

Analyzing all possible combinations of provisions in this way is impractical if their number is large and interaction effects are widespread. You need to use judgment to select the most significant or relevant provisions for such analysis.

You should also discuss the statutory requirements that affect the selection of regulatory approaches. If legal constraints prevent the selection of a regulatory action that best satisfies the philosophy and principles of Executive Order No. 12866, you should identify these constraints and estimate their opportunity cost.

### *B. How To Develop Benefit and Cost Estimates*

#### 1. Some General Considerations

You should discuss the expected benefits and costs of the selected regulatory option and any reasonable alternatives for each rule. How is the proposed action expected to provide the anticipated benefits and costs? What are the monetized values of the potential real incremental benefits and costs to society? To present your results, you should:

- Include separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs and express the estimates in this table in constant, undiscounted dollars (for more on discounting see part C below).
- List the benefits and costs you can quantify, but cannot monetize, including their timing.
- Describe benefits and costs you cannot quantify.
- Identify or cross-reference the data or studies on which you base the benefit and cost estimates.

Similarly, you should discuss the expected cost of the selected regulatory option and any reasonable alternatives.

When benefit and cost estimates are uncertain (for more on this see part D below):

- You should calculate benefits (including benefits of risk reductions) and costs that reflect the full probability distribution of potential consequences. Where possible, present probability distributions of benefits and include the upper and lower bound estimates as complements to central tendency and other estimates.
- If fundamental scientific disagreement or lack of knowledge prevents construction of a scientifically defensible probability distribution, you should describe benefits under plausible assumptions and characterize the evidence underlying each alternative.

#### 2. The Key Concepts Needed To Estimate Benefits and Costs

“Opportunity cost” is the appropriate concept for valuing both benefits and costs. The principle of “willingness-to-pay” (WTP) captures the notion of opportunity cost by measuring what individuals are willing to forgo to enjoy a particular benefit. In general, economists tend to view WTP as the most appropriate measure of opportunity cost, but an individual’s “willingness-to-accept” (WTA) compensation for not receiving the improvement can also provide a valid measure of opportunity cost. WTP and WTA

are comparable measures when the change being evaluated is small and especially where there are reasonably close substitutes available. WTP is generally considered to be more readily measurable and to provide a more conservative measure of benefits. Adoption of WTP as the measure of value implies that individual preferences of the affected population should be a guiding factor in the regulatory decision and that the existing distribution of income is acceptable.

Market prices provide the richest data for estimating benefits based on willingness-to-pay if the goods and services affected by the regulation trade in well-functioning free markets. The opportunity cost of an alternative includes the value of the benefits forgone as a result of choosing that alternative. The opportunity cost of banning a product—a drug, food additive, or hazardous chemical—is the forgone net benefit (*i.e.*, lost consumer and producer surplus<sup>18</sup>) of that product, taking into account the mitigating effects of potential substitutes. The use of any resource has an opportunity cost regardless of whether the resource is already owned or has to be purchased. That opportunity cost is equal to the net benefit the resource would have provided in the absence of the requirement. For example, if regulation of an industrial plant affects the use of additional land or buildings within the existing plant boundary, the cost analysis should include the opportunity cost of using the additional land or facilities. To the extent possible, you should monetize any such forgone benefits and add them to the other costs of that alternative. You should also try to monetize any costs averted as a result of an alternative and either add it to the benefits or subtract it from the costs of that alternative.

Estimating benefits and costs when market prices are hard to measure or markets do not exist is more difficult. In these cases, regulatory analysts need to develop appropriate proxies that simulate market exchange. Estimates of willingness-to-pay based on observable and replicable behavior generally are the most reliable. As one example, analysts sometimes use “hedonic price equations” based on multiple regression analysis of market behavior to simulate market prices for the commodity of interest.<sup>19</sup> Going through the analytical

<sup>18</sup> Consumers’ surplus is the difference between what a consumer pays for a unit of a good and the maximum amount the consumer would be willing to pay for that unit. It is measured by the area between the price and the demand curve for that unit. Producers’ surplus is the difference between the amount a producer is paid for a unit of a good and the minimum amount the producer would accept to supply that unit. It is measured by the area between the price and the supply curve for that unit.

<sup>19</sup> The hedonic technique allows analysts to develop an estimate of the price for specific attributes associated with a product. For example, houses are a product characterized by a variety of attributes including the number of rooms, total floor area, and type of heating and cooling. If there are enough data on transactions in the housing market, it is possible to develop an estimate of the implicit price for specific attributes, such as the implicit price of an additional bathroom or for central air conditioning. This technique can be extended, as

process of deriving benefit estimates by simulating markets may also suggest alternative regulatory strategies that create such markets.

Other approaches may be necessary when a commodity is not directly or indirectly traded in markets. Valuation estimates developed using these approaches are less certain than estimates derived from market transactions or based on behavior that is observable and replicable. While innovative estimation methods are sometimes necessary, they increase the need for quality control to ensure that estimates conform closely to what would be observed if markets did exist.

Ultimately, the method selected to develop a monetized estimate should focus on a value for the specific attribute or end-point of interest (for example, lost school-days). As a cautionary note, the transfer of a valuation estimate from an unrelated context (say, for example, the valuation of lost work-days from labor market studies) as a measure of the value of the attribute (lost school-days) may yield an incorrect benefits estimate.

You also need to guard against double-counting, since some attributes are embedded in other broader measures. For example, when a regulation improves the quality of the environment in a community, the value of real estate in the community generally rises to reflect the greater attractiveness of living in a better environment. Simply adding the increase in property values to the estimated value of improved public health would be double counting if the increase in property values reflects the improvement in public health. To avoid this problem you should separate the embedded effects on the value of property arising from improved public health. At the same time, of course, valuation estimates that fail to incorporate the consequence of land use changes will not capture the full effects of regulation.

#### 3. How To Use Market Data Directly

Economists ordinarily consider market prices as the most accurate measure of the value of goods and services to society. In some instances, however, market prices may not reflect the true value of goods and services. If a regulation involves changes to goods or services where the market price is not a good measure of the value to society, you should use an estimate that reflects the true value to society (often called the “shadow price”). For example, suppose a particular air pollutant damages crops. One of the benefits of controlling that pollutant is the value of the increase in crop yield as a result of the controls. That value is typically measured by the price of the crop. If the price is held above the market price by a government program that affects supply, however, a value estimate based on this price would overstate the true benefits of controlling the pollutant. In this case, you should calculate the value to society of the increase in crop yields by estimating the

well, to develop an estimate for the implicit price of public goods that are not directly traded in markets. For example, the analyst can develop implicit price estimates for public goods like air quality and access to public parks by adding measures for these attributes to the hedonic price equation for housing.