

Knowledge and Information

Every night the 1.5 million residents of Manhattan Island go to bed confident that when they awake, they will be able to purchase food, clothing, gasoline, and dozens of other items that are sent to New York City from thousands of miles away. How can Iowa farmers and Texas oil producers know what products to ship to Manhattan and in what quantities? Because each individual supplier makes an independent decision about how much to send, why do residents of the city not find all the stores nearly empty on some days or full to overflowing on others? When New Yorkers want more pork, how do the suppliers of feed corn know to increase production so that the hog farmers can raise more hogs? How is this activity coordinated with the activities of the butchers and truck drivers and refrigerator repairmen who are the hog farmers' partners in the production of pork chops? How *can* it be coordinated, when all of these producers are unknown to each other?¹

In this chapter, we will see how prices serve to convey information so that complex social activities can be organized and implemented. This will extend our understanding of the social role of prices that was developed in Chapter 8. There we saw how the price system acts to allocate resources efficiently by ensuring that appropriate quantities will be produced. Here we will focus on how prices contribute to the efficient production and distribution of those quantities by embodying vast amounts of knowledge not available to any individual. The two effects work together—hand in invisible hand—to lead to social outcomes that take account of producers' costs and consumers' preferences in ways that no individual planner could hope to accomplish.

9.1 The Informational Content of Prices

Prices and Information

The prestigious journal *Science* once carried an article titled “Limits to Exploitation of Nonrenewable Resources.” It contained this passage:

¹ Such questions were raised by the nineteenth-century French economist Frederic Bastiat in his book *Economic Sophisms* (1873).

To society...the profit from mining (including oil and gas extraction) can be defined either as an energy surplus, as from the exploitation of fossil and nuclear fuel deposits, or as a work saving, as in the lessened expenditure of human energy and time when steel is used in place of wood in tools and structures.²

Presumably, the “energy surplus” associated with, say, a coal deposit refers to the difference between the energy that can be extracted from the coal deposit on the one hand, and the energy required to excavate it on the other.

By this accounting, a society’s choice of energy sources becomes a matter of simple arithmetic. Suppose, for simplicity, that it is necessary to choose between two projects: mining coal (which is located in the eastern half of the United States) and drilling for oil (which is located in the West). Coal mining yields sufficient fuel to provide 1,000 British thermal units³ of energy per month, but the mining process itself consumes 500 BTUs in the same time period. Oil drilling yields 800 BTUs per month but consumes 200 BTUs. Because the “social profit” from oil (600 BTUs per month) exceeds that from coal (500 BTUs), society should choose to drill for oil.

Alas, the world is not so simple. A subsequent issue of the same journal carried a letter from Harvard economist Robert Dorfman, who elucidated the fallacy. Suppose that the land in the West is the only land suitable for growing hops. A society that drills for oil will then be a society without beer. Then perhaps it is best to mine coal instead. Or perhaps not—the eastern land might be the best place to raise cattle. On the other hand, the West might be where everyone wants to live, because of its better climate and greater scenic beauty. (See Exhibit 9.1.) What should society do?

A rational choice involves weighing the importance of the alternative uses of land in the different regions of the country. Essentially, there are two ways to do this. One is to empanel a blue-ribbon commission, peopled by experts in mining, agriculture, ranching, housing, and other fields, and to empower this commission to collect evidence about public desires and technological constraints. The panel would inquire into how the eastern land might be made suitable for the growing of hops, and at what cost. It would ask whether there is a way to make beer without hops, or whether beer can be adequately imported, or whether there is some other beverage that might easily take the place of beer. Having settled these questions, it would move on to analogous questions about housing. At some point the commission would issue a report, making the best recommendation it could on the basis of the information it had been able to acquire.

An alternative is to observe the *price* of land in each region. The price of a parcel of land is equal (under competition) to the marginal cost of providing that parcel. Because a cost is nothing but a forgone opportunity, the price is a measure of the value of the land in the most valuable of its alternative uses.

When we observe that an acre of land in the West sells for \$1,000 and that an acre in the East sells for \$800, we know that someone values the western land at \$1,000 per acre and that no one values the eastern land at more than \$800 per acre. The price alone does not reveal the most valuable use of the western land, but it does reveal how much the land is worth in that use.⁴

Which method is more informative? The commission’s report, which may fill three bound volumes and represent two years’ work, can be worse than useless if the panelists fail to take account of even one important fact. Not knowing about a new breed of

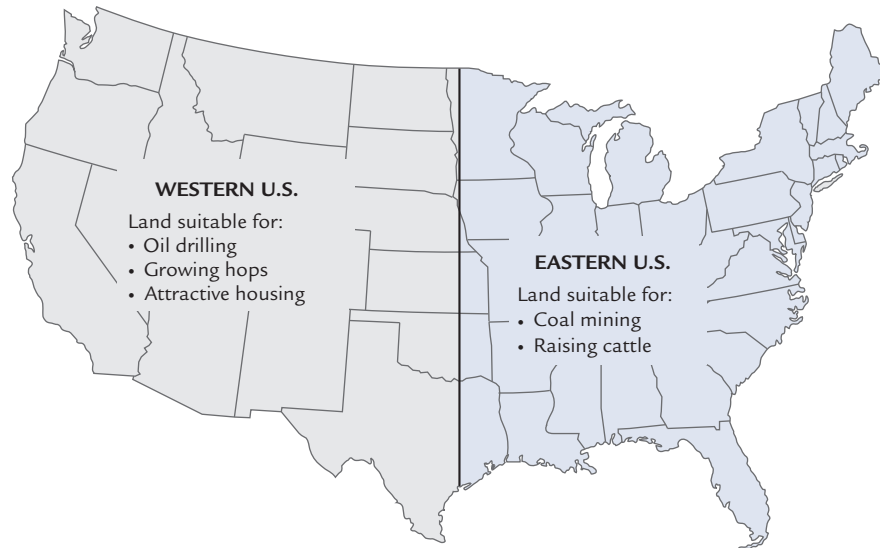
² E. Cook, “Limits to Exploitation of Nonrenewable Resources,” *Science* 191 (1976): 677–682.

³ British thermal units, or BTUs, are the basic units in which energy is measured.

⁴ There are exceptions to this rule, as we shall see in Chapter 13.

EXHIBIT 9.1

Information and Prices



Even if we know that oil drilling produces more energy than coal mining, we still do not have enough information to choose between the two projects. If we drill for oil, we must do without beer and attractive housing, while if we mine coal we must do without beef. The desirability of either alternative depends on the availability of substitutes for beer, western housing, and beef. A blue-ribbon commission can make a disastrously wrong decision if it is missing just one fact. For example, if the commission is unaware of a new breed of cattle that thrives in the West, it might rule out coal mining in the mistaken belief that eastern land is the only source of beef.

However, prices convey the relevant information. The existence of the new breed of cattle drives up the price of western land and drives down the price of eastern land. Although the prices do not reveal the existence of the new breed of cattle, they do reveal that *something* has raised the value of western land and lowered the value of eastern land. This is precisely the kind of information that is needed to choose between the two energy sources.

cattle that thrives in the West, it recommends that the East be reserved for the vital role of producing beef, and that the West be exploited for energy—sacrificing both beer and good living and unnecessarily impoverishing society.

Had the commissioners observed the high price of land in the West, they would have known that something was afoot—in this case, the owners of the new breed of cattle bidding up the price of land. Although observers of the price might know less about ranching than the commissioners do, they will know more about how to extract energy efficiently.

Prices convey information. They reflect the information available to all members of society (in this case, the small number who know about the new cattle reveal the relevant part of their knowledge through the price of land). The commissioners, no matter how wise and how benevolent, can never gather more than a fraction of the information that may be relevant to their decision—but *all* of that information is reflected in the price.

Prices have at least two other advantages over expert panels. One is that observing prices is free. Expert panels consume resources—lots of resources, if they do their jobs well.

The other advantage of prices is that in addition to conveying information, they also provide appropriate incentives to act on that information. When a price tells you (by being high) that western land is valuable to someone, you will not choose to use it yourself unless it is even more valuable to you.

Here is Dorfman again:

Clearly, then, social costs cannot be measured in... simple physical units. The only adequate measure is what economists call "social opportunity costs," meaning the social value of the alternative commodities that have to be forgone in order to obtain the commodity being produced. Under certain idealized conditions this opportunity cost is measured by the dollars-and-cents cost of producing the commodity. Under realistic conditions the dollars-and-cents production cost is a fair approximation to the social cost. Under almost any conceivable conditions the dollars-and-cents cost is a much better approximation to social cost than the amounts of energy expended or any other simple physical measure.

Energy is indeed a scarce and valuable resource; but... there is a good deal more to life... than British thermal units.⁵

The Problem of the Social Planner

Try the following experiment: Ask your friends to name the two ways to get a chicken to lay more eggs. Few will know. The two ways to get a chicken to lay more eggs are to feed it more or to provide it with more heat from blowers that are usually powered by natural gas.⁶ In chicken farming natural gas and chicken feed are close substitutes.

Imagine a chicken farm next door to a steel mill. In a typical week each consumes 100 cubic feet of natural gas. The steel mill has no economical alternative production process, and it would have to curtail its operation significantly if natural gas became unavailable. The chicken farmer, at an additional cost of a few cents per day, could switch off the blowers and use more chicken feed.

One day it transpires that only 100 cubic feet of natural gas per week will be available in the future. A benevolent economic planner, seeking only to benefit society, must decide how to allocate this natural gas. Perhaps he observes that the steel mill and the chicken farmer have historically used natural gas in equal quantities, and on this basis he decides that their "needs" for natural gas are roughly equal. He assigns 50 cubic feet per week to the steel mill and 50 cubic feet to the chickens.

As a result, there is a substantial cutback in steel output, to society's detriment. If all 100 cubic feet had been assigned to the steel mill, production would have continued about as before, with the chicken farmer having slightly higher costs and perhaps cutting egg production by a small amount.

Why does the benevolent planner not recognize his mistake? Because he—like the friends you were invited to poll on this question, and almost everybody else except for chicken farmers and the readers of this book—has never remotely suspected that chicken feed can be substituted for natural gas. Why doesn't the chicken farmer tell him? If he did, he would lose his natural gas allocation and his costs would go up—only slightly, to be sure, but the incentive is still to keep mum.

An alternative social arrangement is to abolish the planner and to allocate the gas via the price system. Now when natural gas becomes more scarce, the price gets bid up.

⁵ From *Science*, letter to editor by R. Dorfman, 1976.

⁶ Chickens use calories from feed to produce both eggs and body warmth. A chicken in a heated henhouse can divert more calories to egg production.

This has two effects on the chicken farmer: He acquires the information that the available natural gas is more valuable to someone else than it is to him, and he acquires an incentive to react accordingly. He puts in an order for some chicken feed.⁷

The Use of Knowledge in Society

In 1945, Friedrich A. Hayek (later a Nobel Prize winner) addressed the American Economic Association on the occasion of his retirement as its president. The title of his address was “The Use of Knowledge in Society.” In it he called attention to the social role of prices as carriers of information, allowing the specialized knowledge of each individual to be fully incorporated in decisions concerning resource allocation. He contrasted this knowledge with so-called scientific knowledge and found it unjustly underrated by comparison:

A little reflection will show that there is beyond question a body of very important but unorganized knowledge which cannot possibly be called scientific in the sense of knowledge of general rules: the knowledge of the particular circumstances of time and place. It is with respect to this that practically every individual has some advantage over all others in that he possesses unique information of which beneficial use might be made, but of which use can be made only if the decisions depending on it are left to him or are made with his active cooperation. We need to remember only how much we have to learn in any occupation after our theoretical training, how big a part of our working life we spend learning particular jobs, and how valuable an asset in all walks of life is knowledge of people, of local conditions, and special circumstances. To know of and put to use a machine not fully employed, or somebody's skill which could be better utilized, or to be aware of a surplus stock which can be drawn upon during an interruption of supplies, is socially quite as useful as the knowledge of better alternative techniques. [Emphasis added.]⁸

The special knowledge of the chicken farmer is a sort of knowledge of the particular circumstances of time and place. But Hayek is referring here to knowledge even much more specialized (and inaccessible to the planner) than that: the knowledge of the foreman that a leak in a certain machine can be plugged with chewing gum, the knowledge of a manager that one of the file clerks has a knack for plumbing repairs, the knowledge of a shipper that a particular tramp steamer is half-full. No planner can have access to this knowledge:

The sort of knowledge with which I have been concerned is knowledge of the kind which by its nature cannot enter into statistics and therefore cannot be conveyed to any central authority in statistical form. The statistics which such a central authority would have to use would have to be arrived at precisely by abstracting from minor differences between the things, by lumping together, as resources of one kind, items which differ as regards location, quality, and other particulars, in a way which may be very significant for the specific decision.⁹

⁷ Economist, financial planner, and chicken expert Dan Gressel reports that when natural gas prices were controlled in the 1970s, chicken farmers routinely consumed large and socially inefficient quantities of natural gas. When the controls were lifted and prices rose, farmers switched to chicken feed.

⁸ F. A. Hayek, “The Use of Knowledge in Society,” *American Economic Review* 35 (September 1945): 519–530.

⁹ *Ibid.*

Suppose that you and your friends discover a new science fiction writer whose works you all rush out to buy. It may not occur to you that this requires more linseed plants to be grown in Asia, but it does, because the oil from those plants is used to make the ink to print the books that the stores now want to restock. The Asian linseed farmer is no more aware of the change in your reading habits than you are of your need for his services, but he nevertheless responds by increasing his output. Your increased demand for books causes a rise in the price of linseed and informs the farmer that someone, somewhere, wants more linseed for some reason.

A competing economics textbook begins its first chapter by observing that “the rest of us people” (together with nature) “dominate your life and prevent you from having all you want.”¹⁰ However, the authors warn:

Do not suppose that if we were less greedy, more would be within your grasp. For greed impels us to produce more, not only for ourselves, but, miraculously, more for you too...

What the authors have in mind is that other people’s greed enables you to offer them incentives to act as you want. It is because the carpenter is “greedy” that you can hire him to build your house.¹¹ In fact, we can say more. Although greedy neighbors are more likely than apathetic neighbors to respond to your desires, you might imagine that the best possibility is a third one that the authors did not consider: What if the rest of the world were neither greedy nor apathetic, but actively altruistic, attempting to cater to all of your wishes? Although such a world would have obvious advantages, it would also have a less obvious disadvantage: In the absence of a price system, you would be severely limited in your ability to communicate your desires. The farmer in Asia, wanting only to make your life more pleasant, has no criterion by which to choose between producing more linseed or more of some other crop. You have no way of informing him because you don’t realize that a yen for science fiction creates a need for more linseed oil—or, if you do realize this, then you don’t realize that you also need more glycerin, to make the glue with which the books are bound.

Your need for the selfishness of others stems not just from the fact that it motivates them to respond to your desires—altruism on their part would serve that purpose even better. It also stems from your need to *communicate* those desires. Students—and others who have not previously encountered the idea—generally find it quite surprising that a major role of prices in society is to fulfill this need.

The Costs of Misallocation

We now want to explicitly relate the “informational” aspect of prices to the “equilibrating” aspect that has been stressed in previous chapters. Exhibit 9.2 displays the marginal value curves of three consumers in the market for eggs and the corresponding market demand curve. (The graph and tables are identical to those of Exhibit 8.6.)

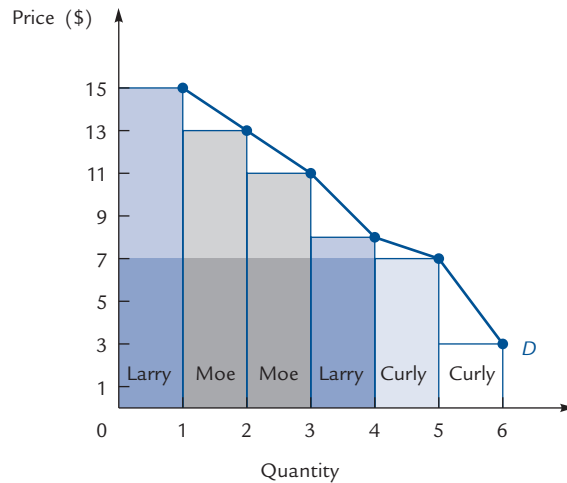
The rectangles represent marginal values associated with individual eggs, each labeled with the name of the man who buys the corresponding egg and receives the corresponding value. When the market price is \$7 per egg, 5 are sold and the top parts of the shaded rectangles constitute the consumer’s surplus.

¹⁰ A. Alchian and W. Allen, *Exchange and Production: Theory in Use* (Belmont, CA: Wadsworth, 1969).

¹¹ Adam Smith put this very well. In *The Wealth of Nations*, he said, “It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest. We address ourselves not to their humanity but to their self-love.”

EXHIBIT 9.2

The Costs of Misallocation



Larry		Moe		Curly	
Quantity	Marginal Value	Quantity	Marginal Value	Quantity	Marginal Value
1	\$15/egg	1	\$13/egg	1	\$7/egg
2	8	2	11	2	3

When the market price is \$7 per egg, 5 eggs are sold (2 to Larry, 2 to Moe, and 1 to Curly) and their total value (the sum of the shaded rectangles) is \$54. If the same 5 eggs were distributed by a mechanism other than the market, the total value might be less. For example, if a social planner gave 2 eggs to Larry, 1 to Moe, and 2 to Curly, the total value would be only \$46. In this case, therefore, the usual measures of social gain would overstate the true social gain by \$8.

Exercise 9.1 Assume a flat supply (5 marginal cost) curve at \$7 and calculate the total value of the eggs produced, the total cost of producing them, and the social gain. (Assume that eggs can be consumed only in “whole-number” quantities for this calculation.)

Now let us reintroduce our benevolent social planner. Although the price system has been abolished he has managed through painstaking research to discover the demand and supply curves for eggs. Plotting both of these on the same graph, he discovers that equilibrium occurs at a quantity of 5. Wishing to maximize social gain and realizing that this is accomplished at equilibrium, he orders 5 eggs to be produced and distributed to consumers.

It appears that the social planner has succeeded in duplicating the workings of a competitive market, but this need not be true and, in fact, is not likely to be. Suppose that the planner orders the 5 eggs to be distributed as follows: 2 to Larry, 1 to Moe, and 2 to Curly. The marginal values of these eggs are equal to the areas of the first, second, fourth, fifth, and sixth rectangles in Exhibit 9.2. In comparison with competition, Moe has lost his second egg (worth \$11 to him), and Curly has gained a second egg (worth only \$3 to him). There is a net social loss of \$8.

Exercise 9.2 Calculate the total value and total cost of the 5 eggs distributed by the planner. Compare these with your answer to Exercise 9.1.

In attempting to justify his actions, the social planner might look at the graph in Exhibit 9.2 and argue: “It is clear from this graph that social gain is maximized at a quantity of 5. That is the quantity I ordered produced. Therefore, social gain is maximized.” But in actuality the social gain is a sum of 5 rectangles. We compute it by looking at the area under the demand curve out to a quantity of 5, implicitly assuming that it is the sum of the *first* 5 rectangles. This in turn assumes that the 5 eggs are distributed where they will be valued the most. In a competitive market this assumption is justified (Curly simply won’t buy a second egg at \$7, whereas Moe will). In the absence of a price system, it is not.

What must the social planner do to really maximize welfare? He must give Curly’s second egg to Moe instead. (Of course, by doing this, he increases welfare and so can make both parties better off.)

Exercise 9.3 Describe explicitly how the social planner can make both Curly and Moe better off.

Now we return to the problem that is the theme of this chapter. How is the planner to *know* that Moe values a second egg more than Curly does? This information is available only to Moe and Curly. Its inaccessibility to the social planner renders him powerless to make improvements.

We can summarize as follows:

When allocation decisions are not made on the basis of price, the traditional measures of social gain (via areas) overstate the actual gains to society. Equivalently, the traditional measures of deadweight loss underestimate the losses.

Exercise 9.4 Suppose that the supply curve for eggs is as given in Exhibit 9.3 (which is identical to the curve in Exhibit 8.7). A social planner orders 5 eggs to be produced, 1 by Firm A and 2 each by Firms B and C. What is the extent of the social loss due to the social planner’s failure to perceive that A is the low-cost producer?

Example: A Military Draft

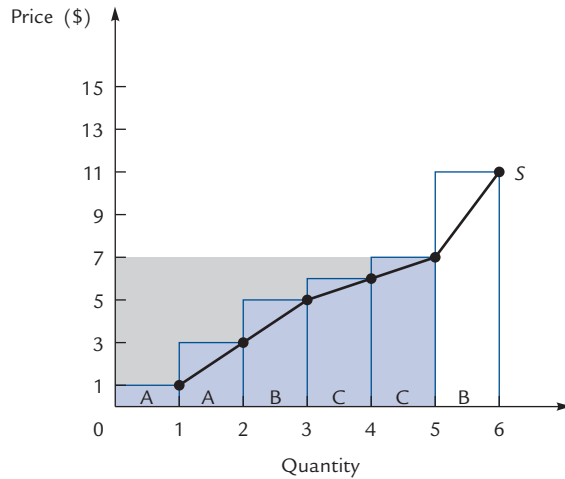
Society, through its armed forces, demands military services that are supplied by young people between the ages of 18 and 26. Suppose that the armed forces are able to set a maximum price (below equilibrium) that they will pay for military services, and suppose that they can *compel* young people to supply the quantity of military services that is demanded at that price (Q_d in Exhibit 9.4). The “*Draft*” column of the table in Exhibit 9.4 shows the distribution of gains; the “Volunteer Army” column shows the gains in equilibrium for comparison.¹²

Exhibit 9.5 elaborates on the reason why the producers’ surplus is $F - C - D - E$ in the presence of a draft. Panel A of Exhibit 9.5 reproduces the relevant part of the graph

¹² By drawing one graph, we are implicitly assuming that all young people would make equally good soldiers. To dispense with this assumption, we could draw several graphs, each showing the demand for soldiers of a different level of quality. None of our conclusions would be substantially altered.

EXHIBIT 9.3

Planning versus Market



Firm A		Firm B		Firm C	
Quantity	Marginal Cost	Quantity	Marginal Cost	Quantity	Marginal Cost
1	\$1	1	\$5	1	\$6
2	3	2	11	2	7

At a market price of \$7, 5 eggs are produced in the least costly way possible. If a social planner orders 5 eggs to be produced and fails to realize that the low-cost producer is Firm A, then the total cost of production will be higher than necessary.

in Exhibit 9.4. Revenue to producers (i.e., the wages paid to soldiers) is given by price times quantity, that is, the rectangle $X + Z$. The sum of the marginal costs to producers is the sum of the rectangles in panel B, which is the same as area $Y + Z$ in panel A. The difference is $(X + Z) - (Y + Z) \times X - Y$, which is the same as $F - C - D - E$ in Exhibit 9.4.

Exercise 9.5 Verify the deadweight loss in Exhibit 9.4 by calculating social gain directly (i.e., using rectangles representing marginal value minus marginal cost, without breaking things down into consumers' and producers' surpluses).

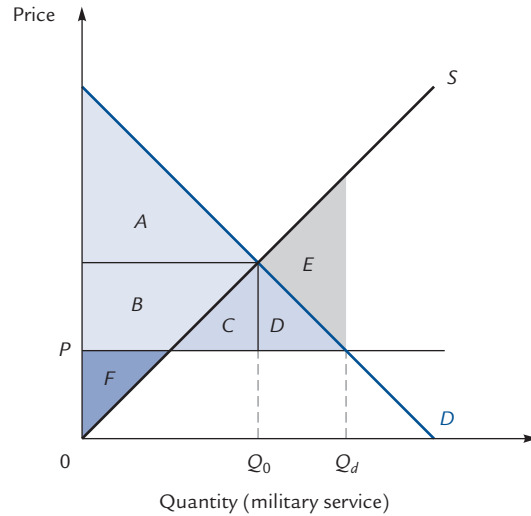
Now consider an alternative policy. Suppose that at the same controlled price P , the armed forces can compel services only from that number of young people who would have enlisted voluntarily at the equilibrium price. In Exhibit 9.4, the number of soldiers is Q_0 and the social gains are computed in the "Limited Draft" column of the table. Notice that the measured deadweight loss becomes *zero*.

Exercise 9.6 Verify all of the entries in the "Limited Draft" column of the table. Recompute the deadweight loss by a different method and make sure the answers coincide.

Notice that, compared with the volunteer army, the new "limited" version of the draft transfers the amount $B + C$ from young people to the other members of society.

EXHIBIT 9.4

A Military Draft



	Volunteer Army	Draft	Limited Draft
Consumers' Surplus	A	$A + B + C + D$	$A + B + C$
Producers' Surplus	$B + F$	$F - C - D - E$	$F - C$
Social Gain	$A + B + F$	$A + B + F - E$	$A + B + F$
Deadweight Loss	—	E	—

Military services are supplied by young people and demanded by society through the armed forces. The first column shows the gains at equilibrium, with a volunteer army. We assume that the wage rate is set at P , so that more young people are demanded than will volunteer. If the army can draft as many young people as it wants to at the price P , it will choose the quantity Q_d , and social gains will be as depicted in the second column. If, on the other hand, the army is permitted to hire only Q_0 young people, social gains will be as in the third column, seemingly eliminating the deadweight loss. This leads to the apparent conclusion that the limited draft is as efficient as the volunteer army. As explained in the text, however, this conclusion is misleading.

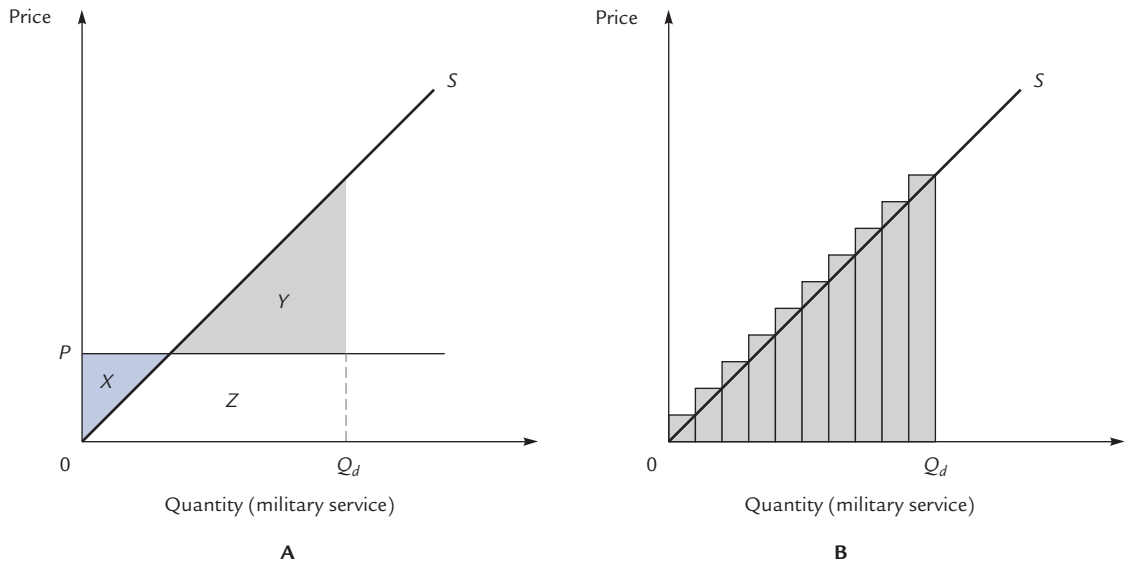
Exercise 9.7 Give an economic interpretation of the area $B + C$ in Exhibit 9.4.

Now we are closing in on the main point: Even though the computed deadweight loss is zero, the limited draft is still inferior to the volunteer army from the point of view of economic efficiency. There are social costs associated with the draft that are not captured in our representation of deadweight loss.

Consider the calculation of producers' surplus, which is illustrated anew in Exhibit 9.6. We begin with the total revenue of soldiers and subtract from it the sum of the shaded rectangles. These rectangles are the costs of joining the army for the Q_0 young people who would volunteer at the equilibrium price. But it is unlikely that these are the same young people who are drafted. Instead of drafting the young people represented by rectangles a , b , and c , the authorities may draft those represented by rectangles d , e , and f . The true producers' surplus is reduced by the area $(d + e + f) - (a + b + c)$. The measured producers' surplus—and consequently the measured deadweight loss—is too optimistic.

EXHIBIT 9.5

Computing Producers' Surplus with a Draft



If the army forcibly hires Q_d soldiers at the price P , then soldiers will earn $P \cdot Q_d \times X + Z$ in wages. Their opportunity cost of being in the army is the sum of all the rectangles in panel B, which is the same as area $Y + Z$ in panel A. This leaves a producers' surplus of $(X + Z) - (Y + Z) \times X - Y$.

In concrete terms, what this means is that the Selective Service Board will draft young people who are potentially brilliant brain surgeons, inventors, and economists— young people with high opportunity costs of entering the service—and will leave undrafted some young people with much lower opportunity costs. The social loss is avoided under a voluntary system, in which precisely those with the lowest costs will volunteer.

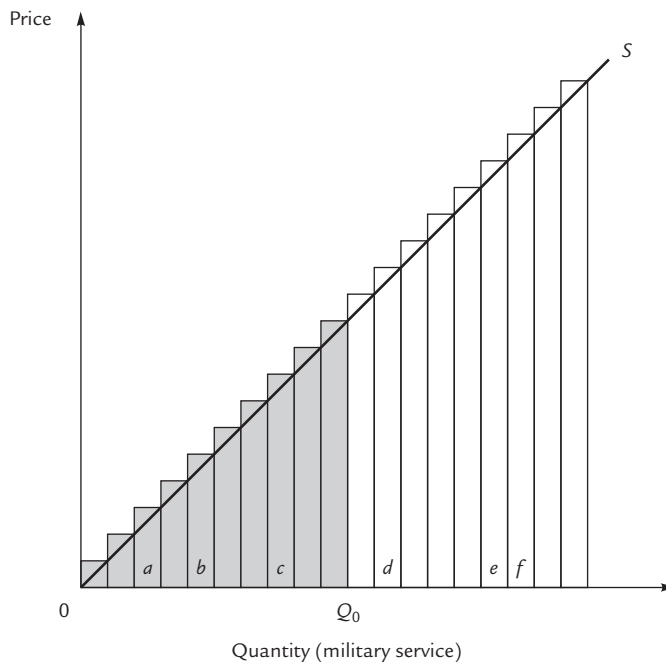
What if the authorities choose to draft only the low-cost young people? Here, of course, the problem of knowledge becomes insurmountable. Information about individual opportunity costs, available for free under a voluntary system, is available only at high cost and with great uncertainty in the absence of prices. The Selective Service authorities can pass out questionnaires—but who will freely reveal that his costs are low? They can observe people's behavior—but who can observe the difference between two starving novelists in garrets, one with a brilliant vision that needs only careful nurturing to become great literature, the other barren of ideas, frustrated, and ready to quit?

It is often argued that the draft is better for society than a volunteer army because it is less costly. This argument is wrong.¹³ The cost of maintaining an army is the sum of the opportunity costs of its soldiers and is independent of the wages paid to those soldiers. Higher wages mean less wealth for taxpayers and more for soldiers, but no more or less for society, to which taxpayers and soldiers equally belong. There are two ways

¹³ Of course, there are many other arguments for and against the draft, but their validity does not concern us here.

EXHIBIT 9.6

Underestimating Deadweight Loss



Q_0 is the number of young people who would join a volunteer army. Each of these young people has an opportunity cost of joining that is represented by one of the shaded rectangles. When we compute producers' surplus, we take the total revenue earned by young people and subtract this shaded area.

Under a limited draft, the same number of young people enter the army. However, those who are drafted are not identical to those who would have volunteered. Suppose that the draft board selects the young people represented by rectangles d , e , and f instead of rectangles a , b , and c . In that case, social welfare is reduced by the area $(d + e + f) - (a + b + c)$, even though this reduction is ignored in the usual welfare computations. Hence, the measured deadweight loss is overly optimistic.

in which an army can be unnecessarily costly: It can be the wrong size or it can consist of the wrong people. Exhibits 9.4 and 9.6 illustrate these two mistakes.

The Social Role of Rent

Rent

Payments to a factor of production in excess of the minimum payments necessary to call it into existence. In other words, the producer's surplus earned by the factor.

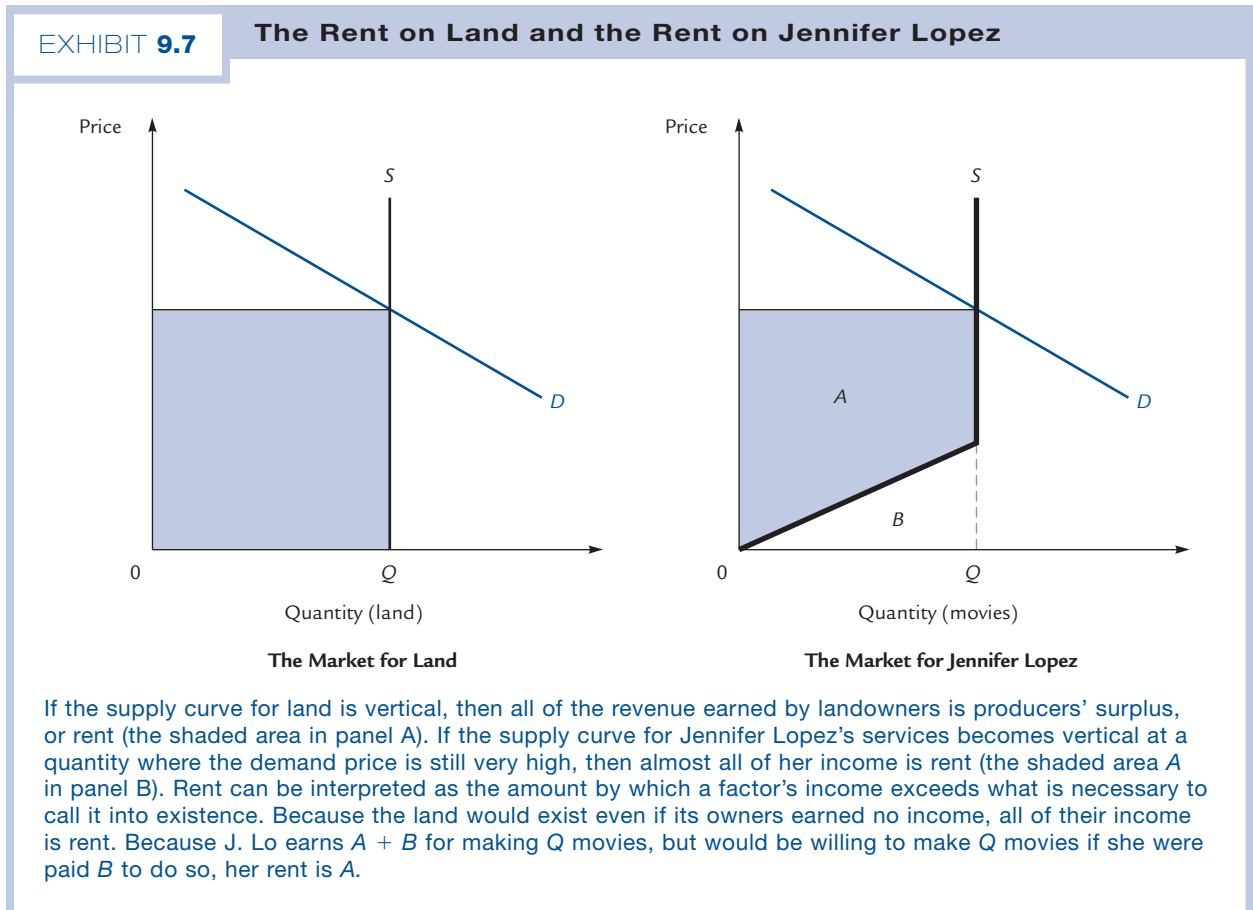
An issue of great importance in the history of economic thought has been the social function of the rent on land. The nineteenth-century English economist Henry George argued in his book *Progress and Poverty* that because the quantity of land is fixed, the payment of rent to landlords serves no economic purpose. Increased demand for land (which, he argued, is an inevitable consequence of population growth) bids up prices, but, unlike in other markets, this increased price calls forth no additional output. Landlords are enriched to no social end.

This analysis, applied to a more general notion of "rent," was a recurrent theme in the writings of Fabian socialism.¹⁴ The **rent** earned by a factor of production is the

¹⁴ The Fabian Society was a major contributor to British political discourse in the early part of the twentieth century. Its most prominent spokesmen were the economists Sidney Webb and George Bernard Shaw.

excess of payments received by that factor over the minimum payments necessary to call it into existence. When Jennifer Lopez earns \$20 million a picture for starring in movies that she would be willing to star in for \$100,000, the difference, \$19.9 million, is rent. In other words, rent is producers' surplus. The lowest annual income that would induce J. Lo to become a movie star is equal to the area under her supply curve out to the quantity of movies she appears in each year. Her revenue is a rectangle representing the quantity of movies times the wage per movie. The difference is producers' surplus, or rent.

Exhibit 9.7 shows the markets for land and for Jennifer Lopez. We adopt, for the sake of argument, George's assertion that the supply curve for land is vertical.¹⁵ In this case, all of the revenue collected by landlords is rent (the shaded area in panel A of Exhibit 9.7). J. Lo's supply curve becomes essentially vertical above a certain price; there is a limit to the number of movies that a person can make in a year. As a result, her revenue (area $A + B$ in panel B) consists almost entirely of rent (the shaded area A). In general:



¹⁵ In fact, this is probably false in any reasonable sense. The relevant market for a given purpose is not land, but "agricultural land" or "land suitable for building," and the like. Such things *can* be created: Irrigation converted the Negev Desert to productive farmland, for example.

When a factor is in fixed (or nearly fixed) supply, the revenue it earns will consist entirely (or almost entirely) of rent.

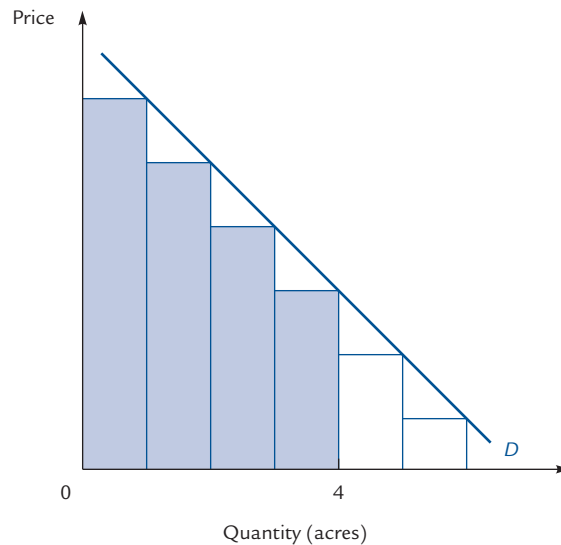
The Fabians argued that there would be no social cost associated with the appropriation of rents by the government. Suppose that landlords were not permitted to collect rent, but were told by the government to allow designated individuals to use their land at a price of zero. Suppose that J. Lo, who now makes two movies per year, were given a government salary equal to area *B* in panel B of Exhibit 9.7 and ordered to continue making two movies per year. Such confiscation of rents (the Fabians argued) would not affect social welfare.

Exercise 9.8 Compute consumers' and producers' surpluses in the markets for land and for Jennifer Lopez's services, both before and after the confiscation of rents. Verify that there is no deadweight loss.

The fly in the Fabian ointment is that land is not equally valuable in all uses, and Jennifer Lopez is not equally valuable in all movies. Exhibit 9.8 shows the sort of error that can arise in the allocation of land. When landlords earn rents, they let their land to the people who will pay the most for it: those represented by the shaded rectangles. If land is not allocated to precisely those people, there is a diminution in social welfare. If land is not allocated by price, there is no way to identify those people.

EXHIBIT 9.8

The Social Role of Rent



With the supply of land fixed at 4 acres, landlords let those acres to those who value them the most. The total value of the land to its users is the sum of the 4 shaded rectangles. If all rent were confiscated, the 4 acres of land would still exist, which led some thinkers to believe that no social harm would be done. But in fact the confiscation of rents leaves landlords with no incentive to seek out the users represented by the 4 shaded rectangles. Land will be used for less valuable projects, represented by the unshaded rectangles, and social welfare will be diminished.

Similarly, it matters not only that Jennifer Lopez makes two movies per year; it matters *which* movies she makes. Those movie producers who will pay her the highest salary are those who value her talents most highly; that is, those who think that her presence will most enhance people's desire to see their movies. If she works on projects where her talents contribute less, efficiency is lost. Notice that even if J. Lo is given the freedom to choose her acting assignments, and even in the event that she is entirely altruistic and wants to work only where she is most valuable, she is unlikely to *know* where she is most valuable if the studios cannot bid for her services.

The Fabian literature contains much interesting economic argument, some of it correct, and the tracts by Shaw are both readable and highly entertaining. His *Intelligent Woman's Guide to Socialism and Capitalism* is a rare phenomenon: economic writing by a master of English prose. It is a fertile source of propositions on which you can test out the analytic skills you have been developing in this course. It's also fun to read.

9.2 Asymmetric Information

Everybody bet lots of money on the eggplant, thinking that if a vegetable challenges a live animal with four legs to a race, then it must be that the vegetable knows something.

—D. Pinkwater, *Borgel*

Although the price system routinely accomplishes miracles in the dissemination of information, it also sometimes fails to deliver all that one could hope for. When information is distributed asymmetrically, so that some types of knowledge are more readily available to one group than to another, market outcomes can fail to be Pareto-optimal. Other times, Pareto-optimal outcomes are achieved, but in unexpected ways. In this section, we present a potpourri of examples in which asymmetric information can produce surprising outcomes.

Signaling: Should Colleges Be Outlawed?

Going to college will probably increase your income. Perhaps you will also pick up some useful skills along the way. But even if colleges taught nothing of practical value, and even if employers were fully aware of this deficiency, a college education could still be a path to higher wages.

To see why, let us make the cynical assumption that everything you are taught in school is completely useless. However, the ability to graduate requires a certain level of intelligence and ambition. If employers have no other way to distinguish one high school graduate from another, they will prefer to hire the ones who have gone on to success in college. And that alone can make college a good investment for a bright student.

In this case, going to college is an example of what economists call a *signal*. This means that on the one hand, it produces nothing of any value (such as actual skills or knowledge), but on the other hand its owner reaps rewards because of the information that it telegraphs to others (in this case, it signals employers about your basic abilities).

Signals are socially costly. In our example, the resources spent on college don't increase anyone's productivity and hence constitute pure social waste. Whenever there is social waste, there is room for an improvement that could benefit everybody.

Suppose that we closed all the colleges and simply asked each high school graduate whether she *would* have gone to college given the opportunity; suppose also that everybody answered honestly. Employers would have exactly the same information for sorting job candidates that they have today, and bright students would save four years and many thousands of dollars. They could, of course, share part of this windfall with those of their high school friends who never were college material, as a reward for their honesty, making *every* high school graduate better off.

Unfortunately, that social improvement is impossible to achieve as long as colleges are allowed to exist. If we relied strictly on voluntary announcements, then each dull student would have an incentive to misrepresent herself as bright. Employers would have no way to distinguish bright students from dull ones, and the genuinely bright students would return to college in order to signal their truthfulness.

However, we could still increase social welfare by outlawing colleges completely. Employers would no longer be able to distinguish bright students from dull ones and would treat each student equally, paying them more than if they were known to be dull and less than if they were known to be bright; the gains to one group would balance the losses to the other. And the bright students' losses might be more than compensated by their savings in tuition costs. Thus, both groups of students can gain. Finally, employers end up with the same pool of employees as before and pay them the same salary on average. Therefore, employers neither lose nor gain, and social welfare is unambiguously increased.



Dangerous
Curve

This discussion implicitly assumes that although bright students are more productive than dull ones, they both perform essentially the same tasks. In fact, employers might prefer to reserve certain tasks for the best and brightest and other tasks for the rest of us. If the signal is abolished, this becomes impossible, so productivity falls and the abolition imposes real social costs. Those costs might or might not outweigh the benefit of removing the costly signal.

So far we have assumed that bright students can survive college and dull students can't. But the same conclusions hold even with a less radical assumption. Suppose instead that any student can survive college, but it is in some way less costly for bright students to survive than for dull ones. For example, bright students need to spend less time studying than dull students, or they have less need to hire tutors for exams and ghostwriters for term papers, or they pay less extra tuition making up courses that they have failed. Then even if we continue to assume that colleges teach nothing of value, the bright students might still choose to go to college.

To see why, suppose that employers are willing to pay more to bright students than to dull ones—enough so that it is worth \$10,000 to convince an employer that you are bright. Suppose that it costs a bright student \$7,000 to get through college and a dull student \$15,000. Then bright students will find the college signal worthwhile, dull students will find that it is not worthwhile, only bright students will go to college, and employers will continue to reward college graduates because the college graduates really *will* be smarter than their non-college-trained contemporaries.

Once again, the college education is pure social waste. If dull students were willing to voluntarily identify themselves, then bright students would still get the better jobs and save themselves \$7,000 each. This \$7,000 could be shared to make *everybody* better off. Once again, though, this agreement cannot be maintained because dull students would misrepresent themselves. Only an absolute ban on colleges could have a chance of yielding an actual improvement.

Dressing for Success

Signaling behavior is a widespread social phenomenon. “Dressing for success” is a signal. Surely the clothes you wear do not make you a more productive manager, but your ability to choose clothes that are both tasteful and fashionable without being too ordinary is a meaningful signal of your ability to interpret social norms and to be creative within acceptable limits. These are skills that are extremely valuable in business, and it can be rational to invest in displaying them just as it can be rational to invest in an unproductive education that displays your intellect.

Here again it is genuinely rational for the signaler to invest in sending the signal and for the observer to be guided by it. Nevertheless, as with college, everyone could benefit if the signal were abolished. We might all be better off if wearing clothes to job interviews were against the law.

Signaling in the Animal Kingdom

The male birds of many species—peacocks and birds of paradise most prominently—have tails that appear to be too long for their own good. Besides requiring nutrients that could be put to other productive uses, the tails are cumbersome and actually impede locomotion. They make the birds more vulnerable to predators.

How could such a characteristic survive the pressures of natural selection? A simple theory is that the tails are part of a signaling equilibrium. Suppose that the healthiest males can bear the burdens of a long tail more cheaply than weaker males can. Suppose also that females have a natural preference for healthy males. (Such a preference would be naturally selected for, because healthy males tend to produce healthy offspring, so a female with this preference has a greater chance of eventually becoming a grandmother.) Then it can be to the reproductive advantage of every male to signal his health with a long tail, even if the tail itself is a burden in everyday life. Females choose the males with the longest tails, and tails get longer over time until the marginal cost of additional growth outweighs the marginal advantage in terms of attracting females.

Such a signaling equilibrium is suboptimal. If all the males agreed to cut their tails in half, the females would still be able to identify the longest tails and would make exactly the same choices as they do now. No valuable information would be lost, and the costs of excessive tail growth would be partly eliminated. Unfortunately for the birds, such an agreement must fall apart. Each individual male would try to cheat by letting his tail grow, and the original signaling equilibrium would soon be restored.

The Supply of Jokes

Why do people tell jokes? Frequently, it is to entertain their friends. But there are other reasons. According to an article in *The Wall Street Journal*,

Jokes still play an important role in the discourse of financial markets, where the sober business of making money is lubricated by fast, topical jokes. “If you’re going to be perceived as a great salesman, proving you have information first is really important,” says a trader at a small securities firm. “If someone calls you up and starts a joke, and you can finish it, you have the edge. It proves you’re plugged in.”

If all salesmen could be induced to honestly reveal how “plugged in” they are, they wouldn’t have to spend time learning jokes. That would be a welfare improvement. But because there is no mechanism to induce those honest revelations, jokes survive as a signal of general knowledgeability.

Adverse Selection and the Market for Lemons

The seller of a used car typically knows more about its quality than potential buyers do. Professor George Akerlof has demonstrated that under such circumstances, it can be impossible for high-quality cars ever to be sold.¹⁶

Suppose that there are two equally common types of used cars: “good” cars and “lemons.” Potential sellers value the good cars at \$100 and potential buyers value them at \$120. Potential sellers value the lemons at \$50 and potential buyers value them at \$60. If there were perfect information, there would be separate markets for the two kinds of cars, and all of them would sell.

Exercise 9.9 What is the possible range of prices at which a good car could sell? What about a lemon?

Suppose for the moment that neither buyers nor sellers can distinguish between a good car and a lemon. Each seller figures that if her car is good, it’s worth \$100 to her and if not, it’s worth \$50; taking account of both possibilities, she values the car at \$75. Each buyer does a similar calculation, figuring that the car is equally likely to be worth either \$120 or \$60 and valuing it at \$90. All of the cars sell at some price between \$75 and \$90.

But now suppose instead that the sellers actually know the quality of the cars. We shall see that this simple assumption has drastic consequences.

What can the price of a used car be? Suppose first that it is over \$100. At that price, all sellers put their cars up for sale. Buyers, who cannot tell one car from another, value a used car at only \$90 and will not pay the asking price. So the quantity supplied (namely, all the cars) exceeds the quantity demanded (namely, zero). There can be no equilibrium price above \$100.

Now suppose that the price is above \$60 but below \$100. In this range, sellers are willing to part with their lemons (which they value at \$50), but not their good cars (which they value at \$100). Only lemons come on the market. Buyers, realizing this, are willing to pay only \$60 (the value that they place on a lemon). Once again the quantity demanded is zero, so we still haven’t found an equilibrium.

Suppose a price below \$50. At this price, buyers want to buy, but no sellers want to sell. That leaves only one possibility: The market price must be above \$50 but below \$60. At such a price, sellers supply only lemons and buyers are willing to buy them. But no good car ever changes hands.

If all sellers were truthful about the quality of their cars, social welfare could be improved, because the good cars would find their way into the hands of the buyers, who value them more than the sellers do. Unfortunately, such truthfulness cannot be maintained, because if there is any market at all for good cars, each lemon owner will want to deceptively sell her car in that market to command a higher price.

Adverse Selection and Insurance Markets

In the lemons market, one group of traders (in this case the sellers) knows more than the other group (the buyers), and each uses the extra information to decide whether to participate in the market. In equilibrium, the “high-quality” participants are driven out altogether.

¹⁶ G. Akerlof, “The Market for Lemons: Qualitative Uncertainty and the Market Mechanism,” *Quarterly Journal of Economics* 84 (1970): 484–500.

This **adverse selection** problem arises in several contexts and is particularly acute in the market for insurance.

If your insurance company knows you have a 10% chance of getting sick next year, it will sell you \$10 worth of insurance for \$1. If the company knows your less healthy neighbor has a 90% chance of getting sick, it will sell him the same \$10 worth of insurance for \$9. But what if the company can't tell which of you is the healthy one? You might think they'd charge you each a compromise price, like \$5. But as long as *you* know you're unlikely to get sick, you might not be willing to pay that much. The result? Healthy people like you choose to stay uninsured; sickly people like your neighbor get their insurance for \$5, and the insurance company goes broke.

Obviously, that's not sustainable in equilibrium. Instead, at least as long as the insurance company can offer only one kind of policy, it charges \$9, insures sickly people like your neighbor, and leaves healthy people like you uninsured.

But there's an alternative. The company can offer a choice: \$1 worth of insurance for a dime (a fair price for you), or \$10 worth of insurance for \$9 (a fair price for your neighbor). At those prices, you'll buy the cheap policy, but your sickly neighbor—who expects to be making a lot of insurance claims—wants the expensive one. By allowing people to buy only *small* amounts of insurance at the 10% rate, the company can keep both kinds of customer.

That's still imperfect. What you would really like—and what the insurance company would be perfectly willing to sell you if it could—is \$10 worth of insurance for \$1. But the company dares not offer that policy, lest your neighbor buy one and bankrupt them.

The real social optimum is for sickly people to identify themselves so the insurance company can set rates separately for each customer. But of course sickly people have no incentive to do that. As in the lemons market, the social optimum is not an equilibrium.

Adverse selection

The problem that arises when people know more about their own risk characteristics than others do.

The Financial Crisis of 2008

Beginning in 2008, the world suffered from a shattering financial crisis: It became very difficult for borrowers to find willing lenders, and therefore much economic activity ground to a halt.

The simplest economic models seem to predict that such crises are impossible. If borrowers want more loans than lenders are willing to provide, we'd expect the price of loans (that is, the interest rate) to rise until the quantities supplied and demanded became equal.

Why didn't this happen in 2008? Economists don't completely understand what went wrong, but many believe that adverse selection had a lot to do with it.

The problems seem to have begun in the market for home mortgages. Suppose you borrow money to buy a house from, say, the First Bank of Springfield. You agree to make monthly payments, and the bank's right to collect those payments is called a mortgage. If the First Bank needs to raise some money in a hurry, it might sell your mortgage to the Second Bank of Springfield. The First Bank collects some money upfront, and the Second Bank acquires the right to collect your monthly payments. Selling mortgages is one way the First Bank raises money to lend to other customers.

In 2008, housing prices fell dramatically, leading many homeowners to default on their mortgages—essentially, people were no longer willing to make large monthly payments for houses that were no longer worth very much. As a result, mortgages became less valuable and their prices fell.

That by itself is not enough to cause a crisis. As long as everyone's aware that a particular mortgage comes with, say, a 30% chance of default, then the price of that mortgage should fall by about 30%—but mortgages should continue to be traded.

But now add one more element to the story: Suppose some mortgages are riskier than others, and suppose also that *the First Bank has better information than the Second Bank about which mortgages are riskiest*. In that case, the First Bank will try to pass off its “lemons” to the Second Bank; and the Second Bank, foreseeing this, will be unwilling to trade.

The market stops functioning for exactly the same reason that a used car market might stop functioning. If there are good mortgages worth \$100 and bad mortgages (that is, mortgages with a high default probability) worth \$50, and if everyone knows which are which, then the good mortgages will sell for \$100 and the bad ones will sell for \$50. That’s not a problem. If *nobody* knows which are which, then you might expect all mortgages to sell for about \$75—again no problem. But in a world where only the First Bank can tell the good mortgages from the bad ones, a \$75 price won’t work. At that price, the First Bank offers only the bad mortgages, and the Second Bank, realizing what the First Bank is up to, refuses to buy them. As a result, the First Bank has difficulty raising funds that it needs to continue serving its customers.

Many, but not all, economists believe that this sort of adverse selection played a major role in the events of 2008 and their aftermath. The dissenters have argued, among other things, that there’s no reason the First Bank should have any better information than the Second Bank about default probabilities. After all, these economists argue, the First Bank probably acquired most of its mortgages from the Third Bank, which acquired them from the Fourth Bank. If the First Bank has never dealt directly with the homeowners, then it might well be just as uncertain as anyone else about which homeowners are most likely to keep up their payments.

So did adverse selection contribute significantly to the crisis of 2008 or didn’t it? It’s a sure bet that economists will be working hard on this question for many years to come.

Moral Hazard

People who are insured take more risks than people who aren’t. Insurance companies, recognizing this, adjust their rates accordingly.

Suppose that there is a 1 in 10 chance that your uninsured house will burn next year. After you buy insurance, you become lax about checking for frayed electrical wires and take up smoking in bed. Consequently, the chance of a fire rises from 1 in 10 to 1 in 5.

Which probability is reflected in your insurance rate? The answer is the one that is relevant for insured homeowners, namely, 1 in 5. \$10 worth of fire insurance will sell for \$2, not \$1.

If you could promise to buy insurance and still remain as careful as ever, the company would be able to reduce your premium to \$1. Unfortunately, because it can’t watch you every minute of the day, the company has no way to know whether you are keeping your promise. This leaves you with no incentive to keep it, which the insurance company realizes. The bottom line is that your standard of care goes down and your insurance premium goes up.

The problem here is called a **moral hazard**. Moral hazards arise when an insured driver is more reckless than an uninsured one, when a homeowner fails to install a security system because she is insured against break-ins, and when a person with health insurance takes more risks on the ski slopes than she otherwise would. If you live in a rented apartment, your rent is probably higher because of moral hazard: Your landlord cannot be certain that you won’t scratch the floors or write on the walls and wants to be compensated for her risk.

Moral hazard

The incentive for an individual to take more risks when insured.

Moral hazard occurs whenever you behave differently because you're insured. Sometimes "behaving differently" means taking more risks; other times it means demanding better remedies. One study¹⁷ found that patients are far more likely to buy expensive brand-name medicines when an insurance company is footing the bill, but to switch to cheaper generics when they're covering the costs themselves.

If the moral hazard were eliminated, insurance rates would fall and everyone could benefit. And in fact, there are some remedies available. Insurance companies can refuse to insure you unless you agree to modify your behavior.

Some homeowner's policies are offered only to those with burglar alarms, and some health insurance is offered only to nonsmokers. However, these remedies are effective only insofar as the company can observe its customers' behavior.

There is another class of remedies in which the insurance company, even though it cannot require good behavior, creates incentives to elicit it. Your fire insurance company cannot require you to install a fire extinguisher, but it can offer to sell you a fire extinguisher at a subsidized price that you are likely to accept.¹⁸ Your health insurance company can make it easier for you to stay healthy by sending you free newsletters about the advantages of diet and exercise.

There is another kind of moral hazard that arises from the insurance company's inability to verify that you have a valid claim. When you report that your insured diamond ring has been stolen, the company might well wonder whether you are telling the truth. Because the company has to be compensated for such risks, theft insurance rates are higher than they would otherwise be.

In cases where the legitimacy of a claim is completely unverifiable, insurance markets might disappear completely. An unexpected fire and an unexpected urge to visit Hawaii can be equally devastating financially, but you can insure against one and not the other. The ashes of your house are easily observable; the depths of your psyche are not.

Students sometimes find it hard to tell the difference between adverse selection and moral hazard. In the adverse selection problem, one group of people *starts out at* higher risk than the other. In the moral hazard problem, people incur additional risks *as a result of being insured*.



Dangerous
Curve

Principal–Agent Problems

When you've hired somebody to fix your roof, it is difficult to be sure how good a job he's doing. You can offer to pay extra for more careful work, but you can never be certain that you're getting what you've paid for.

When an employer cannot fully monitor his employees' work efforts, we say that there is a **principal–agent problem**. The word *principal* refers to the employer, the word *agent* refers to the employee, and the word *problem* refers to the fact that an opportunity for social gain is being lost. If the employer could be sure of getting what he pays for, he could offer a higher wage for better work, to the benefit of both employer and employee.

Principal–agent problem

The inability of the principal to verify the behavior of the agent.

¹⁷ Douglas Lundin, Moral Hazard in Physician Prescription Behavior, *Journal of Health Economics* 19 (2000): 639–662.

¹⁸ This doesn't necessarily work without some further restrictions, because it would enable you to buy insurance, go into the fire extinguisher business, and bankrupt the insurance company by buying all your inventory from them.

In December 1990, the *New York Times* reported the plight of Harriette Ternipsede, a ticket agent at TWA. The airline uses sophisticated computer methods to monitor her performance, and supervisors are alerted instantly if she so much as stands up to stretch her muscles. Mrs. Ternipsede and other workers are taking legal action in an attempt to prevent TWA from keeping such close tabs on them.

It might seem obvious to you that employees would be better off without their supervisors breathing over their shoulders at every moment. But strict supervision does not just allow the employer to observe low productivity; it allows him to observe high productivity too. This in turn enables him to reward high productivity so as to elicit more of it. On the other hand, if monitoring is impossible, employees (except for those with extraordinary motivation) put forth the minimum effort and employers pay accordingly.

Short of perfect monitoring, the market provides a variety of partial solutions to the principal–agent problem. The economists Paul Yakoboski and Kenneth McLaughlin have stressed the importance of productive fringe benefits.¹⁹ Suppose you hold a job in which having a \$1,000 home computer would increase your productivity by \$2,000. In a world of perfect monitoring, you buy the computer and your wages increase by more than enough to compensate you. In a world with no monitoring, your employer is unaware of the productivity increase and does not reward you, so you never buy the computer. In the real world we live in, your employer might buy you a computer as part of your fringe benefit package, offering himself some assurance that it will be put to good use.

Another way to improve employees' performance is to offer them a share of the firm's profits. Unfortunately, the resulting incentives are still far from optimal. An employee who is entitled to 1% of the profits must increase his output by \$100 to reap a \$1 reward. If the necessary effort costs him \$5, he won't undertake it, and an opportunity to increase social welfare by \$95 (\$100 in extra profits minus \$5 in extra costs) is sacrificed.

There is, however, an extreme version of profit sharing, which *does* work perfectly, at least in principle. It requires paying each employee 100% of the firm's profits. Under such a plan, the worker who saves the firm \$100 earns \$100 for himself. If he can accomplish this at a personal cost of less than \$100, he will be entirely self-motivated to do so. There is never any need for the employer to provide additional incentives.

The problem that has probably occurred to you is that the owners of a firm with 8 employees might be reluctant to pay out 800% of their profits in wages. The solution is that each worker pays, up front, a large flat fee in exchange for his job, so that his net compensation is reasonable. Once he starts working, the flat fee becomes a sunk cost and does not affect his incentive to perform.

Why, then, does this scheme strike us as outrageous? Probably because profits depend on a lot of random events, not just on worker performance. An unexpected change in market conditions can cause a large corporation's profits to fluctuate by tens of millions of dollars. It would be a rare worker who was either able or willing to accept that kind of fluctuation in his yearly income. In the absence of large random fluctuations, the 100% profit-sharing plan might work.

Efficiency Wages

Another solution to the principal–agent problem is to punish severely those employees who get caught shirking. Although most shirkers never get caught, the possibility of a

¹⁹ P. Yakoboski, "Productive Fringe Benefits: Theory and Evidence," Ph.D. Dissertation, University of Rochester, 1990; also P. Yakoboski and K. McLaughlin, "The Economics of Productive Fringe Benefits," 1990.

sufficiently severe punishment still serves as a strong incentive to perform. Workers respond to the incentive, become more productive, and earn higher salaries.

An impediment to this solution is that there are limits to the employer's ability to punish. Usually the most severe punishment available is termination. If the worker can just move on to an identical job at another firm, this is no punishment at all. To overcome this impediment, the employer might offer an **efficiency wage**; that is, a wage higher than the market equilibrium. This makes the job a particularly desirable one that workers will be reluctant to risk losing.

Now you might think that if *every* employer offers an efficiency wage, then losing your job and having to move on is still no punishment. But this is not correct. The reason is that when employers offer higher wages, they demand less labor. Thus, efficiency wages lead to unemployment. The wage is set higher than the market equilibrium and the quantity of labor demanded is less than the quantity supplied. This in turn means that the worker who loses his job risks not finding another one.

Efficiency wages lead to higher productivity by employed workers who are scared of losing their jobs but also to unemployment of other potentially productive workers. Many economists believe that efficiency wages should play a significant role in macroeconomic models of unemployment.

Executive Compensation

The principal-agent problem is a major factor in the relationship between shareholders and corporate executives. Shareholders want executives to pursue aggressive, creative, and intelligent strategies to maximize corporate income. Because it is impossible to monitor all of the executives' behavior, it is hard for shareholders to reward good decisions and punish bad ones. If General Motors has an opportunity to build a new electric car that would revolutionize the industry, and if the chief executive officer (CEO) of General Motors passes up the opportunity out of foolishness or sloth, stockholders might never become aware of his mistake. On the other hand, if he builds the car and it fails in the marketplace, stockholders are left to wonder whether an intelligent risk happened to turn out badly or whether further market research should have revealed the paucity of demand before it was too late. When the CEO spends \$10 million to upgrade the executive air fleet, stockholders can never be certain whether the decision was motivated by the best interests of the firm or the personal comfort of the chairman.

Therefore, we should expect to see executive compensation schemes that reward executives for good performance and punish them for the opposite. The way to do this is to create a close link between the firm's profits and the CEO's wealth. Typically, this is accomplished in two ways: First, the CEO gets an annual bonus that depends on the firm's performance; a typical bonus might be zero in a bad year and twice the CEO's annual salary in a very good year. Second, the CEO is either given or required to purchase a large quantity of the company's stock or take **stock options**. Typically, a stock option issued in the year 2001 might give the CEO the right to buy shares of stock 10 years down the line, in 2011, at the 2001 price. This gives the CEO an incentive to take immediate actions that will raise the share price 10 years in the future.

Salaries and bonuses are typically not very sensitive to firm performance; this might be because they are set by boards of directors who owe their positions to the CEO. Thus, most of the CEO's performance incentives come from stock ownership and stock options, both of which have become dramatically more important over the past 15 years. As a result, CEOs do reap substantial rewards and punishments. According to

Efficiency wage

A wage higher than market equilibrium, which employers pay in order to make workers want to keep their jobs.

Stock option

The right to buy a share of stock at some future date at a price specified in advance.

Professors Brian Hall and Jeffrey Liebman,²⁰ a CEO who raises his firm's performance from the 30th to the 70th percentile (that is, from a bit below average to a bit above average) can expect to see his compensation rise from \$1 million to \$5 million.

We have focused on the problem of motivating executives to expend effort and avoid waste. Another source of conflict between executives and shareholders involves their attitude toward risk. The typical shareholder has only a small percentage of his wealth invested in any single corporation. Consequently, he is prepared to have the corporation take on considerable risk in return for the prospect of considerable gains. Even if the corporation goes bankrupt, the shareholder's lifestyle is unlikely to be greatly affected.²¹ The executive, by contrast, can have a large personal stake in the corporation's success. Consequently, CEOs are likely to be far more cautious than stockholders prefer.

In fact, the two principal-agent problems call for diametrically opposite solutions! If you're afraid your CEO is not working hard enough, you want him to hold more stock in the company so his efforts will be better rewarded. But if you're afraid your CEO is too cautious, you want him to hold *less* stock in the company so he'll be willing to take more risks. Attempts to solve one problem make the other problem worse.

There are other ways to limit a CEO's downside risk. One is to assure him that he is unlikely to be fired even if some of his decisions turn out badly—and in fact, it appears that as few as 4% of CEOs lose their jobs because of poor performance. Another is to assure him that even if things do turn out so badly that he gets fired, he will still receive a substantial severance payment. Such payments are sometimes called *golden parachutes*. Many people cannot understand why corporations pay tens of millions of dollars to former officials who have been fired for poor performance. An answer is that without the implied assurance of those settlements, the successors to those officials would exercise great caution in their decisions, contrary to the interests of the stockholders.

Shielding executives from risk improves their willingness to take chances but damages their incentives to perform responsibly. Is there an alternative way to elicit more risk taking, without such detrimental side effects? Possibly. In general, people with high incomes are more willing to risk large losses. Essentially, this is because a smaller percentage of their income is at risk.²² Therefore, a simple solution might be to make certain that corporate executives are wealthy. Stockholders can accomplish this easily by paying high salaries. This could partially explain why CEO salaries are as high as they are. When the president of General Motors must decide whether to introduce a new model line, stockholders do not want him unduly influenced by concern about making his next month's mortgage payment.

A Theory of Unemployment

For many decades before the 1970s, economists observed a correlation between the rate of inflation and the level of employment. When inflation (the rate of increase in absolute prices) was higher than usual, employment tended to be high also. In periods of low inflation, employment was low. More recently, this relationship has broken down. Many explanations have been offered for these phenomena, although there is no consensus among economists as to which come closest to the truth. Here we will present

²⁰ B. Hall and J. Liebman, "Are CEO's Paid Like Bureaucrats?", National Bureau of Economic Research, 2000.

²¹ We will give a more rigorous treatment of attitudes toward risk—and will return to this example—in Chapter 17.

²² Chapter 18 elaborates on this point also.

one possible explanation, of particular interest because it focuses on the informational content of prices. The version we will present is a caricature; a fully articulated model is more appropriate for a course in macroeconomics. In its general outlines, however, the theory we will present has been a highly influential one and has occupied a central role in macroeconomic thinking for the last 20 years.²³

We know from Chapter 2 that only relative prices are relevant to the determination of equilibrium. If all prices (including wages) were to double tomorrow, markets could remain in equilibrium without any quantity adjustments. If it were known that such a doubling occurred every Wednesday, nothing of any real economic significance would be affected.²⁴

Now imagine an unemployed worker. He is unemployed not because there are no jobs available to him but because the only available jobs pay wages lower than he is willing to accept. The highest wage offer he has received has been \$8,000 a year, but he is not willing to work for less than \$10,000.

One night, while our worker is sleeping, all prices and all wages double. He is awakened the next morning by a telephone call from an employer who says, "I am now prepared to offer you an annual salary of \$16,000." Of course, \$16,000 today will buy only what \$8,000 bought yesterday, so the worker, if he is fully informed, will not accept the position.

But what if he is *not* fully informed? What if he went to sleep unaware of the changes that were to take place in the middle of the night, and, having just been awakened by a telephone call, is still unaware of them? In that case, he will accept the job, convinced that he will be earning far more than his minimum requirement of \$10,000.

Now, after a day on the job, our hero is likely to stop at the supermarket to indulge the temptations of his new economic status. When he sees the prices on the items, he will recognize himself to be the victim of a cruel hoax and begin the mental task of composing a letter of resignation.

This story suggests a reason why an increase in inflation could lead to an increase in employment. It also suggests that the effect is ephemeral. More important, it implies that employment is affected only by *unexpected* inflation. When inflation becomes the norm (as it did in the 1970s), workers can no longer be "fooled" by high absolute wages.

Another important implication is that the increase in employment resulting from an unexpected inflation is not socially beneficial—it is a consequence of deceiving people into working more than they would choose to if they were fully aware of their economic environment.

The fundamental role of inflation in this model is to dilute the informational content of prices. A rise in the nominal wage rate for plumbers may indicate either an increase in demand for plumbers' services or a rise in the general price level. If plumbers know the inflation rate, they can make the distinction. An increased demand for plumbers will lead to a higher relative price for their time and call forth more plumbing services—an example of prices transmitting the necessary information to the appropriate parties. If plumbers are uncertain of the inflation rate, they will be uncertain of the real value of their wages and may provide the "wrong" amount of service from a social point of view. If they underestimate the rate of inflation, they will provide too much plumbing; if they overestimate, they will provide too little.

²³ The broad outlines of this theory were sketched around 1968 by Milton Friedman and Edmund Phelps (working independently). The first careful development was by Robert E. Lucas, Jr., in "Expectations and the Neutrality of Money," *Journal of Economic Theory* 4 (1974): 103–124.

²⁴ There is one important exception to this statement. Briefly, a rise in absolute prices reduces the purchasing power of money, so an expected rise in absolute prices makes it more desirable to hold nonmonetary assets, such as real estate. The increase in demand for these "inflation-proof" assets has real effects. For the current discussion, those effects are irrelevant.

Exercise 9.10 Explain in detail why a plumber who has overestimated the rate of inflation will provide less plumbing service as a result.

Macroeconomists have devoted considerable effort to understanding the ways in which uncertainty about inflation introduces “static” into the price signals that people use to make economic decisions. Much research is devoted to the methods that people use to disentangle valuable information from this static and to the consequences of the necessary imperfections in these methods. An underlying theme is that society is best served by the accurate dissemination of knowledge and that prices are the most effective known tool for accomplishing this task.

9.3 Financial Markets

Hayek’s 1945 article was prescient. Since that time the vision of prices as carriers of information has become ubiquitous in economics. This is especially true in the study of markets for financial securities, such as stock exchanges. Financial markets are extraordinarily efficient processors and disseminators of information. Their informational role affects our understanding of issues ranging from the social allocation of resources to individual investment strategy.

Efficient Markets for Financial Securities

Efficient market

A market in which prices fully reflect all available information.

An **efficient market** is one in which prices fully reflect all available information. Here we shall be interested in the markets for financial securities, such as the shares of corporate stock that are traded on stock exchanges. The owner of a share of stock owns a fraction of the corporation and participates fully in its profits and losses.

Efficient securities markets serve an important social function, because they allow firms to make appropriate decisions regarding the allocation of resources (how much to produce, how much to invest in future growth, and so on) and assure investors that the prices they are paying for assets are meaningful indications of those assets’ actual value. However, many noneconomists believe that asset markets in general and the stock market in particular are inefficient.

Technical Analysis

The most extreme believers in inefficient markets are the so-called *chartists*, or *technical analysts*. They argue that a careful study of the past prices of a given stock conveys useful information about future prices.

It is easy to see why this analysis cannot be correct if markets are efficient. Suppose that the past behavior of the stock of XYZ Corporation exhibits a pattern that indicates a probable price rise in the near future. That probable price rise is an important feature of XYZ stock, making it more valuable to hold. In an efficient market that higher value will already be reflected in the *current* price. (It is also easy to see the mechanism by which this would occur: Smart investors, observing the pattern, expect a price rise tomorrow and rush out to buy the stock today. This bids up *today’s* price.) If the market is perfectly efficient, the chartist cannot expect to profit, because any stock that can be identified as a “good buy” will be expensive—and therefore *not* such a good buy!

There is overwhelming evidence against the chartists.²⁵ Hundreds of careful statistical studies indicate that knowledge of past price changes contributes nothing to the prediction of future price changes. All of the information contained in the past history of the stock is already embedded in a single number—the current price.

Analysis of Market Conditions

Some dissenters from the efficient-markets hypothesis are less extreme. While admitting the unprofitability of technical analysis, they claim that a more general analysis of market conditions (still making use only of publicly available information) can provide important clues to the savvy investor. This proposition is harder to test than the claims of the chartists, and the empirical evidence is correspondingly less definitive. Nevertheless, the overwhelming majority of researchers in the field, basing their conclusions on decades of empirical work, reject this claim as well. The theoretical basis for this rejection is the same as that for rejecting chartism: Any publicly available information indicating that a stock will soon go up (or down) will cause an immediate shift in demand and an immediate price adjustment, leaving no opportunity for profit.

There is still room for argument over the meaning of the word *immediate*. How quickly do prices adjust to new information? If the adjustment process takes sufficiently long, an observant investor may have time to cash in. To put the question another way: Prices reflect all available information in the long run, but how long is the long run? Recent evidence supports the hypothesis that the long run is shorter than 30 seconds—that is, all information entering the marketplace is fully incorporated into prices within 30 seconds of its arrival.²⁶ Hardly comforting news to the investor who analyzes patterns at leisure over a cup of coffee and the daily business page.

Asset Markets and the Royal Head-Flipper

Does this mean that no technical analyst will ever succeed in the stock market? Of course not; some will do well, for the same reasons that some people do well at the roulette wheel. If there are enough such analysts (and there are), a few will even win consistently, by the simple laws of probability. All of these will attribute their success to their singular talents. To them we dedicate a bit of economic folklore: The Fable of the Royal Head-Flipper.

In a faraway land with 64 million inhabitants, the king wished to appoint a royal head-flipper. Calling all of his subjects before him, he gave each one a coin and ordered all to flip. Thirty-two million came up heads and 32 million came up tails. Those who flipped tails were obviously no good at flipping heads and were eliminated from the competition. The remaining 32 million flipped again. When 16 million failed, they too were sent home. On the 25th trial, only 2 remained. They each flipped, and one prevailed. He was appointed the royal head-flipper by the king, who congratulated him with a toast: “Here’s to the royal head-flipper, whose prowess has enabled him to flip heads 26 times in a row. According to the royal statistician, the odds against such a feat occurring by chance are a staggering 64 million to 1!”

²⁵ See E. Fama, “Efficient Capital Markets: A Review of Theory and Empirical Work,” *Journal of Finance* 25 (May 1970): 383–417, for an overview.

²⁶ See L. J. Feinstone, “Minute by Minute: Efficiency, Normality and Randomness in Intra-Daily Asset Prices,” *Journal of Applied Econometrics* 2 (1987): 193–214.

Stock Market Crashes

In October 2008, the value of stocks traded in U.S. markets fell by about 20% in a single week; worldwide, other markets faced similar declines. Dramatic as it was, the crash of 2008 was hardly a once-in-a-lifetime event. Just 21 years earlier, in October 1987, U.S. stocks fell by over 28%. And even more recently, in the spring of 2000, technology-based stocks (as measured by the NASDAQ composite index) fell by about 40% over a few months; a year later, they had fallen almost 60%.

The theory of efficient markets suggests that even such remarkable price drops must be responses to new information about firms' expected future profitability. In 2000, for example, the government was aggressively pursuing antitrust action against Microsoft, raising expectations that other firms would soon come under similar scrutiny. In 2008, the crash followed a sudden drop in house prices that led many homeowners to default on their mortgages, wreaking havoc among banks and other financial firms, as we've discussed on page 301–302.

Why were house prices so high to begin with? It's widely believed that in the years leading up to 2008, the housing market was driven by self-fulfilling expectations: Everyone expected prices to keep rising, so everyone wanted to buy, so prices kept rising. The resulting **speculative bubble** eventually burst (as all speculative bubbles must), resulting in a sharp decline in prices.

Speculative bubble

A situation in which expectations of rising prices cause prices to rise.

Might stock prices themselves be subject to speculative bubbles, and could this help to explain the crashes of 1987, 2000, and 2008? Nobody knows for sure. But Professor Sanford Grossman of the University of Pennsylvania has laid out a plausible scenario, based on two related assumptions. First, he assumes there are a large number of investors who are determined not to let their wealth fall below a predetermined level. When a downturn in the market brings them close to that level, they become extremely sensitive to negative fluctuations. Even a slight downward movement in prices can cause many such investors to sell simultaneously.

Grossman's second assumption is that some traders are better informed than others about real financial conditions. When prices begin to fall, poorly informed traders (and even well-informed traders who aren't sure that they are well-informed) cannot be sure whether the downturn is due to some genuine bad news that other traders have discovered. The possibility that bad news is in the process of spreading leads them (rationally) to sell immediately. This in turn exacerbates the downturn. The same process in reverse can magnify upturns as well. The net effect is to substantially increase the volatility of stock prices, particularly in the short run. Grossman argues that such a theory is necessary, because observed short-run price volatility appears to be greater than can be accounted for by traditional theory.

The two phenomena Grossman describes can be mutually reinforcing. A small downturn causes a group of investors to protect their assets by selling stocks; a second group worries that the first group knows something bad, leading them to sell also. This in turn causes the first group to sell more, and so forth.

Following a stock market crash, there's always quite a bit of public discussion about how to prevent future crashes. But it's not at all clear that crashes are bad, or that preventing them is desirable. If a fall in stock prices is a response to genuine bad news about future corporate productivity, then it is almost surely a good thing. The signal it sends to investors is: "Stop diverting so many resources to enterprises that are about to become less productive." On this interpretation, the markets don't cause the bad news; they merely publicize the bad news while there's still time to limit the damage. If that's correct, then taking steps to prevent future crashes is like taking steps to prevent messengers from alerting you that your troops need reinforcements.

Summary

The price of an item reflects the value of that item to some potential user. It also provides an incentive for others to act on that information. If the item is valuable elsewhere, the high price will tell potential users to search for substitutes.

Prices allow complex economies to be coordinated in ways that take account of vast amounts of knowledge. This knowledge includes what Hayek called the “particular circumstances of time and place.” Each individual producer and consumer has access to special information that is not available to anyone else, and prices lead him to use this information in deciding how to allocate resources. A social planner without access to all of this information will allocate resources less efficiently.

The conventional measures of social welfare that were introduced in Chapter 8 make the implicit assumption that all goods are produced by the low-cost producers and distributed to the consumers who value them the most. In the absence of a price system, this assumption may be unjustified, in which case the usual measures of social welfare are overly optimistic.

When the informational content of prices is diluted, as by an inflation that makes it difficult for people to distinguish absolute from relative price changes, resources are allocated less efficiently. This provides one possible explanation of why the level of employment will change in response to an unexpected inflation but not to an expected one.

When information is distributed asymmetrically, surprising and sometimes inefficient outcomes can result. Examples include signaling equilibria, adverse selection, moral hazard, and principal–agent problems.

Author Commentary

www.cengage.com/economics/landsburg

- AC1.** There is a principal–agent problem when corporate officers engage in hiring practices that are detrimental to stockholders.
- AC2.** News stories and scientific theories are more likely to get published when they’re surprising and more likely to be surprising when they’re wrong. So, unlike financial markets, markets for news can systematically lead to *inefficient* outcomes where stories that get published are more likely to be wrong than right.
- AC3.** For more on the informational content of college grades, read this article.
- AC4.** Just as stockholders depend on executives, voters depend on politicians—and similar principal–agent problems arise for both.

Review Questions

- R1.** A social planner equipped with knowledge of all market supply and demand curves would still lack much of the knowledge necessary to duplicate the functioning of the price system. Give some examples of the knowledge that would be lacking. How is this knowledge taken into account when prices are used to allocate resources?

- R2.** Explain why a rise in soldiers' wages does not increase the cost of maintaining an army.
- R3.** What is the social role of rent? If all rents were confiscated, would there be a consequent loss of efficiency? Why or why not?
- R4.** What is an efficient market?
- R5.** "If it is well known that IBM will soon release a new and highly desirable product, then it is a good idea to buy IBM stock." Explain why this statement is wrong.
- R6.** What is a signaling equilibrium? In what sense is it inefficient?
- R7.** What is adverse selection? What is inefficient about the equilibria that result from adverse selection?
- R8.** What is moral hazard? What are some of the ways in which an insurance company can attempt to reduce moral hazard?
- R9.** Give some examples of principal–agent problems.
- R10.** Explain why stockholders might want their CEO to own more stock. Now explain why stockholders might want their CEO to own *less* stock.

Problem Set

- 1.** A race of timid elves passes the time by sneaking out at night, locating machinery that is in disrepair, and fixing it while people are sleeping. The human beneficiaries of this largesse are, of course, surprised and delighted when they discover the elves' handiwork the following morning. **True or False:** If the elves were to start charging for their services, humans would certainly be made worse off.
- 2.** A chemical company is considering locating a plant on the outskirts of a certain town. Although the town welcomes the benefits that this plant will bring, some residents have expressed concern about the possibility of an accident involving toxic chemicals. The city council has met to discuss the matter. Although none of the council has any background in chemistry or engineering, many have strong opinions (some pro and some con) about whether a building permit should be issued. One councilor, who has remained neutral throughout, suggests that the permit be issued if and only if the chemical company can demonstrate the ability (either through its own assets or an adequate insurance policy) to reimburse the townspeople for any damage caused by its factory. Explain the councilor's reasoning. Explain why this policy might be expected to lead to a socially optimal decision.
- 3.** In 1993, the Mississippi River flooded, causing widespread devastation and leaving midwesterners desperate to acquire basic necessities such as food and ice (for food storage). Profiteers soon emerged, selling ice for as much as \$50 per pound. Editorialists and politicians decried this price-gouging and called for an end to it.
 - a.** Suppose that the authorities had effectively prohibited price-gouging. What would have been the effect on the amount of ice brought into the affected area?

- b. Suppose that the authorities had effectively prohibited price-gouging and somehow managed to ensure that their action had no effect on the quantity of ice in the area. What would have been the effect on social welfare?
 - c. Suppose that a pure altruist in the affected area had come into possession of a small amount of ice. Explain why he might have charged \$50 a pound for it, even if he was completely unconcerned with his own welfare.
 - d. Do you think that it would have been a good idea to prohibit price-gouging?
4. **True or False:** In a large corporation it is usually better for the central management to make decisions rather than divisional managers, because the central management has access to a wider range of information.
5. Aramis, Porthos, and Athos have the following marginal value schedules for swords:

Marginal Values			
Number of Swords	Aramis	Porthos	Athos
1	\$15	\$9	\$13
2	11	5	7
3	0	3	2
4	0	1	0

Aramis, Porthos, and Athos are the only buyers of swords in the community, and swords are produced at a constant marginal cost of \$7 per sword.

- a. If the industry is competitive, how many swords will be produced and at what price will they be sold? Justify your answer.
 - b. Suppose that a social planner orders 5 swords to be produced, with 4 distributed to Porthos and 1 to Athos. What is the social loss in this situation (compared with competitive equilibrium)? Justify your answer.
6. Evaluate the following methods of providing an army. Rank them in order of preference from the point of view of (a) young people, (b) consumers of military service, and (c) economic efficiency. Assume that the army will be of the same size in all cases.
- a. A volunteer army, financed by a tax on all citizens.
 - b. A draft, with soldiers paid a wage of zero.
 - c. A volunteer army, financed by a tax on young people.
 - d. A draft, with soldiers paid a wage of zero but with the proviso that draftees may hire other young people to take their place.
7. Suppose that the supply curve for land is perfectly vertical.
- a. **True or False:** Although the Fabians were wrong to argue that a 100% tax on land rents entails no social loss, it would be *right* to argue that a 99% tax on land rents entails no social loss.
 - b. Would your answer change if it requires some effort for landlords to locate the highest bidder for their land?
8. Suppose the equilibrium price of haircuts is \$2 per haircut. A new law sets the price at \$5 per haircut and requires certain demanders to buy as many haircuts as suppliers want to sell at that price.
- a. Illustrate the smallest possible deadweight loss from this program, and justify your answer.

- b. Explain why the actual deadweight loss is almost surely greater than what you calculated in part (a).
9. The University of Rochester has a fixed number of parking spaces for students on campus. They are currently sold at a price that clears the market. It has been proposed that the price should be lowered and a lottery held to determine who may park on campus. Each winner of the lottery would receive a ticket entitling him to purchase a parking space, and these tickets could be freely bought and sold. The number of winners would be equal to the number of parking spaces.
- a. Graph the supply and demand for parking spaces. Show on your graph the price of a ticket. Show the consumers' surplus (earned by parkers), the producers' surplus (earned by the university), and the total value of the tickets to the winners of the lottery. Who gains, who loses, and who is unaffected if this plan is adopted?
- b. The nearby University of Retsehcor is identical to the University of Rochester in every way except two. First, nobody at Retsehcor has proposed a lottery plan as at Rochester. Second, someone at Retsehcor has proposed that the university hold a lottery and give cash gifts to randomly chosen students. (An alternative proposal is to simply randomize tuition.) Compare the effects of the Retsehcor plan with those of the Rochester plan.
- c. An alternative proposal at the University of Rochester would institute the lottery without allowing the resale of tickets. The university would carefully monitor compliance, expelling any lottery winner who allowed his parking spot to be used by anybody else. How would this revision affect welfare if the enforcement mechanism were successful? If it were unsuccessful?
10. Pizza is provided by a competitive industry. Suppose that in a burst of generosity, the producers of pizza decided to continue producing the same quantity as always, but to give their pizzas away for free.
- a. Use a graph to show the change in consumer and producer surpluses.
- b. Is it possible that (despite what your graph shows) this burst of generosity could make consumers as a group worse off? Why or why not?
11. Santa Claus always gives away exactly 1,000,000 toys per year, at a price of zero. It costs him nothing to produce these toys. There is also a market where toys can be purchased from commercial toy manufacturers.
- a. Use a graph to show how the existence of Santa Claus affects the supply of toys, the price of toys, the number of toys that consumers acquire, and the number of toys that are provided by commercial manufacturers.
- b. Use your graph to show how Santa affects the consumer surplus in the toy market and the producer surplus earned by commercial toy manufacturers. (Don't forget that the toys Santa gives away are free.)
- c. According to your graph, how much does Santa add to social welfare? Explain why this answer may overestimate the true social value of Santa Claus. (*Hint:* How does Santa decide who gets the toys?)
12. No coffee is produced in the United States. Americans can buy as much coffee as they want from foreign producers at a price of \$10 per pound. At this price, they buy 1,000 pounds per week. The U.S. government has decided to make coffee available to all U.S. citizens at a price of \$3 per pound. It gets the coffee by purchasing it from foreigners.

- a. Show the gains and losses to all relevant groups of Americans as a result of this program. Compute the deadweight loss.
 - b. **True or False:** The deadweight loss in this problem is entirely attributable to the fact that Americans consume an inefficiently large quantity of coffee.
 - c. Suppose that the government modifies the program. It will continue to sell coffee at \$3, but will provide only 1,000 pounds per week, choosing randomly those citizens who are permitted to buy them. Recompute the deadweight loss by the methods of Chapter 8, and show that it is now zero.
 - d. What important social costs does the analysis of part (c) overlook?
13. In equilibrium, 500 widgets are sold at \$40 apiece. Suppose a new law prohibits the sale of widgets but requires certain firms to produce a total of 600 widgets and give them away for free. The recipients of the widgets are allowed to resell them.
 - a. Use a graph to illustrate the new price of widgets.
 - b. Assuming the widgets are produced as cheaply as possible, illustrate the gains and/or losses to consumers, producers, and the people who get the free widgets. Illustrate the deadweight loss.
 - c. Explain why the “as cheaply as possible” assumption is overly optimistic, and how it biases your computation of the deadweight loss.
14. Suppose that a bright student can get through college for a cost of \$A, a dull student can get through college for a cost of \$B, and that it is worth \$C to convince an employer that you are bright. Suppose also that nothing of value is learned in college. In which of the following circumstances would bright students go to college?
 - a. $C > B > A$
 - b. $B > C > A$
 - c. $B > A > C$
15. Ten people with different incomes have applied for membership in an exclusive club. One of the club’s criteria in deciding whom to accept is to favor those applicants whose incomes are high relative to other applicants’. Each applicant knows his own income and can reveal it voluntarily by submitting his income tax returns. Also, everyone happens to know that there is exactly one applicant whose income is \$10,000, one whose income is \$20,000, and so forth up to \$100,000. How many applicants reveal their incomes?
16.
 - a. What are some of the consequences of prohibiting insurance companies from charging higher rates to people who are in high-risk groups for AIDS?
 - b. What are some of the consequences of prohibiting insurance companies from requiring AIDS tests as a precondition for coverage?
17. The government is considering a law that would require all sellers of used cars to provide independent certification of their quality. Make an argument in defense of such a law, from the viewpoint of promoting social welfare.
18. Many insurance companies sell group policies that cover all of the employees at a particular firm, or all of the members of a particular organization. How could this policy help to overcome the problem of adverse selection?

19. If all used cars were required to come with warranties, we might solve an adverse selection problem while creating a moral hazard problem to take its place. Explain.
20. Many insurance companies sell auto insurance that includes a “deductible” of \$250 or \$500. If you have an accident, your insurance covers all of your costs *minus* the amount of the deductible. The amount that they pay on a typical claim is far more than the amount of the deductible. **True or False:** If the deductible were eliminated, the percent increase in claim payments would be small. Therefore, because insurance companies must earn zero profits, the percent increase in premiums would be small as well.