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# The Economic Cost of Illness Revisited

by BARBARA S. COOPER and DOROTHY P. RICE\*

In and out of government, determining the cost of illness is a major concern. The allocation of health care resources and the evaluation of current research and program efforts depend in large measure on such information. This article updates the 1963 benchmark study of the cost of illness. For the 16 major diagnostic categories of illnesses, the cost is presented in terms of the direct costs for prevention, detection, and treatment; the morbidity losses due to disability; and the mortality losses resulting from premature death. The method of calculating the cost of any illness is described, and data necessary for the calculation are provided.

In 1972, the estimated total cost of illness was \$188 billion: \$75 billion for direct costs, \$42 billion for morbidity, and \$71 billion for mortality. Diseases of the circulatory system were the most costly, representing about one-fifth of all costs of illness.

ESTIMATING the economic cost of illness has been a matter of great interest for a number of years. These estimates are used by health planners for a variety of purposes: In cost-effectiveness analysis to determine the most efficient treatment for a particular disease; in cost-benefit analysis to justify or bolster program expenditures; or for comparisons among diseases. The Department of Health, Education, and Welfare alone is currently funding about a dozen different studies on the cost of specific diseases. Subsequent comparisons of the cost of these 12 diseases may not be valid, however, since such costs, when they are calculated independently, are often based on differing methodologies.

About 9 years ago, to establish comparability in disease costs, Dorothy P. Rice prepared a study on estimating the cost of illness,<sup>1</sup> which spelled out in great detail the methodology for costing the major diagnostic categories. Recent changes

in treatment modes, disease incidence, and earnings distributions, as well as the development of some new theoretical approaches, indicated a need for more current data. This paper updates the earlier study. It presents findings for 1972, a brief description of the methodology, and a demonstration of the application of its methods and results to calculating costs for more specific disease categories.

## BACKGROUND

The economic cost of illness is measured in terms of the direct outlays for prevention, detection, and treatment and the indirect costs or loss in output due to disability (morbidity) and premature death (mortality). These are the costs to society rather than to the sick individuals or their families. Only the indirect costs resulting from lost earnings, however, represent losses to the gross national product (GNP). The losses due to illness of housewives who cannot perform their housekeeping duties are not part of the GNP, because nonmarket labor is not a part of GNP.

One major category of costs is omitted here—that of pain and suffering. No one has successfully quantified this dimension of illness, yet some diseases impose more pain and suffering than others. The cost relationship among diseases is thus not completely correct.<sup>2</sup> But though this aspect of illness cannot be taken fully into account, it is undoubtedly reflected in the allocation of resources. The pain connected with cancer is probably partly responsible for the relatively large appropriation of Federal funds to this disease. The Federal Budget shows cancer receiving about 18 percent of 1975 Federal research dollars even though the disease represents only 5 percent of the total cost of illness.

Two other categories of cost were purposefully

Social

Cost = direct  
Dx, Rx  
2. indirect  
loss in  
output

ONLY GNP factors  
no housewives  
pain/suffering  
transfer  
taxes

\*Office of Research and Statistics, Social Security Administration. Adapted from a paper presented at the annual American Public Health Association meetings in Chicago, Ill., November 20, 1975.

<sup>1</sup>Dorothy P. Rice, *Estimating the Cost of Illness* (Health Economics Series No. 6), U.S. Public Health Service, 1968.

<sup>2</sup>Rashi Fein, "Definition and Scope of the Problem: Economic Aspects," *Assessing the Effectiveness of Child Health Services* (A.B. Bergman, editor), Ross Laboratories, 1967, pages 44-50.

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Social loss - the "intangibles"  
loss of self-esteem  
loss of love of family & friends  
Family disintegration  
Mental anguish

omitted—transfer payments and taxes. When income loss is used as a measure of indirect costs, adding pension or relief payments would be double counting. As for tax payments, it would be double counting to add income tax losses to loss of earnings and triple counting if the tax receipts were used for public payments for medical care.

### DIRECT COSTS

The direct cost of illness represents expenditures for prevention, detection, treatment, rehabilitation, research, training, and capital investment in medical facilities. The Social Security Administration annually publishes estimates of such spending by type of expenditure—that is, hospital care, physicians' services, etc., and source of funds. The Social Security Administration estimates that in 1972 health expenditures—direct costs—exceeded \$90 billion.\* Not all of these outlays can or should be allocated by disease category. As shown below, about four-fifths or more than \$75 billion was distributed, by diagnosis.

Type of expenditure	Amount (in millions)	Percentage distribution
Total.....	\$90,391	100.0
Allocated by diagnosis.....	75,231	83.2
Hospital care.....	34,219	37.0
Physicians' services.....	16,916	18.7
Dentists' services.....	5,561	6.2
Other professional services.....	1,717	1.9
Drugs and drug sundries.....	8,028	9.0
Eyeglasses and appliances.....	1,596	2.1
Nursing-home care.....	6,274	6.9
Not allocated.....	15,161	16.8
Expenses for prepayment and administration.....	2,697	4.1
Government public health activities.....	1,664	2.0
Other health services.....	3,306	3.7
Research.....	2,173	2.4
Construction.....	4,150	4.6

Under the general methodology used here to allocate direct expenditures by diagnosis the total expenditure for each type of service was distributed by a consistent source of data on utilization and costs (see methodology section for details).

Of the \$75 billion allocated for direct costs, diseases of the digestive system represented the

\* Nancy L. Worthington, *National Health Expenditures, Calendar Year 1929-73* (Research and Statistics Note No. 1), Social Security Administration, Office of Research and Statistics, 1975.

largest share—14.8 percent (table 1). Half these funds, however, went for dentists' services, classified in this category. Diseases of the circulatory system were the next costly (14.5 percent), followed by mental disorders (9.3 percent).

The largest item of expenditure is for hospital care, representing 45 percent of all allocated outlays. Most of these outlays occur in community hospitals, but a sizable portion—about one-tenth—is spent in psychiatric hospitals. As a result, mental disorders, along with diseases of the circulatory system, showed the highest hospital bills—\$5.3 million each.

Physicians' services represent the second largest direct cost—\$16.9 billion. Although a different source of data was used here to distribute outlays for physicians' services, the findings confirm those recently reported by the National Center for Health Statistics (NCHS)—the largest portion of physicians' services is not for a specific illness.<sup>4</sup> More than one-fourth of the expenditures for doctors' care went for "special conditions without sickness" and for "symptoms and ill-defined conditions," classified here as "other." The next largest categories (both at about one-tenth of all spending for physicians' services) were respiratory diseases and those of the circulatory system.

Nearly two-fifths of the expenditures for other professional services (with dentists excluded) were for diseases of the nervous system and sense organs, reflecting the large portion of this category spent for optometrists' services. Chiropractors account for another big share of this category, allocated to diseases of the musculoskeletal system and connective tissues.

Spending for out-of-hospital drugs and drug sundries (\$8.0 billion) is largely for persons with diseases of the respiratory and circulatory systems and those with no specific illness. Dental services (\$5.6 billion) were all classified with digestive diseases; eyeglasses and appliances (\$1.9 billion) were classified under diseases of the nervous system and sense organs. The remaining expenditures (\$6.3 billion) went for nursing-home care, with two-fifths of the expenditures spent for diseases of the circulatory system.

<sup>4</sup> National Center for Health Statistics, *Physician Visits, Volume and Interval Since Last Visit, United States, 1971* (Vital and Health Statistics Series 10, No. 97), 1975.

TABLE 1.—Direct costs, by diagnosis, 1972

Total.....	100.0
Infective and parasitic diseases.....	1.0
Neoplasms.....	1.0
Endocrine, nutritional, and metabolic.....	1.0
Diseases of the blood and blood-forming organs.....	1.0
Mental disorders.....	9.3
Diseases of the nervous system and sense organs.....	14.8
Diseases of the circulatory system.....	14.5
Diseases of the respiratory system.....	14.5
Diseases of the digestive system.....	14.5
Diseases of the genitourinary system.....	14.5
Complications of pregnancy, childbirth, and the puerperium.....	14.5
Diseases of the skin and subcutaneous tissue.....	14.5
Diseases of the musculoskeletal system and connective tissue.....	14.5
Congenital anomalies.....	14.5
Accidents, poisonings, and violence.....	14.5
Other.....	14.5
Total.....	100.0
Infective and parasitic diseases.....	1.0
Neoplasms.....	1.0
Endocrine, nutritional, and metabolic.....	1.0
Diseases of the blood and blood-forming organs.....	1.0
Mental disorders.....	9.3
Diseases of the nervous system and sense organs.....	14.8
Diseases of the circulatory system.....	14.5
Diseases of the respiratory system.....	14.5
Diseases of the digestive system.....	14.5
Diseases of the genitourinary system.....	14.5
Complications of pregnancy, childbirth, and the puerperium.....	14.5
Diseases of the skin and subcutaneous tissue.....	14.5
Diseases of the musculoskeletal system and connective tissue.....	14.5
Congenital anomalies.....	14.5
Accidents, poisonings, and violence.....	14.5
Other.....	14.5

### MORBIDITY COSTS

Morbidity losses result in absence from work of a housewife from per day of disability that produces a loss of earnings at all. The lost earnings are the unperformed labor, the morbidity costs.

Calculation of morbidity losses requires knowing average earnings in each year, attaching a value to each day of services and applying labor-force data, by age and sex, to institutions who are kept at home.

These procedure steps and issues. Calculation of the value of such measurement

Keene cott Copper (Emus Cook - 1976)  
 A/C = 5/1 Sickness & Accident  
 A/C = 3/1 hospital & Surgical  
 A/C Frequency rates (Dupont) = 220

Decreased 55% after Program  
 In year 1970 9 million Alcoholics - 10% under treatment

Alcoholics in work force of US (3% to 6.5%)  
 5.9% Federal work force (another 10% have drinking problem)  
 2.5 x as much absenteeism (22 days/year loss of work)

TABLE 1.—Direct costs, selected categories: Estimated amount and percentage distribution, by type of expenditure and diagnosis, 1972

Diagnosis	Total	Hospital care	Physicians' services	Dentists' services	Other professional services	Drugs and drug sundries	Eye-glasses and appliances	Nursing-home care	Amount (in millions)									
									10 days/yr (20-30%)									
Total	\$75,231	\$34,219	\$19,916	\$3,581	\$1,717	\$8,828	\$1,896	\$6,724										
Infective and parasitic diseases	1,412	600	233		8	192		222										
Neoplasms	3,872	2,937	526		47	186		154										
Endocrine, nutritional, and metabolic diseases	8,438	920	1,294		28	899		828										
Diseases of the blood and blood-forming organs	491	228	181		4	77		31										
Mental disorders	8,963	5,261	683		9	654		556										
Diseases of the nervous system and sense organs	8,947	1,033	1,294		655	594	1,896	478										
Diseases of the circulatory system	10,919	8,271	1,674		86	1,440		2,561										
Diseases of the respiratory system	5,931	2,478	1,851		30	644		117										
Diseases of the digestive system	11,100	3,968	853	8,681	43	644		156										
Diseases of the genitourinary system	4,471	2,699	1,069		34	671		78										
Complications of pregnancy, childbirth, and the puerperium	2,807	2,331	161		30	85												
Diseases of the skin and subcutaneous tissue	1,225	488	656		8	354		412										
Diseases of the musculoskeletal system and connective tissue	8,638	1,661	770		368	625		18										
Congenital anomalies	861	313	44		8	8												
Accidents, poisonings, and violence	8,121	3,184	1,222		88	332		375										
Other	7,868	794	4,292		228	1,271		716										
									Percentage distribution									
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0										
Infective and parasitic diseases	1.9	1.9	2.0		.8	2.2		3.5										
Neoplasms	5.1	8.6	8.1		2.7	2.2		2.5										
Endocrine, nutritional, and metabolic diseases	4.8	2.7	7.8		1.5	10.0		5.2										
Diseases of the blood and blood-forming organs	.7	.7	.9		.2	.9		.8										
Mental disorders	9.8	15.4	4.0		.5			8.8										
Diseases of the nervous system and sense organs	7.9	8.0	7.8		88.1		100.0	7.5										
Diseases of the circulatory system	14.5	18.4	9.9		8.0			41.1										
Diseases of the respiratory system	7.9	7.2	10.9		1.7			1.9										
Diseases of the digestive system	14.8	11.7	8.9	100.0	2.5	5.1		2.5										
Diseases of the genitourinary system	5.9	7.9	6.4		2.0	6.0		1.2										
Complications of pregnancy, childbirth, and the puerperium	3.8	6.8	.9		2.1	1.0												
Diseases of the skin and subcutaneous tissue	2.0	1.1	2.9		.3	4.1		6.7										
Diseases of the musculoskeletal system and connective tissue	4.8	4.9	4.6		21.4	4.9		1.2										
Congenital anomalies	.8	.9	.1		.2	.1		.1										
Accidents, poisonings, and violence	8.8	9.2	7.2		2.2	4.1		9.1										
Other	9.8	2.8	28.4		15.9	14.7		8.3										

2 1/2 x mortality rate

MORBIDITY COSTS

Morbidity losses are incurred when illness results in absence from employment, prevents a housewife from performing her duties, or results in disability that prevents someone from working at all. The lost earnings and the dollar value of the unperformed housekeeping services are the morbidity costs.

Calculation of morbidity costs involves applying average earnings by age and sex to work-loss years, attaching a dollar value to housewives' services and applying it to their bed-days, and applying labor-force participation rates and earnings, by age and sex, to persons in and out of institutions who are too sick to be employed or keep house.

These procedures involve several economic concepts and issues. One issue concerns measurement of the value of housewives' services. Because such measurement is difficult, it is often omitted

from these types of analysis. Such omission, however, produces serious underestimates of the value of women and the costs of diseases associated with them.

In the earlier Rice study,\* all housewives were given the value of a domestic servant—an assumption considered an underestimate. More recently, the Social Security Administration has examined other approaches to the problem, primarily the market-cost and opportunity-cost approaches.† Briefly, the opportunity-cost approach assumes the economic value of unpaid work to be at least as much as the wage rate that the same person would command in the market place. In essence, if a woman chooses housework over employment, the housework must be equal to or greater than

\* Dorothy P. Rice, *op. cit.*  
 † Wendy H. Brady, *Economic Value of a Housewife* (Research and Statistics Note No. 9), Social Security Administration, Office of Research and Statistics, 1975.

the value of the employment.<sup>1</sup> If this approach were used here, however, it would not be consistent with the approach used for the employed population where what one does is valued rather than what one could be doing. A physician in research or academia, for example, could earn much more in private practice, yet only his earnings as a researcher or teacher are counted. To be consistent, the market-value approach was used here.

This approach values each duty a housewife performs. Based on a time-motion study of housewives, the relevant market wages for various services performed were multiplied by the hours reported for doing that service.<sup>2</sup> That figure represents an estimate of the cost of replacing the housewife's duties with person-hours from the labor force to do the same work. It takes into account the housewife's age, number of children, and age of youngest child. The psychic value of a housewife to her family or society was not considered in this calculation. Such measurement would involve obvious difficulties.

Another issue is the treatment of persons too sick to be in the labor force or keeping house. If these persons were well, not all of them would be employed or keeping house. Some would not be able to secure employment, some would be in school, and some would choose a life of leisure. It was assumed here that if these persons had been able to work, they would have had the same labor-force experience as the general population. The assumption was that a theoretical influx of these persons into the labor force would not depress the employment rates or earnings levels. The employment rates applied were for 1970—the last year of full employment, now defined at about 5 percent unemployment.<sup>3</sup> Without the assumption

<sup>1</sup> Reuben Gronau, "The Measurement of Output of the Nonmarket Sector: The Evaluation of Housewives' Time," in *The Measurement of Economic and Social Performance*, National Bureau of Economic Research, 1973.

<sup>2</sup> Katherine E. Walker and William H. Ganger, "The Dollar Value of Household Work," *Information Bulletin No. 60*, New York College of Human Ecology, Ithaca, 1973.

<sup>3</sup> According to the statements of many economists presented in *Reducing Unemployment to 2 Percent* (Hearings Before the Joint Economic Committee, 92d Cong., 2d sess., October 17-18, and 20, 1972), full employment falls between 4.5 and 5 percent unemployment. The presence of more women and youth in the labor force adds 0.5 percent to the original 4-percent figure and the effect of inflation adds somewhat more.

of full employment, losses because of disability could not be isolated from losses because of unemployment.<sup>4</sup> Mean annual earnings by age and sex for 1972 were applied. These annual earnings, 1970 employment rates, and housekeeping values are shown below.

Age	Percent employed, 1972		Mean earnings, 1972		Housewife	
	Men	Women	Men	Women	Percent of female population, 1970	Mean value, 1972
15-19.....	31.57	73.51	\$4,590	\$4,194	7.21	\$5,299
20-24.....	53.50	48.00	7,921	5,884	24.53	6,061
25-29.....	35.61	40.55	10,574	7,455	32.36	6,417
30-34.....	90.26	37.46	12,892	7,423	34.35	6,418
35-39.....	90.97	43.63	13,922	7,250	49.77	8,592
40-44.....	90.29	47.74	14,875	7,341	44.99	8,908
45-49.....	89.57	50.35	14,382	7,306	40.93	8,222
50-54.....	87.89	48.98	13,861	7,387	42.15	8,222
55-59.....	83.63	46.53	13,309	7,094	41.81	8,618
60-64.....	73.61	37.87	12,259	7,052	44.47	9,942
65 and over.....	26.99	10.43	9,062	5,456	31.88	1,333

When morbidity costs are allocated by diagnosis, several methodological problems also arise. Chief among these is the reliance on patients for diagnostic information. Data on productivity losses for the noninstitutional population is based on information from the National Health Survey, which is a household interview survey. Use of this source undoubtedly results in conservative estimates for some diseases and overstatements for others. Losses for diseases such as cancer are probably understated. The household respondent can report only the information given to the family by the physician. The respondent may not have been told what the condition was. In other cases, the respondent may have misunderstood or forgotten what the physician said. For conditions not medically attended, such as diseases of the respiratory system, the diagnostic information supplied by the respondent may indicate only a symptom, and the result is a possible overstatement of morbidity and of losses.

The presence of multiple diseases also creates problems in allocation by diagnosis. The data from the National Health Survey include multiple listing of conditions. These data were uniformly adjusted downward to yield an unduplicated total, but this procedure assumes that all associated conditions are evenly distributed, which is obvi-

<sup>4</sup> Selma J. Mushkin, "Health as an Investment," *Journal of Political Economy*, October 1962, Part 2, Supplement, pages 129-157.

TABLE 2.—Morbidity o

Total.....
Infective and parasitic diseases
Neoplasms.....
Endocrine, nutritional, and Diseases of the blood and lymphatic system
Mental disorders.....
Diseases of the nervous system
Diseases of the respiratory system
Diseases of the digestive system
Diseases of the genitourinary system
Complications of pregnancy
Diseases of the skin and subcutaneous tissue
Diseases of the musculoskeletal system
Congenital anomalies.....
Accidents, poisonings, and other.....

Total.....

Infective and parasitic diseases
Neoplasms.....
Endocrine, nutritional, and Diseases of the blood and lymphatic system
Mental disorders.....
Diseases of the nervous system
Diseases of the respiratory system
Diseases of the digestive system
Diseases of the genitourinary system
Complications of pregnancy
Diseases of the skin and subcutaneous tissue
Diseases of the musculoskeletal system
Congenital anomalies.....
Accidents, poisonings, and other.....

ously not the case. For example, are multiple causes secondary causes

#### Noninstitutional

In 1972, employment equivalent of 1.7 million ill-health—a loss of 1.7 million persons (tables 2 and 3). Diseases of the respiratory system far the greatest loss, both the years 1970 and 1972 were next with 1.1 million persons.

Women usual million persons.

<sup>5</sup> Another calculation to illness estimate Price, "Cash Benefits Social Security II

TABLE 2.—Morbidity costs: Estimated amount and percentage distribution, by labor-force status and diagnosis, 1972

Diagnosis	Total	Noninstitutional			Institutional	
		Total	Currently employed	Keeping house		Unable to work
Amount (in millions)						
Total	\$42,373	\$34,118	\$17,619	\$3,295	\$15,204	\$6,234
Infective and parasitic diseases	1,200	977	899	119	184	228
Neoplasms	862	820	438	104	278	42
Endocrine, nutritional, and metabolic diseases	1,137	1,027	214	91	722	110
Diseases of the blood and blood-forming organs	230	208	78	82	98	17
Mental disorders	6,179	2,210	896	98	1,716	3,999
Diseases of the nervous system and sense organs	3,944	3,752	450	137	2,765	192
Diseases of the circulatory system	6,417	5,389	1,781	495	3,313	828
Diseases of the respiratory system	7,089	7,040	5,083	845	1,110	49
Diseases of the digestive system	2,606	2,547	1,501	245	801	59
Diseases of the genitourinary system	1,249	1,226	745	234	247	23
Complications of pregnancy, childbirth, and the puerperium	245	245	79	166	.....	.....
Diseases of the skin and subcutaneous tissue	460	456	333	18	83	4
Diseases of the musculoskeletal system and connective tissue	5,103	4,919	1,666	362	2,601	184
Congenital anomalies	238	232	12	12	208	8
Accidents, poisonings, and violence	3,883	3,794	3,058	242	494	89
Other	1,494	1,063	45	96	493	411
Percentage distribution						
Total	100.0	100.0	100.0	100.0	100.0	100.0
Infective and parasitic diseases	2.8	2.7	3.8	3.6	1.2	3.7
Neoplasms	2.0	2.3	2.5	3.2	1.8	.7
Endocrine, nutritional, and metabolic diseases	2.7	2.8	1.2	2.8	4.7	1.8
Diseases of the blood and blood-forming organs	.5	.5	.4	1.0	.6	.2
Mental disorders	14.6	6.1	2.2	3.0	11.3	64.0
Diseases of the nervous system and sense organs	9.3	10.4	4.8	4.2	18.2	3.1
Diseases of the circulatory system	15.2	15.4	10.1	15.0	21.8	13.3
Diseases of the respiratory system	16.7	19.5	29.0	25.8	7.3	.8
Diseases of the digestive system	6.2	7.1	8.2	7.4	5.3	1.0
Diseases of the genitourinary system	3.0	3.4	4.2	7.1	1.6	.4
Complications of pregnancy, childbirth, and the puerperium	.6	.7	.4	5.0	.....	.1
Diseases of the skin and subcutaneous tissue	1.1	1.3	2.0	.1	.5	.....
Diseases of the musculoskeletal system and connective tissue	12.1	13.6	11.0	11.0	17.7	3.0
Congenital anomalies	.6	.6	.1	.1	1.4	.1
Accidents, poisonings, and violence	9.2	10.5	17.4	7.3	3.2	2.8
Other	3.6	3.0	2.8	2.9	3.2	6.6

ously not the case. Heart disease conditions, for example, are much more likely than cancer to be secondary causes of disability.

#### Noninstitutional Losses

In 1972, employed men and women lost the equivalent of 1.7 million years of work because of ill-health—a loss to our economy of \$17.6 billion (tables 2 and 3).<sup>11</sup> Colds, influenza, and other diseases of the respiratory system resulted in by far the greatest losses—about three-tenths for both the years and the dollar amount. Accidents were next with about 17 percent of the losses.

Women usually keeping house had close to 1 million person-years of disability at a value of

\$3.3 billion. Respiratory illness was again the major cause, claiming 26 percent of their losses. Circulatory diseases followed with 18 percent of the lost years and 15 percent of the monetary costs.

The population unable to work suffered 1.7 million years of disability, losing \$15.2 billion in earnings or housework values. More than one-fifth (\$3.3 billion) were the result of diseases of the circulatory system. Blindness, deafness, and other diseases of the nervous system and sense organs cost \$2.8 billion; arthritis, rheumatism, and other diseases of the musculoskeletal system cost another \$2.7 billion.

These three noninstitutional population groups combined—currently employed, keeping house, and unable to work—lost 4.3 million person-years of productivity, a cost to the Nation of \$36.1 billion. Nearly half this loss was due to illness attacking three body systems—respiratory, circulatory, and musculoskeletal.

<sup>11</sup> Another calculation of work-related income loss due to illness estimates \$10.4 billion for 1972. See Daniel N. Price, "Cash Benefits for Short-Term Sickness, 1973," *Social Security Bulletin*, March 1975, pages 12-14.

### Institutional Losses

The Bureau of the Census reports 1.7 million persons residing in illness-related institutions in 1970. Since no later data exist, this number was assumed for 1972. Application of employment and keeping-house rates for 1970 (the last year of full employment) by age and sex yielded a total of 1.1 million person-years lost to productivity. More than one-third of the institutional residents and about one-half of the person-years lost were in homes for the aged, but the largest monetary losses—\$2.7 billion—were for persons in mental hospitals. The younger population in mental hospitals and their higher earnings account for this difference, displayed below.

Type of Institution	Number of persons	Person-years lost (in thousands)	Indirect costs (in millions)
Total.....	1,670,167	1,106	\$4,203
Homes for:			
Aged.....	628,633	816	1,483
Blind.....	8,949	2	14
Deaf.....	8,911	1	6
Mentally handicapped.....	201,922	82	939
Other physically handicapped.....	6,879	4	23
Nursing homes.....	298,881	148	608
Hospitals:			
Chronic disease.....	67,130	38	301
Mental disease.....	433,840	203	2,713
Tuberculosis.....	16,912	12	118

Allocation of institutional losses by diagnosis was made largely on the basis of the type of institution. All losses in mental hospitals and homes and schools for the mentally retarded were classified under mental disorders; those in tuberculosis hospitals were under infective and parasitic diseases; those in institutions for the blind or deaf under diseases of the nervous system and sense organs; and other physically handicapped under diseases of the bones and organs of movement. The distribution of losses for persons in chronic disease hospitals and nursing homes was based on data from NCHS showing the number of residents in homes with intensive and with limited nursing care, by diagnosis. The Center's diagnostic distribution of residents in homes with personal care or no nursing care was used for homes for the aged.<sup>12</sup> Not surprisingly, two-thirds

<sup>12</sup> National Center for Health Statistics, *Charges for Care and Sources of Payment for Residents in Nursing Homes, United States, June-August 1969* (Vital and Health Statistics Series 12, No. 21), 1974.

or \$4 billion of the morbidity costs for the institutional population was for mental disorders. The next largest category was circulatory diseases, comprising 13 percent.

### MORTALITY COSTS

Measurement of mortality costs—losses due to premature death—has aroused much discussion in recent years. Attaching a dollar figure to death—that is, determining how much a life is worth—is an emotion-laden issue. Some economists refuse to make such a determination, claiming life is priceless.<sup>13</sup> Nevertheless, whenever public spending decisions are made, values are implicitly attached to life.

Jan Acton, in a recent report, delineated five basic approaches to evaluating life-saving programs: (1) Values implicit in past decisions, (2) explicit statements of political representatives or their designees, (3) implicit values of individuals, (4) explicit statements of value by individuals ("willingness to pay"), and (5) the livelihood ("human capital") approach.<sup>14</sup> The first three approaches have too many drawbacks to be seriously considered in a cost of illness study. In discussing these three approaches, Herbert Klarman pointed out that "Life insurance holdings are clearly not applicable to bachelors and jury verdicts are inconsistent. The implications of public policy decisions or governmental spending are difficult to elicit in the absence of information on the alternatives that faced the decision makers. Moreover, such valuation may lack stability and consistency."<sup>15</sup>

The fourth approach—"willingness to pay"—was first proposed in 1968 by Thomas Schelling.<sup>16</sup>

<sup>13</sup> Richard M. Titmuss, *The Gift Relationship*, Pantheon Books, 1971.

<sup>14</sup> Jan Paul Acton, *Measuring the Social Impact of Heart and Circulatory Disease Programs: Preliminary Framework and Estimates*, Rand Corporation, April 1975. See also Jan Paul Acton, *Evaluating Public Programs To Save Lives: The Case of Heart Attacks*, Rand Corporation, January 1973.

<sup>15</sup> Herbert E. Klarman, "Application of Cost-Benefit Analysis to the Health Services and the Special Case of Technologic Innovation," *International Journal of Health Services*, Spring 1974.

<sup>16</sup> Thomas C. Schelling, "The Life You Save May Be Your Own," in *Problems in Public Expenditure* (S. H. Chase, Jr., editor), The Brookings Institution, 1965.

TABLE 3.—Morbidity and diagnosis, 1972

Total.....	
Infective and parasitic diseases.....	
Neoplasms.....	
Endocrine, nutritional, and metabolic diseases.....	
Diseases of the blood and lymphatic system.....	
Mental disorders.....	
Diseases of the nervous system.....	
Diseases of the circulatory system.....	
Diseases of the respiratory system.....	
Diseases of the digestive system.....	
Diseases of the genitourinary system.....	
Complications of pregnancy.....	
Diseases of the skin and subcutaneous tissue.....	
Diseases of the musculoskeletal system.....	
Congenital anomalies.....	
Accidents, poisonings, and other.....	
Total.....	
Infective and parasitic diseases.....	
Neoplasms.....	
Endocrine, nutritional, and metabolic diseases.....	
Diseases of the blood and lymphatic system.....	
Mental disorders.....	
Diseases of the nervous system.....	
Diseases of the circulatory system.....	
Diseases of the respiratory system.....	
Diseases of the digestive system.....	
Diseases of the genitourinary system.....	
Complications of pregnancy.....	
Diseases of the skin and subcutaneous tissue.....	
Diseases of the musculoskeletal system.....	
Congenital anomalies.....	
Accidents, poisonings, and other.....	

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<sup>17</sup> See Gary Fr in *Measuring He Dorfmann, editor) E. J. Mishan, C Pre ger Publish*

TABLE 3.—Morbidity losses: Estimated person-years lost to productivity and percentage distribution, by labor-force status and diagnosis, 1972

Diagnosis	Total	Noninstitutional			Institutional	
		Total	Currently employed	Keeping house		Unable to work
Number (in thousands)						
Total.....	5,431	4,325	1,748	834	1,743	1,108
Infective and parasitic diseases.....	164	119	73	26	17	45
Neoplasms.....	115	104	46	26	33	11
Endocrine, nutritional, and metabolic diseases.....	157	128	20	27	78	81
Diseases of the blood and blood-forming organs.....	34	30	11	7	13	3
Mental disorders.....	720	237	40	22	175	483
Diseases of the nervous system and sense organs.....	482	429	77	38	314	63
Diseases of the circulatory system.....	913	640	157	182	371	233
Diseases of the respiratory system.....	840	825	534	194	98	18
Diseases of the digestive system.....	256	262	143	64	75	18
Diseases of the genitourinary system.....	164	158	85	48	26	6
Complications of pregnancy, childbirth, and the puerperium.....	48	48	12	27	8	1
Diseases of the skin and subcutaneous tissue.....	38	38	34	4	400	61
Diseases of the musculoskeletal system and connective tissue.....	728	677	171	106	20	2
Congenital anomalies.....	26	24	1	3	53	24
Accidents, poisonings, and violence.....	438	414	294	67	81	129
Other.....	265	136	81	24	81	129
Percentage distribution						
Total.....	100.0	100.0	100.0	100.0	100.0	100.0
Infective and parasitic diseases.....	3.0	2.7	4.2	3.4	1.0	4.2
Neoplasms.....	2.1	2.4	2.6	3.1	1.9	1.0
Endocrine, nutritional, and metabolic diseases.....	2.9	2.9	1.2	3.2	4.5	2.8
Diseases of the blood and blood-forming organs.....	.6	.7	.6	.8	.7	.3
Mental disorders.....	13.3	5.5	2.3	2.6	10.0	43.7
Diseases of the nervous system and sense organs.....	8.9	10.0	4.4	4.5	18.0	4.8
Diseases of the circulatory system.....	16.8	15.7	9.0	18.2	21.3	21.1
Diseases of the respiratory system.....	15.5	19.0	30.5	23.2	5.6	1.4
Diseases of the digestive system.....	5.5	6.5	8.2	7.6	4.3	1.6
Diseases of the genitourinary system.....	3.0	3.7	4.9	5.7	1.5	.8
Complications of pregnancy, childbirth, and the puerperium.....	.9	1.1	.7	3.2	.8	.1
Diseases of the skin and subcutaneous tissue.....	.7	.9	1.9	.5	23.0	4.6
Diseases of the musculoskeletal system and connective tissue.....	13.4	15.8	9.8	12.7	1.1	.2
Congenital anomalies.....	.5	.6	.1	.3	3.0	2.2
Accidents, poisonings, and violence.....	8.1	9.6	16.8	8.0	4.6	11.7
Other.....	4.9	3.1	2.9	2.8	4.6	11.7

It measures the value of human life by the amount people are willing to spend to buy a specified reduction in the probability of death or disability. The Acton report is the only known published survey of willingness to pay for health programs, but several other economists advocate that approach.<sup>17</sup>

Such a survey permits the respondents to register different relative preferences for different health outcomes and different diseases, as well as the relative attractiveness of these outcomes in comparison with those for nonhealth goods that could be purchased for the same amount. The major drawback of the approach is the likelihood that the respondents may not grasp the question's meanings, and considerable uncertainty exists about the validity and consistency of the

<sup>17</sup> See Gary Fromm, "Civil Aviation Expenditures," in *Measuring Benefits of Government Investment* (A. Dorfman, editor), The Brookings Institution, 1965, and E. J. Mishan, *Cost-Benefit Analysis, An Introduction*, Praeger Publishers, 1971.

responses since this method has not been frequently employed. On a day when someone has stomach pains, for example, programs to combat digestive diseases may be "worth" far more than they are on a day when that person has a respiratory ailment. Furthermore, how do the respondents perceive the differences between a 1-percent reduction in the probability of death and a 0.1-percent reduction? Because of the infant state of the art and the concerns about its accuracy, that approach was not used here.

Mortality costs were calculated here on the basis of the "human capital" approach. This approach values one's life according to one's earnings or, in the case of housewives, according to the market value of one's duties. It is the most commonly used formal method and dates back to 1915.<sup>18</sup> There have been objections to this approach because it assumes that changes in earn-

<sup>18</sup> Edgar Crammond, "The Cost of the War," *Journal of the Royal Statistical Society* (Series A), May 1915.

ings streams bear a direct relationship to what society values in health program outputs: Men are valued higher than women, whites higher than other races, and those in the employed ages higher than the very young and very old. Nevertheless, if one is aware of the shortcomings, this method can be used and, in fact, is the only method today that yields consistent, reliable numbers.

Under the human capital approach, calculation of mortality costs considers earnings over a lifetime rather than a single year since, if an individual had not died in 1972, he would have continued to be productive for a number of years. It is the present value of these future losses that is the appropriate measure.

The estimating procedure for the development of lifetime earnings was described in detail in the earlier Rice report. Except for the treatment of housewives, discussed previously, the procedure used here was essentially the same. The method developed takes into account life expectancy for different age, sex, and race groups, varying labor-force participation rates, the current changing pattern of earnings at successive ages, imputed value of housewives' services, and the discount rate.<sup>19</sup> The basic assumptions and economic concepts employed are described here in the methodology section. Mortality costs were developed for two net discount rates—4 percent and 6 percent. Lifetime earnings at these rates are shown in table 4 by age, sex, and race.

#### Findings

In 1972, there were nearly 2 million deaths representing over 33 million years lost (table 5). Total years lost are estimated by multiplying the number of deaths in each age, sex, and race group by the expected number of years (the life expectancy) remaining to persons in the midyear of that group. Application of lifetime earnings to the deaths yielded more than \$71 billion in losses at a 4-percent discount rate. At a 6-percent discount rate, the losses amounted to \$57 billion.

<sup>19</sup> Barbara S. Cooper and Wendy H. Brody, 1972 *Lifetime Earnings by Age, Sex, Race, and Education Level* (Research and Statistics Note No. 14), Social Security Administration, Office of Research and Statistics, 1975.

TABLE 4.—Present value of lifetime earnings, discounted at 4 percent and 6 percent, by age, sex, and race, 1972

Age	Men			Women		
	Total	White	Other	Total	White	Other
4 percent						
Under 1.....	\$55,965	\$100,807	\$60,045	\$58,429	\$50,889	\$50,044
1-4.....	105,107	110,043	66,195	63,532	65,078	64,978
5-9.....	128,288	134,277	60,501	77,536	79,395	67,063
10-14.....	156,322	163,613	95,602	94,830	96,689	81,751
15-19.....	186,590	68,028	117,940	111,603	113,827	95,937
20-24.....	211,537	221,116	133,069	119,737	122,248	101,958
25-29.....	229,884	230,892	136,384	118,647	118,208	97,847
30-34.....	213,713	223,647	128,268	105,979	106,559	87,262
35-39.....	196,143	203,423	113,931	95,149	97,721	78,793
40-44.....	171,149	179,120	97,784	83,008	85,476	63,473
45-49.....	141,077	147,328	80,472	69,315	71,613	49,933
50-54.....	108,561	112,956	63,301	53,929	56,015	35,842
55-59.....	74,750	77,377	46,078	37,940	39,695	22,808
60-64.....	41,630	43,293	27,103	23,874	24,321	12,865
65-69.....	19,715	20,302	13,894	12,054	13,656	7,066
70-74.....	10,667	11,000	7,370	7,148	7,433	3,960
75-79.....	5,821	6,079	3,949	3,421	3,763	2,098
80-84.....	3,343	3,495	1,918	1,867	1,825	950
85 and over.....	534	558	299	199	206	132
6 percent						
Under 1.....	\$48,720	\$51,011	\$31,223	\$30,978	\$31,657	\$27,099
1-4.....	85,433	87,992	35,768	35,148	35,765	30,800
5-9.....	74,418	77,295	48,012	47,141	47,990	41,430
10-14.....	99,742	104,263	64,458	63,172	64,267	55,873
15-19.....	129,294	135,142	83,555	80,588	82,016	70,622
20-24.....	156,640	163,669	101,006	91,114	92,534	79,123
25-29.....	170,758	178,483	107,823	90,439	92,237	77,800
30-34.....	170,788	178,519	104,179	84,813	86,378	71,237
35-39.....	181,672	186,690	94,492	77,513	79,444	63,204
40-44.....	144,266	150,504	82,760	69,218	71,335	51,158
45-49.....	121,456	127,250	69,559	59,157	61,074	43,578
50-54.....	98,158	100,633	55,964	47,115	48,874	31,677
55-59.....	67,583	70,128	41,783	33,825	35,317	20,349
60-64.....	38,868	39,800	24,961	21,409	22,436	11,702
65-69.....	18,107	18,631	12,659	11,850	12,436	6,467
70-74.....	9,888	10,181	6,911	6,298	6,861	3,665
75-79.....	5,431	5,675	3,164	3,295	3,529	1,936
80-84.....	3,209	3,334	1,839	1,807	1,862	912
85 and over.....	519	543	291	194	200	128

The greatest losses were for circulatory disorders. More than half the deaths and nearly one-third of the lost years and earnings were caused by diseases in this one diagnostic category. Losses were a lower share of the total than deaths because those disorders mainly afflict the aged whose remaining years alive and employed are relatively few.

Deaths from accidents are also very costly to the Nation. Ranking second in lost years and earnings, accidental deaths resulted in a \$17.7 billion loss to the economy (at a 4-percent discount rate). Deaths in this category ranked third but hit those in the relatively young and productive ages.

The third largest mortality losses were for cancer. Ranking second in deaths, cancer deaths caused nearly 6 million lost years and \$12.6 billion lost dollars.

The greatest losses were for persons aged 45-64 and for men (table 6). About one-fourth of

TABLE 5.—Mortality in 1972

Cause of death	Total	White	Other	Sex	
					Male
Total.....	1,972,000	1,810,000	162,000	1,000,000	972,000
Infective and parasitic diseases.....	100,000	90,000	10,000	50,000	50,000
Neoplasms.....	500,000	450,000	50,000	250,000	250,000
Endocrine, nutritional, and metabolic diseases.....	100,000	90,000	10,000	50,000	50,000
Diseases of the blood and blood-forming organs.....	100,000	90,000	10,000	50,000	50,000
Mental disorders.....	100,000	90,000	10,000	50,000	50,000
Diseases of the nervous system.....	100,000	90,000	10,000	50,000	50,000
Diseases of the circulatory system.....	1,000,000	900,000	100,000	500,000	500,000
Diseases of the respiratory system.....	100,000	90,000	10,000	50,000	50,000
Diseases of the digestive system.....	100,000	90,000	10,000	50,000	50,000
Diseases of the genitourinary system.....	100,000	90,000	10,000	50,000	50,000
Complications of pregnancy, childbirth, and the puerperium.....	100,000	90,000	10,000	50,000	50,000
Diseases of the skin and subcutaneous tissue.....	100,000	90,000	10,000	50,000	50,000
Diseases of the musculoskeletal system and connective tissue.....	100,000	90,000	10,000	50,000	50,000
Congenital anomalies.....	100,000	90,000	10,000	50,000	50,000
Accidents, poisonings, and other injuries.....	100,000	90,000	10,000	50,000	50,000
Other.....	100,000	90,000	10,000	50,000	50,000

<sup>1</sup> Less than 0.05 percent.

the deaths and lost years in this 20-year age group more than half the dollar amount was for women, especially in complications of pregnancy and housewives' services according to the reference.

#### TOTAL ECONOMIC

When all types of mortality, morbidity of illness for 1972 percent discount rate or one-fifth, was for circulatory system were followed by cancer and cancer, each of these are staggering toll in 1963 and highest ones? In 1966 slightly less than billion. The major Although the additional \$8.6 billion to the direct costs have The ever increasing direct costs the in illness, \$3.8 billion

TABLE 5.—Mortality losses: Number of deaths, estimated total person-years lost, and discounted earnings, by diagnosis, 1972

Diagnosis	Deaths		Total years lost		Discounted earnings at—			
	Number	Percentage distribution	Number (in thousands)	Percentage distribution	4 percent		8 percent	
					Amount (in millions)	Percentage distribution	Amount (in millions)	Percentage distribution
Total.....	1,982,270	100.0	33,222	100.0	\$71,235	100.0	\$37,380	100.0
Infective and parasitic diseases.....	18,800	.8	447	1.4	831	1.2	622	1.1
Neoplasms.....	152,800	15.0	8,701	17.2	12,633	17.7	10,907	19.0
Endocrine, nutritional, and metabolic diseases.....	47,100	2.4	496	1.5	1,357	1.9	1,144	2.0
Diseases of the blood and blood-forming organs.....	4,901	.2	110	.8	210	.3	164	.3
Mental disorders.....	5,917	.5	228	.7	753	1.1	618	1.1
Diseases of the nervous system and sense organs.....	18,844	.8	478	1.4	1,050	1.5	812	1.4
Diseases of the circulatory system.....	1,046,217	53.3	12,163	36.6	22,724	31.9	20,004	33.0
Diseases of the respiratory system.....	111,590	5.7	1,934	5.8	3,434	4.8	2,744	4.8
Diseases of the digestive system.....	78,064	3.8	1,492	4.2	3,781	5.3	3,225	5.6
Diseases of the genitourinary system.....	27,215	1.4	300	1.2	736	1.0	624	1.1
Complications of pregnancy, childbirth, and the puerperium.....	760	( <sup>1</sup> )	35	.1	60	.1	62	.1
Diseases of the skin and subcutaneous tissue.....	2,041	.1	36	.1	66	.1	55	.1
Diseases of the musculoskeletal system and connective tissue.....	8,335	.2	107	.3	209	.3	174	.3
Congenital anomalies.....	18,030	.8	942	2.8	1,784	2.5	1,766	3.1
Accidents, poisonings, and violence.....	182,820	8.3	8,471	16.8	17,674	24.8	12,643	22.0
Other.....	70,410	3.6	2,299	9.9	4,402	6.2	2,733	4.8

<sup>1</sup> Less than 0.05 percent.

the deaths and two-fifths of the losses fell in this 20-year age group. Although only slightly more than half the deaths struck men, the lost dollar amount was three times greater than it was for women. The higher earnings for men especially in comparison with the values for housewives' services account for this substantial difference.

#### TOTAL ECONOMIC COSTS

When all types of disease costs are combined—mortality, morbidity, and direct—the total cost of illness for 1972 reached \$189 billion at a 4-percent discount rate (table 7). About \$40 billion, or one-fifth, was for persons with diseases of the circulatory system. Accidents cost \$27 billion and were followed by diseases of the digestive system and cancer, each costing about \$17 billion.

These are staggering numbers. What was the toll in 1963 and were the same diseases the costliest ones? In 1963, the total cost of illness was slightly less than half the 1972 figure, or \$93.5 billion. The major growth has been in direct costs. Although the addition of the drug category added \$8.6 billion to the 1972 total, even without it direct costs have tripled in the 9-year period. The ever increasing cost of medical care has made direct costs the largest component in the cost of illness, \$3.8 billion higher than the cost of pro-

nature death. In 1963, mortality costs were about double direct costs, as shown below.

Cost component	1963		1972	
	Amount (in billions)	Percentage distribution	Amount (in billions)	Percentage distribution
Total.....	\$93.5	100.0	\$188.8	100.0
Direct costs.....	\$22.5	24.1	\$76.2	39.8
Morbidity.....	21.0	22.5	42.3	22.5
Mortality.....	49.9	53.4	71.2	37.8

<sup>1</sup> Excludes expenditures for drugs and drug sundries amounting to \$4.3 billion.

<sup>2</sup> Includes expenditures for drugs and drug sundries amounting to \$8.6 billion.

The distribution by diagnosis has also changed slightly since 1963 (table 8). Diseases of the circulatory system represented about the same share in both years, but accidents have grown in importance because of a relatively higher number of deaths. Neoplasms have dropped with relatively fewer cancer victims in the unable-to-work category.

#### APPLICATION TO SPECIFIC DISEASES

The preceding discussion emphasized the importance of consistent definitions and data sources for estimating disease costs. The data presented, however, are for broad diagnostic categories. In most cases, more finite categories are needed, but the time required for calculating these costs is

TABLE 6.—Mortality losses: Lost earnings, discounted at 4 percent, by age, sex, and diagnosis, 1972

Diagnosis	Sex			Age			
	Total	Men	Women	Under 25	25-44	45-64	65 and over
Amount (in millions)							
Total	\$71,233	\$34,283	\$16,933	\$15,934	\$16,868	\$39,733	\$7,808
Infective and parasitic diseases	831	874	258	349	192	744	48
Neoplasms	12,633	8,436	4,177	947	2,503	7,567	1,617
Endocrine, nutritional, and metabolic diseases	1,357	856	489	183	333	639	199
Diseases of the blood and blood-forming organs	210	128	83	77	69	52	16
Mental disorders	753	640	114	172	303	281	17
Diseases of the nervous system and sense organs	1,080	746	318	429	283	270	61
Diseases of the circulatory system	22,721	17,914	4,607	497	3,627	14,067	4,530
Diseases of the respiratory system	3,454	2,679	654	675	636	1,437	493
Diseases of the digestive system	3,781	2,851	930	243	1,177	2,107	254
Diseases of the genitourinary system	736	479	237	100	203	327	106
Complications of pregnancy, childbirth, and the puerperium	60	36	31	14	20	(1)	5
Diseases of the skin and subcutaneous tissue	209	94	115	38	62	60	17
Diseases of the musculoskeletal system and connective tissue	1,284	877	406	1,092	113	66	5
Congenital anomalies	17,674	14,915	2,758	7,657	6,848	2,927	242
Accidents, poisonings, and violence	4,402	3,123	1,279	3,221	460	617	103
Other							
Percentage distribution							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Infective and parasitic diseases	1.2	1.0	1.5	2.2	1.1	.8	.6
Neoplasms	17.7	15.6	24.6	5.9	14.8	24.6	21.0
Endocrine, nutritional, and metabolic diseases	1.9	1.6	2.9	1.1	2.0	2.1	2.6
Diseases of the blood and blood-forming organs	.3	.2	.5	.8	.3	.2	.2
Mental disorders	1.1	1.2	.7	1.1	1.8	.8	.2
Diseases of the nervous system and sense organs	1.5	1.4	1.9	2.7	1.7	1.0	.7
Diseases of the circulatory system	31.9	33.0	28.4	3.1	21.5	45.8	58.3
Diseases of the respiratory system	4.8	4.8	3.0	3.3	3.7	4.7	6.2
Diseases of the digestive system	5.3	5.3	5.5	1.5	7.0	6.9	3.3
Diseases of the genitourinary system	1.0	.9	1.5	.6	1.2	1.1	1.4
Complications of pregnancy, childbirth, and the puerperium	.1	.1	.2	.1	.1	(1)	.1
Diseases of the skin and subcutaneous tissue	.3	.3	.3	.7	.4	.3	.2
Diseases of the musculoskeletal system and connective tissue	1.8	1.6	2.4	6.9	.7	.2	.1
Congenital anomalies	24.8	27.5	16.3	45.1	40.6	9.5	3.1
Accidents, poisonings, and violence	6.2	8.6	7.8	20.2	2.7	2.0	1.4
Other							

<sup>1</sup> Less than 0.05 percent.

TABLE 7.—Total economic earnings discounted at 4 percent

Diagnosis	Total
Total	
Infective and parasitic diseases	
Neoplasms	
Endocrine, nutritional, and metabolic diseases	
Diseases of the blood and blood-forming organs	
Mental disorders	
Diseases of the nervous system	
Diseases of the circulatory system	
Diseases of the respiratory system	
Diseases of the digestive system	
Diseases of the genitourinary system	
Complications of pregnancy, childbirth, and the puerperium	
Diseases of the skin and subcutaneous tissue	
Diseases of the musculoskeletal system and connective tissue	
Congenital anomalies	
Accidents, poisonings, and violence	
Other	

TABLE 8.—Comparison of 1972, by diagnosis

Diagnosis	Total
Total	
Infective and parasitic diseases	
Neoplasms	
Endocrine, nutritional, and metabolic diseases	
Diseases of the blood and blood-forming organs	
Mental disorders	
Diseases of the nervous system and sense organs	
Diseases of the circulatory system	
Diseases of the respiratory system	
Diseases of the digestive system	
Diseases of the genitourinary system	
Complications of pregnancy, childbirth, and the puerperium	
Diseases of the skin and subcutaneous tissue	
Diseases of the musculoskeletal system and connective tissue	
Congenital anomalies	
Accidents, poisonings, and violence	
Other	

<sup>1</sup> Present value of future

usually too short for the systematic framework described here. In these instances, the broad category of which the disease in question is a part can provide a parameter for its cost and with the use of readily available data, an estimate can be made in a relatively short period of time.

The cost of stroke—a component of diseases of the circulatory system—provides a demonstration (table 9). For direct costs, three categories—hospital care, physicians' services, and nursing-home care—represent 87 percent of circulatory disease cost and would be sufficient indicators of stroke's share of the category. Days of community hospital care, number of outpatient physician visits, number of nursing-home residents, and average monthly charge, by diagnosis, are available from NCHS. Stroke's share of the circulatory disease category for each of these measurements is calculated and applied to the appropriate cost figure. The sum of these three costs as a percentage of the same costs for circulatory

diseases is applied to total direct costs for circulatory diseases to arrive at a figure of \$2,031 million, the direct cost of stroke.

Morbidity costs for stroke can be calculated separately for the institutional and noninstitutional populations. For the latter group the NCHS publishes diagnostic disability data for both acute and chronic conditions.<sup>20</sup> Persons with stroke—a chronic condition—comprised 7.6 percent of work-loss days for cardiovascular diseases, representing a \$135 million loss for the currently employed. Housewives' losses for this category are insignificant because of the relatively old population affected. For the population unable to work, bed-days can be used as a measure. Stroke

<sup>20</sup> National Center for Health Statistics, *Current Estimates from the Health Interview Survey, United States, 1973* (Vital and Health Statistics Series 10, No. 05), 1974; *Prevalence of Chronic Circulatory Conditions, United States, 1972* (Vital and Health Statistics Series 10, No. 01), 1974; and *Limitation of Activity and Mobility Due to Chronic Conditions, United States, 1972* (Vital and Health Statistics Series 10, No. 06), 1974.

TABLE 7.—Total economic costs: Estimated direct costs, indirect costs of morbidity and mortality, with present value of lifetime earnings discounted at 4 percent and 6 percent, by diagnosis, 1972

Diagnosis	Amount (in millions)				Percentage distribution			
	Total	Direct costs	Indirect costs		Total	Direct costs	Indirect costs	
			Morbidity	Mortality			Morbidity	Mortality
4 percent								
Total.....	\$188,789	\$75,231	\$42,323	\$71,235	100.0	100.0	100.0	100.0
Infective and parasitic diseases.....	3,443	1,412	1,200	831	1.8	1.9	2.8	1.2
Neoplasms.....	17,367	3,872	827	12,633	9.2	5.1	2.0	17.7
Endocrine, nutritional, and metabolic diseases.....	5,930	3,436	1,137	1,357	3.1	4.6	2.7	1.9
Diseases of the blood and blood-forming organs.....	921	491	220	210	.7	.7	.8	.3
Mental disorders.....	13,917	6,983	6,179	753	7.4	9.3	14.6	1.1
Diseases of the nervous system and sense organs.....	10,951	5,947	3,944	1,060	5.8	7.9	9.3	1.5
Diseases of the circulatory system.....	40,060	10,919	8,417	22,724	21.2	14.5	15.2	35.9
Diseases of the respiratory system.....	16,434	5,931	7,069	3,434	8.7	7.9	10.7	4.8
Diseases of the digestive system.....	17,437	11,100	2,606	3,781	9.3	14.8	6.2	8.3
Diseases of the genitourinary system.....	6,453	4,471	1,249	734	3.4	5.9	3.0	1.0
Complications of pregnancy, childbirth, and the puerperium.....	2,932	2,607	245	80	1.6	3.5	.6	.1
Diseases of the skin and subcutaneous tissue.....	2,052	1,525	460	67	1.1	2.0	1.1	.1
Diseases of the musculoskeletal system and connective tissue.....	8,948	3,636	3,103	209	4.7	4.8	12.1	.3
Congenital anomalies.....	1,003	361	238	1,284	1.0	.8	.6	1.8
Accidents, poisonings, and violence.....	25,678	8,121	3,863	17,674	14.1	6.8	9.2	24.8
Other.....	13,294	7,358	1,494	4,492	7.0	9.8	3.5	6.2
6 percent								
Total.....	\$174,934	\$75,221	\$42,323	\$57,360	100.0	100.0	100.0	100.0
Infective and parasitic diseases.....	3,234	1,412	1,200	622	1.8	1.9	2.8	1.1
Neoplasms.....	15,641	3,872	822	10,907	8.9	5.1	2.0	19.0
Endocrine, nutritional, and metabolic diseases.....	5,717	3,436	1,137	1,144	3.3	4.6	2.7	2.0
Diseases of the blood and blood-forming organs.....	873	491	220	164	.8	.7	.8	.3
Mental disorders.....	13,782	6,983	6,179	618	7.9	9.3	14.6	1.1
Diseases of the nervous system and sense organs.....	10,703	5,947	3,944	812	6.1	7.9	9.3	1.4
Diseases of the circulatory system.....	37,430	10,919	8,417	20,094	21.4	14.5	15.2	35.0
Diseases of the respiratory system.....	15,764	5,931	7,069	2,744	9.0	7.9	10.7	4.8
Diseases of the digestive system.....	16,931	11,100	2,606	3,225	9.7	14.8	6.2	8.6
Diseases of the genitourinary system.....	6,344	4,471	1,249	674	3.6	5.9	3.0	1.1
Complications of pregnancy, childbirth, and the puerperium.....	2,914	2,607	245	82	1.7	3.5	.6	.1
Diseases of the skin and subcutaneous tissue.....	2,040	1,525	460	55	1.2	2.0	1.1	.1
Diseases of the musculoskeletal system and connective tissue.....	8,913	3,636	3,103	174	5.1	4.8	12.1	.3
Congenital anomalies.....	1,373	361	238	736	.8	.8	.6	1.3
Accidents, poisonings, and violence.....	21,649	8,121	3,863	12,615	12.4	6.8	9.2	22.0
Other.....	11,623	7,358	1,494	2,733	6.6	9.8	3.5	4.8

TABLE 8.—Comparison of the economic cost of illness for 1963 and 1972, by diagnosis<sup>1</sup>

Diagnosis	Amount (in millions)		Percentage distribution	
	1963	1972	1963	1972
Total.....	\$93,600	\$188,789	100.0	100.0
Infective and parasitic diseases.....	2,135	3,413	2.3	1.8
Neoplasms.....	10,940	17,367	11.3	9.2
Endocrine, nutritional, and metabolic diseases.....	2,623	5,930	2.8	3.1
Diseases of the blood and blood-forming organs.....	373	921	.4	.8
Mental disorders.....	7,277	13,917	7.8	7.4
Diseases of the nervous system and sense organs.....	6,795	10,951	7.3	5.8
Diseases of the circulatory system.....	20,048	40,060	22.4	21.2
Diseases of the respiratory system.....	7,413	16,434	7.9	8.7
Diseases of the digestive system.....	7,837	17,437	8.4	9.3
Diseases of the genitourinary system.....	2,840	6,456	2.7	3.4
Complications of pregnancy, childbirth, and the puerperium.....	1,817	2,932	1.6	1.6
Diseases of the skin and subcutaneous tissue.....	480	2,052	.5	1.1
Diseases of the musculoskeletal system and connective tissue.....	2,783	8,948	3.0	4.7
Congenital anomalies.....	1,212	1,003	1.3	1.0
Accidents, poisonings, and violence.....	11,811	25,678	12.6	14.1
Other.....	7,116	13,294	7.6	7.0

<sup>1</sup> Present value of future earnings is calculated at a 4-percent discount rate.

victims had 18.6 percent of the bed-days for the circulatory disease category. Since stroke does affect an older population, however, 15.0 percent was used, and the resulting figure for costs in this category was about \$500 million. Persons in institutions with cardiovascular diseases are in three types of institutions—nursing homes, homes for the aged, and chronic disease hospitals. The distribution of residents in nursing homes can be used as a measure of costs. As reported by NCHS, stroke residents comprise 10.7 percent of all residents with circulatory disease. Thus, institutional costs for stroke amount to \$89 million (.107 x \$828 million).

For mortality costs, a shortcut need not be used. Mortality statistics are available for each diagnosis by age, sex, and race. The present value of lifetime earnings are applied, and total mortality costs are estimated. In 1972, these costs

amounted to \$3,432 million (table 10). When morbidity and direct costs for stroke are added to the mortality figure, the estimated total economic cost of stroke amounts to \$6.2 billion, as the following figures show:

Type of cost	Amount (in millions)
Total	\$6,187
Direct	2,031
Morbidity:	
Currently employed	135
Unable to work	500
Institutional	80
Mortality	3,432

#### METHODOLOGY

The cost of illness was calculated for 16 disease categories shown below with their code numbers.

Diagnosis	ICDA code
Infective and parasitic diseases	000-136
Neoplasms	140-239
Endocrine, nutritional, and metabolic diseases	240-270
Diseases of the blood and blood-forming organs	280-289
Mental disorders	290-315
Diseases of the nervous system and sense organs	320-359
Diseases of the circulatory system	360-458
Diseases of the respiratory system	460-519
Diseases of the digestive system	520-577
Diseases of the genitourinary system	580-629
Complications of pregnancy, childbirth, and the puerperium	630-678
Diseases of the skin and subcutaneous tissue	680-709
Diseases of the musculoskeletal system and connective tissue	710-738
Congenital anomalies	740-759
Accidents, poisonings, and violence	800-869
Other <sup>1</sup>	700-799

<sup>1</sup> Certain causes of perinatal morbidity and mortality, symptoms and ill-defined conditions, and special conditions without sickness and symptoms.

Source: National Center for Health Statistics, *Eighth Revision, International Classification of Diseases, Adapted, 1963*.

#### Direct Costs

The total direct cost of illness—the cost of prevention, detection, and treatment—represents the amount published by the Social Security Administration for national health expenditures.<sup>11</sup> Not all types of expenditures were allocated here

<sup>11</sup> The data for calendar year 1972 came from Nancy L. Worthington, *op. cit.*

TABLE 9.—Estimating procedure for calculating direct costs of stroke, 1972

Type of expenditure	Diseases of the circulatory system	Strokes	
		Amount	Percent of circulatory disease category
Hospital care:			
Days of care (in thousands) <sup>1</sup>	44,590	7,832	17.7
Expenditures (in millions)	\$3,271	\$933	17.7
Physicians' services:			
Number of visits (in thousands) <sup>1</sup>	75,670	3,745	6.0
Expenditures (in millions)	\$1,670	\$84	
Nursing homes:			
Number of residents <sup>2</sup>	208,400	80,893	
Average monthly charge <sup>3</sup>	\$315	\$368	
Weights charges (in millions)	103	30	29.1
Expenditures (in millions)	\$2,581	751	29.1
Hospital, physicians' services, and nursing-home care:			
Expenditures (in millions)	\$9,828	\$1,768	18.6
Total direct costs (in millions)	\$10,919	\$2,031	18.6

<sup>1</sup> National Center for Health Statistics, "Utilization of Short-Stay Hospitals, by Diagnosis: United States, 1972," *Monthly Vital Statistics Report*, July 1974.

<sup>2</sup> Data from table 1.

<sup>3</sup> National Center for Health Statistics, *Physician Visits, Volume and Interval Since Last Visit, United States, 1971*, Series 10, No. 97; and unpublished data from the Center.

<sup>4</sup> National Center for Health Statistics, *Chronic Conditions and Impairments of Nursing Home Residents, United States, 1969*, Series 12, No. 21.

<sup>5</sup> National Center for Health Statistics, *Charges for Care and Sources of Payment for Residents in Nursing Homes, United States, June-August 1969*, Series 12, No. 21.

according to diagnosis. Included are hospital care, physicians' services, dentists' services, other professional services, drugs and drug sundries, eyeglasses and appliances, and nursing-home care. For each type of expenditure, the total expenditure was distributed, by diagnosis, on the basis of utilization and cost data, with the same data sources used for each diagnosis.

TABLE 10.—Stroke: Number of deaths and present value of lifetime earnings discounted at 4 percent, by age and sex, 1972

Age	Number of deaths <sup>1</sup>			Discounted earnings (in thousands)		
	Total	Men	Women	Total	Men	Women
Total.....	213,314	98,366	117,948	\$3,431,046	\$2,299,411	\$1,141,636
Under 1.....	147	88	54	11,601	8,445	3,156
1-4.....	120	64	52	10,466	7,147	3,319
5-9.....	95	48	38	10,399	7,441	2,958
10-14.....	124	66	52	18,375	13,444	4,931
15-19.....	248	130	88	39,661	29,840	9,821
20-24.....	460	222	138	47,608	36,884	10,724
25-29.....	898	338	258	76,560	49,036	27,524
30-34.....	1,134	454	340	103,849	106,643	37,940
35-39.....	2,186	1,030	1,126	274,063	179,709	94,277
40-44.....	3,710	1,834	1,882	389,166	258,735	130,431
45-49.....	5,434	2,674	2,760	483,701	333,778	149,923
50-54.....	8,496	4,330	3,956	600,313	361,042	179,271
55-59.....	12,800	7,334	8,326	438,338	267,515	130,823
60-64.....	19,288	10,344	8,904	320,985	204,252	116,733
65-69.....	28,128	14,330	13,808	241,423	133,751	98,672
70-74.....	37,794	17,096	20,698	174,543	99,833	74,710
75-79.....	41,718	16,810	24,828	98,368	56,463	41,905
80-84.....	49,956	16,836	33,120	16,681	8,666	8,015

<sup>1</sup> Excludes 30 deaths with no age specified.

calculating direct costs

Diseases of the circulatory system	Stroke	
	Amount	Percent of circulatory disease category
41,200	7,852	17.7
85,271	833	17.7
75,870	2,745	5.0
81,676	854	
88,420	80,893	
8345	8366	
103	30	29.1
2,661	751	29.1
97,628	11,708	18.6
10,919	12,031	18.6

Utilization of Short-Stay Hospitals, Vital Statistics Report,

Physician Visits, Volume and Series 10, No. 97; and unpublished Conditions and Impairment, 1969, Series 12, No. 22.

led are hospital patients' services, other and drug sundries, nursing-home care. The total expenditure, on the basis of the same data

and present value of by age and sex, 1972

Accounted earnings (in thousands)

	Men	Women
1968	12,290,411	11,141,638
1969	8,415	3,104
1970	7,147	2,319
1971	7,411	2,954
1972	12,444	4,631
1973	22,840	9,821
1974	30,834	16,524
1975	49,024	27,524
1976	72,245	37,040
1977	108,663	63,186
1978	179,796	94,297
1979	254,735	130,431
1980	333,778	149,923
1981	341,012	139,271
1982	307,510	130,573
1983	204,732	116,733
1984	132,731	68,672
1985	99,633	75,010
1986	59,463	34,905
1987	8,900	6,801

**Hospital care.**—Data for hospital care expenditures, as reported by the Social Security Administration, include estimates by type of hospital, shown below. For each type, a separate diagnostic

Type of hospital	Amount (in millions)	Percentage distribution
Total	\$31,219	100.0
Federal hospitals	3,619	10.6
Defense Department	1,275	3.7
Veterans Administration	1,662	4.9
Public Health Service	610	1.8
St. Elizabeths	52	.1
Other <sup>1</sup>	14	.1
Non-Federal hospitals	20,001	69.4
Community	20,199	76.0
Psychiatric	3,233	9.4
Tuberculosis	117	.3
Long-term	753	2.2
Other <sup>2</sup>	299	.9

<sup>1</sup> Represents consumer spending in Federal hospitals.  
<sup>2</sup> Represents hospitals in outlying areas of the United States.  
Source: Unpublished data from the Social Security Administration.

distribution was estimated. Community hospital expenditures, representing the bulk of the hospital bill, were distributed by days of care, weighted by expenses per patient day. This weighting was not done in the original study, because no such data were available. There is, however, a tremendous variation in daily costs by diagnosis—a range of \$63—reflecting the vast differences in and complexities of treatment.

The diagnostic distribution of days of care is based on primary diagnosis only, although the presence of associated conditions or multiple diagnoses will affect length of stay. Data on days of care by diagnosis for those under age 65 and for the population aged 65 and over came from the hospital discharge survey of the NCHS.<sup>12</sup> Unpublished data on expenses per patient day by diagnosis were available from Aetna for their enrollees in the Federal Employees Health Benefit Plan. Figures for daily expenses for the population aged 65 and over were provided by Medicare.

Non-Federal psychiatric and tuberculosis hospitals were classified under the diagnoses their names imply. Non-Federal long-stay hospital costs were allocated according to the product of the number of residents in nursing homes with intensive nursing care and the average monthly charge; these data were reported by diagnosis

<sup>12</sup> National Center for Health Statistics, "Utilization of Short-Stay Hospitals, by Diagnosis: United States, 1972," *Monthly Vital Statistics Report*, July 1974.

by NCHS.<sup>13</sup> The remaining non-Federal hospital expenditures were for outlying areas and were distributed according to those for the United States.

Expenditures in Federal hospitals were distributed by diagnosis according to days of care. Since the same daily charge is used in Federal hospitals regardless of incurred cost, no weights were available on differing daily costs. Days of care in Veterans Administration hospitals are available by diagnosis in the *Administrator of Veterans Affairs Annual Report*. For Department of Defense hospitals, each service provided the number of total days of care. The Navy and Air Force provided diagnostic data as well. Admissions to Navy and Marine Corps hospitals are reported by diagnosis in their quarterly reports, *Statistics of Navy Medicine*. Average length of stay by diagnosis was published in a 1973 study.<sup>14</sup> Data for days of care by diagnosis in Air Force hospitals were provided directly by that service. Data for Public Health Service hospitals came directly from the Bureau of Medical Services. All spending in St. Elizabeths Hospital was allocated to mental illness.

**Physicians' services.**—Expenditures for physicians' services are allocated according to the distribution of physicians' visits in 1972 by diagnosis, as reported by the National Diseases and Therapeutic Index (NDTI) (a service of IMS America Ltd., Ambler, Pennsylvania). The NDTI is a continuing study of private medical practice in the United States in which data are obtained from a representative panel of physicians who report case-history information on private patients seen over a given period of time. The assumption is made here that the cost of each physician visit is the same.

**Dentists' services.**—All of the expenditures for the services of dentists, as reported by the Social Security Administration, are classified under "diseases of the digestive system." Included in

<sup>13</sup> National Center for Health Statistics, *Charges for Care and Sources of Payment for Residents in Nursing Homes, United States—June-August 1969* (Vital and Health Statistics Series 10, No. 21), 1969.

<sup>14</sup> Robert D. Lumson, John J. Waggoner, and Dale E. Mauer, *Navy Medical Care Study, Costs and Economic Efficiency*, Boeing Computer Services, Inc., Consulting Division, December 1973.

this diagnostic group are diseases of the buccal cavity, such as dental caries; abscesses of supporting structures of teeth; other inflammatory diseases of supporting structures of teeth; disorders of occlusion, eruption, and tooth development; toothache from unspecified cause; and other diseases of teeth and supporting structures.

*Other professional services.*—Included in this category are expenditures for self-employed private-duty nurses, visiting nurses, optometrists, chiropractors, physical and speech therapists, etc. Expenditures for private-duty nurses are allocated by diagnosis according to the distribution of hospital days on the assumption that most of their services are provided in the hospital. The National League of Nurses provided diagnostic data for visiting nurses; optometrists' services were classified in neurological diseases and sense organs; and chiropractors' services in diseases of the musculoskeletal system. The remainder—\$319 million—was classified as "other." Since the Internal Revenue Service reports such expenditures in a lump figure, they could not be allocated by diagnosis.

*Drugs and drug sundries.*—This category was omitted in the 1963 study of the costs of illness, but the availability of new data allowed its inclusion here. As part of its survey of physicians, the NDTI, which collects data on the type of drug prescribed for each patient seen, provided a listing of the number of times each therapeutic category was prescribed for each diagnosis. Price weights were applied, based on the National Prescription Audit of R.A. Gosselin & Co., Inc., which reports data on average wholesale charges per prescription, by therapeutic category.

*Nursing-home care.*—Expenditures for nursing-home care were allocated according to the number of nursing-home residents and the average monthly charge for each diagnosis reported in the NCHS study, referred to previously.

#### Morbidity Costs

The definitions and issues involved in calculation of morbidity losses are discussed in the body of this report. The sources of data used for the calculations are described below.

*Noninstitutional population.*—Losses were calculated separately for three groups—the currently employed, women keeping house, and those unable to work. The NCHS collects disability data for the currently employed and unemployed populations, according to the following classifications of usual activity: Working, keeping house, retired for health reasons, retired for other reasons, and doing something else. These data were supplied by age, sex, and diagnosis. All work-loss days for the currently employed were multiplied by mean annual earnings; bed-days for unemployed women usually keeping house were multiplied by mean housekeeping values (see the text tabulation on page 24). Mean average earnings came from the Current Population Survey of the Bureau of the Census, and housekeeping values were those developed in the Brody study.<sup>25</sup>

The number of persons unable to work in 1972 was reported by age and sex in the January 1973 issue of *Employment and Earnings* (Department of Labor). Employment rates and housekeeping rates for 1970 from the same source, January 1971, were applied and the appropriate dollar values attached. The diagnostic distribution of these dollars, by age and sex, was based on bed-days for the "retired for health" and "something else" categories of the NCHS data. The diagnostic distribution of the group under age 25, however, came from data for disability allowance under the social security program, since the NCHS "something else" category includes students as well as those unable to work.

*Institutional population.*—The number of persons in each type of institution in 1970 is reported, by age and sex, by the Bureau of the Census.<sup>26</sup> Employment and housekeeping rates for 1970 and the appropriate 1972 dollar values were applied. The diagnostic distribution was based mainly on type of institution, as described on page 26.

#### Mortality Costs

Mortality costs were calculated by multiplying the number of deaths (by age, sex, and race) by

<sup>25</sup> Wendyce Brody, *op. cit.*

<sup>26</sup> Bureau of the Census, *Persons in Institutions and Other Group Quarters* (PC(2)-1E), 1973.

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The estimating procedure for the development of lifetime earnings was described in detail in the earlier Rice report on the costs of illness. Except for the treatment of housewives, discussed earlier, the procedure used here was essentially the same.

The method developed takes into account the life expectancy for different age, sex, and race groups, varying labor-force participation rates, the current changing pattern of earnings at successive ages, imputed value of housewives' services, and the discount rate. The basic assumptions and economic concepts employed follow.

*Life expectancy.*—The lifetime earnings data were developed on the assumption that each cohort will follow his or her pattern of life expectancy as reported for 1972 at successive ages. The NCHS publishes life tables by age, sex, and race. Cohort data were obtained for four groups: White and nonwhite males, white and nonwhite females.

*Labor-force participation.*—The estimate of lifetime earnings takes into account varying labor-force participation rates at different ages. The assumption is that an individual will be in the labor force and productive during his expected lifetime in accordance with the current pattern of labor-force participation for his sex and race group. For this calculation, the Bureau of the Census provided unpublished data from their Current Population Survey for 1970 on the number of employed persons by age, sex, and race. Use of the number employed in 1970 assumes conditions of full employment (approximately 5 percent of the labor force unemployed).

*Earnings.*—The appropriate measure of output loss for individuals is year-round, full-time earnings, and the proper measure of expected earnings is the arithmetic average or mean. Mean earnings data for 1972 by age, sex, and race were provided by the Current Population Survey of the Bureau of the Census.

In applying these cross-section survey data to the estimates of lifetime earnings, it is

assumed that the future pattern of earnings for an average individual within a particular race and sex group will remain the same as that reported for the base year, 1972. This model recognizes that the average individual may expect his own earnings to rise as he ages and gains experience, in accordance with the cross-section survey data for 1972.

The use of these average earnings based on cross-section surveys may understate the present value of expected lifetime earnings because of the failure to take into account future economic growth patterns by age. If, however, an average annual rate of gain in productivity is projected, it can be applied as a partial offset to the discount rate, discussed below.

*The discount rate.*—The calculation of the present value of expected lifetime earnings raises the question of the importance of discounting and the appropriate discount rate. From the economist's viewpoint, it is recognized that the arithmetic sum of lifetime earnings overstates the present value of an individual. Determining the present value of the future earnings stream is the correct way to measure the economic value over a period of time; discounting converts a stream of earnings into its present value.

Economists agree that comparison of streams of earnings over varying timespans should employ the process of discounting, but there is no agreement on the discount rate to be used.<sup>21</sup> The higher the discount rate, the lower the present value of a given money stream. With a high rate of discount, earnings far into the future yield a relatively small present value.

Conversely, lowering the discount rate increases the present value of these future earnings. The discount rate can be adjusted for expected changes in productivity. An increase in productivity of 1.75 percent a year, for example, can be incorporated into the discounting calculations to obtain a net effective discount rate. Thus, a 6-percent discount rate adjusted for a rise in productivity of 1.75 percent a year will yield an effective dis-

<sup>21</sup> See Herbert E. Klarman, *The Economics of Health*, Columbia University Press, 1975, and P. D. Henderson, "Investment Criteria for Public Enterprises," in *Public Enterprise* (R. Turvey, editor), Penguin Modern Economics Readings, Penguin Books, 1968.

count rate of approximately 4 percent ( $1.06/1.0175 = 1.042$ ). An 8-percent discount rate similarly adjusted results in a rate of 6 percent ( $1.08/1.0175 = 1.061$ ). These two rates, 4 percent and 6 percent, are intermediate in the range of rates currently employed and were used in this study to estimate the present value of lifetime earnings.

*Consumption.*—In the past, there was some diversity of opinion regarding the treatment of consumption—whether or not to deduct it from

a person's contribution to output.<sup>22</sup> Recently, however, there has been wider agreement among economists that to deduct consumption in cost-of-illness calculations would be wrong since it is the losses to society that are being measured rather than those to the individual family.<sup>23</sup>

<sup>22</sup> See Burton A. Welsbrod, *Economics of Public Health*, University of Pennsylvania Press, 1961; Louis I. Dublin and Alfred J. Lotka, *The Money Value of Man*, The Ronald Press Company, 1946; and Rashi Feln, *Economics of Mental Illness*, Basic Books, 1958.

<sup>23</sup> E. J. Mishan, "Evaluation of Life and Limb," *Journal of Political Economy*, 1971.

## Notes and Brief Reports

### Self-Employment Income At Low Earnings Levels\*

The social security tax rate on self-employment earnings differs from the tax rate on wages. Under certain conditions this situation could lead to the taxing of workers with low earnings at a higher average rate than those with high earnings.

Since 1951, when self-employment first became covered by the social security system, the self-employment tax rate has ranged from about 68 percent to about 75 percent of the combined employee and employer rates on wages. If it is assumed for the purpose of this study that the employee ultimately bears the entire wage tax then the self-employed pay a lower rate than wage earners do. And if self-employment is concentrated among individuals of moderate and higher earnings—the question this study investigates—it follows that the average tax rate is regressive in relation to taxable earnings, that is, the rate is higher for taxable earnings at the lower levels.

This assumption on the burden, or incidence, of the tax means that were it not for the employer tax (a) the market wage structure would be higher by precisely the amount of the tax and

(b) employers would therefore have to pay the higher going wage to obtain the employees they desire. Economists disagree on the extent to which the tax burden shifts.<sup>1</sup> (The incidence of the employee's share of the tax is part of the same theoretical question, yet observers appear to agree that at least half of the combined employee-employer tax falls on the worker. Controversy in the literature on the proportion of the tax borne by the worker seems limited to a range that goes from half to all of it.)

This note presents data on the proportion of taxable earnings that is derived from self-employment at various earnings levels and examines the hypothesis of regressivity in the light of the data.

#### TERMINOLOGY

"Earnings" in the context of taxes and the social security program are not identical with income. They consist only of those portions of income that result largely from the personal effort of the earner—wages and income from self-employment. Dividends, rent, interest, and other forms of property income that involve relatively little personal effort are not called earnings and are not taxable or creditable for benefits under the program.

Earnings from covered employment are taxed each year to the "maximum" amount specified

\* By Aaron J. Prero, Division of OASDI Statistics. Acknowledgement is made to Robert H. Finch, Jr., and Katherine P. Merrick for their work in calculating the standard errors.

<sup>1</sup> For a presentation of the views of several economists on the incidence of the social security tax, see John A. Brittain, *The Payroll Tax for Social Security*, The Brookings Institution, 1972, chapters II and III.

in the law. The portion of earnings that falls below the maximum and is taxed is called self-employment income (SEI). "Taxable earnings" (wages) and SEI.

The weighted average of wages and SEI is  $W \cdot T_w + S \cdot T_s$ , where  $T_w$  and  $T_s$  are the tax rates on wages and SEI, respectively. The average tax rate on wages declines as wages rise and is regressive in relation to earnings. The average tax rate on SEI will necessarily be regressive in relation to earnings beyond the maximum itself, but the special SEI tax rate on earnings above the maximum is neither regressive nor progressive. The regressivity caused by the SEI tax is not considered in the present procedure. SEI, of course, is not taxable as wages in the present procedure. The regressivity caused by the SEI tax is not compensated for by d

#### THE DATA

The data were obtained from the Continuous Enrollment Survey of all workers covered by the Social Security Administration for old-age, survivors, and disability insurance were 4.8 percent for employer and 6.9 percent for employee. The taxable maximum for the year ending in 1972 was \$12,960. The accompanying table shows the distribution of taxable earnings and the weighted average of the employee portion, as well as the employer portion.

Earnings are divided into intervals of \$600, except for the highest interval. Earnings in the lowest interval are considered self-employment earnings for social security purposes and are not taxable for benefits. Earnings in the highest interval are not comparable.

<sup>2</sup> See the Technical Report on the Sampling Procedure.