Incorporating Equity in Regulatory and Benefit-Cost Analysis Using Risk Based Preferences

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Abstract

Governmental guidance for regulatory and benefit-cost analysis is targeted for applied analysts. Existing Federal guidance recommends sensitivity analysis in general without being specific regarding the implicit distributional assumptions of standard benefit-cost analysis. Recommendations for Federal guidance are developed to: 1) better communicate expectations for distributional analysis, 2) develop guidance for descriptive statistics related to distributional issues, and 3) integrate Government published measures of inequality aversion and to evaluate compensation for identified sensitive populations. While such actions have a data collection and analysis cost, they may make the results of regulatory analysis more relevant by investigating both efficiency and equity measures.

Key words: benefit, risk, equity, distribution, income

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1. FEDERAL REGULATORY AND BENEFIT-COST GUIDANCE

The economic and risk analysis professions both lack governing bodies that promulgate analytical standards. This may be desirable in general but the practice creates a vacuum when governmental organizations such as the Office of Information and Regulatory Affairs (OIRA) considers revisions to its guidelines for regulatory analysis[1,2] This paper considers the purpose and possible sources of specific guidelines and provides substantive and procedural suggestions for guidelines to integrate distributional and equity impacts into regulatory and benefit-cost analysis..

The Office of Information and Regulatory Affairs and its predecessors have issued guidelines for the benefit-cost and related analysis of regulations and government investments for decades[1,2]. Other parts of the Office of Management and Budget also regularly issue guidelines of varying complexity, such as those issued annually for budget submissions which sometimes include elements of risk and economic practice[3]. Each circular is generally issued under legal authority delegated by statute or an Executive Order[1].

The target audience for OMB guidelines is personnel in the Executive Branch and their consultants. The subject is the analytical expectation for specialized products, such as regulatory reviews. The personnel may practice a wide range of professions and degrees but are generally applied practitioners of each discipline, whatever degree they are holding. For instance, about 2

[1] For instance, Circular A-4 on Regulatory Analysis cites as authority "… Section 6(a)(3)(c) of Executive Order12866, "Regulatory Planning and Review," the Regulatory Right-to-Know Act, and a variety of related authorities." [2]

percent of EPA's personnel with advanced degrees (Master's, J.D. or Ph.D.) were economists; about 16 percent in the life sciences, 3 percent health professionals, and so on[4]. As Lave[5] has well articulated, benefit-cost analysis in practice may fall significantly short of its capability in an ideal setting. Not only are there conceptual difficulties for even the most advanced analysis but at least time, budget, strategic pressures and training limitations in practice affect the product produced. Consequently, the guidelines appear designed to communicate "standard" practice to be implemented by government analysts and consultants rather than "frontier" practice as might be implemented by researchers implementing new approaches, although some advanced practices are mentioned. In that context, advanced approaches to distribution such as proposed by Adler[6] or Zerbe[7] may be more appropriately the subject of academic development than the content of standard guidelines for practice.

The guidelines can provide criteria for Executive Office review either by OMB or by other parties. OMB review is a standard part of agency regulatory procedures[8]. In addition, the U.S. Governmental Accountability Office (GAO) considers OMB guidelines as sources of criteria by which to review agency products; and academic or think tank analysts also use the guidelines as review criteria[9-11]. However, the guidelines do not appear to create a source of judicial review although they mix guidance on implementation of Executive Orders, which is crafted so as not to create a basis for judicial review, with guidance on statutory requirements which have varying exposure to judicial review[8]. In some professional organizations there is a clearly specified hierarchy of sources of guidance. For instance, the Governmental guidelines under discussion, and the professional literature from which it is drawn, are included in the lowest level of acceptable sources for guidance in the accounting profession[12].

2. GUIDANCE ON DESCRIPTIVE DISTRIBUTIONAL IMPACTS

Providing guidance on distributional issues could be focused on three steps: 1) enforcing distributional impacts as more central to the process, 2) identifying typical types of descriptive distributional statistics, and 3) identifying typical welfare adjustments or distributional test. Each is discussed in turn.

2.1 Communicating Distributional Impact Expectations

Currently, distributional analysis is described relatively well in initial portions of regulatory guidance where it is stated:

> **"**Those who bear the costs of a regulation and those who enjoy its benefits often are not the same people. The term "distributional effect" refers to the impact of a regulatory action across the population and economy, divided up in various ways (e.g., income groups, race, sex, industrial sector, geography). ….
>
> Your regulatory analysis should provide a separate description of distributional effects (i.e., how both benefits and costs are distributed among sub-populations of particular concern) so that decision makers can properly consider them along with the effects on economic efficiency. Executive Order 12866 authorizes this approach. Where distributive effects are thought to be important, the effects of various regulatory alternatives should be described

> quantitatively to the extent possible, including the magnitude, likelihood, and severity of impacts on particular groups."[3]

Substantial research has indicated that many agencies do not as yet regularly comply with the basic requirements for regulatory and benefit-cost analysis as defined by OMB guidance and the distributional guidance appears to be one of the less studied features[9-11]. However, the Director of OIRA in 2009 appears favorable to considering distributional issues as he stated with regard to regulation:

> "Suppose that in terms of overall welfare, the regulation is not desirable; it makes aggregate welfare lower rather than higher. But suppose, too, that those who benefit are less advantaged than those who lose (and) ….suppose that the redistribution is not going to happen through the tax system. If so, then the regulation in the harder cases cannot be ruled off-limits despite its inefficiency."[13]

Whether or not redistribution can occur more effectively, or at all, through the tax code or another mechanism gets at the core of some economist's concern with investigating equity through benefit-cost analysis. Projects may be inefficient means of transferring income such that it would be better to increase the over-all "pie" and then redistribute it although such approaches may ignore the behavioral immediacy of project impacts and the feasibility of adjusting the tax code [14].

Although OMB has to date avoided a public checklist of required elements of a regulatory analysis, such a checklist or other means of communicating the importance of distributional issues seems appropriate, leading to a recommendation that OMB should develop a communication method to consistently expect data or discussion on the distributional impacts of a regulation as requested in existing guidance.

2.2 Identifying Acceptable Distributional Statistics

Although substantive guidance exists for many elements of regulatory and benefit-cost analysis, additional detail is desirable but lacking for the analysis of distributional impacts. There is very little guidance from OMB on data analysis related to distribution, either as its own subject or where it might be integrated with the benefit-cost analysis. In other areas of economics however, there are extensive discussions of descriptive statistics and of normative measures related to distribution[15-17].

Additional guidance should exist on typical measures of distributional information. Distributional data may be relevant on a wide range of sub-groups of potential interest identified in legislation, executive orders or other sources based on criteria such as income, poverty, race, gender, ethnicity, location, health status, age and so on. However, guidance may more appropriately be targeted at acceptable or preferred measures irrespective of their particular application. Numerous options exist for quantifying distributional measures in a benefit-cost analysis, among them:

- Tableaus of impacts on economic actors such as the decomposition of surplus measures

- Frequency or cumulative distribution plots
- Quantile measures
- Variance
- Coefficient of variation (s/μ)
- Lorenz curves--ordered quantiles of the population with quantiles of the variable of interest, such as income
- Gini coefficients--derived from Lorenz curve information, range 0 to 1
- Atkinson index of inequality--based on measure related to income inequality aversion, range 0 to 1

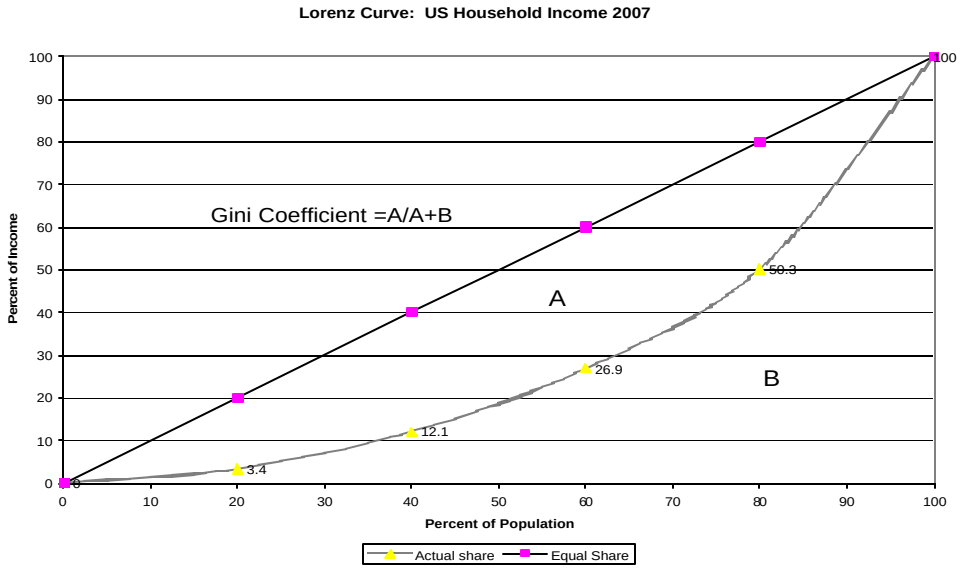
The first item, impacts on economic actors from decompositions of welfare effects, is well established in textbook expositions[18-20] and in the literature[21,22]. OMB briefly identifies some elements of distributional tableaus under "other benefits and costs" such as consumer and producer surplus[2]. A benefit of analyzing distributional effects on consumers, producers, government and externally affected parties is that the categories are generally consistent with the welfare economic of the analysis; a cost is that those specific categories may not represent the sub-groups of interest in any particular project or government redistribution objective. As with all analysis, implementation takes data and time.

Other statistical measures of variation as listed above have been used in the study of inequality, especially that of income[15]. There is some overlap with communicating distributions of risk information about which Krupnick, et al.[23] have investigated the responses of some decision-makers. The U.S. Census Bureau has long reported various measures of inequality in income in the U.S. including the summary measures of the Gini, Theil, and

Atkinson measures several of which are reported in Table 1 for 2007[24,25]. The Lorenz curve for the United States for 2007 is also graphable from Census data as in Figure 1.

The development of the Atkinson measure[26] is discussed in more detail below as it is the basis for an implementable weighting of distributional impacts. Suffice it here to interpret a value from Table 1, such as .095 for the Atkinson measure with *e* equal to .25 in column 1. This indicates a degree of inequality aversion such that at most 9.5% of money income could be given up in exchange for an equal income while holding utility constant.

Figure 1: US Lorenz Curve for 2007 and Gini Coefficient Definition



Data (24).

Table I: Summary inequality statistics reported by U.S. Census Bureau

Measures of Distribution	2007
Percent of aggregate income by percentile	
Lowest quintile	3.4
Second quintile	8.7
Middle quintile	14.8
Fourth quintile	23.4
Highest quintile	49.7
Top 5 percent	21.2
Summary measures	
Gini index of income inequality	.463
Atkinson inequality aversion	
e=0.25	.095
e=0.50	.185
e=0.75	.281

Date: (24).

The existence of inequality data published regularly by a part of the U.S. Government leads to two recommendations: 1) OMB should meet with the U.S. Census Bureau and an interagency statistical and economic group to provide guidance on methods and measures for the quantitative analysis and visual display of distributional measures, and OMB should report the status quo (baseline) estimates of its preferred measures periodically using nationwide data as a benchmark for analyses.

3. LINKING DISTRIBUTIONAL ANALYSIS TO SOCIAL WELFARE

Regulatory and benefit-cost analyses seek to answer when a governmental action will make society better off with a regulation or project than without. Despite long effort, this is understood to be a normative and not a positive question. The foundation and standard practice

in benefit-cost analysis is to count each dollar equally no matter who receives or pays that dollar[1,2,19,20]. It is well understood that benefit-cost analysis using these equal weights and the Kaldor-Hicks potential compensation criteria answers the societal question only with the unrealistically stringent assumption that the marginal social utility of income for all members is equal[27]. It is here that economist's stated aversion to mixing efficiency with equity when doing benefit-cost analysis removes the profession from what is arguably *the* central topic of policy debate, the distributional impacts of governmental actions. What quantitative measures can link distributional impacts with the welfare underpinnings of benefit-cost analysis? Two lines of thought are investigated, that of sub-group Pareto improvement, and that of sensitivity to distributional weights.

3.1 Actual Compensation: Pareto Improvement

If all those who bear costs from a government action were compensated sufficiently to achieve at least their original utility and some residual remained; there would likely be acceptance that society would be better off with the action than without. Such compensation is generally ruled out due to high transaction costs when costs are spread widely. However, much legislation and data collection is based on sub-groups of concern, for instance: those in poverty, racial and ethnic minorities, age cohorts (children, the elderly), gender, spatially distinct regions, and so on. For instance, Executive Order 12898 on Environmental Justice focuses on the importance of assessing impacts on minority and low income populations[28]. Farrow[29] recommended that sub-groups identified as sensitive populations in the regulatory process

receive actual instead of hypothetical compensation[2]. As a group, at least indifference or Pareto improvement (each group being at least as well off as prior to the action) would occur. In a benefit-cost analysis, the compensation would be a transfer and not affect the net benefits although real resources used in the transfer would add costs to the action.

In a similar vein, Graham[30] suggests that a test be included for those below the poverty line. Adler[31] defines such measures social gradients for which there may be various difficulties with bright lines (those just above and those just below) and within-group equity. At the same time, identifying sub-groups and considering actual compensation is responsive to the type of distributional criteria that tends to be identified in legislation.

The potential for guidance on actual compensation leads to a recommendation that OMB should consult with the Department of Justice and convene a multi-disciplinary advisory panel to review whether a reasonable reading of legislation and executive orders has identified sub-populations where the intent is not to make that group worse off as a result of Government actions. If any such groups are found, OMB should request the estimated cost in regulatory analyses to include compensation to the identified sub-groups.

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[2] For context, this recommendation was the result of participation in a benefit-cost analysis for a developing world project. The project was forecast to meet standard benefit-cost criteria when distribution was ignored but regional and occupational sub-groups of the population would bear a substantial portion of the cost. The project plans included compensation to restore the prior level of utility but distribution was an important issue in the region as significant economic and political unrest accompanied projects nearby.

3. Distributional Weighting

Several of the descriptive distributional statistics have a welfare basis that can be linked to benefit-cost analysis. For instance, the edited volume by Cowell[15] contains a section of eight "classic" articles on inequality that take an explicit welfare theoretic approach and include authors such as Rothschild, Stiglitz, Atkinson, Kolm, Meade and others. In textbook formats, much of these discussions are summarized as the use of distributional weights that might be placed on outcomes for various groups from a project[19]. Importantly, the conceptual development of welfare based inequality measures is symmetric to and owes a large debt to measures of risk. This may be clearest in the work of Atkinson[26,31] and Rothchild and Stiglitz[15]. In particular, it was noted that when outcomes are dispersed and marginal utilities decline for larger values, then there is symmetry between risk aversion and inequality aversion whether over income or other variables.

Atkinson[15] noted the parallel mathematical structure between the welfare based modeling of risk and the welfare based modeling of inequality. He defined the "equally distributed equivalent income" symmetrically with the certainty equivalent in the risk literature and defined an inequality measure, I(e), based on the ratio of the certainty equivalent income (now equally distributed equivalent income, CE) to the mean, μ.:

$$I(e) = 1 - \frac{CE(e)}{m} = \frac{Z}{m}$$

As with measures of risk aversion, a key component in Atkinson's measure is the functional form of the social utility function and its parameter(s). A power or CRRA (constant

relative risk aversion) functional form in risk depends on one parameter, *e*; social welfare functions for inequality aversion follow analogous development[32]. The parameter *e* measures the degree of inequality aversion and is interpreted as the elasticity of marginal utility with respect to income. The central "equity" result of these forms is that movements toward a more equal distribution increase welfare if *e* differs from 0, the current default in benefit-cost analysis.

The link between these power forms and social marginal utility weighting can be straightforward. Consider that the default distributional assumption in benefit-cost analysis is that the marginal utility of income, U'(y), is a constant, ?, across all individuals and groups, alternatively $U'(y)=?y^0$. Inequality aversion can be based on diminishing social marginal utility of any factor, but let it remain income for now such that $U'(y,e) = ?y^{-e}$. Here *e* is interpreted as the elasticity of marginal social welfare with respect to income of group i. Given this specification of marginal utility, one can integrate to the utility function itself which yields the power functional form; or more directly, use weights in benefit-cost analysis that depend on the relative marginal utilities of individuals or groups compared to the mean:

$$\frac{U'_i}{\overline{U'}} = \left(\frac{y_i}{\overline{y}}\right)^{-e} = \left(\frac{\overline{y}}{y_i}\right)^{e}$$

If *e*, the inequality aversion parameter is zero then the standard assumption applies of equal impact or no inequality aversion. Let that remain the default assumption for regulatory analysis. But consider that sensitivity analysis is almost universally identified as good practice[2,19] and so alternative distributional weights can and should be investigated. Review articles exist on the values of e, the inequality aversion parameter[33,34]. The U.S. Bureau of the Census regularly reports measures based on values of .25, .5, and .75 for *e*[24,25]. The Government of the United Kingdom[35] uses in its illustration of weighting for benefit-cost analysis a value of *e* equal to 1,

implying a marginal utility as simple as 1/y. Table 2 uses these governmentally identified values of *e* to estimate weights for the median and quintiles of the U.S. household income distribution for 2007. The ratio of weights for the lowest quintile compared to the highest quintile increases from 1:1 for the standard assumption when e equal zero, to 2:1 for *e* equal to .25, and then up to 7.5:1 for *e* equal to .75, the highest value used by the U.S. Census Bureau.

Table II: Atkinson distributional weights used by the U.S. Census Bureau and the UK Treasury

Population Quintile, Median, %	Mean US HH Income by Quintile: 2007	Default: e=0	e=.25	e=.5	e=.75	e=1
0-20	$11,551	1	1.4	2.1	3.0	4.3
20-40	$29,442	1	1.1	1.3	1.5	1.7
Median	$50,233	1	1.0	1.0	1.0	1.0
40-60	$49,968	1	1.0	1.0	1.0	1.0
60-80	$79,111	1	0.9	0.8	0.7	0.6
80-100	$167,971	1	0.7	0.5	0.4	0.3

Data source: (25,35)

As OMB guidance[2] recommends both sensitivity analysis and the use of certainty equivalents for the analysis of risk, it seems appropriate to consider parallel analysis for distributional impacts based on a parallel structure to risk aversion. Consequently, a final recommendation is that OMB should convene a multi-disciplinary advisory group to provide advice on methods to apply sensitivity analysis to the standard equal marginal utility of income assumption. Further, OMB may consider, as it has for the discount rate, several "anchoring" values for sensitivity tests perhaps using an inequality aversion parameter and values published by the U.S. Census.

4. CONCLUSION

Guidance for benefit-cost analysis is targeted at implementation by applied analysts. Existing guidance recommends sensitivity analysis in general without providing substantive discussions of how that might be implemented with respect to the implicit distributional assumptions of standard benefit-cost analysis. After consideration of existing guidance documents and implementable alternatives in the literature, recommendations are targeted at: 1) better communication regarding Governmental expectations for distributional analysis, 2) developing guidance for descriptive statistics related to distributional issues, and 3) investigating the sensitivity of the standard regulatory and benefit-cost results to Government published measures of inequality aversion or to actual compensation for identified sub-groups. While such actions have a data collection and analysis cost, they may make the results of benefit-cost analysis more relevant by informing both efficiency and equity issues.

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