Special Papers

Individuals' Time Preferences for Life-Saving Programs: Results from Six Less Developed Countries

by Christine Poulos and Dale Whittington, May 1999

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Abstract

Individuals' time preferences for mortality reductions are measured in six Less Developed Countries in Africa, Eastern Europe, and Asia using the contingent valuation method. The results indicate that individuals' discount factors are much lower than those estimated for a United States sample. Also, respondents' intertemporal preferences for saving lives are characterized by a nonexponential discount function. We conclude that the discounting practices currently used in standard economic analyses of development projects are probably poor representations of individuals' actual intertemporal preferences.

1. Introduction

A fundamental principle of welfare economics is that individuals' preferences should be the building blocks of social cost-benefit analyses. Economists typically assume that the economic value to an individual of a public action that confers benefits over multiple time periods is the discounted sum of net benefits experienced by that person, and that the net benefits to society of the consequences of a policy are the algebraic sum of individuals' willingness to pay (Boardman et al. 1996). There is a voluminous literature on the selection of the discount rate to be used for this aggregation over time periods, and many economists agree that the appropriate discount rate for evaluating public investments and programs is the individual's rate of time preference.

In the United States policy analysts usually use market interest rates to infer individuals' intertemporal preferences[1]. The selection of discount rates for cost-benefit analyses in Less Developed Countries (LDCs) has been more difficult, in part because market imperfections typically cause interest rates and time preferences to diverge widely (Binswanger and Rosenzweig 1986; Lind 1982). There is, in fact, little empirical research on individuals' actual rates of time preference in LDCs for goods and services in general and for nonmarket goods in particular. This lack of attention to the task of estimating individuals' rates of time preference in LDCs is odd considering the increased attention that has been placed in recent years on demand-oriented development planning approaches. Analysts working on problems of developing countries often go to great lengths to obtain empirical information on individuals' preferences for infrastructure services or environmental quality improvements, only to make very crude assumptions about individuals' rates of time preference that can easily determine the results of a project or policy appraisal.

For example, the primary objective of many development projects is to reduce risks of mortality, yet there is virtually no published literature on how residents of LDCs perceive the value of saving lives today versus saving lives in the future. This paper presents the first such evidence. In this research we employ a stated preference approach, using a question developed by Cropper, Aydede, and Portney (1994). We have slightly modified their question to make it more appropriate to a developing country context. Respondents were questioned about their preferences for saving lives today versus saving lives in the future in household surveys carried out in Africa (Uganda, Mozambique, and Ethiopia), Asia (Indonesia), and the transition economies of Eastern Europe and the former Soviet Union (Bulgaria, Ukraine) over the period 1994-1997. Our analysis in this paper is based on in-person interviews with almost 3000 respondents in these six countries.

There are three important findings from our research. First, individuals in all six countries in our study are much more present-oriented than the individuals in Cropper et al.'s (1994) United States study. Second, respondents' intertemporal preferences for saving lives are best characterized by a nonexponential discount function. Relative to the constant exponential discount function currently used in cost-benefit analyses, nonexponential discount functions place less weight on the near future and greater weight on the more distant future. Although support for nonexponential discount functions has been found in other settings, these multi-country results provide the first evidence that these findings are representative of populations in LDCs. Third, we find large differences in time preferences for saving lives in different countries that do not appear to be explained by differences in income or other socioeconomic factors. We conclude that the discounting practices currently used in development planning and project appraisal are probably poor representations of individuals' actual intertemporal preferences.

In the next, second section, we present the concepts and definitions used throughout the paper, and briefly summarize some of what is known about individuals' time preferences in developing countries. In the third section we describe the research design and field procedures, including a discussion of Cropper et al.'s stated preference question and how we have modified it for our research purposes. The fourth section presents the modeling framework used for the analysis of the data collected in our household surveys. The fifth section presents the results of the analysis for all six countries, both the raw tabulations of individuals' responses to the stated preference question and the multivariate analyses of the determinants of these answers. In the sixth and final section we offer some concluding remarks on the significance of the results.

2. Background

Standard discounted utility theory posits that individuals weight benefits conferred in the current time period more heavily than benefits conferred in future time periods. Individuals and public decisionmakers are assumed to make intertemporal choices by comparing the time-weighted benefits of alternatives and selecting the alternative with the largest aggregate utility.

More formally, the discounted utility model assumes that an individual's lifetime utility is the weighted sum of time-period specific utilities:

$$U = \sum_{t=0}^{T} w_t u(C_t) \qquad (1)$$

where U is the lifetime utility from the present ($t=0$) until the individual dies ($t=T$); $u(C_t)$ is the utility the individual receives in period t from consumption C_t;[2]and w_t are weights attached to utility in different time periods, termed "discount factors." The discount factor is normalized to one in the current time period and declines over time.

A "discount function" relates a discount factor to time and other parameters. The most commonly used discount function is the constant exponential:

$$w_t = \frac{1}{(1+r)^t} \qquad (2)$$

which is characterized by a single discount rate, r, that is the same regardless of the time period t. The discount rate is inversely proportional to the discount factor; therefore, patient individuals have high discount factors and low discount rates.

There is a large body of research on intertemporal preferences that confirms that individuals do discount the future, i.e., that their discount factors are less than one. There is also a growing body of empirical evidence that the discount functions of individuals in the United States are not best characterized as constant exponential functions such as (2) (Thaler 1981; Henderson and Bateman 1995; Loewenstein and Elster 1992)[3]. This evidence shows that individuals' use a lower discount factor to weight benefits in the near future, and a higher discount factor to weight benefits in the distant future, than a constant exponential discount function would suggest. This implies that individuals' discount rates decline monotonically as the time delay of benefits increases. That is, the near future is discounted with a higher discount rate and the more distant future is discounted with a lower discount rate than implied by a constant exponential discount function.

Loewenstein and Prelec (1992) present a utility-theoretic framework that is consistent with these empirical findings. In this framework, the discount function is the generalized hyperbola (a nonexponential function):

$$w_t = (1+\alpha t)^{-r/\alpha} \qquad (3)$$

where α, $r>0$. Figure 1 compares the discount factors generated by the constant exponential function and a generalized hyperbolic function. Although equation (3) is generally consistent with empirical evidence on individuals' rates of time preference, there has been relatively little empirical work done on the value of the parameters in this generalized hyperbolic discount function, or on the most appropriate functional form for a nonexponential discount function.

In this paper we do not follow the standard practice of using only the discount rate as the parameter to describe intertemporal preferences and will generally refer instead to the discount factor. We do this because reporting a single discount rate for different time periods implies a constant exponential discount function, and we want to present results consistent with a nonexponential discount function.

In one of the few published studies on intertemporal rates of time preference in developing countries, Holden et al. (1998) use stated preference methods to measure rural households' annual discount rates for money in Indonesia, Zambia, and Ethiopia. Assuming time preferences are characterized by a constant exponential discount function, Holden et al. (1998) estimate mean annual discount rates of 93 percent in Indonesia, 105 percent in Zambia, and 53 percent in Ethiopia (assuming a one-year planning horizon). These discount rates are equivalent to first-year discount factors of 0.52 in Indonesia, 0.49 in Zambia, and 0.65 in Ethiopia. Holden et al. find that poorer, liquidity-constrained households have higher discount rates; while larger households and more risk averse households have lower discount rates. The sample sizes in these studies are small, however, ranging from 35 to 120 households.

In one of the few empirical studies that measures individuals' discount rates for nonmonetary impacts of public environmental regulations, Cropper et al. (1994) posed the following stated preference question to a nationwide sample in the United States to measure intertemporal preferences for lives saved:

> Each year some people in the United States may die as a result of exposure to certain kinds of pollutants. Unless there are programs to control this pollution, 100 people will die this year from pollution, and *B* people will die *T* years from now. The government has to choose between two new programs to control this pollution. The two programs cost the same, but there is only enough money for one.
>
> Program A will save 100 lives now.
>
> Program B will save *B* lives *T [5,10,25,50,100]* years from now.
>
> Which program would you choose?

Each respondent is randomly assigned a combination of *B* and *T*, where *B* ranges from about 60 to about 1000 lives saved.

Cropper et al. (1994) report three main findings from their research (their results are summarized in Table 1). First, many people in their sample have very high discount rates for lives saved in the future. For time horizons of less than 25 years, the median discount rates are higher than most discount rates used in social cost-benefit analysis. Second, the median discount rates decline over time. Thus, a nonexponential discount function appears to more accurately characterize respondents' intertemporal preferences for saving lives than a constant exponential discount function. Third, income and education are not statistically related to an individual's rate of time preference. However, older respondents and African Americans have higher discount rates than other respondents do.

A comparison of Cropper et al.'s (1994) results and Holden et al.'s (1998) results suggests that individuals in LDCs discount the future more heavily than individuals in the United States. For example, Holden et al. (1998) find that individuals in Indonesia, Zambia, and Ethiopia weight benefits one year in the future using discount factors ranging from 0.49 to 0.65. Cropper et al. (1994) find that U.S. residents discount benefits five years in the future using a discount factor of about 0.46. Since the discount factor declines over time(with both constant exponential and nonexponential discount functions), these results suggest that individuals in LDCs place much less value on receiving benefits in five years than United States residents.

3. Research Design and Field Procedures

We replicated Cropper et al.'s (1994) experiment at sites in Ethiopia, Mozambique, Uganda, Bulgaria, Ukraine, and Indonesia. Table 2 shows the study and site characteristics for each country sample. The sample sizes vary from 284 households in Marracuene, Mozambique, to 889 households in 18 villages in the Tigray region of Ethiopia. The study areas in Uganda, Ethiopia, and Mozambique are rural and much poorer than the urban sites in Bulgaria, Ukraine, and Indonesia. Wealth and income levels vary widely among the countries in which the surveys were conducted. Bulgaria has the highest annual per capita GDP at USD 1500; Mozambique has the lowest at USD 77 (Infonation 1997). Using life expectancy and infant mortality rates as indicators of health status, the populations of Uganda, Mozambique, and Ethiopia have the poorest health, and look quite similar to each other. Health conditions in Bulgaria and Ukraine are much better. Indonesia lies in the middle, but is closer to Bulgaria and Ukraine in terms of life expectancy and infant mortality rates than to the three African countries.

The following is an example of the stated preference question that respondents were asked in our surveys[4],which is slightly modified from that used by Cropper et al. (1994):

> Suppose that the Lugazi (Uganda) Water and Sanitation Project was considering two hypothetical improved sanitation programs for Lugazi. Suppose that the two programs cost the same, but that there was only enough money for one of these programs to be implemented here. I want to ask you which one of these programs you would choose, or which one you would vote for.
>
> Program A would save 100 lives this year.
>
> Program B would save *B [200, 500, 1000]* lives in *T [2, 5, 10]* years.
>
> Which of the two programs would you choose?

Respondents were either the household head or the spouse of the household head. The question was asked in in-person interviews.[5]

We expect poorer respondents to have lower discount factors because they must be more present-oriented in order to survive and meet their basic needs. Also, per capita income and mortality risk are highly correlated, so poorer respondents may have shorter planning horizons because life expectancies are shorter. We expect this income effect to be exhibited both within samples and between countries.

4. Modeling Framework

The discrete choice valuation question posed in our multi-country study presents each respondent with the following problem: to assess whether the utility obtained from saving *A* lives today (Program A) is greater than, less than, or equal to the utility obtained from saving *B* lives in *T* years (Program B):

$$U_A \text{ (A lives saved today)} \Leftrightarrow U_B \text{ (B lives in T years).} \qquad (4)$$

or

$$100 \text{ lives today} \Leftrightarrow w_t * \text{(B lives)} \qquad (5)$$

where w_t is a function of *T*.

A respondent will choose Program A instead of Program B if the rate at which lives are traded off over time

(*A/B*, i.e., lives saved today/lives saved in the future) is greater than or equal to the respondent's discount factor, w_t. This can be shown by assuming that an individual's lifetime utility is a function of lives that will be saved by environmental regulations in her lifetime:

$$U = u(\mathbf{L}) = u(L_0, L_1, L_2, \ldots, L_T) \qquad (6)$$

where U is the utility function and L_t is the number of lives saved by environmental regulations in time period t. Assuming (i) lifetime utility is additively separable, (ii) the single-period utility function is the same for all periods, and (iii) the individual's intertemporal preferences are characterized by a constant exponential discount function, an individual's lifetime utility is:[6]

$$U = \sum_{t=0}^{T} (1+r)^{-t} u(L_t) \qquad (7)$$

$\partial u / \partial L_t$ is positive and decreasing in L_t, and r is the pure rate of time preference, i.e., the rate at which the individual discounts future utility (Olson and Bailey 1981).[7]

Consider an individual that chooses among alternative combinations of lives saved today (t=0) and lives saved in period T, keeping lives saved in all other periods constant. At the individual's point of indifference between marginal changes in periods 0 and T,

$$dU = u'(L_0)dL_0 + (1+r)^{-T} u'(L_T)dL_T = 0 \qquad \text{or} \qquad (8)$$

$$-c_2 + \mu h_2 = 0 \quad - \quad \frac{c_2}{h_2} = \mu \qquad (9)$$

The discount factor, w_t, is equal to the intertemporal marginal rate of substitution, which is a function of the pure rate of time preference (r) and the marginal utility of lives saved in periods 0 and T. This implies that the individual's discount factor for T is equal to the rate at which she will trade off lives saved today for lives saved in T.

The choice facing each respondent, represented in (4) and (5), can now be stated more precisely. The utility function is:

$$U = u(L_0, L_T) \qquad (10)$$

If the respondent chooses Program A, this implies:

$$U(A,0) > U(0,B) \qquad (11)$$

where A is the number of lives saved by Program A, and B is the number of lives saved by Program B in time period T.

$$U(A) > (1+r)^{-T} U(B) \qquad (12)$$

$$u'(A)A > (1+r)^{-T}u'(B)B \quad (13)$$

Rearranging terms yields:

$$(1+r)^{-T}\, {U'(B)}\big/{U'(A)} < {A}\big/{B} \quad (14)$$

and substituting from (9) yields:

$$w_t < {A}\big/{B} \quad (15)$$

The respondent's choice of program *A* thus yields the information that the individual discount factor for time period *T* is less than the ratio of *A* to *B*. We refer to *A/B* as the implied discount factor.

The individual discount factors, w_t, are assumed to be randomly distributed in the population and the cumulative distribution function (CDF) is $F(w_t)$. If the respondent is chosen randomly, the probability that the respondent chooses Program *A* is the probability that the individual's discount factor is less than the implied discount factor, which is the value of the CDF at the implied discount factor:

$$P(w_t < A/B) = F(A/B) \quad (15)$$

We estimate the CDF with the discrete distribution function using sample proportions. The proportion of the sample choosing Program A is an estimate of the value of the cumulative distribution of w_T at the value of *A/B*.

Although this model employs the constant exponential discount function, this does not affect the estimation of the CDF because the estimation is based on the raw data. However, this assumption does affect the estimate of the discount rate because the discount rate is calculated assuming that the discount function is constant exponential. If the calculated discount rate is not, in fact, the same for all *T*, this is evidence that the constant exponential function is not the appropriate discount function.

The dependent variable, *w*, in our multivariate analysis describes whether a respondent chose Program A or B; it takes the value one if Program A is chosen and zero if Program B is chosen. We use a probit model to explain the determinants of this choice. The respondent's discount factor, w_t^*, is unobserved:

$$w_t^* = \beta X + \varepsilon \quad (16)$$

X is an nxk matrix including a constant and other explanatory variables, β is a $kx1$ vector of parameters; and ε is a $nx1$ vector of random terms distributed $N(0,\sigma^2)$. We observe:

$$w = 1 \text{ if } w^* < A/B, \quad (17)$$

$$w = 0 \text{ if } w^* \geq A/B.$$

The estimation function is:

$$\Pr(w^* < {A}/{B}) = \Pr(\beta X + \varepsilon < {A}/{B}) = \Pr(\varepsilon < {A}/{B} - \beta X) = F({A}/{B} - \beta X)$$

(18)

Table 3 presents the definitions of the independent variables and their expected direction of influence on the dependent variable. We expect that the respondent is less likely to choose Program B as *T* increases, and will be more likely to choose Program B as the number of lives saved increases. We expect that greater income, education levels, and number of children will make the respondent less likely to choose Program A. We anticipate that older respondents will be more likely to choose Program A (this effect is expected to be magnified in countries with lower life expectancies). The direction of influence of the respondent's gender, marital status, and religious affiliation are unknown.

5. Results of the Analysis

The raw results for the program choice question are shown in Table 4; Figure 2 shows the CDFs of discount factors estimated from these raw data. The percentage of respondents choosing Program A is on the y-axis, and the ratio of the lives saved by Program A to the lives saved by Program B is on the x-axis.

In all cases we observe two results that increase our confidence that respondents took the stated preference question seriously. First, the percentage of respondents choosing Program *A* (on the y-axis) increases as the ratio (x-axis) increases. Thus, as expected, the percentage of respondents choosing Program A decreases as the number of lives saved by Program B increases.

Second, we observe that the CDF for *T*=10 years is above the one for *T*=5 years, which is above the one for *T*=2 years. Thus, as the time horizon increases, the percentage of respondents choosing Program *A* increases because they have to wait longer for the benefits of program *B*.

The median discount factors are taken from these CDFs by determining the value of *A/B* at which 50 percent of the sample chooses Program A. The median discount factors for different values of *T* are shown in Table 5 and Figure 3. In Figure 3, discount factors on are the y-axis and time, *T*, is on the x-axis. For comparison, Table 5 and Figure 3 also include Cropper et al's (1994) results for the United States.

As shown in Figure 3, the discount functions for the six LDCs are clearly lower than those from Cropper et al.'s US sample**.** Two of the striking aspects of the results presented in Figure 3 are (1) the similarity of the discount functions for the study sites in Bulgaria, Ethiopia, and Indonesia, and (2) the similarity of the discount functions for the study sites in Ukraine and Uganda. Figure 3 shows that respondents from Uganda and Ukraine place essentially no weight on lives saved more than 5 years in the future. On the other hand, respondents from Bulgaria, Ethiopia, and Indonesia place greater weight on the future. The median discount factors for Bulgaria and Indonesia do not drop to zero until about 10 years in the future. The median discount factor for Mozambique is still greater than zero at 10 years.

Further, all of the median discount factors from developing countries for all years are far below the discount factors implied by a 10 percent discount rate and constant exponential discount function that is commonly used by donors and planning agencies. For a planning horizon of up to 5 years, the constant exponential discount factor associated with a 10 percent discount rate is from two to eight times larger than individuals' median discount factors in the six LDCs. This suggests a wide difference in planning perspective between policy analysts and the individuals in developing countries who are affected by projects.

Although the median discount factors for our sample are much lower than those for the US sample, the income effect we anticipated between countries in our sample is not evident. Ukraine has the third largest income (in terms of annual per capita GDP) and the lowest median discount factor. On the other hand, Mozambique has the lowest income (in terms of annual per capita GDP) and the highest median discount factors.

Table 5 also shows the median discount rates calculated from the median discount factors, assuming that the discount function is constant exponential. The countries for which more than one median discount rate can be calculated exhibit a consistent pattern: median discount rates decline over time. For instance, the median discount rate for Ethiopia falls from 49 percent for 2 years; to 39 percent for 5 years; and to 28 percent for 10 years. Declining median discount rates are also found in Mozambique, Bulgaria, and Indonesia, providing strong evidence against the constant exponential discount function. Uganda and the Ukraine have extremely high discount rates for the 2 year horizon. The median discount factors for these two countries essentially fall to zero by the 5-year planning horizon, implying infinitely high discount rates.

Table 6 shows the sample means for several sociodemographic variables by country. On average, respondents in Bulgaria and Ukraine have completed at least some post-secondary education, respondents in Uganda and Indonesia have completed at least some secondary school, and respondents in Ethiopia and Mozambique have not completed primary school. The respondents in the wealthier countries (Bulgaria, Ukraine, and Indonesia) tend to be older and have fewer children than respondents in the poorer countries (Ethiopia, Mozambique, and Uganda).

Table 7 shows the results of the multivariate probit regression analyses, by country and for a pooled data set including all six countries.[8] We find that the influence of income on individual's time preferences is not strong. There is limited evidence, from the pooled model and from the Ukraine model, that older respondents have lower discount factors (i.e., higher discount rates). Education is statistically significant in Ethiopia and Ukraine, but the direction of influence is not consistent. Finally, the results from the pooled model show that married respondents have lower discount factors (higher discount rates). Table 8 shows the marginal effects of the statistically significant sociodemographic variables on the probability of choosing Program A; the effects are small in most cases. The marginal effects of the dummy variables for country are large, suggesting that additional differences between the samples that are not included in this model may account for differences in intertemporal preferences.

6. Concluding Remarks

Individuals in developing countries place less value on lives saved in the future than on lives saved today, just as people do in industrialized countries. Indeed, our results show that individuals in developing countries attach *much less* value to lives saved in the future than to lives saved today. Moreover, our results suggest that constant exponential discounting of future benefits does not appear to be an adequate framework for representing respondents' intertemporal preferences.

Four findings from this research may surprise some policy analysts and development planners. First, the extent to which our results suggest that households discount the future is significant. Very few individuals in our multi-country study attached any value to saving lives ten years in the future. In Cropper et al.'s (1994) study, the median respondent in the United States considered saving two lives in five years equivalent to saving one life today (assuming constant exponential discounting, this implies a discount rate of 17 percent). In Ethiopia and in Sofia, Bulgaria, the median respondent considered saving seven lives in five years equivalent to saving one life today. In Semarang, Indonesia, the median respondent considered saving ten lives in five years equivalent to saving one life today.

Second, although respondents in all of the locations in our study exhibited the same pattern of decline in discount factors over time, there were substantial differences between countries. Respondents in Lugazi, Uganda, and Odessa, Ukraine, placed much less value on saving lives in the future than respondents in Ethiopia, Mozambique, Bulgaria, or Indonesia. We cannot explain these inter-country differences, but we speculate that they are strongly influenced by widespread doubt and pessimism about the future of macroeconomic and political reform efforts in Ukraine, and by the high prevalence of AIDS in Uganda.

Third, consistent with Cropper et al.'s US findings, the multivariate analyses of individual intertemporal preferences show that sociodemographic variables have little explanatory power. Older respondents and married respondents are more present-oriented, but, contrary to our expectations, household income is not a strong determinant of time preferences. Further multivariate analyses are planned to supplement these preliminary results and gain greater insight into intertemporal preferences in LDCs.

Fourth, some people may be surprised by the robustness of our results obtained by asking respondents such an abstract, hypothetical stated preferences question. In fact, our field experiences are entirely consistent with this evidence that respondents were, in fact, seriously considering this and other questions in the surveys, and giving carefully considered answers.

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Footnotes

[1] The U.S. Office of Management and Budget uses either the rate of return on private investment or the government borrowing rate as measured by the rate of return on US Treasury securities. The National Oceanic and Atmospheric Administration, the Department of Interior, and the Congressional Budget Office recommend a social discount rate of 2 or 3 percent (net of inflation) on the basis of US Treasury rates. **Back to** Text

[2] The utility function is assumed to be identical in ach time period. **Back to** Text

[3] Nonexponential discounting has been found in stated preference as well as revealed preference studies, using monetary rewards (Thaler 1981; Benzion et al. 1989; Holcomb and Nelson 1989; Horowitz and Carson 1990; Ainslie and Haendel 1983; Loewenstein and Thaler 1989; Winston and Woodbury 1991; Horowitz 1991; Loewenstein 1987) and nonmonetary rewards (Cropper et al. 1994). Ainslie and Haslam (1992) provides a review of much of this empirical research. **Back to** Text

[4] Our stated preference question was included in surveys designed to estimate household demand for three different environmental goods and services (improved water and sanitation, air quality improvements, and malaria prevention). Respondents always answered the question about saving lives after the other valuation questions in the interview. It is possible that their responses to the question about saving lives was influenced by their answers to previous valuation questions. **Back to** Text

[5] Mozambique has a slightly different research design because of the small sample size. There were only two different levels of lives saved and years, rather than three. **Back to** Text

[6] We avoid an individual-specific index here by assuming that all individuals have the same utility function. **Back to** Text

[7] Note that this model employs the constant exponential discount function even though we will argue that this function does not characterize the intertemporal preferences of respondents in our surveys. This choice will be

justified subsequently. **Back to** Text

[8] The pooled model includes dummy variables indicating the country the respondent is from, and the reference country is Ethiopia. **Back to** Text

Table 1. Median Discount Factors and Median Discount Rates for U.S. Sample: Cropper, Portney, and Aydede's (1994) Results

Time Horizon *(Years)*	Median Discount Factor†	Median Discount Rate *(Percent)* ‡	Median Number of Lives Saved in *T* Equivalent to One Life Saved Today
5	0.46	17	2
10	0.35	11	3
25	0.18	7	6
50	0.09	5	11
100	0.02	4	50

† The median discount factor is obtained from the raw data. It is the discount factor at which 50 percent of respondents choose Program A.

‡ A constant exponential function is used to calculate the median discount rate from the median discount factor, where $r = w_t^{-(1/t)} - 1$.

Back to Previous Page

Table 2. Characteristics of Study Sites

Country	Study Location	Population of Sampling Frame	Per Capita GDP (1995 USD) (Infonation 1997)	Life Expectancy at Birth (Years, 1995) (Infonation 1997)	Infant Mortality Rate (per 1,000 Births, 1995) (Infonation 1997)	Sample Size (households)	Date of Survey
Ethiopia	18 villages in Tigray Region	~ 520 per village	96	48	119	889	January 1997
Mozambique	Town of Marracuene	66,000	77	46	118	284	November 1994
Uganda	Town of Lugazi	10,000	305	41	122	384	June 1994
Bulgaria	City of Sofia	~ 1 million	1,518	72	18	514	September 1995
Ukraine	City of Odessa	~ 1 million	694	69	16	737	June 1996

Indonesia	City of Semarang	1.2 million	1,019	63	58	319	August 1996
United States	n.a.	272 million	26,037	76	9	n.a.	n.a.

Back to Previous Page

Table 3. Variables Used in Data Analysis

Variable Name	Type of Variable	Variable Definition	Expected Influence on the Dependent Variable
CHOOSEA	Dichotomous	0 if respondent chose Program B; 1 if respondent chose Program A	n.a.
LIVES	Continuous	Number of lives saved by Program B	-
YEARS	Continuous	Number of years from present in which lives are saved by Program B	+
GENDER	Dichotomous	0 if male; 1 if female	?
EDUC	Categorical	0 if no schooling completed; 1 if some or all of primary school completed; 2 if some or all of secondary school completed; 3 if some or all of college/university completed	-
MARRIED	Dichotomous	0 if not married; 1 if married	?
NONCHRIS	Dichotomous	0 if Christian; 1 if non-Christian	?
INCGROUP	Categorical	1=first quartile; 2=second quartile; 3=third quartile; 4=fourth quartile	-
NUMCHILD	Continuous	Number of children in household	-
AGE	Continuous	Age of respondent in years	+

Back to Previous Page

Table 4. Percent of Respondents Choosing Program A[1]

T (years)	Number of Lives Saved in *T* years by Program B		
18 Villages in Ethiopia			
	200	*500*	*1,000*
2	65	29	19
5	83	56	46

10	89	85	60
Lugazi, Uganda			
	200	*500*	*1,000*
2	78	59	53
5	84	79	73
10	97	91	82
Marracuene, Mozambique[2]			
	100	*500*	--
2	57	29	--
10	66	43	--
Sofia, Bulgaria			
	200	*500*	*1,000*
2	63	23	25
5	83	59	43
10	87	67	77
Odessa, Ukraine			
	200	*500*	*1,000*
2	75	58	54
5	94	78	71
10	95	71	95
Semarang, Indonesia[3]			
	2,000	*5,000*	*10,000*
2	79	30	26
5	69	87	49
10	95	81	77

[1] Program A saves 100 lives in the current year unless otherwise noted.
[2] Program A saves 50 lives in the current year.
[3] Program A saves 1000 lives in the current year.

Back to Previous Page

Table 5. Median Discount Factors and Median Discount Rates

Back to Previous Page

Table 6. Sample Means

Independent	18 Villages	Marracuene,	Lugazi,	Sofia,	Odessa,	Semarang,

variables	in Ethiopia	Mozambique	Uganda	Bulgaria	Ukraine	Indonesia
Sample Size	889	284	384	514	737	319
INCGROUP	2.49	2.21	2.88	2.4	2.58	2.37
EDUC	0.24	0.84	1.49	2.2	3.24	1.72
AGE	42	40	33	46	46	49
FEMALE	0.58	0.41	0.48	0.56	0.59	0.39
NONCHRIS	0	0.61	0.24	0.21	n.a.	0.79
NUMCHILD	2	2	2	1	1	1
MARRIED	0.83	0.81	0.84	n.a.	0.67	0.88

n.a.: not available

Back to Previous Page

Table 7. Multivariate Analysis with Probit Model (Dependent Variable=*CHOOSEA*)

	Parameter Estimates (p-values), by Study Site						
Independent variables	18 Villages in Ethiopia	Marracuene, Mozambique	Lugazi, Uganda	Sofia, Bulgaria	Odessa, Ukraine	Semarang, Indonesia	Pooled
YEARS	0.159 *(0.00)*	0.037 *(0.11)*	0.118 *(0.00)*	0.135 *(0.00)*	0.142 *(0.00)*	0.166 *(0.00)*	0.122 *(0.00)*
LIVES	-0.001 *(0.00)*	-0.002 *(0.00)*	-0.001 *(0.00)*	-0.001 *(0.00)*	-0.001 *(0.00)*	-0.000 *(0.00)*	-0.000 *(0.00)*
INCGROUP	-0.079 *(0.09)*	-0.136 *(0.11)*	-0.020 *(0.75)*	0.021 *(0.74)*	0.013 *(0.83)*	-0.082 *(0.31)*	-0.046 *(0.06)*
EDUC	0.272 *(0.02)*	-0.092 *(0.66)*	0.078 *(0.51)*	0.003 *(0.96)*	-0.143 *(0.00)*	-0.193 *(0.24)*	-0.051 *(0.10)*
AGE	0.005 *(0.20)*	0.002 *(0.82)*	0.010 *(0.23)*	0.004 *(0.40)*	0.008 *(0.05)*	-0.006 *(0.50)*	0.004 *(0.05)*
FEMALE	0.197 *(0.09)*	-0.086 *(0.69)*	-0.177 *(0.29)*	0.081 *(0.51)*	-0.067 *(0.61)*	-0.174 *(0.39)*	-0.037 *(0.95)*
NONCHRIS	-0.120 *(0.85)*	-0.159 *(0.42)*	0.082 *(0.67)*	-0.147 *(0.33)*	N.A.[4]	-0.135 *(0.54)*	-0.073 *(0.41)*
NUMCHILD	-0.067 *(0.09)*	0.030 *(0.52)*	-0.001 *(0.97)*	-0.071 *(0.36)*	-0.086 *(0.31)*	0.032 *(0.64)*	-0.013 *(0.51)*
MARRIED	0.715 *(0.00)*	0.096 *(0.70)*	0.169 *(0.43)*	N.A.[5]	0.075 *(0.61)*	0.255 *(0.40)*	0.257 *(0.00)*
CONSTANT	-0.484 *(0.12)*	0.539 *(0.37)*	0.200 *(0.67)*	-0.159 *(0.69)*	0.585 *(0.11)*	0.831 *(0.28)*	-0.565 *(0.00)*
UKRAINE							0.806 *(0.00)*
UGANDA							0.738 *(0.00)*
MOZAM							-0.325 *(0.01)*

INDONESIA							1.167 *(0.00)*
BULGARIA							0.302 *(0.01)*
N	807	201	375	488	580	251	2702
Percent of responses correctly predicted (%)	72	67	78	72	78	74	70
chi2 (9)	207.66	24.69	38.76	71.49[6]	78.33[7]	54.32	437.42[8]
Prob>chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Log Likelihood	-443	-127	-177	-292	-255	-136	-1516
Pseudo-R2	0.19	0.09	0.09	0.11	0.13	0.17	0.13

[4] This variable is dropped due to collinearity.
[5] This variable is dropped due to collinearity.
[6] This is χ^2 with 8 degrees of freedom.
[7] This is χ^2 with 8 degrees of freedom.
[8] This is χ^2 with 14 degrees of freedom.

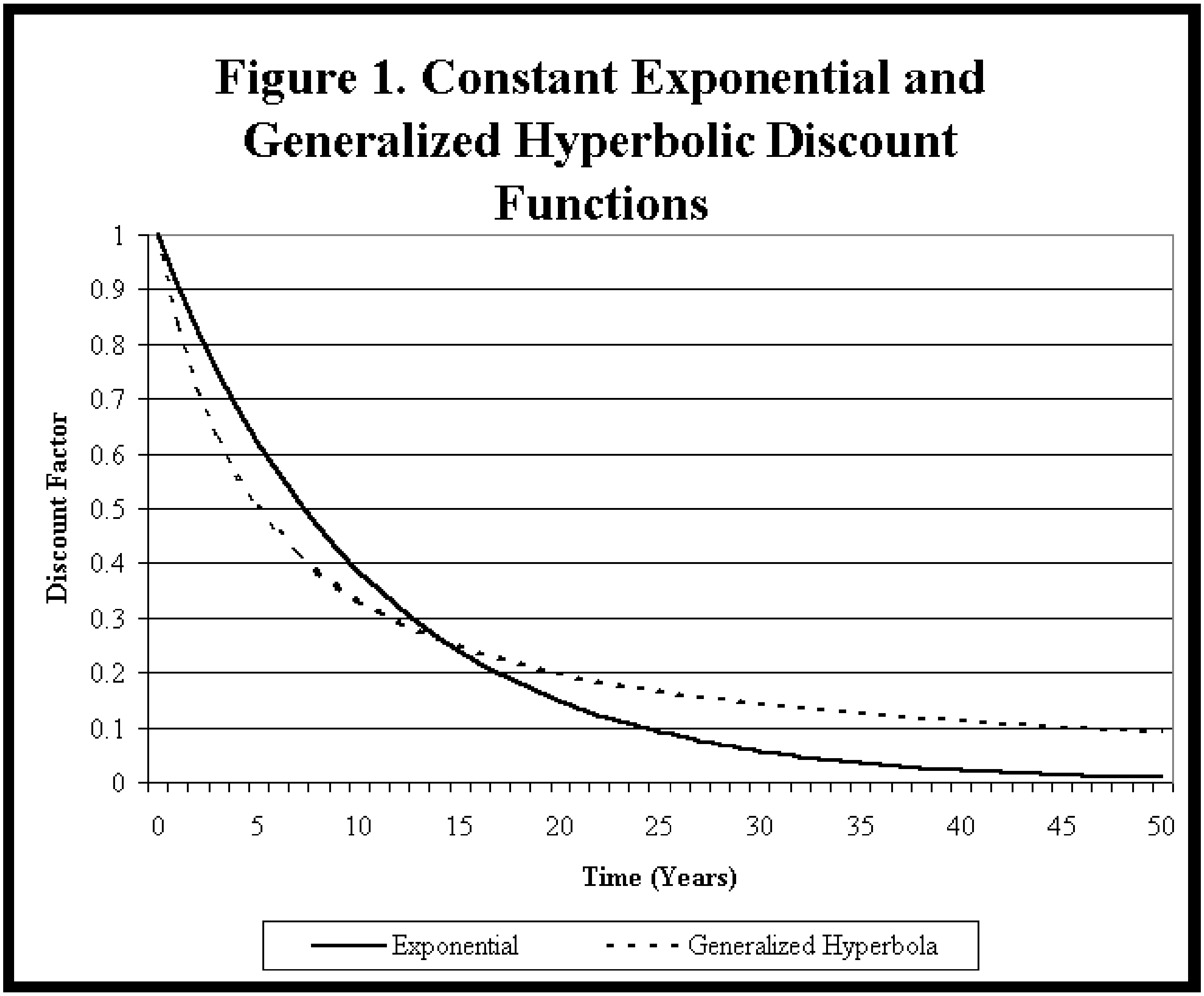
Back to Previous Page

Table 8. Marginal Effects of Independent Variables on Probability of Choosing Program A

Independent variables	18 Villages in Ethiopia	Marracuene, Mozambique	Lugazi, Uganda	Sofia, Bulgaria	Odessa, Ukraine	Semarang, Indonesia	Pooled
YEARS	0.061	0.015	0.032	0.052	0.036	0.060	0.043
LIVES	-0.001	-0.001	-0.000	-0.000	-0.000	-0.000	-0.000
INCGROUP	-0.031	-0.544	-0.005	0.008	0.003	-0.030	-0.016
EDUC	0.105	-0.036	0.021	0.001	-0.036	-0.070	-0.018
AGE	0.002	0.001	0.003	0.002	0.002	-0.002	0.001
FEMALE	0.076	-0.034	-0.048	0.031	-0.017	-0.063	-0.001
NONCHRIS	-0.047	-0.063	0.022	-0.057	N.A.[9]	-0.048	-0.026
NUMCHILD	-0.026	0.012	-0.000	-0.027	-0.022	0.011	-0.005
MARRIED	0.279	0.038	0.048	N.A.[10]	0.019	0.095	0.093
UKRAINE							0.248
UGANDA							0.221
MOZAM							-0.122
INDONESIA							0.295
BULGARIA							0.102

[9] This variable is dropped due to collinearity.
[10] This variable is dropped due to collinearity.

Back to Previous Page



Back to Previous Page

Figure 2.

Figure 2a. Percent of Respondents Choosing Program A Versus Ratio of Lives Saved Today to Lives Saved in T Years (18 Villages in Ethiopia)

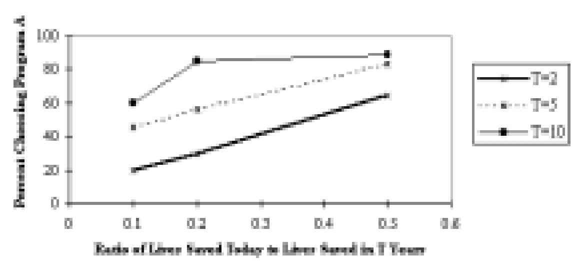


Figure 2b. Percent of Respondents Choosing Program A Versus Ratio of Lives Saved Today to Lives Saved in T Years (Sofia, Bulgaria)

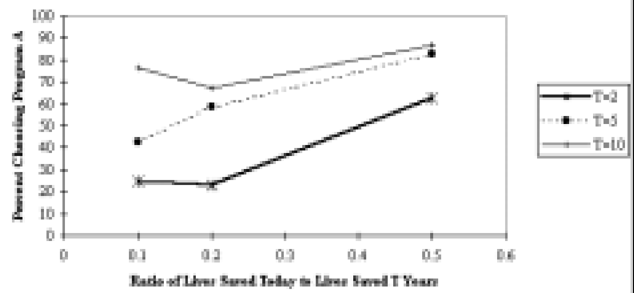


Figure 2c. Percent of Respondents Choosing Program A Versus Ratio of Lives Saved Today to Lives Saved in T Years (Marracuene, Mozambique)

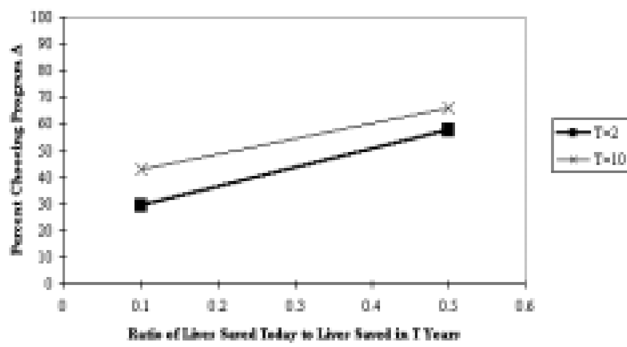
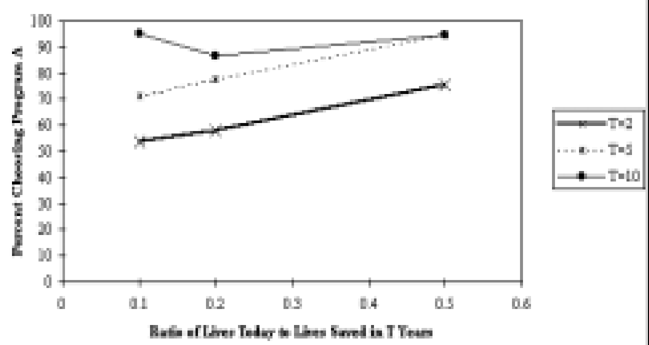
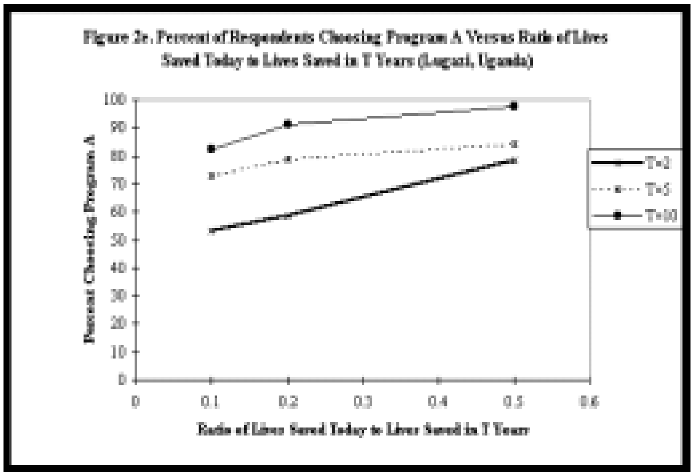
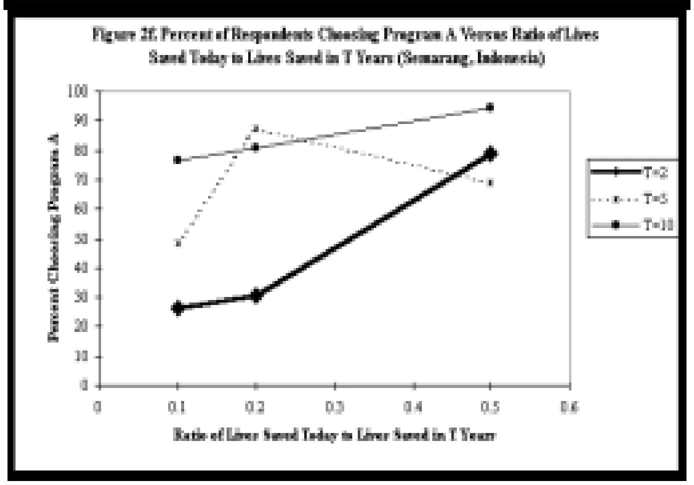


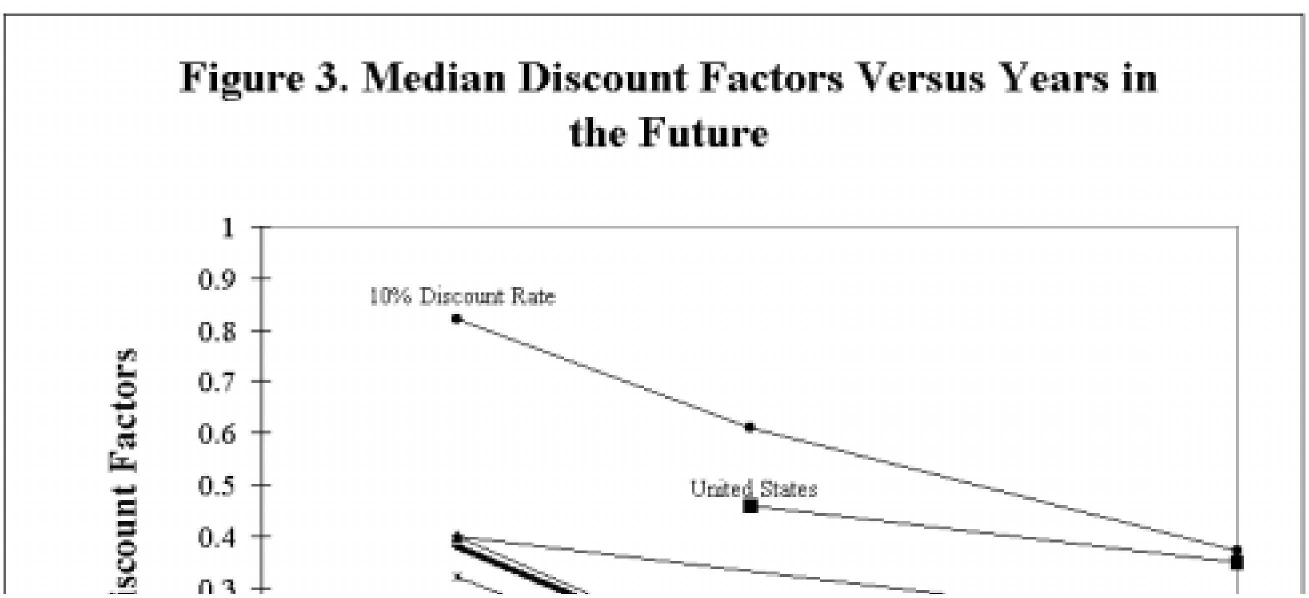
Figure 2d. Percent of Respondents Choosing Program A Versus Ratio of Lives Saved Today to Lives Saved in T Years (Odessa, Ukraine)

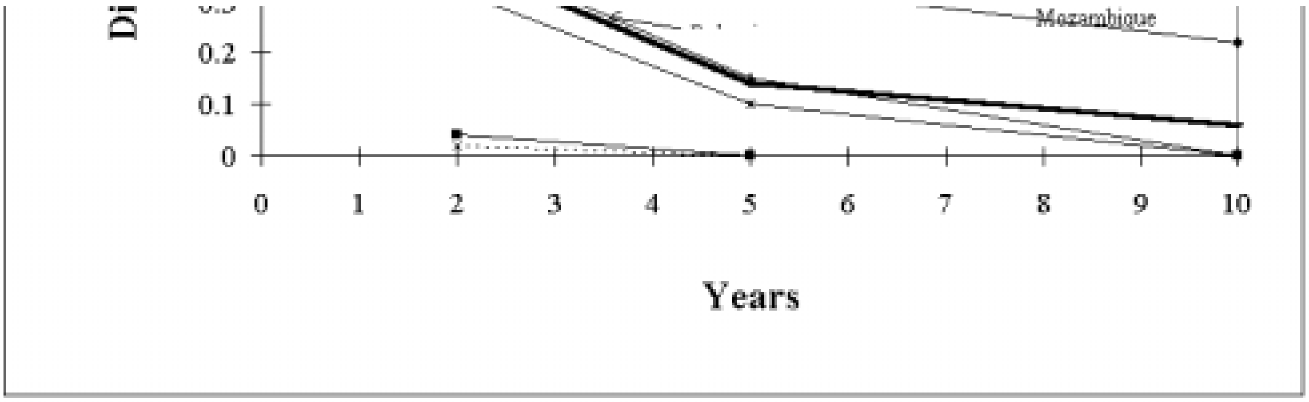






Back to [Previous Page]





Back to Previous Page

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