

# Chapter 9: Distributional Analyses: Economic Impact Analyses and Equity Assessments

## 9.1 Introduction

In an effort to fully understand a regulation's impact and make an informed judgement regarding its desirability, policy makers study many different regulatory consequences. Economic information is important to the evaluation of at least two consequences—a regulation's efficiency and its distributional consequences. In principle, both types of consequences could be estimated simultaneously by a general equilibrium model. In practice, for reasons discussed in Chapter 5, they are usually estimated separately.

A benefit-cost analysis (BCA) calculates the social benefits and costs of an environmental policy and answers the question of whether the benefits are sufficient for the gainers to potentially compensate the losers, leaving everyone at least as well off as before the policy. Its calculation of net benefits helps ascertain the economic efficiency of a regulation. Two other ways to express economic information—an economic impact analysis (EIA) and an equity assessment—assess changes in social welfare by examining the distributive effects of a regulation. An EIA focuses on traditional classifications of affected populations<sup>1</sup> (e.g., industrial sector classifications). Under the heading of equity assessment analysts can address broad concerns such as changes in the national dis-

tribution of income or wealth. In addition, an equity assessment can provide information to decision makers on how policies affect specific sub-populations. Disadvantaged or vulnerable sub-populations (e.g., low income households) may be of particular concern.

### *Economic Impact Analysis (EIA)*

An EIA helps answer the questions, "Who are the losers and gainers from a policy?" and "By how much do they lose or gain?" Traditionally, EIAs have focused on the losers and the negative impacts of an environmental regulation. This focus is in response to existing legislative and administrative statutes and policies which direct analysts to examine the distribution of negative regulatory impacts or costs. Currently, several of these same statutes and policies call for a similar examination of the positive impacts of a regulation.

Unlike a BCA which rests its conclusions exclusively on comparisons of social benefits and costs, an EIA examines the distribution of many different economic impacts. Conventional impacts include monetized effects such as changes in profitability or in government revenues, as well as non-monetized effects such as increases in unemployment rates or numbers of plant closures. An EIA will often examine and report on regulatory outcomes that a BCA would not. For example, when measuring impacts on private

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<sup>1</sup> The term "affected" is applied throughout the chapter in its most general use as an economic term. Analysts should be aware of how the authorizing statute for the rule, as well as other applicable statutes and administrative orders noted in this chapter, make more specific use of this term. For example, the Regulatory Flexibility Act includes the clause "subject to the requirements of the rule" when quantifying economic impacts. This results in analyzing entities that are directly affected, so that conclusions can be drawn as to the significance of impacts of the rule. Alternatively, provisions in UMRA and EO 12866 address both direct and indirect impacts, so that the affected population of entities may be more inclusive than only those "subject to the requirements of the rule." For more information, Chapter 8, Section 3 on "Social Cost Analysis" covers the economic concepts and terminology relevant to direct and indirect impacts.



businesses, an EIA will include changes in transfer payments from firms to the public sector whereas a BCA would not. Transfer payments become important when analyzing the distributional consequences of a regulation. To achieve the objective of an EIA and educate policy makers about who will lose or gain as a result of a particular regulation, analysts have traditionally relied upon the assortment of impacts described in Section 9.2 below.

### ***Equity Assessment***

Generally, assessments of equity examine a regulation's impact on the distribution of national income or wealth. Decision makers may use this information in conjunction with economic efficiency measures as captured in a benefit-cost analysis to evaluate tradeoffs between equity and efficiency. For the most unified treatment, both equity and efficiency issues can be addressed in a computable general equilibrium model.<sup>2</sup> In practice, data constraints will limit analysts to undertake distributional analyses independently from benefit-cost analyses.

As is true for an EIA, an equity assessment is generally more concerned with sub-populations who experience net costs or other negative impacts than with those who experience net benefits or positive impacts. An equity assessment may consider effects on any sub-population, but it should always consider the economic effects of a regulation on disadvantaged or vulnerable sub-populations; specifically, sub-populations who are physically susceptible to environmental contamination, are less than fully capable of representing their own interests, or are economically disadvantaged or vulnerable. Examples include children, low-income or minority communities, and small businesses, governments, and not-for-profit organizations. For many of these sub-populations, EPA has been directed by statute or policy to examine the effects of its rules when they are expected to have a "disproportionate," "significant and substantial," or other such impact.

An equity assessment draws on information and analytic tools used in BCA and may report on impacts using measures found in an EIA. Therefore, an early step in an equity assessment is to identify sub-populations likely to be affected by a regulation. Once identified, if data permits, the social costs and benefits estimated for the BCA can be disaggregated and net benefits for the sub-population(s) or

the distribution of net benefits among sub-populations, can be examined. An equity assessment may also examine economic impacts, such as increases in rates of unemployment or other traditional impact measures, for the identified sub-population(s).

### ***Consistency Between BCA and Distributional Analyses***

Ensuring consistency in analytic design and interpretation of results for the BCA, EIA and equity assessment supporting a particular regulation is essential. All three examine impacts that, in principle, could be estimated by a single general equilibrium model (see Section 5.2). Both an EIA and an equity assessment must be conducted following the principles that frame a BCA, even if the formal preparation of BCA is not undertaken. When a BCA is undertaken, to the extent possible, both distributive analyses should adopt the same set of assumptions used in the BCA. For example, all three should rely upon the same set of baseline assumptions and all three should assume the same values for relevant elasticities. However, because all the information needed to estimate distributive outcomes is often not integral to the calculations performed in a BCA, in many cases further assumptions must be developed specifically for the EIA or the equity assessment. For example, new assumptions regarding definitions of sub-populations must be developed and there might be good reason to assume different elasticities for different sub-populations. Even in these cases, analysts should ensure that the implications, if any, of the added assumptions for the outcome of the BCA are understood and made manifest to policy makers.

### ***Using a Social Welfare Function to Evaluate Efficiency-Equity Tradeoffs***

Potentially, a regulation's effects on distribution, analyzed by its EIA and/or equity assessment, and its effects on efficiency, analyzed by its BCA, can be incorporated into a single social welfare function. A social welfare function establishes criteria under which efficiency and equity outcomes are transformed into a single metric, making them directly comparable. A potential output of such a function is a ranking of policy outcomes that have different aggregate levels and distributions of net benefits. A social welfare function can provide empirical evidence that a policy alternative yielding higher net benefits, but a less

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<sup>2</sup> Computable general equilibrium models are discussed in section 8.4.5.

equitable distribution of wealth, is better or worse than a less efficient alternative with more egalitarian distributional consequences.<sup>3</sup>

In practice, developing a universally acceptable social welfare function is difficult because it requires explicit decisions to be made about society's preferences for the distribution of resources. Nonetheless, future research may result in some feasible practical alternatives.<sup>4</sup> These guidelines do not suggest a particular social welfare function or that analysts attempt to use this approach at this time, but the approach may merit further consideration as additional research and applications develop.

### Chapter Summary

This chapter begins with a brief discussion of an iterative process between analysts and management to facilitate thorough consideration of the output from distributional analyses. The bulk of the chapter occurs in Section 9.2 on Economic Impact Analysis which, after reviewing statutes and policies that require examination of economic impacts, describes methods for estimating economic impacts that are relevant for both EIAs and equity assessments. The final section of this chapter discusses the relatively new distributional analysis, equity assessment. Statutes and policies that require equity assessment, definitions of sub-populations, and a general framework for conducting an equity assessment, including possible data sources, are reviewed.

### 9.1.1 A Process for Economic Impact Analyses and Equity Assessments

This section describes an iterative process between EPA analysts and senior management<sup>5</sup> as an integral part of an EIA and an equity assessment. At several points of the regulatory development process, senior analysts should report the results of distributional analyses to senior management and receive feedback. Only through such ongoing

communication can senior management remain sufficiently informed so that potential economic effects of proposed environmental regulations receive proper attention within the regulatory development process.

As discussed above, ensuring consistency between the EIA, equity assessment, and BCA is critical. The methods and results of an EIA and an equity assessment are inherently linked to their corresponding BCA. Consequently, concerns regarding distributional outcomes that arise through the iterative process that necessitate a change in the regulatory approach will also require adjustments to the assessment of social benefits and costs.

This iterative process is not expected to add significant additional administrative procedures to the current EPA regulatory development process. Rather, its objective is to bring greater attention to opportunities for the workgroup and senior management to have ongoing communication related to potential economic impacts and equity dimensions of proposed environmental regulations. Frequent and timely exchanges of information between senior management and the workgroup will focus greater attention on affected sectors of the economy as well as affected sub-populations and may influence the final regulatory alternative selected.

Information contained in Exhibit 9-1 illustrates such a process. Its contents are consistent with the procedures outlined in the document, *Regulation Development in EPA* (EPA, 1997) and with the process for promulgating a regulation illustrated by the flow chart in *Guidance for Analytic Blueprints* (EPA, 1994). There are two key components of Exhibit 9-1 that are designed to institutionalize the iterative process between the workgroup and senior management for EIAs and equity assessments. The first component is an explicit incorporation of the identification and analysis of economic impacts and equity dimensions such as those listed in Exhibits 9-2 and 9-5 into the regulatory development process. The second component, depicted by the arrows, is a process for initiating multiple

<sup>3</sup> For more on the use of social welfare functions in policy analysis see Sen (1970), Arrow (1977), and Jorgenson (1997). An empirical application of this approach can be found in Norland and Ninassi (1998).

<sup>4</sup> For a recent description of potential alternatives see Farrow (1998).

<sup>5</sup> Senior management is used as shorthand for persons responsible for authorizing and using these forms of analysis. Most often, these persons will include the Assistant or Regional Administrator of the lead office or region that is considering the regulation or other upper management within that office or region.

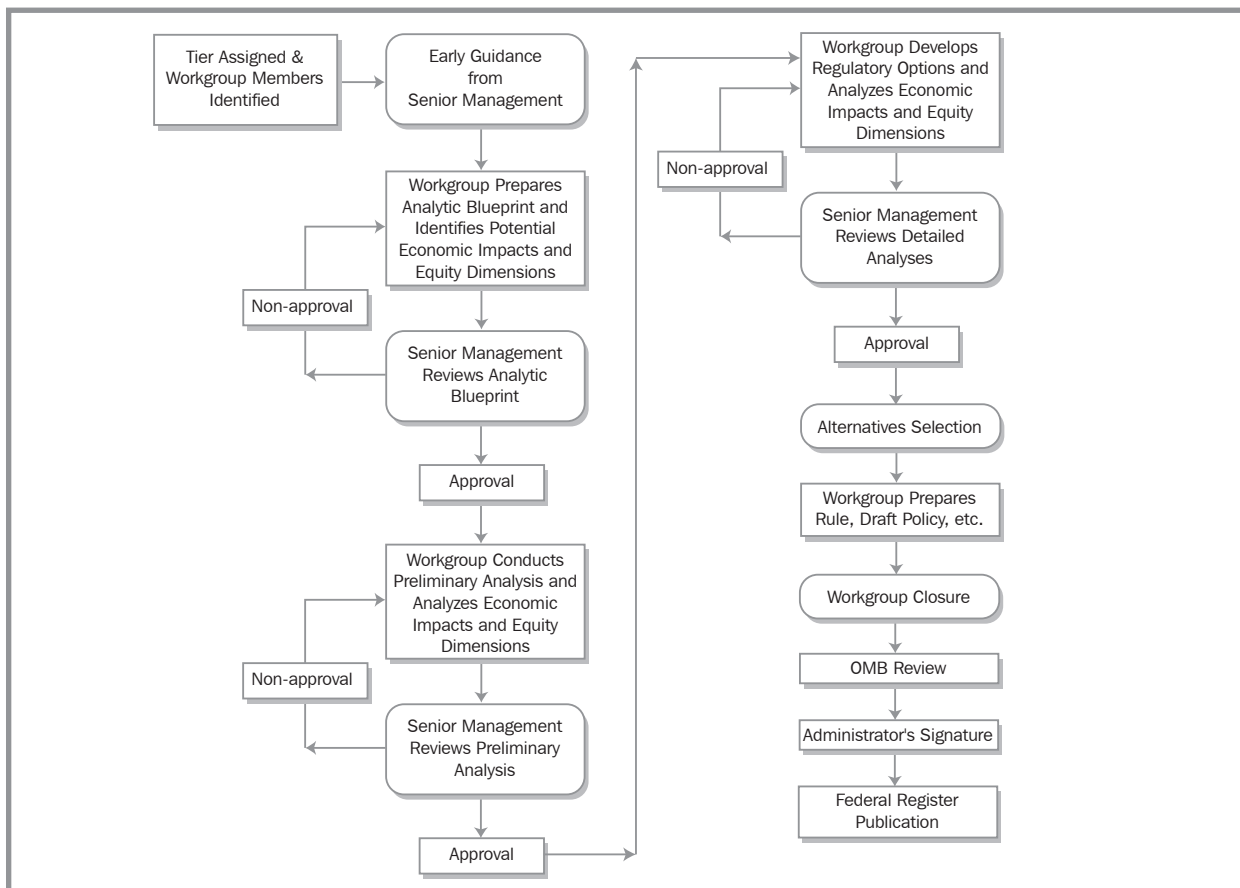
re-evaluations of a regulation during the development process. This process includes three key tasks.

- Identify potentially important economic impacts and equity dimensions for senior management** to help determine which may be of concern. This should be done as part of the analytical blueprint process. The analytic blueprint provides an opportunity for early identification of important issues in order to enhance the quality of information provided to senior management to assist in decisions for a particular regulation or policy. While required for Tier 1 and 2 regulations, analytic blueprints are encouraged for Tier 3 regulations as well.
- Conduct a preliminary analysis of these economic impacts and equity dimensions** once senior management has approved the analytic blueprint. This is the second point where the iterative process affects a regulation's development. Analysts should

share the results with senior management who should then determine whether to proceed to a more detailed analysis or to revisit the preliminary analysis. Senior management may even decide to alter the overall regulatory approach being considered which could require revising the BCA as well as the analytic blueprint. The potential need to revise the analytic blueprint is consistent with the idea that it is a living document.<sup>6</sup>

- Develop options and prepare detailed economic analysis** after the preliminary analysis is complete. Data and information developed as part of this effort will provide input for conducting distributional analyses for the impacts and dimensions identified earlier. Here is the third point where the iterative process comes into play. It is recommended that input from senior management be sought once more before proceeding to closure. Additional economic impact and

**Exhibit 9-1** Flow Chart: A Process for Economic Impact Analyses and Equity Assessments



<sup>6</sup> For a detailed discussion of the concept of the analytic blueprint as a living document and more information on the "Tiering" of rules, see pp. 12-13 *Guidance for Analytic Blueprints* (EPA, 1994) and see section 5, p. 31 *Regulation Development in EPA* (EPA, 1997).

equity analysis may be warranted for a variety of reasons including new insights gathered from the regulatory review process.

## 9.2 Economic Impact Analysis

### 9.2.1 Introduction to Economic Impact Analysis

As discussed in Chapter 5 above, a BCA calculates the total social benefits and total social costs associated with an environmental policy and measures the change in overall economic efficiency. As part of the effort to inform policy makers, it is important to not only understand the change in economic efficiency, but to understand the distribution of negative and positive impacts associated with this change. An EIA contributes to this understanding. It identifies losers and gainers from a policy and estimates the magnitude of their gains and losses. An EIA does this by studying the economic changes occurring across broadly defined economic sectors of society such as industry, government, not-for-profit organizations, and consumers. In addition to these broad categories, an EIA will examine more narrowly defined sectors within these broad categories such as the solid waste industry or an individual solid waste company. Traditionally, EIAs have focused on the losers and the negative impacts of an environmental regulation, although at least two general directives (see Exhibit 9-2) suggest that the positive impacts be examined as well.

EIAs measure impacts in different ways, from direct impacts on private business—including individual plants, whole firms, and industrial sectors—to indirect impacts on customers and suppliers. EIAs also measure direct and indirect impacts on governments and not-for-profit entities such as schools or hospitals. Impacts include changes in profitability, employment, prices paid by consumers, government revenues or expenditures, trade balances, and other changes of interest to policy makers.

Ensuring consistency of the EIA with the BCA for a particular regulation is essential. For consistency, an EIA must be conducted within the analytical bounds of its correspon-

ding BCA. To the extent possible, the EIA should adopt the same set of assumptions used by the BCA. Adjustments or additions to these assumptions or to the overall modeling framework used for the BCA should be made only when they help bridge the difference between social and private perspectives, such as the difference between the social cost of a regulation and private compliance costs.

EPA's programs and regulations vary greatly in the types of parties affected and the nature of economic impacts that may be important. The data available for analysis vary widely as well. Thus, while specific methods for estimating impacts are reviewed, it is expected that every EIA will focus on the particular issues associated with the set of regulations under review. The general methods outlined here should be adapted to fit the needs of a particular analysis.

The remainder of this section is divided into twelve subsections. The first outlines the statutes and policies that direct EPA, and other government agencies, to study the distribution of positive and negative impacts. The second gives a broad overview of models for estimating social costs and how such models might relate to distributional analyses. In the third section, we begin explaining how to assess economic impacts. We begin with the first step, which is to calculate compliance costs. The next steps—how to screen for significant impacts and how to profile affected entities—are outlined in the fourth and fifth sections. Finally, beginning in Section 9.2.7, we review methods for estimating specific impacts, in the following order: impacts on prices; impacts on production and employment; impacts on profitability and plant closures; impacts on related industries and consumers; aggregate impacts on innovation, productivity, and economic growth; impacts on industry competitiveness; and impacts on governments and not-for-profit organizations.

### 9.2.2 Statutes and Policies Requiring Examination of Economic Impacts

There are at least two general administrative laws or orders that direct analysts to examine economic impacts; each is reviewed below. Some parts of environmental statutes also require consideration of economic impacts. Relevant quotations from a selection of these are presented.



### 9.2.2.1 General Administrative Laws or Orders

At least one statute—the Unfunded Mandates Reform Act of 1995 (UMRA)—and one executive order—EO 12866, "Regulatory Planning and Review"—require agencies to analyze various economic impacts of regulatory actions.<sup>7</sup> These directives require analysts to report on economic information that does not directly concern the net benefits tests for efficiency in a BCA. The first calls for analysts to examine the distribution of benefits and costs across different sectors of the economy. The second directs that certain outcomes be examined, such as changes in unemployment rates. For each policy, Exhibit 9-2 gives the dimensions for which impacts are to be analyzed and the corresponding analytical requirements. A discussion of these requirements follows the table.

As outlined by Exhibit 9-2, UMRA requires analysts to examine the costs, benefits, and budgetary effects of regulatory actions as experienced by state, local, and tribal governments; regions; urban or rural or other types of communities; or particular segments of the private sector. For the national economy, UMRA suggests many impacts that must be examined, including effects on productivity, economic growth, full employment, creation of jobs, and international competitiveness. These requirements apply only to rules that include federal mandates "which may result in the expenditure by state, local, and tribal governments, in the aggregate, or by the private sector, of \$100 million or more in any one year."<sup>8</sup>

Exhibit 9-2 also briefly summarizes relevant parts of guidance from the Office of Management and Budget for EO 12866<sup>9</sup> (OMB, 1996 or *Best Practices*) and *Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements*<sup>10</sup> (OMB, 2000 or *OMB Guidelines*). The *Best Practices* suggests that analysts examine the distribution of impacts across various sectors of the economy: "Information on distributional impacts related to the (regulatory) alternatives should accompany the analysis of aggregate benefits and costs."<sup>11</sup> In the *OMB Guidelines*, the focus for a distributional analysis is placed on those sectors that are likely to feel substantial impacts: "If these distributive effects are important, you should describe the effects of various regulatory alternatives quantitatively to the extent possible, including their magnitude, likelihood, and incidence of effects on particular groups."<sup>12</sup> The *Best Practices* also states, "The term 'distributional effects' refers to the description of the net effects of a regulatory alternative across the population and economy, divided up in various ways . . ."<sup>13</sup> This clearly suggests that both positive and negative impacts are relevant.

OMB cautions analysts conducting distributional analyses to recognize that transfer payments will become relevant, to avoid double-counting even when mixing monetized and physical effects, and to describe distributional effects without judging their fairness.

"Since generally accepted principles do not exist for determining when one distribution of net benefits is more equitable than another, you should describe distributional effects without

<sup>7</sup> EO 13132, *Federalism* which took effect on November 2, 1999, and EO 13084, *Consultation and Coordination With Indian Tribal Governments* which took effect on August 12, 1998, both support the objectives of UMRA.

<sup>8</sup> UMRA § 202.

<sup>9</sup> U.S. Office of Management and Budget's *Economic Analysis of Federal Regulations Under Executive Order 12866*, January 11, 1996. This "Best Practices" document can be found at the U.S. White House, Office of Management and Budget website: <http://www.whitehouse.gov/OMB/inforeg/riaguide.html> under the section titled "Regulatory Policy" (accessed 8/28/2000).

<sup>10</sup> U.S. Office of Management and Budget's M-00-08 *Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements*, March 22, 2000. The *OMB Guidelines* serves to implement Section 638(c) of the 1999 Omnibus Consolidated and Emergency Supplemental Appropriations Act and Section 628(c) of the Fiscal Year 2000 Treasury and General Government Appropriations Act. They require OMB to issue guidelines to help agencies estimate the benefits and costs of Federal regulations and paperwork and summarize the results of the associated analysis. The *OMB Guidelines* can be found at the U.S. White House, Office of Management and Budget website: <http://www.whitehouse.gov/OMB/memoranda/index.html> under the section titled "Selected Memorandum to Heads of Federal Departments and Agencies" (accessed 8/28/2000).

<sup>11</sup> *Best Practices*, p. 10.

<sup>12</sup> *OMB Guidelines*, p. 16.

<sup>13</sup> *Best Practices*, p.23.

**Exhibit 9-2** Economic Impacts Required by General Administrative Law or Order<sup>14,15</sup>

General Administrative Law or Order	Dimension	Analytical Requirements
UMRA	State, local, and tribal governments; the private sector	Qualitative and quantitative assessment of anticipated costs and benefits of the federal mandate, including costs and benefits to state, local, and tribal governments or the private sector.
	Geographic location	Estimates of any disproportionate budgetary effects of the Federal mandate upon any particular regions of the nation or particular state, local, or tribal governments; urban or rural or other types of communities; or particular segments of the private sector.
	National economy	Estimates of the effect of the federal mandate on the national economy, such as the effect on productivity, economic growth, full employment, creation of productive jobs, and international competitiveness of U.S. goods and services.
OMB Guidance for EO 12866 and Accounting Statements	Population and economy, divided up in various ways (e.g., income groups, race, sex, industrial sector)	An economic analysis (EA) should describe the net effects of a regulatory alternative across the population and economy. "Irrespective of the presentation of monetized benefits and costs, the EA should present available physical or other quantitative measure of the effects of the alternative actions to help decision makers understand the full effects of alternative actions." <sup>16</sup>

judging their fairness. You should describe these effects broadly, focusing on large groups with small effects per capita, as well as on small groups experiencing large effects per capita. You should also note any equity issues not related to the distribution of policy effects if they are important, and describe them quantitatively to the extent you can."<sup>17</sup>

### 9.2.3 Models for Assessing Economic Impacts

As noted above, the analytic methods used for a distributional analysis of a particular regulation should be consistent with those used for the corresponding BCA. This section returns to the four methods for estimating social costs covered in Chapter 8, adding more insights on their application to distributional impacts.<sup>18</sup> The most sophisticated method—computable general equilibrium (CGE)—is

<sup>14</sup> Exhibit 9-2 does not include a discussion of The Regulatory Flexibility Act of 1980 (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), as they are discussed below in Section 9.3, "Equity Assessment."

<sup>15</sup> The Office of Regulatory Management and Information's Rule and Policy Information Development System (RAPIDS) <http://intranet.epa.gov/rapids> (accessed 8/18/2000, internal EPA document) is a resource for EPA personnel who wish to read relevant statutes, executive orders or Agency policy documents in their entirety or to acquire copies.

<sup>16</sup> *Best Practices*, p. 23.

<sup>17</sup> *OMB Guidelines*, p. 16.

<sup>18</sup> For additional information regarding the four methods for estimating social costs see Section 3 of Chapter 8.

treated first and moves to less complex approaches, concluding with direct compliance costs.

### **9.2.3.1 Computable General Equilibrium Models**

A CGE framework can be used to describe the effect of a particular policy on overall measures of economic performance, such as aggregate output, welfare, and the level of employment. CGE models are particularly effective in assessing static resource allocation and welfare distribution effects. These include the allocation of resources across sectors (e.g., employment by sector), the distribution of sectoral output, the distribution of income among factors, and the distribution of welfare across different consumer groups, whole regions, and countries. By construction, the basic capacity to describe and evaluate these sorts of distributional impacts exists to some extent within every CGE model. More detailed impacts, or impacts of a particular kind, will require a more complex and/or tailored model formulation (and the data to support it).

The simplest CGE models generally include a single, representative consumer, a few production sectors, and a government sector, all within a single-country, static framework. Complexities may be specified for the model in a variety of ways. Consumers may be divided into different groups along the lines of income, occupation, or other socioeconomic criteria. Producers may be disaggregated into dozens, or even hundreds, of sectors, each producing a unique commodity. The government, in addition to implementing a variety of taxes and other policy instruments, may produce public sector outputs, provide a public good, or run a deficit. CGE models may be international in scope, consisting of many countries or regions linked by international flows of goods and capital. The behavioral equations that characterize economic decisions may take on simple or complex functional forms. The model may be solved dynamically over a long time horizon, incorporating inter-temporal decision-making on the part of consumers or firms. This will have implications for the treatment of savings, investment, and the long-term profile of consumption and capital accumulation.

### **9.2.3.2 Multi-Market Models**

CGE modeling captures multiple effects of a given policy change throughout an entire economy and can provide comprehensive distributional information across economic sectors (e.g., employment by sector). A CGE model may not be feasible or practical to use as a consequence of limited data and resources or when the scope of expected significant market interactions is limited to a subset of economic sectors. In such instances a multi-market analysis can be adopted as an alternative to a CGE model.<sup>19</sup> Multi-market analysis considers the interactions between a regulated market and other important related markets (outputs and inputs), requiring estimates of elasticities of demand and supply for these markets as well as cross-price-elasticities also found in CGE models. Multi-market models are best used when potential economic impacts and equity effects on related markets might be considerable, but more complete modeling using a CGE framework would offer a negligible improvement on the quality of information produced.

### **9.2.3.3 Partial Equilibrium Models**

Unlike multi-market and CGE models, a partial equilibrium framework limits a distributional analysis to considering impacts on entities associated with the directly affected output markets only. Distributional consequences for other output markets and input markets are not estimated using these models. As discussed in Chapter 8, a partial equilibrium framework requires knowledge of demand and supply functions for directly affected markets only.

If information is required for distributional outcomes that this method is not designed to address, it may be possible to adopt further assumptions and acquire additional data to approximate distributional consequences of concern. These new assumptions should be consistent with those used for the corresponding BCA.

### **9.2.3.4 Direct Costs of Compliance**

A relatively unsophisticated distributional analysis examines the direct costs of compliance paid by regulated entities. Often these analyses simply assume that the quantity of output and state of technology in the regulated industry

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<sup>19</sup> For a detailed discussion of multi-market analysis see Chapter 9 in Just et al. (1982).



remain unchanged after the regulation becomes effective. An analyst could disaggregate compliance costs for regulated industries or sectors or geographic regions.

### 9.2.4 Calculating Compliance Costs

The first step in assessing impacts is to estimate and verify the costs of compliance. This step is necessary regardless of whether the entities affected are for-profit, governmental, communities, or not-for-profit entities. Compliance costs include annual costs (such as operation and maintenance of pollution control equipment or increased production cost) and any capital costs. In certain situations it may be appropriate to estimate the costs year by year, especially in cases where the costs are expected to vary over time. Depending on the nature of the analysis, these costs may be annualized, so that they can be compared to average annual income and other measures of financial strength.<sup>20</sup>

Verifying the compliance cost estimates entails two steps. First, the full range of responses to the rule needs to be identified, including pollution prevention alternatives. Second, the costs for each response need to be checked to determine if all elements are included and the costs are consistent with a given base year. Either a general inflation factor, such as the Gross Domestic Product (GDP) implicit price deflator, or various cost indices specific to the type of project can be used.<sup>21</sup> The base year and indexing procedure should be stated clearly. Implicit costs that do not represent direct outlays may be important. The cost estimates should include such elements as production lost during installation, training of operators, and education of users and citizens (for example, for programs involving recycling of household wastes). The cost of acquiring a permit is not so much the permit fee as it is the lost opportunities during the approval process.

Likewise, the cost of having a car's emissions inspected is not so much the fee as it is the value of registrant's time.

EIAs and BCAs use different concepts of cost. BCA relies on estimates of the social costs of a regulation. EIA costs are the private costs needed to predict compliance responses and assess economic impacts in several ways. Social costs represent costs to society as a whole, whereas private costs reflect costs as they are experienced by the affected parties. Often, the same basic engineering compliance cost estimates are used as the basis for developing both social and private cost estimates and are adjusted to provide the required costs.

There are several issues analysts must consider when estimating the private costs of environmental policies. These include:

- ✦ **Before- versus after-tax costs:** The costs of complying with regulations are generally deductible as expenses for income tax purposes. The effective burden of compliance costs is reduced for taxable entities because they can reduce their taxable income by the amount of the compliance costs. The effect of a regulation on profits is therefore measured by after-tax compliance costs. Different components of engineering cost estimates should be adjusted based on their specific impact on taxes, to provide the inputs needed for an EIA.<sup>22</sup> Operating costs are generally fully deductible as expenses in the year incurred. Capital investments associated with compliance must generally be depreciated over some number of years.<sup>23</sup>

In most cases, communities, not-for-profits, and governments do not benefit from reduced income taxes that can offset compliance costs. Therefore, adjustments to cost estimates, annualization formulas, and cost of capital calculations required to calculate after-tax costs should not be used in analyses of impacts on governments and not-for-profits.

<sup>20</sup> As previously discussed, the discount rate used should be specific to the task. The rate used to annualize costs is dependent on the entity's cost of capital and, thus, the sources of financing used as well as the credit rating of the borrower. When calculating the present value of a stream of future social costs (or benefits), the social rate of time preference is the appropriate discount rate. See Chapter 6 for a complete discussion of discount rates.

<sup>21</sup> The GDP implicit price deflator is reported by the U.S. Department of Commerce, Bureau of Economic Analysis in its *Survey of Current Business*. The annual *Economic Report of the President*, Office of the President, is another convenient source for the GDP deflator time series.

<sup>22</sup> Engineering costs can often be used in their before-tax form to calculate social costs. Adjustments may be required, however, if the available compliance cost estimates do not reflect the social cost of the resources used.

- **Transfers:** Social costs reflect the real value of economic resources—labor, equipment, supplies—used to achieve compliance. However, some types of compliance costs incurred by the regulated parties may represent transfers among parties. Transfers, such as payments for insurance or payments for marketable permits do not reflect use of economic resources. Private cost estimates used in the EIA should include such transfers, but these transfers should be excluded when calculating social costs for the benefit-cost analysis.
- **Discounting:** Compliance costs often vary over time, perhaps requiring initial capital investments and then annual operating costs. To estimate impacts, the stream of costs is generally discounted to provide a Present Value of Costs (PVC) that reflects the time value of money.<sup>24</sup> In contrast to social costs and benefits, which are discounted using a social discount rate, private costs are discounted using a rate that reflects the regulated entity's cost of capital.<sup>25</sup> The private discount rate used will generally exceed the social discount rate by an amount that reflects the risk associated with the regulated entity in question.<sup>26</sup> For firms, their cost of capital may also be determined by their ability to deduct debt from their tax liability.
- **Annualized costs:** Annualizing costs involves calculating the annualized equivalent of the stream of cash flows associated with compliance. It provides a single annual cost number that reflects the various components of compliance costs incurred over some selected time period (e.g., 15 or 30 years).<sup>27</sup> The annual value is the amount that, if incurred each year over the selected time period, would have the same pres-

ent value as the actual stream of compliance expenditures. Annualized costs are therefore a convenient compliance cost metric that can be compared with annual revenues and profits. It is important to remember that using annualized costs masks the timing of actual compliance outlays. For some purposes, using the underlying compliance costs may be more appropriate. For example, when assessing the availability of financing for capital investments, it is important to consider the actual timing of capital outlays.

- **Fixed versus variable costs:** Some types of compliance costs vary with the size of the regulated enterprise (e.g., in proportion to production). Other components of cost may be fixed with respect to production, such as the costs involved in reading and understanding regulatory requirements.<sup>28</sup> Requirements that impose high fixed costs will impose a higher cost per unit of production on smaller firms than on larger firms. It is important that the effects of any "economies of scale" be reflected in the compliance costs used to analyze economic impacts.<sup>29</sup> Using the same average annualized cost per unit of production may mask the importance of such fixed costs and understate impacts on small entities.

## 9.2.5 Screening for Potentially Significant Impacts

A comprehensive analysis of all aspects of economic impacts associated with a rule can be highly resource intensive. Detailed and explicit analysis of impacts may not be justified in all cases, if a preliminary analysis

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<sup>23</sup> Current federal and state income tax rates can be obtained from the Federation of Tax Administrators in Washington, D.C. FTA, *State Tax Rates & Structure*, available from [http://www.taxadmin.org/fta/rate/tax\\_stru.html](http://www.taxadmin.org/fta/rate/tax_stru.html) (accessed 8/28/2000).

<sup>24</sup> This Present Value of Costs may then be annualized to provide an annual equivalent of the uneven compliance cost stream, as described below.

<sup>25</sup> While the discount rate differs, the formula used to discount private costs is the same as used for social costs. See Chapter 6.

<sup>26</sup> Risk adjusted rates for different industries can be obtained from the Ibbotsen Associates *Handbook* or for specific firms from the Value Line *Investment Survey*.

<sup>27</sup> Annualized costs are also discussed in Chapter 6 on social discounting. The formula for calculating annualized costs is presented in Section 6.2.

<sup>28</sup> Note that fixed versus variable costs is not the same thing as capital versus operating costs. Capital costs may be fixed or variable with respect to the size of the operation, as may operating costs. This distinction between capital and operating costs is important for calculating after-tax costs.

<sup>29</sup> Economies of scale characterize costs that decline on a per unit basis as the scale of an operation increases.

suggests that economic impacts will be minor. Screening analyses provide a way to focus attention and analytic resources on the areas where economic impacts are most likely to be significant. These screening analyses generally use simplifying assumptions about market outcomes (e.g., the alternative no-cost-pass-through and full-cost-pass-through assumptions) or simple tests of financial impacts (e.g., a ratio of compliance costs to sales or to profits) to screen for potentially significant impacts.

It is important to keep in mind the limitations in screening analyses when interpreting and presenting their results. They typically identify cases of potentially significant impacts. More detailed investigation beyond the screening analysis is usually needed to reach a reliable conclusion about the likelihood of significant impacts.

In addition, screening analysis criteria should be chosen to balance the risk of identifying "false positives" versus "false negatives." That is to say, using too low a threshold will do little to distinguish true differences in potential impacts (false positives), while using too high a threshold runs the risk of missing some sectors that may be significantly affected (false negatives).

Finally, when screening analyses are based on alternative assumptions about market responses, it is important to note in presenting the results that they represent extreme assumptions that in practice cannot occur simultaneously. For example, worst case impacts on profits cannot occur simultaneously with worst case impacts on prices.<sup>30</sup>

## 9.2.6 Profile of Affected Entities

### 9.2.6.1 Compiling an Industry Profile and Projected Baseline

The impact of a regulation on business profitability and other economic outcomes depends on the magnitude of the compliance costs associated with the rule, on the distribution of compliance costs across firms, and on the economic and financial characteristics of the affected firms and industries.<sup>31</sup> A substantial portion of an EIA involves

characterizing the affected firms and industries as a basis for evaluating economic impacts. The following are important inputs to an EIA:

- ☛ **Standard Industrial Classification (SIC) and North American Industrial Classification System (NAICS) industry codes:** These definitions can be developed by working with engineering analysts, the EPA project team and workgroups, industry roundtables and industry specialists at the Department of Commerce. The SIC codes and their definitions appear in the *Standard Industrial Classification Manual: 1987*, available from the Government Printing Office (OMB, 1987). This industry classification system is being replaced by the North American Industry Classification System (NAICS), which will be reflected in the forthcoming data series (OMB, 1998). A regulated entity that is a small part of a larger industry may require fractional multipliers in order to estimate the regulated category's share of the larger industry.
- ☛ **Compilation of summary statistics:** Data regarding total employment, revenue, number of establishments, and number of firms are available from the economic censuses and interim updates (e.g., Department of Commerce *Annual Survey of Manufactures*, for non-manufacturers, the Department of Commerce *County Business Patterns*, and *Agricultural Statistics* from the Department of Agriculture). The profile should also define the industry and its products, describe major production technologies, and discuss important business and regulatory trends.
- ☛ **The level and distribution of compliance costs:** Estimates of compliance costs reflect predicted responses to the rule and are often developed based on engineering estimates. It is important to know how costs are distributed among plants and firms in the same industry, since firms that are not affected by the rule or that incur lower compliance costs than their competitors may gain competitive advantage as a result of the rule. If only a few producers in an industry incur added costs, they are less likely to be

<sup>30</sup> A more detailed treatment of the considerations in the conduct of sensitivity analysis is presented in Chapter 5.

<sup>31</sup> Generally, analysts should presume a perfectly competitive market structure. The purpose of developing an industry profile is to confirm this presumption or discover evidence to the contrary.

able to raise their prices to recover costs. In contrast, a rule that affects all industry participants equally is more likely to result in price increases and less likely to change the competitive structure of the industry. In addition, some rules impose different requirements and costs on new versus existing sources. Such rules may affect industry competition, growth, and innovation by raising barriers to new entry.

- ☛ **Baseline industry growth and financial condition:** Industries and firms that are relatively profitable in the baseline will be better able to absorb new compliance costs without experiencing financial distress. Industries that are enjoying strong growth may be better able to recover increased costs through price increases than they would have been had there been no demand growth. Section 9.2.9 provides suggestions for using specific ratios to assess the significance of economic impacts on a firm's financial condition.
- ☛ **Baseline industry structure:** Industry-level impacts depend on the competitive structure and organization of the industry and the industry's relationship to other economic entities. In addition, the number and size distribution of firms and facilities and the degree of vertical integration are important aspects of industry structure that affect the economic impacts of regulations.
- ☛ **Characteristics of supply and demand:** Assessing the likelihood of changes in production and prices requires information on the characteristics of supply and demand in the affected industries. The relevant characteristics are reflected in price elasticities of supply and demand, which, if available, allow direct quantitative analysis of changes in prices and production. Often, reliable estimates of elasticities are not available, and the analysis of industry-level adjustments must rely on simplifying assumptions and qualitative assessments.

The industry profile provides a general understanding of an industry or industries affected by a regulatory action and characterizes their ability to absorb compliance costs.

This information provides the basis for assumptions central to the impact analysis, as well as information needed for some of the special analyses such as Regulatory Flexibility Analyses.

### 9.2.6.2 Profile of Other Affected Entities

Careful consideration needs to be given to the question of whether or not a particular rule will affect government entities,<sup>32</sup> not-for-profit organizations,<sup>33</sup> or households. For example, air pollution regulations that apply to power plants may affect municipally owned electric companies; air regulations that apply to vehicles may affect municipal bus companies, as well as other municipal vehicles such as police cars and public works vehicles; effluent guidelines for machinery repairing activities may affect municipal garages. Thus, the first step is to identify all the government entities that may be affected.

Relevant characteristics of government entities may include:

- ☛ the community's size (number of people living in the community);
- ☛ household income levels (both median and some measure of the income range);
- ☛ number of children (since education is frequently the major service provided by local governments);
- ☛ number of elderly residents (who frequently have fixed incomes);
- ☛ unemployment rate;
- ☛ revenue amounts by source; and
- ☛ the credit or bond rating of the community.

If the property tax is the major revenue source, then the assessed value of property in the community and the percentage of this assessed value represented by residential versus commercial and industrial property should be determined. If the government entity serves multiple communities, such as a regional water or sewer authority,

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<sup>32</sup> Government entities that may be affected by a program include states, cities, counties, towns, townships, water authorities, villages, Indian Tribes, special districts, military bases, etc.

<sup>33</sup> Examples of not-for-profits include non-profit hospitals, colleges, universities, and research institutions.

then this information needs to be collected for all the communities covered by the entity.

Data on community size, income, number of children and elderly, and unemployment levels are available from the U.S. Bureau of Census. Data on property values, amount of revenue collected from each revenue source, and credit rating will need to be collected directly from the community or state finance agencies. If the regulated activity is provided by an "Enterprise Fund" then revenue and cost information will need to be obtained directly from the fund.<sup>34</sup> Depending on the number of communities affected and the level of detail warranted, the analysis may rely on generally available data only. In other cases, a survey of affected communities may be necessary. However, in cases where a survey is needed, there will be a need to comply with the requirements of the Paperwork Reduction Act (PRA).

Relevant characteristics of not-for-profit entities include their size, the goods or services they provide, their operating costs, and the amount and sources of their revenue. If the entity is raising its revenues through user fees or in other ways charging a price for its goods/services (such as university tuition), then the income levels of its clientele are relevant. If the entity relies on contributions, then it would be helpful to know the financial and demographic characteristics of its contributors. If it relies on government funding (such as Medicaid) then possible future changes in these programs should be identified.

Relevant features of households are standard socioeconomic and demographic characteristics. These characteristics include, for example, their income level, size, age distribution, education level, and ethnic group.

### 9.2.6.3 Profile Data Sources

Profiles generally draw from at least two types of information: 1) literature from economic journals, dissertations, and industry trade publications, and 2) quantitative data describing the characteristics of the industry. The relevant literature can be useful in characterizing the industry

activities and markets as well as regulations affecting the industry. Identification of relevant literature is most efficiently performed through a computerized search using on-line services such as Dialog, BRS/Search Services, or Dow Jones News/Retrieval. These on-line services contain more than 800 databases covering business, economic, and scientific topic areas. Exhibit 9-3 lists some commonly used sources.

The industry profile may also identify those situations where sufficient data for an EIA cannot be obtained through published and commercial sources. These situations arise particularly when the affected industry is one of many product lines or other activities of identified facilities; in addition, for some industries, identification of the appropriate SIC or NAICS code for all the firms or facilities included in the industry may be difficult if the industry can be categorized in a variety of ways. In these cases, and particularly if facility-level data are required to estimate economic impacts, a survey of either a statistical sample or a census of affected facilities may be required to provide sufficient data for analysis.

### 9.2.7 Impacts on Prices

Predicting impacts on prices is the basis for determining how the burden of compliance costs will be shared between the directly-affected firms and their customers and suppliers in a typical market. At one extreme, regulated firms may not be able to raise their prices at all and they will bear the entire burden of the added costs in the form of reduced profits. Reduced profits may result from reduced earnings on continuing production, lost profits on products or services that are no longer produced, or some combination of the two. At another extreme, firms may be able to raise prices enough to recover costs fully. In this case, there will be no impacts on the profitability of the directly-affected firms but their customers will bear the burden of increased prices. Another possible outcome is that suppliers to the directly-affected firms will bear some of the burden in lost earnings if the regulation results in a decline in demand for particular products.<sup>35</sup>

<sup>34</sup> Public services that are funded entirely by fees charged to users are referred to as "enterprises" and their revenues are referred to as "Enterprise Funds."

<sup>35</sup> Regulations limiting sulfur emissions may result in reduced demand for high-sulfur coal, for example, which will result in a fall in the price of such coal and lost profits for its producers.



**Exhibit 9-3** Frequently Used Profile Sources

Source	Data
Trade Publications	Market and technological trends, sales, location, regulatory events, ownership changes.
U.S. Department of Commerce, Economic Censuses <sup>36</sup>	Total revenue by 4-SIC (generally); payroll; quantity and value of products shipped and materials consumed; value added; capital expenditures, assets, inventories, employment, and geographic area, distribution by size, kind of business.
U.S. Department of Commerce, <i>U.S. Industry &amp; Trade Outlook</i>	Description of industry, trends, international competitiveness, regulatory events.
United Nations, <i>International Trade Statistics Yearbook</i>	Foreign trade volumes for selected commodities, major trading partners
Robert Morris Associates, <i>Annual Statement Studies</i>	Income statement and balance sheet summaries, profitability, debt burden and other financial ratios, all expressed in quartiles and available for recent years. Based on loan applicants only.
Dun & Bradstreet, Information Services	Type of establishment, SIC code, address, facility and parent firm revenues and employment.
Standard & Poor's	Publicly held firms, at 4-digit SIC level. Prices, dividends, and earnings, line-of-business and geographic segment information, S&P's ratings. Quarterly History (10 years): income statement, ratio, cash flow, and balance sheet analyses and trends.
Standard & Poor's, Research Reports	Industry profiles, competitors for selected firms. Firm Level Data: (publicly traded companies) company background, stock prices, major competitors, description of business organization, summary financial data.
Securities and Exchange Commission 10k Filings, EDGAR System Database	Income statement and balance sheet, working capital, cost of capital, employment, outlook, regulatory history, foreign competition, lines of business, ownership and subsidiaries, mergers and acquisitions.
Value Line <i>Industry Reports</i>	Industry overviews, company descriptions and outlook, performance measures.
FINDS database	Facility SIC, latitude and longitude, zip code, size, ownership structure.

In general, the likelihood that price increases will occur can be evaluated by considering whether competitive conditions will allow the affected facilities to pass on their costs. The methods used to conduct the analysis of the directly-affected markets will depend on the availability of appropriate estimates of supply and demand elasticities. In many cases, reliable estimates of elasticities will not be available.<sup>37</sup> In these cases, the analyst will need to rely on a more basic investigation of the characteristics of supply and demand in the affected market to reach a judgment about the likelihood of full or partial pass-through of costs via price increases.

### 9.2.8 Impacts on Production and Employment

Regulations may raise the cost of doing business sufficiently to make some or all production unprofitable or may reduce the quantity demanded as producers raise their prices to maintain profitability. The associated reductions in output may result from lower operating rates at existing plants, closure of some plants, or reduced future growth in production relative to what would have occurred in the baseline. Losses in employment are typically associated with reductions in output.

<sup>36</sup> Economic Censuses include: *Census of Manufacturers, Census of Construction Industries, Census of Mineral Industries, Census of Retail Trade, Census of Service Industries, Census of Transportation, and Census of Wholesale Trade.*

<sup>37</sup> See Chapter 8 for a more complete discussion of costs and elasticity.

EPA has used a variety of methods to assess reductions in production and employment. In some cases, demand and supply elasticities are used directly to calculate changes in output and prices that would result from a shift upward in the supply curve associated with compliance costs. Often estimates of the shape of the supply curve are not available and assumptions are made about its shape in the region of interest to allow use of demand elasticity estimates to predict output and price adjustments.

In other cases, analysts may assess the impacts of rules on the profitability of specific firms or industry segments, and identify potential line or plant closures based on a financial analysis.<sup>38</sup> If partial or full plant closures are projected, it is important to consider whether the production lost at the affected facilities will be shifted to other existing plants or to new sources or will simply no longer be produced. If there is excess capacity in the industry in the baseline and some plants with excess capacity can operate profitably in compliance with the rule, they may expand production to meet the demand for products no longer produced at plants that can no longer operate profitably.<sup>39</sup>

Even if total production does not decline but is simply shifted from higher-cost plants to more efficient competitors and even if total employment does not change, localized changes in employment may interest policy makers. This is especially the case for rules that may have a strong regional impact. For example, UMRA § 202 requires such an analysis as an element of the UMRA cost analysis. Data on the ratio of production or sales to employment can help predict the number of jobs lost as a result of reductions in production. The regional distribution of job losses can be calculated based on plant locations.

## 9.2.9 Impacts on Profitability and Plant Closures

The availability of financial information used to assess profitability varies greatly, depending on the industry in

question and the extent to which EPA is able to collect new information by surveying the affected entities. With limited exceptions, detailed financial information is not generally available for individual plants or for privately-held companies from published sources. Financial data for publicly-held companies may be too aggregated to allow analysis of the specific business practices affected by the rule. In the absence of new data collection by EPA, analysts may need to rely on financial profiles constructed for model plants, or on industry-average data provided by the Census Bureau and other sources.<sup>40</sup> In some cases, financial profiles used in the analysis of a previous rule-making might be adapted and updated to analyze the impacts of the rule in question.

Analysis is conducted by determining how the added costs of compliance will affect the financial strength of the firm. As with predicting price increases, it may be worthwhile to start with a screening analysis based on an extreme assumption about the incidence of costs—in this case, that no costs can be recovered through price increases. This assumption provides a worst case estimate of impacts on profits, potential closures, and employment reductions in the directly-affected market. Where firms in an industry do not appear to experience financial distress under the no-cost-pass-through scenario, more detailed analyses to predict actual market adjustments and price increases are not needed.

The severity of financial impacts to firms from a rule can range from no impact (if all costs are recovered through price increases, for example) to a modest reduction in profits, closure of a production line or plant, to bankruptcy of the firm. Criteria for assessing the degree of financial distress and for predicting when a production line or plant would be shut-down are not clear-cut.<sup>41</sup> If detailed financial profiles can be developed, including revenues, costs, income statements, and balance sheets, a variety of financial tests can be used to assess the likelihood of financial distress or closure. These tests address the following issues:

<sup>38</sup> Analysis of impacts on profitability and plant closures are discussed later in this section.

<sup>39</sup> Some surviving plants could experience increases in production, capacity utilization, and profits even though subjected to regulatory requirements, if their competitors face even greater cost increases.

<sup>40</sup> Sources of financial data are listed in Exhibit 9-3.

<sup>41</sup> This section assumes a perfectly competitive market, which in practice does not always correctly characterize the market structure being analyzed. In these cases, this section should be adapted to the relevant market structure.

- ☛ Do the costs of the regulation result in a negative discounted after-tax cash flow?<sup>42</sup>
- ☛ Does the facility or firm's profitability fall below acceptable levels?
- ☛ Is the facility or firm's ability to finance its operations and pay its obligations jeopardized?

Establishments that fail the first test are potentially at risk for closure.<sup>43</sup>

### **Closure Decisions**

A variety of considerations affect a firm's decision to close a production line or a plant.

- ☛ **The profitability of the plant itself** provides insight into whether the operation will be continued if the plant represents a stand-alone business. This also assumes that it is possible to construct a financial profile of that business.
- ☛ **The role the plant plays in a larger operation** may influence closure decisions. For example, some plants may be part of a vertically or horizontally integrated operation. Such plants might not be viable as a stand-alone operation but may continue to operate based on its contribution to the business line as a whole. In general, however, the analysis should assume that an operation will be closed if compliance with the rule would increase costs to the point where continued operation is no longer profitable.
- ☛ **A negative discounted cash flow** indicates that returns are below the rate of return required to provide the required return on equity and payment of interest. Closures in the short run are likely to occur if earnings do not cover variable costs plus the cost of compliance. Disinvestment and closures will occur over the longer term if earnings are not sufficient to justify investment in plant and equipment as well.

Where closures and reduced production are likely for some but not all plants, firms may face complex decisions about which plants to close. These decisions reflect relative operating costs, age of equipment, tax and other incentives offered by local communities and states to retain business, and logistical considerations. Analyses of plant closures should include caveats stating that the analysis identifies candidates for closure, rather than providing reliable predictions of which specific plants will close. The available information on plant-level operating costs and contributions to earnings is generally too uncertain to allow more precise prediction of plant closures.

### **Financial Distress Short of Closure**

Short of closure, financial distress may occur. Financial distress measures a continuum from mild to severe financial weakness and may result in difficulties obtaining financing and attracting capital.<sup>44</sup> Although in practice, analysts may use a variety of measures of financial distress, use of specific financial ratios has the advantage that it mirrors analyses that investment and lending institutions perform to evaluate industries and businesses. Particular measures include:

- ☛ **Measures of impacts on profitability**, e.g., pre-tax return on assets (net operating income divided by total assets) or return on equity. These measures reflect the profit performance of a firm's capital assets. If returns are reduced to unacceptable levels when compliance costs are included, the firm may have difficulty financing new investment or attracting capital even if it is not earning negative returns.
- ☛ **Measures of impacts on liquidity**, e.g., interest coverage ratio (cash operating income divided by interest expense), times-interest-earned (earnings before interest and taxes divided by interest expense), and the current ratio (current assets divided by current liabilities.) These measures reflect the firm's

<sup>42</sup> If after-tax cash flow is negative under baseline conditions (before considering compliance costs), the facility is a likely candidate for closure even in the absence of additional compliance costs. These closures should not be attributed to the rule, but rather should be classified as baseline closures.

<sup>43</sup> If it is possible to estimate plant liquidation values, another test can be added to assess the likelihood of closure. Plants may be predicted to close if the value of continuing to operate is less than the liquidation value.

<sup>44</sup> Researchers have developed various composite measures that are designed to assess the potential for bankruptcy. The most commonly cited is the ZETA model or "Z-score" developed by Altman et al. (1993). This model uses a weighted average of five variables to predict potential for bankruptcy. The ratios include working capital/total assets, retained earnings/total assets, earnings before interest and taxes (EBIT)/total assets, market value of equity/par value of debt, and sales/total assets. The model includes levels for this composite score that represent clear potential for bankruptcy, low or no potential for bankruptcy, and an uncertain grey area.

ability to meet its financial obligations out of current, on-going operations. If operating cash flow does not comfortably exceed its payment obligations, the firm may have to use resources required for on-going operations to pay contractual obligations and its creditworthiness will suffer.

### 9.2.10 Impacts on Related Industries and Consumers

The economic and financial impacts of regulatory actions propagate to industries and communities that are linked to the regulated industries, resulting in indirect business impacts. These indirect impacts may include employment and income losses, as well as changes in the competitiveness and efficiency of related markets. Compliance-related industries, on the other hand, may yield offsetting gains in employment and income when a regulated industry purchases equipment, facilities or labor in order to comply with a regulation.

Although, in principle, every economic entity can be thought of as having a connection with every other entity, practical considerations usually require an analysis of indirect impacts to be performed or presented for a manageable subset of economic entities that are most strongly linked to the regulated entity. In addition to considering major customers and specialized suppliers of the affected industry, it is also important to consider less obvious but potentially significant links, for example, basic suppliers such as electricity generators.

For this reason, the analysis of linkages should use a framework that thoroughly measures indirect as well as direct linkages. Whatever the approach, the goal of the analysis is to measure—given a certain amount of employment and income change in a regulated market—how employment and income will likely change in related entities.

### 9.2.11 Impacts on Innovation, Productivity, and Economic Growth

While regulatory interventions can theoretically lead to macroeconomic impacts, such as growth and technical efficiency, such impacts may be impossible to measure or observe.<sup>45</sup> In some cases, however, it may be feasible to use macroeconomic models to evaluate the regulatory impact on gross national product (i.e., including trade effects and plant location decisions), factor payments, inflation, and aggregate employment.

For programs or rules that are expected to have significant impacts in a particular region, use of regional models—either general equilibrium or more limited models—may be valuable.

Some macroeconomic regulatory effects are beyond the capacity of the typical regulatory impact analysis to quantify. For example, price changes induced by a regulation can lead to technical inefficiency because firms are not choosing the production techniques that minimize the use of labor and other resources in the long run. Instead, firms will tend to overuse resources whose prices are artificially depressed by the regulation compared to the resources' true cost to society.

Additional anecdotal, theoretical and limited empirical literature are available that point to possible macroeconomic impacts.<sup>46</sup>

### 9.2.12 Impacts on Industry Competitiveness

Regulatory actions that substantially change the structure or conduct of firms can produce indirect impacts by changing the competitiveness of the regulated industry, as well as that of linked industries. An analysis of impacts on competitiveness begins by examining barriers to entry and market concentration and by answering two key questions.

<sup>45</sup> OMB states that macroeconomic effects are likely to be measurable only if the impact of the regulation exceeds 0.25 to 0.5 percent of GDP. See OMB (1995).

<sup>46</sup> See Jaffe et al. (1995) and Gray and Shadbejian (1997).

- ☛ **Will the regulation erect entry barriers that might reduce innovation by impeding new entrants into the market?** High sunk costs associated with capital costs of compliance or compliance determination and familiarization would be an entry barrier attributable to the regulation. Sunk costs are fixed costs that cannot be recovered in liquidation; they can be calculated by subtracting the liquidation value of assets from the acquisition cost of assets facing a new entrant, on an after-tax basis.<sup>47</sup> Lack of access to debt or equity markets to finance fixed costs of entering the market can also present entry barriers, even if none of the fixed costs are sunk costs. However, if financing is available and fixed costs are recoverable in liquidation, the magnitude of fixed costs alone should not present any barrier to entry.
- ☛ **Will the regulation tend to create or enhance market power and reduce the economic efficiency of the market?** The tools presented in the section describing how to create an economic profile also address this question. The most important of these tools include measures of horizontal and vertical integration (i.e., concentration), among both buyers and sellers, in the baseline compared to post-compliance cases. Closely related to concentration, product differentiation may occasionally be either increased or decreased by a regulatory action. For a hypothetical example, certain labeling restrictions might reduce the ability of firms to segment their market by differentiating an essentially uniform product with packaging. In such a hypothetical baseline, firms might enjoy effectively higher concentration ratios and less competition after imposition of a uniform labeling policy.

### 9.2.13 Impacts on Government Entities and Not-for-Profit Organizations

Section 9.2.9 of this chapter discussed ways of measuring the impact of regulations and requirements on private entities, such as firms and manufacturing facilities. When dealing with private entities, the primary focus is on meas-

ures that assess changes in profits. This section describes impact measures for situations where profits and profitability are not relevant—where the regulations affect government entities and/or not-for-profit organizations. Many of the same questions, however, apply:

- ☛ Which entities are affected and what are their characteristics?
- ☛ How much will the regulation increase operating costs?
- ☛ What impact will the regulation have on operating procedures?
- ☛ Will this change the amount and/or quality of the goods and services provided?
- ☛ Can the entity raise the necessary capital and will this change its ability to raise capital for other projects?

The major difference is that instead of ultimately measuring the regulation's impact on profit levels, when government entities are involved, the ultimate measure is the ability of its citizens to pay for the requirements. Likewise, in the case of a not-for-profit, the measure is the reduction in the organization's ability to provide its goods and services.

#### 9.2.13.1 Measures of Government Impacts

EPA regulations can affect governments in at least three ways. They can directly impose requirements on the governmental entity, such as water pollution requirements for publicly-owned wastewater treatment works (POTWs) or air pollution restrictions that affect municipal bus systems or power plants. Second, they can involve costs for governments to implement and enforce regulations imposed on other parties. Finally, they can impose indirect costs on government entities, such as increased unemployment in a community because an EPA regulation has resulted in reduced production (or even closure) at a factory in the community. Keep in mind that some of the impacts may reduce the community's financial resources and thus its ability to pay for the requirements. For example, the

<sup>47</sup> Sunk costs are sometimes referred to as exit barriers. Without exit barriers, there can be no entry barriers, as long as there are no liquidity constraints.



closure of a facility may increase the drain on social services at the same time that tax revenues are declining.

### **Impacts of Programs That Directly Affect Government and Not-for-Profit Entities**

The direct impact measures can be divided into two categories, (1) those that measure the impact itself in terms of the relative size of the costs and the burden they place on citizens and (2) those that measure the economic and financial conditions of the entity that affect its ability to pay for the requirements. For each category, there are several types of measures that can be used either as alternatives, or jointly, to illuminate various aspects of the question.

**Measuring the relative cost and burden of the regulations.** There are three commonly used approaches to measuring the burden of the rule; all involve calculating the annualized costs of complying with the regulation. For *government entities*, the three approaches are:

- ☛ **Annualized compliance costs as a percentage of annual costs for the service included:** This measure tries to define the impact as narrowly as possible and is particularly appropriate when the service or activity to be regulated is provided by a single-purpose entity. For example, if the regulated activity is sewage treatment, the POTW may not be able to draw on general government revenues to cover its increased cost. Thus the appropriate comparison would be to estimate the resulting increase in its costs. Even if the affected entities are not able to draw on general government revenues, it is useful to know how the rule affects the cost of the activity in question. In practice, EPA has often used the condition that if compliance costs are less than one percent of the current annual costs of the activity, it is usually assumed that the compliance costs are placing a small burden on the entity.
- ☛ **Annualized compliance costs as a percentage of annual revenues of the governmental unit:** The second measure corresponds to the commonly used private-sector measure of annualized compliance costs as a percentage of sales. Referred to as the

"Revenue Test," it is one of the measures suggested in *EPA Revised Interim Guidance for EPA Rulewriters: Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act* (EPA, 1999).<sup>48</sup> This differs from the prior measure in that it compares annualized compliance costs to the total revenues of the entity (which usually is multi-purpose in nature). If compliance costs are less than one percent of revenues, then the requirements are usually considered to be affordable. Compliance costs in the range of one to three percent of government revenues are less easily interpreted. If all affected communities fall in this range, then further thought should be given to lowering annual compliance costs, if only a small percentage of communities fall into this range and the rest fall below one percent, then the requirements can probably be considered affordable. Compliance-cost-to-revenue ratios of greater than three percent indicate that the requirements are placing a heavy burden on the community.

- ☛ **Per household (or per capita) annualized compliance costs as a percentage of median household (or per capita) income:** The third measure compares the annualized costs to the ability of residents to pay for the cost increase. Commonly referred to as the "Income Test," it is described in the *Revised Interim Guidance* (EPA, 1999) and EPA's Office of Water *Interim Economic Guidance for Water Quality Standards. Workbook* (EPA, 1995a).<sup>49</sup> Costs can be compared to either median household or median per capita income. In calculating the per household or per person costs, the actual allocation of costs needs to be considered. If the costs are entirely paid through property taxes, and the community is predominately residential, then an average per household cost is probably appropriate. If, however, some or all of the costs are allocated to users (e.g., fares paid by bus riders or fees paid by users for sewer, water, or electricity supplied by municipal utilities), then this needs to be taken into account. In addition, if some of the costs are borne by local firms,

<sup>48</sup> See Section 9.3 for a discussion of the analytic and procedural requirements under SBREFA.

<sup>49</sup> For example, materials presented in the water guidance and other EPA Office of Water analyses are: less than one percent indicates little impact, over two percent indicates a large impact, with the range from one to two percent being a gray area of indeterminate impact.

then that portion of the costs needs to be handled separately.

Two commonly used impact measures for *not-for-profit entities* are: (1) annualized compliance costs as a percentage of annual operating costs and (2) annualized compliance costs as a percentage of total assets. The first is equivalent to the first of the impact measures described for government entities, measuring the percentage increase in costs that would result from the regulation being analyzed. The second is a more severe test, measuring the impacts if the annualized costs were paid for out of the assets of the institution. As presented in EPA's *Revised Interim Guidelines*, the guidelines for annualized compliance costs as a percentage of annual operating costs are: annualized compliance costs less than 1 percent of operating costs indicate that the rule does not represent a burden, annualized compliance costs between one and three percent of operating costs indicates that the rule may impose a burden, and annualized compliance costs that are more than three percent of operating costs indicates that the rule may impose a heavy burden.

**Measuring the economic and financial health of the community:** This second category of impact measures looks at the economic and financial health of the community involved, since these will affect its ability to finance expenditures required by a program or rule. A given cost may place a much heavier burden on a poor community than on a wealthy one of the same size. As with the impact measures described above, there are three categories of economic and financial condition measures:

📌 **Indicators of the community's debt situation:** Debt indicators are important because they measure both the ability of the community to absorb additional debt (to pay for any capital requirements of the rule) and the general financial condition of the community. While several indicators have been developed and used, this section describes two. One measure is the governmental entity's bond rating. Awarded by companies such as Moody's and Standard & Poor's, bond ratings summarize their assessment of a community's

credit capacity and thus reflect the current financial conditions of the governmental body. A second frequently used measure is the ratio of overall net debt (the debt to be repaid by property taxes) to the full market value of taxable property in the community. Overall net debt should include the debt of overlapping districts. For example, a household may be part of a town, a regional school district, and a county sewer and water district, all of which have debt that the household is helping to pay off.<sup>50</sup> See Exhibit 9-4 for interpretations of the values for these measures. Neither of these two debt measures will always be appropriate. Some communities, especially small ones, may not have a bond rating. This does not necessarily mean that they are not creditworthy, it may only mean that they have not had an occasion recently to borrow money in the bond market. Second, if the government entity does not rely on property taxes, as may be the case for a state government or an enterprise district, then the ratio of debt to full market value may not be relevant. Information on debt and assessed property values are available from the financial statement of each community. The state's auditor's office is likely to have this information for all communities within the state.

📌 **Indicators of the economic/financial condition of the households in the community:** There are a wide variety of household economic and financial indicators. Two commonly used ones are: the unemployment rate and median household income. Both measure the financial well-being of households. Unemployment rates are available from the U.S. Bureau of Labor Statistics. Median household income is available from the U.S. Census and some states maintain more up-to-date databases on income levels. Benchmark values for these two measures are presented in Exhibit 9-4.

📌 **Financial management indicators:** This category consists of indicators measuring the general financial health of the community as an entity, as opposed to the general financial health of the residents. Since

<sup>50</sup> An alternative to the net debt as percent of full market value of taxable property is the net debt per capita. Commonly used benchmarks for this measure are:

Net debt per capita: less than \$1,000	=	strong financial condition
Net debt per capita: \$1,000 and \$3,000	=	mid-range or gray area
Net debt per capita: greater than \$3,000	=	weak financial condition

**Exhibit 9-4** Indicators of Economic and Financial Well-Being of Government Entities

<b>Indicator</b>	<b>Weak</b>	<b>Mid-Range</b>	<b>Strong</b>
<b>Bond Rating</b>	Below BBB (S&P) Below Baa (Moody's)	BBB (S&P) Baa (Moody's)	Above BBB (S&P) Above Baa (Moody's)
<b>Overall Net Debt as Percent of Full Market Value of Taxable Property</b>	Above 5%	2% to 5%	Below 2%
<b>Unemployment Rate</b>	More than 1 percentage point above national average	Within 1 percentage point of national average	More than 1 percentage point below national average
<b>Median Household Income</b>	More than 10% below the state median	Within 10% of the state median	More than 10% above the state median
<b>Property Tax as Percent of Full Market Value of Taxable Property</b>	Above 4%	2% to 4%	Below 2%
<b>Property Tax Collection Rate</b>	Less than 94%	94% to 98%	More than 98%

most local communities rely on the property tax as their major source of revenues, two indicators of property tax health are presented here. One measures the burden property taxes are placing on the community in terms of property tax revenues as a percent of full market value of taxable property. The second indicator measures the efficiency with which the community's finances are managed, and indirectly, whether the tax burden may already be excessive, in terms of the property tax collection rate. As the property tax burden on tax payers increases, they are more likely to not pay their taxes or pay them late.

Measuring the financial strength of not-for-profit entities includes assessing (1) how much reserve the entity has, (2) how much debt the entity already has and how its annual debt service compares to its annual revenues, and (3) how the entity's fees or user charges compare with the fees and user charges of similar institutions. Again, this part of the analysis is meant to judge whether the entity is in a strong or weak financial position to absorb additional costs.

#### ***Impacts of Programs That Place Administrative and Enforcement Burdens on Governments***

Many EPA programs require effort on the part of different levels of government for administration and/or enforcement. These costs must be considered to comply with UMRA and to calculate the full social costs of a program or rule. EPA is currently investigating methods for estimating and evaluating the impacts of such costs. Revisions to this guidance document will be made in the future to incorporate the results of that work.

#### ***Impacts of Programs That Indirectly Affect Government Entities***

The previous section describes how to measure the impact of regulations that directly affect the provision of goods or services by government or not-for-profit entities. This section addresses the indirect or induced impacts on government entities. For example, a manufacturing facility may reduce or suspend production in response to an EPA regulation, thus reducing the income levels of its employees. In turn, these reductions will propagate through the economy by means of changes in household expenditures. These induced impacts include the familiar multiplier

effect, in which loss of income in one household results in less spending by that household and, therefore, less income in households and firms associated with goods previously purchased by the first household. Unlike production-based linkages, income-based linkages tend to be more geographically localized, with the strength of the linkage typically decreasing as geographic distance increases (although the number of linked economic entities increases with distance).

Decreased household and business income can affect the government sector by reducing tax revenues and increasing expenditures on income security programs (the automatic stabilizer effect), employment training, food and housing subsidies, and other fiscal line items. Due to wide variation in these programs and in tax structures, estimating public sector impacts for a large number of government jurisdictions can be prohibitively difficult.

On the other hand, compliance expenditures increase income for businesses and employees that provide compliance-related goods and services. These income gains also have a multiplier effect, offsetting some of the induced losses in tax revenue and increases in government expenditures identified above.

## 9.3 Equity Assessment

### 9.3.1 Introduction

In the context of an EPA economic analysis, an equity assessment is an important type of distribution analysis. An equity assessment examines the accrual of a regulation's net costs, net benefits, or other economic impacts to a specific sub-population(s) and/or examines the distribution of these costs, benefits, and impacts among sub-population(s). This examination includes the possibility of analyzing a regulation's impact on the distribution of national income or wealth.

Generally, cost bearers and beneficiaries belong to one of four populations: individuals, businesses, not-for-profit organizations, or governments. Within each of these populations are sub-populations whose particular circumstances EPA wishes to better understand, either because the sub-population is more physically susceptible to envi-

ronmental contamination, is less than fully capable of representing its own interests, or is economically disadvantaged or vulnerable. For many of these sub-populations, the EPA has been directed by statute, executive order, or agency policy to examine the effects of its rules when they are expected to have a "disproportionate," "significant and substantial," or other such impact on a particular sub-population. An equity assessment gives rule makers a better understanding of the economic effects of the EPA's rules on these sub-populations and, for comparison or other purposes, on other specific sub-populations as well. An equity assessment examines the magnitude as well as the distribution of effects on sub-populations.

There are several considerations to keep in mind when performing an equity assessment. Each of these points will be detailed in this chapter.

☛ **There are specific equity dimensions that must always be considered, but there are none that must always be analyzed** when assessing the impact of environmental regulations. Generally speaking, the regulation under review, and the specific issues associated with it, will determine which equity dimensions are relevant and in need of an equity assessment.

☛ **The methods used by a regulation's BCA and EIA should guide the methodology used by an equity assessment.** Neither this chapter nor OMB's *Best Practices* and *OMB Guidelines* outline a specific methodology for conducting an equity assessment. However, the models and assumptions developed for these other two analyses should not conflict with those used by an equity assessment.

An equity assessment may draw on the information compiled for its corresponding BCA as well as include measures of impact similar to those in its corresponding EIA. An early step in an equity assessment is to identify sub-populations likely to be affected by a regulation. Once identified, if data permits, the social costs and benefits estimated for the BCA can be disaggregated and net benefits examined for the sub-population(s). An equity assessment also examines other economic impacts, such as increases in rates of unemployment or other traditional impact measures, for the identified sub-populations(s).

☛ **An equity assessment is not an independent form of economic analysis**, but is a reflection of decisions made on many of the other analytic issues arising in the benefit, cost, and economic impact sections of this guidance. For example, the analysis of distributions over long time horizons can be greatly affected by the analyst's treatment of uncertainty or choice of a discount rate. Baseline issues are important in the determination of net benefits expected to accrue to specific sub-populations. When making decisions on these and other relevant issues, the analyst should keep in mind the ramifications borne by the equity assessment.

Many of the instructions offered in the preceding sections on estimating economic impacts will be directly applicable to an equity assessment. The difference will be extending the analysis or presentation of results to describe sub-population(s) for which impacts are estimated. Whereas an EIA focuses on traditional classifications of affected populations (like industrial classifications), an equity assessment often focuses on "disadvantaged or vulnerable" sub-populations (like low income households) but, for comparison or other purposes, can also focus on other relevant sub-populations (like upper income households). In this section, we outline a general framework for conducting an equity assessment but refer the reader to Sections 5, 6, and 9.2 for approaches used to estimate specific impacts. As is true for an EIA, generally speaking, an equity assessment is more concerned with sub-populations experiencing net costs or other negative impacts than those experiencing net benefits or positive impacts.

The following parts of this section accomplish three objectives. First, the existing environmental and administrative statutes, executive orders, and agency policies which direct analysts to consider specific sub-populations when assessing the economic effects of EPA's regulations are reviewed. The statutes and policies are enumerated, the relevant sub-populations are identified, and definitions are established for these sub-populations. Second, a broad framework for conducting an equity assessment is outlined.

This section concludes with a review of general sources of data for assessing equity impacts.

### 9.3.2 Statutes and Policies Requiring Equity Assessment and Definitions of Sub-Populations

Equity issues are at the heart of two existing statutes—The Regulatory Flexibility Act of 1980 (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), and The Unfunded Mandates Reform Act of 1995 (UMRA)<sup>51</sup>—and two executive orders—EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" and EO 13045, "Protection of Children From Environmental Health Risks and Safety Risks,"—all of which require agencies to consider a regulation's distributional impact on various entities or sub-populations.<sup>52</sup> These administrative laws or orders suggest several equity dimensions; in particular, entity size, minority status, income level, and childhood status. Exhibit 9-5 lists these equity dimensions and links each to the relevant statute or order, to a population, and to at least one established definition of sub-populations.

A second executive order—EO 12866, "Regulatory Planning and Review" has multiple objectives regarding regulatory planning and review, many that have nothing to do with improvements in equity. It does, however, include a specific directive for agencies to consider distributive impacts and equity when designing regulations. Thus, Exhibit 9-5 lists the equity dimensions suggested by the OMB's *Best Practices* for EO 12866 and noted in its *OMB Guidelines* for economic analyses. The equity dimensions are discussed in more detail below.

### 9.3.3 Entity Size

The RFA as amended by SBREFA and UMRA require agencies to consider economic effects on small entities—specifically, small businesses, small governmental

<sup>51</sup> EO 13132, *Federalism* and EO 13084, *Consultation and Coordination With Indian Tribal Governments*, both support some objectives in UMRA.

<sup>52</sup> The Office of Regulatory Management and Information's Rule and Policy Information Development System (RAPIDS) <http://intranet.epa.gov/rapids> (accessed 4/05/2000, internal EPA document) is a resource for those who wish to read relevant statutes, executive orders or Agency policy documents in their entirety or to acquire copies.



**Exhibit 9-5** Equity Dimensions Potentially Relevant to Environmental Policy Analyses<sup>53</sup>

Equity Dimension	Administrative Law or Order	Population	Definitions of Sub-Populations
Entity Size	RFA; UMRA; OMB Guidance to EO 12866	Businesses, Governmental Jurisdictions, Not-for-Profit Organizations	<p>The RFA references the Small Business Act definition of small business which defines small business using SIC codes. Definitions sometimes depend on number of employees and other times depend on annual receipts.</p> <p>The RFA defines small governmental jurisdiction as the government of a city, county, town, school district, or special district with a population of less than 50,000.</p> <p>The RFA defines a small not-for-profit organization as an enterprise which is independently owned and operated and is not dominant in its field.<sup>54</sup></p> <p>UMRA defines small government jurisdiction, similar to the RFA, as the government of a city, county, town, school district, or special district with a population of less than 50,000, <u>and</u> any tribal government.</p>
Minority Status	E.O. 12898; OMB Guidance to EO 12866; EO 13084 for Indian tribal communities only	Individuals or Households	<p>Minority population of the affected area exceeds 50 percent <u>or</u> minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.</p> <p>(Minorities are those individuals classified by OMB Directive No. 15 as Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-white persons.)</p> <p>"Indian tribe" means an Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a. (See EO 13084.)</p>
Income Level	EO 12898; OMB Guidance to EO 12866	Individuals or Households	<p>Annual statistical poverty thresholds from the U.S. Bureau of the Census' <i>Current Population Reports, Series P-60 on Income and Poverty</i>. Consumers grouped according to consumption expenditures (e.g., into deciles).</p>

<sup>53</sup> Some environmental statutes may also identify sub-populations that merit additional consideration, but this document is limited to those with broad coverage.

<sup>54</sup> The RFA also allows agencies to establish an alternative definition of small entity after notice-and-comment, and for small businesses only, after consultation with the Small Business Administration (SBA).

**Exhibit 9-5** Equity Dimensions Potentially Relevant to Environmental Policy Analyses  
(Continued)

Equity Dimension	Administrative Law or Order	Population	Definitions of Sub-Populations
Childhood Status, Age	EO 13045, OMB Guidance to EO 12866	Individuals or Households	EPA's Office of Children's Health Protection does not adhere to a single definition of "child." It suggests that the definition will vary depending upon the issue(s) of concern.  U.S. Bureau of the Census reports statistics by age in five-year age groups and for the following special age categories: 16 years and over; 18 years and over; 15 to 44 years; 65 years and over; 85 years and over.
Gender	OMB Guidance to EO 12866	Individuals	Male/Female
Time	OMB Guidance to EO 12866	Individuals or Households	Current/Future Generations
Physical Sensitivity	OMB Guidance to EO 12866	Individuals or Households	Varies according to the rule under review. For example, a rule that controls an air pollutant might define a physically sensitive sub-population as individuals with asthma.

jurisdictions, and/or small not-for-profit organizations. Definitions of "small" for each of these entities are considered below. For guidance as to when it will be necessary to examine the economic effects of a regulation under the RFA, analysts should consult EPA guidelines on these administrative laws.<sup>55</sup> These guidelines include the types of economic effects that must be considered and establishment of the baseline for purposes of determining if a rule may have a significant economic impact on a substantial number of small entities. Further, these guidelines explain the requirements in the event the rule is found to have a significant economic impact on a substantial number of small entities. Note that the RFA only applies to rules for which notice-and-comment rulemaking is required.

### 9.3.3.1 Small Business

The RFA requires agencies to begin with the definition of small business that is contained in the SBA's small business size standard regulations.<sup>56</sup> The SBA defines small business by category of business using SIC codes, and in the case of manufacturing, generally defines small business as a business having 500 or fewer employees. For some types of manufacturing, however, the SBA's size standards define small business as a business having up to 750, 1000, or 1500 employees, depending on the particular type of business. In the case of agriculture, mining, and electric, gas, and sanitary services, the SBA size standards generally define small business with respect to annual receipts (from \$0.5 million for crops to \$25 million for certain types of pipelines).

<sup>55</sup> U.S. Environmental Protection Agency, *Revised Interim Guidance for EPA Rulewriters: Regulatory Flexibility Act as Amended by the Small Business Regulatory Enforcement Fairness Act*, dated March 29, 1999.

<sup>56</sup> 5 U.S.C. § 601; see also the SBA's "Small Business Size Regulations" are contained in the [Code of Federal Regulations](#) at 13 CFR 121 and in the [Federal Acquisition Regulation](#) 46 CFR 19. The SBA reviews and reissues the size standards every year. The current version can be viewed at: <http://www.sbaonline.sba.gov/gopher/Financial-Assistance/Size-Standards/> (accessed on 8/28/2000).

The RFA also authorizes any agency to adopt and apply an alternative definition of small business "where appropriate to the activities of the agency" after consulting with the Chief Counsel for Advocacy of the SBA and after opportunity for public comment. The agency must publish any alternative definition in the Federal Register.<sup>57</sup>

### **9.3.3.2 Small Governmental Jurisdiction**

The RFA defines a small governmental jurisdiction as the government of a city, county, town, school district, or special district with a population of less than 50,000. Similar to the definition of small business, the RFA authorizes agencies to establish alternative definitions of small government after opportunity for public comment (consultation with the SBA is not required). Any alternative definition must be "appropriate to the activity of the agency" and "based on such factors as location in rural or sparsely populated areas or limited revenues due to the population of such jurisdiction." Any alternative definition must be published in the Federal Register.<sup>58</sup>

Section 202 of UMRA directs agencies to obtain meaningful input from state, local, and tribal governments for each proposed and final rule "containing significant federal intergovernmental mandates." More specifically, this requirement is for rules that include federal mandates "which may result in the expenditure by state, local, and tribal governments, in the aggregate, or by the private sector, of \$100 million or more in any one year."<sup>59</sup> Section 203 of UMRA requires that agencies assess whether its rules "might significantly or uniquely affect small governments" so as to consider the need for a compliance plan. Small governments are defined in the paragraph immediately above. The phrase "small towns" refers to very small

governments with populations of under 2,500 citizens. As part of the "Small Government Agency Plan" required under UMRA, EPA evaluates such factors as whether small governments will experience higher per-capita costs due to economies of scale, whether they would need to hire professional staff or consultants for implementation, or if they would be required to purchase and operate expensive or sophisticated equipment.<sup>60</sup>

### **9.3.3.3 Small Not-for-Profit Organization**

The RFA defines a small not-for-profit organization as an "enterprise which is independently owned and operated and is not dominant in its field." Examples might include private hospitals or educational institutions. Here again, agencies are authorized to establish alternative definitions "appropriate to the activities of the agency" after providing an opportunity for public comment (consultation with the SBA is not required). Any alternative definition must be published in the Federal Register.<sup>61</sup>

### **9.3.4 Minority Status and Income Level**

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" and its accompanying memorandum have the primary purpose of ensuring that "each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations... ."

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<sup>57</sup> U.S. Environmental Protection Agency, *Revised Interim Guidance for EPA Rulewriters: Regulatory Flexibility Act as Amended by the Small Business Regulatory Enforcement Fairness Act*, dated March 29, 1999.

<sup>58</sup> *Ibid.*

<sup>59</sup> U.S. Environmental Protection Agency, *Interim Guidance on the Unfunded Mandates Reform Act of 1995*, memorandum from Office of General Counsel, March 23, 1995b.

<sup>60</sup> *Ibid.* p. 4.

<sup>61</sup> U.S. Environmental Protection Agency, *Revised Interim Guidance for EPA Rulewriters: Regulatory Flexibility Act as Amended by the Small Business Regulatory Enforcement Fairness Act*, dated March 29, 1999.

The Executive Order also explicitly calls for the application of equal consideration for Native American programs.<sup>62</sup>

EPA's *Interim Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (EPA, 1998), discusses the meaning of key terms and phrases contained in EO 12898. Their conclusions regarding four key phrases: "minority population," "low-income population," "disproportionately high and adverse human health effects," and "disproportionately high and adverse environmental effects" are summarized below.

### 9.3.4.1 Minority Population

Minority individuals are those classified by Office of Management and Budget Directive No. 15 as Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-white persons. A minority population should be identified where either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than its corresponding percentage in the general population (or other appropriate unit of geographic analysis). A minority population also exists if there is more than one minority group present and the percentage calculated by aggregating all minority persons meets one of these thresholds. In identifying minority communities, the Agency may consider as a community either: (1) a group of individuals living in geographic proximity to one another or (2) a geographically dispersed/transient set of individuals (such as migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood, census tract, or other similar unit that is to be chosen so as to not artificially dilute or inflate the

affected minority population. The selection of the appropriate unit of geographic analysis may also be influenced by the accuracy and precision of environmental quality models.

### 9.3.4.2 Low-Income Population

Low income populations in an affected area can be identified with the annual statistical poverty thresholds from the U.S. Bureau of the Census' *Current Population Reports, Series P-60 on Income and Poverty*. In conjunction with census data, the analysis should also consider state and regional low-income and poverty definitions as appropriate. In identifying low-income populations, the Agency may consider as a community either a group of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals (such as migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effects.<sup>63</sup>

One alternative to measuring annual incomes is to examine expected lifetime incomes. Generally, consumption is better than annual income at tracking households' expected lifetime incomes. For example, an analyst might divide the population by consumption deciles and see how the lowest deciles fare. These data will be harder to access as the Census does not contain consumption data.

### 9.3.4.3 Disproportionately High and Adverse Human Health Effects

When determining whether human health effects are disproportionately high and adverse, the Agency is to consider the following three factors to the extent practicable:

- ✦ Whether the health effects, which may be measured in risks and rates, are significant, unacceptable, or above generally accepted norms. Adverse health

<sup>62</sup> In addition, EO 13084, *Consultation and Coordination with Indian Tribal Governments*, requires regulations that "significantly or uniquely" affect the communities of Indian tribal governments and that impose substantial direct compliance costs on such communities to either refund the direct costs incurred or to consult with elected officials and other representatives of the Indian tribal governments and to provide a description of the consultation and/or communication to the Office of Management and Budget.

<sup>63</sup> Two additional tests available for identifying low-income populations in an affected area are: (1) the U.S. Department of Health and Human Services poverty guidelines or (2) the U.S. Department of Housing and Urban Development statutory definition for very low-income for the purposes of housing benefits programs. Information on these and other tests can be found in the CEQ report *Environmental Justice: Guidelines for National Environmental Policy Act* (CEQ, 1997) and the *Interim Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance* (EPA, 1998).

effects may include bodily impairment, infirmity, illness, or death;<sup>64</sup> and

- ☛ Whether the risk or rate of hazard exposure by a minority population or low-income population to an environmental hazard is significant and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group;<sup>65</sup> and
- ☛ Whether health effects occur in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

#### 9.3.4.4 Disproportionately High and Adverse Environmental Effects

When determining whether environmental effects are adverse and disproportionately high, the Agency is to consider the following three factors to the extent practicable:

- ☛ Whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority or low-income population. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities or low-income communities, when those impacts are interrelated with impacts on the natural or physical environment; and
- ☛ Whether environmental effects are significant and are or may be having an adverse impact on minority populations or low-income populations that appreciably exceeds, or is likely to appreciably exceed, those on the general population or other appropriate comparison group; and

- ☛ Whether the environmental effects occur or would occur in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

### 9.3.5 Childhood Status

EO 13045, *Protection of Children From Environmental Health Risks and Safety Risks* states that:

"A growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health risks and safety risks. . . . Therefore, to the extent permitted by law and appropriate, and consistent with the agency's mission, each Federal agency: (a) shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and (b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks."<sup>66</sup>

The order also states that each "covered regulatory action"<sup>67</sup> submitted to OMB, unless prohibited by law, should be accompanied by "...an evaluation of the environmental health or safety effects of the planned regulation on children."<sup>68</sup> The term "children" is not defined. EPA's Office of Children's Health Protection, established in response to this order, does not use a single definition of "child." They suggest that the definition will vary depending upon the issue(s) of concern. See Exhibit 9-5 for age classifications reported by the U.S. Bureau of the Census. EPA is currently developing a practical guide for valuing children's health effects.

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<sup>64</sup> The definition of adverse health effects contained in specific environmental statutes, under whose authority a regulation is being developed, may also guide the consideration of adverse health effects in conducting equity assessments.

<sup>65</sup> The definition of risk or rate of hazard exposure contained in specific environmental statutes under whose authority a regulation is being developed may also guide the consideration of risk or rate of hazard exposure in conducting equity assessments.

<sup>66</sup> EO 13045, *Protection of Children From Environmental Health Risks and Safety Risks* effective April 21, 1997.

<sup>67</sup> A "covered regulatory action" is any substantive action in a rule making that is likely to result in a rule that may (a) be economically significant (have an annual effect on the economy of \$100 million or more or would adversely affect in a material way the economy, a sector of the economy, the environment, and so on) and (b) concern an environmental health risk that an agency has reason to believe may disproportionately affect children.

<sup>68</sup> EO 13045.



### 9.3.6 Case Specific Equity Dimensions

EO 12866, *Regulatory Planning and Review* has several requirements that contribute to the preparation of economic information, including a specific directive for agencies to consider distributive impacts and equity when designing regulations. The *OMB Guidelines* (OMB, 2000) also makes note of several specific equity dimensions. But, unlike the laws and orders mentioned above, it does not suggest that analysts must always consider these dimensions. Rather, the suggestion is that the regulation under review should determine which equity dimensions are relevant.

"Those who bear the costs of a regulation and those who enjoy its benefits often are not the same people. Regulations have 'distributional effects' that affect different segments of the population and economy in various ways: by income groups, race, sex, industrial sector, and others. Regulations often distribute benefits and costs unevenly over time, perhaps spanning several generations... . If these distributive effects are important, you should describe the effects of various regulatory alternatives quantitatively to the extent possible, including their magnitude, likelihood, and incidence of effects on particular groups. You should carefully analyze regulations that significantly affect outcomes for different groups."<sup>69</sup>

OMB seems to be offering a general directive to study distributive effects on any grouping of sub-populations when those effects are expected to be significant, without requiring agencies to always consider a predetermined set of equity dimensions.

#### 9.3.6.1 Additional Equity Dimensions

In its general directive, OMB specifically mentions gender as a way to divide effects. Certain regulations may be found to have differential impacts on males and females. Thus, we add gender to the equity dimensions in Exhibit 9-5.

Later in the *OMB Guidelines* it states, "The economic analysis should also present information on the streams of benefits and costs over time in order to provide a basis for judging intertemporal distributional consequences, particularly where intergenerational effects are concerned."<sup>70</sup> This leans more towards being a directive and suggests that time is an important equity dimension. The *OMB Guidelines* give some suggestions for conducting an inter-generational analysis including:

"Special approaches may also be appropriate when comparing benefits and costs across generations. One approach is to follow the discounting method discussed above, and address the inter-generational equity and fairness issues explicitly, instead of modifying the discount rate."

"One alternative approach is based on the perspective that this generation is concerned about the welfare of future generations and, in fact, is willing to defer consumption and invest or preserve resources for future use at a discount rate that is less than the discount rate used in making decisions within a generation. For this purpose, you could use as a discount rate a special rate of time preference based on the growth of per capita consumption. Again, check with us if you plan to use such an approach."<sup>71</sup>

Both OMB and EPA recognize that inter-generational equity issues are potentially addressed by applying a discounting procedure. In the quotation above, OMB offers some analytical approaches to inter-generational discounting. Chapter 6 of this document provides information on alternative methods of discounting in this context and discusses when such discounting is, and is not, appropriate.

When discussing risk assessment, the *Best Practices* mentions that,

"Exposures and sensitivities to risks may vary considerably across the affected population. These difficulties can lead; for example, to a range of quantitative estimates of risk in health and ecological risk assessments that can span

<sup>69</sup> *OMB Guidelines*, p. 16.

<sup>70</sup> *Ibid.*, p. 8.

<sup>71</sup> *Ibid.*, p. 8.

several orders of magnitude... . All of these concerns should be reflected in the uncertainties about outcomes that should be incorporated in the analysis.<sup>172</sup>

Hence, we include physical sensitivity as an important equity dimension. The definition of who precisely is physically sensitive will vary according to the rule being developed. For example, a rule that controls an air pollutant might have a large impact on individuals with asthma. Or, a rule that diminishes the quantity of a hazardous substance that winds up in soils near residential areas, might have a large impact on children with pica (a disorder that results in an urge to eat non-food substances such as dirt).

The *Best Practices* is not the only source directing attention to physical sensitivity. There are sections of environmental statutes which require EPA to address sensitive populations, analyze effects, and take actions to avert or mitigate adverse impacts. For example, the Clean Air Act section 108(f)(1)(C) requires the Administrator to publish and make available "information on other measures which may be employed to reduce the impact on public health or protect the health of sensitive or susceptible individuals or groups... ."

Finally, the *Best Practices* mentions that economic analyses might need to consider different age categories.

"The literature identifies certain attributes of risk that affect value. These attributes include the baseline risk, the extent to which the risk is voluntarily or involuntarily assumed, and features (such as age) of the population exposed to risk. For regulations affecting some segments of the population (e.g., infants) more than those groups which have served as the basis for most of the information used to estimate (*sic.*) values of a statistical life (e.g., working-age adults), the use of values of a statistical life from the literature may not be appropriate."<sup>73</sup>

Age is clearly the issue in EO 13045, though its specific focus is on childhood status. Thus, Exhibit 9-5 lists child-

hood status and age as two aspects of a single equity dimension and cites the *Best Practices* and *OMB Guidelines*, as well as EO 13045. The next three entries of Exhibit 9-5 list the other equity dimensions suggested by the *Best Practices* and *OMB Guidelines* and links each to a population and at least one established definition of sub-populations.

While directing agencies to consider the differential impact of a regulation on relevant sub-populations, the *OMB Guidelines* state that an economic analysis should focus on the distribution of the costs and benefits of complying with a regulation rather than on the financial well-being of regulated entities.

"Since generally accepted principles do not exist for determining when one distribution of net benefits is more equitable than another, you should describe distributional effects without judging their fairness. You should describe these effects broadly, focusing on large groups with small effects per capita, as well as on small groups experiencing large effects per capita. You should also note any equity issues not related to the distribution of policy effects if they are important, and describe them quantitatively to the extent you can."<sup>74</sup>

OMB cautions analysts conducting distributional analyses to recognize that transfer payments will become relevant; to avoid double-counting even when mixing monetized and physical effects and to describe distributional effects without judging their fairness.

### 9.3.7 A Framework for Equity Assessment

What follows is a very general three-step framework to guide analysts conducting equity assessments.

Instructions for estimating particular impacts on sub-populations are given above in the section on EIA. Whether disaggregating benefits and costs or estimating economic impacts, the primary purpose of an equity assessment is

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<sup>72</sup> *Best Practices*, p. 15.

<sup>73</sup> *Ibid.*, p. 29.

<sup>74</sup> *OMB Guidelines*, p. 16.

to examine regulatory consequences for specific sub-populations of concern. Thus, the framework developed here offers an approach on how to identify a sub-population to be analyzed.

For each step, choosing to measure the equity-related consequences of a regulation involves balancing costs of data acquisition and analysis against the value of improved accuracy. The framework attempts to conserve resources by screening out situations for which any of the variety of equity impacts probably will not occur. This permits more extensive analytical and empirical efforts to focus on circumstances with a higher probability of creating significant equity-related effects. The three steps should not be viewed as necessarily sequential. Instead, at the outset of a particular regulatory analysis, all aspects of the suggested approach should be considered. This will help to ensure that the data gathered and the analyses performed will be well suited to measuring the equity impacts of concern.

### 9.3.7.1 Step 1: Equity Scoping Analysis

This first step consists of several tasks described here in sequential order.

- ☛ **Determine which populations listed in Exhibit 9-5 are within the scope of the analysis or exist relevant markets.** In certain cases, some of the populations might not be connected closely enough to the regulation to be meaningfully affected. For example, governmental entities might not be involved in the activities that would be affected by a regulation. If so, then no further analysis is necessary for these populations. It will be useful to make this determination early so that resources may be used in the most effective manner possible.
- ☛ **Determine whether the rule or regulatory alternative imposes costs, offers benefits, or results in other economic effects too small to warrant further analysis.** When considering the cost side of the analysis, it might be possible to argue that incremental unemployment and plant or firm closures resulting from even small regulatory costs cannot be distinguished from changes that would probably be triggered by the underlying economic viability of these activities. This step also applies when a regulation

imposes one burden on an entity, but reduces another on the same entity, so that the net effect is small. Although some equity impacts might be dismissed on this basis, others will probably require further analysis beyond this initial *de minimis* screen.

- ☛ **Identify which equity dimensions from Exhibit 9-5 are relevant if further analysis is required.** Negative impacts on small entities, low income populations, minority populations, and children are important to consider in all cases because of statutory and other mandates (see Section 9.3.2). For example, rules requiring additional safeguards against contamination of groundwater by landfills clearly benefit communities where landfills are sited. There is a long-standing concern among the environmental justice movement that locally unwanted facilities, including landfills, are sited disproportionately in poor and/or minority neighborhoods. Thus, for regulations affecting siting and management of landfills, wealth and race are equity dimensions of concern. Rules requiring additional safeguards are likely to have a positive impact on neighborhoods hosting landfills. This positive impact should be noted and possibly estimated. For other rules, it is likely that concern for other equity dimensions will naturally arise.

In addition to those equity dimensions that must always be considered for distributional analysis, the other dimensions listed by Exhibit 9-5 should be considered as part of the effort to identify which are relevant. In attempting to decide for a particular case whether some of the less obvious dimensions matter, analysts should collect readily accessible information on the characteristics of affected entities and populations. Attention should be paid to who is expected to receive the benefits of the regulation as well as who will pay the costs. Negative net benefits or net costs are ultimately what should trigger concern. Financial, health, and other non-monetary benefits and costs should be included.

- ☛ **Prioritize relevant equity dimensions.** Assuming there is more than one relevant equity dimension, they should be prioritized according to which dimension seems to warrant greatest concern. The level of concern should be determined by how strongly analysts expect a regulation to affect a particular sub-population.

### 9.3.7.2 Step 2: Define Distributional Variables for the Equity Dimensions of Concern

The next step is to define distributional variables associated with the equity dimensions from Step 1. For example, if one were concerned about a regulation's potential impact on poor neighborhoods, then a classification system for "poor" versus "not-poor" neighborhoods should be developed. The established definitions reviewed in Section 9.3.2 above could be used or alternatives developed. Referring again to the landfill example where one of the relevant equity dimensions is race, analysts would need to establish a rule for defining what qualifies as an African-American neighborhood or a minority neighborhood. In this case, one could rely on the established definitions presented in Section 9.3.2.

### 9.3.7.3 Step 3: Measure Equity Consequences

The next step is to begin to measure specific economic effects across the distributional variables. In some cases, estimating the equity-related effects of a regulation will involve disaggregating existing costs and benefits and tabulating or otherwise accounting for their distribution across the distributional variables defined in Step 2. This process would subject the equity assessment to the same set of assumptions applied to the benefit-cost analysis.

In other cases, an equity assessment will examine other impacts, such as increases in unemployment, for identified sub-populations. The section above on EIA reviews these other impacts and outlines how to estimate them. Any assumptions, for example those concerning elasticities of demand, used in the EIA, should also be applied to the Equity Assessment unless there are specific reasons for why the assumptions are inappropriate for the identified sub-population(s).

A thorough equity assessment, when resources permit, might include a disaggregation of benefits and costs from the BCA as well as an examination of economic impacts for the identified sub-population(s).

## 9.3.8 Data for Conducting Equity Assessments

The discussion in the preceding sections suggests several types of data that would be useful for estimating the distribution of impacts of environmental policy options. This section presents some of the data sources for each category of data needed. This is not an exhaustive list of data sources, but is presented to provide initial guidance for this information.

### 9.3.8.1 Data on Businesses, Governments, and Not-For-Profit Organizations

Two specific Internet sites provide access to some of the most commonly needed data. The first is the SBA's Office of Advocacy website.<sup>75</sup> Data provided on this website include the number of firms, number of establishments, employment, annual payroll, and estimated receipts. The data are available by employment size categories. Data may be viewed and downloaded for the U.S., by state or by metropolitan statistical area. A second website that analysts may find useful is the home page of the U.S. Bureau of the Census, Office of Statistics.<sup>76</sup> Here a variety of relevant data may be accessed including information published in the *County Business Patterns* and other published data series on population characteristics, including income and age distributions.

### 9.3.8.2 Demographic Data

The U.S. Bureau of the Census collects household data and aggregates them in forms that may be useful for environmental justice matters. Data are available on population distributions by race and household income at the state, county, metropolitan statistical area, or census tract level. An additional, Census website allows one to view a map of any part of the U.S., at the desired scale, that shows data on population distributions by family income or a specified race (e.g., percent white or percent black).<sup>77</sup> In addition, income data collected by the Internal Revenue Service and

<sup>75</sup> The address for this site is <http://www.sba.gov/ADVO/stats/> (accessed 8/28/2000, internal EPA document).

<sup>76</sup> The address for this site is <http://www.census.gov> (accessed 8/28/2000).

<sup>77</sup> The address for this site is <http://www.census.gov/geo/www/tiger/index.html> (accessed 8/28/2000).

made available in aggregated form on the Internet may be useful for some analyses.<sup>78</sup>

### 9.3.8.3 Other Potentially Useful Data Sources

There is a range of other sources that may provide useful data on other factors potentially relevant to equity analyses. For example, import and export data are available from the Bureau of the Census publication, *The U.S. Merchandise Trade: Exports, General Imports, and Imports for Consumption*. The U.S. Department of Commerce may also have data that would be useful for estimating changes in demand as a result of regulatory costs, or the turnover rate for capital equipment in various industrial sectors.

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<sup>78</sup> The address of the website providing these data is <http://trac.syr.edu/tracirs/>. Note that a user ID and password are necessary to access the data. Registration is available at <http://trac.syr.edu/register/registration.html> (accessed 8/28/2000).



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# Chapter 10: Using Economic Analyses in Decision Making

## 10.1 Introduction

This chapter provides some general rules for presenting analytical results to policy makers and others interested in environmental policy development. As emphasized several times in these *EA Guidelines*, especially by the flowchart and discussion of equity assessments in Chapter 9, economic analyses play an important role throughout the policy development process. From the initial, preliminary evaluation of potential options and their consequences through the preparation of the final economic analysis document, economic analysts participate in an interactive process with policy makers. The fundamental goal of this process is to refine the information available for making policy choices.

Hence, this guidance for presenting inputs, analyses, and results applies at all stages of this process, not only for the final document embodying the completed economic analysis. In particular, reporting ranges of uncertainty, critical assumptions, and key unquantified effects to decision makers as they weigh various options and alternatives is as critical as including these in a final economic analysis document at the conclusion of the policy development process.

This chapter first reviews some important features of economic analyses of environmental policies to include or describe in all presentations of analyses and results. Following this is some general guidance on what types of results are most useful to report and useful formats for presenting them. Some brief comments on the relationship between economic analyses and environmental policy making conclude the chapter. All of the recommendations in this chapter are, of course, subject to resource availability and statutory prohibitions.

## 10.2 Communicating Assumptions and Methods

All economic analyses of environmental policies must balance the goals of accuracy and completeness against the costs of data acquisition, detailed modeling, and valuation of consequences. Hence, the results of applied economic analyses inevitably contain uncertainties in particular areas, assumptions in the place of data that are not available, and effects that cannot be quantified or monetized. Analysts should highlight these limitations when presenting the inputs, modeling, and results of economic analyses.

Some general guidelines for communicating these considerations include the following:

- ☛ **Clarity and transparency:** Presentations of economic analyses should strive for maximum clarity and transparency of all aspects of the assessments. An analysis whose conclusions can withstand close scrutiny of all of its facets is more likely to provide policy makers with the information they need to develop the best environmental policies. In addition, if a rule is later challenged, the more clear, transparent and thorough analysis is, the easier it is to defend the agency's regulatory approach.
- ☛ **Delineation of data and assumptions:** Economic analyses should clearly describe all important data sources and references used, as well as key assumptions and their justifications. All of these inputs should be available to policy makers, and other researchers and policy analysts, to the extent that these data are not



confidential business information or some other form of private data.

- ☛ **Exposition of modeling techniques:** Although modeling frameworks for many economic analyses can be complex, it is important to convey at least the basic framework used for modeling a policy's consequences. The presentation should highlight the key elements or drivers that dominate the framework and its results.
- ☛ **Ranges for inputs and results:** At a minimum, uncertainties should be explored through the use of expected values supplemented by upper and lower bounds for important inputs, assumptions, and results. Sensitivity analyses using these ranges generally enhance the credibility of environmental policy assessments. If key elements for an economic analysis are extremely uncertain, these should be clearly indicated. Analysts should explore how resolving these uncertainties affects the conclusions of the analysis.
- ☛ **Monetizing a policy's effects:** To the extent feasible and warranted by their contribution to the results, as many of the effects of a policy as possible should be monetized. This enhances the value of the conclusions to policy makers weighing the many, often disparate consequences of different policy options and alternatives.
- ☛ **Highlighting non-monetized and unquantified effects:** Economic analyses should present and highlight non-monetized effects when these are important for policy decisions. Reasons why these consequences cannot be valued in monetary terms are important to communicate as well. Unquantified, but potentially significant, consequences of a policy also should be highlighted, especially when these could be important enough in magnitude to affect the broad conclusions of an economic analysis of different policy options and alternatives.
- ☛ **Presenting aggregate and disaggregated results:** Finally, the analytic framework should be organized to provide information on the separate economic consequences of important individual programs or component parts identified with the regulation. This can be particularly challenging when the underlying physical

science and engineering information needed by the economist to prepare the economic analysis may not be amenable to a simple separation of the individual contributions of pollution control choices (e.g., installed emission control devices) to changes in risks from pollutants. Further, some economic values used in analyses represent a quantified aggregate value for a set of environmental goods (e.g., a consumer benefit measure for total improvements to surface water), and it is unknown how to divide the value among the individual attributes that comprise this reported value. Nevertheless, it is valuable to describe disaggregate information on the costs and benefits attributable to individual policies whenever possible, given the frequent necessity to package or link regulatory actions or evaluations together into a single analysis.

## 10.3 Presenting the Results

The results of economic analyses of environmental policies should generally be presented in three clusters:

- ☛ **Results from benefit-cost analysis:** Estimates of the net social benefits should be presented based on the benefits and costs for which dollar values can be assigned, and a discussion of non-monetizable or unquantifiable benefits and costs should be provided;
- ☛ **Results from economic impact analysis and equity assessment:** Results of the economic impacts analysis and equity assessments should be reported, including predicted effects on prices, profits, plant closures, employment, and other effects, and findings concerning the distribution of effects for particular groups of concern, such as small entities, governments, and disadvantaged and vulnerable populations.
- ☛ **Results from cost-effectiveness analysis:** This policy evaluation technique is used when many benefits are not easily monetized and when the statutes or other authorities dictate specific regulatory objectives. Results of these analyses should also be presented when these analyses are conducted.



The relative importance of these three clusters will depend upon the policy and statutory context of the decision. Generally, analyses leading to these findings normally should be conducted simultaneously and the results should be presented together as different ways to examine a policy's social consequences.<sup>1</sup>

### 10.3.1 Results from Benefit-Cost Analysis

The net social benefits of each major alternative is estimated by subtracting the present value of monetary social costs from the present value of monetary social benefits (as defined in Chapter 6). For this calculation the same baseline must be used in both the benefit and cost analyses. Plausible upper- and lower-bound estimates of net benefits should be provided, the "best" or most-likely estimate should be identified and the sensitivity of the net benefits estimate to variations in uncertain parameters should be examined.

Other considerations for presenting and summarizing the results from benefit-cost analyses include the following:

- ☛ **Discounting benefits and costs is the preferred method for summarizing benefits and costs that accrue over several years.** The conditions for discounting in benefit-cost analysis are outlined in Chapter 6. Alternatives to discounting include annualizing costs and benefits, comparing those figures, and accumulating costs and benefits through time to a future year. When both traditional discounting and these alternatives are not feasible or advisable, it is appropriate to display the streams of costs and benefits over time for policy makers to consider.
- ☛ **Present and evaluate non-monetized and non-quantified effects.** The net social benefit estimate should be carefully evaluated in light of all the effects that have been excluded because they cannot be valued in monetary terms. Thus, immediately following a net benefit calculation, there should be a presentation and evaluation of all benefits and costs that can

only be quantified but not valued, as well as all benefits and costs that can be only qualitatively described.

- ☛ **Present the incremental benefits, costs, and net benefits of moving from one regulatory alternative to more stringent ones.** This presentation should be done both globally and by sub-population. This should include a discussion of incremental changes in quantified and qualitatively described benefits and costs. It is sometimes necessary to evaluate all combinations of options and alternatives when key sources of benefits and costs of a policy are affected by more than one option. In these cases, identifying the combination of alternatives with the highest net social benefits cannot rely only on the incremental benefits and costs of each individual option when added to other pre-existing options.
- ☛ **Discuss other potential costs and benefits that may be by-products of the proposed action.** These include transfers of the pollutant problem from one exposure medium or program office jurisdiction to another or possible exacerbation of exposures for specific groups (e.g., sensitive sub-populations, maximum exposure groups, or specific types of workers) not captured already in the economic impacts analysis and equity assessment.

### 10.3.2 Results from Economic Impacts Analysis and Equity Assessment

Economic impact analyses and equity assessments focus on distributional outcomes. Therefore, the presentation of these results should focus on disaggregating effects to show impacts separately for the groups and sectors of interest. If costs and/or benefits vary significantly among the sectors affected by the policy, then both costs and benefits should be shown separately for the different sectors. Presenting results in disaggregated form will provide important information to policy makers that may help them tailor the rule to improve its efficiency and equity outcomes.

<sup>1</sup> There are other, more limited types of economic analysis that can inform policy decisions. One example is health-health analysis (sometimes known as risk-risk analysis) that assesses the health risks introduced by diverting to regulation resources otherwise available for individual health care. Although limited, health-health analysis may be useful in contexts where benefit-cost analysis is infeasible. The method has been employed by several researchers (Viscusi, 1994; Keeney, 1997), but is not without criticism (Portney and Stavins, 1994).

The results of the economic impact analyses should also be reported for important sectors within the affected community—identifying specific segments of industries, regions of the country, or types of firms that may experience significant impacts or plant closures and losses in employment.

Reporting the results of equity assessments may include the distribution of benefits, costs, or both for specific sub-populations including those highlighted in the various mandates. These include minorities, low-income populations, small businesses, governments, and non-profits, and sensitive and vulnerable populations (including children). Where these mandates specify requirements that depend on the outcomes of the distributional analyses (such as the Regulatory Flexibility Act), the presentation of the results should conform to the criteria specified by the mandate.

### 10.3.3 Results from Cost-Effectiveness Analysis

When many benefits cannot easily be monetized, or when statutes or other authorities set forth a specific policy objective, economic analyses should present the results of a cost-effectiveness analysis. This will provide useful information to policy makers and it conforms to the general principle of minimizing the cost of achieving particular policy goals.

The cost-effectiveness of a policy option is calculated by dividing the annualized cost of the option by non-monetary benefit measures. Such natural units measures range from the amount of the reduction in pollution measured in physical terms, to the ultimate improvements in human health or the environment measured in terms of specific effects and damages avoided.

Cost-effectiveness analysis does not necessarily reveal what level of control is reasonable, nor can it be used to directly compare situations with different benefit streams. Moreover, other criteria, such as statutory requirements, enforcement problems, technological feasibility, or quantity and location of total emissions abated, may preclude selecting the least-cost solution in a regulatory decision. However, where not prohibited by statute, cost-effectiveness analysis can indicate which control measures or policies are inferior options.

## 10.4 Use of Economic Analyses in Policy Choices

The primary purpose of conducting economic analysis is to provide policy makers and others with detailed information on wide variety of consequences of environmental policies. One important element these analyses have traditionally provided to the policy-making process is estimates of social benefits and costs—the economic efficiency of a policy. Hence, the *EA Guidelines* reflect updated information regarding procedures for calculating benefits and costs, monetizing benefits estimates, and selecting particular inputs and assumptions.

Determining which regulatory options are best even on the restrictive terms of economic efficiency, however, often is made difficult by uncertainties in data and by the presence of benefits and costs that can be quantified but not monetized or that can only be qualitatively assessed. Thus, even if the criterion of economic efficiency were the sole guide to policy decisions, social benefit and cost estimates alone would not be sufficient to define the best policies.

A large number of social goals and statutory and judicial mandates motivate and shape environmental policy. For this and other reasons, the *EA Guidelines* contain information concerning procedures for conducting analyses of other consequences of environmental policies, such as economic impacts and equity effects. This is consistent with the fact that economic efficiency is not the sole criterion for developing good public policies.

Even the most comprehensive economic analyses are but part of a larger policy development process, one in which no individual analytical feature or empirical finding dominates. The role of economic analysis is to organize information and comprehensively assess the economic consequences of alternative actions—benefits, costs, economic impacts, and equity effects—and the tradeoffs among them. These results serve as important inputs for this broader policy-making process along with other analyses and considerations.

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