Rates of Time Preference for Saving Lives

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An important characteristic of many environmental programs is that their benefits extend far into the future. The primary purpose of cleanups at hazardous-waste disposal sites, for example, is often to prevent the contamination of groundwater that could pose risks to future residents at these sites. Such cleanups typically involve considerable capital and other costs, which are incurred at the front end of the project, and yield a stream of health benefits, often in the form of cancer cases avoided, that may not be recognized for many years. This would not pose unusual problems for program evaluation if everyone were comfortable with the assignment of dollar values to these reductions in future risk (see Cropper and Portney, 1990). However, regulatory agencies are sometimes reluctant to make such monetary valuations, preferring instead to evaluate programs on a cost-per-life-saved (CPLS) basis (Office of Management and Budget, 1991).

This raises an interesting question. Should lives saved in the future be discounted for the purpose of calculating CPLS, or should they be counted the same as those saved tomorrow? To shed light on this, over the last year we have asked members of the public hypothetical questions that enable us to infer the rate at which they implicitly discount future lives saved (John K. Horowitz and Richard T. Carson [1990] asked similar questions of students). In the remainder of this paper, we summarize the results of this research, details of which can be found elsewhere (Cropper et al., 1991, 1992).

I. Description of the Surveys

In three telephone surveys—one of 1,000 Maryland households (the Maryland poll), another of 1,200 households in the Washington, DC metropolitan area (the Washington poll), and also a national random sample of 1,000 households (the national poll)—we asked questions similar to the following:

> Without new programs, 100 people will die this year from pollution and 200 people will die 50 years from now. The government has to choose between two programs that cost the same, but there is only enough money for one.
> Program A will save 100 lives now.
> Program B will save 200 lives 50 years from now.
> Which program would you choose?

In each survey the number of lives saved in the future was varied randomly across respondents. The time at which future lives were saved also varied within and across surveys, beginning at five years and increasing to 10, 25, 50, and 100 years.[1]

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[1]We also asked some respondents to make choices between hypothetical programs that would save the lives of individuals of different ages (e.g., 100 20-year-olds vs. 500 60-year-olds). Their responses to these questions are not analyzed here (see Cropper et al., 1992).

Our purpose in asking such questions was to put people in the role of social decision-makers: to ask them to choose between two programs that (generally) benefit persons in different generations but whose costs are borne by the present generation. We are also interested in why people make these choices. In each survey, respondents were asked about factors they considered in answering our questions and were allowed to describe reasons for their answers in their own words. In addition, we are interested in whether certain socioeconomic or other characteristics of respondents are correlated with their implicit discount rates for lives saved. For this reason, our surveys were designed to elicit such information.

II. Present-Orientation of Respondents

We choose to focus here on four important findings from our research to date. First, data from all three of the surveys we administered indicate that a surprisingly large fraction of those surveyed could not be induced to choose the future-oriented program, even when it saved 50 times the number of lives saved by the present-oriented program. For example, in the Maryland poll nearly 40 percent of the respondents preferred the program saving 100 lives today to one that would save 4,000 lives 25 years from now. Similarly, 47 percent of those surveyed preferred to save 100 lives today to 7,000 lives 100 years in the future. Results were similar in the Washington poll. In these surveys, however, we did not probe to find out whether there was some number of lives saved that would make the respondents prefer the future-oriented program. In the national survey (where the horizons were only five and ten years), we asked respondents who continued to choose the present-oriented program even as we "upped the ante" in terms of future life-saving whether there was *any* number of lives that could be saved in the future that would be sufficient to induce them to choose the future program; 10 percent said no.

What accounts for this extreme present-orientation? About one-third of the consistently present-oriented respondents believe that society will figure out another way to save those whose lives would be lost in the future because of their choice. In other words, these respondents do not accept the trade-off with which we attempt to confront them. Others are present-oriented because that program might protect them or their loved ones while the future-oriented program might not (especially when the time horizon is 100 years).

III. Discount Rates for Life Saving

In analyzing the responses to our questions, we assume that a respondent chooses program A, the present-oriented program, if the utility of that program exceeds the utility of program B, that is, if

$$U_A = aX_A > U_B = bX_B \tag{1}$$

implying

$$b/a < X_A/X_B$$

where X_i is the number of lives saved by program i, $i = \mathrm{A, B}$, and b/a is the fraction of a person saved today that is equivalent to saving one person at time T. If a person discounts lives at a constant exponential rate,

$$b/a = \exp(-\delta T). \tag{2}$$

We assume that b/a is different for each person and wish to trace out the distribution of b/a in the population, $F(b/a)$, or equivalently, of the discount rate δ. A nonparametric estimate of $F(X_A/X_B)$ may be computed by recording the fraction of persons who favor the present-oriented program when confronted with the ratio X_A/X_B. If one is willing to make assumptions about the form of $F(\cdot)$, the parameters of the distribution may be computed from individual data using maximum-likelihood techniques.

Table 1 shows estimates of the median of the discount-rate distribution for various horizons, T, based on our raw data. The mean and variance of the discount-rate distribution are also computed assuming that δ

TABLE 1—PARAMETERS OF DISCOUNT-RATE DISTRIBUTIONS ASSUMING CONSTANT EXPONENTIAL DISCOUNTING

Horizon (T)	N	Raw-data median δ	δ normally distributed μ_δ	σ_δ
5	475	0.168	0.274 (16.6)	0.314 (22.8)
10	480	0.112	0.179 (19.2)	0.183 (20.0)
25	462	0.074	0.086 (19.0)	0.083 (15.3)
50	528	0.048	0.068 (11.4)	0.092 (6.51)
100	442	0.038	0.034 (21.5)	0.026 (13.7)

Note: Absolute values of t statistics appear in parentheses.
Source: Data for $T = 5$ and $T = 10$ come from the national poll; data for $T = 50$ are from the Washington poll, and data for $T = 25$ and $T = 100$ are from the Maryland poll.

TABLE 2—ESTIMATES OF DISCOUNT-RATE FUNCTION: $\delta(t) = \alpha - \beta t$, $\alpha = X'\gamma$

Variable	$T \geq 25$	$T \leq 10$
μ_α	0.087 (21.0)	0.339 (12.1)
β	7.12×10^{-4} (5.24)	0.0291 (3.82)
σ_α	0.062 (23.3)	0.257 (33.4)
N	904	955
γ_0	0.0385 (3.51)	0.292 (6.47)
Age (years)	6.86×10^{-4} (3.73)	1.03×10^{-3} (1.77)
Male	3.93×10^{-4} (0.08)	-0.0285 (1.49)
Children $\leq$ 18 at home	0.0145 (2.54)	0.0249 (1.13)
Black	0.0303 (4.49)	0.0648 (2.42)
College degree	3.62×10^{-3} (0.62)	-4.36×10^{-2} (0.19)
Married	5.65×10^{-3} (1.01)	1.49×10^{-3} (0.07)
Income $\leq$ \$30,000	-1.85×10^{-3} (0.30)	-3.87×10^{-3} (0.19)
β	6.76×10^{-4} (4.71)	0.0306 (3.93)
σ_α	0.0607 (22.4)	0.250 (32.7)
N	794	887

Note: Absolute values of t statistics appear in parentheses.
Source: $T \geq 25$, Maryland poll; $T \leq 10$, national poll.

is normally distributed. The table suggests three other important conclusions. First, mean discount rates are significantly greater than zero, even at horizons as long as 100 years. Second, as has been found in studies of monetary discounting (Richard Thaler and George Lowenstein, 1989), people do not discount at a constant exponential rate. Discount rates are much higher for short horizons than for long horizons. Third, there is considerable heterogeneity in discount rates: the standard deviation of the discount-rate distribution is approximately equal to the mean for all horizons.

To allow for discounting at a nonconstant exponential rate, we assumed that the discount rate declines linearly over time:

$$\delta(t) = \alpha - \beta t \tag{3}$$

with $\alpha \sim N(\mu_\alpha, \sigma_\alpha^2)$ in the population and β identical for all persons. The parameters of the discount-rate function, shown in Table 2, were estimated by pooling data for 5- and 10-year horizons (column 2), and by separately pooling data for 25- and 100-year horizons (column 1). As the table shows, the discount-rate function for short horizons ($T \leq 10$) is quite steep, with a mean intercept of 0.339 and the discount rate falling to zero at 11.65 years. For longer horizons, the discount-rate function is much flatter, with the discount rate not reaching zero for 122 years. Given this difference, it is likely that the annual discount rate follows a negatively sloped, convex pattern, a hypothesis that we plan to explore in future work.

To see whether we can explain some of the heterogeneity in discount rates apparent in Table 1, we allow μ_α to depend on demographic variables. As indicated in Table 2, age is positively and significantly related to the implicit discount rate for lives saved in the future; this may reflect the fact that the older the respondent, the lower is the likelihood that the future program will afford him any protection. This interpretation is strengthened by the fact that the effect of age on the discount rate is stronger for long horizons than for short horizons. Similarly, for horizons greater than or equal to 25 years, respondents with children of high-school age or less have higher discount rates than persons who do not, all other things being equal. This may reflect self-interest in protecting one's children, especially when they are young. Finally, blacks have significantly higher discount rates than other racial groups, a finding that parallels the literature on monetary discounting.

We found, however, that there was no statistically significant relationship between respondents' sex, education, marital status, or income on the one hand and their discount rate for future lives saved on the other.[2]

IV. Conclusions

For several reasons, our findings should be regarded as preliminary. First, relatively brief telephone interviews (12–15 minutes) are an imperfect vehicle for eliciting preferences over such difficult choices.[3] Second, there is some evidence to suggest that the order in which questions were asked has a slight effect on the implicit discount rates we calculate. Third, as reported above, some fraction of the respondents took into consideration the fact that the present-oriented program could protect them personally while programs with horizons of 50 years or more were unlikely to do so. This calls into question the validity of interpreting our findings as pure social rates of time preference.

In spite of these caveats, however, the overwhelming majority of those questioned attach a lower priority—sometimes much lower—to lives saved in the future, even when the time horizon is quite short (5 or 10 years). For example, for a 25-year horizon the future-oriented program would have to save at least four times as many lives if it is to be preferred to a program that saves lives immediately. If borne out by additional research, this finding would have important implications for the evaluation of many regulatory interventions in the safety and health area. In view of the resources being devoted to these programs, such research appears to be worth undertaking.

[2]In the national poll, we asked respondents some questions about which environmental problems they thought were serious, and we also inquired about their confidence in government environmental regulatory programs. Their responses to these questions were not related in a statistically significant way to their discount rates for future life-saving.

[3]We randomly resurveyed 15 percent of the respondents in the Washington poll to see whether their answers would change when asked the same questions again. The majority gave the same answers.

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