Journal of Economic Perspectives—Volume 22, Number 1—Winter 2008—Pages 67–84

Has Economic Analysis Improved Regulatory Decisions?

Robert W. Hahn and Paul C. Tetlock

Regulation, in a broad sense of the term, covers a vast variety of government rules that affect both individuals and firms. You must obtain a license to drive a vehicle; you must get a permit if you want to expand your home; you must submit to an inspection before traveling on an airplane. Government may restrict entry into certain industries, like foreign entry into the airline industry, or set constraints on prices, as it does for electricity. While economists have the analytical tools to investigate all of these regulatory choices, this article will focus primarily on regulations and laws introduced by the federal government that impose costs on firms for the protection of the health and safety of individuals. Examples include pharmaceutical companies that need to get approval for drugs and medical devices; toy manufacturers that need to comply with safety standards; and automobile manufacturers that need to comply with safety and environmental standards.

Typically, a federal regulation is the result of some law that Congress enacts. For example, Congress may require the Department of Transportation to develop a regulation related to the fuel economy of light duty trucks; or it might require the Environmental Protection Agency to regulate hazardous air emissions from the petroleum and chemical sectors. In special instances, Congress may write a specific regulation into the law, such as in the 1991 Clean Air Act amendments that placed specific requirements on tailpipe emissions from vehicles. The costs and economic impacts of these kinds of U.S. federal regulations appear to be sizable. The U.S. Office of Management and Budget (OMB) provides a rich source of information

■ *Robert Hahn is Co-founder and Executive Director of the AEI–Brookings Joint Center for Regulatory Studies and a scholar at American Enterprise Institute, both in Washington, D.C. Paul Tetlock is Visiting Assistant Professor of Finance, Yale University, New Haven, Connecticut, on leave from the University of Texas, Austin, Texas. Their e-mail addresses are ⟨rhahn@aei-brookings.org⟩ and ⟨paul.tetlock@yale.edu⟩, respectively.*

on the costs of federal regulation. In its 2007 summary, OMB examines individual regulations that generate over $100 million in costs or benefits annually for which analyses exist that monetize a substantial portion of the costs and benefits.

The annualized costs of these major U.S. federal regulations from 1996 to 2006 are estimated to range from $40 billion to $46 billion in 2006 (in 2001 dollars). The corresponding benefits were estimated to be in the range of $99 billion to $484 billion (OMB, 2007). By far the largest category, accounting for roughly half of all costs and benefits, concerns air pollution regulations issued by the Environmental Protection Agency. Other regulations include food safety rules issued by the Food and Drug Administration, traffic safety rules issued by the Department of Transportation, and energy efficiency and renewable energy rules issued by the Department of Energy. The OMB (2007) report only looks back at regulations enacted in the previous ten years. However, because some of the regulations imposed on firms were issued more than a decade ago, the cumulative effects can be staggering. The Environmental Protection Agency (1990) estimated that the total annualized cost of complying with all pollution control activities in the year 2000 would be more than $170 billion (in 1990 dollars).

Economic analysis, such as benefit–cost analysis, is becoming more widely used as a tool for informing regulatory decisions. President Reagan signed an executive order in 1981 that required a benefit–cost analysis for each new major regulation for agencies in the executive branch. All presidents since that time have continued this practice. The European Union and Mexico have embraced this idea, as have many U.S. states, but the U.S. federal government is probably the world's leader in implementing some form of government-sponsored benefit–cost analysis to inform significant regulatory decisions.

Formal regulatory evaluation typically includes a requirement that, when a regulatory agency is instructed by the legislative or executive branch to draw up a regulation, the agency must perform some kind of economic analysis, usually benefit–cost analysis. Regulatory evaluation can also be done by a separate government agency or department whose primary task is to help improve regulations by using economic analysis. In the United States at the federal level, the regulatory agency typically does a benefit–cost analysis of a proposed regulation and its alternatives. This analysis is then sent to the president's Office of Management and Budget, which reviews the proposal. The OMB either offers suggestions for improving the regulation or accepts the regulatory proposal as is. In 2006, for example, 69 percent of the 600 rules reviewed by OMB were accepted with changes, while 27 percent were accepted as is—the remaining 4 percent were either withdrawn by the agency or sent in improperly (according to ⟨http://RegInfo.gov⟩). OMB took 56 days on average to review a regulation. Such centralized oversight can help with interagency coordination, setting priorities, and implementing more cost-effective regulation.

Economic analysis can be a powerful tool in informing regulatory decisions. Regulation uses a sizable amount of resources, so it is relevant to ask whether the benefits of regulation are worth the costs. As we will document, many regulations would not pass a benefit–cost test, while others could yield much higher net

benefits with appropriate modifications. We readily acknowledge that benefit–cost analysis faces limitations, such as difficulties in placing a monetary value on certain key benefits and costs. We generally believe that the regulatory process should use benefit–cost analysis—with benefits and costs stated in quantitative terms and translated into monetary values where possible—as an input into important regulatory decisions. We would leave open the possibility that in particular cases, unquantifiable costs or benefits may tip the balance of the decision.

This paper starts by describing how benefit–cost analyses are done. It will then bring some news that may be welcome to economists seeking research topics, but unwelcome to economists in their role as citizens. Despite the magnitude of the costs and benefits of regulation, the quality of government analyses of regulation falls far short of basic standards of economic research, and it does not appear to be getting any better over time. Indeed, we do not even have answers to basic questions like whether benefit–cost analyses tend to overstate benefits, perhaps out of regulatory zeal, or whether they overstate costs, perhaps because they fail to recognize how innovation will reduce the costs after regulations are imposed. Furthermore, there is little evidence that economic analysis of regulatory decisions has had a substantial positive impact. This is not to say that economists have not had an impact in important areas, such as the deregulation of airlines, but that economic analysis of run-of-the-mill billion-dollar regulations may not be having much impact.

The poor quality of analysis can help explain some of this ineffectiveness. However, regardless of how good the analysis is, politicians sometimes choose not to take basic economic ideas seriously.

Connecting Regulation and Economic Analysis

Benefit–cost analysis is frequently used by economists who analyze regulation. Such analyses can justify additional regulation in some cases and can imply that regulation is overly aggressive or poorly designed in other cases.

One example of a benefit–cost analysis that played an important, if not pivotal, role was the economic analysis of the regulation phasing lead out of gasoline. The regulation would have required refiners to reduce lead in gasoline more quickly because of the health hazards it posed when released into the air. Upon entering office in 1981, the Reagan administration had targeted that regulation for elimination. According to Christopher DeMuth (1994), who was the OMB official in charge of reviewing the regulation: "A very fine piece of analysis persuaded everyone that the health harms of leaded gasoline were far greater than we had thought, and we ended up adopting a much tighter program than the one we had inherited. At the same time, the introduction of marketable lead permits saved many hundreds of millions of dollars from the cost of that regulation."

Both the initial analysis and final analysis of the regulation had an impact on shaping this rule. The initial analysis found the benefits to outweigh the costs so greatly that more detailed analysis was quickly organized. The final analysis found

that tightening the lead standard more than had been proposed could result in net benefits between $4 and $20 billion (1983 dollars) over four years. Nichols (1997) tells the story. The largest benefit from the analysis was the lower blood pressure resulting from lower blood lead levels in adults. This effect, which could be quantified, was then translated into a monetary value. The estimated reduction in medical costs, lost wages, and mortality exceeded $18 billion. In addition, the analysis found that the reduction in lead in gasoline would result in benefits of almost $2 billion for children. This figure was based on the sum of the avoided costs of medical treatment and remedial education from the decrease in the number of children with hazardous levels of lead in their blood. Lead also caused the premature wear of exhaust systems and spark plugs and made more frequent oil changes necessary. The benefits of reducing the otherwise necessary maintenance totaled about $3 billion. The analysis also considered the frequency of "misfueling," or using leaded gasoline in vehicles built to use unleaded gasoline. Misfueling caused damage to catalysts, which increased air pollution emissions of hydrocarbons, carbon monoxide, and nitrogen oxides. The benefits of reducing harmful emissions from misfueling were estimated to be about $600 million.

To calculate a monetary value for costs, the analysis used a complicated linear programming model of the refinery sector, which produced estimates of total costs of less than $2 billion. In addition, the model estimated that a provision in the marketable lead permit system that allowed banking of early lead reduction credits for future use would save an additional $200 million in costs. Thus, the benefit–cost analysis not only provided a justification for strengthening the regulation, but also a suggestion for how to improve its design.

Unfortunately, governments implement a number of regulations where the costs probably exceed the benefits. As one example, Morrison, Winston, and Watson (1999) studied the Airport Noise and Capacity Act of 1990, which specified noise limits around airports. The act called for eliminating many aircraft from U.S. airports that did not meet new noise level limits; in effect, 27 percent of the value of the industry fleet would have to be replaced earlier than planned. The authors found that the costs of this premature replacement would be about $10 billion. Morrison, Winston, and Watson determined the noise reduction in decibels and valued it based on estimates of homeowners' willingness to pay, assuming that a one decibel reduction in noise level raised the present value of homes by 1 percent. The benefits of noise regulation—quieter residential environments around airports—were found to be about $5 billion. Thus, they found the costs were likely to exceed benefits by $5 billion (in 1995 dollars). The authors also used the results of their analysis to propose an alternative solution to the noise problem that could have resulted in net benefits of $200 million.

These examples suggest why it can be difficult to estimate the benefits and costs of individual regulations in a persuasive way. Estimating benefits can involve a chain of reasoning that links basic science to health effects to monetary values placed on those health effects. Costs are also difficult to estimate because it is hard to gauge how firms will respond and how technology will evolve. Furthermore, it

can be quite difficult to estimate how a regulatory policy will affect different segments of the population. Such distributional concerns, while potentially important, have not been a primary focus of benefit–cost analysis.

But based only on a review of the benefits and costs that were actually monetized in the regulatory analyses, the evidence suggests that a significant number of regulations would be likely to fail a benefit–cost test. For example, using OMB's (2006b) numbers on the 95 major rules from 1995 to 2005 for which substantial benefits and costs were monetized in the regulatory analysis, we find that 14 of 95 are likely to fail a benefit–cost test. (When the agency did not provide a best estimate, we used the midpoint of its range as our point estimate.) These analyses suggest that some regulations would have benefited from redesign while others should not have been implemented in the first place. For these regulations, annualized costs exceeded annualized benefits by roughly $2.8 billion.

Furthermore, regulations that imposed very high costs per life saved could actually end up harming the health of workers and consumers and shortening life expectancy. As an extreme example, suppose a regulation aimed at improving safety in the workplace really does nothing, but forces firms to incur a billion dollars in compliance costs. There is a link between personal income and health, in part because some additional spending would go to expenditures on health care. Hahn, Lutter, and Viscusi (2000) found that, using a cut-off of $15 million (1990 dollars) per extra life saved, just over half of the 24 regulations they examined are likely to bring about an unintended increase in the risk of dying. Two examples are a 1988 rule regulating land disposal of waste and a 1991 rule regulating the disposal of solid waste issued by the Environmental Protection Agency. The authors estimate that the land waste disposal rule may have induced 66 fatalities annually and the solid waste disposal rule may have accounted for ten fatalities annually.

At the same time, they note that aggregate mortality risk declines with the enactment of the entire set of 24 regulations, primarily because a few regulations in their sample yield large reductions in risk. An example of one of these life-saving rules is a 1996 rule issued by the Department of Health and Human Services that restricted the sale and distribution of cigarettes and smokeless tobacco to protect children and adolescents. They estimate that this rule saves almost 5,000 lives annually.

Even if the benefits of certain regulations in their current configurations do not outweigh their costs, benefit–cost analysis and related tools can suggest how regulations might be improved (Morrall, 1986; Tengs and Graham, 1996; Winston, 2006). For example, if the costs of a proposed level of regulation are rising more rapidly than benefits at the proposed standard, then reducing the standard will improve the benefit–cost ratio. On the other side, if the benefits of a proposed level of regulation are rising more rapidly than costs at the proposed standard, then tightening the standard will improve the benefit–cost ratio. In addition, as the cases of the lead and airport safety regulations illustrated, regulations can sometimes be redesigned to impose lower costs.

The Effect of Economic Analysis in the Regulatory Process

How much difference has using economic analysis made in the regulatory process? Research to date suggests that while economic analysis probably has had an impact in particular cases, there is little compelling evidence that such analysis has had a large overall impact, though we cannot rule out this possibility.

Observation 1: The quality of government-sponsored economic analysis of regulations appears to fall far short of economic guidelines.

Regulatory scholars and the U.S. Office of Management and Budget have offered a number of guidelines for how best to apply benefit–cost analysis to regulatory issues. These guidelines include seemingly basic statements that costs, benefits, and net benefits should be quantified to the extent feasible, and that alternatives should be considered. OMB also advises on the treatment of inflation, discount rates, and uncertainty (OMB, 1992; Arrow et al., 1996).

Based on evidence from 48 regulatory impact analyses done during the Clinton administration, Hahn, Lutter, and Viscusi (2000) argue that agencies often fail to follow the OMB analytical guidelines. A more recent study by Hahn and Dudley (2007) finds that economic analyses prepared for environmental regulations typically do not provide enough information to make decisions that would maximize the effectiveness of a rule, based on a sample of 74 regulations spanning three administrations. They find that a significant percentage of the analyses in all three administrations do not provide even basic economic information. For example, 69 percent of the analyses in the sample failed to provide any quantitative information on net benefits. A little over half of the analyses quantified at least some benefits of policy alternatives. The regulatory impact analyses tended to calculate either cost effectiveness or net benefits, but rarely both, which is a critical weakness when the two measures rank policy alternatives differently.

In Europe, the "regulatory impact analysis" is typically called an "impact assessment." An impact assessment is required for all major European Commission initiatives and should contain an evaluation of the social, economic, and environmental impacts of various policy options associated with a proposal. The European Commission (2002) encourages estimates to be expressed in qualitative, quantitative, and where appropriate, monetary terms.

Researchers are beginning to evaluate the European system, and the results appear to have some similarities with the United States. Renda (2006) provides the most comprehensive European study to date. He evaluates all 70 impact assessments of major proposed initiatives completed by the European Commission by June 2005, using a "scorecard" method that checks whether an analysis included particular items (similar to the method of Hahn and Dudley (2007), discussed below). He finds that important components of a good impact assessment are frequently missing. For example, the European impact assessments seldom estimated costs, almost never quantified costs to businesses, did not specify benefits, and virtually never compared the costs and benefits. In addition, the European

Table 1
Summary of U.S. Regulatory Impact Analyses and EU Impact Assessments

Scorecard item	*Percent of analyses in U.S. study that include the scorecard item (n = 74)*	*Percent of analyses in European study that include the scorecard item (n = 70)*
Estimation of total costs		
Provided best estimate of total costs	65%	19%
Provided range of total costs	34%	13%
Estimation of total benefits		
Provided best estimate of total benefits	22%	13%
Provided range of total benefits	26%	3%
Estimation of net benefits		
Provided a best estimate of net benefits	12%	13%
Provided a range of net benefits	20%	4%

Notes: U.S. study figures taken from Hahn and Dudley (2007), based on regulatory impact analyses. European Study figures taken from Renda (2006), based on impact assessments. See text for details. Numbers are rounded to nearest percent.

Commission rarely compared alternatives and almost never specified discount rates.

Table 1 compares Renda's (2006) results for European impact assessments with those of Hahn and Dudley (2007) for U.S. regulatory impact analyses. It's important to recognize that the studies involved different scorers, different samples, different standards for analysis, and different time periods. Nonetheless, the U.S. regulatory impact analyses were better in five of six categories. The exception was one where U.S. and European regulatory analyses were both poor—the provision of a best estimate of net benefits.

A skeptic toward these results could argue that there may be limited scientific evidence to inform the quantification or monetization of costs and benefits. Certainly, the degree to which benefits and costs can be monetized varies widely across regulations. Although it is difficult to test whether a regulatory agency did everything it could have done at reasonable cost, some evidence suggests that there are weaknesses in both agency practice and evaluation in the U.S. and Europe. For example, Hahn and Dudley (2007) examine whether the Environmental Protection Agency utilized the available information it developed in its benefit–cost analyses. Of the 60 regulatory impact analyses that monetized at least some costs and considered at least one alternative, 11 did not monetize at least some costs of alternatives. Because the cost models of specific industry sectors were already developed for the initial analysis, it seems odd that the costs of alternatives were not included. In addition, two regulatory impact analyses quantified the number of lives saved, but did not monetize any benefits. These were a 1992 worker protection standard for agricultural pesticides and a 1990 hazardous waste management system for wood preservatives. The omission of a dollar benefit estimate in these cases reflects a failure to multiply the lives saved by the value of a statistical life.

(This value derives from a measure of what an individual would be willing to pay for a small reduction in the risk of dying in a particular time frame.)

Observation 2: The quality of regulatory analysis in the United States does not appear to have changed much over time.

Hahn and Dudley (2007) found no clear trend in the quality of benefit–cost analysis across presidential administrations or across time. Overall, there is some increase in the percentage of analyses that calculate net benefits and cost effectiveness, but also some decline in the consideration of alternatives. Furthermore, the quality of regulatory analysis, as measured by the total number of items checked in Hahn and Dudley's scorecard of important impact assessment components, did not significantly differ across time periods. Of the 76 "yes" or "no" items in their scorecard, regulations before the end of 1990 include an average of 30.0 items, whereas regulations after 1990 include 30.5 items.

Renda (2006) suggests regulatory oversight in the European Union may be getting worse. His study finds that almost all scorecard items decline over the three years for which he has data. For example, the percentage of impact assessments quantifying or monetizing at least some costs, the percentage quantifying or monetizing at least some benefits, and the percentage quantifying costs and benefits of alternatives all declined each year from 2003 to 2005. However, scores on future impact assessments could improve as the European Union gains more experience with this evaluation tool.

Graham, Noe, and Branch (2006) claim that regulatory analyses may have improved since 2001 under the George W. Bush administration. They argue that the average annual benefits for major rules were larger than the average annual costs and that the average benefit-to-cost ratio for major rules was about 13 in the first 44 months of the Bush Administration, as compared to about five during the previous nine years. However, this calculation may be misleading for three reasons. First, comparisons of analyses that include benefit–cost ratios will also exclude many potentially costly regulations without monetized benefits—for example, homeland security and environmental regulations with benefits that are difficult to monetize (OMB, 2005). In 2003–2004 alone, regulatory costs summing to over $3 billion had no monetized benefits. Second, even if these average benefit-to-cost ratios accurately represent the true average benefit–cost ratios over these two periods, it does not necessarily follow that the improvement is attributable to more effective oversight. Some cost-effective rules were issued because of standards and laws that were in place before the Bush administration. For example, the Environmental Protection Agency's non-road diesel engine rule, issued in 2004, had a benefit–cost ratio of about 25. However, the groundwork for this rule was determined by earlier rules governing national air quality standards that were issued in 1997 during the Clinton administration (OMB, 2007). Third, the calculation does not address the degree to which existing regulation falls short of an ideal level of regulation in any particular time period. Suppose, for example, that $100 billion in

net benefits could have been attained by ideal regulation under Bush, but only $20 billion in net benefits could have been attained under Clinton. In this hypothetical example, if the Bush administration realized $50 billion in net benefits and Clinton realized all $20 billion possible, the regulatory review process would seem to be more effective under Clinton, despite the lower realized net benefits.

Observation 3: Economic analysis can improve regulation, but it is not clear whether economic analysis used in regulatory decisions has had a substantial impact.

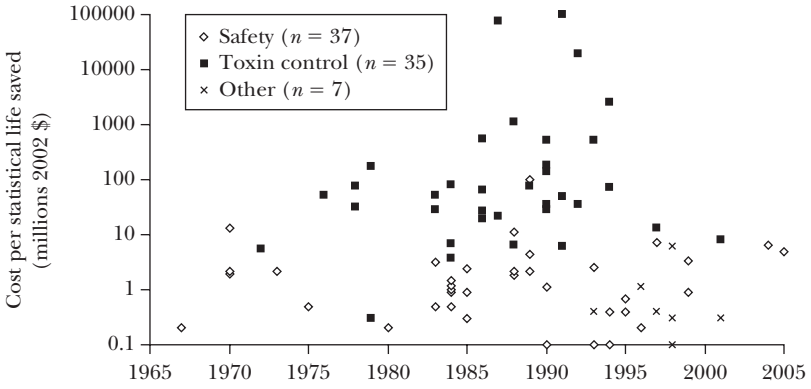
Many case studies of regulatory analyses and regulations have been carried out. When Morgenstern (1997) asked economic analysts to describe their experience with benefit–cost analysis of different environmental regulations during the review period at the Environmental Protection Agency, all respondents agreed that economic analysis improved the quality of the rule being considered. Although the respondents were all economists involved with the rule rather than disinterested observers, we think that their unanimous view is instructive. They identified reductions in cost in all twelve cases and increases in benefits in five of the twelve, implying at least some increase in net benefits in each case.

What kind of improvement actually resulted from economic analysis of regulations? Some of those who argued that analysis made a difference in the rule also expressed the sentiment that such analysis did not typically change how the problem was framed, at least not in any dramatic way. In other words, benefit–cost analysis was helpful in hashing out the details of a rule, such as choosing a level of stringency, but it often did not consider whether there may be an entirely different solution to the problem.

Other research on regulatory analyses reveals some deeper economic problems with environmental, health, and safety regulation. Figure 1 plots data on the cost per statistical life saved—a measure of how effective a regulation is at extending the life-span of the affected population (Morrall, 2003). For regulations aimed primarily at extending life, this measure closely tracks conventional economic efficiency measures. The only caveat is that economists focus on the incremental benefits and costs of the last life saved by a regulation, whereas Morrall (2003) frequently measures the incremental impact of the entire regulation.

Figure 1 covers 79 final regulations, broken down into three categories: regulations aimed at improving safety ("safety"); regulations aimed primarily at reducing cancer ("toxin control"); and a miscellaneous category labeled "other." Two key trends are evident from the data. First, the toxin control regulations appear to cost more at the margin than do safety regulations for each statistical life saved (Tengs et al., 1995). Second, there is substantial variation within and across both the safety and the toxin control categories (Morrall, 2003; Tengs et al., 1995). The cost per statistical life saved ranges from $100,000 to $100 billion (in 2002 dollars). For example, the Consumer Product Safety Commission's 1993 rule for childproof lighters only costs $100,000 per statistical life saved, while the Environ-

Figure 1
Cost Effectiveness of Safety, Toxin Control, and Other Regulations
(n = 79)



Source: Based on Morrall (2003, pp. 230–231), with 3 regulations added to update the dataset through 2006.
Notes: "Safety" denotes that a regulation was aimed at reducing safety risk. "Toxin control" denotes that the regulation was aimed at controlling toxins associated with cancer. "Other" denotes that a regulation fell into a category other than safety or cancer. Morrall (2003), p. 230, uses the term "opportunity costs of statistical lives saved," but we use "cost per statistical life saved" in the interest of simplicity. Although we present the data as point estimates, we note that there is substantial uncertainty in these estimates.

mental Protection Agency's 1991 solid waste disposal rule costs over $100 billion per statistical life saved. In addition, the variation in the cost per statistical life saved increases significantly in the 19 years after 1986 compared with the 19 years before 1986, suggesting that there may now be greater potential gains in reallocating resources across life-saving investments. In particular, there appear to be ample opportunities for refocusing regulations away from those with a high cost per statistical life saved and toward those with a low cost per statistical life saved. The result would be that regulation could either save more lives, or reduce expenditures, or both.

Few studies have attempted to estimate systematically the impact of economic analysis of regulation on actual decisions. However, Farrow (2000) provides a statistical analysis of regulatory oversight using U.S. data. Farrow uses the decision to reject or accept a proposed regulation as his dependent variable. He then examines whether rules that are rejected have a higher cost per statistical life saved, after controlling for other variables. He considers 69 proposed regulations over the period 1967 to 1991. Farrow's main findings are that regulatory oversight had at best a slight effect on the cost per statistical life saved. Rejected rules were only slightly more expensive than rules that were adopted. Additionally, the cost per statistical life saved of final regulations was no better than it was for proposed regulations; and there was no evidence that the cost per statistical life saved decreased over time.

Observation 4: Thus far, comparisons of estimates of regulatory impacts before and after a regulation is implemented do not reveal much about systematic biases.

A number of researchers have suggested that estimates of the effects of regulations made before the regulation is enacted may be systematically biased—but the expected direction of the bias is controversial. Some suggest that costs may be underestimated due to errors of omission, such as not accounting for the time spent by high-level management on regulatory issues and the possible adverse consequences for innovation. Others claim that costs are systematically overestimated by industry, academic, and government analysts alike—because sometimes firms naturally find cheaper ways to achieve regulatory objectives when the regulation is actually in force and sometimes firms may find it in their interest to overestimate the cost of a regulation. Harrington, Morgenstern, and Nelson (2000) investigate the issue of validity of estimates by comparing estimates of costs and benefits of 28 rules from before and after the rules are implemented. They conclude that costs are often overestimated prior to rule implementation and suggest that benefits are also overestimated. Seong and Mendeloff (2004) suggest that benefits can be overestimated when agencies assume that firms will comply fully with regulations.

OMB (2005) did a more comprehensive analysis of 47 rules for which before-and-after comparisons were available. The OMB analysis suggests that benefits are much more likely to be overestimated than underestimated, costs are slightly more likely to be overestimated than underestimated, and taking these together, the benefit–cost ratio is more likely to be overestimated than underestimated. An example is the Occupational Safety and Health Administration's 1987 formaldehyde rule, which overestimated benefits by at least a factor of 10 and overestimated costs by a factor of two, resulting in a benefit–cost ratio that was overestimated by a factor of at least five. On the flipside, some rules drastically overstated costs, such as the Environmental Protection Agency's 1977 dibromochloropropane (DBCP) pesticide rule for grapes, which presented accurate benefits but overestimated costs by a factor of 20. OMB points out that the sample is not random. In fact, Harrington (2006) finds that even small changes in the rules included in the OMB study can drastically change its conclusion.

Evaluating the actual impact of regulations once they are enacted and comparing them with earlier predictions has theoretical appeal. However, these kinds of comparisons face three significant limitations, particularly in regard to their usefulness in improving future regulations.

First, careful and comprehensive benefit–cost studies of regulations after they are enacted are rare, both because of data and funding limitations, and because of little interest on the part of most governmental agencies. Second, academics may select biased samples of regulations—for example, regulations where there is likely to be a publishable finding or applications that have a novel element, such as the performance of market-based approaches for environmental control. Third, results from regulatory analyses could differ for several reasons including the author, data,

model, key assumptions, and source of funding (Thompson, Segui-Gomez, and Graham, 2002). Until we resolve some of the substantial uncertainties in comparisons of regulatory analyses, it is premature to assume that biases go in a particular direction. However, we do think that future before-and-after comparisons of the benefits and costs of regulations by scholars and practitioners could be useful for understanding possible biases in these analyses.

Learning from Experience

Clearly, the use of economic analysis in improving regulations has hardly been an overwhelming success. There is no evidence it has had a significant general impact, the economic analysis supporting it is frequently done poorly (if at all), and there is only anecdotal evidence to suggest that it has made a difference.

What might explain this rather dismal state of affairs? Politics provides one clue. Economists are only one of many interest groups vying for attention in the political process. Stigler (1982) notes that it is important to develop an understanding of why political outcomes deviate from those that might be preferred by economists. Such an understanding can lead to a more realistic assessment of the impacts of changes in rules, procedures, and institutions (Shleifer, 2005).

There are several reasons major regulatory policy choices do not always reflect the underlying economics: First, some centers of political power see value in using economic analysis to inform regulatory decisions, while others do not. Presidents have clearly valued using such analysis, but Congress may believe that regulatory evaluation done within the executive branch unduly limits its authority. Similarly, a regulatory agency may not want to have such analysis when it conflicts with its agenda. Second, good economic analysis of regulations is hard to do. It may be quite difficult, for example, to develop a reasonable estimate of the benefits of a particular homeland security regulation or a rule that calls for increased financial disclosure. (However, we note that many good economists work for the federal government, and the government can also hire consultants to help with such analysis.) Third, it may take time for these economic tools to gain acceptance. We believe there is some truth in this, as ideas like benefit–cost analysis move from the classroom to the real world.

The failure of scholars to demonstrate a clear impact of economic analysis on policy raises the question of whether some form of regulatory evaluation is still worth supporting. To answer that question, we need to articulate the benefits and costs of reviewing regulation. The benefits might include changes in the policy goal, in the date at which a regulation is announced, in the implementation schedule, and in the enforcement mechanism. The impact of possible delay, which some critics point to as a significant cost of regulatory evaluation, would also be considered in such a calculation.

The Case for Expanded Benefit–Cost Analysis of Regulation

Notwithstanding the limitations on data on the benefits and costs of regulatory evaluation, we provide three arguments why several economists, including ourselves, still support expanding efforts to estimate the benefits and costs of regulations before they are finalized (for example, Arrow et al., 1996).

First, it is difficult to measure the effect of doing economic analysis on policy outcomes. Therefore, the fact that we do not find much evidence should not necessarily be cause for alarm. Moreover, the evidence may come primarily from specific cases in which analysis has been helpful in affecting policy decisions. For example, Schultze (1996) notes that analysis from the Council of Economic Advisers played a useful role in stopping the supersonic transport during the Nixon years.

Our personal observations concerning the impact of analysis are consistent with the spirit of scholars and practitioners such as Schultze (1996). One of the authors was closely involved with the drafting of the White House version of the 1990 Clean Air Act Amendments, and saw firsthand how analysis helped inform decisions about shaping various aspects of that bill. For example, early draft proposals to regulate toxic air emissions would have required pollution controls that were either infeasible or extremely costly relative to the benefits. The final law contained less draconian measures, partly as a result of the economic analysis. While politics did matter, economic analysis helped at the margins. Moreover, adjustment at the margin frequently produced net benefits in the billions of dollars for a single regulation.

Second, the mere presence of an evaluation, along with an evaluation process, may prevent agencies and others from adopting economically unsound regulations in the first place. This deterrent effect will not appear in most statistical analyses, but is nonetheless real, and indeed, could be the most important function of economic analysis.[1]

Third, the direct costs of regulatory evaluation appear to be small compared with the likely benefits, though we cannot prove it. Our best estimate, admittedly crude, is that the costs of reviewing regulations are on the order of $100 million annually. The cost estimate consists of two parts: the cost of doing the analysis and the cost of conducting the review process that uses the analysis. The average economic analysis of a major regulation costs about $700,000 (Congressional Budget Office, 1997). This figure includes resources spent directly by the regulatory agency and consulting expenses used to produce an economic analysis. The cost of staff resources in the Office of Information and Regulatory Affairs within the Office of Management and Budget that are used in reviewing a major regulation is

[1] While we will assess some of the static costs and benefits of reviewing regulation below, we do not attempt to quantify the dynamic costs and benefits because the necessary data do not exist. In a dynamic context, legislators could change laws and bureaucrats could change regulations and analysis in response to regulatory evaluation. For example, it is possible that lawmakers would attempt to bypass the regulatory evaluation process. It is also possible that bureaucrats would be less likely to advance regulations that they fear would be flagged in such a process.

on the order of $20,000.[2] Thus, the total cost of analysis for a major regulation is roughly $720,000, most of which is the cost of the initial review. From 2001 to 2005, the annual number of economically significant rule reviews ranged between 82 and 111 (according to ⟨http://RegInfo.gov⟩). Thus a rough estimate that 100 major regulations are reviewed each year would lead to a total cost of regulatory review of roughly $72 million annually (about 100 times $720,000).

We think, but cannot show definitively, that many regulatory proposals have their net benefits increased by at least a billion dollars annually as a result of analysis and evaluation. This pattern appears to hold, for example, with the removal of lead from gasoline and the market-based approach for cutting sulfur dioxide emissions (Carlson, Burtraw, Cropper, and Palmer, 2000). Moreover, many regulations still go forward whose costs appear to exceed benefits. If regulatory review could have eliminated just the major regulations with negative monetized net benefits from 1995 to 2005, the expected incremental net benefits of improved review would have exceeded $250 million per year.[3]

Improving the Regulatory Process

Even though current review of regulations is likely to be justified on economic grounds, the process can be improved. There are two basic ways of improving the process: exploring ways of doing better analysis, and examining institutional and political changes that would make better use of the analysis. We consider both of these briefly.

Several refinements could improve the economic analysis of proposed regulations, including peer review, better data quality, better analysts, and standardized procedures. Peer review poses problems because it is difficult to get good reviewers for this kind of work. Improving data and getting better analysts has potential if the government is willing to allocate the resources and do more outsourcing of analyses. Issuing guidelines for good analysis is problematic unless some mechanism ensures that those guidelines will be followed. Because these kinds of ideas have been addressed elsewhere, we will not dwell on them here (for example,

[2] We make the following calculation: 0.5 x (% of FTEs working on reviews) (OIRA budget) / (economically significant rule reviews), or, 0.5 x (0.40) ($7 million) / (82) = $17,000. For the percentage of OIRA staff working on reviews, see General Accounting Office (2003), which gives the number of full-time employees primarily responsible for reviews in 2003. We assume this ratio still holds. For the current OIRA budget, see OMB (2006a). For the number of economically significant regulations, we use the number reviewed in 2005; see RegInfo.gov (2007). Because the full-time employees responsible for economically significant regulatory reviews also review hundreds of nonsignificant regulations and paperwork under the Paperwork Reduction Act, we multiply by 0.5 to approximate the time actually spent on economically significant regulatory review. Over the period 2000–2005, this estimate ranges from $20,000 (2004) to $12,000 (2001) with a mean of $16,000 because of differences in the OIRA budget and the number of economically significant rules year each.

[3] For the 14 out of 95 major rules with negative net benefits between 1995 and 2005, we divide the total annualized negative net benefits of $2.8 billion by the number of years to obtain $250 million per year. If regulations with negative net benefits remain in place for more than one year, $250 million per year represents a substantial underestimate of the total costs to society that could have been avoided with better regulatory review.

Sunstein, 2002). Rather, we will mention one alternative that could represent a methodological breakthrough: using prediction markets.

Prediction markets are markets for contracts that yield payments based on the outcome of an uncertain future event. These markets frequently outperform both experts and opinion polls (Berg, Nelson, Forsythe, and Rietz, 2003; Wolfers and Zitzewitz, 2004). For example, the government could issue one contract that paid an amount proportional to net benefits if a particular legislative measure were implemented, and a second that paid an amount proportional to net benefits if the measure were not implemented. The difference between the prices of the two contracts could capture the overall impact of the regulation as measured by the change in net benefits from the regulation.[4] It may be difficult to define reasonable proxies for costs and benefits of regulations, but some examples could include pollution levels, deaths from disease, and key price or quantity indices, such as energy or housing. It's easy to think of difficulties with using prediction markets in this way, but our point is mainly to suggest that it's worth exploring ways of dramatically improving the information available to decisionmakers in the future (Arrow et al., 2007).

Improving analysis is only part of the solution. Ensuring that economists and economic reasoning plays a more prominent role in regulatory policy design is also critical. In the United States, there are several ways of elevating benefit–cost balancing in decision making. All would involve a greater degree of political commitment than seems likely at present. First, the president could require benefit–cost analysis for *all* major regulatory decisions made by the federal government, to the extent permitted by law. This requirement would apply both to agencies overseen by the president as well as to independent regulatory agencies, where benefit–cost analysis is not typically required. In addition, the annual Office of Management and Budget report should be expanded to contain the number and percentage of final regulations that pass a benefit–cost test based on factors that can be quantified and monetized, something that OMB's report does not currently contain. We believe such a report has the potential to add to our knowledge as well as promote greater transparency and accountability.

Second, Congress could pass laws that allow or mandate benefit–cost analysis. Congress might even create a Congressional Office of Regulatory Analysis that would complement the regulatory evaluation mechanism within the Office of Management and Budget. Such an office could stimulate healthy competition between two government institutions with analytical responsibility for regulation, in much the same way that the two agencies that work on budget issues—OMB and the Congressional Budget Office— help to keep each other honest. Furthermore, Congress may want to ask this office not only to consider regulations, but also laws that give rise to regulations. Europe, for example, allows for analysis of a wide range of instruments that correspond roughly to guidelines, laws, and regulations. Con-

[4] If market participants recognize that policymakers are using prices to inform decision, the estimate proposed above may be biased. To avoid this bias, a policymaker could commit to implement policies randomly a fraction of the time and issue contracts based on the net benefits from these policies.

gress could also consider subjecting some proposed laws to at least a crude benefit–cost analysis prior to voting on them. After all, Congress now asks for estimates of the budgetary impacts of laws and proposed laws.

Third, Congress might consider creating an independent agency, along the lines of the Federal Reserve, to do cost–benefit analysis for important public policy issues, including regulation. Such an agency would address a key defect in the current system, namely, that agencies tasked with doing benefit–cost analysis may have goals that are in conflict with increasing or maximizing net economic benefits.

Finally, Congress could also allow the courts to strike down regulations that clearly, by an overwhelming weight of evidence, fail a benefit–cost test.

Future Research

In specific cases, scholars have suggested that economic analysis of regulations does matter at the margins. However, there is no strong support for the view that economic analysis has had a significant general impact. Furthermore, the quality of regulatory analysis for a significant fraction of regulations does not meet widely accepted guidelines.

Social scientists can contribute to our understanding of the role of economic analysis in regulatory decision-making in several ways. First, scholars could help identify the conditions under which particular forms of analysis, and particular expenditures on economic analysis, might yield more or less efficient policies. For example, cost-effectiveness analysis may be most useful in eliminating the most inefficient projects, such as a very wasteful chronic toxin regulation. Second, researchers could contribute to the development of analytical tools that could improve evaluation. Possibilities include the prediction markets discussed above and new approaches for valuing the benefits from regulation. Third, researchers could contribute to the development and improvement of data sets that are used as inputs for statistical models that inform regulatory decisions, such as government inventories on private expenditures on pollution control.

Economists may also intervene more directly in the regulatory process by doing timely benefit–cost analyses of important regulations and programs. In the past, economic studies of key sectors of the U.S. economy, such as transportation and energy, have been important factors in the decision to deregulate, or partially deregulate, those industries (Noll, 2006). Studies of regulation, in both the U.S. and other countries, could have a similar effect. Indeed, relatively little is known about the effectiveness of regulations outside of the United States.

Economic analysis cannot be expected to drive the political process. After all, many politicians tend to be more concerned with distributional issues than with overall benefits and costs. Without significant support from key elected officials, most attempts at introducing or strengthening the role of economic analysis of regulation will probably have only a modest effect. Nonetheless, in a world where regulatory impacts are frequently measured in the billions of dollars, margins

matter. Thus, economists should pay more attention to how economic analysis can contribute to improving benefits and costs on the margin, insofar as that is possible.

■ *The authors would like to dedicate this paper to Art Fraas and John Morrall—two outstanding civil servants who have over the years shared their anecdotes, insights, and data on the regulatory oversight process. The authors would like to thank Don Arbuckle, Ken Arrow, Robert Crandall, Scott Farrow, John Graham, James Hines, Robert Litan, Tom Lyon, John Morrall, Roger Noll, Andrea Renda, Fernando Salas, Andrei Shleifer, Kerry Smith, Jeremy Stein, Cass Sunstein, Timothy Taylor, Scott Wallsten, Cliff Winston, and participants at conferences at Stanford, the University of Pennsylvania, and the University of Washington for helpful suggestions. Caroline Cecot and Katrina Kosec provided valuable research assistance.*

References

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. "Is There a Role for Benefit–Cost Analysis in Environmental, Health, and Safety Regulation?" *Science,* April 12, 272 (5259): 221–2.

Arrow, Kenneth J., Robert Forsythe, Robert E. Litan, Michael Gorham, Robert W. Hahn, Robin Hanson, Daniel Kahneman, John O. Ledyard, Saul Levmore, Paul R. Milgrom, Forrest D. Nelson, George R. Neumann, Marco Ottaviani, Charles R. Plott, Thomas C. Schelling, Robert J. Shiller, Vernon Smith, Erik C. Snowberg, Shyam Sunder, Cass R. Sunstein, Paul C. Tetlock, Philip E. Tetlock, Hal R. Varian, Justin Wolfers, and Eric Zitzewitz. 2007. "Statement on Prediction Markets." Related Publication 07-11. Washington, DC: AEI–Brookings Joint Center for Regulatory Studies.

Berg, Joyce, Forrest Nelson, Robert Forsythe, and Thomas Rietz. 2003. "Results From a Dozen Years of Election Futures Markets Research." Unpublished paper.

Carlson, Curtis, Dallas Burtraw, Maureen L. Cropper, and Karen Palmer. 2000. "Sulfur Dioxide Control by Electric Utilities: What are the Gains from Trade?" *Journal of Political Economy,* 108(6): 1292–1326.

Congressional Budget Office. 1997. "Regulatory Impact Analysis: Costs at Selected Agencies and Implications for Legislative Process." CBO Papers. http://www.cbo.gov/ftpdocs/40xx/doc4015/1997doc04-Entire.pdf.

DeMuth, Christopher. 1994. "Christopher DeMuth." In *American Economic Policy in the 1980s,* ed. Martin Feldstein, 504–511. Chicago and London: The University of Chicago Press.

Environmental Protection Agency. 1990. "Environmental Investments: The Cost of a Clean Environment." Report of the Administrator of the Environmental Protection Agency to the Congress of the United States.

European Commission. 2002. "Communication from the Commission on Impact Assessment." COM(2002) 276.

Farrow, Scott. 2000. "Improving Regulatory Performance: Does Executive Office Oversight Matter?" Washington, DC: AEI–Brookings Joint Center for Regulatory Studies. http://www.aei.brookings.org/publications/abstract.php?pid=192.

General Accounting Office. 2003. "OMB's Role in Reviews of Agencies' Draft Rules and the Transparency of Those Reviews." Report to Congressional Requesters.

Graham, John D., Paul R. Noe, and Elizabeth L. Branch. 2006. "Managing the Regulatory State: The Experience of the Bush Administration." *Fordham Urban Law Journal,* 33(4): 1–44.

Hahn, Robert W., Jason Burnett, Yee-Ho I. Chan, Elizabeth Mader, and Petrea Moyle. 2000. "Assessing Regulatory Impact Analyses: The Failure of Agencies to Comply with Executive Order 12,866." *Harvard Journal of Law and Public Policy,* 23(3): 859–71.

Hahn, Robert W., and Patrick Dudley. 2007. "How Well Does the Government Do Cost–Benefit Analysis?" *Review of Environmental Economics and Policy,* 1(2): 192–211.

Hahn, Robert W., Randall W. Lutter, and W. Kip Viscusi. 2000. Do Federal Regulations Reduce Mortality. Washington, DC: AEI–Brookings Joint Center for Regulatory Studies.

Harrington, Winston. 2006. "Grading Estimates of the Benefits and Costs of Federal Regulation: A Review of Reviews." Discussion Paper 06-39. Washington, DC: Resources for the Future.

Harrington, Winston, Richard Morgenstern, and Peter Nelson. 2000. "On the Accuracy of Regulatory Cost Estimates." *Journal of Policy Analysis and Management,* 19(2): 297–332.

Morgenstern, Richard D., ed. 1997. *Economic Analysis at EPA: Assessing Regulatory Impact.* Washington, DC: Resources for the Future.

Morrall, John F. 1986. "A Review of the Record." *Regulation,* 10(2): 30–34.

Morrall, John F. 2003. "Saving Lives: A Review of the Record." *Journal of Risk and Uncertainty,* 27(3): 221–37.

Morrison, Steven A., Clifford Winston, and Tara Watson. 1999. "Fundamental Flaws of Social Regulation: The Case of Airplane Noise." *Journal of Law and Economics,* 42(2): 723–43.

Nichols, Albert L. 1997. "Lead in Gasoline." In *Economic Analysis at EPA: Assessing Regulatory Impact,* ed. Richard D. Morgenstern, 49–86. Washington, DC: Resources for the Future.

Noll, Roger G. 2006. "Still Reforming Regulation." AEI-Brookings Joint Center 2006 Distinguished Lecture. http://www.aei-brookings.org/events/page.php?id=159. (Last accessed December 2001.)

Office of Management and Budget. 1992. "Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs." http://www.whitehouse.gov/omb/circulars/a094/a094.html.

Office of Management and Budget. 2005. "Validating Regulatory Analysis: Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities." Washington, DC: Office of Information and Regulatory Affairs.

Office of Management and Budget. 2006a. "Budget of the United States Government Fiscal Year 2007."

Office of Management and Budget. 2006b. "2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities." Washington, DC: Office of Information and Regulatory Affairs.

Office of Management and Budget. 2007. "Draft 2007 Report to Congress on the Costs and Benefits of Federal Regulations." Washington, DC: Office of Information and Regulatory Affairs.

RegInfo.gov. "Where to find Federal Regulatory Information," through the Office of Management and Budget. http://RegInfo.gov. Last accessed July 2007.

Renda, Andrea. 2006. *Impact Assessment in the EU: The State of the Art and the Art of the State.* Brussels: Center for European Policy Studies.

Schultze, Charles L. 1996. "The CEA: An Inside Voice for Mainstream Economics." *Journal of Economic Perspectives,* 10(3): 23–39.

Seong, Si Kyung, and John Mendeloff. 2004. "Assessing the Accuracy of OSHA's Projections of the Benefits of New Safety Standards." *American Journal of Industrial Medicine,* 45(4): 313–28.

Shleifer, Andrei. 2005. "Understanding Regulation." *European Financial Management,* 11(4): 439–51.

Stigler, George J. 1982. "Economists and Public Policy." *Regulation,* 6(3): 13–17.

Sunstein, Cass R. 2002. *The Cost Benefit State: The Future of Regulatory Protection.* American Bar Association.

Tengs, Tammy O., Miriam E. Adams, Joseph S. Pliskin, Dana Gelb-Safran, Joanna E. Siegel, Michael C. Weinstein, and John D. Graham. 1995. "Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness." *Risk Analysis,* 15(3): 369–90.

Tengs, Tammy O., and John D. Graham. 1996. "The Opportunity Costs of Haphazard Social Investments in Life-Saving." In *Risks, Costs, and Lives Saved,* ed. Robert W. Hahn. New York: Oxford University Press.

Thompson, Kimberly M., Maria Segui-Gomez, and John D. Graham. 2002. "Validating Benefit and Cost Estimates: The Case of Airbag Regulation." *Risk Analysis,* 22(4): 803–11.

Winston, Clifford. 2006. *Government Failure versus Market Failure: Microeconomics Policy Research and Government Performance.* Washington, DC: AEI–Brookings Joint Center for Regulatory Studies, available at http://www.aei-brookings.org/publications/abstract.php?pid=1117.

Wolfers, Justin, and Eric Zitzewitz. 2004. "Prediction Markets." *Journal of Economic Perspectives,* 18(2): 127–42.

This article has been cited by:

1. Claudio M. Radaelli. 2009. Rationality, Power, Management and Symbols: Four Images of Regulatory Impact Assessment. *Scandinavian Political Studies* . [CrossRef]
2. Robert Hahn, Caroline Cecot. 2009. The benefits and costs of ethanol: an evaluation of the government's analysis. *Journal of Regulatory Economics* **35**:3, 275-295. [CrossRef]
3. Caroline Cecot, Robert Hahn, Andrea Renda, Lorna Schrefler. 2009. An evaluation of the quality of impact assessment in the European Union with lessons for the US and the EU. *Regulation & Governance* **2**:4, 405-424. [CrossRef]