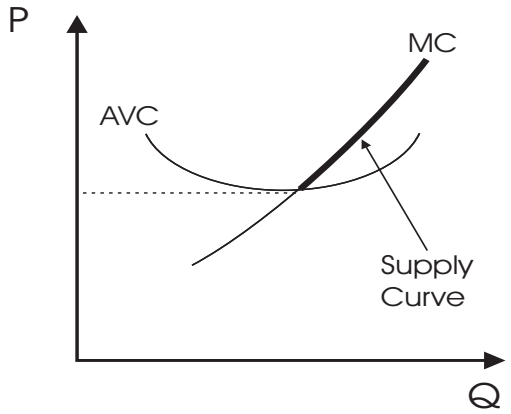

Figure 9-4
The Supply Curve of the Firm

Shifts in Cost Curves

The cost curves of the firm are not fixed, but depend on several factors. Any thing that changes one of the fixed costs will shift the AC curve, but will not shift the MC or AVC. These latter to cost curves depend on the opportunity costs of the firm, not the sunk costs. Anything that changes the variable costs of the firm will shift the AC, AVC, and the MC of the firm.

The marginal cost curve depends on three things: the level of output, the price of the inputs, and the production function. When the level of output changes there is a movement along the marginal cost curve; it does not shift. We can see this in Figure 9-5.

When output is 90, the MC is \$4, but when the level of output increases to 100 units, the MC increases to \$5. The increase in MC is a result of moving along the curve, not from any shift in the curve.

If an input price (like a wage rate) changes or there is a change in technology, then the MC curve will shift. Generally speaking, if an input becomes more expensive this will shift the MC curve up. Hence, if a tax is placed on labor, the firm will find it more expensive, at the margin, to produce output and the MC curve shifts up. On the other hand, if there is a technological change that changes the marginal product of an input, then the MC will shift. If there is a change that

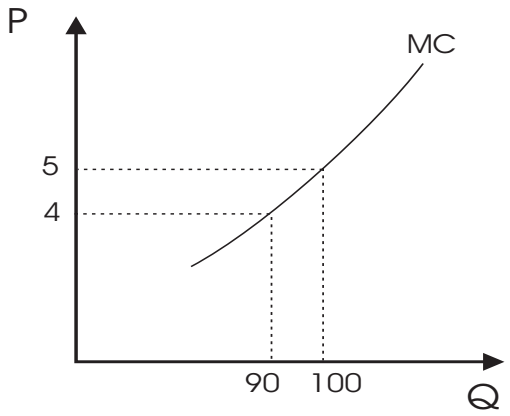

Figure 9-5
Movements Along the MC Curve

makes labor *more* productive, then this will shift the MC curve *down.* That is, the advance in technology makes it cheaper for the firm to produce output. Anything that lowers the marginal product of labor will have the effect of increasing the MC curve.

One relatively easy parameter change to analyze is the effect of a tax on cost. A government can impose two types of taxes: lump sum taxes and per unit taxes. A lump sum tax is one that does not vary with the output of the firm. In other words, it is a fixed cost. A per unit tax is one that varies with the level of output and is, therefore, a variable cost. Figure 9-6 shows the impact of a lump sum tax on a firms costs.

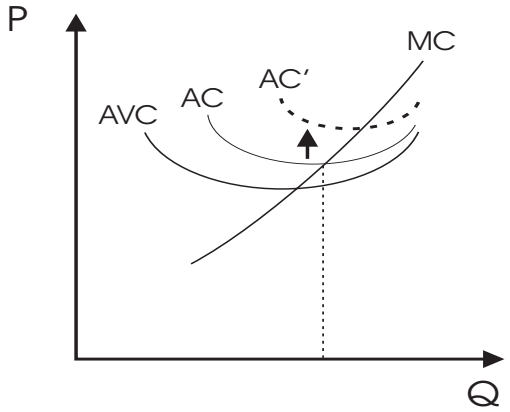

Figure 9-6
Effects of a Lump Sum Tax

The lump sum tax increases the AC curve to AC', but the other cost curves remain in place. This is because a lump sum tax doesn't effect the cost of producing an additional unit. The lump sum tax will influence the profits a firm makes, but it will not affect the rent. The AC curve will increase by the average lump sum tax. If the tax is \$1000, then the AC will shift up by \$1000/Q.

When the firm faces a per unit tax, then all of the cost curves will increase. An example of a per unit tax would be \$2 per unit.[2] Figure 9-7 shows the effect of such a tax. Since the tax influences the variable costs, the marginal cost curve shifts up. It turns out to shift up by an amount *equal to the tax*, which in this case is \$2. This would seem to make perfect sense. Every time the firm produces a unit of output it not only has to pay for the costs of production, it must now also pay the \$2 tax. The AVC curve also shifts up, and also shifts up by the amount of the tax. Again, this makes sense. If the firm produces 20 units then the total tax bill will be \$40, and the average tax is \$2 per unit. If the AVC curve shifts up by \$2, then it must be the case that the AC curve also shifts up by \$2.

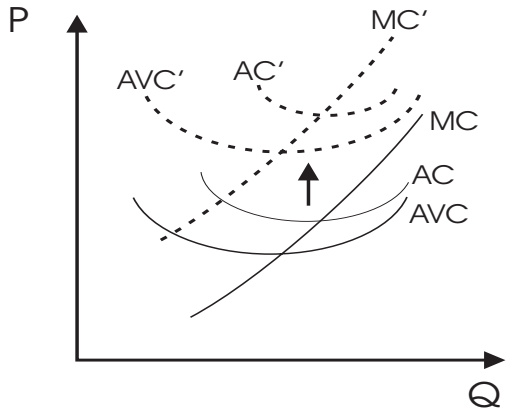

Figure 9-7
Effects of a Per Unit Tax

9.2 **Profits of the Firm**

Nothing is more confusing for students than the concept of economic profits. It is simple enough to say that "profit is equal to total revenue minus total costs." But let's keep in mind that total costs include opportunity costs and sunk costs, and doesn't just include the *cash flow* of the firm. All costs are accounted for in total costs.

For example, suppose you owned a little bicycle repair shop. After the first month in business you tally all of your receipts and find out that you've brought in \$36,000. After you deduct the rental for the shop, the wages for your employee, the price you paid for parts, and all the other costs that involved a cash outlay, you end up with \$4000 in your pocket. Would this money be considered a profit?

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[2] Most taxes that we face as consumers are a type of per unit tax, namely the *ad valorem* tax. These taxes charge a percentage of the value of the purchase. Thus a sales tax might charge 5% of the value of goods bought. The effect of such a tax is to increase the MC, AC, and AVC curves as well.

If you're understanding the concept of opportunity cost, then you should recognize the firm must also cover the cost of the entrepreneur's time ... namely you. If you sacrifice working for another bicycle shop for $3000 a month, then the firm made a profit of $1000. However, if you sacrifice working at another firm for $5000 a month, then the firm lost $1000. The alternative use of the entrepreneur's time might not be the only implicit cost to the firm. The firm might be exposed to risk, and risk requires a yield in order for someone to hold it. Running a bicycle shop is a risky business compared to working for someone else, and as a result this cost should also be factored in.

The bottom line is when an economist talks about economic profit, he's referring to the difference between all revenues and all costs. Consider how different this is from the accountant's income statement. On an accounting income statement there is a list of expenses. Most of these expenses are monthly cash flows like salaries, benefits, rent, office supplies, etc. However, some of the expenses include things like "depreciation" of capital assets. To the economist the true depreciation of a capital asset is its fall in value; that is, the change in the opportunity cost of holding the asset. The accountant, however, has no idea what this is, and so just uses an arbitrary formula for calculating the cost. Likewise the accountant ignores differences in risk, and ignores opportunity costs that do not have a cash flow. Thus the accountant's income statement is not a statement reflecting the firm's profits. Thus, a firm could have a positive number on the bottom of an income statement, but still make zero economic profit.

If we understand what an economic profit is, then the question must be asked: what is the *equilibrium* profit of the firm? Every firm wants to make as much profit as possible, but the firm is constrained by the demands of the consumer, *and* the behavior of other firms in the industry. It turns out the pursuit of profit on the part of all firms leads to the counter intuitive result that all economic profits are zero in equilibrium. We've assumed the market is full of lots of small firms. How similar these firms are determines how profits get driven to zero, but in either case (through costs or price changes) the result is the same.

> *In equilibrium, each firm must earn zero economic profit.*

All Firms are Identical

Let's start with the assumption that every single firm is identical in every respect and no firm has any sunk costs. Under these conditions the marginal costs of every firm would be identical, as would the AVC. Furthermore, the AVC curve would equal the AC curve, since there are no fixed/sunk costs. Suppose, that a situation like the one in Figure 9-8 existed for 10 firms who just happened to be the only firms in the market, even though there are plenty of potential firms just like them not producing.

This firm, and the 9 others just like it, are experiencing an economic profit. The revenues they receive not only cover *all* of their opportunity costs, they exceed them by the amount of the shaded area. The owners of this firm are better off being in this market by the amount of $100. But this can not be an equilibrium because there exists a host of other identical firms just as eager to have this $100 as these firms are. These firms, on seeing the profits to be had, *enter* the industry. When they enter the industry they increase the supply of goods available and this lowers the equilibrium price of the good. This process happens until all firms in the industry earn zero profits. As long as profits exist, firms will enter and prices will fall until the profits are eliminated.

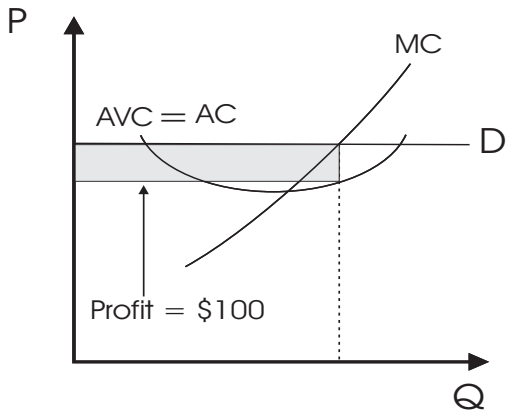

Figure 9-8
Out of Equilibrium Profits

But how can firms stay in business if they earn zero profits? If you find yourself asking this question, then you've got to go back and reconsider what profit is and how it relates to opportunity costs. When the firm earns zero profits it is covering all of its costs, including the return on capital, risk, and the opportunity costs of time of the owner running the firm.

If the ten firms we started out with were earning a loss, would anything have been different? No. Instead of firms entering the industry some firms would have just *exited* instead. When firms exit, the market supply starts to fall and prices increase. This increase in price would continue until all losses were eliminated or all firms left and no market existed. The result though is the same: profits are zero in equilibrium.

Firms Differ in Sunk Costs

When we assume that all firms are identical, the process of equilibrium is quite easy: prices simply adjust. When we assume that firms can be different we not only end up with countless possibilities, but the process that eliminates profits becomes a little more complicated. To keep things simple, let's only consider the case where firms differ in terms of their sunk/fixed costs. Each firm will have an identical marginal cost curve. To keep things even more simple, let's suppose the fixed input is the "talent" of the entrepreneur. Let's suppose the output is hot dogs, and some people are just born great vendors and others less so. Having a lot of hot dog talent means that the AVC of producing hot dogs is lower than a firm whose owner doesn't have a lot of hot dog talent. The *fixed cost* is just the value of this talent, which doesn't vary with the number of hot dogs produced.

Let's begin with an out of equilibrium scenario where the price of "hot dog talent" is zero. Since fixed costs equal the value of the talent times the amount of talent, every firm has zero fixed costs even though they have different levels of the fixed talent. Thus, each firm has a different AVC curve, but AVC=AC. Once again 10 firms are in the market, and two of them are drawn in Figure 9-9.

The firm on the left has an entrepreneur with more talent than the firm on the right. As a result the firm on the left is earning a larger profit than the one on the right. In any event, both of them are

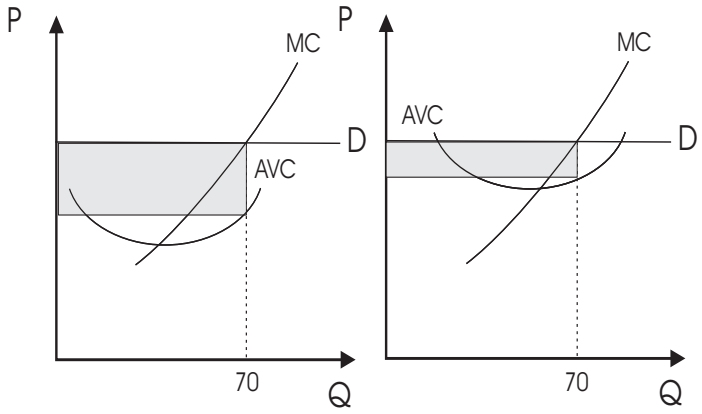

Figure 9-9
Out of Equilibrium Profits Again

earning profits and outside firms are going to be looking in thinking "we want some of that action." If the other firms also differ in terms of their talents; that is, if they differ in terms of their levels of fixed costs, then profits will be eliminated through two forces. First, as other firms enter the market, output will increase and prices will fall, just as before. However, there will also be a demand for this hot dog talent. Firms will offer individuals with such talent a higher and higher wage for these people to work for their firm. As these wages increase, the fixed costs of the firm increase. These increases in fixed costs do not change the AVC curve, but they do change the AC curve, as we've argued above.

Hence, when profits exist, entry by other firms will tend to lower the price, and increases in the cost of the sunk/fixed asset will tend to raise AC ... until the profit is eliminated. Which effect is larger will simply depend on the distribution of talent. If there is lots of talent, then the price fall will dominate. If there is almost no talent for making hot dogs, then the AC curve increase will be larger and the owner of this talent will become wealthier. With hot dog production, it is likely the price does most of the adjusting. With hockey players, where talent is quite limited, the AC would appear to do most of the work. The equilibrium is drawn in Figure 9-10.

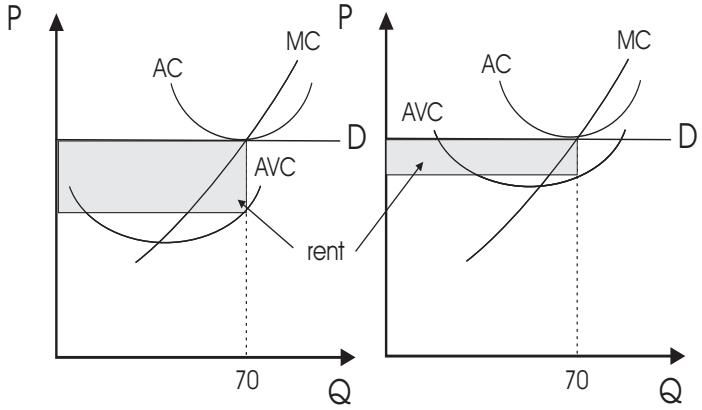

Figure 9-10
Equilibrium Profits with Different Firms

Notice that each firm, though it now earns zero profits, earns a rent. This rent is the payment to the special fixed factor that causes the AVC curve to be lower.

9.3 The Market Supply Curve

We're now ready to talk about the market supply curve. In earlier chapters, where there was no production, the market supply curve was simply the sum of the individual endowments. It is still true that the market supply curve is just the sum of the individual supply curves of each firm. However, in summing up individual supply curves we still need to account for the market structure, or the distribution of firms. As in the section just above, we'll make two simple assumptions: either all firms are identical, or they differ only in terms of their fixed costs.

In Figure 9-11 a series of identical firms is shown. Each has the same AVC=AC, and the same MC. Furthermore, we can assume that there are plenty more of these firms where they came from. We can ask ourselves, what would happen if the price were to rise just a little above $\bar{P}$, the price equal to the minimum AC point? If the price were any higher, then every firm would be earning a profit, entry would occur, output would increase and price would fall back to $\bar{P}$. If the price were below $\bar{P}$, then every firm would make a loss and would leave the market ... nothing would get produced. If nothing got produced the price would again rise back to $\bar{P}$. In other words, in a world like this, the price can never be anything but the minimum of AC. Technology is completely determining the price. In such a world, the market supply curve is the sum of the output each firm produces in equilibrium (equal to $\bar{Q}/N$ which is the total amount supplied divided by the number of firms), and is just a flat line. The elasticity of supply is infinite.

In a market where every firm is identical the equilibrium price and quantity are determined in a special way. It is still true that the equilibrium is found where the market demand and supply intersect each other. However, as just mentioned, the price is determined by the supply curve, which in turn is determined by the cost curves of the firms. The quantity traded, on the other hand, is determined by the market demand curve. When demand increases, the volume of trade increases. This increase in quantity is accomplished by firms entering the market. When demand decreases the volume of trade decreases through firms exiting the market. Changes in demand have no impact on price in this situation.

The case of identical firms is a very special one. When firms differ, even if it is just in terms of the size of fixed costs, then we get a much more standard result. Figure 9-12 shows the derivation of the market supply curve when firms differ. The first firm is the firm with the largest sunk/fixed cost, while the n^{th} firm is the one with zero fixed costs. Presumably there are a number of firms in between these two extremes. Let's consider what happens to the firms as the price moves from very low to higher. When the price is low enough, only the first firm will be in the market because the price is above its shutdown point but below the shutdown point of the other firms. As the price increases, the first firm increases its output (ie. it moves along its supply curve), and eventually the second firm enters the market. As the price continues to increase the firms already in the market continue to produce more, and more and more firms enter the market. The market supply curve, then, is the sum of all the individual firm supply curves and will be upward sloping.

The n^{th} firm in the market earns no rent. The intra marginal firms all earn a rent. The rent for the first firm is shown as the shaded area in the top left graph. When these rents are added up over all

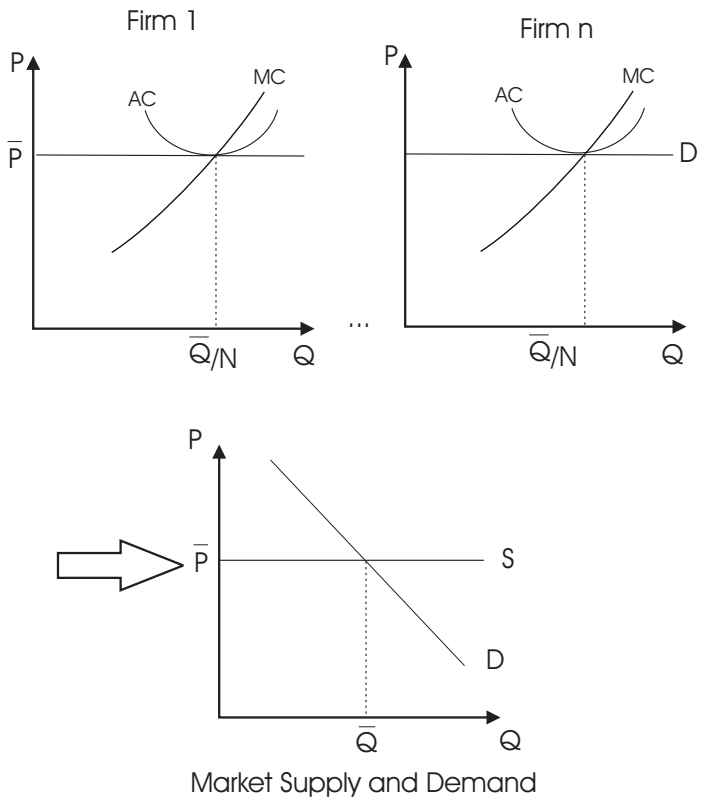

Figure 9-11
Market Supply with Identical Firms

the firms in the market they equal the shaded region above the market supply curve and below the price. This area is called either the rent or seller's surplus, and represents the gains from trade on the production side.

Figure 9-12 shows how a market supply curve is constructed when the firms only differ in terms of their fixed costs. Had firms differed more, for example had their marginal cost curves differed as well, the basic result would have remained the same. The market supply curve would have changed its shape, but it still would have remained upward sloping. Hence, in general the market supply curve is upward sloping.

9.4 **Summary**

The competitive firm is characterized by its price taking. Firms that have no bearing on their price only choose how much output to produce, and they maximize profits by producing until their marginal costs equal the price. At this level of output the profit of the firm depends on the average costs. When a firm is making a profit, it is not an equilibrium situation. Other firms will be attracted by the profit and will either enter the industry and lower the price, or will bid for the special input that allows profits. In either case, an equilibrium is reached when profits are zero.

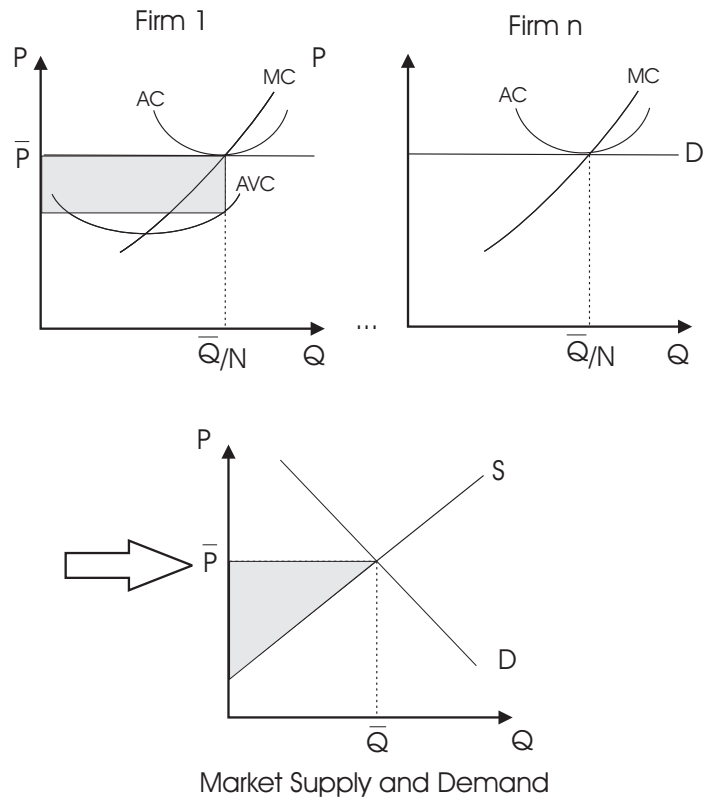

Figure 9-12
Market Supply with Different Firms

This result is counter intuitive, until one realizes that profit is the difference between all revenues and all opportunity costs.

A firm will not produce output unless the price it receives covers its variable avoidable costs. Any price below the minimum average variable cost curve means the firm will shut down. When the price equals the minimum of the average total cost curve, then the firm is breaking even and earning zero profits. How profit is driven to zero depends on the structure of competition. Generally speaking profits are eliminated through a combination of changes in output prices and increases in costs. When we sum up the individual firm supply curves we obtain a market supply curve. This market supply curve is upward sloping, except in the very restrictive case where every single firm is identical in every way. Now that we understand how a market supply curve is generated, we have completed the neoclassical model. In the next chapter we will spend some time using this model to explain different types of behavior.

REVIEW QUESTIONS

1. Why would a firm stay open, even though it is making a loss? Have you ever seen a dumpy roadside motel which always has a vacancy sign outside, why wouldn't such a place shut down?

2. Why might a firm sell a product "below cost"? For example, a pizza restaurant might sell a first pizza at regular price, and sell a second one for \$1. Or a fancy hotel might have "off season" rates at only a fraction of their regular rates. Or an airline might let you fly free if you have enough points.

3. How can a firm have zero profits in equilibrium?

4. What is rent? How is it different than profit?

5. Even though the marginal cost curve is not always upward sloping, and even though the supply curve is equal to the marginal cost curve, how is it that the supply curve is always upward sloping?

6. Are profits maximized when revenues equal cost?

PROBLEMS

1. Answer the following questions about cost functions as True or False, and provide a graph in your explanation.

   a. The difference between AVC and ATC is the fixed cost.

   b. When AC is falling, MC is also falling.

   c. If workers become 10% more productive, then MC remains the same but AC falls.

   d. If for any given amount of labor output is higher by 10 units, then MC remains the same and AVC decreases.

   e. FC continuously fall with output.

2. Assume that a perfectly competitive firm has MC=AVC=$12, MC=ATC=$20, and MC=MR=$24. On the basis of this information, can we tell what level of output will the firm choose? Is the firm making a profit? Is the firm making a rent?

3. You own a cigar company in Cuba. You produce 999 boxes of cigars per year. Your average costs per box is $1.00. Jean Chretien offers you $5.00 to produce an extra box so that he can give it to his best friend George W. Bush. If you accept his offer your average costs per box will be $1.01. What should you do?

4. Which firms are hurt the most when a lump sum tax is put on an industry: those intra marginal firms earning a rent, or those marginal firms that earn no rent?

5. Suppose the following statement is true: "When Q is 300, MC is $75, ATC is $65, and AP of labor is 30." Under these conditions what is the level of labor hired, and is ATC rising or falling?

6. "The law of diminishing marginal product says that the more workers you hire, the less they produce at the margin. How can the twelfth worker hired be less productive than the third worker hired, even if they have the same skills?" Let's assume that the workers do have the same skills. What is wrong with the statement?

7. Why is it that "superstars" like hockey players and baseball players (and university professors!) are spread out evenly among teams? That is, it never seems to pay for a team to have all the best players, (or it never pays one university to have all the best academics). What is going on?

8. A price taking firm makes air conditioners. The market price of one of their new air conditioners

is $120. Its total cost information is given in the following table:

Air Conditioners/day	Total Cost/day
1	100
2	150
3	220
4	310
5	405
6	510
7	650
8	800

How many air conditioners should the firm produce per day if its goal is to maximize profits?

9. Suppose that a firm had two plants, each with different marginal costs. Using a graph, show how you would construct the marginal cost curve for the firm as a whole. Draw in a price for the output, and show on your graph how much output would be produced at each plant. What is true about the marginal costs at each plant in equilibrium?

10. Complete the following table (fractions are ok).

Q	FC	VC	AVC	TC	MC	AC
20			100	6000		
30						
					250	
40						300

11. Farmers have long recognized that "bumper crops" are not always a great thing in terms of their revenues.

    a. In terms of the elasticity of demand, why would this be so?

    b. Would it ever be in the interests of a single farmer to reduce his output in an effort to raise price?

    c. In point form, list three problems farmers would face if they tried as a group to restrict output.

12. The government decides to tax all firms by $1000. This is a one time lump sum tax. What exactly will happen to a) the Marginal Cost of each firm? b) the Average Cost of each firm? c) The Average Variable Cost of each firm? d) the Average Fixed Cost of each firm?

13. A firm that faces a unit elastic demand curve, has constant marginal costs, and zero fixed costs would want to produce how much? (Assume the firm could only produce in discrete units).

14. Complete the following table:

Qs	FC	VC	AVC	TC	MC	AC
					250	
10			100	2500		
20						
					145	
30						195
40		5500				
50		6500				
60		7500				
70		8650				
80		10100				
90		12000				
100		14500				

15. A bumper sticker reads: "People not profits: Smash Capitalism" Comment.

16. If there is one peanut seller in the park, is he a price taker?

17. "Mr. Black, the grocer, buys his bread at 15¢ . What price should he charge in order to make a profit of 50%?" Why is this good arithmetic, but bad economics?

18. What is the difference between a profit and a rent? If a firm is interested in maximizing profits, why would it stay in an industry if profits are zero?

Review Question Answers

1. *Because it would be minimizing its losses. If a firm has sunk costs, the shut down point is below the zero profit point. Hence the firm would lose the sunk investment if it shuts down, but at least covers part of it staying open. Dumpy motels stay open because the few patrons they get cover their marginal cost. Eventually, as the place literally falls apart, the motel is not replaced and the firm shuts down.*

2. *Because it is covering its marginal costs and perhaps some of its sunk costs. The marginal cost of a pizza probably is close to £1, especially if the ingredients have been prepared and cannot be stored. Off season rates cover the marginal costs of the hotel, not the fixed/sunk costs. The marginal cost of a plane seat that would have gone empty is zero.*

3. *It has zero economic profits. The key to remember is the average cost function includes all costs, including the opportunity costs of the entrepreneur, the cost of risk, etc. Economic profit is not the same as accounting net income.*

4. *Rent is revenue minus opportunity costs. Profit is Revenue minus all costs.*

5. *The supply curve equals only the upward sloping part of the marginal cost curve above the minimum average variable cost curve.*

6. *No, when marginal revenues equal marginal cost.*

Odd Numbered Problem Answers

1.

a. *False. The difference is the* **average** *fixed cost. This follows from* $ATC = AVC + AFC$.

b. *False. See the graph. In the dark segment of the MC curve, between* Q_1 *and* Q_2*, the MC curve is rising while the AC is falling.*

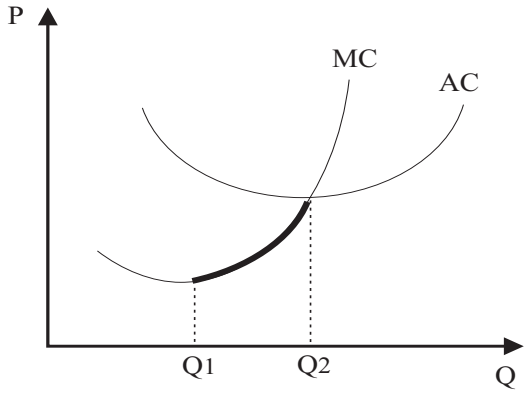

Figure 9-1b

c. *False. A 10% increase in productivity will change the worker's MP, which will change the MC curve and the AC curve.*

d. *True. The marginal product doesn't change, therefore the MC remains the same. However, the average product increases, so the AVC curve must fall.*

e. *False. The AFC continuously falls with output.*

3. *By producing the extra box total costs increase by* $10*. Since this is greater than* $5 *you should turn the deal down ... if there are no consequences from turning a Prime Minister down!*

5. *Since AP=Q/L, there are 10 units of labor hired. Since the MC¿ATC the ATC must be rising.*

7. *The marginal contribution of superstars falls the more a team has. This means the first superstar on a team is worth more than the tenth superstar. As a result, a team with few superstars will be willing to bid away the tenth superstar on another team. In the process there is an equalization. The distribution won't be exactly equal because teams differ from city to city.*

9.

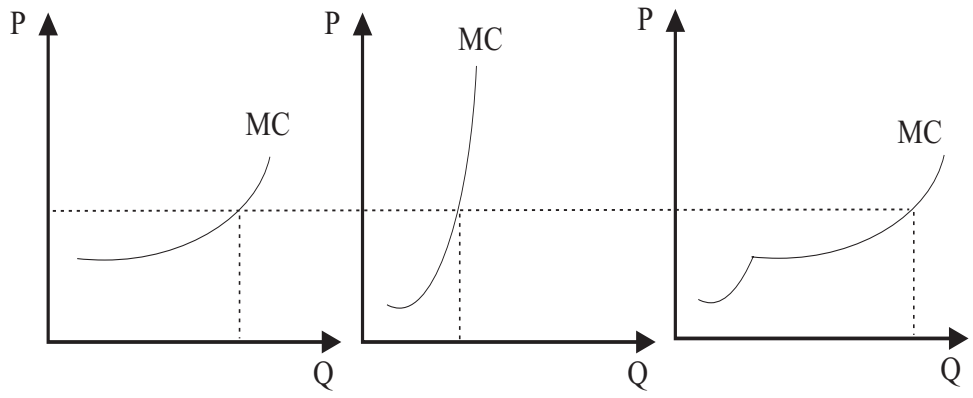

Figure 9-9

The MC curve for the firm is simply the horizontal summation of the individual firm MC curves. The MC cost of each plant will be set the same.

11.

a. *If the elasticity of demand is low, then a bumper crop leads to a great fall in price and a fall in revenue.*

b. *No, because the farmer is just a price taker and has no impact on the price.*

c. *They would face cheating problems within the group, as individual farmers tried to produce more. They would face competition from entry as new farmers produced the crop. And they would face the second law of demand as consumers found better substitutes for the product.*

13. *The firm would produce 1 unit. Producing anymore increases costs without increasing revenues.*

15. *Profits accrue to people and people own capital, so the sticker is slightly inconsistent.*

17. *Mr. Black is a price taker. He takes his price as given.*

CHAPTER 10

APPLICATIONS OF THE NEOCLASSICAL MODEL

10.1 **Market Equilibrium**

We've come along way in just a few short chapters, and it's time to put everything together. We started off with the first principle of economics — maximization. Maximization is what motivates everyone in an economic model. For consumers the principle means they choose bundles of goods in order to maximize their utility. We saw this was equivalent to maximizing their consumer's surplus: the difference between what they would have been willing to pay and what they had to pay. Graphically, the consumer's surplus is the difference between the height of their demand curve and the price they faced. Firms maximized their profits, and this amounted to maximizing their producer surplus, which equaled the difference between their revenues and costs. Graphically, this difference was the area above the supply curve and below the price they faced.

This equilibrium is summarized in Figure 10-1. Maximization for consumers meant they equated their marginal values to the price of the good. Maximization for firms meant they equated their marginal costs to the price of the good. Hence, since firms and consumers face the same price, it must be true that in equilibrium the marginal value of consumers equals the marginal costs of firms. This means that in equilibrium the market demand curve intersects the market supply curve. It is clear from Figure 10-1 that this equilibrium maximizes the gains from trade: the sum of consumer's and producer's surplus.

In equilibrium, MV=MC.

We also know what shifts each of these curves. Any change in the price of other consumer goods, changes in consumer incomes, or changes in tastes will shift the market demand curve and leave the supply curve unchanged. Any changes in input prices, or changes in technology will shift the supply curve and leave the demand curve unchanged. When one of these curves changes there is a movement to a new equilibrium. Our model assumes this movement is instantaneous. Hence there are no dynamic movements in prices — the market moves immediately from one equilibrium to another.

This chapter is intended to pause and consider the equilibrium neoclassical model we have developed thus far. What makes this model so general is its ability to apply to almost anything. In building the model we put virtually no restrictions on the nature of the quantity produced and traded. All that is required is for it to be something people value. As a result, people not only have demands for soap, cars, and dishwashers, they also demand valuable non-market goods as well, like friendship, spouses, and children, or churches, blood, and clean air. Likewise, in developing the concept of price, our only restriction was in terms of willingness to sacrifice. We often use a

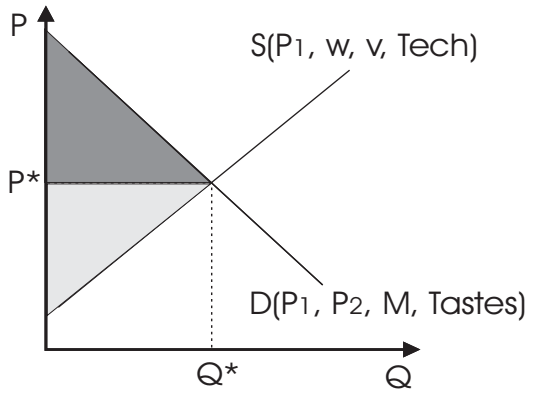

Figure 10-1
The Market Equilibrium

dollar price simply for convenience, but our model assumes that the "price" is the amount of other valuable things forgone. Hence our model can analyze markets for all types of things in life, even when formal markets do not exist.

10. 2 **Shifts in Supply and Demand**

Let's consider what happens to equilibrium price and quantity when market demand and market supply shift. As mentioned, the market demand function for a good can shift for a number of reasons. Tastes may change, causing a shift in market demand. For example, in the 1980s, there was apparently no demand for "grunge" clothing, the "stair-master" exercise machines, or the student back packs that became popular in the 1990s. So, too, the price of either a substitute or a complement for the good may change, causing the market demand for that good to shift accordingly. If the price of a substitute for good 1 goes up, then the market demand function for good 1 will shift upward and to the right. For example, if coffee becomes more expensive, the demand for tea will shift upward and to the right. If the price of a complement goes up, the opposite will occur. For example, if a ski-lift ticket becomes more expensive, the demand for ski-equipment rentals will shift down and to the left.

Suppose for some reason the demand function for good 1 does shift up and to the right. Then both the equilibrium price and quantity will increase. This can be seen in panel (iii) of figure 10-2, where the initial equilibrium is point A and the new equilibrium is point B. If, for some reason the demand function for good 1 shifts to the left, as in panel (iv) of figure 10-2, then the equilibrium price and quantity both fall.

Let us turn now to changes in market supply. Again, a number of factors can cause a shift in the market supply function. Technological change — the development of more efficient production processes, for example — can cause shifts in market supply functions. So can changes in the prices of inputs. If the price of a variable input goes up then the market supply functions will shift upward and to the left. For instance, the dramatic increases in the price of crude oil in the 1970s caused a shift in the supply functions for a whole range of plastic products, including plastic cups, because crude

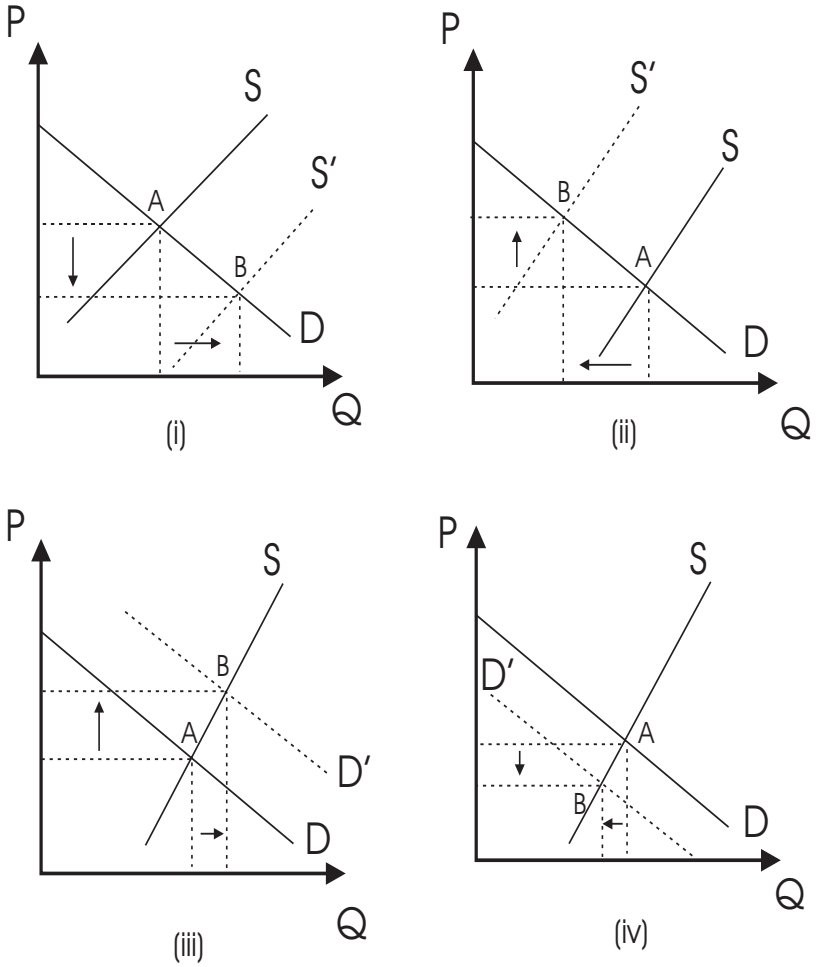

Figure 10-2
Changes in Demand and Supply

oil is an essential input in the production of many plastics. Suppose, then, that the market supply function does shift up and to the left, as in panel (ii) of figure 10-2. Given the downward sloping market demand curve the equilibrium price will increase and equilibrium quantity will decrease. If the supply curve had shifted to the right as in panel (i) of figure 10-2, then the equilibrium price would have fallen and the equilibrium quantity would have increased.

Increases in demand lead to movements along the supply curve, an increased equilibrium price, and an increased equilibrium quantity.

Increases in supply lead to movements along the demand curve, an increased equilibrium quantity, but a decreased equilibrium price.

We saw this basic movement in prices in Chapter 6 when the supply curve was vertical and no production took place. These movements in prices and quantities in response to changes in market demand and market supply result from maximization and the competitive allocation of resources. An equilibrium occurs where "supply equals demand" because at that quantity all consumers have equal marginal values (and therefore have no incentive to trade), and all firms have equal marginal costs (and therefore have no incentive to shift production).

It is easy to draw these curves and to shift them around. The hard part is to see how they manifest in the world around us. Have you ever been to Europe and noticed the differences in house construction? Homes in Europe are mostly made of stone, concrete, and bricks. Most notably, they tend not to use a wood frame construction. In North America a stone home is rare, and most homes are made of dimensional lumber covered with plaster board. This reflects the relative prices of building materials. In North America we have vast supplies of softwood timber, while in Europe this is not the case. The increase in supply here lowers the price of wood, and as a result we use wood for applications that are not used elsewhere. Over time the price of wood in North America has been increasing, caused by increases in both domestic and foreign demand for wood, and by reduced supplies of timber. As a result, we use wood for fewer applications now than in the past. Wood used to be a common fuel for heating homes, but this is no longer the case. As hard as it is to believe, white oak was used for railway ties in the 19th century, and these ties are now made of cheaper wood or concrete.

When demand and supply curves shift they cause the above changes in prices and quantities. The actual size of these changes depends on the elasticities of demand and supply. The more inelastic the demand and supply curves, the more the price changes relative to the quantity. The opposite is true when the curves are more elastic. For example, in the winter of 1998 Quebec suffered a disastrous ice storm that knocked out power lines and electricity for weeks. Two years earlier in 1996, hurricane Fran hit North Carolina and caused a similar amount of destruction. Generally speaking there is much less inter-provincial trade in Canada than inter-state trade in the U.S. This is due to poorer trade routes in Canada and to government restrictions on trade between provinces. This essentially makes the supply of repair goods and services more elastic in North Carolina than in Quebec. These differences are shown in Figure 10-3. Predictably, there were huge changes in prices for generators and repair parts in Quebec and virtually no changes in prices in North Carolina. Corresponding to this, there were large changes in the volume of repair goods sent to North Carolina (new reports showed freeways congested with tractor trailer units heading to major centers), while in Quebec CBC Radio was hosting shows across the country for donated goods!

Prices are Determined by Supply and Demand

One of the most profound things you can learn from the simple demand and supply model we've developed is that prices and quantities are *determined* by the intersection of supply and demand curves. Prices don't fall from space, they aren't determined by costs alone, they come from the competitive interaction of consumers and producers.

A lot of very smart people just never get this point. For example, in 1972 a group of social and physical scientists published a book called *The Limits to Growth.* It was a volume produced by a group of academics who had gathered at a conference in Rome. Later this group became known as "The Club of Rome". The book sold over 9 million copies in almost 30 different languages. The book had, and continues to have, a tremendous impact on the way many people think about the future and natural resources, even though it contains a flawed analysis of the way markets work.

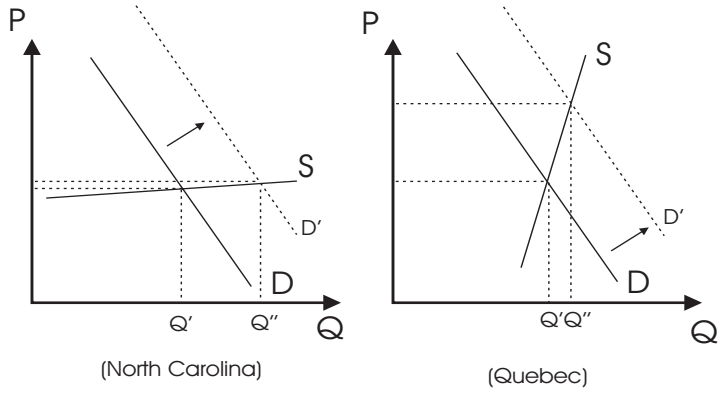

Figure 10-3
Different Elasticities Lead to Different Outcomes

The book *The Limits to Growth* made many bold predictions. Tin and silver were to be completely exhausted by the mid 1980s, other precious metals were to be depleted by the 1990s, and population and pollution were to grow unchecked — eventually terminating life as we know it. The basic reason for these calamities was that our industrialized world uses up resources that are presumably fixed, and so eventually we must run out.

Although this line of reasoning has been going on since the time of Malthus in the 19th century, it continues to go on today. In 1980 U.S. president Jimmy Carter commissioned the Global 2000 report which predicted "barring revolutionary advances in technology, life for most people on earth will be more precarious in 2000 than it is now." An article by Robert Kaplan in the February 2002 Atlantic monthly called "The Coming Anarchy" has been causing a stir in government circles by again making grim forecasts on the future.

As we saw in Chapter 6 the catastrophic predictions of the Club of Rome never came true because prices and quantities are endogenously determined in the competitive model. When the demand for a resource like tin increases, there is a movement along the supply of tin, and the quantity of tin demanded and supplied both increase. At the new equilibrium, supply still equals demand. Had the price not increased, more tin would have been demanded and less would have been supplied, and there would have been a shortage. However, the rise in the price acts to equilibrate the quantity demanded and supplied.

When people write books like the *Limits to Growth*, or *The Population Bomb* by Paul Ehrlich, about the coming shortages of our limited planet, they make several fundamental mistakes. The first, as just mentioned, is to ignore the role of the price mechanism in directing consumption and production. The second, is to ignore long run impacts. Over time, demand curves tend to become more elastic, given the second law of demand. The increased elasticity is a result of improved knowledge of substitutes. When the price of commodities increase because of reduced supplies these high prices induce individuals to begin exploring new substitutes. This mitigates the initial price increase, and in essence reduces the scarcity problem. In addition, there are long run effects on the supply side as well. At high prices firms seek new methods of production and new sources of inputs. In the 19th century the great social scientist Stanley Jevons predicted that England's growth would soon terminate because the reserves of coal would soon be exhausted. As the price of coal increased, however, new reserves were found, better extraction and transportation methods

were developed, and eventually oil replaced most uses of coal. This process of innovation tends to increase the elasticity of supply over time, which tends to mitigate the initial rise in price.

Human history provides one example after another of exogenous shocks resulting in high prices, followed by the development of new substitutes, new methods of production, and new sources of supply. In spite of growing world populations, output in goods and services have easily grown faster. Mortality is down, life expectancy, literacy and consumption is up. We don't live in paradise, but the world is healthier, safer, and wealthier than it was 20 years ago. Necessity may be the mother of invention, but it is the equilibrating movement of prices that signals to individuals to move into action. Our equilibrium model suggests we should be optimistic about the future of the planet, not doomsayers.

Futures Markets

Movements in prices not only save us from the disasters resulting from over exploitation of resources, prices act as social coordinators for all types of goods, most of which we never give a second thought to. In the Pacific Northwest area of North America (Washington, Oregon, British Columbia) a major agricultural product is apples. When the harvest is done in late summer some of the apples get shipped to markets around the world for immediate consumption, but many are put into storage for consumption over the coming year until the next harvest. How do people decide how many apples to put into storage? Who bears the consequences if too many are put into storage, or not enough? One thing is clear: in any fruit market in North America one can eat apples all year long, and though the price fluctuates over the seasons, the change in price is quite minimal given that apples are only harvested once a year.

Apple growers don't store apples over the winter. Nor does McDonalds store apples for their apple pies. Apples are stored by thousands of people through commodity markets. Why would someone store an apple? At harvest time the price of apples falls because the supply of apples is large. In the winter, when the supply of apples has fallen the price is expected to increase. *Speculators*, in anticipation of the higher price in the winter time, purchase apples in the fall and store them for resale later in the year. They do this by simply calling a broker who arranges the storing space, insurance, etc. They do it because they hope to make a profit in the apple commodity market.

Apple speculators decide on their own when they want to sell their apples. Their decision depends on the price apples are selling today (called the spot price) and the price they expect to get in the future. If the demand for apples increases today, then the spot price of apples increases. This reduces the incentive for speculators to hold apples, and they sell more today. If the expected future price of apples increases, then speculators hold on to their apples, and save them until they are more valuable to consumers ... and themselves. But how does the speculator know what the future price will be? It turns out there is a market for apples that approximates the future price: *the futures market.* A futures market is where people agree on contracts *today* to deliver a certain quantity at a given price, in the *future*. This future price is today's best guess at what the price will be in the future. As new information is learned, the futures price changes.

You can look up futures prices in the financial section of almost any newspaper. It will tell you the spot price today and the futures price for various times in the future. If the harvest takes place in September, the futures price will increase over the year until the next harvest. This increase in price over the year is sufficient to cover, on average, the cost of storage, insurance, and interest costs of investment in holding the apples over the time period. Anyone who thinks the futures prices are

wrong, and buys or sells futures, stands to make a fortune if correct ... or lose if incorrect. Suppose apples are currently selling for $6 a bushel at harvest, but the May futures price is $6.75. If you believe that the May price will actually be $7 (because you think over the next year someone is finally going to prove an apple a day keeps the Dr. away) then you should buy now a May futures contract for say 10,000 bushels. These apples will be delivered and paid for by you next May. In the meantime, you wait. If the May spot price turns out to be $9, then you get to buy your 10,000 bushels at $6.75 and sell them at $9, making a smooth $22,500 profit. If, on the other hand, the price falls to $6 a bushel, they you have to pay the $6.75 and sell at $6, losing $7500.

If you're not the only one who thinks the price next May will be higher than the current $6.75, then others will join you in bidding for May futures. This increase in demand will raise the price of May futures. At this higher price it is more profitable to store apples, and so more are taken out of the spot market and put into storage. In this way the futures market allocates goods from the spot market to the future. The result is quite amazing. Thousands and thousands of people are involved in futures markets, no one tells them what to do. The result is I end up eating apples in December at a cost that basically reflects the cost of storing an apple from September to December. Those speculators who are good at their job make lots of money, and consumers are rewarded with goods available at the right time. Those speculators who are bad at their job end up misallocating apples throughout the year, and they are punished by losses. Markets are social coordinators because the prices allocate goods in a decentralized fashion.

10.3 **Trade One More Time**

Before we move on to different types of applications, we should look at trade one more time. In Chapter 3 we saw that when individuals have different marginal values, they gained from trade. In Chapter 6 we saw this trade took place until the marginal value of the traders was equalized. In Chapter 7 we saw that when individuals or firms had different marginal costs, they could also gain from trade and that trade would take place until the marginal costs were equal across individuals or firms. Now, with our equilibrium supply and demand model we can put it all together.

Suppose Tom and Gary are two cattle farmers who, though living next to each other, do not trade. Both Tom and Gary produce and consume pigs, and their demand and marginal cost curves are shown in Figure 10-4.

Since both Tom and Gary essentially eat what they produce, they are simultaneously consumers and producers. Their surpluses are shown as the grey shaded areas. Tom produces and consumes 10 pigs, while Gary produces and consumes 11. It is clear from the graph that each produces pigs until their marginal value equals their marginal costs. In other words, both farmers are behaving efficiently. On the other hand, it is also obvious that the marginal values and costs across the two farmers are not equal, which means they can both gain from trading with each other. Suppose a market develops for these two. The market supply would simply be the summation of the individual marginal cost curves, and the market demand curve would be the summation of the individual demand curves. Both farmers can buy and sell as many pigs as they would like at the market price. The equilibrium outcome is shown in Figure 10-5.

The market equilibrium shown on the far right graph produces an equilibrium price of P^*. Gary, who is the low cost producer of pigs, increases his production to 20 pigs until his marginal cost equals this price. Gary does not consume all of these pigs, however, since he only demands 9

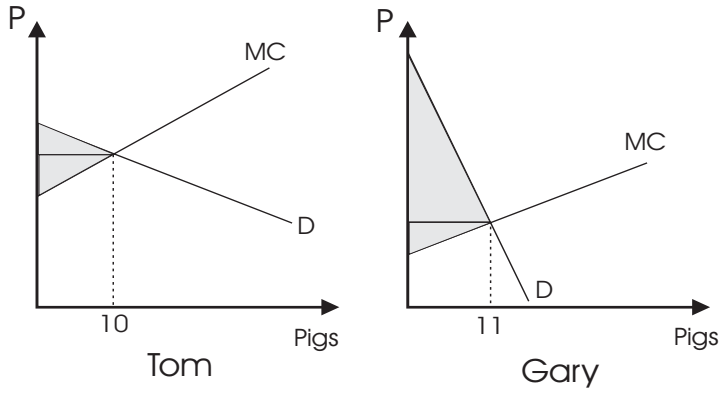

Figure 10-4
No Trade for Tom and Gary

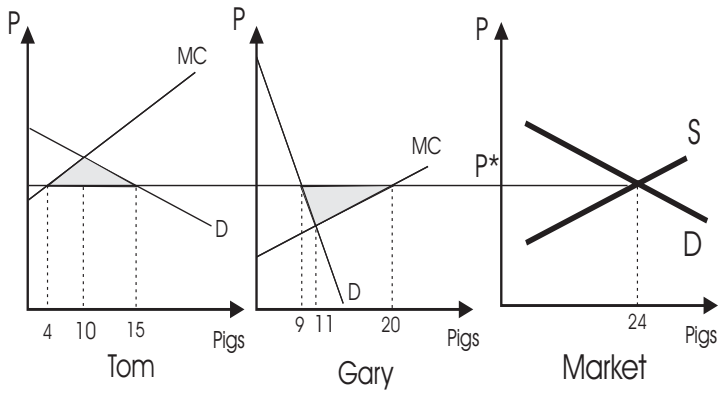

Figure 10-5
Trade for Tom and Gary

pigs at this higher price. The 11 extra pigs get traded to Tom. When Tom sees the new price P^* he wants to increase his consumption of pigs because the price is lower than his marginal value. He increases consumption to 15 pigs, but cuts down his production to only 4 pigs. The extra 11 he consumes come from Gary. The *net* gains from trade are shown as the shaded areas in figure 10-5. Tom is better off as a consumer of pigs, while Gary is better off as a seller. Notice now that once again the marginal values and marginal costs of each individual are equal. However, now also notice that the marginal costs of Gary are equal to the marginal costs of Tom, and their marginal values are equal as well. In other words, the trade is efficient and the gains from trade are maximized.

A market allocates goods such that the low cost producers (at the margin) produce the goods, and the high valued users (at the margin) consume the goods. The remarkable thing about this allocation is that each person acts independently of the other and only requires knowledge of the price to make decisions.

10.4 **Taxes**

In Chapter 9 we analyzed the different effects a lump sum and a per unit tax had on a firm's cost curves. Now we want to analyze the effects of these taxes in the context of our supply and demand model. We will see that our model provides a result that is almost counter-intuitive, and goes against what our common sense might first suggest. For example, we might think that in terms of tax revenue, it does not matter what goods get taxed. After all, if the government is faced with two goods to tax, each with a current volume of trade of 10,000 units, then a \$1 tax per unit placed on either good should raise \$10,000 in revenue. However, this is not the case. We might also think that if the government puts a tax of \$1 per unit on a good that the price of the good must rise by \$1, but this is not the case either! Finally, we might think that it matters a great deal whether or not the consumer is taxed at the point of consumption or the firm is taxed at the point of production. Yet again, our model suggests otherwise.

Let us begin by considering only the effect of a \$1 per unit tax on a group of firms in a particular industry. Recall that a per unit tax means that for every unit of output produced, the cost of production is increased by the amount of the tax. Hence the marginal costs of production increase by the amount of the tax, in this case by \$1. If every firm in the industry is taxed by the same amount, then the market supply curve must also shift up by the amount of the tax.

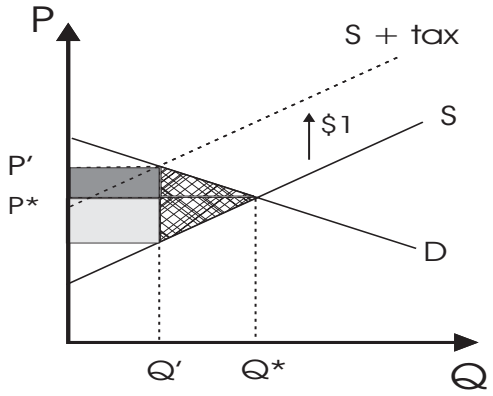

Figure 10-6
The Effect of a Tax

Figure 10-6 shows the effect of an imposition of a \$1 per unit tax placed on all firms. Before the tax, the equilibrium price and quantity are P^*, Q^*. Since the tax shifts the supply curve up by \$1, the new equilibrium price and quantity are P', Q'. Several things are immediately apparent from Figure 10-6. First, it is clear that as long as the demand curve is not perfectly inelastic, then the price will not increase by the full amount of the tax. In this case, though the tax increased marginal costs by \$1, the price clearly goes up by less than this amount. As firms raise the price, consumers substitute out of the good being taxed and into goods that have become relatively cheaper. This substitution hinders the ability of firms to pass the tax on to consumers, and as a result, prices rise but by less than the amount of the tax.

A \$1 *tax per unit raises price by less than* \$1 *as long as the demand curve is not perfectly inelastic.*

A second feature of the graph in figure 10-6 is that since price does not rise by the full amount of the tax, the consumer does not pay all of the tax revenue. The relative tax burdens are shown by the shaded regions. Consumers pay an amount of taxes equal to the dark shaded area. The area is defined by the increase in price they face $(P' - P^*)$ multiplied by the amount of the good they purchase, Q'. On the other hand, firms do not receive the price P', but rather receive $(P' - 1)$. Therefore the amount of the tax that the firms pay is given by $[p^* - (P' - 1)]Q'$, which is equal to the light shaded area.

A third feature of the graph is that the level of output traded has been reduced from Q^* to Q'. This fall in the amount of trade causes a "deadweight loss" to result. The concept of a deadweight loss is used by economists to denote a loss of wealth, or an inefficiency. A deadweight loss is wealth that should exist (because marginal values are greater than marginal costs) but does not exist for some reason, in this case because of taxes. The total deadweight loss in this case is the lost consumer's and producer's surplus caused by the reduced output, and is given by the crosshatched triangle. This should be considered a cost of taxation.

A per unit tax increases the equilibrium price by less than the amount of the tax, and creates a deadweight loss.

The effect of a per unit tax on the amount of tax collected and on the incidence of who pays the tax, depends critically on the elasticity of demand. Figure 10-7 shows two markets which have an identical per unit tax placed on the firms. In panel (A) we see that the demand curve is very inelastic. This good has very few substitutes and as a result, the bulk of the tax is passed on to the consumer in the form of a higher price. If the demand curve were perfectly inelastic, then the entire tax would have been passed on. Notice that in the case of panel (A), there is also very little reduction in the amount of the good that is traded. As a result there is only a trivial deadweight loss, and the amount of tax revenue is almost equal to the original traded volume times the amount of the tax.

On the other hand, panel (B) shows a much different situation. Here the demand for the good is highly elastic. There are many substitutes for this good, and as a result consumers are quick to substitute into other goods when the price increases. This means consumers pay very little of the tax. In addition, when the demand curve is relatively elastic, there is a relatively large reduction in the volume of trade, and therefore, a relatively large deadweight cost from the tax — shown again as the crosshatched area.

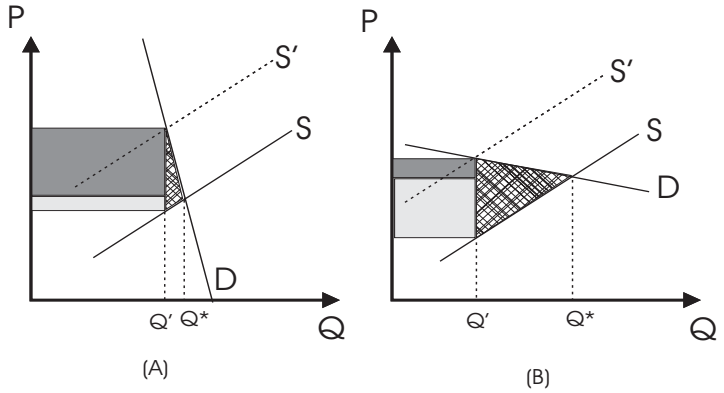

Figure 10-7
Taxes With Different Elasticities of Demand

The deadweight loss is created because output is being reduced. If you'll recall our discussion of firms and market supply curves you'll remember that output changes along the supply curve because firms change how much they produce, and because firms enter and leave the market. When a tax is put on, the marginal firms will leave the industry as a way of avoiding the tax. If the demand curve were extremely elastic, a per unit tax might have the effect of every firm leaving the industry. This sounds incredible, but it essentially means that if consumers have a perfect substitute for a good, then that good cannot be taxed without the firms ceasing production. For example, there are no gas stations on the Canadian side of the border with the United States. The differences in taxes between the two countries, along with the fact that American gasoline is identical to Canadian gasoline in the eyes of consumers, means that no one would buy gasoline from the Canadian station.

Differences in elasticities of demand can explain a great deal of tax policy. Governments look for goods with low elasticities of demand to tax, because if consumers and/or producers can avoid the tax, then tax revenues obviously fall. This explains why consumers firmly believe that if a good gets taxed, they're likely to pay. Historically, one of the most commonly taxed goods was salt. Not surprisingly, throughout the centuries, salt had a very low elasticity of demand, and before refrigeration, was used for more important things than flavoring food. In modern times it is fashionable to tax gasoline, alcohol, and tobacco. All of these goods have relatively low elasticities of demand. What we never see is the taxation of a particular brand of gasoline, beer, or cigarette. If the government suddenly decided that it wanted to tax Bud Light Beer, it would quickly find itself with zero revenue. Not only would consumers switch immediately to other light beers, but Budwiser would cease to produce that particular brand as well.

Who pays the tax depends on the elasticity of demand. Lower elasticities lead to consumers paying a larger fraction.

When we say "producers" pay part of the tax, we need to remember production invovles all types of inputs. Consider a tax on cars. Cars are produced in factories along an assembly line,

with parts produced elsewhere, made from raw inputs obtained from other firms. Once cars are produced they are shipped, and then sold by retail outlets. Which one of the hundreds of thousands of producers actually ends up paying for a tax on cars? Any inputs that can move to other industries without facing any costs of moving, would do so in order to avoid paying any of the tax. Moving inputs, however, is not costless, and some inputs will find it better to pay the tax than move elsewhere. Those inputs specialized to producing cars will pay for more of the tax than inputs not so specialized. As we've mentioned, these differences in producers is summarized by the upward slope of the supply curve. The more elastic the supply curve, the better options the inputs have in other industries, and the less tax they will bear. An industry with a fixed supply curve is one where the inputs cannot escape, and hence they will bear the entire tax. An industry with a perfectly elastic supply curve is one where the inputs have equal opportunities elsewhere and consumers will bear all of the tax.

> *Who pays the tax depends on the elasticity of supply. Lower elasticities lead to producers paying a larger fraction.*

Taxing Consumers

We have been examining taxes in the context of a tax on the firms at the point of production. An alternative form of taxation would be a sales tax placed on the consumer. One question we might ask is: would a tax of \$1 per unit placed on the consumer lead to a different equilibrium price and quantity than what we just observed with producers? The answer, quite surprisingly, is no!

Consider Figure 10-8 which shows the effect of a sales tax on the demand curve. The demand curve tells us the maximum consumers are willing to pay for the good. When a tax is put on, consumers are still only willing to pay at most the height of their demand curve. As a result, the demand curve that the *firm perceives* shifts down by an amount equal to the tax. For example, if a consumer is willing to pay \$10 for the first unit and the tax is \$1, then the most that the firm can receive is \$9. Hence, a sales tax has the result of lowering the demand for the good by the amount of the tax.

As with the case of the producers, however, the price received by the firm does not fall by the amount of the tax. Rather, as is shown in Figure 10-8, the price to the consumer rises to P, and the price to the firm falls to $(P-1)$. The difference between the two prices is the amount of the tax. Since the demand curve falls by the amount of a tax when consumers are taxed directly, and the supply curve shifts up by the amount of a tax when firms are taxed directly, the impact on price and quantity is identical. In other words, it does not matter if consumers are taxed or producers are, the outcome is the same. Not only this, but the incidence of who pays the tax is also the same, with the relative shares of tax burden again depending of the elasticities of demand and supply.

One of the general lessons of the analysis of taxation is that changes in costs are not fully borne by the firm or the consumer in general. These changes in costs, however, need not just result from taxes. When an industry experiences an increase in shoplifting, due to a change in the nature of the product for example, this raises the costs to the firms in that industry and some of those costs will be passed on to consumers. Workers may demand firms be forced to offer employees medical and

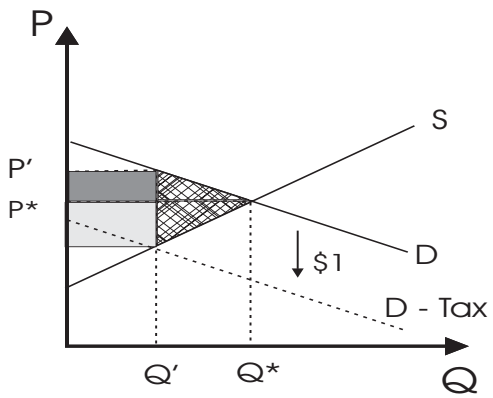

Figure 10-8
Taxing Consumers

dental coverage, but again this will partially be offset by slightly lower wages. How much consumers and workers pay depends on the elasticities involved, but the bottom line is there's no free lunch.

10.5 **Quotas in Agriculture**

A great number of agricultural policies can be analyzed with our simple supply and demand model. For example, farmers have been very successful in lobbying governments to establish farm programs. In Canada only about 4% of the population live on farms, yet in 1986 about 8 billion dollars were transferred from governments to farmers. These transfers accounted for almost 43% of agricultural income. One question that comes to mind is, do these farm income policies simply amount to transfers of wealth from non-farmers to farmers, or are there economic losses that result from them?

One type of agricultural policy is the farm quota. A government issued quota is essentially a license for a particular farmer to grow a specified amount of some crop or animal. Quotas are common for turkey, chicken, egg, and milk production. Most of the quotas in Canada were introduced during the 1970s. Figure 10-9 shows the effect of a quota on the turkey market. Prior to the quota a price of P^* existed. At this price, each individual turkey farm was earning zero profits, and there was no incentive to leave or enter the industry. At the price P^*, there are Q^* turkeys supplied, which amounts to Q^*/n turkeys per farm on average. When the quota is introduced only those farmers that have a quota can supply the market. The entire purpose of a quota is to raise the price of turkeys, and so the total supply must fall below Q^*. Suppose that quota allows for Q' turkeys in total, or Q'/n per farm on average. At that supply, the market clearing price is P'.

An effective quota reduces the quantity supplied and raises the price to consumers. At the new price the marginal value of turkeys is greater than its marginal cost. As a result the quota leads to a dead weight loss equal to the crosshatched triangle. This loss is made up of a loss of consumer surplus and a loss of producer's surplus, resulting from the reduction in turkeys produced. But there is also a transfer of wealth from consumers to producers equal to the grey shaded area. This transfer results from the higher price that consumers now face for purchasing turkeys. Hence consumers are

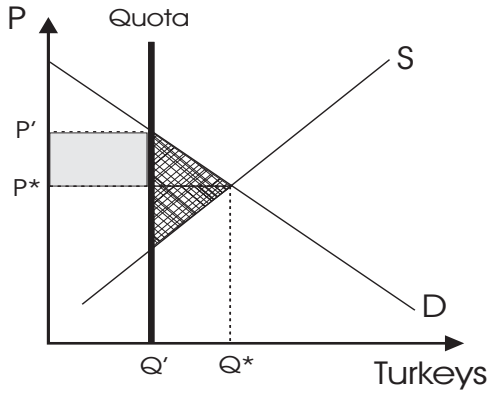

Figure 10-9
Quotas For Turkeys

unambiguously hurt by the quota. On the other hand, the farmers benefit from the quota because presumably the transfer from the higher price is greater than the loss from reduced output.

Quotas introduce a number of distributional problems for farmers. Under perfect competition farmers decide to enter the industry and what number of turkeys to produce based on the price of turkeys. At the higher price P' more farmers want to enter the industry than the quota will allow, and for every individual farmer with a quota there is an incentive to produce more than their individual quotas allow. Since the price mechanism is ruled out as a solution to this problem, farmers must decide how to allocate the smaller output Q' to the farmers that are still producing and how to keep new farmers from entering. Fortunately for the farmers, the problem of preventing entry is taken care of by the government, which enforces the quota. However, the problem of allocating the reduced output to the existing farmers remains. An additional problem is deciding whether some farmers with quotas should leave the industry or not. Given that output has been reduced, only the lowest cost producers should remain. However, if the quotas are allocated evenly among all existing producers, then the high cost producers remain in the industry. Our model does not indicate how these distribution problems are solved, but to the extent the solution is costly, the net benefits of the quota to the producers are reduced.

As a method of raising incomes to farmers, quotas have an additional drawback. Suppose that the quota is introduced as a complete surprise to a group of farmers. Overnight they find that if they obey their quota and reduce their production the price will rise and their incomes will increase. To these farmers, the quota is like a gift from Heaven. The quota allows them to earn an economic rent year-in, year-out. If the farmer wished to sell his quota to another farmer, however, what price would he set for it? Clearly he would charge what it is worth, the present value of the stream of rents. But if he charges this amount, this means that the subsequent farmer who purchases this quota is now earning a zero profit return. The quota has simply increased his costs of entering the business, and in fact, the quota is now necessary for him to avoid losses. Hence, when a quota is sold to another farmer, the value of the quota is transferred completely to the original farmer. This problem is called the transitional gains trap, and points to how difficult it is to actually improve the incomes of farmers with quotas.

10.6 **Warm Houses in Cold Climates**[1]

The competitive model often yields surprising solutions to puzzling observations. Take, for example, the case of home heating. Anyone who has lived in a climate like Ottawa in the winter knows the meaning of the word cold! Winter temperatures are often 30 degrees below zero, which is cold in both Fahrenheit and Celsius. On the other hand, winters in Vancouver are very mild in comparison. Seldom does the temperature fall below freezing, and when it does it is short lived. Given the differences in outside temperatures, what would you expect to be the inside temperatures of the homes?

Common sense might tell you that in cold locations where people have to spend a lot on heating, the inside temperature would be colder, with the opposite happening in warmer climes. However, just the opposite tends to happen. Homes in cold climates have hotter indoor temperatures, other things equal, than homes in warmer climates.

Before we can explain this, some basic facts about the nature of home heating are necessary. Heat inside a house flows, like water down a hill, to the cooler outside air. The walls of the house slow down this flow, depending on how well the wall is insulated. The rate of heat flow also depends on the difference between the outside and inside temperatures. Anyone who has ever camped in a poorly insulated cabin in the winter knows that as the temperature outside falls the cabin becomes more drafty inside. Often, as the difference in temperature increases, you can hear the heated air whistle through the cracks in the doors and windows as it escapes outside.

It turns out that we can write the heating cost function in a very simple form:

$$TC = P_h B(T_i - T_o)$$

where P_h is the price of heat, T_i is the temperature inside, T_o is the temperature outside, and B is the "barrier" to heat loss. The size of B depends on how well the home is insulated as well as the shape and size of the home. If a home is poorly insulated, or if the home has a large surface area exposed to the outside due to the style and size, then B is a larger number. This cost function is very simple, since total costs are linear with respect to the inside temperature. Figure 10-10 draws three different cost functions representing three different homes. TC_1 is a poorly insulated home that has an outside temperature of 32 degrees Fahrenheit. Notice that if you wanted to have the inside temperature to be 32 degrees it costs nothing, you just open the window. TC_2 is the identical house to house 1 in terms of insulation, but the outside temperature is now 70 degrees. Notice that for a given inside temperature house 2 will have a lower total cost of heating because nature is "adding" 38 degrees to the home's heat. TC_3 is a better insulated home which also has an outside temperature of 32 degrees. Compared to home number 2, home number 3 starts heating sooner, but the marginal cost of an additional unit of heat is lower due to the better insulation. For high inside temperatures, it is possible that home number three even has a lower total heating bill.

Now lets see if we can resolve the paradox of warm houses in cold climates. Suppose there is an identical house in Ottawa and Vancouver, and that the only difference is the outside temperature. Let the Ottawa house be house 1 and the Vancouver house be house 2. Furthermore, let's suppose

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[1] This example is taken from David Friedman "Cold Houses in Warm Climates and Vice Versa: A Paradox of Rational Heating." *Journal of Political Economy* 95 1987.

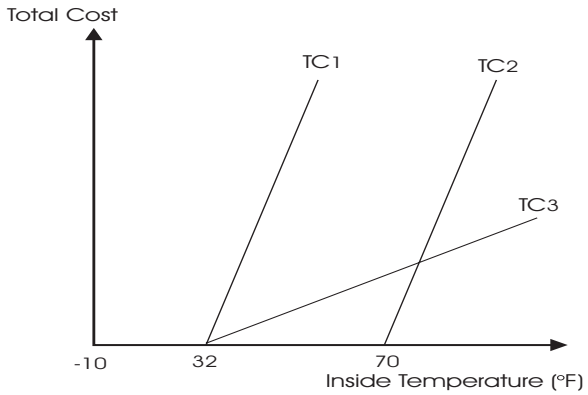

Figure 10-10
Total Costs of Heating Different Homes

that the demand for heat is identical for both homes; that is, at a given price residents in both places want the same inside temperature. Figure 10-11 shows the optimal temperature for each house. Since both homes are identical, they both have identical marginal costs of heat. Notice that the marginal cost curves are flat because the total cost curves are linear. Each additional unit of heat costs the same for both homes. Since each home has the same marginal cost of heat, both home owners heat their homes to the same temperature. The only difference is that the home in Ottawa heats sooner and has a higher total heating bill.

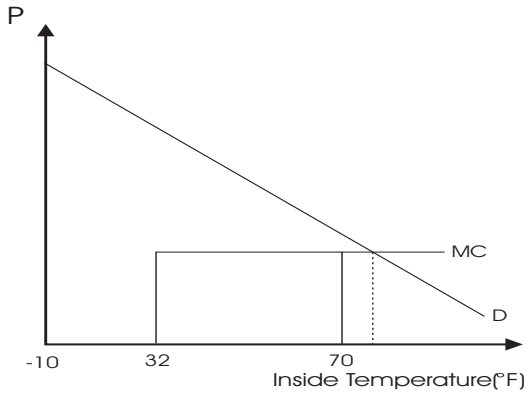

Figure 10-11
Optimal Temperatures for Identical Homes

But why should we assume that the homes in Vancouver and Ottawa are identical? What would be true for the demand for insulation in Ottawa versus Vancouver? In Ottawa a little insulation saves a lot of money because more heating is being done. Likewise, homes in Ottawa will more likely be designed to lower the value of B because there are so much more benefits. In other words, homes in Ottawa are more likely to have cost functions like home number 3 in Figure 10-10. Figure 10-12 shows the heating situation for homes number 2 and 3. The home in Vancouver is cooler because at the margin it is more expensive to heat. In Ottawa homes are not only better insulated, they are made of brick rather than wood, they are two stories with basements rather than ranchers and

split-levels, they have smaller windows, no cathedral ceilings, and often share walls with homes next door. All of these features lower the marginal cost of heating and lead to higher inside temperatures. It is a very subtle application of the supply and demand model, but houses in cold climates have warmer inside temperatures because they are better insulated and designed to lower the marginal cost of heating.

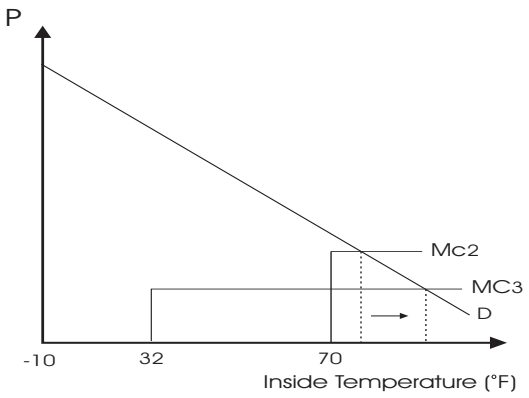

Figure 10-12
Optimal Temperatures for Different Homes

10. 7 **Criminal Behavior**

Although there are many aspects of crime that are beyond the simple model of supply and demand, there is a great deal that can still be understood. The use of economics to understand criminal behavior and the criminal law strikes many as incongruous. After all, are criminals not irrational, acting on impulse and upbringing? This may be the common view of the criminal, but for the economist, as always, we assume that crime is the result of maximization. Ultimately the proof is in the pudding. To the extent that economics can explain this type of behavior, it is consistent with rational criminals.

When saying criminals are subject to economic analysis, we are saying the quantity of crime depends on the costs and benefits of crime, and that criminal behavior takes place when the benefits are greater than the costs. Criminals, like everyone else, participate in this type of "employment" because they earn more than they can in other, more socially desirable, methods of employment. When the costs of crime increase, the amount of crime should fall. When the benefits of crime increase, the amount of crime should increase. As economists, we do not claim everyone is engaged in rational criminal behavior. We only claim that as the cost of crime is reduced, those committing crime will commit more, and that some individuals will find it in their interests to become criminals.

Figure 10-13 shows a simple supply and demand model where the horizontal axis measures the quantity of "crime" committed. The demand curve is downward sloping because the marginal benefits of committing a crime fall with increased criminal activity. This results from diminished marginal productivity in crime. For example, suppose one was engaged in tax evasion. The first efforts at such crime might yield high payoffs as the obvious places to cheat are exploited. However, the more tax evasion one is involved in, the lower the return, as it becomes more and more difficult

to find tax loopholes to exploit. The supply of crimes is upward sloping, demonstrating the rising marginal costs of production. One of the major costs of crime is the forgone income from legitimate employment. Those who have a comparative advantage in crime will have low alternative earnings. These are the first individuals to engage in crime. As the returns to crime increase, others are induced into the industry, but these people naturally have higher opportunity costs. In equilibrium the amount of crime is where the marginal benefits equal the marginal costs.

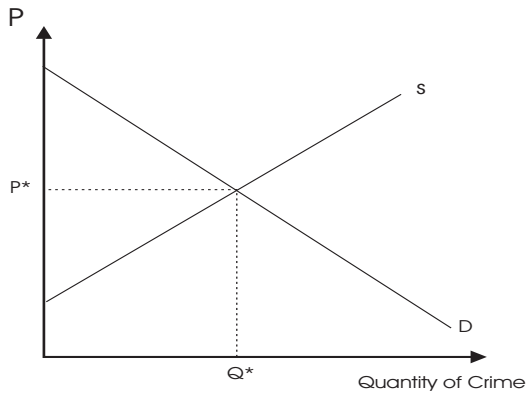

Figure 10-13
The Optimal Amount of Crime

This simple model suggests two methods of reducing crime. The first is that the net benefits can be reduced. Societies make all kinds of provisions that attempt to achieve this goal. One of the most common is to impose penalties for crimes and to create an environment where there is some positive chance that a criminal will get caught. When a criminal is anticipating a crime, he or she will compare the expected penalty (the amount of the penalty times the probability of getting caught) with the expected benefit. If the expected penalty is too high, then the crime is not committed. The other method of reducing crime is to raise the opportunity cost of crime. If employment opportunities improve, or if one is eligible for social services given no criminal record, then the costs of crime increase, and again there will be less crime. Here again, most societies have parts of their social safety nets designed to discourage low-income individuals from engaging in crime.

In terms of penalties, it is important to note that both the size of the penalty and the chance of detection are under social control. Penalties can always be made more severe, and more police and detection devices can be employed. In situations where the chance of detection is very small, as in cattle rustling in the old west or late-night muggings in large cities, the penalties tend to be high in order to compensate for the low probability of getting caught. It may seem that the rational thing to do is to spend very little on detection and simply make penalties enormous. For example, we could have the death penalty for jay-walking! However, there are a number of costs of this type of penal system. First, occasionally mistakes are made in detection. If mistakes are made, we wouldn't want to have only extreme penalties. Second, by having one penalty the principle of substitution is ignored. If the penalty of a crime is always death, then anyone about to be caught goes to extreme lengths to get away. Kidnappers are more likely to kill their victims if the penalties are the same for murder and kidnapping because it reduces the number of witnesses to their crime at no cost to them. More generally, with extreme penalties, criminals have a clear incentive to kill witnesses. An

example of this lack of marginal deterrence is found in prisons with inmates who have no chance of ever being released. They often become extremely violent and difficult to keep under control because the maximum penalty has already been imposed.

In Chapter 4 we touched on an example of how increasing the penalty of crime can reduce the amount of crime is found in the recent fascinating work of Lott and Mustard, who have been studying the "right to carry" gun laws of the United States.[2] This study provides a nice example of using the economic model to understand crime. The murder rate in the United States has been in the news for many years because it is so high compared to other countries. Interestingly, the murder rate in the United States is closely tied to legislation regulating and enforcing the use of drugs and alcohol. In the 1930s, murder rates in the United States peaked during prohibition, which banned alcohol consumption. When this law was repealed the murder rate collapsed, and then slowly began to climb again. By the 1980s, murder rates in some states were as high as during the height of prohibition, and were undoubtedly related to the new war on drugs that began in the 1960s.

During most of this time, it was illegal for a private citizen to carry a concealed hand-gun. However, throughout the 1970s a number of states passed laws that allowed ordinary citizens to carry concealed weapons, and to use them in self defense. As mentioned in Chapter 4, the number of individuals in any given state that actually applied for a weapon was quite small, between 2% and 4%. However, even with this low take up rate the effects were quite large. Lott and Mustard have found that all violent crime rates fell with the introduction of right to carry laws. Murder rates fell by 8%, rape by 5%, robbery by 3%, and aggravated assault by 7%. Interestingly, for crimes that involved stealth, such as burglary, crime rates increased.

This application indicates that there is evidence that many criminals do behave in ways that are consistent with our general model. As a society we design our laws in light of this model. Laws are made such that there is marginal deterrence, repeat offenders get larger sentences, and young offenders get lighter sentences (in order to raise the cost of future crime by not destroying their future earning ability).

10. 8 **The Marriage Market**

Marriage is a complex institution which legally regulates the terms of formation and dissolution of a union between a man and woman. Though there can be marriages without children, most people marry for the purpose of raising their own children. Marriages involve the state, family members, often the church, and even friends and larger social groups. Marriage is mostly about how production in the household is organized, and as such is a topic better left for the last section of this book. However, if we're willing to make some very strong assumptions, and think about the entire marriage market as opposed to specific relationships, we can see that our current model can tell us a few things regarding the volume of marriages and the (implicit) terms of trade.

To begin with, let's assume individuals are free to marry whomever they wish, and that all benefits and costs from marriage accrue to the couple. Historically, women were the property of their

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[2] John Lott Jr. and David Mustard, "Crime, Deterrence and Right to Carry Concealed Handguns." Journal of Legal Studies 26, 1997.

fathers, and upon marriage their ownership transferred to their husbands under the legal doctrine of coveture. Even today, we can't say only a husband or wife receives all the benefits or costs of marriage, as many grandparents will attest. But we'll make this assumption anyway.

Second, let's assume every marriage is monogamous, and everyone is homogeneous. That is, all males are the same and all females are the same. We'll also assume it is possible for a price for a spouse to exist. This price is either negative or positive. In a western society we don't have explicit prices for a spouse, but we do have implicit ones. When a couple gets married, they bring assets, human capital, and expected future earnings with them. To the extent one person brings more than others, that person is paying the other spouse. If a wife pays a positive price to obtain a husband, then by definition the husband pays a negative price to obtain a bride. To keep matters simple, we'll assume there is an explicit price for a spouse.

Third, let's assume that everyone wants to get married in order to engage in some type of household production. This production might be the raising of children or simply producing the mundane daily goods of food, shelter and clothing. Under these circumstances we might expect a market situation as shown in Figure 10-14. In this graph we've drawn the demand and supply curves for wives such that at the equilibrium A, the price of the spouse is zero. Keep in mind there would be a symmetrical graph for the market for husbands, since the supply of wives is the mirror image of the demand for husbands.

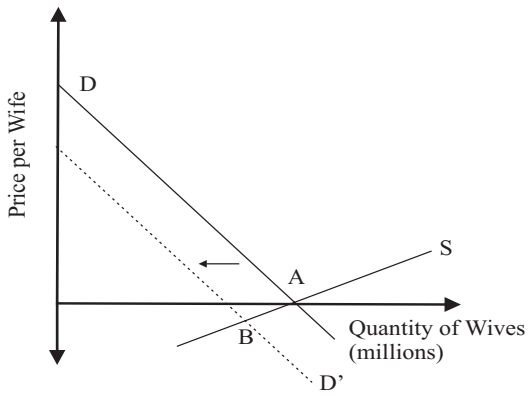

Figure 10-14
The Marriage Market

Now let's consider what happens in such a market when there are shocks to either the supply or demand for wives. Suppose, for example, a large war breaks out and most of the eligible men in a town leave to fight. The effect would be a fall in the demand for wives, and is shown as a movement to equilibrium B. This fall in demand means the price of wives becomes negative, or which is the same thing, the price of husbands becomes positive. In a western culture where prices are implicit, how might this fall in price manifest? Women would find they would have to promise men more things in order for them to agree to marriage. Perhaps more of the household duties would be assigned the wife, perhaps the husband would have more say in the number of children, where the couple lives, and what the relative shares in the marriage would be. One form of competition women might engage in when the terms of trade go against them is pre-marital sex. Historically sex was much more costly for women to engage in than men. Even today women bear most of the costs of

sex when a pregnancy arises. As a result women tend to be less willing to engage in pre-marital sex than men. When the price of a wife falls, however, one form of payment to men might be to engage in sex before marriage. There is a humourous scene in the beginning of the movie *The Englishman Who Went Up a Hill and Came Down a Mountain* starring Hugh Grant, where the local minister is chastising the loose morals of the townsfolk while the local boys are off fighting in WWII. As the camera pans the congregation almost every young woman is seen holding a baby with red hair. Later we learn the only male left in town is the red headed bar keeper!

What would happen to this market if instead of a war, the number of eligible females in society fell? Since women often marry men a few years older than they are, this can happen when age cohorts are not the same. For example, if a large birth rate is followed by a small one, by the time the women of the small group are of age to marry, they will be in relatively small numbers to those men in the large group slightly older than them. Such situations happened in North America during the 1930s and the 1980s. According to the simple model, the supply of wives is reduced, and the price of wives increases. Now potential husbands must pay more for a spouse than previously. This might arise in terms of commitments to allow the wife more say in the marriage. It might also manifest in more commitment from the male prior to the marriage. Males, under such circumstances are more likely to commit to marriage, and less likely to pressure the woman to engage in pre-marital sex. Both the 1930s and 1980s were conservative times in the popular culture.

Our simple little marriage market model cannot explain much about marriage. However, it does tell us how changes in the sex ratio in the population of men and women of marrying age effects the terms of trade in marriage. To test your intuition, consider what would happen if polygamy were made legal. Polygamy is where a husband is allowed to legally have more than one wife. Our intuition might suggest this would make women worse off, after all, who would want to share a husband. But consider the model. Polygamy increases the demand for wives, and this raises the price of wives. Some wives will accept being the second wife because the price paid to them compensates for the reduced attention they get from sharing. Those wives in a monogamous marriage are much better off because they too receive the higher price. Those males with only one wife are made worse off.

There are only a few examples of widespread voluntary polygamy in history. One important case was the Mormon experience in Utah during the 19th century. Studies have shown that opposition to polygamy at the time did not come from women in Utah or the rest of the U.S., but from unmarried men in Utah and males outside the state. When Utah was granted statehood, one of the conditions was that polygamy be made illegal. This restriction was placed by the U.S. congress, made up and elected by men in the states other than Utah. An interesting counterfactual question is: had women been allowed to vote in the 19^{th} century, would polygamy have been made illegal?

10.9 **Summary**

The neoclassical model presented in this chapter is the fundamental tool in an economist's tool kit. Its usefulness stems from its relative intuition and its applicability to a vast number of situations. The model assumes that there are many consumers and producers engaged in efforts to maximize utility or profit, and in this process the gains from trade are also maximized. The competitive model does not depend on the type of good we happen to place on the horizontal axis. If the competitive conditions are met for consumers and producers, then anything that is valued can be analyzed with this model. This means not only can we apply the model to market situations, like the effect of a tax on the price of orange juice, but we can also apply the model to nonmarket transactions like

marriage, religion, or crime. This chapter completes our analysis of the basic neoclassical model. In Part II of the book we extend this model to two important applications and consider what happens when firms are no longer price takers.

REVIEW QUESTIONS

1. Explain why a competitive market produces efficient outcomes in terms of the allocation of resources?

2. Does cost determine price? If something becomes more costly, won't the price increase?

3. In the spring of 2004 gasoline prices in Canada hit $1.00 per liter. At that magical price almost everyone was paying attention to the pricing of gasoline, and many noticed that the price at every station was essentially the same. Many called for a public investigation into collusion on the part of the gasoline retailers. Does the same price at different outlets mean there is collusion?

4. Are speculators parasites on the economic system? Are they getting rich at the expense of others in an economy?

5. From a deadweight loss point of view, is it better to tax goods with inelastic demand or elastic demand?

6. There was a time before guns. Prior to the 15^{th} century, hand guns and affordable muskets did not exist. Do you think this was a safer time or a more deadly time?

PROBLEMS

1. For a given home that is being heated, will individuals be constantly adjusting their thermostat based on the temperature outside?

2. Suppose the demand and supply of chickens is given by:

$$Q_d = 20,500 - 250p$$

$$Q_s = 5000 + 100p$$

   a) Graph the demand and supply curves and determine the equilibrium price and quantity.

   b) Suppose a quota of 4000 chickens is imposed. What will be the new equilibrium price? What is the loss to consumers? What is the net gain, if any, to producers?

3. Suppose a tax of $1 per pound is put on apples. (Be very brief in your answers).

   a. What will happen to the output of peanuts and the price to the sellers of peanuts? Draw a graph as part of your answer.

   b. Given that apples grow from plants that last a long time, and are not costless to remove, what will happen to the value of apple land?

   c. What will happen to the value of general farm tractors?

   d. What will happen to the value of specific apple growing equipment?

4. For each long distance call anywhere in Canada, a new phone service will charge users 30 cents per minute for the first 2 minutes and 2 cents per minute for additional minutes in each call. Tom's current phone service charges 10 cents per minute for all calls, and his calls are never shorter than 7 minutes. If Tom's dorm switches to the new phone service, what will happen to the average length of his calls? Provide a supply and demand graph in your answer.

5. Tofu was available 25 years ago only from small businesses operating in Chinese quarters of large cities. Today tofu has become popular as a high-protein health food and is widely available in supermarkets throughout Canada. At the same time, production has evolved to become factory based using modern food processing technologies. Draw a diagram with demand and supply curves depicting the market for tofu 25 years ago and the market for tofu today. What does the model predict about the price and quantity of tofu over time?

6. Suppose the BC government were to import heating oil to Vancouver Island at a price of $2/gallon and make it available to residents for $1/gallon. If an Islanders' demand for heating oil is given by $p = 6 - q$, where p is the price per gallon in dollars and q is the quantity in millions of gallons per year, how much economic surplus is lost as a result of the government's policy? Provide a graph in your answer.

7. In 2000 the BC government estimated that 1 million Salmon were missing from the Fraser River. This created a debate over what has happened to the fish. Some people argued that

the fish were poached (caught illegally) and then sold, while others argued exceptionally warm ocean water killed the fish before they could reach the river. Knowing that 1,000,000 fish is a significant number in terms of the total quantity caught and sold, how could you look at the BC fish market and tell if the 1,000,000 missing fish were caught illegally or killed by nature? (You must draw a demand and supply graph as part of your answer. Label it carefully.)

8. "Medical costs would be lower if the government paid for tuition, because then the Drs would not need to recoup their investment." True or False, comment.

9. Suppose a city places a "green-belt" area around itself that effectively kills any future development. What will happen to current housing rental rates, future housing rental rates, and the current price of housing? Briefly explain why.

10. Would exchange ever be possible if all people had the same preferences?

11. Renters in Vancouver must pay three times as much as renters in Halifax. Suppose the BC government decides this is unfair and offers subsidies to Vancouver renters. Draw a graph of the situation and carefully explain what would happen if this were to take place.

12. "Hockey players are crazy if they think the NHL can survive free agency. Salaries will go out of the roof, and teams will bid so high for a few outstanding players, that they will be financially ruined." This comment was made in the Vancouver Sun almost 15 years ago. Salaries have risen a great deal, and yet the NHL has survived. What is the mistake made in the analysis?

13. Why is it that the prices of some goods increase during times of heaviest consumption while others go down?

14. "The Premier is wrong about the effect of taxes on the consumption of cigarettes. Now that the the tax on cigarettes is lower it is true that the demand for cigarettes will increase, but this increase in demand will drive the price of smoking up, and in the end there will be little change in the amount of smoking done." Comment.

15. Canada pension contributions are paid one-half by employers, and the other half is withheld from employees' paychecks. Does this mean that the employer and the employee in fact each share half the burden of the tax? What would determine their respective shares? Draw a graph to explain your answer.

16. Draw a market demand and supply curve, making sure you label the graph carefully. Suppose the government passes a price floor law that states the price of the good cannot fall below a certain price. Draw this situation in your graph. What is the new quantity demanded? Quantity supplied? Is there a shortage or a surplus?

17. The following equations are the market demand and supply schedules before the imposition of a sales tax.

	Supply	Demand
Good X	$Q^s = P$	$Q^d = 10$
Good Y	$Q^s = P$	$Q^d = 10 - P$

Assume that there is an imposition of a tax of $2 on each good sold. Graph the demand and

supply curves before and after the tax for each good. On each graph, shade in the tax incidence for the producers and the consumers.

18. "A decrease in supply will lead to an increase in the price, which will decrease demand, thus lowering price. Thus, a decrease in supply will have little effect on the price of a good." True or False, explain.

19. Given the following demand and supply schedules, find the market equilibriums algebraically.

    a. $Q = 16 - 4P$ and $Q = 2P - 2$.

    b. $Q = 20 - 2P$ and $Q = 4P - 4$

    c. Now graph them. Do you get the same answer?

20. (This is a long hard question.) An industry consisting of 1,000 firms produces a standardized product. Each firm owns and operates one plant, and no other size of plant can be built. The variable costs of each firm are identical and are given in the following table; the fixed costs of each firm are \$100.

Output	TVC	Output	TVC
1	10	13	101
2	19	14	113
3	27	15	126
4	34	16	140
5	40	17	155
6	45	18	171
7	50	19	188
8	56	20	206
9	63	21	225
10	71	22	245
11	80	23	266
12	90	24	288

The industry demand curve is $pq = \$255,000$. Calculate the marginal and average costs of a firm, and the demand schedule of the industry for prices from \$10 to \$20. (The MC equation is $MC = q - 2$).

    a. Draw the supply curve — that is, the sum of the marginal cost curves — and demand curve of the industry on the same graph. Read off the equilibrium price and quantity. Calculate the same price and quantity algebraically.

b. Draw the cost and demand curves of the individual firm on another graph. Explain their construction.

The government now unexpectedly imposes a tax of $4 per unit on the manufacture of this commodity. The tax becomes effective immediately and remains in effect indefinitely. Assume (1) no changes in the economic system other than those attributable to the tax; and (2) none of the changes due to the tax has any effect on the prices of productive services used by this industry.

c. Draw the new supply curve and the demand curve of the industry. What is the new equilibrium price?

d. Draw the new cost curves and demand curve of the individual firm.

e. Why can the price not remain as low as $15? Why can it not rise to and remain at $19?

Review Question Answers

1. *In a competitive market those who value goods the most are the ones who get them, and those who produce the goods at the lowest cost are the ones who make them. Hence the gains from trade are maximized and the outcome is efficient.*

2. *Costs do not determine prices. Prices are the endogenous outcome of the interaction of supply and demand. Costs, however, lie behind the supply curve. Therefore, when costs change, the supply changes and this will generally lead to a change in price. The change in price, however, will not generally match the change in costs. This will depend on the various elasticities.*

3. *This is the great irony of competitive markets, they result in all firms selling at the same price, just like collusive firms! The Canadian Competition Bureau has investigated the oil and gas industry three times over the past 15 years and has never found evidence of collusion.*

4. *No. A speculator is one who prevents the premature use of resources. By holding onto an asset, like a piece of land, the speculator keeps it out of use until the most valued use comes along. This increases wealth, even though on the surface it looks like the speculator is making money by doing nothing. No one seems to worry when the speculator is wrong and loses money.*

5. *You want to tax those goods with an inelastic demand. If the demand were perfectly inelastic, then the deadweight loss would be zero.*

6. *Historians claim that "medieval England was boisterous and violent." In the thirteenth century they estimate 18-23 homicides per 100,000 people. This had fallen by two thirds by the end of the eighteenth century. In 1900, London had only 2 murders in a city over 1 million people. There are lots of factors going on, but the increase in the use of guns held by individuals, did not come along with an increase in violence. Starting at the turn of the twentieth century, England started to restrict the ownership and use of guns in self-defense.*

Odd Numbered Problem Answers

1. *No. They set the temperature based on the demand and marginal cost for heat. So unless either changes based on the temperature outside, the inside temperature remains the same.*

3.

   a. *There will be an increase in the price of apples. If apples and peanuts are substitutes, then the demand for peanuts should increase, causing an increase in the price of peanuts.*

   b. *The value of the land will fall as the owners absorb the tax.*

   c. *Nothing.*

   d. *The value of this equipment will fall for the same reason the value of apple land falls.*

5.

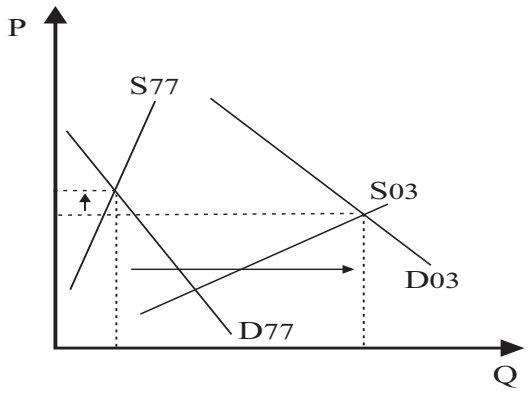

Figure 10-5

Both the demand and supply curves shift out. This leads to an ambiguous change in the price, but a predicted increase in the quantity traded.

7. *If the fish died at sea, it would reduce the supply of salmon and raise the price. If the fish were caught illegally and sold, there would be no change in supply and no change in price.*

9. *Assume the area is growing so the green belt is a binding constraint. The current rental rates will not change since they are determined by the current demand and supply of rental housing. Future rates are expected to increase, however, since growth in demand will lead to higher prices. These higher future rental prices will be capitalized into the price of current homes and so the price of a house will increase.*

11.

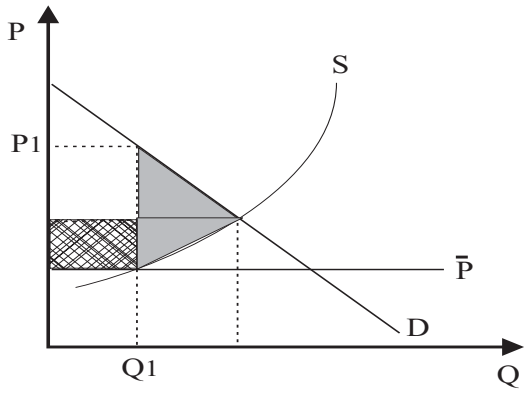

Figure 10-11

When the rental price is lowered to $\bar{P}$, suppliers of rental housing reduce their supply to Q_1. This creates a shortage of rental housing. At this lower supply, the marginal value of rental housing is P_1. People desperate for a place to live will be willing to pay this much to get an apartment. They may pay this in terms of key deposits, rented furniture, waiting in line, or some other method. If the rent control is binding, then there is a deadweight loss equal to the dark triangle. If those who rent the apartment only pay the price $\bar{P}$, then they get a transfer equal to the crosshatched area. How much they actually get depends on the nature of the competition for the apartments.

13. *It depends what drives the increased consumption. If the supply increases, then prices fall. If the demand increases, then prices go up.*

15. *The actual shares depend on the elasticities of supply and demand.*

17.

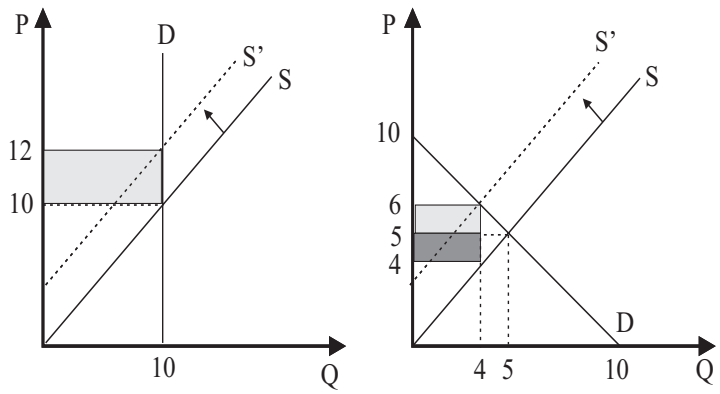

Figure 10-17

19. *For (a) P=3, Q=4. For (b) P=4, Q=12. Yes, you get the same answer.*

PART II
EXTENSIONS OF THE NEOCLASSICAL MODEL

Now that the basic economic model is complete, Part II extends the analysis in different directions. Every chapter in this second part involves minor differences in assumptions or topics. Chapters 11 and 12 are simply extended applications of the basic model. Chapter 11 considers what happens when a consumer's choice over consumption is extended over time, rather than just across goods. We'll see that a few simple adjustments allow us to analyze interest rates, captial values, and markets for loanable funds. Chapter 12 looks at the market for labor services and analyzes policies and issues such as minimum wages and why some individuals are paid more than others. Chapter 13 changes our assumption of price taking and assumes that firms are price makers rather than price takers. Finally, Chapter 14 looks at the incentives for firms to collude and act like price makers, and touches on the law and economics of competition policy.

CHAPTER 11

CHOICE OVER TIME AND THE INTEREST RATE

11.1 **The Interest Rate**

In the model developed over the past 10 chapters, time played no role. Consumers were faced with the problem of choosing between different goods, but those goods all existed at the same time. For example, should they buy grapes or potato chips? ... today. However, in life many decisions, if not most, also involve choices over time. For example, to eat grapes now means they will not be converted to wine and consumed later. Decisions made regarding education and careers are intertemporal because they involve how time will be spent over the next several years. Decisions to spend money today instead of saving it for a future use is an intertemporal decision. A farmer's decision to sell off his herd today, rather than wait for the new calves next spring, is an intertemporal decision. In fact, when you think about it, most of what you do is a type of investment, and all investment decisions are intertemporal.

Making a choice over time involves comparing goods today with goods in the future. As always, to make things simpler, we'll often convert this to a problem of comparing sums of money at different points in time. Hence, in comparing the choice between becoming a professor or a cabinet maker, we can compare the different streams of earnings that the two occupations would earn over a lifetime. To be a professor involves a long period of training during which very little income is earned, but it promises a high annual income once training is completed. In contrast, cabinet making involves a much shorter training period, but the annual income of a journeyman cabinet maker is small relative to that of a professor. A person who faces the choice between these occupations needs to compare the two income streams. But how does an eighteen-year-old student trying to choose an occupation go about comparing two such different streams of earnings?

The key to making such comparisons is the interest rate. The interest rate is a price that allows us to translate future values into current values. Interest rates sound mysterious and complicated, but they are simply prices. Quite often, one hears the remark that "interest is the price of money". This is not true. The price of one dollar is one dollar, not a number like 10%. The interest rate is the price of borrowing money. In fact, money doesn't even need to exist for there to be interest. Interest is the price paid for early consumption of one good in terms of another. In other words, it is just a relative price.

> *The interest rate is simply the price of early consumption.*

If the interest rate is just a price, then it must be determined in a market. If it is determined in a market, then it must be determined by the supply and demand in that market. In the second part of this chapter we'll examine this market explicitly. Before we do that, however, we want to

examine how the interest rate allows us to compare values over time. It turns out that the price of durable goods depends on the interest rate, and we'll look at a number of examples.

11.2 The Value of Durable Goods

Some goods, like a raspberry, don't last very long. Leave a picked raspberry on the table for a day or two and there isn't much edible when you return. On the other hand, if that berry is converted to jam, jelly, or juice, it could last a long time. Not only could a jar of jam be saved for a rainy winter morning, but once opened it can last for some time still. Jam, as compared to the fragile berry, is a durable good. A durable good is simply one that yields a service now and in the future. Some durable goods yield services for a very long time. A good table saw or set of wrenches could last a life time. Of course, some durable goods, like the jam, may only last a few weeks.

When one buys a durable good, the price paid reflects the future service yields as well as the current ones. Anyone who buys a house, for example, is paying for all the future shelter services the house will provide. That's why the price of a house is so much greater than one month's rent. But what is the relationship between the stream of services over time and the price today? How does the price of wheat seed depend on the future crops that can be generated from that seed; how does the price of an agricultural quota that allows farmers to charge higher prices depend on those future revenues; or how does price of a piece of wood depend on how long the wood will last?

You might be thinking that all you have to do is add up all of the future values and this determines the current price. Thus, if a cedar deck provides services of $100 for 12 years, then the price of the deck should be $1200. Unfortunately, this simple procedure generally is not true. The $1200 is too big for two reasons. The first is because people are impatient. The second is because most current services can be converted into more future services, making current services more valuable than future ones.

Impatient People

In earlier chapters we discussed characteristics of individual preferences like maximization, substitution, etc. We now introduce yet another assumption about human tastes: impatience. If you ask someone, "would you rather have an apple now, or the same sized apple one year from now" everyone always picks the apple today. There could be a host of reasons why this is so. Perhaps the person doesn't trust you'll give the apple a year from now; perhaps they think you'll forget. Regardless, people prefer goods today rather than goods in the future. This means that the marginal value of the same good today is always greater than the marginal value of the same good in the future. The old proverb, "a bird in the hand is worth two in the bush" could be interpreted to mean the same thing. If we want to get someone to defer their consumption, then we'll have to pay them. Perhaps for two apples next year, you'll give up having an apple today. This is the sixth principle of economics, which is often called the rate of time preference.

PRINCIPLE #6

Rate of Time Preference: *Other things equal, people always prefer a good today, rather than in the future.*

Children seem to have a huge rate of time preference. When the ice cream truck rolls around on a summer day, you can ask a child "I'll give you three ice creams of your choice tomorrow, if you don't have one today" and they always turn it down! Turning down a 300% return over 24 hours is an enormous case of impatience, but children just want everything today. This often causes large frictions between parents and their children. Teenagers engage in all types of hazardous behavior (smoking, pre-marital sex, fast driving) in part because they discount the future so heavily. "Living for today" might mean skipping classes at school or spending money on clothes rather than saving for college. Although a parent is hard pressed to convince even their teenagers to save their money (ie. postpone consumption), at every age people demonstrate impatience.

When people are impatient, future services of durable goods are valued less than if they were available currently. If there are two different apple trees — one that will bear fruit in 5 years, and the other that will bear fruit in 10 — then assuming the quality of apples are the same, impatient people will value the first one more. In other words, they value the slow growing tree less. For this reason, it would be improper to simply add up the value of future services to get the current price of a durable asset.

Investment Productivity

When current goods are not consumed, they can be used to produce future goods. This is called *investment*. An amazing feature about our world is that many things grow. Not consuming a large Douglas Fir tree today, means that next year there will be an even larger tree to cut down. Farmers who hold back 100 bushels of oats from the crop this year can plant those oats and reap enough oats to pay all of the expenses and still have more than 100 bushels next year ... perhaps 110 bushels. This extra 10 bushels of oats is the *net productivity of investment*, and it's what the world calls *interest*.

When an asset can be transformed today, such that it will yield much more in the future through growth, it is better to have the asset today (so you could invest it) rather than have it in the future and miss the investment opportunity. For this reason again, it would not be correct to simply add values over time to get the current price.

11.3 Present Values

The key to understanding the relationship of future and current values is, as mentioned, the interest rate. As we just saw, 100 bushels of grain can grow to 110 bushels, and the 10% premium is the interest rate. We can write this in an arithmetic form: \$1 will grow to a future value of $\$1(1+i)$,

where $i = 0.10$, at the end of the specified period. The i in this little equation is the interest rate: the rate of growth of the investment. More explicitly we can say that

$$FV = PV(1 + i)$$

where FV is the future value of the investment, and PV is the present value of the good. Given this simple formula, we can calculate the present value of a lump sum simply as $FV/(1 + i)$. In other words, the present value of \$1 one year from now is $\$1/(1 + i)$. For example, \$1 a year from now is only worth approximately 90.9¢ today if the interest rate is 10%.

The Present Value of a lump sum future payment is FV/(1+i).

The above formula would be good for calculating the price of a jar of jam, or a bottle of wine where the future value is a one time consumption. So if a bottle of wine is worth \$100 next year, and the interest rate is 8%, then today you would pay $\$92.59 = 100/(1 + .08)$. But how would we calculate present values if there is a *stream* of future amounts that must be discounted? For example, suppose we wanted to know the present value of double paned window that will provide better insulation and heat savings year after year?

Suppose we have the following income stream: $(M_0, M_1, M_2, ..., M_T)$. Income M_0 is received today, income M_1 is received one year in the future, and so on. First let us calculate the present value of M_t — income that is received t years in the future. The key to this calculation is the following definition: the present value of M_t is a sum of money 'PV' such that, if we were to invest PV today at interest rate i, it would be worth M_t in t periods. Suppose, for example, that you deposit \$1 in your savings account at interest rate i. At the end of one period, your balance will be the original dollar plus interest i on that dollar, or $\$(1 + i)$. At the end of two periods, your balance in dollars will be

$$FV = (1 + i)^2 = (1 + i) + i(1 + i).$$

The first expression on the right, $(1 + i)$, is the balance at the end of the first period, and the second expression on the right, $i(1 + i)$, is the interest earned in the second period. As you can easily verify, at the end of t periods, the balance will be $(1 + i)^t$. Therefore, \$1 invested today at interest rate i will be worth $(1 + i)^t$ in t periods.

Now we can use this result to find the present value of M_t. If you deposit 'PV' in your savings account today, then at the end of t years you will have $PV(1 + i)^t$. But this sum must be equal to M_t, since 'PV' is the present value of M_t. By solving the following equation for PV, we have the present value of M_t.

$$PV(1 + i)^t = M_t.$$

Solving for PV we have,

$$PV = M_t/(1 + i)^t.$$

As you know, if today you invested PV at interest rate i, you would have M_t in t years. Alternatively, the maximum sum your banker would lend you today in exchange for a payment of M_t in t years is PV. In these two senses, then, PV today is equivalent to M_t in year t.

With the help of this formula, we can calculate the present value of income stream $(M_1, M_2, ..., M_T)$[1]

$$PV = M_0 + M_1/(1+i) + M_2/(1+i)^2 + ... + M_T/(1+i)^T.$$

Calculating the value of this stream is rather tedious because each value of M is different. When each value of M is the same it is made easier. Such a simple income stream with equal payments is called an *annuity*. If the annuity lasts forever it is called a *perpetuity*. When a perpetuity is discounted at a constant rate of interest, an incredibly simple and useful present value formula results:

$$PV = M/i.$$

This simple formula closely approximates the PV of an annuity, especially when the annuity lasts for more than 20 years and the interest rate is above 10%. The present value of annuity streams beyond 20 years or discounted at interest rates greater than 10% are so small this formula comes quite close to the true value.

To help understand this arithmetic, consider the following example. Suppose an income stream A consists of \$0 today, \$6,000 one year from today, \$19,000 two years from today, and then stops. Income stream B consists of \$13,000 today, \$7000 one year from today, \$0 two years from today, and then stops as well. Which income stream has the larger present value? Hopefully, you now realize that we can't just add up the numbers. If we just add them up the first income stream would be worth \$25,000, and the second one would be worth \$20,000. What we need to know is the interest rate in order to compare them. Suppose the interest rate was 5%. The present value of income stream A would be:

$$PV_A = 0 + 6,000/(1+.05) + 19,000/(1.05)^2$$

$$= 22,947.84.$$

The present value of income stream B would be:

$$PV_B = 13,000 + 7,000/(1+.05) + 0/(1.05)^2$$

$$= 19,666.67.$$

Thus we see that the two streams are not equal, and at this low interest rate income stream A is worth more. What's happening is the interest rate is *discounting* the future values. The one that yields the most money up front is being discounted the least, but since the interest rate is so low it makes little difference. The greater the interest rate, the greater this discounting is, and the more valuable income stream B is compared to stream A. For example, if the interest rate were 20%, then PV_A would be \$18,194.44, while income stream B would be worth \$18,833.33. Notice when the interest rate goes up, both present values go down, but A goes down by more. At an interest rate of 20% the income stream B is actually worth more, even though it yields fewer nominal dollars. Can you see what the present values are if the interest rate were 0%? Now stream A is worth \$25,000 and stream B is worth \$20,000. This is the only time when it is correct to simply add values across time.

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[1] Where M is received at the end of each year.

Value of Lotteries

Many lotteries in the U.S. boldly announce that the winner will walk away with a substantial prize, followed by a brief statement that payments are made annually for a period like 20 years. If you were told that you had won $1,000,000, but that you would receive this in 20 installments of $50,000 over twenty years, would you have won a million dollars? If the interest rate was more than zero, the answer is no. What the lottery is offering you is a $50 000 annuity, not a 1 million dollar lump sum payment. In order to convert the annuity to current dollars we need to calculate its present value. Suppose the interest rate was 10%. The value of the first payment is $45,454=50,000/1.1. The value of the last payment in twenty years is only $7,400 in current dollars! If we calculate the value of the entire annuity, it amounts to $425,500 — not quite half the value of the stated prize.

Calculating the value of an annuity by hand is quite painful, and fortunately there are several methods to ease the burden. First, most calculators do the job in seconds. But if you don't have a calculator, you can consult a present value table. Tables 11-1 and 11-2 are two such tables. The first table gives the present value of a future lump sum payment of $1 for various interest rates and various years. The second table provides the present value of a $1 annuity for various interest rates and various years. Together, these two tables can calculate the present value of some complicated income streams.

TABLE 11-1: Present Value of a Future $1.

Year	3%	4%	5%	10%	15%	20%
1	.971	.962	.952	.909	.870	.833
2	.943	.925	.907	.826	.756	.694
3	.915	.889	.864	.751	.658	.578
4	.888	.855	.823	.683	.572	.482
5	.863	.822	.784	.620	.497	.402
6	.837	.790	.746	.564	.432	.335
7	.813	.760	.711	.513	.376	.279
8	.789	.731	.677	.466	.326	.233
9	.766	.703	.645	.424	.284	.194
10	.744	.676	.614	.385	.247	.162
11	.722	.650	.585	.350	.215	.134
12	.701	.625	.557	.318	.187	.112
13	.681	.601	.530	.289	.162	.0935
14	.661	.577	.505	.263	.141	.0779
15	.642	.555	.481	.239	.122	.0649
16	.623	.534	.458	.217	.107	.0541
17	.605	.513	.436	.197	.093	.0451
18	.587	.494	.416	.179	.0808	.0376
19	.570	.475	.396	.163	.0703	.0313
20	.554	.456	.377	.148	.0611	.0261
25	.478	.375	.295	.0923	.0304	.0105
30	.412	.308	.231	.0573	.0151	.00421
40	.307	.208	.142	.0221	.00373	.000680
50	.228	.141	.087	.0085	.000922	.000109

Using these tables is quite easy. In our lottery example the winnings are $50,000 for 20 years. To find the present value of this annuity, we go to Table 11-2, row 20 years, and column 10%. There we find the number 8.51. We multiply this by the $50,000 and we get: $425,500. The answer above. If we won $1,000,000, but it was paid as a lump sum after 20 years, then the present value of this would come from Table 11-1, row 20 years, and column 10%. This present value would be $.148 \times \$1,000,000 = \$148,000$. From the tables you can notice the more distant the payment is off in the future, and the higher the interest rate, the lower is the present value.

TABLE 11-2: Present Value of an Annuity of $1 at the end of Year.

Year	3%	4%	5%	10%	15%	20%
1	.971	.962	.952	.909	.870	.833
2	1.91	1.89	1.86	1.73	1.63	1.53
3	2.83	2.78	2.72	2.48	2.28	2.11
4	3.72	3.63	3.55	3.16	2.86	2.59
5	4.58	4.45	4.33	3.79	3.35	2.99
6	5.42	5.24	5.08	4.35	3.78	3.33
7	6.23	6.00	5.79	4.86	4.16	3.60
8	7.02	6.73	6.46	5.33	4.49	3.84
9	7.79	7.44	7.11	5.75	4.78	4.03
10	8.53	8.11	7.72	6.14	5.02	4.19
11	9.25	8.76	8.31	6.49	5.23	4.33
12	9.95	9.39	8.86	6.81	5.41	4.44
13	10.6	9.99	9.39	7.10	5.65	4.53
14	11.2	10.6	9.90	7.36	5.76	4.61
15	11.9	11.1	10.4	7.61	5.87	4.68
16	12.6	11.6	10.8	7.82	5.96	4.73
17	13.2	12.2	11.3	8.02	6.03	4.77
18	13.8	12.7	11.7	8.20	6.10	4.81
19	14.3	13.1	12.1	8.36	6.17	4.84
20	14.9	13.6	12.5	8.51	6.37	4.87
25	17.4	15.6	14.1	9.08	6.46	4.95
30	19.6	17.3	15.4	9.43	6.57	4.98
40	23.1	19.8	17.2	9.78	6.64	5.00
50	25.7	21.5	18.3	9.91	6.66	5.00

If you didn't have a calculator or a set of tables handy, you can still get a pretty good ball park estimation of annuity present values by using the simple perpetuity formula. Twenty years isn't quite forever, so we only get an approximate value, but it is amazing how close you can come. In this case we would have come up with \$500,000=50 000/0.1, which is quite close to \$425,500, and easy enough to do in your head. The higher the interest rate and the longer the annuity, the more accurate this formula becomes. It's a good formula to keep in mind when you want to impress you new boss with how good you are with figures.

Rates of Return

Suppose a gold bar is currently selling for \$1000 and is expected to sell for \$1200 one year from now. What is the expected rate of return on the gold bar? The rate of return is given by the difference in the two prices divided by the current price, or:

$$R = (p_1 - p_0)/p_0,$$

where the subscripts represent the two years. In the case of the gold bar, the rate of return is $20\% = (1200 - 1000)/1000$. The more important question is, what rate of return would we expect on an asset like a gold bar in equilibrium? In answering this question, let us ignore any aspect of risk and assume that all investments have equal risks. Let us further assume that there is no utility found in holding gold bars per se. That is, they are valued strictly for their financial rate of return.

Under such conditions the rate of return on the gold bar must equal the rate of interest! Suppose that it did not, and that the rate of interest was only 10%. Given that gold bars yield a return of 20%, people will begin to invest in gold bars, and in so doing they will drive the price today up. This takes place until the current price is \$1110. At this price the rate of return is equal to $R = (1200 - 1110)/1110 = 10\%$. If the current interest rate had been 30% rather than 10% then individuals would have sold gold bars and driven down the current price until the rate of return again equaled the interest rate.

In equilibrium, and ignoring risk, rates of return must equal the rate of interest.

This equalization of rates of return across assets is another application of the principle of maximization, and in principle is no different than our example of traffic moving at the same speed across different lanes, or the example of equal MV's over old Seinfeld and Simpsons episodes. In equilibrium one asset cannot systematically be yielding a higher rate of return than other assets.

The television show *60 Minutes* once ran an episode on some decrepit manufacturing plants in England. The show mostly consisted of visiting various plants that were using very old machines for producing clothing, porcelain, and the like. Some of the machines in use dated back to the industrial revolution. The driving theme of the show was that these ancient techniques were inefficient, and without a massive injection of capital, England would cease to exist as an industrial power. Ignoring their melodramatic conclusion, the show still raised an interesting question: how is it that firms can use old machines, trucks, computers, and the like and still stay in business?

The answer is that the prices for these used pieces of equipment adjust until the rates of return are equal to those on the newer equipment. If you were starting a business and you had to decide between two computers to purchase, the price you would be willing to pay would be the present value of the stream of income each machine would generate. The more productive the computer, the larger the income stream it yields, and the more you are willing to pay. In this way, the differences in productivity are *capitalized* into the price of the computers, and as a result, their rates of return are equal. Firms that use old equipment pay less for the equipment. These lower costs just compensate for the lower productivity. Firms that use newer equipment pay more for it and these higher costs are just compensated for by the higher productivity. The rates of return must be the same in both cases.

As another example, suppose you own two stocks: A and B. Stock A has had a great previous week, increasing by 50% in value. Unfortunately stock B has done very poorly, and has fallen in value by 30% over the last week. If you want to sell one of the stocks, and if you are only concerned with the rate of return, which stock should you sell? ... you should be indifferent!

The stock prices were adjusting to reflect the future streams of income of each company. For company A there must have been good news regarding the future profits of the firm. With this news the current price of the stock increased until these future profits were capitalized into the price. For company B the news must have been bad, and this bad news was capitalized into its stock price. As we have seen, the prices adjust until the rates of return are the same, and so as an investor, you should be indifferent between them.

The preceding discussion is important enough to consider more carefully. Our assumption of maximization, when applied to rates of return on different assets, predicts that past movements in prices have no bearing on future price movements. All information about interest rates and future expected incomes are capitalized into the current price and the past prices are irrelevant. A great example of this is found in the movie *Wall Street*, starring Michael Douglas and Charlie Sheen. The Sheen character impresses his boss, Michael Douglas, by passing on some inside information that allows him to make some money on a stock deal. Sheen then stays up night after night tracking stock prices in an effort to repeat his insightful advice — all to no avail. In the end he discovers that the only way to make an above normal return is to engage in illegal activity. Keep this in mind the next time you get a hot tip on a stock based on its past market performance.

If the preceding is true, why are the returns to many assets so obviously different? One reason is that assets have different risks involved, and more risky assets must pay a premium in order for individuals to invest in them. However, it is not difficult to find assets with similar risk, still with much different rates of return. At your university, for example, more students apply for admission into the accounting program than the philosophy department because the financial rate of return is higher for accountants. Degrees in dentistry, medicine, law, and engineering all give higher financial rates of return than do degrees in drama, history, education, and political science. How is this so?

> *In equilibrium, differences in rates of financial return reflect differences in non-financial factors like risk and utility.*

Part of the answer is that many assets yield utility as well as income, and it is the total rate of return that must be equal across assets, not just the financial rate of return. For example, suppose there are two assets: gold bars that yield a financial return of 10% and yield no utility; and a painting, that yields a financial return of 10%, and a utility return of 3%. Could this be an equilibrium? No, because at a return of 13% the painting is too good of a deal. The price of the painting must rise until its financial rate of return is 7% and its total rate of return is 10%. The opposite is true for an asset that yields disutility. That is, if holding an asset is dangerous, distasteful, or painful, then its financial return must be higher in order to compensate. So take heart that dentists get paid so much ... it is simply the price of boredom, smelling bad breath, and knowing that no one wants to come visit you.

11.4 **The Equilibrium Interest Rate**

We now have a handle on the relationship between asset prices and the value of the stream of services they provide. This relationship depends critically on the rate of interest, but the question

is, how is the rate of interest determined? As with all prices, it is determined by the intersection of demand and supply curves.

The interest rate is determined in the market for loanable funds. This is the market people borrow and lend in for early consumption, and is shown in Figure 11-1. The horizontal axis has on it "current consumption" which we can think of as the number of dollars people have for spending on goods today. The vertical axis has one plus the interest rate, which is the price of current consumption. The demand for current consumption is positive because people are impatient, given our sixth principle. We want consumption now, rather in the future, other things equal. The height of this demand curve shows how much we are willing to sacrifice in terms of future consumption to consume now. That is, it is the marginal value of current consumption. The supply curve for current consumption is positive and upward sloping because it reflects the opportunity cost of investment and diminishing marginal product of investment. When we consume goods today, we cannot invest them, and this is a cost. The more we consume today, the less there is to invest, and the greater is the cost. Hence the supply curve is the marginal cost of current consumption. Together these determine the equilibrium interest rate i^*.

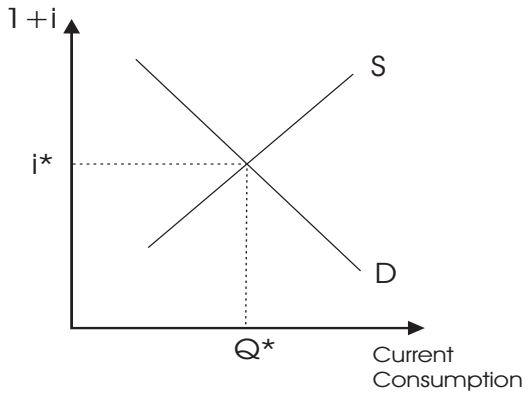

Figure 11-1
The Equilibrium Rate of Interest

Changes in the interest rate come about by changes in the demand or supply curve. If the demand for current consumption increases, then the interest rate increases. If the supply of current funds decreases, then the interest rate increases once more. Thus, if many people in the world thought that the earth was going to end tomorrow, these people would become much more impatient. Why put off consuming anything if the earth won't be here? Such a belief would shift the demand curve way out, and the interest rate would increase. On the other hand, if things in the world start to grow faster, then the opportunity cost of consuming today increases. So if trees start to grow faster, the supply curve of current consumption starts to shift left, and the interest rate increases.

A Note on Nominal and Real Interest Rates

As with most prices mentioned in this book, this chapter has been assuming that the interest rate is the *real* interest rate, even though it has been couched in terms of dollars. By real interest

rate, we mean the amount of real goods one must sacrifice to obtain more current consumption. A *nominal* interest rate is denoted in terms of dollars, and is the amount of dollars one must sacrifice in order to obtain dollars of current consumption. The two rates of interest are equal, as long as there is no *inflation*. As noted in Chapter 4, inflation is an increase in the overall price level. If the inflation rate is 17%, then all prices are moving up at 17% per year.

When someone holds a real asset, like real estate, the rate of inflation is quite neutral. Prices go up, but the price of the land goes up as well, and there is no change in wealth. However, when one holds cash, its value falls with inflation. For example, if I hold $1000, and face a price of $50 for some pants, I could purchase 20 pairs if I wanted to. However, if there is an inflation, and the price of the pants jumps up to $100, the money in my wallet stays the same at $1000. Hence now I can only buy 10 pairs of pants at most. Inflation amounts to a depreciation rate on cash holdings.

Thus, when people hold cash and there is a threat of inflation, they demand a premium over the real rate in order to compensate for the expected inflation depreciation. As a result the nominal rate of interest is equal to the real rate of interest, plus the expected rate of inflation. If we let the real rate of interest be r, then we have the simple formula:

$$i = r + \text{expected rate of inflation}$$

For us we'll just assume that the expected rate of inflation is zero, and as a result the real rate of interest will equal the nominal rate.

11.5 Summary

In one respect the analysis of markets over time is a simple application of the basic neoclassical model. This chapter essentially only changed the analysis from exchange and production choice between two goods at a point in time, to choices of exchange and production of the same good over time. Yet, we've seen that this is an elaborate application indeed. This simple change leads to all sorts of extra behavior we can discuss and consider. The first issue dealt with in the chapter was simply how stocks and flows are related. Capital assets have prices that depend on the flow of services they provide. We saw that it was appropriate to discount this flow to arrive at the price of the asset. This discounting depended critically on the interest rate. The interest rate was the price of current consumption, which, like all prices, was determined by supply and demand.

REVIEW QUESTIONS

1. Why is the interest rate not the price of money?

2. Does the interest rate have a huge impact on the price of short lived goods, like clothing?

3. What is the present value of $10 sixteen years from now, if the interest rate was 15%?

4. What is the present value of a stream of $10 per year for 25 years if the interest rate was 4%?

5. Suppose you've worked for a firm for 6 years and have made contributions to your pension fund amounting to $12,000. Your employer has made matching funds, so your total pension is at $24,000. For the sake of argument, suppose it will earn 4% for the next 30 years. Suddenly you've been offered a job by a different firm, and you have to choose whether or not to pull your contribution out of the pension fund to invest yourself (the $12,000) or keep the entire $24,000 in the fund and redeem it 30 years from now. What should you do?

6. If you announce today that you intend to save all your income for the next year, what happens to the value of your wealth now?

PROBLEMS

1. Recently Bell labs announced the invention of a battery that potentially could replace gasoline engines for cars. A caller to a local radio show stated that this invention would never hit the market and would be suppressed because too many people stand to lose if the oil industry goes out of business.

   a. What is wrong with this caller's comment?

   b. Under what conditions (assuming the battery does exist) would the battery be used?

2. Sam is a mushroom farmer. He invests all his spare cash in additional mushrooms, which grow on otherwise useless land behind his barn. The mushrooms double in weight during their first year, after which time they are harvested and sold at a constant price per pound. Sam's friend Dick asks Sam for a loan of $200, which he promises to repay after 1 year. How much interest will Dick have to pay Sam for Sam to be no worse off than if he had not made the loan?

3. You have a friend who is a potter. He holds a permanent patent on an indestructible teacup whose sale generates $30,000/year more revenue than production costs. If the annual interest rate is 20 percent, what is the market value of the patent?

4. The following was in the *Wall Street Journal*. "Indoor sprinklers can save on insurance rates by providing added protection. By one estimate the savings over 30 years would pay for the system, but high-rise buildings are often built by speculators who plan to sell them far sooner than that."

   a. Why is the fact that builders soon sell the buildings irrelevant?

   b. Suppose a sprinkler system costs $30,000 to install and produces savings in insurance premiums of $1000 per year. How many years of such savings would be required to justify the expenditure?

5. Sam and Bob are very different people. Sam likes to eat, drink, and be merry, and let the future care for itself. He thinks the world is going to disintegrate in a few years anyway. Bob is only 21 but is already planning for his retirement. How do people like Sam benefit from people like Bob, and vice versa?

6. What effect would you expect the rate of technological innovation in a society to have on the level of interest rates? Why? Use a graph in your answer.

7. One auto dealer offers you a car for $20,000 cash. Another offers you the same car for $22,500, but you can pay in one year. Under what condition would you be indifferent?

8. Your dad has $100,000 to invest and is considering a stock that is expected to yield about $10,000 per year in dividends. If you advise purchase of stocks that pay out no earnings as dividends, your dad complains there will be no income. How would you explain that there still is an income of $10,000 per year?

9. Why would people plant trees that take 150 years to harvest when the average person only lives 70 years?

10. A piece of land is expected to sell for $100,000 in five years, and currently sells for $30,000. The current interest rate is 2%. What is expected to happen to the interest rate over the next five years?

11. Comment on the following sentence (taken from a Federal Reserve Bank publication). "Everything has a price. And money is no exception. Its price — the interest rate — is determined in the marketplace where money is borrowed and lent".

12. You purchase for $900 a $1000 government bond maturing one year from the date of purchase.

    a. Will you make a profit if you hold the bond to maturity?

    b. Will you make a profit if there is a sharp, general increase in prevailing interest rates a week after your purchase?

13. You have recently purchased some shares of General Motors (GM) common stock, and also some GM bonds with a maturity date of 30 years from now. The stocks pay dividends according to how much profit (in the lay sense) GM is expected to make, while the bonds are promises to pay a certain fixed dollar amount each year. Explain how each of the following events would affect the price of GM stocks and the price of GM bonds.

    a. Passage of a new law reducing the level of anti-pollution devices required in new cars.

    b. A sudden, widespread increased desire for earlier availability of goods.

14. People in a certain nation are anticipating having a war in the future. The economists there, who don't have too much concern about human sufferings, are only interested in what will happen to the interest rate.

    a. suppose people figure that they don't have a great chance of surviving the war. Will the interest rate increase or decrease?

    b. If it is expected that goods and property will be destroyed during the war but no people will be killed, how will this affect the interest rate?

15. I bought two stocks on Jan. 1, 2002. By August one had risen in price, while the other had fallen. If I want to sell one stock, which one should I sell. (Hint: don't add any more information to the problem).

16. Two refrigerators are available for purchase. One costs more to buy but less to operate.

	Price	Oper. Costs/year
A	$400	$100
B	340	120

At what interest rate would you be indifferent between the two machines?

17. You own both stocks and bonds issued by Natural Fruits, Inc., an apple-growing corporation. Explain the effects on: i) the price of apples now and in the future; ii) the value of your shares of stock and; iii) the value of your bonds, of the following events:

    a. an increase in the real rate of interest.

    b. an increase in the nominal rate of interest, due to anticipated higher inflation.

    c. the announcement by the government of an available new hybrid that will increase the number of apples per tree, when these new trees reach maturity in 10 years.

18. Currently in the US, interest on a home mortgage is deducted from income when calculating federal income taxes. How would the removal of this provision affect the wealth of

    a. current home owners?

    b. prospective home owners?

    c. people in the construction business?

19. If everyone lived forever, what would the interest rate be?

20. In 1975 the BC government passed a law allowing farmers to pay considerably less property tax than other land owners. This law is still in effect today. A real estate person was heard stating "The great thing about buying acreage in BC, is that you don't have to pay property tax on small farms". Although this is technically true, in what sense do purchasers in 2002 have costs similar to those who pay the full tax?

21. What form would the rate of interest take in a society that used no money but depended entirely on barter for the exchange of goods?

22. "Save it," somebody says. "Don't sell it. It's not worth much now, but in 20 years it will probably be worth five times as much." Should you save it or sell it?

23. Every year publishers come by my office and try to convince me that their textbook is the one I should adopt, and in the process they always leave me a complimentary copy to look at. About a week later a used-book wholesaler comes by and asks if I have any books to sell. I usually give him my complimentary copies. The publisher doesn't like it when I do this, but they don't mind too much because they keep sending me books. Recently, one of them sent me this neat poster for my wall, that proudly says "I don't sell my Professional review copies!"

    a. Publishers don't like the used book market. Suppose they could invent a new ink that would disappear as soon as the book is sold a second time. Would their profits go up or down?

    b. Why do you think the publisher doesn't want me to sell the books he gives me, given

your answer to part (a)? Why does he give me the copies anyway?

Review Question Answers

1. *The price of one dollar is $1. The interest rate is a percentage. It doesn't make any sense to say it is the price of money. What people mean when they use this phrase is "the interest rate is the price of renting money."*

2. *No, the interest rate will have no significant impact on clothing already made.*

3. *$1.07. Not very much is it?*

4. *$156.00.*

5. *So the issue here is, do you sacrifice $12,000 now for the opportunity to invest money on your own. The critical issue is, how much could you earn investing on your own. If you could earn 10%, then the $12,000 will grow to $208,800 in thirty years, but at 4% the $24,000 will only grow to $77,000 in thirty years! Surprised? Only if you failed to earn over 6.7% would you be better off leaving the money in the pension fund.*

6. *Assuming you don't save it under your matress, your wealth will remain the same.*

Odd Numbered Problem Answers

1.

   a. *If the battery yields a stream of income which is greater than the stream of income generated from gasoline engines, then those in that industry will not be able to pay enough to keep the battery off the market.*

   b. *It would only be used if it was profitable to use it. The battery might exist, but it may be too expensive to produce, or it produces too little power. There are many battery powered cars around in 2003, yet none of them can effectively compete against the traditional motor.*

3. *$30,000/.2= $150,000.*

5. *Sam is likely a net borrower. He borrows funds to consume now, and pays the loan back with interest later on. Bob is a net lender. He supplies funds now to earn interest for later on. Goods cannot literally travel through time. To borrow goods from the future means you borrow from someone else right now. Thus, without people like Sam, Bob would have a hard time saving today.*

7. *If the interest rate was such that $20,000 = $22,500/(1+i), then you would be indifferent. If the interest rate was higher, you would take the delayed payment.*

9. *Because the value of the tree is capitalized into its price. Therefore, at 70 years of age the tree can be sold, or be used as collateral for a loan.*

11. *The price of money is the number on the currency. That is, a dollar sells for a dollar. The interest rate is the price of early consumption, not the price of money.*

13.

   a. *If this increases the profitability of GM, then stock prices increase, but bond prices remain unchanged.*

   b. *Interest rates increase, the bond price falls. The future earnings are also worth less, so stock prices fall as well.*

15. *You should be indifferent. Prices have adjusted until the rates of return are expected to be the same.*

17.

   a. *no change in the price of apples now. If this leads to fewer trees being planted the price in the future could increase. Stock prices will fall, and so will the value of bonds.*

   b. *The real price of current and future apples remains the same. Stock prices increase, bond prices decrease.*

c. *The current price remains the same, future prices decrease. Stocks and bonds remain unchanged.*

19. *Many fiction writers seem to thing immortals become very patient and interest rates go to zero. I personally think nothing would happen. On the demand side you'd still prefer goods today rather than tomorrow.*

21. *It would still be a percentage, but it would mean the amount of real goods you would have to pay back on a loan.*

23.

a. *The value of the secondary market is capitalized into the price of the first book. So if it costs more to produce the self destructing book, then it will not be worth making.*

b. *Just because the second market price is capitalized into the price, doesn't mean he won't benefit from another sale. Suppose purchasers anticipate selling the book, but after reading it they decide to keep it. This amounts to a windfall for the publisher. They send me books because the marginal cost of sending is zero, and the cost of it ending up on the resale market is offset by the slight chance I might adopt it.*

CHAPTER 12

LABOR MARKETS

All chapters thus far have analyzed the markets for final goods. Those goods might have been baseball gloves and hockey sticks, or consumption today versus tomorrow, but in any event the final consumer was doing the demanding and firms were doing the supplying. Now we want to extend our analysis to input markets, especially labor markets.

When we analyze input markets, output markets cannot be completely ignored, since an input's value to any firm depends on the price the firm can charge for its output. Because of this, the demand for an input is often called the "derived demand," to reflect the value of the input is partially derived by the value of the output. For example, demand for leather seats for cars or assembly line workers depends on the output price of the automobiles. This chapter will develop the model of equilibrium price and quantity in a perfectly competitive input market. As we analyze the resulting allocation, we will deepen our understanding that competitive markets are efficient. That is, in competitive markets, resources are successfully allocated to their most valuable uses. Once comfortable with the basic model, we will move on to labor market applications.

12.1 **The Demand for Labor**

Chapter 8 discussed one element of labor markets — an individual firm's demand for labor. In that chapter we saw that the demand for labor or capital was always equal to the value of the marginal product of that factor. This can be seen in Figure 12-1.

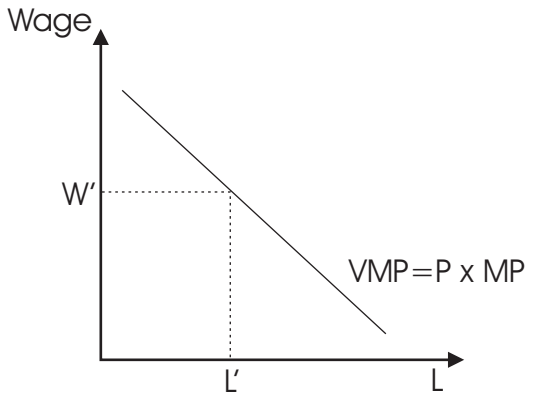

Figure 12-1
The Firm's Demand for Labor

The demand for labor tells us how much a firm is willing to pay for a given input. Hence, for L' units of labor, the firm is willing to pay W'. Conversely, for a wage of W' the firm demands a quantity of labor equal to L'. The willingness of a firm to pay for labor comes from two sources: the marginal

product and the price of the output. The more productive a worker is, the higher is the marginal product, and the more the firm is willing to pay. Likewise, the higher the value of the output of the worker, the more the firm is willing to pay. Given that the firm pays each worker a fixed wage rate, the firm maximizes its "consumer's surplus", if you will, by choosing workers until the wage rate equals the value of the marginal product.

> *Profit maximizing firms hire workers until the wage equals the value of the marginal product:* $w = p \times MP$.

Changes in wage rates lead to changes in the quantity of labor any firm demands. When wages are high, firms hire fewer workers, because large numbers of workers would lead to low marginal products and losses for the firm. When wages are low, firms increase the number of workers they hire. Changes in the level of *other inputs* leads to shifts, or changes, in the demand for labor. For example, better libraries and other research services at a given university make professors more productive in their research at that university, and increase the demand for their research services at that university. It is no surprise to find high demands for research professors at those universities with large amounts of complementary inputs to research. Changes in the level of capital can also act as a substitute for labor, and can shift the demand curve for labor inward. Hence, the introduction of robotic arms in assembly line production, might lower the demand for assembly line workers. As always, it is the case that we can make no predictions about shifts in the demand curve when there are changes in the "other things constant" category. But one thing is clear: the demand for labor is downward sloping and lower wages lead to more workers hired.

Every firm will have a demand for labor and other inputs used in the production of its outputs. If the demand curves of the firms are summed up over each input, then this yields a market demand curve for that input. You'll notice there is nothing new here — the market demand curve is calculated exactly the same way all market demand curves are arrived at. The derivation of market demand curves is shown in Figure 12-2, where for simplicity it is assumed there are only two firms demanding labor in this market.

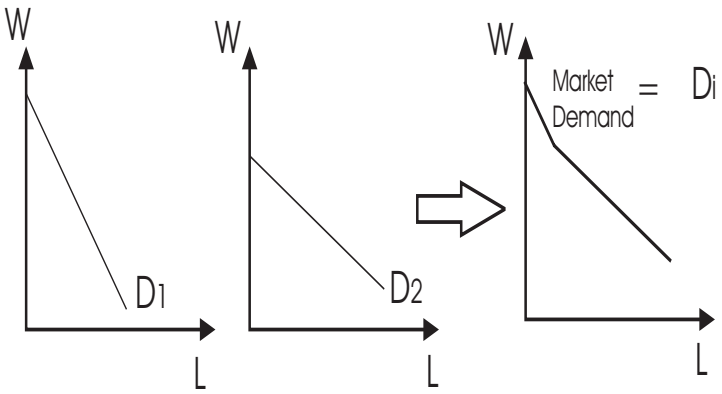

Figure 12-2
The Market Demand for Labor

The market demand for labor is made under our normal set of assumptions for a competitive market. That is, a perfectly competitive input market is characterized by firms that are price takers; that is, firms cannot have any significant impact over the price they pay for labor. Essentially we are assuming once again that the number of input demanders is large enough and each demander is small enough so that no individual firm hires a significant portion of the total quantity traded.

12.2 **The Supply of Labor**

Now let us turn to the supply of labor which depends on the decisions that individuals make about how much of their time to spend at work rather than do leisure-time activities. At any given time, about 60–70% of abled bodied adults are either working in the labor force or seeking employment. This number has remained quite stable for the past century, although for certain subgroups, like women, the number has changed over time. At the turn of the century less than 25% of women were in the workforce, while today over 50% of women are working. This change in the participation rate of working women no doubt reflects the increased education of women, changes in household technology (like appliances and ready made meals), changes in birth control methods, and rising wages. In addition to workforce participation, a large class of workers not usually counted in official statistics are those (mostly) women working at home as spouses and parents.

One of the critical factors in deciding to enter the workforce is the wage that is offered. Wages are the opportunity cost of leisure activities. When someone takes an hour to spend sailing or playing tennis that they could have used to generate income, that income is the cost of the time used for sailing or tennis. Since leisure is a good, valued like all other goods, it is subject to the principles of economics outlined in our earlier chapters. Thus the law of demand applies to leisure as it applies to apples and oranges. When the cost of leisure goes up, people substitute out of leisure and into work. Thus, when the wage rate goes up, people spend more time in the labor force, other things equal.

The economics of labor supply imply that entering the workforce is a choice. People decide all of the time whether or not they should take one job or another, go to school, travel, or become married and specialize in household production. At times the choices people make might be incredibly constrained, perhaps to the point where it appears one is forced, but fundamentally, labor market participation is a choice we all make. Quite often we hear in the press "there are not enough jobs" or "this government created 5000 jobs." This is a fallacy. If you recall, one of the basic implications of the principle of maximization is that our life is characterized by scarcity. We always want more of just about everything. We want more schools, roads, and shopping. We want better movies to watch, sports teams to cheer for, and bigger homes and gardens. When more and more goods are always wanted, it must be the case that there is a surplus of jobs to do. There are never too few jobs, ... there are too many! The problem for an economy is how should the scarce labor available be allocated among the limitless number of possible jobs in such a way as to maximize the wealth of that economy. Thus labor supply is a constrained choice we make, but one that is not constrained by the number of jobs available.

12.3 **The Market for Labor Services**

As complicated as the issue of labor supply is, one basic truth is that the supply curve is upward sloping. Pay people more, and more hours of work will be forthcoming. If we add all of

these individual supply curves up, we get a market supply curve for labor. Figure 12-3 shows the market demand and supply curves for labor.

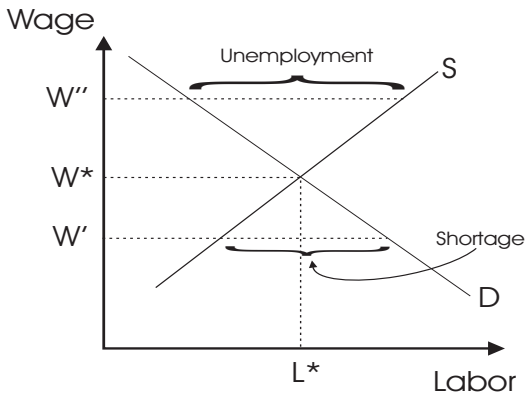

Figure 12-3
The Market for Labor

For some, just drawing this graph is offensive. "Labor is not a commodity" they might cry. In some regards, they are right. When we decide to enter the workforce, it is a personal decision, and one that is likely entered into with a lot of thought and consultation with family, teachers, and people in the market already. Much of our personal identity is tied up in our occupation, and for many our jobs are a source of pride. Labor contracts can be complicated and involve negotiations, legal documents, and friendships. Furthermore, the age of slavery is over and it is illegal the world over for a firm or individual to completely own a human being. Instead firms "rent" worker services, and pay for it by the hour, for example. However, as true as this is, labor services are bought and sold everyday. In fact, income from labor services accounts for about 80% of the value of all goods and services produced in countries like Canada and the United States. So although the procedure for buying and selling, say, legal services, is different than for buying a jug of milk, the forces of demand and supply are still acting. Labor services can be understood as a commodity.

Figure 12-3 shows the equilibrium wage and quantity of labor as W^* and L^*, which are determined by the intersection of demand and supply. One of the first things we can see from this graph is that the level of *unemployment* is a function of the wage. At the equilibrium wage rate, there is no unemployment. Only when the wage rate is above the equilibrium wage W^* does unemployment begin to exist. Furthermore, the higher the wage rate is, the greater the level of unemployment is. So often in the media we read about unemployment as an exogenous force. Unemployment is said to be structural, cyclical, chronic, etc. Though the circumstances for unemployment change all of the time, the fundamental reason for unemployment is a wage that is higher than equilibrium.

Likewise, shortages of workers result from wages that are below the market clearing levels. The wage W' in Figure 12-3 is such that the quantity demanded of labor services is greater than that supplied. As a result a shortage exists. The province of British Columbia, over the past several years, has experienced tremendous shortages of doctors and nurses, especially in remote towns and regions. Hospitals have closed, hours of operation have been limited, and services cut back as a result of this shortage. In response to this a number of suggestions have been made to solve the problem: train more nurses and doctors, force nurses and doctors to start their careers in remote

rural communities, and other non-price solutions. The key to the solution, however, is to simply let the wages in these communities rise to the point where private doctors and nurses are willing to work there.

Labor markets work the same way other markets do. Figure 12-4 shows two examples. In panel (A) the demand for labor has increased, and as always this means a movement to a new equilibrium with a higher wage and level of employment. Hence, when a new sports league starts up, as in the case of the WHA, XFL, or Arena Football, competition for the scarce athletic talent increases and wages are driven up. In panel (B) the supply of labor has fallen, and as in output markets, this leads to a reduction in trade and higher prices. One of the great reductions in the supply of labor came during the Black Death. Starting around 1350 AD and ending *c.*1500, populations in Europe were reduced from 1/3 to 1/2 by the Black Death. This drastic reduction in the supply of labor led to large rises in wages at the time. As the population recovered relative to the amount of land and capital available, wages fell.

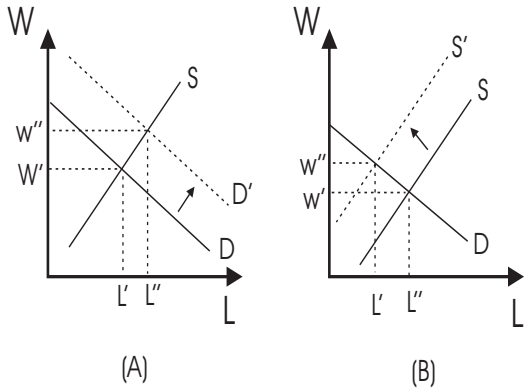

Figure 12-4
Changes in the Demand and Supply of Labor

12. 4 **Income Differences**

It is a fact of life that our personal incomes are not equal. Many over the centuries have felt this a social injustice and have attempted to rectify the situation. Others, have taken matters into their own hands and have engaged in theft or conquest to change the distribution of income. Every morning on radio sports casts across the country, commentary is made on ridiculous salaries and bonuses paid to professional sports athletes. No matter what side of the issue you are on, it is important to understand why salaries differ across individuals. Understanding might change your mind on whether incomes should be equalized by force, or it might help you think up a better way to equalize them.

Incomes are determined by supply and demand. It can't be stressed enough how counter-intuitive this is to most of us. Many have "justice theory of wages." In our mind we often think about some occupations being more important than others in a deep justice sort of way. Firefighters, policemen, medical doctors, and other people who save lives, so the justice theory goes, should be

paid well. Inventors of pet rocks, game show hosts, and middlemen, are people we think we can do without, and therefore should not earn large incomes. When we look around we see some musicians earning millions of dollars and others singing on the street corner. None of this seems fair according to our notions of justice through wages. Still others of us have a "working theory of wages." According to this view, those people who work really hard should make more money. If someone digs a ditch and sweats a lot, we think that person should have a higher wage than the lumber broker who just talks on the phone four hours each day. Alas, neither of these views is correct, and the proof is in the pudding — they are rejected by the evidence we see around us every day.

Differences in Supply

One reason wages and incomes vary is due to differences in supply. If throwing a football accurately for 80 yards while under the pressure of 300 pound men charging to crush you was a common skill, and if simple arithmetic knowledge was hard to come by, then professional quarterbacks would likely be paid less than bookkeepers. If, over night, the number of lawyers increased by tenfold, then the salary of lawyers would fall below bookkeepers as well, since with so many lawyers there marginal value would also be low.

People invest in their human capital all the time in order to meet shortages in labor supplies for various markets. In the university you attend, there are no doubt more business and computer majors than English and history majors. The computer and business majors, seeing the relative wages for computer scientists versus English teachers, are attempting to increase the supply of workers in business and computers. In fields where talent is difficult to acquire, the wages will tend to remain high because people can't easily train to enter the market. Some occupations simply require a natural talent one is only born with. Great singers, musicians, and actors, all earn huge rents because they have a gift no others can exactly acquire. Could these talents be produced at no cost, the incomes in these occupations would simply equal their next best alternatives.

Differences in Risk

Some occupations come with a large amount of risk attached to them. If you become a real estate agent your income is more variable than if you become a janitor. If risky occupations paid the same income as other safer occupations, no one would enter them. As a result, competitive pressure raises the incomes to compensate for the increase in risk. Entrepreneurs, often bear large amounts of risk. As a result, they often earn incomes that seem out of line with their more visible contributions to the firm. Government jobs, at least in the past, often provide security of tenure and as a result government workers often earn less than their counterparts in the private sector. Differences in risk work through the supply function. Workers are less willing to supply labor in risky occupations, and this raises the wage and reduces employment.

Differences in Productivity

When one worker is much more productive than another worker, the wage will reflect this because the demand for the more productive worker will be greater. For most occupations, though we might personally feel otherwise, the difference in performance between people is not that great. Consider a job like a secretary. One person might be better at filing and answering the telephone than another, but the difference is likely not to be great. Furthermore, the difference probably has little bearing on the productivity of the firm. As a result, in many low level jobs differences in productivity means little in terms of income. However, for high level jobs differences in performance

could have huge consequences for the firm. A president of the company might make better decisions than someone else only some of the time, but this slight margin could mean millions of dollars generated or saved. This difference in talent will thus be reflected in different salaries, since high productivity workers have a higher demand for their labor.

Difference in Non-Pecuniary Benefits

Seldom is a job defined exclusively by the income earned. For most jobs, there are differences in the work environment. Is the job inside or outside? Does it involve chemicals that could be harmful, dangerous machinery, or obnoxious people? Do the windows in the office open up? Some jobs include benefits like dental and extended health coverage. Other jobs require lots of travel or commitments to overtime workloads. Issues like location of work, chance of relocation, and the size of office often matter a lot to people. In order for there to be an equilibrium in the labor market, incomes adust to these differences in non-pecuniary benefits and costs. As with risk, differences in non-pecuniary benefits work through the labor supply function. If a job has a host of negative attributes, then the wages will be relatively higher. If a job comes with many amenities, then the wages will be relatively lower.

Differences in wages across the Sexes

In the 21st century, the wage rates of women are still lower on average than those of men occupying the same job. That is, if you take cross sections of female employees in almost any occupation, from secretaries and clerks to sales workers and painters, you will find that they earn less (as much as 40% less) than the men in those jobs. This is not a recent phenomenon, and has been observed throughout the ages. In fact, it is often called the Levitical curse, based on the following Biblical passage: "When a man shall clearly utter a vow of persons unto the Lord, according to thy valuation, then thy valuation shall be for the male from 20 years old even to sixty years old, even thy valuation shall be fifty shekels of silver ... And if it be a female, then thy valuation shall be thirty shekels." (Lev. 27:1-4). Why would this difference in wages be so pervasive?

There is an on-going debate in economics over what explains this difference in the pattern of wages. This debate is not settled yet, and we do not resolve it here. However, we will articulate the debate in terms of the competitive supply and demand model for inputs. In this way, we can see how our model helps to articulate and better understand the issues of the debate. In the competitive labor model, wages are determined by the intersection of the demand and supply for labor, where the demand curve reflects the value of the marginal product of labor, and the supply curve is determined by the trade-off between work and leisure. Given that the interaction of supply and demand determine wages, there are only two potential general explanations for the wage differences. First, the supply of female labor could be larger for women, and men and women compete in separate labor markets. Second, the demand for female labor is lower in labor markets where men and women compete together. The first explanation simply does not fit the facts. Universally men participate in the work force at a much higher rate than women, so the first explanation should be rejected. Hence, the only general explanation left is that the demand for female labor must be lower. But why would the demand for female labor be lower than for men? Here again, there are a number of explanations. First, there may be wide spread discrimination on the part of firm owners (both male and female) to offer lower wages to female workers. Second, consumers may be willing to pay more for products made by men than by women. Finally, women may have lower marginal products than men.

The second explanation would appear to be rejected immediately. Consumers generally have no idea whether men or women were used as inputs in the production of a good, nor is it obvious why they should care. Hence it is unlikely that the lower wages for women are the result of a lower price of their output. A more plausible explanation of the wage difference is that there is widespread discrimination against female workers. However, there are a number of problems with this explanation when applied to women. First, suppose that this were true, and that the degree of discrimination varied among firms. If there were small amounts of women in the labor market, women would work for the firms that discriminated least among them, and female wages would be close to those of men. As the number of women in the market increased, though, more women would be forced to work for firms that discriminated more at the margin, and the wage rate would tend to fall. This grinds against the experience of the last forty years, which has seen the large increases in female labor force participation and the move of female wages a little closer to male wages.

Many economists find a simple discrimination model like this implausible because a firm that indulges in a taste for workers that is not reflected in productivity, pays more for labor than a firm that takes advantage of the lower wage rate for women. If women were equally productive on average as men, an owner of a firm would be forgoing huge profits by not hiring them at lower wage rates. Recall the movie *Schindler's List*, where the main character, Oskar Schindler, hires Jewish prisoners not because he likes them, but because he can get an unlimited supply at virtually a zero wage rate.

Employers tend to keep a close eye on the bottom line, because the discipline of a competitive market stands ready to punish firms with higher costs. Competition among firms forces the wage rate of women up when they are equally productive because employers are more concerned with the tastes of their customers than with their own preferences for workers. Hence, in a competitive model, simple discrimination seems unlikely. It should be mentioned that in models of incomplete information, or in markets where there is a monopsony employer, discrimination of workers can make more sense.

The final explanation for a lower demand for female labor is that women on average, have lower marginal products than men. On the surface this seems as silly as some of the other explanations, unless one is talking about purely physical occupations. However, this argument usually revolves around the fact that women often take time out of the work force to bear and raise children. This directly handicaps them against men since continuity in the job is a valuable attribute of an employee. In anticipation of being absent from the work force, women may invest less in their own human capital, which further lowers their productivity. Finally, as an empirical matter, mothers are more likely to stay at home when children are sick, less likely to work late and travel away from home, and are more likely to work part time. All of these factors lower the marginal productivity of women on average, and therefore, lower the wages of all women — even though any given woman may not behave this way.

To sum up, lower wages for woman can best be explained by a lower demand for their labor. This results from either widespread discrimination or widespread lower productivity. Of the two explanations, the later seems more likely. In occupations where the effects of having children on a woman's human capital are less severe, the wages of men and women should be closer together.

12.5 **Unions and Minimum Wages**

Unions are legalized labor cartels, whose purpose is to advance the economic interests of its

members. Although unions attempt to do this in a number of fashions, here we will look at two general methods. First is the restriction on entry into the labor market. Figure 12-5 shows what happens to wages and the gains from trade when workers are restricted from entering an industry.

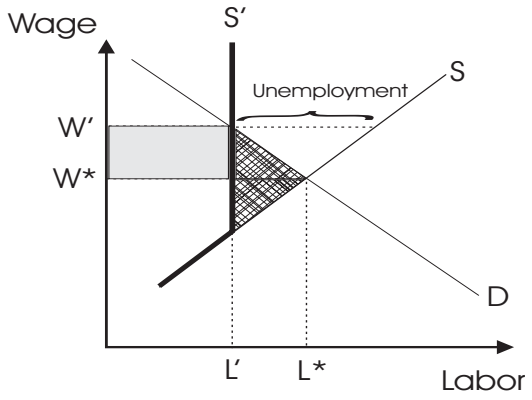

Figure 12-5
Restrictions on Entry Into the Labor Market

Restrictions on entry essentially create a new supply curve — at least a new supply curve as far as the firm is concerned. With the new supply curve S', increases in wages are not met with increases in labor supply. As a result, the restriction on entry raises the wage rate of workers in the industry to W', and creates a transfer of wealth from firms to workers of an amount equal to the grey shaded area. The grey shaded area was surplus to the firm before the restriction was put on. After the restriction, this surplus is captured by the workers in terms of higher wages. The crosshatched area is the deadweight loss caused by the restriction placed on labor supply. This happens because the total amount of labor employed falls from L^* to L'. Thus, firms that used to earn surplus on these workers no longer do, and some workers who earned a supplier's surplus from working are now out of work. Finally, notice that at this higher wage rate, more workers are attracted to the industry, but fewer are able to get work. Hence the restriction on entry creates unemployment.

A second method unions use to benefit their members is to raise the price of substitutes. When the price of non-union labor increases, this increases the demand for union labor. Higher demands mean higher wages for the members. Two of the ways unions accomplish this is to support restrictions on the age of employment and minimum wage laws. Unions have always been huge supporters of minimum ages of employment. In the province of British Columbia children under the age of 15 are essentially prohibited from working ... not even a paper route is allowed. Unions have also supported minimum wage laws, even though those laws are essentially irrelevant for most of their workers. However, both of these policies discourage firms from finding uses for low wage employees that might substitute for the more expensive wage labor. Figure 12-6 shows the effect of a minimum wage.

The graph is very similar to the one on restrictions on entry. Rather than working on the supply of labor, though, a minimum wage has a direct impact on the wage rate by creating a wage floor. Minimum wage laws create a transfer of wealth to those workers who manage to keep their jobs, but create a deadweight loss from reduced employment. Because the minimum wage increases the wage rate, it also induces more unemployment. There has been a considerable amount of debate over the

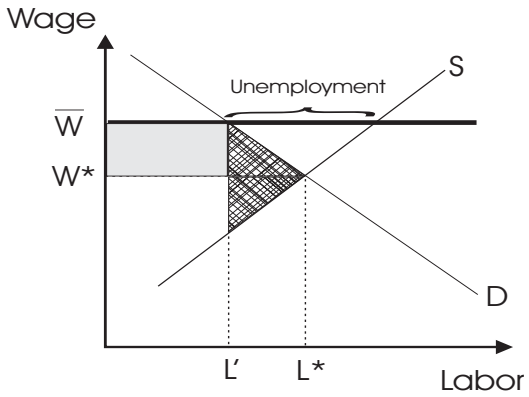

Figure 12-6
Minimum Wages

past few years over the actual size of these changes. Some economists have argued that they are not very big, others suggest they are. What is not in dispute is that employment is lowered when minimum wages are introduced.

12.6 **Summary**

As humans, we naturally find labor markets more interesting than markets for most other goods. Unless your income depends on coffee beans, its hard to get excited about the bean market. But labor is important for other reasons. Eighty per cent of national income is generated in labor markets, and this sheer size makes it one of the most critical markets. Furthermore, many government policies influence labor markets, and therefore the incomes of many people.

Despite this inherent appeal, it is important to realize that labor markets are fundamentally ruled by economic principles, the way other markets are. Many object to treating labor as a commodity, but by using demand and supply analysis to understand how incomes are determined and change, we are not dehumanizing people. A supply and demand model is meant to understand the price of things and how much gets traded. It is a fact of life that labor is used to produce goods. By analyzing the demand and supply of labor we come to understand the level of employment and the level of wages — nothing pejorative is implied.

REVIEW QUESTIONS

1. What happens to the demand for labor if workers become less productive?

2. Why is it meaningless to talk about unemployment independent of a wage rate?

3. If we observe two people with different incomes, does that mean their skill sets are different?

4. Why might unions support minimum wage laws?

5. When machines are used instead of labor for the production of some good, we often hear the phrase "capital replaced labor." Why is this phrase misleading?

6. Would unions that are successful in raising their wages above the competitive level be more or less likely to racially discriminate in their hiring than the owner of a competitive firm?

PROBLEMS

1. Some industries are dominated by women because women are more productive than men in those industries. For example, mushroom pickers tend to be women because their smaller hands don't bruise the mushrooms. Often men are able to compete with women in this market by working for lower wages. What would happen if mushroom workers formed a union and required all workers to be paid the same wage rate?

2. The following question is about minimum wages. Treating labor as a commodity traded in the economy at some price (wage), determined by the supply and demand for various types of labor,

    a. What types of workers are likely to be most affected by min. wages? Eg. teenagers, skilled craftspersons, handicapped workers, etc.

    b. Explain the effect on wages, levels of employment, and possible unemployment in the market most directly affected by this law. Also, what forms of competition among workers might be more prevalent with the higher minimum wage?

    c. Consider that unionized workers generally earn much more than the minimum wage. Unions, however, have always strongly advocated increases in the minimum wage. Are the unionists just interested in the welfare of their poor cousins?

3. A proposition known as "comparable worth" states that people engaged in similar work should receive similar pay. Consider that salaries for professors in different fields at SFU and elsewhere vary considerably, even though faculty in these various disciplines on average work equally hard and are held to the same standards. What accounts for these pay differences, and can one conclude from these data that we value the study of economics more than say, literature? What famous paradox is relevant here?

4. "There are too many jobs." Comment.

5. The following question is dedicated to Don James, former coach of the Washington Huskies. Do the relative salaries of humanities professors and football coaches at major state universities reflect the relative value of football and humanities? Do they reflect the number of years that professors and coaches must spend acquiring an education? The number of hours they work? The difficulty or unpleasantness of their work? Why do the football coaches usually receive salaries that are so much higher?

6. Until the program was abolished in 1987, the government of Holland paid a stipend to artists, based on such factors as marital status and number of children, and took in return a selection of the artists' work deemed equivalent in value. Most of the work so purchased disappeared into warehouses.

    a. Do you think a program like this raises the average income of artists?

    b. How might it actually lower the average income of artists?

7. Should college students be required to pay the full cost of their own education?

a. Who benefits from a person's obtaining a college education?

b. If only low-income students are to receive educational subsidies, where would you place the ceiling on low incomes?

c. If education is an investment designed to secure a higher future income, why don't people who want to acquire years of expensive education simply borrow the money — the way business firms borrow to finance investment?

8. The government borrows money by selling at auction $1,000 bonds, payable in two years, with no interest payments. The market interest rate is 10 percent.

a. How much will the bonds sell for? You must provide a formula for the calculation.

b. Even though the bonds do not "pay interest" (the buyer receives $1,000 when the bonds mature and nothing before that), buyers still end up receiving interest on their inve stment. Explain.

c. What interest rate are buyers of the bonds actually receiving on their investment? Explain.

d. What will happen to the wealth level of bond holders if, immediately after the bonds are sold, the market interest rate unexpectedly falls to 5 percent?

Review Question Answers

1. *When workers become less productive their marginal product falls, and the demand for their services also falls.*

2. *Unemployment is the difference between the quantity supplied and demanded of labor. These quantities depend on the wage rate. Thus, there may be large amounts of unemployment at a wage of $200 per hour, but very little at a wage of $1.*

3. *No. Wages vary for many reasons, some of which are mentioned in the text. Individuals choose occupations based on many different factors, not just the incomes. Thus, two identical people in terms of skill levels could choose different career paths and thus different income streams.*

4. *They don't like low wage competition.*

5. *It took labor to make the machines. When refrigerators replaced the iceman, it took workers to make refrigerators. Thus capital replacing labor is really "labor replacing labor."*

6. *They are more likely to racially discriminate. Since the wage is above the competitive level, there will be an excess demand to join the union, allowing the union members to exercise their preferences in hiring. A competitive market forces the employer to hire the most efficient worker, independent of racial characteristics.*

Odd Numbered Problem Answers

1. *At the same wage rate women are more attractive to the employer. Hence only women will be hired.*

3. *The pay differences reflect the value of different human capital in the market place. Universities must pay accounting, computer, engineering, and finance professors much more than the average salary because these fields have market firms bidding for their services. Since the demand for history professors is low, they are willing to work at the university for low salaries.*

5. *Football coaches, like Don James in the 80s and 90s, earn large sums of money because they generate large sums for the university. Universities are willing to pay large salaries because the marginal products of these people is so high. Don James brought the University of Washington tens of millions of dollars by producing a series of winning football teams. Your average professor brings less than this.*

7.

   a. *Most of the benefit goes to the student. Some argue there is an positive externality to society. However, universities add very little to citizen characteristics.*

   b. *I don't know.*

   c. *The problem is one of collateral. Who would lend money to someone who is unlikely to pay it back given slavery is illegal.*

CHAPTER 13

PRICE SEARCHING

13.1 Facing a Downward Sloping Demand Curve

For many problems of human behavior, the assumption of competitive markets and price taking is a decent approximation. Most workers in the job market face competition from other workers who offer services identical to their own. Most firms compete with other firms, both existing and potential, which provide goods essentially equivalent to theirs. Men and women compete for spouses in competitive marriage markets, churches compete for attendance in competitive religious markets, and on and on it goes.

And yet, as good as the price taking model is for analyzing some problems, it is inadequate for others. There are markets where firms supply products for which there are not immediate substitutes. There are markets where consumers are not well aware of prices. And there are markets for which firms have various advantages over other firms. In such markets, when a firm raises the price of its product, not every customer abandons the firms and buys elsewhere. Some customers remain behind and purchase at the higher price. In these markets, the firms are no longer price takers, since the amount of output they produce determines the price they can charge. These types of firms are called *price searchers*.

> *A price searching firm faces a downward sloping demand curve.*

You've probably noticed that the price of milk is not the same at your neighborhood corner store and your closest Safeway. No doubt Safeway is cheaper. Though your corner store no doubt sells less milk at the higher price, they do manage to sell enough milk to stay in business. Your corner store is a price searcher ... it faces a downward sloping demand curve for its products. You've also no doubt noticed that Microsoft products also sell for different prices at different locations, and that Microsoft has engaged in all types of complicated pricing practices, some of which have cost them a great deal of money in anti-trust lawsuits. Microsoft is also a price searcher and also faces a downward sloping demand curve for its products. Although the two firms are price searchers, they obviously behave differently. This is because the reasons for why they are price searchers are so different. Why would a firm face a downward sloping demand curve.

Costly Product Information

We have been quite silent about assumptions of information in our model. In the competitive model it is assumed that consumers know the products they are buying, they know the price at all stores, and they know firms are unable to cheat in product quality. Of course, no one knows all there is to know about anything, let alone goods purchased. Consider all the things you do in

just a simple grocery store that reflect your poor information on product quality. You inspect the apples you buy because you don't want any with bruises or worms. If you knew everything about the apples you wouldn't have to inspect them. You sort through the oranges and mangos for the same reason. If the product is new you might buy a smaller quantity than normal just to "try it out" or the store might have tables set up with samples for you to try. If you knew everything, you would know what the taste and texture was like; you wouldn't need a sample. When you buy a car you take it for a test drive, get it inspected, and make sure a knowledgeable friend is with you. You phone around for the best price, don't trust fly-by-night salesmen, and ask for warranties. All because you need to aquire information to make decisions.

When information is costly, consumers don't switch brands or stores completely due to a price changes. When different firms offer different prices, consumers often suspect that the difference actually reflects something they simply don't know about. Perhaps the service is lacking; perhaps the good is of lower quality; perhaps it really is a good deal. Some consumers switch, but not everyone. Hence, a firm might raise its price, and not all of the customers leave. As information improves, firms find the elasticity of demand for their products increases. And with perfect information they become price takers.

Locational Advantage

Recall the old real estate adage "what are the three most important things in buying a house: location, location, location. In the competitive model, little attention was paid to the fact that we live in a three dimensional world where everything is located in a specific space. When location becomes important, then firms will face downward sloping demand curves because travel across space is not free. When a store is located close to my home, I spend less time traveling to that store compared to a store farther away. If the stores have equal nominal prices, the store farther away has a higher total cost once the travel time is included, and as a result, I will shop at the closer store. This means, however, that the closer store can raise the price of its goods, and I'll still shop there. Some marginal customers may go elsewhere, but the closer customers remain. As a result the firm keeps some of the customers with an increase in price and thus faces a downward sloping demand.

Slightly Different Products

One day I took my wife shopping for a jointer. A jointer is a specialized woodworking tool used for getting a straight edge and a flat surface. A wonderful tool. When we got to the "House of Tools" there were three jointers available. All were the same size, but not all were the same price. I bought the more expensive one, much to my wife's chagrin. When I pointed out the differences (the six inch longer bed, the better fence adjustment, and the fancy chrome knobs) she was not impressed. If she had to choose one of the three jointers, she would have gone with the cheapest version.

In our competitive model, we assumed that the products of all firms were homogeneous; that is, they were all the same. However, if you pick any product, whether blue jeans, frozen juice, or jointers, there is always a slight difference. As similar as they are, Pepsi and Coke don't taste exactly the same *and* not everyone ranks the difference the same. Some people like just like Pepsi, as hard as that is for a Coke drinker to understand, and vice versa.

When products are viewed as different by consumers, then again, the firm will not face a perfectly elastic demand curve, but will face one that is downward sloping. When Pepsi raises the

price of its cola, the marginal consumers who think Pepsi and Coke are close substitutes switch and consume Coke, but the die-hard Pepsi drinkers stick with the product.

Monopoly

The extreme case of a price searcher is a monopolist. A monopoly firm is literally the only firm in the market, and a firm that faces the entire market demand of the product. A monopoly doesn't exist just because the market is too small to support more than one firm, a monopoly could exist for a number of reasons. First, a monopoly might exist because the government has granted the firm a special license. This might take the form of a special charter, like in the case of the original Hudson's Bay Company or Wheat Board in Canada, or the East India Company. Similarly, the government might provide a firm with a patent, which is an exclusive license to sell a product innovated by the firm. Or the firm might be in an industry where there are such huge fixed costs, average total costs are always falling. In such an industry, larger firms are always able to charge lower prices than smaller firms, and as a result only one firm ends up surviving in the market. This is called a "natural monopoly." Still a firm might end up a monopoly due to some unique superior input that other firms have no access to. When a firm is a monopoly, they obviously face a downward sloping demand curve, because the market demand curve is downward sloping.

13. 2 **Marginal Revenue Curve**

Figure 13-1 shows a very simple downward sloping demand curve that a firm could face.

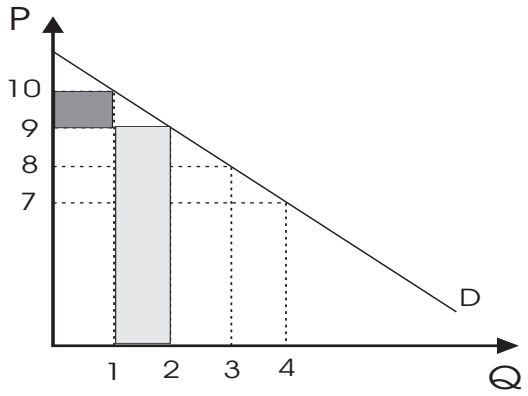

Figure 13-1
Marginal and Total Revenue

When the price of the good is \$10, the firm sells 1 unit, and has a total revenue of \$10. When the firm lowers the price to \$9 the firm sells 2 units, and total revenue becomes \$18. For the third unit sold, the price falls to \$8, and total revenue is \$24. Notice what is happening. In the price taking case the marginal revenue was always equal to the price, but here the marginal revenue is lower than the price. When the firm sells the second unit, the marginal revenue is \$8 (18-10), which is less than the \$9 price. When the firm sells the third unit, the marginal revenue is \$6 (24-18), which is again less than the price of \$8.

This happens because the firm faces a downward sloping, rather than a flat demand curve. Every time the firm lowers its price, it must lower the price for all of the goods it is selling. In Figure 13-1, consider the shaded areas. When the firm goes from selling 1 to 2 units, the firm earns \$9 on the sale of the second unit. However, it must lower the price of the first unit from \$10 to \$9. Hence the firm gains the light shaded region (\$9), but loses the dark shaded region (\$1), which nets out to \$8.

Notice also that as the price falls by \$1 for each extra unit sold, the marginal revenue is falling by \$2. In other words, the marginal revenue is falling twice as rapidly as the price. This is a general result. The marginal revenue curve will always lie below the demand curve and it will always have a slope twice that of the demand curve. Figure 13-2, shows the marginal revenue curve and the demand curve together.

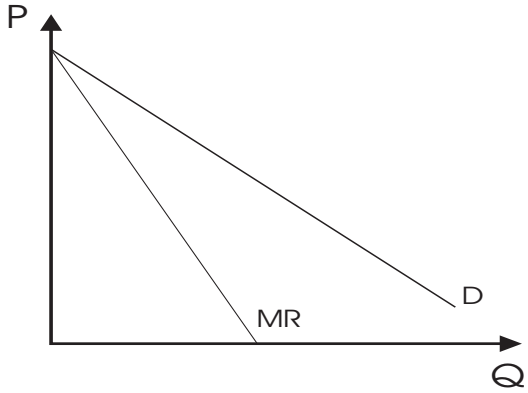

Figure 13-2
Marginal Revenue and The Demand Curve

13.3 **The Price Searching Equilibrium**

If the price searching firm had no costs of production, what would be the profit maximizing price to charge and output to produce? Think about this for a moment. If you recall from the discussion of elasticity, when we move down a demand curve, the total revenue is not constant. As the price falls, total revenue increases, is maximized, and then begins to fall. If a firm had no costs of production, then that firm would want to maximize revenues, because this would also maximize profits. This would be at a quantity of Q_R in figure 13-3. As always, profit maximization implies that marginal revenues should equal marginal costs. Since marginal costs are zero for a firm with no costs, such a firm would maximize revenues, and this occurs when marginal revenue equals zero.

Total revenue is maximized when marginal revenue equals zero: $MR = 0$.

Fortunately, when a firm has production costs, the price searching solution is very similar to the price taking one. In particular, it is still true that a profit maximizing firm sets marginal revenue equal to marginal cost. Just because a firm is a price searcher, doesn't mean they are any more or less interested in making money. Hence the profit maximizing rule remains. Figure 13-3 shows the equilibrium for a firm with costs.

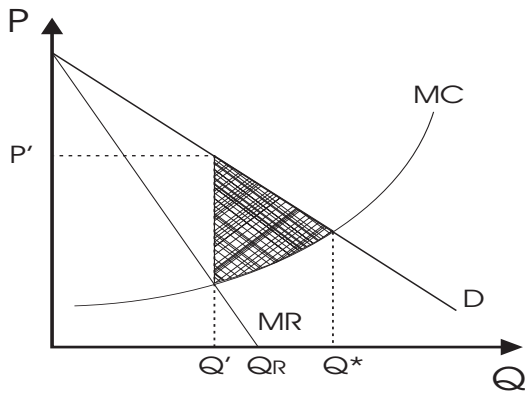

Figure 13-3
Profit Maximizing Equilibrium

The firm produces Q' output, and sells at price P'. This is the highest price the firm can charge for that level of output. Notice that this level of output is less than both the revenue maximizing level of output Q_R and the socially desired level of output Q^*. This latter level of output deserves some elaboration. From a social point of view, output should be produced as long as the marginal value (height of the demand curve) is greater than the marginal cost (height of the marginal cost curve). This condition is true until Q^*. The firm does not produce to this level because to produce that much means that marginal revenue is below marginal costs. The firm wants to maximize profits, not the gains from trade. Hence, because the marginal revenue is less than the price, a price searcher creates a deadweight loss equal to the crosshatched area. The deadweight loss results because the value of this lost production was greater than its costs.

A profit maximizing price searcher chooses a quantity which equates the MC and MR. As long as MC is positive, this quantity is not the quantity that maximizes total revenue, which is maximized when MR is zero, which is at a lower price and higher quantity than the price searching. This fact explains the behavior of many artists with respect to the price of their products. A few years ago Bono, the lead singer of the rock group U2, complained in an interview that his record company charged a price for CD's that he thought was too high. He was not alone. Musicians, authors, and actors often complain that the price of their music, books, and plays are set too high. Indeed, the author of this book complains that the price of his conventionally published book is too high! The question is, are these people (me included) altruists or are they actually acting in their own self interest?

The key to resolving this puzzle is that performers and authors are usually paid a royalty based on the revenue generated from gross sales. Artists are not paid based on profits. When someone is paid a fraction of the revenues, then their income is maximized when revenues are maximized, not when profits are maximized. As a result, their interests are at odds with the firm selling the

product. In particular, an artist, or author, or singer, will want a lower price in order to sell a larger volume. In this way, they personally would make more money. Since artists do not bear the costs of production, they do not care that profits are not maximized when revenues are. Bono, and company, are not altruists — after all he didn't make the case that records should be given away!

If you understood the equilibrium with price takers, this one is not much different. You may be wondering where the firm's profits are? As with the price taking firm, the definition of profits remains the same: TR-TC. In order to tell how large profits are, we need to know what the average costs of the firm are. Figure 13-4 shows two situations.

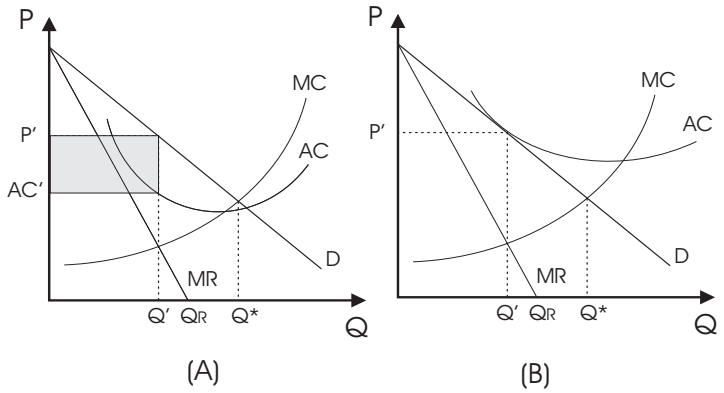

Figure 13-4
Profits For A Price Searching Firm

In panel (A) on the left, the firm has an AC curve that lies below the price when the firm produces Q' output. At this level of output, the firm's average costs are AC'. The difference between $P' - AC'$ is the profit the firm makes per unit of output. If we multiply this by the amount of output the firm produces, Q', we get the total amount of profit, equal to the shaded area. Just because a firm is a price searcher, however, doesn't mean the firm earns a profit. In panel (B) on the right, we see a firm with average costs that just equal price at the profit maximizing level of output. This firm would be making zero economic profit.

Like the case of price taking, the long run equilibrium for a price searcher must also have profits equal to zero. The firm is a price searcher for a special reason. Perhaps the firm has a great location, a trade secret, a franchise monopoly, or a special input. Whatever the reason, if the firm is earning a profit as in panel (A) of Figure 13-4, then the value of this special input must increase. As the value of this input increases, the average costs of the firm increase until the profits are zero. If the firm had been earning a loss, then the value of the asset allowing the price searching would have to fall. Hence, panel (B) represents the ultimate equilibrium for a price searcher.

13.4 Price Discrimination and Other Pricing Practices

The key interesting result of the price searcher model is the deadweight loss that results when a firm prices in such a way as in Figure 13-3. Normally a deadweight loss is produced when the

government puts on a tax, subsidy, or some other type of market interference. Yet here we have a profit maximizing firm, trading with utility maximizing consumers, but still not maximizing profits! Something is wrong here. The crosshatched area in Figure 13-3 represents money on the table that is not realized. What is going on?

What has happened is an assumption has been sneaked into the model. The simple price searching model we've been learning about assumes that the firm can only charge one price. Presumably there is a cost to charging more than one price, and so the firm *cannot* capture the deadweight loss. If the firm cannot capture it, it seems silly to call it a loss, but that's the history of the model.

If we relax this assumption, we see that a price searching firm has a tremendous incentive *not* to charge a simple single price to everyone. When simple pricing is done, the gains from trade are not exhausted. By using more complex pricing schemes, the firm can capture more of the gains from trade and make more money. We now turn to this incentive.

Price Discrimination

Economists usually view cases of price discrimination as falling into three broad theoretical categories. The first category is perfect price discrimination: an "ideal," but usually unrealizable case. Here the firm successfully extracts the maximum possible profit from each customer and therefore captures the entire gains from trade. The second category is ordinary price discrimination. This is the familiar case in which the firm identifies potential customers by groups and charges each group a separate price. For example, the pervasive phenomenon of charging different admission prices for groups called "seniors," "adults," "students," and "children" is one instance of ordinary price discrimination. The third category, block or multipart pricing, is the case in which the monopolist charges different rates for different amounts, or "blocks," of a good or service. For instance, it is common practice to charge one rate for the first block of so many kilowatt-hours of electricity in a period and lower rates for subsequent blocks.

Perfect price discrimination results when every consumer pays their total value for the good. Consider the market demand curve in Table 13-1 (note that the numbers under MR lie in between the quantities sold because marginal revenue is the change in revenue for a change in quantity). For simplicity it is assumed that each individual only demands one good; that is, we'll consider the case of unit demand curves discussed in Chapter 6. Hence when the price is \$14, one unit is sold, and when the price falls to \$13, two units are sold to two individuals. The market demand curve falls with increased quantity because lower prices induce more people to enter the market.

Elasticity and Total Revenue

Quantity	Price	Total Revenue	MR	AR
0	15	0		
			14	
1	14	14		14
			13	
2	13	27		13.5
			12	
3	12	39		12.25

etc.

Assume for the moment that the monopolist firm facing this demand curve knows each individual's reservation price and can prevent the resale of the product through perfect market segmentation. Furthermore, assume that the firm exploits this knowledge by perfectly price discriminating. What becomes of the marginal revenue curve? From Table 13-1 it is clear that the marginal revenue equals the demand curve, which also equals the price. This is shown in Figure 13-5.

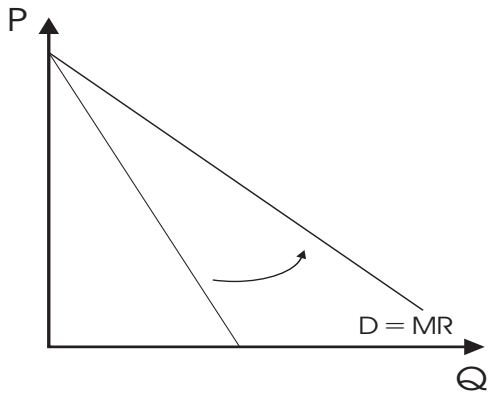

Figure 13-5
Marginal Revenue for Perfect Price Discrimination

In the simple monopoly case, MR fell faster than the price because a reduction in price at the margin meant that all the intramarginal units were reduced in price as well. This is no longer the case. With perfect price discrimination the firm can lower the price to the marginal customer, but those already purchasing continue to pay their reservation prices. Figure 13-6 shows the new equilibrium. As long as $MR > MC$ the firm continues to produce. When MR=MC, as always, the firm reaches the profit maximizing level of output. Since MR now equals the price, at output Q^* $MR = MC =$ price. In other words, the perfectly price discriminating firm produces the efficient level of output. At this level of output, however, the consumer's surplus is zero since each consumer pays their total value. The shaded area of Figure 13-6 is the rent to the firm. Notice as well, that in a market like this there is no single price; every consumer pays a different amount.

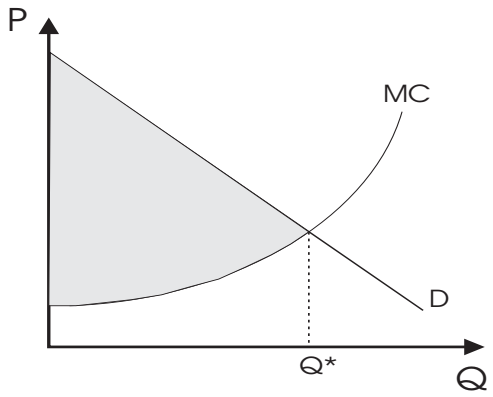

Figure 13-6
Perfect Price Discrimination Gains From Trade

The ability to extract the maximum amount of surplus through perfect price discrimination probably has no precise real world counter part because the conditions necessary for it are too extreme. Seldom do firms have perfect knowledge of their customers individual demands, and seldom can they perfectly segment the market to prevent resale. However, there may be examples that come close. For example, some people have interpreted Dutch auctions as a method of perfect price discrimination. Unlike an English (or ordinary) auction where the price starts out low and is bid higher, in a Dutch auction the price starts out high and then falls. The first person to bid takes the lot for sale at that price. Because there is only one bid, there is an incentive to bid close to the reservation price, and because the high marginal value users bid first, there is a built-in mechanism to prevent resale.

Another example of perfect price discrimination might occur in the provision of accounting services by small firms. Accountants routinely charge their clients different prices for the same service. Given their unique knowledge of their clients books, the professional restrictions on advertising prices, and the inability of a client to resell the accounting service, this type of industry appears to meet the requirements for perfect price discrimination. Accounting firms are not monopolists, but restrictions on advertising and the nature of the business gives each firm some market power.

Ordinary Price Discrimination

Now let us look at ordinary price discrimination by considering first the theory and then the circumstances in which this strategy is feasible. To keep matters simple, we will ask how a firm sets price in a market divided into just two segments. Suppose one segment of the market is characterized by low elasticity of demand, while the other segment has a high elasticity of demand. When a firm decides which market to sell in, it must ask: in which market will there be a larger contribution to profits? The answer to this question is: the market with the higher marginal revenue. So, a profit maximizing firm will sell products in the market with the higher marginal revenue. But when a firm sells in that market the marginal revenue falls, and so it will keep selling until the marginal revenue in each market is the same. Furthermore, the firm will make goods until the total marginal revenue is just equal to their marginal costs, since this is the condition for overall profit maximization.

Ordinary Price Discrimination involves: equalizing the marginal revenues across markets, and setting the total marginal revenue equal to the marginal costs.

This is shown in Figure 13-7. The graph in panel (c) on the far right side shows the joint market situation, where the firm's total demand curve is not shown. What is shown is the sum of the marginal revenues in each of the separate markets. Thus the heavy line marked MR is the horizontal summation of MR_1 and MR_2. The firm equates this marginal revenue with the total marginal costs and ends up producing a total output of $Q_1 + Q_2$. This output is divided between the two segmented markets. To determine what price is charged, a straight line is drawn across to panels (A) and (B). Where this line intersects the individual marginal revenue curves determines the quantities sold in that market. The price in each market is determined by the demand in those separate markets.

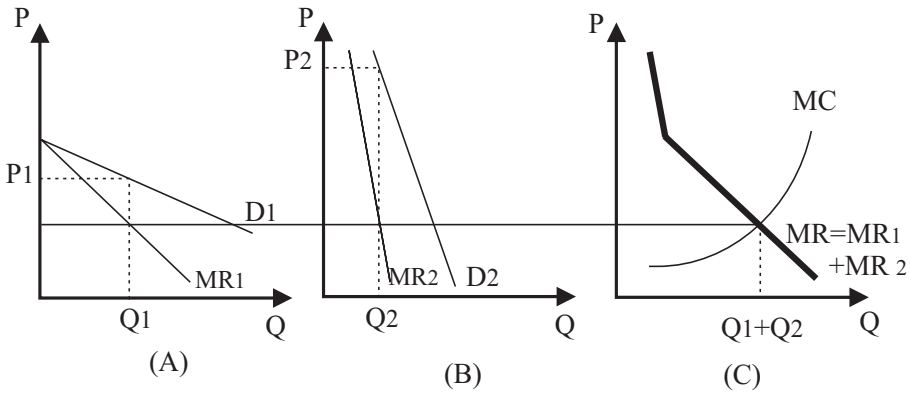

Figure 13-7
Ordinary Price Discrimination

The key result in this simple two sector model is that the price is higher in the market segment with the lower price elasticity of demand. This result makes good sense of ordinary observations. If one of your parents falls desperately ill in Paris, or if your branch plant in London is threatening to close, you will catch the next flight out, of say Canada, almost regardless of the fare. Your demand for airline travel is relatively price inelastic. By contrast, if you have decided to treat yourself to a holiday next spring, but do not care whether you go to Aruba or Mazatlan or Saskatoon, you can pick and choose your flights and airfares. Accordingly, your demand on any of these routes is relatively price elastic. Airline companies respond to these differing elasticities by discriminating — by charging the traveler who wants to depart tomorrow one price and the traveler who wants to depart sometime in the next month or two another, much lower price. The next time you're on a plane, ask the person beside you what price they paid and when they booked their flight ... one of you will feel better.

With ordinary price discrimination, the market with the lower elasticity of demand has the higher price.

To be successful at ordinary price discrimination, the price searching firm must be able to identify different price elasticities of demand and to segment its market accordingly by isolating one portion of the market from the other in order to prevent resale. If the firm cannot separate the markets this way then someone will arbitrage over the price difference: which means buying in the cheap market and selling in the expensive one until the price difference disappears. Where arbitrage can occur, market segmentation cannot be achieved effectively.

In some markets arbitrage is virtually impossible. For example, in a wide range of cases characterized by what we might call personal services, arbitrage is impossible. Although "seniors" get a discount on movie admission prices, for example, they cannot arbitrage in this market because they cannot transfer the good — a movie they have seen — to someone else. Similarly, children cannot arbitrage in the market for haircuts — even though they can buy them more cheaply than adults — because haircuts are not transferable. All sorts of personal services from massage therapy and fitness classes to dental and medical services are markets in which arbitrage between customers cannot occur.

In other cases, arbitrage is possible but unprofitable. For example, the retail price of a new car in Oshawa, Ontario, is sometimes lower than the price of the identical model in Regina, Saskatchewan. But, relative to the price differential, the cost of transporting a car from Oshawa to Regina is high enough to discourage significant arbitrage. If a price differential is large enough, however, arbitrage will occur. Thus, the possibility of arbitrage limits the degree to which prices can diverge in the two markets. In general, where arbitrage costs — the costs of buying, selling, and transporting — are significant, arbitrage will be unprofitable.

In still other cases, arbitrage may be both possible and potentially profitable, but the price discriminator may be able to subvert it effectively. A classic example is the case in which the duopolists Du Pont and Rohm and Haas sold the plastic molding powder methyl methacrylate to general industrial users for $0.85 per pound and to dental manufacturers for $22 per pound. When arbitragers began buying methyl methacrylate at the industrial price and reselling it to denture manufacturers at a price below $22 per pound, Rohm and Haas considered cutting the ground out from under the arbitragers by mixing arsenic with the plastic powder sold for industrial use so that it could not be used for denture work. Although the firm ultimately rejected the idea, it did circulate rumors suggesting that the industrial methyl methacrylate had been adulterated.

The contamination of products is not that uncommon actually. For example, grain intended for seed use only is often poisoned to prevent its use in consumption. An unusual example involved Alcoa, the monopolist aluminum company of America. Alcoa was selling aluminum to aircraft manufacturers at a very high price. Simultaneously, they were selling aluminum to electrical cable companies, and household appliance companies at a significantly lower price. Alcoa quickly found out that the latter group were reselling their inventories of raw aluminum. To counteract this, Alcoa began its own production of cable and pots and pans. Alcoa even had to go to the extreme lengths

of adding plastic handles, steel rivets, and copper bottoms to its pots in an effort to stop firms from melting them down in an effort to resell the aluminum.

Damaging goods to prevent resale is quite common in the high-tech software industry. Some financial service firms offer software that provides either real time or delayed stock prices. The delayed price service actually costs more to provide than the real time service because of the added storage capacity required. However, firms incur this higher cost in order to price discriminate between users. Another interesting example is Intel's creation of the 486SX computer chip, which was the regular 486DX chip with its math coprocessor disabled. These software developers are reducing the gross value of some of their products in order to prevent customers from capturing the rents in the high end market.

A final example of product tampering to prevent resale is "purple gas". Most Canadians are unaware that farmers are able to purchase gasoline for their farm vehicles (including their trucks) at a price well below the market level. Farmers could not only exploit this by using this gas in the family car, but could clearly set up a "Farmer Doug's resale gas station" behind the barn to sell gas to their urban cousins. One method used to police this is to dye the gas purple. Police occasionally set up road blocks in rural areas and test the gas in the tank. Those found driving a non-farm vehicle with purple gas face a fine. The threat of the fine then segments the market and reduces the amount of resale.

In cases where arbitrage is either impossible or not profitable, how can the monopolist achieve market segmentation? One method is to sort the individuals in different segments of the market by requiring them to identify themselves. For example, for "seniors" to receive lower prices on prescription drugs or movie tickets, they must somehow certify their age. When the accountant does a clients books, the client obviously must hand the books over to the accountant and reveal his financial status. Requiring direct identification is the most obvious way to isolate market segments from one another. Another method is to rely on self-selection; that is, to induce individuals to sort themselves into the appropriate market niche voluntarily. In the Dutch auction case above, the high demanders sort themselves by bidding first. A more conspicuous example is the two-segment market for airline travel. In the business travel segment of the market, demand is likely to arise on relatively short notice and to be relatively price inelastic. In the holiday travel segment, demand is usually anticipated well in advance and is likely to be relatively price elastic. A standard discriminatory mechanism is the "advanced booking discount," often hedged by such other restrictions as requiring the traveler to stay at least a week or to stay over at least one Saturday night. Because only holiday travelers are able to plan well ahead and stay for at least a week — and are therefore able to take advantage of the discount, the airline's customers reveal their identity as business people or vacationers simply by their response to its price structure.

Another form of market segmentation is intertemporal. Many individuals love the "newest" and "latest" models of everything from cars and stereos, to books and movies. Firms that have some market power over their commodities can price discriminate over time by charging a high price at the product's launch and then lower the price over time. Books are first printed in hard copy versions, and then later sold as paperbacks. Movies are first sold through theaters, and then later through videos. New products in general, whether they are calculators, computers, or water beds, often have prices that fall through time. As with the case of sales, the market is segmented through time, with those willing to pay the highest prices purchasing first.

When you go to Disneyland you pay an entrance fee to get in, but once in you get to ride everything for free. When you go to your favorite nightclub, you might pay a cover charge at the door, and then pay for your drinks inside. If you want to shop at Costco, you pay a yearly fee and then purchase the goods inside for a certain price. All of these examples are of what is often called a *two part price* or a *compound price*. Essentially the price has two components: a "fee" for the privilege of consuming the good, and a price per unit.

The question is, if a price searching firm is going to use this type of pricing, what should the fee and per unit price be to maximize profits? To keep things very simple, suppose the firm faced customers that all had demand curves like the one in figure 13-8. As shown in figure 13-8, the firm also has flat marginal costs.

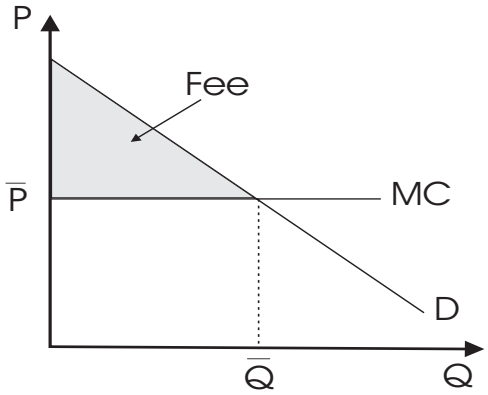

Figure 13-8
Two Part Pricing

Let's start with the profit maximizing combination, shown in figure 13-8. The fee is essentially a transfer of consumer's surplus to the firm, so what the firm wants to do is create as much consumer's surplus as is profitable, and then "tax" it away with the fee. The best way to maximize consumer's surplus, as we've seen from our discussion of competitive markets, is to charge a price equal to marginal costs. In figure 13-8 the firm charges a price equal to $\bar{P}$ and sells $\bar{Q}$. The fee would then be the shaded area. Notice that the firm would completely capture all of the surplus with this pricing scheme, and would produce the optimal amount of output. In this regard, two part pricing is like perfect price discrimination.

Figure 13-9 shows what would happen if the firm charged a per unit price higher than marginal costs. If the price is P', then only Q' is demanded. At this lower quantity, the consumer's surplus is lower, and hence the fee is also lower. This is shown by the smaller light shaded region. Since the firm is charging a higher price, the dark shaded region is rent to the firm. However, the firms overall profits are lower by the crosshatched area. Hence the best thing for the firm to do is set the per unit price equal to the marginal costs.

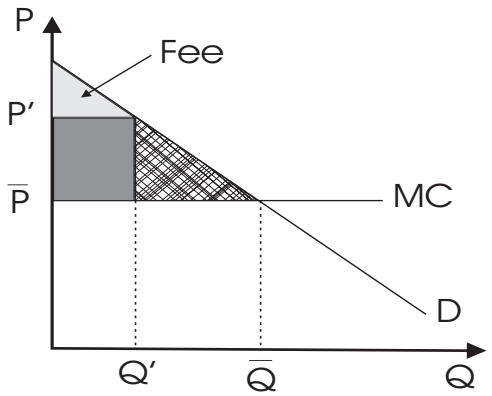

Figure 13-9
Inefficient Two Part Pricing

The optimal two-part pricing strategy is to set P=MC, and charge an entry fee equal to the consumer's surplus.

The major advantage of this type of pricing is that, unlike the situation with price discrimination, the firm does not have to worry about market segmentation and the problem of resale. Here everyone pays the same price. This type of pricing strategy explains the pricing at such firms as Disneyland and Polaroid. Other examples include golf courses that charge a membership fee and green fees, car rental firms that charge a daily fee and a charge per mile, night clubs that charge a cover charge and prices for food and drinks inside, and telephone and cable TV companies that charge a hookup fee and a monthly rental fee.

Two-part pricing is more profitable than ordinary price discrimination because all of the consumer's surplus is transferred to the firm. If two-part pricing brings in more revenue and avoids the problem of having to police resale, why would firms ever bother with price discrimination? Why wouldn't two-part pricing be even more popular? As with all complex pricing practices, two-part prices have their costs. The problem is one entry price is charged to everyone, and not everyone is necessarily willing to pay that price. Suppose there are two types of customers: high demand types and low demand types. If the firm charges the same per unit price to both types of customers, then the high demand types generate a higher consumer's surplus. If the firm decides to extract this surplus through the use of an entry charge, then the low demanders drop out of the market. If there are enough low demand types in the market, the firm may find it more profitable to price discriminate between the two types.

Two-part prices work best when the consumers are homogeneous, or tend to be similar in the demand for the product. As the consumers become more heterogeneous, it will become more profitable to price discriminate. Hence we observe the wholesale distributor Costco charging and entry fee, while ordinary grocery stores do not. Costco caters to large families and small businesses, and has a more homogeneous set of customers than does a store like Safeway. Night clubs charge entry

fees because individual clubs create atmospheres that cater to similar types of people. Neighborhood pubs on the other hand do not charge fees because their clientele are quite varied.

In economic circles, the most famous example of two-part pricing is popcorn at the movies. The example is famous because the price of popcorn is apparently too high. Before you read this book, you might have explained this high price as follows. "Once you enter the theater, the theater owner is a monopolist popcorn seller, so he sets a high price." But you know now that this does not make any sense. Setting a high popcorn price lowers the price one is willing to pay at the door. If the movie house is engaged in simple two-part pricing in an effort to extract more surplus from movie goers, surely they could do better by lowering the price of the popcorn and charging a higher price for the movie. One explanation is that perhaps the marginal cost of the popcorn is \$4 for a small bag. ... Not. A better explanation might be that popcorn is used as a tie-in sale.

Tie-In Sales

Tie-in sales are another possible way for a price searching firm to extract surplus from its customers. A tie-in sale is where a firm has a monopoly over good 1, but refuses to sell it to you unless you also buy good 2 from them, even though it is available in a competitive market. Tie-in sales have a special history in the folklore of anti-trust cases because of the infamous IBM case. IBM was founded in 1911, and changed its name to IBM in 1924 — long before the invention of computers! IBM made a great deal of money on tabulating machines, and in order to purchase a machine IBM required its customers to purchase "punch cards" through IBM. These cards could also be purchased through the market at prices substantially below what IBM was charging. A law suit was brought against IBM, charging that a tie-in sale was "extending the monopoly power" of IBM into a market that was competitive.

The IBM case launched an entire industry as economists and lawyers developed defenses against the charge. Here we will not consider other explanations for tie-in sales, but simply consider how it could be a method of extracting surplus. Suppose we have a firm that has a monopoly on an adding machine, and that the demand for this machine is given in Figure 13-10, panel (a). For simplicity we can assume that the marginal cost and average cost of producing these machines is zero, and that it is not profitable to price discriminate or use a two-part tariff. If the firm acted as a simple monopoly it would maximize total revenue and charge a price P' and sells Q', generating consumer's surplus equal to the shaded region.

Now suppose there is another good called "paper" that sells in the competitive market. For simplicity, assume the marginal costs of paper are also zero, and therefore, that its price in the market is also zero. The demand for paper is given in Figure 13-10, panel (b), and at the market price of 0, Q_0 is the amount consumed. One strategy for the monopolist firm is to tie the sale of paper to its adding machines and charge a price of paper above marginal costs. If the firm sets its price for adding machines equal to P', then it can charge a price of paper equal to $P'' > 0$. The total shaded area in panel (b) must equal the shaded area in panel (a). That is, the loss of consumer's surplus from paying more for the paper will just equal the gain in consumer's surplus from consuming the adding machines.

By tying in the paper, the firm is able to extract the consumer's surplus; however, it is unable to extract all of it. The revenue from paper is equal to the entire shaded area of panel (b), but the firm only gets the light shaded area. That is, the tie-in sale creates a deadweight loss by charging

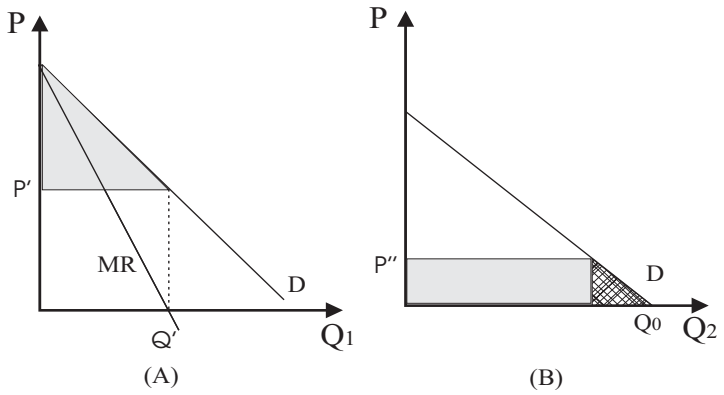

Figure 13-10
Tie In Sales

above marginal cost for the tied good. It turns out that the situation in panels (a) and (b) do not represent the equilibrium prices, because the firm can still do better. Do you see how? If the firm lowers the price of the adding machines it increases the consumer's surplus. This means that there is more surplus to extract, and as a result the firm can charge more for the paper. As the price of the paper increases though, the deadweight loss increases. Hence it will never pay for the firm to give its own good away and try to extract all of the surplus away through a tied in good. For us, however, the point is simply that a firm can do better using a tie-in than it can using simple pricing.

With a tie-in sale the firm lowers the price of the monopoly good and raises the price of the tied-good.

So why is popcorn so expensive at the movies? One explanation is that popcorn is used as a tie-in sale in order to extract the surplus from people who really like movies. In order for this argument to work, there must be different tastes for movies and popcorn among the population. Suppose there are two types: movie lovers and marginal movie goers, equally distributed in the population. Further, let's suppose that the movie lovers also love popcorn, but the movie goers just watch the movie. Perhaps the movie lovers are willing to pay \$12 to see a movie, while the movie goers are only willing to pay \$7. What are some pricing strategies that the theater can charge? Once again, we see that a two-part price probably won't work because there is too much heterogeneity in the population. Setting a large entrance fee at \$12 will lose half of the customers. Straight price discrimination is unlikely because the movie lovers and goers may not be part of an identifiable group, and so market segmentation is too costly. A tie-in sale might work, however. By setting a low price of admission, the theater extracts the maximum willingness to pay from the marginal movie goers, but leaves a \$5 surplus to the movie lovers. Once inside, however, the movie theater charges an above marginal cost price for its popcorn in an effort to extract the \$5 from the movie lovers. Notice that in this context, a tie-in sale is a subtle form of price discrimination.

All-or-Nothing Demands and the Exploitation of Affection

An all-or-nothing demand curve is different from an ordinary demand curve. An ordinary demand curve tells us the marginal value of a given quantity, while an all-or-nothing demand curve tells us the average value of a given quantity. Another way of putting this is that an all-or-nothing demand curve tells us the maximum amount per unit a customer would be willing to pay for a given amount of some good, rather than have nothing at all. When a consumer pays the average value for a good, rather than the marginal value, then the consumer's surplus is zero. If a monopolist can charge an all-or-nothing price, then, it is able to extract the entire consumer's surplus.

In Figure 13-11 we have drawn an ordinary demand curve (the marginal value line, MV), and an all-or-nothing demand curve (the average value line AV). Under normal circumstances, at a price P_2, the consumer would set price equal to marginal value in order to maximize utility and would consume Q_1 units. At this level of consumption the consumer would earn a consumer's surplus equal to the light shaded triangle above the price P_1 plus the white area below P_1 and above P_2. However, a price searching firm could offer the following deal to the consumer: pay price P_1 for the quantity Q_1, or receive nothing at all. Even at the price P_1, the consumer receives the light shaded surplus for the first units consumed; however, for the last units consumed the level of surplus is the dark shaded negative area. The light shaded triangle above P_1 is the positive consumer's surplus, while the dark shaded triangle below P_1 is the negative surplus. When these two triangles are equal the firm has found the maximum *average* price the consumer is willing to pay for Q_1, and this price exhausts the surplus. If we calculate this price for every potential level of output, then we get the average value curve AV, which is the all-or-nothing demand curve.

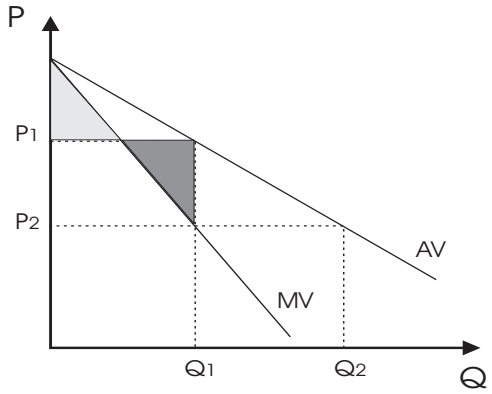

Figure 13-11
The All-Or-Nothing Demand Curve

Another way of interpreting the all-or-nothing demand curve is that it tells us the maximum amount a consumer will purchase at a given price rather than have nothing at all. For example, at price P_1, the consumer, if left on his own, would maximize utility at quantity Q_1. However, the firm could force the consumer to purchase Q_2 units rather than have nothing at all. Again, at this higher quantity, the consumer's surplus is completely transferred to the firm. All-or-nothing pricing, then, is yet another form of perfect price discrimination, and as such can only exist when there is knowledge of the demand curve, and perfect market segmentation.

All-or-nothing pricing may not seem very common, but it occurs all of the time in personal relationships where people generate affection towards one another. Suppose we use a fictitious couple, call them Pat and Heidi. Suppose Heidi loves Pat, and loves doing little favors for him. She buys him clothes, cooks his favorite meals, and even scratches his balding head every now and then. She does these things because they generate utility for her, but her marginal value for head scratches, like all marginal values, diminishes the more she does it. To keep matters simple, call all of these acts of kindness "gifts". The marginal value of gifts to Pat by Heidi is given in Figure 13-12, along with the marginal costs.

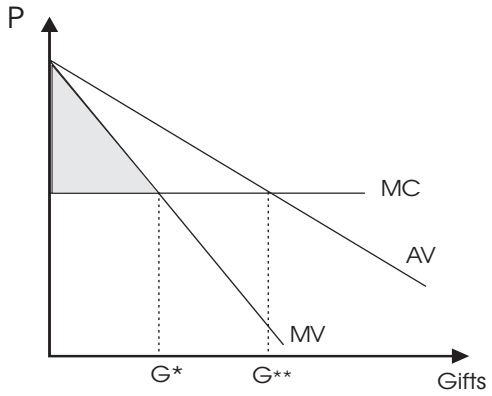

Figure 13-12
The All-Or-Nothing Demand for Gifts

As a maximizing gift giver, Heidi would like to supply Pat with G^* gifts. In doing so she would generate a consumer's surplus equal to the shaded area. However, now let's bring Patrick into the picture. Pat is, in fact, a monopolist with respect to Heidi — it is only his head she likes to scratch. What can Pat do? He can exploit Heidi's affection by demanding G^{**} gifts or threaten to accept none at all. Heidi may only want to scratch Pat's head 3 nights a week, but Pat may be able to extract 6, by threats of not participating at all.

Several things are apparent from this example. The more inelastic is the marginal value of gift giving, the more affection can be exploited. In any interpersonal relationship it is never a good idea to be too dependent on any one person. If you only have one friend in the whole world, that friend will be able to exploit great rents from you. In a marriage relationship, if the wife is homebound, without a car, and has few contacts with the outside world, while the husband is out working and playing golf with his buddies on the weekend, then the wife will be the one with the exploited affection.

Since asymmetries in a relationship lead to one party being exploited to the advantage of the other, we might expect that people enter into relationships with others that are similar in terms of their outside relationship opportunities. This certainly seems to hold for marriage. In a marriage it is uncommon for one partner to continue to have friends of the opposite sex. In fact, the marriage vows often state that each partner promises to "forsake all others." Having friends of the opposite sex, puts one at an advantage in bargaining for gifts, and so will be discouraged. Casual observation also suggests that when individuals engage in adultery, they do so with someone who is also married. Having an affair with an unmarried person is just asking to be blackmailed. Recognizing that

affection is potentially exploitable explains why couples fight more as their relationship progresses. When a man and woman first meet, their marginal value curves for gift giving to each other is perfectly elastic, because the number of substitutes for each other is huge. As time progresses, though, each person becomes more specific to the other, and love between the couple develops. As affection grows, however, so does the opportunity to exploit it. No one likes to be exploited, though, and as a result fights arise. On the other hand, any attempt to exploit affection on a first date doesn't lead to fighting; it just leads to the other party telling you to take a hike.

The exploitation of affection also explains some aspects of sibling rivalry. Anyone who has ever seen a proud parent of a first born child has met someone who has an extremely inelastic demand for affection towards the child. For a first time parent, there is no substitute for the new child. As a result, the only child is in a unique monopoly position, and can exploit the affection of the parent to no end by making statements like "If I can't have a pony, I won't love you anymore!" The solution to this problem is to introduce competition in the market for affection. By having more children parents create rivalry for their attention, which increases the elasticity of demand. When a child threatens to withhold affection if they don't get a pony, the parent can now reply "fine, I'll go play with your sister." The model presented would predict that only children would tend to be more spoiled than children from large families.

13.5 **Summary**

This chapter introduced a major change in one of our key assumptions in the neoclassical model. Rather than assuming firms were price takers, we assumed that firm were price setters. This condition meant that firms could raise their prices and not lose all of their customers. There are many reasons for why a firm might be a price setter: locational advantage, differentiated product, and monopoly being just three. This major change in assumption manifested in only one key difference in our model: price no longer equals marginal revenue for the firm. When price is greater than marginal revenue, the profit maximizing firm ends up producing less than was optimal. This provides the firm with a strong incentive to use complex pricing to capture more of the gains from trade and increase the volume of trade. Several of these pricing schemes were looked at, including price discrimination, two part pricing, tie in sales, and all or nothing pricing.

REVIEW QUESTIONS

1. If a firm wants to make as much money as is possible, does this mean it sets a price as high as possible?

2. Why would a price searching firm try to charge different prices to its customers?

3. Does a profit maximizing price also maximize revenue?

4. How would you explain "Ladies Day" at bars, clubs, and on-line dating services, where women usually get in for free, but men still pay admission?

5. What is the problem with using two-part (Mickey Mouse) pricing?

6. What is the consumer's surplus along the all-or-nothing demand curve?

PROBLEMS

1. Suppose the demand function is $P = 100 - Q$ and that the cost function is $TC(Q) = 40Q$. On one diagram, carefully construct the average revenue, marginal revenue, average cost, and marginal cost functions. Then show that the optimal quantity Q^* is 30 and the optimal price P^* is \$70. Construct the profit rectangle and show that profit is equal to \$900.

2. Canadian Tire offers a 4% discount for cash payments. Instead of taking 4% off the total bill, however, the firm gives customers the equivalent in Canadian Tire money. This "money" then can be presented in lieu of cash the next time customers make a purchase at a Canadian Tire store. Can you identify the form of price discrimination through self-selection at work here?

3. What would a theater company using popcorn as a tie-in sale do if the movie lovers didn't snack while watching movies, and it was the marginal movie goers that had the high demand for popcorn?

4. Using Figure 13-12, under what circumstances would a divorce occur? How would the feminist movement have effected the exploitation of affection in a marriage? Given this, what effect on the divorce rate would the feminist movement have had?

5) Answer the following questions about price searchers as True or False, with an explanation.

   a. A price searcher may not always earn a profit, but it always earn a rent.

   b. The profit maximizing rule to choose output for a price searcher who can only charge one price is different from the rule used by a price searcher who can charge more than one price.

   c. All natural monopolies are price searchers, but not all price searchers are natural monopolies.

   d. Two part pricing, when all consumers are identical, exhausts consumer's surplus.

   e. Two-for-one pizza is an example of first degree price discrimination.

   f. A price searcher sets price and quantity independently, while a price taker just sets quantity.

   g. Sequential monopolies make more profit than single monopolies because they charge two monopoly prices rather than one.

   h. When Kodak offers film along with developing they are engaging in two part pricing.

   i. Bowlers pay by the frame; that is, the more frames they bowl, the more they pay. This is an example of price discrimination.

6. Suppose a price searching firm can only charge one price to all of its customers. Also it has a flat marginal cost of \$5. If MC increases to \$6, how much will the price increase by? Use a

graph in your answer.

7. "A monopolist always sets price equal to the unitary elastic point on its demand curve." True or false, use a graph in your answer.

8. A restaurant sells the same meal at dinner and lunch, but charges twice as much for the dinner. It has been sued for price discrimination, and has hired you to defend it. You can make one argument before the judge, what is your defense?

9. "Monopolist will not produce durable goods because they decrease the units sold and therefore the revenues of the firm, and they cost more and therefore also reduce profits." T/F/U. Explain.

10. A monopolist faces the following demand curve and cost function:

$$P = 50 - .5Q \qquad TC = 2Q + 1000$$

    a. Find the following equations: Marginal Cost: Marginal Revenue: Aver. Total Cost: Now carefully graph them, along with the demand curve on the same graph.

    b. What is the optimal price and quantity if the firm can only set one price for all units?

    c. Calculate the elasticity of demand at the profit maximizing price.

    d.

    d. If the government forced the firm to produced the socially efficient level of output, and set a per unit subsidy in order to compensate for any losses, what would the per unit subsidy be? (Assume the firm can still set only one price per unit).

    e. What would be the total amount of the subsidy assuming nothing else changes?

11. Suppose a market can be separated into two distinct markets, where $P_1 = 42 - 4Q_1$ and $P_2 = 22 - 2Q_2$ are the demands in each market. Total costs are given by $TC = 5 + 10(Q_1 + Q_2)$

    a. Find the profit maximizing level of output and the price per unit in each segment of the market.

    b. Find the elasticity of demand at the profit maximizing price.

12. Suppose there is a monopolist that has constant (flat) MC=1, and he faces two sets of consumers:

    * Set I consists of 100 buyers, each with the demand curve $p = 16 - q$.

    * Set II consists of 50 buyers, each with the demand curve $p = 10 - q/2$.

a. Determine the profits and price with simple monopoly; that is, where the firm cannot discriminate between the two types. Hint: add up the demands to find the total market demand.

b. Now determine the profits and price when the firm can charge one different price between the two groups.

c. Finally, what are the profits and prices if the firm can charge an entry fee and separate price to both types? Rank the three pricing schemes in terms of profitability.

13. Why might camera retailers so often sell the cameras themselves at prices very close to their own wholesale cost, while marking up the price of accessories (carrying cases, extra lenses, filters, and so on) by 100 percent or more?

14. Why are there "Ladies nights" at certain bars, and "Ladies days" at many professional sports events where entrance fees for the female patrons are radically reduced? At what type of events might there be "Gentlemen days"?

15. Following are cost and revenue tables for a price searcher.

Q	P	TR	MR	AC	TC	MC
0	10					
1	9			4		
2	8			4		
3	7			4		
4	6			4		
5	5			4		
6	4			4		
7	3			4		
8	2			4		
9	1			4		
10	0			4		

a. Complete the table.

b. Graph the demand curve, the MR, AC, MC curves all on the same graph.

c. What is the monopolist's P and Q?

d. What are its profits?

e. What is the value of consumer's surplus?

f. Suppose the monopolist is forced to determine his price and output by the competitive criterion. What output and price does this imply? In doing this, what assumptions are you making about costs?

g. At this new output level, what is the value of the monopolist's profits?

h. What is the new level of consumer's surplus?

i. What is the 'deadweight loss' due to this monopoly?

j. Suppose (instead of f), the government imposes a profits tax (99%) on the monopolist that extracts most of the profits, and later redistributes the money back to the customers. What is the new output level? What is the actual price paid, and what is the effective price? What is the 'deadweight loss' now? What is the consumer's surplus?

Review Question Answers

1. *No, if you set the price as high as possible, you'll sell nothing and have no revenue. Maximizing profits is not the same as maximizing price ... or sales.*

2. *Ordinary price searching leads to a deadweight loss. This represents lost profits to the firm. Hence the firm may try some type of compound pricing in order to capture this wealth.*

3. *No, except in the rare case it has no costs.*

4. *This is a form of ordinary price discrimination. There are high demanders (men) and low demanders (women), and the bar has set prices accordingly.*

5. *If different people have vastly different demands, then setting too high of an entry fee will result in a loss of customers. The scheme works best when the customers all have similar demands.*

6. *Zero.*

Odd Numbered Problem Answers

1.

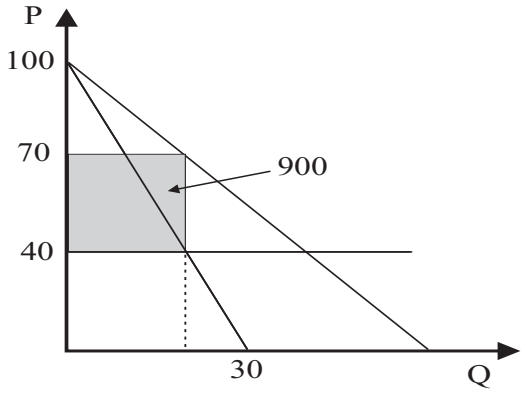

Figure 13-1

3. *It would set a higher price for movies and a lower price for popcorn.*

5)

a. *True. A price searcher doesn't necessarily earn a profit. Though it could earn a zero rent, if the rent is negative it would go out of business.*

b. *True. It will be different. For example, if the firm uses two part pricing it sets P=MC and charges a lump sum equal to the consumer's surplus. This is different from setting MR=MC.*

c. *True.*

d. *True.*

e. *False. First of all, this would not transfer all of the consumer's surplus.*

f. *False. A price searcher sets price and quantity simultaneously.*

g. *False. They make less, since the mark up is magnified and the total gains are lower.*

h. *False. It could be interpreted as a tie in sale.*

i. *True. Better bowlers play faster and therefore pay more per hour.*

7.

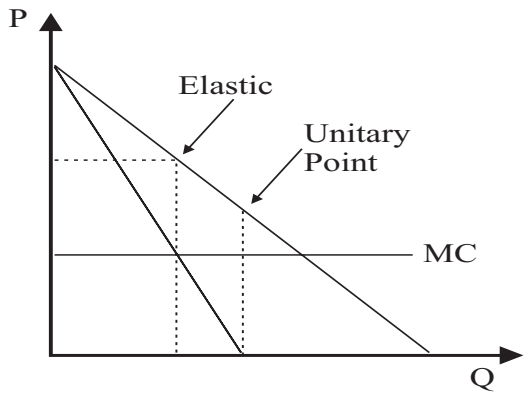

Figure 13-7

False. The price will always be in the elastic portion.

9. *False. Monopolists don't care about the number of units sold. If it is more profitable to sell durable goods, they'll do so.*

11.

a. *In market 1 P=26, Q=4. In market 2 P=16, Q=3.*

b. *In market 1* $E = -1.63$. *In market 2* $E = -2.66$.

13. *They are exploiting the consumer's surplus of the camera through tie in sales.*

15.

Q	P	TR	MR	AC	TC	MC
0	10	0				
1	9	9	9	4	4	4
2	8	16	7	4	8	4
3	7	21	5	4	12	4
4	6	24	3	4	16	4
5	5	25	1	4	20	4
6	4	24	-1	4	24	4
7	3	21	-3	4	28	4
8	2	16	-5	4	32	4
9	1	9	-7	4	36	4
10	0	0	-9	4	40	4

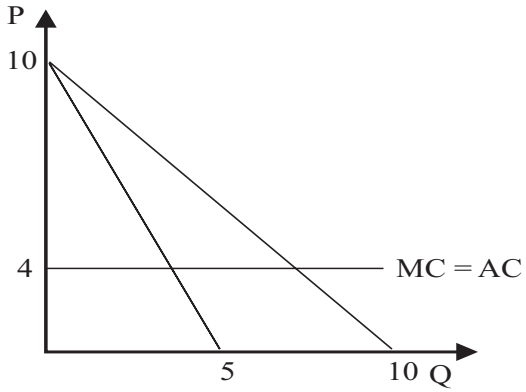

Figure 13-15b

b.

c. *P=7, Q=3.*

d. *Profit is $9.*

e. *Consumer's surplus is $4.5.*

f. *P=4, Q=6. We're assuming nothing happens to the firms cost curves.*

g. *Zero.*

h. *Consumer's surplus is $18.*

i. *$4.5*

j. *The firm still produces 3 units. Consumer's now pay $7, but the effective price is $4.03. The DWL is still $4.5, but the consumer's surplus is now $13.41.*

CHAPTER 14

GAME THEORY, COLLUSION, AND COMPETITION POLICY

A few years ago a group of Fraser Valley raspberry growers were holding a meeting to discuss methods to restrict raspberry production and raise the price. An economist in the audience, who happened to also grow raspberries on the side, stood up and raised the objection that it wouldn't work since the farmers sold some 90% of the crop into the U.S. in direct competition with Washington and Oregon growers. To which an elderly man rose up and said "don't listen to him, we just want to make money!" The old man's sentiments carried the day, but in the end no raspberry cartel was ever forthcoming.

That's a great story for a number of reasons. First, it doesn't take a genius to figure out that an increase in price can be accomplished if the entire industry collectively restricts output. This increase in price, accompanied by a decrease in costs (since output is lower) will mean greater profits for those still producing. Second, as attractive as this is, it seldom comes about because the costs of enforcing the collusive agreement are so high. Like the raspberry farmers, there are failed cartels spread all over the economic landscape. Third, the raspberry cartel failed in part because there were simply too many raspberry producers to bring together. This chapter discusses these issues. However, we first consider a few famous elements of game theory, a branch of mathematics concerned with the interactions of small numbers of people. In this first section we will deal with a game called the prisoner's dilemma, and we will use this result to understand when and why some firms are able to collude together and when they cannot.

14.1 **Simple Game Theory: Interactions With Others**

Until this point in the book, we've been able to ignore how different individuals interact with one another. In our model of the competitive firm, each firm was so small it had no direct impact on anyone else. Thus this firm ignored other firms, and other firms ignored it. In our model of price searching, the firm faced a downward sloping demand function, and this was independent of the behavior of other firms. Thus this firm could again ignore all others.

But quite often in life interactions between people and firms is very important. Have you ever been watching a baseball game when an announcer starts to say something like this: "Johnny is at the plate, he's got a man on second, the count is three and one you just know he's going to get a slider to the outside." Perhaps that's what the batter is actually thinking. He's saying to himself "when there's a man on second, and the count is three and one, there's only one obvious pitch to do the slider to the outside of the plate!" But perhaps our batter thinks a little harder. If the batter knows a slider to the outside is the best pitch, and the announcer knows a slider to the outside is the best pitch, then it isn't too much of a stretch of the imagination to believe the pitcher also knows a slider to the outside of the plate is the best pitch. If the pitcher knows this, thinks the batter, and if the pitcher knows the batter knows this, then perhaps the pitcher will throw a fastball instead! As you can imagine, this type of thinking could go on forever. At the very least, unlike our announcer, we have to admit the solution over which pitch to throw is not so obvious.

Jim Bouton, a New York Yankee pitcher in the 1960's, was often frustrated by the sort of 20/20 hindsight thinking sports announcers and coaches would often use. In his book *Ball Four* he has the following humorous story:

> These pearls are of a special kind, absolutely valueless at best, annoying enough to upset your concentration at worst. ...Old Chicken Colonel Turner was a master at this. He' sit in the dugout and shout to Stan Bahnsen, "Now, keep the ball down, Bahnsen," and Stan would throw a letter high fastball that would get popped up into the infield and The Colonel would look down the bench and say, "The boy's fastball is moving. The boy's fastball is rising." Two innings later, same situation, the very same pitch, home run into the left-field seats. The Colonel looks up and down the bench and says very wisely, "Got the ball up. You see what happens when you get the ball up?" Then you'd get a weak lefthanded hitter up in Yankee Stadium and somebody would throw him a change-up and he'd hit it for a home run into the short porch and The Colonel would say, "You can't throw a change-up to a lefthanded hitter, boys. Not in this ballpark." A week later a guy would throw the same pitch to the same kind of hitter and the guy would be way out in front and The Colonel would say, "Change-up. One of the best pitches in baseball. You can really fool the hitter with it." Whatever the result, The Colonel always knew the cause.
>
> [pp. 59–61, 1970]

Whenever there are a few players interacting with one another, the behavior of other players cannot be ignored because their actions affect the outcome. Life is often characterized by situations where the interactions cannot be ignored. If you play squash, tennis, or badminton you cannot ignore the strengths of your opponent. Perhaps your forehand is your best shot, but you might never use it because your opponent knows this and keeps the ball away from your forehand. If you are in a sailing race you try to find the best point of sail for the wind conditions, but you must also watch what the boats behind and ahead of you are doing. Quite often boats in the lead of a race simply copy the tactics of the boat behind them, not because the second place boat chooses a better point of sail, but because by copying them there is no way for the second place boat to catch them. And, of course, for many firms changing the price of their product or changing the volume of sales cannot be done without considering how other firms in the industry will respond.

Whether we are talking about the decisions of Ford, Honda, and Toyota, or the decisions of a husband and wife, the interactions of decision makers often can be important. Game theory provides a language for articulating the issues of such cases, and provides a solution concept to resolve them.

14.2 Dominated and Dominant Strategies

We're going to examine one extremely simple game. This game is simple because it contains *dominated strategies*. A strategy is simply something you can do like move your price up or down, or invest or not invest. It could be anything really. A dominated strategy is one which is worse than all other choices you have, *no matter what the other players in the game are doing.*

A dominated strategy is worse than all other choices you have, independent of what others do.

Suppose you're playing baseball and you've made it to first base. There are two outs, and there's a full count on the batter. In this situation everyone knows the runner on first will run, no matter what. If the batter swings and strikes out, running doesn't hurt. If the batter walks, then running doesn't hurt. If the batter hits the ball, then running helps the situation because a jump start might prevent being put out on second. When you're on first base in this situation, running is the dominant strategy, and every other strategy you might have (staying put, waiting to see what the batter does, etc), is dominated by this one. Not only this, it doesn't matter what the actions of the other team are, running is always the dominant strategy.

Examples of Dominant Strategies

In the most democracies the right to vote in a free election is one of the most treasured rights held by citizens. Yet in many elections as few as 20-30% of the eligible voters ever bother to show up to cast their ballot. Recently the city of Vancouver held an election on whether or not to support the bid for the 2010 Olympic games. The voter turn out was around 60% of registered voters and this was hailed as a remarkable achievement in civic elections. A 60% turn out is a remarkable achievement? What is going on here? If voting is such a sacred right, why do so few individuals not bother to exercise it?

The answer comes from dominant strategies. Suppose it costs something to vote. You might have to take time off work, you have to travel to the polling station, and you may want to investigate something about the candidates. On the other hand, if you assume large numbers of other people are going to vote, the benefit to voting is close to zero unless you like voting for its own sake. The benefit is close to zero because your single vote is likely to have no impact on who is elected. Thus if you vote you incur costs and have no impact on the election. If you do not vote you save on costs and you still have no impact on the election. Thus it is a dominant strategy to not vote in elections. If everyone thinks this way, then very few people vote, which is what generally happens. Once we understand dominant strategies, perhaps the real question should be "why does anyone actually vote?" The answer must be that for some people there is an intrinsic value to voting. For some it is a patriotic duty, and to not vote causes guilt. Sometimes the margin of victory is almost as important as the victory in an election. When Quebec has a vote on sovereignty, the outcome would mean much more if 60% turn it down rather than just 51% turn it down. In such cases there is a benefit to voting, and if this outweighs the cost one might vote. Finally, some elections are very close, and an individual's vote might be very important.

In 1989 Harrison Ford and Sean Connery teamed up in the movie *Indiana Jones and the Last Crusade*. In the movie Connery plays father to the adventuresome Indiana Jones as they seek out the Holy Grail. In one of the last scenes Connery has been mortally wounded and is about to die. Jones recognizing the situation for what it was, realizes he must get his father to drink from the Holy Grail and be healed. He enters a large room where the Grail is, but is confronted with thousands of cups ... which one is the Holy Grail? This is a mighty problem for Jones because to

drink from the wrong cup would mean instant death. Just as he finally selects a cup, Jones has a second thought: "What if I'm wrong?" He quickly fills the cup with water and says "There's only one way to find out" and then proceeds to drink from the cup himself! When nothing happens he realizes he's actually found the Grail. He refills the cup and gives it to his father, his father lives, and they both live happily ever after.

What is wrong with the actions of Indiana Jones? The problem is he's ignored his dominant strategy! The strategies for Jones are to drink of the cup first, or give the cup first to his father. When Jones picks the right cup it doesn't matter what he does ... his father lives either way. But if Jones had picked the wrong cup, it matters a great deal. If he has the wrong cup and Jones drinks first then he dies from the drink and his father dies of his wounds. If he gives the bad drink to his father, then his father dies but he lives. Clearly, the dominant strategy is for Jones to let his father drink first. Failure to follow the dominant strategy ruined the whole movie!

The Prisoner's Dilemma

The most famous game in the world just happens to be a game of dominated strategies. The setting of the prisoner's dilemma is a police station. Two suspects have been arrested on charges of a serious crime, and they've been placed in separate rooms. There isn't enough evidence to convict both of the crime and so the police are trying to get a confession out of them. In order to do this, they've offered each prisoner the following deal. Any prisoner who finks on his partner will be let go if the other suspect won't talk and confess. If a prisoner does not confess, but his partner does, then the book will be thrown at silent prisoner. If they both confess they'll spend a lot of time in jail, and if they both remain silent they'll be convicted of a minor charge.

Suppose our two thieves are Ryan and Petra. Ryan and Petra had the great idea to steal Brian's car one night. In the middle of the theft Brian caught them just as they got the car started and drove down the road. The next day the police caught up with Ryan and Petra with possession of the car. They have enough evidence for the charge of possession of stolen property, but they'd really like to convict them of theft as well. Brian got a look at both of them, but he's only 80% sure he can make a positive identification, not enough to be assured of a conviction. The police have separated the two and made the standard prisoner's dilemma pitch. The payoffs being offered are given in Figure 14-1.

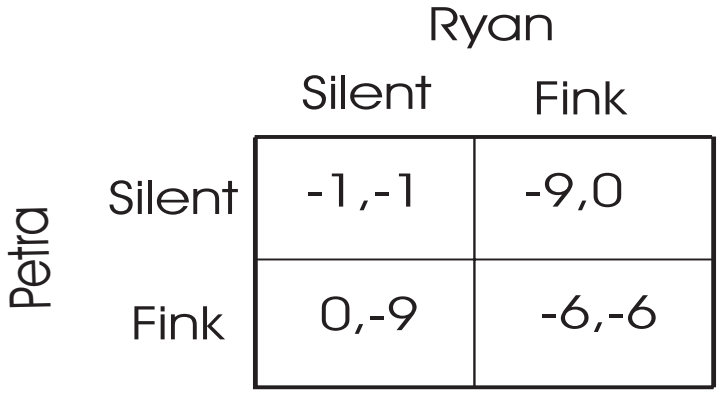

Figure 14-1
The Prisoner's Dilemma

If Petra remains quiet and Ryan finks, then Petra is going to spend 9 months in jail and Ryan is going to walk free. If they both fink, then they will both be convicted of theft and each will spend 6 months in jail. If neither of them fink, then they will only be charged with possession of stolen property and each will spend only one month in prison. What will Ryan and Petra do? In other words, what is the equilibrium outcome of this game?

An easy way to find an equilibrium is to draw arrows showing the direction of preferences over strategies for each player. Horizontal arrows show the preferences of Ryan, while vertical arrows show the preferences of Petra. When two arrow heads meet, then we have what is called a Nash Equilibrium. Figure 14-2 repeats the information of Figure 14-1, except now the arrows are in place.

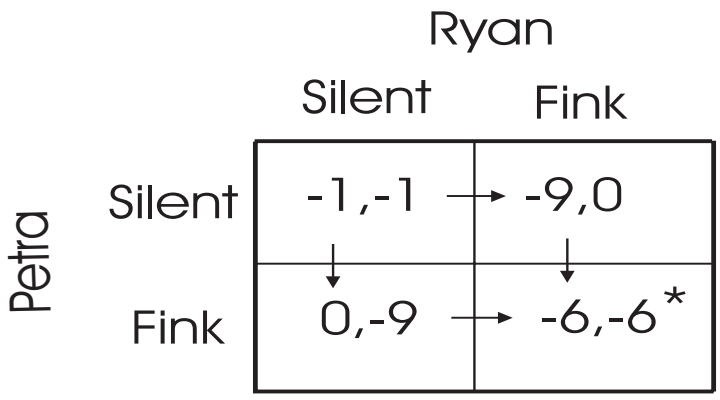

Figure 14-2
The Prisoner's Dilemma, Again

Notice the arrows meet at the cell where both Petra and Ryan fink. (Fink, Fink) then is the equilibrium of the prisoner's dilemma game. There are at least three reasons for why this game is so interesting. First, it has many applications in real life. Below I'll show you how the problem with cartels can be thought of as a prisoner's dilemma game. Second, the equilibrium results from a dominant strategy for both players. As far as Petra is concerned, it doesn't matter what Ryan has in mind, her dominant strategy is to fink. Likewise for Ryan, he's going to fink no matter what Petra does. Finally, the prisoner's dilemma is interesting because the equilibrium outcome is not Pareto optimal. Clearly both Ryan and Petra would be better off if they both remained silent.

14.3 **The Evolution of Cooperation**

Before we move on to examine how the Prisoner's Dilemma game might be applicable to firms, it is worthwhile considering why Ryan and Petra are unable to reach the Pareto optimal result of silence. What would have happened if Ryan and Petra were not in separate rooms? Then, when Ryan was about to fink Petra might give him a look which said "if you fink, my big brother Braun is going to hunt you down and break your legs when you get out." Under such a threat Ryan might think twice about finking. However, if Ryan and Petra are part of a community which often interacts

with each other, Ryan might know Braun is going to break his legs for finking, even if Petra isn't there to remind him. Essentially the prisoner's dilemma game assumes the game is a one time thing. That is, there are no consequences to decisions outside the payoffs mentioned in the game. When individuals interact with one another in repeated prisoner dilemma settings, the outcome is usually one of cooperation and Pareto outcomes. However, when there is no ability to punish opposing players for choosing the fink strategy, the outcome is as above.

In the 1979 a political scientist named Robert Axelrod sent a letter to a number of experts in game theory and computers around the world. He told them he was going to hold computer tournament where various programs would play the Prisoner's Dilemma game with each other for 200 rounds. Those receiving the letters were invited to submit their programs. In all, fourteen programs were received, and they varied in complexity and length. The longest program was 77 lines long, the shortest only 4. It turned out that the simplest program won quite easily. What was the strategy for playing the Prisoner's Dilemma over and over again? It was called TIT FOR TAT. TIT FOR TAT simply starts out cooperating (staying silent in our example), and then it does whatever the opposition does in the previous move. Hence, if TIT FOR TAT comes up against a finker, it loses out in the first round, but retaliates in the second.

After Axelrod produced the results of his tournament, he sent them to the fourteen entrants, and invited them to try a second time in another tournament. This time he also opened up the tournament to anyone who wanted to enter, and he advertised it in computer magazines around the country. In the second tournament there were 62 entries, including TIT FOR TAT, sent in by the original author Anatol Rapoport from the University of Toronto. Once again, TIT FOR TAT won. In subsequent tournaments TIT FOR TAT consistently won, and quite often won by a considerable amount.

An interesting feature of TIT FOR TAT is that it is *not* a Nash Equilibrium. If you were playing a TIT FOR TAT strategy, and you run into a non-cooperative player in round one, then you should still cooperate in round 2 if you thought the player would now cooperate. But the TIT FOR TAT strategy says, no, you must retaliate with one defection yourself. The TIT FOR TAT strategy never out performs any other strategy in a single encounter. However, over multiple encounters it starts to rack up points when it meets other cooperative players, and it never gets hurt by players who always defect. Essentially cooperation starts to evolve.

Axelrod came up with four characteristics for strategies that work well over multiple interations. First a strategy should be "nice." This means the first interation should be to cooperate (remain silent in the classic example). Starting off playing nice means that when you run into other nice strategies you get a big payoff. If you keep playing nice with one another, then you do well over time. The second feature of a successful strategy is to be "forgiving." To be forgiving is to not hold a grudge too long. TIT FOR TAT only retaliates once, and then it goes back to being its nice old self. The third characteristic is to be "provocable." That is, one should not get pushed around. When a player uses a non-cooperative strategy (eg. finks) TIT FOR TAT gets mad quickly and doesn't wait around to punish. The final characteristic is to be "clear." TIT FOR TAT is about as simple a strategy you can get, and other players quickly understand it and start cooperating.

A successful strategy over a multiple period Prisoner's Dilemma game is characterized by being nice, forgiving, provocable, and clear.

Everyone faces Prisoner's Dilemma like games everyday in life. When you visit a roadside restaurant on vacation, are you ever tempted not to tip the waitress? Why tip, you'll never be back anyway. The dominant strategy is to not tip, but often you tip anyway. Why would you do this? One answer is that we recognize, as a culture, the value of being nice, forgiving, provocable, and clear. If we raise our children to play this way, sure they may tip too much in a roadside restaurant, but they might not get robbed on the roadside when they have a flat tire. Socially, we are all much better off to cooperate with one another, and through multiple interactions this type of behavior can evolve into an equilibrium.

The ancient Hammurabi code, "an eye for an eye, a tooth for a tooth," is essentially a TIT FOR TAT strategy. The Bible certainly teaches us to be nice and forgiving, and some would say even provocable when it comes to the sinful actions of others. Even the concept of a "just war," so much in the news when the U.S. invade Iraq, resembles the characteristics of a socially winning strategy. Wars should be defensive (ie. nice and provocable), they should be proportional (ie. forgiving), and wars should be declared (clear). During the war of 1812, as their ships blocked the American ports for months at a time, the British would have to leave their stations and head to Halifax in Canada or Bermuda for supplies. They did this even though they were often within throwing distance of the American shore, where water, wild and domestic animals were everywhere. They did not take these American provisions because that would violate the "rules of war" at the time. Rules of War? Just another example of how cooperation can evolve, even among countries at war.

14.4 The Incentive to Collude For Firms

When firms act independently of one another in order to maximize their profits, they do not act in the interests of the group. If the market is generally competitive, we've seen that this leads to the competitive equilibrium, where price is equal to marginal costs and all firms earn zero profits. When there are only a few firms, if they act independently they will still end up producing an amount of output that does not maximize the rents to the individual firms. The incentives to collude then, come from the increased rents that arise from a group of firms acting as a monopolist. As we saw in the last chapter, when a firm is a monopolist, it will set the marginal revenue equal to the marginal costs, and it will maximize the rent to the firm.

Firms want to collude in order to make money.

We can see the incentive to collude in Figure 14-3. The left hand side graph presents the market situation. Suppose this is our raspberry market. The market demand and supply for raspberries produces an equilibrium price and quantity of P^* and Q^*. If all of the raspberry producers were able to get together and somehow restrict raspberry production, they might be able to restrict output to $\bar{Q}$. At this lower level of output, the price rises to $\bar{P}$, and the rents to the industry increase by the dark shaded region. A deadweight loss is also created, although this is not marked on the figure.

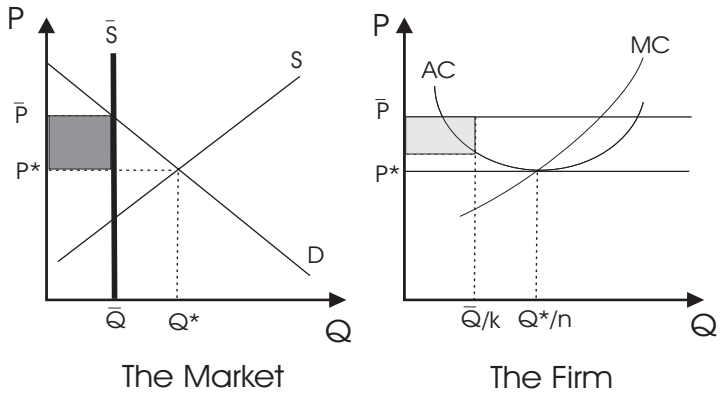

Figure 14-3
The Incentive to Collude

The right hand side graph in figure 14-3 shows the situation for a given raspberry firm. Before the restriction on output the price taking raspberry farmer faced the equilibrium price of P^* and produced until his marginal cost equaled this price. Assuming all raspberry farmers have equal marginal costs, the farmer produces Q^*/n berries, where n is the number of farmers in the market when there is no collusion to restrict output. When the output is restricted, however, this is accomplished in two ways. First, every farmer will have to restrict output. Second, some farmers may be bought out or simply not allowed to farm. In the right hand graph, both have occured. The individual farmer reduces his output, and the number of farms falls from n to k. The farmer earns the light shaded area as an economic profit.

14.5 **The Problem of Collusion**

Almost as soon as we see the firm graph in figure 14-3, we can tell this outcome cannot be an equilibrium. Just because a group of farmers are able to agree to limit competition among them, does not mean that competition is eliminated. Every farmer is just as much of a maximizer as he always was. The problem with the firm graph in 14-3 is that the firm's marginal costs are below the price, and that means the farmer's private personal incentive is to increase output, hoping that everyone else will stay the course and hold to the agreement. In other words, the dominant strategy for the individual firm is to choose an output where price equals marginal costs. Consider Figure 14-4, which shows the incentive of the individual firm.

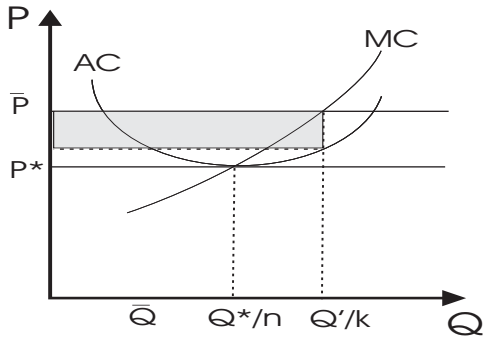

Figure 14-4
The Incentive to Cheat

When the firm produces where marginal costs equal the price $\bar{P}$, the profits to the firm are equal to the light shaded region. These profits are clearly higher than those when the firm cooperates. Hence the major problem with a cartel is that the agreement is not *self enforcing* because the dominant strategy is to cheat. In other words, each firm has an incentive to cheat, and unless something is done about this, each firm *will* cheat. In cheating on the agreement, the price and quantity simply revert back to the original competitive equilibrium. For most industries this cheating problem is so great cartels are simply never formed.

The history of the OPEC cartel illustrates this problem. OPEC is a cartel of oil-exporting countries that operates by assigning export quotas to individual member countries in an attempt to reduce the supply of crude oil to the world market. At various times, particularly during the mid-1970s, the cartel has been successful in restricting supply and thereby raising prices. At other times, however, many OPEC member countries have cheated on their collusive agreement by exporting more than their allotted quotas. For instance, in the late 1980s and early 1990s, newspapers often carried reports about individual OPEC countries that were "keeping their spigots wide open" — that is, exceeding their quotas on the sale of crude oil in the international oil market.

OPEC has not been a successful cartel. Most price shocks to oil have come from Saudi Arabia reducing its supplies while the other smaller countries free ride on this restriction and produce as much as they want. Saudi Arabia is such a large producer that even with this cheating it finds it is in the country's private interests to restrict oil production. Saudi Arabia would like the other producing countries to cut production as well, but has never been able to enforce the agreements.

14.6 **Conditions for Collusion**

In order for collusion to happen, an enforcement mechanism must be in place to prevent the cheating which ultimately breaks the cartel. Economists have come up with a number of conditions that could foster collusive agreements.

Small Numbers of Firms

When there are vast numbers of suppliers in an industry, collusion is virtually impossible. Imagine all of the corn farmers in the United States, coming together and attempting to reach an agreement on the amount of corn to be grown. There isn't a convention center in the world that could accommodate them. Not only this, how could any of them be policed in terms of the output they produce. In order for collusion to work, the number of firms must be small, and the smaller the better. Evidence seems to suggest that even as few as five firms is too many to effectively enforce a cartel.

No Fringe of Small Firms

Although there may be a small number of firms accounting for perhaps 90% of industry output, in many industries there are often "fringe" firms. These firms may produce goods in the cartel industry as a secondary product, or they may simply be small independent producers. Such firms pose a huge problem for cartels. On the one hand, no cartel wants to include them on the agreement because their individual outputs are so small, any reductions have little impact on price. If they are brought into the agreement, the firms essentially hold the larger firms hostage by demanding larger shares of the rents than there size warrants. The demands for large rents are serious because fringe firms have a credible threat ... they can break the cartel. When a group of large firms restricts output, they raise price. Fringe firms benefit from this by, like our raspberry farmer above, increasing output until their marginal costs equal the new higher price. This increased output, reduces the effectiveness of the cartel.

When US Steel was formed by J.P. Morgan's merger of the twelve largest steel plants in the United States, it became the largest firm in the world, controlling 80% of U.S. steel producing capacity. At that time there was a little known steel firm called Bethlehem Steel. As US Steel restricted output and raised prices, Bethlehem increased output. Since US Steel was not pricing where marginal costs equaled price, but Bethlehem was, the profit margins at Bethlehem Steel were greater. Over a period of twenty years, US Steel lost market share and Bethlehem and other small fringe firms grew. By the 1920s, US Steel no longer had the size to be a dominant firm in the industry.

Costly Entry

Related to the role of fringe firms is the cost of entry. When a group of firms forms a cartel, they not only have to worry about existing small firms, but also potential firms. High returns attract entry, and when entering firms are not part of the cartel agreement, they destroy the cartel. Collusion is often found in industries like oil, or other natural resource commodities, where entry is restricted to those firms with access to the resource.

Standard Products

One method of cheating on a cartel is to slightly alter the good and sell the new quantity. Firms involved in collusive agreements will attempt to monitor the inventories and sales of the group members. When products are complicated and not similar across firms, this monitoring of output becomes more difficult. New products, changes in quality, upgrades, all make the monitoring process difficult. When output is difficult to monitor, the cartel again breaks down. Hence, collusion is much more likely in industries with simple one dimensional products.

Inelastic Demand

When an industry restricts output, it must generate more total revenue at the lower level of output in order for the cartel to work. If less revenue is generated, then there's no point in forming a cartel. This means that there cannot be close substitutes for the product. If raspberry farmers restrict output and consumers simply buy strawberries and blueberries, there will be no increase in revenues. One fundamental problem for collusive agreements is the second law of demand. It states that over time demand curves become more elastic. When a cartel is successful in raising prices, consumers and other individuals seek out substitutes and invent new ones. This raises the elasticity of demand, and eventually terminates the cartel.

There are other conditions that help cartels police their agreements. For example, it helps if all firms are selling at the same level of distribution. But the point is that collusion is difficult to muster. Consider the unsuccessful raspberry farmers once again. They had a lot going against them. First, there's just too many farmers. Not only are there lots of farmers in the Fraser Valley, there are lots of farmers in British Columbia, Washington state, and other parts of the world. There are no major tariffs on raspberries, and so the number of producers is huge. Second, entry is easy and every farmer is a fringe firm. There are no monster raspberry farms, and berries grow on all types of land that at any given time is not in berry production. Increasing the price of raspberries would bring lots of land into raspberry production. Finally, there a many, many great substitutes for raspberries. A cartel is never going to work for raspberries.

Unless, that is, the cartel is formed the way most agricultural cartels are formed: through government protection and quotas. As we'll see below, most often forming a cartel is illegal. The exception is when the government acts as the enforcer of the cartel. As mentioned in chapter 10, a quota is one method of restricting output and raising prices. A quota works for farmers because the government prevents fringe and potential firms from competing, the government policies the output of each farmer, and the government monitors the quality of the goods produced. Now the light grey area in the right hand graph of figure 14-1 is earned by the farmer producing the good.

The Transitional Gains Trap

But does the farmer really earn this grey area? A quota involves a transfer of wealth from consumers to producers equal to the shaded area. This transfer results from the higher price that consumers now face for purchasing the raspberries. Hence consumers are unambiguously hurt by the quota. On the other hand, the farmers benefit from the quota because presumably the transfer from the higher price is greater than the loss from reduced output.

Yet quotas introduce a problem for farmers. Suppose the quota is introduced as a complete surprise to a group of farmers. Overnight they find that if they obey their quota and reduce their production the price will rise and their incomes will increase. To these farmers, the quota is like a gift from Heaven. The quota allows them to earn an economic rent equal to the grey shaded area of figure 14-3, year-in, year-out. If the farmer wished to sell the quota, however, what price would he set for it? Clearly he would charge what it is worth: the *present value* of the stream of rents. But if he charges this amount, this means that the subsequent farmer who purchases this quota is now earning a zero profit return. The quota has simply increased his costs of entering the business, and in fact, the quota is now necessary for him to avoid losses. Hence, when a quota is sold to another farmer, the value of the quota is transferred completely to the original farmer. This problem is called the *transitional gains trap*, and points to how difficult it is to actually improve the incomes of farmers with quotas.

The transitional gains trap is not limited to quotas or farmers. Any time the government

generates a transfer of wealth to someone through the creation of a license, permit, or quota, the transfer is capitalized into the value of the paper that gives the right to earn the transfer. Those who purchase these rights only earn a normal rate of return. This explains much of the perpetual plight of the farmer. After decades of government aid, farmers in the US and Canada still claim that they are constantly living on the edge. Droughts, too much rain, and other abnormal weather patterns make national news because of the effect they have on farmers. Surely, with all of the help farmers have received over the years, they can stand some bad weather now and then? The problem is that those farmers helped by the transfers are no longer there. They sell their quota rights to new farmers. These new farmers not only make a normal rate of return, they also have large debts to cover the cost of the price of quota!

14.7 **Competition Policy**

Both the United States and Canada have laws that presumably are intended to protect consumers against monopoly practices and collusion. In Canada the Combines Investigation Act was enacted in 1889, while in the U.S. the Sherman Antitrust Act was enacted in 1890. In both cases the law was aimed at solving the problem of collusion, but in both cases the wording of the law was less than precise. In Canada the law stated it was a "criminal offense to conspire to unduly lessen competition." By making collusion criminal, a strong burden of proof was required. By using the word "conspire" the prosecution had to show intent, and no one has ever figured out what "unduly" actually means. In the U.S. the law stated that "every contract, combination ... or conspiracy, in restraint of trade ... is illegal." In the U.S. court cases arose immediately and over time the competition laws (called anti-trust laws in the U.S.) were modified by these decisions and other legislation. In Canada, there was relatively little litigation, although the law was modified over time to include a whole host of business practices, including mergers, predatory pricing, price discrimination, resale price maintenance, and the like. In 1986 the law in Canada changed substantially when the cartel clauses were strengthened, circumstantial evidence was allowed, and no intent had to be shown. Furthermore, a civil tribunal was set up to review cases.

In both countries, the law takes a dim view of "collusion." This would make sense from an economic point of view. Collusion is simply an effort to lower output for the sole purpose of transferring wealth to producers. Since collusion creates a deadweight loss, it is socially harmful and should be illegal. Much of the economic reasoning in these cases comes from one of the most famous anti-trust cases: *Addyston Pipe & Steel* (1898). This case involved six firms spread throughout the eastern U.S. who had agreed not to compete with one another in their various home regions. The case is not only famous for the outcome, but also because the judge hearing the case was William Taft the future president, and because the only reason the cartel got caught was because the accountant finked. You need to choose your accountant as carefully as you choose your spouse!

Taft argued that there are two types of "restraints of trade": naked and ancillary restraints. A naked restraint of trade is one that is done for the sole purpose of transferring wealth. These types of collusion, Taft argued, should be *per se* illegal. If caught in such an agreement, the perpetrators are guilty and have no excuse. An ancillary restraint of trade, on the other hand, was merely a by-product of some productive endeavor. These types of restraints are not *per se* illegal, but rather a "rule of reason" is to apply. This means the guilty party is allowed to justify the restraint. If an efficiency reason is found for the practice, the firm is allowed to continue. For example, a firm might be using a tie-in sale form of pricing, and might argue that it does so for quality control purposes. If the court agrees, the firm will be allowed to continue. What Taft realized is that much of economic

activity restrains trade, and not all of these restraints are bad. If I provide you with a one year lease to my home, this prevents me from renting it to someone else three months later. This type of restraint on trade is a good thing, however, and should not be illegal.

The notion of a "rule of reason" has carried through much of competition policy, and as a result there are all types of legal collusive behavior. Unions are legal collusive agreements among workers. Medical doctors, teachers, and other professionals cannot practice without the approval of their respective professional associations. These associations are legal entities that restrict the number of practioners in their fields. The NHL, NBA, and NFL are all sports leagues that legally prevent teams from setting up a sports franchise in any city they want. On and on the list goes.

For those industries where collusion is illegal, barring an accountant finking, courts often look at circumstantial evidence for collusion. First courts consider many of the conditions mentioned earlier. If a market is not conducive to collusion, courts will not hear the case. If the industry is conducive to collusion, then the courts often look at other evidence to infer collusion took place. For example, are their trade associations, sealed bids for jobs, stable market shares, formal exchanges of price information between firms, identical or suspicious bidding, excess capacity in the plants, or some other behavior indicating collusion. When a firm is found guilty in Canada the usual penalty is an injunction against the practice and an order to sell off assets to induce competition and eliminate excess capacity. In the U.S., firms are ordered to pay damages, which are then tripled. In the U.S. many of these damage awards are absolutely enormous.

Other Pricing Practices

Competition laws address all types of pricing behavior, most of which we have not discussed at all. In general the rule of reason is applied to these cases. Consider the case of price discrimination. In Canada, price discrimination became an offense under the Act in 1935. It turns out, however, that price discrimination is not as easy to prosecute as it is to observe. The problem is one of taking proper account of costs. If a firm charges two separate prices to different customers, but this difference in price is completely the result of differences in the cost of servicing the customers, then under the law this is not price discrimination. For example, one can purchase a perpetuity that pays an annual income until the time of death. Firms charge women higher prices than men, but this is not price discrimination. The difference in price is a reflection of the longer life expectancy of women over men. Allowing differences in costs to excuse differences in prices is like opening up Pandora's box. In most of the examples of price discrimination it is relatively easy to come up with a cost difference explanation.

Consider the case of airline travel. When airlines offer lower fares to customers who book in advance, they could be passing the savings of advanced planning on to their customers. If airlines could only book customers on the spot, they would be required to hold larger inventories of planes, flights might leave either half full or with passengers left on the ground. In effect, by booking early the passengers are providing the airline information about the demands for different routes and times. This information lowers costs, and hence this is reflected in the price. Is the difference in price worth 1/3 the business fare? It is not obvious, which is what makes price discrimination cases so difficult. Thus when firms are charged with price discrimination, they are allowed to make the case that differences in prices are a reflection of differences in costs. This is an efficiency argument that sometimes works and sometimes doesn't.

The IBM case of tie-in sales was also mentioned in the last chapter. IBM was sued for "extending its monopoly power." This is another violation of the Sherman Act in the U.S. In the case, a rule of reason was applied, and so even though IBM admitted that it did indeed tie the use of its adding

machines to the paper cards used, it claimed that this was an efficient practice. IBM claimed that if it allowed its customers to choose their own paper cards they would select the cheapest material they could find. The cheap paper cards would bind in the machine and customers would blame IBM for a bad machine, rather than themselves. IBM lost that argument, but many other firms charged with the same offense have successfully used it since.

14.8 **Summary**

This brief chapter has intended to provide a short introduction to the issue of competition policy. These types of laws came into being at the end of the 19^{th} century over the concern of "restraints of trade." The big concern of the time were trust practices used to form collusive agreements. Early on it was recognized by the courts that some agreements restrain trade in good ways while some practices definitely reduced social welfare. The hard part is to distinguish such practices. As mentioned in the chapter, naked collusive actions are illegal per se, but again the hard part is to actually catch some firm in the act. Courts have adopted a series of methods to deal with this, and some of these were mentioned in the chapter. Competition policy becomes even harder when dealing with forms of compound pricing. Almost any pricing practice has an efficiency rationale, and generally courts have developed a rule of reason to judge whether or not the practices are efficiency enhancing or not. In any event, the entire area is laced with economics, and provides a rich ground of consulting work for economists.

REVIEW QUESTIONS

1. Is walking on the right side of a sidewalk a Nash Equilibrium? Is walking on the left side?

2. Why is it difficult for firms in an industry to collude?

3. Safe driving courses always say "drive defensively." Is this a Nash Equilibrium?

4. "Dumping" is a phrase firms use when foreign firms sell here at prices less than what they charge in their home country. What are these foreign firms doing? Why would local firms be upset by this? Should the domestic government try to stop this?

5. Are dominant strategies Nash Equilibriums?

PROBLEMS

1. Why would a cartel among diet sodas be less likely to work than a cartel among breweries?

2. In the interior of the province of British Columbia there is a toll highway called the Coquihala. Trucks on the Coquihala highway are charged a higher toll to use the road than cars are. Is this price discrimination? Briefly explain.

3. Why are public washrooms so dirty and often disgusting? Are there any dominant strategies in using such facilities?

4. One of the implications of the neoclassical model is that private vice often leads to public virtue. That is, the pursuit of maximization on the part of individuals and firms often leads to socially efficient outcomes. Every Fall, British Columbia starts a new flu season. During this time there are advertisements and public health announcements in all media outlets encouraging everyone to get a flu vaccination shot. The cost is nominal, and for those most vulnerable, the shot is actually free. However, fewer than 30% of people ever get their shot.

    a. What is the economic name given to this type of situation?

    b. Explain why, if socially we're all better off to be vaccinated, so many people decide not to?

5. The level of noise at a party often gets so loud that you have to shout to make yourself heard. Surely everyone would be better off if everyone kept his voice down. Explain this behavior in terms of dominant strategies.

Review Question Answers

1. *Yes. Yes. If you think others will walk on the right (left), then you should walk on the right (left). If you walk on the right, then others will walk on the right (left).*

2. *Because collusion is not a Nash Equilibrium. This means, unless the cartel is enforced, individual firms will not follow the instructions to reduce output.*

3. *No it is not. If everyone is going to be defensive, then I will drive aggressively, knowing everyone else will get out of my way. A lot of public "norms" are this way. You may hear an environmental group say "boycott Shell gasoline" or some such thing. But if enough follow this course of action, the price will fall and others then have an incentive to buy.*

4. *They are price discriminating. They don't like low price competition. No. Hurt us more this way!*

5. *Yes.*

Odd Numbered Problem Answers

1. *The demand for diet sodas is likely to be much more elastic. This means reduced output is likely to lead to reduced industry revenue, defeating the purpose of the cartel.*

3. *The dominant strategy in a public washroom is to incur no costs of clean up, and to use the facility in a manner minimizing contact. This often leads to the disgusting level of filth in public washrooms. Washrooms where the clientele are more transient and more often one time users (such as in bus and train depots) are in worse shape than washrooms used by small numbers of people (for example, in an office complex).*

5. *Same answer as in (4). Everyone wants to talk just a little louder than the person beside him. Therefore, everyone ends up yelling.*

PART III
THE ORGANIZATION OF MARKETS AND INSTITUTIONS

In his book on Trust, Francis Fukuyama states that:

> Over the past generation, economic thought has been dominated by neoclassical or freemarket economists ... The rise of the neoclassical perspective constitutes a vast improvement from earlier decades in this century, when marxists and Keynesians held sway. We can think of neoclassical economics as being, say, eighty percent correct: it has uncovered important truths about the nature of money and markets because its fundamental model of rational, self-interested human behavior is correct about eighty percent of the time. But there is a missing twenty percent of human behavior about which neoclassical economics can give only a poor account.
>
> [p. 13, 1995]

In Part III of this book we concern ourselves with this extra "twenty" percent. Until now, we have essentially assumed that markets worked for free, and therefore, that prices were always the best way of coordinating production and consumption. Throughout the next part of the book this assumption is relaxed. When markets are costly to use, at times other forms of organization are seen as more effiecient methods of coordination.

CHAPTER 15

ECONOMIC PROPERTY RIGHTS AND TRANSACTION COSTS

Thus far we have examined a very simple but powerful model. One of the assumptions of our economic model has been that markets work for free. In such a world, individuals never leave mutual benefits unclaimed. To do so would be to go against the fundamental principle of maximization. Yet casual observation suggests that many important situations exist where this is not true. For example, when I go to restaurants, movies, and the grocery store, I quite often have to wait in line. You have no doubt experienced this yourself. Why does the price of a dinner not rise to eliminate the queue? Quite often a particular restaurant will habitually have a long line outside, and so we cannot argue that customers showed up unexpectedly. Not only this, but have you noticed that some people are unemployed? Why do wage rates not adjust to eliminate this surplus? And it is worse. As you read this book, at school or at home, look around you and see all of the capital that is unemployed! Chairs sit empty, books collect dust on the shelf, toilets are unused. In fact, during class time most of the toilets on campus are unemployed, but in between classes there is often a shortage! Why are there no markets, as described in earlier chapters, to eliminate these problems?

If you're thinking economically (and by now you should be), you should have no problem thinking up examples that refute our basic model. For example, individuals persistently drive their own cars to work, congesting the streets and highways, even though car pooling or rapid transit would reduce commute times dramatically. Tariffs are levied which raise the prices of domestic goods to an extent that often produces larger loses to consumers than the total gains to the protected industries. Pollution, health care, and the decimation of the Atlantic cod industry are all examples where pure price allocation is not (or was not) used.

It may appear from the examples just stated that "prices couldn't be used in cases like these". But if prices are free to use, why not? If you don't like that answer, consider cases where prices are explicitly and conscientiously not used. As much as you might try, you probably can't buy a grade in your economics class. The penalties are such that trade on this margin is usually eliminated. Not only can you not buy a grade, but you cannot sell your student card to one of your high school buddies. When your future boss tells you to do some task, you are unlikely to respond "what's it worth to you". Your father, if he is like mine, probably didn't bid for your labor services around the house. In firms and families, direction (being told what to do) is used more often than prices to allocate resources.

And so as we come to this last section of the book, we also come to the end of our simple model where information is free, the cost of transacting is zero, and ownership is always perfectly defined. In this chapter we'll begin to explore what happens when these assumptions are relaxed a little. The answer is quite fascinating, but first we must seek to understand the nature of a term called "transaction costs."

15.1 **The Coase Theorem**

So you think you understand the principles of economics? Let's see. Consider two worlds, both made up of farmers, ranchers, and no fences. Everything in the two worlds is exactly the same —

except one thing. In one world the rancher is liable for the damage his cattle cause as they trespass on the farmer's field. In the other world he is not liable. Both worlds are characterized by zero transaction costs; that is, it costs nothing for the farmer and the rancher to trade with one another. Would the number of cattle be different in either world?

Think about it. Would the production of cattle depend on who had the property right over where cattle should roam? This was the question posed by the Nobel economist Ronald Coase in 1960, and if you answered "No, it would not matter" then you're in very good company.

This is such an outrageous claim, it requires further development. To make the analysis more concrete, consider the data in Table 15-1. Column 1 indicates an amount of cattle produced, and column 2 indicates the marginal cost of producing each additional steer.

Table 15-1
The Coase Cattle Example

(1) Number of Steers	(2) Marginal Private Cost	(3) Marginal Crop Damage	(4) Marginal Social Cost
1	$100	$100	$200
2	150	100	250
3	200	100	300
4	250	100	350
5	300	100	400
6	350	100	450

The figures in column 2 indicate the "private" cost to the rancher of producing steers. These would include, for example, feed, cowboys, etc., meaning all the costs to the rancher of raising cattle to maturity and bringing them to market. According to the table, it costs the rancher $100 to raise one steer, an additional $150 to raise a second, $200 more to raise a third, etc. Not included in these costs, however, are the damages imposed on the neighboring farmer. Each steer tramples $100 worth of crops during its lifetime. These costs, which are "external" to the rancher, are often referred to as "externalities". Thus, the actual cost to society of raising 1 steer is not just the $100 diverted from other uses by the rancher, but also the $100 in crops that never get harvested, yielding a true marginal cost of $250. The complete, actual cost to society of producing a good is generally referred to as its "social cost". Likewise, "marginal social cost" refers to the true, complete cost of producing an additional increment of the good. The "private" cost is really a misspecification of cost; it leaves out part of the true effects of producing this good: in particular, the costs imposed on someone else. We consider private costs because it often seems that producers do not in fact always bear all of the costs of their decisions.

The total cost of producing a good, regardless of who bears this cost, is called the "social cost"

Suppose now the market price of mature steers is $300. How many steers will the rancher produce, and how does the answer depend, if at all, on the rancher's liability for crop damage caused by his steers? Assume first that the rancher is liable for all such crop damage. In this case, the figures in column 4, marginal social cost, are also the rancher's own marginal costs of production. For each steer produced, the rancher must compensate the farmer $100 to cover the cost of the ruined crops. The rancher produces 3 steers under these constraints. Production is carried out until marginal cost rises to the market price. The rancher makes $100 on the fist steer, $50 on the second, and zero on the third, but, as usual, we assume production is carried out to this limit. He receives total rents of $150 on this production.

Suppose now the rancher is not liable for crop damage. In this case, the rancher does not have to compensate the farmer for the $100 of crops each steer destroys. It appears the "private" marginal cost figures in column 2 will determine output. In that case, the rancher would produce 5 steers, where the private marginal cost equals the market price. Coase showed, however, that this conclusion depends on the assumption that the farmer and rancher are unable to negotiate a mutually beneficial contract with each other.

When the rancher produces a fourth steer, his rents are potentially $50: the difference between the market price, $300, and the private marginal cost of that steer, $250. However, this steer produces a greater amount of damages, $100, than the rents received. The farmer would benefit by $100 if the steer were not produced; the rancher gains only $50 from producing it. In this situation, where the loser loses more than the gainer gains, the loser can pay the gainer something greater than the potential gain and less than the potential loss, and the position of both parties will be improved. For example, if the rancher accepts a payment from the farmer of $75 to not produce the fourth steer, then the farmer and the rancher each gain $25. Similarly, since the rancher makes no rents on the sixth steer, any small payment from the farmer will induce him not to produce it, thereby saving the farmer almost $100 in the process. If damages are being produced by someone's actions, those costs must be weighed against the benefits of the actions. If the costs are larger than the benefits, the parties can contract with each other to avoid these losses. Assuming, therefore, that the cost of transactions is sufficiently low that the farmer and the rancher can negotiate, resource allocation is the same, regardless of the assignment of liability. In this example, the rancher produces 3 steers under either assignment of liability. The wealth of the farmer and rancher are of course affected by who has to pay whom. If the rancher is liable for crop damage, he is worse off and the farmer is better off than if the rancher were not liable. The production outcome is the same, however, in either case: 3 steers. This remarkable insight has been dubbed the Coase Theorem. It follows because, in the absence of transactions costs, the gains from trade must be exhausted. Inefficient outcomes violate the axioms of behavior.

The Coase Theorem: *The allocation of resources is independent of the distribution of property rights, when transaction costs are zero.*

Notice, however, that there is nothing the farmer can do to induce the rancher not to produce up to 3 steers. The gains from the rancher, e.g., $200 for the first steer, exceed the crop damage. The farmer could offer the rancher $100 to not produce the fist steer, for example, but the offer will be rejected. More importantly, in terms of producing net benefits for consumers, it is appropriate that the offer be rejected. The market price of $300, after all, measures consumers' marginal value of resources in the form of a steer. If the resource cost of producing that steer is only $200, production of the steer raises the net value of resources by $100 over their next best alternative, even including the crops that are inadvertently trampled. The efficient amount of "externalities" of damage to third parties is not likely to be zero. Sometimes the costs may be less than the benefits generated.

15.2 No-Fault Divorce and the Coase Theorem

If you're like most students, you probably think the Coase Theorem is obvious by now. Let's try another example and see how you fare. In 1969 California was the first state to switch to no-fault divorce. In 1985 South Dakota became the last state to switch to no-fault divorce. In Canada the entire country switched to no-fault divorce in 1968. In fact, most of the western world switched to no-fault divorce in the 1970s.

What is no-fault divorce? Well, prior to these laws, in order for a divorce to take place one party had to commit a "fault". These varied from state to state, but they usually included things like adultery, cruelty, criminal behavior, and other such things. One of the realities of fault divorce was that it was often hard to prove a fault had been committed, especially if the guilty party didn't wish to be caught. What tended to happen was that couples would agree to a fault and then perjure themselves in court. Why would someone agree to a fault? Because they are compensated, of course!

Suppose the husband wanted to leave the marriage. Under the old fault law he would have to "pay" his wife to agree to some fault. This payment often took the form of a certain percentage of the marital assets. For example, the wife might consent to a ground for divorce for full possession of the house, or custody of the children. The point is that the individual *most* wanting the divorce had to pay the individual who *least* wanted to divorce. We could say the "property right" over divorce belonged to the one who least wanted the divorce — in our example the wife.[1]

When the law switches to no-fault divorce, no grounds are required. It is enough that there are "irreconcilable differences", and these differences need only be established by *one* party. In our example, if the husband decides to end the marriage under a no-fault regime, he can just leave. If the wife wants him to stay them she must pay him! Hence the property right to divorce switches from the one who *least* wants a marriage to the one that *most* wants it.

This would appear to provide a nice Coase Theorem experiment. We have two worlds, one where the wife holds the property right, while in the other the husband holds the right. Let's ask

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[1] Most divorces are filed for by the wife. Who actually causes the divorce is a more difficult question to answer. The best estimates are that men and women seem to instigate divorce at the same rate. Of all divorces, about half appear to be "opportunistic", that is, where one party is trying to gain at the other's expense. Of these types of divorces, husbands tend to go after the financial resources of the marriage, while women tend to go after the children.

the Coase question: will the divorce rate be the same in those states where the law is fault as in those states where the law is no-fault? The answer is, according to the Coase theorem, there should be no difference. But can you see why? Consider Table 15-2.

	Husband	Wife
Married	\$50	\$50
Divorced	\$60	\$30

Table 15-2
Joint Values Married and Divorced

Table 15-2 describes a situation where we have an efficient marriage. That is, the marriage is worth more (\$100) than the joint value of the divorce (\$90). This is a couple who should stay together given our notion that more is better than less. However, it is also a situation where the husband would prefer a divorce to marriage because his wealth is higher when divorced. For the wife, the opposite is true, she prefers being married.

Suppose the state that this couple lives in is a fault state. This means that the husband must pay his wife to agree to a divorce. What is the maximum he is willing to pay (ie. what is his marginal value for the divorce)? Ten dollars? Right. However, the wife will require at least \$20 to agree to a divorce. The husband is unwilling to pay this amount, the wife does not consent, and the efficient result happens — no divorce.

Now suppose this couple had lived in a no-fault state. Now the husband decides to leave and does not require his wife's permission. Will the wife be able to convince her husband to stay? Yes, indeed. She is willing to pay \$20 to have him stay, while he only requires \$10 to be convinced. The efficient result happens again, the husband remains and there is no divorce. To see if you understand this, switch the numbers around so that you have an inefficient marriage; that is, one where the joint value together is lower than the joint value apart. It should be easy for you to show that this couple always divorces, no matter what the law is. So the decision to divorce is independent of the distribution of property rights between the couple. Just like in the cattle example where liability did not matter, here the divorce law didn't matter. The outcome is the same, and it is always efficient. That's the Coase theorem.

The Coase theorem states that the allocation of resources is independent of the distribution of property rights. That means, when transaction costs are zero, it doesn't matter what laws we have, it doesn't matter what types of contracts we make or firms we work in. Every rule is irrelevant. Why? Because individuals respond to costs and benefits, and the rules of the game do not change these fundamental things.

If this is the Coase theorem, you may be thinking like many people think at this stage: "let's take that Nobel prize back!". It doesn't take a genius to realize that rules, laws, contracts, and organizations all matter a great deal. Yet this is the most important feature of the Coase theorem, namely that it is always wrong in practice! For you see, Coase did not stop writing after the

cattle/farmer example — he kept on going. The key to the Coase theorem is that it holds for when "transaction costs are zero," which is never true in the world we live in. When they are positive, rules and property rights do matter. Hence, if we are to understand rules, laws, organizations, and all of these sorts of things that cannot be explained by our simple model we must understand transaction costs.

15.3 What are Transaction Costs?

Ironically, before we get started defining transaction costs, we need to define property rights.

Economic Property Rights: *are one's ability to freely exercise a choice.*

The words "Property Rights" get bantered about quite a bit, and different disciplines tend to use the word quite differently. In particular, the legal profession has long used the words to define that body of law which applies to what they call "real property," something like land, a car, or a book. Others talk about "human rights," "natural rights" or even "power," and they often have meanings which overlap with the economists notion of rights. So before we begin discussing property rights, perhaps we should consider the differences in interpretation.

Let's consider the difference between legal property rights, natural rights, and economic property rights. Let's define the former as the right *under the law* to freely exercise a choice.[2] We can define natural rights as the right under Nature or God to freely exercise a choice. These three definitions may have considerable overlap, and it is useful to consider the diagram in Figure 15-1 where each definition is represented by a circle.

Consider section A. Here are a set of choices where one has the economic, legal, and natural right to do something. That is, the person is able, allowed, and morally justified in making such a decision. Many things in life fall into this category. When you go to a store, buy a candy bar and eat it you have all these rights in line. Consider section B, however. Here you have the economic and legal right to do something, but not the natural right. Some might consider abortion to fall into this category. It is legal and available in most North American jurisdictions, but many would consider it a violation of the natural right to life. In section C an individual has the economic and natural rights, but not the legal ones. This might apply to some religious sect which believes in polygamy and is tolerated by the state (there is such a community in Southwestern British Columbia). They are able to have this type of polygamous marriage, they obviously feel it is right, but they do not

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[2] This definition would not satisfy many legal scholars. Some would add that legal property is a right to real things, belonging to one person against the whole world. For us we will focus on the distinction between *rights under the law* and *rights through possession.* Thus, I may have the legal property right to sell my car, but if it was stolen last night I no longer have any economic property right to the car.

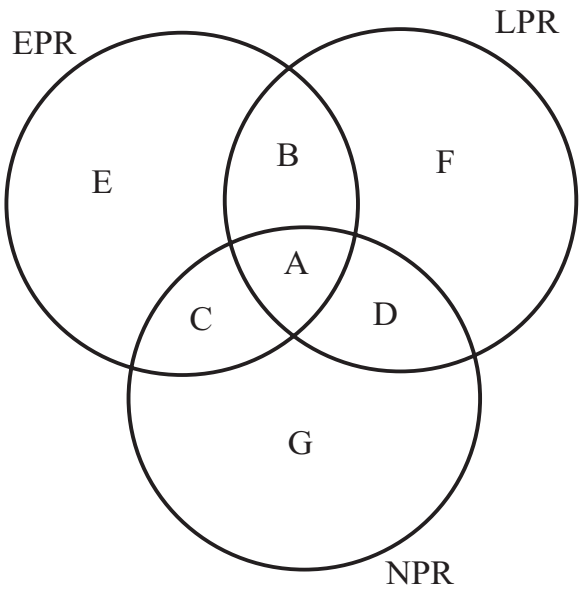

Figure 15-1
Different Definitions of Property Rights

have the legal right to the behavior. How about section D? Can you think of an example of this type where you have the legal and natural right to do something, but not the economic right? You have the legal and natural right to walk through Central Park in New York City at 11:00PM, but if you try to do it you might find yourself robbed and prevented of the pleasure. Section E is quite opposite to this. This is where a thief has possession of some goods and is able to use it, even though it is not his legal or natural property. Section F might apply to abortions in Prince Edward Island. They are legal, but no hospitals perform them. Thus many would consider them a violation of natural law, and the inability to receive one means the economic right is missing. Now that you're getting the hang of it, can you think up some examples that would fit in section G?

Let's return to the discussion of economic property rights (I'm going to start dropping the term "economic"). A property right relates to making choices, and these choices can be over many dimensions. For example, you might decide to possess, use, or improve something, you might exclude others, destroy or sell, you might transform, donate, bequeath, lease, mortgage, consume, or develop, there is a very long list of decisions you could make with respect to something you consider "your property." A property right is *complete* if you are able to make all of the decisions with respect to the good. A property right is *perfect,* if on the demension you are choosing, there is no infringement on the choice you are making. The important thing to realize is that the degree of completeness and perfectness of property rights hinges on the *ability* to make choices. Quite often our ability to make choices is limited, and in these cases we would say our property rights are limited. If our choices are totally limited, then we have no property rights at all. Economic property rights are not an all-or-nothing affair.

It is interesting to think of how limited our property rights really are. We say things like "I own this house". But what happens when you decide to park three cars on blocks in the front yard, or build a ten foot high brick wall around the property, or dig for gold, or start up a soup kitchen? Very quickly you realize that there are many choices with respect to "your" house that you cannot

make, and as a result your property rights in that house are not complete.

Quite often property rights are limited by simple facts of nature. If I consumed some wood yesterday by burning it in my fireplace, my choices (hence property rights) over the wood today are severely limited — they are incomplete. More interestingly, my economic property rights are often incomplete because somebody else is the true holder of the rights. You cannot legally sell "your" student card because it legally belongs to the school. All laws and regulations ultimately distribute economic property rights to various individuals, and the simple truth is, none of us end up with all of them. Other times our rights are imperfect because it just doesn't pay to enforce them. Every now and then one reads the bumper sticker "As a matter of fact, I do own the road". Well, as a matter of observation, you don't. Even on private roads, trespass is common, and to the extent you can use logging roads for your weekend pleasure without paying for it, you have the economic property right, not the forest company. When rights are too costly for anyone to own, the asset in question is said to be in the public domain.

The Public Domain is the state where property rights do not exist

There are two important points to be made with respect to property rights. First, when there are no property rights, there is no trade and no wealth. Think about this for a moment. What would a world be like without property rights? That would mean no one could make any decisions. No one would produce anything because as soon as it was made it would be stolen. No one would save for the same reason. It would be literal anarchy. This is one of the reasons why economic rights are so closely linked with legal rights. It is very difficult to trade when one person holds one type of right and someone else holds the other. I have a friend who had his car stolen. This is a situation where my friend has a legal right to the car, but the thief had the economic rights. (When the police found the car it was locked!) Imagine if the thief tried to sell the car back to my friend. The conversation might go something like this "Oh, hello, I'm the fellow who stole your car last night, and I'd like to sell it back for $10,000. Just leave the money in small bills in a paper bag under the third bench at the park." "Oh, well thanks for calling. Unfortunately I have hay fever and the park is really bad for me. Perhaps you could meet me at my house around 10:00 o'clock." This is a transaction that's not going to happen.

The second point regarding property rights is that at the other end of the spectrum, when they are complete and perfectly defined, the gains from trade are maximized. This is the Coase theorem again. And so we see there is a spectrum of rights ranging from zero to perfect completeness, and corresponding to this there are wealth levels that range from zero to some maximum. We live in a world that is at neither extreme. Individuals own property but never completely. This is shown in figure 15-2.

Given that wealth is always higher when property rights are better defined, however, it is always true that individuals prefer better defined rights to poorer ones, other things equal. As a result, individuals will make efforts to establish property rights, and once established, efforts will be made to maintain those rights. This finally leads to a definition of transaction costs.

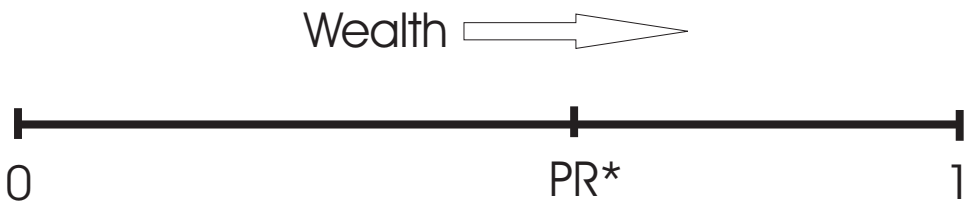

Figure 15-2
The Property Rights Spectrum

Transaction Costs: *The costs of establishing and maintaining property rights.*

These costs include the costs of protection, stealing, and any concomitant losses that result from such efforts. We see immediately that property rights are linked in a fundamental way to transaction costs. When property rights are perfectly defined, no effort is required to establish or protect them, and as a result transaction costs are zero. When transaction costs are prohibitive, no one would engage in them and property rights are zero. Finally, when transaction costs are positive, property rights will be incomplete.

15.4 **Back to the Coase Theorem**

Now let's return to the no-fault divorce example. It is common knowledge, and it has been shown, that the divorce rate increased with the change in the law. Why might it have increased? What was wrong with the simple numbers in Table 15-2?

In the simple discussion above we assumed that the property rights of the wife and the husband were perfect because transaction costs were zero. Recall, however, that property rights are limited in the world we live in. For example, some states had property laws which stated the owner of a marital asset was the individual whose name was on the title. If a husband divorces after the law has changed, and the home and other major assets are in his name, then the wife may have no wealth to compensate the husband to stay. This would be true despite the wife having made some economic contribution to those assets. The law effectively allows the husband to take the wife's wealth. Positive transaction costs in this situation mean her property rights are incomplete, and this leads to the Coase theorem breaking down. Or as another example, perhaps the wife put her husband through medical school and was expecting a return on this investment. Until recently, courts did not recognize a medical diploma as property, and therefore it could not be divided at divorce. Again, when the law switches to no-fault, the wife might be unable to compensate her husband because her investment is in his head and there is no legal remedy to get it back. As a final example, the wife might have remained in the home and out of the workforce for the entire duration of the marriage, and at the time of divorce may have no liquid assets to compensate her husband. Transaction costs arise in this situation on the part of banks, which will unlikely provide a loan when human capital is the only collateral, since default is likely and slavery is illegal.

Thinking about transaction costs within a marriage reminds one of the story of the married couple who are driving along a highway at a steady forty miles per hour. The wife is behind the wheel when her husband suddenly looks across at her and speaks in a clear voice. "Darling," he says. "I know we've been married for twenty years, but I want a divorce." The wife says nothing, keeps looking at the road ahead, but slowly increases her speed to 45 mph. The husband speaks again. "I don't want you to try and talk me out of it," he says, "because I've been having an affair with your best friend, and she's a far better lover than you are." Again the wife stays quiet, but grips the steering wheel more tightly and slowly increases the speed to 55 mph. He then pushes his luck. "I want the house," he says insistently. The car's now up to 60. "I want the car, too," he continues. 65 mph. "And ," he says, "I'll have the bank accounts, all the credit cards and the boat." The car slowly starts veering towards a massive concrete bridge. This makes him a wee bit nervous, so he asks her "Isn't there anything you want?" The wife at last replies — in a quiet and controlled voice. "No, I've got everything I need." she says. "Oh, really?" he inquires, "what have you got?" Just before they slam into the wall at 75 mph, the wife turns to him, smiles, and says ... "The airbag."

This is what makes transaction costs so special: they are the only costs that break the Coase theorem down. Once they exist, it is no longer true that rules, laws, contracts, etc., no longer matter. They matter indeed. One young lady once wrote Miss Manners and asked her if she should move in with her boyfriend. She wrote "He tells me he loves me, and what's in a piece of paper anyway". Miss Manners wrote back simply "Gentle reader, tell your young friend that Miss Manners has a safety deposit box full of pieces of paper, and they matter a great deal".

Earlier we noted that individuals maximized utility, and that firms maximized profits. None of this changes with the introduction of transaction costs. However, there is a slight modification in that individuals now maximize utility net of transaction costs, and firms maximize profits net of transaction costs. Firms, for example, are not indifferent to the *way* they pay their workers, because different methods of payment lead to different levels of output when it is costly to monitor employees. For example, wage workers take longer to do a given task than a piece rate worker. When firms are not indifferent to organizational forms, then they chose the one that helps to maximize profits. As a result, we have a theory of organizations.

And transaction cost economics is even broader than this. When condominium developers are designing the constitution for the apartments they want to sell, they are not indifferent to the laws they establish. Giving votes based on square footage, results in different behavior of the tenants, that one vote per person, or one vote per apartment. The developers pick those rules that allow them to charge the most for the homes. As a result, we have a theory of rules. And on and on. Transaction cost economics has been used to explain the nature of the common law, regulations, the nature of the firm, and just about every type of rule you can imagine.

This leads us to the last principle of economics:

PRINCIPLE #7

Optimal Organization: *All economic organization is designed to maximize the gains from trade net of transaction costs.*

For our purposes, this will amount to saying that all organizations are organized to minimize the transaction costs involved in the production of their enterprise.

15.5 What Causes Transaction Costs[3]

The underlying theme in understanding transaction costs is the notion of ignorance. Let's face it, if you knew everything, you wouldn't be reading this book ... or attending college. In life, knowledge is scarce and costly to come by. Negotiation, fraud, communication, and contract stipulation all come about because knowledge is incomplete and not common. However, information costs are not the same thing as a transaction cost. An information cost is the cost of obtaining information. For transaction costs to exist, it must be costly to acquire information about anything: goods, people, institutions.

This means information costs are a *necessary* condition for a transaction costs to exist. Information costs, to repeat, are not transaction costs. You might have no idea if it will rain tomorrow, and this is an information problem. That doesn't mean that you necessarily have a transaction cost problem. The acts of finding a trading partner, determining the correct good for a particular need, or searching for the "best price" are information costs, not transaction costs. All kinds of behavior seems to depend on information costs and not transaction costs. Unemployment, search, and clearance sales are all events that only require costly information.

It is necessary, however, to do more than assume costly information in order to generate transaction costs, because costly information merely makes for risky events. An additional assumption is required that enhances the problem of costly information. Goods are not simple, but are both *variable* and *alterable*.

	Alterable	Non-Alterable
Variable	Everything else	Earthquakes Hurricanes
Non-Variable	a rose	God

Table 15-1
Variable and Alterable Goods

The distinction between variability and alterability can be thought of as those changes brought about by nature and by man. Consider the taxonomy of Table 1. God and the speed of light, for

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[3] This section is advanced and can be skipped without paying a price in following chapters.

example, do not vary in nature, nor are they alterable by man. The weather changes constantly, but despite accusations against the Russians and rain dancers, weather storms are probably independent of human manipulation. It is difficult to imagine something that does not vary in nature but that can be altered by man — although Gertrude Stein must have thought a rose fit this category.

The distinction is important. When goods are both variable and alterable (and, of course, information is not free), then cheating becomes possible. Consider the purchase of an apple. Suppose apples never varied in nature, but could be manipulated in some way — for example, hollowing out the apple and filling it with foam. Could a merchant sell a foam-filled apple and not be accused of cheating? No, because any change in the quality of the apple is, by assumption, blamed on the seller. Likewise, if apples came in all different shapes, sizes, and insides, but were impossible to alter, then no suspicion of cheating would exist. All bad apples would be attributed to nature. When both conditions exist, that is, when a bad apple may be produced by the weather or the seller — only then can cheating occur *without* detection. That it is so difficult to think of examples of goods that are non-variable or non-alterable tends to imply that the possibilities of cheating, and therefore transaction costs, are ubiquitous.

When a good contains attributes that are either alterable or variable, but does not contain both, then transaction costs are zero or negligible. Both alterability and variability are needed in order for transaction costs to arise, because these costs stem from the inability to attribute changes in product quality directly to random events or non-random exploitation. When nature and humans play a role in the ultimate quality of a good, then there is confusion on the part of the buyer over who is to blame for the differences in quality. Under these circumstances transaction costs can exist.

15.6 Private Property, Common Property, and Open Access

Let's use the discussion of property rights and transaction costs to examine three types of property found everywhere. Private property is a concept familiar to all of us. The owners of private property decide how an item is to be used, who is to use it, and what happens to the income or utility of the item. As we've mentioned in the discussion of the property rights spectrum, nothing is perfectly private, but there are many things in life we consider our private property. Common property is where access to a good or resource is limited to some group, but within the group no one has the right to exclude others. In an office, the workers may have equal access to the photocopy machine, the washroom, or the secretaries time, but someone off the street doesn't have access to these things. Open access is a situation where no one has the right or ability to exclude anyone. The high seas are an open access resource, as were the bison on the American frontier. Each one of these different property right regimes has different benefits in terms of the wealth they generate. However, each one has different transaction costs associated with them as well. Which one is chosen as the optimal form of ownership depends on which one maximizes the value net of these transaction costs. Let's consider each one in turn.

Private Property

Let's consider a famous example in economics. Suppose there is a lake with fish in it, and there is one boat available for fishing. A community lives on the edge of the lake, and the people make their living off the fish. When someone stands on shore to fish, they catch 4 fish in a day. But if they use the boat to fish, then the number of fish caught per person depends on the number of people

in the boat according to our normal production function. Every fisherman in the boat, therefore, contributes to the number of fish caught. The marginal and average product of fish caught is given in Figure 15-3. We've seen marginal products before, but we haven't talked about average products. The average product is just the total amount of fish caught divided by the number of people in the boat. If the people in the boat share the fish caught, then each will get the average product.

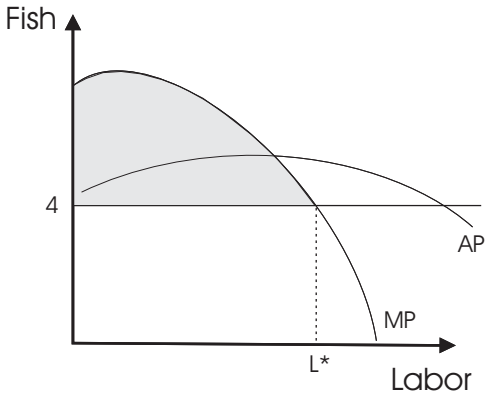

Figure 15-3
Private Property for the Boat

When the boat is privately owned, the owner of the boat decides how many workers will be allowed on. We can think of the boat owner as hiring workers for the boat. Since workers can catch 4 fish on shore, the boat owner must pay each fisherman 4 fish to come fish on the boat. How many fishermen will be hired? We know the answer to this question is determined by where the marginal product just equals the wage. In this case the boat owner hires L^* fishermen. Notice when this is done, the surplus of fish, equal to the light grey shaded area, is maximized. We can think of this area as the value of the boat. If the boat were for sale, the boat owner could receive this area as its price, since that is how many extra fish are capable of being caught with the boat. Hence, ignoring any transaction costs, private property maximizes the wealth of the little village.

Private property maximizes the gross value of the resource.

Common Property

Suppose now that no single person owns the boat, but the boat is owned in common by a small group of fishermen. These fishermen share the catch, and decide how many fishermen should enter the boat. Under these circumstances, the owners of the boat don't want to put men in the boat

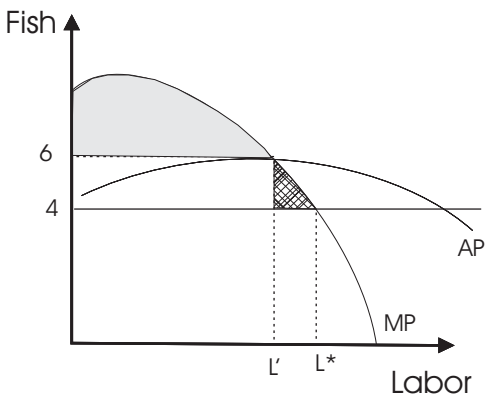

Figure 15-4
Common Property for the Boat

until the wage equals the marginal product. What they want to do is maximize the *average product* because that's what each one of them gets. Figure 15-4 shows this situation.

Now the number of fishermen in the boat equals L', not L^*. This reduction in the number of fishermen comes about because the fishermen want to maximize the average product. At this lower number of men, the average catch is 6 fish, not 4. This extra income for the fishermen comes from the value of the boat, which is now reduced to the light grey shaded area. But there is more than a transfer from capital to labor involved here. Because the number of fishermen has been reduced, along with the total catch, there is a deadweight loss associated with the common property ownership of the boat.

Common property does not maximize the value of the resource

Open Access

With open access, no one owns the boat. Any one who wants to jump in and go fishing can do so. When this property right structure exists, people will enter the boat as long as the average number of fish they catch on the boat is equal to the number they can catch on shore, in this case 4 fish. Figure 15-5 shows this result, which is often called "the tragedy of the commons."

Now too many people hop onto the boat. In fact, L'' fishermen get on, and at this level the deadweight loss, equal to the crosshatched area, is large indeed. In fact, it turns out that the size of the deadweight loss is just equal to the value of the boat under private property. This means the value of the resource is driven to zero! The boat is worthless, which makes sense because incomes with the boat are the same as if there were no boat.

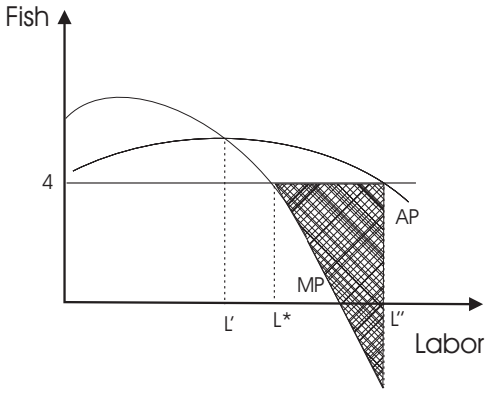

Figure 15-5
Open Access for the Boat

Open access drives the value of the resource to zero.

The Optimal Property Right Rule

If this were all there was to the story, then clearly private property would be the best of all possible worlds. Many believe this to be true. Yet when we look around, we see common property rights all over the place, and even open access property rights, though rarer, can be found. If we believe in maximization, and if we believe that private property is the best system, then how can we explain the choice of common property? People are leaving $500 bills on the sidewalk again.

The reason why we observe all types of property right rules is that the transaction costs of each regime are not the same and they vary depending on the nature of the good. In the real world, owned goods must be protected, and these protection costs are costly. Since private property generates a lot of wealth societies are always trying to find inexpensive ways of enforcing private property. Courts and police are designed to protect private property, for example. For some goods though, the benefits of private ownership are small, and the costs might be enormous. When this is the case, common property often develops. Small groups band together to keep outsiders ... well, out. The groups are often designed to make sure any individual within the group doesn't treat the resource as open access. This usually amounts to making sure the group is homogeneous, or held together by some common bond.

The Swiss Alps are pastures high in the mountains and used for summer cattle grazing. These Alps are owned in common by the local village. Members of the village have access to the Alps and must follow rules for its use, but members of other villages do not have access. The Alps have been managed for centuries this way. Lobsters on the east coast of North America are harvested by groups of fishermen called "lobster gangs" (I'm not making that up!). These gangs police outside fishermen from interloping on their fishing grounds, and they share the catch within their grounds. When gold was discovered in California in 1849, the miners set up common fields in which a group would mine an area and band together to defend the mines. When private or state enforcement comes along, most of these common property regimes disappear. In the case of the California miners, when

U.S. marshals finally moved in the mines became private property. Until then, however, common property is one method of protecting a resources from becoming open access.

Open access occurs when it is simply too costly to keep anyone out of the resource. At one time, virtually the entire ocean was an open access resource. As navies developed, and as cannon fire from shore improved, countries laid claims to the water off their shores. At first countries established sovereignty over two miles; now it is common for countries to claim 200 miles off shore. Still, no country lays claim to the middle of the Pacific. As a result, the resources there are exploited to the limit and the value of fisheries there are close to zero. If the world wasn't the way it is, we could say that open access was inefficient. However, since it costs too much to defend private property at times, on occasion the best we can do is have open access.

Homesteading: The Optimal Property Right Rule?

During the first half of the 19th century a small, debt ridden, loosely held together, sparsely populated new country called the United States had a difficult problem to solve. On paper it claimed ownership to vast tracks of land to the west, yet this land was occupied by native Indians, Mexicans, British trappers, and a host of other minor interests. How were they to actually take possession?

At the very beginning of the 19^{th} century the U.S. government sold public lands in the areas of Ohio, Kentucky and Tennessee, but they quickly switched over to a system of first come, first served called homesteading. A homestead was 160 acres that could be had by the first person to claim it, pay a small registration fee of $10 and improve the land for five years. The advantage homesteading had over land sales was the settler had to occupy the land. Occupation was important because the government did not have the resources to defend the land against others claiming it.

Homesteading allocated the land on a "first come, first served" basis, and this forced individual settlers to show up early and claim the land. Someone purchasing land could buy it, and not show up to farm for many years when it is optimal to show up. A homesteader who waited to show up, would find his plot had long been taken by someone else who got there earlier. The advantage of homesteading was it got people onto the frontier in a hurry, and gave these people an incentive to defend the land against those also claiming possession.

When it came time for Canada to settle its western frontier the new country faced a similar problem, only this time the threat was not Mexicans or Indians, rather it was Americans moving north. Selling the land to private interests would not improve the Canadian claim to sovereignty on the prairies if there were no guns to back it up. Thus the Canadian government adopted the identical homesteading laws the U.S. had used to settle their frontier. By providing an incentive to settlers to "rush" to the prairies and stay to improve the land, the area was populated by Canadians who quite naturally kept the Americans out.

Homesteading was not free. Suppose the optimal time to arrive in say, Lone Spruce, Saskatchewan, in order to start farming was 1920. The problem for a young family living in Ontario in 1900 was that if they waited until 1920, the homestead would be gone, and so the settlers would plan to move out west a year early. Other potential farmers would think the same way and would plan on moving two years early. This process continues until it was just barely worth moving at all. By allocating the frontier this way both governments forced settlers to move too soon and wait for development to catch up. This meant many settlers waited years for railways, schools, and the rest of civilization. As one settler put it "there ain't no such thing as free land." Still, homesteading was the optimal thing to do in light of the threat of enemy invasion.

15.7 The Optimal Value of an Asset

Let's suppose, for sake of argument, that an asset can either be in the public domain, where open access reigns, or it can be held as private property. In other words, let's ignore the option of common property for a moment. We might ask two questions: what happens to the optimal ownership of an asset as the value of an asset increases, and is there an optimal value for an asset to be?

The first question was initially raised by Harold Demsetz who argued that private property rights are established when the benefits of establishment exceed the cost of establishment. Figure 15-6, captures this idea. On the horizontal axis is the zero transaction cost value of an asset, determined by underlying demand and supply conditions. This gross value is independent of transaction costs and is set by a competitive market. On the vertical axis are the dollar benefits and costs of ownership over the asset. Assuming ownership is complete, meaning the owner of the asset receives all of its value, the benefit of property rights is simply the 45^0 line. The total cost function in figure 15-5 gives the cost of establishing and maintaining property rights over the asset. In other words, this is the *transaction cost* function. This function incorporates *all* of the costs of ownership.

The vertical distance between the two lines represents the asset's actual value. That is, this is the amount of money someone would actually pay for the asset. For example, if the zero transaction cost value of an asset was V', then the actual value would be given by distance AB. The critical point made by Demsetz and others was that, assuming these functions had an intersection, a critical zero transaction cost value, V^C, determines whether property rights exist or not. To the left of V^C the asset is in the public domain because the costs borne by those attempting to establish ownership exceed the benefits and wealth maximizers exert no rights to the asset. The asset remains in the public domain and has no value. To the right of V^C private property exists.

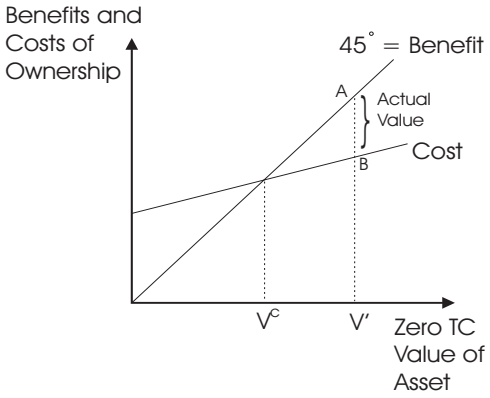

Figure 15-6
The Optimal Ownership with Linear Costs

The key implication from figure 15-6 is that as an asset's value increases from zero — that is, as we move from left to right in the figure — at some point it becomes worthwhile to protect the asset and it moves from open access to private property. History is full of examples of this happening. The western frontier was, for the most part, an open access resource in the first half

of the 19th century. Settlers would move out to the frontier and lay claim to the land, but often interlopers would come along and ignore these claims. Sometimes the outcomes were tragic, like the near extinction of the bison. Other times fights broke out, like the disputes between cattle and sheep ranchers. As the value of the frontier increased over the century, protection of private claims increased. Eventually barbed wire was invented, and this allowed a cheap way to fence off claims. Violence on the frontier fell, as did over grazing and other misallocations of resources.

Non-linear Transaction Costs

In figure 15-6 the transaction cost function is linear, but this violates our principle of diminishing marginal products. It would be more realistic to assume marginal costs of protection are increasing. The more valuable an asset is, the more it costs at the margin to protect it. Making this modest change in the model leads to several predictions. First, it is still the case that for low valued assets, as their zero transaction cost value exogenously increases they are likely to move from the public domain to private ownership. In other words, in the neighborhood of V^L in figure 15-7 the original Demsetz prediction still holds. A second observation is just as apparent. It is possible that assets may have zero transaction cost values that are so high the transaction costs of ownership again exceed the benefits and the asset reverts back to the public domain. Hence, paradoxically, in principle the public domain may contain extremely valuable (in a zero transaction cost sense) and extremely low valued assets. Pebbles on the side of the road are low valued and in the public domain. Practical examples of high valued assets in the public domain are rare, but an example of the "urban legend" variety, is of an owner of a convertible who leaves his top down when parking on public streets because he does not want the top damaged by a thief. This would place the valuable interior of his car in the public domain. A third implication from the model is that there exists a finite optimal second-best value of an asset, V^*.

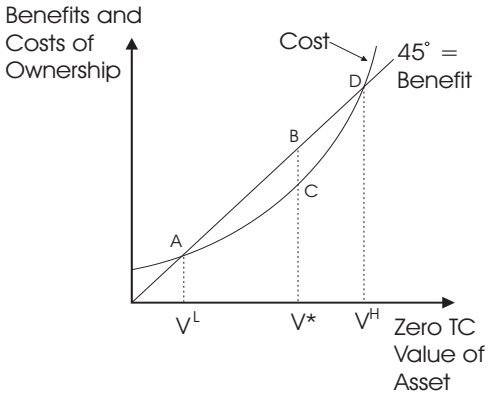

Figure 15-7
The Optimal Ownership with Non-Linear Costs

Wealth maximizers do not like assets in the public domain. When assets are in the public domain because they are too costly to protect given their high zero transaction cost value, there are two general solutions available. The first is to innovate on the transaction cost margin. As shown in Figure 15-8, a fall in transaction costs brought about by an innovation in policing technology allows the high valued asset to be removed from the public domain. This type of innovation is common. For example, the innovation of barbed wire mentioned above brought vast amounts of land in the

arid west out of open grazing to enclosed pasture. Another example from the old west comes from innovations in western water law. Historically, ownership of fresh water was limited to use rights in England and the Eastern U.S. These poorly developed rights reflected the low value of water in wet climates. In the arid western states, however, water is an extremely valuable resource. Hence changes in the law developed to create a low transaction cost legal framework for trading water rights. A modern example of protection innovation is the new DVD technology. Although DVD provides a higher quality video and audio output, the driving force behind its development was the ability to prevent pirated copies of the contents through various encryption devices. DVD's are capable of a "Regional Lock" that prevents a DVD from North America being used in any of five other world regions. DVD's carry extra signals, called Macrovision, that prevent the contents being copied to video tape. DVDs also contain a "content scrambling system" that encrypts data and requires a reader decoding key. Ironically, all of these measures were "broken" rather quickly and "patches" can easily be downloaded from the Web to avoid them. History is full of examples of innovations that reduce transaction costs, and therefore, increase net wealth. However, innovation takes time, and its success is always uncertain. In the short run another option may be more profitable.

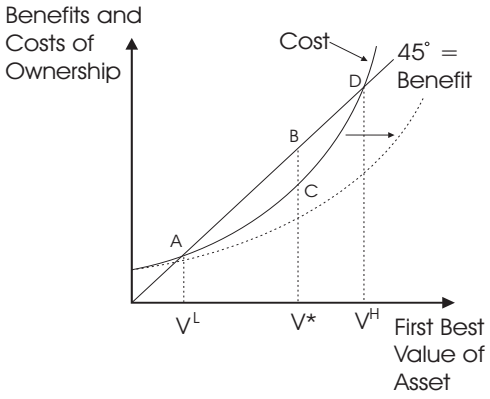

Figure 15-8
Changes in the Transaction Cost Function

A second solution to removing assets from the high zero transaction cost valued end of the public domain is to lower their *gross value*. Lowering the gross value makes the asset less attractive to theft, and given the non-linear transaction costs, the costs of enforcing the property right falls by more than the value of the property right. The net result is private ownership and a positive second-best value. The asset should be reduced in value to the level of V^* in figure 15-7, where the second best value is maximized. Here we can focus on the dramatic case of actual wealth destruction, but a more common practice is simply hiding or disguising wealth. Wealth can be hidden through non-conspicuous consumption, trade-secrets, and off-shore holdings. Apparently it was not uncommon during the Renaissance, when public protection of private wealth was minimal, for elaborate palaces to be constructed behind a ghetto facade. It is critical to note that this type of behavior is different from efforts at protection that raise *both* gross and net values. For example, we are *not* referring to cases such as putting locks on doors, "the club" on car steering wheels, or security strips in currency. We're talking about actually destroying some gross wealth to make the net wealth higher. Let's turn to two examples to show there are many examples in life where the cost of maintaining a property right are higher than a good's value.

The Rhino's Horn.

Let's begin with the example of the rhinoceros because it provides such a stark and simple example of the model. The wild rhinoceros is valued for many attributes, not the least of which is its horn. The horn is essentially made of compressed hair (keratin), and is similar in makeup to a human fingernail. The horn continually grows, and achieves its shape from constant sharpening. Although the horn is used to decorate ceremonial dagger handles in the Middle East, its chief use is in Far East medicine where it is ground into a powder for the relief of fevers.

Generally speaking the governments of Africa manage rhinos as a common property resource in conservation areas and on public lands. In North America, where legal property rights to land are well developed and where state regulation is often enforced, many migratory and wild specie attributes are owned by private landowners, conservation groups, or local, state, and federal governments. In some parts of Africa, most notably South Africa, there are large private reserves for mammals such as rhinos. Over the entire continent, however, rhinos are generally managed as open access.

Since the 1970s there has been an international ban on the trade of rhino horn, making it costly to develop private ranges to farm the animal. In light of the ban a black market trade in horns has developed, which has encouraged poaching. As a consequence rhinoceros populations fell considerably between 1970 to 1990 as poachers killed rhinos for the valuable horn. For example, Black Rhinos numbered between 65,000-100,000 in 1970 and today population estimates are between 3,000-4000. Similar reductions have occured in other rhino species both in Africa and Asia.

To date no one has developed a method or technology to lower the transaction cost function for rhinos. Given the nature of the beast they require vast amounts of territory and are difficult to relocate to safe places. Rhinos require special bacteria to digest food and relocation means that new bacteria must develop when there are small changes in diet. The time lag involved means that rhinos often "starve" to death when moved. However, a solution has been found that appears to be working — dehorning. Dehorning involves the drugging of the rhino and sawing off the horn just above the skin line. The horn eventually grows back and the procedure is repeated every 18–24 months. Dehorning, like having fingernails cut, does not hurt the rhino, nor does it appear to seriously reduce the rhinos ability to forage, defend, or breed. Apparently rhinos often lose their horns in the wild with no major side effects. This is quite different from detusking elephants, whose tusk is essentially a tooth and full of nerves. Although removal of tusks has been done to elephants to reduce poaching, because it destroys other attributes of the animal, it has been less successful.

There is no question that removing a rhino's horn lowers the value of the rhino. However, given that the poacher only values the horn and that the state values the rhino for other attributes (tourism, biodiversity, etc.), removal of the horn lowers the cost of enforcement by much more than the fall in the gross value. The result is an increase in the net value of the rhino. Although it is still early in the program, it appears the policy has reduced poaching. Reports are that dehorning essentially eliminated poaching in northwest Namibia when it was first introduced. Dehorning lowers the gross value of the rhino by systematically eliminating the attribute that the thief values highly.

Built in Obsolescence

On March 3, 1998 the USDA in partnership with Delta and Pine Land, a small Louisiana cotton seed company, announced a new patent for the control of germination in seeds. Monsanto, the largest seller of genetically modified seeds in the world, later purchased Delta and Pine Land and acquired the patent. Called the "terminator gene" the modification essentially makes plants sterile and unable to germinate. Almost immediately there was a massive public campaign against

the use of such technology and in 1999 Monsanto announced that it would not commercially use the terminator gene, although it reserved the right to use it in the future.

From a neoclassical perspective the terminator gene presents itself as an economic puzzle: a case of built in obsolescence if ever there was one. The gene itself does not increase output or change the plant in anyway. Its sole purpose is to prevent reproduction and the storage of seed. Forcing farmers to buy seed that lasts only one period over seed that can perpetuate itself only lowers the price of the seed. Since seed is costly to produce, destroying the reproduction capabilities of the plant can only reduce profits — at least in a zero transaction cost world.

The problem for producers of genetically modified seed is that the seeds become stolen and future crops are not captured by the current price. "Seed pirates" are a common problem in third world countries, but the case of a Saskatchewan farmer, though trivial in terms of the revenue to Monsanto, demonstrates the magnitude of the problem. Percy Schmeiser, age 68, lives in Bruno, a small town close to Saskatoon, where he has farmed all of his life. He recently was found guilty by the Federal Court of Canada where he was accused of stealing 320 acres worth of "Round-Up ready canola".[4] Mr. Schmeiser, despite having a field of Monsanto product, never paid Monsanto the $37/ha annual fee for growing it, and claimed the seeds floated onto his property from passing grain trucks. Most remarkable about the case was the extent to which Monsanto had gone to protect its property. Monsanto employees entered the farm without permission to take crop samples for genetic testing; they obtained permission from local flour mills to test Schmeiser's seeds that had been left at the mill for cleaning; and they tried to hire the flour mill owner to report on other local farmers that might be cheating. All of this for a farmer growing a 1/2 section of canola. Clearly, the problem with genetic crops is that they are "too valuable" and encourage theft.

Contracts with farmers to forgo storage and private sales, along with inspection of crops, and tours of flour mills are expensive. The lowering of the first best value of the seed by introducing sterility is not a corporate trick to exploit farmers, but a method to increase the second-best value of the crop by reducing the transaction costs of protection. Interestingly enough, outcries in the press against the use of the terminator gene have not come from farmers using Monsanto seeds, but from farmers who do not use it (many in the third world). One wonders at how many of these farmers, like Mr. Schmeiser, actually are using stolen seed? Although it is yet to be seen if the strategy is feasible, by having a seed that cannot reproduce, problems of theft over future crops are eliminated.

The terminator gene provides an excellent example of attributes that are valuable to seed pirates, but not the legitimate farmers who purchase the seed. Assuming there are some economies of scale in growing and storing seeds, an "honest" farmer who pays for his Monsanto seed would prefer to buy one time seeds each year from Monsanto, rather than produce and store seeds himself. On the other hand, seed pirates highly value a seed's germination qualities. Without the ability to replicate, stolen seeds are only worth the bread they can make. Monsanto did not willy-nilly lower the value of its seed. Rather it lowered the value by eliminating the attribute that was valued more by the thief than by the farmer.

The general issue with the terminator gene is one of built-in obsolescence. Built-in obsolescence may not be as rare as neoclassical textbooks claim it is. By lowering the value of a product the

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[4] Round-Up is a Monsanto product that farmers use to kill weeds. The Court ruled on March 27, 2001.

benefits of theft are also reduced. Lowering the value in a way that targets the thief increases net value. Consider the case of computer software. A frequent complaint about such software is that there is "excessive upgrading"; that is, producers of software are inefficiently inventing upgrades that consumers would prefer not be invented given the cost.

But there may be another reason. Software for computers is extremely easy to steal and the better the product the more likely the chance that it will be pirated. One strategy to protect the investment of the firm is to continually issue upgrades, or to postpone improvements, *even if the improvements are currently known!* Learning how to use a new upgrade or being incompatible with other users are costs of not upgrading. By offering legal owners of the software easy and cheap upgrades the software company lowers the value of theft of the early versions.

An interesting example comes from one of the most popular typesetting packages for scientific writing. TEX, was released by Donald Knuth into the public domain virtually complete in the 1970s. At the time TEX was capable of producing mathematical expressions, tables, and publisher quality typesetting that privately owned word processor packages only developed in the 1990s. Word processing packages that came later, and that have been notorious for failures and constant upgrades cannot be explained by a lack of knowledge over how to program mathematical expressions, tables, or other features that were in the public domain. Rather, the inferior products and constant upgrades reduced the amount of stolen software revenue and increased profits. Software companies lowered the cost of upgrades to legitimate users by offering lower prices for registered users, with manuals, and phone support.

15.8 **Summary**

This chapter has introduced you to a much more complicated model than the neoclassical model of the first 14 chapters. A standard assumption about the neoclassical model is that markets work for free. This assumption is adequate for most applications, especially in the analysis of price movements and changes in the volume of trade. However, since prices allocate goods freely, there is no room for other types of mechanisms to organize exchange and production. Yet even a casual look around not only suggests markets do not work for free, but other institutions are used to allocate resources as well. The start to understanding organizations is to understand the concept of transaction costs. Transaction costs are a special type of cost: they are the cost of establishing and maintaining ownership over an asset, a stream of income, or anything else you might value.

When transaction costs are zero, any distribution of property rights lead to the same efficient outcome. This is the Coase Theorem. When transaction costs are not zero, then every distribution of property rights lead to a different outcome and the one that provides the most wealth is the optimal organization. This model was applied to different types of ownership. Private property is valuable because it provides the right incentives to use resources, but also requires private protection. Common property and open access are alternative methods of ownership that provide worse incentives, but mitigate protection costs. We also saw that as an asset increases in value it is more likely to be owned. However, given that extremely valuable assets might to too costly to protect, there is an optimal value of assets. In the next chapter we take this transaction cost notion of optimal ownership and apply it to firms.

REVIEW QUESTIONS

1. Is a fence a transaction cost?

2. What is the point of the Coase Theorem?

3. Are property rights human rights? Are human rights property rights?

4. In feminist theories there is the concept of "power." How might this fit into the discussion of property rights offered here?

5. If mother nature didn't exist, would there be transaction costs?

6. A squash partner always leaves his dirty old boots outside the court when he plays. Every time he comes out and says "Look, my boots are still here, that shows you once again how honest people are. I just don't see how you can believe people are always greedy." What is an alternative explanation for the lack of theft?

PROBLEMS

1. When something is stolen ransom seems like the obvious thing for the thief to always do. The original owner must be the high marginal valued user of the good, so why not sell it back? Can you think of why children tend to be ransomed rather than automobiles?

2. A common explanation for the breakdown of the Coase theorem is that the husband may simply beat his wife to accepting the poorer circumstance. How is this also a problem of transaction costs and incomplete property rights?

3. The golden rule states that "we should do unto others, as we would like others do unto us". Is this a low or a high transaction cost rule for social interactions? Briefly explain.

4. In a world of zero transaction costs, what will the effect of changing liability for accidents be due to the amount of safety equipment in a coal mine? That is, suppose initially workers are responsible for accidents, but courts later switch this to employers being responsible. Explain your answer briefly.

5. Why might a gallery owner who sells a painting create more economic surplus than the artist who painted it? (Provide a supply and demand graph in your answer).

6. Would there not be any violence in a world of zero transaction costs?

7. Why did the bison die out, but cattle didn't?

8. Why do shopping centers often provide free parking — even to people who don't shop in the stores?

9. Using the ideas we learned in the "neoclassical model" what would be the best thing to send to an area that has been devastated by a flood or other similar tragedy? Why? Using the ideas from this chapter; that is, considering that the world is always characterized by positive transaction costs, why do we seldom send the good you just mentioned to victims of natural disasters? What do we tend to send instead and why?

10. In Europe, if you go to a public washroom, most of the time you have to pay for the toilet paper or pay some form of user fee. This never happens in North America. Why?

11. Everyone in my house loves pumpkin pie, and there is often an argument at the dinner table over who got the biggest piece. The solution was to use the simple rule that one child gets to cut the pieces of pie, while the other children get to decide which piece they want. What economic principle is being exploited here? Can you think of a problem that results from this allocation rule?

12. If it was illegal for anyone to own pigs, what would happen to the price of pork?

13. What would be an example of a transaction cost in using money? Do your examples explain why gold was so commonly used as money? (Hint: Think about why diamonds were seldom used as money.)

14. Why did domestic turkey's survive, but wild turkey's became practically extinct, given that the latter is much smarter than the former?

15. Seattle is made up of many small communities. One of these communities, Innes Arden, was on a hill overlooking the Puget Sound, and was developed in the 1950s by the Boeing company for its executives. At one point there were over 30 court cases pending — all of them over the height of trees. Supposedly trees planted 50 years ago were now blocking views. Why was the Coase theorem not working here? That is, (and you should be able to answer this in one sentence) why were the neighbors not bargaining over the trees? If the views were worth more than the trees, then the trees should come down. If they were not, then the trees should stand. Eventually one of the cases was settled in court. What do you suppose happened to the remaining 29 cases when the first case was decided?

16. Consider the following four cases:

    a. A man speeds and wipes out a fence of yours worth $100. The man gets fined.

    b. A man steals $100 from your house, is caught, and thrown in jail.

    c. A man plants a tree on his property that blocks your view and reduces the value of your property by $100. The police just tell you to take him to court.

    d. A man opens a business just like yours and draws $100 worth of customers away. The man gets a pat on the back.

In each case you lose $100, yet the social rules used to respond to each loss is different. Questions:

    i) Why is there no penalty in (d)?

    ii) In (a) and (b) laws were broken. Why might some crimes have fines and others internment? (Don't say that everyone speeds).

    iii) Why does the Coase theorem not apply in (c)?

17. Many economists have argued that there is a property right problem with the fisheries. Since no one owns the fish, more than an optimal level of effort is applied to the fishery, and the rents from fishing are driven to zero. Now, consider retailing. A retailer is just like a fisherman, he fishes for customers. Since entry into retailing is open to anyone, there is too much retailing — just as there is too much fishing. Do you agree? Why or why not?

18. Why would a local residential community often have flower beds or other physical interruptions in street intersections that slow down traffic?

19. When you look around most of the furniture on a university campus, especially the furniture in the public spaces, it isn't very comfortable, and it certainly isn't very pretty. This is a common aspect of most public furniture. Why would this be?

20. What is the relationship between transaction costs, sunk costs, and opportunity costs?

Review Question Answers

1. *Yes. In our world, where property rights are not perfect, a fence is certainly a transaction cost. We put them up to protect what we own.*

2. *Coase was trying to argue that the neoclassical model leads to what we call the "Coase Theorem." He did not suggest that this is how the world is. Rather, he was arguing that since property rights do matter, we must look towards transaction costs to explain why they matter.*

3. *I believe property rights include human rights. Historically human rights were synonymous with natural rights: the right to life, free speech, liberty. More recently they have included such things as rights to education and minimal standards of living. To the extent one is able to obtain these things, they are economic property rights. To the extent they are defined under law they are legal rights.*

4. *"Power" and "economic property rights" would appear to be the same thing.*

5. *No, at least nothing of significance. If there were no nature, then there really can be no confusion over outcomes and actions. We would always be able to trace back why we were cheated, and as a result, there would be no cheating.*

6. *Who wants a pair of used ugly boots.*

Odd Numbered Problem Answers

1. *The problem with selling it back is the original owner knows the good is stolen. When the economic property rights are separated from the legal rights, trade is very difficult. In the case of children, the next best offer will be extremely low, probably zero. So there is an incentive to sell them back to the original parents.*

3. *If everyone were to obey it, it would lower transaction costs. The problem is one wolf in the fold can destroy a lot of sheep. So unless we can identify and trust people to follow this strategy, it is a high cost rule.*

5. *Bringing buyers and sellers together is valuable. This value could be greater than the good being traded. In Figure 15-5, the artist on his own has a cost of $p_2 - p_1$ per unit to bring customers together. At this high cost, only q' units of art are sold. The dealer's costs might be $p_4 - p_3$, at which trade increases to q''.*

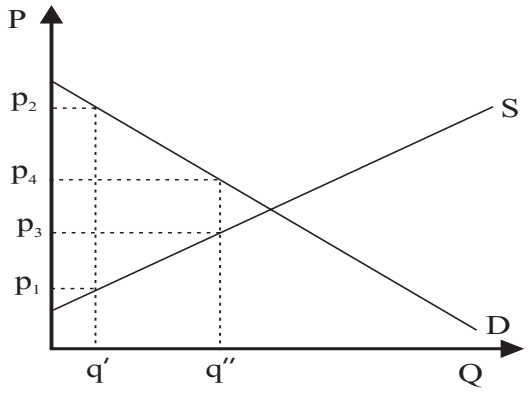

Figure 15-5

7. *The bison were controlled as common property by the Indians for their valuable robes. This meant killing them in the fall. The early hunters also exploited them for their robes. Later, the bison became valued for their leather hides and were killed in the summer while they were in large herds. Because cattle also provided leather, there was no price change as the bison were falling in number, and no great incentive to privatize them. The bison hunt soon became open access. Bison were also hindered by the fact no one in the 19th century really knew how to raise bison in captivity, and attempts to raise them as cattle were huge failures. Thus the lack of knowledge and incentive lead to no ownership over bison and over exploitation. With cattle the opposite was true. They were domesticated, valuable, and privately owned. As a result they were not exploited the extinction.*

9. *The standard economic response would be to send money. The people in trouble know better what they need than we do, so we should provide cash. We don't send cash, however, because it is too easy to steal, and often doesn't get to the people who need it. Therefore, aid is almost always in the form of goods.*

11. *It exploits maximization. The problem is too much time is spent in measurement. This isn't such a big deal with dessert, but it becomes a big problem with other valuable goods. As a result, this method is not used for expensive goods.*

13. *The big cost is in verifying the quality, that is, in measuring the money. Diamonds are very hard to measure, and therefore have always made a poor currency. Gold is relatively easy to measure and difficult to fake.*

15. *The Coase theorem couldn't work because it was not clear who had the property right to the view. Once the first case was settled, the other cases negotiated.*

17. *The problem with the analogy is that customers are not fish. They only buy when it makes them better off. Too much retailing would be punished by consumers and so it doesn't happen.*

19. *This is the same answer as in number 18. They lower the value of the furniture to prevent theft.*

CHAPTER 16

THE ECONOMICS OF ORGANIZATION: FIRMS

16.1 **The False Dichotomy of Firms and Markets**

In 1937 Ronald Coase published a paper that was, in today's language, his undergraduate senior's thesis. In that paper he made the following observation: if prices work for free, why do we see so much allocation in life not using prices? In particular he focused in on firms. Within a firm prices are not always used. Many times allocation is by direction; that is, the boss tells the workers what to do, and his boss tells him what to do, and the stockholders tell that boss what to do. Coase's answer to the question was that the assumption of free prices was wrong; markets don't work for free — they have transaction costs. He also noted that firms don't work for free either; there are transaction costs within firms. This was a brilliant insight.

Unfortunately the notion that allocation is either done through firms or markets is really a false dichotomy. Most of us think we know a firm when we see one; likewise for markets. But even when looking closely it is often hard to tell where the firm begins and the market ends. Take, for example, your local horse racetrack. The track is a firm. There are owners of the track and they hire people to sell tickets, meals, and clean the barns. Horse owners use the track and they rent barns and pay for feed often supplied by the track or sub-contractors who bring the feed in. The track hires some people to inspect the horses and make sure the correct horses are running, and aren't drugged or injured. The track also uses a system of claiming races whereby any member of the racing community can buy any horse running in a race for a prespecified price. The track runs claiming races in order to monitor honesty in horses. Horses sell all the time at the races, and when a certain number of sales are expected in a race, and none are sold, the track becomes suspicious that something dishonest has happened and they investigate. The potential buyers of horses who snoop around the barns inspecting horses end up providing a great service to the track in helping it police honesty and therefore promote betting.

Of all these people, which ones are part of the firm and which ones are part of the market? Some seem pretty obvious. The owners of the track, the wage workers like the ticket seller and the janitor, they are all part of the firm. The person delivering feed, who is paid by the load, probably isn't part of the firm. But what about the people who snoop around the horse barns? The track can manipulate their behavior by changing the purses and claiming prices. They provide a service to the firm like the workers in the kitchen, and they are residual claimants just like the owners of the track. Are these people part of the firm or part of the market? It really is impossible to say.

It is better, again, to think of organization along a spectrum, as shown in figure 16-1. At the right end of the spectrum prices work almost freely and the transaction costs are minimal. Perhaps this is because the nature of the good simply allows for trivial monitoring. Many of these types of exchanges are simple on the spot transactions. We conduct these types of exchanges everyday, hardly giving them a second thought. For example, buying a chocolate bar, renting a video, and taking the bus are simple pure exchanges. At the other end of the spectrum we have pure direction. Here we would observe situations that everyone would agree are production within firms. When Starbucks hires a person to make coffee, the owner of the outlet tells the person when to show up for work, how much whipped cream to put on the moccas, and all the other little tasks involved.

In between these two extremes there are a host of examples that are sort of firms, sort of market transactions. For example, a short term contract between me and Safeway when I rent one of their rug cleaners, is pretty close to a pure exchange. Yet, the contract we sign prohibits me from using the machine in various ways, and protects my rugs to some extent if any damage is done. There is a certain amount of non-price allocation of the surplus in this exchange through the conditions and warranty of the contract. A long term contract between a coal mine and a steel mill, will have many more restrictions. A franchise contract even more. At some point we recognize a "firm" happens, but we also need to acknowledge that a simple choice between firms and markets doesn't exist.

Figure 16-1
The Organization Spectrum

In this chapter we're going to start with the left hand side of the spectrum. We'll talk about the advantages of a firm, and its costs. Then we'll slowly start moving across the spectrum, each time in the context of a specific example. In the next chapter we'll take up exchanges that are more closely related to market exchanges.

> *There is a spectrum of control in all exchanges, ranging from pure direction to pure market exchanges.*

16.2 **The Nature of the Firm**

In the earlier chapters on production, we assumed production takes place within firms. At the time, nothing much was said about the character or nature of the firm because we were only concerned with the volume of output produced. But as we consider more realistically the act of production, we realize that production takes place in buildings and factories, that these physical places have managers and different types of workers, and that people within these places of employment are paid in many different ways.

In principle, production could be organized anywhere along the spectrum in figure 16-1. Consider what production would be like if organized through markets; one owner of a resource meets with the owner of some other resource, the resources would be exchanged at a certain price, and

some output is produced. For example, a landowner might contract with a laborer to rent his land and grow some crops. When production is organized through a firm, one owner of a resource combines other resources through direction, not prices, and produces some output. For example, a wheat farmer might buy his own land, apply his own labor in combination with some hired labor, purchased seeds, and the like, and produce a crop. As another example, if someone wanted to use the market to produce cars they could contract independently for labor, rent equipment, hire consultants to instruct individuals as to how to run the machines and coordinate activities, and the like. This doesn't usually happen. Instead, workers, managers, and capitalists come together in some sort of institutional structure with rights and duties either specifically assigned or informally agreed to. Within a firm, there is a great deal of direction, and people are told what to do, when to arrive and leave work, and their actions are monitored.

How do people decide whether to produce things using a market, a firm, or some type of hybrid? The answer comes from the last chapter. The distribution of property rights leading to the maximum gains from trade, net of transaction costs, will be chosen. A firm is nothing more than a distribution of property rights. Within a firm certain people have rights to control the way the firms assets are used, everyone has rights to certain parts of the revenues of the firm, and the ownership of the assets are defined in a specific way. What makes firms different is the different ways these rights exist. When using a market to produce goods there are certain benefits and certain costs. When using firms to produce goods there are different benefits and costs. The one system that provides the largest net difference is the one that is chosen.

Firms exist for one general reason: they avoid transaction costs that might arise in terms of market production. As we saw in the chapters on production, output is increased when resources are brought together. When large numbers of workers are brought together, they are able to specialize in certain ways that allows output to expand tremendously. However, when large numbers of people come together, they might not work very hard. They might steal other inputs, sleep on the job, or run away with the output. A firm is designed to minimize these transaction costs. When it succeeds production takes place in a firm, when it fails production takes place in a market. Many times organization within the firm involves "bosses" and "direction." Workers put up with this because in solving the transaction cost problem, the net gains from trade are higher and therefore the wages of the workers are higher as well. Shirking, and other forms of individual maximizing behavior not in the interests of the firm, lowers the wages to all workers. A firm is a team, and like a sports team, when someone is not pulling their weight, the whole team suffers. Although every worker might engage in some type of shirking, that worker would wish no one else was engaged in that type of behavior. A firm that fails to get its workers to act in the interests of the owners, is a firm that will ultimately fail. Those firms successful in finding solutions to the cheating problems among workers, are the firms that will survive.

Firms are designed to make the incentives of the workers compatible with those of the owners.

16.3 The Nature of the Farm

Farms are nice firms to study in order to get a handle on incentives and transaction costs. Because they are small firms, the incentives are fairly easy to understand. Also, most of us have some type of connection with a farm somewhere, and well ... wheat is just so darn interesting. Let's consider the history of wheat farming in North America.

Have you ever noticed that farms are organized around the family. Two hundred years ago, if you looked around at the firms in any town, they would have been organized around families as well. That is, the bakery, blacksmith shop, general store, etc. were small firms owned by a husband, and run with the assistance of the wife and children. Now, about the only industry where family production really amounts to anything is in farming. All other industries have long switched over to corporate forms of organization. Why would this be?

Part of the answer is in the gains from specialization. As technology has changed, workers in virtually all industries have been able to specialize more and more into well defined tasks. These specialized tasks not only allow for great leaps in levels of output, but they often are easily monitored. Hence, large firms can hire masses of workers, and pay them simple wages knowing they cannot cheat the firm easily. When it is easy to monitor workers, cheating is hard and seldom takes place. Consider an assembly line for automotive workers. Assembly lines are extremely specialized. Every one has a specific job to do, and everyone knows whose job it is to do what. If one person decides to take it easy and not keep up with the line, or does a job poorly due to lack of attention, this causes problems on the line that are easily attributed to the poor worker. On most assembly lines, when a worker performs a duty improperly, such that the line must be shut down, that worker is sent home without pay. If it happens a second time, then the worker is usually fired. In terms of the definition of transaction costs, on an assembly line Nature plays a very minor role, and as a result, the transaction costs of a firm are small.

Consider now a farm. On a farm the role of Nature is huge. The actions of any one farmer influence output, but the weather plays a large role as well. Better soil, better timing of rains and sun, and a lack of storms during harvest, mean a much higher crop. When Nature plays such a large role, it is almost impossible to hire a "farmer." I'm not talking about hiring a worker to clean a barn, I'm talking about hiring a worker to plant, cultivate, and harvest the crop. Such a worker could shirk until the cows came home and he'd be unlikely to get caught ... he'd just blame the weather for the bad outcome.

The history of farming and the rise and fall of family farms can be explained by this role of nature and the effect it has on transaction costs in conjuction with the role of specialization. When the gains from specializing increase, family production is less likely. When the role of nature increased, family production was more likely. Let's look at three cases of this evolution: the shrinking of tasks done by the family farm; the rise and fall of the great Bonanza farms; and the industrialization of livestock farming.

The Shrinking Family Farm

Until the middle of the nineteenth century, the family farm did virtually everything. They made the farm by clearing land and raising buildings, they processed cheese and milk and made sausage, and they did just about everything in between. The one thing the family never did was grind the grain. This was done at a local gristmill. Gristmills were the first of many firms that

specialized in what would otherwise be a single stage of the farm production process, and ultimately evolved into large firms that developed factory production techniques. Because grains are easily stored and a mill can be operated continuously, milling grain for flour is almost completely removed from seasonal forces of nature, and the gains from specialization are high. These factors reduce the value of family production and favor large-scale, factory production. Thus the gristmill was the first stage of production in farming that was not done by the family.

But it was not the last. After the early 1800s dramatic changes in technology led to the rise of separate firms that specialized in single stages of production and operating all year round. New technologies such as refrigeration and railroads limited Nature and allowed seasonal tasks to be performed throughout the year. Overwhelmingly, the new firms engaged in production at either the beginning (equipment, fertilizer, and seed) or the end (marketing, processing, transportation, and storage) of the agricultural production sequence. In the late nineteenth century these firms included flour mills, cheese factories, creameries, early equipment manufacturers (plows, reapers), grain brokers, meat packers, slaughterhouses, livestock breeders, canneries, and other food processors. This process has continued throughout the twentieth century as advances in biological and chemical technology and new product developments in artificial insemination, feeds, fertilizers, pesticides, and seeds that result in gains from specialization and reduced seasonality for certain stages of production. Accordingly, the family farm has abandoned these stages and now controls only the purely biological growth stages of farm production. The biological stage of production is the one where nature still plays a large role. In this stage monitoring is costly, and thus the family is the efficient form of firm.

The Great Bonanza Experiment

In the last quarter of the 19^{th} century, an experiment in farm organization took place on the virgin prairie of the Red River Valley dividing Minnesota and North Dakota. Between 1870 and 1890 a number of extremely large wheat farms were established, some exceeding 50,000 acres (roughly 78 square miles). Even by modern standards these farms were enormous, but their main distinguishing feature was not their size, but rather their factory-corporate organization. The owners were typically businessmen with little or no farm experience. These owners raised capital in eastern markets and organized these farms along the lines of contemporary manufacturing firms typically as corporations with professional managers and a specialized wage labor force. The"bonanza farms,"as they came to be known, were hailed as the future of agriculture. Yet after only one generation, nearly all the bonanza farms were gone, systematically replaced by family farmers.

Most bonanza farms focused exclusively on wheat production and kept virtually the entire production sequence within the firm: from sod-busting, seed development, machine repair, and hardware supply to blacksmithing, seed cleaning, grain storage, and flour milling. The farms were also highly mechanized and used the latest large-scale equipment. Labor was organized in a complex hierarchical system common to industrial manufacturing. Managers were paid a combination of a salary and a commission that depended on farm profits. The farms were broken into 5,000-acre divisions headed by superintendents and 1,200-acre stations headed by foremen. Most of the manual labor force worked out of the stations and were hired in monthly increments and paid a daily wage. Accountants, blacksmiths, mechanics, and hands involved in grain cleaning and storage worked at the farms headquarters. The labor force varied greatly in size over the seasons, with harvest crews typically twice the size of seeding crews.

The bonanzas combination of modern technology, specialized labor, and professional management practices seemed unstoppable. Yet Bonanzas began to disappear as early as 1890, and by 1910

they were virtually extinct. Why? Because the costs of monitoring such large labor forces in an industry where Nature played a large role was simply too costly. These large firms had managers, superintendents, and foremen to monitor workers. All of these men were paid, and these salaries raised costs. Grain from every field was weighed and recorded so that responsibility could be assigned to foremen and superintendents. Labor was performed in crews one task at a time (such as plowing or seeding) to make supervision easier for the foremen; and rigid rules governed the daily routines of the field hands at work and in the bunkhouse. All of this raised costs, ... but more importantly there were no large gains in output. Thus 10 small family farmers could jointly produce as much as a Bonanza farm 10 times as big, but they could do it at much lower costs. Hence, the large farms were broken up and replaced by hundreds of small family farmers.

The Industrial Chicken

Nowhere in farming have firms moved more from family firms to factory-farms than in livestock. This has been especially true for chickens, feedlot cattle, and hogs. The general trend has been to remove stock from an open environment and rear them in climate-controlled barns. This has happened because once animals are moved indoors, the role of Nature is reduced, and monitoring wage employees becomes feasible as firms take advantage of specialization gains.

The chicken industry has its roots in small farms. In fact, the industrialization of chicken production preceded that in cattle feedlots. Prior to the 1930s, most chickens were raised in relatively small flocks on family farms. During this period eggs, not meat, were the primary products and most chickens were slaughtered in the spring. The reorganization of the poultry industry began in the 1930s, and today virtually all broilers (2 to 3 pound chickens) are produced by large, factory-corporate firms. The introduction of antibiotics and other drugs have allowed poultry to be bred, hatched, and grown in highly controlled indoor environments in which disease, climate, food, water, vitamins and other inputs are regulated to the point where poultry barns are virtual assembly lines. At the various stages of production, broiler companies employ wage laborers who undertake specialized but routine tasks such as cleaning, feeding, and immunizing.

A striking example of factory-corporate livestock production is in feedlot cattle. In the first half of this century "farmer-feeders," located primarily in the Corn Belt in the US, supplied the overwhelming majority of finished cattle to slaughterhouses. These farmers typically had less than 1,000 head of cattle that were purchased in late summer or fall and fattened during the late fall and winter (an off season for grain farming). During the last 40 years, the fed cattle industry has been almost completely transformed into one dominated by large corporate firms that employ highly specialized wage labor. In the last two decades, the hog industry has followed the path of the broiler industry. Hog production is increasingly dominated by large, factory-corporate firms that breed and farrow (birthing) pigs in confinement in huge indoor facilities.

The contrast between industrial livestock and grain farming could hardly be more dramatic. This difference results from the elimination of Nature and the reduction of random forces in the production of animals. The driving force in modern livestock production is to reduce the role of nature by bringing production indoors to control climate and disease. As result the livestock industry is perhaps the most specialized of any farm commodity, and the most dominated by companies organized in the corporate-factory form.

16.4 The Success of the British Navy

What could be more different from the family farm in Nebraska or Saskatchewan than the British Navy during the age of fighting sail? The British Navy was the largest firm in England in the 18th century, and also the most successful navy. The King of England, however, had the same basic problem that the owner of any firm has: how to get the most out of his workers? The navy is an interesting example because the transaction cost problem in monitoring a captain or admiral was so severe. The British were successful because they were able to keep the incentives of the officers in line with the incentives of the King.

All navies during the age of fighting sail (approximately 1580 – 1827) faced a serious transaction cost problem. Ships of war were expensive, powerful, and critical for the protection of overseas trade. Yet they were put in the hands of a captain who was sent out with the most general orders: to blockade a port, patrol for pirates and privateers, escort merchant vessels, and in times of war, engage the enemy. The captain had a large informational advantage over the Admiralty in terms of local conditions; in fact, it is hard to imagine a more severe case of asymmetric information. During the age of sail, communication was intermittent, slow, and limited; the world was still generally unexplored, with shoals, waterways, and trade winds not mapped; and even methods for finding positions of longitude were only developed towards the end of the Eighteenth century. Worse, given that ships were propelled by wind, disasters, losses in battle, and other failures of duty could be blamed on the ill fortunes of nature. Added to the severe information asymmetry was the temptation of a captain or admiral to seek out private wealth and safety rather than engage in more dangerous and less profitable assignments. For example, a captain always had the incentive to seek weak, but wealthy, merchant prizes rather than enemy frigates. They also preferred avoiding monotonous and dangerous blockades for profitable raids on shore. Hence, as in the case of farming, we have a situation where Nature played a huge role, and the incentives of the workers were not in line with the owners of the firm. Unlike farming, though, a family cannot run a battleship, and so a family firm was not the solution.

Although the British Navy dominated the open seas for most of the age of fighting sail, the obvious explanations are refuted: their ships were not better; their tactics were 'flawed' according to the experts of the time; and the raw material of their sailors and officers had no distinct advantage over the navies of Spain, France, or Holland. It turns out the British Navy was an effective fighting force because of the set of rules under which the British fought. The British Admiralty created a set of clever monitoring devices that were only slowly copied by their opponents, and which worked even for single ships thousands of miles from home.

Before looking at a couple of these devices, one must understand that the central compensation scheme in the British Navy was a wage system which revolved around the taking of prizes or spoils of war. Unlike on land, where prizes are located in specific places, enemy prize vessels float about. Thus the use of prizes in the navy was a two-edged sword — it motivated captains to be active at sea, but encouraged them, at the margin, to hunt for lucrative prizes instead of pursuing more strategic objectives.

In order for this system to work, some form of monitoring was necessary. Thus, in conjuction with the system of prizes the British Navy used several clever rules to monitor their captains, and which encouraged British captains to fight rather than run. The creation of an incentive to fight led to an incentive to train seamen in the skills of battle. Hence, when a captain or admiral is commanding a ship that is likely to engage in fighting, then that commander has an incentive to

drill his crew and devote his mental energies to winning.

So what were these rules? There were lots, so let's just consider a couple. First there was the Weather Gage, which meant to fight windward of the enemy ship — a tactic that was considered inferior by the military intelligentsia of the time. Through out the 18th century French strategists discussed the general benefits of fighting *leeward* of the wind (without the weather gage). When fighting leeward the ship is tilted by the wind away from the enemy and all of the ships gun ports are above the water line. In heavy seas a ship with the windward position might not be able to open its lower gun decks and as a result its fire power was drastically reduced. This is shown in the sad drawing of figure 16-2.

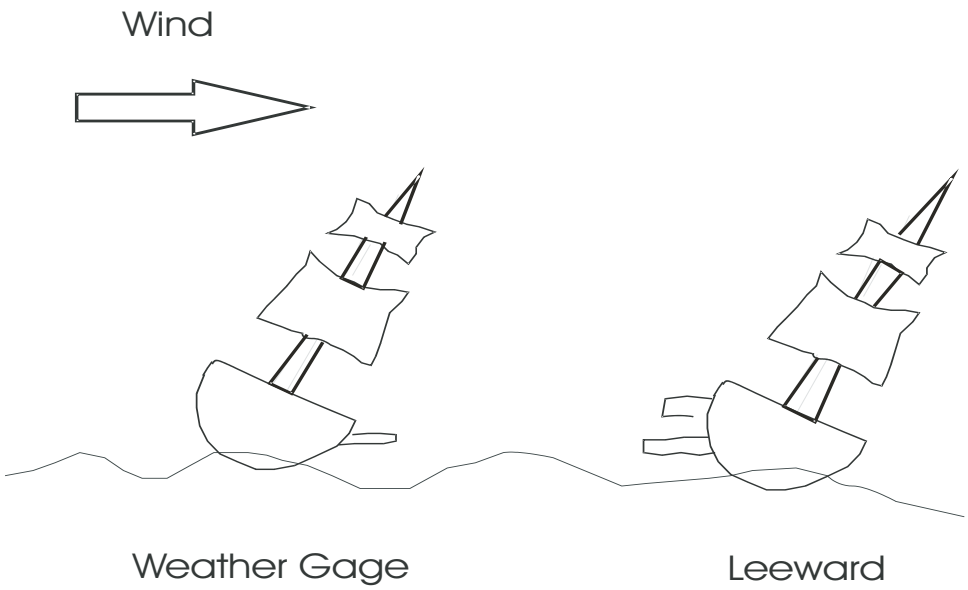

Figure 16-2
Fighting With the Weather Gage

A more important advantage of the leeward position was that if the battle was going poorly, the fleet had the opportunity of simply sailing downwind to escape. Likewise, if an individual vessel became severely damaged it stood a chance of escaping behind its own line. The French proclivity for shooting the masts and rigging of the enemy ships, as opposed to the hull, increased the opportunity of escape and increased their preference for the leeward position. Given the advantages of not having the weather gage, why were the British so insistent upon having it? The answer lies in that it both increased the incentive to fight, and prevented captains from drifting away from battle.

A square rigged ship from the age of fighting sail, was difficult to maneuver, and could could not sail well into the wind at all. Not only could it not sail into the wind at any great angle, but the ship would often drift backwards as well, often making no progress at all. Hence, when attacking from the weather gage a square rigged ship had little choice but to drift upon the enemy. It would have been very difficult for a captain of a British ship in the fleet to casually or inadvertently not engage the enemy once the fleet had formed a line with the weather gage. Whereas this was not generally true with the leeward position. The incentive mechanism of the weather gage is that once

engagement is certain, it was in the interests of the British ship to fight most effectively. Just as the weather gage ensured engagement, failure to fight well meant that the ship would eventually drift into the enemy fleet where it would certainly be captured. Thus the weather gage was an easily monitored action that encouraged engagement and effective fighting.

A second rule the British fought under was that an English ship *must* attack an enemy ship of the same class. If the captain failed to do so, the punishment was death! This led to some interesting situations. For example, there was the fateful meeting between the British *Guerriére* and the USS *Constitution* on August 19th 1812. The *Guerriére* was small frigate, totally outclassed by the larger American frigate. The *Guerriére* had only 38 18-pound guns to the *Constitution's* 44 24-pounders, and only 244 men to the *Constitution's* 460. Furthermore, the *Guerriére* was in desperate need of refitting. It was leaking and had recently been hit by lightning. The *Constitution* on the other hand, was recently out of home port. If ever there was an unfair fight, this was it. Still Captain Dacres of the *Guerriére* engaged rather than flee, with the inevitable result of defeat. Dacres managed to live, and though he was no hero for surviving, he was given another ship to command. Just to see how different this rule was, consider the French rule for engagement. For the French, if an enemy ship was spotted, and the captain didn't have overwhelming superiority of force, he was to flee upon the penalty of death.

So the British had a number of rules that essentially forced their captains to fight. But how did the British navy know what the captain was up to? After all the captain was just floating around in the big ocean somewhere. Here's where the British crown was even more clever ... they had spies, and the spies were the lieutenant and the master. The actual system was quite complicated, but essentially the job of the lieutenant was to watch the captain and report on his every move. The job of the master was to watch both of the others, and report on their actions. The lieutenant had an incentive to catch the captain in an error because promotion to captain depended, in part, on a vacancy in the captain's list. The master was essentially an independent observer who could not be removed by the captain, and was there to keep the system honest.

Once again we see that a firm is designed to make the incentives of the worker compatible with those of the owner of the firm. With the navy, the use of the prize system to pay captains created an incompatible incentive. Thus the navy was structured in such a way as to restrict the captain from going after the wrong prizes. The system worked. In the next section, we'll look at the British Army and see how a few differences in logistics made a big difference in the way the Army was organized versus the Navy.

16.5 The Purchase System in the British Army

As mentioned way back in the opening chapter of this book, 1st Duke of Wellington, Arthur Wellesley, purchased his first commission as ensign in 1787, and by 1794, after purchasing seven further commissions and having seen no military action nor having received any military training, had reached the rank of colonel and was in charge of his own regiment. Were it not for his subsequent victories, such a process of purchase over merit and formal training might seem folly both on the part of Wellington and the British Army. Yet Wellington was hardly alone since the purchase system, crudely founded in Medieval times and continued until 1871 in Britain, was the central means by which the European armies staffed their officer corps.

Most historians appear to have a dim view of the purchase system, and it is common in the historical record to find the purchase system blamed for the excesses, foibles and disasters of military history, and seldom given any credit for victories. Yet this conclusion must be premature and result from a myopic view of the role purchase played, given that it was an integral part of successful armies for great lengths of time.

On the surface, the thought that anyone would *pay* to be a soldier seems illogical. After all, it seems illogical for someone with no formal training in war, to actually pay to lead a company. Furthermore, added to the illogic of the general scheme were the large sums paid for an army commission when by all accounts the official wages were so low. For example, in 1832, Lord Brudenell bought a Lieutenant Colonelcy for between £35,000 and £40,000. Higher ranked officers also incurred other expenses in addition to the purchase of their commissions. Although the Crown subsidized them, Colonels were required to pay for all regiment expenses. These included the costs of recruitment, uniforms, wages, equipment, and any welfare paid to the wounded or widows. Yet, among the commissioned soldiers there was no serious and persistent grumbling or revolts about the low pay, nor was there any increase in pay over the last 200 years of the system. All of which points to the fact that there is more to the system of purchase than the simple selling of offices. If the purchase of commissions was part of some *rational* scheme designed to best staff the army, then there was clearly more to the method of compensation than straight wages.

A Little Background

The practice of purchasing a position in an army dates back to the 13th century, peaks in the 17th and 18th centuries, and dies out in the 19th century. Throughout this time the purchase system evolved, and thus the purchase of command in 1200 was considerably different from purchase in 1870. Although the purchase system was used by all European powers, the focus here is on the British Army.

The purchase system has its beginnings when Henry II (1133–1189) relieved the landed class of a medieval tradition introduced by William the Conqueror which required landowners to supply the King with knights for 40 days of the year. Instead, Henry II began a form of taxation with which he hired mercenary companies. The modern commercial connotation of the word "company", in part, reflects the commercial nature of these armies. In addition to pay, the companies received a fraction of the plunder of war, including any ransom from captured prisoners and contributions for protected property. Shares in these companies were determined by the capital investment of its members and were tradable. The purchase of shares by active soldiers was the institutional forerunner of the formal purchase of commissions, which fully developed in the 17th century.

Initially these corporations were composed mostly of foreigners. Eventually, they became dominated by nationals, and by the time of the Tudors the Crown was granting commissions only to landed subjects who then raised a company in service to only the British King. Until the late 1600s, the British never had a standing army. In time of war the King would raise an army in the fashion just mentioned, and it would be disbanded in peacetime. After the Restoration in 1680 and the Glorious Revolution in 1687, there was great debate over the necessity of a standing army. However, perpetual problems with France and colonial struggles resulted in a de facto standing army. The practice of purchasing commissions, begun by Henry II, carried through to the standing army.

The institution of purchased commissions meant that the Crown and Parliament did not have total control over the staffing decisions of the army because each commission was owned in large part by the buyer who had the right to resell it. This led to several conflicts, and attempts by

the government to regulate resale. For example, the government established various prices for the different ranks. In practice a black market arose and the traded prices varied considerably, often being much higher (and lower) than the stipulated prices. This was despite the fact that selling above the regulated price (cashiering) was against the law. Furthermore, over time rules were imposed on minimum ages, minimum times between ranks, and conditions for transfer.

Why Were Commissions Purchased?

We can think of the Army as a firm, but not a firm at the far right of the spectrum in figure 16-1. Rather it was a firm somewhere in the middle. Kings at the time could not monitor their soldiers very well, and so the prize system they developed created an incentive for soldiers to fight without being monitored. Thus the military constraints faced in Europe from 1400 to 1800 were best matched with the set of incentives created by the purchase system, in order to minimize the cost of raising an army. In general two major incentive problems existed: how to recruit high quality officers; and how to provide incentives to actually fight in battle in a way that increased the net gain from war.

The first problem in raising an army is to find highly qualified soldiers and officers. An army that experiences no disincentives among its soldiers, but whose soldiers are totally inept at fighting is a losing army just the same. Prior to the 19^{th} century, it was generally thought that a great soldier was born, not made. This implicitly reflected the fact that the inputs for a good soldier were unobservable. What makes a great military leader? One who can motivate troops, ensure they are fed, take some risks but not others, make the right decision in the heat of battle. The question is fundamentally unanswerable, and is similar to "what makes a great entrepreneur?". Furthermore, direct supervision of inputs in battle was also difficult because officers essentially made their decisions in isolated situations where communication was difficult. Furthermore, nature played an extremely large role and soldier efforts were mostly matched against opponents in hand-to-hand combat. In addition, easily observable signals that may have been correlated with ability did not exist. There were no military schools, nor were there obvious skills that could be measured.

Under these conditions military officers can best be paid in terms of output as residual claimants. In this way the purchase of commissions acts in the same manner as the purchase of any business, with soldier entrepreneurs self-selecting what type of fighting they were best suited for. Those who were correct in their personal assessments were rewarded by large residuals and continued to purchase higher positions which in turn led to larger shares of prizes. Those who were incorrect were likely to exit the industry ... permanently and horizontally. The key to the success of such a market structure to the officer corps would be the process of self-selection. Only those who truly thought they could command successfully would advance in ranks.

Throughout the time of purchased commissions, successful regiments were paid in part through the spoils of war. This in effect made the soldiers residual claimants. A key feature of the purchase system is the actual payment for the commission, because it established a property right over the expected residuals from battle. Were the spoils in the public domain, too many individuals would enter the army and the average quality of soldier would have fallen. By introducing a pricing mechanism, only those officers that anticipated a future stream of earnings higher than the marginal soldier entered service.

Having high quality soldiers, however, is only half the battle. Soldiers require the proper incentives to perform. These include not only the incentives to fight, but also to fight in the interests of the entire army. Due to the extreme situations and opportunities for being killed,

incentive problems abound in armies at war. The private desire to preserve one's life, regardless of the effect this might have on the overall mission, is a problem of first order that armies must overcome. Transaction cost problems are no doubt extremely high in army regiments where one's life is on the line.

The key aspect of the purchase system — namely that officers were ultimately rewarded through residual claims — is also an important mechanism for establishing incentives to fight. Soldiers received minimal levels of pay for supplies, but their incomes could only grow through actual battle. Residuals mostly arose from the spoils of battle, and rewards from the crown for victory. In paying officers this way, the Crown encourages soldiers to engage the enemy. The common theme in the historical record is that the hope of treasure was a major motivator of the officer corps.

The purchase system was not perfect. The payment to soldiers with prize money was useful in attracting quality soldiers, but could still have hindered the army if the private incentives it provided jeopardized the object of the mission. Premature or excessive looting that prevented the army from victory, should be discouraged. If looting or extortion in themselves begin to affect the overall agenda of the army, then the purchase system should not survive. "Too much" fighting as well may hinder success if regiments have strategic value in containing or defending an enemy rather than attacking.

The purchase system was obviously part of the incentive structure of the individual soldier. Its Achilles heel was that under some circumstances, the incentives of the individual soldiers did not match those of the army. When the incentives reasonably matched those of the Crown, all was well, but when they did not, the system failed.

To reiterate then, the system of purchasing a military commission was used to self-select officers into the military given the general difficulty in observing military talent and the lack of alternative screens or signals of quality. Secondly, the purchase system, by paying with prize money, provided an incentive to engage the enemy in battle. With this form of payment there is a tendency for "too much fighting". This acted as a cost of the system, and in order for it to function properly, the incentives to fight of the individual soldier and commander must match those of the Crown.

Why were commissions sold in the Army but not in the Navy? In the Army the purchase of commissions generally created a compatible incentive with the King, and so the King did not have to have the complicated rules for fighting and promotion that were found in the Navy. In the Navy, the prize system created the incentive for captains to seek after the wrong prizes, and this led to rules over promotion that helped to police this. Thus, commissions in the Navy could not be purchased. The British Army and Navy provide a nice example of movements along the figure 16-1 spectrum. The Navy was more of a "firm" than the Army because it involved more direction, and less use of the price mechanism. The Army more closely resembled a market transaction because the transaction costs involved in the prize system were less severe. They were less severe because prizes on land do not float about like prizes on water!

16.6 **Franchising and the Big Mac**

Perhaps you don't know much about farming, the British Navy in the 18^{th} century, or the military purchase system, but one firm you're bound to be familiar with is McDonalds. It all started

with a man named Ray Kroc who was a peddler of milkshake machines in the early 1950s. He met up with brothers Mac and Dick McDonald who had opened the "Speedee Shakes and Burgers" drive-in in 1953 in St Bernadino, California. They were persuaded to sell the name to "McDonalds" to the milkshake salesman, Kroc, who opened the first store of the McDonald's Corporation in 1955 in Des Plaines, Illinois. The rest is history. McDonald's now has over 20,000 stores in 90 countries, serves 29 million people a day, and opens a new store opens every seven hours. The real genius of Ray Kroc was to figure out how get an employee to sell a decent 5¢ hamburger, and he did this with the use of a franchise contract.

What would be the transaction cost problem of selling an idea? Suppose I come to you and say "Hey, if you give me $30,000 I'll tell you the secret to making a great 5¢ hamburger ... you'll be rich!" Maybe you're dumb enough to give me the money. If you do, you can bet I'll tell you something, but it sure won't be how to make a great 5¢ burger. Maybe you're smart enough to say "Well, you tell me, and if I think its a good idea I'll pay you the money." If I'm dumb enough to tell you the truth, you sure won't tell me its a great idea. You'll just go off and make your fortune on cheap burgers. Information is a strange good to sell. How can I let you look at my "information product" without letting you have it? Also, just because you have the information, doesn't mean that I still don't have it. How can you trust that I'll sell you the right information? After all, you don't know what I'm selling. This is the problem that Ray Kroc faced. He didn't want to flip burgers himself, he wanted to tell others how to do it, and he wanted to be paid for the knowledge.

The franchise was the key. A franchise essentially makes the local manager of the McDonalds restaurant a part owner. When Ray Kroc sells the idea to a franchisee, the latter can trust Kroc because if the wrong information is given the restaurant won't succeed and Kroc won't make any serious money. Also, since Kroc makes money when the local outlet makes money, he won't sell the idea to someone who will open up right next door. Since the local franchisee has a financial interest in his local outlet, he has an incentive to make sure it is run the way it is supposed to.

The problem with the franchise contract is that the local owner of McDonalds can still try to steal the idea and open up his own restaurant that looks the same but just happens to be called "Dougs" or "Burger King." The solution is for a series of restrictions placed on the contract. The parent company, McDonalds corporation, supplies all of its outlets with the food, napkins, manuals, ... everything. The local owner usually has little more than a list of phone numbers for supplies. By keeping the local owner a little in the dark, the corporation prevents him from stealing the idea.

Another way the local owner could cheat the corporation is to tell them he made no money, and therefore their share is zero. The McDonalds corporation gets around this problem by sharing revenues with the local outlet, not profits. It is easy for the corporation to know how many burgers and fries are being sold. Since they set the prices, they know the revenues. Costs on the other hand, are more difficult to keep track of. Since they are harder to keep track of, the local owner could exaggerate them, and cheat the parent company. By using just revenues, this is prevented.

One last way a local McDonalds owner could cheat the parent company is to free ride on the brand name. In most cases your local McDonalds restaurant is just that: local. If they provide bad food or service you just stop going there. But what about a McDonalds on the interstate or trans-Canada highway. For these locations most of the customers are just passing through. They stop because their kids saw the golden arches three miles away and wanted to eat. The customers go to this new McDonalds because they've experienced other local McDonalds restaurants ... not this one. The McDonalds on the interstate could cut costs and free ride on this reputation. The customers won't go back to McDonalds given the poor food and service, but they weren't coming back to this

restaurant anyway ... they're from out of town. How does McDonalds solve this problem? For those restaurants that are located in places where there are few repeat customers, the corporation runs the restaurant directly. They hire a manager who gets paid a wage, and they monitor his performance.

16.7 Summary

This chapter has analyzed, mostly through examples, the organization of firms and quasi firms. Some production takes place within very centralized organizational structures, and these institutions we call firms. Firms can increase output using direction of resources without prices because they allow gains from specialization without incurring the transaction costs that arise using prices in a market. In the chapter we saw how various aspects of farming have moved from within the control of the family to the market, and back again depending on the transaction costs involved. The modern movement to industrial farming is the result of changes in transaction costs allowing large firms to out produce small family farmers. We also contrasted the historic organization of the British army and navy, and showed that the army was less of a firm than the navy was because the prize (price) system provides the proper incentives in the army, but not in the navy. We also argued that the navy had superior incentives than the other navies at the time, and this lead to their huge successes over a long period of time. Finally, we considered the incentive structure of a franchise firm. A franchise is a contract that lies in between a market and a firm.

REVIEW QUESTIONS

1. If there were no transaction costs, would there be firms?

2. If there were no transaction costs, what types of markets would there be?

3. Are family farms disappearing, or are there just fewer farms?

4. Why was their purchase in the army, but not in the navy?

5. Is a farmer a capitalist or a laborer?

PROBLEMS

1. "At Segal Furniture we offer you the lowest prices because we sell direct from the factory and bypass the middleman." Under the assumptions of the neoclassical model with zero transaction costs, what is wrong with the logic of this statement? If there are positive transaction costs, can this statement make sense?

2. Suppose a new device is developed which allows your employer to determine at zero cost who is using the photocopying machine for non-business copying. Would that make the typical employee better or worse off?

3. The use of mercenaries paralleled the use of the purchase system in European armies. That is, when armies were staffed with officers who purchased their commissions, these officers were very likely foreigners. With the introduction of professional soldiers paid on a wage basis came the introduction of armies staffed only with nationals. Why would this be?

4. Emily likes to buy her produce at a local store called "Ralph's Market". The store has a common practice of offering its produce for a lower price if it is pre-bagged by the store. For example, apples might cost 89¢ per pound unbagged, but only 79¢ per pound if bagged. Given that the store must pay someone to bag the apples (ie. the cost is higher) why would the price be lower if bagged?

5. The showers in the men's change rooms at most university gyms have only a single faucet for each shower head. That is, it basically turns on or off, and the showeree can't adjust the pressure or temperature. I've noticed that this is very common in public male showers (I'm assuming ... really ... that it is also true of public female showers), but almost never happens in private homes. Why would this be?

6. As economists we naturally think the best way to induce people to supply goods and services is to offer a sufficient price for them. However, sometimes, like in the provision of blood, the good is asked in the form of a donation.

    a. Why would volunteer blood donation be able to out compete for profit blood clinics?

    b. What are some economic problems that arise with volunteer blood giving?

    c. How are these handled?

    d. Every time you give blood, no matter where, they give you a sweet drink and some cookies afterwards. Never a stick of celery or some food with low sugar levels. Can you guess how this might be related to part (b)?

7. "When one company has made specific investments in the manufacture of another company, then a merger is likely." Under what circumstances will this be true, and when will it be not true? Provide an example of each case?

8. Once upon a time a poor graduate student and his wife had a baby. Of course, this was the most beautiful child ever born, and so of course, the wife says, "we must get a professional picture of her." So the couple and child went to Sears. When they returned to look at the

pictures there were a number of options. For $9.95 they could have a package that consisted of the ugliest poses ever seen. The child's parents can't believe their child could look so bad. "But wait!" says the clerk, who pulls out the largest, and most lovely picture of a baby ever taken in the history of the world, "take a look at this!" "Great, we'll take these", say the proud parents. "Fine" says the clerk, "that'll be $179.95". (Parents fall down). Now Sears has a problem here. Sure the couple are willing to pay $180, but no one else in the whole world is willing to pay $2 for this picture. Sears know that, the couple knows that. Question: what is the problem for Sears, and how do they solve it by having the couple deal with a clerk making $6.50 per hour, and who could care less if the couple buy the picture or not?

Review Question Answers

1. *No.*

2. *There would only be simple "spot" trades. We certainly wouldn't see organized markets, or markets with security or other complexities.*

3. *There are fewer farms as the optimal size increases. Most farms, however, are still organized as family firms.*

4. *The navy had the problem that they never knew the conditions of the wind or the exact location of their ships. Thus, if they sold their commissions, they would only attract captains who planned to go after the enemy merchant vessels. In other words, the incentives of the captain would have been incompatible with the king.*

5. *He's both, which points to the natural ambiguity of using such terms.*

Odd Numbered Problem Answers

1. *With zero transaction costs, this makes no sense. The middleman is providing a service, and presumably he has a comparative advantage in doing it. The Segal company must now be doing it, and they must be doing it at a higher cost. With positive transaction costs this could make sense. For some reason, using a middle man could increase the transaction costs considerably.*

3. *Mercenaries fight because there are big pay outs to winning. When the soldiers are paid by a wage, this incentive is mostly gone. Therefore it needs to be replaced. The solution was to use motives of national pride.*

5. *In a public shower where you are not paying for the water or the heat you use too much. In a private home you don't behave this way. So the option is removed.*

7. *The merger is more likely if it solves a transaction cost problem between the two firms without increasing costs of production.*

CHAPTER 17

THE ECONOMICS OF ORGANIZATION: CONTRACTS AND MARKETS

In the last chapter we analyzed exchanges that took place within the context of what we would generally consider firms. At least they were organizations with considerable hierarchy. In this chapter we start off by looking at situations where agents contract with one another over a specific asset. In such cases individuals are linked together, but not as formally as within firms. The focus will be on the contract for land in farming, but after going over this case in considerable detail, examples in other areas of life will also be dealt with. After this, we will move onto the organization of market transactions. Most market exchanges are not simple on the spot trades, and we want to look at how some more complicated trades are organized.

17.1 **Contract Choice in Farm Land Leases**

Farming, as mentioned before, is a simple type of production relatively familiar to most of us. Farming a crop like wheat or oats requires human capital embodied in the farmer. A farmer needs to know when and how to plant, cultivate, and harvest. The farmer usually needs to know a number of other skills in order to maintain his equipment, keep accounts, and the like. Farming requires equipment. Sometimes this equipment is general, like a tractor, and can be used for all types of farming. Other times the equipment is very specific, like a cherry picker, and can only be used for one type of farming. Farmers tend to always own their equipment. They do this because of the large role the weather plays on production. Perhaps you've heard the phrase "make hay when the sun shines." For a farmer, when the weather provides a window for a task, he needs to perform it right away. A delayed harvest, for example, can mean the crop might get hailed on, blown over by storms or snow, and generally might lower the total yield. Thus farmers own their own equipment so they can work the fields on their own schedule. The last major input in all farming is land. For some types of farming, like grain, land is a huge input. For other types of farming, like chickens, it plays less of a role in total costs.

Interestingly, across Canada and the United States, about 50% of the land farmed is actually owned by the farmer; the rest is rented. When the land is rented, it is rented in one of two ways: cash rent or cropshare. A cash rent contract is where the farmer pays the landowner some fixed amount of rent in dollars. For example, the farmer might pay $150 per acre for the year to use the land. When a farmer rents the land on a cash rent basis, he keeps all of the crop for himself and sells it on the market. A cropshare contract on the other hand, is where the farmer uses the landowners land, harvests the crop, and then pays the landowner with a share of the output. Normally these shares take on a few values. Shares of 1/2, 1/3, and 2/5 to the landowner are the most common. Thus, a wheat farmer might give the landowner 40% of the crop at the end of the season. The puzzle we want to solve is "what explains the use of the different contracts?"

As we will see, the answer will again come down to the transaction costs of each contract under different circumstances. Sometimes the cash rent contract provides the best incentives, and other times the cropshare contract provides the best incentives. Let's start by noting the level of output from a farm depends on a few things. It certainly depends on the level of effort of the farmer — no

effort, no crop. But the quality of soil, the weather, pests, and other random features all play a role in the level of crop. Furthermore, output depends on how well the farmer looks after his soil. When a farmer owns his own land he manages his soil, even when it means a lower crop in the current year. Soil is a resource that contains nutrients like nitrogen, moisture, and the like. When a farmer uses too many of these things, he reduces the ability of the soil to produce crops in the future. A farmer who owns his own land will use the nutrients efficiently and will use them until the cost is equal to the value of the marginal product of the nutrient. Furthermore, a farmer who owns his own land will provide the optimal amount of labor on his farm as well. That is, he will supply labor until the value of his marginal product is equal to the wage he could earn off the farm. A farmer does not maximize the size of the current crop, he maximizes the value of his farm. This is shown in figure 17-1, where the farmer chooses the level effort and soil nutrients optimally. The wage w^* is determined in a labor market off of the farm, while the cost of using nutrients n^* can be thought of as the opportunity cost in terms of lost future crops of using nutrients today.

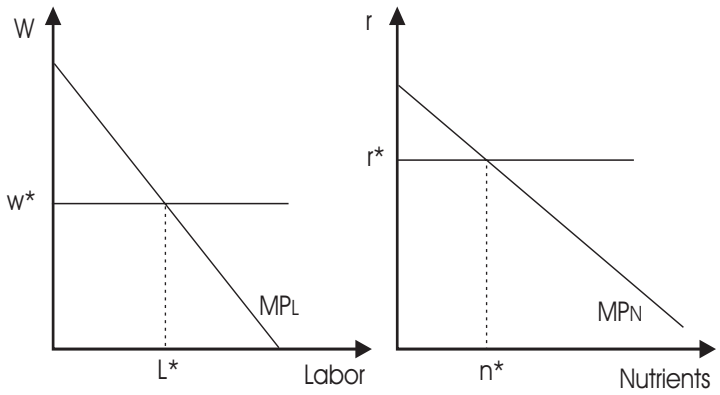

Figure 17-1
Input Use With Full Ownership

Suppose now that instead of owning his land, the farmer rents the land from a landowner. A renter on the other hand, cares less about the soil than the farmer does. This is a common problem with renters. When you rent an apartment from a landlord you treat the place differently than if it was your own. If you spill coffee on the rug, you might mop it up, but you're unlikely to clean the rug. In fact, you probably just move the couch over the stain. You slam doors, overload the dishwasher with unrinsed dishes, leave the water on when you leave for the weekend, and tell your guests to leave their shoes on. When you rent a car, you drive differently than when you own a car. It's what renters do. Economists have a name for this type of behavior, it is called *moral hazard*. Whenever someone doesn't bear the full costs of their decisions, they tend to overuse and abuse the goods they don't fully own.

For the farmer who rents the land by cash, any crop that comes off the land is income to him, and soil be damned. A cash renter has an incentive to mine the soil, and although the landowner may try to directly police this, many soil exploitation techniques are very hard to detect. When the farmer does this he increases the crop he receives this year, but future crops are hurt because the value of the soil is reduced. This type of behavior is shown in figure 17-2, where the cost to the farmer of using soil attributes is r', which is lower than the true cost the landowner bears. When

faced with this lower cost, the farmer uses too much of the soil nutrients, and now uses n'. Since the value of the marginal product of these extra nutrients is lower than their true cost, a deadweight loss is created, and is equal to the crosshatched area. We can think of this as being the cost of a cash rent contract.

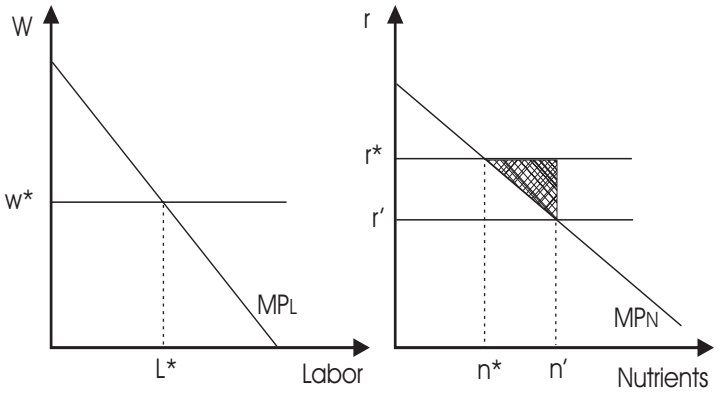

Figure 17-2
Input Use With Cash Rent Contracts

One way to mitigate this moral hazard problem is to slow the farmer down in his desire to use the land by using a share contract rather than a cash rent contract. In many ways a share acts like a tax on behavior. Every time the farmer puts effort into farming, or uses soil nutrients, the landowner takes a cut. This reduces the incentive of the farmer to put effort into the farm and use the soil. Technically what the share does is lower the marginal product of the input to the farmer. This is shown in figure 17-3.

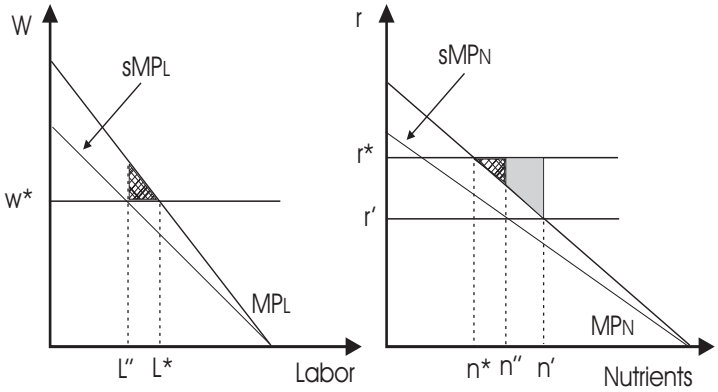

Figure 17-3
Input Use With Cropshare Contracts

The share to the farmer is s, and so as far as the farmer is concerned the value of the marginal product of each input is sMP under the cropshare contract. When the farmer equates his new

marginal product curve with his costs we see that he provides less effort (e'') and uses fewer soil nutrients (n'') than he would have under the cash rent contract. The farmer still uses more nutrients that a pure owner would, but he uses less than under the cash rent. Hence the cost of the cropshare contract includes the two crosshatched triangles, but the contract saves the dark shaded region.

You may be wondering, "if the share benefits the landowner (and ultimately the tenant) by getting him to back off on his land abuse, why would a landowner ever use a cash rent contract?" Can you think of a transaction cost problem that arises with a share contract that doesn't arise with a cash rent contract? The problem is that a share contract creates an incentive for the farmer to lie about the amount of crop harvested. Every part of a shared crop that is under reported counts as income to the farmer. For example, suppose the crop is bales of hay, and suppose a field produces a 1000 bales and the share to the landowner is 50%. If the farmer is honest, his income will be 500 bales. But if he reports that only 800 bales came off the field he pays the landowner 400 bales and keeps 600. In other words, his income is higher by 100 bales. Notice that this incentive to under report is missing from the cash rent contract, because there the farmer keeps everything. Just as with the case of soil exploitation, the landowner anticipates this problem and will make some effort to avoid under reporting. However, if the problem of under reporting is serious enough, a cash rent contract solves the problem.

Hence when crop theft is important it is expected that a cash rent contract will be chosen; when soil exploitation is a problem share contracts should be used. This holds for many crops, but consider grass crops versus row crops. Hay, alfalfa, and other grass crops are planted and then harvested several times a year. These crops require little soil manipulation and the output can be sold many ways as well as being used on the local farm for feed. Row crops, like corn, require extensive soil manipulation, and are generally sold through a local elevator. Which do you think is grown with cash rent contracts and which with cropshare? If you said grass and row, respectively, then good for you, you're starting to think like an economist.

Almost all grass crops grown under a land lease are contracted with a cash rent contract. Grass crops are easy to steal and the soil is hard to exploit. Hence they are perfect for a cash rent contract. The costs of these contracts are minimal. Almost all row crops on leased land are grown under cropshare contracts. Row crops are hard to steal, and yet the soil is easily manipulated and exploited. If you grew row crops with cash rent contracts, there simply would be no soil left after a couple of years. Hence we see that contracts are designed to maximize the value of the exchange, taking into account the transaction costs involved. Once you understand what the cheating problems are, the contract solutions seem rather obvious.

Contract choice issues are quite common. Anytime individuals enter into a contract there usually are a number of types of contracts available. For example, when an owner of a stand of trees sells his trees to a logging company he either sells them on a lump sum basis or by the amount of timber that comes out of the forest. That is, the landowner might say "I'll charge you $100,000 and you can go in and cut whatever you want." Or the landowner might say "If you cut down a Douglas Fir tree, you'll pay me $30 for every cubic foot that comes out of the forest." Each contract will have its own specific transaction cost problems. With a lump sum payment the logging company is going to spend a lot of time measuring what quality and volume of trees exist in the forest, and this type of measurement is costly. With a per unit fee for trees the company doesn't have to measure before they commit to logging, but the problem is the company won't want to take all of the trees out. The per unit fee again acts as a tax because it lowers the net price the firm gets per tree. Thus the landowner will have to monitor the logger to induce the optimal level of logging. Hence in stands of forests where all the trees are the same and measurement is easy, lump sum fees are used.

In second growth, heterogeneous stands of trees, the per unit contracts are used.

Movie contracts are another area where we see contract choice. When an actor works on a movie they are either paid a fixed sum or they are paid a share of the film revenues. Payment by a fixed sum is simple, but it requires monitoring. The actor cares less about his performance because his income doesn't depend on how well the film does. When the actor is paid by a share of the revenues, he cares more and puts more effort in. Thus, when the actor's input is more important, he is more likely to be paid by a share than a fixed sum. Actors in sequels, actors who've won an Oscar, and actors whose films have done well in the past, all tend to be paid a share of revenues rather than a fixed sum.

17.2 **Market Enforced Quality Control**

When you walk up to a vending machine, drop some change into the slot, and then punch the button for an *Oh Henry* candy bar, what guarantee do you have that it will be fresh and tasty? If the candy bar is old, lacking peanuts, or for some other reason is generally unsatisfactory, what is a consumer to do? You could write to the Hershey company and demand your money back, but this hardly seems worthwhile. How is a guarantee, guaranteed?

Here is a more general problem. If my car is defective, it is valuable enough that I will pursue the manufacturer until it is fixed. Because I behave this way I am even willing to purchase a guarantee from the automotive company, but when it comes to small time purchases like a chocolate bar or a T-shirt, why would I believe a seller's guarantee of quality when I know it will never pay me to act on it? Furthermore, if firms know that there is little or nothing I will do in response to being cheated, and if cheating is more profitable than being honest, then they will always cheat by promising high quality goods but not delivering them. If consumers anticipated this behavior then they would never be willing to pay more than a low quality price for goods and that is all that would get produced. When quality cannot be guaranteed, it would appear that many markets would simply fall apart! The general market solution to this problem is for the firm to establish a reputation for selling high quality goods. Reputations, therefore, are a market response to a transaction cost problem between buyers and sellers.

Suppose we have the following situation. A number of price-taking firms are selling refrigerators, with every firm deciding whether to sell high quality units that will last for 10 years or sell low quality units that will only last for 1 year. The problem for the consumer is that he cannot tell them apart, and will not know until one year after the purchase which type he has. The problem for the firms is that a high quality refrigerator sells for more than a low quality one, but also costs more to produce. Figure 17-4 shows the three options available for a given firm. Point A represents the case for a firm that decides to produce the low quality refrigerator and announce this truthfully. The firm receives the low quality price P_L, and earns zero profit. Point B is the outcome for a firm that decides to sell a high quality refrigerator, announces its intentions truthfully, and is believed by its customers. In this case, the firm produces along the higher cost functions and again earns zero profit. Point C represents the case of a firm that produces low quality, lies and announces that it has produced high quality, and is believed by its customers. In this case the firm receives the high quality price P_H, but faces the low quality costs, and so earns a profit equal to the shaded area.

Of these three cases, only one is an equilibrium, can you tell which one? If you picked point A, you are right. Clearly the most profitable thing for any firm to do is to lie and announce it

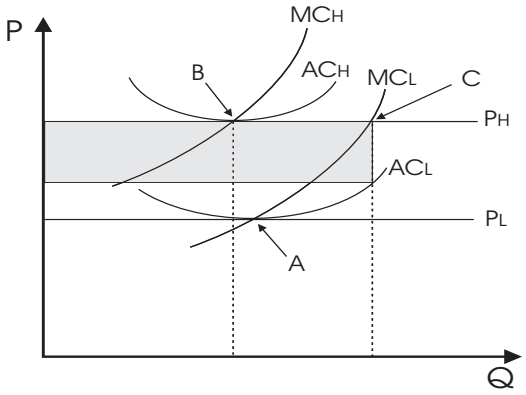

Figure 17-4
The Cheating Equilibrium

is producing a high quality product when in fact, it is producing low quality. However, every customer knows that this is the dominant strategy of the firm and therefore never offers to pay a price higher than P_L. If a firm is honest and produces a high quality refrigerator, no one believes the announcement and the firm loses money because it still receives the low quality price. Hence the only equilibrium is at point A.

Notice punishing a cheating firm by never shopping there again has no impact on their behavior because the firm is better off cheating than being honest. True, the firm will go out of business if it is discovered to be dishonest, but in the meantime it earned a rate of return greater than the return to being honest. Since we do observe firms producing high quality goods, what is the solution? The answer is for the honest firm to be paid a premium for producing high quality. Once this is done, then consumers can punish cheating firms by never buying from them again and this punishment has some bite.

Suppose customers could pay a higher price for the high quality good, such that the honest quality producer could now earn a profit. Figure 17-5 shows if the price of high quality products is raised to P'_H then the honest firm will earn a profit equal to the shaded region. At this higher price there is an even larger gain to cheating, but when a firm cheats it only gets the gain one time and then is "fired" by the consumers. An honest firm gets the shaded region year in year out. As long as the present value of the shaded region from being honest is greater than the one time gain from cheating, firms will be honest, and high quality goods can exist in equilibrium.

The one last thing needing to be resolved is that at point E the high quality firm is earning profit, and in equilibrium we know that profits must be driven to zero. Unfortunately, if prices fall, the firms begin to cheat again. The solution is for the firms to invest in sunk capital until profits are zero. Because the capital is sunk, the shaded region is a rent. Profits are zero, but if the firm cheats it loses its sunk investment. In effect, the sunk investment acts as a bond or a guarantee of quality.

Now we can see the role of a reputation. Reputations are not cheap, and they are always in some form of sunk investment. When a firm advertises, spends money in the community, or takes a costly action that informs customers about itself, it incurs sunk costs. If the firm cheats customers, then it loses these investments, and as a result the existence of a reputation enforces a firm's claims

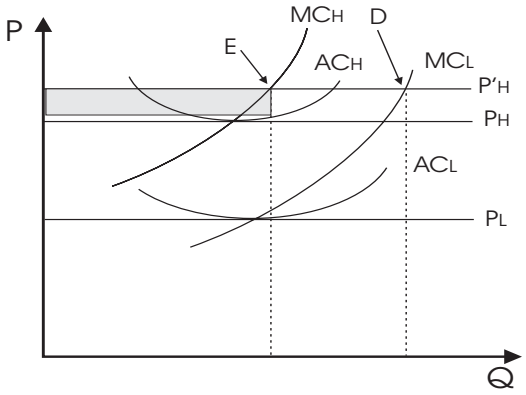

Figure 17-5
Producing High Quality

of high quality.

This provides an interesting explanation for several puzzling observations. How many times have you watched an advertisement on TV for General Motors or Nike running shoes, where there was almost no informational content to the ad? Perhaps the ad showed a beautiful lady on a sailboat in tropical waters, with the camera circling the boat, coming closer and closer. As the picture focuses in on the face of the woman, she turns and says "GM". What information could this possibly convey? The standard reply is that General Motors is playing with our sub-conscious. If we buy a GM car, the story goes, then we will also have a great boat in sunny waters. The answer provided by this model suggests a totally different solution. What the consumer really needs to know is whether they can trust GM or not. If GM is willing to "throw" money away on useless advertisements, then they must be earning a rent. If they are earning a rent then they must be planning on staying in business for a while, and that means they must be planning on producing high quality. Hence General Motors is indirectly advertising that they are honest. Banks are often chastised for having elaborate buildings and expensive interiors. If you travel from city to city you will find the major local bank often owns the nicest place in town. Why would this be? Suppose that a new bank was set up just outside your university. We could call this bank "The Allen Bank". The main feature of this bank would be that it operates out of a motor home (with the motor running). Are you going to put your money in a bank like that? Of course not. Banks, historically, have been required to invest in sunk physical assets in order to guarantee their customers that they will not abscond with their money. Once again, the sunk investment backs up the reputation of the firm and tells customers that they are dealing with an honest firm. On one occasion I was walking down Chicago's "miracle mile", a street with extremely expensive stores. I came upon a Rolex store that was unlike any other. The walls were marble, the door handles were gold, the carpet six inches deep (well, not quite, but it was thick!), and inside were watches that cost up to $25,000. Ironically, around the corner was a gentleman in a long overcoat who was selling Rolex watches for $25! To my eye the watches looked the same. Clearly Rolex had to make extreme investments to guarantee that the watches they were selling were not fakes.

17.3 **Signals of Quality Type**

Have you ever worn a nice suit to an interview? If you have, you are signaling. It's not clear

what you are signaling, but it must be important since everyone who goes to an interview always wears a new suit. Every year around Christmas time economists have their annual meeting, and at this meeting first interviews are done with all of the new Ph.D.'s. Now picture your average Ph.D. student. Perhaps you have one for a teaching assistant. The last thing you would ever picture that person in is a suit right? But at the annual meetings he or she will have one on. In fact, you can always tell the interviewees, and not just be the sweat on their palms ... they're the only ones with new suits!

Signals provide information. In a world where information is costly, and where people take advantage of other's lack of knowledge, signals can be very useful. In order for something to be a good signal it must be difficult to imitate *and* it must be more costly to acquire for the low quality commodity. Hence, dressing in a suit is a lousy signal. Any one can dress in a suit, and good job candidates have no advantage over the bad ones.

An interesting example of signaling was provided by the Air Traffic Controllers (ATC) during the 1970's. In 1972 Congress passed a disability act that allowed "stress" and "burn out" to count as a disability. This act also increased the disability pay so that for some government employees the tax free disability was higher than their after tax wage. In 1974 Congress modified the rules to allow a worker to chose their own physician. Claims made by ATC jumped by 150%. Now this could have been due to the fact that they really were under stress, and the new laws simply lowered the cost of making a claim, but there appears to be more to it. In order to increase the probability of a successful claim ATC's could signal that they were under stress. Planes suddenly started to come closer together. There are several degrees of closeness, and all of them qualify as evidence of stress. Interestingly, planes were brought closer together, but not to the point where there was a near mid air collision! Most of these errors occurred in the daytime, when the weather was nice, with passenger jets, and at non-peak times. This increased the probability that some one else (like a passenger or pilot) would report the error and that the ATC could devote all of his energy to sending the signal. Relax though, Congress changed the rules again in 1978, so the skies are friendly once again.

That was an example of a signal that dissipated wealth. Signals are not always like that. The veal market provides an example of a simple signal that saves resources. Veal is produced from a milk and grain fed steer of 6-12 months old. By feeding the calf heavy doses of milk and grain, and no hay, the farmer produces meat that is pale, soft and valuable. Beef that is fed hay, is red and tougher. Unfortunately it is expensive to feed only milk and grain. Furthermore, veal is almost exclusively sold through auctions where the seller is unknown to the buyer. Can you see a potential transaction cost problem here? A less than honest farmer could feed his calf cheap hay, and try to pawn it off as veal. No one could catch him because the auction doesn't reveal the seller. But, of course, buyers would anticipate this and so they would only offer the red meat price. But we do see veal being sold through the auction. The reason is that there is one breed of cattle that provides a signal for what it has been fed.

The Holstein breed is bred to produce milk not meat. It is a tall skinny animal compared to its beef cousins. The Holstein is the black and white cow most people think of when they think of a cow. Just in case you've never seen one, figure 17-6 shows a picture of one. However, when this animal is fed hay, it develops a "pot-belly" that any farmer can recognize from one end of the barn to the other. Other breeds do not develop this unique signal. The result is that if you go to a cattle auction, and you hear the auctioneer announce that the veal calves on coming, the only breed you'll see are the Holsteins. Well, you may see some others, but you watch what happens their price!

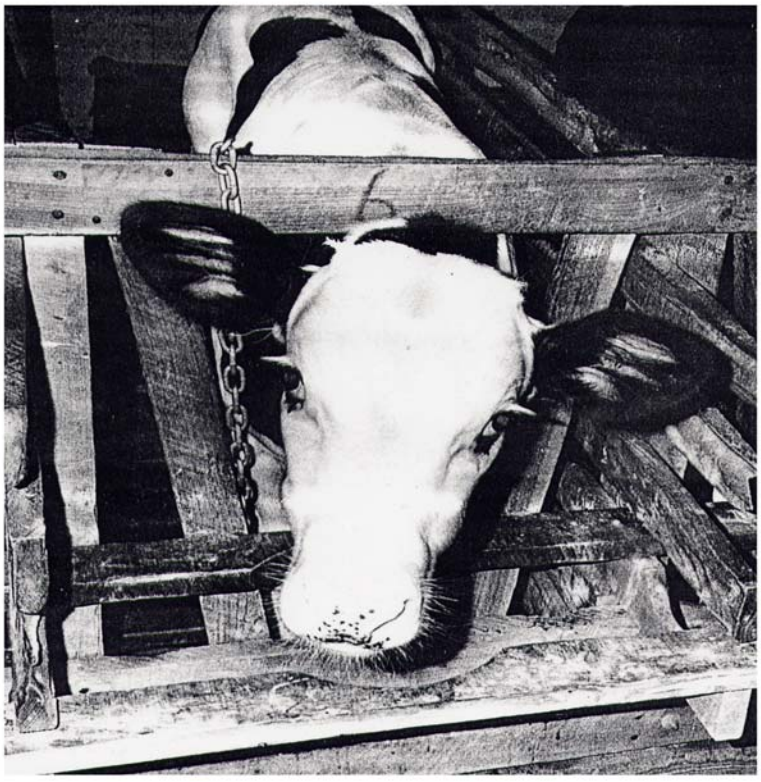

Figure 17-6
A Holstein Vealer

If you're following this argument, you probably recognize that the reputation argument discussed above is an example of "brand name" signal. When a firm invests in a reputation and announces it as such, this investment acts as a bond for good performance. The consumer sees the brand name signal and recognizes the firm will be worse off if it cheats the consumer. Speaking of posting bonds. Your mother and grandmother probably have very nice diamond engagement rings, but your great-grandmother, and certainly your great-great-grandmother probably didn't. Not only this, your grandmother's ring is probably bigger than you mother's ring, and in terms of the fraction of marital wealth, both will be bigger than your's or your wife's. About 50 years ago it became popular to make substantial investments in diamond engagement rings. Since then it is still customary to buy such rings, but now it is possible to simply purchase 5 point diamonds or high quality Cubic Zirconiums at very modest prices. Why did this happen?

Before you read this book you might have said "It happened because tastes changed; DeBeers came along and told everybody that diamonds are forever, and they just believed them." If you still think this way then you should consider a career in dentistry or accounting. If you're becoming an economist, you should be unsatisfied with theories that cannot be refuted, and you should be trying to think up an explanation based on changing constraints. At one time a broken engagement meant more than embarrassment. Quite often couples would lose their virginity during the engagement, and a broken engagement meant a serious loss of human capital for the woman since this was a serious offense for women 50-100 years ago. A broken engagement meant fewer and poorer options in the marriage market.

Prior to the 1930's women had legal redress through the courts and could sue for breach of promise to marry. Most of these suits were settled out of court, and mostly with the result being a marriage. After 1930, however, different states started to strike these laws from the record. In order to prevent "sleeping and running," diamond rings were used as a promise to fulfill the contract. The more serious the loss of virginity, the more serious the diamond!

17.4 **Screening and the Duel of Honor**

When a person does something like "dress for success" or tatoo their body, they are trying to signal what type of person they are. Sometimes, however, firms take an action to "screen" or "filter" some types of people from others. When you apply for a job it is often limited to individuals who have completed certain levels of education, or who pass some type of exam. A fascinating screen was used by the aristocracy of Europe during the premodern era to filter out trustworthy people for civil service. This screen was the "duel of honor" seen so often in hollywood movies.

From 1500 to 1900 AD thousands of aristocrats lost their lives in duels of honor. Dueling had a long history before this time, but earlier duels were nothing like the duel of honor. In medieval times justice was often metered out in a judicial duel. These duels took the place of court actions, and the winner was considered chosen by God to be innocent of whatever crime was committed. In addition to these duels, there were the chivalrous duals between knights. These contests were public events used to raise the profile of brave fighters.

Unlike the judicial and chivalrous duels, duels of honor were held in secret and were illegal. Duels of honor were not fought over serious crimes, but of issues of honor (a bad look, a slap to the face, or an accusation of lying). More interestingly, they were conducted with a limited set of lethal weapons (rapiers, sabers, and later pistols), and along a specific set of rules. When an aristocrat

was caught dueling no legal action would take place unless the rules were not followed. If someone outside the ruling class was caught dueling they were charged with attempted murder.

There have been many famous duels of honor between many famous people. Abraham Lincoln was in a duel, although a rather humorous one. He had been challenged by a rather small individual, and as the challenged he had the right to choose the weapon. On seeing the stature of his opponent he opted for a set of extremely heavy broad axes (an unconventional weapon). The duel was unable to get off the ground when the opponent was unable to lift the weapon! Another president, Andrew Jackson, was in a duel early in his career. His duel is most remembered for his use of a large overcoat. Normally duelers would strip to the waist in a duel to avoid infection caused by dirty cloth. Jackson kept his large coat on, and when the bullet passed through the coat at a spot where his heart should have been, the witnesses were shocked to see Jackson rise and return a fatal shot to his opponent. The skinny Jackson had apparently shifted his body to one side inside the large coat. Such behavior, if caught was very frowned upon.

The most famous duel of all time was between Alexander Hamilton, one of the founding fathers of the United States, and Colonel Aaron Burr, Vice-President of the United States under Jefferson. Hamilton, a federalist, had lobbied against Burr for the presidency in the election of 1800. When Burr, who did not get along with Jefferson attempted to join the federalist party, Hamilton started a secret campaign to stop him. When Burr discovered some of the things Hamilton had said at a dinner party about him, he challenged Hamilton to a duel. Hamilton did not want to fight the duel, and in a letter to a friend he outlines several reasons why he should not fight: "My religious and moral principles are strongly opposed to the practice of Duelling ...; My wife and children are extremely dear to me ...; I feel a sense of obligation towards my creditiors; I am conscious of no ill-will to Colonel Burr ...; Lastly, I shall hazard much, and can possibly gain nothing by the issue of the interview." Yet he went ahead with the duel, and died from a shot to the abdomen the next day.

So here's the question: why would someone like Alexander Hamilton, or the Duke of Wellington or the Duke of Marlborough (both dueliests), put their valuable lives at stake for such petty issues? The answer is the duel of honor was acting as a screen to enter and stay in the ruling class. Bureaucracies are a modern invention, and in the pre-modern era governments were run by aristocrats with strong reputations for honesty. Reputations were made through sunk investments in the aristocratic society, and the duel was the method by which this reputation was tested. If any aristocrat ever turned down a duel, they became a social outcast, removed from any position of influence. By entering a duel an aristocrat was demonstrating his investment in society and his trustworthiness.

There are many facts about dueling consistent with its role as a screen. First, the outcome of a duel was irrelevant. Win or lose, the participant in a duel was allowed to continue on in the aristocratic world because they demonstrated they had made an investment into society and could be trusted. Only those who turned down the duel and failed the screen were expelled. Ironically, many duelist rekindled friendships after a duel. Aaron Burr was allowed to finish his term as Vice President and had a successful career as a lawyer afterwards. Second, there was a serious attempt to make the outcome of a duel random. As mentioned, duels of honor were fought under specific rules. Many of these rules attempted to make the duel mostly a game of chance. This was necessary, because a duel based on skill could not act as a screen. Someone who was a good duelist could go around challenging people, and pretend they were a trustworthy person. Thus, in pistol duels, for example, the aiming beads were removed, the barrel was shortened, and the barrel was not rifled. All of these efforts made the weapon inaccurate. Furthermore, the participants could not take much

time in aiming. These efforts essentially randomized the outcome, and better allowed the duel to act as a screen for reputation. Finally, it didn't matter who made or accepted the challenge. All that mattered in dueling was whether or not one entered or declined.

17.5 Summary

This final chapter has considered the organization of markets. It began with a section on farm land lease contracts. Contracts are not pure market trades, but neither are they firms. A contract, like a franchise firm, lies in between pure firms and markets. We saw that the choice of the type of contract depended on the incentives each one created. Every contract creates different incentives, and lead to different allocations of resources. The contract with the highest value is chosen. Next we looked at how firms make commitments to produce high quality goods. Because firms always have an incentive to cheat customers when customers can't measure the quality of goods, firms invest in specific forms of sunk capital to convince customers of their honesty. We saw that this sunk capital acts as a reputation for the firm. This model explained why so much advertising we observe contains so little informational content. Its sole purpose is to demonstrate the firm's investment in sunk capital. We then looked at how individuals signal quality in veal markets where information is not very good. Finally, we briefly discussed how dueling in the pre-modern era functioned as a screen of trustworthiness in the civil service of the day.

REVIEW QUESTIONS

1. What would happen to the optimal share to a farmer is there was another input besides land attributes and labor (say seed). Suppose this input is supplied by the farmer, not the landowner.

2. Suppose some farmland was to be converted to a shopping center in two years. What type of contract would be used, a share or cash rent?

3. Would the role of reputation would if the firm in figure 17-4 was a price searcher rather than a perfect competitor?

4. Why would ordinary citizens not be allowed to duel?

5. Does the breed of cow matter in private veal sales?

PROBLEMS

1. Mail order firms send out catalogues and then receive orders from their customers. What is a serious transaction cost problem for a mail order firm to overcome? Can you think of methods that might be used to overcome this problem? Can this explain why Sears, when it first started as a mail order business, placed a picture of their new Chicago warehouse on their early catalogs, with each brick stamped with "Sears" on it.

2. Mules are a cross between a horse and a donkey. Mules are very tough and robust. Mules have a tendency to not hurt themselves (they don't overeat or drink, and they simply quit working if worked too hard). On the other hand, mules are less productive than horses on a farm. Mules were heavily used in the American South before tractors, but were never that common in the American North or in Canada where horses were used. In the South most agriculture was done on plantations where many wage workers were employed, while in the north farms were operated by families. Can you use this last fact to explain the use of the mule over horses in the south?

3. In a certain developing country, wheat farms have the following production function, where L=labor input and TP=total product. Labor can earn $4 per day in the nonagricultural sector of the economy.

L	TP
1	10
2	18
3	25
4	31
5	35
6	38
7	40
8+	40

   a. Suppose the farms are owned by landlords who hire workers to farm the land. How many people will work on each farm? Explain.

   b. Suppose the land is "common property": the land is farmed by communes, where the commune is a closed group that decides it own size and then shares equally among its own members. How many people will work on each farm? Explain.

   c. Suppose that the land is still common property, but also the commune cannot prevent anyone from joining and sharing the benefits. How many people will work on each farm? Explain.

   d. If the demand for wheat increased substantially in the economy, so that many additional farms entered into wheat production, what would happen to the rents received by the owner of this land?

   As mentioned in this chapter, share tenancy is a common form of rental agreement in agriculture. In this contract, the farmer agrees to pay some fraction of his or her output to the

landlord as payment for rent. The system has been likened by some to a tax on labor.

e. Using the numbers derived above, explain why a tax on labor would lead to "too little" labor being used on the land, and why the rent on the land would decrease.

f. A share contract, however, is not a tax. It is a voluntary contract between the landlord and the tenant. The landlord keeps this "tax". Would landlords enter into a contract which gave them less rent than a fixed wage contract as in part a. above?

4. Cars come in every color, independent of brand make. Likewise, street motorcycles also come in any color independent of who made them. But tractors do not. Ford's are blue, John Deere's are green and yellow, International Harvester are red and gold, Case are yellow, etc. Furthermore, off road motorcycles tend to have colors that depend on brand: Honda's are red, Kawasaki's are green, Yamaha's are yellow (I think). Why would this be?

5. Far fewer babies are currently offered for adoption in the United States than couples want to adopt. Would you call this a shortage? Why doesn't the price of an adopted baby rise? By what criteria are the scarce babies rationed to prospective adopters? Why do you think we aren't allowed to sell babies?

6. When I shop at Safeway, there are a number of tellers, each with their own queue. When I shop at the Royal Bank, there is one queue and you go to the first teller available. Why?

7. Here are some lyrics from Fleetwood Mac's *Hold Me*, off their 1982 Mirage Album.

   I don't want no damage

   But how'm I gonna manage with you

   You hold the percentage

   But I'm the fool payin' the dues

   The song is in the context of a personal relationship, but from the lyrics we can see the cause of the problem is a general transaction cost one. What is the general problem that is being referred to? Can you provide your own example of this type of problem?

Review Question Answers

1. *The share will increase to the farmer. You can see this if you draw a figure like that in 17-3, but with three inputs.*

2. *It would be a cash rent contract because you wouldn't care about the lost nutrients, and you'd avoid monitoring the under reporting problem.*

3. *With price searching it plays an even more effective role, since the falling demand curve makes it harder to sell a lot of the low quality product as good quality.*

4. *Dueling was a way for the aristocrats to screen for social capital. Commoners were not allowed into their social circle, so there was no purpose in them dueling. By allowing them to duel it would have simply added noise to the screen.*

5. *No. All breeds are used in private, non-auction veal sales.*

Odd Numbered Problem Answers

1. *The problem is people send in their money, and nothing comes back. Mail order firms have to make some type of reputation investment to convince people they won't rip them off. Sears sunk a lot of money into a building it would never recover if it went out of business.*

3.

   a. *Workers will be hired until their marginal product equals their marginal cost. In this case 5 workers will be hired on each farm.*

   b. *The commune wants to maximize the average product. In this case each farm only has one worker. Some commune!*

   c. *Now people will arrive until the average product is equal to the $4 cost. This happens when 10 people are on each farm.*

   d. *It would depend on which regime we're talking about. In case (a), if the price of wheat increased then the rents to the land would increase.*

   e. *The share would lower the marginal product, this would lower the number of workers on the farm and lower the rent earned.*

   f. *No. So it must be the share contract has some type of value. Workers on a farm tend to exploit the soil of the landowner. The share contract slows this down.*

5. *Yes, it is a shortage. There is no explicit price for babies, so it cannot rise. However, there is an implicit price. People now wait, for example, much longer than before to adopt. There are many non-price allocation mechanisms ... race, religion, stability of couple, etc. I think making babies for sale would increase the number of baby thefts. People would then go to great lengths to protect their children.*

7. *The issue is sharing benefits and costs. Clearly from the song one party gets a share of benefits, while the other bears all of the costs. Just as in the example of the author versus the publisher, this will lead to conflicts over all kinds of things.*