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Policy Watch
Economics and the Clean Air Act

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Public policies are often made without much recourse to economic reasoning. Economists are often unaware of what is happening in the world of public affairs. As a result, both the quality of public decision-making and the role that economists play in it are less than optimal. "Policy Watch" will publish short articles on topics that are currently on the agendas of policy makers and provide nonspecialists with a better understanding of the role of economic analysis in illuminating current debates. Suggestions for future columns and comments on past ones should be sent to Isabel V. Sawhill, c/o *Journal of Economic Perspectives*, The Urban Institute, 2100 M Street N.W., Washington, D.C. 20037.

Introduction

The Clean Air Act, arguably the nation's most important environmental statute, is sure to be amended by the 101st Congress. In neither its current nor its likely new form does the Act feature much of a role for economic considerations. In fact, one approach that many economists would presumably favor—the balancing of benefits and costs in setting air quality or source discharge standards—has been found by courts to be inconsistent with the law (*Lead Industries Association v. EPA*, 1980). Here I describe the likely changes in the Clean Air Act and what is known (and, more often, not known) about their associated costs and benefits, and identify respects in which air quality regulation could be improved from an economic perspective.

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The Changing Face of Air Pollution Control

About $90 billion is spent each year in the United States to comply with federal environmental regulations (Environmental Protection Agency, 1990b). Of this amount, approximately $30 billion is required by the Clean Air Act, about $30 billion by the Clean Water Act, and the remaining $30 billion by a variety of statutes concerned with solid and hazardous wastes; pesticides, herbicides, and fungicides; drinking water contaminants; and the manufacture and use of potentially toxic chemicals. As explained in more detail below, the Clean Air Act amendments may—when fully implemented in ten to fifteen years—add more than $30 billion (in current dollars) to annual compliance expenditures.[1] Thus, they will more than double current annual spending for air pollution control in the United States, and produce important benefits, as well.

The proposed changes have three major components. First, to curb "acid rain," electric utilities will be forced to reduce their cumulative annual emissions of sulfur dioxide (SO_2) by 10 million tons per year from 1980 levels, after which emissions will be capped at the new, lower level. This is to be accomplished in two phases, the first to be completed by the mid-1990s, the second by the year 2000. They must also reduce nitrogen oxide emissions by about 2 million tons annually.

Second, in response to slow progress in conquering smog and other urban air quality problems, a variety of additional control measures will be required of factories and other so-called stationary sources, and tighter emissions standards will be established for cars, trucks, and buses. Third, all major sources of what are called hazardous air pollutants—those substances capable of causing cancer or other illnesses—will be required to install new pollution control equipment to be specified by the Environmental Protection Agency, and may have to take further control measures in the future.

I turn now to the costs and benefits associated with these three provisions.

Acid Deposition

We have a better understanding of the expenditures required to control SO_2 emissions at coal-fired electric power plants than for any other source of air pollution. There exists a fairly accurate inventory of pollutant emissions from each of these plants, as well as a variety of models designed to predict

[1]As shown by Kopp and Hazilla (1990), environmental compliance expenditures are not identical to the social costs of pollution control. Ideally, the latter should be measured by the aggregate compensation required to "make whole" all individuals suffering utility losses as a result of environmental regulation (from job losses, higher prices, reductions in product quality and so on). The two measures will be equal only under conditions unlikely to obtain in reality. Nevertheless, there is a close connection between them, and compliance expenditures are often compared to benefits for seat-of-the-pants program evaluation; this is the approach taken here.

pollution control expenditures as a function of the type and level of control required (Starobin, 1990). According to these models, affected utility sources will have to spend about $4 billion annually to comply with the acid rain provisions of the clean air amendments once the whole program is in place.

This total would have been much greater, for the same emissions reduction, had President Bush and congressional leaders not embraced an approach to pollution control long championed by economists. Namely, affected power plants will be allowed to meet their emissions reductions using any approach they choose, including purchasing "excess" emissions reductions from other sources willing to cut back by more than required in the legislation. Unless state governors or public utility commissions restrict this trading, which they will have the legal authority to do, the 10 million ton per year reduction will take place at those sources which can control SO_2 emissions most inexpensively. Had Congress instead required the adoption of flue-gas desulfurization equipment at existing plants, as it did in the 1977 amendments affecting all future power plants, the acid rain provisions would have cost $2–3 billion more annually.[2]

The benefits of SO_2 control are much harder to pin down. The legislation was originally motivated by a concern that acid rain was rendering many lakes in New England and elsewhere incapable of supporting aquatic life, was threatening forest and agricultural productivity, and was damaging statuary and other exposed materials. To assess the seriousness of these problems, in 1980 the federal government launched the National Acid Precipitation Assessment Program (or NAPAP), a ten-year, $500 million research effort.

The NAPAP program has produced some unexpected conclusions (NAPAP, 1990). First, surveys show that the percentage of lakes that are acidified is less than first feared, about 14 percent in the Adirondacks, 23 percent in Florida, and less than 5 percent in other regions. Moreover, it is unclear the extent to which these problems are due to power plant emissions. Second, research suggests that acid rain is having virtually no effect on agricultural output, and that its effects on forests are limited to mountaintops in the northeastern United States. Finally, the NAPAP report concludes that while acid rain is responsible for some damage to exposed materials, reliable estimates of nationwide damages are not yet available.

Controlling power plant emissions is also expected to reduce airborne concentrations of sulfate particles by about 40 percent in the eastern U.S. Experts believe these particles are among the more harmful air pollutants from the standpoint of human health (Lippman, 1989). SO_2 control may reduce sulfate-related morbidity and possibly even premature mortality, although

[2]As Ackerman and Hassler (1981) point out, Congress took this forced-technology approach in 1977 to protect the jobs of high sulfur coal miners. The new amendments may contain a provision to assist coal miners and other workers who lose their jobs as a result of new air pollution controls.

there is little consensus about the magnitude of such effects.[3] Also, sulfate particles are a cause of poor visibility, and several studies have reported large aesthetic benefits to visibility improvement (Tolley and Fabian, 1988). Taking all these factors into account, I hazard the guess that the benefits from SO_2 control will be $2–9 billion annually.

Urban Air Pollution

Although it receives little attention, air quality has improved significantly in most U.S. cities over the last two decades. For example, airborne concentrations of lead and particulate matter, two of the more harmful pollutants, have fallen by 95 percent and 38 percent, respectively (Environmental Protection Agency, 1990a). Nevertheless, air quality in many metropolitan areas still falls short of the health-based standards set by EPA. To speed up progress, Congress is enacting a number of additional measures aimed mostly at the volatile organic compounds (VOCs) that help create smog. These measures include possible additional controls on petroleum refineries, chemical plants, and other large industrial facilities, and for the first time controls on many dry-cleaning establishments, auto paint shops, bakeries, and other so-called "area sources" of VOCs. In addition, the clean air amendments will mandate a new round of emissions reductions for all cars and light-duty trucks and require enhanced vehicle inspection and maintenance programs, as well as the installation of vapor recovery equipment on gasoline pumps, in moderately "dirty" metropolitan areas. In the most polluted areas, the amendments will additionally require plans to limit vehicle use, probably impose a second round of reductions in tailpipe emissions from cars, and implement a "clean fuels" program (which requires the use of reformulated gasoline, methanol, or ethanol).

No one has yet carefully estimated the annual compliance expenditures associated with these proposals. However, the Office of Technology Assessment (1989) recently surveyed a number of available measures to reduce urban smog. The options OTA examined are very similar to those likely to be adopted under the new clean air proposals and thus provide valuable information about possible new compliance expenditures.

According to OTA, the control measures examined would cost the nation $9–12 billion annually when fully implemented by 2004. However, OTA did not include several measures contained in the proposed clean air amendments, like the second round of motor vehicle emissions controls sure to be required

[3]As Lipfert, Morris and Wyzga (1989) point out, some epidemiological studies have found statistically significant links between ambient sulfate concentrations and premature mortality; however, these findings are often quite sensitive to model specification, thus calling into question the size (or even the existence) of this effect. In its 1984 review of the potential benefits of controlling sulfates and other particles, the Office of Technology Assessment concluded, "... this pollutant mix [small particles including sulfate] could be responsible for about 50,000 premature deaths per year..."

for model year 2004. The costs of this add-on is quite uncertain, with estimates ranging from $100–600 per vehicle. Splitting the difference, this will add about $5 billion to the annual cost of the urban air quality measures. Nor did OTA consider an alternate fuels provision of the sort Congress seems sure to pass. This will add another $3 billion or so to annual compliance expenditures. Finally, under the new legislation, costs will be incurred for the control of other air pollutants besides VOCs that OTA did not consider: notably, fine particulates and carbon monoxide. These controls, too, will add to annual pollution control expenditures. All things considered, these urban air quality provisions seem likely to add $19–22 billion annually to air pollution control costs by the year 2005.

As part of its 1989 study, the OTA also commissioned an analysis of the economic benefits that would accompany the control measures it examined (Krupnick and Kopp, 1989). By design, this analysis looked only at acute health effects and the deleterious effect of ozone on agricultural output. To estimate health benefits, the most defensible clinical and epidemiological studies were used to make predictions of the reduced incidence of asthma attacks, chest pain, and other adverse health effects that would accompany reduced ozone concentrations. These effects were then monetized using the results of surveys eliciting individuals' willingness to pay for reduced likelihood of specific symptoms and illnesses, resulting in annual health benefits ranging from $0.5 to $4.0 billion. Agricultural benefits were estimated in a somewhat analogous fashion: assumptions about reduced ozone concentrations were used to make predictions about increases in output for specific field crops; yield increases were then valued using market prices for each crop, resulting in agricultural benefits of $1 billion annually.

Of course, other benefits are also possible. Because there is no convincing epidemiological evidence linking prolonged exposures to ozone to chronic respiratory disease, no benefits of this sort were included. If such a link is demonstrated, benefits might be substantially larger. Nor did the OTA benefit study include possible reductions in damage to forests or materials; this imparts a downward bias to the estimate. Also, reduced VOC emissions may improve visibility; this effect was also ignored in the benefit estimate. Controlling VOCs from mobile sources will reduce ambient concentrations of benzene, butadiene, and other carcinogens, so that some reduction in cancer may result. Finally, the cost estimate above ($19–22 billion per annum) includes added controls on particulate matter. These will produce benefits not included in the OTA study. Taking all these things into account, the benefits associated with the urban air quality provisions should fall in the range of $4–12 billion per year.

Hazardous Air Pollutants

By far the least well understood part of the impending changes in air quality regulation pertains to added controls on sources of hazardous air pollutants. In response to the slow pace of regulation to date (only seven substances have been regulated in 20 years), Congress will require the adoption of the "maximum available control technology" (or MACT) for all major sources of about 190 chemicals and compounds. The controls required for a particular kind of plant are to be identical regardless of its location or the size of the affected local population. A second round of controls aimed at residual risk—that remaining after the adoption of MACT—may also be required, as well.

Little is known about the compliance cost associated with this set of provisions because it will depend on the control technologies that EPA specifies as the maximum achievable. The Bush administration estimated that these technological requirements would cost about $3 billion annually, but this was for only a subset of all the sources now likely to be regulated. More pessimistic analyses conducted for industry groups put the costs of the MACT and residual risk provisions in the range of $14–62 billion per year (Denny Associates, 1990). An educated guess here—and it is no more than that—is that when fully implemented, spending for technological controls on hazardous air pollutants will fall in the range of $6–10 billion per year.

What will these controls buy? According to EPA (1989) the 100 or so most prominent hazardous air pollutants may be responsible for as many as 1,700–2,700 additional cancer cases per year. Of these, only 20 percent were associated with the large stationary sources installing controls. Coupled with the fact that EPA's risk assessment methodology is designed to overestimate risk far more often than it underestimates it, 500 cases is probably a generous estimate of the reduced cancer risk associated with the emissions controls.[4]

Recent hedonic wage studies yield an implicit value of a "statistical life" of about $3 million (Fisher, Chestnut and Violette, 1989). If the regulations actually prevent 500 cancers, and if all would result in death, benefits would amount to $1.5 billion annually. In addition, some non-cancer health benefits may accompany the controls, although these are even more difficult to quantify.[5]

On the other hand, the average age of the individuals on whom the hedonic studies are based is about 40 years, and the mortality risks posed by the occupations in which they work are generally immediate. Thus, on average, 35 life years would be lost due to premature mortality among these individuals, and this clearly affects the risk premia they require. However, the average number of life years lost due to pulmonary disease (such as lung cancer) is about 12. This suggests that $1.5 billion might overestimate the true health benefits of hazardous air pollution control. Taking all these factors into account, I put the benefits of controlling hazardous air pollutants at $0–4 billion

[4]Using a different approach to estimate reduced cancer incidence, Graham and Gray (1990) arrive at a similar figure.

[5]One might argue that prevention of cancer deaths should be valued more highly than deaths due to other causes because of the lengthy morbidity that often precedes it, and because the risks are involuntarily borne.

annually (the lower bound is zero because it is possible that no cancers will be prevented by the legislation).

Summary and Recommendations

By the year 2005 or so, the U.S. may be spending $29–36 billion more each year on air pollution control than it is today. Annual benefits of the proposed changes probably range from $6–25 billion ($2–9 billion for acid rain, $4–12 billion for urban air quality, and $0–4 billion for hazardous air pollutants). I would speculate that the most likely value is about $14 billion or so ($5 billion for acid rain, $8 billion for urban air quality and no more than $1 billion for air toxics). A similar estimate comes from Blodgett (1990), who recently reviewed air pollution benefit studies and concluded that "attaining the goals of the [amended] Clean Air Act would yield benefits valued at $16 billion dollars per year, or more."

If these estimates are even close to correct, Congress and the President are about to shake hands on a landmark piece of environmental law for which costs may exceed benefits by a considerable margin. Why is this so?

To repeat, the costs of the proposed new air quality controls have been little analyzed and even the preliminary results have not been accessible to the public. If it were more widely appreciated that, when fully implemented, the clean air amendments may cost each U.S. household $300–400 per year, perhaps opposition would be sharper. In addition, the likely benefits of the program may be misperceived. For example, the public may feel that cancer will be materially affected by the impending regulations, even though the analysis above suggests otherwise.

A more positive explanation is possible, of course. Many proponents believe that regulation-induced innovation will cause pollution control costs to fall over time. Also, some argue that individuals attach higher values to reduced health and ecological risks than those used above; if so, benefits could exceed my estimates. While I believe the former set of explanations is more likely than the latter, one certainly cannot rule out a more favorable benefit-cost ratio than that projected here.

Putting aside this question for the moment, consider the means by which our air quality goals are pursued. The cost-effectiveness of the clean air legislation could be improved substantially.

First, the marketable permit approach embodied in the acid rain portion of the legislation should be extended to the urban air quality and hazardous air pollution portions of the law. Study after study has shown great disparities in control costs between air pollution sources (Tietenberg, 1985). While there exists some flexibility in the proposed amendments, sources of VOCs should be given the full range of opportunities for cost-effective pollution control, as are sources of SO_2. The potential cost savings are difficult to predict but they may be in the billions annually.

Second, in several respects the clean air legislation described above takes a broad national approach even though serious urban air quality problems are limited to a dozen or so cities, and even though only a relatively small number of sources of hazardous air pollutants pose unacceptably high risks to nearby populations. By targeting control efforts more effectively, we could probably capture most of the benefits of the broader, scattergun approach at a fraction of the costs (Nichols, 1984). Analyzing this possibility would be worth the time and effort required.

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References

Ackerman, Bruce, and William Hassler, *Clean Coal/Dirty Air*. New Haven: Yale University Press, 1981.

Blodgett, John, "Potential Benefits of Enacting Clean Air Act Amendments," Congressional Research Service Report for Congress, Feb. 5, 1990, p. i.

Denny Technical Services, "Clean Air Legislation Cost Evaluation," prepared for The Business Roundtable, January 8, 1990.

Environmental Protection Agency, (Office of Air Quality Planning and Standards), "Cancer Risk from Outdoor Exposure to Air Toxics," External Review Draft, September 1989.

Environmental Protection Agency, *National Air Quality and Emissions Trends Report*, Report no. EPA-450/4-90-002, March 1990a.

Environmental Protection Agency, *Environmental Investments: The Cost of a Clean Environment*. Draft Report of the Administrator of the EPA to the Congress of the United States, May 1, 1990b pp. 8–14.

Fisher, Ann, Lauraine Chestnut, and Daniel Violette, "The Value of Reducing Risks to Death: A Note on New Evidence," *Journal of Policy Analysis and Management* 1989, *8*, 88–100.

Graham, John, and George Gray, "Preliminary Analysis of EPA Report, 'Cancer Risk from Outdoor Exposure to Air Toxics,'" Harvard School of Public Health memorandum, March 1990.

▶**Kopp, Raymond, and Michael Hazilla,** "Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis," *Journal of Political Economy*, 1990, *98*, 853–873.

Krupnick, Alan, and Raymond Kopp, "Technical Appendix," in Office of Technology Assessment, 1989.

Lead Industries Assn., Inc., v. EPA, 647 F. 2d 1130, 10 ELR 20643, DC. Cir. 1980.

▶**Lipfert, Frederick, Samuel Morris, and Ronald Wyzga,** "Acid Aerosols: The Next Criteria Air Pollutant?" *Environmental Science and Technology*, 1989, *23*, 1316–22.

Lippman, Morton, "Health Benefits from Controlling Exposure to Criteria Air Pollutants." In Blodgett, John, ed., *Health Benefits of Air Pollution Control: A Discussion*, Congressional Research Service Report to Congress, Feb. 27, 1989, pp. 75–143.

National Acid Precipitation Assessment Program, *1989 Report to the President and Congress*, 1990. (Available from the Council on Environmental Quality.)

Nichols, Albert, *Targeting Economic Incentives for Environmental Protection*. Cambridge: MIT Press, 1984.

Office of Technology Assessment, *Acid Rain and Transported Air Pollutants: Implications for Public Policy*, Report no. OTA-0-204, 1984.

Office of Technology Assessment, *Catching Our Breath: Next Steps for Reducing Urban Ozone*, Document no. 052-003-01159-0. Washington: Government Printing Office, 1989.

Starobin, Paul, "Foggy Forecasts," *National Journal*, May 19, 1990, *22*, 1212–1215.

Tietenberg, Thomas, *Emissions Trading: An Exercise in Reforming Pollution Policy*. Washington: Resources for the Future, 1985, esp. pp. 70–74.

Tolley, George, and Robert Fabian, eds., *The Economic Value of Visibility*. Mt. Pleasant, MI: The Blackstone Co., 1988.

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