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Abstract

Cost-benefit analysis as performed by governments and public-sector organisations typically applies equal weights to changes in incomes accruing to individuals from projects even when there is no proposal to compensate losers. One reason for the use of equal weights despite the absence of a theoretical justification for this practice is that all weights appear arbitrary. This note proposes the us e of weights based on two axioms: (1) that all lives should be equally valued, and (2) that the monetary value attached to a person's life should be his or her own. This implies weights that are proportional to the reciprocals of the values of statistical lives.

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Social cost-benefit analysis as actually practiced by governments and inter-governmental agencies around the world usually does not incorporate distributional concerns. For example, the European Union's (1997, p.30) guidelines mention distributional concerns almost as an afterthought. Projects are typcially evaluated on the basis of whether the sum of monetary benefits to all persons exceeds the sum of monetary costs. Economists have pointed out that there is no reason why distributional concerns should not be incorporated in project evaluation (Drèze and Stern, 1987). Pareto-improving projects would pass a cost-benefit test with any welfare function that placed a positive weight on all persons' incomes, not only when the weights are equal, as is the usual practice. The issue is important because most public projects are not Pareto-improving since compensating transfers are not made in most cases, and therefore, income is redistributed.

One reason why distributional weights are not often applied is that there has appeared to be no natural choice for the weights.[1] It may appear that a solution to this problem would be to present the decision-makers with the results of the analysis under several sets of weights and allow them to choose. This proposal, however, overlooks one of the advantages of systematic cost-benefit analysis: it constrains decision-makers so as to prevent them from choosing projects to favour private interests. Giving the decision-maker too much leeway to pick and choose undermines this function. The *ad hoc* manner in which distributional concerns are sometimes incorporated in project choice also has this drawback.

This note proposes a social welfare function based on two axioms: (1) the widely-shared ideal that all lives should be valued equally, and (2) the standard notion of consumer sovereignty that the monetary value placed on a person's life should be the one that she herself places on it. The social welfare function follows from these axioms. For suppose persons in group i with income y_i are willing to forego a dollar in return for a reduction of $\alpha_i(y_i)$ in their probability of death. Then, the members of this group consider the loss of $\alpha_i(y_i)N$ additional lives in their group to be equivalent to a loss of \$1 each, where N is large. Therefore, the social welfare function must weight incomes accruing to such persons by $\alpha_i(y_i)$. Hence, it must be (upto a positive affine transformation)

$$W(y_1, ..., y_n) = \sum_{i=1}^{n} \alpha(y_i) y_i. \tag{1}$$

The weights $\alpha(y_i)$ are proportional to the reciprocal of the value of a statistical life for a

[1] This appears to have deterred many from using weights. Arrow and Kalt's (1979) study of petroleum price deregulation is an exception, but the authors were not acting for a government. They used weights that are inversely proportional to income.

person with income y_i. Lives, rather than money, are used as the unit of account.

It may be asked why the weights are functions of income alone, and not of other characteristics of individuals that affect their willingness to pay to reduce risk to their lives. The answer is that we wish to protect people from being discriminated against because their incomes are low, but we do not want to award greater weights to the incomes of people who place a low value on their lives simply because they are less risk averse than others of the same income. For example, people without children may be less risk averse than those with children, implying that the former value money more highly in terms of their lives. But we would not, for this reason, wish to discriminate against people with children.

The welfare function implied by the two axioms above is utilitarian in spirit, in that it treats *differences* in risks to life equally rather than treating *levels* of risks to life equally (Sen, 1973: 43-46). The difference between the two approaches may be seen from the following example. Suppose individuals in Groups A and B have survival probabilities of 90% and 80% respectively, perhaps because the latter have lower incomes that reduce their access to healthcare. Suppose a policy were available that raised survival probabilities of those in B to 81% by redistributing income, at the cost of lowering survival probabilities of those in A to 81%. A welfare function, such as the Rawlsian, that treated levels equally would accept the policy while the one described here would reject it.

While most of the practice of cost-benefit analysis has ignored distribution, there are some notable exceptions. Cost-benefit analysis of regulations intended to save lives have taken distribution into account. For example, the US Department of Transportation (2002) explicitly recognises that airline passengers have a higher monetary value of life than automobile passengers but refuses to take this into account in framing safety regulations. It uses a uniform average value of a statistical life to assess the benefit from a safety regulation, thus valuing all lives equally.

Miller (2000) has estimated the elasticity of the value of life with respect to income to range from about 0.85 to 1.00, based on a meta-analysis of 68 studies in 13 countries. This would imply that monetary benefits accruing to a person with twice the income of another would be weighted by only 0.50 to 0.54 times as much as benefits accruing to the latter. Costa and Kahn (2002), using US data at 10-year intervals from 1940 to 1980, get higher estimates for the elasticity ranging from 1.5 to 1.7. These would imply corresponding weights of 0.37 to 0.4. Better and more precise estimates may be expected as research on this topic expands.

While this note has focused on the application of the proposed welfare function to cost-

benefit analysis, it should be clear that many other applications are possible. Ignoring distribution is the same as ignoring the fact that the marginal utility of money, or, more precisely, the marginal rate of substitution between money (or marketed goods) and non-marketed goods, will vary with income. Ignoring this can lead to anomalies, as the following example shows. There has been a large recent literature on the "Environmental Kuznets Curve" which consists mainly of regressions examining the relation between per capita income and levels of various pollutants. Different pollutants may have quite different values, due to differing toxicities, for example. Since the intention is to examine the relation between economic growth and environmental degradation, one needs to value pollutants to get an overall measure of environmental degradation. But dollar valuations of pollution are likely to rise with income, so that there may be a recorded rise in environmental degradation even if all physical measures show a decline. Using lives as the numeraire is quite natural in this context, since many pollutants pose risks to life. It also avoids the anomaly described.

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