Introduction

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The papers included in this volume were presented at the Second NBER Conference on Health Economics held at Stanford, California on 30–31 July 1980. The first conference (V. Fuchs and J. Newhouse, *The Journal of Human Resources* 13, Supplement, 1978) was concerned with the economics of physician and patient behavior; i.e., it dealt with medical care markets in a traditional demand-supply framework. This second conference focused on the other principal concern of health economics—health status—as measured by mortality, morbidity, disability, and the like. Within this broad area the ten papers fall into three separate categories. Four papers report the results of empirical investigations of the determinants of health status; four are empirical studies of the consequences of ill health; and two are theoretical treatments of health in relation to public policy.

Determinants of Health

Two papers (Harris; Rosenzweig and Schultz) in the determinants category deal with fetal development and infant health; one (Fuchs) focuses on adults aged 25–64; the fourth (Taubman and Rosen) is concerned exclusively with the health of older males.

Harris pays particular attention to the relationship between prenatal care and outcome of pregnancy. He argues that previous attempts to study this question have been plagued by several significant conceptual problems. First, the relationship between the timing of prenatal medical visits and the duration of pregnancy has been poorly characterized. Although mothers with little or no care have a high proportion of preterm

babies, it is possible that early termination of pregnancies from unrelated causes interrupts the course of care. In addition, the phenomena of spontaneous and induced fetal losses exert a powerful selective effect on maternal and fetal characteristics. As a result, mothers who initiate late care may have fitter infants than those who initiate early care. These differences in fitness may be difficult to observe (cf. Shepard-Zeckhauser in this volume); moreover, these unobserved maternal and infant health characteristics may affect the demand for care. It is unclear how nonexperimental, cross-section data can resolve these problems of inferring causality.

Harris's empirical work is based primarily on a sample of 6,800 black women in Massachusetts who were pregnant for at least twenty weeks during 1975–76. Using a continuous time stochastic model in which the initiation of care and the termination of pregnancy are competing risks, and controlling for other variables such as age, parity, schooling, and marital status, he finds that prenatal care appears to reduce the risk of premature birth. The relation between care and birth weight, given length of gestation, however, is much weaker.

In the last part of his paper, Harris addresses the question of the sharp decline in U.S. neonatal mortality since 1965. He shows that nearly all of the decline reflects a decrease in birth weight-specific mortality rates, not a shift in the weight distribution of births. How prenatal care might have contributed to this result is not at all clear. Harris argues that complex structural models are required to investigate this question, and presents some preliminary versions of such models. Although the conventional wisdom holds that prenatal care contributes to favorable pregnancy outcome because the physician modifies maternal behavior with respect to smoking, nutrition, and weight gain, Harris speculates that prenatal care may be serving as a proxy for a more complex set of phenomena associated with access to a wide range of social support services. Moreover, if prenatal care truly has a causal role, it may be because it permits early identification of those pregnancies which will most benefit from intensive *perinatal* care.

Rosenzweig and Schultz, like Harris, are concerned with the outcome of pregnancies, and they also devote a considerable portion of their paper to the theoretical and methodological problems that they believe have limited the usefulness of much previous research. In particular, they emphasize the necessity of jointly estimating the *demand* function for health production inputs (parental behavior) and the *production* function that relates behavior to health outcomes. Their model, which embeds a health production function in a utility-maximizing framework, distinguishes among (*a*) goods that are desired purely for their consumption value but have no effect on child health (e.g., a pretty dress); (*b*) goods that affect child health but otherwise provide no utility (e.g., medical

care); and (c) goods that affect health and also directly affect utility (e.g., cigarettes). The key feature of this model is that the family does not maximize child health, but treats child health as one of many sources of utility.

One conclusion Rosenzweig and Schultz draw from their theoretical analysis is that a tax on a c-type good such as cigarettes does not unambiguously lead to better child health even if it is certain that cigarettes are harmful and that the tax will reduce the demand for cigarettes. The tax's effect on health will also depend on the relation between cigarettes, health, and other goods in the utility function. Rosenzweig and Schultz also stress that unobserved heterogeneity in the population (e.g., with respect to the health of the fetus) can bias estimates of the effects of medical care on pregnancy outcome. They propose a two-stage procedure in which the first-stage demand equations provide predicted values which can be used to obtain unbiased estimates of the production function parameters.

Along with many other authors in this volume, Rosenzweig and Schultz discuss the relation between schooling and health. They believe that greater parental schooling affects pregnancy outcome by improving parental perceptions of the true nature of the production function (leading to a different mix of inputs). They contrast this with the view that schooling improves health by raising the marginal products of a given set of inputs.

The empirical portion of the Rosenzweig-Schultz paper is based on a national probability sample of over 9,000 legitimate births in the United States during 1967, 1968, and 1969. Three measures of birth outcome are used in the analysis: birth weight, gestation period, and standardized birth weight (actual birth weight divided by predicted birth weight based on gestation).

The endogenous variables tested for potential influence on birth outcome are the number of months of elapsed pregnancy before the mother visited a medical doctor, the number of packs of cigarettes smoked by the mother while pregnant, the live birth order of the pregnancy, and the age of the mother at birth.

The exogenous variables include several related to the individual, such as schooling, income, and race, and several describing the area in which the individual resides, for example, hospital beds per capita, physicians per capita, unemployment rate of women, price of cigarettes, and availability of family planning programs.

The authors' most significant finding is that cigarette smoking by the mother has a large negative effect on birth weight, both unadjusted and adjusted for gestation. Assuming mean values for the other variables, a differential of one pack of cigarettes per day during pregnancy lowers birth weight by 279 grams, or by 8.5%. Delay in seeking prenatal care

also is unfavorable to birth weight, but the effect is very small—45 grams as a result of a delay of six months. According to Rosenzweig and Schultz, the strong impact of smoking helps to explain some puzzling coefficients for other variables in the reduced-form equations. For instance, mothers with some high school education have lower weight babies than do mothers with no high school; also, residence in an SMSA (a Standard Metropolitan Statistical Area) tends to lower birth weight despite the greater availability of medical care. In both instances the authors suggest that the difference in smoking behavior is the reason.

One result which cannot be explained by smoking is the lower birth weight of babies born to black mothers. A standardized (for socioeconomic and area characteristics) differential of 185 grams is observed despite the fact that black mothers smoke much less than white mothers. After controlling for smoking, delay, age, and birth order, the black-white differential is 229 grams.

Fuchs, in his paper on time preference and health, argues that time preference (unwillingness to delay gratification) is likely to be negatively correlated with schooling, negatively correlated with investments in health (such as not smoking), and negatively correlated with health status. He believes that differences in time preference among individuals could help explain the frequently observed correlation between schooling and health, either because time preference is a determinant of investment in both, or because education changes time preference and subsequent investments in health. He assumes that capital market imperfections result in individual differences in the marginal rate of time discount, and that these differences can be measured (albeit imperfectly) by hypothetical questions.

The empirical portion of the paper reports the results of a telephone survey of five-hundred men and women aged 25–64. Time preference was measured by a series of six questions asking the respondent to choose between a sum of money now and a larger sum at a specific future time ranging from one to five years. The interest rates implicit in the questions varied from 10% to 50% per annum. Other questions dealt with family background, education, health behavior, health status, work and income variables, and expectations about inflation.

About two-thirds of the respondents gave consistent replies to the six money questions; any implied preference for a lower over a higher discount rate was defined as inconsistent. In analyses limited to the consistent replies, the implicit interest rate was found to be correlated with years of schooling (negative), cigarette smoking (positive), and health status (negative). Family background, especially religion, appears to be an important determinant of time preference.

Taubman and Rosen use a relatively new longitudinal data set (the Retirement History Study) to explore several long-standing questions regarding the relationships between health and schooling and marital

status. The sample consists of approximately 10,000 white men who were aged 58–63 in 1969. Health status is defined in relative terms by the subjective evaluation of the respondent and by mortality or change in health status between 1969 and subsequent surveys in 1971 and 1973. The authors analyze the effects of the independent variables on the qualitative dependent variables by calculating cell means from frequency tables, with allowance for interactions where appropriate.

The effects of schooling on health in this sample are quite large. For instance, among married men with sixteen years or more of schooling, 47% report their health as better than average and 9% say it is worse than average. By contrast, among married men with eight years or less of schooling 28% classify themselves as in better than average health, while 25% say their health is worse than average. Holding schooling constant, divorced men appear to be in the worst health; widowers, surprisingly, evaluate their health at about the same level as that of married men.

The longitudinal aspect of the survey permits Taubman and Rosen to compare mortality rates by schooling, marital status, and initial health status. The death rate of married men is substantially lower than that of widowed, divorced, or single men at each level of schooling. This is true even after controlling for initial level of health. Many of the married men do show a worsening of health, however, suggesting that the presence of a spouse prolongs life, in part, by keeping a mate alive but in a state of ill health.

Holding marital status constant, the death rate of college graduates is about 20% lower than that of men with twelve years of schooling or less. Of those men alive throughout the four years, the better educated are more likely to report an improvement in health over time and much less likely to report a worsening. This is true either conditioned or not conditioned on level of health in 1969; the differentials are, however, smaller in the conditioned case.

More fully specified models include variables such as earnings or family income in 1968 and utilization of medical care. These variables do not significantly alter the schooling-health or marital status-health relationships. For married men, spouse's education is positively and significantly related to health, but the size of the effect is smaller than that of own education.

Consequences of Ill Health

Differences in health status can affect a wide variety of economic and quasi-economic behaviors, including the demand for medical care (considered in the paper by Manning, Newhouse, and Ware), educational attainment (Shakotko and Grossman), and labor market performance (Benham and Benham, Salkever).

It is quite obvious that health status is an important determinant of the demand for medical care. It is also obvious that errors in the measurement of health status can affect the coefficients and standard errors of all other variables not orthogonal to health status as well as bias the estimates of the effect of health status itself. The paper by Manning, Newhouse, and Ware addresses two principal problems in the measurement of health—the time of measurement and the kind of health measures used.

Most previous studies of the demand for medical care that have included a health status variable have measured health at time $t+1$ to help explain utilization during the period from t to $t+1$. Manning, Newhouse, and Ware show that such "postdiction" can cause inconsistent estimates of the effects of health status, whereas "prediction" (measurement of health status at t) is not subject to the same bias. This is true even if utilization does not affect health status; the problems with postdiction may be even more severe if it does.

One frequently used measure of health status—self-evaluation on a four-point scale of excellent, good, fair, or poor—receives some critical attention from the authors. They believe it needs to be supplemented with measures of limitation of function, psychological state, and social activity as well as counts of symptoms and chronic diseases. They also suggest that measures of attitude towards and knowledge of medical care may be useful in explaining utilization.

The empirical work is based on data for the first year of the Health Insurance Study in three sites (Seattle, Washington; Fitchburg, Massachusetts; and Franklin County, Massachusetts). The sample consists of 1,557 adults aged 18–61 who answered self-administered questionnaires at the beginning and the end of the year under study. The analysis is limited to covered outpatient expenditures, excluding those for mental health and dental care. The right-hand side variables, in addition to health status, include demographic characteristics, insurance coverage, income, and other variables relating to different aspects of the health insurance experiment.

The authors conclude that the more comprehensive measures of health status do increase explanatory power significantly; the gain in precision is at least equivalent to a 10% increase in sample size. The coefficients of some of the other independent variables are also affected, but the changes are typically not large. In the prediction-postdiction comparison, the health status coefficients are typically larger in the latter equations. This may reflect an effect of medical care on reported health problems (through greater awareness) or it may reflect the effect on utilization of exogenous variation in health status subsequent to t. Which explanation is the correct one is not resolved in this paper.

In discussions of the correlation between years of schooling and health status, numerous writers have suggested that at least part of the explana-

tion may lie in a causal chain that runs from health to schooling rather than the reverse. Poor health in childhood, it has been hypothesized, may result in lower educational attainment. To be sure, economic theory does not unambiguously predict such an effect. It is theoretically possible that persons with poor health might seek more education as an offsetting investment.

Shakotko and Grossman investigate this question empirically with a longitudinal data set in which high school seniors were surveyed in the spring of 1972 and resurveyed in October of each year through 1976. The original sample included 21,000 seniors, but exclusion of nonwhites, students with mental or emotional handicaps, and those with missing relevant data reduced the number to 10,430 young men and women. Of these, 120 were reported by the school as having a physical disability. Compared to other students, the disabled scored somewhat lower on aptitude and achievement tests. After controlling for such differences, however, Shakotko and Grossman find no evidence that the disabled are less likely to pursue post-secondary education or more likely to leave such education sooner than the nondisabled. An analysis of earnings for those individuals in the sample who were employed full time in October 1976 provides weak evidence that the disabled have lower earnings but a higher rate of return to education.

With very few exceptions,[1] research on the economics of health has concentrated on physical health. The importance of mental illness is frequently acknowledged, but the difficulty of diagnosis, the uncertainty of the effects of therapy, the chronic character of many mental health problems, and the paucity of useful data have discouraged most economists from attempting systematic analyses. In their paper, Lee and Alexandra Benham attempt to analyze the effects of mental illness on employment and earnings, but the retrospective character of the diagnoses limits the authors' ability to infer causality. Instead, they report a series of interesting "associations" between various psychiatric disorders and labor market behavior.

Their data set consists of 434 white males born between 1910 and 1930 who, when their median age was 44, were the subjects of extensive interviews conducted by sociologist Lee Robins. Of this group, 365 had been patients at the St. Louis Municipal Psychiatric Clinic between January 1, 1924 and December 30, 1929. The other 69 "controls" had been selected on the basis of St. Louis elementary school records that showed socioeconomic characteristics similar to those of the 365 patients, but no record of school failures, school expulsions, or transfer to a correctional institution while in elementary school. Some thirty years after the referral to the clinic (or graduation from elementary school in the case of the controls) two or more psychiatrists assigned each individual to a psychiatric category on the basis of a personal interview plus information from relatives, police, schools, armed forces, credit bureaus,

medical and mental hospitals, welfare agencies, and coroners. The diagnostic categories are: well, neurosis, psychosis, sociopathy, alcoholism, no diagnosis but sick, and no estimate.

Simple comparisons of mean values across diagnostic categories show that compared with the well, the mentally ill tend to have lower IQ's, less schooling, lower labor force participation, and lower earnings. They also tend to be in worse physical health and much less likely to be married with spouse present. In multiple regressions that control for schooling, marital status, IQ, and physical health, the mentally ill typically show lower earnings and lower labor force participation. The one conspicuous exception to all these findings is the neurosis category. Compared with the well group, individuals with this diagnosis have higher IQ's, more schooling, and substantially higher earnings even after controlling for IQ and schooling.

Nearly all economic investigations of the effects of ill health have concentrated on the behavior of the individuals whose health is under study. But the ill health of one person can clearly have effects on others, especially on other family members. For example, the mothers and fathers of disabled children may have different hours of work and earnings than do otherwise similar parents of healthy children. David Salkever addresses these and related situations with data from the Survey of Income and Education (SIE). This random sample of 151,170 households contains 4,000 households with children aged 3–17 with reported disabilities. Restriction of the study to white, two-parent, single-family households with no married children, no children over 18, no other relatives present, and no reported maternal health problems, reduced the number with disabled children to 2,685 families. They were compared with 3,200 families with no disabled children who were randomly selected from the larger sample.

Controlling for demographic and socioeconomic characteristics, Salkever finds that the mothers of disabled children are slightly less likely to be in the labor force. Those who do participate work significantly fewer hours than do comparable mothers of children without disabilities, and earn significantly less per hour. The effect on wages tends to increase with the age of the disabled child, suggesting a cumulative impact through differential accumulation of human capital. The effects on the fathers of disabled children are less clear cut, and frequently not statistically significant.

The presence of school work or school attendance limitations in disabled children seems to have a substantial additional effect on parental employment and earnings. These limitations, which may indicate greater disability, are associated with mothers' substantially lower employment and earnings compared to those of mothers with disabled children who have no such limitations.

Health and Public Policy

The last two papers in this volume are theoretical investigations of important aspects of health policy—the effects of population heterogeneity on policy choices (Shepard and Zeckhauser), and the properties of socially optimal health insurance plans (Bergstrom).

The central thesis of the Shepard-Zeckhauser paper is that heterogeneity among members of the population with respect to health poses a variety of important problems for analysis and policy. Heterogeneity is simply the differences among individuals in their responsiveness to different treatments. For instance, some people are more susceptible to heart attacks, some are more sensitive to pollution, some will benefit more from a new drug.

Unobserved (or latent) heterogeneity can introduce serious biases into interpretations of the effects of various health interventions. One type of bias arises in estimating efficacy for individuals (or homogeneous strata) based on observed data from a mixed population. Shepard and Zeckhauser show that failure to take account of potential heterogeneity can lead to incorrect inferences even in a randomized clinical trial. If initial application of the treatment results in the differential survival of high-risk individuals, over time the composition of the experimental group will be altered compared with that of the control group. One might then observe what appears to be diminishing effects of the treatment over time, even though there would be no diminution for a homogeneous population. The other type of bias arises in extrapolating from a known effect on an individual to the impact on a population. The authors show that the benefits of a favorable intervention will tend to be overstated in a mixed population if there is a greater reduction in mortality for high-risk individuals. This is because the intervention generally increases the proportion of high-risk people among survivors. As a result, subsequent morbidity and mortality is likely to exceed that which would be experienced in a population that did not include as large a proportion of high-risk individuals.

When heterogeneity is observable the problem becomes primarily one of incorporating both efficiency and distributional considerations into the policy analysis. Whose health should be considered in setting air pollution standards? The average person's? The health of the person at the 90th percentile of susceptibility? Is society ever justified in withholding medical care from a sick person, regardless of how low the probability is that the care will do some good? The authors discuss but do not completely resolve the ethical issues involved when cost-benefit or cost-effectiveness analyses are applied in the presence of population heterogeneity. They suggest one way out of the ethical dilemma through an "original position" approach.[2]

Bergstrom's theoretical investigation of desirable properties for health insurance yields provocative results. For instance, he shows that an optimal insurance plan would not include coverage for all treatments that are technically possible. Some care would be excluded because the cost would be too great relative to the potential benefit. Thus his model provides a theoretical rationale for ceilings on insurance coverage—a phenomenon frequently observed in private plans purchased by groups or individuals in the United States. It could also explain the explicit and implicit limits on care observed in centrally imposed, uniform national plans such as the British National Health Service.

A second discussion centers around the desirability of health insurance policies which pay a predetermined amount contingent on the insured's diagnosis rather than on the amount actually spent for care. This predetermined amount would permit the insured to buy the socially optimal amount of care for that diagnosis. Insurance plans of this type would eliminate the "moral hazard" implicit in policies which reimburse for actual expenditures and thus induce excessive care. Current insurance policies which reimburse for expenditures approximate the one discussed by Bergstrom to the extent that physicians order the socially optimal amount of care at any point in the treatment process.

The final section of the paper considers a model in which survival in impaired health is a possible outcome, along with death and full health. One striking conclusion is that a medical treatment which increased the probability of being an invalid and lowered the probability of dying without changing the probability of being healthy could be socially undesirable even if it were free. It would depend on how unpleasant and how costly it is to be an invalid.

Conclusion

Although the ten conference papers are quite diverse in their topics, data, and methodologies, three subjects appear explicitly or implicitly in many of them. They are (1) the definition and measurement of health status, (2) questions of heterogeneity and selectivity, and (3) the health-schooling relationship.

The question of how best to measure health status is given most explicit consideration by Manning, Newhouse, and Ware, but it is of considerable importance in nearly all of the papers. While Manning, Newhouse, and Ware emphasize the limitation of the "excellent-good-fair-poor" measure, Taubman and Rosen find that even a three-point subjective evaluation (better-average-worse) is a good predictor of subsequent mortality. Using the same Retirement History Study data in a study of labor market behavior, Fuchs found that self-reported health limitations by working men is an excellent predictor of future participation.[3]

Economists have typically emphasized physical measures of health status, but the Benhams' paper is a useful reminder that mental and emotional illness may have major economic consequences. The Sha-kotko-Grossman finding that the health status of high school seniors did not significantly affect their subsequent schooling might have been differ-ent if they could have measured mental as well as physical disability. In his paper, Fuchs experimented with alternative definitions of health status and found that conclusions regarding the relationship with school-ing and time preference are altered somewhat by changes in the health measures.

In general, the papers appear to underscore two important truths about health. First, it is multi-dimensional, posing complex problems of valua-tion, especially when one is trying to assess the costs or benefits of some intervention that alters health status. Second, there is no one measure of health status (or even one summary measure) that is best for all purposes. The health status measure that is most useful for predicting medical care utilization may be very different from the one that is best for predicting mortality, and both may differ from the measure that is most useful for understanding labor force participation or earnings.

Questions of heterogeneity and selectivity, which are treated most fully in the paper by Shepard and Zeckhauser, appear explicitly or implicitly throughout the volume. These questions are receiving increasing em-phasis in general econometric discussions.[4] The most important consid-erations for health economists are, first, to be aware of the potential biases that may be introduced by heterogeneity, and second, to be aware that there are ,some techniques for partly correcting for these biases. Finally, there is a major challenge to health economists to help policy-makers think through the problems posed by observable heterogeneity. As government becomes increasingly involved in setting health and safety standards in the workplace and for a wide variety of goods and services, the need for more sophisticated cost-benefit analyses increases. For instance, it would probably be inefficient to set a safety standard for an occupation so high as to protect the most susceptible potential entrant to that occupation. But if the standard implicitly or explicitly excludes some workers, the distributional consequences need to be considered. Furthermore, economists will need to help policymakers try to achieve greater consistency across the diverse programs and regulations that impact upon health.

The third subject appearing in many of the conference volume papers is the schooling-health relationship. On the whole, there is strong con-firmation of previous findings that this relationship is positive, and there is additional progress toward helping to clarify the nature of the rela-tionship. Shakotko and Grossman's paper throws doubt on the hypoth-esis that the causal direction runs from health to schooling. Fuchs's

emphasis on time preference suggests one mechanism through which education could affect health, as well as the possibility that both health and schooling are attributable to differences in time preference. Given the importance and robustness of the health-schooling correlation, additional research that clarifies the nature of the relationship would greatly increase understanding of the factors that determine health.

In general, the studies indicate that research on economic aspects of health has made considerable progress during the past fifteen years. Herbert Klarman's thorough review of the health economics literature through the early 1960s[5] reveals that only a small fraction of earlier research dealt with health per se. Health economists, for the most part, concentrated primarily on the demand for medical care, the supply of physician and hospital services, and problems of planning and organization of care.

In recent years economists have developed more powerful theoretical and statistical tools, have acquired more insight into health processes, and have gained access to larger and more diverse bodies of data. Many of the early attempts to estimate health production functions, for instance, relied on aggregate data for countries, states, or cities. The estimates in this volume are all based on microdata sets, in some instances very large ones. The papers reveal increasing sophistication about issues of measurement, more awareness of advances in econometric methodology, and a concern with real world health problems that augurs well for the future.

Notes

1. See, e.g., Rashi Fein, *Economics of Mental Illness* (New York: Basic Books, 1958).

2. Cf. John Rawls, *A Theory of Justice* (Cambridge: Harvard University Press, Belknap Press, 1971).

3. Victor R. Fuchs, "Self-Employment and Labor Force Participation of Older Males," *Journal of Human Resources* (Summer 1982), vol. 17, no. 3.

4. James J. Heckman, "Sample Selection Bias as a Specification Error," *Econometrica* 47 (1979): 153-161.

5. Herbert E. Klarman, *The Economics of Health* (New York: Columbia University Press, 1965).