

CHAPTER 17

Markets with Asymmetric Information

For most of this book, we have assumed that consumers and producers have complete information about the economic variables that are relevant for the choices they face. Now we will see what happens when some parties know more than others-i.e., when there is *asymmetric information*.

Asymmetric information is characteristic of many business situations. Frequently, a seller of a product knows more about its quality than the buyer does. Workers usually know their own skills and abilities better than employers. And business managers know more about their firm's costs, competitive position, and investment opportunities than do the owners of the firm.

Asymmetric information explains many institutional arrangements in our society. It is a reason why automobile companies offer warranties on parts and service for new cars; why firms and employees sign contracts that include incentives and rewards; and why the shareholders of corporations need to monitor the behavior of the firm's managers.

We begin by examining a situation in which the sellers of a product have better information about its quality than buyers have. We will see how this kind of asymmetric information can lead to market failure. In the second section, we see how sellers can avoid some of the problems associated with asymmetric information by giving potential buyers signals about the quality of their product. Product warranties provide a type of insurance that can be helpful when buyers have less information than sellers. But as the third section shows, the purchase of insurance entails difficulties of its own when buyers have better information than sellers.

In the fourth section, we show that managers may pursue goals other than profit maximization when it is costly for the owners of private corporations to monitor the managers' behavior. (In other words, managers have better information than owners.) We also show how firms can give managers an incen-

tive to maximize profits even when monitoring their behavior is costly. Finally, we show that labor markets may operate inefficiently when employees have better information about their productivity than employers have.

17.1 *Quality Uncertainty and the Market for "Lemons"*

Suppose you bought a new car for \$10,000, drove it 100 miles, and then decided you really didn't want it. There was nothing wrong with the car—it performed beautifully and met all your expectations. You simply felt that you could do just as well without it and would be better off saving the money for other things. So you decide to sell the car. How much should you expect to get for it? Probably not more than \$8000—even though the car is brand new, has been driven only 100 miles, and has a warranty that is transferable to a new owner. And if you were a prospective buyer, you probably wouldn't pay much more than \$8000 yourself.

Why does the mere fact that the car is second hand reduce its value so much? To answer this question, think about your own concerns as a prospective buyer. Why, you would wonder, is this car for sale? Did the owner really change his or her mind about the car just like that, or is there something wrong with it? Perhaps this car is a "Temon."

Used cars sell for much less than new cars because *there is asymmetric information about their quality*: The seller of a used car knows much more about the car than the prospective buyer does. The buyer can hire a mechanic to check the car, but the seller has had experience with it, and will know more about it. Furthermore, the very fact that the car is for sale indicates that it may be a "lemon"—why sell a reliable car? As a result, the prospective buyer of a used car will always be suspicious of its quality—and with good reason.

The implications of asymmetric information about product quality were first analyzed by George Akerlof in a classic paper.¹ Akerlof's analysis goes far beyond the market for used cars. The markets for insurance, financial credit, and even employment are also characterized by asymmetric quality information. To understand its implications, we will start with the market for used cars and then see how the same principles apply to other markets.

The Market for Used Cars

Suppose two kinds of used cars are available—high-quality cars and low-quality cars. Also, *suppose that both sellers and buyers can tell which kind of car is*

¹ George A. Akerlof, "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics* (Aug. 1970): 488-500.

which. There will then be two markets, as illustrated in Figures 17.1a and 17.1b. In Figure 17.1a, S_H is the supply curve for high-quality cars, and D_H is the demand curve. Similarly, S_L and D_L in Figure 17.1b are the supply and demand curves for low-quality cars. Note that S_H is higher than S_L because owners of high-quality cars are more reluctant to part with them and must receive a higher price to do so. Similarly, D_H is higher than D_L because buyers are willing to pay more to get a high-quality car. As the figure shows, the market price for high-quality cars is \$10,000, for low-quality cars \$5,000, and 50,000 cars of each type are sold.

In reality, the seller of a used car knows much more about its quality than a buyer does. Consider what happens, then, if sellers know the quality of cars, but buyers do not. (Buyers discover the quality only after they buy a car and drive it for a while.) Initially, buyers might think that the odds are 50-50 that a car they buy will be high quality. (The reason is that when both sellers and buyers knew the quality, 50,000 cars of each type were sold.) When making a

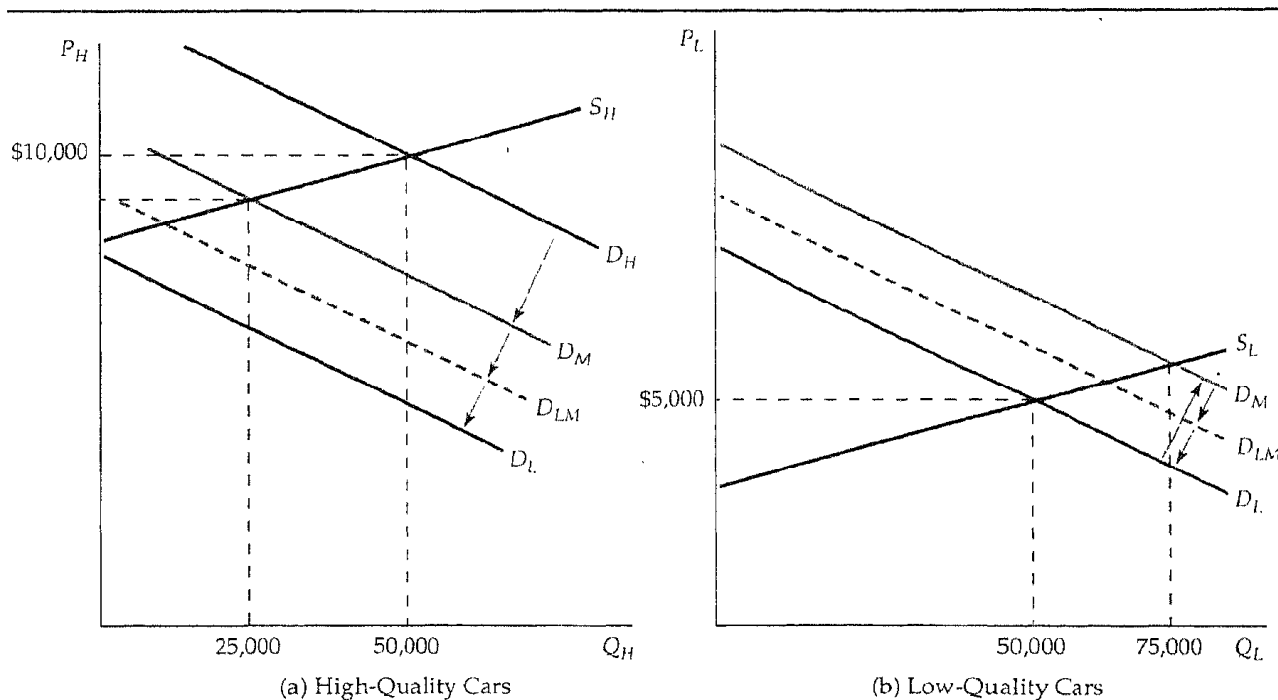


FIGURE 17.1 The Lemons Problem. When sellers of products have better information about product quality than buyers, a lemons market may develop in which low-quality goods drive out high-quality goods. In (a) the demand curve for high-quality cars shifts from D_H to D_M as buyers lower their expectations about the average quality of cars on the market. Likewise, in (b) the demand curve for low-quality cars shifts from D_L to D_M . As a result, the quantity of high-quality cars sold falls from 50,000 to 25,000, and the quantity of low-quality cars increases from 50,000 to 75,000. Eventually, only low-quality cars are sold.

purchase, buyers would therefore view all cars as being of "medium" quality. (Of course, after buying the car, they will learn its true quality.) The demand for medium-quality cars, denoted by DM in Figure 17.1, is below D_H but above D_L . As the figure shows, *fewer high-quality cars (25,000) and more low-quality cars (75,000) will now be sold.*

As consumers begin to realize that most cars sold (about three-fourths of the total) are low quality, their demands shift. As Figure 17.1 shows, the new demand curve might be D_{LM} , which means that on average cars are of low to medium quality. However, the mix of cars then shifts even more heavily to low quality. As a result, the demand curve shifts further to the left, pushing the mix of cars even further to low quality. *This shifting continues until only low-quality cars are sold.* At that point the market price would be too low to bring forth any high-quality cars for sale, so consumers correctly assume that any car they buy will be low quality, and the demand curve will be D_L .

The situation in Figure 17.1 is extreme. The market may come into equilibrium at a price that brings forth at least some high-quality cars. *But the fraction of high-quality cars will be smaller than it would be if consumers could identify quality before making the purchase.* That is why I should expect to sell my brand new car, which *I know* is in perfect condition, for much less than I paid for it. Because of asymmetric information, low-quality goods drive high-quality goods out of the market.

Implications of Asymmetric Information

Our used cars example shows how asymmetric information can result in market failure. In an ideal world of fully functioning markets, consumers would be able to choose between low-quality and high-quality cars. Some would choose low-quality cars because they cost less, while others would prefer to pay more for high-quality cars. Unfortunately, consumers cannot in fact easily determine the quality of a used car until after they purchase it, so the price of used cars falls, and high-quality cars are driven out of the market.

Used cars are just a stylized example to illustrate an important problem that affects many markets. Let's look at other examples of asymmetric information, and then see how the government or private firms might react to it.

Insurance

Why do people over age 65 have difficulty buying medical insurance at almost any price? Older people do have a much higher risk of serious illness, but why doesn't the price of insurance rise to reflect that higher risk? The reason is asymmetric information. People who buy insurance know much more about their general health than any insurance company can hope to know, even if it insists on a medical examination. As a result, there is *adverse selection*, much as with used cars. Because unhealthy people are more likely to want insur-

ance, the proportion of unhealthy people in the pool of insured people increases. This forces the price of insurance to rise, so that more healthy people, realizing their low risks, elect not to be insured. This further increases the proportion of unhealthy people, which forces the price of insurance up more, and so on, until nearly all people who want to buy insurance are unhealthy. At that point selling insurance becomes unprofitable.

Adverse selection can make the operation of insurance markets problematic in other ways. Suppose an insurance company wants to offer a policy for a particular event, such, as an auto accident that results in property damage. It selects a target population—say, men under age 25—to whom it plans to market this policy, and it estimates the frequency of accidents within this group. For some of these people, the probability of being in an accident is low, much less than .01; for others it is high, much more than .01. If the insurance company cannot distinguish between high- and low-risk men, it will base the premium for all men on the average experience, i.e., an accident probability of .01. With better information some people (those with low probabilities of an accident) will choose not to insure, while others (those with high probabilities of an accident) will purchase the insurance. This in turn raises the accident probability of those who are insured above .01, forcing the insurance company to raise its premium. In the extreme, only those who are likely to suffer a loss will choose to insure, making it impractical to sell insurance.

These kinds of market failure create a role for government. For health insurance, it provides an argument in favor of Medicare or related forms of government health insurance for the elderly. By providing insurance for *all* people over age 65, the government eliminates the problem of adverse selection.²

The Market for Credit

By using a credit card, many of us borrow money without providing any collateral. Most credit cards allow the holder to run a debit of several thousand dollars, and many people hold several credit cards. Credit card companies earn money by charging interest on the debit balance. But how can a credit card company or bank distinguish high-quality borrowers (who pay their debts) from low-quality borrowers (who don't)? Clearly, borrowers know more about whether they will pay than the company does. Again, the "lemons" problem arises. Credit card companies and banks must charge the same interest rate to *all* borrowers, which attracts more low-quality borrowers, which forces the interest rate up, which increases the number of low-quality borrowers, which forces the interest rate up further, and so on.

In fact, credit card companies and banks *can*, to some extent, use computerized credit histories, which they often share with one another, to distinguish "low-quality" from "high-quality" borrowers. Many people think that com-

² The same general argument applies to all age groups. That is one reason that insurance companies avoid adverse selection by offering group health insurance policies at places of employment.

puterized credit histories are an invasion of privacy. Should companies be allowed to keep these credit histories and share them with other companies? We can't answer this question for you, but we can point out that credit histories perform an important function. They eliminate, or at least greatly reduce, the problem of asymmetric information and adverse selection, which might otherwise prevent credit markets from operating. Without these histories, even the creditworthy would find it extremely costly to borrow money.

The Importance of Reputation and Standardization

Asymmetric information is also present in many other markets. Here are just a few examples: *retail stores* (Will the store repair or allow you to return a defective product? The store knows more about its policy than you do.); *dealers of rare stamps, coins, books, and paintings* (Are the items real or counterfeit? The dealer knows much more about their authenticity than you do.); *roofers, plumbers, and electricians* (When a roofer repairs or renovates the roof of your house, do you climb up to check the quality of the work?); *restaurants* (How often do you go into the kitchen to check if the chef is using fresh ingredients and obeying the health laws?).

In all these cases, the seller knows much more about the quality of the product than the buyer does. Unless sellers can provide information about quality to buyers, low-quality goods and services will drive out high-quality ones, and there will be market failure. Sellers of high-quality goods and services, therefore, have a big incentive to convince consumers that their quality is indeed high. In the examples cited above, this is done largely by *reputation*. You shop at a particular store because it has a reputation for servicing its products; you hire a particular roofer and plumber because they have a reputation for doing good work; and you go to a particular restaurant because it has a reputation for using fresh ingredients, and nobody you know became sick after eating there.

Sometimes it is impossible for a business to develop a reputation. For example, most of the customers of a diner or a motel on a highway go there only once, or infrequently, while on a trip, so that the business has no opportunity to develop a reputation. How, then, can these diners and motels deal with the "lemons" problem? One way is by *standardization*. In your hometown, you may not prefer to eat regularly at McDonald's. But a McDonald's may look more attractive when you are driving along a highway and want to stop for lunch. The reason is that McDonald's provides a standardized product; the same ingredients are used and the same food is served in every McDonald's anywhere in the country. Who knows? Joe's Diner might serve better food, but you *know* exactly what you will be buying at McDonald's.

EXAMPLE 17.1 LEMONS IN MAJOR LEAGUE BASEBALL

How can we test for the presence of a lemons market? One way is to compare the performance of products that are resold with similar products that are

seldom put up for resale. In a lemons market, purchasers of second-hand products will have limited information, and resold products should be lower in quality than products that rarely appear on the market. One such "second-hand" market has been created in recent years by a change in the rules governing contracts in major league baseball.³

Before 1976, major league baseball teams had the exclusive right to renew their players' contracts. After a 1976 ruling declared this system illegal, a new contracting arrangement was created. After six years of major league service, players can now sign new contracts with their original team or become free agents and sign with new teams. Having many free agents creates a second-hand market in baseball players. The original team can make an offer that will either retain a player or lose him to the free-agent market.

Asymmetric information is prominent in the free-agent market. One potential purchaser, the player's original team, has better information about the player's abilities than other teams have. If we were looking at used cars, we could test for the existence of asymmetric information by comparing their repair records. In baseball we can compare player disability records. If players are working hard and following rigorous conditioning programs, we would expect a low probability of injury and a high probability that they will be able to perform if injured. In other words, more motivated players will spend less time on the bench owing to disabilities. If a lemons market exists, we would expect free agents to have higher disability rates than players who are renewed. Players may also have preexisting physical conditions that their original teams know about that make them less desirable candidates for contract renewal. Because more such players would become free agents, free agents would experience higher disability rates for health reasons.

Table 17.1, which lists the postcontract performance of all players who have signed multiyear contracts, makes two points. First, both free agents and renewed players have increased disability rates after signing contracts. The disabled days per season increase from an average of 4.73 to an average of 12.55. Second, the postcontract disability rates of renewed and not-renewed players are significantly different. On average, renewed players are disabled 9.68 days, free agents 17.23 days.

TABLE 17.1 Player Disability

	Days Spent on Disabled List per Season		
	Precontract	Postcontract	Percent Change
All players	4.73	12.55	165.4
Renewed players	4.76	9.68	103.4
Free agents	4.67	17.23	268.9

³ This example is based on Kenneth Lehn's study of the free-agent market. See "Information Asymmetries in Baseball's Free Agent Market," *Economic Inquiry* (1984): 37-44.

These two findings suggest a lemons market in free agents that exists because baseball teams know their own players better than the other teams with which they compete.

17.2 Market Signaling

We have seen that asymmetric information can sometimes lead to a "lemons problem": Because sellers know more about the quality of a good than buyers do, buyers may assume that quality is low, so that price falls, and only low-quality goods are sold. We also saw how government intervention (in the market for health insurance, for example) or the development of a reputation (in service industries, for example) can alleviate this problem. Now we will examine another important mechanism through which sellers and buyers deal with the problem of asymmetric information: *market signaling*. The concept of market signaling was first developed by Michael Spence, who showed that in some markets sellers send buyers *signals* that convey information about a product's quality.⁴

To see how market signaling works, let's look at a *labor market*, which is a good example of a market with asymmetric information. Suppose a firm is thinking about hiring some new people. The new workers (the "sellers" of labor) know much more about the quality of the labor they can provide than the firm (the buyer of labor). For example, they know how hard they tend to work, how responsible they are, what their skills are, and so forth. The firm will find these things out only after workers have been hired and have been working for some time. At the time they are hired, the firm knows little about how productive they will turn out to be.

Why don't firms simply hire workers, see how well they work, and then fire those with low productivity? Because this is often very costly. In many countries, and in many firms in the United States, it is difficult to fire someone who has been working more than a few months. (The firm may have to show just cause or pay severance pay.) Also, in many jobs workers do not become fully productive for at least six months. Before that time, considerable on-the-job training may be required, for which the firm must invest substantial resources. Thus the firm might not learn how good workers are for six months to a year. As a result, firms would be much better off if they knew how productive potential employees are *before* they hired them.

What characteristics can a firm examine to obtain information about people's productivity before it hires them? Can potential employees convey informa-

⁴ See Michael Spence, *Market Signaling* (Cambridge, MA: Harvard University Press, 1974).

tion about their productivity? Dressing well for the job interview might convey some information, but even unproductive people sometimes dress well to get a job. Dressing well is thus a weak signal—it doesn't do much to distinguish high-productivity from low-productivity people. *To be strong, a signal must be easier for high-productivity people to give than for low-productivity people to give, so that high-productivity people are more likely to give it.*

For example, *education* is a strong signal in labor markets. A person's educational level can be measured by several things—the number of years of schooling, degrees obtained, the reputation of the university or college that granted the degrees, the person's grade point average, and so on. Of course, education can directly and indirectly improve a person's productivity by providing information, skills, and general knowledge that are helpful in work. But even if education did *not* improve one's productivity, it would still be a useful *signal of productivity* because more productive people will find it easier to attain a high level of education. (Productive people tend to be more intelligent, more motivated, and more energetic and hard-working—characteristics that are also helpful in school.) More productive people are therefore more likely to attain a high level of education *to signal their productivity to firms and thereby obtain better-paying jobs*. And firms are correct in considering education a signal of productivity.

A Simple Model of Job Market Signaling

To understand how signaling works, it will be useful to discuss a simple model.⁵ Let's assume there are only low-productivity workers (Group I), whose average and marginal product is 1, and high-productivity workers (Group II), whose average and marginal product is 2. Workers will be employed by competitive firms whose products sell for \$10,000, and who expect an average of 10 years of work from each employee. We also assume that half the workers in the population are in Group I and the other half in Group II, so that the *average* productivity of all workers is 1.5. Note that the revenue expected to be generated from Group I workers is \$100,000 (\$10,000/year X 10 years) and from Group II workers is \$200,000 (\$20,000/year X 10 years).

If firms could identify people by their productivity, they would offer them a wage equal to their marginal revenue product. Group I people would be paid \$10,000 per year. Group II people \$20,000. On the other hand, if firms could not identify people's productivity before they hired them, they would pay all workers an annual wage—equal to the average productivity, \$15,000. Group I people would then earn more (\$15,000 instead of \$10,000), at the expense of Group II people (who would earn \$15,000 instead of \$20,000).

Now let's consider what can happen with signaling via education. Suppose all the attributes of an education (degrees earned, grade point average, etc.)

⁵ This is essentially the model developed in Spence, *Market Signaling*.

can be summarized by a single index y that represents years of higher education. All education involves a cost, and the higher the educational level y , the higher the cost. This cost includes tuition and books, the opportunity cost of foregone wages, and the psychic cost of having to work hard to obtain high grades. What is important is that *the cost of education is greater for the low-productivity group than for the high-productivity group*. We might expect this for two reasons. First, low-productivity workers may simply be less studious. Second, low-productivity workers may progress more slowly through degree programs in which they enroll. In particular, suppose that for Group I people the cost of attaining educational level y is given by

$$C_I(y) = \$40,000y$$

and for Group II people it is

$$C_{II}(y) = \$20,000y$$

Now suppose (to keep things simple and to dramatize the importance of signaling) that *education does nothing to increase one's productivity; its only value is as a signal*. Let's see if we can find a market equilibrium in which different people obtain different levels of education, and firms look at education as a signal of productivity.

Consider the following possible equilibrium. Suppose firms use this decision rule: *Anyone with an education level of y^* or more is a Group II person and is offered a wage of \$20,000, and anyone with an education level below y^* is a Group I person and is offered a wage of \$10,000*. The particular level y^* that the firms choose is arbitrary, but for this decision rule to be part of an equilibrium, firms must have identified people correctly, or else the firms will want to change the rule. Will this rule work?

To answer this, we must determine how much education the people in each group will obtain, *given that firms are using this decision rule*. To do this, remember that education allows one to get a better-paying job. The benefit of education $B(y)$ is the *increase* in the wage associated with each level of education, as shown in Figure 17.2. Observe that $B(y)$ is 0 initially, which represents the \$100,000 base 10-year earnings that are earned without any college education. But when the education level reaches y^* or greater, $B(y)$ jumps to \$100,000.

How much education should a person obtain? Clearly the choice is between no education (i.e., $y = 0$) and an education level of y^* . The reason is that any level of education less than y^* results in the same base earnings of \$100,000, so there is no benefit from obtaining an education at a level above 0, but below y^* . Similarly, there is no benefit from obtaining an educational level above y^* because y^* is sufficient to allow one to enjoy the higher total earnings of \$200,000.

In deciding how much education to obtain, people compare the benefit of education with the cost. People in each group make the following cost-benefit calculation: *Obtain the education level y^* if the benefit (i.e., the increase in earnings) is at least as large as the cost of this education*. For both groups, the ben-

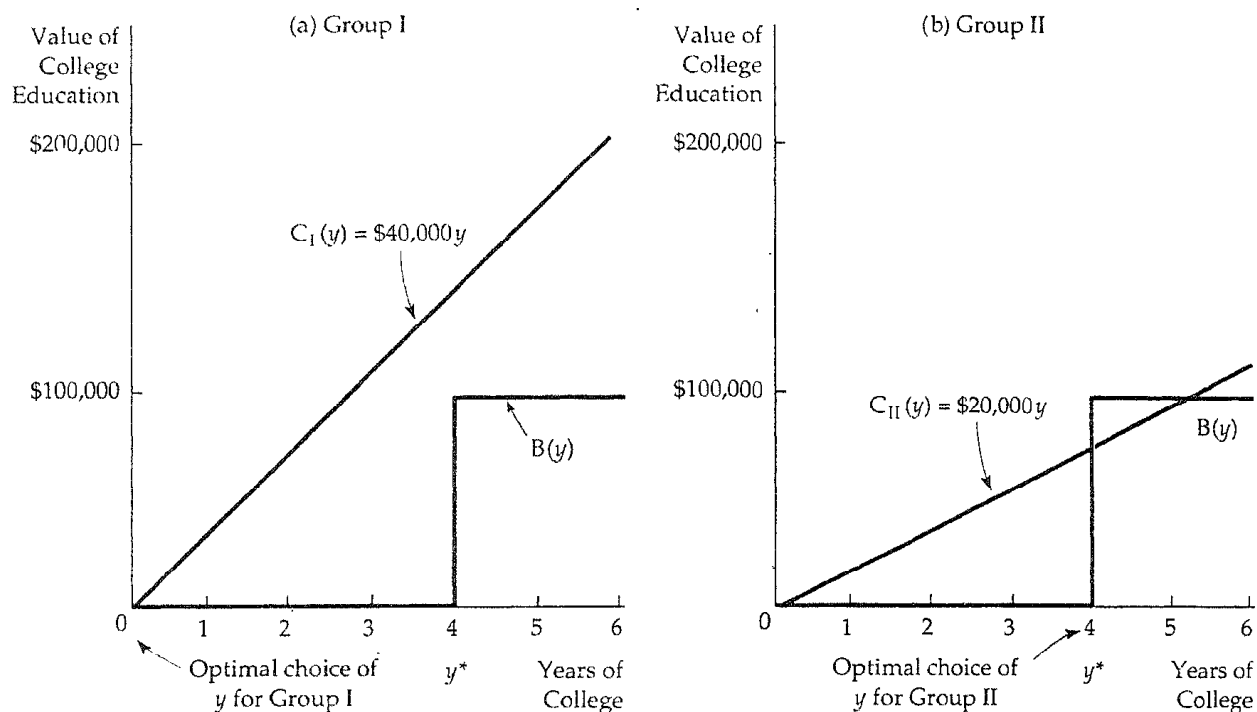


FIGURE 17.2 Signaling. Education can be a useful signal of the high productivity of a group of workers if education is easier to obtain for this group than for the low-productivity group. In (a) the low-productivity group will choose an education level of $y = 0$ because the cost of education is greater than the increased earnings. However, in (b), the high-productivity group will choose an education level of $y^* = 4$ because the gain in earnings is greater than the cost.

efit (the increase in earnings) is \$100,000. The costs, however, differ for the two groups. For Group I, the cost is $\$40,000y$, but for Group II the cost is only $\$20,000y$. Therefore, Group I people will obtain *no* education as long as

$$\$100,000 < \$40,000y^* \text{ or } y^* > 2.5$$

and Group II people will obtain an education level y^* as long as

$$\$100,000 > \$20,000y^* \text{ or } y^* < 5$$

These results give us an equilibrium *as long as* y^* is between 2.5 and 5. Suppose, for example, that y^* is 4.0, as in Figure 17.2. Then people in Group I will find that education does not pay, and they will not obtain any, whereas people in Group II will find that education does pay, and they will obtain the level $y = 4.0$. Now, when a firm interviews job candidates who have no college education, it correctly assumes they have low productivity and offers them a wage of \$10,000. Similarly, when the firm interviews people who have four years of college, it correctly assumes their productivity is high, and their wage

should be \$20,000. We therefore have an equilibrium; high-productivity people will obtain a college education to signal their productivity, and firms will read this signal and offer them a high wage.

This is a simple, highly stylized model, but it illustrates a significant point: Education can be an important signal that allows firms to sort workers according to productivity. Some workers (those with high productivity) will want to obtain a college education, *even if that education does nothing to increase their productivity*. These workers simply want to identify themselves as being highly productive, so they obtain the education to send a signal.

Of course, in the real world, education *does* provide useful knowledge and does increase one's ultimate productivity. (We wouldn't have written this book if we didn't believe that.) But education also serves a signaling function. For example, many firms insist that a prospective manager have an MBA. One reason for this is that MBAs learn economics, finance, and other useful subjects. But there is a second reason—to complete an MBA program takes intelligence, discipline, and hard work, and people with those qualities tend to be very productive.

Guarantees and Warranties

We have stressed the role of signaling in labor markets, but signaling can also play an important role in many other markets in which there is asymmetric information. Consider the markets for such durable goods, as televisions, stereos, cameras, and refrigerators. Many firms produce these items, but some brands are more dependable than others. If consumers could not tell which brands tend to be more dependable, the better brands couldn't be sold for higher prices. Firms that produce a higher-quality, more dependable product would therefore like to make consumers aware of this, but how can they do it in a convincing way? The answer is through *guarantees and warranties*.

Guarantees and warranties effectively signal product quality because an extensive warranty is more costly for the producer of a low-quality item *than* for the producer of a high-quality item. (The low-quality item is more likely to require servicing under the warranty, which the producer will have to pay for.) As a result, in their own self-interest, producers of low-quality items will not offer an extensive warranty. Consumers can therefore correctly view an extensive warranty as a signal of high quality, and they will pay more for products that offer one.

17.3 Moral Hazard

When one party is fully insured and cannot be accurately monitored by an insurance company with limited information, its behavior may change *after* the insurance has been purchased. This is the problem of *moral hazard*. *Moral haz-*

ard occurs when the party to be insured can affect the probability or magnitude of the event that triggers payment. For example, if I have complete medical insurance coverage, I may visit the doctor more often than I would if my coverage were limited. If the insurance provider can monitor its insurees' behavior, it can charge higher fees for those who make more claims. But if the company cannot monitor behavior, it may find its payments to be larger than expected. With moral hazard, insurance companies may be forced to increase their premiums or even to refuse to sell insurance at all.

Consider, for example, the decisions faced by the owners of a warehouse worth \$100,000 and by their insurance company. Suppose that if the owners run a \$50 fire prevention program for their employees, the probability of a fire is .005. Without this program, the probability of a fire increases to .01. Knowing this, the insurance company faces a dilemma if it cannot monitor whether there will be a fire prevention program. The policy that the insurance company offers cannot include a clause stating that payments will be made only if there is a fire prevention program. If the program *were* in place, the company could insure the warehouse for a premium equal to the expected loss from a fire, which is \$500 ($.005 \times \$100,000$). Once the insurance policy is purchased, however, the owners no longer have an incentive to run the program. If there is a fire, they will be fully compensated for their financial loss. Thus, if the insurance company sells a policy for \$500, it will incur losses because the expected loss from fire will be \$1000 ($.01 \times \$100,000$).

Moral hazard is not only a problem for insurance companies. It also alters the ability of markets to allocate resources efficiently. In Figure 17.3, for example, D gives the demand for automobile driving in miles per week. The

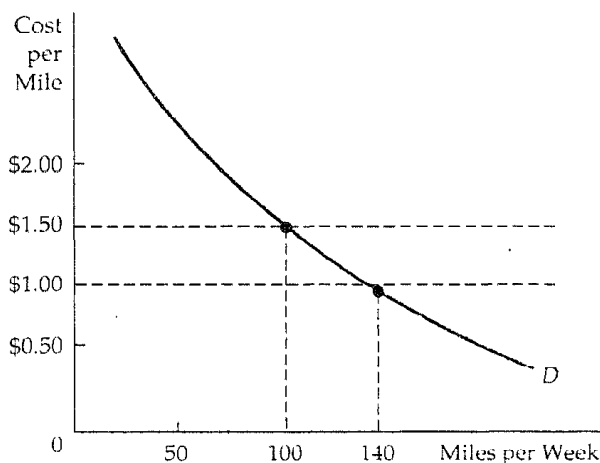


FIGURE 17.3 The Effects of Moral Hazard. Moral hazard alters the ability of markets to allocate resources efficiently. D gives the demand for automobile driving. With no moral hazard, the cost of transportation is \$1.50 per mile, and the driver drives 100 miles, which is the efficient amount. With moral hazard, the driver perceives the cost per mile to be \$1.00 and drives 140 miles.

demand curve is downward sloping because some people switch to alternative transportation as the cost of driving increases. Suppose initially that the cost of driving includes the insurance cost, and that insurance companies can accurately measure miles driven. In this case, there is no moral hazard. Drivers know that more driving will increase their insurance premium and hence increase their total cost of driving (the cost per mile is assumed to be constant). For example, if the cost of driving is \$1.50 per mile (50 cents of which is insurance cost), the driver will go 100 miles per week.

A moral hazard problem arises because it is difficult for insurance companies to monitor individual driving habits; the insurance premium does not depend on miles driven. As a result, drivers assume that any additional accident costs that they incur will be spread over a large group, with only a negligible portion accruing to each of them individually. Since their insurance premium does not vary with the number of miles that they drive, an additional mile of transportation will cost \$1.00, rather than \$1.50. The number of miles driven will increase from 100 to the socially inefficient level of 140.

EXAMPLE 17.2 REDUCING MORAL HAZARD—WARRANTIES OF ANIMAL HEALTH

For buyers of livestock, information about the animals' health is very important.⁶ Unhealthy animals gain weight more slowly than healthy animals, and are less likely to reproduce. Because of asymmetric information in the livestock market (sellers know the health of an animal better than buyers do), most states require warranties on the sale of livestock. Under these laws sellers promise (warrant) that their animals are free from hidden diseases and are responsible for all costs arising from any diseased animals.

Although warranties solve the problem of the seller's having better information than the buyer, they also create a form of moral hazard. Guaranteeing reimbursement to the buyer for all costs associated with diseased animals means that insurance rates are not tied to the level of care that buyers or their agents take to protect their livestock against disease. As a result of these warranties, livestock buyers tend to avoid early diagnosis of diseased livestock, and losses increase.

In response to the moral hazard problem, half the states have modified their animal warranty laws by requiring sellers to tell buyers whether livestock are diseased at the time of sale. Some states also require sellers to comply with state and federal animal health regulations, thereby reducing disease. Beyond this, however, warranties that animals are free from hidden disease must be an explicit written or oral guarantee to buyers.

⁶ This example is based on Terence J. Centner and Michael E. Wetzstein, "Reducing Moral Hazard Associated with Implied Warranties of Animal Health," *American Journal of Agricultural Economics* 69 (1987): 143-150.

EXAMPLE 17.3 CRISIS IN THE SAVINGS AND LOAN INDUSTRY

In 1934, during the Great Depression, the U.S. government introduced a broad-based system of financial insurance. The Federal Deposit Insurance Corporation provided insurance for deposits at commercial banks, and the Federal Savings and Loan Insurance Corporation did the same (up to \$100,000 per account) for deposits at savings and loans. These insurance programs created the seeds of moral hazard on the part of depositors, since a depositor could lend money to any financial institution, no matter how risky that institution's loans, without bearing any risk.

Later, depositor moral hazard was coupled with moral hazard by owners of savings and loans. Beginning in 1982, new participants in the business found that they could attract large sums of government-insured capital and invest the money virtually without restriction in highly speculative investments. Because the deposits were insured, they had little incentive to evaluate the risks involved.

Essentially, deposit insurance enabled savings and loans to make riskier loans on a larger scale than they would otherwise. The adverse incentives created by moral hazard coupled with the collapse of the real estate boom in the sun belt and energy-producing states led to the failure of many savings and loans.

In 1990 the cost of bailing out depositors whose money was lost when over 1000 savings and loans failed was estimated conservatively to be over \$200 billion.⁷ The biggest losses were in Texas, where over \$42 billion had been spent by October 1990. The total outlays by the agencies responsible for deposit insurance were nearly \$100 billion just-through 1990.

While the prospects for the future are not bright, there are some hopeful signs. Aware of the adverse incentives that were created by moral hazard, the government has modified its insurance system. Today, the Federal Deposit Insurance Corporation regulates the savings and loan and banking industries, and savings and loans now face stiff capital requirements that force managers to bear a stake in the outcome of their investment policies. With a good deal of their own money at risk, managers are less inclined to invest speculatively.

A number of additional reforms could help to remove the moral hazard problem on the part of depositors and savings and loan owners. Proposals that would affect depositors include (i) lowering the amount of insurance coverage; (ii) making the maximum coverage apply to each individual, no matter how many accounts that individual has; and (iii) allowing for coinsurance, whereby the deposit insurance reimburses losses on less than a dollar-for-dollar basis. Proposals directed towards owners include (i) charging savings and loans insurance premiums that are based on the riskiness of the savings and loan portfolio—the greater the risk, the higher the premium; and (ii) restricting the investment opportunities available to savings and loan owners.

⁷ *American Banker*, October 9, 1990.

17.4 *The Principal-Agent Problem*

If monitoring the productivity of workers were costless, the owners of a business could ensure that their managers and workers were working effectively. In most firms, however, owners can't monitor everything that employees do—employees are better informed than owners. This information asymmetry creates a *principal-agent* problem.

An *agency relationship* exists whenever there is an employment arrangement in which one person's welfare depends on what another person does.⁸ The *agent* is the person who acts, and the *principal* is the party whom the action affects. In our example, the manager and the workers are agents, and the owner is the principal. *The principal-agent problem is that managers may pursue their own goals, even at the cost of obtaining lower profits for owners.*

Agency relationships are widespread in our society. For example, doctors serve as agents for hospitals, and as such, may select patients and do procedures consistent with their personal preferences, but not necessarily with the objectives of the hospital. Similarly, managers of housing properties may not maintain the property the way that the owners would like.

How does incomplete information and costly monitoring affect how agents act? And what mechanisms can give managers the incentive to operate in the owner's interest? These questions are central to any principal-agent analysis. In this section we study the principal-agent problem from several perspectives. First, we look at the owner-manager problem within private and public enterprises. Second, we discuss how owners can use contractual relationships with their employees to deal with the principal-agent problems.

The Principal-Agent Problem in Private Enterprises

An individual family or financial institution owns more than 10 percent of the shares of only 16 of the 100 largest industrial corporations.⁹ Clearly, most large firms are controlled by management. The fact that most stockholders have only a small percentage of the firm's total equity makes it difficult for them to obtain information about how well the firm's managers are performing. One function of owners (or their representatives) is to monitor the behavior of man-

⁸ For more discussion of agency costs, see Richard Jensen and William Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure," *Journal of Financial Economics* 11 (1976): 305-360; and Eugene Fama, "Agency Problems and the Theory of the Firm," *Journal of Political Economy* 88 (1980): 288-307. See also Oliver Williamson, *The Economic Institutions of Capitalism* (New York: Free Press, 1985).

⁹ See Merritt B. Fox, *Finance and Industrial Performance in a Dynamic Economy* (New York: Columbia University Press, 1987).

agers. But monitoring is costly,¹⁰ and information is expensive to gather and use, especially for an individual.

Managers of private enterprises can thus pursue their own objectives. But what are these objectives? One view is that managers are more concerned with growth than with profit per se; more rapid growth and larger market share provide more cash flow, which in turn allows managers to enjoy more perks. Another view deemphasizes growth but does emphasize the utility that managers get from their jobs, not only from profit but also from the respect of their peers, the power to control the corporation, the fringe benefits and other perks, and a long tenure on the job.

However, there are important limitations to managers' ability to deviate from the objectives of owners. First, stockholders can complain loudly when they feel that managers are behaving improperly, and in exceptional cases they can oust the current management (perhaps with the help of the board of directors of the corporation, whose job it is to monitor managerial behavior). Second, a vigorous market for corporate control can develop. If a takeover bid becomes more likely when the firm is poorly managed, managers will have a strong incentive to pursue the goal of profit maximization. Third, there can be a highly developed market for managers. If managers who maximize profit are in great demand, they will earn high wages, which in turn will give other managers an incentive to pursue the same goal.

Unfortunately, the means by which stockholders control managers' behavior are limited and imperfect. Corporate takeovers may be motivated by personal and economic power, for example, instead of economic efficiency. The managers' labor market may also not work perfectly, given that top managers are frequently near retirement and have long-term contracts. As a result, it is important to look for solutions to the principal-agent problem in which owners alter the incentives that managers face, without resort to government intervention. We consider some of these solutions in the next section.

The Principal-Agent Problem in Public Enterprises

The principal-agent framework can also help us understand the behavior of the managers of public organizations. There managers may be interested in power and perquisites, both of which can be obtained by expanding their organization beyond its "efficient" level. Because it is also costly to monitor the behavior of public managers, there are no guarantees that they will produce the efficient output. Legislative checks on a government agency are not likely to be effective as long as the agency has better information about its costs than the legislature has.

Although the public sector lacks some of the market forces that keep private managers in line, government agencies can still be effectively monitored.

¹⁰ There are economies of scale in gathering information but there is no obvious way in which the information can be sold.

First, managers of government agencies care about more than just the size of their agency. Indeed, many choose lower-paying public jobs because they are concerned about the "public interest." Second, public managers are subject to the rigors of the managerial job market, much the way private managers are. If public managers are perceived to be pursuing improper objectives, their ability to obtain high salaries in the future might be impaired. Third, the legislature and other government agencies perform an oversight function. For example, the Government Accounting Office and the Office of Management and Budget spend much of their energy monitoring other agencies.

At the local rather than the federal level, public managers are subject to even more checks. Suppose, for example, that a city transit agency has expanded bus service beyond the efficient level. Then, the citizens can vote the transit managers out of office, or, if all else fails, use alternative transportation or even move. And competition among agencies can be as effective as competition among private firms in constraining the non-profit-maximizing behavior of managers.

EXAMPLE 17.4 THE MANAGERS OF NONPROFIT HOSPITALS AS AGENTS

Do the managers of nonprofit organizations have the same goals as those of for-profit organizations? Are nonprofit organizations more or less efficient than for-profit firms? We can get some insight into these issues by looking at the provision of health care. In a study of 725 hospitals, from 14 major hospital chains, the return on investment and average costs of nonprofit and for-profit were compared to determine if they performed differently.¹¹

The study found that for 1977 and 1981 the rate of returns between the two types of hospitals did indeed differ. For example, in 1977 for-profits earned an 11.6 percent return, while nonprofits earned 8.8 percent. In 1981, for-profits earned 12.7 percent and nonprofits only 7.4 percent. A straight comparison of returns and costs of these hospitals is not appropriate, however, because the hospitals perform different functions. For example, 24 percent of the nonprofit hospitals provide medical residency programs as compared with only 6 percent of the for-profit hospitals. Similar differences can be found in the provision of speciality care, where 10 percent of the nonprofits have open-heart units as compared with 5 percent of the for-profits. In addition, 43 percent of nonprofits had premature infant units, while only 29 percent of the for-profits had the equivalent units.

Using a statistical regression analysis, which controls for differences in the services performed, one can determine whether differences in services account for the higher costs. The study found that after adjusting for services performed, the average cost of a patient day in nonprofit hospitals was 8 percent

¹¹Regina E. Herzlinger and William S. Krasker, "Who Profits from Nonprofits?" *Harvard Business Review* 65 Jan-Feb. 1987): 93-106.

higher than in for-profit hospitals. This implies that the profit status of the hospital affects "its performance in the way principal-agent theory predicts: Without the competitive forces faced by for-profit hospitals, nonprofit hospitals may be less cost-conscious and therefore less likely to serve appropriately as agents for their principals, society at large.

Of course, nonprofit hospitals provide services that society may well wish to subsidize. But the added cost of running a nonprofit hospital should be considered when determining whether it should be granted tax-exempt status.

Incentives in the Principal-Agent Framework

We have seen why managers' and owners' objectives are likely to differ within the principal-agent framework. How, therefore, can owners design reward systems so that managers and workers can come as close as possible to meeting the owners' goals? To answer this question, let's study a specific problem.¹²

A small manufacturer uses labor and machinery to produce watches. The owners want to maximize their profit. They must rely on a machine repairperson whose effort will influence the likelihood that the machines break down, and thus affect the firm's level of profit. Profit also depends on other random factors, such as the quality of parts and the reliability of other labor. As a result of high monitoring costs, the owners can neither measure the effort of the repairperson directly nor be sure that the same effort will always generate the same profit level. Table 17.2 describes these circumstances.

The table shows that the repairperson can work with either a low or high amount of effort. Low effort generates either \$10,000 or \$20,000 profit (with equal probability), depending on the random factors that we mentioned. We've labeled the lower of the two profit levels "poor luck," and the higher profit level "good luck." When the repairperson makes a high effort, the profit will be either \$20,000 (when there is poor luck) or \$40,000 (when there is good luck). These numbers highlight the problem of incomplete information, because the owners cannot know whether the repairperson has made a low or high effort when the firm's profit is \$20,000.

TABLE 17.2 The Profit from Making Watches

	Poor Luck	Good Luck
Low effort ($a = 0$)	\$10,000	\$20,000
High effort ($a = 1$)	\$20,000	\$40,000

¹²This discussion is motivated in part by Bengt Holmstrom, "Moral Hazard and Observability," *Bell Journal of Economics* 10 (1979): 74-91.

Suppose the repairperson's goal is to maximize the wage payment that he receives, net of the cost of lost leisure and unpleasant work time associated with any effort that he makes. To simplify, we'll suppose that the cost of effort is 0 for low effort and \$10,000 for high effort. (Formally, $c = \$10,000a$.)

Now we can state the principal-agent problem from the owners' perspective. The owners' goal is to maximize expected profit, given the uncertainty of outcomes and given that the repairperson's behavior cannot be monitored. The owners can contract to pay the repairperson for his work, but the payment scheme must be based entirely on the measurable output (profit) of the manufacturing process, not on the repairperson's effort. To signify this link, we describe the payment scheme as $w(\pi)$, stressing that payments can depend only on measured profit.

What is the best payment scheme? And can that scheme be as effective as one based on effort rather than output? We can only begin to study the answers here. The best payment scheme depends on the nature of production, the degree of uncertainty, and the objectives of both owners and managers. The arrangement will not always be as effective as an ideal scheme that is directly tied to effort. A lack of information can lower economic efficiency because both the owners' profit and the repairperson's payment may fall at the same time.

Lets see how to design a payment scheme when the repairperson wishes to maximize his payment received net of the cost of effort made.¹³ Suppose first that the owners offer a fixed wage payment to the repairperson. Any wage will do, but we can see things most clearly if we assume that the wage is 0. (Here, 0 could represent a wage no higher than the wage rate paid in other comparable jobs.) Facing a wage of 0, the repairperson has no incentive to make a high level of effort. The reason is simple: The repairperson does not share in any of the gains that the owners enjoy from the increased effort. It follows, therefore, that a fixed payment will lead to an inefficient outcome. When $a = 0$, and $w = 0$, the owner will earn an expected profit of \$15,000, and the repairperson a net wage of 0.

Both the owners and the repairperson will be better off if the repairperson is rewarded for his productive effort. Suppose, for example, that the owners offer the repairperson the following payment scheme:

$$\text{If } \pi = \$10,000 \text{ or } \$20,000, w = 0 \quad (17.1)$$

$$\text{If } \pi = \$40,000, w = \$24,000$$

Under this bonus arrangement, a low effort generates no payment. A high effort, however, generates an expected payment of \$12,000, and a payment net of the cost of effort of \$2,000. Now, the repairperson will choose to make a high level of effort. This makes the owners better off than before because they get an expected profit of \$30,000, and a net profit of \$18,000.

¹³We assume that the repairperson is risk neutral, so that no efficiency is lost. If, however, the repairperson were risk averse, there would be an efficiency loss.

This isn't the only payment scheme that will work for the owners, however. Suppose they contract to have the worker participate in the following profit-sharing arrangement. When profits are greater than \$18,000:

$$w = \pi - \$18,000 \quad (17.2)$$

(Otherwise the wage is zero.) Now if the repairperson offers low effort, he receives an expected payment of \$1000. But if he offers a high level of effort, his expected payment is \$12,000, and his expected payment net of the cost of effort is \$2,000. (The owners' net profit is \$18,000 as before.)

Thus, in our example, a profit-sharing arrangement achieves the same outcome as a bonus payment system. In more complex situations, the incentive effects of the two types of arrangements will differ. However, the basic idea illustrated here applies to all principal-agent problems. When it is impossible to measure effort directly, an incentive structure that rewards the outcome of high levels of effort can induce agents to aim for the goals that the owners set.

*17.5 *Managerial Incentives in an Integrated Firm*

We have seen that owners and managers of firms can have asymmetric information about demand, cost, and other variables. We've also seen how owners can design a reward structure to encourage managers to make the appropriate effort. Now we focus our attention on firms that are *integrated*—that consist of several divisions, each with its own managers. Some firms are *horizontally integrated*—several plants produce the same or related products. Others are also *vertically integrated*—"upstream" divisions produce materials, parts, and components that "downstream" divisions use to produce final products. Integration creates organizational problems. We addressed some of these problems in the Appendix to Chapter 11, where we discussed *transfer pricing* in the vertically integrated firm, that is, how the firm sets prices for parts and components that upstream divisions supply to downstream ones. Here we will examine problems that stem from asymmetric information.

Asymmetric Information and Incentive Design in the Integrated Firm

In an integrated firm, the managers of the different divisions are likely to have better information about their operating costs and production potential than central management has. This asymmetric information causes two problems,

First, how can central management elicit accurate information about divisional operating costs and production potential from the divisional managers?

This is important because the inputs to some divisions may be the outputs of other divisions, because deliveries must be scheduled to customers, and because prices cannot be set without knowing overall production capacity and costs. Second, what reward or incentive structure should central management use to encourage the divisional managers to produce as efficiently as possible? Should the divisional managers be given a bonus based on how much they produce, and if so, how should it be structured?

To understand these problems, consider a firm with several plants that all produce the same product. Each plant's manager has much better information about its production capacity than central management has. The firm's central management wants to learn more about how much each plant can produce, so that it can avoid bottlenecks and schedule deliveries reliably. It also wants each plant to produce as much as possible. Let's examine how central management can obtain the information it wants and also encourage the plant managers to run the plants as efficiently as possible.

One way is to give the plant managers a bonus based on either the total output of their plant or its operating profit. While this would encourage the plant managers to maximize their plants output, it would penalize managers whose plants have higher costs and lower capacity. (Even if these plants produced efficiently, their output and operating profit—and hence their bonus—would be lower than that of plants with lower costs and higher capacities.) The plant managers would also have no incentive to obtain and reveal accurate information about cost and capacity.

A second way is to ask the plant managers about their costs and capacities, and *then to* base their bonus on how well they do relative to their answer. For example, each manager might be asked how much his or her plant can produce each year. Then at the end of the year, the manager would receive a bonus based on how close the plant's output was to this target. For example, if the manager's estimate of the feasible production level is Q_f , the annual bonus in dollars, B , might be

$$B = 10,000 - .5(Q_f - Q) \quad (17.3)$$

where Q is the plant's actual output, 10,000 is the bonus when output is at capacity, and .5 is a factor chosen to reduce the bonus if Q is below Q_f .

With this scheme, however, the plant managers would have an incentive to *underestimate* the capacity of their plant. By claiming a capacity below what they know to be true, they can more easily earn a large bonus, even if they do not operate efficiently. For example, if a manager estimates the capacity of her plant to be 18,000 rather than 20,000, and the plant actually produces only 16,000, her bonus increases from \$8,000 to \$9,000. Thus, this scheme fails to elicit accurate information about capacity, and does not ensure that the plants will be run as efficiently as possible.

Now let's modify this scheme. We will still ask the plant managers how much their plants can feasibly produce and tie their bonuses to this estimate. However, we will use a slightly more complicated formula than (17.3) to calculate the bonus:

$$\begin{aligned} \text{If } Q > Q_f, \quad B &= .3Q_f + .2(Q - Q_f) \\ \text{If } Q \leq Q_f, \quad B &= .3Q_f - .5(Q_f - Q) \end{aligned} \quad (17.4)$$

The parameters (.3, .2, and .5) have been chosen so that each plant manager has the incentive to reveal the *true* feasible production level, *and* to make Q , the actual output of the plant, as large as possible.

To see that this scheme does the job, look at Figure 17.4. Assume that the true production limit is $Q^* = 20,000$ units per year. The bonus that the manager will receive if she states the feasible capacity to be the true production limit is given by the line $Q_f = 20,000$. The line is continued for outputs beyond 20,000 to illustrate the bonus scheme, but dashed to signify the infeasibility of such production. Note that the manager's bonus is maximized when the firm produces at its limit of 20,000 units; the bonus is then \$6,000.

Suppose, however, that the manager reports a feasible capacity of only 10,000. Then the bonus she receives is given by the line $Q_f = 10,000$. The maximum bonus is now \$5,000, which is obtained by producing an output of 20,000. But note that this is less than the bonus the manager would receive if she correctly stated the feasible capacity to be 20,000.

The same line of argument applies when the manager exaggerates available capacity. If the manager states the feasible capacity to be 30,000 units per year,

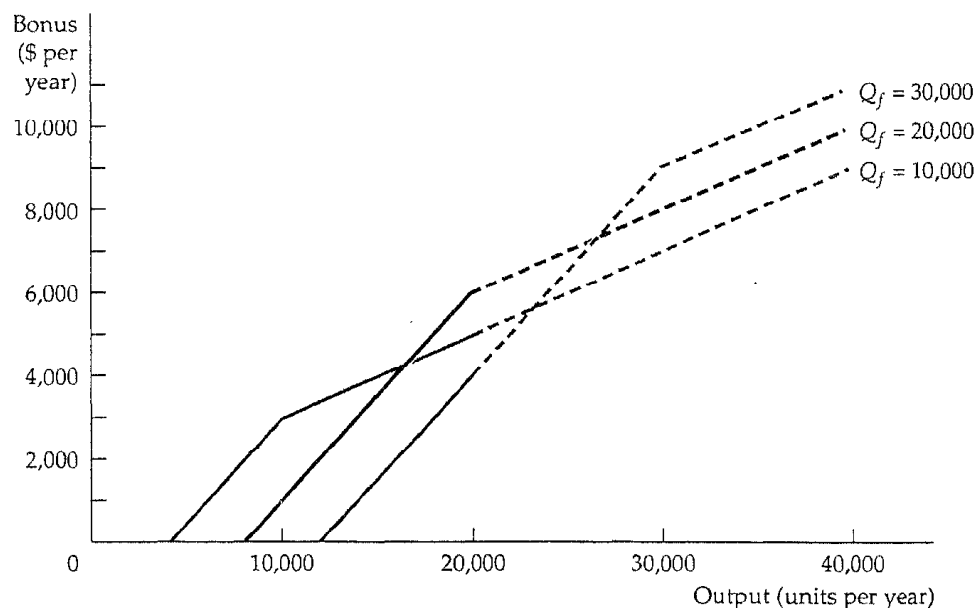


FIGURE 17.4 Incentive Design in an Integrated Firm. A bonus scheme can be designed that gives a manager the incentive to estimate accurately the size of the plant. If the manager reports a feasible capacity of 20,000 units per year, equal to the actual capacity, then the bonus received is maximized (at \$6000).

the bonus is *given* by the line $Q_f = 30,000$. The maximum bonus of \$4,000 which is achieved at an output of 20,000, is less than the bonus she could have received had she reported feasible capacity correctly.¹⁴

Applications

This problem of asymmetric information and incentive design comes up often in managerial settings, so incentive schemes like the one described above arise in many contexts. One example is how to encourage salespeople to set and reveal realistic sales targets, and then work as hard as possible to meet them.

Most salespeople cover specific territories. A salesperson assigned to an urban and densely populated territory can usually sell more product each month than a salesperson assigned to a sparsely populated area. The company, however, wants to reward all its salespeople equitably. It also wants to give them the incentive to work as hard as possible and to report realistic sales targets, so that it can plan production, and delivery schedules. Companies have always used bonuses and commissions to reward salespeople, but the incentive schemes have often been poorly designed. Typically, salespeople's commissions were proportional to their sales. This elicited neither accurate information about feasible sales targets nor maximum performance.

Now companies are learning that bonus schemes of the sort given by equation (17.4) provide better results. The salesperson can be given a matrix of numbers that shows the bonus as a function of both the sales target (chosen by the salesperson) and the actual level of sales. (The numbers would be calculated from equation (17.4) or some similar formula.) Salespeople will quickly figure out that they do best by reporting a feasible sales target, and then working as hard as possible to meet it.¹⁵

17.6 *Asymmetric Information in Labor Markets: Efficiency Wage Theory*

When the labor market is competitive, all who wish to work will find jobs for a wage equal to their marginal product. Yet most countries have substantial unemployment even though many people are aggressively seeking work.

¹⁴ Any bonus of the form $B = \beta Q_i + \alpha(Q - Q_i)$ for $Q > Q_i$, and $B = \beta Q_i - \gamma(Q_i - Q)$ for $Q \leq Q_i$, with $\gamma > \beta > \alpha > 0$ will work. See Martin L. Weitzman, "The New Soviet Incentive Model," *Bell Journal of Economics* VII (Spring 1976): 251-256. There is a dynamic problem with this scheme that we have ignored: Managers must weigh a large bonus for good performance this year against being assigned more ambitious targets in the future. This is discussed in Martin Weitzman, "The 'Ratchet Principle' and Performance Incentives," *Bell Journal of Economics* 11 (Spring 1980): 302-308.

¹⁵ See Jacob Gonik, "Tie Salesmen's Bonuses to their Forecasts," *Harvard Business Review* (May-June 1978): 116-123.

Many of the unemployed would presumably work even for a lower wage rate than that being received by employed people. Why don't we see firms cutting wage rates, increasing employment levels, and thereby increasing their profit? Can our models of competitive equilibrium explain persistent unemployment?

In this section we show how the *efficiency wage theory* can explain the presence of unemployment and wage discrimination.¹⁶ We have thus far determined labor productivity according to workers' abilities and firms' investment in capital. Efficiency wage models recognize that labor productivity also depends on what wage rate is paid.¹⁷ There are various explanations for this relationship. In developing countries, economists have suggested that the productivity of workers depends on the wage rate for nutritional reasons. Better-paid workers can afford to buy more and better food and are therefore healthier and can work harder.

A better explanation for the United States is found in the *shirking model*. Because monitoring workers is costly or impossible, firms have imperfect information about worker productivity, and there is a principal-agent problem. In its simplest form, the shirking model assumes perfectly competitive markets, so all workers are equally productive and earn the same wage. Once hired, workers can either work productively or slack off (shirk). But because information about their performance is limited, workers may not get fired for shirking..

The model works as follows. If a firm pays its workers the market clearing wage w^* , they have an incentive to shirk. Even if they get caught and are fired (and they might not be), they can immediately get hired somewhere else for the same wage. In this situation, the threat of being fired does not impose a cost on workers, so they have no incentive to be productive. As an incentive not to shirk, a firm must offer workers a higher wage. At this higher wage, workers who are fired for shirking will have to face a decrease in wages if they get hired by another firm at w^* . If the difference in wages is large enough, workers will be induced to be productive, and this firm will not have a problem with shirking. The wage at which no shirking occurs is the *efficiency wage*.

Up to this point, we have looked at only one firm. But all firms face the problem of shirking. This means that all firms will offer wages greater than the market clearing wage w^* , say, w_e (efficiency wage). 'Does this remove the incentive for workers not to shirk because they will be hired at the higher wage by other firms if they get fired? No; because all firms are offering wages greater than w^* , the demand for labor is less than the market-clearing quantity, and there is unemployment. This means that workers fired for shirking will face a spell of unemployment before earning w_e at another firm.

¹⁶ See Janet L. Yellen, "Efficiency Wage Models of Unemployment," *American Economic Review* 74 (May 1984): 200-205. The graphical analysis relies on Joseph E. Stiglitz, "The Causes and Consequences of the Dependence of Quality on Price," *Journal of Economic Literature* 25 (March 1987): 1-48.

¹⁷ This linkage between productivity and wages has been discussed by economists before the development of efficiency wage theory, most notably by Karl Marx.

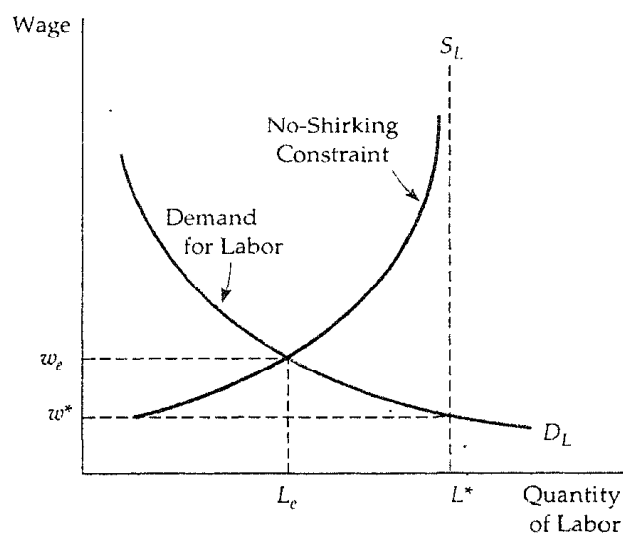


FIGURE 17.5 Unemployment in a Shirking Model. Unemployment can arise in otherwise competitive labor markets when employers cannot accurately monitor workers. Here the "no shirking constraint" gives the wage necessary to keep workers from shirking on the job. The firm hires L_e workers (at a higher than competitive efficiency wage w_e), creating $L^* - L_e$ of unemployment.

Figure 17.5 shows shirking in the labor market. The demand for labor D_L is downward-sloping for the traditional reasons. If there were no shirking, the intersection of D_L with the supply of labor (S_L) would set the market wage at w^* , and full employment would result (L^*). With shirking, however, individual firms are unwilling to pay w^* . Rather, for every level of unemployment in the labor market, firms need to pay some wage greater than w^* to induce workers to be productive. This wage is shown as the no-shirking constraint (NSC) curve. This curve shows the minimum wage workers need earn in order not to shirk, for each level of unemployment. Note that the greater the level of unemployment, the smaller the difference between the efficiency wage and w^* . This is because with high levels of unemployment, people who shirk risk long periods of unemployment and therefore don't need much inducement to be productive.

In Figure 17.5, the equilibrium wage will be at the intersection of the NSC curve and D_L curves, with L_e workers earning w_e . This is because the NSC curve gives the lowest wage that firms can pay and still avoid shirking. Firms do not need to pay more than this to get the number of workers they need, and they will not pay less than this because of shirking. Note that the NSC curve never crosses the labor supply curve. This means that there will always be some unemployment in equilibrium.

EXAMPLE 17.5 EFFICIENCY WAGES AT FORD MOTOR COMPANY

One of the early examples of the payment of efficiency wages can be found in the history of Ford, one of America's major automobile producers.¹⁸ Before 1913 automobile production had depended heavily on skilled workers. But the introduction of the assembly line drastically changed the workplace. Now jobs demanded much less skill, and production depended on maintaining the assembly-line equipment. As the automobile plants changed, workers became increasingly disenchanted. In 1913, turnover at Ford was 380 percent. The following year, it rose to 1000 percent, and profit margins fell sharply.

Ford needed to maintain a stable work force, and Henry Ford (and his business partner James Couzens) provided it. In 1914, when the going wage for a day's work in industry averaged between \$2 and \$3, Ford Motor Company introduced a pay policy of \$5 a day for its workers. Improved labor efficiency (not generosity) was behind this policy. The goal was to attract better workers who would stay with their jobs, and eventually to increase profits.

Although Henry Ford was attacked for it, this policy succeeded. The work force did become more stable, and the publicity helped Ford's sales. And because Henry Ford had his pick of workers, he could hire a group that was on average more productive. Ford stated that the wage increase did in fact increase the loyalty and personal efficiency of his workers, and quantitative estimates support his statements. According to calculations by Ford's chief of labor relations, productivity increased by 51 percent. Another study found that absenteeism had been halved, and discharges for cause had declined sharply. So the productivity increase more than offset the increase in wages. As a result, Ford's profitability rose from \$30 million in 1914 to \$60 million in 1916.

Summary

1. The seller of a product often has better information about its quality than the buyer. Asymmetric information of this type creates a market failure in which bad products tend to drive good products out of the market. The market failure can be eliminated if sellers offer standardized products, provide guarantees or warranties, or find other ways to maintain a good reputation for their product.

¹⁸ See J.R. Lee, "So-called Profit Sharing System in the Ford Plant," *Annals of the American Academy of Political and Social Science* (May 1915): 297-310; David Halberstam, *The Reckoning* (New York: William Morrow, 1986), pp. 91-92; and Daniel M.G. Raff and Lawrence H. Summers, "Did Henry Ford Pay Efficiency Wages?" *Journal of Labor Economics* (1987): 557-586.

2. Insurance markets frequently involve asymmetric information because the insuring party has better information about the risk involved than the insurance company. This can lead to adverse selection, in which the poorer risks choose to insure, and the good risks do not. Another problem for insurance markets is moral hazard, in which the insuring party takes less care to avoid losses after insuring than before.
3. Sellers can deal with the problem of asymmetric information by sending buyers signals about the quality of their product. For example, workers can signal their high productivity by obtaining a high level of education.
4. Asymmetric information may make it costly for the owners of firms (the principal) to monitor accurately the behavior of the firm's manager (the agent). Managers may seek higher fringe benefits for themselves, or a goal of sales maximization, even though the shareholders would prefer to maximize profit.
5. Owners can avoid some of the principal-agent problems by designing contracts that give their agents the incentive to perform productively.
6. Asymmetric information can explain why labor markets have substantial unemployment when some workers are actively seeking work. According to efficiency wage theory, a wage higher than the competitive wage (the efficiency wage) increases worker productivity by discouraging workers from shirking on the job.

Questions for Review

1. Why can asymmetric information between buyers and sellers lead to market failure when a market is otherwise perfectly competitive?
2. If the used car market is a "lemons" market, how would you expect the repair record of used cars that are sold to compare with the repair record of those not sold?
3. Explain the difference between adverse selection and moral hazard in insurance markets. Can one exist without the other?
4. Describe several ways in which sellers can convince buyers that their products are of high quality. Which methods apply to the following products: May tag washing machines. Burger King hamburgers, large diamonds?
5. Why might a seller find it advantageous to signal the quality of her product? How are guarantees and warranties a form of market signaling?
6. Why might managers of firms be able to achieve objectives other than profit maximization, the goal of the firm's shareholders?
7. How can the principal-agent model be used to explain why public enterprises, such as post offices, might pursue goals other than profit maximization?
8. Why are bonus and profit-sharing payment schemes likely to resolve principal-agent problems, whereas a fixed wage payment will not?
9. What is an efficiency wage? Why is it profitable for the firm to pay an efficiency wage when workers have better information about their productivity than firms do?

Exercises

1. Many consumers view a well-known brand name as a signal of quality and will pay more for a brand-name product (e.g., Bayer aspirin instead of generic aspirin, or Birds Eye frozen vegetables instead of the supermarket's own brand). Can a brand name provide a useful signal of quality? Why or why not?
2. Gary is a recent college graduate. After six months at his new job, he has finally saved enough to buy his first car.
 - a. Gary knows very little about the differences between makes and models of cars. How could he use market signals, reputation, or standardization to make comparisons?
 - b. You are a loan officer in a bank. After selecting a car, Gary comes to you seeking a loan. Since he has only recently graduated, he does not have a long credit history. Despite this, the bank has a long history of financing cars of recent college graduates. Is this information useful in Gary's case? If so, how?
3. A major university bans the assignment of D or F grades. It defends its action by claiming that students tend to perform above average when they are free from the pressures of flunking out. The university states that it wants all its students to get As and Bs. If the goal is to raise overall grades to the B level or above, is this a good policy? Discuss with respect to the problem of moral hazard.
4. Professor Jones has just been hired by the economics department at a major private university. The president of the board of regents has stated that the university is committed to providing top-quality education for its undergraduates. Two months into the semester, Professor Jones fails to show up for his classes. It seems he is devoting all his time to economic research rather than to teaching. Professor Jones argues that his research will bring additional prestige to the department and the university. Should he be allowed to continue exclusively with research? Discuss with reference to the principal-agent problem.
5. Faced with a reputation for producing automobiles with poor repair records, a number of American automobile companies have offered extensive guarantees to car purchasers (e.g., a seven-year warranty on all parts and labor associated with mechanical problems).
 - a. In light of your knowledge of the lemons market, why is this a reasonable policy?
 - b. Is the policy likely to create a moral hazard problem? Explain.
6. To promote competition and consumer welfare, the Federal Trade Commission requires firms to advertise truthfully. How does truth in advertising promote competition? Why would a market be less competitive if firms advertised deceptively?
7. An insurance company is considering issuing three types of fire insurance policies: (i) complete insurance coverage, (ii) complete coverage above and beyond a \$10,000 deductible, and (iii) 90 percent coverage of all losses. Which policy is more likely to create moral hazard problems?
8. You have seen how asymmetric information can reduce the average quality of the products sold in a market, as low-quality products drive out the high-quality ones. For those markets where asymmetric information is prevalent, would you agree or disagree with each of the following? Explain briefly:
 - a. The government should subsidize *Consumer Reports*.
 - b. The government should impose quality standards; e.g., firms should not be allowed to sell low-quality items.
 - c. The producer of a high-quality good will probably want to offer an extensive warranty.
 - d. The government should require *all* firms to offer extensive warranties.
9. Two used car dealerships compete side by side on a main road. The first, Harry's Cars, sells high-quality cars that it carefully inspects and, if necessary, services. It costs Harry's, on average, \$8,000 to buy and service each car that it sells. The second

dealership. Lew's Motors, sells lower-quality cars. It costs Lew's on average only \$5,000 for each car that it sells. If consumers knew the quality of the used cars they were buying, they would gladly pay \$10,000 on average for cars Harry's Sells and pay only \$7,000 on average for the cars Lew's sells.

Unfortunately, the dealerships are too new to have established reputations, so consumers don't know the quality of each dealership's cars. Consumers shopping at these dealerships figure that they have a 50-50 chance of ending up with a high-quality car, no matter which dealership they go to, and hence are willing to pay \$8,500 on average for a car.

Harry's has an **idea**—it will offer a bumper-to-bumper warranty for all the cars it sells. It knows that a warranty lasting r years will cost $\$500r$ on average, and it also knows that if Lew's tries to offer the same warranty, it will cost Lew's $\$2000r$ on average.

a. Suppose Harry's offers a one-year warranty on all the cars it sells. Will this generate a credible signal of quality? Will Lew's match the offer, or

will it fail to match it so that consumers can correctly assume that because of the warranty, Harry's cars are high quality and hence worth \$10,000 on average?

b. What if Harry's offers a two-year warranty on its cars? Will this generate a credible signal of quality? What about a three-year warranty?

c. If you were advising Harry's, how long a warranty would you urge it to offer? Explain why.

10. A firm's short-run revenue is given by $R = 10e - e^2$, where e is the level of effort by a typical worker (all workers are assumed to be identical). A worker chooses his level of effort to maximize his wage net of effort $w - e$ (the per-unit cost of effort is assumed to be 1). Determine the level of effort and the level of profit (revenue less wage paid) for each of the following wage arrangements. Explain why these different principal-agent relationships generate different outcomes.

a. $w = 2$ for $e \geq 1$; otherwise $w = 0$.

b. $w = R/2$.

c. $w = R - 12.5$.