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The Demand for
Medical Care Services:
Review of Literature

I. THREE APPROACHES OF MEDICAL CARE DEMAND THEORY

The studies on the demand for medical care can be classified into three categories: i.e., the traditional demand theory approach, the household production function approach, and the hedonic approach.

The interests of the traditional theory are focused on the estimation of price or insurance elasticity and income elasticity. The household production approach added time price (travel time and waiting time) elasticity. And the hedonic approach emphasizes analysis of the quality of service demanded as well as the effect of income and price of services.

A. Traditional Approach

1. Basic Model

Assume two goods enter the individual's utility function: medical care services, M, and all other goods and services, X. The model can be simply represented as follows:

(1)   Maximize $U = U(M, X)$

(2)   subject to $Y = P_m M + P_x X$

where U = utility

M = medical services

X = all other goods and services

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$$P_m = \text{out-of-pocket money price per unit of medical services}$$

$$P_x = \text{price per unit of X}$$

$$Y = \text{income}$$

Maximization of (1) subject to (2) gives the equilibrium conditions

(3)
$$U_M = \lambda P_m$$

$$U_X = \lambda P_x$$

$$Y = P_m M + P_x X$$

Where U_M and U_X are partial derivatives of the utility function with respect to medical services and all other goods and services, and λ is a Lagrange multiplier (or marginal utility of each good divided by its price).

From equation (3), we can obtain the demand function for medical care services as equation (4)

(4)
$$M + M(P_m, P_x, Y, SD)$$

where   SD = other socio-demographic variables, such as education, age, family size, sex, etc.....

2. Empirical Studies

Rosenthal (1970) estimated the elasticity of price in the inpatient care by using the sample of medical records and financial information in New England in the year 1962. In this research, he used two kinds of price variables: one is the proportion of actual cash payment to total bill, the other is average room charge. The results suggest that the proportion of actual cash payment to total bill does not provide significant degree of explanation for the variation observed in the length of stay, while there is significant price elasticity with respect to the average room charge (positive to -.7 in different surgical categories).

Anderson and Benham (1970) focused on the estimating the elasticity of income, classifying the income variable as the permanent and observed income using the National Survey Data in 1964. They adopted three dependent variables such as total expenditure on medical care, number of visit, and dental expenditure. Their estimation shows that income elasticity in physician expenditure was .41 in observed income and .63 in permanent income.

Davis and Russell (1972) used the data for 48 states on outpatient visits in non-governmental, non-profit hospitals in 1969. Their analytical interests rest on the outpatient and inpatient price elasticity and cross elasticity between outpatient and inpatient. The results of this study suggest that outpatient price elasticity (1.0) is higher than that of inpatient (-.32 and -.46 respectively in admission rate and length of stay) in terms of absolute value.

The effect of health insurance on the demand for medical care had not been examined until the studies

of Rosett and Huang (1973), Scitovsky and Snyder(1972), Phelps and Newhouse (1972), and Scitovsky and McCall (1977). Rosett and Hung used the individual cross-section data from the 1960 Survey of Consumer Expenditure. Perhaps the highest price elasticity reported in the literature are those of Rosett and Huang, showing that the price elasticity of around -.35 at a 20 percent coinsurance rate, and -.1.5 at a 80 percent coinsurance rate with respect to expenditures. The income elasticities range from .25 and .45 as income decreases from $4,000 to $1,000. The other three studies used the same experiment data from Group Health Plan which was offered since December 1965 by Stanford University to all its employees who work at least 50 percent of full time. These studies compared demand by a group of individuals before and after the introduction of a 25 percent coinsurance led to a substantial decline in the demand for physician services in a year: the number of all physician services per capita went down by 24.1 percent and per capita cost 23.8 percent. Phelps and Newhouse also showed similar tendency indicating that the introduction of 25 percent coinsurance reduced the demand for physician services by 32 percent and ancillary services 13 percent. Scitovsky and McCall reconfirmed the same effect of coinsurance on the demand for medical care four years later.

Fuchs and Kramer (1972) use simultaneous equation system. Their concerns are the development and testing of a formal model to analyze the behavior of physician and patient, expecially focusing on medical technology and factors influencing the supply of physician. They used six structural equations in which demand function for medical services is included. The data used by them is cross-section aggregate data. The results suggest that income elasticity and price elasticity with respect to expenditures for medical care services are very low, since the demand is derived from consumer's demand for health.

This traditional approach is very useful in the measurement and prediction of the health insurance effects on the demand for medical care. All of the above studies suggest that the introduction of coinsurance reduce the demand for medical care. According to Anderson and Benham, the expansion of insurance coverage apparently results in a drastic increase in the demand for medical care especially for low income group, and the decline in the out-of-pocket prices deminishes the role of income as an important determinant of consumption of medical care. Rosenthal, and Anderson and Benham recommended that the analysis should be conducted by medical service categories, since the medical services in heterogeneous.

B. Household Production Function Approach

1. Basic Model

This model was developed within the context of a Becker-type consumer's choice model. The model concentrated on the role of money prices, time prices, and earned and nonearned income.

To proceed, let us assume that two goods enter the individual's utility function; medical services, M, and a composite, X, for all other goods and services. Using an assumption of fixed proportion of money and time to consume M and X and the full wealth assumption, the model can be represented as follows:

(1)   Maximize $U = U(M, X)$

(5)   subject to $(P_m + wt)M + (P_x + ws)X \leq Y = y + wT$

where   M = medical service

X = all other goods and services

P_m = out-of-pocket money price per unit of medical service

t = own-time input per unit of medical service

W = earning per hour

P_x = money price per unit of X

s = own-time input per unit of

Y = total (full) income

y = non-earned income

T = total amount of time available for market and own production of X

Maximization (1) subject to (5) gives the equilibrium conditions, and the demand function as equation (6)

(6) $M = m(P_m, P_x, q, s, Y, T, SD)$

where   SD = same as in equation (4)

2. Empirical Studies

Acton (1976) replaced the money price with time price and divided income variable into earned and non-earned income. He estimated the time price (waiting time and travel time) elasticity and income elasticity by using Tobit regression functional form. The data used to estimate the model was taken from two household surverys conducted in New York City. The results of this study suggest that the elasticities of time price (-.25 to -1.0) are higher than those of traditional money price elasticities, whereas the income elasticities are smaller than those of the traditional analyses. These findings suggest that the national health policy must consider the supply of medical facilities to shorten travel and waiting time if the policy emphasize to increase the demand for medical services.

Holtman and Olsen (1976) use time variable as well as price and other traditional variables. By using the household survey data in New York and Pennsilvania in 1971 and 1972, they estimated the price, time, and income elasticities in the demand for dental hygine. The estimated money price elasticity alone is smaller than that of the traditional approach, but the price elasticity which includes money price and time price is larger than that of traditional approach. The results of this study are that the lower income

class appears to be more sensitive to money price and waiting time, thus reduction in waiting time may be at least important as price reduction in increasing the demand of poor class.

Phelps and Newhouse (1974) measured the effect of insurance on the demand for medical care services through the household production approach. Phelps and Newhouse used several data sources to estimate the effect of coinsurance and to compare the result with the other studies. The data used by them are premium charge by insurance company, GHP data by Stanford University (same as in Scitovsky and Snyder), and Student Health Service data of the University of Rochester. They argue that the money price elasticity is smallar than that of Scitovsky and Snyder, but the price elasticity (money price plus time Price) is larger than that of Scitovsky and Snyder. They conclude that the higher the price elasticities are, the higher coinsurance rate. Services with a relatively high time price (especially in Physician office visits) affects the demand for medical care in a systmatic fashion depending upon the time price of the services.

Manning and Phelps (1979) also show that the introduction of a coinsurance rate reduces the demand for dental care by using 1970 National cross-section survey. They compare the demand between the insured and the uninsured, and the high income group and the low income group. They conclude that with full coverage, the predicted number of visits is over twice as high for adult with no dental insurance coverage. The price elasticities in the insured group and in the high income group are higher than that of the uninsured group and the low income group respectively.

Feldstein (1977) uses a simultaneous equation model to explain the cause of the rising cost of medical care services. According to him, the rising cost of hospital care reflects the rapid change in the quality, and the quality change is primarely due to the increased demand caused by the growth of insurance. He analyzes cross-section of time series for the individual states from 1958 through 1973 fitting 15 structural equations. He concludes that a 10 percent increase of insurance raises the price of services 7.2 percent in the short-run, and 81.0 percent in the long-run.

Sindelar (1982) empirically tests the hypothesis that women use more medical care than men, by using a 1-year retrospective survey data of 1,550 families were randomly selected in 1973-1974 from Dayton, Ohio, for a social science experiment entitled the "Health Insurance Study." The empirical results show that differences in opportunity cost of time do not account for women's greater utilization of medical care, that marital status and spouse's labor force participation are important variables in the exlanation of the Utilization. Men generally use less medical care if they have a spouse present, regardless of the labor force participation of the spouse. In contrast, women use more medical care.

The household production approach has an advantages over the other approaches, in estimating the time price elasticities. Therefore in the free-fee-system of insurance the price elasticities can be replaced by time price elasticities. The introduction of time price is important, because the earned income results from time consumption, and the consumption of medical care is also associated with time consumption.

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C. Hedonic Approach

1. Basic Model

This approach basically rests on the Lancaster-type demand theory. This approach develops a model to analyze properties of demand functions for the quantity and quality of physicians' services. The theoretical model of quantity-quality substitution provides a framework for demand analysis whenever the market for a good is distinguished by a quality components.

Assume two goods enter the household utility function and three inputs enter production function of medical care services.

(1) $\qquad$ $U = U(M, X)$

(7) $\qquad$ $M = M(v,q,D)$

Substitution of equation (7) into equation (1) yields a derived utility function (8).

(8) Max $\qquad$ $U = U(v,q,X)$

(9) Subject to $\qquad$ $S = X + pvq + vf$

where $\qquad$ M = medical service

$\qquad$ X = other commodities

$\qquad$ v = number of visits to physicians

$\qquad$ q = quality per visit

$\qquad$ D = vector of additional variables

$\qquad$ S = full income

price of $\qquad$ X = 1

$\qquad$ p = average price per visit

$\qquad$ $\hat{p}$ = the given (quality-adjusted) price of one unit of vq

$\qquad$ f = fixed cost of a visit

(10) $\qquad$ $p = \hat{p}q$

(11) $\qquad$ $f = c + w(t_1 + t_2)$

where $\qquad$ c = transportation costs

$\qquad$ t_1 = travel time

$\qquad$ t_2 = waiting time

The first order conditions for the optimal amounts of X, q, and v are:

(12) $\qquad$ $U_X = \lambda$

(13) $\qquad$ $U_q = \lambda v \hat{p} v$

(14) $\qquad$ $U_v = \lambda (\hat{p}q + f)$

where U_i $(i = X, q, v)$ = the marginal utility of the i th argument in the utility function the

λ = marginal utility of income

Equations (13) and (14) contain definition of the shadow price of quality and quantity (visits):

(15) $\quad\quad\quad\quad\quad\quad \pi q = \hat{p}v$

(16) $\quad\quad\quad\quad\quad\quad \pi v = \hat{p}q + f$

Equilibrium condition is that the marginal rate of substitution between quality and quantity must equal the price of quality relative to the price of visits:

(17) $\quad\quad\quad\quad\quad\quad \dfrac{U_q}{U_v} = \dfrac{\pi_q}{\pi_v} = \dfrac{\hat{p}v}{\hat{p}v + f}$

2. Empirical Implementation of the Model

(18) $\quad\quad\quad\quad\quad\quad \ln p = \ln q + \ln \hat{p}$

(19) $\quad\quad\quad\quad\quad\quad \ln q = aZ$

where $\quad\quad\quad\quad Z$ = vector of physician's characteristics.

Hedonic fee function is:

(20) $\quad\quad\quad\quad\quad\quad \ln p = aZ + \ln \hat{p}$

Estimation of equation (20) by regression methods allows one to compute both the natural logarithm of quality from the predicted value of fee for a given observation and a preliminary estimate of quality-adjusted price from the regression residual. These computations serve as inputs into the estimation of two stage least squares demand functions. The demand function for the quality and quantity is specified as:

(21) $\quad\quad\quad\quad$ visits = f $(\hat{p}$, income, travel cost, child age, number of children, ...)

(22) $\quad\quad\quad$ quality per visit = f (...same as above...)

(23) $\quad\quad\quad\quad\quad\quad \hat{p} = \sum_{i=1}^{n} K_i \hat{p}_i$

Equation (23) is obtained directly from the hedonic fee function.

3. Empirical Studies

Empirical studies on the demand for medical care have rarely employed the hedonic approach. Goldman and Grossman (1978) used data from a longitudinal and cross-sectional survey covering 21 months in the period 1965-66. The findings of this research suggest that the income elasticity for quantity (1.32) is larger than that of quality (.16), and the price elasticity for quantity is smaller than that of quality. This study can be applied in the choice of polices whether we choose the national health insurance or direct cash subsidy to increase the utilization of medical services. Since the findings indicate that the number of visits are very sensitive to income, it might be more efficient to increase the visits by means of the direct

cash subsidies rather than by means of national health insurance. On the other hand national insurance policy which pays a fixed percentage of the fee of a visit would lower quality-adjusted price and cause a substitution of quality for quantity.

II. DISCUSSION OF EMPIRICAL RESULTS IN RELATION WITH DATA AVAILABILITY

Data founded in the literature of the demand for medical care could be classified into four categories, i.e., insurance claims or premium data, natural experiment data, individual household cross-section data, and aggregate cross-section data.

A. Insurance Claims or Premium Data

This data has a number of strengths. It is usually straightforward to specify the variation in price, because one can examine a well-defined change in coinsurance or deductible rates, which can be easily applied to estimate the response of demand to variation in coinsurance and deductible rates. Second, because the data usually pertain to large employer groups, one can reasonably presume that insurance is exogenous or that any self-selection is minimal. Third, the variation in utilization occurs for a small group in the market.

The disadvantages of this data are as follows: First, this kind of data only contains very little information about the characteristics of the insured, but also has no any information about services that are not covered by insurance policy. Second, using this data to estimate the effect of a deductible, one must know the probability density function of demand, something that may be difficult to obtain in practice. Third, individuals (or providers) may not claim reimbursement for all services actually used because of transaction costs incurred in filing a claim. This may cause biased estimation of demand elasticity.

B. Experiments Data

Advantages of using this data are as follows: First, price variable is directly specified. Second, same group of individuals can be consistantly compared before and after a change in insurance policy in that self-selection problem does not arise. Third, sufficient information about individual characteristics is available.

The use of this data intends to examine the sole effect of price change. However the change of demand may be compoundly resulted from price and other variables. The inability of taking into account of other variables' effects is one of the disadvantages of using this kind of data.

C. Individual Household Cross-Section Data

Individual household cross-section data contains several information on the uninsured as well as on the insured such as demographic characteristics of household members, actual medical utilization and expenditure, and detailed data on health insurance policies. However the cross-section data has the problem of specification of the price variable: Health insurance policies frequently contain deductibles, coinsurance, internal limits on utilization, or fee-schedule limits for provider payments. Provisions frequently differ for different medical services. As a result, the price schedule of medical services is multi-dimensional and non-linear. Another disadvantage of survey data in general is that it relies on recall by the individual. This frequently leads to an underreporting of some variables, particularly medical utilization and income.

D. Cross-Section Aggregate Data

This data can avoid the multi-dimensionality and non-linearity of price. But this kind of data has another misspecification problem in price variable in case that services vary in the extent of coverage. In this case, theory permits such aggregation only when relative price is constant. Another problem of aggregated data is aggregation bias or instability. Finally the aggregation of cross-section data will reduce the information on important demographic characterists of the consumers.

III. ECONOMETRIC PROBLEMS IN THE ESTIMATION OF DEMAND FUNCTION

Most of the problems in the estimation of demand function arise from the specification of price variable. The problem we consider arises from specifications in which price is correlated with the error term. One common problem of this sort arises when the insurance policy contains a deductible and either marginal or average price is used as the explanatory variable. There are four examples of specification error and the price variable: First, ignoring the presence of a deductible; Second, use of a dummy variable to indicate the presence of insurance coverage, together with a variable describing the gross (market transaction) price; Third, estimation of price by dividing expenditure by quantity; and Fourth, aggragation error across services.

Ignoring the presence of a deductible, the estimated value is overstated. One common problem of this sort arises when the insurance policy contains a deductible and either marginal or average price is used as an explanatory variable. Another problem is the possibility of endogeneity. Most health insurance, however, is not selected by individuals, but provided through the place of employment with a subsidy from the employer. Insurance might, therefore, be treated as exogeneous. But an unknown number of

work groups allow choice among a number of plans that causes the endogeneity problem.

The general method for resolving first problem would be to use a simultaneous equation estimation. However the simple solution of this problem is to exclude individuals with deductibles from the sample.

The second type of specification error arises from the use of a dummy variable to represent insurance. Such a specification assumes that all those with insurance have the same kind of insurance policy. This measurement error will in general cause the estimated coefficient of the gross price variable to be inconsistent. Unfortunately, we have not found a satisfactory way of identifying the insurance variable. However the first and second type problems can be avoided by using the experiment data.

A third type of specification error occurs because price is not observed in some data, although expenditure and quantity data are observed. In this case, a number of researchers have estimated price by dividing expenditure by quantity, i.e.,

(24)
$$\frac{E}{X} = \frac{pX}{P} = P$$

where E = expenditure

        X = quantity

        p = price

If there is measurement error in X but not E, then p will contain error that is negatively associated with the true price variable. A solution to this problem exists if E is measured with negligible error. Then negligible inconsistency results if E is used as an explanatory variable rather than E/X.

Suppose the true relationship is

(25) $\ln X = \alpha - \beta \ln p + \varepsilon$

Since $\ln p = \ln E - \ln X$, substituting this into equation (25), we have

(26) $\ln X = \frac{1}{1-\beta} (\alpha - \beta \ln E + \varepsilon)$

                   $= \alpha' - r \ln E + \varepsilon'$

If there is negligible error in measuring E, the estimate of r is approximately consistent, and $\beta = \frac{r}{1+r}$ If expenditure as well as quantity is measured with error, then the problem is more complicated. An inconsistency in r due to measurement error in E will also creat an inconsistency in the estimate of β.

A fourth type roblem occurs if expenditures on medical services having different kinds of insurance coverage are aggregated and a coinsurance rate averaged across the service is used to explain demand. Coefficient estimates are likely to be unstable when we aggragate across either different type of medical care services of different individuals.

REFERENCE

Acton, P.J., "Nonmonetary Factors in the Demand for Medical Services: Some Empirical Evidence," *Journal of Political Economy, vol. 83, 1975.*

Acton, P.J., "Demand for Health Care among the Urban Poor, with Special Emphasis on the Role of Time," *in The Role of Health Insurance in the Health Services Sector,* edited by R.N. Rosett, NBER, New York, 1976.

Anderson, R. and L. Benham, "Factors Affecting the Relationship between Family Income and Medical Care Consumption," in *Empirical Studies in Health Economics,* edited by H. Klarman, Baltimore: John Hopkins Press, 1970.

Becker, G., "A Theory of the Allocation of Time," *Economic Journal,* vol. 75, Sept. 1965.

Boulding, K.E., "The Concept of Need for Health Services," *Milbank Memorial Fund Quarterly,* vol. 44, pt. 2, Oct. 1966

Colle, A.D. and M. Grossman, "Determinants of Pediatric Care Utilization," *The Journal of Human Resources,* vol. 13, Supplement 1978.

Davis, K. and L.B. Russell, "The Substitution of Hospital Outpatient Care for Inpatient Care," *The Review of Economics and Statistics,* vol. 54, no. 2, May 1972.

Feldstein, M.S., "An Econometric Model of the Medicare System," *Quaterly Journal of Economics.* vol. 75, no. 1, Feb. 1971.

Feldstein, M.S., "Econometric Studies of Health Economics," in *Frontiers of Quantitative Economics,* vol. 2, edited by M.D. Intriligator and D.A. Kendrick, North-Holland Publishing Co., 1974.

Feldstein, M.S., "Quality Change and the Demand for Hospital Care," *Econometrica,* vol. 45, no. 7, Oct. 1977.

Feldstein, P.J., "Research on the Demand for Health Services," *Milbank Memorial Fund Quarterly,* vol. 44, no. 8, pt. 2, July 1966.

Fuchs, V.R. and M.J. Kramer, *Determinants of Expenditures for Physicians' Services in the United States 1948-68,* NBER Occasional Paper 117, DHEW Publication No. (HSM) 73-3013, Dec. 1972.

Grossman, M., *The Demand for Health: A Theoretical and Empirical Investigation,* NBER Occasional Paper 119, Columbia University Press, 1972 a

Grossman, M., "On the Concept of Health Capital and the Demand for Health," *Journal of Political Economy,* vol. 80, no. 2, March/April 1972 b

Goldman, M. and M. Grossman, "The Demand for Pediatric Care: An Hedonic Approach," *Journal of Political Economy,* vol. 86, no. 2, pt. 1, 1978.

Holtman, A.C. and E.O Olson, Jr., "The Demand for Dental Care. A Study of Consumption and Household Production," *The Journal of Human Resources,* vol. 11, no. 4, Fall 1976.

Lancaster, K.J., "A New Approach to Consumer Theory, *"Journal of Political Economy,* vol. 74, no. 2, April 1966.

Manning, W.G., Jr. and C.E. Phelps, "The Demand for Dental Care," *Bell Journal of Economics,* vol. 10, 1979

Newhouse, J.P., "The Demand for Medical Care Services: A Retrospect and Prospect," in *Health, Economics, and Health, Economics, and Health Economics,* edited by J. van der Gaag and M. Perlman. North-Holland Publishing Co., 1981.