Valuing Human Life:

Estimating the Present Value of Lifetime Earnings, 2000

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Abstract

Objectives. This paper describes the methodology for estimating the present value of lifetime earnings (PVLE) for the year 2000.

Methods. Estimation takes into account life expectancy by gender and age group, percent of people in the labor force or keeping house, current pattern of earnings at successive ages, an imputed value for household production, and the discount rate.

Results. At a discount rate of 3 percent, males and females aged 20-24 have the highest PVLE — $1,517,045 and $1,085,188 respectively. Lifetime earnings for men are higher than for women. Higher discount rates yield lower values at all ages.

Conclusions. The present value of lifetime earnings yields useful estimates of the value of life. These estimates are conservative compared with other approaches.

1. Introduction

The value of human life is often expressed in terms of potential lifetime earnings, a measure of the productivity of an individual. This measure is used as a basic tool of the economist, program planner, decision-maker, and others who are interested in measuring the societal benefits associated with investments in particular programs to prevent, treat, or cure disease.

Quantification of human life values in economic terms is not a new concept. Dublin and Lotka traced this method from the valuation of slave labor in ancient times through the various estimates made by Sir William Petty in the 17th century and Adam Smith a century later up to the time of their first edition of their book, *Money Value of a Man* published in 1930 and revised in 1946 [9]. More than 35 years ago, the *American Journal of Public Health* published estimates of the "Economic Value of Human Life" [21]. Since that time, lifetime earnings have used by analysts in many cost-of illness studies. The value of human life concept has also been applied in the fields of life insurance [13], education [2,7,11,18] and health [10,15-17,20,22,27].

The aim of this paper is to describe the methodology for estimating the present value of lifetime earnings (PVLE), to present up-to-date estimates by gender and age (in 5-year age groups) and two discount rates (3 and 5 percent), and to discuss the use of this and other methods for valuing life in cost-of-illness studies. Presentation of the data in this form will enable analysts to choose the most appropriate series of data for program evaluation. For example, a health program to reduce mortality in a specific gender and age range can be evaluated by use of the lifetime earnings data developed for that group.

2. Methods

The method for estimating the PVLE takes into account life expectancy for different gender and age groups, the percent of people in the labor force or keeping house, the current pattern of earnings at successive ages, an imputed value of household production, and the discount rate. PVLE is calculated as follows:

$$PVLE_{y,g} = \sum_{n=y}^{85+} P_{y,g}(n)\,[Y_g(n)E_g(n) + Y^h_g(n)E^h_g(n)]^* (1+p)^{n-y}/(1+r)^{n-y} \quad (1)$$

where $PVLE_{y,g}$ is the present discounted value of lifetime earnings for a person of age y and gender g

$P_{y,g}(n)$ is the probability that a person of age y and gender g will survive to age n

y is the age of the person at present

g is the gender of the individual

n is the age of the person

$Y_g(n)$ is the mean annual earnings of an employed person of gender g and age n

$E_g(n)$ is the proportion of the population of gender g and age n that are employed in the labor market

$Y^h_g(n)$ is the mean annual imputed value of household production for a person of gender g and age n

$E^h_g(n)$is the proportion of the population of gender g and age n that are keeping house p is the rate of increase of labor productivity

r is the real discount rate

Following is a brief review of the basic assumptions, economic concepts, and sources of data used.

2.1. Life Expectancy

The PVLE estimates are based on the assumption that each cohort will follow his or her pattern of life expectancy at successive ages for males and females as reported in the U.S. Life Tables for 2000 by the National Center for Health Statistics [1]. Table 1 shows the data inputs for estimation of the PVLE for males and females. Column 1 shows the number of person-years lived within each age interval for a population of 100,000 males or females of each single year of age born alive, reflecting the life expectancy for that age group. These data were summed across age groups to obtain life expectancy for five year age intervals.

2.2. Labor Force Participation

Labor force participation rates assume that people will be working and productive during their expected lifetimes in accordance with the current pattern of work experience for their gender and age group. For this calculation, the percent of the population whose major activity in the past week was working at a job or business as reported in the 2000 National Health Interview Survey is used [6].

2.3. Earnings

Mean annual earnings for full-time, year-round workers are used, as reported in the 2000 Current Population Survey [25] for each 5-year age and gender group. The mean earnings are adjusted upward to account for fringe benefits and employer contributions to social insurance, assuming that these should be included as a measure of total output. The adjustment for wage supplements in 2000 amounted to 1.16, obtained from the US Bureau of Economic Analysis [3].

2.4. Percent Keeping House

The value of housekeeping services is included in order to realistically estimate the value of the lifetime productive contribution of persons, females and males, who perform such services. The percent of men and women whose major activity in the past week was "keeping house" was obtained from the 2000 National Health Interview Survey [6].

2.5. Value of Housekeeping Services

The value of household production is based on time-motion studies of housekeepers, in which the time spent in each activity is multiplied by the relevant market wages for the service performed. The value of housekeeping services for persons not in the labor force as well as for employed men and women is estimated using the methodology developed by Douglas, Kenny, and Miller, 1990 [8]. The values were updated to 2000 using the index of hourly compensation in the business sector reported by the Bureau of Labor Statistics [4].

2.6. Discounting

The arithmetic sum of lifetime earnings overstates the current year economic value of an individual. Determining the present discounted value of the future earnings stream is the appropriate way to measure economic value over time. The higher the discount rate, the lower the present value of a given stream of earnings. The PVLE estimated using discount rates of 3 and 5 percent are presented in Table 2.

2.7. Productivity Increases

While future earnings must be discounted to reflect lost interest, earnings in the future must be increased to reflect likely gains in productivity. It is an understatement of lifetime earnings to assume that a person ten years from now will earn the same amount

as a person of the same age and gender earns today. A 1 percent annual gain in productivity is assumed in calculating the PVLE.

2.8. Allowance for Consumption

There is a diversity of opinion regarding the treatment of consumption in estimating the value of human life. Insurance companies deduct consumption from a person's contribution to output. Dublin and Lotka [9] and Weisbrod [27] deducted consumption from total output in their calculations of earnings. In current cost-of-illness studies, the concern is with the total cost to society, not just the output an individual contributes in excess of consumption. However, the consensus of economists today is that consumption should not be deducted [12].

3. Findings

PVLE are estimated using an Excel 2000 spreadsheet-based program developed by the authors. Table 2 shows the present value of future lifetime earnings by age and gender discounted at 3 and 5 percent. The PVLEs for discount rates of one through 10 percent are available from the authors. The value of lifetime earnings varies at different ages and for men and women. For men and women, discounted expected lifetime earnings increase rapidly and sharply, peaking in the young adult years- ages 20 to 30 - and then decreasing at an even faster rate beginning in middle age. Older persons have relatively few remaining years of working life and those years are usually at lower earnings levels. At all ages, the imputed dollar value of housekeeping services is included for those who report keeping house. Thus, for males, the value of lifetime earnings discounted at 3 percent ranges from about $1.0 million for those under one year

of age to a peak of over $1.5 million at ages 20-24, and decreases to $2,835 at ages 85 and over.

Female earnings reveal a similar pattern, but at a lower level than for men. The value of lifetime earnings, discounted at 3 percent, ranges from $763,000 for those under one year of age to a peak of over $1 million at ages 20-24, and down to $778 at ages 85 and over. The PVLE for older women and men who have left the labor force consists of the imputed dollar value of their housekeeping services.

Men generally have higher lifetime earnings than women, reflecting their greater market earnings. At ages 20-24, the lifetime earnings of men are 40 percent higher than for women; at ages 65-69, men's lifetime earnings are twice that for women.

The higher the discount rate, the lower the values. Thus, lifetime earnings for men discounted at 5 percent peak at $1,107,047 while the maximum at 3 percent is $1,517,045. Similarly, for women the peak PVLE is $778,400 at 5 percent and $1,085,188 at 3 percent.

4. Discussion

Traditionally, lifetime earnings have been an important component of cost-of-illness studies that employ the human capital approach. This is an approach to valuing life in which productivity is based on market earnings and an imputed value for housekeeping services. In the human capital approach, a person is seen as producing a stream of output that is valued at market earnings and the value of life is measured as this discounted future earnings stream. Morbidity and mortality destroy labor, a valuable economic resource, by causing persons to lose time and effectiveness from work and other productive activities, forcing them out of the labor force completely, or bringing

about premature death. Thus, productivity losses comprise the indirect costs of illnesses for which resources are lost; the direct costs are those for which payments are made, i.e. hospital, home health, and nursing home care, physician services, and prescription drugs.

The human capital method has been criticized because it tends to underestimate costs; it values life using market earnings thereby yielding very low values for children and the retired elderly. It also undervalues life if labor market imperfections exist and wages do not reflect true abilities. In addition, psychosocial costs, such as pain and suffering, are components of illness omitted from the human capital computations of indirect costs.

Another approach to valuing human life is the willingness-to-pay approach, first proposed by Schelling [24] and Mishan [19]. The willingness-to-pay approach values life according to what individuals are willing to pay for a change that reduces the probability of illness or death. This method could be helpful in indicating how individuals value health and life, in deriving social preferences regarding public policy, and in assessing the burden of pain and suffering, which have an intangible quality not amenable to evaluation in terms of the monetary value of resources used or forgone. This method is influenced by the wealth (thus ability to pay) of the individual involved and it suffers from circularity because the values placed by individuals on government health programs are clearly influenced by those policies [23]. Willingness to pay measures ascribe a value of $160,000 per year of life in perfect health corresponding to an average value of $4.8 million for a "statistical life" assuming a 3 percent discount rate and a life expectancy at birth of 76 years [14]. This value of life of $4.8 million can be compared with our estimates of lifetime earnings (at a 3 percent discount rate) for peak-producing years at

ages 20-24 of $1.5 million for men and $1.1 million for women (see Table 2). Using the willingness- to-pay methodology in place of the human capital approach, the cost to society for various diseases could be at least five times greater.

Over the years, the costs of various diseases which were estimated employing the human capital approach have been cited in Congressional testimony, official reports, publications, or speeches as partial justification for the expansion of research in specific diseases. In recent years, Congress has expressed considerable interest in estimates of cost of diseases as one justification for allocating research dollars amongst the National Institutes of Health (NIH). For example, in 1995, in response to a request by the Senate Committee on Appropriations, NIH prepared a report showing estimates of the societal cost impact of the diseases on which NIH institutes, centers, and divisions conduct and support research. The first report was submitted to Congress in 1995, and subsequent reports were issued in 1997 and in February 2000 [26]. The latest report contains cost estimates for 60 diseases. The report states "cost-of- illness estimates do not provide a simple formula for the allocation of research resources. They cannot substitute for the well-informed judgment required to synthesize information about the broader dimensions of disease burden with knowledge of scientific opportunities in developing strategies and budgets for research and development programs. However, cost-of-illness estimates can provide order of magnitude indicators of the economic burden of particular diseases. While they should be interpreted with caution, cost-of-illness estimates can help decision-makers in Congress and in the Administration anticipate and respond to public interests" (page 4).

Another example of uses of COI estimates is the recent report of the Institute of Medicine (IOM) which recommended that in setting priorities, NIH should strengthen its analysis and use of health data, such as burdens and costs of diseases [5]. It is clear that NIH, IOM, and the Congress of the United States recognize the importance of COI estimates in setting research priorities.

5. Conclusions

The present value of lifetime earnings is a useful measure of the value of human life and productivity. Compared to other methods of valuing life such as the willingness-to-pay approach, the PVLE yields conservative and conceptually comprehensible estimates. The lifetime earnings presented in this paper are an essential tool for economists and health planners in developing indirect cost-of-illness estimates.

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TABLE 1- Inputs for Estimating the Present Value of Lifetime Earnings by Age and Gender, 2000

Age and Gender	Number of Persons[1]	With Earnings			Keeping House[3]	
		Percent of Population	Mean Earnings[2]	Value of Housekeeping Services	Percent of Population	Value of Housekeeping Services
Males						
<1	99,333	-	-	-	-	-
1-4	396,617	-	-	-	-	-
5-9	495,241	-	-	-	-	-
10-14	494,806	-	-	-	-	-
15-19	493,370	20.6	$20,138	$2,959	0.2	$7,378
20-24	490,361	75.2	29,315	4,652	0.8	9,071
25-29	486,846	88.6	42,565	5,314	0.5	9,733
30-34	483,289	91.2	54,110	5,917	0.5	10,335
35-39	478,957	91.8	59,981	6,342	0.7	10,761
40-44	472,949	89.7	64,017	6,486	0.4	10,905
45-49	464,066	88.5	68,981	6,520	0.4	10,939
50-54	451,313	85.1	66,364	6,520	0.3	10,939
55-59	433,126	75.0	73,108	6,696	0.3	11,115

60-64	406,367	53.6	66,366	6,696	0.4	11,115
65-69	368,518	29.1	65,055	6,696	0.4	11,115
70-74	317,033	16.6	68,474	4,768	0.6	7,914
75-79	252,099	9.5	50,918	3,242	1.1	5,382
80-84	176,440	5.4	42,464	1,884	0.3	3,127
85+	153,202	3.1	35,452	1,066	0.8	1,770
Females						
<1	99,454	-	-	-	-	-
1-4	397,229	-	-	-	-	-
5-9	496,115	-	-	-	-	-
10-14	495,772	-	-	-	-	-
15-19	496,075	22.8	18,539	7,274	2.7	15,612
20-24	493,960	67.8	24,555	8,544	12.8	16,882
25-29	492,681	72.8	34,128	11,036	16.9	19,374
30-34	491,092	71.5	38,431	12,736	19.7	21,075
35-39	488,795	72.9	40,294	13,404	17.8	21,743
40-44	485,330	75.1	41,580	12,905	14.4	21,244
45-49	480,248	76.1	40,556	11,886	12.7	20,224
50-54	472,696	71.4	41,476	11,970	13.5	20,309

55-59	461,199	60.7	38,973	12,001	15.0	20,339
60-64	443,363	39.6	35,765	12,101	15.0	20,440
65-69	416,753	17.4	35,001	11,799	13.8	19,929
70-74	378,647	9.4	30,483	8,401	11.9	14,189
75-79	325,325	4.2	26,856	5,712	10.1	9,649
80-84	253,384	2.7	22,701	3,319	9.1	5,606
85+	280,461	0.5	19,198	1,878	6.7	3,173

[1]Number of persons surviving at the beginning of the age group out of a population of 100,000 (for each year of age)

[2]Including wage supplements

[3]Not in the labor force

TABLE 2-Present Value of Lifetime Earnings by Age, Gender, and Discount Rate, 2000

Age and Gender	Discounted at 3 Percent	Discounted at 5 Percent
Males		
<1	$1,032,002	$484,478
1-4	1,085,807	534,842
5-9	1,187,240	637,670
10-14	1,310,689	775,028
15-19	1,437,691	931,390
20-24	1,517,045	1,057,041
25-29	1,507,221	1,107,047
30-34	1,419,293	1,087,015
35-39	1,274,801	1,012,436
40-44	1,095,701	900,684
45-49	886,824	752,933
50-54	661,956	578,860
55-59	433,642	388,814
60-64	237,765	216,091
65-69	119,286	109,541

70-74	56,213	52,292
75-79	23,280	21,769
80-84	10,460	9,901
85+	2,835	2,767
Females		
<1	763,468	371,396
1-4	803,012	409,872
5-9	877,833	488,566
10-14	968,928	593,695
15-19	1,051,945	704,002
20-24	1,085,188	775,771
25-29	1,041,050	778,400
30-34	950,088	736,723
35-39	832,609	667,837
40-44	695,718	576,288
45-49	547,161	467,465
50-54	392,402	344,916
55-59	243,840	219,113
60-64	128,221	116,832

65-69	59,505	54,630
70-74	26,327	24,382
75-79	11,089	10,367
80-84	4,531	4,314
85+	778	759