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The Economics of Pollution

By CHARLES UPTON

GRADUATE SCHOOL OF BUSINESS
UNIVERSITY OF CHICAGO

CHARLES UPTON is Assistant Professor of Business Economics at the University of Chicago's Graduate School of Business. He earned the B.A. degree in mathematics at Rice University, and the M.S. and Ph.D. in economics at Carnegie-Mellon, and became a member of the Graduate School of Business faculty in 1968. His special interests include public policy issues in the management of natural resources. This paper represents an extension of Professor Upton's talk on "The Economics of the Environment" at the 19th Annual Business Economists Conference of the Graduate School of Business, held at the Center for Continuing Education of the University of Chicago on April 30, 1970.

The Economics of Pollution

POLLUTION is not only very much in the public eye: it is one national problem upon which all sectors of our society seem able to agree. Such unanimity is rare and it may not last, but it exists along with an overwhelming attention to the problem. Every major news magazine, television network, and newspaper has given pollution extensive coverage in recent months.

Much of this coverage depresses me because it calls attention to my personal responsibility.

I am told that every time I drive my car the engine exhaust pollutes the atmosphere; the offshore oil wells and tankers which provide gasoline for the car pollute the water and beaches and destroy plant and animal life; the highways upon which I drive the car pollute the scenery of our country and contribute to urban sprawl.

I am told that every empty package I dispose of contributes to the problem; we are, I am told, being engulfed in a sea of metal, glass, and plastic.

Recently I have been told that every time I do my laundry-in itself a socially desirable act -phosphates in the detergents pollute the water.

From the point of view of a corporation the "war on pollution" is even more depressing. As an example, consider Commonwealth Edison Company, which provides Chicago's electric power. Commonwealth Edison was told that the coal-fired steam generators it uses to produce electricity are a major source of Chicago's air pollution and was ordered to reduce its use of high-sulphur coal. When the company sought to build smokeless nuclear power plants, it ran into protest groups complaining that the

thermal pollution created by those plants would destroy fish life in Lake Michigan. Now the company faces proxy fights organized to force it to do even more to reduce pollutants.

Some discussions of pollution have emphasized the question, "Can man survive?" Pollution is blamed for the disappearance of many forms of life. We are told that the carbon dioxide which we are pouring into the atmosphere will trap the sun's heat, eventually melting the polar ice caps and flooding much of the worlds land mass. The emphasis on the question of man's survival does a disservice to the rational discussion of pollution. I question whether the problem is that critical. Certainly the survival of the human race does not depend upon how many beer cans are strewn along the highways, nor will the world be ended by the influx of oil on California beaches. Even should we agree that human survival is at stake, such agreement does not answer the more important question: What shall be done? It is certainly possible that a cure will be worse than the condition itself. The major difficulty with the question, "Can man survive with pollution?" is that it ignores the quite obvious fact that man cannot survive without pollution. Pollution is created every time we produce any good. The only way we can totally eliminate pollution is to produce nothing.

ONE MAY OBJECT, of course, that this point is irrelevant. It is certainly as relevant to the problem of Commonwealth Edison's smokestacks as questions of whether man can survive those smokestacks. Human life will not end if Commonwealth Edison does not shut down its smokestacks. Nor, if the smokestacks are shut down, will we starve. In this example, as in all others, there are costs of eliminating pollution as well as costs of maintaining it. The problem is to choose a level of pollution that balances those costs. Thus the first problem in the anal-

ysis of pollution is to balance the costs of polluting against the costs of not polluting.

The second problem in the analysis is to define standards of acceptable levels of pollution. The recent debates on the goal of clean air and clean water have ignored the problem of defining "clean."

Let me give an example of the difficulties of defining "clean." Unpolluted water contains a certain amount of dissolved oxygen, essential to the maintenance of fish life. Pollutants such as sewage combine chemically with dissolved oxygen. As the level of dissolved oxygen is lowered, the ability of the stream to support fish life is reduced. If all oxygen disappears, the process of sewage decomposition enters the nitrogenous stage. The nitrogen gas which is given off causes the smell associated with polluted streams. The problems of preserving fish life and preventing smell suggest that a natural measure of water quality is the level of dissolved oxygen.

Under ideal conditions, the highest possible level of dissolved oxygen in the water is 14 parts per million. But this can be maintained only if the water is very cold-about 33" F-and if no pollutants are present. For practical purposes, the highest level of stream quality which can be maintained is about eight parts per million. As the level of dissolved oxygen drops below this point, fish life begins to disappear. But there is no critical level of dissolved oxy gen necessary for the support of fish life.

HOW, THEN, shall we define our goal of clean water? Shall we define it in terms of eight parts per million? That seems unreasonable; the costs of attaining that stream quality are quite high, and although there is some damage to fish life from allowing stream standards to drop from eight to (say) five parts per million, the damage is relatively small. Shall we define it at five or three or one (which would kill all

fish life, but would prevent the smell)? At each level there will be those who believe either that the costs of reaching that quality are too high or that the damages due to pollution are too high. In short, there is no objective standard of clean water. For purposes of public policy, we can set an arbitrary standard of (say) four parts per million, but we cannot claim this is an objective standard of clean water.

We have now laid the foundation for an objective discussion of pollution, a discussion centering around classic economic concepts of marginalism. There is no "cost of pollution." Nor is there any thing such as doing away with pollution. We talk instead of marginal changes in the level of pollution and of the marginal benefits vs. the marginal cost of that change. Hopefully we will set standards of pollution where marginal benefits equal marginal costs, and not in terms of some "objective" standard of man's survival.

Now that we have set an economic framework for a discussion of pollution, we can begin to discuss some of the difficult questions. I think there are three important ones:

(1) Why is pollution a problem?
(2) How shall we achieve the desired level of pollution?
(3) How much pollution do we want?

1. WHY IS POLLUTION a problem? I have argued that pollution is a good, like steel. But clearly pollution is not exactly like steel. Most of us do not worry about whether the economy produces too much or too little steel, but we do worry about the level of pollution. We can approach this matter by envisioning two firms, the Ajax Paper Works and the Stardust Inn, located on the same lake. Both Ajax Paper Works and Stardust Inn use steel to build their buildings; both firms also use the lake. Ajax Paper Works use it to dump refuse from the manufacture of paper: Stardust Inn, a resort

hotel, uses it to attract customers. We must allocate both the supply of steel and the lake between these two firms. The more steel Ajax uses, the less there is for Stardust. Analogously, the more Ajax uses the lake-by dumping pollutants-the less Stardust can "use" the lake to attract customers, as people are less likely to patronize a resort hotel that features a polluted lake.

We do not concern ourselves about the allocation of steel between these two firms, for we count on the market mechanism to do the job. The steel company will charge both firms the same price; both firms will buy steel and expand their plants until a dollar's worth of steel will yield a dollar's revenue.

We know that if we take a ton of steel from Ajax and give it to Stardust, we reduce Ajax's profit and increase Stardust's. But economic theory tell us that Stardust, which could have purchased an additional ton of steel but did not, will not use it as profitably as Ajax, and hence the combined profits of Ajax and Stardust are lower.

Having established the manner in which the market works to allocate steel between the two concerns, let us now examine the allocation of the uses of the lake between them.

Ajax finds that it pays no price to use the lake to dump the pollutants which it creates while producing paper; as a profit-maximizing firm, it will dump all of its pollutants into the lake, and set its level of production without taking into account the effect of the pollutants. However, Stardust Inn does not find the dollar benefit of cleaner water equal to zero. The cleaner the water, the more customers Stardust will attract; hence Stardust wants a lower level of pollution.

The difference between the successful allocation of steel and the unsuccessful allocation of the use of the lake occurs because there is no appropriate pricing mechanism for the right to use the lake. Since Ajax does not have to take

into account the costs that it imposes on Stardust, it does not make the optimal social decision. Since both firms must pay the same price for steel, the steel is allocated correctly. Stardust can get clean water by building swimming pools and treating the lake, but this costs money. It can thus buy clean water, but at a higher price than Ajax pays for the clean water it destroys.

The price mechanism fails because no one "owns" the lake. An individual who owns steel can refuse to sell it unless he gets his price, but Stardust cannot refuse to "sell" Ajax the right to use the lake. If people who purchased steel feared that it could be used by others without compensation, the price mechanism would break down. But buyers do not have to fear loss of the steel; it is property and, by law, can be used only with their consent.

2. HOW MUCH POLLUTION do we want? One problem we face is classifying the types of pollution. Although we talk freely of "pollution" as though it were a single concept, in practice we must deal with a wide range of pollutions. Water, for example, is polluted by sewage, heat, chemicals and so on, and each type of pollution must be dealt with in a different way. In practice, stream standards or air standards must be specified for a wide spectrum of pollutants. A second problem is that we really don't know very much about the costs of pollution. It is true that we can get some measure of the cost of cleaning up the streams and the air. A study by the Federal Water Pollution Control Administration concluded that the cost of treating human wastes alone would run to approximately $6 billion over a five-year period. But this study raised no question as to what level of pollution was desirable. If one asks, "How much will it cost to cut the level of pollution in Lake Michigan by (say) one-half?" no one really knows. Our ability to mea-

sure the benefits of less pollution is equally lacking. We frankly have no idea how much the public would be willing to pay to clean up our streams.

We do know that there are some redistributional issues. In the instance of Ajax Paper Works and Stardust Inn, it might be reasonable to argue that if Stardust Inn caters to middle and upper-income groups, the benefits of cleaner water will accrue to those groups, and if the users of Ajax Paper products are mostly lower-income people, the benefits of dirty water will accrue to lower-income people.

In addition to these practical problems there are some theoretical problems in measuring the costs of pollution. The usual procedure for deciding upon the socially desirable level of production of a good is to estimate demand and supply curves on the basis of historical data. It is possible to measure the supply curve for cleaner water (the cost of not polluting). We can have engineering data on the cost of installing pollution abatement devices at the Ajax Paper Works, and economists can tell us the effect on Ajax's sales of the increased price resulting from the added cost. The problems lie at the other end of the lake, measuring the demand curve for cleaner water. The measurement cannot be made unless we have data on the effect of different levels of water quality on Stardust's business. In general, we cannot easily obtain this data. The measurement problems, severe enough for water quality, become even more severe with air pollution.

3. LET US TURN our attention to the last question-that of control. On our hypothetical lake, the problem is quite simple. The managers of Ajax and Stardust could simply sit down and decide how much pollution there should be. They will disagree over whether Ajax pays Stardust for the damage caused by this level of pollution, or whether Stardust pays Ajax for

the damage caused by the limitation on pollution. They may eventually force a court or legislature to decide, but they will agree on the level of pollution and sign an agreement to maintain that level. For whether Ajax buys the right to pollute or Stardust buys the right to clean water, the eventual solution will be to set the standard where the cost of a marginal unit of pollution is equal to the cost of cleaning up that unit of pollution.

But if there are thousands of resort hotels and paper mills along the lake, negotiations become more costly. It is hard to conceive that negotiations among so many establishments will arrive at any solution, much less the right one. Experience suggests that the more firms involved in a dispute, the more difficult it is to settle the issue. Although it is true that thousands are also engaged in the buying and selling of steel, the difference lies in the existence of a property right to steel.

IN THE INSTANCE of the lake, the lack of property right suggests that some governmental intervention is required to set the level of pollution which will be allowed and to see that that level is achieved. Let us suppose the government decides upon a pollution standard. We hope it chooses the correct one, but mindful of the difficulties discussed above, we accept the possibility that it may be the wrong one. In any case, how do we go about achieving this standard? Thre possible solutions come to mind.

1) Control by fiat. Once a pollution standard has been decided upon, the problem is that of assigning the permissible levels of discharge among the various firms and deciding how fast these levels should be achieved. Current government practice is to mandate maximum permissible levels of discharge and then give firms a year or two to meet these standards. If we really know the correct level of

treatment, this method is satisfactory. However if it is not known-and usually it is not-there is no guarantee that the allocation adopted is efficient. We may impose intolerable burdens on some firms and relatively easy burdens on others. We may not judge correctly the amount of time required to make adjustments to new standards. Insofar as we make these errors, we will increase the real cost of meeting pollution standards.

One approach to dealing with errors in judgment is to allow variances from published standards for firms which can demonstrate "special hardship." However, the process of granting variances seems a cumbersome and expensive method of adjusting errors made in setting the original standards.

One feature of fiat control-and I think it may be an integral part of the process-is that it tends to operate in terms of requiring each industry to achieve a certain level of pollution, rather than in terms of meeting some total level of pollution for a city or river as a whole. And that, presumably, is what we are after.

2) Control by taxation. Earlier, we decided that the problem of pollution arose because firms did not have to pay the correct price for the use of the right to pollute. So one possibility is to impose a tax on the discharge of pollutants, thus giving firms an incentive to reduce their discharges. If we set the tax high enough, we can insure that the water or air quality standard will be met. Further, since all firms must pay the same price for the use of the right to pollute, we can be sure that the allocation of the burden of treatment among the firms is efficient. On the margin, a dollar spent on pollution treatment will have the same effect on the level of pollution, regardless of which firm spends it.

Further, there would be no necessity for hardship variances. A "hardship case" means that a firm finds it exceptionally expensive to

reduce its pollution immediately. If so, it may elect to pay the tax.

Under an inverse tax scheme the government could pay or "bribe" firms to reduce pollution. For example, a firm that discharges 100 pounds of pollutants could be offered a bribe or subsidy of 10 cents for every pound it reduces pollution below 100. This has risks, however, as firms might be tempted to step up their production of pollutants in order to qualify for larger potential payments. Also, the costs of regulation would make this less desirable than the direct tax plan.

3) *Control by property right.* Another method of control is to sell off "rights" to pollute.

If we sell permits for the "right to pollute" and require firms to own these "rights" in order to use them, we can control the level of pollution. If we want only five million units of pollution a year, we can simply sell five million rights to discharge a unit of pollutant. If we further allow firms to buy and sell those rights, we can insure that the division of the burden of treatment is optimal. Firms which find it cheaper to treat their pollutants than the "going price of rights" will sell off their rights, and firms which find it more expensive will purchase additional rights. Eventually we will reach the point where each firm finds that the cost of reducing its discharge of pollutants will be equal to the market price of the "rights," and the problem will be solved.

THE LAST TWO proposals are similar in that both would force firms to take the cost of their pollutant emissions into account. As an important side benefit, we would have information on the cost of less pollution without having to make independent estimates of such cost. The tax, or the selling price of the property right, will tell us the marginal cost of cleaner (or alternatively the marginal benefit of dirtier) air or water, and we can use this

information as a guide in setting standards.

Indeed, one method of determining the "right" standard of pollution would be to allow those who are affected by pollutants to buy up and pocket rights to pollute, and deny those rights to others who might use them. People who felt sufficiently upset by five million units of pollution could buy and pocket one million and reduce discharge to four million.

Under such a plan, of course, a firm would buy and use pollution permits to the extent it needed them to operate profitably, and would presumably derive a dollar's revenue from a dollar's purchase. An individual who bought a pollution unit in order to pocket it, on the other hand, would derive only part of the benefit from his action; the reduced pollution would benefit the public at large. Unless the individuals interested in reducing pollution were to act in concert, it is unlikely that they would purchase pollution permits to the point where they would receive one dollar's benefit for each dollar expended.

To be sure, the problems involved in a national policy on pollutants are more complicated than this simple analysis suggests. I have not discussed the very real technical difficulties involved in implementing either of the two proposals I have outlined. But most discussion of the problems of pollution ignores the issues I have raised here; and I do not believe that a proper solution can be had without this consideration.