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The Impact of Economics on Environmental Policy

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J O I N T C E N T E R

In response to growing concerns about understanding the impact of regulation on consumers, business, and government, the American Enterprise Institute and the Brookings Institution have established the new AEI-Brookings Joint Center for Regulatory Studies. The primary purpose of the center is to hold lawmakers and regulators more accountable by providing thoughtful, objective analysis of existing regulatory programs and new regulatory proposals. The Joint Center will build on AEI's and Brookings's impressive body of work over the past three decades that has evaluated the economic impact of regulation and offered constructive suggestions for implementing reforms to enhance productivity and consumer welfare. The views in Joint Center publications are those of the authors and do not necessarily reflect the views of the staff, council of academic advisers, or fellows.

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Executive Summary

Environmental economists have seen their ideas translated into the rough-and-tumble policy world for over two decades. They have witnessed the application of economic instruments to several environmental issues, including preserving wetlands, lowering lead levels, and curbing acid rain. This essay examines the impact of the rise of economics in the policy world on the making of environmental policy. I focus on two related, but distinct phenomena–the increasing interest in the use of incentive-based mechanisms, such as tradable permits, to achieve environmental goals; and the increasing interest in the use of analytical tools in regulatory decision making, such as benefit-cost analysis.

I argue that economists and economic instruments have had a modest impact on shaping environmental, health and safety regulation, but that economists will play an increasingly important role in the future. Although the role of economics is becoming more prominent, it does not follow that environmental policy will become more efficient. This apparent inconsistency can be explained by the political economy of environmental policy.

The Impact of Economics on Environmental Policy

Robert W. Hahn

1. Introduction

Many scholars dream about having their ideas put into practice. Yet, when the dream becomes a reality, it frequently feels different—in large part because of the gulf between the ivory tower and the real world. Environmental economists have seen their ideas translated into the rough-and-tumble policy world for over two decades. They have played an important role in shaping some key aspects of policy. They have, for example, witnessed the application of economic instruments to several environmental issues, including preserving wetlands, lowering lead levels, and curbing acid rain. Despite a few notable successes, the influence of economists on environmental policy to date has been modest.

I will focus on two related, but distinct phenomena—the increasing interest in using incentive-based mechanisms, such as tradable permits, for achieving environmental goals; and the increasing interest in using analytical tools in regulatory decision making, such as benefit-cost analysis.[1] For purposes of this essay, an *economic instrument* is defined as any instrument that is expected to increase economic efficiency relative to the status quo. This broad definition includes traditional incentive-based mechanisms, process reforms, and economic analysis that is used as a basis for designing more efficient policies.[2]

Economists can influence environmental policy in several ways. One is by advocating the use of particular tools for achieving better environmental outcomes through research, teaching, and outreach to policy makers. Another is by analyzing the benefits and costs of regulations and standards, which may demonstrate the inefficiencies of the goals themselves. A

[1]Other tools include cost-effectiveness analysis and risk-risk analysis. By risk-risk analysis, I mean an evaluation of potential increases in health risks that may arise from efforts to combat a targeted health risk. Such an evaluation can help decision makers compare policies (Lave, 1981). Farmers, for example, may increase the use of an equally toxic alternative pesticide if use of the original pesticide is restricted or banned to prevent drinking water contamination. For a more detailed description of risk-risk analysis, see Graham and Wiener (1995).

[2]The narrow definition of economic instruments is typically restricted to incentive-based mechanisms, such as emission taxes, deposit-refund schemes, tradable permits, subsidies, and removal of subsidies. Such mechanisms have the potential to achieve environmental outcomes at a lower cost than direct regulation. For a broader perspective on economic instruments that highlights the importance of transaction costs, see Richards (1998). Note

third way is by analyzing how decisions are made—by examining the political economy of environmental regulation.[3] Each of these approaches can eventually have an impact on the different branches of government.

My thesis is that economists and economic instruments are playing an increasingly important role in shaping environmental, health and safety regulation. Although the role of economics is becoming more prominent, it does not follow that environmental policy will become more efficient. This apparent inconsistency can be explained by the political economy of environmental policy. I argue that economists need to do more than simply develop good ideas to influence policy. They need to understand how the political process affects outcomes, and actively market the use of appropriate and feasible economic instruments for promoting more efficient environmental policy.

Section 2 provides background on U.S. laws and regulations. Section 3 highlights the use of economic instruments in environmental policy.[4] Section 4 examines critical factors leading to the increased prominence of economics in environmental policy and also explains why economic efficiency is rarely central in environmental decision making. Section 5 summarizes the main arguments and suggests ways to enhance the impact of economists on environmental policy.

2. Laws, Regulations and the Need for Economic Instruments

Most environmental laws cover specific media, such as air, water, and land, and specific problems such as the control of toxic substances and the prevention of oil spills. They give rise to a staggering array of regulations requiring firms to obtain permits and meet specific requirements and guidelines. In some cases, firms must gain permission from federal or state authorities before making changes to production processes that have little or no impact on environmental quality.

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that the definition used here explicitly allows for command-and-control regulation to be an economic instrument in situations where it would lead to improvements in economic efficiency.

[3] See, for example, Metrick and Weitzman (1998) for an analysis of choices related to biodiversity preservation.

[4] I focus on the United States because that is the country with which I am most familiar; however, I believe the theses advanced in the paper are generally applicable to a wide range of developed countries as well as some developing countries.

There are now at least ten major U.S. federal laws that address environmental quality.[5] The largest in terms of estimated costs are the Clean Air Act (CAA), the Resource Conservation and Recovery Act (RCRA) and the Safe Drinking Water Act (SDWA).[6] According to the first comprehensive government report on the benefits and costs of federal regulation produced by the Office of Management and Budget, the direct costs of federally mandated environmental quality regulations in 1997 is approximately $144 billion (OMB, 1997).[7] This is more than half of total federal government spending on all domestic discretionary programs.[8] Estimates of direct and indirect costs using general equilibrium approaches suggest that the costs are substantially higher (Hazilla and Kopp, 1990; Jorgenson and Wilcoxen, 1990).[9] The benefits from these laws are less certain than the costs. Some estimates suggest that aggregate benefits are in the neighborhood of costs (Freeman, 1990; OMB, 1997); others suggest they substantially exceed costs (U.S. EPA, 1997).[10]

The aggregate analysis of benefits and costs masks some important information on individual regulations, such as evidence that many environmental regulations would not pass a

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[5]Consider the following laws that primarily the EPA administers: the Federal Insecticide, Fungicide, and Rodenticide Act, Clean Water Act, Clean Air Act, Resource Conservation and Recovery Act, Ocean Dumping Act, Safe Drinking Water Act, Toxic Substance Control Act, Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), Emergency Planning and Community Right-To-Know Act, and Pollution Prevention Act. The list would be longer if it included laws not primarily under EPA's jurisdiction, such as the Endangered Species Act.

[6]According to the present value of compliance costs for final regulations published between 1982 and 1996, the CAA is the most burdensome with $192 billion, second is RCRA with $121.6 billion, and third is SDWA with $43.6 billion in 1995 dollars (Hahn, 1998).

[7]Direct costs include the costs of capital equipment and labor needed to comply with a standard or regulation. Most of the cost estimates of individual regulations used by the OMB to calculate the aggregate costs only include direct costs, although a few also include indirect net changes in consumer and producer surplus. The OMB derives the aggregate cost estimate by using the EPA 's estimate of the federally mandated compliance cost (EPA, 1990) as the baseline estimate for 1988 and adding the incremental costs from EPA 's major regulations finalized between 1987 and 1996 (OMB, 1996). Unless otherwise stated, all dollar figures have been converted to 1996 dollars using the GDP implicit price deflator (Council of Economic Advisers, 1998).

[8]The total outlays in 1997 for domestic discretionary programs were $258 billion (OMB, 1998). This figure does not include expenditures related to national defense or international affairs.

[9]Hazilla and Kopp (1990) find that although social costs were below EPA's compliance cost estimates in 1975, they exceeded compliance costs in the 1980's. This result is partially explained by people's substitution of leisure for direct consumption as a result of pollution control regulation, thereby decreasing output over time.

[10]The EPA estimates that the total benefits from the Clean Air Act between 1970 and 1990 are in the range of $5.6 to $49.4 trillion in 1990 dollars, while the direct compliance costs for the same period are $0.5 trillion in 1990 dollars (EPA, 1997). For an insightful critique of the EPA's estimate, see Lutter (1998).

standard benefit-cost test. For example, more than two-thirds of the federal government's environmental quality regulations from 1980 to 1995 fail a strict benefit-cost test using the government's own numbers.[11] Indeed, if the government did not implement all major social regulations that failed a benefit-cost test during this period, net benefits would have increased by about $300 billion (Hahn, 1998). Moreover, there is ample room to reallocate expenditures to save more lives at lower cost (Goklany, 1992; Morrall, 1986). A reallocation of mandated expenditures toward the regulations with the highest payoff to society could save as many as 60,000 more lives a year at no additional cost (Tengs and Graham, 1996).

For over two decades, economists have highlighted two significant problems with the current legal framework in U.S. environmental policy. The first is that the laws are overly prescriptive. Both laws and regulations frequently specify a preferred technology or set of technologies for achieving an outcome. For example, scrubbers were required for some power plants as part of a compromise reached under the 1977 Clean Air Act Amendments (Ackerman and Hassler, 1981). Economists have argued that a more flexible approach, such as an emissions tax, could achieve the same or similar environmental results at much lower cost (see, e.g., Bohm and Russell, 1985; Tietenberg, 1985). A second problem is that, while some statutes now require agencies to at least consider, if not balance, the benefits and costs of regulations, many laws prohibit such balancing (Crandall *et al.*, 1997; Portney, 1990). According to the courts interpretation of Section 109 of the Clean Air Act, for example, the Environmental Protection Agency cannot consider the costs of determining national ambient air quality standards for designated pollutants. The result has been that many environmental programs and regulations have been put in place that would not pass a strict benefit-cost test. Both observations suggest that economic instruments could play a critical role in designing more efficient policies.

3. An Overview of Economic Instruments

It is useful to consider two categories of economic instruments for framing policy choices. The first includes *policies* whose purpose is to improve on the efficiency of the status quo. The second category consists of a group of analytical tools, such as benefit-cost analysis,

[11]Of the 70 final regulations analyzed, monetized benefits exceeded the costs in only 31 percent of EPA's rules (Hahn, 1998).

whose aim is often to improve the economic efficiency of policies. The first category would include process reforms such as a regulatory budget, sunset provisions, peer review, requirements to evaluate alternatives to a regulation, and the provision of better information to Congress (Litan and Nordhaus, 1983). It would also include incentive-based mechanisms such as emission fees, tradable permits, deposit-refund schemes, direct subsidies, removal of subsidies with negative environmental impacts, reductions in market barriers, and performance standards.[12] The idea behind such instruments is that they create incentives for achieving particular goals that are welfare enhancing. Generally not included in this category are highly prescriptive technology-based standards. The second category includes benefit-cost analysis, cost-effectiveness analysis, and risk-risk analysis.

The preceding definition of economic instruments has the advantage that it includes a wide array of instruments, such as approaches to monitoring and enforcement, the use of the courts, and the use of information. One drawback is that, unlike the conventional definition, an instrument is not necessarily an economic instrument just because it is incentive-based. For example, an emission fee need not be an economic instrument using my definition if it leads to a reduction in economic efficiency. The definition used here requires the ability to specify a counterfactual—what would have happened in the absence of the application of a particular economic instrument—to determine how the policy would affect efficiency. I offer this definition because it seems natural that we should want economic instruments to improve economic efficiency.

Economists rarely frame the instrument choice problem in such general terms. Instead, they tend to focus on particular mechanisms, such as fees and permits, which are known to have efficiency-enhancing properties in theory. Below I examine these instruments, but also consider other instruments, including the increasing role of economic analysis in the formulation of environmental policy.

The Increasing Use of Incentive-Based Mechanisms

[12]See Stavins (1998a) for a good overview of instrument types and their application. Kneese and Schultze (1975) provide an early treatment of some of the practical issues to consider in shifting to effluent taxes.

A broad array of incentive-based mechanisms has been used in U.S. federal environmental policy. Table 1 highlights some of the more important applications of fees, subsidies, tradable permits, and the provision of information. These mechanisms have been used for all media in a variety of applications.[13] Perhaps best known in terms of their potential for achieving cost savings are tradable permits. As can be seen from the table, their use has steadily increased over time at the federal level. Moreover, there has been increasing interest in the potential application of economic instruments as well (U.S. EPA, 1991).

The table shows that the ideas of economists regarding economic instruments are being taken seriously. President Clinton's 1993 Executive Order 12866 for Regulatory Planning and Review provides a good example. The order directs agencies to identify and assess incentive-based mechanisms, such as user fees and tradable permits, as an alternative to traditional command-and-control regulation, which provides less flexibility in achieving environmental goals.

The use of incentive-based mechanisms is also growing at the state level. Table 2 lists a sampling of state and regional programs. It shows that the use of these mechanisms is also increasing at the state level. There are now many programs at the regional level, such as Southern California's Regional Emissions Clean Air Incentives Market (RECLAIM) that allow polluters to trade emission allowances to achieve air pollution goals.

The interest in using incentive-based mechanisms is also growing in other countries. A survey by the Organization for Co-operation and Development (OECD) showed that, in 1992, twenty-one OECD countries had various fees and charges for emissions, twenty had fees and charges for specific high pollution products, sixteen countries had deposit-refund programs, and five countries had a tradable permit program (Opschoor *et al.*, 1994). Although the United States has predominantly used the tradable permits scheme at the federal level, European countries have more often used fees to help achieve their environmental goals. These fees typically have not had a direct effect on pollution because they have not been set at a level that directly affects behavior.[14]

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[13]This section focuses on efforts to improve environmental quality through pollution control measures, and does not review incentive-based mechanisms used in natural resource management. There are, however, notable initiatives at the state and federal level such as wetlands mitigation banking programs.

[14] Revenues from these fees, however, are often used to invest in improvements in environmental quality.

In principle, the use of these mechanisms has the potential to achieve environmental objectives at the lowest cost. Many economic studies have projected cost savings from replacing the traditional command-and-control regulations with more flexible incentive-based regulations. A review of *ex ante* empirical studies on cost savings from achieving least-cost air pollution control pattern shows significant potential gains from incentive-based policies (Tietenberg, 1990). The ratio of costs from a traditional command-and-control approach to the least-cost policy for the eleven studies reviewed ranged from 1.07 to 22.00, with an average of 6.13. These studies generally assume that a market-based approach will operate with maximum efficiency to achieve the same level of environmental quality at lower cost. In the real world, the counterfactual is less clear. It would be more realistic to compare actual command-and-control policies with actual market-based approaches (Hahn and Stavins, 1992).

An aggregate savings estimate from all current incentive-based mechanisms for air, water, and land pollution control in the United States was developed by Anderson *et al.* (1997) using published estimates of potential savings and rough estimates where no studies were available. The authors estimate that in 1992, existing incentive-based programs saved $11 billion over command-and-control approaches and will save over $16 billion by the year 2000. This estimate includes significant state programs in addition to federal initiatives.

Although such an estimate provides a rough picture of the magnitude of potential cost savings, it does not provide an assessment of the actual cost savings. Many of the studies used to compile the estimate are based on *ex ante* simulations that assume incentive-based mechanisms achieve the optimal result. This is rarely the case in practice. Political obstacles frequently lead to markets that have high transaction costs and institutional barriers that reduce the potential for cost savings. Another problem with the estimation of savings is that it is difficult to assess what would have happened in the absence of a particular program. Even where cost savings are measured based on actual market data, it is not always clear if the program in question can be solely credited with the savings.[15]

There are three general categories of cost savings estimates for incentive-based mechanisms. The first is *ex ante* savings estimates that generally rely on simulations that assume the least cost abatement pattern is achieved. The second is *ex post* savings estimates that

[15] For example, railroad deregulation led to lower than expected prices for sulfur dioxide allowances by reducing the premium for low sulfur coal (Burtraw, 1996).

rely on market simulations similar to the *ex ante* estimates. The third is *ex post* savings estimates that use actual data from trades. Although there are a number of *ex ante* simulation studies of potential cost savings from achieving the least-cost pollution abatement scheme for various pollutants, there are relatively few *ex post* assessments of actual incentive-based programs and even fewer *ex post* assessments of actual cost savings. Table 3 highlights some of the problems with current knowledge of cost savings. The table shows *ex ante* and/or *ex post* estimates of cost savings for five tradable permit programs for air pollution control. I chose these programs since they represent programs where the most information is available; however, as the table shows, there are relatively few assessments of the actual impact of programs.

I was not able to find any *ex ante* assessments of the potential savings from the various parts of the Emissions Trading Program designed to reduce the cost of meeting air pollution regulation.[16] Hahn and Hester (1989) produced the only comprehensive study of costs savings based on actual trades. They estimated that the program achieved savings on the order of $1.4 to $19 billion over the first 14 years. These savings, however, do not represent the full extent of potential cost savings. The program generally failed to create an active market for emission reduction credits, but it did allow for the environmental goals to be met at a lower cost (Hahn and Hester, 1989).

Lead trading, on the other hand, comes much closer to the economist's ideal for a smoothly functioning market. The EPA originally projected cost savings of $310 million to refiners from the banking provision of the program between 1985 and 1987 (U.S. EPA, 1985). The actual cost savings may be much higher than anticipated since the level of banking was higher than EPA's expectations. There are no *ex post* estimates of cost savings based on actual trading.

There was at least one *ex ante* study of cost savings from using an incentive-based approach to curb the use of ozone depleting chemicals. The Rand study estimated that between 1980 and 1990, a price based incentive policy would save a total of $143 million over a command-and-control approach (General Accounting Office, 1982). The EPA implemented an allowance trading program, and a tax on the ozone depleting chemicals was later added. Although the primary intent of the tax was to raise revenue, it may have been set high enough to

[16] For examples of early assessments of cost savings from using market-based approaches to achieve particular air pollution goals, see General Accounting Office (1982) and Tietenberg (1985).

have a significant incentive effect. The actual cost savings from the two approaches are unclear since there are no comprehensive *ex post* studies.

There have been some *ex ante* and *ex post* studies of the sulfur dioxide allowance trading program to reduce acid rain. *Ex ante* studies projected savings on the order of $1 billion per year (ICF, 1992). The magnitude of actual cost savings achieved is estimated to be significantly less.[17]

The pattern of prices provides one indicator of cost savings, assuming that the marginal cost of abatement equals the price and total costs increase as marginal costs increase. In 1990, predictions of SO_2 permit prices were $400 to $1,000 per ton. The estimates from the beginning of the current phase of the program were significantly lower—between $250 and $400 per ton. Today actual SO_2 permit prices are about $90 to $110 per ton.[18] The discrepancy arises for a couple of reasons. First, early analyses did not include all provisions of the final bill such as the distribution of 3.5 million extra bonus allowances. The one estimate that included the extra allowances predicted prices of $170 to $200 per ton. Second, much of the remaining difference between predicted and actual permit prices is due to railroad deregulation, the resulting fall in the price of low-sulfur coal, and the decision to scrub (Burtraw, 1996; Schmalensee *et al*., 1998)

Although the absolute savings that were projected have not materialized, relative savings are in the range of what was predicted by *ex ante* studies—approximately 25 to 35 percent of costs absent trading (Ellerman *et al.* 1997, Carlson *et al.*, 1998). Interestingly, Burtraw (1996) has found that the primary source of cost savings was not directly from trading across utilities, but rather from the flexibility in choosing abatement strategies within utilities, which is consistent with earlier predictions. Therefore, improving the trading program may allow utilities to achieve further cost savings.[19]

The RECLAIM program in Southern California has received much attention over the last few years. The program was expected to produce significant cost savings. The South Coast

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[17] This discussion draws from Stavins (1998b).

[18] Actual incremental SO_2 abatement costs may be in the order of $200 per ton. Permit prices are lower than abatement costs for three reasons. First, in the 1990 CAA Amendments, allowances are "not property rights," which means that the allowance would have a lower value than if they were a secure property right. Second, public utility commissions place restrictions on some utilities' ability to purchase permits, thus raising their abatement costs. Third, utilities may have believed early high price predictions, and so over invested in scrubbers.

[19] However, these savings are likely to be less than the savings that accrue from intrautility trading (ICF, 1989).

Air Quality Management District (SCAQMD) had estimated that the program would yield cost savings of $52 million in 1994 (Johnson and Pekelney, 1996). Although the potential savings are sizable and a review of the trading activity to date suggests significant cost savings have been achieved, there are no comprehensive studies that have assessed the actual savings.

As these examples show, the use of these mechanisms has increased and the potential savings are substantial; however, a more detailed review of these applications suggests that their performance has varied widely (Hahn and Hester, 1989). The variation in performance of these programs can be explained, in part, by differences in the underlying politics governing the choice and design of these programs. These political forces have led to policies that deviate from the economist's ideal**.**

Although the tradable permit schemes reviewed here did not exhaust cost savings, the programs generally improved environmental quality at a lower cost than alternatives under consideration. In contrast, the purpose of many environmental taxes and fees in the U.S. has been to raise revenue rather than reduce pollution. For example, the Superfund tax levied on crude oil, chemicals, and gross business profits is used to help finance cleanup. When fees have been levied directly on pollution, they have not been large enough to have significant impacts on behavior. Absent adequate incentives from fees, regulators have relied on command-and-control approaches to achieve desired levels of environmental protection. Thus, most environmental fees in the U.S. would not be economic instruments using the definition in this paper.[20]

The incentive based mechanisms considered above are primarily concerned with issues of cost-effectiveness—that is, achieving a given goal at low cost. In contrast the regulatory analysis considered below addresses the choice of goals.

Moves Toward Analyzing the Benefits and Costs of Environmental Regulation

To address the dramatic increase in regulatory activity beginning in the late 1960s, the past five Presidents have introduced mechanisms for overseeing regulations with varying

[20] Some fees in Europe, such as Sweden's charge on nitrogen oxides from stationary sources, would be economic instruments (Smith and Vos, 1997).

degrees of success. A central component of later oversight mechanisms was formal economic analysis, which included benefit-cost analysis and cost-effectiveness analysis.

As a result of concerns that some environmental regulations were ineffective or too costly, President Nixon established a "Quality of Life" review of selected regulations in 1971. The review process, administered by OMB, required agencies issuing regulations affecting the environment, health, and safety to coordinate their activities. In 1974, President Ford formalized and broadened this review process in Executive Order 11281. Agencies were required to prepare inflationary impact statements of major rules. President Carter further strengthened regulatory oversight in 1978 by issuing Executive Order 12044, which required detailed regulatory analyses of proposed rules and centralized review by the Regulatory Analysis Review Group. This group consisted of representatives from the Executive Office of the President, including the Council of Economic Advisers, and regulatory agencies. A major focus of this review group was on environmental regulations such as the ozone standard, diesel particulate emissions, and heavy-duty truck emissions (White, 1981).

Since 1981, Presidents have required the use of regulatory impact analysis (RIA) for major regulations. President Reagan's Executive Order 12291 required an RIA for each "major" rule whose annual impact on the economy is estimated to exceed $100 million (Smith, 1984).[21] The aim of this Executive Order was to develop more effective and less costly regulation. President Bush used the same Executive Order. President Clinton issued Executive Order 12866, which is similar to Reagan's order in terms of its analytical requirements but differs in terms of its stringency. Generally, the Executive Order directs agencies to choose the most cost-effective design of a regulation to achieve the regulatory objective, and to adopt a regulation only after balancing the costs and benefits. Unlike Reagan's order, however, Clinton's order requires agencies to promulgate regulations if the benefits "justify" the costs. This language is generally perceived as more flexible than Reagan's order, which required the benefits to "outweigh" the costs.[22] Clinton's order requires a benefit-cost analysis for major regulations as

[21] While the definition of a "major" rule has changed somewhat over time, it is generally a regulation that is expected to have one or more of the following characteristics: an annual impact on the economy of $100 million or more; a major increase in costs or prices for consumers or business; or significant effects on competition, employment, investment, productivity, or innovation.

[22] Clinton's order also places greater emphasis on distributional concerns**.** For instance, Clinton's Principles of Regulation instructs that "…each agency shall consider… distributive impacts, and equity." On the other hand,

well as an assessment of reasonably feasible alternatives to the planned regulation and a statement of why the planned regulation was chosen above the alternatives. Most of the major federal environmental, health and safety regulations that have been reviewed to date are promulgated by the EPA because those regulations tend to be the most expensive.

The Congress has been slower to support efforts to require the balancing of benefits and costs of major environmental regulations. In 1982 the Senate unanimously passed such a law, but it was defeated in the House of Representatives. The two primary environmental statutes that allowed the balancing of benefits and costs prior to the mid-1990s are the Toxic Substances Control Act and the Federal Insecticide, Fungicide, and Rodenticide Act (Fraas, 1991). Recently, Congress has shown greater interest in emphasizing the balancing of benefits and costs. Table 4 reviews recent regulatory reform initiatives, which could help improve environmental regulation and legislation. The table suggests that Congress now shares the concern of the Executive Branch that the regulatory system is in need of repair and could benefit from economic analysis (Crandall *et al.*, 1997). All reforms highlighted in the table emphasize a trend towards considering the benefits and costs of regulation, although the effectiveness of the provisions is as of yet unclear. Perhaps owing to the politicized nature of the debate over regulatory reform, these reform efforts have come about in a piecemeal fashion, and there is some overlap in the requirements for analysis.[23] These incremental efforts fall into the two categories of economic instruments described earlier in the paper: policies and analytical tools.

In the policy category, the Small Business Regulatory Enforcement Fairness Act of 1996 requires agencies to submit final regulations to Congress for review. The Telecommunications Act of 1996 requires the Federal Communications Commission to conduct a biennial review of all regulations promulgated under the Act. The regulatory accountability provisions of 1996, 1997, and 1998 require the Office of Management and Budget to assess the benefits and costs of existing federal regulatory programs and recommend programs or specific regulations to reform or eliminate. The OMB must report the results of its research in a report, released every one or

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Reagan's Executive order instructs agencies to merely identify the parties most likely to receive benefits and pay costs.

[23] There has been some recent interest in Congress in reducing this overlap by establishing a single congressional agency that would have the responsibility for assessing the government regulation. This agency would be similar to the Congressional Budget Office, but have responsibility for regulation. It could help stimulate better analysis and review of agency rules by providing an additional source of information.

two years depending on statutory requirements. The reports represent perhaps the most significant recent step towards strengthening the use of economic analysis in the regulatory process.[24]

The addition of statutory language to require the use of analytical tools has generally received more attention than the addition of policy reforms, partly because of their prominence in the Reagan and Clinton executive orders and partly because of controversy regarding their impact. The variation of the language and the choice of analytical tool for each of the statutes listed in Table 4 reflect the results of the ongoing controversy regarding analytical tools, which takes place every time Congress debates requiring their use. Some statutes require only cost-effectiveness analysis, some full-fledged benefit-cost analysis, and some combine some form of benefit-cost analysis with risk-risk analysis.

The Unfunded Mandates Reform Act of 1995 requires agencies to choose the "most cost-effective" alternative and to describe the costs and benefits of any unfunded mandate, but does not require the benefits of the mandate to justify the costs. The Safe Drinking Water Amendments of 1996 require the Administrator of the Environmental Protection Agency to determine whether the benefits justify the costs of a drinking water standard, but the Administrator does not have to set a new standard if the benefits do not justify the costs.[25] Amendments in 1996 to the process through which the Secretary of Transportation sets gas pipeline safety standards, on the other hand, require the Secretary to propose a standard for pipeline safety *only* if the benefits justify the costs. Other statutes simply require the agency to only consider costs and benefits. The Food Quality Protection Act of 1996 is even more vague. The Act eliminates the Delaney Clause in the Food, Drug, and Cosmetic Act, the zero-tolerance standard for carcinogenic pesticide residues on processed food. Instead, the Administrator of the

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[24] Other examples in the policy category include the Paperwork Reduction Act, which sets measurable goals to reduce the regulatory burden, and the Government Performance and Results Act, which establishes requirements for agencies to develop mission statements, performance goals, and measures of performance.

[25] The Amendments also require some form of risk-risk analysis. They require the Administrator of the Environmental Protection Agency to set maximum levels for contaminants in drinking water at a "feasible" level, defined as feasible with the use of the best technology and treatment techniques available, while "taking cost into consideration." The Administrator must ignore the feasibility constraint if the feasible level would result in an increase in the concentration of other contaminants in drinking water or would interfere with the efficacy of treatment techniques used to comply with other national primary drinking water regulations. If the feasibility constraint does not apply, the Administrator must set the maximum level to minimize "the overall risk of adverse health effects by balancing the risk from the contaminant and the risk from other contaminants."

Environmental Protection Agency must set a tolerance level that is "safe", defined as "reasonable certainty of no harm." While the Food Quality Protection Act does not explicitly require the Administrator to consider benefits and costs when determining safe tolerance levels, the new language suggests increased balancing of costs and benefits relative to the original requirement. While the addition of such language to statutes represents an improvement over the status quo, it is clear that that the major aims of the efforts to date have been to require more information on the benefits and costs of regulations and to increase oversight of regulatory activities and agency performance. Ensuring that regulations pass some form of a benefit-cost test has not been a priority.

There is evidence that states are also moving towards the systematic analysis of significant regulatory actions. According to a survey by the National Association on Administrative Rules Review (NAARR) in 1996, administrative law review officials in 27 states answered that their state statutes require an economic impact analysis for all proposed rules, and 10 states require benefit-cost analysis for all proposed rules.[26] Table 5 highlights efforts in six states. The first section describes efforts to review existing rules and procedures including any measures of success, and the second section describes the analysis requirements for new activities. While the efforts vary in their authority, coverage of activities, and amount of resources, they all place greater emphasis on economic analysis and the review of existing regulations and procedures. In addition, some states have begun to document the success of their efforts; however, the measures have generally been limited to the number of rules reviewed or eliminated. No estimates of actual welfare gains are available.

The use of RIAs is also increasing in other countries. Although the requirements for analysis and the structure of oversight vary from country to country, there are eighteen OECD countries, including the United States, that require some assessment of the impacts of their regulations (OECD, 1997). Although there is some anecdotal evidence of significant impacts RIAs have had on policy, the OECD study concluded that RIAs generally only have a "marginal influence" on decision making. Just as the review of U.S. federal experience with RIAs in Hahn

[26] All fifty states, except for Rhode Island, responded to a questionnaire sent by the NAARR (NAARR, 1996). Unfortunately, little is known about the level of compliance with these requirements, the quality of the analysis, and the influence it has on decision making.

(1996) showed inconsistencies in the quality of the analysis, the same pattern appears to exist in other countries.

The preceding discussion suggests that both incentive-based mechanisms and economic analysis are playing a more important role in environmental policy. One key challenge is to better understand the ways in which economics can influence the environmental policy debate.

4. Understanding the Role of Economics and Economists in Shaping the Reforms

This section addresses the avenues through which economists have affected environmental policy, the limited influence of economics on policy, and the likely impact economists will have on future policy.

Avenues of Impact

There are three ways in which economists have influenced the debate over environmental policy—through research, teaching, and outreach.

The literature on economic instruments is voluminous and growing. There are three key ideas in the literature that have had an important impact on environmental policymaking: first, incentive-based instruments can help achieve goals at a lower cost than other instruments; second, benefit-cost analysis can provide a useful framework for decision making; and third, all policies and regulations have opportunity costs. Those ideas may seem obvious to economists, but they have not always been heeded in policy debates.

Economists have provided a normative framework for evaluating environmental policy and public goods (see, e.g., Samuelson, 1954; Baumol and Oates, 1988).[27] The literature on using incentive-based instruments to internalize externalities dates back to Pigou (1932), and for tradable permits, to Crocker (1966) and Dales (1968). The application of benefit-cost analysis to public projects begins with Eckstein (1958). Economists have also been helpful in comparing benefit-cost analysis with other frameworks for assessing the impacts of policies (see, e.g., Page, 1977; Lave, 1996).

[27] An excellent survey of the academic literature is provided by Cropper and Oates (1992).

Studies of incentive-based instruments have revealed that there are large potential cost savings from applying those instruments (Tietenberg, 1985). Moreover, economists have now marshaled some evidence of the potential cost savings of such systems in practice, as shown in Table 3.

The second way in which economists have translated their ideas into the policy process is by educating students who subsequently enter the world of policy and business. Many of those students embrace aspects of the economist's paradigm, in this case, as it applies to environmental policy. Thus, for example, as more students in policy schools, business schools, and law schools are exposed to the idea of pollution taxes and tradable permits, it is more likely that they will consider applying economic ideas to particular problems, such as curbing acid rain and limiting greenhouse gas emissions.

Formal education is part of the *diffusion* process from the ivory tower to the policy world. Most major environmental groups, businesses, and agencies involved in environmental policy now have staff members with at least some graduate training in economics. Environmental advocates are more likely to support policies that embrace incentive-based mechanisms, and their advocacy is more likely to be couched in the language of economics. A comparison of today's debate over policy instruments for climate change with earlier debates on emission fees is revealing. In the seventies, emission fees were more likely to be viewed as "licenses to pollute." Today, most policy discussions on climate change identify the need for using incentive-based instruments to achieve goals in a cost-effective manner. The sea change in attitude toward the use of incentive-based instruments represents one of the major accomplishments of environmental economics over the last three decades.

A third, more direct way that economists have translated their ideas into policy is through policy outreach and advocacy. They have become increasingly effective "lobbyists for efficiency" (Kelman, 1981).[28] For example, my colleague, Robert Stavins, developed a very influential policy document that helped affect the course of the debate on acid rain by highlighting the potential for using incentive-based mechanisms (Stavins, 1988). Another example is the letter on climate change policy signed by over 2,500 economists (Arrow, Jorgenson, Krugman, Nordhaus and Solow, 1997). I have personally been involved in several

[28] There are also a growing number of economic consultants and part-time consultants that may serve to impede the cause of efficiency (Noll, 1998).

efforts that developed a consensus among academics to help inform the broader policy community (Arrow *et al.*, 1996; Crandall *et al.*, 1997). The impact of such consensus documents, while difficult to measure, should not be underestimated.

To increase their influence on policy, economists may wish to think carefully about how they allocate their time among the activities discussed above. In terms of getting policies implemented effectively, it is generally not sufficient simply to develop a good idea. Some kind of marketing is necessary before the seedling can grow into a tree.

Limitations of Impact: Economics in the Broader Policy Process

Economists, of course, are only one part of the environmental policy making puzzle. Politics affects the process in many ways that can block outcomes that would result in higher levels of economic welfare. Indeed, one of the primary lessons of the political economy of regulation is that economic efficiency is not likely to be a key objective in the design of policy (Noll, 1998; Becker, 1983).

Policy ideas can affect interest group positions directly, which can then affect the positions of key decision makers (such as elected officials and civil servants), who then structure policies through the passage of laws and regulations that meet their political objectives. Alternatively, ideas may influence decision makers directly.[29]

Policy proposals can help shape outcomes by expanding the production possibility frontier; however, the precise position on the frontier is determined by several factors. Take, for example, the design of incentive-based instruments for environmental protection (see, e.g., Hausker, 1992; Cason, 1993; and Franciosi *et al.*, 1993). Several scholars have argued that the actual design of economic instruments typically departs dramatically from the "efficient" design of such instruments for political reasons (see, e.g., Buchanan and Tullock, 1975; Maloney and McCormack, 1982; Keohane, Revesz and Stavins, 1998; Barthold, 1994). Frequently, taxes have been used to raise revenues rather than to reflect optimal damages (Hahn, 1989; Barthold, 1994). Standards have been made more stringent on new sources than old sources as a way of inhibiting growth in selected regions (Ackerman and Hassler, 1981); and agricultural interests

[29] In this discussion, the institutional environment (e.g., the three branches of government and the rules governing each branch) is taken as a given. Obviously, other ideas can affect the structure of those institutions.

have fought hard against the idea of transferable water rights because of concerns over losing a valuable entitlement. In some cases, the government has argued for a command-and-control approach when affected parties were ready to endorse a more flexible market-oriented approach. This was the case, for example, in the debate over restoring the Everglades (Passell, 1992). In short, rent-seeking and interest group politics have been shown to have a very important impact on the design of actual policy (Yandle, 1989).[30]

Political concerns affect not only the design of incentive-based instruments, but also the use and abuse of economic analysis in the political process. Notwithstanding such concerns, some scholars have argued that economic analysis has had a constructive impact on the policy process (Fraas, 1991; Morgenstern, 1997; Portney, 1998). In certain instances, research suggests that such optimism is justified; however, one must be careful about generalizing from a small sample. In many situations, analysis tends to get ignored or manipulated to achieve political ends. This is particularly true for environmental issues that have political saliency.[31] At the same time, by exposing such analysis to sunshine and serious reanalysis, there is a hope that politicians may be encouraged to pursue more efficient policies in some instances. My own experience suggests that analysis can help shape the debate in selected instances by making trade-offs clearer to decision makers.[32]

The key point is that environmental economists should not be too optimistic about implementing some of their most fervently held professional beliefs in the real world. By improving their understanding of the constraints imposed by the political system, economists can help design more efficient policies that have a higher probability of being implemented.[33]

Likely Impact in the Future

[30]In addition, examination of particular rule making proceedings has shown the relative influence of particular factors in shaping environmental decisions (see, e.g., Magat, Krupnick and Harrington, 1986; Cropper, 1992).

[31] See, for example, the optimistic account of the cost to the U.S. of reducing greenhouse gases provided by the Council of Economic Advisers (Yellen, 1998).

[32]The impact of analysis on policy outcomes is not well understood; however, participants in the process can usually point to special cases where analysis was important. For example, in the clean air debate over alternative fuels, analysis of the cost and benefits of imposing of requiring companies to sell a large fraction of methanol-powered vehicles made this option look very unattractive.

[33] For example, in the debate over acid rain, it was clear there would be some implicit or explicit compensation to high sulfur coal interests. The challenge was to develop approaches that would maximize cost savings subject to that constraint.

To understand the likely impact of economics on environmental policy in the future, it is helpful to understand the reasons for its importance in the past. A simple story is that federal environmental policy was initially designed without much regard to cost in the wake of Earth Day in 1970, which marked the beginning of an acute national awareness of environmental issues. As the costs increased and became more visible, and the goals became more ambitious, the constituencies opposing such regulation on economic grounds grew. Currently, the political (as opposed to economic) demands for environmental quality are high, but the costs are also high in many instances. This is an obvious situation in which economists can help by building more cost-effective mechanisms for achieving goals.

So far, environmental economists have enjoyed limited success in seeing their ideas translated into practice. That success is likely to continue in the future. In particular, there are likely to be more incentive-based mechanisms, greater use of benefit-cost analysis, and more careful consideration of the opportunity costs of such policies. But that does not mean that the overall net benefits of environmental policy will necessarily increase because the political forces that lead to less efficient environmental policy will still be strong.[34]

For those who believe benefit-cost analysis should play a more prominent role in decision making—in particular, the setting of goals—it will be a long, uphill struggle. The recent fight over the Regulatory Improvement Act of 1998 sponsored by Senators Levin and Thompson provides a good example. This bill essentially codifies the Executive Orders calling for benefit-cost analysis of major rules; yet, many within the environmental community are strongly opposed, arguing that it could lead to an analytical quagmire (Skrzycki, 1998; Hawkins and Wetstone, 1998). There are at least three reasons such opponents would take this stand. First, because making such claims is good for mobilizing financial support.[35] Second, because of concerns that such legislation could help lead to more serious consideration of economics in

[34] Environmentalists have been successful in framing the debate as being either "for" or "against" the environment, making it difficult to introduce the notion of explicit trade-offs. Their success is likely to continue for the foreseeable future.

[35]The 1994 Republican plan to repeal regulations, for example, breathed new life into the green movement. The highly-publicized plan resulted in a dramatic increase in memberships to environmental groups and an increase in donations by active members (The Economist, 1997). To the extent that benefit-costs analysis is perceived as a means to repeal regulations, opposing the use of such tools may have a similar revenue-enhancing effect.

environmental decision making. Third, opponents are concerned that agencies will misuse cost-benefit analysis and related analytical tools. In particular, there is concern with what will happen if politicians decide that cost is no longer a "four-letter" word—so that benefits and costs can be compared explicitly! Given the limited scope of this bill and the level of resistance encountered thus far, it is clear that the potential for change in the short term is limited.

The problem facing economists who want benefit-cost analysis to play a greater role in decision making is that it is difficult for politicians to oppose environmental laws and regulations simply because they may fail a benefit-cost test. After all, who could be against an environmental policy if it has some demonstrable benefits for some worthy constituency? It is hard to make arguments opposing such regulation in a ten-second soundbite on television.

But economists will continue to make slow progress in the area of balancing benefits and costs. In the short term, they will do so by making arguments about the potential for reallocating regulatory expenditures in ways that can save more lives or trees. Over the longer term, they will build a better information base that clearly shows that many environmental policies will pass a benefit-cost test if they are designed judiciously, but many also will not.

5. Concluding Thoughts

This paper has made a preliminary attempt to assess the impact of economics on environmental policy. There are at least three key points to be made about the nature of this impact. First, the impact often occurs with considerable time lags. Second, the introduction of economic instruments occurs in a political environment, which frequently has dramatic effects on the form and content of policy. Third, economists are not very close to a public policy heaven in which benefit-cost analysis plays a major role in shaping environmental policy decisions that governments view within their domain.

The latter topic concerning the appropriate domain for environmental policy may be one on which the profession contributes a great deal in the future. In particular, it is difficult to determine when it is "appropriate" for a particular level of government to intervene in the development of environmental policy (Oates and Schwab, 1988; Revesz, 1992). This is a subject on which there is a great deal of legitimate intellectual and political ferment. At one extreme, free market environmentalists wish to leave most, if not all, choices about such policy

to the market (Anderson and Leal, 1992; Krier, 1992). At the other extreme some analysts believe there is a need for many levels of government intervention, including the design of a global environmental institution (see, e.g., Esty, 1994). Achieving some degree of consensus on that issue is likely to be difficult, but not impossible. For example, most economists agree that for global environmental problems, it is difficult to address them effectively without having some kind of international agency or agreement. At the same time, many economists recognize that the arguments suggesting competitive jurisdictions will under provide environmental amenities is somewhat weaker than was suggested two decades ago (see, e.g., Stewart, 1977).

Environmental economists will have many opportunities to shape the policy debate in new areas. Examples include international trade and the environment and the development of new taxation systems (Bhagwati, 1996; Kalt, 1989; Terkla, 1984; Goulder, 1995.) One of the critical factors that will affect the rate of diffusion of ideas from environmental economists to the policy world is the *perception* of their success. If, for example, markets for environmental quality are viewed as a successful mechanism for achieving goals by both business and environmentalists, their future in the policymakers' tool chest looks brighter. The same can be said of benefit-cost analysis.

There are many challenges that lie ahead for the environmental economics community. The most important one is becoming more policy relevant.[36] To achieve that end, economists need to become more problem driven rather than tool driven. There seems to be a move in this direction, but there are also incentives in the profession that still push it in the opposite direction—most notably publish or perish.

Another challenge for the economics community is to determine how far it is willing to push the paradigm. Some would like government regulations, including environmental regulations, to at least pass a broadly defined benefit-cost test (Crandall *et al.*, 1997). Others more skeptical about the tool and less skeptical about the outcomes of certain kinds of

[36] It is possible that the influence of economics on environmental policy in developing countries may be greater because these countries have fewer resources to waste. That is, governments in developing countries may more likely use the tools advocated by economists to develop policies. While there are certainly many applications of economics in environmental policy in developing countries, the general thesis has yet to be demonstrated (see, e.g., Wheeler, 1998). Moreover, judging by the levels of inefficiency of other policies in developing countries, it is unclear why environmental policies may be designed more efficiently (see e.g., Bates, 1981).

government intervention, think economists and policy makers should not ask benefit-cost analysis to bear too much weight (see, e.g., Lave, 1996; and Bromley, 1990).

Finally, economists need to get more comfortable with the idea of being lobbyists for efficiency or advocates for policies in which they believe. This comfort level is increasing slowly. Moreover, economists are finding ways to institutionalize their power in certain policy settings. A good example is the Environmental Economics Advisory Committee within the Science Advisory Board at the Environmental Protection Agency. The primary function of that group is to help provide economic guidance to the agency on important regulatory issues. Now economists have a voice.

In sum, the impact of economists on environmental policy to date has been modest. Economists can claim credit for having helped changed the terms of the debate to include economic instruments–no small feat. They can also claim some credit for legislation that promotes greater balancing of costs and benefits. But specific victories of consequence are few and far between. Most of the day-to-day policy that real folks must address involves the activities associated with complying with standards, permits, guidelines and regulations. While economists have said a few intelligent things about such matters, their attention has been largely focused on those parts of environmental policy that they enjoy talking about—areas where theoretical economics can offer relatively clean insights. Perhaps if we expand our domain of inquiry judiciously and continue to teach tomorrow's decisionmakers, we can also expand our influence. Hope springs eternal.

References

Ackerman, Bruce. A. and William T. Hassler. 1981. *Clean Coal/Dirty Air: Or How the Clean Air Act Became a Multibillion-Dollar Bail-Out for High-Sulfur Coal Producers and What Should be Done About It.* New Haven, CT: Yale University Press.

Anderson, Terry L. and Donald R. Leal. 1991. *Free Market Environmentalism.* San Francisco, CA: Pacific Research Institute for Public Policy.

Anderson, Robert C. and Andrew Q. Lohof. 1997. *United States Experience with Economic Incentives in Environmental Pollution Control Policy*. Washington, D.C.: Environmental Law Institute.

Anderson, Robert C., Alan Carlin, Al McGartland, and Jennifer Weinberger. 1997. "Cost Savings from the Use of Market Incentives for Pollution Control," In *Market-Based Approaches to Environmental Policy,* eds. Richard Kosobud and Jennifer Zimmerman. New York: Van Nostrand Reinhold.

Arrow, Kenneth J., Maureen L. Cropper, George C. Eads, Robert W. Hahn, Lester B. Lave, Roger G. Noll, Paul R. Portney, Milton Russell, Richard Schmalensee, V. Kerry Smith, and Robert N. Stavins. 1996. *Benefit-Cost Analysis in Environmental, Health, and Safety Regulation: A Statement of Principles.* Washington, D.C.: AEI Press.

Arrow, Kenneth J., Dale Jorgenson, Paul Krugman, William Nordhaus, and Robert Solow. 1997. *The Economists' Statement on Climate Change,* Redefining Progress. San Francisco, CA.

Barthold, Thomas A. 1994. "Issues in the Design of Environmental Excise Taxes*." Journal of Economic Perspectives* 8: 133-51.

Bates, R. H. 1981. *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies.* Berkeley, CA: University of California Press.

Baumol, William J. and Wallace E. Oates. 1988. *The Theory of Environmental Policy,* 2nd ed. Englewood Cliffs, NJ: Prentice-Hall.

Becker, G. 1983. "A Theory of Competition Among Pressure Groups for Political Influence." *Quarterly Journal of Economics* XCVII: 371-400.

Bhagwati, Jagdish and T. N. Srinivasan. 1996. "Trade and the Environment: Does Environmental Diversity Detract From the Case for Free Trade?" In *Fair Trade and Harmonization: Prerequisites for Free Trade?* eds. Jagdish Bhagwati and Robert E. Hudec. Cambridge, MA: MIT Press.

Bohm, Peter and Clifford S. Russell. 1985. "Comparative Analysis of Alternative Policy Instruments." In *Handbook of Natural Resource and Energy Economics*, Volume I, eds. Allen V. Kneese and Jame L. Sweeney. Amsterdam: North-Holland.

Bovenberg, A. and Lawerence H. Goulder. 1996. "Optimal Environmental Taxation in the Presence of other Taxes: General Equilibrium Analyses." *American Economic Review,* 86: 985-1000.

Bromley, D.W. 1990. "The Ideology of Efficiency: Searching for a Theory of Policy Analysis." *Journal of Environmental Economics and Management* 19: 86-107.

Buchanan, J. M. and G. Tullock. 1975. "Polluters' Profits and Political Response: Direct Controls Versus Taxes." *American Economic Review* 65: 139-47.

Burtraw, Dallas. 1996. *Cost Savings Sans Allowance Trades? Evaluating the SO2 Emission Trading Program to Date*, Discussion Paper 95-30-REV. Washington, D.C.: Resources for the Future.

Carlson, C., Dallas Burtraw, Maureen Cropper, and Karen L. Palmer. Forthcoming. *SO_2 Control by Electric Utilities: What Are the Gains from Trade?*, Discussion Paper. Washington, D.C.: Resources for the Future.

Cason, Timothy N. 1993. "Seller Incentive Properties of EPA's Emission Trading Auction." *Journal of Environmental Economics and Management* 25: 177-95.

Council of Economic Advisers. 1998. *Economic Report of the President.* Washington, D.C.: U.S. Government Printing Office.

Crandall, Robert W., Christopher DeMuth, Robert W. Hahn, Robert E. Litan, Pietro S. Nivola, and Paul R. Portney. 1997. *An Agenda for Reforming Federal Regulation.* Washington, D.C.: AEI Press and Brookings Institution Press.

Crocker, T. 1966. "The Structuring of Atmospheric Pollution Control Systems." In *The Economics of Air Pollution,* ed. H. Wolozin. New York: Norton.

Cropper, Maureen L. and William E. Oates. 1992. "Environmental Economics: A Survey." *Journal of Economic Literature* 30: 675-740.

Cropper, Maureen L., *et al*. 1992. "The Determinants of Pesticide Regulation: A Statistical Analysis of EPA Decision Making." *Journal of the Poitical Economy* 100: 175-97.

Dales, J. H. 1968. *Pollution, Property and Prices*. Toronto, Canada: University Press.

Eckstein, Otto. 1958. *Water-resource Development: The Economics of Project Evaluation*. Cambridge, MA: Harvard University Press.

Esty, Daniel C. 1994. *Greening the GATT: Trade, Environment, and the Future*. Washington, D.C.: Institute for International Economics.

Fraas, Arthur G. 1991. "The Role of Economic Analysis in Shaping Environmental Policy." *Law and Contemporary Problems* 54: 113-25.

Franciosi, Robert, R. Mark Isaac, David E. Pingry, and Stanley S. Reynolds. 1993. "An Experimental Investigation of the Hahn-Noll Revenue Neutral Auction for Emissions Licenses." *Journal of Environmental Economics and Management* 24: 1-24.

Freeman, A. Myrick. 1990. "Water Pollution Policy." In *Public Policies for Environmental Protection*, ed. Paul R. Portney. Washington, D.C.: Resources for the Future.

General Accounting Office. 1982. *A Market Approach to Air Pollution Control Could Reduce Compliance Costs Without Jeopardizing Clean Air Goals*, PAD-82-15. Washington, D.C.: General Accounting Office.

_____. 1994. *Air Pollution: Allowance Trading Offers an Opportunity to Reduce Emissions at Less Costs*, GAO/RCED-95-30. Washington, D.C.: Resources, Community, and Economic Development Division, General Accounting Office.

Goklany, Indur. 1992. "Rationing Health Care While Writing Blank Checks for Environmental Hazards." *Regulation* 14-15.

Goulder, Lawrence. 1995. "Environmental Taxation and the 'Double Dividend:' A Reader's Guide." *International Tax and Public Finance* 2(2): 157-84. August.

Graham, John D. and Jonathan Baert Wiener. 1995. *Risk vs. Risk: Tradeoffs in Protecting Health and the Environment*. Cambridge, MA: Harvard University Press.

Hahn, Robert W. (Forthcoming). *Reviving Regulatory Reform: A Global Perspective.* Washington, D.C.: AEI Press.

Hahn, Robert W. and Gordon L. Hester. 1989. "Marketable Permits: Lessons for Theory and Practice." *Ecology Law Quarterly* 16: 361-406.

Hahn, Robert W. and Robert N. Stavins. 1992. "Economic Incentives for Environmental Protection: Integrating Theory and Practice." *American Economic Review 82:* 464-8.

Hausker, Karl. 1992. "The Politics and Economics of Auction Design in the Market for Sulfur Dioxide Pollution." *Journal of Policy Analysis and Management* 11: 553-72.

Hawkins, David and Greg Wetstone. 1998. "Regulatory Obstacle Course." *Washington Post* A18. March 9.

Hazilla, Michael and Raymond J. Kopp. 1990. "The Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis." *Journal of Political Economy* 94(4): 853-73.

ICF Resources, Inc. 1989. *Economic, Environmental, and Coal Market Impacts of SO_2 Emissions Trading Under Alternative Acid Rain Control Proposals*, prepared for the U.S. Environmental Protection Agency, OPPE. Fairfax, VA.

_____. 1992. *Regulatory Impact Analysis of the Final Acid Rain Implementation Regulations*,

prepared for Office of Atmospheric and Indoor Air Programs, Acid Rain Division, U.S. Environmental Protection Agency. Washington, DC. October 19.

Johnson, S. L. and D. M. Pekelney. 1996. "Economic Assessment of the Regional Clean Air Incentives Market: A New Emissions Trading Program for Los Angeles." *Land Economics* 72: 277-97.

Jorgenson, Dale W. and Peter J. Wilcoxen. 1990. "Environmental Regulation and U.S. Economic Growth." *Rand Journal of Economics* 21: 314-40.

Kalt, J. P. 1989 "Exhaustible Resource Price Policy, International Trade, and Intertemporal Welfare." *Journal of Economics and Environmental Management* 17.

Keohane, N., Richard Revesz, and Robert N. Stavins. Forthcoming. "The Positive Political Economy of Instrument Choice in Environmental Policy." In *Environmental Economics and Public Policy: Essays in Honor of Wallace Oates*, eds. Paul Portney and Robert Schwab. London England: Edward Elgar, Ltd.

Kelman, Steven 1981. *What Price Incentives?: Economists and the Environment*. Boston, MA: Auburn House.

Kneese, Allen V. and Charles L. Schultze. 1975. *Pollution, Prices, and Public Policy*. Washington, D.C.: Brookings Institution.

Krier, James E. 1992. "The Tragedy of the Commons, Part Two." *Harvard Journal of Law and Public Policy* 15: 325-47.

Lave, Lester B. 1981. *The Strategy of Social Regulation*. Washington, D.C.: Brookings Institution.

Lave, Lester B. 1996. "Benefit-Cost Analysis: Do the Benefits Exceed the Costs?" In *Risks, Costs, and Lives Saved: Getting Better Results from Regulation,* ed. Robert W. Hahn. New York: Oxford University Press and AEI Press.

Litan, Robert E., and William D. Nordhaus. 1983. *Reforming Federal Regulation*. New Haven, CT: Yale University Press.

Lutter, Randall. 1998. *An Analysis of the Use of EPA's Clean Air Benefit Estimates in OMB's Draft Report on the Costs and Benefits of Regulation,* Comment 98-2. Washington, D.C.: AEI-Brookings Joint Center for Regulatory Studies.

Maloney, Michael and Robert E. McCormick. 1982. "A Positive Theory of Environmental Quality Regulation." *Journal of Law and Economics* 25: 99-123.

Metrick, A. and M. L. Weitzman. 1998. "Conflicts and Choices in Biodiversity Preservation." *Journal of Economic Perspectives* 12(3): 21-34.

Morgenstern, R. D., *ed.* 1997. *Economic Analysis at EPA: Assessing Regulatory Impact.*

Washington, D.C.: Resources for the Future.

Morrall, John F. 1986. “A Review of the Record.” *Regulation* 10: 25-34.

National Association on Administrative Rules Review. 1996. *The National Association on Administrative Rules Review 1996-97 Administrative Rules Review Directory and Survey*. Lexington, KY: The Council of State Governments, Midwest Office.

Noll, Roger G. 1989a. “The Economics and Politics of the Slowdown in Regulatory Reform.” In *Regulatory Reform: A Global Perspective*, ed. Robert W. Hahn. Washington, D.C.: AEI Press.

_____. 1989b. “Economic Perspectives on the Politics of Regulation.” In *Handbook of Industrial Organization*, eds. Richard Schmalensee and Robert Willig. North Holland.

Oates, Wallace E. and Robert M. Schwab. 1988. “Economic Competition Among Jurisdictions: Efficiency Enhancing or Distortion Inducing?” *Journal of Public Economics*, 35: 333-54.

Office of Management and Budget. 1996. *More Benefits, Fewer Burdens: Creating A Reglatory System that Works for the American People*, a report to the president on the third anniversary of executive order 12866. Washington, D.C.: Office of Management and Budget, Office of Information and Regulatory Affairs.

_____. 1997. *Report to Congress on the Costs and Benefits of Federal Regulations*. Washington, D.C.: Office of Management and Budget, Office of Information and Regulatory Affairs.

_____. 1998. *Budget of the United States Government, Fiscal Year 1999: Historical Tables*. Washington, D.C.: Executive Office of the President, Office of Management and Budget.

Opschoor, J.B., A. F. de Savornin Lohman, and Hans B. Vos. 1994. *Managing the Environment: Role of Economic Instruments*. Paris, France: Organisation for Economic Co-operation and Development.

Organisation for Economic Co-operation and Development. 1997. *Regulatory Impact Analysis: Best Practices in OECD Countries*. Paris, France: Organisation for Economic Co-operation and Development.

Page, Talbot. 1977. *Conservation and Economic Efficiency: An Approach to Materials Policy*. Baltimore, MD: Resources for the Future, Johns Hopkins University Press.

Passell, Peter. 1992. “A Free-Enterprise Plan for an Everglades Cleanup.” *New York Times*, May 1.

Pigou, A. C. 1952. *The Economics of Welfare*. London, England: Macmillan & Co., 4th edition.

Portney, Paul R., *ed.* 1990. *Public Policies for Environmental Protection*. Washington, D.C.:

Resources for the Future.

Portney, Paul R. 1998. “Counting the Cost: The Growing Role of Economics in Environmental Decisionmaking.” *Environment* 40: 14-21.

Revesz, Richard L. 1992. “Rehabilitating Interstate Competition: Rethinking the ‘Race-to-the-Bottom’ Rationale for Federal Environmental Regulation.” New York University Law Review, 67: 1210-54.

Richards, Kenneth R. 1998. *Framing Environmental Policy Instrument Choice*, Working Paper. Bloomington, IN: School of Public and Environmental Affairs, Indiana University.

Samuelson, Paul A. 1954. “The Pure Theory of Public Expenditure.” *Review of Economics and Statistics*, 36: 387-9.

Schmalensee, Richard, *et al*. 1998. “An Interim Evaluation of Sulfur Dioxide Emissions Trading.” *Journal of Economic Perspectives* 12(3): 53-68.

Skrzycki, Cindy. 1998. “A Bipartisan Bill Runs into a Lott of Opposition.” *Washington Post*, F01, March 20.

Smith, V. Kerry, *ed.* 1984. *Environmental Policy under Reagan's Executive Order: The Role of Cost-Benefit Analysis*. Chapel Hill, NC: University of North Carolina Press.

Smith, S. and H. B. Vos. 1997. *Evaluating Economic Instruments for Environmental Policy*. Paris, France: Organisation for Economic Co-operation and Development.

Stavins, Robert N. *ed.* 1988. *Project 88: Harnessing Market Forces to Protect Our Environment—Initiatives for the New President*, Public Policy Study sponsored by Senator Timothy E. Wirth and Senator John Heinz. Washington, DC.

_____. 1998a. *Market Based Environmental Policies*, Discussion Paper 98-26, Washington, D.C.: Resources for the Future.

_____. 1998b. “What Can We Learn From the Grand Policy Experiment: Positive and Normative Lessons From the SO_2 Allowance Trading.” *Journal of Economic Perspectives* 12(3): 69-88.

Stewart, Richard B. 1977. “Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementation of National Environmental Policy.” *Yale Law Journal* 86: 1196-272.

Tengs, Tammy O. and John D. Graham. 1996. “The Opportunity Cost of Haphazard Social Regulation.” In *Risks, Costs and Lives Saved: Getting Better Results from Regulation*, ed. Robert W. Hahn. Washington, D.C.: Oxford University Press and AEI Press.

Terkla, D. 1984. “The Efficiency Value of Effluent Tax Revenues.” *Journal of Economics and Environmental Management* 11: 107-23.

The Economist. 1997. “The Defense of Nature (2): Sprouting Again, The Economist Newspaper Limited,” April 12.

Tietenberg, Thomas. 1985. *Emissions Trading: An Exercise in Reforming Pollution Policy*. Washington, D.C.: Resources for the Future.

Tietenberg, Thomas. 1990. “Economic Instruments for Environmental Regulation.” *Oxford Review of Economic Policy* 6: 17-33.

U.S. Environmental Protection Agency. 1985. *Costs and Benefits of Reducing Lead in Gasoline*, Final Regulatory Impact Analysis III-2. Washington, D.C.: U. S. Environmental Protection Agency, Office of Policy Analysis.

_____. 1990. *Environmental Investments: The Cost of a Clean Environment*. Washington, D.C.: U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation.

_____. 1991. *Economic Incentives: Options for Environmental Protection*. Washington, D.C.: U. S. Environmental Protection Agency, Policy, Planning and Evaluation.

_____. 1997. *The Benefits and Costs of the Clean Air Act: 1970 to 1990*. Washington, D.C.: U. S. Environmental Protection Agency, Office of Air and Radiation.

White, Lawrence J. 1981. *Reforming Regulation: Processes and Problems*. Endlewood Cliffs, NJ: Prentice-Hall, Inc.

Yandle, Bruce. 1989. “Bootleggers and Baptists in the Market for Regulation.” In *The Political Economy of Government Regulation,* Topics in Regulatory Economics and Policy Series, ed. Jason F. Shogren. Norwell, MA: Kluwer, Dordrecht, and London.

Wheeler, David. 1998. *Pollution Charge Systems in Developing Countries,* mimo. Washington, D.C.: World Bank.

Yellen, Janet. 1998. *Statement of Janet Yellen, Chair, White House Council of Economic Advisers, before the U.S. Senate Committee on Agriculture, Nutrition, and Forestry on the Economics of the Kyoto Protocol*. Washington, D.C.: Government Printing Office. March 5.

Table 1: Federal Incentive-Based Programs

Fees/Charges/Taxes		
Air	1978-	Gas Guzzler Tax on vehicles with low miles per gallon
	1990-	Ozone Depleting Chemicals Fees
	2005-	Ozone Nonattainment Area Fees
Land	1980-1995	Superfund Taxes
Water	NA	National Pollution Discharge Elimination System Fees
Subsidies		
Air	NA	Clean Fuel and Low-Emission Vehicle Subsidies
	NA	Renewable Energy and Conservation Subsidies
Land	1995-	Brownfield Pilot Project Grants
Water	1956-	Municipal Sewage Treatment Construction
Cross Media	early 1980's-	Supplemental Environmental Projects, to reduce non-compliance penalties
Tradeable Permits		
Air	1974-	Emissions Trading Program
	1978-	Corporate Average Fuel Economy Standards
	1982-1987	Lead Credit Trading
	1988-	Ozone Depleting Chemicals Allowance Trading
	1990?-	Emissions Averaging for Heavy-Duty Truck Manufacturers
	1992-	Reformulated Gasoline Credit Trading Program
	1992-	Early Reduction Program, to reduce hazardous air pollutants
	1992-	Joint Implementation Program, to reduce green house gas emissions
	1994-	Emissions averaging under NESHAPs for Synthetic Organic Chemical Manufacturing
	1995-	Sulfur Dioxide Allowance Trading
	1995-	Emissions averaging under NESHAPs for Petroleum Refining
	1995-	Emissions averaging under NESHAPs for Marine Tank Vessel Loading Operations
	1998-	Open Market Trading, to reduce ozone
	pending	El Paso region cross border trading for air pollution
	NA	Clean-Fuel Vehicle Credit Trading Program
Water	1983	Effluent Bubble
Other		
Cross Media	1986	Emergency Planning and Community Right-To-Know Act

Notes:
NESHAPS=National Emissions Standards for Hazardous Air Pollutants

Sources: Anderson and Lohof (1997); Stavins (1998a)

Table 2: State/Regional Incentive-Based Programs

Deposit-Refund Schemes		
Land	1972-	Bottle Bills
	1985-	Maine Pesticide Container Deposit System
	1988-	Rhode Island Tire Deposit
	NA	Battery deposit systems
Fees/Charges/Taxes		
Air	1989-	Texas Clean Fuel Incentive Charge
	1995-	Southern California Congestion Pricing Scheme
	NA	Operating Permit Fees
	NA	California "Hot Spots" Fees
Land	-1998	North Carolina Advanced Disposal Fees
	1993-1995	Florida Advanced Disposal Fees
	1995-	Minnesota Contamination Tax
	NA	Variable Cost Pricing for Household Waste
	NA	Landfill Taxes
	NA	Hazardous Waste Tax
	NA	Tire Charges
	NA	Rhode Island Hard-to-Dispose Materials Tax
	NA	Fertilizer Charges
Water	NA	Effluent Charges for Publicly Owned Treatment Works
	NA	Stormwater Charges
Subsidies		
Air	199? -	Vehicle Scrappage
	NA	Clean Fuel and Low-Emission Vehicle Subsidies
Land	1990-	New Jersey Information Awards Program, for reporting illegal dumping
	NA	Recycling Loans and Grants
	NA	Recycling Tax Incentives
	NA	Brownfield Tax incentives and Loans
Cross Media	1990-1992	Louisiana Environmental Scorecard, tax exemptions linked to environmental performance
	NA	Tax Benefits for Pollution Control Equipment
	NA	Loans and Tax-exempt Bonds for Pollution Control Projects
Tradeable Permits		
Air	1987-	Colorado Wood Stove and Fireplace Permit Trading
	1990-	Spokane Grass Burning Permit Trading
	1993-	Texas Emissions Trading
	1994	RECLAIM: Emissions Trading for NOx and SO2
	1995-	Massachusetts Emissions Trading for VOC, NOx, and CO
	1996-	Delaware Emissions Trading for VOC and NOx
	1996-	Michigan Emissions Trading for VOC and criteria pollutants
	1996-	Wisconsin Emissions Trading for VOC and NOx
	1997-	Illinois Emissions Trading for VOC
	1999-	OTC/OTAG Regional NOx Reduction Program
	pending	New Jersey Emissions Trading
Water	1981-	Wisconsin Effluent Trading (point to point)
	1984-	State Effluent Trading (point to non-point)

Source: Anderson and Lohof (1997)

Table 3: Estimates of Cost Savings over Command-and-Control Approach

Emissions Trading Program (1974-)		
ex ante	No comprehensive studies on compliance cost savings.	
ex post	Total cost savings between 1974 and 1989 were between $960 million to $13 billion. "Netting" portion of the program was estimated to have saved $25 million to $300 million in permitting costs, and $500 million to $12 billion in emission control costs; "Bubbles" provision of the program was estimated to have saved $300 million from federally approved trades, and $135 million from state approved trades (1984 dollars).	Hahn and Hester (1989b)
Lead Credit Trading (1982-1987)		
ex ante	Refiners were expected to save approximately $200 million over the 1985 to 1987 period (1983 dollars).	EPA (1985)
ex post	None thus far.	
Ozone Depleting Chemicals Allowance Trading (1988-)		
ex ante	The Rand study calculated that under an incentive based policy, the total compliance cost would be $77 million, or roughly 40 percent, less than a command and control approach between 1980 and 1990 (1980 dollars).	Palmer *et al* (1980), as reported in GAO (1982)
ex post	None thus far.	
Sulfur Dioxide Allowance Trading (1995-)		
ex ante	$689 million to $973 million per year between 1993 and 2010 or 39 to 44 percent less than the costs without allowance cost trading (1990 dollars).	ICF (1992)
	Annual savings in 2002 is $1.9 billion with internal trading, $3.1 billion with interutility trading or 42 and 68 percent less than the cost absent trading (1992 dollars).	GAO (1994)
ex post	Total annual compliance cost savings in 2010 under the least cost approach is $600 million or 35 percent less than the command and control approach (1995 dollars).	Carlson et al. (1998, forthcoming)
	$225 to $375 million dollars or 25 to 35 percent of compliance costs absent trading (1995 dollars).	Ellerman et al. (1997)
RECLAIM (1994-)		
ex ante	The RECLAIM program is expected to reduce compliance costs by $38.2 million in 1994, $97.8 million in 1995, $46.6 million in 1996, $32.9 million in 1997, $67.7 million in 1998, and $64.0 million in 1999 (1987 dollars). In the early years, the compliance costs are approximately 80 percent less than under a command and control approach, and close to 30 percent less in the later years.	Johnson and Pekelney (1996)
ex post	None thus far.	

Table 4: Recent Legislation Promoting Regulatory Reform

Statute	Description
Unfunded Mandates Reform Act of 1995	An executive branch agency must prepare a cost-benefit analysis of regulations with new mandates in excess of $100 million in any one year on state, local, and tribal governments or the private sector. The agency must also choose the least burdensome alternative.
Small Business Regulatory Enforcement Fairness Act of 1996	An agency must submit each final regulation and the supporting analyses to Congress and the General Accounting Office for review. Congress can enact a joint resolution of disapproval that, if passed and signed by the president, can void the regulation.
Regulatory Accountability Provisions of 1996 and 1997	In 1997 and 1998, OMB must submit an assessment of the annual regulatory benefits and costs of all federal regulatory programs to Congress. OMB was also asked to make recommendations for reforming or eliminating inefficient programs.
Food Quality Protection Act of 1996	This act eliminates the Delaney Clause for pesticides that sets a zero-tolerance standard for carcinogens from residues in processed foods. The EPA will now establish a tolerance level based on an analysis of risks, and may consider the benefits from the pesticide in determining a tolerance level.
Safe Drinking Water Act Amendments of 1996	Under the amendments, the EPA administrator is directed to publish a determination as to whether the benefits of the maximum contaminant level justify, or do not justify, the costs.

Source: Hahn (1998a)

Table 5: State Efforts to Assess the Economic Impacts of Regulation

	Review of Existing Rules		Analysis of New Rules			
	Initiated	Coverage	Examples of Results	Key Revisions[1]	Required Analysis	Requirement that Benefits Exceed Costs
Arizona	1986	Continuous (S)	49% of 1,392 rules reviewed in FY 1996 were identified for modification.	1993	Economic impact (S)	All rules (S)
California	1995	One-time (E)	3,900 regulations were identified for repeal; 1,700 were recommended for modification.	1991-1993, 1997	Economic impact (S, E)	Selected rules (S, E)
Massachusetts	1996	One-time (E)	Of the 1,595 regulations reviewed, 19% were identified for repeal and 44% were identified for modification.	1996	Economic impact (E)	All rules (E)
New York	1995	One-time (E)	In progress.	1995	Economic impact (S, E); Benefit-cost for selected rules (E)	All rules (E)
Pennsylvania	1996	One-time (E)	The Department of Environmental Protection identified 1,716 sections of regulations to be eliminated.	1996	Economic impact for selected rules (S); Benefit-cost for selected rules (E)	All rules (E)
Virginia	1994	Continuous (E)	Of the rules reviewed, 27% were identified for repeal and 40% for modification.	1994	Economic impact (S, E)	None

Notes:

Authority: E = Executive Order, S = Statute

1. Although many of these states previously had some requirements for analysis of new rules, they resulted in cursory review. Important revisions were made through new executive orders and statutory changes to clarify and expand requirements and establish oversight.

Source: Hahn (1998a)