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An Economic Analysis of Variations in Medical Expenses and Work-Loss Rates

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1. OBJECTIVES AND ORGANIZATION

This paper employs a number of the standard tools of economic analysis to explore unpublished data on the medical expenses and work-loss days due to illness or injury of currently employed persons. Section 2 deals with the data, statistical techniques, and variables employed in the study. The primary objective of Section 3 is to estimate elasticities of demand for medical care (totally and by type) with respect to family income. Knowledge of these elasticities should contribute to more accurate forecasts of the demand for medical care and aid in the formulation of policy-related judgments concerning the equity of the current distribution of medical services.

Like earlier studies of the demand for medical care[1] which have

NOTE: This paper appeared previously in Herbert E. Klarman (ed.), *Empirical Studies in Health Economics; Proceedings of the Second Conference on the Economics of Health*, Baltimore, Johns Hopkins Press, 1970, pp. 121–40.

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[1] Paul J. Feldstein and Ruth Severson, "The Demand for Medical Care," *Report of the Commission on the Cost of Medical Care*, Chicago, American Medical Association, 1964, pp. 57–76; Grover Wirick and Robin Barlow, "The Economic and Social Determinants of the Demand for Health Services," in *The Economics of Health and Medical Care*, ed. S. J. Axelrod, Ann Arbor, The

utilized other bodies of data, the present study utilizes data on medical expenses to measure the amount of care received. Expense data are useful because, unlike the available physical measures, they reflect not only the quantity but the quality of medical care. On the other hand, the use of expense data creates a number of problems (e.g., free care) which are given detailed consideration in Section 3.

Unlike many previous studies, this study makes use of grouped or "ecological" data. The use of average incomes to estimate income elasticities which describe individual behavior can be justified in two ways. First, grouped data should minimize "simultaneous-equation bias." The individual correlation between income and medical care will reflect not only the effect of income on the amount of medical care demanded but also the effect of health on income. This problem would be more severe for individual than for grouped data because individual health is affected not only by differences in "erratic" factors among groups but by intragroup variations in such factors. Second, measurement errors (including transitory influences) in individual incomes would lead to underestimates of regression coefficients even if these errors were not correlated with the true (or long-run) individual incomes.[2] Errors of this type often cancel out in grouped data.

One of the important innovations of Section 3 is the inclusion of the earnings rate with family income in the regressions. This allows empirically for the previously ignored possibility that higher-income individuals may need more medical care or use less patient–time-intensive methods of dealing with their medical problems.

The mortality rate has been the most widely used measure of health for many years, but the recent growth of quantitative interest in the determinants of health status has sharply increased the demand for more flexible measures. One of the most promising alternative measures

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University of Michigan Press, 1964, pp. 95–125; Paul J. Feldstein and W. John Carr, "The Effect of Income on Medical Care Spending," *Proceedings of the Social Statistics Section of the American Statistical Association*, 1964, pp. 93–105. For useful summaries, references to the literature, and discussions of many of the relevant issues in the theory and empirical application of the demand for medical services, see Herbert E. Klarman, *The Economics of Health*, New York, Columbia University Press, 1965, chap. 2; Paul J. Feldstein, "Research on the Demand for Health Services," *Milbank Memorial Fund Quarterly* 44, July 1966, pp. 128–62; and Jerome Rothenberg, "Comment," *Proceedings of the Social Statistics Section of the American Statistical Association*, 1964, pp. 109–10. See also Part III of this volume.

[2] J. Johnston, *Econometric Methods*, New York, McGraw-Hill Book Co., 1963, pp. 148–50.

of health is the work-loss rate due to illness or injury. Section 4 attempts to test the validity of using the work-loss rate as a measure of health by ascertaining whether variations in work-loss rates reflect differences in the degree to which individuals can afford to lose income or in the amounts that would be lost, and, if so, the extent to which they do so. The principal findings of the study are summarized in Section 5.

2. DATA, VARIABLES, AND STATISTICAL TECHNIQUES

The medical expense and work-loss data analyzed are drawn from the National Health Survey of the National Center for Health Statistics. These data, which are restricted to currently employed persons, are in the form of averages for each of twenty-four groups, by regions (Northeast, North Central, South, and West), age group (17–44, 45–64, and 65 and over), and sex.

The information was obtained through household health interviews and mail-in questionnaires left after completion of the interviews. The averages for medical expenses are based on a sample of about 71,000 persons from 22,000 households and include all medical bills paid, or to be paid, by the ill person, his family or friends, and any part paid by insurance. The average work-loss rates are based upon a sample of 134,000 persons from 42,000 households. The expense data refer to the twelve months prior to the interview period of July 1, 1962–December 31, 1962, while the work-loss data refer to the interview period July 1962–June 1963.[3]

The primary data utilized in the paper are shown in Table 6-1. The data for the quantitative independent variables are, of necessity, also in the form of averages for each of the twenty-four region-age-sex cells and refer to employed persons at work. However, those averages which refer to 1959 or 1960 are derived from a different sample than the medical expenses and work-loss rates, the 1-in-1,000 sample of the census of 1960.[4]

[3] For more detailed discussions of the work-loss and expense data, see U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, *Personal Health Expenses per Capita Annual Expenses, United States: July–December 1962,* Vital and Health Statistics, series 10, no. 27, Washington, D.C., 1966, and *Disability Days in the United States: July 1963–June 1964,* Vital and Health Statistics, series 10, no. 24, Washington, D.C., 1965.

[4] U.S. Department of Commerce, Bureau of the Census, *Census of Population and Housing, 1/1,000 and 1/10,000: Two National Samples of the Population of the United States,* Washington, D.C., 1960.

The more important variables employed in the multiple regressions of Sections 3 and 4 are listed below and discussed when appropriate.

TABLE 6-1

Selected Data on Medical Expenses and Days Lost from Work, by Age Group and Sex

Region	Age Group	Sex	Average Medical Expenses per Currently Employed Person per Year (July–December 1962)	Average Days Lost due to Illness or Injury per Currently Employed Person per Year (July 1962–June 1963)
NE	17–44	M	$106.99	3.5
NE	45–64	M	175.12	7.1
NE	65 and over	M	228.89	8.2
NE	17–44	F	154.47	6.5
NE	45–64	F	193.81	8.7
NE	65 and over	F	269.79	6.4
NC	17–44	M	90.30	3.9
NC	45–64	M	161.00	6.9
NC	65 and over	M	190.45	10.6
NC	17–44	F	129.83	5.5
NC	45–64	F	181.17	6.7
NC	65 and over	F	163.53	5.4
S	17–44	M	95.50	5.4
S	45–64	M	156.92	9.8
S	65 and over	M	175.12	13.8
S	17–44	F	140.95	6.5
S	45–64	F	168.23	6.3
S	65 and over	F	142.09	7.1
W	17–44	M	114.59	4.8
W	45–64	M	192.37	6.2
W	65 and over	M	203.94	9.8
W	17–44	F	216.81	6.6
W	45–64	F	249.30	6.0
W	65 and over	F	183.05	7.5

Dependent Variables:

Y_1, total medical expense per currently employed person per year
Y_2, hospital expense per currently employed person per year
Y_3, medicine expense per currently employed person per year
Y_4, doctor expense per currently employed person per year
Y_5, dentist expense per currently employed person per year
Y_6, days lost from work due to illness or injury per currently employed person per year

Independent Variables:[5]

Average weekly earnings are obtained by dividing mean total earnings for a given cell by its mean number of weeks worked. Earnings per day are estimated by dividing the above quotient by 5; the resulting dollar figure is multiplied by mean work-loss days in the cell to obtain the value of lost time, which is then added to X_{1u}.

X_1, adjusted mean total family income for employed persons at work who are in families

X_{1u}, unadjusted mean total family income for employed persons at work who are in families

X_{1d}, 0 if adjusted mean total family income for employed persons at work in families (X_1) is below its median value; the actual value of X_1 when it is above its median

X_2, 0 for female, 1 for male

X_3, region: 0 for non-South, 1 for South

X_4, age: 0 for 17–44, 1 for 45–64, 2 for 65 and over

X_3 and X_4 are the primary measures of region and age utilized in the study. The forms of these variables are derived from a priori considerations and from a desire to conserve degrees of freedom, to limit multicollinearity problems, and to avoid exhausting the sample space. The age variable is the most controversial, but it is important to note that the possibility that its use biases the coefficients of the economic variables upon which our interest centers is lessened by the use of a variety of regression forms. However, as an additional precaution, key results are checked by replacing X_3 with:

X_5, age: 1 if age 17–44, 0 otherwise

and

X_6, age: 1 if age 45–64, 0 otherwise

[5] The following midpoints were assumed for open-ended classes: total family income of employed persons at work in families (Item 60, Code X), $60,000; total earnings of employed persons at work (Item 39, Code X), $40,000; highest grade of school completed by employed persons at work (Item 26, Code X), 17.5 years.

X_7, mean highest grade of school completed by employed persons at work
X_8, percentage of employed persons at work residing in rural areas
X_9, percentage of employed persons at work residing outside SMSA's
X_{10}, percentage of employed persons at work who are married with spouse present
X_{11}, percentage of employed persons at work who are Negro
X_{12}, earnings per week worked of employed persons at work (estimated by dividing mean total earnings in 1959 for those with earnings by the mean number of weeks worked in 1959 by those who worked)

Since the relevant bodies of theory do not specify functional forms, both natural values and a logarithmic transformation are employed. Further, the regressions are run in both unweighted and weighted form, in which the weights are the square roots of the number of persons in each of the twenty-four region-age-sex cells. The use of weights is designed to achieve homoscedasticity and reduce the chances of errors in regression coefficients caused by large random errors in a small cell. However, unweighted regressions are run also because relevant information might be lost by the assignment of low weights to small but extreme cells (e.g., those for the 65-and-over age group).

3. REGRESSION ANALYSIS OF MEDICAL EXPENSES

The primary objective of this section is to estimate elasticities of demand for medical care with respect to command over goods and services. Amounts of medical services received are measured by the mean medical expenses of currently employed persons in a region-age-sex cell (Y_1–Y_5), while command over goods and services is measured by a cell's adjusted mean total family income for employed persons at work who are in families (X_1).

An important advantage of expense data is that they reflect both the quantity and quality of medical care, whereas the available physical measures (e.g., physician visits) reflect only the quantity. However, as in previous studies, the use of expenses gives rise to a number of difficulties. First there is the (probably minor) problem of "free" care which is received by some currently employed persons with very low incomes but is not included in the expense data. Second, medical care prices may be positively correlated with income because physicians charge the more affluent higher prices for given services, or because the more affluent are more likely to have health insurance and those covered by insurance are charged higher prices.[6] Third, and most important, when more affluent individuals are ill or undergoing preventive care, they attempt to maintain their customary living standards by purchasing amenities and complements to medical care such as private hospital rooms and "Park Avenue doctors." As a result, the medical expenses of the more affluent overstate the amount of medical care they have received.

The available data do not permit dealing with the last two problems. However, the purchase of amenities is probably most important in the case of hospital expense, and the data do permit the estimation of separate income elasticities for the various components of medical care.

As has been pointed out in Section 1, the use of mean incomes helps to minimize bias due to errors of measurement and simultaneous-equation problems. However, if variables not included in the statistical model reduced health in certain of our region-age-sex cells and resulted in higher medical expenses and lower family income, income elasticities would still be biased. In order to deal with this possibility, data for each region-age-sex cell on average earnings rates and work-loss days due to illness or injury were used to estimate the value of working time lost due to poor health. These estimates were added to the mean family income figure for each of the cells to secure "adjusted" mean total family income (X_1), which was utilized in the regressions.

Since higher-income individuals can afford to purchase more and better medical care and are unlikely to prefer purchases of other types of consumer goods when they are ill, and since it seems unlikely that most consumers regard the services provided by preventive medical care as lower-quality members of some broader family of services (as is margarine in the family of table fats), there is reason to expect the income elasticity to be positive. On the other hand, given appropriate assumptions about time preferences, it is possible that those with higher incomes might purchase more preventive care, resulting in lower average current expenses.[7] In the opinion of this writer the arguments suggest-

[6] These possibilities are mentioned by Victor R. Fuchs in his Comment in *The Economics of Health and Medical Care*, 1964, p. 126. It should be noted that the direction of the bias caused by a sliding scale of fees depends upon the elasticity of demand for medical care with respect to its price. If, as is generally assumed, demand is inelastic, a positive correlation between medical care prices and income would lead to overestimation of income elasticities.

[7] Wirick and Barlow, "The Economic and Social Determinants of the Demand for Health Services," p. 107.

ing a positive relationship are far stronger than those supporting a negative one, but in the final analysis the issue must be resolved by the data.

Previous empirical studies indicate that the income elasticity is positive and somewhat below unity. The latter magnitude is a useful benchmark because of the "necessity" character of much, if not most, medical expenditure. If we continue to think in terms of the "degree of necessity," it seems reasonable to expect the income elasticity of dentist expense to be relatively high and that of hospital expense to be relatively low. This hypothesis receives support from the findings of Feldstein and Severson[8] and is reexamined in the present study.

Because of their intrinsic interest and to avoid biased estimation of the income elasticity, a number of additional independent variables are included in the regressions. Dummy variables measuring age, sex, and region are utilized because they may reflect differences in physiological or psychological needs for medical care,[9] or perhaps in its cost. Later in the analysis, the percentage rural, the percentage living outside SMSA's, the percentage Negro, and measures of marital status and education are included in the regressions. In the final phase the earnings rate is introduced. The studies cited above suggest that being younger and better educated lowers expenses, while being female raises them. The results of the regressions are presented in Table 6-2.

Regressions 1–4 show that whatever the form employed, the coefficient of income is positive and statistically significant at conventional levels.[10] The estimated income elasticities of demand for medical services, which range from 1.4 to 2.0, are quite high in comparison with those observed in previous studies.

The inclusion of bills paid by insurance in the expense data, taken together with a positive correlation between family income and the amount of health insurance (whether directly paid for by the family

[8] See "The Demand for Medical Care."

[9] Wirick and Barlow, pp. 101, 104.

[10] X_{1d} was introduced into the regressions in order to ascertain whether the effect of income varies with its level. It was found that the coefficient of this variable, which measures the difference in the effect of income in the range below its median from that in the range above its median, fluctuates in sign and is statistically insignificant.

In practice, the use of "adjusted" income did not matter very much; when regression 4 was rerun utilizing unadjusted income (X_{1u}), the income elasticity was 2.04 and its computed t value was 5.44, while the adjusted coefficient of determination was 0.89.

or by third parties), may help to explain the above discrepancy. Along the same lines, some studies include insurance coverage as an independent variable, which causes income elasticities to be underestimated since, to a large extent, insurance coverage is a positive function of income. Unfortunately, the data at my disposal do not permit quantitative statements of the role of these factors. Another possibility which is difficult to test is that preventive care, which is probably more income-elastic than care of the curative variety, comprises a larger fraction of total medical expenses for the currently employed population than for the population as a whole.

Since the LW form showed the strongest results, sole reliance was now placed upon it. The next step taken was to replace X_4 by the less demanding age variables X_5 and X_6 (see regression 5).[11] Since the coefficients of these variables were found to be statistically significant, to increase the unadjusted coefficient of determination slightly, and to raise the estimated income elasticity from 2.0 to 2.5, it was decided to retain them in the succeeding regressions. Regressions 6–9 are for the separate components of medical expense and show the relative magnitudes of the income elasticities to be consistent with a priori considerations and previous empirical work—i.e., the income elasticities range from 1.8 for hospital expense to 3.2 for dentist expense.

The results for the other independent variables utilized in regressions 1–9 may be summarized as follows: Other things being equal, the proxy for the quantity of medical services is higher for females, Southerners, and older persons (with the exception of dental care) than for males, non-Southerners, and younger persons.[12] Some possible interpretations are (1) that younger persons and non-Southerners require less medical care because they are healthier than older persons and Southerners, and (2) that for physiological or psychological reasons females purchase more and/or more expensive medical care than males.

In regressions 10–14 some new independent variables are introduced one at a time into regressions for total expenses. The coefficients of the percentage rural (X_8) and the percentage outside SMSA's (X_9) are

[11] The coefficients of X_5 and X_6 show how much the level of the entire equation must be adjusted for the influence of the corresponding age groups; the influence of the age group sixty-five and over is reflected in the constant term of the equation.

[12] When X_4 is used in regressions 6–9 instead of X_5 and X_6, the ordering of income elasticities remains the same while the coefficients of X_4 are 0.15, 0.16, 0.08, and −0.04, respectively. The corresponding computed t values are 4.20, 11.67, 3.73, and −1.25, respectively.

TABLE 6-2

Regressions of Medical Expenses per Currently Employed Person per Year on Various Independent Variables for Twenty-four Region-Age-Sex Cells[a]

Regression No. (1)	Form of Regression[b] and Dependent Variable (2)	Regression Coefficient and Computed t Value (in Parentheses)[c]: Income (X_1) (3)	Sex (X_2) (4)	Region (X_3) (5)	Age (X_4) or Age (X_5) (6)	Age (X_6) (7)	X_7–X_{12} (8)	Biased Coefficient of Determination and Unbiased Coefficient of Determination (in Parentheses) (9)
1	NU_W	0.03	−34.90	33.50	37.19			.70
	Tot. exp. (Y_1)	(3.42)[e]	(−3.01)[e]	(1.45)	(5.27)[e]			(.63)
2	NW	0.03	−43.95	47.33	36.10			.88
	Tot. exp. (Y_1)	(4.32)[e]	(−6.15)[e]	(2.92)[e]	(5.38)[e]			(.85)
3	LU_W	1.55	−0.10	0.12	0.11			.75
	Tot. exp. (Y_1)	(4.01)[e]	(−3.61)[e]	(2.04)	(6.24)[e]			(.70)
4	LW	2.02	−0.14	0.18	0.11			.91
	Tot. exp. (Y_1)	(5.61)[e]	(−7.64)[e]	(4.16)[e]	(6.40)[e]			(.90)
5	LW	2.53	−0.14	0.24	−0.26	−0.18		.92
	Tot. exp. (Y_1)	(5.38)[e]	(−8.10)[e]	(4.35)[e]	(−6.34)[e]	(−3.79)[e]		(.90)
6	LW	1.82	−0.14	0.17	−0.32	−0.19		.74
	Hos. exp. (Y_2)	(1.74)	(−3.69)[e]	(1.43)	(−3.56)[e]	(−1.77)		(.67)
7	LW	2.23	−0.15	0.29	−0.34	−0.20		.96
	Med. exp. (Y_3)	(5.62)[e]	(−10.52)[e]	(6.16)[e]	(−10.05)[e]	(−4.93)[e]		(.95)
8	LW	2.88	−0.15	0.29	−0.21	−0.18		.86
	Dr. exp. (Y_4)	(4.56)[e]	(−6.42)[e]	(3.94)[e]	(−4.04)[e]	(−2.78)[d]		(.82)
9	LW	3.19	−0.13	0.22	0.04	−0.04		.71
	Den. exp. (Y_5)	(3.55)[e]	(−3.75)[e]	(2.08)	(0.47)	(−0.44)		(.62)

(continued)

Den. exp. (Y_5)	(3.55)[e]	(−3.75)[e]	(2.08)	(0.47)	(−0.44)		(.62)

(continued)

TABLE 6-2 (continued)

							[Ed. X_7]	
10	LW	2.61	−0.13	0.28	−0.34	−0.22	0.74	.93
	Tot. exp. (Y_1)	(5.47)[e]	(−5.70)[e]	(4.11)[e]	(−3.81)[e]	(−3.58)[e]	(1.01)	(.90)
							[% rural X_8]	
11	LW	2.39	−0.13	0.24	−0.26	−0.17	−0.05	.92
	Tot. exp. (Y_1)	(4.12)[e]	(−5.24)[e]	(4.17)[e]	(−6.19)[e]	(−3.35)[e]	(−0.43)	(.90)
							[% out. SMSA X_9]	
12	LW	2.38	−0.14	0.23	−0.25	−0.18	−0.04	.93
	Tot. exp. (Y_1)	(4.16)[e]	(−7.34)[e]	(4.08)[e]	(−6.21)[e]	(−3.50)[e]	(−0.47)	(.90)
							[% married X_{10}]	
13	LW	2.35	−0.20	0.21	−0.29	−0.22	0.35	.94
	Tot. exp. (Y_1)	(5.30)[e]	(−6.32)[e]	(4.08)[e]	(−7.11)[e]	(−4.59)[e]	(2.06)	(.92)
							[% Negro X_{11}]	
14	LW	2.29	−0.16	0.27	−0.24	−0.16	−0.11	.93
	Tot. exp. (Y_1)	(4.70)[e]	(−8.09)[e]	(4.69)[e]	(−5.77)[e]	(−3.37)[e]	(−1.45)	(.91)
							[Ed. X_7]	
15	LW	1.56	−0.19	0.05	−0.08	−0.07	−2.26	.77
	Hos. exp. (Y_2)	(1.51)	(−3.87)[e]	(0.34)	(−0.41)	(−0.51)	(−1.44)	(.69)
16	LW	2.37	−0.13	0.36	−0.48	−0.27	1.26	.97
	Med. exp. (Y_3)	(6.54)[e]	(−7.71)[e]	(6.87)[e]	(−7.15)[e]	(−5.69)[e]	(2.28)[d]	(.96)
17	LW	3.06	−0.12	0.38	−0.39	−0.26	1.59	.88
	Dr. exp. (Y_4)	(5.02)[e]	(−4.21)[e]	(4.35)[e]	(−3.47)[e]	(−3.35)[e]	(1.71)	(.84)
18	LW	3.20	−0.12	0.22	0.02	0.04	0.10	.71
	Den. exp. (Y_5)	(3.41)[e]	(−2.80)[d]	(1.67)	(0.15)	(−0.38)	(0.07)	(.60)

(continued)

TABLE 6-2 (continued)

Regressions of Medical Expenses per Currently Employed Person per Year on Various Independent Variables for Twenty-four Region-Age-Sex Cells[a]

Regression No. (1)	Form of Regression[b] and Dependent Variable (2)	Regression Coefficient and Computed t Value (in Parentheses)[c]: Income (X_1) (3)	Sex (X_2) (4)	Region (X_3) (5)	Age (X_4) or Age (X_5) (6)	Age (X_6) (7)	X_7–X_{13} (8)	Biased Coefficient of Determination and Unbiased Coefficient of Determination (in Parentheses) (9)
							[% married X_{10}]	
19	LW	1.28	−0.31	0.10	−0.42	−0.31	1.03	.83
	Hos. exp. (Y_2)	(1.44)	(−4.84)[e]	(0.93)	(−5.12)[e]	(−3.15)[e]	(2.97)[e]	(.77)
20	LW	2.23	−0.16	0.28	−0.34	−0.20	0.01	.96
	Med. exp. (Y_3)	(5.34)[e]	(−5.35)[e]	(5.79)[e]	(−8.88)[e]	(−4.41)[e]	(0.05)	(.95)
21	LW	2.57	−0.25	0.25	−0.28	−0.25	0.60	.91
	Dr. exp. (Y_4)	(4.67)[e]	(−6.30)[e]	(3.80)[e]	(−5.48)[e]	(−4.11)[e]	(2.79)[d]	(.87)
22	LW	3.33	−0.08	0.24	0.06	−0.01	−0.28	.72
	Den. exp. (Y_5)	(3.60)[e]	(−1.20)	(2.18)[d]	(0.74)	(−0.09)	(−0.77)	(.62)
							[% Negro X_{11}]	
23	LW	2.04	−0.13	0.14	−0.34	−0.21	0.10	.75
	Hos. exp. (Y_2)	(1.81)	(−2.97)[e]	(1.05)	(−3.50)[e]	(−1.83)	(0.58)	(.66)
24	LW	2.08	−0.16	0.31	−0.33	−0.19	−0.07	.96
	Med. exp. (Y_3)	(4.93)[e]	(−9.89)[e]	(6.09)[e]	(−9.27)[e]	(−4.48)[e]	(−1.06)	(.95)
25	LW	2.35	−0.18	0.36	−0.18	−0.14	−0.24	.90
	Dr. exp. (Y_4)	(4.02)[e]	(−7.79)[e]	(5.21)[e]	(−3.62)[e]	(−2.38)[d]	(−2.63)[d]	(.87)
26	LW	3.22	−0.12	0.21	0.03	−0.04	0.01	.71
	Den. exp. (Y_5)	(3.28)[e]	(−3.20)[e]	(1.81)	(0.40)	(−0.43)	(0.10)	(.60)
							[Earn. rate X_{12}]	
27	LW	1.20	−0.69	0.28	−0.37	−0.32	2.07	.96
	Tot. exp. (Y_1)	(2.30)[d]	(−4.50)[e]	(6.34)[e]	(−8.22)[e]	(−5.94)[e]	(3.58)[e]	(.94)

(continued)

							[Earn. rate X_{12}]	
27	LW	1.20	−0.69	0.28	−0.37	−0.32	2.07	.96
	Tot. exp. (Y_1)	(2.30)[d]	(−4.50)[e]	(6.34)[e]	(−8.22)[e]	(−5.94)[e]	(3.58)[e]	(.94)

(continued)

TABLE 6-2 (concluded)

28	LW	1.20	−0.40	0.19	−0.37	−0.25	0.96	.75
	Hos. exp. (Y_2)	(0.79)	(−0.89)	(1.50)	(−2.82)[d]	(−1.61)	(0.57)	(.66)
29	LW	1.46	−0.47	0.31	−0.41	−0.28	1.20	.97
	Med. exp. (Y_3)	(2.81)[d]	(−3.12)[e]	(7.03)[e]	(−9.08)[e]	(−5.21)[e]	(2.10)[d]	(.96)
30	LW	0.85	−0.99	0.35	−0.40	−0.40	3.15	.94
	Dr. exp. (Y_4)	(1.38)	(−5.43)[e]	(6.74)[e]	(−7.39)[e]	(−6.13)[e]	(4.60)[e]	(.92)
31	LW	2.39	−0.45	0.24	−0.03	−0.12	1.24	.72
	Den. exp. (Y_5)	(1.85)	(−1.20)	(2.22)[d]	(−0.31)	(−0.93)	(0.87)	(.62)

[a] For detailed definitions of the variables employed in the regressions, see Section 2.

[b] Natural unweighted, NU_W; natural weighted, NW; logarithmic unweighted, LU_W; logarithmic weighted, LW. The weights are obtained from the following:

Region	Age	Sex	No. of Persons	Region	Age	Sex	No. of Persons
NE	17–44	M	6,338	S	17–44	M	7,103
NE	45–64	M	3,980	S	45–64	M	3,820
NE	65—	M	525	S	65—	M	495
NE	17–44	F	3,031	S	17–44	F	3,460
NE	45-64	F	2,036	S	45–64	F	1,833
NE	65—	F	190	S	65—	F	181
NC	17–44	M	7,372	W	17–44	M	3,977
NC	45–64	M	4,236	W	45–64	M	2,205
NC	65—	M	589	W	65—	M	300
NC	17–44	F	3,181	W	17–44	F	1,800
NC	45–64	F	1,939	W	45–64	F	1,062
NC	65—	F	248	W	65—	F	102

[c] The estimated income elasticities at points of means for the natural regressions are 1.44 (regression 1) and 1.83 (regression 2).

[d] Statistically significant at the .05 level on a one-tail test for the earnings rate (X_{12}) and on a two-tail test for all other variables.

[e] Statistically significant at the .01 level on a one-tail test for the earnings rate (X_{12}) and on a two-tail test for all other variables.

found to be insignificant, and it is wisest to ignore them. The computed t value for the education variable (X_7) is more respectable but is statistically insignificant. However, in view of the wide interest in the role of this variable, it is worth noting that its sign is positive, which might be interpreted to mean that education leads individuals to take better care of their health. The coefficient of the percentage Negro (X_{11}) is negative, which might mean that, other things being equal, Negroes are healthier than whites and therefore require less medical care, but is more likely to mean that cultural and other factors result in Negroes receiving less medical care for a given problem. However, these speculations should not be emphasized, since the coefficient of X_{11} is not statistically significant. Finally, the coefficient of the marital status variable (X_{10}) is positive and is in the range of statistical significance. In order to obtain further information on the role of the last three independent variables, they were included in regressions for each of the four types of medical expense, with the results shown in regressions 15–26.

The results for the education variable (regressions 15–18) are quite interesting: the coefficient of X_7 is negative for hospital expenses, positive for medicine and physician expense, and positive but of negligible magnitude for dentist expense. A possible interpretation is that education results in emphasis being placed on preventive care, which leads to relatively low hospital and dentist expense and relatively high medicine and physician expense.[13]

The coefficient of the marital status variable is found to be positive and statistically significant for hospital and physician expense, positive but insignificant for medicine expense, and negative but insignificant for dentist expense (regressions 19–22). These results probably mean that the positive correlation between X_{10} and total expenses is a reflection of the fact that being married with a spouse present is associated with child-bearing expenses for females; child-bearing raises hospital and physician expenses but does not greatly affect dentist and medicine expenses.

It is found that the inverse relationship between the percentage Negro and total expenses is derived from a strong negative relationship for physician expense and a somewhat weaker negative effect on medicine expense (regressions 24 and 25). The basis for the observed

[13] Caution is justified here, as the computed t values of the education variable are not very large, and there is evidence of harmful multicollinearity in regression 15.

differences in the results for the various components is not apparent to the present writer.[14]

To the extent that analysts have been willing to take a position on this issue, they have tended to interpret positive relationships between income and medical expenses to mean that higher income permits individuals and groups to receive the benefits flowing from more and better medical care. At the same time, policy-related judgments concerning the equity of the current distribution of medical services are in part based upon the magnitude of the income elasticity. However, aside from the problems that arise in using expenses as a measure of the amount of medical care, such interpretations and judgments are spurious to the extent that (1) activities raising money incomes simultaneously depress health status and consequently increase the demand for medical services, and (2) individuals or groups with higher income use less patient-time-intensive (more medical-goods-and-services-intensive) methods of dealing with their medical problems.

Both of these conditions that give rise to upward-biased income elasticities might occur because of a positive correlation between income and the earnings rate.[15] A higher earnings rate may reduce health status while raising income by inducing individuals to "work harder," to go to work instead of staying at home when they are ill, to take more sedentary jobs, or to take more dangerous jobs. Further, it seems reasonable to believe that an increase in the earnings rate, and hence in income, will lead patients or their physicians to substitute medical goods and services for the patient's time in dealing with a given medical problem. In recognition of these possible sources of biased income elasticities, the earnings rate (X_{12}) is included in regression 27. It is found that the coefficient of the earnings rate has the expected positive sign and is statistically significant, while its inclusion lowers the income elasticity of total expenses from 2.5 (regression 5) to 1.2 and raises the adjusted coefficient of determination from 0.90 to 0.94.

In interpreting the results of the above regression it should be noted

[14] Charlotte Muller suggests that these differences may be explained by the fact that in the Negro subculture (and in other subcultures of poverty) there exists a tendency to substitute medicine for the services of physicians (self-medication) and to substitute home remedies for market purchase of medicines.

[15] Actually, the bias could be downward if (1) an increase in the volume of medical services needed to produce a given level of health resulted in a *decline* in medical expenditures (i.e., the price elasticity of demand for health was numerically greater than 1), and (2) health were relatively time-intensive and substitution in consumption outweighed substitution in production. These possibilites were called to my attention by Michael Grossman.

that the correlation coefficient between the earnings rate and sex variables is in the range of 0.9.[16] Intercorrelations of this magnitude often produce highly unstable parameter estimates. A check on the stability of the conclusions suggested by regression 27 is provided by regressions 28–31, which are for the separate components of medical expense. Although multicollinearity problems are evident in each of the regressions, the results are consistent with expectations: in every case the coefficient of the earnings rate is positive, and its inclusion in the regression causes a perceptible decline in the estimated income elasticity. The explanatory value of the earnings rate is greatest for physician expense (the adjusted coefficient of determination rises from 0.82 to 0.92) and weakest for hospital and dentist expense (virtually no change occurs in the adjusted coefficient of determination). The statistically insignificant result for dentist expense seems reasonable, since it is unlikely that higher earnings rates lead individuals to substitute money income for dental health or to use higher ratios of dental services to their own time in the production of dental health. A factor which may help to explain the exceptional showing of the earnings rate for physician expense is that in the absence of information about income doctors may discriminate in their charges on the basis of occupation, which is more highly correlated with the earnings rate than with income.

With the inclusion of the earnings rate in the regressions, the legitimacy of interpreting the estimated coefficients of income as "income elasticities" is increased. Using expected values, it is found that the elasticity for medical care as a whole is 1.2, while the elasticities for its components range from a low of 0.85 for physician expense to a high of 2.4 or 3.2[17] for dentist expense.[18]

These results demonstrate that, even when proper account is taken of the earnings rate, command over goods and services as measured by family income exerts a strong positive influence upon the amount of medical care received by individuals.[19]

[16] The correlation between the income and sex variables is only .05, while that between the earnings rate and income is .41.

[17] The latter value results when the statistically insignificant earnings rate is dropped from the regression.

[18] Medical care is produced by the market goods analyzed above together with the *patient's time*. The best available measure of the latter input is days lost from work due to illness or injury per currently employed person (Y_6), which in Section 4 is found to have an income elasticity of about 2—i.e., intermediate between medicine and dentist expense.

[19] The reader is reminded that since some free care is available to persons with very low incomes, the income elasticities in the text, which apply to the

4. REGRESSION ANALYSIS OF WORK-LOSS RATES

The primary objective of this section is to obtain information on the question of whether the work-loss rate due to illness or injury is a worthwhile addition to the currently scant stock of quantitative health measures. This purpose is accomplished by testing two hypotheses suggesting that variations in the work-loss rate reflect differences in economic variables (health status remaining constant) rather than in the objective state of health. The primary hypothesis is that the higher the earnings rate in a region-age-sex cell, the lower its rate of work loss. The secondary hypothesis is that the higher the adjusted mean total family income in a cell, the higher its work-loss rate.

The prediction concerning the earnings rate flows from both consumption and production considerations. The consumption argument runs as follows: (1) It is more pleasant to recover from an illness while resting at home than while working; (2) the earnings rate can be considered the price of the consumption good "recovery at home" or "rest"; (3) the "law of demand" predicts an inverse relationship between price and quantity. The production argument is based upon the belief that individuals with higher earnings rates (or their physicians) substitute medical goods and services for their own time in dealing with a given medical problem. Since the patient's time input is, at least in part, reflected in the work-loss rate, the above substitution results in a negative correlation between the earnings rate and the work-loss rate.

The predicted relationship between family income and the work-loss rate rests upon a consumption argument and a mixed consumption-production argument. Stated briefly, the consumption argument is that "recovery at home" or "rest" is a superior consumption good. The mixed argument is based on the assumption that health or "recovery" is a superior consumption good produced according to a production function which is homogeneous of degree one (or of any other form which excludes the possibility of "inferior" factors of production). If these assumptions hold, an increase in family income would increase the demand for health, and hence the demand for all the relevant factors of production, including the patient's own time. An increase in the patient's time input would be reflected in an increased work-loss rate.

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relatively affluent, currently employed segment of the population, overestimate to an unknown degree the differential benefits received by the more affluent members of our society.

In order to avoid biasing the results and to increase their reliability, dummy variables representing region, age, and sex were included in the regressions shown in Table 6-3.

Negative regression coefficients for the earnings rate and positive ones for family income[20] are observed in three of the four forms utilized in regressions 1–4. In the fourth case (regression 3) the signs of family income, the earnings rate, and the sex variable (positive in the other three cases) are reversed. While none of the computed t values are impressive, the strongest results are obtained in regression 2, in which the positive coefficient of income is statistically significant while the negative one for the earnings rate is insignificant but respectable.

It is well known that high intercorrelations between independent variables often result in unstable parameter estimates and small computed t values. In the present analysis the previously noted deviant results for regression 3 and generally small computed t values may be symptoms of harmful multicollinearity (primarily) between the earnings rate and sex variables whose coefficient of correlation is in the range of 0.9. One method for dealing with this type of problem is to narrow the scope of the model by removing the less theoretically interesting variable, which in this case is the dummy for sex. This is done in regressions 5 and 6 for the weighted forms, which earlier yielded higher multiple correlation coefficients than the unweighted forms. It is found that the coefficients of family income and the earnings rate maintain the predicted signs and, especially in the case of the LW form, are statistically significant. The results are not greatly affected by the use of the less restrictive age variables X_5 and X_6 (see regression 7).

Of course, the danger inherent in the above precedure is that the price of avoiding harmful multicollinearity may be biased parameter estimates. Little can be done to deal with this possibility beyond running separate regressions for the twelve observations on each sex. This is done in regressions 8 and 9, which exclude the family income and region variables because they are now highly correlated with the earnings rate.[21] The results are ambiguous: while the coefficient of the male

[20] It is worth noting that the simple correlations between family income and work-loss days are small and negative.

[21] Taking all twenty-four observations together, the simple correlations between the earnings rate and the family income and regional variables are 0.41 and −0.31, respectively, while for males the corresponding values are 0.97 and −0.83 and for females, 0.89 and −0.79. The correlation between the earnings rate and age is .06 for all the observations, .21 for males, and close to 0 for females.

earnings rate is negative and statistically significant, the coefficient for females is positive and unreliable.

Obviously, the results are far from conclusive, but in my opinion they lend some support to the economic arguments presented above. The observed signs of the income and earnings rate variables, together with their relatively high partial correlation coefficients, suggest that differences in work-loss days may be unreliable measures of health status.[22] To the extent that the magnitudes of the regression coefficients can be taken seriously, it appears that the elasticity of the work-loss rate with respect to family income is surprisingly high, while that with respect to the earnings rate is low.

Turning to the other independent variables, it is found that, other things being equal, work-loss rates are higher for males, Southerners, and older persons than for females, non-Southerners, and younger persons. Like the findings for medical expenses (see Section 3), the resu.ts are consistent with the view that non-Southerners and younger persons enjoy better health than Southerners and older persons. The generally positive signs for sex are subject to a variety of interpretations, including the notion that females enjoy better health than males.

5. SUMMARY OF MAJOR FINDINGS

The empirical analysis in Section 3 reveals an income elasticity of demand of 1.2 for medical care as a whole, while the elasticities for its

[22] There are alternative, but in my opinion less plausible, interpretations according to which the empirical results are consistent with the view that the work-loss rate is a pure measure of health. First, the earnings rate might be negatively correlated with the work-loss rate because the former is an "efficiency variable"; that is, market skills might be positively correlated with skill in the production of health. Second, even after adjusting for differences in the earnings rate it might be the case that groups with higher incomes have poorer health.

A crude check of the alternative explanations presented above were obtained by running LW regressions utilizing a less ambiguous measure of health, the mortality rate, Y_M, as the dependent variable. (The mortality data utilized include deaths of persons who were not employed during the relevant period; the data were taken from the 1962 and 1963 volumes of *Vital Statistics of the United States*, from National Center for Health Statistics, *Health Insurance Coverage, United States: July 1962–June 1963*, Table 13, and from the *1960 Census of Population*, vol. 1, Pt. 1, Table 52.) The regressions offered little if any support for the alternative interpretations: (1) When the sex variable is included, the coefficient of income is positive but far from statistical significance, while the coefficient of the earnings rate is positive and insignificant; (2) when sex is dropped from the regression in order to avoid multicollinearity problems, the coefficient of income becomes *negative* and insignificant, while the coefficient of the earnings rate is positive and highly significant.

TABLE 6-3

Regressions of Days Lost from Work due to Illness or Injury per Currently Employed Person per Year (Y_6) on Various Independent Variables[a]

Regression No. (1)	Form of Regression[b] and Number of Observations (2)	Regression Coefficient and Partial Correlation Coefficient (Computed t Value in Parentheses)						Biased Coefficient of Determination and Unbiased Coefficient of Determination (in Parentheses) (9)
		Income[c] (X_1) (3)	Sex (X_2) (4)	Region (X_3) (5)	Age (X_4) or Age (X_5) (6)	Age (X_6) (7)	Earnings Rate[c] (X_7) (8)	
1	NU_W	0.001	3.55	2.07	1.42		−0.05	.52
	24	0.22	0.26	0.31	0.53		−0.21	(.38)
		(0.94)	(1.14)	(1.39)	(2.65)[d]		(−0.90)	
2	NW	0.002	3.27	3.23	1.85		−0.08	.74
	24	0.43	0.26	0.56	0.67		−0.32	(.67)
		(2.04)[d]	(1.13)	(2.85)[d]	(3.88)[e]		(−1.44)	
3	LU_W	−0.05	−0.21	0.15	0.13		0.83	.54
	24	−0.01	−0.23	0.38	0.67		0.25	(.41)
		(−0.06)	(−1.02)	(1.73)	(3.86)[e]		(1.11)	
4	LW	1.96	0.02	0.28	0.12		−0.42	.77
	24	0.35	0.02	0.63	0.66		−0.10	(.71)
		(1.61)	(0.10)	(3.44)[e]	(3.69)[e]		(−0.42)	
5	NW	0.001		2.96	2.02		−0.02	.73
	24	0.39	0.52		0.71		−0.40	(.67)
		(1.85)[d]	(2.66)[d]		(4.39)[e]		(−1.92)[d]	

(continued)

TABLE 6-3 (concluded)

6	LW	1.86		0.27	0.12		−0.33	.77
	24	0.55	0.64		0.70		−0.53	(.72)
		(2.91)[e]	(3.64)[e]		(4.23)[e]		(−2.76)[e]	
7	LW	2.28		0.32	−0.28	−0.18	−0.33	.78
	24	0.53	0.61		−0.67	−0.45	−0.54	(.72)
		(2.64)[e]	(3.24)[e]		(−3.83)[e]	(−2.13)	(−2.76)[e]	
8	LW Males			0.24			−0.86	.82
	12			0.90			−0.56	(.78)
				(6.39)[e]			(−2.04)[d]	
9	LW Females			0.03			0.24	.18
	12			0.37			0.24	(−.00)
				(1.20)			(0.73)	

[a] For detailed definitions of the variables employed in the regressions, see Section 2.

[b] See Table 6-2, note b.

[c] The estimated income elasticities at points of means for the natural regressions are 0.79 (regression 1), 2.38 (regression 2), and 1.32 (regression 5). The corresponding values for the earnings rate are −0.66 (regression 1), −1.29 (regression 2), and −0.29 (regression 5).

[d] Statistically significant at the .05 level on a one-tail test for income and the earnings rate and on a two-tail test for all other variables.

[e] Statistically significant at the .01 level on a one-tail test for income and the earnings rate and on a two-tail test for all other variables.

components range from 0.85 for physician expense to 3.2 for dentist expense. The ordering of the income elasticities is not unreasonable, and the magnitudes suggest that family income exerts a strong influence upon the amount of medical care received by individuals. However, an important question for future research is why the income elasticities reported in the present study are so high relative to those estimated from other bodies of data. The elasticity of total expenses with respect to the earnings rate is positive and statistically significant and is not negligible in magnitude—its value is 2.1.

In Section 4 it is seen that the work-loss days due to illness or injury are usually positively related to family income and inversely related to the earnings rate, which suggests the tentative conclusion that differences in unadjusted work-loss days may be unreliable measures of variations in health status.