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Competitive Enterprise Institute
1001 Connecticut Avenue, N.W., Suite 1250
Washington, D.C. 20036
(202) 331-1010 ♦ Fax: (202) 331-0640 ♦ www.cei.org

Competitive Enterprise Institute Comments
OMB Draft Report to Congress on the Costs and Benefits of Federal Regulation
May 5, 2003

Introduction

By Fred L. Smith
President

The Office of Management and Budget's (OMB) draft report is disappointing at several levels: It fails to address the major challenge posed by the growth in regulations over the last several decades; it fails to challenge the misuse of analysis by the regulators themselves; and (perhaps most disturbingly) by viewing "market failures" as a necessary and sufficient condition for regulation, has stimulated a massive search for "imperfections" determined by comparing reality to a utopian "perfect competitive market." This latter point has led OMB's Office of Information and Regulatory Affairs (OIRA) to grant credibility to such foolish ideas as the precautionary principle and contingent valuation. OIRA can—and should—do much better. OIRA was created to ensure that regulatory interventions in the economy received the same scrutiny as expenditure decisions, not to provide intellectual legitimacy to whatever policies might be advanced by regulators. I recommend that OIRA rewrite its report to address the many problems contained therein.

Failing to Understand the Nature of the Regulatory Problem

OIRA seems to have little understanding of the nature of regulation and how it might be disciplined. By "discipline," it should be understood, we are not asserting that regulations are "good" or "bad," but rather that OIRA ensure that this question is addressed. To see how badly OIRA has missed this point, consider how its approach would fare if applied to OMB's major task of reviewing government spending.

Under this approach, an OMB Office of Information and Spending Affairs would request each agency to indicate the "costs" and "benefits" of their various expenditure programs. Smart agencies would soon report glowingly high benefit/cost (B/C) ratios. Imagine further that OMB were to argue that many of the expenditure programs were in areas where markets were lacking (defense and national parks) or weak (welfare and highway development) and that, therefore, in those areas, the agencies would be allowed to assert a whole array of non-use values (existence values, contingent valuation) to ensure a "balanced" B/C analysis. Would OMB be able to credibly argue against any spending decision?

In fact, of course, OMB deals with expenditures in a much more realistic manner. No effort is made to compare the "benefits" of a new carrier group vs. an innovative education program vs. a spruced-up national monument vs. the "Big Dig" highway project. Instead, each agency has been assigned a budget and the OMB fights vigorously to ensure that the agency does not exceed that budget. OMB will, of course, favor some programs over others (via the directives of the administration) and Congress will favor others. But OMB's policies—and strength—come from the widespread understanding that every agency will champion the largest possible expenditures on its programs and will provide convincing evidence on the value of those programs. OMB's job is not primarily to see that this process produces the maximum value to the American citizenry (that would require an ability to make tradeoff analyses beyond their and anyone else's ability) but rather to see that the "costs" of the program are kept within limits.

Regulatory agencies face far weaker restraints. Indeed, once the organic legislation empowering the regulatory agency is enacted, it faces few further checks. Before promulgating any specific regulation, it will, of course, have to jump through various procedural hoops, but there will be no effective check on the costs it can impose on the U.S. economy. OIRA now requires many agencies to demonstrate that the costs and benefits of each regulation have been calculated. Most regulatory agencies soon find out, however, how to employ creative accounting to ensure high B/C ratios. And when they find even this weak criteria difficult, they note that they deal with areas where markets are either weak or non-existent (in many cases because the regulatory agencies have preempted the emergence of private risk management arrangements) and advance various non-use values to justify their programs. Regulators have to be very stupid to actually be disciplined.

Consider the U.S. Environmental Protection Agency (EPA). In the one overview book on EPA written to my knowledge, *EPA: Asking the Wrong Questions*, the authors discuss EPA's strategy of posing as a public health agency to gain political support for their programs. Nothing surprising about this—those at the Department of Education or the Transportation Security Administration similarly pose as pro-education and pro-security agencies. The difference is that to do this, EPA has had to systematically frighten the American people. EPA routinely produces frightening "Stephen King" documents about the vast dangers that Americans face because of trace elements in the water or air, the possible dangers that biotechnology might pose to future generations, and, of course, the possible destruction of our planet arising from global warming. Indeed, OIRA has encouraged this development by "grading" agencies on their abilities to misuse analysis to support their case.

The expenditure debate swirls around the question of whether an agency's objectives (say, the Department of Defense, or DOD) would be better advanced by spending more in category A (say, a new air mobile division) than in Category B (say, a new battleship). An agency will, of course, fight for the highest possible budget, but it does so largely on political grounds, as would a regulatory agency in a similar situation). The difference, however, is that attention in the expenditure case focuses on the question of whether one believes the Defense budget is too high, too low, or just about right. DOD has most to say about how that money is to be allocated between the services or between technologies or between weapon systems and training—or, more often, between one congressional district and another.

In contrast, the regulatory debate focuses on the merits of each specific regulation. There is no budget cap because most regulatory costs are off-budget and therefore largely ignored. Moreover, the absence of any cap means that neither the regulatory agency nor OIRA have any reason to consider whether the agency's mission might not better be addressed by tightening some regulations and loosening or eliminating others. Agencies fight for all regulations individually without regard to their cumulative effect.

What Should OIRA Do?

OIRA should recognize that regulatory agencies now face no serious discipline, and that, even worse, no one within the agency sees regulation A competing with regulation B. Each regulation is seen as *sui generi*—standing on its own grounds, to be decided only on the grounds that it is, or is not, a "good" thing. The use of B/C analysis to disguise this inherently political decision is foolish. We're merely encouraged agencies to distort the facts, alarm the public, and posture in the media. The idea that OIRA can replicate the decisions *that would have been made had a market existed* is foolish. Markets without property rights—without exchange possibilities—are a Grand Illusion. The information does not exist to determine what might have happened. We should not encourage SONKing—the Scientification of Non-Knowledge—to obscure that fact.

OIRA should recast its review process, seeking to make regulatory review more akin to expenditure review. One approach would be for OIRA to develop better cost estimation procedures, to send to Congress for "advice and consent" all "major" regulations (say initially those costing the economy more than $100 million annually) and then gradually roll back this cap as the agency, OMB, and Congress became more familiar with the process. Within some phase-in period, each regulatory agency would face

hearings on the Hill arguing that its impact on the economy was justified by the "benefits" it produced. That process would work as well — and no better — than the current expenditure program. But, at least, Congress would be held responsible for this impact and there would be less "let's pretend" analysis by the agencies.

OIRA could now—with no further authority—announce its intentions to request the advice of Congress on major rules. It could also post a request for comment on these rules at the earliest possible period—for example, at the time when the agency announces its intention to launch the rule-making. OIRA should require each agency to detail its procedures for costing out its regulatory proposals, and solicit comments from those impacted by the rules. OIRA might also request Commerce, CEA or other agencies to review the costing procedures. OIRA should not passively accept agency estimates. Its mission is to advance the public interest—not the special interests involved in the formulation of each regulatory agency's proposals. An agency unable or unwilling to provide defensible cost estimates should find its regulations blocked. OIRA should then work with the appropriate congressional committees to ensure an informative hearing on the rule. Major rules are likely to have strong proponents and opponents. Thus, OIRA should start this review process with major rules and then move down as experience in regulatory review develops.

Conclusion

Efforts to control Leviathan have evolved slowly throughout our history. As the disciplining effects of controls in the tax and spending area have improved, there has been a natural tendency by regulators to select the least disciplined instrument of regulation. For that reason, regulations have become the preferred tool of special interests and those who believe the public interest is best advanced by expanding political interference in the economy. It is time to begin to subject regulations to the same type of controls to which expenditures have long been exposed. That does not mean that OIRA should presume to "know" what regulations are best, but, rather, that OIRA should ensure that the information provided on the costs of regulation (and benefits to the extent these continue to be requested) are reasonably honest and defensible. That goal is ambiguous enough—OIRA should reject all speculative arguments (the various gimmicks discussed in the latter part of the report) based on theoretical deviations from a "perfect market." OIRA should examine whether an agency has considered the possibility that existing regulations might have created the problems that the new regulation supposedly "solves" and instead call for reducing the scope and scale of government interference in the economy.

OIRA is an heroic effort to gain control over the regulatory state. It must continually refine its ability to achieve that goal. It should not become part of the problem. The current report would not advance that mission.

OMB's Assessment of Cost and Benefits of Regulation

By Angela Logomasini, Director of Risk and Environmental Policy

Congress passed the regulatory right to know law—mandating that the Office of Management and Budget produce a report on the cost and benefits of federal regulation—because consumers generally have little idea about the cost of regulations, which are essentially hidden taxes. OMB's responsibility is to help shed light on these costs and make them more understandable. That means it should evaluate agency cost and benefit estimates, review other independent cost estimates, and make adjustments to agency estimates to derive its own estimates. It should also critique agency estimates, highlight methodological problems, and promote a more consistent approach for agencies to apply in the future.

OMB has failed to make any such contributions, but has simply rehashed agency estimates, without any substantive analysis or any serious effort to qualify problems. As a result, some of its findings are misleading and are of little value to citizens.

In particular, the report finds that 52 to 72 percent of all benefits from the 107 major rules studied come from just four EPA Clean Air Act regulations, suggesting that less than 4 percent of regulations produce up to 72 percent of the benefits. Were this finding correct, OMB should probably propose scraping the 103 regulations that produce a net loss to society of $7 billion to $8 billion every year and engage in a massive governmental reorganization to model rules after the four EPA rules. Perhaps a major reorganization is necessary, since such a large portion of rules produce a net loss to society. But it is highly unlikely that the four EPA rules produce the benefits that EPA claims. OMB hasn't suggested any such reorganization because it must be aware that something is seriously wrong with the EPA calculations, yet it does little to address that issue.

It is not surprising that EPA's cost-benefit data is shamefully confusing and grossly misleading. Last year, CEI pointed out that EPA has always exhibited a tendency to vastly overestimate its benefits—which is a serious problem that OMB should be making a better attempt to address. We offered an example worth repeating here. Several years back, in an article in the journal *Risk Analysis*,[1] scientist Michael Gough demonstrated that the total number of cancers that EPA could possibly regulate is likely much smaller than the number of lives that EPA benefit calculations indicate that regulations save. Gough analyzed the data found in the landmark study by Sir Richard Doll and Richard Peto on the causes of cancer[2] along with EPA estimates of cancer risks estimated in EPA's report *Unfinished Business*.[3] Like Doll and Peto, Dr. Gough found that between 2 and 3 percent of all cancers could be associated with environmental pollution.

Accordingly, Gough reported that EPA action could only address a very small percentage of cancers:

> If the EPA risk assessment techniques are accurate, and all identified carcinogens amenable to EPA regulations were completely controlled, about 6,400 cancer deaths annually (about 1.3% of the current annual total of 435,000 cancer deaths) would be prevented. When cancer risks are estimated using a method like that employed by the Food and Drug Administration (FDA), the number of regulatable cancers is smaller, about 1,400 (about 0.25%).[4]

These findings raise serious doubts about a huge portion of EPA benefit estimates, which claim to reduce thousands of cancer deaths annually. For example, EPA claims that its disinfection rule saves more than 2,000 lives, which is a huge portion of lives EPA could theoretically save under EPA calculations, and it's more lives than EPA could theoretically save using more reasonable FDA calculations. Add all EPA calculations on expected cancer deaths prevented, and it is surely multitudes higher than what is reasonably predictable.

EPA has attempted to move its mission beyond cancer deaths prevented, claiming to prevent all sorts of deaths. EPA's clean air rule on particulate matter allegedly will save 15,000 lives a year, which would include non-cancer deaths, such as deaths caused by respiratory complications and asthma-related deaths. Serious questions about agency science underlying the particulate matter standard indicate that EPA's estimates go far beyond what is reasonable in these areas as well. CEI has produced several reports on the scientific failings of EPA's particulate matter standards, two of which are included along with these comments (Appendices A and B). These studies demonstrate numerous reasons why OMB should be far more skeptical of EPA estimates on the particulate matter rule.

Analysis and Management of Emerging Risks
By Gregory Conko

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[1] Michael Gough, "How Much Cancer Can EPA Regulate Away?" *Risk Analysis* 10, no. 1 (1990).
[2] Richard Doll and Richard Peto, "The Causes of Cancer: Quantitative Estimates of Avoidable Risks of Cancer in the United States Today," *Journal of the National Cancer Institute* 66, no. 6 (June 1981): 1257.
[3] U.S. Environmental Protection Agency, *Unfinished Business: A Comparative Assessment of Environmental Problems*, Overview Report, February 1987.
[4] Gough, "How Much Cancer Can EPA Regulate Away?"

Director of Food Safety Policy

In Chapter II of its 2003 Draft Report to Congress, the Office of Management and Budget (OMB_ specifically requests comments regarding the use by agencies of precautionary approaches to the regulation of potential hazards. There is broad disagreement regarding how regulatory agencies should approach policymaking when the likelihood or magnitude of risk posed by a product or activity cannot be calculated or estimated with great certainty. "Precaution," in this sense, is applied in cases such as the introduction of novel technologies, where little real world experience prevents either variable from being estimated with any confidence.

The once-generic term "precaution" has recently taken on greater and greater meaning in the regulatory arena, as advocates of a so-called "precautionary principle" seek to impose early preventive measures to ward off even those risks for which we have little or no basis on which to predict the future probability of harm. U.S. regulatory officials differentiate between this "precautionary principle" and the "precaution" that is built into risk analysis. Although there are some important distinctions between the two,[5] the latter approach is similar in that it incorporates highly conservative assumptions regarding risk specifically to err on the side of caution when hazard or exposure are uncertain.

Naturally, when new technologies are introduced, we often lack the experiential data necessary to make good estimates of probabilistic risk. So, when genuine and substantial uncertainty about a novel technology's risk remains, should regulators "err on the side of caution" by incorporating especially conservative assumptions into calculations of its safety? Superficially, prudence seems to suggest that they should. However, as the draft OMB report correctly notes, an "appropriate level of precaution in risk assessment and management is complicated by the need to balance efforts to mitigate these potential risks with countervailing risks that may arise from other sources."[6]

When new technologies are introduced, it is not just difficult to estimate their potential risks. It is also impossible to estimate the whole range of benefits new technologies will deliver—such as the potential to reduce risk vis-à-vis alternative technologies and the potential to increase societal wealth, which has its own positive health effects. All "precautionary" approaches fail to acknowledge that real harm can result from overly conservative assumptions just as easily as it can from overly optimistic assumptions. Thus, although much will be unknown about new products at the time they are commercialized, it can be unreasonable—indeed, even dangerous—to bias measurements of risk intentionally. Doing so leads inexorably to regulatory policies built on nothing more than speculation.

Uncertainty of some magnitude is an omnipresent phenomenon. Science can never prove the absence of a risk, and all activities pose some non-zero risk of adverse effects.[7] Taken literally, if "precaution" were to insist upon resolving uncertainty before a new product could be marketed or a new activity engaged in, that would mean no action could ever be taken because an assurance of absolute safety can never be given. This is an unachievable standard, and one that, for the reasons identified above, does not actually lead to greater safety. Thus, regulatory policy that truly hopes to improve overall well-being—rather than to reduce risk solely along a single isolated axis—must begin by using the most accurate assessment of risks and benefits as its underlying basis and must fully account for the opportunity costs of regulatory limitations.

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[5] See, for example, Gregory Conko, "Can the Precautionary Principle be Made Safe? Thoughts on Applying the Precautionary Principle for Risk Assessment and Management of Transgenic Plants," National Academy of Agricultural Sciences Workshop on Biosafety of Transgenic Rice, Chennai, India, October 29, 2002; and Henry I. Miller and Gregory Conko, "The Perils of Precaution," *Policy Review* (June/July 2001) pp. 25-39.
[6] Office of Management and Budget, "Draft 2003 Report to Congress on the Costs and Benefits of Federal Regulations," *Federal Register*, Vol. 68 (February 3, 2003), p. 5498.
[7] John Harris and Soren Holm, "Extending human lifespan and the precautionary paradox," *The Journal of Medicine and Philosophy* 27 (2002): 355-368.

Below, these comments will briefly address OMB's three specific areas of interest:

- Ways in which "precaution" is embedded in current risk assessment procedures;
- Examples of risk assessment and management methods that appear unbalanced; and
- How the U.S. balances precautionary approaches with other interests.

Few would dispute that potential risks should be taken into consideration before proceeding with any new activity, but the danger in precautionary thinking is that it distracts consumers and policymakers from other significant threats to human health that are or could be mitigated by the regulated product or activity. Too much effort focused on reducing the risk of one product, technology, or activity can blind regulators to the potentially greater risks of alternatives. Yet precautionary thinking often diverts limited public health resources from those other genuine and far greater risks.

Some of these precautionary measures flow directly from statutory obligations—and naturally, effective oversight by OMB will be limited. Other precautionary measures are strictly a function of regulatory judgments, over which OMB has considerably more oversight jurisdiction. It is also important that OMB not restrict its oversight to proposed rulemaking. Some of the most important abuses of precaution revolve around the use of regulatory discretion in making judgments on individual regulated articles. In all of these cases, however, risk analysis and management fail to consider properly the risks of alternatives—that is, the risk that can arise from the regulatory decision-making itself. The end result is public policy that traps society into more dangerous outcomes.

A good example is the EPA rule for pesticide tolerances under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Federal Food, Drugs and Cosmetics Act (FFDCA). When EPA regulators set the permissible level of exposure to these chemicals, for example, they set a safety factor of 10 to account for the difference between lab animals and humans, then add an additional safety factor of 10 to account for variation among human populations.[8] EPA also routinely over-estimates the amount of pesticide residues to which consumers are exposed.[9]

There is no scientifically justifiable basis for building such assumptions into the pesticide testing process. In fact, consumers are routinely exposed to endogenous chemicals of equal or greater toxicity and carcinogenicity in the foods they eat, and these are present at much greater levels than would be permitted under FIFRA/FFDCA if the chemicals were added by humans rather than Mother Nature.[10] Consequently, this 100-fold difference is thought to create a very wide margin of safety, exceeding that required to ensure consumer protection.[11] Nevertheless, the Food Quality Protection Act passed by Congress in 1996 requires EPA to add an additional safety factor of ten to account for the difference between adults and children.[12] But neither Congress, in drafting the statute, nor EPA, in drafting its various rules, nor agency personnel, in setting tolerance levels for individual regulated chemicals, ever fully considered the opportunity cost of limiting pesticide use. Such limitations would be substantial if measured in terms of the likelihood of reduced fresh fruit and vegetable consumption that would result from higher agricultural production costs.

Another example of agency regulation based on unrealistic and overly conservative assumptions is the Environmental Protection Agency's regulation limiting arsenic in drinking water to 10 parts per billion. That rule is based upon a combination of poor data and unrealistic assumptions, needlessly biasing the risk analysis result. Evidence supporting that rule came primarily from epidemiological studies of a Taiwanese

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[8] National Research Council, *Regulating Pesticides in Food* (Washington, D.C.: National Academy Press, 1987).
[9] Sandra O. Archibald and Carl S. Winter, "Pesticides in Our Food," in *Chemicals in the Human Food Chain* (New York: Van Nostrand Reinhold, 1990).
[10] Bruce N. Ames, Margie Profet and Lois Swirsky Gold, "Nature's chemicals and synthetic chemicals: Comparative toxicology," *Proceedings of the National Academy of Sciences* 87 (1990): 7782-7786.
[11] National Research Council, *Regulating Pesticides in Food*.
[12] Frank Cross, "Dangerous Compromises of the Food Quality Protection Act," *Washington Law Quarterly* 75, no. 1155 (1997): 1163-1166.

population that differed in many important respects from the U.S. population, and which was exposed to a level of arsenic in their drinking water that was an order of magnitude higher than already permitted under EPA's old rule. It is unreasonable to believe that any meaningful comparison can be drawn between the two populations. Nevertheless, this already conservative assumption was compounded by the addition of a no-threshold model that assumed a linear dose-response relationship, which is not consistent with other available evidence on the mode of action for arsenic-associated cancers.[13]

Perhaps the prime example of overly conservative agency decision-making is the U.S. Food and Drug Administration's approval process for new medical drugs, biologics, and devices. The agency spends an average of 18 months reviewing new product applications, with many reviews lasting several years — and this is ***after*** all required clinical testing is complete.[14] The downside risk of such agency caution in ensuring the safety and efficacy of new medical products is the fact that, in the absence of other effective treatments, real human patients stay sick longer, and some of them die. The more than three-year delay in approving misoprostol, a drug for the treatment of gastric bleeding, is estimated to have cost between 8,000 and 15,000 lives per year. The delay in approving streptokinase for the treatment of blocked coronary arteries is estimated to have cost as many as 11,000 lives per year.[15] Making matters worse is the fact that FDA reviewers have for the past two decades been requiring increasingly more clinical trials and more test subjects to support each new drug or new medical device application.[16] All of these added costs during the regulatory review process make the products that eventually are commercialized more expensive for end-use consumers.

Although U.S. regulatory officials like to claim that their "precautionary approach" is superior to the "precautionary principle," both are fundamentally flawed. Regardless of when, or in what context, such "safety" margins enter the risk analysis/risk management process, the entire concept of "precaution" clouds the fact that overly-restrictive policies could just as easily pose a risk to consumer or environmental health as they could create a benefit.

Thus, it is incumbent upon regulatory agencies to base policy decisions upon the best available evidence and to acknowledge that overly conservative assumptions can have a genuine human cost. The addition of arbitrary safety margins probably increases, not decreases, net risk. So, OMB should insist that regulatory agencies demonstrate a solid scientific basis to justify any assumptions regarding hazard or exposure that are built into agency risk analyses—especially those that appear to be overly conservative or overly permissive. There may, at certain times and in certain circumstances, be reason to be overly conservative in the management of risk. But agencies should not be permitted to bias outcomes by skewing the assessments upon which risk management decisions rest.

Several specific recommendations regarding OMB's review of agency risk analyses are included elsewhere in these comments. However, it is also important to note that the opportunity costs of overly conservative regulation do not just include the financial costs of compliance. Whether or not conservative safety margins ***are*** to be used in managing risks, OMB should insist that regulatory agencies take into consideration the potential for lost or forgone health and other consumer benefits that may result from overly conservative restrictions on the use of new technologies.

Of course, the human costs of regulatory policies are seldom easy to calculate. But trying to do so is among the most important goals of regulatory analysis. The cost of regulation is not merely financial, nor is the sole purpose of regulatory analysis to ensure that government and taxpayers get the most bang for

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[13] EPA Science Advisory Board, *Arsenic Proposed Drinking Water Regulation: A Science Advisory Board Review of Certain Elements of the Proposal*, EPA-SAB-DWC-01-001 (Washington, D.C.: U.S. Environmental Protection Agency, December 2000).
[14] Henry I. Miller, *To America's Health: A Proposal to Reform the Food and Drug Administration* (Stanford, Cal.: Hoover Institution Press, 2000).
[15] Sam Kazman, "Deadly Overcaution," *Journal of Regulation and Social Costs* 1, no. 1 (August 1990): 31-54.
[16] Henry I. Miller, *To America's Health: A Proposal to Reform the Food and Drug Administration*.

their regulatory bucks. Regulatory analysis is also useful because it can help determine whether a specific regulatory intervention actually improves well being on balance, or if it makes society worse off. Thus, it is imperative that the Office of Management and Budget — and the regulatory agencies themselves — ensure that "regulatory analysis" and "risk analysis" are performed properly and that overly precautious assumptions and estimates are not incorporated into regulatory standard-setting.

OMB's Regulatory Guidelines

By Angela Logomasini
Director of Risk and Environmental Policy

In General

OMB has embarked on an important mission with its efforts to improve the regulatory process. CEI has published several reports making recommendations on ways to improve the process. Included with these comments is Clyde Wayne Crews's paper *Jump, Jive an' Reform Regulation* (Appendix C), which offers some suggestions on this process. In that report, Crews noted:

> Effective regulatory reform must make regulatory costs as transparent as possible through such tools as improved annual cost and trend reporting, and enact institutional reforms that allow voters to hold Congress responsible for the regulatory state by ensuring a congressional vote on major agency rules before they are effective. … *Jump, Jive* makes the following proposals aimed at improving Congress's accountability and cost disclosure:
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> - Halt Regulation Without Representation: Require Congress to Approve Agency Regulations
> - Publish an Annual Regulatory Report Card
> - Require that Agencies Calculate Costs, but not Benefits
> - Lower "Major Rule" Thresholds
> - Create New Categories of Major Rules
> - Explore Regulatory Cost Budgets
> - Publish Data on Economic and Health/Safety Regulations Separately
> - Disclose Transfer, Administrative and Procedural Regulatory Costs
> - Explicitly Note Indirect Regulatory Costs
> - Agencies and the OMB Must: (1) Recommend Rules to Eliminate and (2) Rank Rules' Effectiveness
> - Create Benefit Yardsticks to Compare Agency Effectiveness
> - Reconsider Review and Sunsetting of New and Existing Regulations
> - Establish a Bipartisan Regulatory Reduction Commission to Survey Existing Rules

In addition, CEI has reviewed comments submitted by the Mercatus Center, at George Mason University, which we find have many useful suggestions and insights for OMB. We urge that OMB consider Mercatus's suggestions, many of which overlap with those offered by CEI in the attached study.

Data Quality Guidelines

OMB does not say much about the data quality guidelines that it recently established and are now being tested by various organizations. These guidelines can make an important contribution to regulatory accountability if implemented and enforced. OMB made an important first step with these, but it needs to continue its efforts by doing the following: 1) assess how they are working; 2) assess whether the guidelines could be improved based on the experiences of those groups attempting to use them; and, 3) define the process by which the guidelines are being used.

OMB should periodically assess and report on data quality petitions to government agencies, indicating the number of petitions and the agency responsiveness to answering requests, as well as on the effectiveness of the process. To meet this end, it might want to request that parties notify OMB when they file petitions and provide copies. That will enable the office to assess and track data quality developments.

This first step would assist in the second recommendation above: OMB's assessment of the effectiveness of the guidelines to meet the goal of ensuring that government data meet the law's mandate for "quality, objectivity, utility, and integrity." With these assessments, OMB should then work to revise standards to improve implementation.

The third recommendation above suggests that OMB address what appears to be a problem in the current data quality process. That is, there is no defined process for submitting petitions and receiving agency answers. Accordingly, each agency is making separate decisions on when such petitions can be issued and how to respond, if at all. For example, agencies are demanding that petitions related to information subject to public comment be filed as part of the comment. But sometimes it is important for petitions to be addressed before public comment so that the information learned can be useful in the process. Accessing the information after the agency has considered comments and is ready to make a decision, or after such decisions, can defeat the purpose of the data quality law.

In one case, CEI decided to seek data and a copy of the peer review on a study conducted by the Consumer Product Safety Commission (CPSC) on whether to proceed with a ban on playground equipment made with pressure treated-wood. CPSC would not release the data or peer review and would not accept data quality petitions on the subject except as part of the comment process. But this data should be available upon release of the report because the report has implications for the rulemaking. Interested parties should know what peer reviewers concluded when filing their comments, and they should be able to evaluate the data and attempt to reproduce findings before comments are due and decisions made. In addition, the study has immediate effects for the manufacturers of the product under consideration, who are involved in ongoing litigation.

In addition, OMB needs to set timelines during which agencies must respond to petitions. Otherwise, agencies can use delay to prevent a proper response or can simply refuse to respond. Again, both possibilities defeat the purpose of this law.

OMB's Comments on Why Regulatory Action is Needed

OMB needs to rethink its assertions about the reasons for regulation. The reason agencies regulate is largely related to legislative mandates. Agencies should seek to implement those mandates in the most reasonable and effective manner practicable.

OMB should not suggest that "market failure" is a key justification for regulation because this rationale has served largely as an excuse to justify nearly anything regulators and policy makers want. In an ideal world, policymakers should not act in areas where the market can address an issue. That means that the government need not act at all in the vast majority of human interactions. Instead, the government should act to ensure that the institutions necessary to make markets function, such as an enforceable rule of law, are working.

Unfortunately, the vast majority of regulations exist *to preempt markets*, not *because of* alleged market failure. They exist because policymakers and regulators do not like existing market outcomes and hence seek to impose a market outcome of their choice. These choices simply represent lawmakers' political preferences; the job of regulators is to implement those laws in the most reasonable fashion possible while meeting their obligations under the law. When the laws are unreasonable, it is the responsibility of executive branch officials at the agencies and at OMB to petition Congress for redress.

When regulators have discretion to decide whether to regulate, they should err on the side of allowing the maximum amount of market-driven solutions as possible and assume that market failure is rare if it exists at all. If there is a market failure, chances are that it is temporary and will be corrected as a market evolves. The government is likely to do more harm than good by acting because it has even less information and it cannot act quickly enough. In many cases of alleged market failure, government regulations have only come into effect after the issue resolved itself.

Many times, regulators assume that a market has failed if communities choose not to implement federal standards. But communities desire that option because federal laws are often unsuited to particular communities' needs. For example, the government requires monitoring for drinking water contaminants that are highly unlikely to appear in the water for many communities, even though such monitoring can be very costly. Another reason why communities may choose a different, less stringent standard is because they recognize that their limited financial resources are better devoted elsewhere, perhaps for purchasing fire trucks, building and maintaining schools, or tax relief. It is not market failure for communities and businesses to devote resources to activities that are more valuable to them.

OMB should not give much, if any, credence to the notion of market failure because it is simply an excuse for numerous unjust and needlessly coercive policies. There may be a few areas where markets don't serve particular needs. However, the problem is not market failure, but the failure to have markets. More often than not, markets don't serve certain needs because government intervention has preempted such markets. In that case, OIRA should encourage agencies to remove such obstacles whenever they are able under their authorities outlined in the statutes.

OMB also lends credibility to misguided arguments regarding so-called "natural monopolies." It even goes so far as to suggest that government should validate monopolies when "a market can be served at the lowest cost only when production is limited to a single producer." Under this rationale, the government should validate a national monopoly for shoe sales. It certainly would be cheaper if we only had one company to offer one design of shoe for everybody. A large operation could produce numerous shoes at a very low cost per pair, and it could ship shoes directly to homes—eliminating costs of designing shoes, transaction costs associated with marketing them, and the consumer costs associated with shopping. In fact, OMB's advice would justify government establishment of monopolies for nearly all economic activities.

We don't accept this approach because it is inconsistent with our freedom and the principles underlying our market economy. People enjoy the freedom to choose their shoes as well as other products. But there is an assumption that people don't need choices when buying water, electricity, telephone service, and certain other things because the final product is the same in all circumstances. This assumption is unfounded. There are different ways and terms under which companies can deliver electricity, phone, trash collection, and other basic services that are often run by government monopolies.

However, the natural monopoly argument goes a bit further than OMB's short definition. The theory suggests that some markets are simply more efficient with one service provider, which allegedly happens naturally, allowing the provider to charge monopoly rents. The fear of monopoly rents is the main reason employed to justify government-created and regulated monopolies. As result, regulators designate the monopolist, ban competition, and attempt to regulate profits.

But the mere fact that the government has to ban competition demonstrates why such "natural monopolies" are not natural. Government monopolies are actually designed to serve special interests to the disadvantage of consumers and potential competitors. Consider the silly laws governing U.S. mail. Why is it a federal crime for a boy scout to put a leaflet in your mailbox? The only advantage of this system is to the monopolist in this case, the U.S. Postal Service. The disadvantages are to nonprofits, small businesses, neighbors, and others who could beneficially deliver mail and notes into people's mailboxes.

Other government monopolies are as contrived as the postal monopoly. The reality is, one is hard pressed to find a single example of where a natural monopoly actually exists without having resulted from government coercion. As economist Vernon L. Smith notes, by definition, natural monopolies are supposed to occur spontaneously, yet governments must outlaw competition to maintain monopolies, which they then regulate.[17] Milton Friedman makes similar observations, noting: "In practice, monopolies frequently, if not generally, arise from government support or collusive agreements between individuals."[18]

Rather than creating monopolies and then imposing bureaucratic price regulation, it would make more sense to wait and see if a natural monopoly emerged and whether it caused any harm. Milton Friedman argues that if natural monopolies exist, it is probably best that governments leave them well enough alone. The other options—government-created monopolies or public regulations—yield far worse consequences. Given that society is not static and that conditions that may create a natural monopoly at one point in time may not persist, Friedman notes that it is not justifiable to make it illegal for anyone else to compete. The only way to discover whether a monopoly no longer serves the interests of consumers is to allow others to enter the market.[19]

In the past, government did leave well enough alone, competition existed, and the public was better off. According to Economics Nobel Laureate Vernon Smith, regulation of a particular industry was introduced "to protect the industry from competitive pricing that dominated its early history."[20] He explains:

> A study of the period 1900-20 shows that the first states to adopt regulation were those in which electric rates and profits were lowest and output highest. Furthermore, the effect of regulation during the early period was to increase prices and profits and to reduce output. These data support the hypothesis that regulation was a response to the utilities' desire to protect profits, not a consumer response to monopoly pricing. Indeed, monopoly pricing had not been a significant problem.[21]

It appears that the real reason we have monopolies today stems from government control; there is nothing "natural" about them. The utility industries that economists have labeled natural monopolies all experienced competition during their early years. UCLA business economist Harold Demsetz notes that, during their early development, intense competition existed in both electricity and telephone service.[22] While in the United States cities generally chartered individual firms to provide water exclusively to cities,[23] competitive water supply existed in other nations where the government did not intervene. For example, during the 1800s, several firms had constructed water supply lines in rural England, yet when government officials—not a natural market process—decided that such competition was wasteful, they selected a single firm to provide the service. Steve H. Hanke quotes Edwin Chadwick who commented on water supply competition at that time:

> From 1838 to 1841, whilst examining the sanitary conditions of town populations, I found urban districts in England where there are two or three sets of water pipes carried through streets which might be as well or better supplied under one establishment, [resulting in] bad and deficient suppliers at high charges to the public. ... These competitions are what I then designated as

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[17] Vernon L. Smith, "Regulatory Reform in the Electric Power Industry," *Regulation,* no. 1 (1996): 35.
[18] Milton Friedman, "The Role of Government in a Free Society," *Capitalism and Freedom*, (Chicago: University of Chicago Press, 1962).
[19] Ibid.
[20] Vernon L. Smith, 34.
[21] Ibid.
[22] Harold Demsetz, "Why Regulate Utilities," *Chicago Studies in Political Economy*, George Stigler (editor), (Chicago: The University of Chicago Press, 1988), 271-272.
[23] Michael J. LaNier,"Historical Development of Municipal Water Systems in the United States, 1976-1976," *Journal of the American Water Works Association* (April 1976): 173-180.

> 'competitions within the field of service.' As opposed to that form of competition, I proposed, as administrative principle, competition for the field.[24]

Hence, OMB should discard its suggestion that government should validate monopolies of any kind. It should add language calling on agencies to deregulate and privatize industries (and government services) to the maximum extent allowed under existing laws. Then OMB and agency heads should lobby Congress for increased deregulatory authority.

OMB also touches upon another issue, which should be a key focus on this administration. It suggests that regulations can create anti-competitive effects. The Federal Trade Commission has recognized this fact as a major problem and is working toward solutions.[25] Indeed, CEI comes across cases, on a regular basis, in which government regulations are used to eliminate competition. Very often, large industries can edge out small businesses by promoting expensive regulatory approaches that they can afford but smaller businesses cannot. In other cases, businesses will lobby for bans on certain products because they own patents on new alternatives.

The character of some laws actually promotes this activity. For example, the Federal Insecticide, Fungicide and Rodenticide Act mandates that pesticides be registered before sale to ensure safety. While this mandate is not anti-competitive, it is easily manipulated by industries to achieve that effect. For example, consider what a company that has a registered product might do if its patent on that product is about to run out. If it has an alternative product that is patented, it may petition EPA to cancel its registration and ban others from registering the product. (Often when cancellations come in, EPA announces that it will ban the product. EPA even attempts to take credit for bans on specious environmental grounds.). Then that company can market the alternative product without competitors. It is true that there may be other products registered for the same use, but that is not always the case.

Hence, agency officials should be given guidelines and encouraged to aggressively investigate, identify, and correct instances in which industries have manipulated, or are attempting to manipulate, the process for anti-competitive ends. In addition, OMB should scrutinize rules for anti-competitive impact and urge agencies to provide greater scrutiny and consideration of such impacts before finalizing a rule or risk failing regulatory review. OMB might also seek to form a partnership with the Federal Trade Commission to root out government-induced anti-competitive behavior.

Eliminating the anticompetitive impacts of government regulation should become a government-wide priority. Agencies should not be putting small businesses and entrepreneurs out of business. Unfortunately, it happens every day, as so-called “stakeholders” negotiate deals with agencies that put the less politically organized individuals and small firms out of business. In some cases, regulations are used to preempt parties from entering a market. This type of regulatory policy is clearly at odds with the principles of a free society.

Contingent Valuation

OMB’s section on contingent valuation (CV) is disturbing. OMB’s role should be to promote the best available, peer-reviewed science. But CV is better described as an unscientific and speculative tool that is easily manipulated. It should not serve as a basis for depriving the public of freedom or access to resources. In fact, an endorsement of CV by OMB essentially gives agencies leeway to develop surveys to boost benefit calculations when actual data is lacking. One might argue that it gives agencies an additional “fudge factor” with which they can justify just about anything.

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[24] Edwin Chadwick, Before the Statistical Society of London (1859), as quoted by Steve H. Hanke and Stephen J. Walters, “Privatizing Water Works,” *Prospects for Privatization*, Steve H. Hanke (editor), (New York: The Academy of Political Science, 1987).

[25] See http://www.ftc.gov/be/advofile.htm.

Values are best measured by individual actions in the marketplace. If there are cases in which markets are lacking, the government should find what impediments it may have created to preempt such markets. For example, CV is often used to estimate what price or value the public would place on the creation of a government park. However, private parks determine values based on individuals' willingness to pay recreation fees. Values for parks' wildlife preserves that are not based on actual visits (a person's satisfaction associated with simply knowing that the preserve exists) can be measured by voluntary donations to organizations that support and manage those lands. CV is not a good replacement for such markets.

CEI has produced two studies on the topic, both of which are included as attachments to these comments (Appendices D and E). The following provides some highlights of our findings and details why CV is not an appropriate regulatory tool.

In a study for CEI, Roger Bate explains why CV-generated values "are unreliable, both statistically and methodologically, and do not conform to any recognized economic theory." A key problem is that the method measures stated preferences rather than actual choices that have real impacts. Lacking consequences, such stated preferences are unlikely to give any relevance to actual decisions that people would make in the real world. Bate notes, for example, a person may indicate in CV questionnaires that he or she would give $100 each to eight different charities. The researcher would conclude support worth $800 in total, when the respondent may only actually be willing to give a total of $100. People state what they might do in theory, which is very often different from reality.

As Bate explains, actual choices in a marketplace cannot be replaced with CV studies because they don't represent true public choice:

> The fundamental difference here is between actual choice and potential preference. From the ethical and economic perspectives, there are significant reasons why choice is superior to mere preference in the allocation of resources. At most, preference constitutes a disposition to choose. Choice, on the other hand, requires action: it is the behavior itself. Economists recognize the superiority of using choice rather than preference because with the latter (or, in this case, a willingness to pay claim) "there is no cost to being wrong, and therefore no incentive to undertake the mental effort to be accurate."[26]
>
> The philosophical reason for preferring choice to preference in allocating resources is because it is considered to be ethically superior. Choice expresses consent, engagement and commitment. In making a choice one becomes accountable and responsible for it. Also, choice exercises liberty in an open society. By choosing incorrectly one may not satisfy one's preferences; however, at least one was free to make the choice. "To confuse preference and choice is to conflate acts of will with inferred states of mind."[27] Clearly, willingness to pay is a state of mind; it is not an action.

Bate identifies numerous methodological problems innate in CV studies, which include:

- **Unfamiliarity:** "Most individuals have no experience with purchasing environmental assets, it would seem unlikely that they will value the sites accurately … Individuals are, not surprisingly, ill-trained to evaluate the monetary value of environmental damage, much in the same way that it would be difficult for them to choose between competing designs of nuclear submarines."

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26. A. Myrick Freeman III, "Approaches to Measuring Public Goods Demands," *American Journal of Agricultural Economics* no. 61 (1979),: 157.

27. M. Sagoff, "Should Preferences Count?" p. 4. This paper was presented at *Resources For The Future* in 1992 and is available from its author at the University of Maryland, Institute for Philosophy and Public Policy.

- **Strategic Bias:** "CV answers do not report pre-existing preferences, only the numbers that emanate from respondents while constructing responses. The respondents know that their answers may be used in evaluating policy, and even in the pricing of cleanup costs or liability claims. Therefore, they may answer strategically. For example, if they believe that the government does not spend enough on wildlife protection, they may be inclined to state a figure vastly higher than they would actually be prepared to contribute, knowing they will not directly foot the bill."

- **Question Sequencing and Embedding the Problem:** Surveys can yield widely different responses when the question is asked alone or when respondents are asked to consider an issue in light of other issues. At question is which is more relevant. For example, in one survey, respondents stated that they would be willing to pay an average of $85 per household to clean oil spills in Alaska. But when asked how much they would spend when asked to consider alternative uses of those funds for education, crime and other issues, the willingness to pay for oil cleanup dropped to 29 cents per household. Such large ranges indicate the weakness of these studies to produce meaningful conclusions, and they indicate that studies can be easily manipulated to produced desired results.

- **Failure to Find Consistency in Testing:** "CV cannot be tested empirically,[28] and the CV panel acknowledges 'the impossibility of validating externally the results of CV studies.'[29] One therefore has to look to internal consistency tests to see if CV methodology is acceptable." Yet tests show little internal consistency.

These are just some of the failures of CV studies. It is worth noting that the researcher's bias as represented by question selection and formulation can be used to dramatically bias the results. Questions tend to focus on the public's willingness to pay for the benefits of some amenity or program. To be fair, shouldn't CV studies consider possible pitfalls of government policies? If CV is used for benefits, then why not for costs? For example, to play devil's advocate for a moment, perhaps CV studies should:

- Measure the public's angst about the federal government's 100-year long fire suppression policies, which led to about half of the Yellowstone National Forest burning to a crisp in 1988. These feelings could be used to calculate costs of federal land management and acquisition policies.

- Measure the anger people feel when they learn about homes that burned down when the federal government mismanaged prescribed burns in the national forests. These feelings could also be used to calculate costs of federal land management and acquisition policies.

- Attempt to measure the anger some people feel about the costs of government regulations on small businesses, which can be used before more costs are placed on these businesses.

- Calculate costs based on respondents' feelings about aggravation paperwork, which could be considered before any new paperwork mandates—ranging from EPA reporting laws to IRS mandates—are issued.

- Measure public disdain when the public learns that thousands of people die every year because of government corporate average fuel economy standards, which downsize cars and thereby reduce safety. People could reveal how much they would pay for the government to reverse this deadly policy.

Advocates of contingent valuation might suggest that this approach would not pass scientific standards, but it is no less scientific than the traditional CV questions. They just offer a different perspective and attempt to measure negative feelings about government actions. They, accordingly, are less likely to be used by

[28] From the work of Karl Popper and Imre Lakatos, if a theory is non-refutable it cannot be classed as scientific, only pseudo-scientific. The failure of CV to be testable reduces its applicability to valuation, as interesting but not verifiable and consequently unusable.
[29] Report of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) Panel on Contingent Valuation (Washington, D.C.: U.S. Department of Commerce, January 12, 1993), 6.

regulators whose main aim will be to boost benefit calculations. Clearly CV is not about science. It's about manipulating public sentiment to make claims that cannot be validated by marketplace transactions. It has no place in the regulatory process. OMB should be discouraging its use rather than validating it with alleged "standards."

Appendix A

Competitive Enterprise Institute Comments on the Draft Report to Congress on the Costs and Benefits of Federal Regulation
May 5, 2003

COMPETITIVE ENTERPRISE INSTITUTE

PARTICULATE AIR POLLUTION
WEIGHING THE RISKS

JOEL SCHWARTZ

ADJUNCT SCHOLAR
COMPETITIVE ENTERPRISE INSTITUTE

APRIL 2003

Executive Summary

America's air quality has vastly improved in recent decades due to progressive emission reductions from industrial facilities and motor vehicles. The country achieved this success despite substantial increases in population, automobile travel, and energy production. Air pollution will continue to decline, both because more recent vehicle models start out cleaner and stay cleaner as they age than earlier ones, and also because already-adopted standards for new vehicles and existing power plants and industrial facilities come into effect in the next few years.

Nonetheless, both the Bush Administration and congressional Democrats have proposed sweeping new measures to further crack down on power plant emissions. The Administration's Clear Skies Initiative and a more stringent Democratic alternative are largely justified by claims that current levels of particulate matter (PM) pose a serious public health threat. Supporters of these bills promise substantial benefits from additional PM reductions.

Nevertheless, the benefit claims for PM reductions rest on a weak foundation. EPA based its new annual fine PM ($PM_{2.5}$) standard on a study known as the American Cancer Society (ACS) study of PM and mortality, which assessed the association between the risk of death between 1982 and 1998 with $PM_{2.5}$ levels in dozens of American cities.

Although the ACS study reported an association between PM and mortality, some odd features of the ACS results suggest that PM is not the culprit. For example, according to the ACS results, PM increased mortality in men, but not women; in those with no more than a high school degree, but not those with at least some college education; in former-smokers, but not current- or never-smokers; and in those who said they were moderately active, but not those who said they were very active or sedentary.

These odd variations in the relationship between $PM_{2.5}$ and mortality seem biologically implausible. Even more surprising, the ACS study reported that higher $PM_{2.5}$ levels were *not* associated with an increased risk of mortality due to respiratory disease; a surprising finding, given that PM would be expected to exert its effects through the respiratory system.

EPA also ignored the results of another epidemiologic study that found no effect of $PM_{2.5}$ on mortality in a cohort of veterans with high blood pressure, even though this relatively unhealthy cohort should have been more susceptible to the effects of pollution than the general population. The evidence therefore suggests that the existing annual standard for $PM_{2.5}$ is unnecessarily stringent. Attaining the standard will be expensive, but is unlikely to improve public health.

EPA also promulgated a standard for daily $PM_{2.5}$ levels. Hardly any areas exceed this standard, making it moot for policy purposes. Nevertheless, the epidemiology of short-term PM exposure and mortality suffers from deficiencies that call into question the extent to which typical short-term increases in PM levels can increase mortality.

Sulfate PM—the type of PM caused by coal power plant emissions—is a particularly implausible culprit as a cause of increased mortality. Ammonium sulfate, the main form of sulfate PM, is used as an inactive control substance in human studies assessing the

health effects of inhaling acidic aerosols. Inhaled magnesium sulfate is used therapeutically to *reduce* airway constriction in asthmatics. Sulfate is also naturally present in bodily fluids at levels many times the amount that could be inhaled from air pollution.

The evidence suggests that exposure to PM at current levels likely has little or no effect on mortality in most of the United States. Regardless, processes already set in motion guarantee substantial PM reductions in coming years. Additional near-term reductions in PM are probably best achieved by dealing with the stock of high-polluting older vehicles that account for a substantial portion of ambient PM levels in metropolitan areas. This flexible, more cost-effective approach is far more likely to result in net public health benefits than other proposals that are the focus of current legislative and regulatory activity and debate.

Introduction

There is no question that high levels of air pollution can kill. About 4,000 Londoners died during the infamous five-day "London Fog" episode of December 1952, when soot and sulfur dioxide soared to levels tens of times greater than the highest levels experienced in developed countries today, and visibility dropped to less than 20 feet.[1] A number of other high-pollution episodes up through the 1970s exacted a similarly horrifying toll.[2]

Fortunately, the United States has been very successful in reducing air pollution. Due to a combination of technological advances and regulatory intervention, pollution levels have been declining for decades, despite large increases in population, energy use, and driving.

Nevertheless, many health researchers, regulators, and environmental activists are concerned that airborne particulate matter (PM), especially smaller particulates known as PM_{10} and $PM_{2.5}$,[3] might still be causing tens of thousands of premature deaths each year, even at the relatively low levels currently found in most areas of the United States.[4] Policymakers and environmental activists have recently focused special attention on the health effects of power-plant emissions, which are a significant contributor to $PM_{2.5}$ levels in parts of the eastern United States.

Bills introduced by Senator James Jeffords (I-VT) and the Bush Administration would require cuts in power plant emissions well beyond current requirements; advocates for both proposals claim they would save thousands of lives per year.[5] Environmental

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[1] I. M. Goklany, *Clearing the Air: The Real Story of the War on Air Pollution* (Washington, DC: Cato, 1999).

[2] Ibid.

[3] PM_{10} and $PM_{2.5}$ refer, respectively, to airborne particulates less than or equal to 10 or 2.5 micrometers in diameter.

[4] R. Wilson and J. Spengler, eds., *Particles in Our Air: Concentrations and Health Effects* (Cambridge, MA: Harvard University Press, 1996).

[5] Senator Jeffords's bill S.366 is known as the "Clean Power Act," while the Bush Administration's proposed "Clear Skies Initiative" is embodied in S.485 and H.R.999. The Jeffords bill would require substantial cuts in sulfur dioxide (SO_2), nitrogen oxides (NOx), mercury, and carbon dioxide by 2008 (see table below). The Clear Skies Initiative does not address carbon dioxide emissions, and cuts other emissions by slightly less than the Jeffords bill on a schedule extending out to 2018.

Comparison of Power Plant Emissions under the Jeffords and Bush Proposals*

Pollutant	Estimate for 2000	Clean Power Act	Clear Skies Initiative
SO_2	11.2	2.25	3.00
NOx	5.1	1.51	1.70
Mercury	48	5	15

* SO_2 and NOx emissions are in millions of tons per year. Mercury emissions are in tons per year. The Clean Power Act caps would take effect in 2008, while the Clear Skies Initiative caps would take effect in 2018. Clear Skies also includes intermediate caps for SO_2 and NOx of, respectively,

groups have published a series of reports claiming substantial harm to public health from power plant emissions.[6] These groups ardently oppose the Clear Skies Initiative as well as the Bush Administration's proposed reform of the Clean Air Act's New Source Review regulation, arguing that it would allow substantial increases in power plant emissions.[7]

PM health effects studies have reported both acute increases in death and disease due to daily variation in PM levels, as well as increases in death due to chronic exposure to elevated PM levels. The Environmental Protection Agency (EPA) promulgated annual-average and daily PM_{10} health standards in 1987. However, after reviewing recent PM health research, EPA in 1997 decided to also promulgate health standards for $PM_{2.5}$ specifically.

The annual-average $PM_{2.5}$ standard is controversial because it is among the most stringent ever promulgated by EPA, and will be difficult and expensive to attain in many areas that do not currently comply with it. EPA and environmental activists believe attaining the $PM_{2.5}$ standard will save as many as tens of thousands of lives per year and mitigate respiratory symptoms for hundreds of thousands of people.[8]

On the other hand, critics of EPA's interpretation of the PM health literature contend that the effects of low-level PM exposure are probably much smaller than advocates of $PM_{2.5}$ regulation have concluded. The effects of high-pollution episodes such as the London Fog were obvious, even without epidemiologic analysis, because both pollution levels and mortality soared by many times above typical levels. However, current PM levels at worst increase mortality and disease by a few percent above background rates. Such small relative changes can't be observed directly and must be teased out using the statistical analysis methods of epidemiology.

However, epidemiological analyses are susceptible to various methodological biases and errors that could cause misattribution of health effects to PM when they are caused by another pollutant or by factors unrelated to pollution, such as weather or diet. Some epidemiologists believe that epidemiologic methods are not even capable of accurately teasing out very small increases in health risks. Although epidemiologic studies have had mixed results on the link between particulates and health, the media and politicians have

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4.5 million and 2.1 million tons that take effect in 2008, and a 26-ton-per-year cap for mercury that would take effect in 2010.

[6] See, for example, Clean Air Task Force, "Power to Kill: Death and Disease from Power Plants Charged with Violating the Clean Air Act" (Boston: 2001); Public Interest Research Group, "Darkening Skies: Trends toward Increasing Power Plant Emissions" (Washington, DC: 2002); and Clean Air Task Force, "Death, Disease and Dirty Power: Mortality and Health Damage Due to Air Pollution from Power Plants" (Boston: 2000).

[7] See, for example, Public Interest Research Group, "Bush Policies would make Air Smoggier," July 1, 2002, www.commondreams.org/news2002/0701-05.htm. New Source Review is the regulatory regime for new and modified industrial sources of pollution.

[8] See, for example, Abt Associates, "The Particulate-Related Health Benefits of Reducing Power Plant Emissions" (Bethesda, Maryland: 2000); Clean Air Task Force, "Death, Disease and Dirty Power."

often failed to convey the nuances, uncertainties, and controversies surrounding the science of PM health effects.[9]

Critics of EPA's PM standards and the pending power plant-related bills also contend that the costs of meeting the annual $PM_{2.5}$ standard would exceed the value of the health benefits achieved, resulting in a net loss in the public's welfare.

Overview of this Report

This study assesses current PM health risks and identifies PM air pollution policies that are most likely to generate net public health benefits. To that end, it sets up the policy discussion with analyses of baseline air pollution levels and trends, the weight of the evidence on PM health effects at current ambient levels, and likely costs and benefits of attaining current air pollution standards. The final section draws on these discussions to recommend policies geared toward maximizing net benefits to society.

Air pollution sources and trends. Appropriate policy depends not only on current pollution levels, but also on expected future pollution levels. This paper begins with a summary of air pollution trends, current levels, and prospects, based on pre-existing trends and regulations already on the books. It shows that PM and other kinds of air pollution have been declining for decades—few areas of the United States now have high air pollution levels, relative either to current health standards or past levels. The study concludes that baseline trends—mainly turnover of the vehicle fleet—combined with existing requirements for industrial sources, will result in large reductions in all major air pollutants in coming years. This means that air pollution has been largely addressed as a long-term problem, but also that these already-adopted measures will take time to come to fruition.

PM health effects. The report then focuses on the state of the science for both long-term and short-term health effects of PM at current levels. Health-effects studies have reported associations between elevated PM and increases in both death and disease. I focus on mortality, because this is by far the most serious adverse effect attributed to PM, and because there is widespread agreement that the vast majority of the benefits from PM reductions would result from reductions in premature death.[10] Furthermore, the discussion of the strength of the evidence on PM and premature death applies equally well to PM and increased disease, because the same suite of statistical methods is used for both types of health studies.

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[9] See, for example, C. Seabrook, "Dirty Air Raises Cancer Risk, Study also Links Pollution to Heart Attacks," *Atlanta Journal Constitution*, March 6, 2002; E. Pianin, "Study Ties Pollution, Risk of Lung Cancer; Effects Similar to Secondhand Smoke," *Washington Post*, March 6, 2002; and U. S. Senate, Committee on Environment and Public Works, "Majority Report on the Clean Power Act of 2002," June 27, 2002.

[10] For example, a study commissioned by a coalition of environmental groups estimates that 95 percent of the benefits of PM reductions would come from reductions in mortality, while EPA predicts more than 90 percent of benefits would come from mortality reductions (Abt Associates, "The Particulate-Related Health Benefits of Reducing Power Plant Emissions," and EPA, *Technical Addendum: Methodologies for the Benefit Analysis of the Clear Skies Initiative* (Washington, DC, 2002), www.epa.gov/clearskies/tech_adden.pdf).

The report concludes that current PM levels are generally too low to increase risk of death due to long-term exposure and that EPA's current annual-average $PM_{2.5}$ standard is more stringent than necessary to protect public health. The weight of the evidence for short-term health effects is less clear. Although many studies have reported increases in death and disease due to daily increases in PM levels, a number of researchers have raised substantive concerns over whether PM is the pollutant responsible for the observed health effects, whether pollution reduces life-expectancy by more than a few days, whether there is a threshold level below which PM has no health effects, and whether the confounding effects of non-pollution factors such as weather have been adequately addressed. Recently discovered software glitches may also have caused dozens of studies to overestimate the acute health effects of PM.

A detailed review of the dozens of studies of short-term PM health effects is beyond the scope of this report, which aims to give the reader an understanding of the key issues and the current state of the science. The report concludes that there is still substantial uncertainty in the degree of increased mortality due to daily variation in PM levels, though the evidence suggests that PM is at worst shortening life by no more than a few days in already-frail individuals. In addition, progressive refinements in the research literature have tended to reduce the size of the estimated effects. It also concludes that the issue is currently moot for policy purposes, since no more than a few percent of monitoring locations exceed the federal health standard for daily PM_{10} or $PM_{2.5}$ levels.

Net benefits for public health. People ultimately bear regulatory costs through reductions in their disposable income, because regulations increase the costs of producing useful goods and services. People, on average, use their income to increase health and safety for themselves and their loved ones. Therefore reducing people's income reduces their health. Only by ensuring that a given policy will do more good than harm can policymakers ensure *net* benefits for public health and welfare. Because of the high projected costs of attaining the current annual $PM_{2.5}$ standard and the small health benefits that would accrue, requiring attainment of the standard on the current regulatory timeline would likely cause net harm to public health.

Policy considerations. The first three sections of the report feed into an assessment of policy options, including the following conclusions:

- Based on the weak evidence for long-term health effects of $PM_{2.5}$ at levels below 20 $\mu g/m^3$, EPA could relax the annual $PM_{2.5}$ standard from 15 $\mu g/m^3$ to 20 $\mu g/m^3$ while still adequately protecting public health, and avoiding most of the costs of attaining the current standard.
- Because PM air pollution has been mitigated as a *long-term* problem, policy should focus on *near-term* measures to mitigate PM in areas that still have high levels.
- Most motor-vehicle pollution comes from a small percentage of older vehicles. Incentives to retrofit or scrap these vehicles would generate large near-term PM reductions at relatively low cost compared to other proposals currently on the table, such as the Bush Administration's Clear Skies Initiative and Senator Jeffords' Clean Power Act.

Pollution Levels, Sources, and Trends[11]

Ambient air pollution levels have been declining almost everywhere in the United States for decades. Average levels of carbon monoxide (CO) and sulfur dioxide (SO_2) declined 75 percent during the last 30 to 40 years, while nitrogen oxides (NOx) declined more than 40 percent.[12] Virtually all areas of the country now comply with federal health standards for these pollutants.[13] Eighty-seven percent of monitoring locations now comply with the federal one-hour ozone standard, up from 50 percent in the early 1980s. Only 60 percent comply with EPA's new, more stringent ozone standard, known as the "eight-hour standard." However, most eight-hour ozone non-attainment locations are relatively close to the standard, with 70 percent exceeding the standard by 10 percent or less.[14]

Particulate matter has also declined substantially. A number of local agencies collected data on PM levels as far back as the early 1900s, while national data go back as far as the 1950s.[15] These early PM measurements focused on "dustfall," "smoke density," and total suspended particulates (TSP; that is, all particulates suspended in air) until 1988, when EPA began requiring states to collect data on PM_{10}.

Data from the early 1900s through the 1960s and 1970s show that dustfall and TSP declined throughout the 20th Century. For example, dustfall in Pittsburgh declined by about 90 percent between the early 1900s and 1977, while TSP levels declined about 60 percent between the late 1950s and 1975. Smoke density in Chicago declined by 50 percent between 1911 and 1933. Cincinnati achieved a 50 percent decline in dustfall between the 1930s and 1960s. Many other U.S. metropolitan areas also achieved substantial PM declines.[16]

TSP data from dozens and later hundreds of locations around the U. S. are available from 1957 to the early 1990s. These data show average TSP levels in urban and suburban areas declined by roughly 50 percent during this period. Rural particulate levels actually increased about 80 percent from 1957 to 1970, though rural levels started out at one-fourth to one-sixth of levels in populated areas.[17]

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[11] For a more detailed discussion and analysis of air pollution trends, see Joel Schwartz, "Understanding Air Pollution: Trends, Health Effects, and Current Issues" (Washington, DC: Cato, May 2003, forthcoming).

[12] Goklany, *Clearing the Air*, F. W. Lipfert and S. C. Morris, "Temporal and Spatial Relations between Age Specific Mortality and Ambient Air Quality in the United States: Regression Results for Counties, 1960-97," *Occupational and Environmental Medicine*, vol. 59, no. 3 (2002), pp. 156-74.

[13] Three of 557 monitoring locations exceed the CO health standard. Two of 667 monitoring locations exceed the SO_2 standard. The entire country attains the NOx standard. (Based on analysis of AirData pollution monitoring data reports downloaded from EPA, www.epa.gov/aqspubl1/select.html.)

[14] Based on analysis of ozone monitoring data for 1982 through 2002 downloaded from www.epa.gov/aqspubl1/select.html.

[15] Goklany, *Clearing the Air*, and references therein.

[16] See figures 1-2 and 1-7 in Goklany, *Clearing the Air* for graphical displays of early PM trends in several cities as well as citations for the original data sources.

[17] See figure 3-1 in Goklany, *Clearing the Air*.

PM_{10} data are now collected at hundreds of unique locations around the U.S. Data for many sites go back to 1988. EPA has two health standards for PM_{10}—a daily standard of 150 micrograms per cubic meter ($\mu g/m^3$) and an annual-average standard of 50 $\mu g/m^3$.[18] PM_{10} levels declined 19 percent from 1991 to 2000 and more than 96 percent of PM_{10} monitoring locations now meet all federal PM_{10} health standards.[19] There is also evidence of large declines from major sources of PM emissions. For example, PM emissions from diesel trucks declined 83 percent between 1975 and 2000.[20] As noted earlier, SO_2 emissions, some of which are converted to sulfate PM, have also declined substantially.

Based on evidence that very fine particulates might be the most problematic for health, EPA promulgated new PM standards in 1997, this time for $PM_{2.5}$.[21] More than 97 percent of monitoring locations comply with the daily $PM_{2.5}$ standard. However, only 70 percent comply with the annual standard. After the eight-hour ozone standard, the annual $PM_{2.5}$ standard is EPA's most stringent.

Although EPA has required nationwide $PM_{2.5}$ data collection only since 1999, $PM_{2.5}$ data were also collected from 1979 to 1983 in 51 large metropolitan areas. Based on these data, annual-average $PM_{2.5}$ levels have declined about 33 percent during the last 20

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[18] The annual standard requires that mean annual PM_{10} level, averaged over the last three years, be less than or equal to 50 micrograms per cubic meter ($\mu g/m^3$) at each monitoring location in a given region. Until recently, the daily standard required that during a 24-hour averaging period, PM_{10} levels could not exceed 150 $\mu g/m^3$ on more than 3 days in any consecutive three-year period. EPA revised the standard in 1997 as follows: For each of the last three years, determine the daily PM_{10} reading that represents the 99th percentile for the year, and average these three readings. A region exceeds the standard if the result is greater than 150 $\mu g/m^3$ for at least one monitoring location in the region. (EPA, "National Ambient Air Quality Standards for Particulate Matter: Final Rule," *Federal Register*, July 18, 1997, pp. 38652-753).

[19] Based on analysis of AirData pollution monitoring data reports downloaded from EPA, www.epa.gov/aqspubl1/select.html.

[20] Alan W. Gertler et al., "Emissions from Diesel and Gasoline Engines Measured in Highway Tunnels," Health Effects Institute, January 2002, www.healtheffects.org/Pubs/GertGros.pdf. The 83 percent figure represents a decrease in emissions per mile of travel. According to the federal Bureau of Transportation Statistics, total diesel truck mileage increased 180 percent from 1975 to 1999, so the decrease in *total* truck PM_{10} emissions is about 52 percent (calculate this as follows: set total truck PM emissions in 1975 equal to an arbitrary baseline level of one, then multiply by an 83 percent decrease in the emission rate, and then by a 180 percent increase in total mileage: 1 * (1 - 0.83) * (1 + 1.8) = 0.48, or a 52 percent reduction from the initial level). There are no data on ambient diesel PM levels over time in American cities, and these estimates of changes in total emissions and the emissions rate for diesel PM can't easily be used to infer percent changes in ambient levels. Ambient levels are probably more closely related to diesel PM emissions per unit of land area. Because American metropolitan areas have generally become less densely populated during the last 25 years, the reduction in emissions per unit of land area is probably closer to or even greater than the 83 percent figure. (Truck mileage data come from Bureau of Transportation Statistics, "National Transportation Statistics, 2001," publication BTS02-06, www.bts.gov/publications/nts/index.html, Table 1-29).

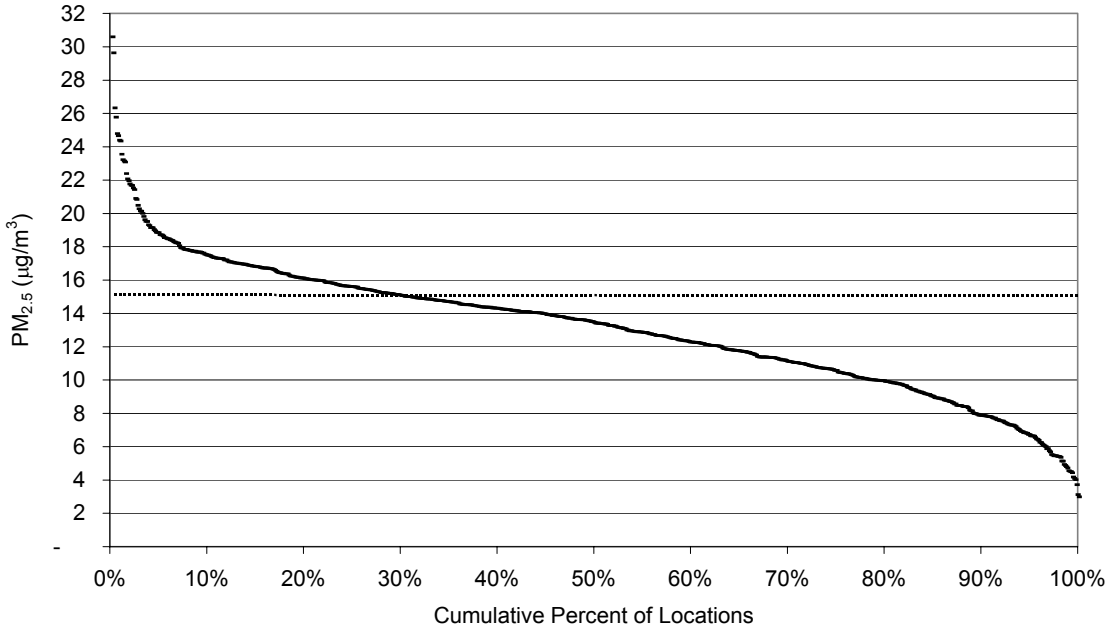
[21] The annual $PM_{2.5}$ standard requires that the mean annual particulate level, averaged over the last three years, be less than or equal to 15 $\mu g/m^3$ for each monitoring location in a given region. Attainment of the daily standard is calculated as follows: For each of the last three years, determine the daily $PM_{2.5}$ reading that represents the 98th percentile for the year, and average these three readings. A region exceeds the standard if the result is greater than 65 $\mu g/m^3$ for at least one monitoring location in the region. (EPA, "National Ambient Air Quality Standards for Particulate Matter: Final Rule.")

years.[22] These declines occurred across the board, with the worst areas achieving the largest reductions.[23]

Figure 1 shows the distribution of annual-average $PM_{2.5}$ levels for all U.S. monitoring locations. The dotted line marks the 15 $\mu g/m^3$ federal health standard. The graph shows that most $PM_{2.5}$ non-attainment locations have $PM_{2.5}$ levels relatively close to the standard—three-quarters of non-attainment locations exceed the standard by less than 20 percent. Seventeen of the worst 20 locations (with $PM_{2.5}$ ranging from 21.4 to 30.6 $\mu g/m^3$) are in California, specifically the southern portion of the Central Valley, parts of Los Angeles, and the greater San Bernardino area.[24]

Figure 1

Distribution of Annual-Average $PM_{2.5}$ Levels for All U.S. Monitoring Locations, 1999-2001



The graph plots the annual-average of $PM_{2.5}$ readings for 1999-2001 at 839 locations across the United States (all locations with three years of data), ranked from worst to best. The dotted line marks EPA's 15 $\mu g/m^3$ annual $PM_{2.5}$ standard.

Figure 2 displays the distribution of high daily $PM_{2.5}$ levels across the U.S. The graph plots the average of the 99th percentile of daily $PM_{2.5}$ levels for 1999-2001, and includes

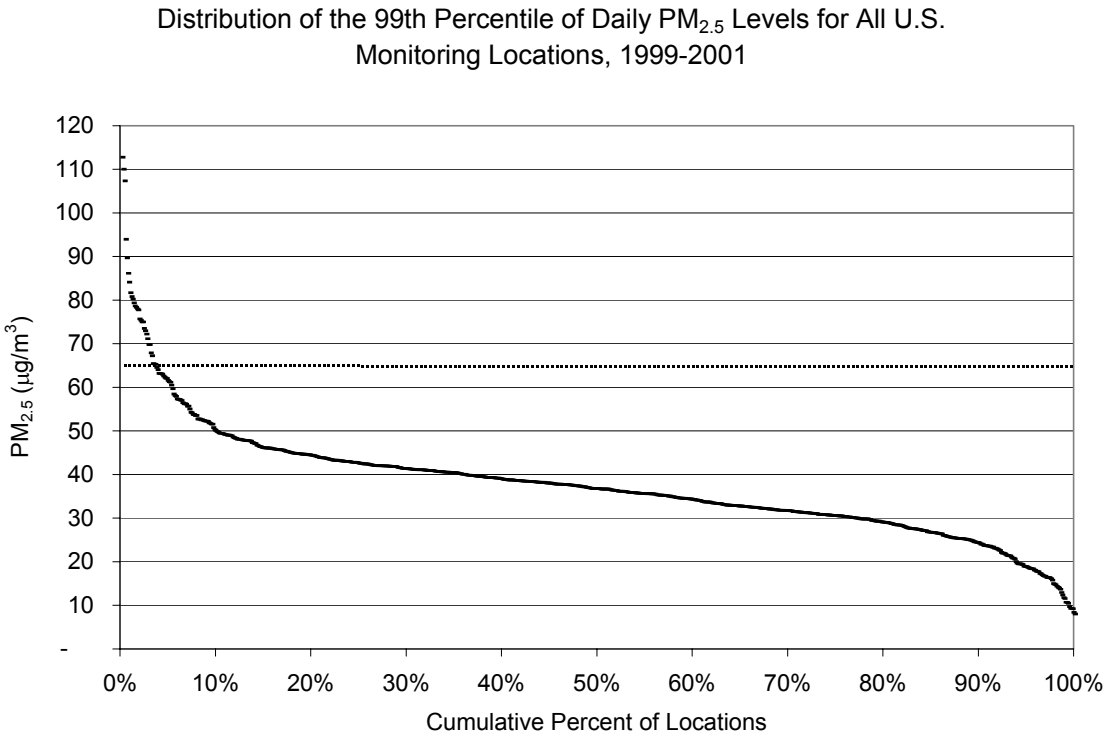
[22] C. A. Pope, 3rd et al., "Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution," *Journal of the American Medical Association*, vol. 287, no. 9 (2002), pp. 1132-41.

[23] Ibid.

[24] The other three locations are in Atlanta, GA, Birmingham, AL, and a rural area of Sumner County, TN. The top 11 locations, ranging from 23.1 to 30.6 $\mu g/m^3$, are all in California.

all locations with three years of data (a total of 839 locations). As the graph shows, only a few areas of the country ever have high daily $PM_{2.5}$ levels.[25] Among the 30 locations with values greater than 65 $\mu g/m^3$, 26 are in California, including the top 16.[26] Thus, as for annual-average $PM_{2.5}$, few areas have very high levels.

Figure 2



The graph plots the average of the 99th percentile of daily $PM_{2.5}$ readings for 1999-2001 at 839 locations across the United States (all locations with three years of data), ranked from worst to best. The dotted line marks EPA's 65 $\mu g/m^3$ daily $PM_{2.5}$ benchmark. But note that the federal standard is based on the 98th percentile of daily $PM_{2.5}$ values, rather than the 99th percentile. This chart therefore overestimates the number of locations that exceed the daily $PM_{2.5}$ standard.

PM Composition and Sources

Particulate matter can be emitted directly into the air as "primary particulates," or formed from gaseous "precursors"—NOx, SO_2 and volatile organic compounds (VOCs)—through chemical transformations in the atmosphere, resulting in "secondary particulates." As a result, determining the sources of PM in air requires sophisticated

[25] 3.4 percent of monitoring locations have 99th percentile daily $PM_{2.5}$ levels exceeding 65 $\mu g/m^3$. This is greater than the percent of locations that actually exceed the federal daily $PM_{2.5}$ standard. The federal standard is based on the 98th percentile of daily $PM_{2.5}$ readings. However, the EPA online database of pollution monitoring data provides only the 99th percentile of daily readings.

[26] The other four are Pocatello, ID, Liberty, PA, Hammond, IA, and Columbus, GA.

"source apportionment" studies that combine measurements of PM composition in air with profiles of the composition of emissions from various sources of primary and secondary PM, such as gasoline and diesel vehicles, power plants and factories, and soils or other geological materials. These studies show that PM sources and composition vary by location and season. A number of generalizations can be made, as follows:[27]

Sulfate, secondary PM derived from gaseous SO_2, makes up a larger portion of $PM_{2.5}$ in the east than the west, due mainly to much greater use of coal for electricity in the east.[28] Based on recent studies, sulfate averages about 25 percent of $PM_{2.5}$ mass in the northeast, 30 percent in the southeast, and more than 40 percent in Washington, DC and Virginia.[29] Daily fluctuations can result in substantial variation around these long-term averages.[30] EPA estimates that about two-thirds of sulfate-forming SO_2 emissions come from coal-fired power plants. Sulfate accounts for a much smaller portion of $PM_{2.5}$ in the west, for example, a few percent in Denver, several percent in California's Central Valley, and about nine to 17 percent in southern California.[31]

Organic and elemental carbon (OC and EC), mainly from cars and trucks, but also due to agricultural burning, residential wood burning, and meat cooking, make up a large portion of $PM_{2.5}$ in the west and in urban areas almost everywhere.[32] The organic carbon includes both primary and secondary particulates. Based on the studies referenced above, EC and OC together typically make up about 20 to 60 percent of $PM_{2.5}$ mass.

These same studies show nitrates, secondary particulates derived from NOx emissions, are a small contributor to $PM_{2.5}$ in the east, but generally make up 15 to 40 percent of $PM_{2.5}$ in western areas.[33] Cars and trucks are the overwhelming sources of NOx in the west, with power plants contributing about 10 to 15 percent.[34]

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[27] This discussion presents mainly averages over periods of weeks to months. But particulate composition can fluctuate from day to day and by season, based on variations in emissions levels and meteorological factors, such as winds, temperature, and sunlight.

[28] Sulfate is typically in the form of ammonium sulfate, formed by reaction with ammonia in the atmosphere.

[29] Mei Zheng et al., "Source apportionment of $PM_{2.5}$ in the Southeastern United States Using Solvent-Extractable Organic Compounds as Tracers," *Environmental Science and Technology*, vol. 36 (2002), pp. 2361-71, Glen R. Cass et al., "Determination of Fine Particle and Coarse Particle Concentrations and Chemical Composition in the Northeastern United States, 1995," prepared for NESCAUM, December 1999.

[30] See, for example, William K. Modey et al., "Fine particulate ($PM_{2.5}$) Composition in Atlanta, USA: Assessment of the Particle Concentrator-Brigham Young University Organic Sampling System, PC-BOSS, During the EPA Supersite Study," *Atmospheric Environment*, vol. 35 (2001), pp. 6493-6502.

[31] Bong Mann Kim, Solomon Teffers, and Melvin D. Zeldin, "Characterization of $PM_{2.5}$ and PM_{10} in the South Coast Air Basin of Southern California: Part 1—Spatial Variations," *Journal of the Air and Waste Management Association*, vol. 50 (2000), pp. 2034-44, John G. Watson et al., "Receptor Modeling Application Framework for Particle Source Apportionment," submitted to *Chemosphere*, Judith C. Chow and John G. Watson, "Review of $PM_{2.5}$ and PM_{10} Apportionment for Fossil Fuel Combustion and other Sources by the Chemical Mass Balance Receptor Model," *Energy and Fuels*, vol. 16 (2002), pp. 222-60.

[32] Residential wood combustion is of course a more important source in winter than in other seasons.

[33] As with sulfate, most nitrate is in the form of ammonium nitrate.

[34] According to the California Air Resources Board (CARB), power plants contribute only two percent of total NOx emissions in southern California and in California's Central Valley. California generates

For PM_{10}, geological material—that is, soil and dust—typically makes up 15 to 50 percent of total mass, with some combination of OC, sulfates, and nitrates accounting for most of the rest.[35] Both PM_{10} and $PM_{2.5}$ also generally contain trace amounts of various metals, such as iron, vanadium, selenium, and zinc.

Future PM Levels

Pollution will continue to decline even without any additional regulatory intervention. Motor vehicles are generally the largest source of $PM_{2.5}$-forming pollution in populated areas. But emissions from gasoline vehicles are declining by about six to 12 percent per year, as lower-emitting and more durable newer models replace older high-polluters.[36] Likewise, EPA projects diesel truck NOx emissions are declining by about five percent per year and PM emissions by about three percent per year due to fleet turnover.[37] EPA projects regulations that will take effect between 2004 and 2009 will reduce emissions from new cars and trucks by an additional 80 to 90 percent below current new-vehicle requirements.[38] Based on these trends and the upcoming regulations, per-mile emissions from gasoline vehicles will decline about 90 percent during the next 20 years, while the current fleet-turnover trend, combined with future new-truck requirements will reduce diesel PM by 75 percent and NOx by 80 percent.[39]

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hardly any electricity from coal. (NOx emissions for the western U.S. were downloaded from EPA's National Emissions Inventory (NEI) database, www.epa.gov/air/data/repsst.html. Regional emission inventories for California were downloaded from CARB's web site, www.arb.ca.gov/emisinv/maps/statemap/abmap.htm).

[35] Kim et al., "Characterization of $PM_{2.5}$ and PM_{10} in the South Coast Air Basin of Southern California: Part 1—Spatial Variations;" Cass et al., "Determination of Fine Particle and Coarse Particle Concentrations and Chemical Composition in the Northeastern United States, 1995." Geological material and road dust can make up more than 70 percent of PM_{10} in a few cases, such as Calexico, CA and Las Vegas (Chow and Watson, "Review of $PM_{2.5}$ and PM_{10} Apportionment for Fossil Fuel Combustion").

[36] The data showing this come mainly from on-road remote sensing, vehicle inspection programs, and tunnel studies of vehicle emissions (see Joel Schwartz, "No Way Back: Why Air Pollution Will Continue to Decline" (Washington, DC: American Enterprise Institute, April 2003), and A. J. Kean et al., "Trends in Exhaust Emissions from In-Use California Light-Duty Vehicles, 1994-2001" (Warrendale, Pennsylvania: Society of Automotive Engineers, 2002)).

[37] EPA, "Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements" (Washington, DC: 2000).

[38] Ibid., EPA, "Regulatory Impact Analysis: Tier 2 / Gasoline Sulfur Final Rulemaking" (Washington, DC: 1999).

[39] Schwartz, "No Way Back," and EPA, "Regulatory Impact Analysis: Tier 2 / Gasoline Sulfur Final Rulemaking." Increases in vehicle travel will offset only a small percentage of these pollution reductions. For example, if per-mile emissions decline by 85 percent and total vehicle miles traveled increase by 40 percent, total emissions would decline by 78 percent (calculate this as follows: set current emissions equal to an arbitrary baseline level of one, then multiply by an 85 percent decrease in the emission rate, and then by a 40 percent increase in total mileage, as follows: 1 * (1 - 0.85) * (1 + 0.4) = 0.22, or a 78 percent reduction from the initial level). Measurements of recent trends in vehicle emissions confirm this. For example, Kean et al. found that between 1994 and 2001, total HC and NOx emissions from gasoline vehicles in the San Francisco Bay Area declined 63 percent and 43 percent, respectively, even though gasoline consumption increased 13 percent, and SUVs and light trucks increased from 31 percent to 38 percent of the vehicle fleet (Kean et al., "Trends in Exhaust Emissions from in-Use California Light-Duty Vehicles, 1994-2001").

Industrial emissions will also continue to decline due to already-adopted regulations. For example, starting in 2004, EPA will cap warm-season NOx emissions from coal-fired power plants and industrial boilers at 60 percent below current levels, while power-plant SO_2 emissions will be capped at 20 percent below 2000 levels, and 43 percent below 1990 levels, by 2010.[40]

These results suggest that natural fleet turnover, along with already adopted regulations, will remove most remaining air pollutant emissions during the next two decades.

Epidemiologic Basis for PM Health Concerns

Concerns about the health effects of PM rest on the results of epidemiologic studies that have found associations between ambient PM levels and increases in death and disease. The gold standard for epidemiologic studies is the randomized, controlled experiment, in which participants are randomly assigned to "treatment" and "control" groups. This technique is used in the final stages of drug development to ensure that new medicines are both safe and effective. Random assignment ensures that treatment and control groups differ only in whether or not they received a candidate drug. Any resulting effects can then be confidently ascribed to the drug, rather than to other differences between groups. In addition, the amount of a drug to which participants are exposed is known with great accuracy. Chemical toxicity studies with laboratory animals also use random assignment and controlled chemical doses.

Due to both practical and ethical concerns, studies of particulate matter and human health do not have the luxury of random assignment or accurate exposure measurement. Instead PM epidemiology is based mainly on "observational studies"—studies in which researchers assess pollution exposure and health outcomes on people as they find them in the real world. This chapter reviews the challenges this creates for the design and interpretation of air pollution health studies.

Key Policy-Related Questions in PM Epidemiology Studies

The ultimate goal of epidemiologic studies is to establish whether there is a genuine causal relationship between a given pollutant and reduced health, and, if so, the scope of the effects and the conditions under which the effects occur. The rest of this section summarizes the specific issues that need to be addressed to make such a determination.

Accounting for non-pollution factors that affect health. Health is affected by a wide range of other factors besides pollution levels, including smoking, income, education, diet, level of physical activity, temperature, humidity and other meteorological factors, etc. These factors are also often correlated with pollution levels. When this happens, the effect of pollution is said to be "confounded," that is, mixed together with the effects of other factors. These other factors are then called "confounders" or "covariates." A study

[40] EPA, "Addendum to the Regulatory Impact Analysis for the NOx SIP Call, FIP, and Section 126 Petitions" (Washington, DC: 1998), EPA, "EPA's Acid Rain Program: Results of Phase I, Outlook for Phase II" (Washington, DC: 2001).

that inadequately accounts for confounding could mistakenly attribute to PM a health outcome that was really caused by some other factor unrelated to air pollution.

To avoid confounding, researchers measure not only pollution levels, but also many potential confounding factors, and use statistical models to remove their effects—a process called "controlling" or "adjusting" for the confounder in question. Any residual relationship that remains between health and air pollution can then more confidently be attributed to a genuine causal relationship, rather than a chance correlation. Nevertheless, it is often impossible to adequately measure and account for all potential confounders, and there is always the risk that a study's results will suffer from "residual confounding"—that is, incomplete accounting for the effects of all important factors that could affect health and that are correlated with air pollution exposure.

Confounding is particularly problematic in air pollution studies. As the effect of interest gets smaller, the potential for confounding becomes greater. The reason is that confounding occurs when a third factor—the confounder—is correlated with both air pollution and health. The chances of this joint correlation having a significant impact on a study increase as the strength of the correlation between air pollution and health decreases. Epidemiologists usually consider a strong effect to be on the order of a factor of two or three increase in the risk of experiencing the health effect of interest.[41] But the putative effects of air pollution are on the order of a few percentage points or less over the typical range of pollutant levels, while the health effects of potential confounders like diet and physical activity are much larger. For example, a major study of the long-term effects of $PM_{2.5}$ exposure reported that a 10 $\mu g/m^3$ increase in long-term $PM_{2.5}$ level increases the risk of an early death by four percent. But for a six foot, 200-pound, non-smoking man, gaining just 15 pounds increases risk of an early death by 17 percent.[42]

What are the responsible pollutants? People are exposed to a wide range of pollutants that could affect health. Exposure varies from person to person based on where people live, how active they are, how much time they spend outdoors, etc. Individual pollutant exposures are almost never directly observed, but are estimated based on centrally located monitoring stations in a given region. Although there are dozens or even hundreds of individual pollutants in the air, data are often available for only six—CO, NOx, SO_2, ozone, $PM_{2.5}$ and PM_{10}. Furthermore, levels of these pollutants are often correlated, sometimes making it difficult to sort out which one is most strongly associated with particular health outcomes. Thus, even if a health effect is caused by air pollution, it can be difficult to determine which pollutant is the culprit. It's therefore important to account for levels of as many pollutants as possible in an epidemiologic analysis, in order to be more certain of which are most associated with particular health effects.

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[41] See, for example, E. L. Wynder, "Epidemiological Issues in Weak Associations," *International Journal of Epidemiology*, vol. 19, suppl. 1 (1990), pp. S5-7, G. Taubes, "Epidemiology Faces Its Limits," *Science*, vol. 269, no. 5221 (1995), pp. 164-9, and E. L. Wynder, "Invited Commentary: Response to Science Article, 'Epidemiology Faces Its Limits'," *American Journal of Epidemiology*, vol. 143, no. 8 (1996), pp. 747-9.

[42] Pope et al., "Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution," E. E. Calle et al., "Body-Mass Index and Mortality in a Prospective Cohort of U.S. Adults," *New England Journal of Medicine*, vol. 341 (1999), pp. 1097-105.

PM is also made up of several different components whose proportions vary by location and season. PM might affect health regardless of its composition, or there might be particular components of PM—for example, PM emissions from diesel vehicles, sulfate generated from power-plant SO_2 emissions, or metals emitted from industrial mills—that are actually responsible for harm. Understanding which pollutant or mixture of pollutants causes the observed health effects is key for designing pollution control strategies that will actually result in public health improvement.

Are pollutant health effects caused by long-term exposure, short-term exposure, or both? Pollution levels vary from day to day and also over longer periods of time. Pollution can have "acute" effects—harm due to a rise in pollution on a given day that can cause respiratory aggravation or even death in susceptible individuals. However, some diseases, like heart disease and cancer, have very long "latencies"—that is, they develop over a long period of time, on the order of 15 to 20 years. Long-term exposure to high average pollution levels might contribute to the risk of developing such diseases. On the other hand, what appear to be long-term effects might actually be due to an accumulation of acute effects. The implications for policy depend on how pollution affects health.

Is there a threshold, below which pollution causes no harm? Pollution might cause some harm at any exposure, or might not have an effect on health if exposure drops below a particular level, called a "threshold." If a threshold exists, then reducing pollution below the threshold ensures protection of public health from pollution. However, if at least some health damage can occur at any level of a pollutant, then there might be no way to provide complete protection. A concept related to the threshold is the "concentration-response function" (CRF)—the rate at which health effects increase with increases in pollution exposure. A goal of the Clean Air Act is to ensure that air pollution health standards are sufficiently stringent to protect even the most susceptible individuals. If PM has no threshold, then the harm from a given level of PM would be larger than if there were a threshold.

Does pollution shorten life by days, months, or years? If a pollutant shortens life by a matter of days in already-frail individuals who would have died soon in any case—a phenomenon known as "harvesting"—then reducing the pollutant would provide few health benefits. However, if a pollutant can shorten life by months or years in healthy people, then the benefits of pollution reduction would be substantial.

Are proposed health effects biologically plausible? Epidemiologic studies can only identify statistical associations between pollutants and health effects, but cannot by themselves demonstrate a causal connection. Toxicologic studies, in which animals or human volunteers undergo controlled exposures to a pollutant, can help determine whether pollution at levels found in ambient air can actually cause various types of toxic effects, such as inflammation or respiratory distress, and by what biologic mechanisms these effects can occur. Studies of workers occupationally exposed to pollution can also help pin down toxic effects of a given pollutant.

Once the nature and magnitude of health effects is established, the results can feed into an analysis of costs and benefits of various pollution control options.

Health Effects of Long-Term PM Exposure

Health effects from long-term exposure to pollution are usually assessed via types of epidemiologic studies known as "cohort studies" and "ecological studies." Cohort studies follow a cohort of individuals over time. Ecological studies assess the relationship between pollution and health at the group level.

Cohort studies have the advantage of having information on the health status and health-related behaviors of each individual in the study, which allows for more robust control for confounding. Ecological studies have only average information for groups in the study, but not information on each individual. However, in terms of air pollution epidemiology, even cohort studies are partially "ecological" in the sense that much of the data, including air pollution exposure, is available only at the group level, making even nominal cohort studies "semi-ecological."

There are five major U.S. studies of the association between mortality and long-term exposure to PM. Four are semi-ecological cohort studies and one is a fully ecological study.

American Cancer Society (ACS) study.[43] The original ACS cohort study (hereafter referred to as ACSI) included 50 cities and more than 500,000 people, mostly of middle-class socio-economic status. ACSI followed these individuals from 1982 to 1989 and looked at the relationship between measured $PM_{2.5}$ levels and mortality across the cities in the study. ACSI was also the subject of a detailed reanalysis by the Health Effects Institute (HEI), an independent, non-profit research foundation funded by EPA and industry.[44] More recently, the original authors of ACSI, along with some participants in the HEI reanalysis, published another report on the ACS cohort (hereafter referred to as ACSII), this time with a longer follow-up period from 1982 to 1998.[45]

ACSII reported that a 10 $\mu g/m^3$ increase in long-term-average $PM_{2.5}$ levels was associated with a 4 percent increase in the risk of death from 1982 to 1998.[46] The study was based on average $PM_{2.5}$ levels measured in the various cities from 1979 to 1983, which ranged from about 10 to 30 $\mu g/m^3$.[47] By 2000, the range across these cities was about 5 to 20 $\mu g/m^3$. ACSII also reported that chronic PM_{10} exposure was not associated with increased mortality.

A number of features of the various ACS analyses suggest that the reported association of $PM_{2.5}$ with mortality might not represent a genuine cause-effect

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[43] Pope et al., "Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution," C. A. Pope et al., "Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults," *American Journal of Respiratory and Critical Care Medicine*, vol. 151, no. 3 Pt 1 (1995), pp. 669-74.

[44] D. Krewski et al., "Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality" (Cambridge, Massachusetts: Health Effects Institute, 2000).

[45] Pope et al., "Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution."

[46] Ibid.

[47] Ibid.

relationship. For example, ACSI and ACSII assessed health effects using a statistical model that included $PM_{2.5}$ as the only pollutant. But the HEI reanalysis included SO_2 levels in the analysis as a potential confounder and found that the $PM_{2.5}$ effect disappeared. Only SO_2 appeared to be associated with mortality. This strongly suggests that the ACS results suffered from confounding by other pollutants.[48]

Other ACS study results suggest that the apparent association of $PM_{2.5}$ with mortality might instead be a spurious association caused by residual confounding. For example:

- There was no association between $PM_{2.5}$ and mortality for persons with more than a high-school education, for women, and for people between the ages of 60 and 69.[49]
- $PM_{2.5}$ was associated with increased mortality for former smokers, but not current- or never-smokers.
- $PM_{2.5}$ was associated with increased mortality for people who said they were moderately active, but not for people who said they were either sedentary or very active.
- $PM_{2.5}$ was *not* associated with an increase in lung cancer mortality in the HEI reanalysis, which covered the period 1982-1989, but was associated with an increase in mortality due to other cancers.[50]
- When population change was added into the statistical model as a potential confounder, the $PM_{2.5}$ effect declined by two thirds and became statistically insignificant.[51] The hypothesis is that people who leave a city are more likely to

[48] Epidemiologists do not believe that SO_2 at current low levels could be causing harm, but rather that SO_2 may be acting as a surrogate for the pollutant mixture in a given area (see, for example, G. Hoek et al., "Daily Mortality and Air Pollution in the Netherlands," *Journal of the Air and Waste Management Association*, vol. 50, no. 8 (2000), pp. 1380-9, S. H. Moolgavkar, "Air Pollution and Daily Mortality in Three U.S. Counties," *Environmental Health Perspectives*, vol. 108, no. 8 (2000), pp. 777-84, and F. W. Lipfert, "Commentary on the HEI Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality," *Journal Toxicology and Environmental Health, Part B,* in press). Current SO_2 levels are 50 percent below those of 1980 and 75 percent below those of the 1960s. 98 percent of monitoring locations never reach SO_2 levels of even half the federal health standard (current SO_2 levels are based on author's analysis of national SO_2 monitoring data downloaded from EPA's AIRData Web site, www.epa.gov/aqspubl1/select.html. SO_2 trends since 1980 come from EPA, "Latest Findings on National Air Quality: 2000 Status and Trends." Pre-1980 trends come from Goklany, *Clearing the Air*, Figure 3-2. The pre-1980 data are based on only 21 monitoring locations, while more recent data are based on several hundred locations).

[49] When cardiopulmonary and lung cancer mortality were looked at separately, both men and women had an increased risk of the former, while only men had an increased risk of the latter.

[50] See Table 20 in Krewski et al., "Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality." ACSII did find an association between $PM_{2.5}$ and lung-cancer mortality for the period 1982-1998. However, even this association held only for men, those with no more than a high-school education, and those not in the 60-69 age range.

[51] See Table 37 in Ibid. The term "statistically significant" is a term of art in statistical analysis used to signify a result that is considered, based on objective criteria, unlikely to have occurred by chance due to random variability in the data. The word "significant" in this context does not in any way mean "important" or "noteworthy" as it would in everyday use. In addition, simply because a result is statistically significant does not mean that it represents a "real" effect, because the underlying data or statistical model could suffer

be healthier than people who remain behind. Cities that lost population—Midwest "rust belt" cities—also had higher $PM_{2.5}$ levels on average. Thus, the apparent effect of $PM_{2.5}$ could actually have resulted from a reduction in the average health of residents caused by healthier people moving away from areas of the country that were in economic decline.

These odd variations in the relationship between $PM_{2.5}$ and mortality appear to be biologically implausible and suggest that other factors besides pollution would better explain the results. In addition, the ACS study reported that higher $PM_{2.5}$ levels were *not* associated with an increased risk of mortality due to respiratory disease; a surprising finding, given that PM would be expected to exert its effects through the respiratory system.[52]

Another concern with the ACS study is that information about participants' health-related behaviors and status, such as diet, body-mass index (BMI; a measure of relative body size) and smoking were assessed only in 1982 when they entered the study, but not afterward. If any of these factors changed after 1982, and if the changes were correlated with pollution levels, then the study results would suffer from additional uncontrolled confounding. For example, if people living in areas with higher pollution were also either more likely to get fatter, or less likely to stop smoking between 1982 and 1998 when compared with people in lower-pollution areas, researchers could mistake an effect of body weight or smoking for an effect of air pollution. The rate of BMI increases or smoking decreases and the likelihood of living in an area of greater air pollution are probably positively correlated through their common association with socio-economic factors such as income and education, suggesting this is a concern worth additional investigation.[53]

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from various kinds of bias (e.g., confounding), which are a much larger source of uncertainty in epidemiologic studies than the effect of random variation in the data. Statistical significance is thus generally considered a necessary, but not sufficient condition for a statistical result to be considered as genuinely representing some underlying real feature of the world.

[52] See Table 20 in Ibid.

[53] According to the Centers for Disease Control, Americans' average BMI has indeed increased substantially during the last 20 years, and poorer people and minorities are at greater risk for obesity than whites and wealthier people. People with less education were less likely to stop smoking during the last 20 years when compared with more educated people. Minorities are more likely to live in areas with more particulate pollution. Thus, there is a significant potential for changes in BMI, smoking or other health-related behaviors to be mistaken for an effect of air pollution through their common association with socio-economic factors. (Sources: Obesity: National Center for Health Statistics, "Health, United States, 1998, with Socio-Economic Status and Health Chartbook," Centers for Disease Control, 1999, www.cdc.gov/nchs/data/hus/hus98.pdf; Smoking: National Center for Health Statistics, "Health, United States, 2001," Centers for Disease Control, 2001, www.cdc.gov/nchs/data/hus/hus01.pdf; Air Pollution: National Center for Health Statistics, "Health, United States, 1998," and Victor Brajer and Jane V. Hall, "Recent Evidence on the Distribution of Air Pollution Health Effects," *Contemporary Policy Issues*, vol. 10 (April 1992), pp. 63-71).

Because the risks of smoking and obesity are so much larger than the risk the ACS study estimated for $PM_{2.5}$, even a small difference in smoking and obesity trends between areas with differing pollution levels could swamp the ostensible effect of differences in air pollution. For example, ACSII found that a 10 $\mu g/m^3$ increase in $PM_{2.5}$ increases mortality risk by 4 percent. But for a six foot, 200-pound, non-smoking man,

Long-term studies are based on the hypothesis that chronic exposure to elevated pollution causes the development of cardiovascular disease or cancer. These diseases have latencies of 15 to 20 years between exposure and manifestation of disease, suggesting that pollution exposure should be measured during a time period years before the health effect appears. Yet the ACS pollution measurements occurred around the same time the study began in early 1980s, and the range of PM levels was about four times higher during the 1960s than during the 1980s.[54] If it was these earlier high PM levels that actually caused the health effects, then the real effect of air pollution would be one-fourth that estimated in the ACS study. This is because studies like ACS estimate the concentration-response function for PM health effects based on the range of PM levels across cities in the study. If this range is actually four times greater than the range used in the ACS study, then the health effects of a given increase in PM would be one-fourth of what the ACS study estimated.[55]

The ACS results also suggest that $PM_{2.5}$ risks are decreasing with time. ACSI reported that a 10 $\mu g/m^3$ increase in $PM_{2.5}$ was associated with a 6.9 percent increase in mortality for the period 1982-1989. But this risk declined to 2.5 percent for 1990-1998 period, or 64 percent lower than for 1982-1989.[56] The PM-mortality relationship for 1990-98 is also statistically insignificant.[57]

Harvard Six Cities (HSC) study.[58] This cohort study compared chronic mortality data with annual-average $PM_{2.5}$ levels in six cities located in the Midwest and northeast. $PM_{2.5}$ measurements were collected from the late 1970s through the mid-1980s, and mortality data were based on a 14- to 16-year follow-up of about 8,000 individuals. The HSC study was also the subject of a detailed reanalysis by HEI.[59]

HSC found, after adjusting for confounders such as smoking and educational attainment, that there was a 26 percent increase in risk of death between the city with the highest mean $PM_{2.5}$ level (29.6 $\mu g/m^3$) and the lowest (11 $\mu g/m^3$). This works out to a mortality increase of 14 percent for each 10 $\mu g/m^3$ increase in $PM_{2.5}$—substantially larger than that found in any of the other long-term mortality studies.

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gaining just 15 pounds increases his risk of an early death by 17 percent (Calle et al., "Body-Mass Index and Mortality in a Prospective Cohort of U.S. Adults").

[54] Lipfert, "Commentary on the HEI Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality."

[55] Ibid.

[56] Pope et al. did not point out this key feature of their analysis in their published results. They reported only results for 1982-1989 (in ACSI) and 1982-1998 (in ACSII). However, the results for 1990-1998 can be inferred from the data presented ACSI and ACSII.

[57] The fact that the 1990-1998 PM-mortality relationship is statistically insignificant can be inferred from the magnitude of the PM-mortality relationship for 1990-1998 and the 95 percent confidence intervals reported for the other time periods.

[58] D. W. Dockery et al., "An Association between Air Pollution and Mortality in Six U.S. Cities," *New England Journal of Medicine*, vol. 329, no. 24 (1993), pp. 1753-9.

[59] Krewski et al., "Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality."

Although the study found a mortality increase between the highest and lowest $PM_{2.5}$ cities (Steubenville, OH and Portage, WI, respectively), the increase in mortality for the other four cities when compared with Portage was not statistically significant. This is noteworthy, because after Steubenville, the next highest $PM_{2.5}$ level was 20.9 $\mu g/m^3$ for Harriman, TN. Based on national $PM_{2.5}$ data for 1999-2001, less than 2 percent of monitoring locations have annual mean $PM_{2.5}$ levels greater than 21 $\mu g/m^3$.[60] Taking the results of the HSC study at face value, this suggests that very few areas of the country now have $PM_{2.5}$ levels associated with increases in mortality due to long-term exposures.

There is also evidence that the HSC results suffer from residual confounding. For example, HSC did not account for physical activity level of the study participants, yet exercise is strongly correlated with health. It turns out that levels of physical activity in the six cities are inversely correlated with pollution levels in these cities.[61] HSC might therefore have attributed to air pollution a health effect that was actually caused by lower physical activity levels. Like the ACS study, there was no association between $PM_{2.5}$ and mortality in people with more than a high-school education. HSC also found that greater $PM_{2.5}$ was associated with a statistically insignificant *decrease* in mortality due to respiratory causes specifically.

The HSC study was based on $PM_{2.5}$ levels measured concurrent with the beginning of the follow-up period, even though mortality was due to diseases with long latency times. Therefore, like the ACS study, the HSC study might therefore have inflated the apparent effect of $PM_{2.5}$ on mortality, compared to an assessment based on much greater $PM_{2.5}$ levels in the two decades leading up to the HSC follow-up period.

Because HSC included only six locations, it was not possible to investigate whether including other pollutants in the statistical analysis affected the apparent mortality contribution of $PM_{2.5}$.

Washington University-EPRI Veterans study (Veterans study).[62] The Veterans' study assessed the relationship between $PM_{2.5}$ and mortality in 50,000 male U.S. veterans. The study population included men with preexisting high blood pressure, which should have made them more susceptible to the effects of PM, and a 21-year follow-up period. Data on total suspended particulates (TSP) were available dating back to 1953, while $PM_{2.5}$ data were available for the period 1979-84. Unlike the ACS and HSC studies, the Veterans study assessed associations between PM and mortality for several time periods, and assessed both concurrent and delayed health effects of pollution exposure.

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[60] Of the 19 monitoring locations in the U.S. that fall into this category, 17 are in southern California and California's Central Valley. None of the cities in the HSC study currently have $PM_{2.5}$ levels above 21 $\mu g/m^3$. Steubenville is still the highest at 19.3 $\mu g/m^3$.

[61] F. W. Lipfert, "Estimating Air Pollution-Mortality Risks from Cross-Sectional Studies: Prospective vs. Ecologic Study Designs," Health and Regulatory Issues, Proceedings of the International Specialty Conference, Air and Waste Management Association, 1995.

[62] F. W. Lipfert et al., "The Washington University-EPRI Veterans' Cohort Mortality Study," *Inhalation Toxicology*, vol. 12 (suppl. 4) (2000), pp. 41-73.

The study found a statistically significant *decrease* in mortality associated with $PM_{2.5}$. When various ecological confounding variables were added to the statistical analysis, $PM_{2.5}$ was associated with an even greater reduction in mortality. While it is not plausible that higher $PM_{2.5}$ could improve health, this study suggests that chronic exposure to elevated $PM_{2.5}$ is not associated with increases in mortality. The reported associations between mortality and pollution were greatest for pollution exposures occurring within a few years of death, which is unexpected if $PM_{2.5}$ is causing diseases with long latency periods, such as cancer and heart disease.

The Veterans study did not control for diet and exercise. In addition, the study also assessed people only at entry, so some personal characteristics may have changed. As a result there may be some residual confounding that could explain the anti-correlation between $PM_{2.5}$ and health. Nevertheless, this study's statistical analysis of individual health factors is more comprehensive than that of the ACS or HSC, because it includes other non-pollution health-related factors, such as age, smoking-status, blood pressure, and body-mass index. Further, these factors had the expected association with mortality (e.g., high blood pressure was associated with increased risk of death), making it more difficult to discard the pollution results. The study assessed the effect of $PM_{2.5}$ alone, and was not able to determine whether adding other pollutants to the analysis would change the apparent $PM_{2.5}$ effect.

Because this study assessed only male veterans with high blood pressure, the results might not hold for the U.S. population in general. However, one would expect that the study group would be *more* susceptible to PM-induced health effects than the general population.

Adventist Health Study of Smog (AHSMOG).[63] AHSMOG followed a cohort of about 6,300 white, non-smoking Seventh Day Adventists in California from 1977 to 1992, and assessed the association of PM_{10} with mortality. The study found that a 20 $\mu g/m^3$ increase in the average PM_{10} level was associated with a 9 percent increase in mortality in males, but the increase was not statistically significant. PM_{10} had no association with mortality in females.

AHSMOG also assessed whether frequent exposure to high daily PM levels was associated with mortality. In this case the study found a statistically significant 12 percent increase in male mortality when PM_{10} exceeded 100 $\mu g/m^3$ on at least 43 days per year. Once again, there was no effect in females.

These results are based on past PM_{10} levels, which were much greater than current levels. For example, only about one percent of U.S. PM_{10} monitoring locations, most in southern California and California's Central Valley, now exceed 100 $\mu g/m^3$ on more than 37 days per year.[64]

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[63] D. E. Abbey et al., "Long-Term Inhalable Particles and Other Air Pollutants Related to Mortality in Nonsmokers," *American Journal of Respiratory and Critical Care Medicine*, vol. 159, no. 2 (1999), pp. 373-82.

[64] Author's analysis of national PM_{10} monitoring data downloaded from EPA's AIRData Web site, www.epa.gov/aqspubl1/select.html. I was not able to assess the 43rd highest reading directly, as the closest

County-based ecological study (County study).[65] This fully ecological study included all U.S. counties with air pollution monitoring data, and assessed the relationship between pollution levels and mortality at the county level between 1960 and 1997. Like the Veterans study, this study also assessed the relationship between pollution and mortality for several time periods, and assessed both concurrent and delayed health effects of pollution exposure.

The County study found an association between greater $PM_{2.5}$ and increased mortality. However, there appeared to be a threshold somewhere between 20 and 25 $\mu g/m^3$, below which $PM_{2.5}$ had no effect. In addition, the relationship between pollution and mortality was strongest when pollution exposure occurred within a few years of death. There was little or no evidence for cumulative effects from longer-term pollution exposure.

In a comparison with counties that were part of the HSC, this study found that $PM_{2.5}$ was associated with an increase in mortality only for Steubenville, and that the threshold $PM_{2.5}$ level for mortality increases was at least 23 $\mu g/m^3$.

When looking at different age groups, the health effects of pollution were larger for younger age groups. This argues against chronic effects, because effects should be greater for people with more cumulative exposure. Like the ACS study, the County study did not find a mortality risk associated with PM_{10}.

This study included a wider range of non-pollutant confounders in the analysis when compared with other studies of long-term mortality, and found the expected directions for their effects, also adding weight to the validity of the estimated pollution effects.

Responsible Components of PM

Some of these studies also assessed the effects of long-term exposure specifically to the sulfate component of PM. Sulfate is created mainly from gaseous SO_2 emissions from power plants and other industrial sources in the eastern half of the United States. However, the epidemiologic results for sulfate suffer from the same concerns as for PM as a whole.

For example, in the ACS study, sulfate appeared to have a substantial protective effect against death due to respiratory causes that almost reached statistical significance. The relationship of sulfate particles to mortality became statistically insignificant when either SO_2 or population change were included in the statistical model, and the sulfate effect dropped to zero when multiple confounders were added to the analysis.[66] The Veterans study found an inverse relationship between sulfate and mortality, while the County study found small risks from sulfate in the 1960s and 1970s that declined to zero

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value easily available from EPA is the 10^{th} percentile of daily PM_{10} readings for each year. This is equivalent to roughly the 37^{th} highest daily PM_{10} reading in a given year.

[65] F. W. Lipfert and Morris, "Temporal and Spatial Relations between Age Specific Mortality and Ambient Air Quality in the United States: Regression Results for Counties, 1960-97."

[66] Krewski et al., "Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality," see Table 20, page 158, and Table 34, page 180.

during the 1990s.[67] The AHSMOG study did not find a statistically significant increase in risk due to sulfates. Therefore, to the extent PM or one of its components is associated with mortality due to long-term exposure, sulfate doesn't seem to be a good candidate for the causal factor.[68]

Summary of Long-Term PM Effects

The evidence suggests that long-term PM exposure at current levels is unlikely to increase risk of death. The ACS and HSC studies suffer from confounding from other pollutants and non-pollution factors that call into question their claimed association between long-term $PM_{2.5}$ exposure and mortality. The Veterans and County studies suggest that $PM_{2.5}$ either has no effect at current or past levels, or that the threshold for harm is somewhere above 20 $\mu g/m^3$—a level exceeded in only a few locations, mainly in parts of California.

Health Effects of Short-Term PM Exposure

The previous section assessed whether long-term exposure to PM might increase the prevalence of deadly diseases that develop over time. In this section, we look at the potential for daily variation in PM levels to cause acute increases in mortality. There is no way to pin down a one-to-one relationship for any given person between death and daily air pollution levels. Therefore, researchers use epidemiologic methods to look for statistical associations between daily variation in pollution levels and the rate of various health outcomes among residents within a community or region. These studies are always ecological, because both air pollution exposure and health effects are assessed at the group, rather than individual, level.

Researchers have performed dozens of studies to assess whether acute changes in daily air pollution levels can cause death or disease.[69] Based on the results of these studies, the conventional wisdom has been that typical daily changes in $PM_{2.5}$ and PM_{10}—on the order of up to tens of micrograms per cubic meter—change rates of death and hospitalization by up to a few percentage points. This might seem like a small effect, and indeed an effect of this size suggests that air pollution accounts for a tiny fraction of all death and disease. However, when multiplied by tens of millions of people in a population, this result suggests PM could be killing tens of thousands of people per year and causing respiratory distress to hundreds of thousands. A number of recent developments have, however, raised serious concerns over the validity of these results, which I review below.

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[67] Lipfert and Morris, "Temporal and Spatial Relations between Age Specific Mortality and Ambient Air Quality in the United States: Regression Results for Counties, 1960-97," and Lipfert et al., "The Washington University-EPRI Veterans' Cohort Mortality Study."

[68] As will be discussed below, toxicologic results also suggest that sulfate is a poor candidate for the harmful component of PM.

[69] See Chapter 8 of EPA (2002) and Lipfert (2002) for a detailed listing of relevant studies (EPA, "Air Quality Criteria for Particulate Matter, Third External Review Draft" (Washington, DC: 2002), and F. W. Lipfert, "Review Comments on the U.S. Environmental Protection Agency's Air Quality Criteria for Particulate Matter, Third External Review Draft" (Annapolis, MD: Annapolis Center for Science-Based Public Policy, 2002).

It is also worth remembering that hardly any monitoring locations exceed EPA's daily standards for PM_{10} or $PM_{2.5}$, so for current policy purposes the question of deaths due to daily PM increases is somewhat moot. However, there is still the substantive and important issue of whether PM at levels below the EPA standards could be causing harm, which would bolster the case for more stringent daily PM standards.

Software Glitches

The National Mortality and Morbidity Air Pollution Study (NMMAPS) is arguably the most comprehensive analysis of the acute effects of PM_{10} on health.[70] Funded and overseen by the Health Effects Institute and performed by researchers from Johns Hopkins and Harvard, NMMAPS assessed the relationship between PM_{10} and daily mortality in 90 U.S. cities, and PM_{10} and hospital admissions in 14 cities.

By pooling the results from the 90 cities in the study, NMMAPS estimated that a 10 $\mu g/m^3$ increase in daily PM_{10} levels increases daily deaths by 0.41 percent. However, early in 2002 the NMMAPS researchers discovered a software glitch that caused this result to be spuriously high.[71] After correcting the error, the new estimate is 0.27 percent—34 percent lower than the original estimate. Using a different statistical technique, the estimate declined further, to 0.21 percent.[72]

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[70] J. M. Samet et al., "The National Morbidity, Mortality, and Air Pollution Study. Part II: Morbidity and Mortality from Air Pollution in the United States," *Research Report / Health Effects Institute*, no. 94, pt. 1 (2000), pp. 5-70; discussion 71-9, and J. M. Samet et al., "The National Morbidity, Mortality, and Air Pollution Study. Part I: Methods and Methodologic Issues," *Research Report / Health Effects Institute*, no. 94, pt. 2 (2000).

[71] The details of the problem are quite technical, but the basic idea is as follows: Statistical software packages come with default settings for the level of precision required in any given set of statistical calculations. These default settings are appropriate for the vast majority of users. However, in air pollution epidemiology researchers are assessing exceedingly small effects—on the order of a one percent change or less. The default precision settings in statistical software are typically set at about this same level of precision. However, to ensure valid results the default settings need to be at no more than a small fraction of the size of the effect being measured. As a result of this problem, acute-effects air pollution studies published during the last several years might have in effect failed to control for confounding.

The particular problem identified here is a special case of what might be a more general problem in the PM epidemiology literature. Recent studies on the acute effects of PM and other air pollutants use relatively new, computationally intensive statistical techniques. Such techniques are prone to numerical inaccuracy when implemented on a computer, because computers must use "floating-point arithmetic" for computations. This means that computers can carry only a certain number of decimal places in the numbers used for successive computations. Computations that involve many iterations, as the epidemiological techniques do, can turn small numerical inaccuracies into large ones. These effects are unimportant in most applications, but can become dominant when the real effect is small, as it is in the epidemiologic studies. Econometricians have been documenting numerical inaccuracies of various statistical software packages, but it appears that no one has yet checked the extent to which they might have affected the results of published epidemiologic studies (A. E. Smith and T. H. Savage, "Comments on the Environmental Protection Agency's Third External Review Draft of Air Quality Criteria for Particulate Matter" (Washington, DC: Charles River Associates, 2002)).

[72] The NMMAPS authors have posted their updated results at www.biostat.jhsph.edu/biostat/research/nmmaps_faq.htm.

This software problem potentially affects dozens of air pollution health studies that used the same methods and the same or similar software. As a result, EPA, other agencies, and epidemiologists are reevaluating the acute-effects air pollution epidemiology literature.[73] The software issue has exacerbated concerns about the specific methods and results used to support calls for tougher daily PM standards. The sections below review these concerns.

Confounding

As with the long-term studies, studies of the relationship between daily changes in PM levels and mortality can suffer from confounding due to inadequate control for either other pollutants or non-pollution factors that are correlated with both health and air pollution. Many studies of the acute effects of PM on health have considered only PM, but not levels of other pollutants. Studies that employed "multi-pollutant" models have often found that the apparent effect of PM is greatly diminished or disappears completely when other pollutants are considered.

For example, a number of studies have variously found that SO_2, CO, or NO_2 diminish the apparent PM effect when added to models of acute air pollution effects. A study of daily mortality in Los Angeles, Chicago, and Phoenix from 1987 to 1995 found that CO was much more strongly associated with mortality than were particles. $PM_{2.5}$ had no association with mortality in Los Angeles when CO was included in the analysis, while the effect of PM_{10} was diminished or removed entirely when various gaseous pollutants were included.[74] Some multi-city studies in Canada and Europe have found similar results.[75] The new NMMAPS result reported above was not adjusted for the effects of other pollutants, and may therefore overestimate the apparent effect of PM_{10} on health. On the other hand, there are also multi-pollutant studies that have found that the PM effect remains even after including gaseous pollutants in the statistical model.[76]

A recent meta-analysis[77] of studies of pollution and acute mortality found that including one or more additional pollutants in a statistical analysis generally diminished the apparent effect of the first pollutant alone, often rendering it statistically insignificant. However, when all the studies were pooled, PM_{10} and SO_2 were still associated with a

[73] For a list of studies suggested for review, see L. Grant, letter to Philip Hopke, Chair, Clean Air Scientific Advisory Committee, and Smith and Savage, "Comments on the Environmental Protection Agency's Third External Review Draft of Air Quality Criteria for Particulate Matter."

[74] Moolgavkar, "Air Pollution and Daily Mortality in Three U.S. Counties." $PM_{2.5}$ data were available only for Los Angeles, so this analysis was not performed for the other two cities.

[75] See, for example, R. T. Burnett et al., "The Effect of the Urban Ambient Air Pollution Mix on Daily Mortality Rates in 11 Canadian Cities," *Canadian Journal of Public Health*, vol. 89, no. 3 (1998), pp. 152-6, and Hoek et al., "Daily Mortality and Air Pollution in the Netherlands."

[76] See, for example, K. Katsouyanni et al., "Short-Term Effects of Ambient Sulphur Dioxide and Particulate Matter on Mortality in 12 European Cities: Results from Time Series Data from the APHEA Project. Air Pollution and Health: A European Approach," *British Medical Journal*, vol. 314, no. 7095 (1997), pp. 1658-63.

[77] Meta-analysis is a statistical technique in which results from many different studies are combined in an effort to identify consistent overall results.

statistically significant increase in mortality.[78] Even so, when it comes to mixtures of air pollutants, it is not possible to control for confounding in the traditional sense. There are dozens of pollutants in ambient air, measurements are available for only a few, and most "multi-pollutant" studies have included no more than two or three pollutants in their analyses. Furthermore, pollutants that appear to have the greatest association with health effects are often present at such low levels that they probably could not actually be causing harm.[79] This has led to the suggestion that whatever pollutant appears most associated with health effects might be acting as a surrogate marker for the effects of the particular pollution mix in a given area, and that epidemiologic studies are not capable of determining which specific pollutant(s) is(are) causing observed health effects.[80] This is consistent with the observation that the magnitude of the association of pollution with mortality is similar across all pollutants studied.

Non-pollution factors create a potentially even more serious confounding problem. While the putative health effects of the various pollutants are of similar magnitude at current ambient levels, the health effects of some confounders, including weather and season, can be much larger than the pollution effects.[81] Improperly accounting for these non-pollution effects could cause one to mis-attribute health effects to pollution that were in fact caused by weather.[82]

Most studies of pollution and daily mortality published before the mid-1990s may have failed to adequately account for key confounders, making their results potentially invalid.[83] More recent studies have found that accounting for all the important confounding factors can be difficult and often leads to a reduction in the apparent health effects of PM.[84] For example, NMMAPS reported that higher ozone was associated with

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[78] D. M. Stieb et al., "Meta-Analysis of Time-Series Studies of Air Pollution and Mortality: Effects of Gases and Particles and the Influence of Cause of Death, Age, and Season," *Journal of the Air and Waste Management Association*, vol. 52, no. 4 (2002), pp. 470-84.

[79] See, for example, Moolgavkar, "Air Pollution and Daily Mortality in Three U.S. Counties," and Hoek et al., "Daily Mortality and Air Pollution in the Netherlands."

[80] Moolgavkar, "Air Pollution and Daily Mortality in Three U.S. Counties," S. H. Moolgavkar, "Review of Chapter 8 of the Criteria Document for Particulate Matter (Comments Submitted to EPA)" 2002, and F. W. Lipfert et al., "Daily Mortality in the Philadelphia Metropolitan Area and Size-Classified Particulate Matter," *Journal of the Air and Waste Management Association*, vol. 50, no. 8 (2000), pp. 1501-13.

[81] P. Switzer, "A Review of Statistical Methods Used in Time-Series Epidemiologic Studies of Ambient Particulate Matter and Acute Health Effects Cited by the April 2002 EPA Draft PM Criteria Document" (Palo Alto, California: Stanford University, 2002).

[82] See, for example, E. Hennessy, "Air Pollution and Short Term Mortality," *British Medical Journal*, vol. 324, no. 7339 (2002), pp. 691-2, and R. L. Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama," *Environmetrics*, vol. 11 (2000), pp. 719-43.

[83] S. H. Moolgavkar and E. G. Luebeck, "A Critical Review of the Evidence on Particulate Air Pollution and Mortality," *Epidemiology*, vol. 7, no. 4 (1996), pp. 420-8, and Smith and Savage, "Comments on the Environmental Protection Agency's Third External Review Draft of Air Quality Criteria for Particulate Matter."

[84] See, for example, Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama," Hennessy, "Air Pollution and Short Term Mortality," and P. Switzer, "Estimating Separately Personal Exposure to Ambient and Nonambient Particulate Matter for

increased mortality in summer, but with reduced mortality in winter, something that is not biologically plausible. Mortality rises in all climates in winter and also during summer heat waves. But ozone is also at its highest during summer heat waves and lowest during winter. This indicates that the NMMAPS results might suffer from inadequate accounting for the effects of seasonal changes in mortality unrelated to air pollution.[85]

The very nature of the mathematical techniques used in epidemiology can also make it difficult to sort out which pollutants or non-pollutant confounders are actually responsible for observed health effects. Epidemiologic studies use a statistical technique called regression analysis to identify which factors are most associated with health outcomes.

There are two technical issues here: First, the mathematical properties of regression are such that factors that have greater variation over time or space will appear to be more strongly associated with health outcomes, regardless of the intrinsic hazard caused by the factor in question.[86] In other words, given two pollutants that are equally toxic at ambient levels, a regression analysis will nevertheless spuriously suggest that the more variable pollutant has a greater effect on health. Ozone, $PM_{2.5}$, and acidic aerosols are more variable than PM_{10} or NO_2. The same concern applies to non-pollutant factors that affect health and often vary greatly from day to day, such as temperature and humidity.

Second, there is error associated with measurement of all pollutants and non-pollutant factors. This error comes from both random error in the measurements themselves and also error associated with using a single monitoring location to characterize air pollution exposure for people all over a city who spend varying amounts of time outdoors and have varying levels of physical activity. In a regression analysis, if two pollutants have an equal intrinsic effect on health, the one measured with the least error will spuriously appear to have a larger effect on health.[87] For example, some studies have reported a greater effect of $PM_{2.5}$ on health than that attributed to coarser particles.[88] There is good reason to believe that measurement error is greater for coarse particles than for fine particles, which would tend to make $PM_{2.5}$ spuriously appear more toxic than coarse

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Epidemiology and Risk Assessment: Why and How," *Journal of the Air and Waste Management Association*, vol. 51, no. 3 (2001), pp. 322-3; discussion 29-38.

[85] Lipfert, "Review Comments on the U.S. Environmental Protection Agency's Air Quality Criteria for Particulate Matter, Third External Review Draft."

[86] F. W. Lipfert and R. E. Wyzga, "Air Pollution and Mortality: The Implications of Uncertainties in Regression Modeling and Exposure Measurement," *Journal of the Air and Waste Management Association*, vol. 47, no. 4 (1997), pp. 517-23.

[87] F. W. Lipfert and R. E. Wyzga, "Statistical Considerations in Determining the Health Significance of Constituents of Airborne Particulate Matter," *Journal of the Air and Waste Management Association*, vol. 49, no. 9 (1999), pp. 182-91.

[88] See, for example, J. Schwartz et al., "Is Daily Mortality Associated Specifically with Fine Particles?" *Journal of the Air and Waste Management Association*, vol. 46, no. 10 (1996), pp. 927-39, and R. J. Klemm et al., "Is Daily Mortality Associated Specifically with Fine Particles? Data Reconstruction and Replication of Analyses," *Journal of the Air and Waste Management Association*, vol. 50, no. 7 (2000), pp. 1215-22.

material even if their real effects are the same.[89] This too makes it difficult to determine which pollutant(s) or non-pollutant factor(s) are actually responsible for observed health outcomes.

A recent assessment of the difficulties in sorting out these issues in air pollution epidemiology studies concluded that, "Estimation of very weak associations in the presence of measurement error and strong confounding is inherently challenging. In this situation, prudent epidemiologists should recognize that residual bias can dominate their results."[90]

Heterogeneity of Effects Among Cities

As noted earlier, NMMAPS pooled the results from 90 cities to arrive at a single estimate of the effect of daily PM_{10} levels on mortality. But the pooled estimate glosses over the considerable variation in results from city to city. In 32 of the 90 cities, increases in PM were associated with a *decreased* risk of mortality, and the protective effect was statistically significant for one of the cities (Little Rock).[91] Among the 58 cities where PM was associated with increased mortality, the effect was statistically significant for only two cities (New York and Oakland).[92] A number of other multi-city studies have also found substantial variability of estimated effects in different locations.[93]

This weakens the case for current PM levels as a cause of increased mortality, and also suggests that a pooled average mortality rate from NMMAPS or other studies may have no real meaning. Pooling results across locations is only justified when measuring the same effect in different regions. The large variation from city to city suggests that different factors might be at work in different places, and that PM is acting as a surrogate for different mixes of health-related factors in different cities.[94]

The NMMAPS results also highlight the effect of outliers on the overall estimate of PM health effects. As noted earlier, NMMAPS reported that only New York and Oakland had a statistically significant increase in mortality associated with PM_{10}, while Little Rock had a statistically significant decrease in mortality. When these three outliers are removed from the analysis, the estimated average risk for a 10 $\mu g/m^3$ increase in PM_{10}

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[89] Lipfert and Wyzga, "Air Pollution and Mortality: The Implications of Uncertainties in Regression Modeling and Exposure Measurement."

[90] T. Lumley and L. Sheppard, "Time Series Analyses of Air Pollution and Health: Straining at Gnats and Swallowing Camels?" *Epidemiology*, vol. 14, no. 1 (2003), pp. 13-4.

[91] This doesn't mean that PM_{10} should be considered beneficial to health in these cities, but it does make it unlikely that PM_{10} was detrimental, and also suggests that important health-related factors are missing from the epidemiological modeling.

[92] NMMAPS used exactly the same statistical model for all 90 cities, so the large differences between cities can't be due to differences in modeling strategy.

[93] See, for example, Moolgavkar, "Air Pollution and Daily Mortality in Three U.S. Counties," Katsouyanni et al., "Short-Term Effects of Ambient Sulphur Dioxide and Particulate Matter on Mortality in 12 European Cities: Results from Time Series Data from the APHEA Project. Air Pollution and Health: A European Approach."

[94] Moolgavkar, "Review of Chapter 8 of the Criteria Document for Particulate Matter (Comments Submitted to EPA)."

across the remaining 87 cities declines from 0.22 to 0.15 percent. Since the 0.22 percent result is barely statistically significant, removing the three outlier-cities presumably also causes the newly estimated overall PM_{10} effect to become statistically insignificant.[95]

Variability of Results Among Different "Models"

The process of estimating the health effects of air pollution involves developing a mathematical equation or "model" intended to represent the key real-world features of the relationship between pollution and health. In research parlance, the development of this model is known as "model specification." In addition to uncertainties in the data that go into the model, the structure of the model itself is a source of considerable uncertainty in air pollution studies. Subtle variations in the structure of statistical models of air pollution's health effects can have great influence on the estimated effect of PM on health.

A recent review on model uncertainty in PM studies noted that modeling "is often done in a highly exploratory fashion, and different model selection strategies may lead to different models and conclusions about the magnitude of relative risks associated with changes in particulate matter…For making inferences, the selected 'best' model is often treated as if it were the true model. This procedure ignores the uncertainty involved in model selection, and may lead to overconfident predictions and policy decisions that are riskier than one thinks they are…Model uncertainty often outweighs other sources of uncertainty, but is typically ignored in practice."[96] Specific issues include:[97]

- **Overall modeling approach.** There is a wide array of modeling techniques corresponding to different mathematical forms for the equation relating PM to mortality or other health outcomes. The details of these different approaches are technical and beyond the scope of this paper. However, the degree to which daily PM levels appear related to health depends on the specifics of the chosen model.[98]
- **Definition of PM exposure.** Study results vary based on how PM exposure is defined. For example, mortality might depend on PM levels today, yesterday, the day before yesterday, etc., or on some average of PM levels during the last few days. This is known as the "lag structure" of the model, because mortality is expected to follow or "lag" an increase in PM levels.

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[95] Ibid.

[96] M. Clyde, "Model Uncertainty and Health Effect Studies for Particulate Matter," *Environmetrics*, vol. 11 (2000), pp. 745-63.

[97] On these issues, see, for example, Ibid., Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama," Moolgavkar and Luebeck, "A Critical Review of the Evidence on Particulate Air Pollution and Mortality," Lipfert and Wyzga, "Air Pollution and Mortality: The Implications of Uncertainties in Regression Modeling and Exposure Measurement," and Switzer, "A Review of Statistical Methods Used in Time-Series Epidemiologic Studies of Ambient Particulate Matter and Acute Health Effects Cited by the April 2002 EPA Draft PM Criteria Document."

[98] See, for example, Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama," and S. H. Moolgavkar et al., "Particulate Air Pollution, Sulfur Dioxide, and Daily Mortality: A Reanalysis of the Steubenville Data," *Inhalation Toxicology*, vol. 7 (1995), pp. 35-44.

Researchers often test several different lag structures because no one knows what the genuine temporal relationship is between exposure to PM and changes in health. Different lag structures lead to different conclusions regarding whether increases in PM can harm health. Furthermore, results vary from city to city as to which lag structure results in the greatest apparent PM effect. This appears to be inconsistent with the expectation that PM would have similar health effects in different locations, and may suggest inadequate control for confounding.[99]

In studies that consider multiple lags, researchers often select the lag that gives the largest PM effect. This creates an upward bias in estimates of PM health effects, because random variability in the data can result in high PM effects at particular lags that are due to chance alone. For example, a recent simulation study found that, even if PM has no real effect on health, picking only the lag with the maximum PM effect gives a result of about the same magnitude as is typically reported in PM acute effects studies.[100]

- **Choice of monitoring locations used to represent PM exposure.** Results of PM studies vary by which monitoring locations in a given region are chosen to represent PM exposure. For example, choosing different monitors or groups of monitors in a city to represent the PM exposure of city residents results in different estimates of PM health effects.[101]

- **Non-pollution variables included in statistical models and their measurement.** Weather variables such as temperature, humidity, and atmospheric pressure affect health and are often correlated with air pollution. For example, in a study in Birmingham, Alabama, including humidity in the statistical model reduced the apparent effect of PM_{10} on mortality, but not all studies of PM in Birmingham included humidity the their models.[102] Weather variables can also be included based on different types of measurements. Humidity, for example, can be specified as specific humidity, relative humidity, or dew point. And just as for

[99] Moolgavkar and Luebeck, "A Critical Review of the Evidence on Particulate Air Pollution and Mortality."

[100] R. D. Morris, "Airborne Particulates and Hospital Admissions for Cardiovascular Disease: A Quantitative Review of the Evidence," *Environmental Health Perspectives*, vol. 109, suppl. 4 (2001), pp. 495-500. Even if there is no real underlying PM effect, random fluctuations in the data will create both positive and negative associations in the statistical relationship between PM and mortality on different days following a PM exposure, and these random fluctuations would average out to a zero effect overall. Picking off the one day with the greatest positive association will therefore cause an overestimate of the real PM effect. As an analogy, imagine you ask five people to each toss a coin 10 times. On average, each person will get five heads in ten tosses, but the actual number of heads will vary for each set of ten tosses. Just by chance, one person might get, say, 7 or 8 heads. Imagine that many other people do the same experiment, and all of them report results only for the person that got the highest number of heads. It would then spuriously appear that tossing a coin ten times typically results in maybe 7 or 8 heads, rather than 5.

[101] Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama." Also see, Switzer, "Estimating Separately Personal Exposure to Ambient and Nonambient Particulate Matter for Epidemiology and Risk Assessment: Why and How."

[102] Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama," Moolgavkar et al., "Particulate Air Pollution, Sulfur Dioxide, and Daily Mortality: A Reanalysis of the Steubenville Data."

pollution itself, these weather variables can be included with a range of different lag structures. The apparent effect of PM can vary depending on which variables are included in the model and how they are measured.

- **Accounting for Trends in Mortality Unrelated to Pollution.** Many unmeasured factors, such as demographic changes, changes in health care, etc., affect mortality and show up as trends in mortality over time. Researchers use "smoothing functions" to removing potential confounding due to these trends, yet there is no standardized means to determine the "correct" smoothing function.[103] A recent study found that changing the degree of smoothing can change the estimated health effects of pollution by a factor of three or more.[104]

Modeling decisions often must be based on the judgment of the researcher, because there are frequently no definitive criteria for making a determination of what represents the "best" approach. Therefore, conclusions vary from study to study, even when different researchers use the same data sets for the same cities.[105] The differences result from different choices regarding how to set up the mathematical model that relates health outcomes to pollution and other factors. Based on the variability of results given different approaches, a recent study concluded "there are many possible interpretations of the data and no single conclusion is definitive."[106]

Threshold and Concentration Response

A key issue in air pollution epidemiology is whether there exists a threshold below which PM has no effect on health. A related issue is the concentration-response function (CRF)—the rate at which health effects increase with increasing pollution levels—above the threshold level. A number of studies have reported evidence that there is no threshold for PM health effects and that the CRF increases linearly with increasing PM levels.[107] However, critics point out that any errors in the measurement of pollution exposures will cause an *underestimate* of a threshold, should one exist, and will cause a non-linear CRF

[103] Lumley and Sheppard, "Time Series Analyses of Air Pollution and Health: Straining at Gnats and Swallowing Camels?"

[104] R. Klemm "Reanalysis of Harvard Six-City Mortality Study Replication," EPA Workshop on GAM-Related Statistical Issues in PM Epidemiology, Durham, North Carolina, November 4-6, 2002.

[105] See, for example, Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama," Moolgavkar et al., "Particulate Air Pollution, Sulfur Dioxide, and Daily Mortality: A Reanalysis of the Steubenville Data," Clyde, "Model Uncertainty and Health Effect Studies for Particulate Matter," Moolgavkar and Luebeck, "A Critical Review of the Evidence on Particulate Air Pollution and Mortality," Moolgavkar, "Review of Chapter 8 of the Criteria Document for Particulate Matter (Comments Submitted to EPA)," and J. M. Samet et al., "New Problems for an Old Design: Time Series Analyses of Air Pollution and Health," *Epidemiology*, vol. 14, no. 1 (2003), pp. 11-12.

[106] Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama."

[107] Recent examples include M. J. Daniels et al., "Estimating Particulate Matter-Mortality Dose-Response Curves and Threshold Levels: An Analysis of Daily Time-Series for the 20 Largest US Cities," *American Journal of Epidemiology*, vol. 152, no. 5 (2000), pp. 397-406, and J. Schwartz et al., "The Concentration-Response Relation between $PM_{2.5}$ and Daily Deaths," *Environmental Health Perspectives*, vol. 110, no. 10 (2002), pp. 1025-9.

to appear linear.[108] In addition, a number of studies have reported identifying a threshold below which PM does not appear to affect health.[109]

Harvesting

A central question in air pollution epidemiology is: To the extent that acute increases in PM cause death, does PM reduce life expectancy by only days in already-frail people or by months or years in healthy people? If the latter is the case, PM could have a large effect on public health. If the former, the health effects of PM would be far smaller.

The harvesting hypothesis centers on the idea that there is a population of already-frail individuals with an average life expectancy of only a few days, who are "pushed over the edge" by some external stress, such as pollution or hot weather. People in an already frail condition have an impaired ability to maintain a stable internal environment and this prevents them from adapting to even small changes in the external environment.[110]

A number of studies have concluded that most mortality from daily air pollution variability does not represent harvesting, but rather death is advanced by months or years.[111] However, these studies did not directly assess when deaths occurred in relation to PM levels, but inferred a lack of harvesting indirectly from the mathematical properties of the statistical model used for the analysis. In addition, once again due to the properties of the models used, deaths could be counted as due to PM increases even if the deaths *preceded* the increases in air pollution—a physically nonsensical proposition if PM is indeed causing the deaths.[112]

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[108] See, for example, Lipfert and Wyzga, "Statistical Considerations in Determining the Health Significance of Constituents of Airborne Particulate Matter."

[109] R. L. Smith et al., "Threshold Dependence of Mortality Effects for Fine and Coarse Particles in Phoenix, Arizona," *Journal of the Air and Waste Management Association*, vol. 50, no. 8 (2000), pp. 1367-79, R. L. Smith et al., "Assessing the Human Health Risk of Atmospheric Particles," *Novartis Foundation Symposium*, vol. 220 (1999), pp. 59-72; discussion 72-9, Smith et al., "Regression Models for Air Pollution and Daily Mortality: Analysis of Data from Birmingham, Alabama," Moolgavkar and Luebeck, "A Critical Review of the Evidence on Particulate Air Pollution and Mortality."

[110] R. Frank and C. Tankersley, "Air Pollution and Daily Mortality: A Hypothesis Concerning the Role of Impaired Homeostasis," *Environmental Health Perspectives*, vol. 110, no. 1 (2002), pp. 61-5.

[111] S. L. Zeger et al., "Harvesting-Resistant Estimates of Air Pollution Effects on Mortality," *Epidemiology*, vol. 10, no. 2 (1999), pp. 171-5, A. Zanobetti et al., "Generalized Additive Distributed-Lag Models: Quantifying Mortality Displacement," *Biostatistics*, vol. 1 (2000), pp. 279-92, J. Schwartz, "Harvesting and Long Term Exposure Effects in the Relation between Air Pollution and Mortality," *American Journal of Epidemiology*, vol. 151 (2000), pp. 440-48, J. Schwartz, "Is There Harvesting in the Association of Airborne Particles with Daily Deaths and Hospital Admissions?" *Epidemiology*, vol. 12, no. 1 (2001), pp. 55-61.

[112] Switzer, "A Review of Statistical Methods Used in Time-Series Epidemiologic Studies of Ambient Particulate Matter and Acute Health Effects Cited by the April 2002 EPA Draft PM Criteria Document."

Studies that have attempted to estimate directly when death occurs in relation to increases in pollution by estimating the size of this frail population have concluded that acute changes in pollution levels shorten life expectancy by a matter of days at most.[113]

The putative effects of PM based on epidemiologic results are consistent with the harvesting hypothesis. For example, if daily variations in pollution mainly affect an already-frail population, it may be that it's not so much the type of external stress that is important, but that any modest external stress would be enough to cause death. This is consistent with the finding that many different types of pollution—e.g., fine and coarse PM, various gases—appear to have effects on mortality of similar magnitude, as do changes in temperature, atmospheric pressure and other weather variables.[114] If PM and other pollutants were shortening healthy people's lives by months or years, it would be an odd coincidence if several different pollutants, each with a different intrinsic toxicity and each present at different levels in different cities, all happened to exert roughly the same effects, regardless of the pollutant or its ambient concentration.

On the other hand, if PM is actually shortening life by months or years in otherwise healthy people, biological plausibility is still an issue. Various pollutants are always present at some level in ambient air, and pollution levels vary from day to day. It is not clear why apparently healthy people would be suddenly killed on a given day by relatively low PM levels that they have experienced many times in the past.[115] The frail-population hypothesis would explain the possible lack of a threshold for the effect of PM on mortality, since changes in pollution, even at low levels, might be enough to cause death in very frail people.[116]

Responsible Components of PM

PM is composed of many chemicals, with major components including organic compounds and ammonium sulfate formed from ammonia and SO_2 emissions. PM also includes trace amounts of many other compounds, such as various metals emitted from a wide range of sources. Although some of these compounds are toxic given high enough exposures, it is not clear which might be toxic at typical ambient levels.

Sulfates appear to be an unlikely cause of PM health effects. Sulfate occurs naturally in bodily fluids, and the amount of sulfate inhaled from ambient PM is at most a tiny

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[113] Smith et al., "Assessing the Human Health Risk of Atmospheric Particles," C. J. Murray and C. R. Nelson, "State-Space Modeling of the Relationship between Air Quality and Mortality," *Journal of the Air and Waste Management Association*, vol. 50, no. 7 (2000), pp. 1075-80.

[114] F. W. Lipfert, "Unresolved Questions in Air Pollution Epidemiology, Review Comments on the U.S. Environmental Protection Agency's Air Quality Criteria for Particulate Matter, Third External Review Draft" (Annapolis, MD: Annapolis Center for Science-Based Public Policy, 2002), Stieb et al., "Meta-Analysis of Time-Series Studies of Air Pollution and Mortality: Effects of Gases and Particles and the Influence of Cause of Death, Age, and Season."

[115] Lipfert, "Unresolved Questions in Air Pollution Epidemiology, Review Comments on the U.S. Environmental Protection Agency's Air Quality Criteria for Particulate Matter, Third External Review Draft."

[116] Ibid., Frank and Tankersley, "Air Pollution and Daily Mortality: A Hypothesis Concerning the Role of Impaired Homeostasis."

fraction of the amounts that are naturally present.[117] Toxicology studies have found that ammonium sulfate inhalation has no detrimental effects on lung function or other respiratory parameters.[118] Furthermore, inhaled magnesium sulfate is used therapeutically to *reduce* airway constriction in asthmatics.[119] Although acidic aerosols, such as sulfuric acid, can have adverse effects, very high concentrations—70 $\mu g/m^3$ or more, which is many times greater than ambient levels—are necessary to induce changes in lung function, even in asthmatics.[120]

Studies using concentrated ambient PM suggest that trace metals found in PM are likely candidates for the biologically active component.[121] In a recent study, concentrated PM was "instilled"—that is, placed directly into the lungs—of human volunteers. The PM was collected from air in the Utah Valley during periods before, during, and after the temporary closure of a local steel mill. PM collected during operation of the steel mill had relatively high levels of iron, copper, zinc, vanadium, and other metals and caused lung inflammation in the volunteers, while PM from the period of steel mill closure had low metal content and provoked little or no inflammation.[122]

Although there has been little toxicology research on the organic components of PM, a few epidemiologic studies have assessed which components of PM are most strongly associated with health effects. Some of these studies have reported vehicle-related PM to be the component most associated with increased mortality.[123] However, trace metals, rather than organic or elemental carbon, might be responsible for this association.[124]

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[117] D. J. Edwards et al., "Plasma Concentrations of Inorganic Sulfate in Alzheimer's Disease," *Neurology*, vol. 43, no. 9 (1993), pp. 1837-8, D. E. Cole, "Microassay of Inorganic Sulfate in Biological Fluids by Controlled Flow Anion Chromatography," *Journal of Chromatography*, vol. 225 (1981), pp. 359-367.

[118] R. B. Schlesinger and L. C. Chen, "Comparative Biological Potency of Acidic Sulfate Aerosols: Implications for the Interpretation of Laboratory and Field Studies," *Environmental Research*, vol. 65, no. 1 (1994), pp. 69-85, J. Q. Koenig, et al., "Respiratory Effects of Inhaled Sulfuric Acid on Senior Asthmatics and Nonasthmatics," *Archives of Environmental Health*, vol. 48, no. 3 (1993), pp. 171-5. Koenig et al. used ammonium sulfate as an inert control—that is, a compound expected to have no effect on health—to compare with inhalation of sulfuric acid.

[119] L. J. Nannini, Jr. and D. Hofer, "Effect of Inhaled Magnesium Sulfate on Sodium Metabisulfite-Induced Bronchoconstriction in Asthma," *Chest*, vol. 111, no. 4 (1997), pp. 858-61.

[120] J. Q. Koenig, et al., "Respiratory Effects of Inhaled Sulfuric Acid on Senior Asthmatics and Nonasthmatics," EPA, "Air Quality Criteria for Particulate Matter, Third External Review Draft," pg. 7-27.

[121] R. S. Chapman et al., "Ambient Particulate Matter and Respiratory and Cardiovascular Illness in Adults: Particle-Borne Transition Metals and the Heart-Lung Axis," *Environmental Toxicology and Pharmacology*, vol. 4 (1997), pp. 331-8.

[122] A. J. Ghio and R. B. Devlin, "Inflammatory Lung Injury after Bronchial Instillation of Air Pollution Particles," *American Journal of Respiratory and Critical Care Medicine*, vol. 164, no. 4 (2001), pp. 704-8.

[123] See, for example, F. Laden et al., "Association of Fine Particulate Matter from Different Sources with Daily Mortality in Six U.S. Cities," *Environmental Health Perspectives*, vol. 108, no. 10 (2000), pp. 941-7, T. F. Mar et al., "Associations between Air Pollution and Mortality in Phoenix, 1995-1997," *Environmental Health Perspectives*, vol. 108, no. 4 (2000), pp. 347-53, and Hoek et al., "Daily Mortality and Air Pollution in the Netherlands."

[124] For example, the Laden et al. study used PM data collected when leaded gasoline was still in use, meaning that vehicle-related PM would have included a great deal of lead, making it much different from current vehicle-related PM composition.

Summary of Short-Term PM Effects

There is still substantial uncertainty as to the degree of increased mortality due to daily variation in PM levels. Questions remain over the degree to which confounding has been removed, the existence of a threshold, and the extent to which PM has been definitively identified as the responsible pollutant. Subjective modeling decisions appear to have a large effect on the extent to which PM appears associated with short-term health effects. To the extent changes in daily PM levels do increase mortality, the evidence suggests that PM is shortening life by no more than a few days in already-frail individuals. The recent discovery of the software problem has also called into question the validity of previous results reported in the research literature. To the extent that PM at current levels is causing harm, progressive refinements in statistical methods have tended to substantially reduce the size of the estimated PM effects.

Adequacy of EPA's Assessment of PM Health Effects

EPA's pollution standards are based on the agency's assessment of pollution risks. However, EPA's regulatory documents create an unwarranted impression of certainty regarding the overall conclusions to be drawn from PM health effects research. EPA produces reports called "criteria documents" (CD) to provide the scientific backing for its health standards. A number of researchers have pointed out that EPA's latest CD for particulate matter[125]—a report intended to be an objective and rigorous review of the health effects of PM—omits or misrepresents many studies that are critical of the view that relatively low current PM levels cause harm, and cherry picks results from the research literature that are favorable to EPA's proposed $PM_{2.5}$ standards.[126] For example, one commenter noted that of 400 studies related to PM and health published in peer-reviewed journals, 180 were not cited in the CD. Furthermore, studies omitted by EPA were more likely to have found smaller or non-existent PM health effects when compared with studies EPA chose to include in the CD.[127] This suggests that EPA has not adequately considered the weight of the evidence in setting its latest PM standards.

The Mar et al. study used a statistical technique called "factor analysis," which attempts to identify groups of variables (in this case, gaseous pollutants and the individual components of PM) that cluster together into a smaller number of underlying "factors." Each factor might represent a different major source for a given group of pollutants. For example, aluminum, silicon, calcium, and iron (all found in trace amounts in PM) fall into one factor that probably represents soil dust. Organic carbon, potassium, and bromine cluster together into a factor that probably represents vegetative burning. NOx, CO, lead, zinc, iron, manganese, elemental carbon, and organic carbon cluster into a factor that probably represents a combination of motor vehicle exhaust and road dust resuspended into air by passing vehicles. It is possible that the metals, which are mainly from resuspended road dust, are the cause of the association between this factor and mortality.

[125] EPA, "Air Quality Criteria for Particulate Matter, Third External Review Draft."

[126] Lipfert, "Review Comments on the U.S. Environmental Protection Agency's Air Quality Criteria for Particulate Matter, Third External Review Draft," Moolgavkar, "Review of Chapter 8 of the Criteria Document for Particulate Matter (Comments Submitted to EPA)."

[127] Lipfert, "Review Comments on the U.S. Environmental Protection Agency's Air Quality Criteria for Particulate Matter, Third External Review Draft."

Net Welfare Effects of PM regulations

The health effects of PM at current levels appear to be small, yet the costs of attaining the annual $PM_{2.5}$ standard will likely be quite large. Senator Jeffords's Clean Power Act or the Bush Administration's Clear Skies Initiative would add to these costs. This makes it difficult to ensure that pollution reduction measures will result in net health benefits for the people whom the regulations are intended to help. The policy problem is that pollution reduction measures involve "health-health" tradeoffs for the public.[128]

Reducing pollution may improve health. But regulations to reduce pollution increase the cost of useful goods and services, reducing families' disposable income. Because people on average use their income to make their lives safer—by buying better and safer products, more nutritious food, better medical care, and more leisure time—reducing people's disposable income reduces their health.

For example, electricity provides power for safety-enhancing services such as air conditioning. An epidemiologic study found, after controlling for confounders, that risk of death during a five-year period declined 42 percent for people who had central air conditioning in their homes, when compared with people without air conditioning.[129] Yet measures to reduce power plant emissions will increase the cost of electricity. Policymakers must assess all the effects of a regulation to ensure that the net result will be improved public health and welfare.

A number of researchers have attempted to estimate the health costs imposed by regulations. These estimates suggest that every $15 million in additional regulatory costs results in one additional induced fatality.[130] Expected health benefits of a regulation must be weighed against these health costs in order to increase the likelihood that a given regulation will provide net health benefits to the public.

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[128] Randall Lutter and John Morrall appear to be the first to use this term (see R. Lutter and J. F. Morrall, "Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation," *Journal of Risk and Uncertainty*, vol. 8 (1994), pp. 43-66.

[129] E. Rogot et al., "Air-Conditioning and Mortality in Hot Weather," *American Journal of Epidemiology*, vol. 136, no. 1 (1992), pp. 106-16.

[130] R. Lutter et al., "The Cost-Per-Life-Saved Cutoff for Safety-Enhancing Regulations," *Economic Inquiry*, vol. 37, no. 4 (1999), pp. 599-608. Fifteen million dollars was their "best estimate," with a range of $10 million to $50 million.

Health-health analysis is only a partial analysis of the net welfare effects of a regulation, because such analyses currently include only mortality. Cost-benefit analyses attempt to include all costs and benefits of a regulation—not only mortality, but also morbidity (that is, disease and disability), and all the other social-welfare effects of a regulation. In this sense, health-health analysis is a weaker test of the value of a regulation than cost-benefit analysis. However, because it is a weaker test, if a regulation cannot be shown to have net health benefits in a health-health analysis, than it is very likely that the regulation in question will cause net harm to the public. Health-health analysis also has the virtue of making the net health effects of a regulation explicit to the public, while cost-benefit analysis is often perceived (inaccurately) as divorced from concerns over human welfare.

EPA did not include the negative health effects of regulatory costs when setting standards for $PM_{2.5}$.[131] EPA's Regulatory Impact Analysis (RIA) for its $PM_{2.5}$ standard also understates by a large margin the likely costs of attaining the standard. EPA estimated annual full attainment costs at $6.3 billion per year, but a more realistic estimate is at least several times greater.[132] Nevertheless, EPA estimated that full attainment of $PM_{2.5}$ standards would save 15,000 lives per year. Using a similar analysis, EPA estimates that the Clear Skies Initiative would save as many as 12,000 lives by 2020, while costing $3.7 billion annually by 2010 and $6.5 billion by 2020.[133]

If reducing particulates could save that many lives, even costs of tens of billions per year would likely be justified. However, the discussion above of $PM_{2.5}$ health effects showed that current $PM_{2.5}$ levels are probably not high enough to be causing increased deaths except at worst in a handful of locations with extremely high average $PM_{2.5}$ levels. Attaining the current $PM_{2.5}$ standard might therefore not result in any health benefits in all but a few non-attainment areas.[134]

Considering the net welfare effects of pollution-control regulations makes explicit the tradeoffs between the health benefits of lower pollution levels, and the health costs of reducing people's disposable income through imposition of regulatory costs. In the case of the annual $PM_{2.5}$ standard, the costs to the public of measures needed to achieve the standards, combined with the small health benefits that would accrue, will likely cause a net reduction in public health.[135]

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[131] However, EPA argued, and the Supreme Court agreed, that the Clean Air Act prohibits EPA from considering implementation costs when setting air quality health standards (see *Whitman v. American Trucking Associations*, 531 U.S. 457 (2001), supct.law.cornell.edu/supct/html/99-1257.ZS.html).

[132] EPA's $PM_{2.5}$ RIA included only control measures expected to cost less than $1 billion per 1 $\mu g/m^3$ reduction in annual $PM_{2.5}$ levels. But EPA's own analysis indicated that these measures would achieve only half the reductions necessary to achieve the standard, and that marginal costs per $\mu g/m^3$ reduction would rise steeply after the less expensive measures had been implemented. EPA's contractor found that costs for Philadelphia would be at least $4.3 billion per 1 $\mu g/m^3$ reduction, and that the city still might not be able to attain the standard. Based on this figure, a University of Rochester economist estimated national full-attainment costs at $55 billion per year (Stephen Huebner and Kenneth Chilton, "EPA's Case for New Ozone and Particulate Standards: Would Americans Get Their Money's Worth," Center for the Study of American Business, Washington University in St. Louis, June 1997, csab.wustl.edu/csab/CSAB%20pubs-pdf%20files/Policy%20Studies/PS139%20Huebner-Chilton.pdf).

[133] For EPA's estimates, see www.epa.gov/air/clearskies/benefits.html, www.epa.gov/air/clearskies/econ.html.

[134] For example, only 3 percent of $PM_{2.5}$ monitoring locations (10 percent of all non-attainment locations) have annual-average $PM_{2.5}$ levels greater than 20 $\mu g/m^3$. Yet, as shown earlier, epidemiologic research suggests that to the extent $PM_{2.5}$ is causing increased mortality due to long-term exposure, the threshold is somewhere above 20 $\mu g/m^3$.

[135] The high cost of attainment is at least partially due to the Clean Air Act requirement for attainment within the next 5 to 10 years. Most of the costs result from imposing new and costly requirements in advance of "natural" emission reductions that will occur anyway due to turnover of vehicle fleets and other capital stocks (see emission trends section, above).

Activists' Portrayals of PM Risks

PM and other air pollutants have been declining for decades. Current trends in vehicle-fleet turnover and already-adopted regulations for industrial sources of pollution ensure continued pollution declines in coming years. The case for long-term harm from current levels is relatively weak, while short-term changes in PM levels likely shorten life by no more than a matter of days.

Despite this relatively optimistic picture, the public's view of air pollution is just the opposite of reality. Numerous polls show most Americans believe that air pollution has been getting worse or will get worse in the future, and that air pollution is a serious threat to most people's health.[136] One reason for Americans' misperception may be a series of reports from activist groups featuring alarmist rhetoric and misleading portrayals of air pollution levels and health effects.[137]

These reports come under scary titles such as "Darkening Skies;" "Death, Disease and Dirty Power;" and "Power to Kill;" and claim that power plant PM pollution causes 30,000 deaths per year, mainly from coal-fired power plants in the eastern United States. Each of these reports sources the 30,000 deaths claim back to a study commissioned by the Clean Air Task Force, a coalition of environmental groups, and carried out by consultants from Abt Associates.[138]

The Abt study bases its PM-induced mortality estimates on $PM_{2.5}$ effects reported in the ACS cohort study. But, as shown above, the ACS results are likely spurious, suffering from confounding by non-pollution factors not accounted for in the ACS analysis. In addition, the Veterans study and the County study concluded that $PM_{2.5}$ either has no effect on long-term mortality, or that the threshold for harm is somewhere above 20 $\mu g/m^3$—well above $PM_{2.5}$ levels at 97 percent of U.S. monitoring locations. Furthermore, the areas that do have $PM_{2.5}$ greater than 20 $\mu g/m^3$ are mainly located in southern California and California's southern Central Valley, where there are no coal-fired power plants and electricity generation produces no sulfur dioxide and contributes only about 2 percent of regional NOx emissions. The evidence from toxicology studies also shows that sulfates—the portion of PM from coal-fired power plants—have no effect on health. Indeed, inhaled magnesium sulfate is used therapeutically to treat asthmatics.

Given this evidence, the Abt report and the activist reports derived from it have vastly exaggerated the health damage from current levels of PM pollution and the health effects of power plant emissions.

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[136] See, for example, ICR Media, "Survey of Air Pollution Perceptions, Final Report," www.cleanairprogress.org/research/Perceptions.pdf, and www.cleanairprogress.org/news/quorum_res_01_14_02.asp; New York League of Conservation Voters, "Key Findings of A Statewide Survey of New York State Residents on Environmental Issues," (New York, 2001), www.nylcv.org/Programs/NYCEF/NYSPoll_PDF_file.PDF; Mark Baldassare, "PPIC Statewide Survey: Special Survey on Californians and the Environment," (San Francisco, Public Policy Institute of California, 2002), www.ppic.org/publications/CalSurvey28/survey28.pdf.

[137] See, for example, Clean Air Task Force, "Power to Kill", Public Interest Research Group, "Darkening Skies", Clean Air Task Force, "Death, Disease and Dirty Power."

[138] Abt Associates, "The Particulate-Related Health Benefits of Reducing Power Plant Emissions."

Readers of these reports would also never know that PM levels have been dropping and will continue to drop. For example, the Public Interest Research Group's (PIRG) "Darkening Skies" reports that 300 power plants increased their SO_2 emissions between 1995 and 2000. Once emitted, some SO_2 gets converted into sulfate particulates through chemical reactions in the atmosphere. But PIRG never mentions that overall SO_2 emissions declined 33 percent between 1973 and 1999; that total power plant SO_2 emissions declined 29 percent from 1990 to 2000; and that federal law requires an additional 20 percent SO_2 reduction from power plants between 2000 and 2010.[139] PIRG also fails to mention that sulfate PM levels across the eastern U.S. have declined by 10 to 40 percent since the late 1980s, due to these SO_2 reductions.[140] Indeed, "Darkening Skies" contains no information at all on actual trends in pollutant emissions or actual PM levels in any community, despite the wealth of data available from hundreds of monitoring locations in populated areas around the country.

Instead of providing the public with a realistic assessment of air quality, PIRG's report misleads readers to draw conclusions grossly at odds with reality. Other activist-group reports followed similar recipes, using superficially scary, but misleading statistics, while omitting information on actual air pollution levels, trends, and risks.[141]

Policy Considerations

The analysis presented above suggests the following policy considerations and recommendations:

The epidemiologic evidence suggests the annual $PM_{2.5}$ standard should be revised upward to at least 20 $\mu g/m^3$. EPA's annual $PM_{2.5}$ standard is based mainly on the ACS study. Yet this study likely suffers from residual confounding, making its results unreliable. Other recent studies of long-term $PM_{2.5}$ exposure have found either no effect or a threshold greater than 20 $\mu g/m^3$. An annual PM standard of 20 $\mu g/m^3$ has the benefit of being stringent enough to protect public health from chronic $PM_{2.5}$ exposure, while at the same time ensuring that public health isn't harmed by diverting tens of billions per year of Americans' income to attaining an unnecessarily stringent standard. For the same reasons, the evidence does not support the Jeffords Clean Power Act, the Administration's Clear Skies Initiative, or any other costly new measures designed to further reduce PM from relatively low current levels.

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[139] R. E. Baumgardner et al., "Measurements of Rural Sulfur Dioxide and Particle Sulfate: Analysis of CASTNET Data, 1987 through 1996," *Journal of the Air and Waste Management Association*, vol. 49 (1999), pp. 1266-79, EPA, "EPA's Acid Rain Program: Results of Phase I, Outlook for Phase II."

[140] Based on EPA CASTNET data for 42 locations with data for both the late 1980s and the last few years. Data were downloaded from EPA's CASTNET data site, www.epa.gov/castnet/data.html.

[141] For a more detailed exposition of this issue, focusing on ozone air pollution, see Joel Schwartz, "A Dose of Reality on Air Pollution Exposure and Trends," *Regulation* (Summer 2003, in press).

Hardly any areas of the country exceed the EPA's daily $PM_{2.5}$ standard. The substantive case for harm from daily variation in PM at current levels is plagued by uncertainties and appears to be weaker than assumed by advocates for a more stringent standard. Progressive refinements in epidemiologic methods have resulted in smaller estimates of acute PM risks, and PM exposure more likely shortens life by days in the already-frail, rather than months or years in healthy individuals.

Even though policymakers and environmental activists have focused their PM policy efforts on power plants, sulfate is implausible as the component of PM responsible for harm. In any case, the Clean Air Act requires a 20 percent reduction in power plant SO_2 emissions between 2000 and 2010. To the extent that vehicle-related PM can cause harm at current levels, the good news is that current fleet turnover trends mean vehicle PM pollution will continue declining regardless of other policy actions. Vehicle emissions will decline at least 70 to 80 percent during the next 20 years or so, as older vehicles are scrapped and replaced by progressively lower-emitting and more durable newer models. This means that already-adopted measures have essentially mitigated PM and other air pollutants as a long-term problem. The key question for policy makers then is, to the extent some areas currently have harmful PM levels, what policies make the most sense for achieving PM reductions in the near term?

On-road emissions measurements show that a few percent of (mainly older) gasoline-powered vehicles contribute most emissions from the gasoline-powered vehicle fleet.[142] Remote sensing, an on-road emissions measurement technology, can rapidly and cheaply identify many and perhaps most of these vehicles, and their owners can be offered cash to voluntarily scrap the vehicle.[143] For example, an aggressive program could reduce gasoline-vehicle VOC emissions by at least 10 percent within a year and at a nationwide cost of no more than about $500 million.[144] While some areas of the country have small scrap programs, because there is probably no more cost effective or more rapid means for

[142] For example, when cars are ranked from dirtiest to cleanest on VOC emissions, the worst 5 percent of cars produce about 50 percent of tailpipe VOC emissions from the vehicle fleet. Likewise, when cars are ranked based on NOx, the worst 5 percent of NOx emitters produce about 35 percent of NOx from the vehicle fleet. (Based on analysis of remote sensing data for Phoenix, Chicago, and Riverside, CA, downloaded from www.feat.biochem.du.edu/light_duty_vehicles.html).

[143] Pilot programs have shown that even a relatively modest remote sensing campaign can measure a large fraction of the vehicles registered in a region. For example, a pilot program in Sacramento measured 45 percent of registered vehicles in Sacramento County with 555 "unit-days" of measurements—where one unit-day represents a single remote sensing unit operating for a day. In this case, the measurements were made by 10 units operating for about two months each. Another pilot program in Greeley, Colorado measured 70 percent of the area's fleet. (R. Klausmeier et al., "Draft Final Report - Evaluation of the California Pilot Inspection/Maintenance (I/M) Program" (Sacramento, California: California Bureau of Automotive Repair, 1995), R. Klausmeier and P. McClintock, "The Greeley Remote Sensing Pilot Program - Final Report" (Denver: Colorado Department of Public Health and Environment, 1998))

[144] There are roughly 200 million light-duty gasoline vehicles in the U.S. Assuming that half of these are in areas that need additional air pollution reductions, encouraging accelerated scrappage of 0.5 percent of them would likely cost no more than about $500 million (assuming an average cost of $1,000 per scrapped vehicle—the high end of what recent programs have offered). For an overview of issues in designing scrappage program, see Eastern Research Group, "Overview of Vehicle Scrappage Programs for Reducing In-Use Vehicle Emissions," (Austin, TX: July 2002).

achieving large air pollution reductions, this approach deserves a far more aggressive effort in areas with pollution problems.

A similar approach can be applied to diesel vehicles and equipment. However, because diesel engines last much longer than automobiles, retrofitting modern PM controls, or "repowering" older engines with new, lower-emitting ones are usually better choices than scrappage. No one has yet tried to target high-emitting diesels using remote sensing, but this may be possible as well. EPA has recently encouraged voluntary retrofit programs, while California provides funding for an incentive program to encourage public agencies and private businesses to repower or retrofit diesel vehicles and equipment.[145] Preliminary cost-effectiveness estimates suggest that diesel retrofit programs can also be much more cost effective than most other options for reducing NOx and PM pollution.[146]

Scrappage and retrofit programs would thus reduce both direct PM emissions and emissions of secondary PM precursors. Such programs have substantial advantages over blanket national regulations on power plants or new vehicles. First, they can be tailored based on the types of emission reductions most desirable in a given region. Second, they can be targeted toward the most cost effective emission reductions. Third, because they have few sunk costs, they can be easily scaled up or scaled back, depending on regional pollution-reduction needs and the availability of funding.

These programs also entail far fewer risks than either additional emission reduction requirements on power plants or on new vehicles. The latter programs result in substantial ongoing increases in energy costs and costs of new vehicles,[147] while scrappage and retrofit are one-time costs that speed the permanent removal of a large source of emissions. In addition to the direct harm these extra costs will impose on consumers, increasing the cost of new vehicles will also slow fleet turnover and its attendant pollution reductions. Nevertheless, regulatory agencies and environmental activists have emphasized additional controls on power plants and new vehicles, rather than more cost effective programs to deal with older high-polluting vehicles.

The evidence suggests that exposure to PM at current levels likely has little or no effect on mortality in most of the United States. Regardless, processes already set in

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[145] EPA, www.epa.gov/otaq/retrofit/, and California Air Resources Board, "The Carl Moyer Program Annual Status Report, March 26, 2002, www.arb.ca.gov/msprog/moyer/moyer.htm.

[146] CARB, "The Carl Moyer Program Annual Status Report," March 26, 2002, www.arb.ca.gov/msprog/moyer/2002report.pdf. The program generally does not target pollution reduction projects in order of cost effectiveness, so the cost effectiveness of retrofit program could probably be improved even further.

[147] For example, EPA estimates its "Tier II" regulation requiring substantial reductions in emissions from new gasoline vehicles starting in 2004 will cost $5.3 billion. This will make new cars more expensive, but will achieve relatively few overall emission reductions, because newer cars are already so much cleaner than the average car on the road. The federal Energy Information Administration (EIA) estimates that a 75 percent reduction in average power-plant NOx and SO_2 emissions (below levels already required under Title IV of the Clean Air Act and EPA's NOx "SIP Call" regulation) would add a few billion dollars per year to the nation's electricity bill (EPA, "Regulatory Impact Analysis: Tier 2 / Gasoline Sulfur Final Rulemaking." EIA, "Analysis of Strategies for Reducing Multiple Emissions from Power Plants: Sulfur Dioxide, Nitrogen Oxides, and Carbon Dioxide" (Washington, DC: 2000)).

motion guarantee substantial PM reductions in coming years. Additional near-term reductions in PM are probably best achieved by dealing with the stock of high-polluting older vehicles that account for a substantial portion of ambient PM levels in metropolitan areas. This flexible, more cost-effective approach is far more likely to result in net public health benefits than other proposals that are the focus of current legislative and regulatory activity and debate.

ABOUT THE AUTHOR

Joel Schwartz is an independent scientist and policy analyst specializing in air pollution and chemical risk policy, and a CEI Adjunct Scholar.

He has published extensively on a range of environmental science and policy issues. His most recent policy studies include "Particulate Air Pollution: Weighing the Risks," published by CEI, "No Way Back: Why Air Pollution Will Continue to Decline," published by the American Enterprise Institute, and "Hormonally Active Chemicals in the Environment," published by Reason Public Policy Institute. His commentaries have appeared in the *Atlanta Journal-Constitution*, *San Francisco Examiner, Washington Times*, and *Tech Central Station.*

Prior to becoming an independent scholar, Mr. Schwartz directed the Reason Public Policy Institute's Air Quality Project and was the Executive Officer of the California Inspection and Maintenance Review Committee—a government agency charged with evaluating California's vehicle emissions inspection program. He has also worked at the RAND Corporation, the South Coast Air Quality Management District, and the Coalition for Clean Air.

Mr. Schwartz holds a Bachelor's Degree in Chemistry from Cornell University and a Master's Degree in Planetary Science from the California Institute of Technology. He was a German Marshall Fund Fellow in 1993, during which he studied European approaches to transportation and air quality policy. He lives and works in Sacramento, California.

Appendix B

Competitive Enterprise Institute Comments on the Draft Report to Congress on the Costs and Benefits of Federal Regulation
May 5, 2003

THE ONGOING CLEAN-AIR DEBATE

THE SCIENCE BEHIND EPA'S RULE ON SOOT

KAY JONES AND BEN LIEBERMAN

June 2001

THE ONGOING CLEAN-AIR DEBATE

THE SCIENCE BEHIND EPA'S RULE ON SOOT

Kay Jones and Ben Lieberman

EXECUTIVE SUMMARY

The Environmental Protection Agency's 1997 standard for fine particulate matter is perhaps the most controversial environmental rule enacted during the Clinton administration. Critics both inside and outside the administration raised doubts about the claimed public-health benefits to be derived from this costly new standard, and EPA's own science advisory committee questioned its scientific support. Indeed, this rule, along with a concurrent new standard for ozone, drew more opposition than any other in the 30-year history of the Clean Air Act.

Implementation of the fine particulate matter rule has been delayed by litigation, but a recent Supreme Court decision should allow EPA to move forward. Meanwhile, the research on the health effects of fine particulate matter has continued, including an extensive reanalysis of the two key studies that were heavily relied upon by EPA in promulgating the rule. The agency has cited this research as vindication of its regulatory agenda and as justification for moving forward with it as soon as possible.

In truth, the evidence has yet to implicate fine particulate matter as a serious public-health threat. The recent research has only reinforced the original doubts as to the necessity of a new standard.

THE ONGOING CLEAN-AIR DEBATE

THE SCIENCE BEHIND EPA'S RULE ON SOOT

Kay Jones and Ben Lieberman

INTRODUCTION

Of all the environmental regulations enacted during the Clinton administration, the Environmental Protection Agency's 1997 rules setting new standards for ozone and particulate matter (smog and soot) remain among the most controversial. If implemented, these rules would likely become the costliest in the 30-year history of the Clean Air Act (CAA) and impact an unprecedented number of entities.

Perhaps most controversial of all is the science underlying EPA's claim that tightening the already strict existing standard for particulate matter was necessary to protect the public health. In fact, when the rules were finalized in 1997, there were still many unanswered questions about the reliability of the supporting evidence. Those both inside and outside the administration raised doubts about whether the benefits would exceed the costs.

Litigation has held up implementation of this rule and garnered most of the attention since 1997. On February 27, 2001, the Supreme Court removed several (but not all) of EPA's legal hurdles to moving forward, thus focusing attention once again on implementation.

When the rules were finalized in 1997, there were still many unanswered questions about the reliability of the supporting evidence.

In the meantime, research on the health effects of particulate matter has continued. This ongoing research, including an extensive reanalysis of two key particulate matter studies, has been cited by EPA as vindication of its regulatory agenda. However, as will be discussed below, recent findings have only reinforced the original doubts as to the necessity of a new particulate matter rule.

BACKGROUND

Title I of CAA regulates ambient concentrations (the amount in the air) of six so-called criteria pollutants—nitrogen oxides, sulfur dioxide, lead, carbon monoxide, ozone, and particulate matter.[1] EPA sets National Ambient Air Quality Standards (NAAQS) for each criteria pollutant, and states must submit plans for meeting those standards. States with areas not in attainment with the NAAQS are subject to increased EPA controls and potential penalties.

In the nearly 30 years this program has been in place, significant reductions have been measured in ambient concentrations for all six criteria pollutants.[2] In

fact, most of the nation is in compliance with the current NAAQS, and those areas not yet in attainment have shown marked improvement.

EPA is also required to review existing NAAQS every five years.[3] The agency must then tighten any existing standard, if, based on the latest evidence, it is no longer sufficient to protect public health with an adequate margin of safety. Revising a standard is a complex process, involving a thorough agency assessment of the relevant health research, called a Criteria Document, which is reviewed by EPA's Clean Air Scientific Advisory Committee (CASAC). From this, EPA develops a Staff Paper, also reviewed by CASAC, which contains the agency's recommendations. EPA then generates a Regulatory Impact Analysis, and proposes a new standard if deemed necessary. The five-year deadline to complete this process is very tight, especially for a pollutant like particulate matter, where the underlying science is complex. But if EPA fails to comply, any citizen or public-interest group may sue, compelling the agency to do so.[4]

The Revised Standard

In 1994, the American Lung Association successfully sued EPA for failing to complete a timely review of the particulate matter standard, which was last revised in 1987.[5] The resulting court order required an accelerated review process, to be completed in 1996. Based on this review, EPA chose to specifically target fine particulate matter—particles smaller than 2.5 microns in diameter (PM 2.5). On December 13, 1996, EPA proposed its new standard for PM 2.5, while keeping in place the existing rule for particulate matter less than 10 microns in diameter (PM 10, of which PM 2.5 is a subset).[6] The agency's initial proposal included a 24-hour standard of 50 (subsequently changed to 65) micrograms per cubic meter, and an annual standard of 15 micrograms per cubic meter, considered by most to be very stringent.[7] Although not covered under the court order, EPA concurrently proposed a new standard for ozone.[8]

Revising a standard is a complex process, involving a thorough agency assessment of the relevant health research.

EPA initially estimated the implementation costs of the PM 2.5 rule at $6.3 billion.[9] Some non-governmental analysts estimated costs for the rule in excess of $50 billion annually.[10] EPA calculated benefits ranging from $69 billion to $144 billion annually, based on estimated reductions in cardiopulmonary-disease-related deaths and cases of chronic bronchitis.[11]

Opposition to the New Standard

The proposed rules faced an unprecedented level of opposition. Groups as diverse as the National Black Chamber of Commerce and the American Farm Bureau Federation feared the costs of these measures would be higher than estimated by EPA and would vastly outweigh what they believed to be questionable benefits.[12] Even within the Clinton administration, the rules faced criticism from the Departments of Treasury, Transportation, Commerce, Energy, and Defense, as well as the Small Business Administration, Office of Science and Technology Policy, Council of Economic Advisors, and others.

Several agencies argued that the actual implementation costs would likely be considerably higher than initially estimated by EPA. Others questioned the scientific support. For example, the Office of Science and Technology Policy stated:

> the database for actual levels of PM 2.5 is also very poor, and only a handful of studies have actually studied PM 2.5 effects, per se. And current data do not support clear associations…so that causality for the observed mortality and morbidity effects cannot be established.[13]

A series of Congressional hearings highlighted numerous weaknesses in the case for the new standard, most notably the lack of clear support from the agency's own Clean Air Scientific Advisory Committee. George Wolff, CASAC chair, informed Congress of deficiencies in the science supporting the PM 2.5 standard, most of which could not be adequately addressed due to the abbreviated nature of the review process.[14] In particular, CASAC was concerned about copollutants—pollutants whose concentrations correlate with PM 2.5 and which may be the actual causative agent for the adverse health effects observed. According to Wolff, "ozone, sulfur dioxide, or carbon monoxide can be as important, and in some cases, more important than PM."[15] Further, to the extent PM is the problem, the evidence did not clearly establish that it is PM 2.5 and not the larger particles regulated by the PM 10 standard.[16]

Even slight errors in categorizing the smoking histories of study subjects can create a phantom PM 2.5 effect.

In addition, non-pollution-related confounding variables may have skewed the results. Smoking behavior is especially troublesome, as the same health effects believed to be correlated with PM 2.5 exposure are far more strongly correlated with smoking; thus even slight errors in categorizing the smoking histories of study subjects can create a phantom PM 2.5 effect.[17]

Pollution and non-pollution confounders are particularly problematic when trying to discern causation and dose-response relationships from epidemiologic studies showing weak correlations, as EPA did here.

The case for the new PM 2.5 standard rested almost entirely on two large epidemiologic studies, the Harvard Six Cities study and the American Cancer Society study.[18] Both studies concluded that a causal association exists between exposure to PM 2.5 and excess mortalities and incidence of cardiopulmonary disease. Otherwise, very little was known about PM 2.5. CASAC was given little information regarding its makeup, ambient concentrations, levels of exposure, or plausible biological mechanisms by which it affects human health.[19] In fact, much of the case for regulating PM 2.5 came from extrapolations of PM 10 studies.

Although CASAC agreed that a new PM 2.5 standard was advisable, Wolff stated that "only a minority of the Panel members supported a range that includes the present EPA proposals."[20]

As a consequence of these and other criticisms, both the Senate and House introduced bills to block implementation of the new rules.[21] These bills enjoyed

substantial bipartisan support, and represented the first serious congressional challenge to major Clean Air Act regulations. However, the bills were ultimately withdrawn when it became clear that they lacked the two-thirds support necessary to override an expected presidential veto.

In spite of the controversy, EPA finalized the rules on July 18, 1997.[22] EPA's victory was temporary, however, as the rules were immediately challenged in court. Over 40 parties, including both large and small businesses and several state governments, sought to overturn the new standards. The US Court of Appeals invalidated the rules on May 14, 1999, essentially forcing the agency to start over in setting new standards.[23] The decision was largely based on factors other than the underlying science. EPA appealed the case to the US Supreme Court, which released its opinion on February 27, 2001.[24]

In most respects, the Supreme Court's decision is a victory for EPA. Although there still are important implementation details to be worked out by the US Court of Appeals, the Supreme Court decision will likely allow the agency to move forward with a new fine particulate matter standard.

THE CURRENT STATE OF THE SCIENCE SUPPORTING THE PM 2.5 STANDARD

In promulgating the new PM 2.5 standard, EPA had to rely heavily on the Harvard Six Cities and American Cancer Society studies. Members of Congress, CASAC, state-level environmental officials, and industry groups had critical concerns about these studies. Yet, both EPA and the researchers who conducted the work refused all requests for access to the underlying data, effectively denying any chance of independent review. To the limited extent PM 2.5 data were available to other researchers, some concluded that PM 2.5 has not been implicated as a public-health threat.[25]

Given the disproportionate weight accorded these two studies and the widespread questions about their reliability, the refusal to share the data heightened suspicions that the PM 2.5 standard had shaky support. The episode led to new legislation mandating the release of data from federally funded research, when that research is relied upon in setting regulations (although EPA has yet to comply with these provisions).[26]

In a compromise between Congress and EPA, the Health Effects Institute (HEI), an independent research organization sponsored by both government and industry, funded an extensive reanalysis of these two studies. Known as the Reanalysis Project, the results were released in July 2000.[27] EPA immediately claimed its 1997 conclusions regarding PM 2.5 were validated. EPA Administrator Carol Browner stated that HEI "re-evaluated the science and confirmed our results."[28] John Bachmann, EPA Associate Director for Science Policy, asserted that "there is no mistaking that particulate matter is the culprit," and that the reanalysis "strengthens our ongoing scientific re-

view."[29] In addition, Senators Max Baucus (D-Mont.) and Joe Lieberman (D-Conn.) responded by warning their colleagues that any attempt to "attack future proposed standards as 'inadequate'…will not be tolerated."

After the Supreme Court's decision, the agency will revisit the issue and decide whether to go forward with the proposed PM 2.5 standard. EPA is currently reviewing all new research on particulate health effects and will publish a revised Criteria Document in the near future. The Criteria Document will review the HEI reanalysis of the Harvard Six Cities and American Cancer Society studies, as well as other recent additions to the literature. A discussion of the HEI reanalysis and two other key studies follows below.

The Harvard Six Cities Study Reanalysis

This study involved the comparison of chronic mortality data (deaths potentially attributable to long-term exposure to air pollution) to air pollution levels in six cities with different annual PM 2.5 levels (the average level over the span of a year) covering the period 1980 to 1988. The possible influence of cofactors (non-pollution-related variables such as education level, smoking history, or income, that can also influence the health effects at issue) was included in the original study as well as the reanalysis. The relative risks (the extent health risks change with changing levels of exposure to a pollutant) of PM 2.5, sulfur dioxide, and other air pollutants were reported. However, these other pollutants were not directly compared with PM 2.5 in multi-pollutant models (a simultaneous study of two or more pollutants to determine the one most strongly associated with the health effects at issue). An article in *Science* described this reanalysis as "a major victory" for EPA.[30] However, the key results as reported by the Reanalysis Project but not highlighted were:

To the limited extent PM 2.5 data were available to other researchers, some concluded that PM 2.5 has not been implicated as a public-health threat.

u there was no significant association between PM 2.5 and mortality among non-smokers;

u four of the six cities did not show a statistically significant difference in mortality risk with increasing PM 2.5 levels;

u the relative risks were essentially the same for other pollutants as for PM 2.5. The reanalysis team did not conduct multi-pollutant modeling to ascertain which pollutant or pollutants were most strongly associated with mortality.

The American Cancer Society Study Reanalysis

The original study was a chronic-mortality study involving 50 cities (increased to 63 by the Reanalysis Project), using PM 2.5 and sulfur dioxide data for the years 1979 to 1983. The reanalysis expanded the original analysis to examine the singular and combined effects of non-pollution cofactors as well as air pollutants other than PM 2.5. The key results contained in the Reanalysis Project report were:

u there was no significant association between PM 2.5 levels and mortality for persons with more than a high school education, regardless of age, smoking status, or level of exercise;[31]

u when all of the other cofactors which influenced the PM 2.5 relative risks were combined, the association between PM 2.5 and mortality was not significant;

u when sulfur dioxide was included in a multi-pollutant model, it displaced PM 2.5 as the pollutant of concern. The relative risk for sulfur dioxide was statistically significant, while the relative risk for PM 2.5 with the inclusion of sulfur dioxide in the model failed to achieve significance.

The National Morbidity, Mortality, and Air Pollution Study (NMMAPS)

Contrary to the statements made by EPA and others, there is no evidence that the PM 2.5 standard is supportable at this time.

In addition to the Reanalysis Project, HEI undertook this original study on particulate matter and health. As with the above two studies in the Reanalysis Project, NMMAPS has also been publicized as providing support for EPA's PM 2.5 agenda, although it addressed PM 10 and not PM 2.5. This publicity included another article in *Science* touting it as perhaps the most definitive study on the subject.[32] The study attempted to correlate the incidence of acute mortality (sudden deaths caused by short-term exposure to pollutants) with the level of PM 10. The goal was to determine whether the acute mortality rate increased on days with higher-than-average PM 10 pollution. The following NMMAPS results are noteworthy:

u when the 90 city results are examined individually, only nine show a statistically significant association between daily differences in PM 10 and acute mortality—81 cities show no significant association;

u there was no statistically significant association between PM 10 and acute mortality in four of the seven regions studied;[33]

u the effect of other air pollutants, in particular ozone, was not fully addressed;[34]

u the smoking status of study subjects was not taken into consideration.

The Washington University/EPRI Veterans' Cohort Mortality Study[35]

This chronic-mortality study is unique in that it examines a highly sensitive captive population for which detailed personal histories are known, in some 32 cities across the nation. The study population of 90,000 male US veterans was highly susceptible to air pollution effects because the individuals studied had preexisting hypertension heart disease. The data for particulate matter of various sizes were available back to 1953, while the PM 2.5 data were limited to a narrower period, 1979 to 1984. The results of this study contrast rather

dramatically with the public pronouncements from EPA (but generally concur with HEI's actual results) in that it found:

u no statistically significant association between mortality and PM 2.5 with or without the inclusion of any other variables;

u a stronger association between both ozone and nitrogen dioxide and mortality than particulate matter and mortality.

CONCLUSION

Contrary to the statements made by EPA and others, there is no evidence that the PM 2.5 standard is supportable at this time. In fact, CASAC's 1996 conclusion still holds true today, that "the diversity of opinions also reflects the many unanswered questions and uncertainties associated with establishing causality of the association between PM 2.5 and mortality."[36]

NOTES

[1] Clean Air Act, 42 U.S.C. §§ 108-109.
[2] Environmental Protection Agency, "Latest Findings on National Air Quality: 1999 Status and Trends," August 2000. Although many attribute these positive air quality trends to the federal government's involvement since the 1970 CAA, it should be noted that the declines in air pollution began before 1970, thus it is likely that state and local controls as well as technological advances have made substantial contributions to cleaner air. See Indur Goklany, "Clearing The Air: The Real Story of the War on Air Pollution," (Washington, DC: Cato Institute, 1999).
[3] 42 U.S.C. § 109(d).
[4] 42 U.S.C. § 304(a)(2).
[5] *American Lung Association v. Browner*, 84 F.Supp. 345 (D. Ariz. 1994).
[6] 61 Fed. Reg. 65,637 (December 13, 1996).
[7] The 24-hour standard (the daily average) is designed to protect against short-term spikes in particulate concentrations, while the annual standard protects against long-term exposures. The unit of measurement is the mass of particles 2.5 microns or less in size per cubic meter of air.
[8] 61 Fed. Reg. 65,715 (December 13, 1996).
[9] EPA, "Regulatory Impact Analysis for Proposed Particulate Matter National Ambient Air Quality Standard," December 1996 (EPA Regulatory Impact Analysis). EPA subsequently revised the cost estimate to $8.6 billion.
[10] Anne E. Smith, et al., "Costs, Economic Impacts, and Benefits of EPA's Ozone and Particulate Matter Standards," Reason Public Policy Institute, June 1997.
[11] EPA Regulatory Impact Analysis, Table 9-11. EPA subsequently reduced its estimate of annual deaths attributed to PM 2.5 from 20,000 to 15,000, after Dr. Kay Jones (the lead author of this monograph) discovered that the agency made an error in interpreting its data; Kay Jones, "Is EPA Misleading the Public About the Health Risks from PM 2.5?" report prepared for Citizens For A Sound Economy Foundation, May 1997.
[12] National Black Chamber of Commerce, "New Rules Will Crush Efforts to Rebuild, Revitalize Inner Cities, Minority Leaders Tell Administration," June 5, 1997, press release; American Farm Bureau Federation, "Flawed Air Standards Would Choke Agriculture," July 22, 1997, press release.
[13] Memorandum from Rosina Bierbaum, Acting Associate Director at the White House Office of Science and Technology Policy, to Sally Katzen, Office of Management and Budget, entitled "OSTP Questions For EPA On Its Proposed Revisions To The Ozone and Particulate Matter Air Quality Standards," November 15, 1996.
[14] George T. Wolff, "The CASAC Review Of The Ozone And PM Standards," written testimony before the House Subcommittees on Health and Environment and Oversight and Investigations, April 10, 1997.
[15] Ibid.
[16] Ibid.
[17] Jones, "Is EPA Misleading the Public," pp. 14-18.
[18] Douglas W. Dockery, et al., "An Association Between Air Pollution and Mortality in Six U.S. Cities," *New England Journal of Medicine*, vol. 329 (1993), pp. 1753-1759 (cited below as Harvard Six Cities study); C.A. Pope, et al., "Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults," *American Journal of Respiratory Critical Care Medicine*, vol. 151 (1995), pp. 669-674 (cited below as American Cancer Society study).
[19] Wolff, "The CASAC Review Of The Ozone And PM Standards."
[20] Ibid.
[21] H. R. 1984 and S. 1084, 105th Congress (1997).
[22] 62 Fed. Reg. 38,652 (July 18, 1997); 62 Fed. Reg. 38,856 (July 18, 1997). The 24-hour standard for PM 2.5 was changed to 65 micrograms per cubic meter.
[23] *American Trucking Associations v. Environmental Protection Agency*, 175 F.3d 1027 (D.C. Cir. 1999) *rehearing granted in part, denied in part* 195 F.3d 4 (D.C. Cir. 1999).
[24] *Whitman v. American Trucking Associations*, 531 U.S._____(2001).
[25] Suresh Moolgavkar, et al., "Particulate Air Pollution, Sulfur Dioxide, and Daily Mortality, A Reanalysis of the Steubenville Data," *Inhalation Toxicology*, vol. 7 (1995), pp. 35-44; Jones, "Is EPA Misleading the Public," pp. 18-19.
[26] Jennifer Zambone, "The Data Access Law: Decreasing Secret Science While Increasing Accountability" (Washington, DC: Competitive Enterprise Institute, June 7, 1999).
[27] Health Effects Institute, "Synopsis of The Particle Epidemiology Project," press release, July 2000.
[28] Carol Browner, National Press Club, October 3, 2000; available at epa.gov/opa/admspchs.
[29] Bureau of National Affairs Daily Environment Report, "Independent Review of Studies Used by EPA Verifies Link Between Particulates, Mortality," August 1, 2000, p. AA-1.
[30] Jocelyn Kaiser, "Panel Backs EPA and 'Six Cities' Study," *Science*, vol. 289, August 4, 2000, p. 711.

[31] The importance of education status strongly suggests that socioeconomic or demographic factors have a more significant public-health impact than particulate matter exposure, and that these factors have not been adequately addressed in the original study or the reanalysis.
[32] Jocelyn Kaiser, "Evidence Mounts That Tiny Particles Can Kill," *Science*, vol. 289, July 7, 2000, pp. 22-23; but see Suresh Moolgavkar, "Consideration of Copollutants," *Science*, vol. 290, October 20, 2000, p. 453.
[33] The NMMAPS investigators did not provide any rationale for their regional boundaries used in the Regional Adjustment Model, other than citing EPA's prior designation. There is no obvious logic for their boundary assumptions. For example, the 11 Texas cities were split into two geographical regions, and the San Joaquin Valley was similarly divided. In addition, Oakland, Sacramento, San Jose, Stockton, and Modesto, California, and Denver and Colorado Springs, Colorado, were all considered Northwest cities. This unexplained regionalized approach may well have biased the results.
[34] This is due to data trimming (the removal of high and low values so they don't unduly influence the statistical analysis), as well as the averaging time used for the ozone data. The ozone and mortality association found in the Veterans' Cohort study supports this criticism.
[35] Frederick Lipfert, et al., "The Washington University-EPRI Veterans' Cohort Mortality Study: Preliminary Results," *Inhalation Toxicology*, vol. 12, supp. 4 (2000), pp. 41-73.
[36] George T. Wolff, Closure Letter on Draft OAQPS Staff Paper on Particulate Matter from Chairman of Clean Air Scientific Advisory Committee to EPA Administrator, June 13, 1996.

ABOUT THE AUTHORS

Kay Jones is the head of Zephyr Consulting, a Seattle-based environmental consulting firm. Dr. Jones was a senior advisor on air quality to the president's Council on Environmental Quality during the Ford and Carter administrations. He also served as a senior technical advisor and research manager at the Environmental Protection Agency.

Ben Lieberman is a senior policy analyst at CEI. His most recent work has focused on the effect of EPA regulations on energy prices. Mr. Lieberman also covers the consumer impact of environmental regulations, such as those mandating low-flush plumbing fixtures and energy-efficient appliances and residences. He received his JD from the George Washington University.

Appendix C

Competitive Enterprise Institute Comments on the Draft Report to Congress on the Costs and Benefits of Federal Regulation
May 5, 2003

REGULATORY
REFORM
PROJECT

Jump, Jive an' Reform Regulation

HOW WASHINGTON CAN TAKE A SWING AT REGULATORY REFORM

CLYDE WAYNE CREWS JR.

February 2000

ISSN# 1085-9087

Jump, Jive an' Reform Regulation

How Washington Can Take A Swing At Regulatory Reform

Clyde Wayne Crews Jr.

EXECUTIVE SUMMARY

Cost-benefit analysis has long been a centerpiece of regulatory reform proposals, with mixed success. Policymakers still largely don't know the full benefits and costs of the regulatory enterprise. The January 2000 Office of Management and Budget (OMB) *Draft Report to Congress on the Costs and Benefits of Federal Regulations* is the latest attempt to survey the extent of the regulatory state, but has severe limitations both in execution and enthusiasm.

The cost-benefit analysis that Congress requires in OMB's reports is informative, but it is not itself capable of bringing the largely unaccountable regulatory state congressional control. Instead, improved measures to enhance *congressional accountability* and *cost disclosure* matter most to any regulatory reform effort. Effective regulatory reform must make regulatory *costs* as transparent as possible through such tools as improved annual cost and trend reporting, and enact institutional reforms that allow voters to hold Congress responsible for the regulatory state by ensuring a congressional vote on major agency rules before they are effective. One such proposal is the Congressional Responsibility Act introduced by Rep. J.D. Hayworth (R-AZ) and Sen. Sam Brownback (R-KS). Rather than merely try to force resistant and unaccountable agencies and the OMB to report on regulatory benefits, Congress should internalize the need to demonstrate and maximize regulatory benefits.

Jump, Jive makes the following proposals aimed at improving Congress's accountability and cost disclosure:

- Halt Regulation Without Representation: Require Congress to Approve Agency Regulations
- Publish an Annual Regulatory Report Card
- Require that Agencies Calculate Costs, but not Benefits
- Lower "Major Rule" Thresholds
- Create New Categories of Major Rules
- Explore Regulatory Cost Budgets
- Publish Data on Economic and Health/Safety Regulations Separately
- Disclose Transfer, Administrative and Procedural Regulatory Costs
- Explicitly Note Indirect Regulatory Costs
- Agencies and the OMB Must: (1) Recommend Rules to Eliminate and (2) Rank Rules' Effectiveness
- Create Benefit Yardsticks to Compare Agency Effectiveness
- Reconsider Review and Sunsetting of New and Existing Regulations
- Establish a Bipartisan Regulatory Reduction Commission to Survey Existing Rules

JUMP, JIVE AN' REFORM REGULATION

How Washington Can Take A Swing At Regulatory Reform[1]

Clyde Wayne Crews Jr.

INTRODUCTION: THE EXCESSIVE COSTS OF COST-BENEFIT ANALYSIS

Income and excise taxes are the costs of government that citizens pay directly, but there are also indirect costs of government that consumers and businesses bear. Pollution controls, workplace and consumer product regulations, price and entry regulations–all these are well-known components of the regulatory machinery. Health, safety and environmental regulations alone cost between $174 and $234 billion of dollars each year according to the Office of Management and Budget's (OMB) January 2000 *Draft Report to Congress on the Costs and Benefits of Federal Regulations*.[2] Economic regulations and paperwork costs add billions more. Knowing how much of citizens' resources the federal government consumes is a fundamental requirement if consumers are to safeguard their pocketbooks.

Figure 1: Estimates of the Total Annual Benefits and Costs of Social Regulations
(in billions of 1996 dollars, as of 1999)

	Benefits	**Costs**
Environmental Regulations	$97 to 1,595	$124 to 175
Transportation Regulations	$84 to 110	$15 to 18
Labor Regulations	$28 to 30	$18 to 19
Other	$55 to 60	$17 to 22
Total Costs	$264 to 1,795	$174 to 234
Net benefit range		**$30 to $1,621**

Source: OMB, *Draft Report to Congress on the Costs and Benefits of Federal Regulations*, January 2000.

Many observers recognize that regulations often are not well-targeted and cost more than they should. Concerned reformers call for such measures as improved cost-benefit analysis, better assessment of risks to ensure that real rather than trivial hazards are targeted, periodic reviews of statutory regulations, and reductions in regulatory paperwork. Such reforms are important, but they have their limits. They don't get to the fundamental question of who should be in charge of the regulatory state.

Despite widespread appreciation that regulations can get out of hand, the highly charged political atmosphere that erupts upon any hint of a comprehensive reform effort has seemingly rendered Congress incapable of overhauling the regulatory state and making its activities more above-board.[3]

Wide-ranging cost-benefit analyses and risk assessments of health and safety reforms, the changes that reformers most often seek, are easily portrayed by opponents of regulatory overhaul as attacks on agencies, and even on the very notions of public health and safety. As Competitive Enterprise Institute President Fred Smith noted, the most recent high-profile regulatory reform effort (as part of the Republican "Contract With America") was characterized by opponents as "Mad-dog Republican ideologists join with robber-baron capitalists to regain the right to add poison to baby food bottles."[4] The notion that ill-conceived regulations can cause harm received scant attention, and still does.

Regulatory reform is often characterized by opponents as "Mad-dog Republican ideologues join with robber-baron capitalists to regain the right to add poison to baby food bottles."

Important incremental reforms have been made, however. Unfunded mandates reform, small business regulatory relief, and paperwork reduction have been implemented. Another important development over the past few years has been the improvement in regulatory disclosure stemming from the requirement that OMB issue its reports to Congress. While agreement on these reports' format and content has been elusive, the reporting has been valuable and should be made permanent rather than commanded on a year-to-year basis through an add-on to an appropriations bill, as has been the history of this document. Yet another important development has been the compilation of a database on regulations, and sometimes their costs, by the General Accounting Office (GAO).[5]

There is considerable room for improving both content and format of OMB's reports. Nevertheless, cost-benefit analysis–or any kind of procedural reform, for that matter–still doesn't amount to fundamental regulatory reform. OMB, the federal agency watchdog, can do only so much on its own; agencies issue most of their significant regulations because Congress requires it, so they couldn't police themselves even if they wanted to. Along with the important role OMB plays, institutional reforms in the way Congress regulates are needed. Therefore this paper addresses both the roles of both Congress and OMB.

The Constitution designates an elected Congress, not agencies, as America's lawmaking body. Excessive, regulatory agency lawmaking is made possible by Congress either deliberately or carelessly delegating too much legislative power to agencies. Instead of maligning these "out of control" agencies, Congress ought to end "regulation without representation" at its congressional source by approving agency rules upon completion but before they are binding on the public. Without accountability to Congress, agencies can regulate with little concern for weighing costs and benefits. Agencies can never be held accountable to voters, so poor regulatory policies

are unlikely to affect their ability to proceed undisturbed–no matter how much OMB's reports improve.

The mischaracterization of regulatory reform will persist and sink every major regulatory reform initiative until Congress is targeted rather than derivative agencies that are doing Congress's bidding. The link between agency proposals and congressional responsibility for outcomes must be reestablished. Furthermore, emphasizing congressional accountability instead of cost-benefit analysis is consistent with other popular reforms that aim at reining in congressional power such as term limits, committee reform, and lobbying reform. Moreover, agencies pay little heed to what other agencies are doing, and thus inherently cannot contribute to government-wide priority setting among competing regulatory goals. That is a job for Congress. Figure 2 puts regulatory reform's major requirements in a nutshell.

Figure 2: What Does Regulatory Reform Require?

- Cost-benefit analysis? Perhaps, but not really the answer.
- ***Cost disclosure*** and ***congressional accountability*** matter most. The challenge is to make regulatory *costs* as transparent as possible through such tools as annual regulatory reporting, and for voters to have the ability to hold Congress directly responsible for regulations by requiring its approval of new rules. That process would permit Congress to internalize the responsibility to demonstrate and maximize regulatory benefits, rather than try to force resistant and unaccountable agencies to do the same thing. In addition to these ongoing processes, the existing body of rules should be reviewed occasionally.
- In other words, "No regulation without representation!" Regulatory reform should be a populist, not technical, issue.

The key contribution of regulatory reform should not be the increasing accuracy of cost estimates alone, but its role in making Congress more accountable for the regulatory state. Enhancing congressional accountability would help improve regulatory benefits as a by-product by forcing Congress to put its stamp of approval on regulations in full public view. Similarly, agencies brought before oversight committees would often be induced to "compete" for the right to regulate by openly comparing the severity of the risks they regulate with those of other agencies. Since excessive delegation of legislative power to unelected agencies, rather than a failure to perform cost-benefit analysis, is the fundamental root of regulatory overreach, and it is Congress that must be reformed. The following section provides further details on this theme, and remaining sections cover regulatory disclosure and review.

HALT REGULATION WITHOUT REPRESENTATION: REQUIRE CONGRESS TO APPROVE AGENCY RULES

Despite the constitutional stipulation that "All legislative Powers herein granted shall be vested in a Congress of the United States," mandates issued by unelected agency employees are laws. Delegation severs the crucial connection between the power to establish regulatory programs, and responsibility for the results of those programs, institutionalizing regulation without representation. Congress benefits when agencies get the blame for regulatory overreach. Delegation allows Congress to take credit for popular regulatory initiatives, while blaming agencies for costs.

A Competitive Enterprise Institute survey found that 76 percent of Americans "agree that Congress should be required to approve regulations written by federal bureaucrats and administrators before they take effect."

Since cost-benefit analysis is inevitably caricatured as an attempt to put price tags on human life, there may be broader public appeal in a campaign to end regulation without representation. A 1999 Competitive Enterprise Institute survey found that 76 percent of Americans "agree that Congress should be required to approve regulations written by federal bureaucrats and administrators before they take effect.[6] Not only is congressional accountability a more appropriate principle around which to structure regulatory reform, it may be more politically achievable and defensible than cost-benefit or risk assessment analysis in many instances–such as the obvious case when benefits are not quantifiable in dollar terms. Where cost (or cost-benefit) analyses cannot be conducted, or appear impossible to conduct, it is difficult to know whether a particular rule is worthwhile. In such instances the case for sending a rule of uncertain merit back to Congress for approval is clear and compelling.

There has been some progress in the direction of accountability. The 104th Congress passed the Congressional Review Act (CRA), which set up a process for congressional disapproval–not active approval, however–of agency rules. At least symbolically, that was an important recognition of the need for congressional accountability; however short it falls of requiring that Congress go out of its way to approve regulations. Under the law, when an agency publishes a final regulation, a 60-day waiting period commences, a pause that allows Congress to pass a resolution of disapproval to halt the regulation should it so decide. However, the CRA has yet to stop a rule, largely because Congress benefits from the ability to delegate power. Delegation also allows Congress, facing a fundamental time constraint, to increase the amount of legislation it creates, and therefore the number of voting interest groups that it appeases.[7]

The CRA's requiring rule disapproval rather than approval creates another problem. Suppose Congress were to pass a resolution of disapproval and reject a rule. Should the President veto the resolution, Congress would then need to summon a two-thirds supermajority to strike the undesired regulation. This turns the legislative process backward: it should be hard to

pass bad law, not to get rid of it. The Congressional Responsibility Act introduced by Rep. J. D. Hayworth (R-AZ) and Sen. Sam Brownback (R-KS) would go the extra step beyond CRA of requiring congressional approval of agency rules.[8]

It should be hard to pass bad law, not to get rid of it.

A concern with having Congress approve agency rules will be that the legislative process may become bogged down. This isn't the case. Congress can approve agency rules on an expedited basis, or vote on bundles of rules at a time. Clearly Congress can design whatever process it chooses to deal with agency rules on a fast-track basis: the point is that it must deal with agency rules. What kind of society is it that makes so many laws that the elected legislature can't even pass them all? If Congress is spending too much time approving agency rules, that's signifies in a fundamental way that it has delegated too much power.

If answerable for agency-wide priorities, Congress stands in a position to maximize overall benefits in a way that isolated agencies performing cost-benefit analysis could never do. Federal agencies by design are devoted to a single or limited purpose, and have no incentives to assist in the setting of government-wide priorities by making cross-agency comparisons of regulatory options. Thus, only congressional accountability for rules can avoid agency tunnel vision that afflicts regulatory policy. There is no escaping the requirement that Congress must set and approve the broad goals.

Ending regulation without representation would also lessen the problems caused by the fact that agencies are disinclined to quantify or state regulatory costs and benefits in money terms. If rules return to Congress for final approval, Congress will answer for their worthiness regardless of whether agencies take into account costs and benefits. So long as accountability applies, the inability or unwillingness of agencies to conduct cost-benefit analysis is little cause for concern: every elected representative will be on record as either in favor of or opposed to a particular regulation. If regulatory benefits aren't apparent, or if regulatory costs are excessive, citizens have recourse at the ballot box that they will always lack with agencies.

What kind of society is it that makes so many laws that the elected legislature can't even pass them all?

In this sense congressional accountability would offer greater assurances that a regulation's benefits exceed costs. A congressional disinclination to rubber-stamp unjustified rules could inspire agencies to ensure their rules meet a reasonable cost-benefit benchmark before sending them to Congress.

There is no question that Congress likes the fact that delegation allows agencies to take the heat. Given that fact, perhaps one way to get started instituting congressional accountability would be to require a congressional vote for major rules whose costs cannot be quantified, as well as for rules with statutory deadlines that agencies and OMB will never assess. Even stringent cost-benefit analysis wouldn't have much effect in these particular instances, so the need to return such rules to Congress is more apparent.

One way to get started instituting congressional accountability would be to require a congressional vote for major rules whose costs cannot be quantified, as well as for rules with statutory deadlines that agencies and OMB will never assess.

While the public awaits full congressional accountability (indeed it could be a very long wait) steps can still be taken to aggressively monitor and audit agency output. This is the other half of the accountability and disclosure approach to regulatory reform. The incremental regulatory reform options that follow–including Regulatory Report Cards–all have full accountability as their goal. Like the spotlight the annual federal budget shines on government tax policy, a Regulatory Report Card would publicize regulatory costs and trends. That in turn could improve congressional accountability by providing agencies and Congress incentives to ensure that (implied) benefits exceed costs. Even if Congress were to enact the ultimate reform and approve every agency regulation, annual regulatory cost disclosure would remain important. After all, imposing taxes and imposing regulations can be substitutes for one another. Pressures to maintain the U.S. budgetary surplus could increase pressures to regulate unless the "regulatory budget" is known as well.

PUBLISH AN ANNUAL REGULATORY REPORT CARD

The OMB has regarded the adding up of the many varieties of regulatory costs as an apples and oranges exercise and an "inherently flawed approach."[9] Nonetheless some effort to present an aggregate estimate of all costs must be made.

Without consistent summary information about regulatory trends and costs, the ability to debate reform measures is squelched. A considerable amount and variety of regulatory data already exists, but is scattered across government agencies rather than assembled intelligibly in one location. In fact, more than 4,000 rules from more than 50 departments, agencies and commissions appear in the *Unified Agenda of Federal Regulations* each year. Of these, well over 100 are considered "economically significant," meaning they cost at least $100 million annually. This information and much more could be easily condensed and published as an annual chapter on the state of regulation: its cost, and its impact on productivity, gross national product, competitiveness, and so on. The summaries could be compiled into a few charts and historical tables either in the federal budget, the *Economic Report of the President*, or the *Unified Agenda*. Even without enactment of stringent cost-benefit requirements, the data would provide valuable information to researchers, scholars, policymakers and the regulated public.

Items that might be included in a Report Card include: total numbers of major and minor rules produced by each agency; costs of economically significant or major rules; numbers of rules lacking cost estimates; the top rule-making agencies; numbers of rules facing statutory or judicial deadlines; numbers of rules impacting small businesses, and state and local government. Figure 3 includes these and other examples:

Figure 3: Regulatory Report Card
<u>…with 5-year historical tables…</u>

- "Economically significant" rules and minor rules by department, agency and commission
- Numbers/percentages impacting small business and lower-level governments
- Numbers/percentages featuring numerical cost estimates
- Tallies of existing cost estimates, with subtotals by agencies and grand total
- Numbers/percentages lacking cost estimates
- Short explanation lack of cost estimates
- Analysis of the *Federal Register*: Number of pages, proposed and final rule breakdowns by agency
- Numbers of major rules reported on by the GAO in its database of reports on regulations
- Most active rule-making agencies
- Rules that are deregulatory rather than regulatory
- Rules that affect internal agency procedures alone
- Rollover: Number of rules new to the *Unified Agenda*; number that are carry-overs from previous years
- Numbers/percentages required by statute vs. rules agency discretionary rules
- Numbers/percentages facing statutory or judicial deadlines
- Rules for which weighing costs and benefits is statutorily prohibited
- Percentages of rules reviewed by the OMB, and action taken

Pressures to maintain the U.S. budgetary surplus could increase pressures to regulate unless the "regulatory budget" is known as well.

A Report Card would provide a range of relevant regulatory information without bogging down in the controversial "net benefit" analyses emphasized by OMB in its annual reports. Note that where costs aren't available, the proportion of each agency's significant rulemakings lacking estimates can easily be tabulated and published. This exercise wouldn't be wasted effort; rather, knowing where cost estimates do and do not exist would help highlight the best and worst agency efforts at cost disclosure and competence in congressional oversight. Knowing the percentages of rules with and without benefit calculations would reveal whether or not we can truly say the regulatory enterprise is doing more harm than good. Cumulatively, years of reporting will help uncover any agency attempts to circumvent regulatory disclosure, such as any proliferation of minor rules to avoid the $100 million threshold that would trigger an economically significant or major label. A flurry of minor rules might indicate that major rules are being broken up to escape the major classification.

With an eye toward improving Report Cards (and the OMB reports created under current law), Congress could have agencies prepare their own detailed assessments of the scope and costs of their regulations. The Environmental Protection Agency's *The Benefits and Costs of the Clean Air Act 1990 to 2010* is a notable recent example, and received notice and criticism in the OMB Draft Report.[10] The findings of such aggregate studies, combined with annual Report Cards and increasing doses of congressional accountability, would help assure more informed policymaking.

Until 1993, information such as numbers of proposed and final rules, and major and minor rules was collected and published in an annual document called the *Regulatory Program of the United States Government*, in an appendix titled "Annual Report on Executive Order 12291." This report specified what actions a then-more-aggressive OMB took on proposed and final rules it reviewed, along with data for the preceding 10 years. The *Regulatory Program* also provided considerable detail on specific regulations that were sent back to agencies for reconsideration, and listed rules withdrawn. The report also included comparisons of the most active rule-producing agencies, and analysis of numbers of pages and types of documents in the *Federal Register*. The *Regulatory Program* was abandoned when the Clinton administration replaced EO 12291 with an order that returned rulemaking primacy to the agencies and reduced OMB's oversight authority.

The material featured in the former *Regulatory Program* should be revived as part of the annual Report Card. In a small way, what the fiscal budget is to tax policy, the *Regulatory Program* was to regulatory policy. It helped portray the off-budget scope of government, if not in terms of actual regulatory costs, at least in terms of trends in numbers of rules at the agencies. Figure 4 provides an overview of charts and tables formerly compiled in the *Regulatory Program*.[11]

Figure 4: Information Collected in the former *Regulatory Program of the U.S. Government*

- Total number of OMB reviews of regulations, by agency; presented in number, and as a percentage of the total. The material was presented in pie charts and tables
- Number of major ($100 million-plus) and non-major rules, by agency
- A chart comparing the major and non-major rules from current and previous years
- A brief description of all major proposed and final rules
- The twenty most active rule-producing agencies, by number of rules reviewed, 1981-1991
- A chart on types of actions taken on rules reviewed by OMB; "Total Reviews" were broken down as follows: "Found consistent (with executive order principles) without change;" "Found consistent with change;" "Withdrawn by agency;" "Returned for reconsideration;" "Returned because sent to OMB improperly;" "Suspended;" "Emergency;" "Statutory or judicial deadline"
- Several pages of detail on the actions taken on rules reviewed
- Average review time
- A listing of rules exempted from review procedures
- Numbers of *Federal Register* pages, current and prior years
- Analysis of aggregate pages published in the Federal Register (total pages; average pages per month; percentage change year to year; percentage change from 1980 to present
- A breakdown of overall proposed and final rule documents in the *Federal Register*
- Analysis of aggregate final rule documents published in the *Federal Register* by number and percent. These were broken down into New requirement; Revision to existing requirement; Elimination of existing requirement, and Other
- Number of final rule documents by agency

The very fact that OMB often must rely on outside estimates of the costs imposed by the government it helps administer speaks volumes about the lack of accountability over regulatory costs, and the value of enhancing regulatory reporting. But even without formal cost-benefit requirements, an official Report Card would reveal the scope of the regulatory state. While illustrating agency effectiveness, it would also reveal Congress's own responsibility for the extent of the regulatory burden: By showing which rules face congressionally mandated statutory deadlines or prohibitions on cost-benefit analysis, policymakers would gain a better sense of how regulation often is not subject to agency control.

REQUIRE THAT AGENCIES CALCULATE COSTS, BUT NOT BENEFITS

One way to help stem the unending controversy over having agencies weigh regulatory benefits and costs is to simply stop attempting to have agencies weigh costs and benefits. The problem with agency-driven cost-benefit analysis is that, to work, an agency would often need to admit that a rule's benefits do not justify the costs. That rarely happens.

Knowing the percentages of rules with and without benefit calculations would reveal whether or not we can truly say the regulatory enterprise is doing more harm than good.

Agencies face incentives to enlarge their scope by overstating and selectively expressing benefits of their activities. If agencies are encouraged to offset costs of regulation with benefits, as net-benefit analysis requires, regulations will rarely fail a cost-benefit test in the eyes of agencies. No matter how costly or inconvenient, a 15 mph speed limit and mandatory 15-foot bumpers *would* save lives; some agency somewhere could legitimately claim the benefits therefore outweigh the costs.

Agencies should concentrate solely on assessing and fully presenting the costs of their initiatives–much as the federal budget focuses only on the amounts of taxes, not the benefits of the dollars spent.

Emphasizing costs doesn't mean that benefits can be ignored, by any means. In the act of legislating, Congress makes calls regarding where legislative benefits lie and raises taxes and appropriates funds accordingly. Likewise, regulatory benefits sought should be articulated by a Congress that takes responsibility for agency regulatory priorities. If Congress were required to approve agency rules, its implied priorities would become revealed given the potential benefits within the agencies' purview. If agencies operate within an environment in which they will likely be required to defend their regulatory initiatives in oversight hearings and face the requirement that Congress shall bestow final approval or disapproval upon their rules, they may be more inclined to produce rules that have clearer benefits and lower costs. Focusing agencies' attention on costs of their initiatives can indirectly prod them toward maximizing benefits by competing to prove that they save

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the most lives or achieve some other regulatory goal at lower cost than a rival agency. As a result, Congress may choose to rethink some regulatory priorities.

As the legislative prime mover, Congress must make the judgements about which benefits are worth securing through legislation and, ultimately, regulation. The proper time to assess regulatory benefits is while Congress is contemplating legislation that later will become translated into regulations. Saving benefit appraisals solely for the time regulations are written is backward. *Those benefits were presumably the reason for Congress's seeking legislation in the first place*. Doubtless, the manner in which agencies implement rules will have different impacts on benefits; but that doesn't change the fundamental point that the pursuit of certain specified benefits must pre-justify regulation. It is not up to unelected regulators to concoct rationalizations after the fact. Once again the importance of the concept of "no regulation without representation" arises: agencies shouldn't unilaterally decide that benefits are present and that regulations are justified; that determination is a matter for elected lawmakers.

Net-benefit analysis suffers from other problems. The *taxes* individuals pay are not in any way offset by the benefits those taxes provide: No one speaks of a *net* tax benefit with the implication that taxation costs individuals nothing since benefits outweigh the costs. Only grateful recipients would tolerate such claims. Similarly, regulations transfer wealth, and benefits from those transfers don't necessarily accrue to everyone equally. An agency's claim that a regulation produces benefits begs the question of *whose* benefits are promoted, and whose resources were used to achieve those benefits. Moreover, the reality of benefits is often a matter of considerable debate. For example, whether such initiatives as the Department of Energy's costly energy efficiency requirements for appliances are beneficial or wasteful will never be agreed upon. Such disagreements are another argument for congressional approval of regulations rather than agency free rein.

There is yet another advantage of stripping agencies of benefit calculation requirements (They may and should assess benefits voluntarily, of course). Calculating cost-benefit information is a daunting task. But setting aside benefit calculations in the interest of allowing more informative cost analysis will truncate OMB's (and agencies') calculation job. As stipulated by executive order, agencies already assess the costs of some of their major ($100 million-plus) rules with Regulatory Impact Analyses, and these analyses are subject to public comment. But eliminating the mandatory benefit assessment greatly frees resources to improve these analyses. It is difficult enough for policymakers to agree on the benefits of *on-budget* activities whose costs are fully known (Amtrak, highways, welfare), let alone off-budget regulations.

Agency net-benefit estimates also are notoriously wide-ranging, making it difficult to conclude anything about the effectiveness of the regulatory state. The OMB reports a huge range of possible net benefits, noting that "health, safety and environmental regulation produces between $32 billion and $1,621 billion of net benefits per year."[12] Moreover, of the thousands of regulations, just a relative handful may be responsible for the bulk of benefits.

As a practical matter, OMB would be unlikely to aggressively review all agency benefit estimates. In 1999, Agencies were at work on 4,538 rules.[13] But in preparing the 2000 *Draft Report to Congress*, the OMB reviewed 44 of them, less than one percent.[14] What is more, the OMB often monetizes annual benefits only for those rules for which agencies have already quantified them in some manner.[15] Clever agencies can avoid scrutiny by not quantifying benefits. Given that prominent reform proposals today call for recognition of "non-quantifiable" benefits, with the implication that these offset costs, agencies are invited to exaggerate benefits, as well as present yawning ranges of benefits. Finally, *independent* agencies–unlike executive agencies that are required to perform some cost-benefit analysis–present "relatively little quantitative information on the costs and benefits of major rules."[16] Beefing up requirements for cost disclosure would be both more achievable and more useful.

Saving benefit appraisals solely for the time regulations are written is backward. Those benefits were presumably the reason for Congress's seeking legislation in the first place.

Agencies should assess as accurately as possible the costs of their initiatives, which would allow them to more fully analyze more rules with the staffing resources that otherwise would have been directed at benefit assessments. Regulatory benefits are properly Congress's worry. Agencies' proper role is to achieve Congress's pre-determined benefits at least cost, not to determine what those benefits are. This approach will help assure that Congress discloses what it thinks is reasonable for the public to spend to achieve those benefits.

LOWER "MAJOR RULE" THRESHOLDS

If OMB and agencies concern themselves primarily with disclosing regulatory costs, that presents an opportunity to improve reporting and present far more meaningful analysis than that seen today. Under current policies, agencies designate rules "economically significant" or "major" when they cost at least $100 million annually. The October 1999 *Unified Agenda of Federal Regulations*, for example, contained 137 major rules at various stages in the pipeline.[17] If implemented, these rules will cost at least $13.7 billion ($100 million times 137 rules) annually. But note that this threshold only reveals the *minimum* level of costs. The new OMB *Draft Report to Congress*, to its credit, includes tables listing major rules individually, along with their cost estimates where available.

OMB's report as well as most significant studies of regulatory costs naturally focus on major rules, by implication taking agencies at their word that the remaining body of regulations isn't significantly costly. But this isn't necessarily so. The "major" classification would capture more rules if the threshold were lowered. After all, costly rules of up to $99 million can yet dodge the "major" or "significant" label and escape close review by the OMB and other parties. Examples include workplace rules under consideration at the Occupational Safety and Health Administration to address slip, trip and fall hazards.

To address regulations that deserve to be analyzed but that escape scrutiny because they cost less than $100 million, the "major" rule threshold should be reduced to, for example, $25 million annually. This is still a high level of yearly costs. Lowering the threshold will increase the number of rules brought to public attention each year. Disclosing a wider range of costs is fairer to the public, more consistent toward instilling greater accountability in the regulatory system, and not particularly difficult either, especially if agencies are focusing their attention on regulatory costs instead of benefits. With the emphasis placed on costs, the reporting burden becomes much more manageable as well as more informative.

CREATE NEW CATEGORIES OF MAJOR RULES

The threshold at which a rule qualifies as economically significant should be lowered.

As noted, if OMB and agencies emphasize disclosure of regulatory costs–rather than net benefits–to the best of their abilities, that would allow for the presentation of cost analyses considerably more meaningful, and in greater number, than available today. Lowering the threshold at which a rule qualifies as economically significant to capture more regulations is one important step in improving cost disclosure. In addition to lowering the threshold, disclosure would be improved by grouping rules in terms of increasing costs. A new shorthand, beyond merely "economically significant," to refer to increasingly costly classes of major rules would be worthwhile.

The economically significant threshold merely specifies a *minimum* level of costs, revealing that a rule costs more than $99.9 million–but not *how much* more. For example, as noted, the 137 major rules in the October 1999 *Unified Agenda* will cost *at least* $13.7 billion annually. But that's the best one can tell without combing through the *Agenda* or agency cost analyses.

The adoption of additional categories of major rules could easily be realized. OMB and agencies (or Congress) could develop simple guidelines for breaking up economically significant rules into separate categories that represent increasing levels of annual costs, summaries of which could be presented in annual Regulatory Report Cards. Figure 5 offers one suggested breakdown of regulations by assigning them an official category:

Figure 5: Proposed Breakdown of Economically Significant Rules

Category 1	**> $100 million, <$500 million**
Category 2	**> $500 million, < $1 billion**
Category 3	**> $1 billion**
Category 4	**> $5 billion**
Category 5	**>$10 billion**

The benchmark categories, the ones above or some variant, could be selected based on a review of the costs of major rules over the past few years to get an idea of the range of regulatory costs the various agencies are typically generating. By assigning rules to categories, the economically significant designation would carry substantially more meaning than it currently does. Today, merely knowing that a rule is economically significant tells far too little, unless one takes needless, troublesome extra steps of digging up a regulatory impact analysis for more cost detail. For example, some studies of EPA's ozone-particulate matter regulations find that by 2010, the ozone component will cost at least $1.1 billion, and that the particulate matter portion will cost $8.6 billion annually.[18] In this case, knowing that EPA imposed "Category 3" and "Category 4" rules would be far more informative shorthand than merely knowing that both rules are economically significant.

EXPLORE REGULATORY COST BUDGETS

From the government's point of view, spending and regulating can be substitutes for one another. That means pressures to maintain the federal budget surplus could increase pressures to regulate. That possibility increases the urgency of accounting for regulatory costs.

Some have proposed formal regulatory budgeting, which would go beyond the mere reporting of costs. There are many potential versions of a cost budget, some better than others.[19] Lamar Smith, Texas Republican, proposed a version in the 103rd Congress that would require House and Senate budget committees to allocate new regulatory costs for the upcoming seven years to the appropriate authorizing committees, who would in turn allocate costs among agencies. Points of order would apply when agencies under an authorizing committee's jurisdiction report regulatory costs that exceed their allocation. Any member could offer legislation under an expedited procedure to freeze regulations within a committee's jurisdiction.

Another offering, perhaps simpler to implement, is the 106th Congress's bipartisan Mandates Information Act, which would go further in the direction of congressional accountability. This bill would require that Congress explicitly take account of private sector mandates by instituting a point of order against legislation that would cost more than $100 million annually. The Congressional Budget Office would provide the cost estimates on which

From the government's point of view, spending and regulating can be substitutes for one another. That increases the urgency of accounting for regulatory costs.

Congress would base its decision. If raised, the point of order would halt action on bill unless waived by a simple majority vote. By this measure, Congress implicitly approves the imposition of regulatory costs at the time new legislation is created. By requiring cost disclosure for new legislative mandates, Congress would assume significantly more responsibility for what agencies do. Annual cost information by agency and a grand total could be provided to the public in the annual Regulatory Report Card.

Sen. Orrin Hatch (R-UT) also proposed a variant of a regulatory cost budget. During the 103rd Congress, Senator Hatch introduced S. 13, a simple three-year "cost cap" version of a regulatory budget.[20] This proposal was basically a freeze; it would cap regulatory costs at the level prevailing at the time of adoption by requiring any new regulation to be offset by repeal or modification of an existing one. Agencies could freely issue new regulations, but would need to offset the cost by eliminating one or more existing rules of roughly equal cost, or by persuading another agency to eliminate a regulation on its behalf. This is a relatively modest approach, simply holding total regulatory costs at today's aggregate level by requiring that any new regulation be offset by one of equal or greater cost.

The variations on the theme of regulatory cost budgeting are probably endless. What matters is that it be explored. Even if Congress were required to explicitly approve every agency regulation–the "ultimate" regulatory reform–cost tallies would still be essential for the same reasons it is essential that the U.S. formally budget its revenues and outlays. No politician would dream of taxing the public and not providing an accounting of revenues and outlays. Perhaps that policy may eventually apply to regulation also. Preliminary regulatory budgets could be limited in scope to emphasize costs and avoid trying to shift to agencies the accountability that should lie with Congress.

PUBLISH DATA ON ECONOMIC AND HEALTH/SAFETY REGULATIONS SEPARATELY

An assumption underlying regulatory activism is that markets aren't perfect but that political decisionmaking can make up for that shortcoming. The very basis of regulation is the belief in the selflessness of government actors and the fairness of political markets relative to private ones.

That presumption certainly deserves critical analysis. Suffice it to say that, indeed, environmental rules and health and safety rules are popular, generally regarded as advancing the public welfare. But economic regulation, on the other hand, has clearly lost much of its luster over the past decades. Whether wholesale intervention like macroeconomic fine-tuning, or more limited government management of an industry's output and prices (such as agricultural quotas, rules governing electricity generation prices or rules

restricting entry into the trucking industry), economic regulation no longer is automatically assumed to advance consumer welfare. [21]

In its cost estimates over the years, OMB has properly distinguished between economic regulations on the one hand, and environmental/social regulation on the other. While OMB finds net benefits of the entire regulatory enterprise to be positive, separating regulations into either the "economic" or "social" category would help underscore the relative lack of benefits of economic regulation.

One reason economic regulation is no longer regarded as efficient is that regulations don't always spring from a desire to protect the public interest. Often regulation is used to transfer wealth to protect the interests of the regulated parties themselves instead of the public interest. That guarantees regulatory failure. Campaigns to deregulate economic sectors like electricity and telecommunications partly embody a general realization that regulation can hurt more than it helps.

Less recognized is that both environmental and social regulations are likewise subject to political failure and "pork barreling." Even health and safety regulation can harm consumers and benefit regulated firms seeking to protect profits through political means, for instance by seeking to hobble a competitor by raising its costs through regulation. The Food and Drug Administration's food labeling restrictions, for example, limit the health claims food producers can make. But that policy may benefit established food producers that already enjoy healthy reputations and the good graces of the public by making it difficult for upstarts to compete on the basis of health characteristics. To compete, newcomers must instead emphasize features like microwaveability, convenience or taste. The imposed downplaying of health features of new products could have precisely the opposite effect expressed by regulators in their justifications for the regulation.

Both economic and social regulations can be exploited by regulated parties to transfer wealth to themselves.

Other examples of the misuse of regulation include butter producers' attempts to portray margarine as unsafe and filthy at the dawn of the margarine industry,[22] and the advocacy of environmental regulations by businesses that calculate the costs will drive their competitors out of business.[23]

Since health and safety regulations differ in intent from economic regulation, costs and trends in them should be presented separately in Regulatory Report Cards. Purported economic benefits from a trade regulation cannot in any meaningful way be compared with lives saved by a safety regulation. Since no common basis exists for comparing the benefits of economic regulation with health and safety regulation, separating the two kinds of rules will offer reviewers the opportunity to better assess the merits of each, and also better assess when either kind of regulation is being exploited.

DISCLOSE TRANSFER, ADMINISTRATIVE AND PROCEDURAL REGULATORY COSTS

Within the economic and health/safety regulatory categories, further breakdowns within a Regulatory Report Card are warranted. Involuntarily borne costs, such as the paperwork costs involved in tax compliance and workplace reporting requirements, are hardly minimal, and it is appropriate to officially disclose these kinds of cost where possible.

The fact that someone pays on the basis of government compulsion means that government must openly account for both taxes and regulation.

Transfer costs: Transfer costs are those produced when income shifts from one pocket to another, for example from consumers to farmers through farm production quotas that keep prices artificially high. OMB has properly noted that "Redistributive effects, or 'income transfers' should also be measured, noted, and presented to policymakers to help in forming their decision."[24] The need for disclosure of regulatory transfers is most apparent by analogy to the tax code. Our entire tax code is a gigantic system of income transfer: Surely no politician would claim that, since funds go from one pocket to another there are no real costs, and thus no disclosure (budget) is necessary, and taxes can be ignored. The fact that *someone* pays on the basis of government compulsion, regardless of the benefit to a third party, means that the government must openly account for both taxes and regulation.

For purposes of *disclosure* to the public, it makes little difference whether regulations represent direct compliance costs or transfers. To those paying the costs of the transfer, costs are real enough. The US has not embraced a policy of extreme utilitarianism such that supposedly neutral transfers are acceptable so long as "society's happiness" is maximized. *Individual* rights matter–and that means any governmentally imposed costs that individuals bear should be disclosed. An official policy of ignoring or failing to disclose regulatory redistribution invites abuse and further transfers. Regulations and taxation both are subject to interest group manipulation.

Administrative and procedural costs: Analogous to the distinction between economic and social regulation, regulatory cost studies or Report Cards should further distinguish "interventionist" initiatives that regulate private conduct from those that merely affect the public's dealings with the government.

Clearly certain agency activities represent "services" provided by government to the public rather than regulation. Rulings such as those changing eligibility for federal programs, use and leasing requirements for federal lands, and revenue collection standards, should be noted separately from the economic and environmental/social regulations that normally represent the focus of regulatory reform. Service-oriented administrative paperwork–such as that for business loans, passports, and getting government benefits–are other examples. Similarly, agencies could also separately present those rules that affect agency procedures only.

EXPLICITLY NOTE INDIRECT REGULATORY COSTS

Apart from direct compliance costs and transfers, regulations can have other impacts on economic productivity, efficiency and safety that are difficult to measure or are not always immediately apparent. Such indirect costs include reduced employment and hampered job creation, costs that ultimately impact consumers. Regulations can have other perverse effects that are properly regarded as "costs." For example, such interventions as the Corporate Average Fuel Economy standards and drug lag at the Food and Drug Administration can cost human lives. The Endangered Species Act, by imposing land use controls once a listed species is detected on private property, can lead property owners to ensure that their property never becomes livable habitat in the first place. The costs here can include both the costs of lost use of property, and the needless loss of species.

All these examples illustrate the need to monitor indirect costs. The ambiguity of indirect costs alone suggests that policymakers should be particularly sensitive and guard against indirect effects wherever possible. Indeed, some have argued that indirect regulatory costs could even exceed the magnitude of direct costs.[25] Ignoring indirect costs will lead officials to underestimate the true impacts of regulation and thus over-regulate.

Acknowledging indirect costs is a matter of fairness and accountability in government. If indirect costs are too difficult to compute, then government cannot credibly argue that regulatory compliance is simple or straightforward. If government doesn't regard compliance itself as too complex, then the government cannot claim that merely assessing the costs of compliance is too cumbersome.

If indirect costs are too difficult to compute, then government cannot credibly argue that regulatory compliance is simple or straightforward.

Explicit acknowledgment of indirect regulatory costs is necessary even though precise measurement will always be impossible. Luckily, opportunity costs apply even to the economists who review regulations: if agencies are no longer required to perform benefit assessments as recommended in this paper, manpower remains available to better assess and describe indirect regulatory costs.

The wrong kind of incentives could be disastrous. If Congress routinely allows regulators to ignore indirect costs, then regulations will tend to impose them. Suppose outright input or product bans are regarded as indirect costs and not counted in regulatory assessments: after all, they involve no direct "compliance costs" as these are generally understood. Under that structure, nearly every environmental regulation could be expected to entail a ban so regulators would avoid posting high regulatory costs. Part of the answer is to exercise particular caution when imposing those types of regulations–such as product bans–most likely to lead to indirect costs. Determining the sorts of regulatory activities that tend to impose indirect costs would require further analysis.

If government doesn't regard compliance itself as too complex, then the government cannot claim that merely assessing the costs of compliance is too cumbersome.

Ultimately, the only way to properly incorporate indirect regulatory costs into governmental priorities is to require Congress to approve significant final agency rules and thereby internalize such costs. At that level of accountability, handwringing over indirect costs becomes unnecessary. There is no shame or failure in settling for indirect cost estimates that are admittedly rough, so long as regulatory dollars are ultimately allocated in loose correspondence with where an *accountable* Congress believes benefits to lie.

AGENCIES AND THE OMB MUST: (1) RECOMMEND RULES TO ELIMINATE AND (2) RANK RULES' EFFECTIVENESS

Agencies and the OMB should recommend rules to eliminate each year, of their own accord, however unlikely this is without congressional action. OMB, in its *Draft Report to Congress*, is too timid about recommending regulations to eliminate. Instead, OMB grants benefit of the doubt to regulators, going so far as to claim that the agencies' presentations of certain of their deregulatory priorities counts as a recommendation for reform since OMB had provided guidance to them earlier. OMB notes, "The 164 regulations under development in the *Regulatory Plan* may be viewed as specific recommendations for regulatory improvement or reform based on statutory mandates and the Administration's priorities."[26]

Ultimately, the only way to properly incorporate indirect regulatory costs into governmental priorities is to require Congress to approve significant final agency rules and thereby "internalize" such costs.

In fact, agencies have compiled *Regulatory Plans*–annual documents in which they specify priorities for the upcoming year–since 1994, well before OMB was ever required to perform its reports to Congress on regulatory costs and benefits. In spite of its unique knowledge of the regulatory state, all the OMB ventures to do is restate and endorse a few of the agencies' self-offered reforms–ones they were already undertaking. OMB's reluctance here has received congressional support as well. Sen. John Glenn (D-OH), during debate over legislation that led to the creation of the 1998 *Report to Congress*, noted that "OMB will not have to engage in extensive analyses of its own, but rather is expected to use existing information."[27] The OMB likewise noted, "[I]t is the agencies that have the responsibility to prepare these analyses, and it is expected that OIRA will review (but not redo) this work."[28]

Therefore, getting agencies to recommend rules to regulate will require some significant prodding. To clear out regulatory underbrush, Congress should ask agencies to propose rules to cut at the time they offer their submissions for the annual Report Card. If agencies claim not to be able to recommend rules to cut, there are other options. Congress could instead rank health and safety agencies' regulations in terms of potential lives saved, for example. That would let Congress view the costs or emphasis of various agencies' rules in light of their effectiveness, which would set the stage for getting agencies to compete to prove that their least effective rules are superior to another agency's rules. The results of such an exercise could be presented in the Regulatory Report Card.

Regulatory impulses typically place the burden of proof on those who would remove a rule rather than on those who would impose it in the first place. But increasing the degree to which agencies compete with one another should help bring to the surface the fact that regulatory benefits may not always be what they seem, and give OMB the ammunition it needs to recommend cuts in regulation:

- Agencies' have incentives to overstate benefits (just as businesses have incentives to overstate costs).
- Benefits are selectively expressed. For example, air bags and seat belts may induce some to drive more recklessly, placing *others* at risk.
- The benefits of a particular regulation are rarely compared with benefits that the same compliance costs could achieve by another agency, or by state and local regulatory authorities. The benefits of leaving dollars in the public's hands rarely get attention.
- Regulatory requirements may reduce benefits by setting *lower bounds* that regulated parties meet. Safety should be a competitive feature, not one locked in at some minimal level. Competitive incentives for exceeding a particular rule's requirements should be preserved.

Agency benefit claims should be regarded with more healthy suspicion than OMB is willing to muster. OMB can serve as a check to assure that regulators not take credit for nonexistent benefits or benefits that markets would provide on their own.

If agency analyses appear not to justify a rule, OMB should be forthright and not shy away from making recommendations about modifying regulatory programs. In 1998, for example, OMB did question some of EPA claims regarding clean air regulatory benefits, for which the EPA's "estimate implies that the average citizen was willing to pay over 25 percent of her personal income per year to attain the monetized benefits."[29] It will always be an uphill battle to get the agencies and OMB to recommend rules to eliminate; hence the more fundamental argument for congressional accountability.

There is no shame or failure in settling for indirect cost estimates that are admittedly rough, so long as regulatory dollars are ultimately allocated in loose correspondence with where an accountable Congress believes benefits to lie.

CREATE BENEFIT YARDSTICKS TO COMPARE AGENCY EFFECTIVENESS

As noted, if agency regulatory analyses under Executive Orders or independent analyses appear not to justify certain rules, then OMB should be forthright and say so, and should more aggressively help develop tools to aid Congress's assessment of complex rules.

In the meantime, OMB's reluctance to recommend rules to eliminate needn't stop it from developing tools that will aid in regulatory assessments. The process of reviewing regulations needn't always be overly complex, or

subject to tedious analytical techniques. Here is one methodological approach, for example, that could be used in ranking rules: OMB could note the cost of a presumably beneficial regulation. Then, OMB could compare the benefits it is purported to offer to the alternative benefits that could be had if the compliance costs went instead toward hiring policemen or firemen, or simply toward painting while lines down the middle of unmarked rural blacktop roads.

This isn't meant to be cynical. OMB has the experience and know-how to create "benefit yardsticks" of its own, so to speak, by which it can objectively critique high cost, low benefit rules in an annual Report Card. OMB can recommend some modifications of regulatory programs based on plain common sense. Rather than complex risk assessment, regulatory costs can be compared to known reducible risks and ranked on that basis, even across agencies. OMB in the past has performed extremely useful analyses of the cost effectiveness of rules that can be built upon. This is the kind of aggressiveness Congress needs from OMB.

RECONSIDER REVIEW AND SUNSETTING OF NEW AND EXISTING REGULATIONS

Many of the foregoing regulatory accountability and disclosure options focus primarily on *future* mandates, not the existing multi-hundred-billion-dollar regulatory state.

OMB has the experience and know-how to create "benefit yardsticks" of its own, so to speak, by which it can objectively critique high cost, low benefit rules in an annual Report Card.

Review of the current stock of regulations is needed as well, because rules already on the books get a free ride whether they are truly beneficial or not. For example, as the General Accounting Office has noted, "Assessments of the costs and the benefits of EPA's regulations after they have been issued have rarely been done. Of the 101 economically significant regulations issued by EPA from 1981 through 1998, only five were the subject of retrospective studies."[30]

An option that could work might be similar to that proposed as a part of the Contract With America. In 1995 the House Government Reform and Oversight Committee reported the Regulatory Sunset and Review Act (H.R. 994). That bill would have required regulations to sunset after seven years unless reviewed and recommended for continuation by the agencies. Though it ultimately didn't pass, the bill was amended to apply only to $100 million major rules, which would have provided little relief for small businesses and would invite agencies to break regulations up into small bits to avoid review. A further drawback is the fact that agencies, not Congress, would have made the primary determination about whether a regulation continues. But the bill was important in noting the need to revisit earlier regulations.

In requiring that OMB report to Congress on regulatory costs and benefits and to make policy recommendations, Congress is relying on OMB and agencies to police themselves and make recommendations that actually cut against their own interests. That approach has obvious limitations, as noted throughout this paper. Another option for ongoing review of rules is for Congress to take the lead through a regulatory analogue of the Congressional Budget Office. One such bill proposes to establish a Congressional Office of Regulatory Analysis, whose job would be to monitor federal regulation.[31]

ESTABLISH A BIPARTISAN REGULATORY REDUCTION COMMISSION TO SURVEY EXISTING RULES

Whether piloted by a more aggressive OMB or a Congressional Office of Regulatory Analysis, or both, periodic reviews and occasional sunsetting of regulatory underbrush are needed. Yet these could require years to have a significant impact. Furthermore, even if Congress were required to approve regulations, that process would target future mandates rather than the existing regulatory state.

So–what about the overhaul of the existing mass of regulations? One reasonable model for reform is that embodied by the military base closure and realignment commission, which helped resolve the politically impossible task of closing obsolete bases one at a time by instead assembling a bundle of them to vote on at once. Carrying the technique over to the regulatory arena, Congress could appoint a bipartisan Regulatory Reduction Commission that could begin to assess agency regulations and hold hearings, and from that survey assemble a yearly package of proposed regulatory reductions. The package would then be subjected to an up or down, all-or-nothing vote by Congress, with no amendments permitted. The approved package would then be sent to the President for signing. Any Commission recommendation that required no legislation could be implemented directly by the President.

The filtering process of holding hearings combined with the bundling of regulations from across the spectrum of government activity could make the Commission's recommendations more difficult to oppose politically. As in the base closure model, everybody stands a good chance of getting "hit," thus the bundling provides political cover. The Commission could be kept active for as many years as Congress deems necessary, and potentially could shave off large chunks of ineffective regulations over a number of years. Moreover, establishing a commission sooner rather than later will reduce the number of regulations up for reauthorization at the end of the sunset or review periods mentioned earlier. Trimming rules in this manner would over time make annual surveys of the regulatory state more manageable, and greatly improve the quality of disclosure and openness in the regulatory state. The Commission process would also be both aided by, and would contribute to, the annual Regulatory Report Card process.

CONCLUSION

Given the problems in sensibly implementing regulatory policy, *cost disclosure* and *congressional accountability* are needed to guarantee the regulatory enterprise always does more good than harm, and Congress must play the ultimate oversight role in that process. Agencies should focus on cost analysis and on preparing summary Regulatory Report Cards for prominent presentation in the federal budget or some other annual publication. These reports should focus on costs rather than benefits, display multiple classes of major rules, and take several other steps designed to maximize public disclosure of regulatory information. OMB could begin displaying such information in its annual reports to Congress. Along with improved annual regulatory disclosure, steps should be taken to halt the culture of "regulation without representation." Congress should approve agency regulations to preserve the principle of representative government and to ensure that regulatory policies genuinely make sense.

ABOUT THE AUTHOR

Clyde Wayne Crews Jr. is the Director of Competition and Regulation Policy at the Competitive Enterprise Institute, where he studies general regulatory and antitrust reform, risk and environmental issues, electricity deregulation, and other budget issues. Wayne has been published in *The Wall Street Journal*, *The Journal of Commerce*, *American Enterprise*, *The Washington Times*, *The Electricity Journal*, *Public Utilities Fortnightly*, *Journal of Regulation and Social Costs*, and elsewhere. He has appeared on various television and radio programs. Before joining CEI in 1995, Wayne was a legislative aide in the United States Senate, responsible for regulatory and welfare reform issues. Earlier, he was an economist and policy analyst at the Citizens for a Sound Economy Foundation, and before that an economist at the Food and Drug Administration and a research assistant at the Center for the Study of Public Choice at George Mason University. He holds an M.B.A. from the College of William and Mary and a B.S. from Lander College in Greenwood, South Carolina.

ENDNOTES

[1] This paper responds in part to the U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, *Draft Report to Congress On the Costs and Benefits of Federal Regulations* (Washington, D.C., 2000). Available on the Internet at http://www.whitehouse.gov/omb/inforeg/index.html.
[2] *Draft Report*, p. 12 and Table 3 (attachment).
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[5] Located on the Internet at http://www.gao.gov/rules.htm.
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[9] *Draft Report*, p. 6.
[10] *Draft Report*, p. 12-14.
[11] *Regulatory Program of the U.S. Government*, April 1, 1992-March 31, 1993, Appendix IV, "Executive Order No. 12291 Annual Report for 1991."
[12] *Draft Report*, p. 12.
[13] Compiled by CEI from the *Unified Agenda of Federal Regulations*, Regulatory Information Service Center, October 1999.
[14] *Draft Report*, p. 23.
[15] *Draft Report*, p. 29.
[16] *Draft Report*, p. 28.
[17] Compiled by CEI in Clyde Wayne Crews, Jr., *Ten Thousand Commandments: An Annual Policymaker's Snapshot of the Federal Regulatory State*, (Washington, D.C.: Competitive Enterprise Institute, 2000).
[18] "Costs of Ozone Standard Outweigh Benefits, Final Impact Analysis Shows," *BNA Daily Environment Report*, no. 142 (July 24, 1997).
[19] Clyde Wayne Crews, Jr., "Promise and Peril: Implementing a Regulatory Budget," *Policy Sciences*, vol. 31, no. 4 (December 1998).
[20] Senator Orrin Hatch, "Regulatory Accountability Starts Here," *Congressional Record* floor statement, vol. 139, no. 43 (March 31, 1993).
[21] For example, in Table 4 on p. 19 in the earlier *Report to Congress On the Costs and Benefits of Federal Regulations, 1998*, efficiency benefits are "not estimated but likely to be small."
[22] Celia Bergoffen, "Margarine Wars," *Audacity: The Magazine of Business Experience*, vol. 3, no. 4 (Summer 1995), pp. 52-61.
[23] Jonathan H. Adler, "Rent Seeking Behind the Green Curtain," *Regulation*, no. 4 (1996) pp. 26-34.
[24] *Draft Report*, p. 8.
[25] William G. Laffer III and Nancy Bord, "George Bush's Hidden Tax: The Explosion in Regulation," *Heritage Foundation Backgrounder*, no. 905 (July 10, 1992), p. 18.
[26] *Draft Report*, p. 35.
[27] U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, *Report to Congress on the Costs and Benefits of Federal Regulations*, (Washington, D.C., 1998), p. 102.
[28] *Report to Congress*, 1998, p. 45.
[29] Ibid., p. 26.
[30] General Accounting Office, *Report to Congressional Requesters, Environmental Protection: Assessing the Impacts of EPA's Regulations Through Retrospective Studies*, (GAO/RCED-99-250, September 1999), p. 2.
[31] Angela Antonelli, "Two Years and 8600 Rules: Why Congress Needs an Office of Regulatory Analysis," *Heritage Foundation Backgrounder*, no. 1192, (June 26, 1998).

Appendix D

Competitive Enterprise Institute Comments on the Draft Report to Congress on the Costs and Benefits of Federal Regulation
May 5, 2003

MAKING UP THE NUMBERS:
A Critique of the Contingent Valuation Methodology
And Its Application in Public Policy

Roger Bate

November 1993

INTRODUCTION

"For at least the last twenty-five years, economists have recognized the possibility that individuals who make no active use of a particular...natural resource might, nevertheless, derive satisfaction from its mere existence, even if they never intend to make active use of it."[1] For example, the delight one may feel at the vast expanse of the untouched wilderness of Antarctica would be one such "existence value."

While a heated debate is raging among academic environmental economists as to whether such existence values or nonuse values (NUVs)[2] can be quantified, the federal government is attempting to legislate for their enumeration. Under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Oil Pollution Act of 1990 (OPA), the Departments of Commerce and the Interior are developing federal regulations to impose liability for injuries to natural resources caused by discharges of hazardous substances and petroleum. For example, if toxic waste is released into a river, the commercial value of the fish killed can be established and some form of enjoyment loss can be assessed for amenity users. However, it is the question of whether nonuse values can be applied in these liability claims that has caused interest in the calculation of NUV over the past few years.

Even those in favor of measuring nonuse values acknowledge there are many problems in doing so. The contention of this paper is that the values measured are unreliable, both statistically and methodologically, and do not conform to any recognized economic theory. The one legal application, so far, of nonuse values suggests that further use in liability claims would impose unacceptable risks on the insurance industry, and lead to vastly increased social costs.

This paper is divided into several of sections. The first details the origins of nonuse value theory, and the method chosen to calculate these values. The second section details the epistemological and methodological objections to the method of NUV calculation. The third section outlines the measurement problems of nonuse values. The fourth section explains the role of an expert panel convened to analyze the role nonuse values could have in liability claims. The conclusion summarizes the findings of this paper.

1. THE ORIGIN AND DEVELOPMENT OF NONUSE VALUE THEORY

The intellectual origin of nonuse values (NUV) is an article by J. V. Krutilla published in 1967[3]. He felt that environmental resources would be undervalued if calculations were based was a reliance purely on recreational user fees of a site. He argues that, "There are many persons who obtain satisfaction from mere knowledge that part of wilderness North America remains even though they would be appalled by the prospect of being exposed to it."[4] He makes the case for unique, collectively important and irreplaceable assets, such as the Grand Canyon, and he limits his analysis to these sites as he felt that where sites had many substitutes valuation would be made very difficult. Significantly, the tendency of later writers has been to apply NUV to sites of less distinction.

Since Krutilla's article was published resource use has increased, and with it greater knowledge of man's impact on the environment. Most western governments have made various attempts to deal with the perceived consequences. One such attempt, from America, was CERCLA. Under the authority of CERCLA, the Department of the Interior and the Department of Commerce have been developing federal regulations calling for damages for "loss of natural resources."[5] One of the areas of controversy over CERCLA was whether liability could be imposed for nonuse values. Indeed, there was a public meeting to discuss this very point at the Department of Commerce (DOC) on August 12, 1992.[6] The panel[7], convened by the National Oceanic and Atmospheric Administration (NOAA) to investigate the use of NUV, has since reported. Its report is quoted extensively in this paper, as it will form the basis of the forthcoming regulation.

Prior to this meeting, there was a very influential ruling in State of Ohio v. U.S. Dept of the Interior[8] on July 14, 1989, in which the court allowed lost nonuse values to be claimed in damage assessment. However, the Department of the Interior had promulgated regulations in August 1986 that limited damage assessment to actual loss of value. Uncertainty over the legal status of nonuse values has led to inconsistency in legal suits, some being prepared with NUV-derived damage assessments and others without. One of the aims of the 1992 DOC/NOAA meeting was to reduce this uncertainty.

By definition, NUVs cannot be assessed from observing behavior. The chief method of calculation of NUV employed by environmental economists is the survey technique of Contingent Valuation (CV). It is so-called because the amount that respondents say they are willing to pay is contingent upon the particular hypothetical market that is described.[9] The panel convened by NOAA was dubbed the CV panel, as it had to assess whether CV surveys could measure NUVs. Therefore, it is

essential to outline how CV studies are conducted.

How Contingent Valuation Studies are Conducted: Survey Techniques

The usual procedure for a contingent valuation survey is as follows:

a. Background information is given to the respondent as to the nature of the environmental resource: its history, geography scientific interest, etc.

b. The respondent is informed about the change in environmental conditions that are envisaged, or which has occurred in the case of damage and liability claims.[10]

c. The respondent is informed how the money he or she may pledge will hypothetically be collected to finance the environmental change. For example, collection might be by a surcharge to the federal income tax, an addition to monthly utility bills or an increase in gasoline prices.

d. The respondent is asked the maximum he or she would be willing to pay (WTP) to contribute toward the envisaged environmental improvement.[11]

e. Finally the respondents will be asked to give information about themselves, such as age, income, geographical location, sex, education, outdoor activities and membership in any environmental organizations.

Furthermore, respondents may be asked to say how much they would be willing to pay in a variety of approaches:

a. Dichotomous Choice: The respondent is given a price and asked if he or she would be willing to pay it.

b. Open Ended: The respondent is asked to come up with a price with no guidance from the interviewer.

c. The respondent may be asked to select an amount from a list of payment cards (i.e. discrete, as

opposed to continuous, contribution levels).

Depending on where the survey is conducted, the information given by respondents in the willingness to pay section may include use value and nonuse value for a resource for some respondents, and only nonuse value for others.[12] Where possible the use values are stripped out and the remaining figure is assumed to be the nonuse valuation of the change in the condition of the natural resource site.

Whether these asserted values elicited could be used within economic analysis is the question to which this paper now turns.

2. ECONOMIC THEORY AND CONTINGENT VALUATION

An Economic Basis for CV?

Microeconomic analysis is based on the market structure, where supply and demand interact to determine market price and quantity sold. Most economic literature is based on the premise that there is a fundamental difference between people's behavior, as observed in the market, and answers they may give to hypothetical questions about their behavior.[13] It is assumed that consumers will try to maximize benefits from their market purchases. The consumer will take as much effort in making the decision over a purchase as he or she thinks worthwhile. This maximization of preferences obviously occurs *ex ante* and not *ex post*, as invariably the expectations of the consumer about the good purchased will be in error. The ability of the market system to "learn" from the mistakes participants make, due to imperfect information at their disposal, is one of its major attributes. If the initial price of a good, set by a supplier, is too high, (i.e. the demand for the good at that price is lower than the supplier had anticipated) the supplier "learns" and reduces his price, or reduces the quantity he is selling. However, if the price is set, and is not responsive to demand and supply conditions, then too much (or too little) of the good will be supplied at too low (or too high) a price. In other words exercising choice leads to a continually changing valuation for the good or service in question. Without choice value does not change.

What CV surveys do is provide respondents with a selection of choices. Before choosing they can take any of an array of possible choices -- i.e., a set of preferences. Therefore you may be willing to

give $100 to a charity and if asked, you could say that eight charities catch your eye. It is therefore possible that in separate CV surveys, your stated WTP to join each of the eight charities could be taken as $800 in total, even though $100 is all that will be given.

The fundamental difference here is between actual choice and potential preference. From the ethical and economic perspectives, there are significant reasons why choice is superior to mere preference in the allocation of resources. At most, preference constitutes a disposition to choose. Choice, on the other hand, requires action: it is the behavior itself. Economists recognize the superiority of using choice rather than preference because with the latter (or, in this case, a WTP claim) "there is no cost to being wrong, and therefore no incentive to undertake the mental effort to be accurate."[14]

The philosophical reason for preferring choice to preference in allocating resources is because it is considered to be ethically superior. Choice expresses consent, engagement and commitment. In making a choice one becomes accountable and responsible for it. Also, choice exercises liberty in an open society. By choosing incorrectly one may not satisfy one's preferences, however, at least one was free to make the choice. "To confuse preference and choice is to conflate acts of will with inferred states of mind."[15] Clearly, WTP is a state of mind; it is not an action.

What does a WTP figure represent?

"Willingness to pay" figures are assumed, by proponents of contingent valuation studies, to be capable of interpretation within conventional economic theory, as being synonymous with choice. For example, the assumption is that by hypothetically spending money on conserving a natural resource, the income change of the respondent will leave him or her indifferent between the current situation -- higher income and a damaged natural resource -- and the post-event situation: - lower income and a restored resource. In economic parlance, this is known as a Hicksian compensated variation. However, by their very nature, CV surveys are not observed behavior as, at best, they can only reflect hidden preferences and, at worst, ethical judgments.

The DOC/NOAA CV Panel equates the problem of using the CV procedure with that of firms designing "highly innovative" new products. "The field of market research has developed methods -- conjoint analysis, for example -- that are similar to the CV approach."[16] However, what the panel

ignores is that the product will be tested in a market at some stage. It is at this stage that pricing information will be decided. CV surveys have been tested by valuing marketed goods. The resulting WTP of respondents for marketed products may provide interesting information, but any price information they give will soon be superseded by market-place data.

Property Rights

With all marketed goods and services private ownership is required. For example, when someone purchases a good she owns it. The property rights are well established and easily identified. If the good is damaged by a third party after purchase, the purchaser has the right to pursue damages or replacement of that good from the third party or from an insurer.

Natural resource sites, on the other hand, do not have well-defined private property rights and the site is most likely to be owned by "the public": it is a common resource. As the rights will not be traded there is no market for the good, establishing a value for it is not easy and damage assessment is also difficult.

Where a price is charged for entrance to a natural site, this will act as a recreational value for the site. This price will only be an accurate evaluation however, if it is discovered by market forces and not arbitrarily set by a Government agency or other entity. For example, if there is a government subsidy to the site, the valuation will be inaccurate. Yellowstone National Park charges an entrance fee of $10, which yields far less revenue than is required to meet the cost of running the park. Therefore, using the aggregate of gate charges could undervalue the park.[17]

If no price is charged then valuation becomes even more difficult. Nevertheless some assessment of damage can be made if it is still possible to link underlying choice to observed behavior in a related market good. For example, attempts to calculate the lost value have been made by observing the reduction in recreational trips to the site in question, if it becomes damaged.[18] Thus, if toxic waste leaches into a river, individuals may reveal their preferences by decreasing trips to the area. Even though no explicit price is paid for a good, behavior in response to a given event is measurable.[19]

To summarize, economic theory emphasizes how more reliance can be placed on choice, as opposed

to stated preferences. Consequently, consumer models describe how individuals make purchases of goods according to choice (revealed preference) and a budget constraint. Within such models the state of a natural resource may affect a person's happiness but is not a "good" over which an individual can exercise choice, unless the resource is privately owned. If, as is most likely, the resource is owned by a government, then a true market is not permitted to develop for that resource. Only non-revealable preferences, via WTP answers to CV survey questions, can be estimated.

Therefore, however statistically reliable such CV surveys results may be, the fundamental flaw of using stated preferences rather than revealed preferences (actual choices) will always exist when using surveys for valuation.

3. MEASUREMENT PROBLEMS ASSOCIATED WITH CV

The previous section dealt with the epistemological and ethical questions associated with the use of CV surveys. This section looks at the technical details of the method itself. The following is a list of measurement problems associated with the CV technique.

Unfamiliarity

It is generally accepted that over half of all new products introduced into the market place fail. Yet nearly all products are brought on line after market research based on surveys, and real market test sites. The respondent in market research surveys is often familiar with the product's substitutes and hence can at least form some opinion as to whether it will sell, and even assess a potential price for the good.

However, anyone who has seen the TV game show "The Price is Right" will know that general knowledge about prices of marketed goods is not perfect. For those who haven't had the pleasure, this is the format. The contestant is asked to put prices on goods and the one who guesses most accurately. In general, the contestants will know, reasonably well, the price range of items they normally purchase. However, and this is the strength of the program and the weakness of CV surveys, when they are asked to guess the price of an item with which they are completely unfamiliar, the guesses are generally far off target.

Compare this to someone asked about the value of a natural resource. As most individuals have no experience with purchasing environmental assets, it would seem unlikely that they will value the sites accurately.

Individuals are, not surprisingly, ill-trained to evaluate the monetary value of environmental damage, much in the same way that it would be difficult for them to choose between competing designs of nuclear submarines. The issues involved can be so complex that the information required to make an astute judgment could take days, or even weeks to assimilate, whereas most information given at the beginning of CV surveys is often related in less than five minutes. For example, valuing the damage done by the Exxon Valdez oil spill took experts months to calculate and still remained largely subjective. If one uses CV in liability claims, one is effectively asking the (non-expert) respondent to value the resource in a matter of minutes. At best, he may approximate a realistic value. "At worst, if a respondent is unaware of the existence of the resource, a CV survey may create the very nonuse value it purports to measure."[20]

The creation of tacit values seems to be an unintended consequence of the CV methodology. For example, the vast majority of people who were angered or upset at the fouling of the rocky shores of Prince William Sound by the Exxon Valdez were unaware that the Sound even existed prior to the spill. One CV survey[21] estimated that the NUV of Prince William Sound was $50 to $100 per U.S. family. This would equate to a total existence value of between $5 billion and $10 billion for the 100 million U.S. families, yet remains almost completely arbitrary. The exact same "value" could be calculated by concocting a fictional Sound and surveying the same individuals.

Strategic Bias

There is a significant possibility with CV surveys that individuals may express a concern over an environmental issue or group of issues, rather than a realistic willingness to pay. CV answers do not report pre-existing preferences, only the numbers that emanate from respondents while constructing responses. The respondents know that their answers may be used in evaluating policy, and even in the pricing of clean up costs or liability claims. Therefore, they may answer strategically. For example, if they believe that the government does not spend enough on wildlife protection, they may be inclined to state a figure vastly higher than they would actually be prepared to contribute, knowing they will not directly foot the bill. This strategic bias is therefore likely to be prevalent in

CV answers.

There is also the probability that the amount that respondents say they are willing to pay will depend upon the method of financing chosen to pay for the environmental change. For example, increases in the income tax rate will affect people differently from a levy on gasoline. Therefore, individuals may carry out personal cost-benefit analyses rather than describe true preferences.

Methodologically, it is more acceptable to use a CV survey that is conducted before damage takes place.[22] As an accident can occur anywhere, this would entail carrying out CV surveys for every natural resource in the world. The World Bank's Global Environment Facility (GEF), spends some of its money doing just this.

Question Sequencing - The Embedding Problem

One of the key problems that CV surveys face is the problem of "embedding." Kemp and Maxwell[23] explored this problem. They conducted two separate surveys, one a "single-focus" survey and the second a "top-down disaggregation" survey. The first asked respondents how much they were willing to pay (WTP) for a 10-year government program designed to minimize the risk of oil spills off the Alaskan Coast. The average WTP was $85 per household.

The second survey (using an identical selection procedure) was more complex and embedded the above Alaskan question much later in the sequence, initially asking about alternative uses of government funds. First, they asked the WTP about eight social programs. The topics included education, crime prevention and environmental protection. Next, from the stated amount pledged for environmental protection they went through a series of issues, such as acid rain, deforestation, ozone layer depletion and the protection of wilderness areas. They then disaggregated further and differentiated between human-caused problems and those arising for other reasons, and between all other human-caused problems and oil spills. The last question was the same as the single question of the first survey. This time the average WTP for 10 years of protection for Alaskan coasts was 29 cents. The one question survey gave an answer 300 times larger than that of the embedded survey. Therefore, the total WTP of the 100 million American households for Alaskan Coast protection could be evaluated to be $29 million or $8.5 billion.

Consistency Testing and Empirical Testing

CV cannot be tested empirically,[24] and the CV panel acknowledges "the impossibility of validating externally the results of CV studies."[25] One therefore has to look to internal consistency tests to see if CV methodology is acceptable.

One method used to elicit information about the processes involved in respondents' answers is that of "Verbal Protocol." In this process, used by psychologists, the interviewer asks a question and the respondent is asked to "think aloud" while answering the question. A paper by Schkade and Payne[26] used one such verbal protocol method. The questions were designed to obtain WTP responses to protect migratory waterfowl from drowning in waste oil holding ponds. The main type of thought processes involved were explained by the respondent as follows:

One quarter felt that if each household played its part then each household would not have to pay very much.[27] One sixth attempted to calculate how much they would be affected by the posited increase in gasoline prices needed to pay for the waterfowl protection. One sixth compared the amount they might give with donations to charities. One fifth guessed an answer.

These responses reinforce the above-mentioned problem of the unfamiliarity of the respondents with the task asked of them, and seem to indicate that the individuals did not have well-formed or consistent underlying preferences.

The most interesting discovery from this study is that a sixth of the respondents said they would compare what they might contribute with accepted norms of charitable giving. Charitable giving can be viewed as a market activity -- trading money for psychic income (compounded by tax treatment). Therefore, are the figures from this sixth more or less reliable than the figures obtained from the other five-sixths?

A Norwegian study by Seip and Strand[28] may help us to appreciate the problem of calculating a reliable figure from a WTP response. This study gathered data on the WTP of Norwegians to join the most important environmental group in Norway. Only six out of the 101 who said they were willing to pay the membership fee actually did join the group. Unlike most CV analysts Seip and Strand wanted to know why their data had proved to be so inaccurate. In follow-up calls, they found

that the general feeling of the respondents was that there were so many good causes to support that they could not support all of them. Hence, less than six percent had done what they said they would do. One sixth of those in the Schadke and Payne survey said they were willing to pay rates similar to charity donations. Yet it is doubtful that anywhere near all of them would have actually paid the stipulated amount.

Willingness to Pay (WTP) and Willingness to Accept (WTA)

A procedure for testing the stability and reliability of the results obtained from a CV survey is to reverse the question and instead ask how much the respondent would be "willing to accept" (WTA) in compensation, if the environmental benefit is not to occur. A survey that looked at air pollutants and hence visibility at the Grand Canyon asked both WTP and WTA questions.[29] The hypothetical information given to the respondent was that the government had a costly program underway to reduce pollution and hence increase visibility at the Grand Canyon. The respondents were asked what they would be WTP toward the project's completion. Next, the respondents were told that the program had been approved but that the government had yet to appropriate the money to fund it. The respondents were asked how much they would be WTA to be in favor of canceling the project.

At face value the two questions simply seem to be the reverse of each other. However, results from CV surveys have shown large differences in stated values.

Theoretically, one would expect the respondent's WTP figure to be slightly lower than the WTA figure of the same respondent, as the respondent is becoming worse off financially if the environmental improvement goes ahead. In orthodox markets, as income falls so does expenditure. Therefore WTP should be less than WTA.[30] Why then, are some WTA figures so much larger than WTP amounts but other WTA figures are zero?

However, one would expect the difference between WTP and WTA to be very small for two reasons. First, the monetary differential in "initial happiness" between WTP and WTA should be small, as it is assumed that changes in visibility at the Grand Canyon will not take a large percentage of one's income. Second, CV surveys have shown that WTP does not increase in proportion to income.

The reason that the discrepancies are large is easier to appreciate if we follow the argument put forward by Opaluch and Grigalunas.[31] They believe that environmental survey questions receive ethically based responses rather than true preferences. Hence, WTP is the willingness to pursue one's ethical beliefs; whereas WTA is, in ethical terms, akin to accepting a bribe and therefore can be infinite. This would seem to be consistent with the data, where a large number of respondents refused to participate in the WTA section and hence came up as zero on the analysis.

The refusal to participate indicates that the WTA values should not be zero, but infinity. However, this would make mathematical nonsense of the other figures by giving a mean (average) WTA of infinity. The surveyors therefore make the dubious decision to record these as zero values.

Statistical Bias

The WTA responses, as explained above, are often either very large or zero. The results, therefore, tend to be bi-modally distributed, with the larger mode being zero. Drawing a single mean figure from bi-modal data is pointless as no measure of central tendency can provide an adequate summary of the data. Therefore, use of the figure should be treated with caution and a wide range of possible values should be acknowledged. Secondly, a number of the respondents provided implausibly high WTP figures given their level of income.

One could reduce the weighting attached to such extreme figures (outliers), or perhaps just ignore the top and bottom 5% of answers. However, this is yet another reason to avoid using CV studies. Ad hoc data manipulation is bad statistical practice, lending force to the argument that the whole technique is flawed.

Legal Aspects of CV

Since, to a large extent, contingent valuation methodology (CVM) is a creature of liability claims, it is essential to see how it is treated by the courts. Since the 1989 Supreme Court ruling in Ohio v. U.S. Department of the Interior[32], nonuse values can be used in damage measurements. It is therefore useful to consider nonuse valuation in both theoretical and applied settings. This is the aim of this section.

Liability assessment is a measurement of harm for the purpose of imposing liability on a party found to be legally responsible for certain injuries or damages. It is essentially in the spirit of contingent valuation that it should be used to ascertain negligence, since this determination requires an assessment of the magnitude of possible harm. A party is considered negligent if the precautions taken were inappropriately low. The decision as to what is "low" is dependent on the value of the resource being harmed.

If CV is used to calculate the value of the resource, then CV will have to be used to ascertain whether there is negligence, as "low precautions" will depend on the total value of that which is damaged and the reasonableness of precautionary measures. There is a further link here: the amount spent on clean up should relate to the value of the good. If CV values the good, then CV dictates the amount of clean up costs.

If CV is Correct

If the NUV is calculated perfectly by a CV study, then firms and consumers would take the full social value (use value plus nonuse value) into account when making decisions. However, if CV is inaccurate, the inclusion of the estimate will distort public decisions through the incentives created for any parties potentially subject to liability. Therefore, due to the fear of unlimited liability, companies may take unnecessarily defensive precautions, or withdraw from activities such as transporting or disposing of toxic waste that, on balance, are socially desirable. Consequently, if the CV survey has a large degree of bias, it would be worse to include the estimate than to leave it out. In this situation, CV would impose the risk that socially valuable activities will cease.[33]

There is an obvious additional disadvantage to the use of CV in liability claims. Legal costs are likely to increase simply because CV surveys are not empirically testable. For example, a plaintiff may use a CV survey to value a site that the defendant is alleged to have damaged. The defendant disagrees and produces his own survey, neither is testable so some arbiter is called upon to decide, and probably produces a third survey. Therefore, even if the plaintiff's CV survey was perfect (it measured what it purported to measure) the increase in legal costs may prove high enough to make the use of the survey socially inefficient even if the winner in court may personally benefit.

Of course, if the costs of the legal wrangling are borne by the loser in court, there is an incentive for plaintiffs to "invest" significant sums in the CV survey. The more convincing and detailed the CV survey is, the more likely it is to be paid for by the defendant.

In other tort cases, uncertain, subjective components of loss are usually excluded from damage assessments.[34] For example, individuals are not able to collect for non-pecuniary losses they may suffer due to the death of others unless certain conditions are met (such as a close family relationship to the deceased). Individuals are also unable to make claims for the non-pecuniary losses they suffer due to the death of pets. Tort law is interpreted this way because the inclusion of speculative claims would increase the cost of litigation, generating unnecessary and detrimental risk.

CV results are uncertain, subjective and speculative, yet examples of CV use are becoming more prevalent. Since the Valdez tanker accident, Exxon has spent over $6 million on CV studies.[35] The State of Alaska, the Federal Government and Exxon spent an estimated $100 million on litigation before settling.[36] A significant proportion of this was due to Exxon's concern over the size of CV estimates.[37]

Application of CV in a legal cases

Although CV surveys are proliferating, only once so far has a survey been used to assess environmental liability damages. Therefore, it is worthwhile analyzing this case. [The details are in the appendix. The main points are elucidated here.]

A company, SRTI, spilled a toxin into the Little Salmon river in Idaho. The State of Idaho pursued damages for lost existence value as well as lost use value. The court found that the NUV of the fish claimed in the CV survey was over an order of magnitude (over 10 times) larger than the actual commercial value, and it would be "conjecture" to use the CV survey in valuation. The results were found to be "legally insufficient to establish existence value."

The speculative and unreliable value calculated for the existence of Steelhead fish was thrown out by the court in this case. However, because the court accepted -- as will others since the Supreme Court ruling, cited earlier -- that existence value is potentially measurable, further CV studies will be conducted at great expense and will be presented in liability claims, at considerable social costs.

4. THE ROLE OF THE CV PANEL

This paper so far has concentrated first on the ethical problems of using CV responses in assessing nonuse values, second on detailing the myriad measurement problems of the technique itself, and third in analyzing the legal status of CV and its use to date. In this final section the role of the CV Panel is analyzed.

The National Oceanic and Atmospheric Administration (NOAA) is promulgating regulations under the Oil Pollution Act of 1990 and wanted to assess "whether the CV technique is capable of providing reliable information about lost existence or other passive-use values."[38]

The CV panel, whose members were all notable social scientists including the two Nobel Laureates (Professors Arrow and Solow), was formed to address this question. However, it did not question the use of the technique at the ethical and theoretical level. It concentrated purely on the measurement problems, bypassing the economic theory to which most members of the panel had adhered for their academic and commercial lives.

The CV panel painstakingly detailed all of the measurement problems outlined in this paper, drawing on all the relevant CV studies. However, it obviously accepted that using only commercial and recreational values could undervalue a site, and that CVM is the only option for measuring NUV. This concurs with the opinion of Norman Meade, not on the CV panel, (senior economist at the NOAA), who said, " There are not alternatives when it comes to nonuse value. We are setting up a market where we need to determine a value that did not exist before. I do not know how you would do it except by going to the people and asking them."[39]

The panel concludes "that CV studies can produce estimates reliable enough to be the starting point for a judicial or administrative determination of natural resource damages -- including lost passive-use value".[40] The panel accepts the measurement problems but explains that if the surveys are "carefully constructed, administered, and analyzed [they] will contain information that judges, juries and other decisionmakers will wish to use."[41]

Section IV of the panel's report "includes guidelines to which the panel believes any CV study

should adhere if the study is to produce information useful in natural resource damage assessments."[42]

The guidelines the CV panel puts forward are lengthy and would be costly to implement, although they would undoubtedly lead to more consistent results. For example, they insist on: only using person-to-person interviews because mail surveys and telephone interviews are less likely to be reliable; informing the respondent in detail about the environmental change envisaged; using very long questionnaires to deflect the embedding problem (see above, in this paper); and a set of benchmark studies against which any survey can be assessed.

"We [the CV panelists] strongly urge the government to undertake the task of creating a set of reliable reference surveys that can be used to interpret the guidelines and also to calibrate surveys that do not fully meet the conditions."[43]

They continue in section V, "Recommendations For Future Research":

> The federal government should produce damage assessments for a few specific reference oil spills, either hypothetical or actual, ranging from small to large. These standard valuations could be generated by any method. One possibility would be through a jury of experts. Such a jury of experts might wish to conduct a series of CV studies, satisfying the guidelines laid out above. These CV studies would be inputs into the jury process, to be combined with other information and expert judgment. Once these benchmarks were available, they could serve as reference points for later CV studies....Responses to [the benchmark study] could then be used as one reliable source of information in the damage assessment.[44]

A number of questions arise from this statement. First, the panel is recommending the use of a benchmark study, to be designed by a "jury of experts." However, there appears to be a moral hazard with this proposal since any "jury" would be likely to include members of the CV Panel itself. Second, as the panel acknowledges "survey responses are usually found to be...overestimates of WTP".[45] Thus, how can the panel be sure that the benchmark survey is accurate? Regardless of this statement the "panel's conclusion is that a well conducted CV study provides an adequately reliable benchmark."[46]

The Panel's second conclusion is that the appropriate federal agencies should begin to accumulate standard damage assessments for a range of oil spills...That process should further improve the reliability of CV studies in damage assessment. It should thus contribute to increasing the accuracy and reducing the cost of subsequent damage assessment cases. In that sense it can be regarded as an investment.

Pandora's Box

Krutilla intended that NUVs were only relevant to unique and irreplaceable assets. Yet, who determines what is unique? In economic terms, uniqueness is characterized by an absence of substitutes and a low price elasticity of demand. Geologically, all rivers are unique. One could also take the attitude that once you've seen one river you've seen them all. A CV survey is simply an examination of various attitudes that may or may not reflect actual behavior.

This paper has focused on CV surveys in relation to environmental damages. However, what is to stop CV surveys being used in other areas outside of environmental damages? For example, if a plane crash killed several people, CV surveys could be applied by anybody who felt shocked at the news. Airfares would soar to cover the massive insurance needed against future crashes (if such insurance would be offered at all).

Nonuse values do exist, at least for some people. However, if existence values are measured for natural resources, then there is no reason to prohibit measuring them for goods and services outside the environmental area. If the lid to this Pandora's Box is opened will it ever again be shut?

CONCLUSION

One of the most important features of the market mechanism is the ability of the participants to learn from the mistakes they make. Consequently, the values of goods and services are derived over time from adjustments that market participants make in their choices of those goods and services.

CV survey answers bypass this learning process. Genuine purchases do not occur and therefore there

is no way that mistakes can be recognized. The results from these surveys therefore cannot be equated with market behavior, and any use of these figures should be treated with skepticism.

The CV panel brought together by NOAA acknowledges that there are myriad problems in accurately measuring NUVs. As outlined in this paper, respondents tend to be unfamiliar with what they are asked to measure and therefore CV surveys can create the very values, which they purport to measure. The results given can be ethically and strategically biased depending on what is being valued and how it is expected to be paid for. The results are also open to conjecture, as they cannot be tested empirically and are likely to lead to unwanted litigation.

The CV Panel in its capacity as adviser to the NOAA on the use of CV in litigation has recommended that under strict guidelines it be used for liability damage claims. The study conducted was thorough and, given the charge,[47] well accomplished. Considering the restrictions placed on the panel by the original charge (as described earlier) it was not unexpected that they would seem to endorse CV. However, the possibility of self-interest by the economic profession is hard to ignore: any future applications of CV surveys are likely to employ legions of economists. Even if the problems outlined in this paper can be reduced, if not removed, by very thorough, detailed, and expensive studies, the values deduced are unlikely to reflect market values for the identical resources. These values can only be discovered through the actual choices made by individuals. Therefore, the results found in CV surveys are certainly of interest, but their use in the valuation of natural resources is inappropriate.

Appendix

On December 15, 1987, Southern Refrigerated Transport Inc. (SRTI) transported the chemical fungicide Thiram into the State of Idaho. The tractor and trailer carrying the fungicide overturned on the banks of the Little Salmon River. The company salvaged most of the Thiram but 375 gallons were missing. Observers at the scene estimated that 110 to 250 gallons reached the river, the remainder being absorbed by the bank.

The court trial was held at Boise, Idaho, commencing on September 17, 1990, and continuing through October 2, 1990. The plaintiff was the State of Idaho and the defendant was SRTI. The plaintiff claimed that the fungicide killed 90% to 100% of the fish in the river, and sought to recover damages for the injury to the natural resource - the fish.

Substantial and significant damage was considered, by both sides, to have been suffered by the Steelhead fish population in the Little Salmon River.

The first thing that had to be established by the plaintiff was how many fish there were in the Little Salmon River at the time of the spill. There were no specific samples from the site of the spill taken before the spill. However, there were a number of samples (snorkel surveys) that had been undertaken by F&G in 1987 and 1988 at two sites on the Little Salmon River. These samples were taken as evidence because they provided "the best information available, and, in fact the only information that can be provided on this issue. The court further finds that these scientific studies, not prepared with any view towards litigation, rise above the level of speculation and conjecture."[48]

After a variety of toxicity tests and aggregated calculations, it was estimated by the expert witnesses that the number of lost Steelhead fish was approximately 35,500.

Idaho requested damages for the lost fish on the basis of three valuations: commercial, existence and recreational. The court (partly due to the Supreme Court ruling in Ohio), recognized that the three values existed, and were considered to be compensable items of damage if proved at trial.

Idaho requested commercial value for all the fish lost and existence/recreational value for the non-returning adult Steelheads. (It was accepted by the court that approximately half of 1% of those

killed would have returned as adults.)

As such, there was no market price for the fish that were lost. Idaho suggested that the value found in the American Fisheries Society's (AFS) publication, "Monetary Values of Freshwater Fish and Fish-Kill Counting Techniques," be used. The techniques assign a monetary value to fish by inch-class and species. The values set by AFS approximate the average commercial fish prices set by hatcheries around the country. The price per Steelhead given was 88 cents.

Idaho attempted to ascertain the existence value of the non-returning Steelhead by using a CV study. The study was not conducted for the purpose of litigation and had been conducted before the spill - both factors were in the favor of the survey.

However, the study was performed by Batelle Northwest for the Northwest Power Planning Council. The aim was to elicit how much residents would be willing to pay in the form of increases in their power bill to double the runs of Steelhead and Salmon in the entire Columbia River Basin. The theoretical doubling could have occurred via operational changes in the Northwest Hydropower system.

Using this study, Idaho requested $16.97 per non-returning adult Steelhead as existence value. While the court acknowledged that the Salmon River drainage is part of the Columbia River Basin, it found that the survey was "not persuasive and it would be conjecture and speculation to allow damages on this study. Idaho must prove its damages with reasonable certainty and this study does not do so."[49]

The court found that the survey gave no degree of certainty to the existence value of the fish and hence the method chosen by Idaho was "legally insufficient to establish existence value."
It is worth noting that the existence value requested by Idaho was over 19 times larger than the commercial value of the fish. If one aggregates from this assumed existence value for the increase in fish in the Columbia River Basin, we get $37 million. This is a rather large sum, if it were to be borne by the power bill payers of the Northwest, for a good that most of them would never use.

Endnotes

[1]1. *Report of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) Panel on Contingent Valuation*, (Washington, D.C.: U.S. Department of Commerce, January 12, 1993), p. 2.

2. Environmental economists have defined a series of NUVs including existence value, bequest value and option value. Existence value is the most important.

3. J.V. Krutilla, "Conservation Reconsidered," *American Economic Review*, vol. LVII (September, 1967), 777-786.

4. Ibid.

5. The OPA also requires damages for "the diminution in value of ...natural resources pending restoration." Furthermore, under the OPA damages can be recovered for "the reasonable cost of assessing damage..." Therefore, if CV surveys provide acceptable measurements of NUVs then the defendant is liable for the cost of the survey as well as the natural resource values it arrives at.

6. Of the 22 speakers at the meeting, 15 speakers spoke against the use of the Contingent Valuation Method (CVM) in calculating NUV's and only 5 were in favor.

7. The panel consisted of Kenneth Arrow (co-chair), Robert Solow (co-chair), Paul Portney, Howard Schumann, Ed Leamer and Roy Radner.

8. 880 F.2d 432, D.C Cir. 1989.

9. Other methods of calculation exist, however, CV is the most important. A detailed description of all the techniques is to be found in: D.W. Pearce, *Economic Values and the Natural World* (London: Earthscan Publications, Ltd., 1993).

10. To escape the emotional response of a recent accident, it has been suggested the respondents be "asked to pay to prevent future occurrences of similar accidents." (NOAA Report 1993, p. 4.)

11. If however, damage has occurred to the environment then the respondent is asked how much he or she would be willing to accept (WTA) in compensation. The theory from which this idea is drawn is that of Hicksian consumer surplus variations. I do not intend to discuss the theory here. WTP is derived from, and supposed to represent, the Equivalent Variation, for an improvement in environmental quality. WTA is derived from and supposed to represent the Compensating Variation.

12. It will probably be impossible to distinguish between the two sets of values, unless further specific questions are asked. There will still be a great deal of subjectivity about the data even with

extensive questioning.

13. The consumer theory usually studied is that of "revealed preference" developed by Paul Samuelson. More weight is attached to an individual's choices -- revealing of preferences -- than to the statement of those preferences in surveys.

14. A. Myrick Freeman III, "Approaches to Measuring Public Goods Demands," *American Journal of Agricultural Economics* (1979), no. 61, p. 157.

15. M. Sagoff, "Should Preferences Count?" at p. 4. This paper was presented at *Resources For The Future* in 1992 and is available from its author at the University of Maryland, Institute for Philosophy and Public Policy.

16. NOAA Report 1993, p. 37.

17. Of course, political management of the park guarantees that revenues will rarely be related to expenditures or costs.

18. This reduction in recreational trips may not occur. Yellowstone Park had an increase in visitors after the 1989 fires.

19. The standard technique for calculating recreational use value is the Travel Cost Method. There are significant problems with this constructed market methodology. When calculations of value are conducted as to the amount of money that people are willing to spend to go to a resource the calculated value depends on the price of admission to that resource. If this was a market price it would be acceptable, however, as mentioned previously where the price is too low as in Yellowstone Park, people will come from farther away and spend more money than they would if the correct price was charged. Consequently the recreational value is over-emphasized as the government subsidy is not deducted.

20. R. Niewyk, "Ask a Silly Question....Contingent Valuation of Natural Resource Damages," *Harvard Law Review* (June 1992), p. 1986. This problem is mirrored in physics by what is known as Heisenberg's Uncertainty Principle. The act of measurement of the properties of sub-atomic particles alters the properties themselves making absolute measurement impossible, even in principle.

21. Kemp and Maxwell (1992) op cit.

22. To avoid this impact the CV Panel advises that surveys measure similar future damage and not the actual damage that has occurred due to its emotional impact (NOAA Report 1993, p. 3.).

23. M. Kemp and C. Maxwell, "Exploring a Budget Context for CV Estimates" in *CV: A Critical Assessment*, (Cambridge Economics, Inc., 1992).

24. From the work of Karl Popper and Imre Lakatos, if a theory is non-refutable it cannot be classed as scientific, only pseudo-scientific. The failure of CV to be testable, reduces its applicability to valuation, as interesting but not verifiable and consequently unusable.

25. NOAA Report 1993, p. 6.

26. D.A. Schkade, D.A. and J.W. Payne, "Where do the Numbers Come From?: How People Respond to Contingent Valuation Questions" in *CV: A Critical Assessment* (Cambridge Economics, Inc., 1992).

27. This type of response is similar to the attitude one would expect of public goods in general and the free rider problem in particular.

28. K. Seip and J. Strand, "Willingness to Pay For Environmental Goods in Norway: A Contingent Valuation Study With Real Payment" Unpub., SAF Center for Applied Research, Department of Economics, University of Oslo, 1991.

29. J.L. Opaluch and T.A. Grigalunas, *Ethical values and Personal Preferences as Determinants of Nonuse Values: Implications for Natural Resource Damage Assessments* (Peacedale, Rhode Island: Economic Analysis, Inc., 1991).

30. This follows from the economic theory, mentioned in footnotes 6 & 7, developed by John Hicks. The WTP is the equivalent variation. The WTA is the compensated variation.

31. Opaluch and Grigalunas, op.cit.

32. 880 F. 2d 432, (D.C. Cir., 1989)

33. Very few proponents of CV surveys deny that responses have a large mean and variance.

34. Torts are essentially involuntarily imposed contracts (rather than criminal malfeasance).

35. Exxon Annual Reports 1989, 1990 and 1991.

36. This amount was high due to the inexplicable assessment by NOAA that "Exxon...could have no participation in planning the assessment and no access to the data. Thus, Exxon was forced to conduct separate assessment studies." G.R. Cecil and N. Foster, "Natural Resource Injury at Oil Spills: A New Approach" (1993) *Baylor Law Review*, Spring, Vol. 45, No. 2, p. 424.

37. S. Shavell, "Should CV Estimates of the Nonuse Value of Natural Resources be used in Public Decisionmaking and the Liability System?" in *CV: A Critical Assessment* (Cambridge Economics Inc., 1992).

38. NOAA Report 1993, p. 5.

39. J. Mclaughlin, "CV: A Scary Prospect for the Oil Industry" *Lloyd's List* (Insurance Market) 10.2.92.

40. Information in a letter accompanying the NOAA report 1993 to T. Campbell, General Counsel for NOAA) from CV panelist P. Portney, January 11, 1993.

41. Ibid.

42. Ibid.

43. NOAA report 1993, p. 37.

44. Ibid., p. 38.

45. Ibid, p. 37.

46. Ibid, p. 43.

47. They did not question the use of values found in surveys as distinct from values discovered in the market process. The Panel merely considered whether CV techniques could be statistically reliable.

48. Judgment from State of Idaho v. Southern Refrigerated Transport, Inc., 1991 W.L. 22479 (24.1.91)

49. Ibid.

Appendix E

Competitive Enterprise Institute Comments on the Draft Report to Congress on the Costs and Benefits of Federal Regulation
May 5, 2003

HOW MUCH IS GOD WORTH?

THE PROBLEMS
— ECONOMIC AND THEOLOGICAL —
OF EXISTENCE VALUE

Robert H. Nelson

May 1996

COMPETITIVE ENTERPRISE INSTITUTE

HOW MUCH IS GOD WORTH?

The Problems — Economic and Theological — of Existence Value

Robert H. Nelson

EXECUTIVE SUMMARY

Economics has traditionally put a value only on goods and services that are directly consumed. However, in 1967 John Krutilla proposed that economists should also assign a value to the knowledge that a particular wilderness, endangered species or other object in nature exists. By the 1980s, the concept of "existence value" was coming into use by a number of economists for purposes such as estimating the benefits of government actions or calculating damage assessments against corporations whose actions had harmed the environment. In 1993, a panel of leading economists convened by the National Oceanographic and Atmospheric Administration declared that, although great care must be exercised to prevent misuse, existence value should be incorporated into the set of economic tools available to government analysts.

Other leading economists have argued that the concept of existence value is inconsistent with accepted economic theory and in practice will often yield implausible results. The number of features existing in the world about which at least some people will have strong feelings is virtually limitless. Yet, most estimates of existence value have addressed only a select few objects in nature.

The attitude of a person with respect to a state of the world will be greatly influenced by the cultural lens applied. In many cases, that lens will be religious. The values placed on wilderness and endangered species reflect the important role these objects have in environmental religion. The sources of environmental religion are found in figures such as David Brower and John Muir and in New England transcendentalism. The transcendentalists in turn drew heavily on the faith of their Puritan forbearers.

What inspires faith for one person may be regarded by another as a diversion from the true faith. Proponents of wilderness look to these areas as a place of spiritual inspiration. Others, however, see the preservation of wilderness as a waste of good resources and a symbolic assault on the value system of belief in economic progress. The latter group will perceive a "negative existence value" in the creation of a wilderness. It is misguided for society to apply formal methods of economic valuation to try to resolve such claims of competing religious groups.

In summary, a fundamental problem with existence value is that in many cases it attempts to answer a religious question with an economic method. Making estimates of the existence value of an object in nature is then both as silly and as meaningless as asking how much God is worth. Economists should abandon the use of existence value and concentrate their scarce resources on more useful projects that are in fact suited to their analytical tools.

HOW MUCH IS GOD WORTH?

THE PROBLEMS — ECONOMIC AND THEOLOGICAL — OF EXISTENCE VALUE

Robert H. Nelson

INTRODUCTION

In *Encounters with the Archdruid*, John McPhee relates a discussion with David Brower, regarded by McPhee and many others as the leading environmentalist of our time. Brower is talking about the real meaning of wilderness. He notes that "I have a friend named Garrett Hardin, who wears leg braces. I have heard him say that he would not want to come to a place like this by road, and that it is enough for him just to know that these mountains exist as they are, and he hopes that they will be like this in the future." As Brower said of his own views, "I believe in wilderness for itself alone."[1]

Economics as traditionally practiced, however, finds it difficult to accommodate this perspective on the world.[2] Human beings, the way of thinking of economics assumes, live for happiness. Happiness is, moreover, a product of consumption. As economist Stanley Lebergott writes, "the goal of every economy is to provide consumption. So economists of all persuasions have agreed, from Smith and Mill to Keynes, Tobin, and Becker."[3] Historically, there has been little or no place in economic thinking for the idea that something that is never seen, touched or otherwise experienced — that is not consumed in any direct way — can have a value to an individual.

There has been little or no place in economic thinking for the idea that something that is never seen, touched, or otherwise experienced can have a value to an individual.

Yet, as McPhee's discussions with Brower indicated, this economic way of thinking was deeply at odds with an emerging environmental awareness that in the 1960s and 1970s was spreading widely in American society. Economists, it appeared, might be faced with an awkward choice: either reject their own economic perspective on the world or find themselves disagreeing with a powerful new social movement. It is also probably fair to say that some economists were themselves drawn personally to the environmental values that were difficult to express in a conventional economic way. For them, the potential dilemma was also internal: either limit their own commitment to certain environmental goals such as the intrinsic importance of wilderness and endangered species preservation or reject the economic way of thinking in an important area of their life.

However, in a famous 1967 article in the *American Economic Review*, John Krutilla proposed a reconciliation.[4] Krutilla suggested that the scope of economics should be expanded to include a new concept, which has since come be known as "existence value." The enjoyments of life need not be limited to things that can be seen and touched. Consumption, even as economists think about it, should extend as well to the simple fact of knowing that a wilderness, endangered species or other object in nature exists. Formally, the variables in a person's "utility function" would not only include the amounts of food, clothing and other ordinary goods and services consumed, but also the various states of knowledge that each person has of the existence of social and physical characteristics present in the world. Implicitly at least, consumers would be willing to pay something for this form of consumption, thus giving rise to efforts by economics to estimate existence values in dollar terms.[5]

Consumption, even as economists think about it, should extend as well to the simple fact of knowing that a wilderness, endangered species or other object in nature exists.

By the 1980s, the concept of existence value was coming into use by a number of economists for purposes such as estimating the benefits of government actions or calculating damage assessments against corporations whose actions had harmed the environment.[6] A federal appeals court in 1989 directed the Department of the Interior to give greater weight to existence values in its procedures for assessing damages to public resources under the Superfund law.[7] The concept has even been received favorably in literary publications such as *The New York Review of Books*, where the author of one article concluded that it would be central to achieving preservation of tropical forests and other world biodiversity objectives: "But why should citizens of industrialized countries pay to preserve resources that are legally the domain of other countries? An obscure tenet of economics provides a rationale. Certain things have what is known as an `existence value.'"[8]

The potential importance of existence values was emphasized by the large dollar magnitudes that some economists were attributing to this new source of economic benefit. In 1992, Walter Mead surveyed a variety of estimates of existence value.[9] In one study the value to households across the United States of preserving visibility in the Grand Canyon was calculated to equal $1.90 per household per year, yielding a long run discounted value to all U.S. households of $6.8 billion. In another study preservation of the northern spotted in the Pacific Northwest was estimated to be significantly more valuable, having a total existence value for U.S. households of $8.3 billion per year. Still another existence value study calculated that preserving whooping cranes would be worth $32 billion per year for all the people of the U.S. Such dollar estimates raised the prospect that they might sharply alter government calculations of the economic merits of various policy proposals.

A GROWING DEBATE

Initially, most of the economic discussion of existence value reflected the views of proponents. Beginning in the 1970s, a small circle of economists sought to introduced a novel concept to the profession and to show that it could be applied successfully in practice. At first, most mainstream economists paid little attention. However, as the potential uses have widened and the policy stakes escalated, an active debate has broken out within the economics profession concerning the merits of the existence value concept.[10] Non-economists have also entered the controversy, in some cases questioning the use of existence value.[11]

An active debate has broken out within the economics profession concerning the merits of the existence value concept.

The Exxon Corporation, facing large potential damage assessments as a result of the Exxon Valdez oil spill, and fearing that these assessments might be based in part on economic estimates of existence value for various states of nature in Prince William Sound, committed large financial resources to the issue. Exxon hired a number of leading economists to examine whether use of existence value was an appropriate economic method. Their critique was on the whole negative.[12] The State of Alaska and the federal government hired several leading environmental economists who took a more positive view.[13]

Reflecting the growing controversy inside and outside the economics profession, the National Oceanographic and Atmospheric Administration convened a panel of leading economists, chaired by Nobel prize winners Kenneth Arrow and Robert Solow, to review the issue. In 1993, the panel declared that, although great care must be exercised to prevent misuse, existence value should be incorporated into the set of economic tools available to government analysts.[14] However, the NOAA report failed to resolve the matter, and an active debate continues.[15]

From a technical economic standpoint, there are a number of problems with existence value, which a growing literature has been probing.[16] MIT economists Peter Diamond and Jerry Hausman conclude that "surveys designed to test for consistency between stated willingness-to-pay and economic theory have found that contingent valuation responses are not consistent with economic theory."[17] Other critics find that in practice existence value studies often yield estimates that are simply implausible.[18] For example, respondents to survey questionnaires often give similar estimates for saving wild animals from human harm, even when the exact number of animals may vary by orders of magnitude.

From a technical economic standpoint, there are a number of problems with existence value.

Thus far, those who have actually attempted to measure existence values have studied mostly wilderness areas, threatened species and other environmental concerns. However, the use of the concept is potentially much broader. Tropical forests may have an existence value for people in

rich nations, but there will also be a value for these same people in knowing of the existence of higher incomes for people in poor countries — which may depend on cutting the forests.

Indeed, there are endless possibilities for the calculation of existence value. Virtually any object invested with symbolic importance will have an existence value. For example, the presence of an abortion clinic in a community will cause some of the residents to feel good, while others feel bad. Burning the American flag will have a large negative existence value for many people. However, the knowledge that freedom of speech, including flag burning, is protected will also have a large positive value for many others. Should survey questionnaires, based on statements of dollar values as a way of communicating views about the desirability of government actions, be used to try to help resolve such issues? The same sorts of questions can be posed for an endless array of issues.

Diamond, Hausman, and several other leading economists have called on the profession to abandon the use of existence value on both theoretical and empirical grounds, such as those noted above.[19] Nevertheless, others argue that, although there are significant difficulties and major potential pitfalls, Americans care a great deal about the environment, even when they are not directly affected, and any decision making calculus that did not incorporate such preferences as a benefit would be seriously inadequate.[20]

I conclude, like other critics, that use of existence value should be abandoned. My argument, however, is grounded in what might be called "economic theology."

These particular issues, while important, are not the subject of this paper. I conclude, like other critics, that use of existence value should be abandoned. My argument, however, is grounded in what might be called "economic theology."[21] To be sure, I mean theology in a broader sense than Christianity or other traditional religions alone. The distinguished theologian, Paul Tillich, once said in all seriousness that in terms of actual impact Karl Marx was "the most successful theologian since the Reformation."[22] Secular religions such as Marxism, it is now common to point out, have been a leading feature of the modern age, often a decisive force in shaping the course of history.[23]

Secular religions do not speak directly of or appeal to God for authority. However, they are religions in the sense that they set a framework of meaning by which a person understands his or her life and the fundamental values that will shape it. Moreover, secular religions are often suffused with themes that have long been familiar from the history of Christianity and Judaism.[24] That is, in all likelihood, the explanation for their great appeal.[25]

Existence value methods have thus far been applied mostly to issues such as wilderness and endangered species that, as I will show below, have a religious basis. To anticipate the conclusion of this paper, the problem with

existence value is that in such cases it attempts to answer a religious question by an economic method. Making estimates of existence value then is both as silly and as meaningless as asking how much God is worth.

NATURE AS THE PATH TO KNOWLEDGE OF THE DIVINE

McPhee's discussions with Brower went well beyond the importance of preserving wilderness areas. Indeed, for Brower wilderness was simply one element in an overall worldview. Brower had for many years been touring lecture halls on college campuses and other places across the United States, preaching what McPhee labelled "the sermon." Brower's great appeal to many people was essentially religious. As McPhee wrote, "to put it mildly, there is something evangelical about Brower. His approach is in many ways analogous to the Reverend Dr. Billy Graham's exhortations to sinners to come forward and be saved now because if you go away without making a decision for Christ coronary thrombosis may level you before you reach the exit. Brower's crusade, like Graham's, began many years ago, and Brower's may have been more effective" — and was particularly influential in those portions of secular society where environmentalism was most popular and Graham's voice scarcely heard at all.[26]

For Muir the wilderness had an explicitly religious significance.

Indeed, Brower's approach fell in a longer religious tradition. There were previous environmental prophets, great texts, and sacred sites. According to McPhee, "throughout the sermon, Brower quotes the gospel — the gospel according to John Muir, . . . the gospel according to Henry David Thoreau."[27] As a former executive director of the Sierra Club for 17 years in the 1950s and 1960s, Brower was a direct follower in the line of Muir, who had founded the Sierra Club in 1892. In the late 19th and early 20th century, Muir was the foremost advocate of setting aside wild areas to preserve them for the future as free as possible of human impact.

For Muir the wilderness had an explicitly religious significance. He referred to primitive forests as "temples" and to trees as "psalm-singing." As Roderick Nash writes in *Wilderness and the American Mind,* Muir considered that the "wilderness glowed, to be sure, only for those who approached it on a higher spiritual plane . . . . In this condition he believed life's inner harmonies, fundamental truths of existence, stood out in bold relief."[28]

For Muir this was one way of saying that he experienced the presence of God in the wilderness. On other occasions he was still more explicit about this. He believed that in the natural objects of wild areas it was possible to find "terrestrial manifestations of God." They provided a "window opening into heaven, a mirror reflecting the Creator," making it possible to encounter in nature some true "sparks of the Divine Soul."[29]

The experience of nature untouched by human hand was as close to a direct encounter with God as would be possible on this earth.

By creating the world, God had made it possible for human beings to experience directly a product of divine workmanship. The experience of nature untouched by human hand was as close to a direct encounter with God as would be possible on this earth. Yet, as a result of the spread of science and industry in the modern era, this available opening to the mind of God was being erased. Human beings were building dams, cutting forests, farming the land and in any number of other ways were imposing a strong human footprint on the divine Creation. It was only in the limited areas of wilderness that still remained, as Nash relates, that "*wild* nature provided the best `conductor of divinity' because it was least associated with man's artificial constructs."[30] If at some point in the future all the wild areas were lost, future generations would be forever cut off from this main possible avenue of contact with God.

All this is to say that for Muir a wilderness area was literally a church. A church is a place of spiritual inspiration. It is a place where people come to learn about and better understand the meaning of God in their life. It is above all in church settings that God communicates his intentions for the world. A wilderness church is, furthermore, in one sense more imposing and spiritual than any church that can ever be built by the hand of man. A wilderness is a church literally built by God.

A SECULAR RELIGION

These religious convictions that motived Muir still lie behind the creation of wilderness.

Today, these religious convictions that motived Muir still lie behind the creation of wilderness. However, there is one significant difference. Environmentalism has become a secular religion. As Joseph Sax has said, in seeking to preserve national parks and other wild areas, he and his fellow preservationists are "secular prophets, preaching a message of secular salvation."[31] Roger Kennedy, the current director of the National Park Service, agrees: "Wilderness is a religious concept," he wrote recently, adding, "we should conceive of wilderness as part of our religious life." Wilderness puts us "in the presence of the unknowable and the uncontrollable before which all humans stand in awe" — that is to say, although Kennedy does not put it in just these words, in Wilderness we stand in the presence of God.[32]

In his essay, "John Muir and the Roots of American Environmentalism," the distinguished environmental historian Donald Worster explores the process of secularization at work. Muir was brought up in Wisconsin immersed in the doctrines of a strict Protestant sect, Cambellism. These doctrines would play a major role in shaping his thinking for the rest of his life. But like so many others in the modern age, by his twenties he had left the traditional religious forms of his youth well behind. As Muir said, "I take more intense delight from reading the power and goodness of God from 'the things which are made' than from the Bible."[33] Instead, Worster concludes

that, while the influence of his youthful piety remained strong, "Muir invented a new kind of frontier religion; one based on going to the wilderness to experience the loving presence of God." It was a type of religion that would later also prove immensely attractive for the "many Americans who have made a similar transition from Judeo-Christianity to modern environmentalism."[34]

Although Muir abandoned the established Christian churches of his time, he did make frequent reference in his writings to God. Today, environmentalists such as Brower seldom speak directly of God but do regularly describe a "spiritual inspiration," "sense of awe," "source of values," "humbleness of spirit," and so forth that they experience in the wilderness. These descriptions are little changed from the language used by earlier generations to describe the feeling of being in the presence of God.

Many leading environmental thinkers in the United States today do explicitly characterize their mission, if not as Christian, as "religious." In *The Voice of the Earth*, Theodore Roszak states that "the emerging worldview of our day will have to address questions of a frankly religious character." Environmentalism, he argues, will have to provide answers to "ethical conduct, moral purpose, and the meaning of life," and thereby help to guide "the soul" to the goal of "salvation."[35] In early 1996, Interior Secretary Bruce Babbitt stated that "religious values are at the very core of the 1973 Endangered Species Act."[36] Babbitt and other environmental leaders have sought to enlist Christian religious organizations to support the Act as a "Modern Noah's Ark."[37]

Many leading environmental thinkers in the United States today do explicitly characterize their mission, if not as Christian, as "religious."

The motto of the Wilderness Society today, borrowed from Thoreau, is "In wildness is the preservation of the world," i.e., the salvation of the world. In its appeals for public support, the Wilderness Society today typically asserts of wilderness areas that "destroy them and we destroy our spirit . . . destroy them and we destroy our sense of values."[38] The issue at stake in preserving wilderness is not merely a matter of the esthetics of a beautiful landscape or the retention of a museum piece of the geologic past. The real issue, as the Wilderness Society says, is to maintain the very moral foundations of the nation.

This might seem outlandish — or mere fund-raising rhetoric — to those who know little of the theological history of the idea of wilderness. However, in a long religious tradition that dates to seventeenth century New England, "a genuine reading of the book of [wild] nature is an ascension to the mind of God, both theoretical and practical."[39] If the Wilderness Society is telling us today that our national values depend on preserving the wilderness, this is a secularized way of saying what many others have asserted before: that without God no foundation for values is possible. And God, as Muir said explicitly and contemporary secular environmentalism says implicitly, is encountered best of all in the wilderness.

Thus, although some people have seen modern environmentalism as borrowing from Asian religions, pantheism and other sources, in truth, the core of the religious conviction for most environmentalists is a secularized Christianity. This should not be surprising in a nation where the Christian influence is ingrained in the national psyche — whether recognized explicitly in all cases or not.

A SECULAR PURITANISM

The process of secularization did not begin with Muir. He regarded himself as a follower of Emerson, and had studied his writings closely. The philosophy of New England transcendentalism represented the critical point where Christian theology — largely of a Puritan variety — was adapting rapidly to the new demands of the modern age. Historian Arthur Ekirch observes that in the transcendentalist philosophy "nature was the connecting link between God and man;" thus, "God spoke to man through nature."[40]

The core of the religious conviction for most environmentalists is a secularized Christianity.

Emerson, Thoreau, and other transcendentalists in turn drew much of their inspiration from their Boston forebearers. If transcendentalism saw an empty worship of false economic gods spreading across the land, the Puritans had always said that income and wealth were among the most dangerous corrupters of the souls of men. The Puritans also, as the Harvard historian Perry Miller commented, were "obsessed with" the "theology of nature." In Puritan theology of the colonial era, "the creatures . . . are a glass in which we perceive the one art which fashions all the world, they are subordinate arguments and testimonies of the most wise God, pages of the book of nature, ministers and apostles of God, the vehicles and the way by which we are carried to God."[41]

The idea that there is a moral imperative to preserve every species — that God has decreed that every species has a right to exist — has religious origins deep in western civilization. Calvin in the sixteenth century had said that human beings should be "instructed by this bare and simple testimony which the [animal] creatures render splendidly to the glory of God." Indeed, according to Calvin, God intends for "the preservation of each species until the Last Day."[42] The bible had, as some environmental leaders are today invoking, given explicit instructions on this matter in the story of Noah and his Ark.

Jonathan Edwards, by some accounts America's greatest theologian, was a key bridge between the seventeenth century Puritans and their nineteenth century New England intellectual heirs. Edwards said that "the disposition to communicate himself . . . was what moved [God] to create the world."[43] As Miller observed, "what is persistent, from the [Puritan] covenant theology (and from the heretics against the covenant) to Edwards

and to Emerson is the Puritan's effort to confront, face to face, the image of a blinding divinity in the physical universe, and to look upon that universe without the intermediacy of ritual, of ceremony, of the Mass and the confessional."[44]

It is not only in the attitudes towards wild nature that the environmental movement today offers a secular Puritanism. As McPhee relates, Brower commonly referred in his sermon to the human presence in the world as a "cancer."[45] More recently, Dave Foreman, the founder of Earth First, again said that "humans are a disease, a cancer on nature."[46] Or as Paul Watson, a founder of Greenpeace, put it, "we, the human species, have become a viral epidemic to the earth" — in truth, the "the AIDs of the earth."[47] This all harks back to the doom and gloom of a Puritan world of depraved human beings infected with sin, tempted to their own destruction at every step by the devil and his devious tricks. It should be expected, the Puritan ministers said, that a sinful world would soon have to pay a harsh punishment imposed by God — both on this earth and for most people in a life in hell to come.

Environmentalism in these and still other ways is today a powerful secular embodiment of the Puritan impulse in American life.

Environmentalism in these and still other ways is today a powerful secular embodiment of the Puritan impulse in American life. Indeed, the Puritan tradition has had an extraordinary and enduring influence on the entire history of the United States. It should not be surprising that, although it is taking new and most often secular forms today, the Puritan influence is being strongly felt once again. As Worster explains:

> The second legacy [of the environmental movement] from Protestantism is *ascetic discipline*. In large measure Protestantism began as a reaction against a European culture that seemed to be given over, outside the monastic orders, to sensuous, gratification-seeking behavior. . . . There was from the beginning, and it reappeared with vigor from time to time, a deep suspicion of unrestrained play, extravagant consumption, and self-indulgence, a suspicion that tended to be very skeptical of human nature, to fear that humans were born depraved and were in need of strict management.
>
> The Protestant tradition may someday survive only among the nation's environmentalists. . . . Too often for the public they sound like gloomy echoes of Gilbert Burnet's ringing jeremiad of 1679: "The whole Nation is corrupted . . . and we may justly look for unheard of Calamities." Nonetheless, the environmentalists persist in warning that a return to the disciplined, self denying life may be the only way out for a world heading towards environmental catastrophe.
>
> Surely it cannot be surprising that in a culture deeply rooted in Protestantism, we should find ourselves speaking its language, expressing its temperament, even when we thought we were free of all that.[48]

The environmental movement today is strongest in Germany, Sweden, Holland — all countries with strong Protestant heritages. By contrast, in France, Spain and Italy, shaped much more by the Catholic influence, the

role of green parties and environmental groups is much less. In Latin countries the full body of the Catholic church itself — with all its history and authority — was the means by which God communicated with the world. The Pope was the agent of God on earth; the faithful could find in the Catholic church an encounter with the majesty and mystery of God.

But having expelled Catholicism, Protestants had to look elsewhere. They often found their spiritual inspiration in nature. Nature became the place where Protestant believers could hear the voice of God. The Puritans, who most ruthlessly eliminated ceremony and imagery, had a particular need to find in nature a substitute for an abandoned mother church.

HOW MUCH IS A CHURCH WORTH?

The existence value of wilderness, endangered species, and other wild objects in nature is as much a theological as an economic subject.

This brief excursion into theological and environmental history should be enough to show that the existence value of wilderness, endangered species, and other wild objects in nature is as much a theological as an economic subject. Indeed, if the concept of existence value were to be extended into every possible realm, God has the ultimate existence value. A candidate wilderness area at least has the potential to be visited, even by those who value it most for the very fact of its existence.

To be sure, it hardly needs saying, many people will find any such talk of the existence value of God to be sacrilegious. Not that long ago a person could be burned at the stake for less. Yet, as the previous discussion has indicated, calculating a monetary value for the knowledge of the existence of a wilderness area comes close to the same thing. Nature untouched by human hand, as found in a wilderness, is a means of obtaining knowledge of the existence and qualities of God. In secular environmentalism this message comes in only a slightly revised form — wild nature is "the true source of values for the world."

Admittedly, to value a wilderness in this way is to value the instrument of communication of religious truth rather than the actual knowledge itself. Thus, a more precisely analogous question would be: How much is the knowledge of the existence of a church worth?

This is, at least in concept, an answerable question. Economists can point out that, although leaders of institutional religions may be offended by the question, they do in fact make such calculations. Other things equal, more churches are likely to be better. But more churches also cost more money. In making a decision at some point not to build another church, a religious organization is in effect saying that the religious benefit of the additional church is not worth the cost of building and maintaining it. However crass it may seem to say, the additional communication of God's word to the world does not create a benefit large enough to cover the added expense.

So how would one go about putting a marginal value on the existence of one more church (wilderness)? Answering this question, assuming a person is willing to think about the matter in these terms, would involve multiple concerns. One question to be addressed would be: How much does a particular new church (wilderness) add to the religious education of the faithful? How many new people might it draw into the faith? Related to this would be the question, how many churches (wildernesses) should a religious denomination ideally maintain and how many does it already have? This obviously depends partly on the total number of faithful, their geographic distribution, and the expected growth of the religious group in the future.

To be sure, yet another factor is that the building of a church is not just a way to be spiritually uplifted. It can also be a way of publicly and symbolically announcing a depth of religious commitment, a way of formally taking an action for the glory of God. Building a grand cathedral, such as Notre Dame in Paris, can take on a special religious significance when it involves a great sacrifice of effort — as religions have historically found meaning in making large sacrifices of many kinds. A wilderness area thus might become all the more meaningful in the same way: The more valuable the mineral, timber and other natural resources given up, the greater is the sacrifice and the greater the symbolic statement of allegiance to the faith.

So how would one go about putting a marginal value on the existence of one more church (wilderness)?

Indeed, this is precisely why the Arctic National Wildlife Refuge (ANWR) has become so important to the environmental movement today. It is not just the on-the-ground environmental features of the area — there are in truth many other equally desolate and isolated places that are also important to some group of wild animals. The truly distinctive feature of ANWR is that so much oil would potentially be sacrificed. It creates a rare opportunity for a powerful religious statement. An analysis of the benefits and costs of ANWR oil development thus becomes in major part a tradeoff between two alternative "uses" of the oil: (1) as fuel for a modern economy, and (2) as a symbol which, left in the ground, would show the willingness of society to commit vast resources in order to construct a multi-billion dollar cathedral, a religious edifice requiring such large sacrifice that it would stand as one of the greatest (certainly most expensive) testimonies ever made to the glory of the faith.

From a social point of view extending beyond the immediate members of the denomination, it also has to be taken into account that a church may well also be valued by others outside the religion. Like the Vatican for non-Catholics, they may admire it as a work of art, or regard it as an important part of their history. Many people no doubt today do regard a wilderness in much this fashion. It is a museum piece providing a record of one point in the geologic transformation of the earth. Wilderness areas often have beautiful scenery that can be preserved for others in the future to enjoy.

To be sure, the discussion of all these potential analytical problems in putting a marginal value on the existence of a new church (wilderness) has begged the question of whether a religious body would ever want to do anything like that — whatever economists might be inclined to do. Indeed, most religious leaders would very likely reject any such suggestion out of hand. A church involves an element of the sacred; to put a money value on it profanes the faith. The very act of regarding the church in economic terms would in itself diminish the value of the church significantly.

Many environmental leaders do in fact react much as other religious leaders would to proposals to measure the existence value of a wilderness. While recognizing a potential political gain in putting their case in economic terms, environmentalists have on the whole been cool if not antagonistic to efforts by economists to calculate existence values for wild objects in nature.

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Mark Sagoff, the current president of the Society of Environmental Ethics, writes that "contingent valuation [is] an attempt to expand economic theory to cover environmental values. . . . But what makes environmental values important — what makes them values — often has little or nothing to do with 'preferences,' with perceived well being, or with the 'satisfaction' people may feel in taking principled positions." Aside from the many practical analytical problems, Sagoff rejects existence value in principle as an imperialistic attempt by economists to substitute clever techniques for "the role that the public discussion of values should play in formulating environmental policy."[49] In short, it attempts to decide religious questions on (pseudo) scientific grounds.

NEGATIVE EXISTENCE VALUE

For Sagoff and many others, the very act of attempting to put a money value on the existence of an endangered species, a wilderness or other object of wild nature is itself a source of mental distress. It is like trying to put a money value on God, a sacrilege in any faith. Indeed, "negative existence values" are likely to be almost as common as positive evaluations, because in any diverse society it is almost inevitable that a cultural or religious symbol regarded favorably by one group will be seen negatively by some other group. Not surprisingly, the members of the economics profession who advocate use of existence value have largely neglected this particular possibility.

Indeed, in the specific case of wilderness, some people do regard the existence of a newly created wilderness area as a symbolic affront to their own values. It is for some of them offensive in the manner of throwing away good food — a deliberate waste of good timber, mineral and other natural resources. A leader of the current "wise-use" movement, Ron Arnold, thus writes that wilderness and other curbs on development "have bit by bit

impaired our productivity with excessive and unwise restrictions on forest and rangelands, on water and agriculture, on construction and manufacture, on energy and mineral, on every material value on upon which our society is built."[50]

Although they might not put it precisely this way, other critics sense intuitively the following: The legal designation of a wilderness area represents symbolically a testimony to the glory of one faith, but this may be a faith different from their own, and they may thereby feel their own religious convictions diminished. One analyst has characterized the current fierce policy dispute over the creation of wilderness in southern Utah as at heart a clash between the Mormon theology of many Utah natives and a competing set of secular religious precepts.[51]

Still others might object that a wilderness is not a church today of any institutional Christian religion. Indeed, the rise of environmentalism is a reflection of the increasing secularization of American society. This in itself is likely to be an unpleasant thought to contemplate for some traditional Christians.[52] There is also a possible source of "negative utility" in the fact that secular religions often borrow Christian messages and values, even while the followers in these secular faiths may not even be aware of the original inspiration.

The legal designation of a wilderness area represents symbolically a testimony to the glory of one faith.

ENVIRONMENTAL CREATIONISM

A "secular religion" is, in truth, an awkward combination. Such a religion typically appropriates the values, religious energy, organizational forms and other features of an earlier established religion, in most cases in the Judeo-Christian tradition. Yet, it also frequently sets all this in what is said to be a naturalistic or scientific context. The dressing of religion in the garb of science may end up seeking to blend contradictory elements.

Consider the theology of wilderness as found in the secular faith of much of contemporary environmentalism. The Puritans believed it was possible to go to the wilderness to gain a unique access to the mind of God. In the sixteenth and seventeen centuries the Puritans could accept easily enough the biblical message of the Creation — of nature as a literal work of God untouched by human hand. But geological, biological and other sciences since that time have made it clear that the earth is many billions of years old and that it has been the subject of untold upheavals and transformations. Perhaps a wilderness can help to reveal natural laws as they are at work in the universe, and these laws may themselves reflect a divine source. However, a wilderness can no longer in any real sense be said to reveal an original and unchanged condition of the earth, as it was created by God.

Wilderness theology, in short, involves a form of creationism. Sometimes there is an explicit link to the Judeo-Christian story in Genesis. In other cases, where there is no explicit mention of God, it is perhaps best characterized as a "secular creationism." Current environmental writings are in fact filled with references of both kinds to "the Creation." Two recent books on environmental matters are titled *Caring for Creation* and *Covenant for a New Creation*.[53] A magazine article on environmental philosophers describes the belief that the current need is for a "spiritual bond between ourselves and the natural world similar to God's covenant with creation."[54] In much the same vein, if perhaps even more commonly, natural environments isolated from much European contact are widely referred to as a newly found — or currently sought after — "Eden" or "paradise" of the earth.[55]

Such language has begun to invade even mainstream politics: Vice President Gore recently said that we must cease "heaping contempt on God's creation."[56] In a December 1995 speech remarkable for its candor in linking his environmental policy making to his religious beliefs, Interior Secretary Bruce Babbitt said that "our covenant" requires that we "protect the whole of Creation." Wild areas are a source of our "values" because they are "a manifestation of the presence of our Creator." It is necessary to protect every animal and plant species because "the earth is a sacred precinct, designed by and for the purposes of the Creator."[57]

Vice President Gore recently said that we must cease "heaping contempt on God's creation."

Such new forms of environmental creationism involve as much tension with the cannons of scientific knowledge as the older and more familiar forms of Christian creationism. Indeed, while Babbitt made explicit reference to God, others do not, even while they speak religiously of "the creation." Some might find the secular version the most objectionable of all: prominent biologists and other physical scientists sally forth to attack Christian creationism as ignorant obscurantism, even while some of them actively proselytize their own secular brand of environmental creationism.

In short, if awareness of these matters spreads, the designation of a wilderness area at some point could come to represent yet another cultural symbol: the existence of a large element of religious naivete — if not hypocrisy — among portions of the scientific establishment. All this is yet another potential source of negative existence value for at least some people.

The various forms of potential negative existence value are all further affected by an additional factor — whether the cultural symbol is established as a public or private action. If a private group gets together to build its own church, at least in America (it can be much different in other countries) few people are likely to be greatly upset, even though they may disagree strongly with the church creed. However, if it is the government that undertakes to build the church, this is an altogether different matter. It is not only that taxpayer money is being spent. The government is also seen as making an

official declaration formally affirming a particular set of religious values. When a citizen subscribes to another faith, the degree of offense taken — the sense of "negative utility" — will be all the greater.

A person thus might object strongly to the establishment of a government owned and operated wilderness area, but have little or no objection to a private group undertaking precisely the same mission. Indeed, the arguments of this paper suggest that the national system of wilderness areas should be privatized and any further wildernesses be created privately as well.[58]

WHO ASKS THE QUESTION DETERMINES THE ANSWER

A person might object strongly to the establishment of a government owned and operated wilderness area, but have little or no objection to a private group undertaking precisely the same mission.

The multiple meanings of wilderness are typical of cultural symbols. An "X-rated" movie is a source of sexual titillation to one person, while the very existence of this movie may be a sign of society's moral decay to another. The existence of a government welfare program may represent the compassion of society for the poor, but for other people it may symbolize the coercive confiscation of hard earned money from one set of people in order to give it away to undeserving others.

The proponents of the use of existence value methods suggest that in helping to resolve such issues they can apply their techniques according to the cannons of the scientific method. They further suggest that existence value measurement, as a scientific exercise, will be replicable. The results will not be, as some might suspect, a reflection of the beliefs of the scientific investigators. Also, the more resources put into the investigation, the more consistent and reliable the estimates of monetary existence value should presumably become.

None of these things, however, is likely to be the case in practice. In fact, when economists undertake to estimate existence value, the methods they use are not complicated. In essence, the economic researcher solicits answers to a survey questionnaire. The questions and the answers may be given either orally or in writing (and sometimes with follow-up). For a particular wilderness area, for example, the questionnaire might start off with a brief description of the potential wilderness site, and then ask how much money the person — who may be a thousand or more miles away — would be willing to pay to know that this place will be preserved for the future with minimal human intrusion as a wilderness.

However, since the respondent often knows essentially nothing about the possible wilderness, it is typically necessary to provide some background for answering the question. This raises many potential difficulties. Consider some of the possible items that might be mentioned:

1. A brief physical description of the wilderness;

2. In order to provide some needed context, a brief explanation of how many total wilderness areas have already been established in the United States and how this particular potential wilderness area being studied fits into that broader picture;

3. To include some historical context, an explanation that the idea of preserving wilderness has been traced by leading scholars to John Muir and New England transcendentalists, adding that for these people the purpose of visiting wild nature was to experience the presence of God;

4. For those survey respondents who might have an interest in theological analysis, a brief mention that in light of modern scientific knowledge the theology of wilderness today represents a kind of secular creationism.

When economists undertake to estimate existence value, the methods they use are not complicated. In essence, the economic researcher solicits answers to a survey questionnaire.

To be sure, existence value researchers will no doubt strongly object that to administer the questionnaire with any such accompanying materials would be to bias significantly the results. And that is probably true. However, there may be no escaping this problem. To say that only "the facts" will be provided is untenable. There will almost always be far more facts than can ever be provided, requiring a ruthless selection. Why would a geologic description be a more appropriate set of facts than a historic or theological description? To argue for the exclusion of the theological information may be merely a disguised way of affirming the cultural values of a secular society.

Moreover, the more financial resources that are available, and thus the more information that can be conveyed to the set of respondents, the better a scientific analysis should be. However, in this case it will also mean that the greater the selection problem will become. Unlike the normal scientific undertaking, the more systematic the effort, the more variable and thus problematic existence value results may become. The only truly replicable analysis may well be one that conveys little information beyond the simple identification of the natural object under study. And it will be predictable essentially because it is based on a commonality of ignorance.

Even to state such a minimal detail as that the wilderness has "a total area of such and such" will be to give this feature emphasis over other potential descriptions. Another person might think that a more important detail is that the potential wild area has, say, "the second highest elevation in Colorado." Who knows? The point is that no one can say in objective terms. When it comes to matters of cultural symbolism, the researcher can supply the information needed by respondents only by knowing in advance the appropriate cultural frame of reference.

Yet, in matters of public policy debate that relate to the creation of cultural (in many cases religious) symbols, the appropriate cultural frame of

reference is very often precisely the matter at issue. The economic researcher thus ends up merely translating his or her own value system — or that of the client providing the money — into a more formal and in the end pseudo-scientific set of economic results.

CONCLUSION: SCIENTIFIC ECONOMICS IN CRISIS

The idea of existence value, as suggested previously, was introduced as an attempt to address a new problem facing the economics profession. It should be said, in concluding, that the problem was real enough. The existence value cure, however, is worse than the disease.

The economics profession emerged in the progressive era as part of the design for the scientific management of American life. Since then, economists have occupied a privileged position in American professional and intellectual life. The secular religion of America for much of the twentieth century was economic progress. It was not a matter of the mere satisfaction of crass material desires. Rather, economic progress, as the faithful believed, would mean the end of scarcity. And abolishing scarcity would mean the elimination of the source — or so it was supposed — of most human conflict. The end result of economic progress thus would be nothing less than the salvation of mankind, the arrival of heaven on earth.[59]

With belief in economic progress — as one might more formally say, "economic theology" — entering into a period of crisis, environmentalism proposed a new set of cultural symbols.

Biblically, morality is determined by those actions that lead to salvation. Therefore in progressive theology efficient and inefficient would become virtually synonymous with good and evil. It was the efficiency of an action that determined whether it contributed to economic progress and thus the secular salvation of the world. Progressivism has been aptly described by historians as "the gospel of efficiency."[60]

As the group responsible for judging efficiency, professional economists thus became more than a mere group of expert technicians; they were the ultimate judges of the morality of government programs, policies, and other issues. It was no accident that members of the economics profession, not Christian clergy or other social science professionals, were designated by law to sit at the door of the President. This was accomplished by the Employment Act of 1946 which created the Council of Economic Advisors.

By the 1960s, however, this priestly role of economists as the dispensers of moral legitimacy in American society was coming under growing challenge. Many factors contributed but there was one development that probably had the greatest impact. It was simply that the claims for the redeeming benefits of economic progress were not borne out by the actual history of the 20th century. As a matter of material gains alone, the economic progress that had been promised had in significant degree taken place in

developed countries (rare, it might be noted, for a theological prophesy). But the moral transformation also promised had not occurred. Heaven on earth seemed as far off as ever. Indeed, despite immense material advance, the twentieth century has been filled with world warfare, the holocaust, Siberian prison camps, and other dismal events.

With belief in economic progress — as one might more formally say, "economic theology" — entering into a period of crisis, environmentalism proposed a new set of cultural symbols. Environmentalism, it might be said, offered a new religious vocabulary.[61] If a dam taming a raging river had been a cathedral to economic progress, in environmental religion the same dam now became a virtual evil. For environmentalists, the new cathedral would be a wilderness area. The Wilderness Act of 1964 officially announced the arrival of a powerful new religious symbol in American public life.

What the concept of existence value sought to accomplish, in effect, was to elevate new environmental values without abandoning the authority of the reigning economic language.

Progressive religion had looked to the future; constant change was a sign of the continuing advance in building heaven on earth. The constant striving for efficiency was what ensured that progress would be taking place as rapidly as possible. The status quo, by contrast, was something to be left as rapidly behind as possible. What was "in existence" per se had no value.

All this, however, came into question as the hopes for moral as well as economic progress were challenged by so many unhappy events in the 20th century. Perhaps constant change was not the path to salvation. Perhaps greater attention and value should be placed on what already existed. Indeed, preservation of wilderness took on such cultural significance because it represented the longest existing thing of all — nature as it had been found since the Creation (or at least this could be the symbolism, if hard to square with modern geologic science).

The economists who promoted the idea of introducing a whole new realm of economic valuation — putting a value on "existence" for its own sake — very likely sensed all this. They saw that the vocabulary of economics, grounded as it was in the values of change, efficiency, and progress, was facing growing doubts in important parts of American life. Many of these economists were themselves probably sympathetic in some ways to this trend of events.

But what the concept of existence value sought to accomplish, in effect, was to elevate new environmental values without abandoning the authority of the reigning economic language. It was like saying that Christians and Muslims should stop fighting about religion because they are both correct. If efficiency had long been a basic term of social legitimacy, why not simply redefine efficiency to encompass as well the maximum preservation of the existing state of the world?

This was a scheme bound to fail. Theologically, it required that the forward march of progress should be measured by the extent to which people liked the fact that progress was not occurring. If belief in progress at some point down the road should in fact be displaced in the American value system, the accompanying vocabulary of progress would also be abandoned. There would no longer be any point to existence value because the very framework of efficiency analysis would no longer be of much interest. Some other new vocabulary and source of moral legitimacy — one can only guess today at what it might be — would have taken the place of professional economics.

That economists continue to be consulted, continue to receive large payments to make estimates of existence value, merely indicates that the vocabulary of progress is still a powerful source of legitimacy in America. It still pays to appeal to efficiency, even in those cases when the underlying goal may be something else altogether. For the remaining believers in progress, however, they should recognize that existence value amounts to a Trojan horse. It may seem for a time to sustain the social role of economics but in the long run it can only help to undermine it.

Existence value has little or nothing to contribute to this particular religious discussion.

None of this should be taken as arguing that the critics of progress are wrong. Surely, they are at least in part right, in so far as the progressive gospel promised heaven on earth. Yet, it is also true that few people seem prepared to abandon the material comforts that modern science and industry have delivered in such abundance. The ultimate future of progress, in any case, is well beyond the scope of this paper. The important point is that existence value has little or nothing to contribute to this particular religious discussion. The fate of progress will have to be resolved the old fashioned way — through empirical observation, historical awareness, reasoned argument, moral judgment, testimonies of faith, theological analysis and other traditional means of religious exchange.

ABOUT THE AUTHOR

Robert Nelson is a professor at the School of Public Affairs of the University of Maryland and Senior Fellow in Environmental Studies of the Competitive Enterprise Institute. He served as a senior economist in the Office of Policy Analysis of the Department of the Interior, the principal policy office serving the Secretary of the Interior, from 1975 to 1993. During that time he served as the senior research manager for the President's Commission on Privatization (1988) and chief economist for the Commission on Fair Market Value Policy for Federal Coal Leasing (1984). Dr. Nelson also is currently a Senior Fellow at the Center for the New West in Denver and an adjunct scholar at PERC in Bozeman, Montana. He has previously served as a visiting scholar at the Brookings Institution and the Woods Hole Oceanographic Institute. He is author of several books, including *Zoning and Property Rights* (MIT Press, 1977), *Reaching for Heaven on Earth: The Theological Meaning of Economics* (Rowman and Littlefield, 1991), and *Public Lands and Private Rights: The Failure of Scientific Management* (Rowman and Littlefield, 1995). He received a Ph.D. in economics from Princeton University in 1971.

ENDNOTES

[1] John McPhee, *Encounters with the Archdruid* (New York: Farrar, Straus and Giroux, 1971), p. 74.

[2] See Bryan G. Norton, "Thoreau's Insect Analogies: Or Why Environmentalists Hate Mainstream Economists," *Environmental Ethics* Vol. 13 (1991), pp. 235-251.

[3] Stanley Lebergott, "Long-Term Trends in the U.S. Standard of Living," in Julian L. Simon, ed., *The State of Humanity* (Cambridge, MA: Balckwell Publishers, 1995), p. 149.

[4] John V. Krutilla, "Conservation Reconsidered?" *American Economic Review* (September 1967).

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[47] Paul Watson, "On the Precedence of Natural Law," *Journal of Environmental Law and Litigation*, Vol. 3 (1988), p. 82.
[48] Worster, *The Wealth of Nature*, pp. 197-98, 200.

[49] Mark Sagoff, "On the Expansion of Economic Theory: A Rejoinder," *Economy and Environment* (Summer 1994), pp. 7-8.

[50] Ron Arnold, *At the Eye of the Storm: James Watt and the Environmentalists* (Chicago: Henry Regnery, 1982), p. 123.

[51] Brooke Williams, "Love or Power?," *Northern Lights*, Vol. 7, No. 4 (Fall 1991).

[52] The Catholic League for Religious and Civil Rights, for example, reacted to speeches by Interior Secretary Bruce Babbitt defending the Endangered Species Act in biblical terms with a press release, "Bruce Babbitt Maligns Catholicism." Babbitt had said in his speech that he found more spiritual inspiration in nature than in the Catholic church of his youth. The President of the League, William Donohue, declared that the Secretary's explanation of his religious turn away from Catholicism showed political "stupidity as well as unfairness." See *Human Events*, January 12, 1996.

[53] Max Oelschlaeger, *Caring for Creation: An Ecumenical Approach to the Environmental Crisis* (New Haven: Yale University Press, 1994); and Carol S. Robb and Carl J. Casebolt, eds., *Covenant for a New Creation: Ethics, Religion, and Public Policy* (Mary Knoll, NY: Orbis, 1991).

[54] Peter Borelli, "The Ecophilosophers," *The Amicus Journal* (Spring 1988), p. 35.

[55] See, for example, the *Time* magazine cover story on "Inside the World's Last Eden: A Personal Journal to a Place No Human Has Ever Seen," July 13, 1992; or, similarly, John McCormick, *Reclaiming Paradise: The Global Environmental Movement* (Bloomington: University of Indiana Press, 1989).

[56] Quoted in Gustav Niebuhr, "Black Churches' Efforts on Environmentalism Praised by Gore," *Washington Post*, December 3, 1993, p. A13.

[57] Bruce Babbitt, "Our Covenant: To Protect the *Whole* of Creation," circulated to top staff on the Department of the Interior eMail system, December 14, 1995. This speech was delivered on various occasions, including the League of Conservation Voters in New York City in early December 1995.

[58] Robert H. Nelson, "Wilderness, Church, and State," *Liberty* (September 1992).

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