Attention to Distribution in U.S. Regulatory Analyses

Lisa A. Robinson,* James K. Hammitt,† and Richard J. Zeckhauser‡

Introduction

Scholars, decision makers, interest groups, and other concerned citizens are often interested in the distribution of regulatory impacts. To what extent does a regulation benefit or harm those who have high or low incomes, are in good or poor health, are more or less vulnerable to disease, or are very young or very old? Does the regulation disproportionately affect members of minority or other disadvantaged groups? Determining whether and how to address these questions raises thorny normative issues about how to weigh the impacts on different groups as well as the choice of policy instruments. Yet to address these normative concerns, we first need data on impacts—data that are rarely readily available.

The importance of distributional issues is emphasized in the guidelines for U.S. regulatory analysis. Prior to issuing major environmental, health, and safety regulations, federal agencies are expected to estimate their costs and benefits and to assess the distribution of these impacts. However, the conduct of these distributional analyses has not been well-studied.

Theory suggests that regulatory impacts may be regressive, benefitting the wealthy more than the poor. For example, environmental regulations may increase the prices of goods (such as electricity) that account for a much larger fraction of the budgets of low-income families than high-income families, while providing benefits (such as a cleaner environment) that are likely to be valued more by those with higher incomes (Fullerton 2009 and 2011).

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*Harvard University (Center for Risk Analysis and Center for Health Decision Science), 718 Huntington Avenue, Boston, MA 02115. Email: robinson@hsph.harvard.edu.
†Harvard University (Center for Risk Analysis and Center for Health Decision Science); Toulouse School of Economics, 718 Huntington Avenue, Boston, MA 02115. Email: jkh@harvard.edu.
‡Harvard Kennedy School, 79 JFK Street, Cambridge, MA 02138. Email: richard_zeckhauser@havard.edu.

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The empirical literature does not adequately address the extent to which regulatory impacts are consistent with theoretical conjectures. Much of the existing research has focused on the distributional impact of market-based approaches to regulation (e.g., taxes, trading) rather than the impacts of conventional command-and-control approaches that are more commonly implemented (e.g., concentration limits, technology requirements). For example, several reviews find that there is substantial literature on the distributional impacts of environmental and energy taxes and some work on the distributional impacts of emissions trading (Parry et al. 2006; Fullerton 2009; Bento 2013).[1] However, these reviews identify no recent work that addresses both the costs and benefits of more conventional energy and environmental regulations. The few studies of the distributional effects of command-and-control regulations that they identify were completed in the 1970s or 1980s, or address the combined effects of numerous major regulations (such as all those promulgated under the Clean Air Act) rather than individual regulations. Many scholars have written about environmental justice (i.e., the impact of environmental contaminants on the health of low-income and minority groups). However, much of this work considers the degree to which polluting facilities or waste sites are located in areas that have significant minority or low-income populations rather than regulatory costs and benefits (for reviews, see Parry et al. 2006; Fullerton 2009; Banzhaf 2011).

This article, which is part of a symposium on Distributional Considerations in Benefit–Cost Analysis,[2] examines the extent to which U.S. regulatory agencies are assessing distributional impacts and considers several explanations for the behaviors we observe. We address major federal environmental, health, and safety regulations aimed at providing health-related benefits, which impose costs (at least initially) on industry. Our interest is in the extent to which the agencies provide information on distribution. We do not investigate the full administrative record to determine whether distributional consequences play a role in the ultimate regulatory decision. Instead, we assume that distribution is important in at least some cases, and explore the evidence the agencies provide to support related deliberations.

We start by summarizing the current U.S. guidance for conducting regulatory analyses and presenting our review of selected analyses. We next address possible explanations for our findings. These explanations relate to the relationship between the philosophical framework for decision making and the demand for information about distributional impacts, and the role of pragmatic concerns, including political, legal, technical, and resource constraints. We conclude with a summary and recommendations for future work on these issues.

Current Guidelines for Regulatory Analysis

The analysis of federal environmental, health, and safety regulations is influenced by both legislative and administrative requirements. Legislative statutes may restrict the regulatory options agencies can consider (e.g., to standards based on the best available technology), explicitly define the role of benefit–cost analysis (BCA), and, in some cases, raise distributional concerns.

[1]As Parry et al. (2006) and others discuss, revenues from taxes and emissions trading can be "recycled" in ways that may offset any regressive effects of a policy. Conventional command-and-control regulations do not produce revenue that can be recycled.

[2]The other articles are by Adler (2016), which provides an overview of distributional weights, and Fleurbaey and Rafeh (2016), which examines how distributional weights can be introduced into benefit–cost analysis (BCA) using insights from welfare economics.

Regardless of the statutory language, government-wide administrative guidance suggests that agencies should conduct both benefit–cost and distributional analyses. Such analyses may be useful in guiding implementation or in identifying areas where legislative change is desirable, even if the regulatory decision cannot be based on the results.

Presidential Executive Orders

Under Executive Order 12866 (Clinton 1993) and Executive Order 13563 (Obama 2011), U.S. government agencies are expected to assess the costs, benefits, and other impacts of regulations before they are promulgated if the regulation is likely to be economically significant.[3] A regulation is economically significant if it has predicted annual economic impacts of $100 million or more, or may have important adverse effects.

In its statement of regulatory philosophy, Executive Order 12866 notes that "in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; *distributive impacts*; and *equity*)" (Clinton 1993:51735, emphasis added).[4] This language is reaffirmed in Obama's Executive Order 13563, suggesting strong interest in understanding distributional impacts as well as other costs and benefits at the presidential level.

Implementing Guidance

The U.S. Office of Management and Budget (OMB) in the Executive Office of the President is responsible for reviewing regulations and the accompanying analyses before they are finalized. The OMB issued guidance for analyzing the impacts of economically significant regulations in Circular A-4 (OMB 2003). The circular notes: "Your regulatory analysis should provide a separate description of distributional effects (i.e., how both benefits and costs are distributed among sub-populations of particular concern) so that decision makers can properly consider them along with the effects on economic efficiency" (OMB 2003:14).

OMB Circular A-4 defines distributional effects broadly, as including, for example, the way in which regulatory impacts are divided across "income groups, race, sex, industrial sector, geography" and over time. However, it says very little about *how* to conduct this analysis.

Other Requirements

In addition to meeting these general guidelines, agencies must comply with government-wide statutory and administrative mandates for assessing specific impacts. For compliance costs, these mandates focus on distribution across organizations rather than individuals. In particular, the Regulatory Flexibility Act (RFA) requires agencies to assess the costs imposed on small businesses and other small organizations; the Unfunded Mandates Reform Act (UMRA) is concerned with expenditures imposed on state, local, and tribal governments as well as the private sector.

[3]Independent regulatory agencies, such as the Nuclear Regulatory Commission and the Consumer Product Safety Commission, are not subject to these executive orders.

[4]This language is unusual in that it includes the analysis of "distributive impacts" and "equity" in the net benefits calculation. As discussed later, economists traditionally separate the analysis of economic efficiency (i.e., national net benefits) from the analysis of distribution.

For health-related benefits, the government-wide requirements generally focus narrowly on adverse impacts on specific groups. Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks" (Clinton 1997), requires agencies to identify and address risks that may disproportionately affect children, and Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (Clinton 1994), requires agencies to identify and address "disproportionately high and adverse human health or environmental effects" on these groups. The detailed implementation of both the general guidance and these specific requirements for distributional analysis is largely left to the agencies.

Review of Selected Regulatory Analyses

To better understand how the guidance for distributional analysis is being implemented, we reviewed the completed analyses for regulations finalized over a four-year period. In this section, we first describe how we selected analyses for review, and then discuss our findings.

Selection Criteria

To select regulatory analyses for review, we relied on annual reports that catalog the economically significant regulations the OMB reviews each year. We selected all regulations for which a reasonably complete BCA was developed, focusing on those regulations that impose costs on industry to provide health-related benefits.

More specifically, we considered major environmental, health, and safety regulations that the OMB reviewed in fiscal years 2010 through 2013 (October 2009 through September 2013), which were subject to the analytic requirements in Executive Orders 12866 and 13563 and to the implementation guidance in OMB Circular A-4. Targeting this time period allows us to examine a set of regulations sufficiently large to enable us to assess how government practices vary across regulations and agencies, but not so large that a detailed review becomes difficult. It also concentrates our attention on practices during an administration that, in issuing Executive Order 13563, emphasized its commitment to considering distributional impacts.

We selected those regulations that are aimed at achieving health-risk reductions. We focused on health for three reasons: (1) health improvements (particularly increased longevity) frequently dominate the quantifiable benefits of the major environmental, health, and safety regulations subject to the guidance on distributional analysis; (2) these improvements are often the stated goals of these regulations and are the focus of the executive orders that most directly target distribution, suggesting that there is strong political interest in these outcomes; and (3) some argue that health should be viewed as a "merit" good, which means it should be provided regardless of individuals' willingness to pay or their preferences for health relative to other goods, suggesting that there is a strong interest in distribution for normative reasons.

These regulations generally impose monetary costs on industry, rather than directly on individuals. However, ultimately, individuals' disposable income is affected, as industry adjusts by changing prices, wages, and returns to owners of capital. Income is often the primary focus of those concerned about distribution, suggesting that those involved in the decision-making process may wish to know how these regulatory costs—not merely benefits—are likely to be allocated.

We selected only those regulations for which the agencies estimate both costs and benefits, because we are interested in understanding the extent to which the distribution of costs and the distribution of benefits complement or offset each other. For example, regulations that primarily impose costs on the wealthy while benefiting the poor raise very different concerns than regulations that primarily impose costs on the poor but benefit the wealthy.

Characteristics of Selected Regulations

In annual reports to Congress, the OMB lists the major final regulations it has reviewed each year that were accompanied by quantified estimates of both costs and benefits (OMB 2011, Table 1-5a; OMB 2012, Table 1-5a; OMB 2013, Table 1-6a; OMB 2014, Table 1-6a). From these lists, we eliminated the regulations for which health-risk reductions (deaths, illnesses, or injuries averted) were not estimated. Thus we excluded regulations that do not directly address health risks (e.g., they impose administrative requirements or set appliance energy efficiency standards), as well as regulations for which the agency lacked the data necessary to estimate health impacts (and hence their distribution).

For the four-year period that we consider, the OMB lists 24 regulations that meet our criteria (see Appendix A). Environmental Protection Agency (EPA) air pollution regulations dominate our dataset, in terms of both the number of rules (13) and the magnitudes of their costs and benefits.[5] Three of the 13 EPA regulations were issued jointly with the Department of Transportation (DOT). Our dataset also includes eight regulations issued solely by DOT, two Department of Labor (DOL) regulations, and one Department of Health and Human Services (HHS) regulation. For each regulation, we reviewed the preamble to the *Federal Register* notice for the final rule, which provides the agency's official explanation of its decisions and summarizes its regulatory analysis. We also reviewed any separate reports on the regulatory analysis prepared by the agency.

The agencies estimate that the national benefits of these regulations generally exceed their costs (see Appendix A).[6] The only exceptions are two DOT regulations, where the statute limited the agency's ability to choose other regulatory options (DOT 2010, 2013). For some air pollution regulations, the benefits exceed the costs by more than an order of magnitude, while for other regulations the difference between benefits and costs is relatively small. The agencies note that they were unable to quantify or monetize some impacts, particularly ecological effects and other classes of benefits.

Each regulation imposes direct costs on identified industries. Each regulation also reduces health or safety risks for identified groups, including those living in areas with high air pollution levels, those using particular transportation modes, those working in specific occupations, or those sensitive to certain foods. We next summarize our findings concerning the information that agencies provide on the distribution of health benefits, compliance costs, and net benefits.

Findings: Distribution of Health Benefits

The calculation of health-related benefits requires estimating both the number of statistical cases averted (i.e., the change in individuals' risk of illness, injury, or death multiplied by the number

[5]This is consistent with data for other time periods; EPA air pollution rules account for a significant share of all major regulations (OMB 2014).

[6]Some of these differences between costs and benefits are obscured by the rounding in Appendix A.

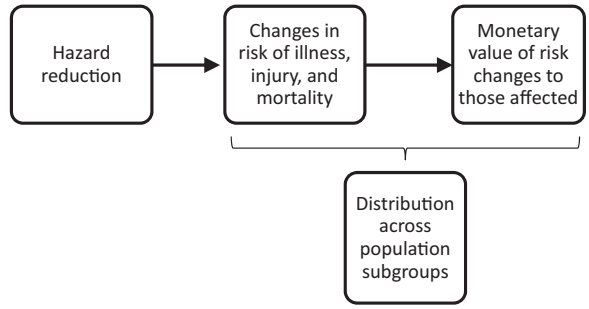

Figure 1 Distribution of health benefits.

of affected individuals) and the monetary values of these risk reductions. Figure 1 illustrates the steps involved in estimating the distribution of these benefits across income or other groups.[7]

All of the analyses we reviewed provide national estimates of health-related benefits. A few also provide information on the distribution of risk reductions, but do not report the monetary value of the benefits received by different subgroups.

Risk reductions

The analyses in our dataset (see Appendix A) each report the expected number of injuries or illnesses and deaths averted nationally, and provide some information on the characteristics of those affected. The EPA usually maps the geographic areas likely to experience air quality improvements and describes the age ranges (and preexisting conditions in some cases) considered in the epidemiological studies that underlie its estimates. DOT and DOL generally identify the transportation modes and/or occupations addressed as well as whether those affected are adults or also includes children. The HHS regulation focuses specifically on individuals with celiac disease.

The language in both the executive orders and OMB Circular A-4 indicates that decision makers are concerned about the distribution of risk reductions across population subgroups defined by income, race, age, and other characteristics. However, we find agencies rarely quantify this distribution. They often simply state that the regulation is consistent with the environmental justice and children's health executive orders because it is not expected to adversely affect the health of minorities, low-income groups, or children.

There are three exceptions that specifically estimate the distribution of health risk reductions across advantaged and disadvantaged groups. All of them are EPA air pollution regulations (EPA 2011a, 2011b, 2012). Mortality risk reductions dominate the benefit estimates for these rules, and the EPA quantifies the distribution of these changes in their own risks across socioeconomic groups defined by factors such as race, income, and educational attainment.

Benefit values

Once the likely number of averted cases is estimated, the next step is to estimate the monetary value of these risk reductions. For mortality risk reductions, the analyses we reviewed apply

[7]Ideally, this calculation would include accounting for behavioral changes in response to the regulation and any changes in associated expenditures.

estimates of individual willingness to pay (WTP) for small changes in their own risks, which are expressed as the value per statistical life (VSL).[8] For nonfatal illnesses and injuries, agencies often use estimates of the cost of illness or of monetized quality-adjusted life years as proxy measures, because there are relatively few empirical estimates of WTP.[9]

The analyses we reviewed generally apply population average values rather than adjusting the values to reflect the characteristics of the risks and of the affected populations. This lack of adjustment in part reflects gaps and inconsistencies in the available empirical research. It also reflects discomfort with applying different values to different population groups (Robinson 2007; Cameron 2010). As a result, the analyses do not reflect variation in the values held across income or other groups.

For example, WTP generally increases with income, and federal agencies often adjust benefit values for population-average income growth over time (Hammitt and Robinson 2011). They do not, however, adjust for the effects of income differences within the population. Applying a population average value to the risk reductions experienced by those in different income groups likely overstates the values held by poorer individuals and understates the values held by wealthier individuals. Relying on these averages obscures the value of the benefits that accrue to each group and can lead to misleading conclusions about the distribution of regulatory benefits.

Because most of the analyses we reviewed lack data on the distribution of health risk reductions and none of them describe likely differences in valuation of risk reductions among population subgroups, we cannot determine whether the benefits that accrue to each group are worth more or less than the costs each group incurs.

Findings: Distribution of Compliance Costs

It is much more complex to assess the distribution of the costs of complying with a regulation. Typically, industry bears the direct costs of compliance. However, affected firms may cope with these costs by raising prices, decreasing wages, and/or doing nothing (which decreases the returns to capital). These decisions in turn affect consumers, workers, and owners who belong to different population subgroups. This distribution may change over time as firms find opportunities to innovate and to alter their products or production processes, both to reduce the costs of complying with the regulation and to address changing technologies, economic conditions, and other factors. The relationships between compliance costs and their distribution are illustrated in figure 2.[10]

Although all of the analyses we reviewed report industry costs, few provide information on how these costs are distributed among consumers, workers, and producers in the aggregate, and none indicate how the costs are distributed across population subgroups.

[8]The VSL is *not* the value that the government places on saving an individual's life. Rather, it represents an individual's willingness to trade off spending on small reductions in his or her own risks (in a defined time period) against spending on all the other things she could use that money to buy. See Hammitt (2000), Robinson (2007), and Robinson and Hammitt (2016) for more discussion.

[9]The construction, advantages, and disadvantages of these measures are discussed in Robinson and Hammitt (2013) and elsewhere.

[10]For more discussion of these pathways in the context of taxes, see Harberger (1962) and Fullerton and Heutel (2007). Bento (2013) also discusses the distributional effects of environmental policies on the value of land and other real property.

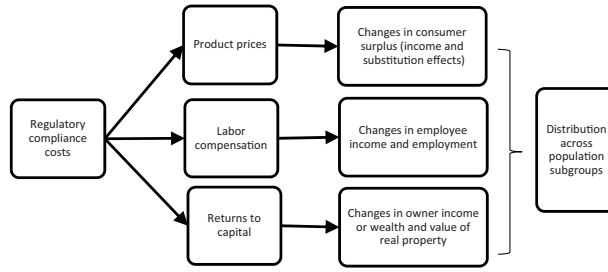

Figure 2 Distribution of compliance costs

Changes in product prices

The analyses for all 24 regulations address direct compliance costs, that is, the capital and operating expenditures required to meet the regulatory requirements as well as any significant offsetting savings. These costs are generally reported both in total and on some sort of per-unit basis (e.g., as average costs per plant or per motor vehicle). For most of the regulations we reviewed, the agencies assess how these costs are distributed across different industries and firms and across for-profit, nonprofit, and government entities, as well as how they affect small businesses and other small organizations—as required by the RFA and UMRA.

In order to determine the extent to which costs are passed on to consumers through price increases, rather than absorbed by industry through decreased labor compensation or returns to capital, information is needed on behavioral responses.[11] Some of the EPA analyses (e.g., EPA 2010) include partial-equilibrium modeling that considers responses by the regulated industry and in closely related industries if relevant.[12] Such modeling describes how costs will be distributed across consumers and producers in the aggregate (as changes in consumer and producer surplus).[13] Several analyses (e.g., DOT 2012a) estimate how the prices of intermediate or consumer products may be affected, but do not quantify how price changes are likely to be distributed across consumers in various income or other groups. Thus the analyses for the 24 regulations we reviewed provide little or no data on how price changes will ultimately affect the disposable income of members of different population groups.

Changes in labor compensation

The analyses we reviewed do not assess the effects of regulation on wages for those who continue to be employed in the affected industries or for those who change their employment, except in very general, qualitative terms, with a few exceptions (e.g., DOT 2011). The EPA discusses the possible range of job gains and losses for some regulations (e.g. EPA 2012) and the potential for plant closures (e.g., EPA 2010), noting that whether these regulations will generate net gains or losses in employment is uncertain. Increased employment may result, for example, if demand for the industry's product is unresponsive to price changes (inelastic) or if production requires additional workers and becomes more labor intensive once regulatory requirements are

[11]In some cases, the distributional effects of price changes induced by a regulation may be counterbalanced or alleviated by other programs, such as those that regulate prices or provide subsidies to consumers.
[12]Federal agencies rarely use computable general equilibrium models to estimate the economy-wide effects of individual rulemakings, in part because many of these rules are too small for their impacts to be easily discerned (with reasonable precision) by such models.
[13]These concepts and methods are described in more detail in EPA (2014) and many economics texts.

implemented (Morgenstern, Pizer, and Shih 2002; Morgenstern 2013). However, the EPA does not assess whether affected workers are likely to transition quickly to new jobs, nor does it estimate the effects on earnings. Moreover, none of the analyses consider how the regulations affect wages across different income groups or other subpopulations.

Changes in returns to capital

On average, we would expect owners to be wealthier than affected workers.[14] However, none of the analyses estimate impacts on owners of capital; neither do they provide information on the demographic characteristics of owners of capital. Thus, overall, we know very little about how regulatory costs are distributed.

Findings: Distribution of Net Benefits

Because the regulatory analyses we review fail to describe how benefits and costs are distributed, we cannot determine the distribution of net benefits. Thus it is not possible to determine whether the regulations are regressive, as hypothesized by Fullerton (2009, 2011), or disproportionately affect groups defined by characteristics other than income, such as minority status or impaired health. Our review suggests that federal agencies largely ignore, and the OMB does not enforce, the guidance on distributional analysis contained in Executive Orders 12866 and 13563 and OMB Circular A-4. In the next two sections, we discuss potential philosophical and pragmatic reasons for this lack of attention.[15]

Explanations Based on Regulatory Philosophy

The philosophical approach to regulation—that is, beliefs about the appropriate role of distributional considerations in decision making—may affect the desirability of obtaining and analyzing information about the distribution of costs and benefits. In this section we examine three possible normative frameworks and their implications for distributional analysis.

Economic Efficiency-Only Framework

The first framework assumes that decisions about environmental, health, and safety regulations should be based *solely* on economic efficiency, thus excluding distributional considerations. This efficiency-only framework is derived from the conventional normative justification for using BCA in decision making, which starts with the Pareto principle: a policy is desirable if it makes someone better off and no one worse off. [16] While using the Pareto principle as a decision-making criterion is attractive in theory, almost any policy will harm at least some people—for example, by raising the prices they pay by more than the value of the benefits they receive. To address this limitation, Kaldor (1939) and Hicks (1940) developed significant innovations, together known as the Kaldor–Hicks criterion: a policy is desirable if the winners are

[14]The effects of regulation on firms are complex and cannot be fully explored in this short summary. Although regulations are often assumed to adversely affect profits (because otherwise firms would have undertaken the actions without the regulations), some scholars have argued that regulation may benefit industry by encouraging innovation (e.g., Porter and Van der Linde 1995; Ambec et al. 2013) and that industry influence may lead regulators to promulgate rules that benefit firms (e.g., Stigler 1971; Peltzman 1976; Carpenter and Moss 2013).
[15]Regulatory agency staff were unwilling to speak on the record about these issues, making it difficult to determine the extent to which each of the possible explanations we discuss affects agency behavior.
[16]Other normative justifications are discussed in Hammitt (2013).

made better off by an amount that is large enough for them to compensate the losers, and alternatively, a policy should be rejected if the losers could compensate the winners for not pursuing the policy. The Kaldor–Hicks criterion does not require that the compensation actually be paid or even contemplated, and assumes such compensation is costless.[17] Applying the Kaldor–Hicks criterion means that, if only one policy is being considered, it should be selected if it yields positive net benefits. If more than one policy provides positive net benefits, the preferred choice is the one that yields the greatest net benefits.

The role of distribution

The conventional goal of BCA is to examine the extent to which policies meet the Kaldor–Hicks criterion, that is, are economically efficient. Some economists argue that decisions about government programs, such as environmental, health, and safety regulations, should be based solely on economic efficiency in order to ensure that resources are invested in those activities that maximize social welfare (Hylland and Zeckhauser 1979; Zeckhauser 1979; Kaplow 2004). Those who make this argument generally believe that distributional goals can be achieved more comprehensively and effectively, and at lower cost, by simply transferring money (through the tax system and programs that provide cash stipends).[18]

More specifically, environmental, health, and safety regulations typically provide heterogeneous benefits to heterogeneous populations. For example, air pollution regulations reduce health and ecological risks for both rich and poor individuals living in the affected geographic areas. In contrast, money transfers can be better targeted to the outcome and population of concern, for instance by providing funds directly to the poor.

Implications for distributional analysis

Under the "efficiency-only" framework, there may be little need for information on distributional impacts. Presumably, advocates of this approach would argue that those interested in distribution should focus their efforts on reforming the tax and income-support systems rather than on redirecting environmental, health, or safety regulations.[19] Nevertheless, distributional analysis may be useful for two reasons.

First, decision makers may desire data on the impacts of the regulation on those at different income levels in order to determine whether any tax adjustments or compensating transfer payments might be justified. Should this be the case, they may be more interested in the net effects of groups of regulations over time and across agencies than the impacts of individual regulations. The combined distributional effects of multiple regulations may be reinforcing or offsetting in ways that strengthen or weaken the rationale for providing compensation. It would be costly—both administratively and politically—to continually tweak the tax and income-support systems, or provide compensating payments, to address the effects of each regulation as it is promulgated.

Second, and perhaps more important, distributional analysis helps to inform the debate about the appropriate role of distribution in decision making. It provides a factual basis for the

[17]See, e.g., Just, Hueth, and Schmitz (2004) for more discussion of these criteria.
[18]See, e.g., Zeckhauser (1971) for discussion of the optimal approach to income transfer.
[19]Some who support the efficiency-only framework from a normative perspective may prefer other frameworks for practical reasons. The tax and income-support systems are extremely difficult to reform, as illustrated by years of debate over issues such as the appropriate taxation of capital gains or large inheritances and the incorporation of incentives to seek work in welfare programs. Thus, taking distribution into account in at least some decisions on environmental, health, and safety regulations may be viewed as a more feasible (albeit second-best) approach.

discussion by indicating both the magnitude of any distributional impacts and the trade-off between efficiency and distribution. Such information can also help decision makers anticipate and address support for and opposition to the regulation. For example, if a regulation will cause significant harm to some groups, then decision makers can anticipate that these groups may fiercely oppose the regulation. Moreover, when interest groups are powerful, distributional analysis may provide decision makers with leverage to resist demands for benefits that appear excessive. Thus even those who firmly believe that efficiency is the appropriate normative framework for regulatory decision making may find that the analysis of distributional impacts is useful.

Economic Efficiency with Selective Protection Framework

The second framework follows the first, with one exception. It again assumes that decisions about environmental, health, and safety regulations should be based solely on economic efficiency and should exclude distributional considerations. But it follows this prescription only if members of particular groups will not be harmed. We include this framework because it appears consistent with current agency practices, which focus on ensuring that regulations do not adversely affect members of specified groups rather than on assessing distribution more generally.

The role of distribution

This framework essentially embraces the normative stance implicit in the environmental justice and children's health executive orders (Executive Orders 12898 and 13045, respectively), which require that certain groups be protected from adverse effects. Both executive orders focus on health and identify groups of concern based on characteristics other than wealth (minorities and children, not only low income). Thus they signal the importance of distributional issues that are not solely income-related, issues that cannot be easily addressed through the types of money transfers envisioned under the efficiency-only framework.

Although appealing in theory, this approach is problematic from a societal perspective because it focuses on avoiding only certain types of losses and ignores positive consequences. It likely reflects the widely observed aversion to losses—the tendency to put disproportionate weight on losses relative to gains, even when the losses and gains are small (Kahneman and Tversky 1979; Tversky and Kahneman 1991).[20]

However, any policy having distributional consequences produces winners and losers, and who benefits may be as important as who is harmed. As discussed in the behavioral economics literature,[21] loss aversion can also lead to inconsistent valuations, such as applying larger absolute values to a risk increase than to a risk decrease of the same magnitude, and to inconsistent decisions, such as rejecting a new regulation but not eliminating an existing regulation that has the same effects.

[20]The baseline for loss aversion is generally the current endowment or the status quo (Samuelson and Zeckhauser 1988; Kahneman, Knetsch, and Thaler 1991; Knetsch 2010).
[21]Robinson and Hammitt (2011) and Hammitt (2013) review the implications of behavioral economics for BCA and discuss these issues in more detail.

Implications for distributional analysis

Under the efficiency with selective protection framework, the only distributional analysis that appears to be needed is to determine whether the groups of concern (such as the poor, children, or minorities) are adequately protected from losses along the specified dimensions (such as health). An important drawback of this approach is that it does not provide information on other distributional consequences that may be of interest to decision makers. For example, if the goal is to protect minorities from adverse health effects, but minorities will incur monetary costs while health-related benefits accrue to others, this approach would not provide the data needed to understand these impacts. More generally, if the regulatory costs primarily affect the disadvantaged while the regulatory benefits accrue to the advantaged, distribution may merit particular attention by decision makers. However, this sort of comparison is not possible if analysts only certify that the health of a few identified groups is not harmed.[22] Thus this selective protection approach has serious flaws as a framework for regulatory decisions and for distributional analysis.

Economic Efficiency and Distribution Framework

The third framework assumes that decision makers seek to jointly consider the results of the BCA and the distributional analyses. The two analyses could be conducted separately or combined; the distinguishing feature of this approach is that the conclusions of both are considered.

The role of distribution

This "efficiency and distribution" framework appears consistent with the language in the executive orders that establish the general guidelines for regulatory analysis (Executive Orders 12866 and 13563), which treat distribution as a component of the net-benefit calculus. It also appears consistent with the implementing guidance in OMB Circular A-4, which indicates that agencies should provide separate analyses of economic efficiency and distribution. In both cases, the underlying normative assumption is that decision makers will weigh both types of impacts.

Implications for distributional analysis

To support joint consideration, the distributional analysis could be conducted separately from the BCA or the two could be combined. The first option would involve preparing a conventional BCA and complementing it with quantitative data on how the costs, benefits, and net benefits are distributed, consistent with the guidance in OMB Circular A-4 (2003). The distribution could be described in tables and text, and standard measures of inequality, such as the Gini coefficient, could be used to summarize the distribution.[23]

[22]A variant of this approach was proposed by John Graham, former administrator of the OMB Office of Information and Regulatory Affairs (Graham 2008). He suggested that a regulation should only be considered desirable if it provides net benefits for the most disadvantaged group (e.g., households below the poverty line) as well as for society as a whole.

[23]The Gini coefficient is a numerical measure of the degree of inequality between two variables. The Congressional Budget Office (2011) provides an example of its calculation and application to U.S. income distribution.

The second option would more fully integrate the efficiency and distributional analyses. This integration could include weighting the benefits and costs for different income groups by an estimate of the marginal utility of income. This marginal utility is expected to vary across income groups, with an incremental dollar yielding more utility to a poor person than to a rich person. Decision makers could then identify which policy maximizes utility (rather than simply efficiency). Although this approach has been implemented in some contexts (see, e.g., HM Treasury 2003), estimating the appropriate weights can be challenging.

This integration could also involve using distributional weights that reflect estimates of society's preferences for distribution. Examples of these approaches, such as applying a social-welfare function that represents preferences for both the level and distribution of well-being throughout society, are discussed in the other articles in this symposium and elsewhere(Adler 2012; Adler 2016; Fleurbaey and Rafeh 2016). Explicit weighting has the theoretical advantage of directly addressing the difficult normative issues associated with comparing different distributional outcomes, such as how to balance large benefits to a small fraction of the disadvantaged with small costs to other members of the population. However, it is likely to be very difficult to agree upon the appropriate weights. (Hammitt 2013)

Clearly, such assessment of distribution, whether separate from or integrated with the BCA, would provide more information on the trade-offs between efficiency and distribution than the conventional BCA. However, these options may be challenging to implement in practice because of pragmatic constraints, which we discuss next.

Explanations Based on Pragmatic Concerns

Although our review suggests that the lack of attention to distribution in regulatory analyses may result from philosophical concerns, with current practices being most consistent with our "economic efficiency with selective protection" framework, agency practices may also, or instead, reflect pragmatic concerns. These concerns may include political and legal considerations, an assumption that distributional impacts are insignificant, or uncertainty about how to best address the technical challenges associated with conducting an adequate distributional analysis.

Political and Legal Considerations

One possible explanation of current practices is that agency leaders and staff are concerned about what might be revealed by more extensive distributional analyses. Agencies generally seek to promulgate timely regulations that fulfill their statutory mandates. Conducting distributional analyses could delay and complicate an already difficult process by highlighting problems that the agency may be unable to remedy, and encouraging groups to oppose the regulation.

To illustrate, assume an agency assesses the distributional effects of the costs and benefits of several regulatory options across income quintiles. Assume further that the agency finds that these effects are regressive for any option that meets the agency's statutory requirements—that is, for poor people, the costs that each regulatory option imposes exceed the value they place on the benefits they receive, while for rich people, the value of the benefits they receive exceeds the costs they pay. By law, the agency may still be required to issue the regulation, but the agency likely has no ability to compensate the poor (either directly or through the tax code) for the net

damages. Moreover, advocates for the poor who do not currently object to the regulation might oppose it if presented with such a distributional analysis.

This example suggests that distributional analysis could cause new groups to coalesce in opposition to the regulation, if the analysis identifies groups of individuals who would be significantly harmed but might not otherwise be aware of such harm. Moreover, because of loss aversion, those individuals who are harmed are likely to protest loudly, while those who benefit may be less likely to counterbalance these protests by becoming vocal supporters of the regulation. The possibility of triggering these sorts of debates and opposition may lead regulatory agencies to avoid conducting distributional analysis, so that they can focus on their primary mission (e.g., protecting the environment in the case of the EPA).

These concerns may also help to explain why the OMB does not more vigorously enforce the guidelines for distributional analysis. The OMB is part of the Executive Office of the President and, as a representative of the president, may not wish to push for analyses that may not be in the president's political interest. If, as in the example above, distributional analysis is likely to identify difficult-to-resolve problems associated with regulations issued by agencies that the president oversees, some may believe it is best to avoid such analysis altogether.

Assumption that Distributional Impacts are Insignificant

The lack of distributional analysis may also reflect an assumption that the effects on groups of concern are small and thus do not warrant detailed analysis.[24] For example, suppose that a regulation imposes net annual losses of $10 on average for poor individuals and provides net gains of $100 on average for an equal number of wealthy individuals. The regulation would be considered regressive because the poor experience losses while the wealthy gain. However, because the losses involved are such small fractions of income and because the efficiency gains are great, decision makers may choose to ignore this adverse distributional consequence.

A simple thought experiment illustrates how some observers may conclude that distributional impacts are likely to be small. The annual costs of the regulations we reviewed range from roughly $100 million to well over $1 billion. If a regulation imposes $1 billion in regulatory costs, and we divide these costs by the total number of U.S. households (115 million), the average cost is less than $10 per household.[25] In terms of benefits, the number of deaths delayed by the regulations we reviewed range from fewer than 10 to more than 13,000 annually. If we divide the 13,000 deaths by the 2.5 million U.S. deaths annually, the number of deaths delayed by a regulation represents a 0.5 percent decrease in deaths per year.[26] Thus these calculations suggest that the impacts are relatively small at the household level.

However, relying on these types of simple thought experiments can be misleading. Although these numbers appear small, they may hide concentrated effects on particular population groups. If all $1 billion in costs, or all 13,000 deaths delayed, were concentrated among the disadvantaged rather than distributed evenly throughout the population, or if the losses were

[24]Note that the absolute value of gains and losses is, by definition, greater than the net effect. Our focus in the discussion here is *perceptions* (which may or may not be accurate) regarding the significance of the impacts for policy.

[25]The number of U.S. households from U.S. Census "Quick Facts" (http://quickfacts.census.gov/qfd/states/00000.html), based on American Community Survey data for 2007 to 2011.

[26]The number of U.S. deaths from Centers for Disease Control and Prevention "FastStats" (http://www.cdc.gov/nchs/fastats/deaths.htm).

concentrated in a few states, some might wish to consider these distributional effects when making decisions. More explicit analysis of distribution would be needed to determine whether it is correct to assume that the consequences are insignificant.

Technical and Analytical Constraints

The technical and analytical challenges of assessing the distribution of costs and benefits may also help to explain the lack of attention to distribution in regulatory analyses. As discussed earlier, there is little guidance available on how to conduct such analysis and, to date, few analyses have been completed that address both the costs and the benefits of individual regulations.

Lack of detailed guidance

Implementation of the government-wide analytical requirements is generally the responsibility of the individual regulatory agencies, but the EPA is the only federal agency that has developed comprehensive guidance for conducting regulatory analyses. The EPA recently added a chapter on "Environmental Justice, Children, and Other Distributional Considerations" (EPA 2014) to its guidelines. Although this chapter provides more detailed information on conducting distributional analyses than was previously available, it focuses on health and environmental impacts for specific groups of concern. It says little about how to value these impacts or how to assess the distribution of costs.

Guidance developed by other agencies says almost nothing about conducting distributional analysis, focusing more on programmatic issues raised by the environmental justice and children's health executive orders. For example, both DOT (2012b) and HHS (2012) have developed environmental justice strategies, which deal primarily with the process for identifying, assessing, and addressing environmental justice concerns through policy design and implementation. These guidance documents generally do not address economic valuation or comparison of benefits and costs. Without more guidance, analysts will remain uncertain about how to best conduct distributional analysis, and will thus be likely to choose to focus on tasks that are more clearly defined instead.

Data constraints

Regulatory agencies appear to have much of the information they need to estimate the distribution of health effects. For example, as we discussed earlier, the EPA is able to conduct relatively disaggregated analyses for its air pollution regulations. Other agencies also appear to have access to sociodemographic information, at least for fatalities. For example, the Bureau of Labor Statistics' Census of Fatal Occupational Injuries provides information on occupational fatalities, and the National Highway Traffic Safety Administration's Fatality Analysis Reporting System provides similar information for motor vehicle accidents. While these databases do not report the income levels of victims, they do provide information on age, location, and employment (for job-related risks), which could be used to estimate income and perhaps other characteristics.

In contrast, agencies may lack the data they need to assess the distribution of regulatory costs. Firms themselves may find it challenging to accurately describe how they have accommodated

regulatory costs because decisions about pricing, wages, and returns to capital are influenced by market factors as well as regulatory requirements. The complexity of these issues (as illustrated in figure 2) and the lack of existing research suggest that new approaches will need to be developed if the distribution of regulatory costs is to be addressed.[27]

Resource and staffing constraints

Constrained resources and staffing may also deter agencies from undertaking distributional analyses. Agencies may view conducting distributional analysis as a lower priority than analyzing other regulatory impacts, providing services, or enforcing existing regulations. Our discussions with many involved in these analyses, as well as our substantial personal experience, suggest that regulatory analyses are usually completed under tight deadlines with limited staff and budgetary resources. Thus, focusing more attention on distribution would likely divert attention and resources from addressing other, perhaps more important, impacts.

Summary and Conclusions

U.S. government agencies are currently expected to assess the distribution of the impacts of major environmental, health, and safety regulations. We reviewed the supporting analyses for 24 economically significant regulations issued over a four-year period that focus on improving health and longevity (and for which a reasonably complete BCA was conducted). We found that these analyses pay relatively little attention to distribution; often they merely address the extent to which the regulation protects the health of low-income and minority groups and children.

We explored possible explanations for this lack of attention, examining three possible philosophical frameworks related to the role of distribution in decision making. The results of our review are most consistent with the belief that regulatory decisions should be based on economic efficiency, as long as the health of specific populations of concern is not directly harmed. However, we find this approach problematic because it ignores the value of the health-related benefits, of benefits not directly related to health, and of monetary costs. In addition, it fails to consider how the effects are distributed across more- and less-advantaged groups. Thus it provides incomplete information on the trade-offs involved in decision making. The two other frameworks we consider, efficiency only and efficiency and distribution combined, argue for more comprehensive analysis of distribution, albeit for quite different reasons.

We also explored the role of pragmatic concerns. Perhaps most important, we found little guidance and virtually no examples of how to comprehensively assess the distribution of regulatory costs and benefits. Given these findings, a useful next step would be to conduct case studies of individual regulations or groups of regulations to experiment with different analytic approaches, including exploring their feasibility and the usefulness of their results.

For benefits, it appears that a more comprehensive distributional analysis may be possible based on available data and methods. Agencies often have access to data sources that would allow them to estimate the distribution of health risk reductions across various subpopulations.

[27]The scholarly research on distribution described at the beginning of this article often relies on economy-wide input–output or general equilibrium models. These models are generally appropriate for assessing the distribution of policies with very large effects (such as a carbon tax), but are generally poorly equipped to identify the effects of policies with smaller impacts, such as most individual environmental, health, and safety regulations.

Existing research on benefit values could be used to estimate how these values vary across income groups and other population subgroups.

For costs, the analytic challenges are more significant. In the near term, it may be necessary to combine the available data with simple bounding analysis to estimate possible impacts. For example, analysts could test the distributional effects of assuming that costs are fully passed on as changes in prices, wages, and/or returns to capital in both the short and long runs. Data from the Bureau of Labor Statistics and other sources on purchases of products by those in different population groups, on the wages paid to those who work in different occupations and industries, and on capital ownership could then be used to estimate possible distributional consequences.

Such case studies would help to inform the debate on the feasibility and desirability of more routine and rigorous distributional analyses, and could also be the starting point for a more thoughtful discussion of the difficult normative issues that such analyses would raise.

By making the trade-offs between efficiency and distribution more apparent, increased analysis of distributional impacts would help decision makers make more informed decisions. If the net benefits were great, decision makers might choose an economically efficient regulatory option, despite knowing that its distributional effects were somewhat adverse, or they might choose a regulation with a preferred distribution, knowing the magnitude of the accompanying efficiency loss was modest. Good regulatory decisions require such positive distributional analysis as an input to sound normative judgment.

Appendix A

Major regulations with quantified health benefits (FY 2010–2013)

Regulation[a]	Annualized costs and benefits[b] (2001 dollars)	
	Costs	Benefits
U.S. Environmental Protection Agency		
Portland Cement Industry NESHAP	$0.8 billion–$0.9 billion	$6.1 billion–$16.3 billion
Sulfur Dioxide Primary NAAQS	$0.7 billion ($0.3 billion–$2.0 billion)	$10.5 billion ($2.8 billion–$38.6 billion)
Compression Ignition RICE NESHAP	$0.3 billion	$0.7 billion–$1.9 billion
Spark Ignition RICE NESHAP	$0.2 billion	$0.4 billion–$1.0 billion
Light-Duty Vehicle GHG and CAFE Standards (joint with DOT)	$3.3 billion ($1.7 billion–$4.7 billion)	$11.9 billion ($3.9 billion–$18.2 billion)
Cross-State Air Pollution	$0.7 billion	$20.5 billion–$59.7 billion
Medium and Heavy-Duty Vehicle Fuel Economy Standards (joint with DOT)	$0.5 billion ($0.3 billion–$0.5 billion)	$2.6 billion ($2.2 billion–$2.6 billion)
Petroleum Refineries NSPS	$0.1 billion	$0.4 billion–$0.7 billion
Electric Utility Steam Generation NESHAP (mercury and other toxics)	$8.2 billion	$28.1 billion–$76.9 billion
2017 and Later Model Year Light-Duty Vehicle GHG and CAFE Standards (joint with DOT)	$8.8 billion ($5.3 billion–$8.8 billion)	$28.8 billion ($21.2 billion–$28.8 billion)
Particulate Matter NAAQS Review	$0.0 billion–$0.3 billion	$3.0 billion–$7.5 billion
Reconsideration of RICE NESHAP	$0.4 billion	$0.6 billion–$1.7 billion
Boilers and Process Heaters NESHAP	$1.2 billion–1.4 billion	$21.2 billion–$56.6 billion
U.S. Department of Transportation		
Hours of Service Recorders	$0.1 billion	$0.2 billion
Positive Train Control	$0.7 billion ($0.5 billion–$1.3 billion)	<$0.1billion
Pipeline Safety Distribution Integrity	$0.1 billion	$0.1 billion
Ejection Mitigation	$0.4 billion ($0.4 billion–$1.4 billion)	$1.5 billion ($1.5 billion–$2.4 billion)
Certified Medical Examiners	<$0.1 billion	$0.1 billion ($0.1 billion–$0.2 billion)
Hours of Service	$0.4 billion	$0.5 billion ($0.2 billion–$1.0 billion)
Positive Train Control Amendments	<$0.1 billion	<$0.1 billion ($0.0 billion–$0.1 billion)
Pilot Certification	$0.1 billion ($0.1 billion–$0.2 billion)	<$0.1 billion
U.S. Department of Labor		
Construction Cranes and Derricks	$0.1 billion	$0.2 billion
Chemical Hazard Communication	$0.2 billion ($0.1 billion–$0.2 billion)	$0.6 billion ($0.5 billion–$1.6 billion)
U.S. Department of Health and Human Services		
Gluten-Free Food Labeling	<$0.1 billion	$0.1 billion ($0.0 billion–$0.2 billion)
TOTAL, All regulations	**<$21.6 billion to $32.6 billion**	**<$114.1 billion to $316.7 billion**

[a]The discussion in the main text is based on a detailed review of the *Federal Register* notice for the final rule and any separate regulatory analysis prepared by the agency. A complete list of the sources reviewed is available from the authors.

[b]These estimates reflect the distinctions between costs and benefits that are used in the individual analyses, which are not necessarily consistent. In some cases, the benefits estimates include cost savings as well as the value of reduced health and environmental risks.

Sources:

Numbers in table are from:

U.S. Office of Management and Budget. 2011. *2011 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*, Table 1-5(a), pp. 25–26.

U.S. Office of Management and Budget. 2012. *2012 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*. Table 1-5(a), pp. 26–27.

U.S. Office of Management and Budget. 2013. *2013 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*. Table 1-6(a), pp. 26–27.

U.S. Office of Management and Budget. 2014. *2014 Draft Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*. Table 1-6(a), pp. 24–25.

Notes: CAFE, corporate average fuel economy; GHG, greenhouse gas; NAAQS, National Ambient Air Quality Standards; NESHAP, National Emission Standards for Hazardous Air Pollutants; NSPS, New Source Performance Standards; RICE, reciprocating internal combustion engine.

References

Adler, M. A. 2012. *Well-being and fair distribution: Beyond cost-benefit analysis*. New York: Oxford University Press.

———. 2016. Benefit–cost analysis and distributional weights: An overview. *Review of Environmental Economics and Policy* 10(2):264–285.

Ambec, S., M. A. Cohen, S. Elgie, and P. Lanoie. 2013. The Porter hypothesis at 20: Can environmental regulation enhance innovation and competitiveness? *Review of Environmental Economics and Policy* 7:2–22

Banzhaf, H. S. 2011. Regulatory impact analyses of environmental justice effects. *Journal of Land Use and Environmental Law* 27:1–30.

Bento, A. M. 2013. Equity impacts of environmental policy. *Annual Review of Resource Economics* 5:181–196.

Cameron, T. A. 2010. Euthanizing the value of a statistical life. *Review of Environmental Economics and Policy* 4:161–178.

Carpenter, D., and D. A. Moss, eds. 2013. *Preventing regulatory capture: Special interest influence and how to limit it*. New York: Cambridge University Press.

Clinton, W. J. 1993. Executive order 12866: Regulatory planning and review. *Federal Register* 58:51735–51744.

———. 1994. Executive order 12898: Federal actions to address environmental justice in minority populations and low-income populations. *Federal Register* 59:7629–7633.

———. 1997. Executive order 13045: Protection of children from environmental health risks and safety risks. *Federal Register* 62:19885–19888.

Congressional Budget Office. 2011. *Trends in the distribution of household income between 1979 and 2007*. Washington, DC: Congressional Budget Office.

Fleurbaey, M., and R. Abi-Rafeh. 2016. The use of distributional weights in benefit–cost analysis: Insights from welfare economics. *Review of Environmental Economics and Policy* 10(2):286–307.

Fullerton, D. 2009. Distributional effects of environmental and energy policy: An introduction. In *Distributional effects of environmental and energy policy*, ed. D. Fullerton . Aldershot, UK: Ashgate.

———. 2011. Six distributional effects of environmental policy. *Risk Analysis* 31:923–929.

Fullerton, D., and G. Heutel. 2007. The general equilibrium incidence of environmental taxes. *Journal of Public Economics* 91:571–591.

Graham, J. D. 2008. Saving lives through administrative law and economics. *University of Pennsylvania Law Review* 157:395–540.

Hammitt, J. K. 2000. Valuing mortality risk: Theory and practice. *Environmental Science and Technology* 34:1396–1400.

———. 2013. Positive vs. normative justifications for benefit-cost analysis: Implications for interpretation and policy. *Review of Environmental Economics and Policy* 7:199–218.

Hammitt, J. K., and L. A. Robinson. 2011. The income elasticity of the value per statistical life: Transferring estimates between high and low income populations. *Journal of Benefit–Cost Analysis* 2:1–29.

Harberger, A. C. 1962. The incidence of the corporate income tax. *Journal of Political Economy* 70:215–240.

Hicks, J. R. 1940. The valuation of the social income. *Economica* 7:105–124.

HM Treasury. 2003. *The green book: Appraisal and evaluation in central government*. London: TSO.

Hylland, A., and R. Zeckhauser. 1979. Distributional objectives should affect taxes but not program choice or design. *Scandinavian Journal of Economics* 81:264–284.

Just, R. E., D. L. Hueth, and A. Schmitz. 2004. *The welfare economics of public policy*. Cheltenham, UK: Edward Elgar.

Kahneman D., J. L. Knetsch, and R. H. Thaler. 1991. Anomalies: The endowment effect, loss aversion, and status quo bias. *Journal of Economic Perspectives* 5:192–206.

Kahneman, D., and A. Tversky. 1979. Prospect theory: An analysis of decision under risk. *Econometrica* 47:263–291.

Kaldor, N. 1939. Welfare propositions of economics and interpersonal comparisons of utility. *Economic Journal* 49:549–552.

Kaplow, L. 2004. On the (ir)relevance of distribution and labor supply distortion to government policy. *Journal of Economic Perspectives* 18:159–175.

Knetsch, J. L. 2010. Values of gains and losses: Reference states and choices of measure. *Environment and Resource Economics* 46:179–188.

Morgenstern, R. 2013. Analyzing the employment impacts of regulation. In *Does regulation kill jobs?*, eds. C. Coglianese, A. Finkel, and C. Carrigan. Philadelphia: University of Pennsylvania Press.

Morgenstern, R. D., W. A. Pizer, and J.-S. Shih. 2002. Jobs versus the environment: An industry-level perspective. *Journal of Environmental Economics and Management* 43:412–436.

Obama, B. 2011. Executive order 13563: Improving regulation and regulatory review. *Federal Register* 76:3821–3823.

Parry, I., H. Sigman, M. Walls, and R. Williams. 2006. The incidence of pollution control policies. In International Yearbook of Environmental and Resource Economics 2006/2007, eds. H. Folmer and T. Tietenberg. Cheltenham, UK: Edward Elgar.

Peltzman, S. 1976. Toward a more general theory of regulation. *Journal of Law and Economics* 19:211–240.

Porter, M. E., and C. Van der Linde. 1995. Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives* 9:97–118.

Robinson, L. A. 2007. How U.S. government agencies value mortality risk reductions. *Review of Environmental Economics and Policy* 1:283–299.

Robinson, L. A., and J. K. Hammitt. 2011. Behavioral economics and regulatory analysis. *Risk Analysis* 31:1408–1422.

———. 2013. Skills of the trade: Valuing health risk reductions in benefit–cost analysis. *Journal of Benefit–Cost Analysis* 4:107–130.

———. 2016. Valuing reductions in fatal illness risks: Implications of recent research. *Health Economics* 25:1039–1052.

Samuelson, W., and R. J. Zeckhauser. 1988. Status quo bias in decisionmaking. *Journal of Risk and Uncertainty* 1:57–159.

Stigler, G. J. 1971. The theory of economic regulation. *Bell Journal of Economics and Management Science* 2:1–21.

Tversky, A., and D. Kahneman. 1991. Loss aversion in riskless choice: A reference-dependent model. *Quarterly Journal of Economics* 106:1039–1061.

U.S. Department of Health and Human Services. 2012. *Environmental Justice Strategy and Implementation Plan*. Washington, D.C.: U.S. Department of Health and Human Services

U.S. Department of Transportation. 2010. *Positive Train Control Systems Regulatory Impact Analysis*.

———. 2011. *2010–2011 Hours of Service Rule Regulatory Impact Analysis*. Washington, D.C.: U.S. Department of Transportation.

———. 2012a. *Final Regulatory Impact Analysis: Corporate Average Fuel Economy for MY 2017–MY*

2025 Passenger Cars and Light Trucks. Washington, D.C.: U.S. Department of Transportation.

———. 2012b. Department of Transportation updated environmental justice order 5610.2(a). *Federal Register* 77:27534–27537.

———. 2013. *Final Regulatory Evaluation: Pilot Certification and Qualification Requirements for Air Carrier Operations*. Washington, D.C.: U.S. Department of Transportation.

U.S. Environmental Protection Agency. 2010. *Regulatory Impact Analysis: Amendments to the National Emission Standards for Hazardous Air Pollutants and New Source Performance Standards (NSPS) for the Portland Cement Manufacturing Industry*. Washington, D.C.: U.S. Environmental Protection Agency.

———. 2011a. *Regulatory Impact Analysis for the Federal Implementation Plans to Reduce Interstate Transport of Fine Particulate Matter and Ozone in 27 States; Correction of SIP Approvals for 22 States*. Washington, D.C.: U.S. Environmental Protection Agency.

———. 2011b. *Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards*. Washington, D.C.: U.S. Environmental Protection Agency.

———. 2012. *Regulatory Impact Analysis for the Proposed Revisions to the National Ambient Air Quality Standards For Particulate Matter*. Washington, D.C.: U.S. Environmental Protection Agency.

———. 2014. *Guidelines for Preparing Economic Analyses*. Washington, D.C.: U.S. Environmental Protection Agency.

U.S. Office of Management and Budget. 2003. *Circular A-4: Regulatory Analysis*.Washington, D.C.: U.S. Office of Management and Budget.

———. 2011. *2011 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*. Washington, D.C.: U.S. Office of Management and Budget.

———. 2012. *2012 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*. Washington, D.C.: U.S. Office of Management and Budget.

———. 2013. *2013 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*. Washington, D.C.: U.S. Office of Management and Budget.

———. 2014. *2014 Draft Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*. Washington, D.C.: U.S. Office of Management and Budget.

Zeckhauser, R. 1971. Optimal mechanisms for income transfer. *American Economic Review* 61:324–334.

———. 1979. *Using the wrong tool: The pursuit of redistribution through regulation*. Washington, DC: U.S. Chamber of Commerce.