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THE PUBLIC POLICY ISSUES INVOLVED
IN DEALING WITH ENVIRONMENTAL DEGRADATION:
A DYNAMIC APPROACH

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A Dynamic Approach

Strong Versus Weak Uncertainties

From a public policy standpoint, the issues of environmental degradation are unique in that they involve making decisions under conditions of "strong uncertainties." No one can calculate in probabilistic terms either the risks to societies of environmental degradation or the costs that will be encountered to bring about a lower rate. With respect to the risk, there is no way of calculating to what extent the lives of people might be shortened by living in a densely populated and multifariously polluted city such as Los Angeles. Physicians have only a very rough idea of how respiratory and heart diseases are affected by certain kinds of contaminants. However, the more that is learned about the risks of environmental degradation, the more serious they do appear. This has been proven true with respect to radioactivity as well as with respect to cigarette smoking. And there is no reason to suppose it will not be true with respect to other pollutants.

This is not to suggest that because precise calculations cannot be made people behave irrationally if they take action to protect their own health. The fact of the matter is that, while some engineers and economists will deny any affect can occur unless it can be measured, when it comes to health, people have no alternative but to be resourceful on the basis of highly ambiguous evidence. Although good estimates

are not obtainable, I would guess that a very significant part of the outmigration from Los Angeles and other cities having similar pollution problems during the past several years was provoked by the effect of smog on health -- and more often than not, upon the advice of a physician. Physicians may not know a great deal about the effects of pollution on health. Yet, they cannot very well advise their patients to wait until better knowledge is available. While there are economic risks involved in acting upon the basis of imperfect knowledge, for particular individuals there are more dangerous risks in waiting until good mortality data are available. A world of weak uncertainties can be defined as one having good mortality data -- and, more generally speaking, as a world which can be described in probabilistic terms. In such a world it would be possible to obtain insurance against pollution. However, if such insurance is not available, people have no alternative but to balance the risks of continuing to live in a polluted area with those of resettling in a healthier environment.

Nor is it possible for public officials to be oblivious to the risks of environmental degradation. They may or may not be sensitive to the impact of pollution on health. But public officials are very sensitive to the impact upon the future tax base of a continued outmigration from a polluted area. In fact, I happen to know as a matter of firsthand knowledge that, on the basis of very scanty information about the reasons for the recent outmigration from the Los Angeles area, a number of political and business leaders saw in the threat of widespread pollution a real dilemma for the city.

To sum up this part of the discussion: When uncertainties are strong, risks cannot be calculated in probabilistic terms. Or to put the proposition the other way around, if the uncertainties were weak, which indicates they could be calculated in probabilistic terms people could insure themselves against living in high pollution areas as they insure themselves against airplane accidents; and there would be no risks of living in high pollution areas.

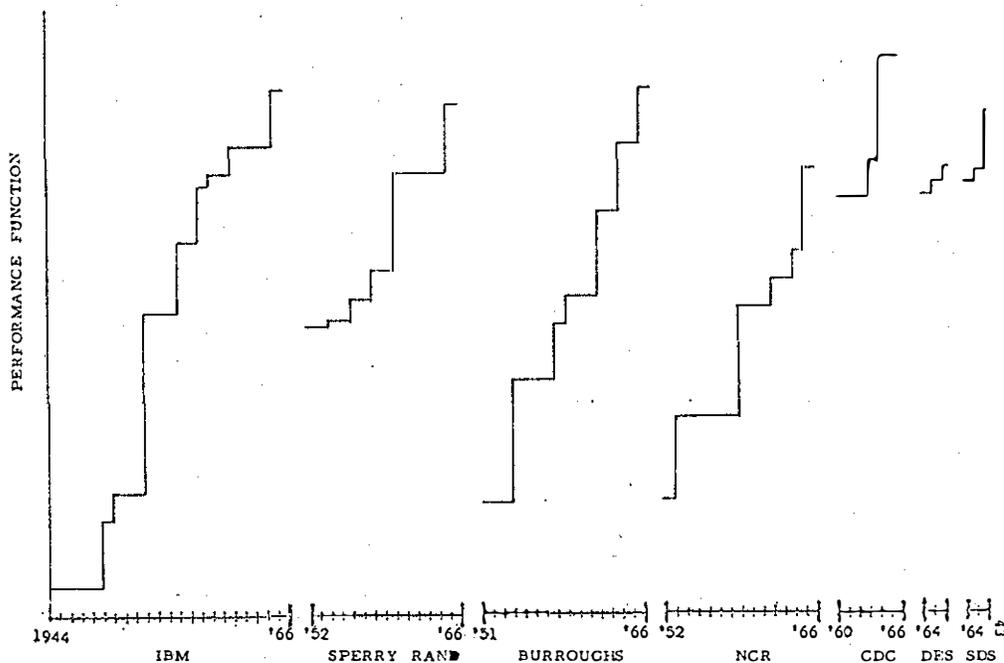
People would simply have to decide whether or not living in a polluted area was worth the additional insurance premium. Governments might, of course, decide upon specific remedies to reduce the rate of environmental degradation. But if they did, it would be because it would cost less to save a polluted area than to allow it to die.

Nor is it possible to make good predictions of the longer-run costs likely to be involved in reducing environmental degradation. How rapidly the risks of environmental degradation are reduced obviously will depend on how imaginative business firms are in developing better menus of alternatives. To be sure, business firms may search for relatively minor advances that call for little imagination, in which case the costs involved in reducing environmental degradation would be highly predictable. But the rate of progress probably would be very slow. Conversely, the advances calling for the greatest degree of imagination would be the least predictable. The reason for this is that imagination, if efficiently employed, leads to more significant ideological mutations -- mutations which must be defined as highly unpredictable. For example, it would have been easier to predict the measures the American automobile industry has adopted to date than it would have been to predict the stratified charge engine developed by the Honda Corporation. And the reason is very clear: from the point of view of permitting better fuel consumption and better emissions performance the stratified charge engine represents a more impressive mutation.

What, then, determines whether business firms are likely to employ relatively little or a great deal of imagination in searching for better alternatives? The answer is: the degree of risk firms impose upon each other. As Chart I shows, in an industry such as the computer industry the advances represented by the stratified charge engine would

CHART I

ACTUAL COMPUTER PERFORMANCE



Data taken from The International Computer Industry, by Alvin J. Harman, Harvard University Press, 1971.

not be looked upon as large. In that industry, engaging in a high degree of unpredictable behavior can be regarded as a routine activity. In fact, as Chart I shows, the advances follow upon each other so regularly the industry can be described as a "predictably unpredictable" industry engaged in the making of "fast history." It is no accident, however, that the computer industry happens to be one in which competitors impose large risks upon each other, as measured in terms of the markets which can be won or lost with the introduction of new computers. It is quite unlikely for an industry as a whole to behave in a predictably unpredictable manner while overcoming large discontinuities unless the firms impose large risks upon each other. After all, unless prodded by competitors, why else would firms continue to deal with large technological risks?

What, then, prodded Honda into taking a large technological risk? One obvious reason is that Honda is not a typical automobile firm. It originated as a bicycle firm and only recently entered the automobile business. Therefore, it is not likely to have the inflexible organizational structure associated with an American automobile firm, whose structure sharply limits the ability to engage in a higher degree of unpredictable behavior. For example, Honda engineers, working at Ford (Detroit) on the development of a stratified charge engine, argue that they are surprised anything new is ever accomplished in the American automobile industry. They point to the fact that in Japan on the basis of rough drawings they can obtain parts from general Japanese machinists in a matter of a few days, but at Ford, where specialized machinists can only work from highly detailed drawings, the same process can take months. Furthermore, Honda may not only have an organizational structure which is more consonant with risk-taking, because it permits a higher degree of unpredictable behavior, but it also may have a greater incentive to engage in

risk-taking. If foreign manufacturers hope to compete in American markets they must have something special to sell. For only trivial differences in gasoline consumption the American consumer will not change his attachment from an American to a foreign product.

To conclude this part of the discussion: Viewed as isolated events, individual advances in technology are quite unpredictable. But a series of impressive advances can be made quite predictable when business firms impose a substantial degree of risk upon each other. Since the uncertainties are strong, they obviously cannot take out insurance against such competitive risks. They must, therefore, hire imaginative people to do to their competitors what their competitors can do to them! And it is the diversity of ideas generated, because competitors cannot predict each others actions, which leads to smooth progress when plotted on a macroscale. Thus, microdiversity is the hidden hand of macrostability.

Why, then, are the issues of the environment to be considered as dynamic issues? As the terms are usually defined, a "static process" is one in which the initial conditions can be taken as givens, and a "dynamic process" is one which involves unpredictable changes in the initial conditions. If this definition is accepted, then the environmental issues must be regarded as "dynamic issues" for all time to come. First, as was already pointed out, as man learns more about the risks of environmental degradation, it seems quite likely he will discover effects which cannot be predicted today. Moreover, as human evolution continues, new interactions with the physical and biological environments will result in the discovery of new risks (as it has since the Middle Ages). Second, growth will wear out technologies from an environmental point of view; and the more rapidly economies attempt to grow, the greater will be the need for dynamic behavior. Third, if effective action is to be taken to bring about smooth progress to

reduce the risks of environmental degradation, then a high degree of unpredictable behavior will be required to generate a diversity of ideas.

Very unfortunate from a public policy point of view is that the industries which contribute most to the problems of the environment, the automobile, petroleum and electric power industries -- industries for whom stable growth has become almost a religion -- are those whose ability to engage in dynamic behavior is not very impressive. Furthermore, as far as the United States is concerned, the automobile and related industries are responsible for about one-sixth of its total employment.¹ Therefore, industrial spokesmen are in a good position to argue that "what is good for General Motors is good for the U. S. A.," Or as Keynes once made the point: When you owe the bank one thousand pounds, the bank owns you. But when you owe the bank one million pounds, you own the bank!

What, then, are the policy options for dealing with environmental degradation? One is the internalization of costs: a prescription which has emerged from classical economic theory. Another is the policy which is being followed by most countries: a policy of direct regulation. And finally, there is a policy which can be described as "risk internalization." Its aim is to make business firms feel (because of their profits) the risk of not reducing environmental degradation at a more rapid rate. However, while the last proposal is based upon dynamic economic theory,² it certainly is not new. In fact, the concept of risk internalization was proposed in a somewhat different context in 1827 by an engineer who, as it happens, is also credited with the key ideas contained in the second law of thermodynamics, Sadi Carnot.

The Internalization of Costs

If it is assumed that an economic system is closed, in the sense that its knowledge can be taken as a given, and if it is further assumed

that all people are more or less equally affected by environmental degradation, then the logic of the proposal which comes out of classical economic theory is unassailable. "Internalization of costs" means, in effect, that the polluters would be made to take into account the costs they are imposing upon society; and expenditures on improving the environment would be increased until the marginal benefits became equal to the marginal costs. One problem, as already was indicated, is that neither the costs nor the benefits are probabilistically known. Another is that, even if they were, people are affected differently. And this, in turn, means that the amount to be spent on pollution abatement is not an economic but a political decision.

The advice economists are qualified to give concerns the most efficient means of bringing about reductions in the risks of environmental degradation. And by pretending they can give advice on both the resources to be devoted to pollution abatement and the means for bringing about an appropriate reduction in pollution, economists end up by laying down pompous preconditions which have little or no operational content.

Direct Regulation

If it were possible to utilize relatively known technology to quickly clean up the environment, then direct regulation probably would be the most efficient way to get the job done. Providing that a centralized planning bureau could collect the same information as a decentralized planning process, then there would be no inherent advantage in decentralized decision making.

The problem with direct regulation is that the relevant information cannot be obtained from a centralized planning system. To be sure, in principle, at least, it should be possible to obtain good information about the impact of environmental degradation on health

and about measures to lower the rate of environmental degradation. But, while responsiveness to feedback makes for a good cybernetic system, it is not the essence of dynamic behavior. The essence of dynamic behavior is the ability to generate new alternatives. And the only way a centralized planning agency could acquire a realistic knowledge of the alternatives is by promoting active competition between business firms. Unless business firms are confronted with real risks, how can a realistic knowledge of the alternatives be acquired?

Because regulation is not ordinarily defined as the promotion of competition, regulatory agencies have tended to represent deplorably inefficient instruments from a dynamic point of view. One reason is that the response of such organizations in adjusting to new circumstances inclines to be just above zero. This slow reaction occurs because in the process of promulgating a particular regulation the regulatory agency and the regulatory industry tend to become a coalition whose main objective in life is to prevent the regulation from being changed. As far as the United States is concerned, regulatory agencies are staffed mainly by lawyers. And, on the whole, lawyers tend to be strict constitutionalists who, once a regulation is promulgated, can be counted upon to resist all future efforts to change it. By contrast, an efficient dynamic system is one which possesses a significant degree of "openness": a real ability to interact with an environment to change the entire system -- man's ideas plus his physical environment. Quite obviously, ideological change must go hand in hand with changes in the physical environment. But, because of the constraints they impose upon ideological change, regulatory agencies tend to have a low degree of dynamic efficiency.

The second problem with regulatory agencies is that the incentives they provide to industry are perverse. As was pointed out, to make smooth progress when reducing environmental risks requires

the generation of a wide diversity of ideas. However, the incentives provided by regulation are inclined to promote consonance of behavior: the regulated industry obviously has an incentive to get the regulation postponed; consequently, from that point of view it is necessary to present a united front to the regulatory agency. And it is not entirely an accident that despite its large R&D expenditures the American automobile industry has featured a low diversity of ideas with respect to reducing pollution -- even in the absence of regulation, it is not an industry known for risk-taking. Unfortunately, instead of counteracting such a tendency regulation reinforces it.

While regulation does make possible some degree of progress, it is a terribly slow and inefficient way of bringing it about. It is slow because of the small degree of openness typically associated with regulatory agencies. It is expensive because it features the generation of a low diversity of ideas. The only way to make progress smoothly and inexpensively is by having a variety of options from which to choose. And the only way regulation can contribute to this result is by the promotion of competition.

The Internalization of Risks

As applied to business competition, the term "internalization of risks" means acting upon a technological risk to avoid a market risk. In a world in which new discoveries can be made, competitors face two risks: a competitive risk and a technological risk. And acting to avoid a competitive risk internalizes a technological risk in the sense that it makes the future rate of progress more predictable. Thus, risk internalization consists of competitors imposing a tax upon each other -- the bigger the tax, the more rapid is likely to be the rate of progress, because the bigger the tax, the greater the incentive to engage in unpredictable behavior in overcoming discontinuities

by generating new ideological mutations.

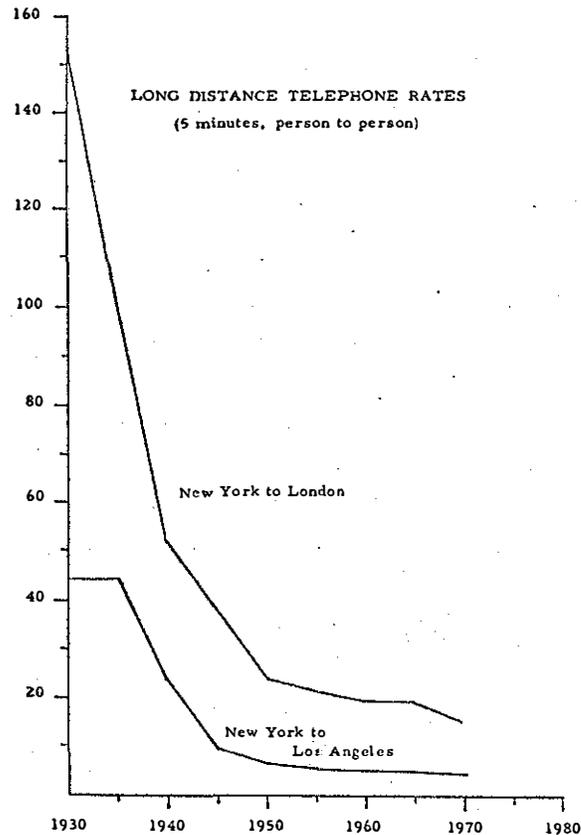
Once the logic of internalizing risks is understood, it quickly becomes apparent that competition provides only one way of internalizing risks. As another illustration, consider rate-making procedures in the field of long distance and international telephone calls. Here, due to the long lag in reducing telephone rates in response to reductions in costs, it really paid AT&T to stay ahead of the ratemakers in discovering ways to reduce costs. And as Chart II shows, the telephone system did a good job of staying ahead of the ratemakers.

In very general terms, risk internalization can be compared to a tax that contains both positive and negative incentives: rewards for achievers and punishments for slackers. An increase in the tax implies, therefore, a strengthening of both positive and negative incentives (i. e., a more differentiated reward system). Risk internalization provides a society with a dynamic insurance policy: assuming there are six to eight firms in an industry, progress will be smooth. And the rate will depend upon the degree to which risks are internalized: the greater the "premiums" -- the more differentiated the reward system -- the more rapid the rate of progress.

More generally speaking, the objective in internalizing risks is to increase the degree of openness by making income after taxes depend on performance in improving productivity, however it is measured. And as the following quotation indicates, Sadi Carnot was familiar with the logic of the argument:

A tax on the rent of a farm would be much better than a tax on the land itself. Proprietors then could only avoid taxes by themselves improving their property. As it is, they merely collect the rents, and usually employ their surplus in unproductive expenditure, while the proprietary farmers devote theirs to the improvement of the land.³

CHART II



Source: AT&T, January 1973.

Apparently in the days Carnot wrote, a tax on land was on its raw (unimproved value), while the rent of land was on its improved value. If these assumptions are made, a tax on land would provide no incentive to improving it. But a tax on rent would provide an incentive to become a proprietary farmer, and to increase the value of the land. Thus, it is quite clear that Carnot had in mind a tax scheme aimed at increasing the degree of risk internalization.

Because the minds of most economists are to this day ruled by equilibrium economics, it is to be expected that they will not favor risk internalization schemes. However, it must be kept in mind that the issue is not one of regulation versus no regulation. It is, rather, an issue of what kind of regulation: direct regulation which would provide perverse incentives for the generation of a diversity of ideas and a risk internalization scheme which would provide positive incentives.

In one sense, a system of regulation does provide positive incentives. Legally speaking, the penalty of failing to meet the standards is a 100 percent excise tax. For example, an automobile company could be prevented from selling cars. But, practically speaking, the threat to escalate to full scale antipollution war would not be a credible threat, because in an industry in which millions of jobs might be affected no one would believe the threat.

Actually, it is no small wonder people in industry often proclaim, "We can live with regulation." What they mean is that they can engage in effective lobbying to get the regulations postponed. On the other hand, it is also easy to understand why direct regulations are very popular with politicians. The tough language contained in the laws makes good reading material for their constituents. In fact,

if politicians want to be popular with both the public at large and business interests, the optimal policy is to carry a big stick but never use it. Another good example is to be found in recent measures taken in the United States to tighten the criminal penalties associated with the antitrust laws. Not only is the effect to make prosecution more difficult, but the politician can tell his constituents he favors a competitive society!

The advantage of incentive schemes over direct regulation is that they supply a more plausible threat when it comes to the internalization of risks. In order to internalize risks it is essential to adopt measures which will have a more or less calculable effect on business profits. Business firms must be left with no uncertainty that their profits after taxes will be larger if they display improved performance in reducing pollution.

Present regulation takes the form of the imposition of more and more stringent standards. There is nothing wrong with this general form of regulation. For the indefinite future there ought to be pressure on firms to discover ways to lower the rate of environmental degradation. Why environmental taxes provide a more efficient method of regulation than direct controls is that whereas the first provides incentives to make technological discoveries to avoid the tax, the latter provides incentives to make political discoveries to escape from regulation.

This is not to say, of course, that with risk internalization measures, the problem of creating perverse incentives would be completely obviated. For example, if an emissions tax was levied on automobiles only on the basis of emissions data obtained from newly manufactured cars, then it would be expected that automobile manufacturers would not put their best efforts into the development of emissions devices which were relatively easy to maintain. Indeed, this is already a problem. Therefore, to avoid this kind of perversity,

an inspection scheme with a supplemental system of penalties would be required. Such measures would not, of course, please the consumer. But only by making the consumer feel the risk can automobile firms be motivated to develop emissions systems which would be easier to maintain. However, while such difficulties are inherent in all types of environmental taxes -- whether on automobiles or newly constructed houses -- usually such perverse effects are worse with direct regulation.

Nor do I want to imply there would be no difficulties in designing appropriate tax incentives. One difficulty is that of obtaining reasonably accurate measurements on the improvements in the performance of a technology from an environmental point of view. However, this is a difficulty which must be faced with any type of regulation. Another difficulty is that of deciding at what level to set the rates. It can be assumed that if the taxes were progressively raised a level would be reached which elicited the appropriate degree of openness. However, given the inflexibility of tax systems when it comes to raising rates, it obviously would be desirable to be able to make predictions on the responsiveness of firms to increased degrees of risks in their environment. But to make predictions which might be accurate within a factor of two will require a good deal of empirical research.

The real constraint on the adoption of risk internalization measures is not, however, a lack of research. Generally speaking, policy oriented research in the social sciences has not preceded the adoption of new policies; rather, it has followed. Thus, with one or two exceptions, economists in the United States did not become interested in the promotion of competition until long after the antitrust laws were adopted. And before Keynes argued that a mere reduction in wages would not restore the economy to a heavenly equilibrium, both the British and American governments were engaged in deficit financing. The real constraint is the attitude held in a number of

countries that it is the responsibility of governments to spare their citizens from risk-taking. The good life, politicians have come to believe, is life in which economic growth is so stable that no unpredictable event dares to occur. To be sure, biologists and psychologists now believe that people differ greatly in their propensities for security and adventure.⁵ And, if this argument is correct, then there is nothing wrong with imposing a higher degree of risk on business firms and labor unions -- for the result would simply be that a different type of personality was favored. When economic policies favor microstability, the people who get to the top of business firms are lawyers and accountants -- people who are trained to perform the same function in modern societies as genetic inbreeding performed in medieval societies. On the other hand, when they favor macrostability -- smooth progress accompanied by a high degree of unpredictable microbehavior -- people with a greater degree of openness are favored, as measured by tolerance of ambiguity tests.

This distinction between the two types of people was once described by Thomas Jefferson as the "artificial" and the "natural" aristocracy. The principal difference, therefore, between a policy of direct regulation and one of risk internalization is that whereas the former favors the artificial aristocracy, the latter favors the natural aristocracy. In fact, the willingness of people to impose risk internalization measures on themselves can be regarded as a necessary condition for the preservation of democratic societies. The test of a democratic society, it may be assumed, is to survive in the face of trying circumstances by making good use of its natural aristocracy. But unless it is willing to impose tough risk internalization measures, how can a society meet this test? The basic reason, therefore, for adopting a dynamic approach is that it allows us to understand the logic of risk internalization.

FOOTNOTES

1. U.S., Department of Commerce, Domestic and International Business Administration, U.S. Industrial 1975 Outlook, no. 0325-00020 (Washington, D.C.: Government Printing Office), p. 133.
2. See my forthcoming book, The Elements of Dynamic Economic Theory.
3. R. H. Thurston, Reflections on the Motive Power of Heat, from the original French of N. L. S. Carnot (New York: John Wiley and Sons, 1890), p. 211.
4. Ibid.
5. See C. D. Darlington, The Evolution of Man and Society (New York: Simon & Schuster, 1969); and Erich Fromm, The Anatomy of Human Destructiveness (New York: Holt, Rinehart & Winston, 1973).