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MICHAEL GROSSMAN
THE CITY UNIVERSITY OF NEW YORK

THE DEMAND FOR HEALTH: A THEORETICAL AND EMPIRICAL INVESTIGATION

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to "choose" a long life

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(Resolution adopted October 25, 1926, and revised February 6, 1933, February 24, 1941, and April 20, 1968)

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FOREWORD

The distinction between health and medical care has been a major concern of the National Bureau's health research program ever since its inception some five years ago. Evidence of this concern is apparent in most of the papers published in *Essays in the Economics of Health and Medical Care* and especially in the contribution of Auster, Leveson, and Sarachek, "The Production of Health: An Exploratory Study." The richest and most elegant theoretical treatment of this distinction, however, is in this new study by Michael Grossman. Drawing on some basic notions of Gary Becker's concerning the household's role in the production of ultimate commodities, Grossman has fashioned a model which is theoretically sound, intuitively appealing, and yields significant testable implications.

Prior to Grossman, studies of the demand for medical care were typically set in the framework of consumer demand for a final product and were thought to depend upon prices, income, and "tastes." Tastes were thought to depend in part on state of health, which was exogenously determined. In Grossman's model, people, to some extent, *choose* their level of health just as they choose the level of consumption of other "commodities." Variables such as age and schooling affect demand by altering the "price" of health.

When he turns to the production of health, Grossman realistically assumes that medical care is one input but not the only one. He asks what factors might affect the efficiency of individuals and families in producing health and he presents a substantial amount of evidence indicating that schooling might be one such factor. There are admittedly many possible alternative explanations for the high correlation between health and schooling but Grossman has at least provided one plausible hypothesis within a sensible economic model.

Grossman also shows both theoretically and empirically that higher income does not necessarily lead to higher levels of health, even on average. His explanation is that higher income may also induce higher levels of consumption of other goods and services that have negative effects on health. He has applied the same model to data for individuals

and to average data for states and has obtained very similar results. The empirical portion of his work represents a significant advance because of his use of disability and restricted activity as measures of health in addition to the customary one of mortality.

This study, which was awarded the Harry G. Friedman prize by Columbia University for the best dissertation defended in economics in 1970, was supported by grants by the Commonwealth Fund and the National Center for Health Services Research and Development (PHS grant no. 2 P 01 HS 00451–04). The National Bureau's program in health has also been assisted by an Advisory Committee under the chairmanship first of the late Dr. George James and currently Dr. Kurt Deuschle, of the Mount Sinai School of Medicine. Other members of the committee past and present include Gary S. Becker, Morton Bogdonoff, M.D., James Brindle, Norton Brown, M.D., Eveline Burns, Philip E. Enterline, Marion B. Folsom, Eli Ginzberg, William Gorham, Richard Kessler, M.D., the late David Lyall, M.D., Jacob Mincer, Melvin Reder, Peter Rogatz, M.D., James Strickler, M.D., and Gus Tyler.

VICTOR R. FUCHS

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This study has been conducted at the National Bureau of Economic Research as part of the economics of health project. My greatest debt is to Gary S. Becker. He suggested the general topic of this study and supervised the work at all stages. When what started out as a relatively simple project developed into a somewhat complex one, his commitment and time input increased. For his help and for the rigorous training in economic theory that he gave me, I am deeply grateful.

I wish to thank many persons at the National Bureau for their help. Victor R. Fuchs made many valuable comments on earlier drafts of this study, encouraged me, particularly when "the going got tough," and tried at all points to transmit his very special research skills to me. Jacob Mincer made several helpful suggestions concerning the empirical implementation of my model and the interpretation of some of the results. Robert T. Michael and Gilbert R. Ghez have done research in areas related to my own and were always willing to discuss difficult theoretical and empirical issues with me. Walter D. Fisher, Kelvin J. Lancaster and W. Allen Wallis read the entire manuscript very thoroughly for the Board of Directors' Reading Committee, and I appreciate their time and effort. Robert Linn and Carol Breckner were extremely able research assistants, and Charlotte Boschan, Susan Crayne, and Martha Jones helped me with computer problems. I am also grateful to Gnomi Schrift Gouldin for editing the manuscript and to H. Irving Forman for drawing the charts.

This study would not have been possible if the Center for Health Administration Studies of the University of Chicago had not been kind enough to make the data from its 1963 health survey available to me. Ronald Anderson supervised the creation of my data decks, and I want to thank him for all his help. I owe a second debt to the Center because I was a member of its research staff during the last year of this project, during which time my research was supported by PHS grant no. HS 00080 from the National Center for Health Services Research and Development.

Finally, I would like to thank my wife Ilene for everything—for drawing diagrams and writing the mathematical formulas in the preliminary drafts and especially for tolerating me while I was working on this project.

INTRODUCTION AND SUMMARY

The aims of this study are to construct and estimate a model of the demand for the commodity "good health." Such a model is important for two reasons. First, the level of ill health, measured by the rates of mortality and morbidity, influences the amount and productivity of labor supplied to an economy. Second, most students of medical economics have long realized that what consumers demand when they purchase medical services are not these services per se but rather "good health."

Early economists related variations in health to starvation. According to the Malthusian theory of population, income fluctuated around a subsistence level. Any temporary increase in income would reduce the rates of mortality and morbidity by improving nutritional and health standards. In modern, developed economies, per capita income far exceeds a subsistence level, at least for a large majority of the population. Therefore, fluctuations in income can no longer be the major determinant of variations in mortality and morbidity. Although in recent years there have been a number of extremely interesting explorations of the forces associated with geographic differences in mortality,[1] these studies have not developed behavioral models that can predict the effects that are in fact observed. For example, why should the age-adjusted mortality rate be *positively* correlated with income across states of the United States, particularly when income and the quantity and quality of medical care are also positively correlated? Again, why should the death rate in the United States be higher than that in many less developed countries? The framework developed in this study can answer these questions and others

[1] See, for example, Irma Adelman, "An Econometric Analysis of Population Growth," *American Economic Review*, 53, No. 3 (June 1963); Richard D. Auster, Irving Leveson, and Deborah Sarachek, "The Production of Health, an Exploratory Study," *Journal of Human Resources*, 4, No. 4 (Fall 1969), and reprinted as Chapter 8 in Victor R. Fuchs (ed.), *Essays in the Economics of Health and Medical Care*, New York, NBER, 1972; Victor R. Fuchs, "Some Economic Aspects of Mortality in the United States," New York, NBER, mimeographed, 1965; Mary Lou Larmore, "An Inquiry into an Econometric Production Function for Health in the United States," unpublished Ph.D. dissertation, Northwestern University, 1967; and Joseph P. Newhouse, "Toward a Rational Allocation of Resources in Medical Care," unpublished Ph.D. dissertation, Harvard University, 1968.

and consequently is one promising way to bridge the existing gap between theory and empiricism in the analysis of health differentials.

Given that the fundamental demand is for good health, it seems logical to study the demand for medical care by first constructing a model of the demand for health itself. Existing models of the demand for health services have not, however, taken this approach. Instead, these models take account of the difference between health and medical care primarily by stressing the importance of variables other than price and income —variables that enter the "taste matrix"—in the demand curve for medical care. For instance, Herbert E. Klarman states that the set of variables in this matrix includes "a person's state of health and his perceptions of and attitudes toward medical care."[2] And Paul J. Feldstein advocates the use of demographic characteristics, like age and education, to measure perceptions and attitudes.[3] Such models of medical care are unsatisfactory because economic analysis does not explain the formation of tastes and thus cannot predict the effects of shifts in taste variables on the demand for health services. It seems quite obvious, for example, that a deterioration in a consumer's health status will cause his medical outlays to increase, but one cannot forecast this effect if health status enters the taste matrix. Again, one may find empirically that the more educated exhibit higher or lower outlays than the less educated, but from models relying on a taste matrix, this finding can only be rationalized in an ad hoc fashion. A complete understanding of the demand for medical care is particularly important because of the rapid increase in its price and share in national income over time. Moreover, government programs play a key role in the medical sector. To maximize the effectiveness of these programs, policy makers must be able to predict the impact of shifts in a wide number of variables on the demand for health and medical care.

Since traditional demand theory assumes that goods and services purchased in the market enter consumers' utility functions, it is obvious why economists have emphasized the demand for medical care at the expense of the demand for health. Fortunately, a new approach to consumer behavior draws a sharp distinction between fundamental objects of choice—called commodities—and market goods.[4] Thus, it

[2] *The Economics of Health*, New York, 1965, p. 25.

[3] "Research on the Demand for Health Services," *Milbank Memorial Fund Quarterly*, 44, No. 4, Part 2 (October 1966), p. 143.

[4] See Gary S. Becker, "A Theory of the Allocation of Time," *Economic Journal*, 75, No. 299 (September 1965); Gary S. Becker and Robert T. Michael, "On the Theory of Consumer Demand," unpublished paper, 1970; Kelvin J. Lancaster, "A New Approach to Consumer Theory," *Journal of Political Economy*, 75, No. 2 (April 1966); and Richard Muth, "Household Production and Consumer Demand Functions," *Econometrica*, 34, No. 3 (July 1966).

serves as the point of departure for the health model utilized in this study. In this approach, consumers *produce* commodities with inputs of market goods and their own time. For example, they use sporting equipment and their own time to produce recreation, traveling time and transportation services to produce visits, and part of their Sundays and church services to produce "peace of mind." Since goods and services are inputs into the production of commodities, the demand for these goods and services is a derived demand.

Within the new framework for examining consumer behavior, the commodity good health is treated as a durable item. This treatment is adopted because "health capital" is one component of human capital, and the latter has been treated as a stock in the literature on investment in human beings.[5] Consequently, it is assumed that individuals inherit an initial stock of health that depreciates over time—at an increasing rate, at least after some stage in the life cycle—and can be increased by investment. Direct inputs into the production of gross investments in the stock of health include own time, medical care, diet, exercise, housing, and other market goods as well. The production function also depends on certain "environmental variables," the most important of which is the level of education of the producer, that alter the efficiency of the production process.

It should be realized that in this model the level of health of an individual is *not* exogenous but depends, at least in part, on the resources allocated to its production. Health is demanded by consumers for two reasons. As a consumption commodity, it directly enters their preference functions, or put differently, sick days are a source of disutility. As an investment commodity, it determines the total amount of time available for market and nonmarket activities. In other words, an increase in the stock of health reduces the time lost from these activities, and the monetary value of this reduction is an index of the return to an investment in health.

Since the most fundamental law in economics is the law of the downward sloping demand curve, the quantity of health demanded should be negatively correlated with its *shadow price.* The analysis in the theoretical sections of this study stresses that the shadow price of health depends on many variables besides the price of medical care. Shifts in these variables alter the optimal amount of health and also the derived demand for gross investment (measured, say, by medical expenditures).

[5] See, for example, Gary S. Becker, *Human Capital and the Personal Distribution of Income: An Analytical Approach,* W. S. Woytinsky Lecture No. 1, Ann Arbor, Michigan, 1967; and Yoram Ben-Porath, "The Production of Human Capital and the Life Cycle of Earnings," *Journal of Political Economy,* 75, No. 4 (August 1967).

It is shown that the shadow price rises with age if the rate of depreciation on the stock of health rises over the life cycle, and falls with education if more educated people are more efficient producers of health. This price may also be related to wealth, wage rates, and other variables as well. Of particular importance is the conclusion that, under certain conditions, an increase in the shadow price may simultaneously reduce the quantity of health demanded and increase the quantity of medical care demanded.

The empirical sections of the study estimate demand curves for health and medical care and gross investment production functions. The demand curves are fitted by ordinary least squares and the production functions by two-stage least squares. The principal data source is the 1963 health interview survey conducted by the National Opinion Research Center and the Center for Health Administration Studies of the University of Chicago. Health capital is measured by individuals' self-evaluation of their health status. Healthy time, the output produced by health capital, is measured either by the complement of the number of restricted-activity days due to illness and injury or by the complement of the number of work-loss days. The main independent variables in the health and medical care regressions are the age of the individual, the number of years of formal schooling he or she completed, his or her weekly wage rate, and family income.

The most important regression results are as follows. Education has a positive and statistically significant coefficient in the health demand curve. The marginal cost of producing gross additions to health capital is roughly 7.1 percent lower for consumers with, say, eleven years of formal schooling compared to those with ten years. An increase in age simultaneously reduces health and increases medical expenditures. Computations based on the age coefficients reveal that the continuously compounded rate of growth of the depreciation rate is 2.1 percent per year over the life cycle. The best estimate of the price elasticity of demand for health is .5. Estimates of the elasticity of health with respect to medical care range from .1 to .3. The wage elasticity of health is positive and statistically significant.

The most surprising finding is that healthy time has a negative income elasticity. If the consumption aspects of health were at all relevant, then a literal interpretation of the observed income effect would suggest that health is an inferior commodity; however, this is not the only possible interpretation of the results. The explanation offered in the study stresses that medical care is not the only market input in the gross investment production function. Instead, inputs such as housing, recreation goods,

alcohol, cigarettes, and rich food are also relevant. The last three inputs have negative marginal products, and if their income elasticities exceeded the income elasticities of the beneficial inputs, the marginal cost of gross investment would be positively correlated with income. This appears to be a promising explanation because it can also account for the observed positive income elasticity of medical care. That is, it can show the conditions under which higher income persons would simultaneously reduce their demand for health and increase their demand for medical care.

The empirical analysis also assesses the impact of disability insurance —insurance that finances earnings lost due to illness—on work-loss. Moreover, to check the results obtained when ill health is measured by sick time, variations in death rates across states of the United States are studied. This analysis reveals a remarkable qualitative and quantitative agreement between the mortality and sick time regression coefficients. Although not all its theoretical predictions are fulfilled, enough are to suggest that the model developed here provides a viable framework for understanding variations in health levels and medical expenditures.

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