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Applying Economic Controls

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Air conservation is an economic function which unequivocally calls for public action. Air, like other open access resources, lacks any kind of tenure protection, and in the absence of explicit public policies to prevent it, is subject to overuse. In this respect it is analogous to open range with unrestricted grazing, high seas fisheries, or public parks without access control. In contrast, a private owner of land will permit only an intensity of use at which the benefits from the last increase in use equal or exceed the resulting increased congestion cost.

Further, air pollution is generally hard to trace from one source to one receptor. Diffusion of responsibility and damage makes contractual or legal procedures inapplicable. In addition, the unprotected air resource moves continually across property lines, so that costs imposed by polluters inflict damage on the use of all other resources. Overuse of open ranges, fisheries, or parks damages exploiters competing for the same resources. Overuse of air damages everyone whom the air envelopes.

One of the most important functions of economic analysis is to evaluate public policy. Economics, contrary to common usage, begins with the postulate that man is the measure of all things. Direct damage to human health and happiness is more directly “economic,” therefore, than damage to property, which is simply an intermediate means to health and happiness. Neither do economists regard “economic” as a synonym for “pecuniary.” Rather, money- is but one of many means to ends, as well as a useful measure of value.

“Economic damage” therefore includes damages to human function and pleasure. The economist tries to weigh these direct effects on people in the same balance with other costs and benefits associated with air pollution, to the end of making decisions to maximize net social benefits.

• *THE ECONOMIST'S MEASURING STICK*

Economic analysis facilitates judgments among alternatives by reducing all to a common measure. The economist’s measure, exchange value, serves as a means of communication and reconciliation among different interest groups and disciplines. For example, the horticultural fundamentalist will insist that fruit trees be protected from air pollution damage by substituting high quality fuel for cheap residual fuel; the fuels conservationist will insist on fullest utilization of residual fuel oil. There is often little in their private vocabularies to settle such a conflict.

However, once one accepts the economist’s measuring stick, it is possible not just to judge between simple alternatives, but to render quantitative judgments, in great

detail, of how much enhancement of air quality is worth what costs at what time and what place. One can decide which of many options is best, securing maximum net benefits over costs. And, having so decided, one can devise means to compensate the losers from the gains of the winners in the interests of distributive equity.

The policy that helps most people is bound to hurt some people, and many or most policy proposals founder on the rock of distributing benefits and costs. Thus, when it is proposed to alleviate air pollution in New York by moving power plants to West Virginia, it is protested that each of, say, one hundred mountaineers affected in the new location will suffer as much as each of, say, one million New Yorkers in the old, and therefore the plants should not be moved.

The economist stresses that the joint benefits should be maximized, and then the losers compensated from the gains of the winners. Indeed, this is constantly being done, through property tax assessments, purchase of casements, and condemnation. However, these redistributive mechanisms are entirely inadequate, so that maximization of joint net benefits from public action is almost always blocked far below one hundred per cent.

We lack, first of all, a sense of community or polity over areas wide enough to handle most air conservation problems. We lack, secondly, any consensus as to what constitutes the proper status quo ante delicta, from which departures should be compensable. There is a pervading uneasiness about accepting as a base the present distribution of property, whose historical origins do not always bear examination, and the received discipline of economics offers inadequate counsel on the subject. There is, however, a general feeling that property has always been received, held, and bought subject to taxation, so that the tax mechanism is a fitting one for redistributing the gains and losses from public actions.

As a first step, air should be regarded as a common domain to be managed under public tenure, as the Bureau of Land Management administers many western grazing lands—only better. Invasions of the domain by polluters then may be regarded as trespass, and the cost of control assigned to the polluter, preferably in such a way as to motivate him to reduce noxious emissions: for example, by imposing an effluent charge. At the same time, nonpolluters who enjoy the benefits of others' forbearance might be regarded as having preempted part of the public domain from rivals who need it for waste disposal, and are likewise subject to fiscal liabilities. These should be of such form as to motivate them to put to full use those areas whose air supply is preempted from polluters: for example, a tax on site capability.

The polluter may bear the costs of control in at least three different ways. He may discontinue the operation altogether; he may modify it to reduce noxious emissions; or he may pay the public a royalty for invasion of the air resource. In the third alternative, he compensates owners of the damaged areas by lightening their tax load. The royalty or tax method of redistribution has several advantages, not the

least of which is that taxation is incremental and permits of very fine gradations. Taxation can also be automatic in the sense that it operates to fine some activities, and reward others, without specific court or police action. Thus, for example, a tax on diesel oil acts to discourage its use in any quantity, including those which are too small to reach the threshold of police action or lawsuit.

In spite of limitations on our knowledge, pollution control technology gives us a considerable range of options in reducing emissions. Most of these techniques may be described in general economic terms as entailing the substitution of capital for demands on nature, with nature being represented by fossil fuel sources and the air. Let us see what economic policies would work toward the goal of substituting capital equipment for demands on nature.

• *TAXES: FORTIFYING SELF-INTEREST*

Over a period of years, property taxes can add up to a significant proportion of the value of control equipment. It would serve air conservation, therefore, to exempt pollution control equipment from property taxation. That might seem like a subsidy to be borne by other taxpayers, but actually it is not. The exemption of the improvement from taxation has the pleasant economic side effect of making the rest of the property more valuable, so that the tax levy may be as high as before. The difference is that it is no longer contingent on installation of control equipment. The polluter is taxed more whether he installs the equipment or not. Tire policy would be more effective if carried further, to exempt not just control equipment, but all combustion equipment, to encourage a generally higher standard, and more rapid replacement. Some economists regard it as ill-advised to tax improvements of any sort, but the case is especially strong when the improvement serves primarily not to help the improver, but to please his neighbors. Where the motive of self-interest is weak, tax policy needs to fortify it, not further weaken it.

Fast tax write-off of control equipment is a second possibility. This proposal amounts largely to a subsidy for control equipment, imposing additional burdens on other taxpayers. As such it is less attractive from the standpoint of distributive equity than the first proposal. Furthermore, economists generally feel that, if subsidies are to be paid, they should be direct, explicit, and specific. Otherwise the initial purpose is often lost in the shuffle. Fast write-off does have the advantage of being subject to federal control, where interstate airsheds are involved, but there is no way to adjust it to the differing needs of different airsheds.

Another device, fuel taxation, is an indirect royalty on invasion of the air resource. Like most indirect measures, it does not hit the bull's-eye exactly. It discourages all use of fuel, regardless of timing or location, and so has some uneconomic side effects. It gives no impetus to types of control technology which operate on principles other than economy of fuel, and it has no effect on air pollution from other sources: for example, trash burning.

The great advantage of fuel taxation is relative ease of policing. Where most fuels

came from a few basic sources—refineries or wholesalers—the cost of control at these points is so much less than that of metering emissions from every exhaust and vent that this might often be the backbone of an air pollution control program. Fuel taxation is currently practiced, of course, but with no regard to questions of air pollution. It is, indeed, the least noxious fuels that bear the highest taxes. Air conservation would prescribe a radical reversal of such practices so that cheaper fuels and sulfurous oils paid higher taxes, while highly refined fuels were exempt. Combining this principle with that of exempting control equipment, it would be desirable to exempt that refining equipment which is designed to increase the percentage of fuel combusted.

• *ROYALTIES: CONSTRAINING WHAT IS MEANT TO BE CONSTRAINED*

Where physically and institutionally feasible, clearly the most perfect constraint on invasion of the common air resource is to require a price for it, a royalty paid to the public for exploitation of a limited natural resource.

The royalty approach has several advantages. It gets directly to the point, constraining exactly what is intended to be constrained, with no side effects. It imposes costs on offenders, and lets them escape in precisely the measure that they abate the offense, because it is graduated to the severity of the offense. It is continuously effective, independent of sporadic crackdowns and let-ups. It permits some pollution to continue to the extent that the cost of abatement would exceed the damage to air quality, and selects out necessary from unnecessary pollution. It continues to be effective even when polluters have met a minimum standard below which police regulation would not take effect. It is non-catastrophic in application, letting polluters make their own best adjustment to the new constraint in their own time. By thus minimizing needless hardship it permits a more stringent basic standard to be set than with clumsier controls. It is based on performance, rather than any arbitrary technique or material, and does not wait on “the gadget” but takes effect immediately, motivating polluters to minimize their damage with all the means and ingenuity at their command. It is adjustable for place and time of emission.

Air pollution royalties would not completely substitute for conventional regulation, even if full metering were feasible. Some pollutants are so dangerous that absolute prohibition under all circumstances is necessary. Some pollutants are released so seldom that metering would not begin to repay the trouble of installation.

An objection to this scheme is that it presupposes a system of prices and costs which are true indices to alternatives. But that is not always true. For example, taxpayers in the 90 per cent bracket (if there really are any) would deduct 90 per cent of the royalty as a local tax, and feel only 10 per cent of it as a constraint. It is still possible to use the price mechanism as a guide, by taking such factors into account and modifying procedures accordingly, but there is no denying that that will increase the danger of error.
A variation of the royalty scheme, where full metering is not feasible, is to sell

licenses to polluters, the price varying with the capacity of the licensed process and facility to pollute the air. The amount of capacity licensed should be limited to an amount considered optimal. License fees should be kept at high levels determined by periodic competitive biddings; otherwise the scheme would have that notorious propensity of licensing systems to degenerate into political footballs, with early licensees establishing squatters' rights growing in value over time and giving them a monopoly.

Royalties or licenses, whichever is used, should be designed to bend with conditions. Nature renews and exchanges air continually, but not steadily. It might be said to afford us some short-run "storage capacity" for absorbing pollutants. This capacity has seduced us into thinking we could continue cramming pollutants into it indefinitely. The potential usefulness of air storage capacity has been badly abused, but that should not blind us to its possible intelligent use.

A sophisticated control program will, and some already do, tighten controls when the ambient air condition worsens and relax them when the air reservoir is emptied. Los Angeles' "smog alerts" are a crude example. It is crude because the control has only two positions, "on" and "off," with no gradations between.

If measurement and monitoring were free or cheap, an elaborate system of full metering and flexible pricing would be desirable to constrain emissions optimally and achieve the maximum social benefits at minimum cost. It is probably premature to elaborate any such scheme now, although it is a direction for future policy development to take. Metering is costly and crude, and we must try to make shift without it.

An alternative is to issue several classes of licenses for polluting the air. Class A might give licenses to pollute under all conditions less polluted than the present "smog alert" level; Class B licenses would become inoperative at a lower concentration of pollutants; Class C at a yet lower level; and so on through as many classes as could be administered or policed. Alternatively, licenses might be graduated according to the number of hours per day they were effective, the particular times of day, or the particular wind directions. Licenses could also be limited as to location.

The big drawback of licenses as a control device is that, since emissions are not actually measured, the license must be based on some substitute for actual emissions, such as emission capacity or type of operation. If the license fee is high enough to be effective it will be high enough to provoke evasive action by the licensee, and he will be motivated to use his licensed capacity more intensively than would otherwise be optimal. Short of actual metering, there seems little remedy for that. However, timing controls might be integrated with locational controls, and policing eased by limiting Class A licenses to certain areas.

• *ZONING: PLANNING FOR POLLUTION*

The above alternatives are measures that could be instituted quickly and, though installation of new equipment might be spread over a period of years, the incentives or pressures would begin immediately. However, long-range urban planning can be equally, if not more, important.

There is a time and place for everything. The time and place to pollute air is downwind. That may be achieved by varieties of zoning. By such zoning, a community buys cleaner air at the cost of extra transportation. Where that is cheaper than other methods, it seems a worthy addition to a panoply of controls. The optimal location for the zone is where the increment to transportation costs from moving it further out becomes equal to the decrement to pollution damage. For fullest maximization of net benefit, zoning constraints should be couched in terms of emission royalties, or license fees graduated by location, rather than black-and-white prohibition here and permission there.

The activities most likely to select a "smoke-zone" location are the export industries which generally have less need for central location than local service industries. These industries also generally yield fiscal surpluses, and are in much demand by communities. The zoning policy must, therefore, supply enough land for smoky industry lest the policy break down under pressure for more space.

One means to that end is to enlarge the smoke zone, but the larger the zone, the less land remains for others. To make the zoning work best, downwind land zones for air pollution should be subject to a substantial annual tax, to minimize underuse of and speculation in industrial sites, thereby enabling a small zone to support a large industrial base. Similarly, laud protected from pollution should be subject to an annual tax to ensure that the sacrifices undergone to protect the land are not wasted on the desert air, so to speak.

If no location is consistently downwind, locational segregation becomes a less advantageous policy. It finally amounts to banishment of heavy polluters to outlying locations where their damage may be inflicted on cheap land and sparse populations. Tire zone might be in one quarter entirely, or it might be stretched into a belt surrounding the city completely. The reason for the second choice would be to keep the level of ambient air pollution down to a point at which the incremental damage of pollution remains low. The choice between the two policies depends very much on particular conditions.

• *ELECTRIC POWER, THE UNREALIZED POTENTIAL*

Electric power transmission is of special importance to air conservation, for it affords a sovereign means to segregate combustion from power delivery. Portland, Oregon, is an excellent example of air pollution control by substitution of electric energy for local combustion. Even the scrap steel mills there use electric power.

New developments in long-distance power transmission at 500,000 volts open important new possibilities for increased substitution of electric energy for local

combustion. Plants at Johnstown, Pennsylvania, and Morgantown, West Virginia, can now serve the New York and Philadelphia markets.

Conceivably, all combustion might be centered in large efficient thermoelectric plants, remote from population centers, but close to coal fields, saving in coal transportation costs what they lose in electric “wheeling” costs. Costly urban distribution networks for gas, coal, and oil could be done away with, their function assumed by increasing the capacity of the electrical network.

One difficulty in this scheme is the physical inefficiency of electrical generation, which cannot convert 100 per cent of the fuel calories into electric power. But the percentage of potential power output which is lost to nature is probably less than that which is lost to the tax collector. Power meters are favored devices for tax collection. The demand is quite elastic, since there are many substitutes, so taxes on generation, distribution, and consumption of electric power serve to hold down power consumption, hold up unit costs of distribution, and doubly discourage substitution of electric power for local combustion.

Another factor in electric rate-making that interferes with optimal air conservation policy is the custom of charging uniform rates over wide areas, in spite of differential costs of service. Rates should be lowest in densely populated areas, where distribution costs are lowest, and near load centers, which should in turn be near the centers of population. These central areas are also where it is most important that electricity be substituted for combustion. Present policy bleeds the centers to subsidize the outlands, and promotes electric consumption in the latter—where it is less important to promote it.

In the interests of air conservation it would be helpful to remove taxes on the generation, transmission, and distribution of electrical energy, as well as on home and industrial apparatus for reconverting it to heat and work. This would permit large drops in rates, with increased consumption and attendant decline of unit costs permitting still further rate reductions. Universal availability of abundant cheap electrical energy would make it feasible to outlaw fossil fuel combustion entirely in areas where necessary, and sharply curtail it elsewhere.

The question immediately presents itself: how will the lost tax revenue be recouped? The answer is that the availability of cheap energy makes land more valuable in the area served, and the revenue foregone from electric taxes may be recouped from land taxes with no additional burden on the landowner, who, after all, is the one who was paying the electric taxes to begin with. He simply pays in a different way, and in return he gets cleaner air and cheaper electricity: a fair exchange.

Many economists go farther, and hold that distributive networks not only should go untaxed, but be subsidized, to the end that they may charge very low rates equal to their marginal costs, which are below average costs.

A difficult problem is posed by the small size of taxing jurisdictions. If a power-consuming city untaxes thermoelectric facilities, little effect will be noted on its power rates if the facilities are largely located in other jurisdictions. Indeed, one community's sacrifice of tax revenue simply adds feathers to the goose for others to pluck. That problem is not insoluble, either, so long as the electric system is in one state. State assessment of rails and utilities and state equalization are established methods of restraining localities from competitive overtaxation of these networks.

With interstate systems the problem is most difficult. How are we to prevent, let us say, West Virginia from capturing the benefits of New York's untaxed electric power, if the generation is in West Virginia? One possibility would be strict interpretation of the commerce clause, with the Federal Power Commission in effect acting as a national board of equalization to prevent West Virginia jurisdictions from taxing power exported to New York. In view of the lenient attitude often displayed by the Supreme Court toward de facto taxation of interstate commerce, wrapped only in specious rationalizations, this approach may not be very promising. Another approach is through expansion, or threatened expansion, of federal power generation and distribution at very low rates. To meet the competition, states would have to rescind taxes on private power plants.

None of that will be easy, but the potential gains warrant the consideration of drastic measures. Unless we can break through the tangle of interests vested in current tax practices we can never realize but a fraction of the latent contribution of Edison's inventions to human welfare.

• *URBAN SPRAWL: DILUTION IS NO SOLUTION*

There has long been an instinctual presumption that air pollution was a problem brought on by the pressure of excessive use on a small air mass, and was to be alleviated by dispersing the population over a wider area and diluting a given volume of pollutants with more air. The experience of Los Angeles, however, is calling into serious question the old saw that dilution is the solution to pollution. Granting that Los Angeles labors under unusual natural disadvantages, it is still striking that the worst air pollution problem in any major American city should be suffered at the lowest density of population.

More generally, evidence does not correlate air pollution with high density. Why? First, the contribution of urban open spaces to natural air recovery is negligible, roughly comparable to their contribution to city water supply. Basically, big cities must import both air and water from the wide open spaces.

Second, dilution is only a good principle provided that the city is in the early stages of pollution, when the average effect of pollutants increases with each increase in the total amount of pollution. In this stage, reduced intensity serves to reduce the average effectiveness per dose of pollution. But in some cities pollution is heavy enough that a small reduction of intensity would have little effect in reducing the damage. Thus, the average effectiveness of pollutants is actually increased by

giving them more air per measure of pollutant, with no corresponding gain from reduced intensity.

Third, when we add air to a city by dispersing settlement, more air must be moved to change the city's supply, and that takes more time. If wind velocity is five miles per hour, an upwind emission needs four hours to traverse a twenty mile belt of urban sprawl, as opposed to two hours at twice the population density over a ten mile belt. In addition, in the wider belt there is a higher probability of irregular wind direction to slow the exhaust of pollutants, and a higher probability of photochemical reaction among pollutants from many independent sources.

If we regard the city as a "target" which emissions should miss, the larger city is harder to avoid. Emissions dispersing inside a given angle will cover a much longer are in twenty miles than in ten (the area polluted increases with the square of the distance from the source). Besides, air turbulence increases the angle of dispersion as pollutants travel farther. Therefore, air refuse areas must be located further from a larger city than from a smaller city, to achieve the same degree of segregation. Hie same factor decreases the effectiveness of vertical segregation in the larger city. The farther smoke must travel between the stack and open country, the more of it reaches inhabited levels.

Physical separation increases the per capita number and reduces the scale of combustion facilities. Central heating, for example, gives way to smaller furnaces, and results in a loss in combustion efficiency. The larger facility can afford better proportioning of inputs, professional operations, taller stacks, and better controls. The larger facility is easier to monitor and police. The number of jurisdictions whose policies must be coordinated increases with the spread into outlying communities.

Dispersal of settlement is bought at the price of added transportation. It reduces walking and has thrown electric power almost completely out of transit. In some cities, transportation has become the primary source of emission either directly from automobile exhaust or from the oil refineries for which it creates the market and need. Increasing city area also adds to the transportation cost of zoning polluters. It becomes farther from the city center to the air refuse zones, and yet farther from the opposite extremity of the city. After some point this situation necessitates the creation of new air refuse zones. In a similar fashion, available dump sites for sanitary landfill disposal of trash recede so far into the back country that truck removal of such wastes becomes an increasingly costly alternative to incineration. Milwaukee, for example, is on the verge of a major shift to greater incineration. This situation is being forced by a shortage of dump sites within thirty miles of the city.

In general, then, the policy of dilution through urban sprawl must be judged a failure —some would say a catastrophe—at least in the extremes to which it has gone. Air conservation is better served by containment of urban sprawl.

• *THE EQUIPMENT ESSENTIAL: FAST REPLACEMENT*

It is important that public policy supply motivation to replace equipment in good time, since most combustion engines lose efficiency with age, and are superseded by more efficient engines. It is especially important in connection with the imposition of new controls over pollution, because it will be difficult to withstand the inevitable pressure to exempt ancient and honorable polluters from the controls (under the prescriptive or grandfather clause principle) and the new controls will only take effect as the old and exempted equipment gives way to new. For effective air pollution control, the inevitable pressures to recognize prescriptive rights to pollute air based on historical priority should be resisted as much as possible. If established firms and plants may pollute air, while new ones may not, the latter are burdened with a serious competitive disadvantage commensurate with the costs of pollution abatement. In that case, the very existence of pollution control law's acts perversely to discourage abatement because the cost differential will retard replacement. The prescriptive right to pollute the air becomes a valuable private asset, to be nurtured and exploited as long as possible.

It is also worth noting that the anticipation that prescriptive rights will be recognized creates a motive in advance of control to establish and maintain a "history" of air pollution, since history is the basis on which prescriptive rights are to be granted. That has quite clearly been the effect of the prescriptive rights principle applied to water use in the seventeen western states, for example.
Aside from resisting prescriptive rights, public policy can serve air conservation by revising the present relationship between taxes and age of buildings, machines, and equipment. Motor vehicle taxes, for example, generally decline with the age of the vehicle. They are on the whole too low to have much effect either way, but to the extent that they do, they tend to retard replacement. Yet it is clearly the old "oil burners," with their plumes of blue smoke, that contribute more than their share to pollution. Motor vehicle taxes should at least remain fixed with age, and preferably rise, thus forcing old cars off the roads sooner than now. Of course, some old cars burn fuel more completely than some new cars, but we have ruled out the possibility of full metering of exhausts and other emissions. Statistically, the age of automobiles is evidently highly correlated with poor carburetion.

In respect to real estate, under present practice assessments are progressively lowered as buildings age and obsolesce and become more offensive to their neighbors, and assessments are raised when the nuisance is abated by demolition and renewal. Thus the tax on buildings serves to retard replacement of the stock of buildings.

The same holds for all their component parts, including heating plants. And in this case, the tax rate is high enough to have a material impact.

With buildings it is not necessary to propose letting assessments increase with age, since buildings, unlike vehicles, rest on sites to which the taxes may be shifted, and which tend to rise in unit value over time. Without abandoning the ad valorem principle, it is possible to accelerate building replacement by exempting buildings

from the real estate tax. The benefit of tax exemption is capitalized into site value, so that the same tax levy may be collected from the average parcel as before. But the tax would not fall as buildings and heating plants deteriorate, nor would it rise when they are replaced. The tax system would accelerate replacement, or at least stop retarding it, and hasten the day when pollution abatement laws which are enacted actually take effect.

• *ADEQUATE POLICY WITH INADEQUATE KNOWLEDGE*

Much more technical information is needed, and the quest warrants public support. Not only is more information needed, but more information is needed concerning what information is needed most. Shotgun support for research is not enough. Interaction is needed between research in social policy and in technology. “Get the facts” is a misleading and artless slogan. Research needs to make sense of known facts, and direct the search for a few key facts needed to guide policy and to serve it.

Meantime our ignorance need not inactivate us. If policy had to wait on perfect knowledge it would wait forever. Rather, policy may be kept flexible to accommodate advances in knowledge and changes in a continuing stream of conditions. Much of the anxiety expressed by representatives of polluting industries centers on the fear that regulation would harden in terms of current concepts, some of them fundamentalistic, and obsolesce rapidly.

One means of building flexibility into law is to couch it in terms of results or performance rather than specific assumed causes. For an analogy: local building codes have become especially obsolete, and reform consists of substituting functional or performance standards for older specific standards. The main obstacle is the vested interest in older materials and crafts. Moral: forswear any policy that contemplates permanent commitment to any specific material, method, gadget, skill, or professional organization. Armed with such flexibility, lawgivers need not be put off by the argument that next year wc will know more, an argument that will be equally paralyzing next year. We know enough now to do more good than harm. If wc also know enough not to impose the incidental details of our present thinking on our more knowledgeable descendants, we can, in good conscience, take effective measures immediately.