Volume Title: The Role of Health Insurance in the Health Services Sector

Volume Author/Editor: Richard N. Rosett

Volume Publisher: NBER

Volume ISBN: 0-87014-272-0

Volume URL: http://www.nber.org/books/rose76-1

Publication Date: 1976

Chapter Title: New Estimates of Price and Income Elasticities of Medical Care Services

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Chapter URL: http://www.nber.org/chapters/c3821

Chapter pages in book: (p. 261 - 320)

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New Estimates of Price and Income Elasticities of Medical Care Services

1. INTRODUCTION

In an earlier paper (Newhouse and Phelps, 1974a) we presented preliminary estimates of the price and income elasticities for various medical care services, including hospital length of stay, hospital room and board price, physician visits, and physician price. The theory on which these estimates were based was derived from the work of Grossman (1972) and one of the authors (Phelps, 1973). The estimates were made from data collected in the 1963 Center for Health Administration Studies Survey (Andersen and Anderson, 1967). Our sample was limited to heads who were employed, because these individuals were assumed to have well-defined values of time. In this paper we extend our earlier work, using the same data source. The extension includes reestimating

The authors gratefully acknowledge the help of Ronald Andersen in making the data used in this study available to them and helpful comments and computation assistance by David Weinschrott and Sharon Yamasaki.

The research reported herein was performed in part pursuant to a grant from the Office of Economic Opportunity, Washington, D.C. This project was also supported in part by Grant No. HS-00840-01 from the National Center for Health Services Research and Development. The opinions and conclusions expressed herein are solely those of the authors, and should not be construed as representing the opinions or policy of any agency of the United States government.

the earlier equations on a larger, more diverse sample, plus estimating the determinants of use or nonuse of medical services.

We first briefly recapitulate the specification we are using. We then consider the question of estimating a value of time for those not employed in order to include such individuals in our sample. Unfortunately, computational problems have prevented us from estimating the value of time in an appropriate fashion, and therefore our estimates of demand curves based on the larger sample that includes individuals not employed must be treated as preliminary. But the estimates based on the larger sample are consistent with and support our estimates using the smaller sample of employed heads.

In the earlier paper our estimates of demand were conditional on some use of the medical care system—for example, length of stay in a hospital, conditional on admission. In this paper we consider, in addition, the question of use or nonuse of hospital and office services. Thus, we estimate an admissions equation for hospital services and its analogue for physician services. Some theoretical complications of estimating these demand curves are discussed and estimates of the price elasticity are presented. With these estimates we are in a position to compute the elasticity of medical care expenditure with respect to price and income. In an appendix we present revised estimates based on the smaller sample used in our earlier paper. These estimates correct some computational errors; the revisions moderately affect the earlier estimates.

2. THE MODEL

This section reviews the specification used in Newhouse and Phelps (1974a); this will also be the basic specification used in this paper. Our specification is a generalization of Michael Grossman's investment model (Grossman, 1972). The significant generalizations include: (1) disaggregation of medical services, so that medical services are not considered a homogeneous commodity; (2) treatment of insurance as endogenous; (3) permitting price to vary among providers and treating the price of the provider selected as endogenous. For a more complete discussion the reader is referred to the earlier paper (Newhouse and Phelps, 1974a). We begin with the dependent variables and then turn to the explanatory variables.

The Dependent Variables

In this paper we explain variation in hospital admissions, hospital length of stay conditional on admission, and hospital room and board price per day conditional on admission. We do not explain variation in hospital ancillary services, so our estimates do not include all components of hospital expenditure.[1] The importance of this omission can be seen by disaggregating hospital expenditure. Hospital expenditure is the product of patient days and price per day. Patient days is the product of the admission rate, whose determinants are discussed in Section 3, and length of stay, whose determinants are discussed in Section 4. Price per day is a weighted average of the room and board price and ancillary services in price per day, with the shares of room and board price and ancillary services in total price per day as weights. These shares each equal approximately one-half (Health Insurance Association of America, 1968). In Section 4, we also explore determinants of the room and board price. To derive estimates of the responsiveness of total hospital expenditure to exogenous variables, one must make an assumption about the responsiveness of ancillary services; we assume that they respond the same way that room and board price does.

We also explain use of the ambulatory services with a similar set of equations (use of any ambulatory visits, number of visits conditional on positive visits, and price per visit conditional on positive visits). Unlike the case of hospital services, our estimates of price per visit include ancillary services received per visit.

In this and in the earlier paper, hospital length of stay (nonobstetrical days) is weighted by the average price across the sample for the type of accommodation (one, two, and three or more bed medical or surgical accommodations); the room and board price equation is estimated as a deviation from the average price for the type of accommodation used. Similarly, physician visits are weighted by the average price across the sample for the type of provider seen (general practitioner or specialist); the physician visit price equation is a deviation from the average price across the sample, given the type of provider used. The rationale for this disaggregation is that variation in average price across type of accommodation or type of provider is assumed to reflect productivity differences. Multiplication of physical units by the average price is therefore assumed to convert utilization to efficiency units. Variation of price holding provider type constant is assumed to reflect amenities, shorter queues, or incomplete search. Our estimates of expenditure elasticities, presented at the end of the paper, are invariant to this disaggregation.

Own-Price

In the length of stay and physician visit equations, this variable represents the price paid for a marginal unit (net of insurance benefits) measured in dollars. The theory underlying either an investment model (Grossman, 1972) or a consumption model (Grossman, 1972; Phelps, 1973) specifies marginal price in the first-order conditions; excluding the Giffen good case, a negative sign is expected. However, the theory assumes that price per unit is constant, and this assumption is violated if a deductible is present in the policy; price per unit then falls with expenditure. In this case, the true price of the price the consumer acts on when below the deductible is less than the observable price, because a unit of consumption raises the probability of later exceeding the deductible (Keeler, Newhouse, and Phelps, 1974). Because the true marginal price cannot be observed, we have excluded individuals with deductibles in their policies, except where otherwise noted. There are other examples of variation in unit price as total expenditure varies (such as an upper limit); however, we do not regard these as empirically important.[2]

Because sicker individuals tend to purchase better insurance (Phelps, 1973), net price is treated as an endogenous variable. Our excluded exogenous variables are size of work group (an instrument for insurance price) and nine occupation dummy variables.[3]

In the equations explaining deviation from the average price, the own-price variable is the coinsurance rate at the margin. In the case of hospital policies it was necessary to account for the policies that pay up to a certain dollar amount per day and nothing thereafter; in this case, the dollar amount of the limit was entered if the policy was of that type (zero otherwise). In addition, we entered a dummy variable that took the value of 1 if the policy did not have a dollar limit so that the intercept could also adjust for this type of policy. These variables are all endogenous. In the price equations (but not the utilization equations) we have excluded individuals who sought care for which there was no charge made by the provider, either for reasons of charity or professional courtesy. This amounted to some 10 to 15 per cent of the sample. Such individuals were of necessity excluded because there is no gross price variable for them.

Because we use the actual marginal price (the marginal coinsurance rate times the gross price) in the length of stay and visit equations, and because the gross price is a function of the coinsurance rate, we cannot simply add the estimated "utilization" and "price" elasticities to derive an expenditure elasticity with respect to coinsurance. To do so would involve some amount of double counting. In order to derive the elasticity of expenditure with regard to coinsurance, we have reestimated the length of stay and visit equations with just the coinsurance rates as the own-price and cross-price variables and have used the resulting elasticity of utilization with respect to coinsurance in our concluding section.

In the admission equation and use-nonuse of office visits equation, we do not use marginal price but, rather, coinsurance rates as explanatory variables. The rationale for this approach is explained in Section 4. Also, the hospital coinsurance rate is a weighted average of the room and board coinsurance rate and the inpatient physician coinsurance rate. (See Section 4.)

Cross-Price

In the length of stay and visit equations, the cross-price is specified as the net price paid for a marginal unit, measured in dollars. It is the physician office visit price in the length of stay equation and the hospital room and board price in the physician visit equation. The predicted sign is ambiguous, depending on whether the good is a complement or substitute. As in the case of own-price, to estimate an expenditure elasticity we have reestimated the length of stay and visit equations using only the coinsurance rate.

In the use-nonuse equations the cross-price is specified as the coinsurance rate, for reasons explained in Section 4.

Wage Rate

This is measured in dollars per week (averaged over the year), because a week is the shortest time period available in the 1963 data. Thus, we assume that labor force adjustments occur through reallocation of weeks worked per year rather than hours worked per week if the wage rate changes. The expected sign of the wage rate (summing its effect over all medical services) is positive in the investment model; the variable has no predicted sign in the consumption model.

Two complications arise when testing this concept empirically. If the health status variables do not adequately control for health status, there will be a downward bias in the measured effect of income, because poor health is often associated with negative transitory income. The second complication concerns sick leave and disability insurance provisions about which we have no data. To the extent that such provisions improve with wage income, the measured effect of income is positively biased.[4] The net effect of these two complications on our estimates cannot be known with certainty; we feel that they are likely to be roughly offsetting.

Nonwage Income

This is measured in dollars per year. There should be no relationship between nonwage income and demand in the investment model, and a positive relationship in the consumption model. The hypothesis of no relationship is difficult to test because the theoretical prediction relates to a lifetime, one-period model, and nonwage income in any single year may be only weakly related to the present value of all nonwage income flows. If the error in measuring the theoretical construct is random, both the coefficient and the t statistic are inconsistent toward zero (Cooper and Newhouse, 1971).

Family Size

This is the number of individuals in the family unit, which is defined as the group of related individuals living together. Family size is expected to have a negative effect if nonwage income has a positive effect, although it may also have an effect if nonwage income has no effect (Grossman, 1972). If neither family size nor nonwage income is significant, support for the investment model is strengthened.

Education

Education is measured by the highest grade completed. The effect is expected to be negative in the investment model (Grossman, 1972); the consumption model yields no simple prediction on the sign.

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Age is measured in years; the effect on consumption is expected to be positive if the depreciation rate rises with age. If depreciation rates are fully captured in health status variables, age should have no effect.

Sex and Race

These are dummy variables that take the value of 1 for females and nonwhites. They are included to standardize for possible underlying differences between the sexes in demand for care and differences in access (especially travel costs) that may confront persons of different races.

Self-Perceived Health Status and Disability Days

These are included as a measure of health stock. As self-perceived health status decreases and disability days rise, demand is expected to rise. Because disability days may be endogenous, we estimated equations with it omitted, and our results did not change.[5]

Beds-Population and Physician-Population Ratios

These ratios refer to the medical resources in the county of residence and are included to account for the stochastic nature of medical demand. The greater community supply is relative to community demand, the smaller proportion of the time will facilities be overfull. Although we have measures of community supply, we have no measure of community demand. Because of the likely positive covariance between community supply and demand, the coefficient of the supply variable is biased toward zero as a gauge of the behavior we seek to measure.

Notice that the problem of simultaneity that exists when equations are estimated from aggregate data is not necessarily present in these data on the demand of individuals. In particular, it will not exist if the error term for the individual is distributed independent of geography (that is, the omitted variables and measurement error are independent of geography).

Region

Four regional dummies are included in the price equations to standardize for differences in nominal prices among regions. The Pacific region is the omitted region.

Rural Place of Residence

This dummy takes the value of 1 if the place of residence is rural and is intended to standardize for differences in travel time and other demographic characteristics between rural and urban areas.

Functional Form, Estimators, and Data Summary

We have entered the variables in a simple linear form. For some variables (price, nonwage income) we have tested a quadratic form; this has not resulted in any improvement. We present estimates using both two-stage least squares (TSLS) and ordinary least squares (OLS).[6] Summary statistics are presented in Appendix 1, Table 1.

3. DEMAND FOR CARE FROM INDIVIDUALS WHO ARE NOT EMPLOYED

Adding individuals who are not employed to our sample has two helpful effects. First, it considerably increases the size of the sample available for estimation, thereby improving the precision of our estimates. Second, the employed population greatly underrepresents individuals who are not prime-age males. If there are interactions between sex (and age) and price elasticities, estimates that do not account for such interactions could be quite inaccurate. But if there are few non-prime-age males in the sample, it is difficult to test for interactions.

The major problem to be solved before individuals who are not employed can be included is estimating an opportunity cost of time for them. For those who are employed, we have followed the conventional practice of assuming that a wage rate (dollars per week in our case) measured this opportunity cost.[7] Obviously, for individuals who are not employed, a wage rate is not available.

The most significant work on estimating the value of time for nonemployed individuals has been done by James Heckman (1974). (See also Gronau, 1973a, 1973b.) Heckman postulated an offered wage function for housewives:

(1) $w = f\,(\text{education, experience}) + e$

and a wage-asking function:

(2) $w^* = f\,(\text{hours, number of children under 6, spouses' wage, education, net assets}) + u$

Furthermore, for women free to choose their working hours

(3) $\text{hours} \cdot (w - w^*) = 0$

If $w > w^*$ when hours equal 0, then the woman will work positive hours until $w^* = w$. If $w \leqslant w^*$ when hours equal 0, the woman will not work (that is, hours are 0). It is the wage-asking equation that is relevant for our purposes, because it yields the value the nonworking woman places on her time.

Heckman estimates equations (1) and (2) with a simultaneous equation version of tobit (Tobin, 1958), allowing the covariance of u and e to be non-zero.[8] The estimator is a nonlinear estimator, and Heckman uses a maximum likelihood routine.

We attempted to use Heckman's procedure, but computational difficulties arose.[9] We therefore resorted to a procedure known to be biased—estimating a wage for those in the labor force and using the resulting equation to estimate values of time for those not in the labor force by setting weeks worked equal to zero. Thus, we estimate (2) using OLS separately for men and women in the labor force and then apply the resulting equations to those not in the labor force, setting the weeks variable to zero to obtain a value of time.[10]

A priori, one cannot say whether this procedure is biased up or down; this reflects ignorance of whether the person does not work because w is "low" (for some reason the person is not suited to the labor force) or because w^* is "high" (the person is very productive at nonmarket work). The direction of bias, if any, in our estimate of w^* will depend on which reason predominates. Based on the work of Gronau (1973a), there is some reason to believe that the bias introduced is substantial and varies with demographic characteristics, such as age, education, and race. Therefore, if the w^* estimated by OLS is applied to the nonworking subsample and used in a demand equation, the coefficient of w^* will be biased toward zero, and the coefficients of the demographic characteristics will also be biased. It is not necessarily the case, however, that the price elasticity is biased. Our estimates using the subsample of employed heads suggest that any bias in the price elasticity is likely to be small.

To estimate w^* we used the specification described in (2) (substituting weeks for hours because that was the measure of labor supply in the 1963 survey) and added two health variables (self-perceived health status and disability days), dummy variables for "don't know" or "not applicable" responses, and used nonwage income rather than net assets. The resulting estimates are shown in Appendix 1, Table 2.[11] Because these equations are used merely to produce an estimated wage and because the procedure is known to contain biases, the results of these auxiliary equations are not discussed.

4. HOSPITAL ADMISSIONS AND USE OR NONUSE OF PHYSICIAN

Hospital Admissions

A major theoretical question to be faced in estimating an equation predicting the probability of admission to a hospital is the specification of the price variable. The issue arises because there is typically some uncertainty about the out-of-pocket price the consumer will have to pay when the physician and the patient contemplate admission to the hospital. The problem may be formulated as follows. Assume that there is a distribution of possible out-of-pocket expenditures resulting from an admission. Assume that the parameters of this distribution depend on the health stock loss and insurance policy of the consumer, so that the distribution can be written as $f(x;L,I)$ where f is a density function of expenditures measured in terms of other goods x that can be bought after paying for medical care. The density function is conditional on the health stock loss L and the insurance policy I. There is also some probability distribution of final health status H after the hospital stay, because neither the physician nor the consumer knows what the outcome of the hospital stay will be. Let this distribution (the benefit) have a density function $g(H;L)$; this function is also conditional on the health stock loss.

The admission decision is discrete; the patient is either admitted or not admitted. Under standard assumptions concerning behavior under uncertainty, the physician and the patient choose admission if the expected utility is positive. That is, the patient is hospitalized if

$$V = \int U(x,H;L)\, g(H;L)\, dH - \int U(x,H;L)\, f(x;L,I)\, dx > 0 \tag{4}$$

where U is a utility function in other goods, x, and health status, H; utility is conditional on the loss. In this expression the first term is the expected benefit, conditional on the loss, and the second term is the expected cost, in terms of utility lost from foregoing consumption of other goods, conditional on the loss and the insurance plan.

The change this formulation makes from the standard model is that uncertainty about price is explicitly introduced. The uncertainty occurs because the consumer is not given a price per unit and asked how many units he wants, but rather an uncertain price for an entire stay (depending on length, tests ordered, etc.) and asked whether he wants exactly one unit (one admission). Deriving the theoretical properties of introducing uncertainty about the price is not important for the purpose of this paper; we point out, however, that for risk-averse consumers the introduction of uncertainty decreases the probability of admission (relative to the certainty case at the same expected price).[12]

What is significant for present purposes about the above model is that demand for admissions is a function of the expected benefits from hospitalization and the expected out-of-pocket expenditure (and perhaps higher moments of the distributions as well). Neither of these values is observable, but they are functions of the health stock loss and the insurance policy. Our basic strategy is to take advantage of this dependence and enter variables that approximate health stock loss and key parameters of the insurance policy. Because policymaking interest centers around the response to insurance, this deviation from the theoretical model loses little, if anything. However, measurement of the health stock loss and the insurance variable is not straightforward.

Health stock loss is not directly observable, yet it is obvious that both the expected benefits and expected costs are typically greater for someone with a severe or life-threatening illness than for a minor illness. It would be a heroic assumption to assume that the variation in L causes no change in V (i.e., that $\partial V/\partial L = 0$). If one is not willing to make this assumption, variation in L will in general affect the probability of hospitalization. Indeed, health stock loss may well be the most important variable in explaining admissions. It is therefore necessary to approximate L, and we have included a general measure of self-perceived health status for this purpose.

This is obviously an imperfect measure, but should serve as a reasonable first approximation. Moreover, the errors in measuring the effect of health stock loss are likely to be random and therefore should not cause estimates of the effect of insurance to be inconsistent.

The difficulties in measuring the insurance variable are largely caused by the presence of deductibles.[13] This can be seen by writing down the expression for expected out-of-pocket price, a natural variable to use in explaining demand:

(5) $$E(f(x)) = \int_0^D xh(x)dx + C \cdot \int_D^\infty xh(x)dx$$

where $h(x)$ is the distribution of gross expenditure (assumed given for the moment) and C and D are the coinsurance rate and the deductible, respectively. If the deductible is zero, the first term is obviously zero, so that the expected out-of-pocket costs are proportional to the coinsurance rate. But if the deductible is positive, the expected out-of-pocket price is clearly not proportional to the coinsurance rate.[14] Therefore we estimate the responsiveness of hospital admissions to the coinsurance rate among those who have no deductibles in their policies.[15]

Additionally, in the admissions and use of physician equation we have used the coinsurance rate and not the expected price as an explanatory variable. This is done for two reasons. First, it is difficult to define an expected price for the 92 per cent of the sample who were not admitted to a hospital. Second, if the expenditure distribution $h(x)$ were invariant with respect to C, the result of estimating the response of admissions to C would be equivalent to estimating the response of admissions to expected out-of-pocket price. Unfortunately, the assumption that $h(x)$ is independent of C is unwarranted; the results presented in Section 5 of this paper show that length of stay and choice of hospital respond to C. This means that estimates of the responsiveness of admissions to the expected out-of-pocket price will *overestimate* the responsiveness to changes in C, because a reduction in the coinsurance rate (which would, *ceteris paribus*, reduce out-of-pocket payments) also introduces a partially offsetting rise in total expenditures with a consequent rise in expected out-of-pocket price (except in the limiting case of full insurance).[16] However, policymaking interest centers around the responsiveness to insurance parameters because that is what policy controls. Therefore, the overall response to coinsurance (rather than the *ceteris paribus* response to expected

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price) is an important value to derive. To find the responsiveness of demand to expected price, it is necessary to add estimates of the responsiveness of the expenditure distribution to estimates of the response to coinsurance.

The results of estimating an equation in which the explanatory variable is the coinsurance rate are presented in Table 1. For these purposes the coinsurance rate is a weighted average of the coinsurance rates for hospital and inpatient physician expenditures, with budget shares as weights (i.e., the hospital coinsurance rate was weighted by hospital expenditure as a fraction of hospital plus inpatient physician expenditures).[17] The coinsurance rate is considered exogenous in these results. Use of an instrumental variable estimate of the coinsurance led to estimates of the own-price elasticity that were further from zero; as a result, we do not present them.[18] The results shown in Table 1 have been generated from a logit regression. This procedure estimates the probability of admission, P, as a function of a vector of explanatory variables X; the function is:

$$P = 1/(1 + e^{-\beta x}) \tag{6}$$

The advantage of this procedure relative to a simple least squares estimation is that it constrains the probability to lie between zero and one, thereby incorporating the prior information that this must be true. This function is obviously nonlinear in β; we have used a maximum likelihood routine to estimate β.[19]

For dummy variables (sex, the health status variables, the rural variable, and race) Table 1 shows the difference in P if the variable assumes the value of 1 (continuous variables at their means, other dummy variables at zero); for continuous variables we show the elasticity at the mean of all variables.[20]

The results in Table 1 show a substantial response to both own-coinsurance and cross-coinsurance; the elasticity at the mean for hospital room and board coinsurance is −0.17 (asymptotic Z = 2.99) and for physician office visit coinsurance is −0.57 (asymptotic Z = 4.82). Hospital and physician services therefore appear to be strongly complementary, although there are so few individuals with insurance for physician services that it is hard to place a great deal of weight on this conclusion. Self-perceived health status is very important; with it included, age is not significant at conventional levels. Nonwhites are around 3.6 percentage points less likely to be admitted to a hospital. Joint tests on the supply variables indicate that they are not significant at the mean.

TABLE 1 Hospital Admissions[a]

Variable	Coefficient	Asymptotic Z Statistic (absolute value)	Elasticity for Continuous Variables; Change in Probability for Dummy Variables[b]
Hospital room and board rate coinsurance	−.34	2.99	−.17
Physician office visit coinsurance	−.71	4.82	−.57
Sex	−.054	.45	−.005
Age	.0006	.19	.018
Wage income	.00002	.66	.023
Nonwage income	.00007	2.87	.037
Health status good	.76	5.56	.069
Health status fair	1.39	7.73	.20
Health status poor	2.40	10.74	.66
Family size	−.014	.45	−.058
Education	−.019	1.82	−.10
Rural dummy	−.030	.22	−.036
Physician-population	.0028	.53	−.28
(Physician-population)^2	−.000042	.97	—
Bed-population	−.10	1.26	.41
(Bed-population)^2	.020	2.69	—
Race	−.63	3.16	−.036
Estimated value of time	.0013	.75	.037
Constant	−2.18	5.02	—

Chi-square of estimate (18 d.f.) = 228.78 ($p<0.01$)

[a] n = 4,522. The sample is arrived at by excluding: (a) 2,760 individuals whose policies were not verified; (b) 38 individuals who have more than three insurance policies; this exclusion was for computational reasons; (c) 7 individuals with wages higher than $500 per week in 1963; (d) 8 individuals who exceeded $50 per visit for office visits; (e) 305 individuals with non-zero hospital deductibles; and (f) 247 individuals with non-zero office visit deductibles. Some individuals are excluded for more than one reason. The mean probability of admission is 0.078.

[b] In computing elasticities, all variables are at their means. In computing the change in probability induced by a change in the dummy variable, continuous variables are at their means and dummy variables are set to zero. The elasticity with respect to the supply variables is shown next to the linear term.

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Physician Office Visits

We have also estimated a use-nonuse equation for the use of physician office visits; the dependent variable takes the value of 1 if there were any physician office visits. The underlying model is the same as for hospital admissions, but the rationale for estimating a separate "admissions" equation is somewhat different. In the case of hospital admissions, we emphasized the uncertainty surrounding the price of an admission relative to the price of an extra day. This uncertainty is not present to the same degree for office visits. But there is a different rationale for estimating a separate visit equation (rather than an equation that combines individuals with some visits and individuals with no visits in an equation estimated by tobit methods). The decision to seek any care from a physician is almost always made solely by the consumer, with no information supplied by the physician. Further visits may well incorporate information from the physician, and this information may alter the responsiveness to the explanatory variables. In this case, combining information on those having visits with those having none is inappropriate.

In our sample the probability of consulting a physician is 56 per cent—well below the estimate for the National Health Survey of 70 per cent. This difference is probably attributable to differences in definition; the CHAS survey does not include telephone consultations in its definition of visits whereas the National Health Survey does.

The CHAS 1963 sample is not optimal for estimating the responsiveness of demand for ambulatory physician services to price, because 89 per cent of the sample does not carry insurance for physician services. With that caveat we present our results for use-nonuse of the physician in Table 2.

The own-coinsurance and cross-coinsurance elasticities are both negative and highly significant, as in the case of hospital admissions. Health status is of considerable importance, as is race; nonwhites have a lower probability of making any visits. The wage, value of time, and nonwage income variables exhibit a small, though significant, elasticity; family size has a significant and negative effect. Notice that with self-perceived health status in the equation, age has a negative effect on use. A joint test on the supply variables shows that the physician-population ratio is significant at the mean (asymptotic $Z = 1.99$), but the bed-population ratio is not.

TABLE 2 Any Use of Physician Services[a]

Variable	Coefficient	Asymptotic Z Statistic (absolute value)	Elasticity for Continuous Variables; Change in Probability for Dummy Variables[b]
Physician office visit coinsurance	−.28	2.60	−.11
Hospital coinsurance rate	−.27	3.94	−.07
Sex	.47	6.90	−.11
Age	−.011	5.32	−.14
Wage income	.000076	4.77	.044
Nonwage income	.000043	2.34	.013
Health status good	.30	4.19	.07
Health status fair	.86	7.69	.21
Health status poor	1.41	8.41	.33
Family size	−.12	7.15	−.23
Education	−.005	.85	−.013
Rural dummy	.069	.84	—
Physician-population	.0019	.67	.049
(Physician-population)^2	.0000036	.30	—
Bed-population	−.046	.92	.035
(Bed-population)^2	.0063	1.28	—
Race	−1.06	11.45	−.22
Estimated value of time	.0053	4.75	.071
Constant	.76	3.00	—

[a] n = 4,522. The sample is the same as in Table 1. The mean probability of a visit is 0.56.

[b] In computing elasticities, all variables are at their means. In computing the change in probability induced by a change in the dummy variable, continuous variables are at their means and dummy variables are set to zero. The elasticity with respect to the supply variables is shown next to the linear term.

5. AMOUNT OF MEDICAL CARE SERVICES DEMANDED, CONDITIONAL ON SOME BEING DEMANDED

In Table 3 we summarize the price and wage elasticities for the amount of medical care services demanded, conditional on some services being demanded. The complete equations can be found in Table 3 of Appendix 1. All own-price elasticities estimated using OLS are small, but all are significantly different from zero. The

TABLE 3 Price and Wage Income Elasticities[a]

	Length of Hospital Stay (n = 364)		Physician Office Visits (n = 2,617)	
	TSLS	OLS	TSLS	OLS
Hospital coinsurance × room and board price	.08	−.062	−.14	−.055
	(.43)	(1.92)	(.95)	(2.95)
M.D. office visit coinsurance × visit price	−.23	.003	−.073	−.081
	(.84)	(.07)	(.46)	(4.65)
Wage income per week	.10	.038	.029	.028
	(.92)	(.89)	(.60)	(1.88)
Nonwage income (less than $3,000 per year)	−.037	−.023	−.00008	−.004
	(.95)	(.77)	(.007)	(.43)

	Room and Board Price (n = 313)		Physician Visit Price (n = 2,346)	
	TSLS	OLS	TSLS	OLS
Coinsurance rate of service	−.022	−.051	−.21	−.15
	(.49)	(2.50)	(1.01)	(3.30)
Wage income per week	.022	.010	.072	.075
	(.81)	(.45)	(2.31)	(5.93)
Nonwage income (less than $3,000 per year)	.041	.022	.005	.009
	(2.12)	(1.41)	(1.47)	(.94)

[a]The absolute values of t statistics are in parentheses. Elasticities are computed at the mean.

TSLS estimates are also near zero but are uniformly not significant at conventional levels.

Length of Hospital Stay

In the length of hospital stay OLS estimates, the own-price elasticity is −0.062 (t = 1.92). In the TSLS results, own-price is insignificant and positive; residual variance is around 30 per cent higher in the TSLS estimates than in the OLS estimates, reflecting the lower efficiency of that estimator. Wage and nonwage income elasticities are small and insignificant.

The full equation is shown in Appendix 1, Table 3. Inspection of the equation reveals that nonwage income higher than $3,000 is positive and significant in the OLS results, although with a small elasticity. This result is consistent with the consumption model, but little should be made of it, because only 5 per cent of the sample has a nonwage income higher than $3,000. A joint test on the supply variables at their means shows them to be insignificant at conventional levels. The effect of race is to increase length of stay, the opposite of the results found in the admissions equations (see Table 1). Although the probability of admission for nonwhites is 3.6 percentage points less than for whites, their length of stay is 2.9 to 3.7 days higher, on average, than for whites. On net, the reduction of admissions more than offsets the increase in length of stay, so that community-rated hospital insurance plans cause some racial redistribution away from nonwhites; the expected number of weighted patient days among nonwhites is some 20 per cent lower than among whites.[21]

In these equations, if a person was employed during 1963, his actual wage rate was entered as an explanatory variable; otherwise, the wage rate variable was zero. If a person was not employed, the estimated time value is entered as a separate variable; this variable takes the value of zero if the individual is employed. Thus, we permit the estimated response to the value of time to differ for the employed and nonemployed, while constraining all other coefficients for the employed and nonemployed to be equal. If the wage and the estimated value of time variables were added together, the estimated coefficients would be constrained to be equal; we leave them separated to test that hypothesis. Although in general we cannot reject the hypothesis that the two coefficients are equal, we have not shown results when we constrained the variables to have the same coefficient because we felt that the wage variable was less subject to measurement error and wanted a separate estimate of it. In any event, the estimates of price elasticity were hardly affected. In the length of stay equations, both the wage and the estimated value of time show elasticities near zero and are not significantly different from zero.

Room and Board Price

The response of hospital price to coinsurance is small, but the elasticity is quite significant in OLS. Based on the OLS result, a change from no coverage to full coverage (other variables at their means) would increase the room and board price by approximately 23 per cent.[22] There is little response to wage or nonwage income. We infer that neither amenities nor time saved from shorter queues are very important in explaining the room and board price, given the type of accommodation. Weighted hospital days is the most significant variable in this equation. A joint test on the physician-population ratio shows it is significant at the 5 per cent level at the mean ($t = 2.2$); we view this result as reflecting the more specialized (and costly) facilities that exist where physicians are concentrated.[23] The bed-population ratio is not significant at its mean, although its elasticity is negative. The full equation is shown in Table 5 of Appendix 1.

Physician Office Visits

In the physician office visit equation using OLS, the estimated elasticity at the mean is −0.08 ($t = 4.65$). The TSLS estimate is −0.07 ($t = 0.46$), so that one cannot determine if the significance of the OLS estimate is due to adverse selection or not. The cross-price elasticity is −0.06 and highly significant in OLS; it is somewhat higher but not significant in TSLS. The negative cross-price elasticities in the admissions and physician office visit equations are consistent with the hypothesis that hospital and office services are complements.[24] The estimated elasticity for wage income is very small, as are the elasticities for nonwage income. Family size is significant and is negative, indicating consumption aspects may play a role in physician utilization. Joint tests on the supply variables indicate that they are very significant, but the elasticities in the vicinity of the mean are very small—.03 for the physician-population ratio and .002 for the bed-population ratio. The negative sign on the coefficient of the $(\text{physician-population})^2$ variable supports the hypothesis that additional physicians reduce the fraction of time that demand exceeds capacity. Visits are slightly higher (0.6 visits more) for nonwhites ($t = 1.99$ in OLS), an increase of 10 per cent above visits for whites, but this does not offset the sharply lower probability of nonwhites using any services.

Physician Price

The responsiveness of physician price to coinsurance in OLS and TSLS is −0.15 and −0.20, respectively, although the coefficient is only significant in OLS. Thus, the apparent significance of the result may be attributable to adverse selection. Using the OLS result, an increase from no coverage to full coverage increases the price of the physician selected by 18 per cent.[25] Wage income elasticities are very significant, but small in both TSLS and OLS, whereas nonwage income is not significant. This pattern supports the inference that a higher-priced physician represents less waiting time or less time devoted to search rather than additional amenities. The quantity of physician office visits is significant in OLS but not TSLS; the OLS result supports the hypothesis that people who make more visits search for lower-priced providers.

Separate Equations for Those in and out of the Labor Force

We estimated results for the subsamples with positive wage income and those with estimated values of time separately. In general, the OLS estimates of the important parameters were not very different between the two subsamples, although some of the TSLS parameters did change. We performed the standard Chow test to determine if the two subsamples could be assumed to come from the same population; in some instances we could reject this hypothesis and in others we could not. Because the greatest interest centers in the estimates for the entire population (and for the sake of economy), we have relegated the results for those with positive wage income to Appendix 2 and have not presented the results for the subsample with zero wage income.

Interaction Effects

We reestimated the length of stay and physician visit equations, allowing the price variable to interact with the following variables: health status good or fair; health status poor (these variables permitted testing whether those in worse health are more or less sensitive to price); wage income; nonwage income; and price itself (i.e., a quadratic term). In the length of stay equations, the additional interaction terms were uniformly insignificant. In the physician visit equation, however, two of them (the interactions of price with poor health and nonwage income) were significant in the OLS results; in addition, a joint test on all the interaction terms was significant at the 1 per cent level in the OLS results. Those with poor health have higher price elasticities (further from zero), whereas those with high nonwage incomes exhibit lower elasticities.

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The predicted number of visits from this equation for two levels of health status, four coinsurance rates, and three combinations of wage and nonwage income (on an annual basis) is shown in Table 4; the complete equations are shown in Table 4 of Appendix 1. The effect of both interaction terms on responsiveness to coinsurance appears small; visits appear some 10 to 15 per cent higher with full insurance than with no insurance. This estimate of responsiveness does not include the decision on use of the physician at all, nor the effect of insurance on the price per weighted visit. In the next section we attempt to combine these effects.

6. OVERALL ESTIMATES AND CONCLUDING REMARKS

In this section we pull together our elasticity estimates for particular services and attempt to estimate overall coinsurance and wage

TABLE 4 Physician Visits per Person for Various Levels of Insurance, Income, and Health Status

Self-Perceived Health Status Good[a]					
Income		Coinsurance			
Wage	Nonwage	1.0	.5	.25	0
3,000	0	4.75	5.01	5.13	5.26
5,000	300	4.89	5.13	5.25	5.37
10,000	1000	5.25	5.46	5.56	5.66

Self-Perceived Health Status Poor[a]					
Income		Coinsurance			
Wage	Nonwage	1.0	.5	.25	0
3,000	0	8.90	9.56	9.89	10.22
5,000	300	9.04	9.69	10.01	10.34
10,000	1000	9.40	10.01	10.32	10.63

[a] Individual assumed to be white, male, 45 years old, single, with a high school education. Other variables at means, including gross price per visit.

income elasticities at the means of our data for hospital and physician expenditures. The obvious imprecision and omissions in our data make such an exercise hazardous, but the policy importance of the issue justifies even crude calculations.

Our most important problem in making such estimates is that neither the OLS nor the TSLS estimates are ideal; the OLS estimates of insurance elasticities are inconsistent away from zero, if there is advance selection of insurance, but the TSLS estimates are very imprecise and may in fact have larger mean square errors than the OLS estimates. We have solved this problem by accepting the OLS estimates but increasing their standard errors so that a 95 per cent confidence interval would include zero. There may be some upward bias in our estimates as a result; the reader who is not happy with this solution can easily construct similar estimates using the TSLS results.

A second problem is that the results for length of stay and physician visit equations use actual price. A change in the coinsurance rate includes a partially offsetting rise in the gross price, as shown by the price equations, and therefore use of an elasticity with respect to the actual price would be expected to overstate the elasticity with respect to the coinsurance rate. (See also the discussion in Section 4.) We have therefore reestimated the length of stay and visit equations substituting the own- and cross-coinsurance rate for the own- and cross-price. The resulting own-coinsurance elasticities are summarized in Table 5, along with the wage and nonwage income elasticities. The expected bias appears in the length of stay results; however, in the physician office visit equa-

TABLE 5 Estimates of Elasticity if Coinsurance Is Used Rather than Marginal Price[a]

	Length of Hospital Stay		Physician Office Visits	
	TSLS	OLS	TSLS	OLS
Coinsurance elasticity	.10	−.020	−.037	−.16
	(.47)	(.50)	(.07)	(3.29)
Wage income elasticity	.071	.047	.014	.018
	(.71)	(1.08)	(.41)	(1.19)
Nonwage income elasticity[b]	−.030	−.029	−.001	−.005
	(.77)	(.98)	(.12)	(.49)

[a] The *t* statistics are in parentheses.
[b] Nonwage income less than $3,000.

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tion the coinsurance elasticity is further from zero than the marginal price elasticity in Table 3. We attribute this result to sampling error.

The question then arises whether the results in Table 3 or Table 5 should be used; because policy interest primarily attaches to changes in the coinsurance rate *per se*, we have used those in Table 5. This means we add elasticities with respect to only the coinsurance rate to arrive at an overall estimate.

A third problem was lack of information on the response of hospital ancillary services to the coinsurance rate. We have assumed that ancillary services, and therefore price per day, respond to coinsurance in the same fashion as do room and board prices. Modest differences in how ancillary services respond to coinsurance will not substantially affect the results. Finally, we have assumed that the estimates are independent of one another for purposes of calculating standard errors.

The values we used to make our calculations are shown in Table 6; they are taken from figures presented in tables 1, 2, 3, and 5. These estimates yield an elasticity with respect to coinsurance of −0.24 for hospital expenditure; this figure is shown in the line entitled summary. A 95 per cent confidence interval is from −0.05

TABLE 6 Values Used to Estimate Summary Elasticities at Means

	Hospital Services		Physician Services	
	Elasticity	Standard Error	Elasticity	Standard Error
Coinsurance				
Admission or use-nonuse	−.17	.085	−.11	.055
Length of stay or visits	−.020	.040	−.16	.08
Price	−.051	.0255	−.15	.075
Summary	−.24	.097	−.42	.12
Wage income				
Admission or use-nonuse	.023	.034	.044	.0092
Length of stay or visits	.047	.044	.018	.015
Price	.010	.022	.075	.013
Summary	.080	.060	.137	.022
Nonwage income				
Admission or use-nonuse	.037	.013	.013	.0056
Length of stay or visits	−.029	.030	−.005	.010
Price	.022	.016	.009	.0096
Summary	.030	.036	.017	.015

to −0.44. The elasticity with respect to physician services is higher, −0.42. A 95 per cent confidence interval is from −0.18 to −0.66. In appraising this estimate we would reemphasize that very few individuals in our sample had insurance for physician office visits, and therefore these figures should not be taken as a very reliable estimate of the effect of changes in coinsurance.

Table 6 also shows summary estimates of wage and nonwage income elasticities. For hospital services the elasticity is 0.08, with a 95 per cent confidence interval from −0.04 to 0.20, and for physician services the elasticity is 0.137, with a 95 per cent confidence interval from 0.094 to 0.18. For nonwage income the elasticity for hospital services is 0.030, with a 95 per cent confidence interval from −0.041 to 0.101, and for physician services it is 0.017, with a 95 per cent confidence interval from −0.012 to 0.046.

From these services we can obtain an estimate of wage income elasticities for hospital and physician services combined, using the fact that 75 per cent of the expenditures on these two services combined are for hospital services (Cooper and Worthington, 1973). The resulting overall value is 0.094, with a 95 per cent confidence interval from 0.006 to 0.18. Because the confidence interval does not include zero, this test supports Grossman's investment model.

Adding nonwage income elasticities for each service in a similar fashion (using the elasticities for nonwage income less than $3,000) yields a value of 0.027 as the elasticity, with a 95 per cent confidence interval from −0.026 to +0.080. Because the confidence interval does include zero, this result is also consistent with the investment model. But as has been pointed out, nonwage income for one year does not exactly correspond to the nonwage income concept of the model; therefore, we would caution against placing much emphasis on this particular finding.

A weak test of this result is the analogous overall elasticity for the family-size variable. For hospital services, family size is quite insignificant; the elasticity is −0.10, with a confidence interval from 0.173 to −0.383. For physician services, quite the opposite result obtains; the elasticity is −0.37 and highly significant, with a 95 per cent confidence interval from −0.24 to −0.50. This is consistent with a non-zero income effect; however, it is also possible to attribute the result to a complementarity between the health stock of adults in a family and child-rearing activities (Grossman, 1972). Across both hospital and physician services, the imprecision of the results for hospital services dominates; the combined elasticity with respect to family size is −0.17, with a 95 per cent confidence interval from 0.04 to −0.38.

Our estimates of elasticities at the mean with respect to coinsurance are somewhat lower than those in the literature (Feldstein, 1971; Davis-Russell, 1972). However, the data used to construct those estimates contain errors in measuring the price variable, which cause the estimates to be inconsistent, most likely in an upward direction (Newhouse and Phelps, 1974b). Our estimates are somewhat higher than those we have made using insurance premium data (Phelps and Newhouse, 1974). But our insurance premium data come from a substantially lower range of coinsurance, and there is some evidence in those data that elasticity falls with coinsurance.

Nevertheless, we would not exempt the data used in this paper from the charge of errors in measurement. Although they are richer than almost any other existing survey data, they are far from ideal. Insurance coverage is measured at the end of the year, and there is no guarantee that the insurance was in force throughout the year. Ambulatory utilization was measured by recall over the year, a procedure known to contain systematic biases by demographic group (Marquis, Cannell, and Laurent, 1972). Although abstracting the key features of the insurance policy and deriving the price of the marginal unit has involved a very lengthy process, there is variation in insurance policies that we have not measured. For example, some policies might not cover a physical examination or psychiatric procedures, whereas others might. Most important, the TSLS results are almost never significant, so the possibility that all elasticities are in fact zero cannot be dismissed on the basis of these data.

Thus, these estimates are fragile. Moreover, our elasticity estimates as well as those in the literature are really most helpful for appraising the effect of variation in coinsurance. To estimate the effect of varying a deductible is a more difficult problem because the marginal price is not a constant, and these estimates shed little light on the question of the effects of varying a deductible. It is obvious that much remains to be learned about the effect of insurance on consumer behavior.

APPENDIX 1

TABLE 1-1 Summary Data Statistics

	Mean[a]	Standard Deviation[a]	Number of Zeros
Exogenous Variables (n = 2,617, with positive office visits)			
Nonwage income (0 if > $3,000)	328.08	651.17	1606
Nonwage income (0 if ≤ than $3,000)	322.63	2151.91	2473
Nonwage dummy (1 if nonwage income > $3,000)	0.05	0.22	2473
Wage income/week	31.70	60.97	1828
Value of time	33.82	35.88	789
Disability days	10.10	32.61	1169
Health status good	0.39	0.49	1596
Health status fair	0.13	0.34	2246
Health status poor	0.05	0.21	2473
Married	0.47	0.50	1389
Sex	0.55	0.50	1180
Race	0.086	0.28	2373
Family size	4.10	1.88	0
Age 25-34	0.13	0.33	2296
Age 35-54	0.24	0.43	1996
Age 55-64	0.081	0.27	2398
Age ≥ 65	0.095	0.29	2328
Education 9-11 years	0.16	0.36	2207
Education 12 years	0.19	0.39	2137
Education 13-15 years	0.081	0.27	2415
Education ≥ 16 years	0.059	0.24	2471
Physician-population	113.16	47.98	0
Bed-population	4.22	2.20	151

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TABLE 1-1 (concluded)

	Mean[a]	Standard Deviation[a]	Number of Zeros
Endogenous Variables			
Weighted length of stay[b] ($n=364$)	7.39	7.49	0
Hospital price[b] ($n=313$)	47.75	26.19	0
Marginal hospital coinsurance rate ($n=313$)	0.27	0.39	142
Weighted office visits[b] ($n=2{,}617$)	4.58	4.76	0
Office visit price[b] ($n=2{,}346$)	7.12	6.43	0
Marginal office visit coinsurance rate ($n=2{,}346$)	0.85	0.35	236

[a] Means and standard deviations include zero values in wage and nonwage income variables. Means and standard deviations are weighted to be representative of national sample by work-group size and income.

[b] The weights are the normalized average prices for the type of service used (1,2,3 or more bed surgical; 1,2,3 or more bed medical hospital room; general practitioners, specialist, or clinic). For example, if a specialist visit cost $10 and the average physician visit price were $8, the specialist weight was 1.25. The price variable is total expenditure divided by the weighted number of days or visits.

TABLE 1-2 Value of Time Equations—Dependent Variable Wage Income per Week

Explanatory Variable	Males (n = 900) Coefficient (t statistic)	Females (n = 527) Coefficient (t statistic)
Weeks worked	.54	.20
	(2.43)	(1.90)
Spouse's wage	−.17	.06
	(3.18)	(1.78)
Spouse dummy (=1 if no spouse)	−25.68	−2.83
	(2.00)	(.27)
Spouse retired	.69	15.68
	(.02)	(1.49)
Nonwage income	.003	.0008
	(1.47)	(.47)
Dummy = 1 if no nonwage income reported	21.28	9.28
	(1.02)	(.87)
Education	7.10	6.45
	(11.29)	(10.74)
Married	23.38	−9.76
	(2.65)	(1.85)
Disability days	.04	.22
	(.42)	(3.64)
Health status good	−3.19	−3.22
	(.71)	(.85)
Health status fair	−10.67	−12.13
	(1.54)	(2.32)
Health status poor	−19.93	−5.53
	(1.48)	(.55)
Number of children under 6	—	−8.00
		(2.74)
Constant	−.11	−9.71
	(.01)	(1.07)
R^2	.19	.27
Corrected R^2	.18	.25

TABLE 1-3 Utilization Equations

Explanatory Variable	Dependent Variable = Hospital Length of Stay (n = 364)	Dependent Variable = Physician Office Visits (n = 2,617)

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(2.74)
−9.71
(1.07)
.27
.25

TABLE 1-3 Utilization Equations

Explanatory Variable Coefficient (t ratio) (η = elasticity)	Dependent Variable = Hospital Length of Stay (n = 364) (weighted by average price of type of room) TSLS		OLS		Dependent Variable = Physician Office Visits (n = 2,617) (weighted by average price of type of provider) TSLS		OLS	
Hospital coinsurance	.05	η = .08	−.04	η = −.06	−.05	η = −.14	−.02	η = −.06
× price of bed	(.43181)		(−1.9199)		(−.95249)		(−2.9520)	
M.D. office coinsurance	−.51	η = −.23	.006	η = .003	−.06	η = −.07	−.07	η = −.08
× price	(−.83824)		(.07482)		(−.46173)		(−4.6463)	
Wage income/week (0 if	.02	η = .10	.008	η = .04	.004	η = .03	.004	η = .03
no wage income)	(.92384)		(.88551)		(.60444)		(1.8787)	
Estimated value of time	.02	η = .07	.005	η = .02	.005	η = .03	.002	η = .01
(0 if wage income >0)	(.38801)		(.38786)		(.27144)		(.53543)	
Nonwage income	−.0007	η = −.04	−.0004	η = −.02	−.000001	η = −.00008	.00006	η = −.004
(0 if > $3,000)	(−.94810)		(−.77462)		(−.00666)		(−.43262)	
Nonwage income if	.0005	η = .04	.0004	η = .03	.00002	η = .001	.000005	η = .0003
> $3,000	(1.3529)		(3.0631)		(.16405)		(.08639)	
Dummy = 1 if nonwage	−1.83		−1.80		.44		.45	
income > $3,000	(−.91436)		(−1.0516)		(.76068)		(.86717)	
Education 9-11 years	1.54		1.03		.05		.08	
	(1.3023)		(1.0310)		(.20275)		(.37187)	
Education 12 years	1.71		1.33		[a]		[a]	
	(1.3208)		(1.2171)					
Education 13-15 years	−2.92		−1.6605		−.1		−.04	
	(−1.0926)		(−.87987)		(−.24149)		(−.10285)	
Education 16+ years	1.26		.48		−.76		−.66	
	(.47202)		(.20978)		(−1.3402)		(−1.5546)	

TABLE 1-3 (concluded)

Explanatory Variable Coefficient (*t* ratio) (η = elasticity)	Dependent Variable = Hospital Length of Stay (n = 364) (weighted by average price of type of room) TSLS		OLS		Dependent Variable = Physician Office Visits (n = 2,617) (weighted by average price of type of provider) TSLS		OLS	
Age 25-34 years	1.20 (.64941)		1.51 (.94820)		−.03 (.06806)		−.08 (−.25135)	
Age 35-54 years	2.83 (1.5025)		3.78 (2.5526)		[a]		[a]	
Age 55-64 years	3.79 (1.6297)		4.61 (2.4101)		.26 (.58305)		.23 (.52337)	
Age 65+ years	5.35 (2.9007)		5.46 (3.4259)		.27 (.65321)		.27 (.66649)	
Family size	−.07 (−.23526)		−.17 (−.78243)		−.17 (−3.0474)		−.16 (−3.0265)	
Sex (=1 if female)	1.60 (1.3919)		.89 (1.1444)		.39 (1.4533)		.42 (2.1834)	
Race (=1 if nonwhite)	2.90 (1.6409)		3.66 (2.7842)		.89 (1.7351)		.63 (1.9900)	
Disability days	.03 (2.7459)		.03 (4.1484)		.02 (4.4782)		.02 (5.4518)	
Health status good	−.23 (−.22586)		−.37 (−.40236)		1.24 (5.6117)		1.22 (6.1537)	
Health status fair	2.09 (1.4809)		1.50 (1.3038)		3.24 (8.1745)		3.12 (10.464)	
Health status poor	.68 (.38235)		.21 (.14528)		5.71 (9.2735)		5.50 (11.125)	
M.D.s per 100,000 population ratio	.03 (.75588)	η = .45	.01 (.32379)	η = .16	.02 (1.5452)	η = .38	.02 (2.3820)	η = .48
(M.D.s per 100,000 population ratio)^2	−.0002 (−1.0369)	η = −.35	−.00009 (−.62583)	η = −.17	−.00006 (−1.5550)	η = .003	−.00007 (−2.0187)	η = −.22
Beds per 1,000 popula-	−.25	η = −.15	−.13	η = −.08	−.26	η = −.24	−.30	η = −.28

	(1.6409)		(2.7842)		(1.7351)		(1.9900)	
Disability days	.03		.03		.02		.02	
	(2.7459)		(4.1484)		(4.4782)		(5.4518)	
Health status good	−.23		−.37		1.24		1.22	
	(−.22586)		(−.40236)		(5.6117)		(6.1537)	
Health status fair	2.09		1.50		3.24		3.12	
	(1.4809)		(1.3038)		(8.1745)		(10.464)	
Health status poor	.68		.21		5.71		5.50	
	(.38235)		(.14528)		(9.2735)		(11.125)	
M.D.s per 100,000 population ratio	.03	η = .45	.01	η = .16	.02	η = .38	.02	η = .48
	(.75588)		(.32379)		(1.5452)		(2.3820)	
(M.D.s per 100,000 population ratio)[2]	−.0002	η = −.35	−.00009	η = −.17	−.00006	η = .003	−.00007	η = −.22
	(−1.0369)		(−.62583)		(−1.5550)		(−2.0187)	
Beds per 1,000 population ratio	−.25	η = −.15	−.13	η = −.08	−.26	η = −.24	−.30	η = −.28
	(−.42985)		(−.25356)		(−1.8271)		(−2.3165)	
(Beds per 1,000 population ratio)[2]	.05	η = .16	.04	η = .15	.02	η = .005	.03	η = .14
	(.80308)		(.92660)		(1.8739)		(2.2566)	
Married	−.07		−.73		.37		.35	
	(−.04842)		(−.67247)		(1.2801)		(1.3241)	
Constant term	1.77		3.45		3.80		3.39	
	(.43692)		(1.4644)		(3.1519)		(5.8703)	
R^2	—		.28		—		.16	
Corrected R^2	—		.23		—		.15	
Dhrymes F	3.09		—		10.47		—	
(d.f.)	(27,7)		—		(25,9)		—	
t ratio adjustment factor	.87		—		.76		—	
F	—		4.92		—		19.65	
(d.f.)	—		(27,336)		—		(25,2591)	

[a] Included in category immediately preceding.

TABLE 1-4 Physician Visit Equations with Interactions

	Dependent Variable = Physician Office Visits; n = 2,617 (weighted by average price of type of provider)			
	TSLS		OLS	
Physician coinsurance × price of visit	.48	η = .56	−.06	η = −.05
	(.35)		(−1.65)	
Hospital coinsurance × price of bed	.04	η = .12	−.02	η = −.07
	(.22)		(−2.32)	
Wage or estimated value of time	.03	η = .37	.004	η = .06
	(.93)		(1.67)	
Nonwage income (0 if >$3,000)	−.001	η = −.09	−.0001	η = −.01
	(−.84)		(−.93)	
Nonwage income if > $3,000	−.0002	η = −.01	−.00002	η = −.001
	(−.21)		(−.35)	
Dummy = 1 if nonwage income >$3,000	−6.54		.10	
	(−1.12)		(.19)	
Education 9-12 years	.35		.05	
	(.29)		(.23)	
Education 13-15 years	−.81		−.09	
	(−.52)		(−.26)	
Education 16+ years	−.62		−.67	
	(−.45)		(−1.59)	
Age 25-54 years	−2.02		−.02	
	(−1.01)		(−.07)	
Age 55-64 years	−1.48		.26	
	(−.83)		(.62)	
Age 65+ years	−1.03		.24	
	(−.77)		(.58)	
Family size	−.23		−.16	
	(−1.51)		(−3.03)	
Sex	−.36		.4	
	(−.42)		(2.11)	
Race	−.21		.66	
	(−.11)		(2.09)	
[illegible]	.02		.02	

Education 16+ years	[illegible]		[illegible]	
	(−.45)		(−1.59)	
Age 25-54 years	−2.02		−.02	
	(−1.01)		(−.07)	
Age 55-64 years	−1.48		.26	
	(−.83)		(.62)	
Age 65+ years	−1.03		.24	
	(−.77)		(.58)	
Family size	−.23		−.16	
	(−1.51)		(−3.03)	
Sex	−.36		.4	
	(−.42)		(2.11)	
Race	−.21		.66	
	(−.11)		(2.09)	
Number of disability days	.02		.02	
	(2.24)		(5.46)	
Health status good	5.06		1.32	
	(.83)		(5.20)	
Health status fair	6.96		3.23	
	(1.18)		(9.59)	
Health status poor	38.05		6.28	
	(1.62)		(9.72)	
Physician-population	.02	$\eta =$ .42	.02	$\eta =$ .47
	(.78)		(2.36)	
(Physician-population)²	−.00008	$\eta =$ −.26	−.00007	$\eta =$ −.22
	(−.97)		(−1.98)	
Bed-population	−.31	$\eta =$ −.29	−.30	$\eta =$ −.28
	(−.98)		(−2.35)	
(Bed-population)²	.04	$\eta =$ .18	.03	$\eta =$ .14
	(1.16)		(2.28)	
Married	1.14		.39	
	(1.23)		(1.47)	
(Physician coinsurance × price of visit)²	.02		−.0002	
	(.66)		(−.17)	
Net price × health status good or fair	−.78		−.02	
	(−.66)		(−.64)	
Net price × health status poor	−5.89		−.15	
	(−1.43)		(−2.09)	

TABLE 1-4 (concluded)

	Dependent Variable = Physician Office Visits; n = 2,617 (weighted by average price of type of provider)	
	TSLS	OLS
Net price × nonwage income	.0002	.00002
	(.77)	(2.59)
Net price × wage income or estimated value of time	−.004	−.000007
	(−.82)	(−.06)
Constant	1.62	3.28
	(.26)	(5.53)
R^2	—	.16
Corrected R^2	—	.15
Dhrymes F	17.47	—
(d.f.)	(29,5)	—
t ratio adjustment factor	2.19	—
F	—	17.25
(d.f.)	—	(29,2587)

TABLE 1-5 Price of Care Equations

	Hospital Room and Board Price (n = 313)		Physician Office Visit Price (n = 2,346)	
	TSLS	OLS	TSLS	OLS

(29,2587)

TABLE 1-5 Price of Care Equations

	Hospital Room and Board Price (n = 313) TSLS		Hospital Room and Board Price (n = 313) OLS		Physician Office Visit Price (n = 2,346) TSLS		Physician Office Visit Price (n = 2,346) OLS	
Room and board coinsurance rate	−4.00 (−.49124)	η = −.02	−9.24 (−2.5040)	η = −.05				
Number of hospital days	−1.26 (−2.4169)	η = −.19	−1.54 (−7.9618)	η = −.26				
Maximum payment per hospital day	1.03 (1.6102)		.04 (.19714)					
Dummy (=1 if no limit on $/day)	−35.71 (−1.4987)		3.81 (.58805)					
Physician office visit coinsurance					−1.73 (−1.0125)	η = −.21	−1.27 (−3.3033)	η = −.15
Number of physician office visits					.09 (1.2043)	η = .06	−.09 (−3.4615)	η = −.06
Wage income/week (0 if no wage income)	.03 (.81409)	η = .02	.01 (.45336)	η = .01	.01 (5.3895)	η = .07	.02 (5.9284)	η = .07
Estimated value of time (0 if wage income >0)	.03 (.56632)	η = .02	.02 (.39000)	η = .01	.01 (1.4437)	η = .04	.01 (1.6210)	η = .04
Nonwage income (0 if > $3,000)	.005 (2.1218)	η = .04	.003 (1.4139)	η = .02	.0001 (.4655)	η = .005	.0002 (.9387)	η = .009
Nonwage income if > $3,000	.0004 (.54128)	η = .005	.0006 (1.0793)	η = .007	.0001 (.3869)	η = .005	.00004 (.4420)	η = .002
Dummy = 1 if nonwage income >$3,000	−10.483 (−1.4544)		−10.138 (−1.6120		−.45 (−.1071)		.9181 (1.1695)	
Education 9-11 years	5.16 (1.1852)		4.99 (1.3386)		.56 (1.4491)		.45 (1.1850)	

TABLE 1-5 (concluded)

	Hospital Room and Board Price (n = 313)				Physician Office Visit Price (n = 2,346)			
	TSLS		OLS		TSLS		OLS	
Education 12 years	5.91		.84		.32		.25	
	(1.2626)		(.24023)		(.7611)		(.6768)	
Education 13-15 years	1.37		−4.64		1.73		1.68	
	(.19276)		(−.82013)		(3.4881)		(3.6613)	
Education 16+ years	4.27		3.30		.83		.62	
	(.63200)		(.59941)		(1.5753)		(1.3327)	
Family size	.27		−.05		−.14		−.20	
	(.29659)		(−.07058)		(−1.6133)		(−2.7072)	
Race	10.786		6.91		.67		.79	
	(1.4946)		(1.1949)		(1.2531)		(1.6161)	
Region: Northeast	−6.62		−6.12		−2.3		−2.17	
	(−1.1395)		(−1.2408)		(−4.5711)		(−4.7685)	
Region: North Central	1.50		−2.71		−.72		−.85	
	(.24536)		(−.56037)		(−1.2368)		(−1.9059)	
Region: South	−5.72		−6.36		−.24		−.34	
	(−1.0498)		(−1.3395)		(−.4604)		(−.7541)	
Region: Mountain	−3.59		−2.3		.93		.77	
	(−.35944)		(−.26700)		(1.0508)		(1.0272)	
M.D.s per 100,000 population ratio	.27	η = .61	.2	η = .45	.0009	η = .01	.006	η = .09
	(1.6535)		(1.4582)		(.0685)		(.4553)	
(M.D.s per 100,000 population ratio)[2]	−.0005	η = .16	−.0003	η = .28	.0001	η = .19	.0001	η = .14
	(−.77473)		(−.48873)		(1.5656)		(1.2592)	
Beds per 1,000 population	.81	η = .08	.03	η = −.002	.30	η = .18	.22	η = .13

	(1.4946)		(1.1949)		(1.2531)		(1.6161)	
Region: Northeast	−6.62		−6.12		−2.3		−2.17	
	(−1.1395)		(−1.2408)		(−4.5711)		(−4.7685)	
Region: North Central	1.50		−2.71		−.72		−.85	
	(.24536)		(−.56037)		(−1.2368)		(−1.9059)	
Region: South	−5.72		−6.36		−.24		−.34	
	(−1.0498)		(−1.3395)		(−.4604)		(−.7541)	
Region: Mountain	−3.59		−2.3		.93		.77	
	(−.35944)		(−.26700)		(1.0508)		(1.0272)	
M.D.s per 100,000 population ratio	.27	η = .61	.2	η = .45	.0009	η = .01	.006	η = .09
	(1.6535)		(1.4582)		(.0685)		(.4553)	
(M.D.s per 100,000 population ratio)^2	−.0005	η = .16	−.0003	η = .28	.0001	η = .19	.0001	η = .14
	(−.77473)		(−.48873)		(1.5656)		(1.2592)	
Beds per 1,000 population ratio	.81	η = .08	.03	η = −.002	.30	η = .18	.22	η = .13
	(.36104)		(.01302)		(1.5239)		(1.1543)	
(Beds per 1,000 population ratio)^2	−.22	η = −.12	−.08	η = −.09	−.03	η = −.009	−.02	η = −.007
	(−1.0121)		(−.45284)		(−1.5126)		(−1.1579)	
Constant term	28.155		46.424		5.99		6.72	
	(1.7698)		(4.4359)		(3.3595)		(6.8796)	
R^2	—		.31		—		.09	
Corrected R^2	—		.25		—		.08	
Dhrymes F	3.07		—		1.71		—	
(d.f.)	(23,17)		—		(21,18)		—	
t ratio adjustment factor	1.08		—		.43		—	
F	—		5.61		—		10.48	
(d.f.)	—		(23,289)		—		(21,2324)	

APPENDIX 2

Recalculating Elasticities for Family Unit Heads

In our earlier paper (Newhouse and Phelps, 1974a) we presented results based on heads of households who had been hospitalized or who used a physician. It later came to our attention that the data included a number of heads who had no wage income during the year. Our algorithm had assigned these individuals a zero wage and hence a zero value of time, obviously an error. Therefore, we reestimated these equations using the subset of heads with positive wage income. In these revised estimates we excluded individuals with deductibles in their policies for reasons explained in the text; these individuals were included in the earlier results. We also excluded from the price equations individuals who had obtained care for which no charge had been made, which we had not done in our earlier estimates. The results are sufficiently changed from those in the earlier paper to warrant some discussion. In general, the elasticities estimated using TSLS are near zero and not significantly different from zero; the elasticities estimated using OLS are rather small, but generally significant. We first consider hospital admissions, then length of hospital stay, and then physician office visits (nonsurgical). We did not estimate a use-nonuse of physicians equation for the subsample of employed heads.

Hospital Admissions

The results (Table 2-1) show that the admissions response to coinsurance among heads is very similar to the full sample; the estimated elasticity is −0.21. Wage income is quite significant and has an elasticity of 0.29, higher than in the full sample, whereas nonwage income has practically no effect (elasticity of 0.04) and is not significant at conventional levels. This finding tends to support Grossman's investment model, although errors in measuring the appropriate value of nonwage income make a strong conclusion about its true value unjustified. However, the weakness of the family-size effect also supports the investment model, and this result is less easily attributed to errors in measurement. These results must, however, be added with the results for length of stay and hospital price to obtain an overall test of the investment model, as is done in the text for the full sample.

Hospital beds in the county of residence were entered in linear form in this table; unlike the full sample they exert a moderately

TABLE 2-1 L
E
V

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Hospital coinsura
Office visit coinsu
Sex (1 if female)
Age
Wage rate
Nonwage income
Health status goo
Health status fair
Health status poo
Family size
Education
Rural area dummy
Physician-popula
Hospital bed-pop
Race (1 if nonwhi
Constant
Chi-square of est

[a] n = 1,579. This is the
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TABLE 2-1 LOGIT Estimation of Nonobstetrical Admission Equation: No Positive Deductibles, Non-Zero Wage Income[a]

Variable	Elasticity at Mean for Continuous Variables; Change in Probability for Dummy Variables	Absolute Value of Asymptotic Normal Variable (significance level in parentheses)
Hospital coinsurance rate	−0.21	2.19 (.03)
Office visit coinsurance rate	−0.40	2.26 (.02)
Sex (1 if female)	0.016	1.56 (.12)
Age	0.22	0.81 (.42)
Wage rate	0.29	2.16 (.03)
Nonwage income	0.036	1.25 (.26)
Health status good (1 if good)	0.050	3.59 (.01)
Health status fair (1 if fair)	0.074	3.62 (.01)
Health status poor (1 if poor)	0.30	6.44 (.01)
Family size	−0.054	0.29 (.77)
Education	−0.41	1.29 (.20)
Rural area dummy (1 if rural area)	−0.007	0.76 (.45)
Physician-population	−0.24	1.01 (.81)
Hospital bed-population	0.35	2.04 (.04)
Race (1 if nonwhite)	−0.022	2.29 (.02)
Constant	−2.33	—

Chi-square of estimate (15 d.f.) = 83.6, significant at 0.01

[a] n = 1,579. This is the sample remaining after excluding from the original sample of 7,803 individuals: (a) 2,760 individuals whose policies are not verified; (b) 38 individuals with more than three policies; this exclusion was for computational convenience; (c) 3,244 individuals with zero wage income or wage income in excess of $500 per week (1963 prices); and (d) 305 individuals with positive hospital or medical deductibles. Some individuals are excluded for more than one reason. The mean probability of admission is 0.077.

strong and statistically significant effect on hospital admissions. We would expect this effect to be even more pronounced had we included variables measuring community demand, as explained above. Even as it stands, the result supports the notion that there is nonprice rationing of hospital services (see also Rafferty, 1971). This discrepancy from the full sample may be attributable to the difference in functional form; we are continuing to explore this question.

The health status dummy variables are the most important determinants of admissions, as in the full sample. (Excellent health status is the omitted value.) Controlling for health status, age does not have a significant effect.[1]

Education has the negative effect predicted by the investment model but the effect is not statistically significant at conventional levels. The rural dummy variable is not significant.

In the results presented in Table 2-1 we excluded individuals whose insurance policy contained a deductible. In order to take account of variation in a deductible, as well as a coinsurance rate, we have entered an expected total price variable directly. We are not very confident about the results, however, because of the difficulties of estimating the expected price. For those who did not go to the hospital, we assumed that the mean gross price of those who went was what was expected and applied the insurance policy they had to this expenditure. For those who did go to the hospital, we made two alternative assumptions: (1) that the expected expenditure was the actual realized expenditure, and (2) that the expected gross expenditure was the mean gross expenditure. We then applied the insurance policy to determine the expected net expenditure. The former is probably the more realistic assumption, because the physician and the individual usually have some information about diagnosis when the patient is being admitted. For this reason, the elasticity with respect to actual price could be expected to be greater (in absolute value) than that estimated using the mean price; those individuals who expected a low price would tend to be admitted more readily, and vice versa. There is a second reason why use of the actual price could be expected to result in a greater elasticity than the mean price. The mean price is approximately proportional to the coinsurance rate in this sample (it is exactly proportional for the 88 per cent of the observations with no deductible); as argued in the text, use of the coinsurance rate results in a lower elasticity estimate than use of actual price because a change in the coinsurance rate introduced a partially offsetting change in expenditure.[2]

The results from these two alternative assumptions are shown in Table 2-2. As expected, the elasticity using actual expenditure is much higher than that using the mean price (0.67 vs. 0.16). This elasticity with respect to expected price compares with an elasticity of approximately 0.2 with respect to the coinsurance rate.

The other results in Table 2-2 are similar to those in Table 2-1, with the following exceptions: (1) The nonwage income coefficient is significant when using actual expenditure (asymptotic Z equals 2.26), but the elasticity is still very small (0.07); (2) The education coefficient has become significant at a 5 per cent level when using

TABLE 2-2 L
F

Variable
Expected price
Physician office v coinsurance
Sex
Age
Wage rate
Nonwage income
Health status goo
Health status fair
Health status poo
Family size
Education
Rural area dumm
Physician-popula
Hospital bed-pop
Race
Constant
Chi-square of est using mean expe

[a] n = 1,761. The samp
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Table 2-1
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vations with no
coinsurance rate
of actual price
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with an elastic-
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2) The education
evel when using

TABLE 2-2 LOGIT Estimation of Admission Equation; Positive Deductibles Included[a]

Variable	Elasticity at Mean for Continuous Variables; Change in Probability for Dummy Variables: Actual Expenditure	Mean Expenditure	Absolute Value of Asymptotic Normal Variable (significance level in parentheses): Actual Expenditure	Mean Expenditure
Expected price	−.67	−.16	5.99 (.01)	1.69 (.09)
Physician office visit coinsurance	−.36	−.46	2.00 (.04)	2.57 (.01)
Sex	.011	.011	1.56 (.12)	1.29 (.20)
Age	.25	.26	0.88 (.38)	0.97 (.33)
Wage rate	.26	.28	1.92 (.05)	2.10 (.03)
Nonwage income	.064	.040	2.26 (.02)	1.40 (.16)
Health status good	.032	.045	3.36 (.01)	3.60 (.01)
Health status fair	.052	.069	3.63 (.01)	3.76 (.01)
Health status poor	.25	.28	6.59 (.01)	6.52 (.01)
Family size	−.086	−.084	0.43 (.67)	0.44 (.66)
Education	−.66	−.48	2.02 (.04)	1.52 (.13)
Rural area dummy	−.002	−.004	0.36 (.72)	0.52 (.60)
Physician-population	−.16	−.15	0.68 (.43)	0.66 (.51)
Hospital bed-population	.25	.28	1.42 (.15)	1.58 (.11)
Race	−.011	−.019	1.53 (.12)	2.20 (.03)
Constant	−1.92	−2.38		

Chi-square of estimate using actual expenditure (15 d.f.) = 125.02, $p<.0001$; using mean expenditure (15 d.f.) of 82 77, $p<0.01$.

[a] $n = 1{,}761$. The sample is the same as for Table 1 plus 182 individuals with positive deductibles who satisfied the other restrictions.

actual expenditure; (3) The size of the elasticities and the asymptotic normal statistics drop somewhat for the hospital bed-population ratio. The values are, however, sufficiently similar to those in Table 2-1 to support the conclusions drawn there.

The results of estimating length of stay, visit, and price equations are summarized in Table 2-3 and shown in detail in tables 2-4 and 2-5.

Length of Hospital Stay

The own-price elasticities at the mean for length of hospital stay are estimated to be −0.29 using TSLS and −0.13 using OLS, somewhat

TABLE 2-3 Own-Price, Cross-Price, and Wage Income Elasticities, Heads Only[a]

	Length of Hospital Stay (n = 76) TSLS	Length of Hospital Stay (n = 76) OLS	Physician Office Visit (n = 563) TSLS	Physician Office Visit (n = 563) OLS
Hospital coinsurance × price of bed	−.29	−.13	−.10	−.12
	(1.89)	(1.28)	(1.08)	(3.04)
M.D. office coinsurance × price	.20	−.09	−.03	−.10
	(1.14)	(.79)	(.21)	(2.70)
Wage income-week	−.35	−.15	.07	.08
	(1.46)	(.53)	(.93)	(.99)

	Room and Board Price (n = 57) TSLS	Room and Board Price (n = 57) OLS	Physician Price (n = 517) TSLS	Physician Price (n = 517) OLS
Coinsurance rate	−.04	−.03	.26	−.25
	(.66)	(.56)	(.56)	(2.25)
Price per day limit in $	.08	−.0004	—	—
	(.77)	(.006)	—	—
Wage	−.08	−.07	.14	.13
	(.33)	(.32)	(1.31)	(1.61)

[a] The absolute value of t statistics are in parentheses. For TSLS, the t statistics are the Dhrymes alternative t statistics (Dhrymes, 1969). We arrived at the sample used to estimate these equations as follows. There were 2,376 heads; of these, 788 had insurance that was not verified and 13 had more than three insurance policies. This latter group was excluded for computational reasons. This left 1,566 heads. This subsample of 1,566 of the national probability sample whose insurance was verified is not representative by work-group size and income of the entire population. Therefore, we weighted the sample along these dimensions to be representative of the national population. To obtain the sample of 76 for the length of stay equation we applied the following restrictions to the 1,566 sample (the numbers in parentheses are the number of 1,566 that the restriction excluded): zero wages or wages greater than $500 per week (1963 dollars) (475); no hospital days or hospital days exceeding 40 days (1,443); physician office visit price higher than $50 per visit (1); positive deductible in the hospital policy (92); expenses exceeding upper limit of policy (3). Some individuals were excluded for more than one reason. The physician visit equation started with the same 1,566 heads, which were reduced to 563 by the following restrictions; zero wages or wages greater than $500 per week (1963 dollars) (475); physician office visit price higher than $50 per visit (1); no physician visits or physician visits exceeding 30 (717); positive deductible in insurance policy applying to physician visits (67). The numbers are reduced for the price equation by the number of individuals who received care for which no charge was made.

TABLE 2-4 Utilization of Heads

Explanatory Variable Coefficient (*t* ratio) (elasticity)	Dependent Variable = Length of Hospital Stay n = 76; Heads Only (weighted by average price of type of room) Eq. (1) TSLS		Eq. (2) OLS		Dependent Variable = Physician Office Visits n = 563; Heads Only (weighted by average price of type of provider) Eq. (3) TSLS		Eq. (4) OLS	
Hospital coinsurance × price of bed	−.25	$\eta = -.29$	−.11	$\eta = -.13$	−.038	$\eta = -.10$	−.046	$\eta = -.12$
	(−1.89)		(−1.28)		(−1.08)		(−3.04)	
M.D. office coinsurance × price	.54	$\eta = .20$	−.25	$\eta = -.09$	−.024	$\eta = -.03$	−.083	$\eta = -.10$
	(1.14)		(−.79)		(−.21)		(−2.70)	
Wage income-week	−.024	$\eta = -.35$	−.010	$\eta = -.15$	.003	$\eta = .07$	.003	$\eta = .08$
	(−1.46)		(−.53)		(.93)		(.99)	
Nonwage income	−.001	$\eta = -.05$	−.0017	$\eta = -.08$	.0003	$\eta = .02$	.0002	$\eta = .01$
	(−.87)		(−.95)		(.98)		(.64)	
Nonwage income if > $3,000	.001	$\eta = -.02$	−.00037	$\eta = -.008$	.0015	$\eta = .07$	.0015	$\eta = .07$
	(−.54)		(−.12)		(3.44)		(2.40)	
Dummy = 1 if nonwage income >$3,000	1.77		.22		−5.93		−5.89	
	(.17)		(.01)		(−2.48)		(−1.75)	
Education 9-11 years	1.58		1.86		−1.00		−.97	
	(.92)		(.73)		(−2.01)		(−1.50)	
Education 12 years	−1.16		.68		−.25		−.26	
	(−.58)		(.24)		(−.60)		(−.43)	
Education 13-15 years	2.69		.13		−.09		.008	
	(.87)		(.03)		(−.16)		(.01)	
Education 16+ years	.21		1.09		−1.12		−1.05	
	(.09)		(.31)		(−2.08)		(−1.44)	

Income

Physician Office Visit (n = 563) TSLS	OLS
−.10	−.12
(1.08)	(3.04)
−.03	−.10
(.21)	(2.70)
.07	.08
(.93)	(.99)

Physician Price (n = 517) TSLS	OLS
.26	−.25
(.56)	(2.25)
—	—
—	—
.14	.13
(1.31)	(1.61)

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TABLE 2-4 (concluded)

Explanatory Variable Coefficient (*t* ratio) (elasticity)	Dependent Variable = Length of Hospital Stay n = 76; Heads Only (weighted by average price of type of room)		Dependent Variable = Physician Office Visits n = 563; Heads Only (weighted by average price of type of provider)	
	Eq. (1) TSLS	Eq. (2) OLS	Eq. (3) TSLS	Eq. (4) OLS
Age 25-34	2.57	4.49	−1.96	−2.04
	(.65)	(.75)	(−2.55)	(1.89)
Age 35-54	7.19	8.08	−2.04	−2.02
	(1.85)	(1.34)	(−2.78)	(−1.93)
Age 55-64	13.64	15.00	−1.58	−1.58
	(3.00)	(2.28)	(−1.96)	(−1.38)
Age 65+	9.25	14.08	−1.60	−1.56
	(1.84)	(2.06)	(−1.70)	(−1.18)
Family size	−.097	−.33	−.10	−.11
	(−.21)	(−.48)	(−.96)	(−.72)
Sex	−8.29	−6.75	1.89	1.90
(=1 if female)	(−2.98)	(1.63)	(2.57)	(1.86)
Race	3.28	1.72	1.79	1.90
(=1 if nonwhite)	(1.58)	(.57)	(3.34)	(2.70)
Disability days	.063	.058	.028	.028
	(5.09)	(3.17)	(6.01)	(4.21)
Health status good	−.39	1.21	1.38	1.36
	(−.18)	(.41)	(4.10)	(2.88)
Health status fair	−2.47	−.54	3.48	3.47
	(−1.03)	(−.16)	(7.64)	(5.36)
Health status poor	−5.00	−2.34	6.70	6.66
	(−1.82)	(−.61)	(8.16)	(5.72)
M.D.'s/100,000	−.028 η = −.35	−.23 η = −.29	.007 η = .17	.008 η = .18

	(−.21)		(−.48)		(−.96)		(−.72)	
Sex	−8.29		−6.75		1.89		1.90	
(=1 if female)	(−2.98)		(1.63)		(2.57)		(1.86)	
Race	3.28		1.72		1.79		1.90	
(=1 if nonwhite)	(1.58)		(.57)		(3.34)		(2.70)	
Disability days	.063		.058		.028		.028	
	(5.09)		(3.17)		(6.01)		(4.21)	
Health status good	−.39		1.21		1.38		1.36	
	(−.18)		(.41)		(4.10)		(2.88)	
Health status fair	−2.47		−.54		3.48		3.47	
	(−1.03)		(−.16)		(7.64)		(5.36)	
Health status poor	−5.00		−2.34		6.70		6.66	
	(−1.82)		(−.61)		(8.16)		(5.72)	
M.D.'s/100,000	−.028	$\eta = -.35$	−.23	$\eta = -.29$	.007,	$\eta = .17$	.008	$\eta = .18$
	(−1.86)		(−1.09)		(1.64)		(1.65)	
Beds/1,000	.48	$\eta = .26$	.28	$\eta = .15$	−.05,	$\eta = -.04$	−.03	$\eta = -.03$
	(1.71)		(.72)		(−.63)		(−.34)	
Married	−6.12		−2.95		1.35		1.42	
	(−2.10)		(−.75)		(1.94)		(1.45)	
Constant term	10.03		4.84		3.80		4.04	
	(1.69)		(.64)		(2.88)		(2.80)	
R^2			.45		—		.23	
Corrected R^2			.20				.20	
Dhrymes F	4.29				12.46		—	
(d.f.)	(24,8)		—		(24,8)		—	
t ratio					1.43		—	
adjustment factor	1.70		—		—		—	
F	—		1.76		—		6.89	
(d.f.)	—		(24,51)		—		(24,538)	

TABLE 2-5 Price of Care Equations, Heads Only[a]

	Hospital Room and Board Price (n = 57) TSLS		Hospital Room and Board Price (n = 57) OLS		Physician Office Visit Price (n = 517) TSLS		Physician Office Visit Price (n = 517) OLS	
Room and board coinsurance rate	−11.23 (−.66)	$\eta = -.04$	−8.28 (−.56)	$\eta = -.03$	—		—	
Number of hospital days	−.72 (−1.15)	$\eta = -.13$	−1.09 (−2.40)	$\eta = -.19$	—		—	
Maximum payment per hospital day	.50 (.77)		−.003 (−.006)		—		—	
Dummy (=1 if no limit on $/day)	42.31 (1.23)		17.07 (.84)		—		—	
Physician office visit coinsurance	—		—		2.68 (.56)	$\eta = .26$	−2.49 (−2.25)	$\eta = -.25$
Number of physician office visits	—		—		.17 (.76)	$\eta = .10$	−.18 (−2.49)	$\eta = -.11$
Wage income	−.030 (−.33)	$\eta = -.08$	.023 (.32)	$\eta = .07$	.01 (1.31)	$\eta = .14$	.009 (1.61)	$\eta = .13$
Nonwage income (0 if >$3,000)	.008 (1.16)	$\eta = .07$	.006 (1.06)	$\eta = .06$	.0002 (.28)	$\eta = .008$	.0002 (.31)	$\eta = .007$
Nonwage income > $3,000	.013 (1.09)	$\eta = .07$	.008 (.70)	$\eta = .04$	−.002 (−1.19)	$\eta = -.05$	−.001 (−.93)	$\eta = -.03$
Dummy = 1 if nonwage income >$3,000	−47.21 (−.75)		−20.78 (−.36)		10.36 (1.24)		6.10 (.98)	
Education 9-11 years	−4.49 (−.40)		−1.33 (−.13)		.88 (.60)		.61 (.54)	
Education 12 years	−5.08 (−.48)		−4.93 (−.49)		1.41 (.94)		.70 (.63)	
Education 13-15 years	−34.88 (−1.71)		−29.75 (−1.61)		4.49 (2.55)		3.87 (2.92)	
Education 16 + years	−8.20 (−.52)		−6.37 (−.44)		1.41 (.79)		.47 (.35)	
Family size	.75 [illegible]		.29 [illegible]		.06 (.20)		.004 (.02)	

	(1.09)		(.70)		(−1.19)		(−.93)	
Dummy = 1 if nonwage income >$3,000	−47.21		−20.78		10.36		6.10	
	(−.75)		(−.36)		(1.24)		(.98)	
Education 9-11 years	−4.49		−1.33		.88		.61	
	(−.40)		(−.13)		(.60)		(.54)	
Education 12 years	−5.08		−4.93		1.41		.70	
	(−.48)		(−.49)		(.94)		(.63)	
Education 13-15 years	−34.88		−29.75		4.49		3.87	
	(−1.71)		(−1.61)		(2.55)		(2.92)	
Education 16 + years	−8.20		−6.37		1.41		.47	
	(−.52)		(−.44)		(.79)		(.35)	
Family size	.75		.29		.06		.004	
	(.29)		(.12)		(.20)		(.02)	
Northeast	−22.40		−22.40		−3.10		−2.11	
	(−1.53)		(−1.62)		(−1.64)		(−1.63)	
North Central	−29.59		−27.63		−2.61		−.98	
	(−1.99)		(−1.99)		(−1.19)		(−.76)	
South	−38.62		−35.62		−2.00		−.53	
	(−2.12)		(−2.15)		(−.97)		(−.40)	
Mountain	−31.77		−23.80		−2.35		−.03	
	(−1.22)		(−1.01)		(−.71)		(−.01)	
Physician-population	−.01	η = −.03	−.001	η = −.002	.04	η = .50	.04	η = .57
	(−.11)		(−.008)		(2.82)		(4.21)	
Beds-population	1.20	η = .13	1.11	η = .12	.22	η = .11	.17	η = .09
	(.73)		(.71)		(.84)		(.84)	
Constant	73.93		72.82		−.58		4.70	
	(3.06)		(3.21)		(−.13)		(2.22)	
R^2	—		.41		—		.12	
Corrected R^2			.11				.09	
Dhrymes F	1.17		—		2.18		—	
(d.f.)	(19,18)				(17,20)			
t ratio adjustment factor	.99		—		.80		—	
F	—		1.37		—		4.13	
(d.f.)			(19,37)				(17,499)	

[a] Excluding those who received care for which no charge was made.

larger than the full sample. OLS should be biased away from the TSLS result (Newhouse and Phelps, 1974b), yet the TSLS result is larger in absolute value; consequently, we feel that the TSLS result is likely to be too high, though how much too high is difficult to say. The cross-price elasticity changes signs between the two estimators and is not significantly different from zero.

Wage income elasticities are negative but are not significant at conventional levels. The negative wage income elasticity by itself does not contradict Grossman's investment model because that model applies to all medical expenditure rather than to any particular component of medical expenditure. Moreover, in the full sample wage elasticities become positive, as shown in Table 1-3. The negative sign on wage income may also indicate a downward bias because of the decline in income associated with sickness. Nonwage income elasticities are not significant.

As for demographic variables, length of stay increases with age, is shorter for females, and shorter for married individuals. This is consistent with the effect of these variables taken one at a time in the data gathered by the National Health Survey (Gordon, 1973). There is no relationship apparent with education nor with self-perceived health status; evidently, self-perceived health status is too crude to measure differences in health status among the hospitalized population.

Room and Board Price

The elasticity of room and board price with respect to the coinsurance rate is near zero and not significant in both OLS and TSLS. This is a marked change from our earlier paper. Wage income elasticities are also not significantly different from zero, nor are nonwage income elasticities. As in the case of the full sample, we infer that neither amenities nor time saved from shorter queues are very important in explaining the deviation of the room and board price, given the type of accommodation. Weighted hospital days are negatively related to the price; those who are in the hospital longer tend to use cheaper hospitals, given the type of accommodation.

Physician Visits

It is difficult to estimate demand for physician services from these data because 85 per cent of this sample had no insurance for physician services.[3] As a result, there is relatively little price variation. The elasticities using TSLS are small and not significantly different from zero; the OLS elasticities (own-price and cross-price) are around −0.1 and quite significant. Because both price and insurance are endogenous, one could argue that there is a bias away from zero in the OLS results. However, other work we have done persuades us that this elasticity is at least as high as −0.1 (Phelps and Newhouse, 1972; Newhouse, Phelps, and Schwartz, 1974). Wage income elasticities are small and not significant; nonwage income is also not significant except for the 5 per cent of the sample whose nonwage income is higher than $3,000, in which case the elasticity is 0.07, and quite significant in both OLS and TSLS. Health status variables are the most closely related to visits; visits steadily increase as self-perceived health status worsens and also increase with disability days. Additional physicians show a weak positive relationship to visits, but beds show none. Nonwhites and females make more visits.

Physician Price

The physician visit price appears quite responsive to coinsurance using the OLS estimate; the elasticity is −0.25 and significant. The TSLS result is of the wrong sign. An increase in insurance from no coverage to full coverage increases the price per (weighted) visit by about 30 per cent. Those who visit the physician more frequently seek out lower-priced physicians; the elasticity with respect to the number of visits is −0.11 (OLS). Wage income has a positive effect that borders on significance at usual levels (the effect is very significant if non-heads are included), whereas nonwage income has no effect. We interpret this to mean that a higher-priced physician means less time spent in search or in a queue, and not additional amenities. The physician-population ratio bears a very strong and positive relationship to price. We have not attempted to treat this variable as endogenous, and therefore its interpretation must remain ambiguous.

NOTES

1. Ancillary services frequently have different insurance provisions. Work is now in progress to estimate their responsiveness to price.
2. We have, however, excluded from the sample all individuals who have exceeded an upper limit, on the grounds that we could only imperfectly control for health stock loss. This excluded a negligible number of individuals. See note to Table 1.

3. The nine are professional, managerial, sales, foreman, agriculture-mining-construction, manufacturing, finance, public administration, and entertainment.
4. We are indebted to Karen Davis for this point.
5. We did not feel we had a sufficient degree of overidentification to treat disability days as endogenous.
6. Because our data come from a multistage probability sample (around seventy-five primary sampling units), the estimated standard errors are biased downward. The amount of bias depends on the size of covariances within the primary sampling units. On the basis of unpublished analyses of utilization data within New York City census tracts, we would guess that these covariances are sufficiently small so as to create negligible bias in the estimated standard errors.
7. This is a heroic assumption; it assumes that individuals who are paid by salary are similar to those paid a wage, as are those who are self-employed. Sick leave provisions are ignored, as is the possibility that one's opportunity cost of time may fall if one is sick. Nonpecuniary aspects of work are assumed to be a constant proportion of the money wage. Despite these problems, the simple wage rate seems to predict some phenomena reasonably well (most particularly use or nonuse of the medical care system and physician price).
8. Michael Grossman has pointed out to us that hours of work at any stage in the life cycle should depend on the rate of interest relative to the rate of time preference. This implies that age should be in Equation (2), and that if it were, (2) might become underidentified, because age is strongly related to experience. The problem can be solved by specifying other variables (such as industry mix in the area) in (1); because Heckman's procedure failed computationally (see text), we have not pursued this issue.
9. The estimator converged to different values depending on the starting point.
10. We also attempted to use the following method for estimating the reservation wage: Let $H = a(w - w^*) + e_H$, where H = hours, w and w^* are as defined in (1) and (2), and e_H is an error term. Let $w^* = bX + e_r$, where X is the vector of variables described in the text. Substituting, $H = aw + cX + e$, where $c = -ab$ and $e = e_H - ae_r$. Therefore, b can be estimated as $-c/a$ and w^* estimated as bX. When we followed this procedure, the results were unsatisfactory. Using an OLS estimator to estimate a and c, many of the predicted reservation wages were negative. Using a tobit estimator, a different problem arose; the standard deviation of the estimated reservation wages seemed unreasonably high (it was six times the standard deviation of w). We therefore resorted to the procedure described in the text, one known to be biased, but nevertheless producing estimates that appeared to have less mean square error. We are exploring alternative estimates of time value.
11. The total number of individuals in the sample for the equation is larger than in the utilization equations because individuals with deductibles in their policies have not been excluded.
12. The proof follows the standard proofs of the level of investment in any risky asset. The asset with the certain return is preferable.
13. Throughout this discussion we ignore the presence of upper limits. We have excluded the 0.2 per cent of individuals in our sample who exceeded an upper limit and have assumed that the behavior of the remainder was not affected by the presence of an upper limit. Because the probability of exceeding an upper limit is slight, this assumption should have little effect on our estimates (Keeler, Newhouse, and Phelps, 1974).

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14. Nor is it in general proportional to the deductible. This is easily seen by differentiating (5) with respect to D:

$$\frac{dE(f(x))}{dD} = (1-C)\,Dh(D)$$

This is proportional to D only if $h(D)$ is constant or, equivalently, if $h'(D)$ is zero, which will be true only in the special case of local maximums and minimums or a uniform distribution of expected expenditure. As a result, if the responsiveness to expected price is linear, responsiveness of demand to a deductible is some nonlinear function.

15. Suppose that higher moments of $f(x)$ as well as the first moment are relevant in explaining demand; policies with no deductibles are more convenient for estimation in this case also. If D is zero, the n^{th} moment is homogeneous of degree n.
16. Partially offsetting, on the assumption that the elasticity is less than 1, as appears reasonable from our estimates in Section 5.
17. This procedure can lead to biased estimates if the services tend to be covered at different rates and one is used without the other (Newhouse and Phelps, 1974b). However, these two services are covered at nearly identical rates (roughly 0.3), and the quantities of services consumed are probably roughly in proportion.
18. Using the instrumental variable estimate of C, the elasticity at the mean for the specification used in Table 2 was on the order of −0.4; asymptotic normal statistics were slightly in excess of 1.
19. The program uses a Fletcher-Powell minimization algorithm.
20. Differentiating (4), one can compute that the elasticity at the mean is $(1-\bar{P})\beta x$.
21. This result can be approximated by assuming that whites have the mean admission rate and length of stay (0.078 and 7.39 days, respectively), whereas nonwhites are similar to whites except for the racial dummy variable effect. The conclusion ignores effects of race on the price per weighted day, if any; however, race is not significantly different from zero in price equation presented next.
22. 0.23 = 9.24/40.97. The 9.24 is the coefficient in the OLS room and board price equation; the 40.97 value is the predicted room and board price at a coinsurance rate of 1.
23. Both this equation and the physician visit price equation were run without the physician-population and bed-population ratios to guard against a simultaneous equation problem. The estimated coefficients were virtually unchanged.
24. There is a positive but essentially zero (and insignificant) cross-price coefficient in the OLS length of stay equations.
25. 0.18 = 1.27/6.93. The 1.27 figure is the coefficient in the price equation; 6.93 is the predicted price selected by an individual with no insurance (other variables at their means).

NOTES TO APPENDIX 2

1. Age and education are not entered in interval form in the logit equations in order to minimize computational costs.
2. This may not be true of a change in a deductible. All those hospitalized in our

sample exceeded the deductible in their policies. A small change in the deductible, therefore, would not affect the marginal conditions.

3. This may explain the near zero cross-price elasticity in estimating cross-price in the length of stay equation.

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7 COMMENTS

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Newhouse and Phelps have made a valuable contribution to the literature on econometric analysis of the demand for medical care. Their work is careful and detailed. They pay ample attention both to rigorous use of economic theory to derive hypotheses and to the relevance of the specification to major policy considerations. Although by no means the first econometric study of this topic, it is distinctive in a number of important ways. First, data on individuals are used instead of data on families or data aggregated by state. Compared to aggregate data, Newhouse and Phelps' data have the advantage of avoiding general aggregation problems (discussed by Theil and others), and provide superior opportunities for accurately specifying price. However, with data on individuals, a change in the price faced by a single individual should have different effects from an across-the-board change for all individuals in an area as community norms of health care change. National health insurance may approximate the latter model (change in utilization through norms) more closely.

A second distinct aspect of this work is specification of a particularly accurate marginal coinsurance rate. This is accomplished through information on the benefit structure of individual insurance policies and by eliminating individuals with deductibles from the sample. Other studies have used the average coinsurance rate to calculate net price. This method is theoretically defective because deductibles cause net price to be underestimated for low expenditures and overestimated for high expenditures, which causes an upward bias in price elasticity estimates. Another problem with the average rate is that it is a function of the dependent variable, giving rise to a bias in the opposite direction. Unfortunately, the overall direction of bias is not clear. A third difference from other studies is treatment of insurance as endogenous. Sicker people allegedly buy more extensive insurance coverage. Although this is not a problem for studies using aggregate data, adverse selection among individuals could give rise to an upward bias in price elasticity estimates. TSLS estimation is used here. Exogenous variables in the insurance equation that are excluded from the demand for care equation are size of the employee group and a series of occupational dummies. A fourth difference from other studies is the inclusion of health status variables in the demand equations. Their inclusion substantially improves the fit in many equations and avoids potential specification bias resulting from their omission. A fifth distinct aspect of this study is estimation of equations for price paid. The authors see differences from the mean in price paid to reflect variation in amenities, queuing, and degree of search. Finally, Grossman's model of the demand for health care as a human capital investment decision is used as the theoretical basis for this work. Although the theory does not suggest inclusion of any new variables, some ambiguity with respect to predicted signs is removed. Wage rate, nonwage income, education, and family size are the principal variables affected.

The elasticity of expenditures with respect to price are estimated to be −0.33 for hospital care and −0.22 for physician services. These estimates, particularly the physician estimates, are lower than those reported by other researchers. (The equations are linear, so elasticity is evaluated at the mean. It should be pointed out that mean coinsurance rates are 0.27 for hospital care and 0.85 for physician services.)

A number of aspects of these results warrant detailed discussion. First, TSLS estimates were uniformly poor. Elasticities were often insignificant, and if not, they tended to be higher than OLS estimates, contrary to *a priori* expectations. Certain implications can be drawn from this result. Adverse selection probably is not so quantitatively important as had been thought, which is plausible considering the large proportion of insurance that is purchased by employers. In fact, the sick may have less insurance rather than more, for they tend to be unemployed or employed by companies without health insurance benefits, thus facing a higher loading charge. In empirical analysis of aggregate data, Frech has found adverse selection to be quantitatively small.

Another implication of these results is that the TSLS estimation is not very efficient in this context. Since other researchers are unlikely to be able to estimate a superior demand for insurance equation to obtain an instrument for insurance coverage, treating insurance as endogenous is not a fruitful endeavor.

A highly interesting series of results are the negative cross-elasticities obtained, implying that hospital and physician services are complements.

These findings run counter to the usual notion of absence of coverage of physician services causing outpatient services to be performed on an inpatient basis. Although this may be the case, this effect is apparently swamped by other cross-price relationships.

Estimating interactions between the price variables on the one hand and income and health status on the other did not turn up any significant interactions. This result is contrary to a general expectation that price elasticities might be higher for low-income individuals and lower for individuals who are ill. However, the authors do not consider their evidence as a firm indication that such interactions do not exist.

Although I am generally enthusiastic about both the competence of the analysis and the usefulness of the results, I have a few criticisms worth mentioning. The authors have been rather ruthless in cutting down their sample in the interest of avoiding errors in the independent variables. For example, all persons other than heads of households were eliminated because of difficulties in establishing a value for their time. (They later were put back.) Those with insurance policies with deductibles were dropped because of difficulties in assigning them a marginal coinsurance rate. For the same reason, those individuals exceeding the limit of their policy were dropped.

Although the reasons for reducing the sample are valid, the costs of doing so are not discussed. By focusing only on heads of households, a large part of the population with potentially different behavior is ignored, reducing substantially the efficiency in estimation. Apparently, as seen in the later results, price elasticities for heads were not different, but the increase in standard errors from reducing the sample was large.

Dropping those individuals with deductibles and limits may cause the estimates to be inconsistent. It is rational for those with high price elasticities for medical care to purchase insurance with large deductibles if their premium depends on use (as in the case of a group of similar individuals). Excluding those choosing deductibles could affect the estimates, although the bias in this sample is limited by the small number of individuals who have deductible provisions in their policies. To maintain consistency, it might be desirable to also drop all of those approaching the limits of their policy as the marginal coinsurance rate is exceeded by the implicit rate that those individuals face. It may be best not to eliminate either group, but to attempt to impute implicit coinsurance rates to all. Although this will be quite a challenge, the preponderance of deductibles in recent proposals for national health insurance makes such an analysis highly relevant.

The equations using price paid as dependent variables are potentially very valuable and are much easier to estimate with data on individuals than with aggregated data. The efficiency of estimation could be improved if the average price in the respondent's community was used instead of the average price over the entire sample. Three regional dummy variables do not do an adequate job of reflecting varying degrees of local monopoly power, differences in wage levels and construction costs, and price differences caused by immobilities of medical resources. Consequently, a great deal of variation in the deviation from average prices is attributable to factors other than amenities, queuing, and search activity—the factors that the deviations are supposed to reflect. Since sampling is concentrated in a limited number of primary sampling units, there may be enough data to obtain prices from the sample for each area. If not, outside price data should be brought in.

Because of the unique position of the physician as an agent for the patient as well as provider of health care, and the evidence that health care markets tend to stay out of equilibrium for long periods of time, supply variables have been included in most economists' estimates of the demand for health care. When individual observations are used, however, variables reflecting demand for care in the community should be included along with the supply variables. For instance, an area may have a large number of hospital beds per capita, but if the population is old and has extensive insurance coverage, the survey respondent may be facing a market in which there is excess demand rather than excess supply. Thus, omitting community demand variables risks losing some of the information that the supply variables are intended to provide.

The authors use type of accomodation to adjust hospital length of stay for productivity in health care. This variable strikes me more as a reflection of amenities than productivity in delivering health care. To the extent that productivity is not adjusted for in the length of stay equation, there should be a downward bias in the price elasticity estimate. However, productivity will wind up in the price of care equation, giving an upward bias to price elasticity in that equation. The net effect when price elasticity of expenditures is computed should be zero. The problem does not affect the physician service equation so severely, because the price differences between G.P.'s and specialists are much better indicators of productivity difference.

Since this study clearly adds to our knowledge about medical care demand, it is appropriate to ask where we should go from here. There are a number of directions that I can see. One, which is suggested by Newhouse and Phelps, is studying the demand for ancillary services in the hospital. Feldstein's calculations of changes in hospital costs over time show that increases in inputs per patient day are a significant cause of cost inflation. In his theory, this increase is predominantly demand-determined. This makes the study of demand for ancillary services particularly important.

Use of health status variables is an endeavor of great potential. Although Newhouse and Phelps characterize their variables as crude, they contribute to the explanatory power of a number of equations. The usefulness of health status variables is pointed out by some of the results that Karen Davis presented in her paper at this conference. With health status variables included, utilization was a positive function of income. With the variables omitted, the relationship was U-shaped.

Finally, more work on the interactions between price and health status, income, age, and other variables is desirable. National health insurance is often advocated not only to correct alleged market failure in private health insurance, but also to subsidize medical care for certain groups such as the poor and the sick to increase their use. All plans involve a tradeoff between

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welfare losses from financing the plan and moral hazard on the one hand and the benefits of increased utilization by target groups on the other. Detailed price elasticity information is needed to both assess and design public financing plans with these considerations in mind.

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This most recent paper by Newhouse and Phelps is important for two reasons, one positive and one negative. On the positive side, it demonstrates the usefulness of microdata sets and the potential for much more detailed analysis of the demand for medical care services. On the negative side, we should be wary of too much concentration on the question of demand and remember that the market for medical care has unique characteristics that require much more study of the supply conditions.

The use of micro survey data by Newhouse and Phelps has several real advantages. They are able to move beyond data based on geographical aggregates for which we have little knowledge of the underlying distributions and for which mean values may be inappropriate. A primary example of the improvement afforded by microdata is the very detailed description of insurance coverage available in the NORC data. This allows the coinsurance and deductible provisions in the policies to be separated and a demand function to be estimated in which the price is truly the marginal price and not an implicit average price based on gross and net expenditures. These microdata also allow the specific decisions concerning the marginal unit of care to be more clearly identified. In addition, the use of a household survey allows data on individual health status to be incorporated. Newhouse and Phelps were also able to include some estimates of geographically based variables, such as the supply of physicians and beds per capita for the counties from which the sample was drawn.

There are, however, a number of problems and cautions that are raised by the use of microdata. The need for using the appropriate sample for each equation and the problem of missing data can lead to widely varying numbers of observations. For instance, the final hospital elasticity results are composed of estimates for length of stay (364 observations), admissions (1,579 observations), and price (313 observations). Other related regressions are based on samples ranging from 76 to 4,536. Although even the smallest of these samples is reasonably large for aggregate series, one must be careful that a variable does not represent only a very small number of observations that may, in the particular sample used, be aberrant. For instance, based on the proportions found in the total sample, only 7 of the 76 people are black and only 4 of 76 have nonwage incomes in excess of $3,000.

When working with aggregate data, ignorance usually leads us to assume that all variables are equally reliable or unreliable. (Discussion of the effects of errors in measurement can usually be traced to coefficients that appear with the "wrong" sign or magnitude.) Concern about the measurement of variables is probably more important for microdata sets in which errors are less likely to average out in aggregation, and the mere number of observations makes looking at the residuals a particularly painful task. In fact, one of the reasons for the Newhouse-Phelps paper was to correct an error in the algorithm that generated the wage variable in their original paper.

Finally, there are some statistical problems that should be recognized. The NORC sample is clustered; this invalidates the assumptions of independence of observations and leads to standard error estimates that are biased downward.[1] This bias should be considered when reporting the results. The clustering also implies that the data for some variables, such as the physician-population ratios, are based on the number of clusters in the sample, not the number of persons.

On the negative side, and more important than the use of microdata, is the use of such data in the context of a very traditional market framework. There are a number of characteristics of the medical care sector that should cause us to focus at least some of our attention on the behavior of the physician rather than solely on the rational consumer making choices among a number of commodities. The pathbreaking article by Kenneth Arrow on "Uncertainty and the Welfare Economics of Medical Care" clearly indicated the importance of uncertainty and the asymmetry of information in medical care.[2] In a recent review of the econometric literature, Martin Feldstein argues persuasively that it is inappropriate to either ignore the physician or assume that utilization is determined solely by the physician.[3] Instead, he proposes that future research consider the physician to be an agent for the consumer and then examine the behavior of the physician when this relationship is not perfect.

Newhouse and Phelps should continue their analysis with this model and further disaggregate the decision process. For instance, the total utilization of hospital care is appropriately broken down into the decision to admit, the length of stay, and the level of services consumed. The admission equation should utilize the expected net price of the episode, including *all* hospital services, (not just the room charge) *and* the net price of physicians' services in the hospital. To test the impact of physicians on the demand curve, it may be appropriate to include a measure of the marginal profit to the physician resulting from the admission decision. (Under fee-for-service, this will be positive and related to gross physician charges; under prepaid plans the marginal profit is zero or negative. It is also likely to vary substantially for surgical and medical procedures.)

After the decision to undergo hospitalization, it is important to examine the determinants of the "intensity of services" or the cost per patient day. Again, net price to the patient and marginal profit to the decision makers are often thought to be completely based on technical considerations and are probably those in which the patient is least competent.[4] Intensity is often a function of the availability of special services in the hospital and standard practices in the area. For instance, costs per day in the West are consistently higher than in the East, but this is probably because of shorter lengths of stay. Long-run availability of services and practice patterns should also be investigated.

The final hospitalization decisions concern the length of stay. For the marginal day in the hospital, the net price of hospital services will be based primarily on the room charge and coinsurance rate; there are generally few ancillary services. The physician is also likely to gain little relative to an additional office visit, and especially little relative to major surgical fees. (The hospital, however, tends to make money on the marginal day and may exert informal pressures on the physician.)

When examining the utilization of physician visits it is important to distinguish four types: (1) those required for employment, insurance, etc.; (2) "purely preventive"—patient initiated; (3) response to symptoms—patient initiated; and (4) physician-suggested follow-up with patient compliance. The first type is relatively uninteresting although it may account for a substantial fraction of the visits of certain population subgroups. Even the purely preventive visit may not be completely patient initiated because the physician can alter the consumer's perception of the benefits of such care. For instance, the proportion of women who think that yearly Pap smears are necessary is probably not independent of the supply of gynecologists in the area. It is, however, in the area of preventive care that Grossman's investment model is probably most applicable.[5] There is also some question about whether preventive visits should be considered in the investment or the consumption category. Education is consistently one of the most important predictors of check-ups but there is little medical evidence to support the value of such visits.

Physician visits in response to symptoms may be viewed in part as investments, but they are largely "consumption" services to reduce pain and anxiety. Net price, search, and time costs are probably of primary importance, but other factors influencing symptom recognition and choice of the type of provider should also be investigated. Finally, physician-suggested follow-up visits comprise a substantial fraction of total visits and are probably the group of visits most subject to provider influence. This influence occurs not just through the statement that the patient should return for a follow-up. This suggestion can be made with varying degrees of force and, in the absence of other specialized information, is likely to shift the location of the demand curve.

The Newhouse-Phelps paper is a valuable contribution; these comments are intended to suggest that further research needs to be done with microdata and with still more disaggregated, and perhaps more realistic, models of the medical care market.

NOTES

1. For estimates of the magnitude of this bias see Leslie Kish and Martin Frankel, "Balanced Replications for Standard Errors," *Journal of the American Statistical Association*, 65 (September 1970), pp. 1071–1094.

2. *American Economic Review*, 53 (December 1963), pp. 941–973.
3. "Economic Studies of Health Economics," in M. Intriligator (editor), Frontiers of Quantitative Economics, II (Amsterdam: North-Holland Publishing Company, 1974).
4. The potential consumer may be willing to pay a substantial premium beyond actuarial value so that he or she is sure to face a very low price (coinsurance rate) when decisions must be made that directly affect his or her health. Moral hazard may be a positive good for the consumer.
5. The testing of such a model is very difficult. For instance, positive coefficients for wage income are predicted by the model and are found by Newhouse and Phelps. One might predict the same findings on the basis of the sliding scale of fees that is more closely related to what the physician *thinks* the patient earns than total income including unearned income. The sliding scale has become less important in the last ten years, so that a comparison of the Newhouse-Phelps results and more recent data should help to answer this question. See Michael Grossman, "On the Concept of Health Capital and the Demand for Health," *Journal of Political Economy*, 80, 2 (March–April 1972), pp. 223–255.

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