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PART TWO

# Effects of Health Insurance on the Market for Health Services

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# Demand for Health Care among the Urban Poor, with Special Emphasis on the Role of Time

## 1. INTRODUCTION

This study examines the demand for medical services by type of provider with particular emphasis on the role of time as a determining factor. The demand for health and medical services has attracted considerable interest in recent years because of the dramatic increase in health expenditures and because of substantial cost inflation in that sector. Although the causes of this rise in demand and cost inflation are complex to analyze, there is reason to believe that the substantial spread of reimbursement insurance in the last twenty years has played a major role by reducing the out-of-pocket money price the consumer faces in buying medical care.[1] Health research is focusing more and more on the economic determinants

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of this demand, explicitly including third-party expenses.[2] Surprisingly, there has been almost no discussion of alternative rationing mechanisms that might become effective if money prices continue to decrease in importance as a result of spreading third-party reimbursement. Since there is every reason to believe that money prices will continue to decline in relative importance because of (1) the secular trend in third-party coverage, (2) the rising opportunity cost of time, (3) increases in time required to receive care, and, perhaps most important, (4) the prospect of national health insurance, it is necessary to examine other factors that may control demand.

This paper suggests that travel time and waiting time may replace money prices as the chief determinant of demand.[3] First, a model of the demand for medical services is developed with time explicitly included as part of the price of the goods purchased. From the model we predict that the time-price elasticity of demand for medical services will exceed the money-price elasticity as out-of-pocket money prices decrease, and also that changes in time prices will have a greater effect on demand for free medical services than on the demand for non-free services. We can further predict a differential effect of earned and non-earned income on the demand for medical services. A rise in non-earned income increases the demand for medical services; the effect of a rise in earned income cannot be predicted because it produces both an income and a price effect (by raising the opportunity cost of time).

The data used to test the predictions of this model were taken from two household surveys conducted in New York City. The city is a particularly good laboratory to estimate the importance of time prices and possible behavior under national health insurance because of the long-standing availability of free ambulatory and inpatient care through municipal hospitals and clinics. Thus, we get some notion of the steady-state behavior of a population with free, governmentally sponsored care available. Demand equations are estimated for four types of medical care: public ambulatory, private ambulatory, public inpatient, and private inpatient. In addition to a number of controlling variables for health and sociodemographic status, the important explanatory variables include travel and waiting times for alternative sources of care, and earned and non-earned income. The results indicate that in low-income neighborhoods of New York City, time-price elasticities already exceed the money-price elasticity of demand for care.

The paper concludes with a number of implications for policy with regard to locating health facilities, queuing practices at ambulatory facilities, and the possibility of substituting income subsidies for subsidies for medical services.

## 2. CONSUMPTION MODEL OF THE DEMAND FOR MEDICAL SERVICES

Details of the model and its implications are described in Appendix 3;[4] the major predictions are summarized here. The model concentrates on the role of money prices, time prices, and earned and non-earned income in determining the demand for medical care. The empirical section concentrates on demand for care from public and private providers of ambulatory and inpatient care. For simplicity, the formal model is developed in terms of only one provider of services, but the implications for several providers can easily be drawn.

Assume that two goods enter the individual's utility function: medical services, $m$, and a composite, $X$, for all other goods and services. Assuming fixed proportions of money and time to consume $m$ and $X$ and the full income assumption, the model can be represented as follows:

Maximize

$$U = U(m,X) \tag{1a}$$

subject to

$$(p + wt)m + (q + ws)X \leq Y = y + wT \tag{1b}$$

where

$U$ = utility
$m$ = medical services
$X$ = all other goods and services
$p$ = out-of-pocket money price per unit of medical services
$t$ = own-time input per unit of medical services consumed
$q$ = money price per unit of $X$
$s$ = own-time input per unit of $X$
$w$ = earnings per hour
$Y$ = total (full) income
$y$ = non-earned income
$T$ = total amount of time available for market and own production of goods and services

First, notice that the consumption of medical services, $m$, does not affect the amount of time available for production, $T$.[5] Second, $p$ is the out-of-pocket expenditure for a unit of medical services, incorporating any deductible and coinsurance rate the individual faces from insurance. It would be appealing to make these insurance parameters endogenous, but data limitations do not permit the estimation of demand for insurance along with the demand for services.[6] Third, the manner in which the goods produce utility is not specified. Some researchers have included "health" in the utility function and allowed health to be produced by combining medical services with other inputs.[7] Health enters because of a demand for the "healthy days" it will cause. The interested reader may consult Phelps (1972) or Grossman (1972a) for these alternative motivations of the demand for medical services. For present purposes, an understanding of this mechanism is not necessary. The simpler formulation used here yields most of the same predictions as the other specifications. Furthermore, the data do not allow us to estimate the manner in which medical services are translated into health.

## Effects of a Change in Price

Assumptions sufficient to make money function as a price in determining the demand for medical services are also sufficient to make time function as a price.[8] Therefore, the first prediction derived from this model is that if medical services are a normal good, time will function as a price, producing negative own-time/price elasticities of demand and positive cross-time/price elasticities.

One of my chief interests in this study is the relative importance of money and time prices in determining the demand for medical services. If we let $\pi$ equal the total price per unit of medical services (that is, $\pi = p + wt$), then the elasticity of demand for medical services with respect to money price is

$$\text{(2a)} \qquad \eta_{mp} = \frac{p}{\pi}\,\eta_{m\pi}$$

and the elasticity with respect to time price is[9]

$$\text{(2b)} \qquad \eta_{mt} = \frac{wt}{\pi}\,\eta_{m\pi}$$

That is, the elasticity with respect to one component of the price equals the elasticity with respect to the total price weighted by the share of the total price owing to that component. Comparing these two elasticities yields the second prediction from the formal model; namely, that

$$\eta_{mt} \gtreqless \eta_{mp}$$

as $wt \gtreqless p$. Clearly, as $p$ falls to zero and $wt$ does not, the time-price elasticity will exceed the money-price elasticity. In other words, as the out-of-pocket payment for a unit of medical services falls, because of either increasing insurance coverage or the availability of subsidized care, demand becomes relatively more sensitive to changes in time prices. Furthermore, this implies that the demand for free medical services should be more responsive to changes in time prices than demand for non-free services, because time is a greater proportion of total price at free than at non-free providers.

## Effects of a Change in Income

Exogenous changes in income can arise either from a change in earnings per hour or from a change in non-earned income. The two effects are not, in general, equal. The assumptions that are sufficient to make money function as a price are also sufficient to mean that an increase in non-earned income will produce an increase in the demand for medical services. So the first prediction about income is that there will be a positive non-earned income elasticity of demand for normal goods.

The effects of a change in the wage rate cannot be determined *a priori* because of offsetting influences. An increase in earnings per hour produces an income effect, which acts to increase demand. It also raises the opportunity cost of time, which reduces demand for time-intensive activities. The net effect on the demand for medical services depends on the time intensity of the price of medical services relative to the time intensity of the price of all other goods and services. We can break the effects of a change in the wage rate, $w$, into an income effect and a substitution effect:

$$\frac{\partial m}{\partial w} = (T - mt - Xs)\frac{\partial m}{\partial y} - \frac{\lambda s(q + ws)(p + wt) - \lambda t(q + ws)^2}{|D|} \tag{3}$$

where $|D|$ is a determinant of the matrix of coefficients from the maximization equations. The first term is an income effect and is, by assumption, positive. The second term is the substitution of $m$ for $X$ because of a change in $w$. We can establish that the substitution term is positive if and only if

$$\frac{ws}{(q + ws)} > \frac{wt}{(p + wt)} \tag{4}$$

that is, if the time price is a larger proportion of the total price for the composite good, $X$, than it is for medical services, $m$. The substitution effect is necessarily negative for free sources of medical care since the condition in Equation (4) will not be met as long as there is a non-zero monetary price for $X$; that is, an increase in the wage rate will always cause a substitution effect away from the free good. Of course, the net effect of a change in wages may still be to increase the demand for medical services if the income effect exceeds the substitution effect. Intuitively, however, the effect of a wage change on the demand for free medical services is primarily a price effect (and therefore is likely to be negative) and the effect of a wage change on the demand for non-free sources is primarily an income effect (and therefore is likely to be positive).

## Predictions from Other Formal Models

The simplified consumption model is adequate to generate empirically verifiable hypotheses for the variables of primary interest in this study. The Grossman (1972a, 1972b) investment model provides additional predictions regarding the effects of education and age. Grossman enters health into the utility function and lets health be produced by combining medical and other inputs. He argues that if education raises health productivity (e.g., more highly educated persons are more skillful in combining medical inputs to produce health) and if the price elasticity of demand for health is less than 1, then when all other things are accounted for, he expects to find a negative relation between education and the amount of medical services demanded.[10]

The second implication of the Grossman formulation involves investment in health over the life cycle. If the price elasticity of demand for health is less than 1, then the effect of age on the demand for medical care is positive if the depreciation rate on health rises with age and is negative if it falls with age. In general, we may suspect that the depreciation rate increases over the life cycle, causing a positive effect of age on the consumption of medical care. However, the evidence presented below (and in

Acton, 1973) suggests that in poor populations, substantial depreciation in the health stock may be occurring early in life.

## 3. THE DATA BASE

In this section I discuss the source of the data used for estimation, the definition of the variables used for analysis, and the expected effect of these variables. The data used came from two household surveys conducted in 1968 by the National Opinion Research Center (NORC) for the Office of Economic Opportunity (OEO). The surveys were conducted in Brooklyn, New York, to establish baseline characteristics on the population before the Red Hook and Charles Drew (in Bedford-Stuyvesant/Crown Heights) Neighborhood Health centers were established. Both surveys were conducted on straight probability samples of the target population. (I will refer to them as Red Hook and Bedford-Crown.) In the completed survey, approximately 1,500 households, containing almost 5,000 individuals, had been interviewed in each study. The completion rates were 82 and 81 per cent for the two samples, respectively, and there is no evidence of bias in the incomplete interviews.[11]

An advantage in using survey data is that it provides much more detail about the variables of interest than the use of aggregate data. Consequently, it allows more precise estimates of the relationships. A weakness of survey data is that it relies chiefly on self-reporting by the individual for some of the most important variables (especially medical utilization and income). Since the actual amounts are usually under-reported, the coefficients may be biased. As long as the under-reporting (or over-reporting) is proportional, the elasticities will be unaffected.[12] Consequently, the empirical section concentrates on the elasticities of the important variables.

### Selected Characteristics of the Red Hook Population

The Red Hook population contains about 25,000 persons. The racial breakdown is 26 per cent Puerto Rican, 43 per cent "other white," and 30 per cent black. It is a relatively stable neighborhood (77 per cent had lived in the Red Hook area for more than five years); average family size is 4.7 persons. The average income is $5,030 per year. In twenty per cent of the households at least one member was receiving welfare, and 23 per cent fell below the OEO poverty line. The mean age is 27.3 years and the mean educational level is 6.8 years in the full sample.

Approximately 33 per cent of the Red Hook population saw a physician in the outpatient department (OPD) of a municipal hospital or a free-standing clinic during the year, and 48 per cent saw a physician in his private office. The average number of visits for users of these physicians is 5.2 and 3.8 per year. In the preceding year, over 9 per cent of the survey population was hospitalized at least once, and, on the average, hospitalized persons spent 14.6 days in the hospital during the year. Almost 14 per cent of the population reported having at least one chronic health condition limiting activity. There is a strong negative correlation between number of chronic conditions and family income, with the under $3,000 individuals reporting five times as many chronic conditions as the over $7,000.

## Selected Characteristics of the Bedford-Crown Population

The general characteristics of the Bedford-Crown survey are similar to the Red Hook population and can be summarized quickly. Bedford-Stuyvesant/Crown Heights is a predominantly black neighborhood. Blacks constitute 84 per cent of all residents, Puerto Ricans, 7 per cent, and "other white," 9 per cent. The mean income is $5,599. In Bedford-Crown, almost 20 per cent of the families fall below the OEO poverty line and in 24 per cent at least one member was receiving welfare. Average household size is 4.3 persons. Females head 41 per cent of the Bedford-Crown households; only 32 per cent of households were so headed in Red Hook. The mean age is 25.2 and educational level is 7.3 years in the full sample.

Although almost 15 per cent of respondents reported at least one chronic health condition that limited activity, medical utilization appears generally lower in Bedford-Crown than in Red Hook. Broken down by type of physician visit, 29 per cent saw a physician at the OPD of a municipal hospital or a clinic (5.0 visits per year), and 40 per cent saw a physician in his private office (3.9 visits). The hospitalization rate was similar to what it was in Red Hook. Less than 8 per cent of the population was hospitalized for an average of 15.3 days per person.[13]

## Definition of Variables Used and Expected Effect

This subsection discusses the nature of the variables used for the empirical analysis and their expected effect on the demand for medical services. For reference, Appendix 1 lists the variables in alphabetical order and provides a brief definition and the mean values. The four dependent variables cover the volume of ambulatory and inpatient care. The number of physician visits in an OPD or clinic is OPDC and the number of private office visits is PRIV. Days of hospitalization in public (municipal) and private (voluntary or proprietary) hospitals are DAZPUB and DAZPRIV. The discussion here will focus on explanatory variables by type—time price, income, sociodemographic, and so forth—and the interpretation that may be given to them.

### Price Variables

Although the surveys conducted by NORC provide us with both travel time and waiting time information, the respondents were not queried about the money prices paid for medical services. I will consider the bias the omitted money-price variables may cause in the estimation after discussing the time variables, but the problem is not severe since the appropriate monetary price for free care is zero anyway.

The questions about travel time and waiting time were similar in form. After determining the usual source of medical care (general practitioner, specialist, clinic, etc.) NORC asked: "How long does it usually take you to get there (the way you usually go)?" (The travel times used for this analysis are for a round trip.) In the Red Hook Survey NORC asked a similar question about usual waiting time. NORC then asked if there were a most trusted source of medical care, and if so, what it was (same options as usual source). Again, a waiting time question was posed in Red Hook. For analysis, it was necessary to associate these times for usual and trusted sources with the dependent variables OPDC and PRIV. This was accomplished by creating travel time variables, TOPDC and TPRIV, and two waiting time variables, ATOPDC and ATPRIV. The waiting time to usual source of care was used for creating the TOPDC variables if the usual source was an OPD or clinic; if it was not, and the trusted source was an OPD or clinic, then the travel time to a trusted source was used. Similarly, if the usual source was a private practitioner, then that time information was used to create TPRIV and ATPRIV. If the usual source was not a private practitioner, but the trusted source was, the trusted source information was used. When trusted and usual providers were of the same type, the time information for the usual source was used. When the above algorithm failed to assign a value to one or more of the time variables (typically because usual and trusted sources of care were both private and TOPDC and ATOPDC were therefore not available), the mean value for those who reported a time was used.[14]

Depending on the particular application of the results, the chief interest may be in the effect of the time variables themselves, or there may be more interest in the effect of the time variables multiplied by the opportunity cost of the unit of time. Each of the four time-price variables is multiplied by the earned income per minute for working persons to create four alternative time-price variables: CTOPDC, CATOPDC, CTPRIV, and CATPRIV. If the person is not working or there is no earned income reported for the family, 1 cent per minute is used as the value of time.[15]

The travel and waiting time data were reported in intervals. For purposes of estimation, I used interval midpoints. The highest value (recorded as an open interval) was calculated by smoothing a cumulative distribution function through the interval midpoints and estimating an intercept. The mean value for travel time to the sources of care generally requiring no out-of-pocket money expenditure, TOPDC, was 72.9 minutes in Red Hook and 64.0 minutes in Bedford-Crown. The corresponding mean travel time for private physician visits, TPRIV, which generally required a money payment, was 44.6 minutes for Red Hook and 48.8 for Bedford-Crown. The greater mean value for travel time to "free" sources of care provides preliminary evidence to support the theoretical model developed above; people seem to be substituting time payments for money payments in their demand for care. The mean waiting times from Red Hook are 59.1 minutes for ATOPDC and 73.7 minutes for ATPRIV. Although waiting time appears to be longer at private providers, the total time required to receive free care still exceeds that for non-free care.

The expected effect of the time variables should be clear from the theoretical development. TOPDC and ATOPDC are the own-time prices for OPDC and the cross-time prices for PRIV. They should have a negative effect on utilization at OPDC and a positive effect on PRIV. Similarly, TPRIV and ATPRIV are the own-time prices for PRIV and cross-time prices for OPDC and should act accordingly. The absence of money-price information acts to bias the estimated effect of time prices associated with non-free sources of care. If there is a negative correlation between money prices and time prices, then the absence of money prices in the regression will bias the coefficient on TPRIV upward. This will bias upward (toward zero) the effect of own-time price in the PRIV equation and bias downward the effect of cross-time prices in OPDC.

For a number of reasons, the demand for medical services may be more responsive to changes in travel time than to changes in waiting time. Travel frequently requires a monetary expense that varies with distance or time; distant facilities require a higher (and unobserved) financial payment. Waiting time does not entail this implicit monetary charge. Furthermore, all other things equal, it may be more pleasant to spend a given amount of time waiting than traveling. Both effects lead us to expect a greater elasticity of demand for travel time than for waiting time.

## Income

Earned (EARN) and non-earned (NEARN) income were asked in the survey instrument by household. The mean earned income reported in Red Hook was $4,110 and non-earned income was $920 per year. The earned and non-earned incomes for Bedford-Crown were $4,532 and $1,067, respectively. The theoretical model showed an unambiguously positive non-earned income elasticity of demand for medical services. The model was developed with medical services as only one good. When there are four components for public and private ambulatory and inpatient care, some may act as inferior goods. In particular, there may be a negative income elasticity of demand for OPDC and DAZPUB. The elasticity with respect to earned income was indeterminate because an increase in earned income also increased the opportunity cost of time.

Relatively few problems were encountered in the income measures in this data file. The figures for earned and non-earned income apply to each member of the family. This differs from the procedure used to create the variables CTOPDC, CATOPDC, CTPRIV, and CATPRIV, wherein earned income was attributed only to working members of the family.[16]

## Age

The age term is entered as AGE and $AGE^2$ to allow for nonlinearity in the demand for medical services. The Grossman (1972) formulation suggested a positive correlation between age and the depreciation rate on health. The nonlinear specification allows detection of variations in the depreciation rate through the life cycle. In particular, Acton (1973) suggested that the city's poor population may be experiencing significant depreciation early in life.

### Insurance

The insurance information is coded in categories that are not mutually exclusive. For ambulatory care, I was forced to create a variable, NOAMB, taking the value 1 if the person unambiguously had no ambulatory coverage. In Red Hook, this meant he either had no insurance at all or Medicare without the doctor coverage and without private insurance. In Bedford-Crown, this meant only that there was no coverage at all. For inpatient care, two dummy variables, CAID and CARE, could be created to indicate if the person had Medicaid or Medicare. Ideally, I would have liked to have the specific deductible and coinsurance rates of the person faced at the margin, but this was totally beyond the available data.

NOAMB should have a positive sign in the equation for OPDC and a negative sign in the PRIV equation, if their effects are significant. If we assume that, all other things the same (such as out-of-pocket payment), people would prefer to be in a non-governmental hospital, then CAID and CARE should have a negative sign in the equation for DAZPUB and a positive sign in the DAZPRIV equation. Indeed, it is the popular impression in New York City that the availability of Medicare and Medicaid caused an exodus of patients from city municipal hospitals to the private and voluntary hospitals.

### Health Status

Several measures of health status are available that seem to be equally effective in explaining use.[17] I chose CHRON, the number of chronic health conditions that limit activity, because it was available in both surveys. Other variables that could have been used in one data file or the other include number of days in bed last year; number of days in bed or indoors last year; and self-perceived health status (excellent, good, fair, poor). When I ran regressions with these alternative measures, they all appeared with the anticipated sign and were highly significant ($t$ ratios on the coefficient in excess of 4) and the remaining coefficients were quite stable.

CHRON is expected to appear with a positive sign in all equations. Persons with chronic conditions are more likely to suffer losses to their health stock during the year, making (at least partial) replacement more likely.[18] This is the gross effect of a decrement in health status. It may be that sufficient decrements in health will have a significant income effect, causing a shift to less expensive forms of care. The chief influence of this income effect should be captured in the income coefficients (which is one reason why they will be entered nonlinearly). If a differential effect on health status persists, it will probably be reflected in a greater coefficient in the OPDC and DAZPUB equations than in the other two equations.

### Hospitalization

Days of both public (DAZPUB) and private (DAZPRIV) hospital care were entered in the ambulatory equations to measure decrements in the health stock that occurred during the year. As such, they should act like the health status measures; the more days of hospitalization, the more likely the person is to consume ambulatory care.[19] This should produce positive coefficients on DAZPUB and DAZPRIV in both the OPDC and PRIV equations. In general, those who received public inpatient care should be more likely to consume public than private ambulatory care. Those who received private hospital care are more likely to consume private ambulatory care, other things being equal. At least two factors could lead to a positive coefficient on DAZPRIV in the OPDC equation. First, many people have insurance that covers inpatient care but not outpatient care (Medicare without Part B is an example).[20] These people may seek inpatient care in private hospitals and ambulatory care in public facilities. Second, there may be an income effect of a long hospitalization in a private facility that causes the person to shift to the public sector for his ambulatory care.

### Education

The highest grade completed is coded in years (EDUC). If the hypothesis is correct that more highly educated persons are more efficient producers of health (along with appropriate price elasticities), then there should be a negative coefficient in all four equations. If, on the other hand, more highly educated persons prefer private rather than public providers, then we should have a negative coefficient in the OPDC and DAZPUB equations. The coefficient in the PRIV and DAZPRIV equations would then be biased toward zero because of the offsetting effects of the efficient effect and the preference.

### Race

Two dummy variables, BLACK and PR (Puerto Rican), were created. Since many of the factors expected to affect demand are already entered (particularly, income and health status), the coefficients on these two variables should reflect differences owing to preferences for a particular type of provider or to discrimination faced by members of particular races.

### Sex

A dummy variable, MALE, was created, taking the value 1 if male and zero otherwise. The expectation, based on the aggregate consumption by sex (and ignoring childbearing as the explanation), is that males will be less intensive users of the system. This may, however, reflect a higher opportunity cost of time that is not controlled for in aggregate data; the current test should shed some light on the partial effect of sex, given value of time. An interesting additional hypothesis to test with this data base is that once they become ill, men will tend to remain under care longer (in a public system that does not require a significant monetary payment at the margin) because they have let their health stock deteriorate more than women have. Thus, we may find a positive coefficient on MALE in DAZPUB.

### Household Size

The final variable is household size (HSIZE). All other things being the same, larger households will have a lower income per capita, reducing the demand for care at non-free sources. On the other hand, taking a lifetime view of family decision making, the number of children is an object of choice, making total family income the relevant variable and causing HSIZE to be relatively insignificant.

## 4. ESTIMATION TECHNIQUES AND RESULTS

Before discussing the results of the estimation, let me comment on estimation techniques. Whenever a non-negligible proportion of the observations of the dependent variable takes on an extreme value (either high or low), the assumptions underlying ordinary least squares (OLS) regression break down. Intuitively, the reason is that OLS requires equal variance in the error terms associated with the dependent variable, regardless of the values of the independent variables. When the dependent variable is constrained (say, it must be greater than or equal to zero), then the variance is reduced near zero. Indeed, in this example, we can never consider negative values.

Such is the case in the estimation here; we never consider negative consumption of medical services. Furthermore, a large proportion of the population reports a zero consumption of any one particular type of service. This general problem was addressed by Tobin (1958), who developed a maximum likelihood estimator for such data (called the tobit estimator). The technique estimates an index from which the probability of a non-zero purchase and the expected value of that purchase can be determined, given the explanatory variables. As the data approach the assumptions underlying OLS estimation, the tobit results approach OLS results.

In the theoretical model developed in Section 2, a general utility function was used. For purposes of estimation, I have deliberately not specified a particular utility function in order to put as few restrictions as possible on the results. Instead, I have entered important explanatory variables in linear and quadratic form. The system can be viewed as the first two terms of a Taylor expansion around whatever is the true model.

The results of the tobit estimation are given in tables 1 and 2. For reference, the OLS estimation results are presented in Appendix 2. For reasons just discussed, the tobit estimations receive all our attention. In general, the coefficients presented in tables 1 and 2 are very significant.[21] Furthermore, their signs and relative magnitudes lend support to the theoretical implication derived in Section 2. Since it is difficult to make a quick judgment of the net effect of variables entered in quadratic form, table 3 gives the elasticities of the expected value locus of the four dependent variables with respect to all quadratically estimated explanatory variables, calculated at the mean values.

## The Time Variables

The effects of time can be measured either from table 1, in which travel and waiting times are multiplied by a measure of the opportunity cost of time, or from table 2, in which time is entered in natural units only. As shown in Appendix 3, the elasticity of demand with respect to time equals the elasticity with respect to

## TABLE 1 TOBIT Regression Results with Time Weighted by the Wage Rate (C · Time)

| Independent Variables | Red Hook Dependent Variables | | | | | | | | Bedford-Crown Dependent Variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OPDC [Eq. (1)] | | PRIV [Eq. (2)] | | DAZPUB [Eq. (3)] | | DAZPRIV [Eq. (4)] | | OPDC [Eq. (5)] | | PRIV [Eq. (6)] | | DAZPUB [Eq. (7)] | | DAZPRIV [Eq. (8)] | |
| | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. |
| CHRON | 3.79 | 12.56 | 1.88 | 8.74 | 17.66 | 4.10 | 11.58 | 10.86 | 5.32 | 15.06 | 3.18 | 11.79 | 16.07 | 5.78 | 10.76 | 6.27 |
| EDUC | −.262 | 4.58 | −.0164 | .43 | 1.85 | 1.63 | .441 | 1.81 | −.167 | 2.41 | .121 | 2.49 | −.603 | .85 | 1.29 | 3.20 |
| MALE | −.705 | 1.89 | −1.79 | 7.25 | 5.24 | .70 | −1.32 | .81 | −2.06 | 4.86 | −1.87 | 6.06 | 2.88 | .66 | −8.28 | 3.19 |
| PR | 3.72 | 7.76 | −1.29 | 4.01 | 8.53 | .85 | −.735 | .35 | 4.20 | 3.81 | −4.26 | 5.58 | 16.46 | 1.27 | 9.08 | 1.51 |
| BLACK | 3.66 | 8.29 | −1.27 | 4.38 | 3.73 | .41 | −6.20 | 3.08 | 3.96 | 4.73 | −3.29 | 6.75 | 22.52 | 2.14 | 3.08 | .65 |
| HSIZE | −.369 | 3.71 | −.489 | 7.30 | −.863 | .43 | −1.31 | 2.88 | −.182 | 1.60 | −.194 | 2.30 | .264 | .25 | −.800 | 1.16 |
| AGE | .048 | 1.19 | .039 | 1.41 | .810 | .90 | .484 | 2.46 | .0053 | .10 | .0340 | .90 | 1.92 | 3.02 | .632 | 1.80 |
| AGE2 $\times 10^{-3}$ | −.679 | 1.30 | −.608 | 1.71 | −9.78 | .76 | −6.45 | 2.27 | −.595 | .85 | −.207 | .41 | −25.99 | 2.69 | −8.77 | 1.69 |
| CTOPDC | −.921 | 1.70 | .905 | 2.23 | 29.16 | 2.85 | .176 | .07 | −.895 | 2.65 | −.0171 | .07 | −8.24 | 2.17 | −4.34 | 2.10 |
| CTOPDC2 | .0139 | .25 | −.0698 | 1.85 | −1.76 | 1.71 | −.0458 | .17 | .0722 | 2.99 | −.0074 | .38 | .930 | 3.39 | .126 | .78 |
| CATOPDC | −2.46 | 3.34 | −.515 | .97 | −46.0 | 3.40 | −2.92 | .81 | | | | | | | | |
| CATOPDC2 | .296 | 3.31 | .0562 | .93 | 4.98 | 2.77 | .349 | .80 | | | | | | | | |
| CTPRIV | 1.159 | 3.65 | −.0174 | .09 | 10.73 | 1.12 | 1.20 | .92 | .286 | 1.02 | −.147 | 1.08 | 10.82 | 1.41 | 3.00 | 1.56 |
| CTPRIV2 | −.0374 | 1.87 | .0154 | 1.38 | −1.40 | .94 | −.0304 | .37 | −.0154 | 1.03 | .0051 | 1.37 | −2.85 | 1.65 | −.154 | 1.14 |
| CATPRIV | .743 | 1.86 | −.481 | 2.48 | −10.64 | 1.66 | −2.96 | 2.24 | | | | | | | | |
| CATPRIV2 | −.0626 | 1.55 | .0186 | 1.35 | .408 | .87 | .204 | 2.26 | | | | | | | | |
| NOAMB | −1.19 | 2.60 | −1.28 | 4.25 | | | | | −.416 | .83 | .0324 | .09 | | | | |
| EARN $\times 10^{-3}$ | .236 | 1.82 | .0813 | 1.19 | 2.24 | .72 | .990 | 1.80 | .0020 | .02 | .282 | 3.83 | .795 | .64 | .765 | 1.24 |
| EARN2 $\times 10^{-7}$ | −.312 | 2.96 | .0262 | .61 | −3.24 | 1.01 | −.610 | 1.43 | .0213 | .52 | −.0784 | 2.32 | −1.39 | 1.72 | −.0663 | .27 |
| NEARN $\times 10^{-3}$ | .248 | .82 | .289 | 1.40 | 7.87 | 1.03 | −.667 | .50 | 2.21 | 6.50 | −.824 | 3.22 | .135 | .04 | 4.02 | 1.88 |
| NEARN2 $\times 10^{-7}$ | .0278 | .05 | −.0922 | .24 | −17.56 | 1.05 | 3.55 | 1.57 | −3.20 | 5.19 | .547 | 1.18 | .343 | .06 | −5.96 | 1.53 |
| DAZPUB | .110 | 3.18 | −.0701 | 2.08 | | | | | .131 | 4.47 | .0120 | .45 | | | | |
| DAZPRIV | .221 | 9.14 | .0438 | 2.37 | | | | | .199 | 6.54 | .124 | 5.12 | | | | |
| CARE | | | | | 15.17 | .68 | 11.48 | 2.32 | | | | | .839 | .05 | 11.65 | 1.35 |
| CAID | | | | | 9.08 | .93 | 8.67 | 4.09 | | | | | 15.53 | 2.95 | 9.17 | 2.74 |
| CONST | −4.33 | 5.60 | 1.13 | 2.24 | −189.76 | 10.63 | −48.71 | 13.62 | −9.30 | 8.38 | −1.31 | 1.75 | −147.98 | 10.87 | −84.65 | 12.67 |
| Prob. $Y>\text{limit}$ $\vert X=\overline{X}$ | .2803 | | .4144 | | .0128 | | .0684 | | .2686 | | .3369 | | .0227 | | .0512 | |
| $\text{Chi}^2$ | 724 | | 347 | | 68 | | 258 | | 562 | | 485 | | 117 | | 143 | |
| (d.f.) | (23) | | (23) | | (22) | | (22) | | (19) | | (19) | | (18) | | (18) | |

# TABLE 2 TOBIT Regression Results with Time Entered

| Independent Variables | Red Hook Dependent Variables: OPDC [Eq. (9)] Coef. | t val. | PRIV [Eq. (10)] Coef. | t val. | DAZPUB [Eq. (11)] Coef. | t val. | DAZPRIV [Eq.(12)] Coef. | t val. | Bedford-Crown Dependent Variables: OPDC [Eq. (13)] Coef. | t val. | PRIV [Eq. (14)] Coef. | t val. | DAZPUB [Eq. (15)] Coef. | t val. | DAZPRIV [Eq. (16)] Coef. | t val. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHRON | 3.84 | 12.90 | 1.87 | 8.82 | 16.92 | 3.94 | 11.55 | 10.87 | 5.43 | 15.20 | 3.28 | 12.26 | 16.75 | 5.97 | 10.79 | 6.27 |
| EDUC | −.262 | 4.60 | −.028 | .764 | 2.05 | 1.82 | .428 | 1.77 | −.154 | 2.23 | .0940 | 1.96 | −.599 | .84 | 1.22 | 3.01 |
| MALE | −1.33 | 3.72 | −1.57 | 6.67 | .921 | .13 | −2.33 | 1.48 | −2.19 | 5.24 | −1.91 | 6.30 | 1.26 | .30 | −9.34 | 3.65 |
| PR | 3.44 | 6.93 | −.992 | 3.03 | −1.99 | .20 | −3.38 | 1.53 | 3.92 | 3.56 | −4.06 | 5.34 | 14.60 | 1.12 | 9.46 | 1.57 |
| BLACK | 3.55 | 7.88 | −1.28 | 4.42 | −5.19 | .56 | −7.65 | 3.74 | 3.51 | 4.18 | −2.69 | 5.54 | 20.63 | 1.95 | 4.76 | 1.07 |
| HSIZE | −.287 | 2.94 | −.503 | 7.70 | .274 | .14 | −1.09 | 2.44 | −.132 | 1.17 | −.188 | 2.27 | .521 | .49 | −.646 | .95 |
| AGE | −.005 | .12 | .043 | 1.63 | .376 | .43 | .381 | 1.98 | −.0148 | .29 | .0284 | .79 | 1.79 | 2.84 | .533 | 1.55 |
| AGE2 $\times 10^{-2}$ | −.017 | .33 | −.059 | 1.73 | −.571 | .46 | −.548 | 1.96 | −.0360 | .52 | −.0145 | .30 | −2.47 | 2.55 | −.778 | 1.52 |
| TOPDC | −.197 | 9.34 | .108 | 5.95 | .485 | .96 | .184 | 1.62 | −.201 | 6.69 | .190 | 6.49 | −.889 | 3.35 | −.200 | 1.04 |
| TOPDC2 $\times 10^{-3}$ | .817 | 9.50 | −.447 | 6.02 | −.690 | .36 | −.738 | 1.62 | 1.10 | 7.26 | −1.07 | 7.02 | 4.53 | 3.41 | .859 | .88 |
| ATOPDC | −.201 | 5.01 | .052 | 1.59 | −1.69 | 2.25 | −.263 | 1.31 | | | | | | | | |
| ATOPDC2 $\times 10^{-2}$ | .160 | 4.93 | −.059 | 2.19 | 1.53 | 2.63 | .265 | 1.67 | | | | | | | | |
| TOPRIV | .065 | 4.10 | −.067 | 6.89 | .135 | .41 | .148 | 2.21 | .0469 | 2.57 | −.090 | 7.32 | .264 | 1.38 | −.225 | 2.28 |
| TOPRIV2 $\times 10^{-3}$ | −.239 | 2.62 | .443 | 7.71 | .286 | .16 | −.620 | 1.60 | −.302 | 2.93 | .538 | 7.96 | −1.77 | 1.54 | 1.64 | 3.11 |
| ATPRIV | .029 | 1.19 | −.156 | 10.47 | .438 | .89 | −.279 | 2.80 | | | | | | | | |
| ATPRIV2 $\times 10^{-2}$ | −.009 | .55 | .104 | 10.15 | −.337 | 1.01 | .198 | 2.90 | | | | | | | | |
| NOAMB | −.859 | 1.88 | −1.42 | 4.78 | | | | | −.656 | 1.31 | .257 | .74 | | | | |
| EARN $\times 10^{-3}$ | −.045 | .40 | .110 | 1.95 | −1.89 | 1.12 | .316 | .72 | −.131 | 1.50 | .253 | 4.14 | −.687 | .52 | .173 | .32 |
| EARN2 $\times 10^{-7}$ | −.139 | 1.64 | −.009 | .29 | 1.08 | 1.48 | −.229 | .84 | .0842 | 2.52 | −.084 | 3.23 | −.352 | .36 | −.0252 | .12 |
| NEARN $\times 10^{-3}$ | .210 | .70 | .289 | 1.42 | 6.42 | .87 | −.894 | .67 | 2.07 | 6.03 | −.707 | 2.78 | −.543 | .16 | 3.76 | 1.75 |
| NEARN2 $\times 10^{-6}$ | .024 | .45 | .024 | .66 | −1.38 | .87 | .377 | 1.68 | −.300 | 4.85 | .0266 | .58 | .0910 | .16 | −.608 | 1.55 |
| DAZPUB | .083 | 2.42 | −.041 | 1.24 | | | | | .127 | 4.38 | .0118 | .43 | | | | |
| DAZPRIV | .226 | 9.50 | .043 | 2.38 | | | | | .202 | 6.69 | .122 | 5.09 | | | | |
| CARE | | | | | 16.32 | .74 | 12.33 | 2.50 | | | | | 1.55 | .09 | 12.88 | 1.49 |
| CAID | | | | | 9.06 | .94 | 8.62 | 4.05 | | | | | 15.53 | 2.90 | 8.93 | 2.65 |
| CONST | 7.00 | 3.88 | 1.16 | .88 | −190.99 | 4.97 | −49.31 | 5.74 | −2.40 | 1.32 | −6.73 | 4.39 | −115.63 | 6.16 | −70.59 | 6.27 |
| Prob. $Y>\text{limit} \mid X = \bar{X}$ | .2472 | | .3533 | | .0095 | | .0741 | | .2396 | | .3255 | | .0337 | | .0404 | |
| $\text{Chi}^2$ | 954 | | 679 | | 84 | | 266 | | 618 | | 608 | | 113 | | 148 | |
| (d.f.) | (23) | | (23) | | (22) | | (22) | | (19) | | (19) | | (18) | | (18) | |

## TABLE 3 Elasticities of Expected Value of Dependent Variable, Evaluated at the Mean[a]

| Independent Variables | Red Hook Dependent Variables | | | | | | | | Bedford-Crown Dependent Variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OPDC | | PRIV | | DAZPUB | | DAZPRIV | | OPDC | | PRIV | | DAZPUB | | DAZPRIV | |
| | [Eq. (1)] | t val. | [Eq. (2)] | t val. | [Eq. (3)] | t val. | [Eq. (4)] | t val. | [Eq. (5)] | t val. | [Eq. (6)] | t val. | [Eq. (7)] | t val. | [Eq. (8)] | t val. |
| CTOPDC | −.199 | 2.14 | .185 | 2.26 | 1.427 | 3.14 | .005 | .02 | −.162 | 2.43 | −.011 | .22 | −.445 | 1.73 | −.410 | 2.39 |
| CATOPDC | −.327 | 3.18 | −.083 | .94 | −1.663 | 3.41 | −.186 | .77 | | | | | | | | |
| CTPRIV | .153 | 3.78 | .002 | .06 | .302 | 1.10 | .077 | .97 | .047 | .99 | −.030 | 1.04 | .246 | .86 | .214 | 1.60 |
| CATPRIV | .126 | 1.85 | −.110 | 2.64 | −.550 | 1.76 | −.252 | 2.14 | | | | | | | | |
| EARN | −.014 | .30 | .078 | 2.37 | −.073 | .28 | .152 | 1.60 | .015 | .29 | .172 | 4.10 | −.111 | .56 | .210 | 1.57 |
| NEARN | .037 | 1.16 | .046 | 1.84 | .177 | .93 | −.001 | .01 | .251 | 6.60 | −.136 | 4.06 | .012 | .09 | .193 | 1.90 |
| AGE | .049 | .74 | .028 | .55 | .312 | .87 | .273 | 1.97 | −.096 | 1.20 | .107 | 1.67 | .821 | 2.98 | .315 | 1.56 |
| | OPDC | | PRIV | | DAZPUB | | DAZPRIV | | OPDC | | PRIV | | DAZPUB | | DAZPRIV | |
| | [Eq. (9)] | t val. | (Eq. (10)) | t val. | [Eq. (11)] | t val. | [Eq. (12)] | t val. | [Eq. (13)] | t val. | [Eq. (14)] | t val. | [Eq. (15)] | t val. | [Eq. (16)] | t val. |
| TOPDC | −.958 | 8.08 | .640 | 5.14 | 1.241 | 1.64 | .415 | 1.45 | −.619 | 4.56 | .629 | 4.16 | −.994 | 2.65 | −.394 | 1.06 |
| ATOPDC | −.120 | 1.12 | −.202 | 1.82 | .301 | .61 | .224 | .91 | | | | | | | | |
| TPRIV | .332 | 5.08 | −.252 | 5.28 | .316 | .87 | .310 | 2.55 | .137 | 1.83 | −.337 | 5.82 | .224 | .93 | −.216 | 1.25 |
| ATPRIV | .196 | 2.73 | −.050 | .94 | −.193 | .48 | .070 | .53 | | | | | | | | |
| EARN | −.110 | 2.54 | .086 | 2.73 | −.182 | .82 | .039 | .47 | −.040 | .86 | .147 | 4.08 | −.229 | 1.39 | .046 | .38 |
| NEARN | .039 | 1.16 | .046 | 1.68 | .158 | .79 | −.014 | .20 | .244 | 6.13 | −.128 | 3.75 | −.019 | .15 | .180 | 1.69 |
| AGE | −.064 | .95 | .057 | 1.07 | .077 | .21 | .166 | 1.26 | −.133 | 1.65 | .098 | 1.47 | .695 | 2.74 | .243 | 1.20 |

[a] The $t$ values test the significance of the above at the mean.

time weighted by the opportunity cost of time. There are likely to be biases in each set of coefficients such that the true elasticities with respect to time prices are greater in absolute value than those estimated. Consider first the specification with time weighted by the opportunity cost of time (table 1). Since the opportunity cost of time had to be imputed to nonworking persons and is not entirely precise even for working persons, the wage rate is measured with error. This error will bias the coefficients on the time variables in table 1 toward zero. Thus, the true elasticities will be greater (in absolute value) than those implied by the first specification. Consider the alternative specification employing time in natural units (table 2). In light of the model developed in Appendix 3, $w \cdot t$ is the correct variable, so that regressions employing $t$ alone constitute an omitted variable bias. If $w$ and $t$ are negatively correlated (as seems reasonable), the coefficients estimated in Table 2 will also be biased toward zero.[22] In general, the elasticities implied by the coefficients in table 2 exceed in absolute value those implied by table 1, suggesting that the bias resulting from the error in measuring the opportunity cost of time is greater than the bias caused by omitting it from the specification. I shall discuss both specifications; almost all the remaining coefficients are quite stable between tables 1 and 2. The chief exceptions are the income coefficients—which are discussed in the next subsection—but even so, their elasticities are reasonably stable. The other apparent instabilities (PR and BLACK in the DAZPUB equations) reflect coefficients that were not significantly different from zero in either specification. Since both sets of estimated elasticities understate the true elasticity, I will concentrate on the generally larger ones implied by table 2.

Let us first concentrate on the travel time-price elasticities for ambulatory care using time in natural units. The elasticities are given in table 4. In this table we find support for many of the hypotheses generated in Section 2. Travel time is indeed functioning as a normal price, producing negative own-time/price elasticities and positive cross-time/price elasticities. Furthermore, the magnitude of the own-time/price elasticities exceeds that of own-money/price elasticities reported by other researchers. Using disaggregated data from several sources, Phelps and Newhouse (1973) derive money-price elasticities for private care on the order of −0.15 in the range of 25 per cent to 0 per cent coinsurance—well below (in absolute value) the −0.25 to −0.337 estimated here for private care and −0.6 to −1.0 estimated for public care. Even using the much higher elasticities for all ambulatory care of between −0.5

**TABLE 4 Travel Time-Price Elasticities for Ambulatory Care [equations (9), (10), (13), and (14)]**

| | Red Hook | | Bedford-Crown | |
|---|---|---|---|---|
| | TOPDC | TPRIV | TOPDC | TPRIV |
| OPDC | −.958 | .332 | −.619 | .137 |
| PRIV | .640 | −.252 | .629 | −.337 |

and −1.0 reported by Rosett and Huang (1971), Feldstein (1971), and Davis and Russell (1972), the travel-time elasticities appear to be of at least a comparable size.

The hypotheses developed above also suggested that demand should be more responsive to changes in TOPDC than to changes in TPRIV—which is the case. In both Red Hook and Bedford-Crown, the own-travel time-price elasticities with respect to TOPDC exceed those for TPRIV by a factor of two or three times. Similarly, the cross elasticities for TOPDC are significantly greater than those for TPRIV. The elasticities calculated for the C·TIME variables support the conclusions drawn for the TIME variables above. Found in table 3 are negative own-price elasticities, positive cross-price elasticities, and larger responses to CTOPDC and CTPRIV. The one exception is Equation (6), in which there is a negative cross-time/price elasticity of demand for PRIV with respect to CTOPDC.

The effect of waiting time is similar to travel time as a determinant of demand. But, as predicted, the elasticities with respect to waiting time are smaller (in absolute value) than the elasticities with respect to travel time. The own-waiting time-price elasticities of demand for OPDC and PRIV are −0.120 for ATOPDC and −0.050 for ATPRIV. The cross elasticities are 0.196 for ATPRIV and −0.202 for ATOPDC. The last figure, giving a negative cross-price elasticity of demand for PRIV with respect to ATOPDC, is the only violation of the theoretical implications developed above.[23] Otherwise, waiting time also functions as a normal price, with demand being more responsive to changes in waiting time at OPD's and clinics than it is to waiting times at private physicians' offices.

We can draw some limited inferences about the effect of time prices on the demand for inpatient care. We do not have a direct measure of the time prices associated with hospitalization. The effects of travel and waiting times for outpatient care should be interpreted primarily as cross prices to inpatient care—the more time one must spend getting ambulatory care, the more likely one should be to demand inpatient care. To a limited degree, we may wish to consider TOPDC as a measure of travel time to public hospitals—the DAZPUB variable—because all municipal OPD's are located in a hospital. In Red Hook equations (3), (4), (11), and (12), inpatient and outpatient care seem to be operating as substitutes. The longer one must wait for ambulatory care, the more likely one is to use inpatient care. The opposite appears to be true in Bedford-Crown. It is not clear why this difference exists at this level of analysis, but it may be compatible with the hypothesis that residents of Bedford-Crown are seeking care only for the more serious health conditions, and in those cases, inpatient and outpatient care are complements.[24]

## Income

The theoretical model predicted that the elasticity of demand for all forms of medical services with respect to non-earned income should be positive unless public care is an inferior good, in which case the elasticity is negative in OPDC and DAZPUB. The sign of the elasticity with respect to earned income was indeterminate because of offsetting effects of income and the time price, although I suggested that it should be lower for free sources than for non-free sources of care. Broadly speaking, the empirical results in table 3 support these hypotheses. With few exceptions, a positive elasticity with respect to non-earned income was found in all equations. With respect to earned income, a generally positive elasticity was found for private care and a negative elasticity for public care. There is little evidence to support the hypothesis that public care is an inferior good (that is, that the elasticity of demand for OPDC and DAZPUB with respect to NEARN is negative). Although the signs of the income elasticities are reasonably stable between Red Hook and Bedford-Crown, the size varies and the whole set of findings must be regarded as provisional.

A word on alternative specification of the equations is in order. Instead of using earned and non-earned income as explanatory variables, I also estimated the entire set of equations using only total income—entered as income and income squared.[25] This alternative specification was used because I thought there might be a high degree of collinearity between EARN and NEARN and the waiting and travel time variables, especially when they were weighted by earned income. This alternative specification left the remaining coefficients virtually unchanged (to the third decimal place) and the significance of INC and INC2 was roughly the same as either EARN and EARN2 or NEARN and NEARN2. The other point worth mentioning about alternative specifications is the effect of the C·TIME versus the TIME variables on the income elasticities. Although the EARN elasticities vary somewhat, the elasticities with respect to NEARN are identical in the two specifications.

In Red Hook, there is substantial support for the hypothesis that medical services are normal goods, producing an elasticity of demand with respect to non-earned income of about 0.04 or 0.05 for ambulatory care and 0.16 for inpatient care.[26] The elasticities with respect to earned income are positive for private sources of care and negative for public sources, supporting the suggestion that they should be smaller for the free sources of care because a change in the wage rate has a greater price effect in demand for free care. In net, the price effect of a wage change dominates in the demand for public care and the income effect dominates in the demand for private care.

The Bedford-Crown results produce elasticities somewhat less in conformity with the predictions of the model and there are two sign reversals of corresponding elasticities between the C·TIME and TIME specifications. I will discuss only aberrations from the picture just described for Red Hook. In equations (6) and (14), there is a negative non-earned income elasticity of demand for private physician care that appears robust, suggesting that public care is a normal good and private ambulatory care is an inferior good. When I discuss the effects of race on demand for care, there is some suggestion of discrimination, and part of the effect may appear here. The two sign reversals occur for earned income in equations (5) and (13) and for non-earned income in equations (7) and (15). The latter may be explained by the critical point lying near the mean of the data, but the former is not so easily accounted for.

Otherwise, the general pattern of effects of income on demand for care that was reported in Red Hook holds in Bedford-Crown. The only support in either set of regressions for the hypothesis that public care is an inferior good is in Equation (15), in which the non-earned income elasticity of demand for DAZPUB is −0.019.[27]

From the estimated elasticities with respect to non-earned income we can calculate the approximate magnitude of the full wealth elasticity. The full wealth elasticity equals the non-earned income elasticity multiplied by the increase of the share of full wealth attributable to non-earned income.[28] Let full earned income ($wT$) be the earning of a person employed full time and assume that all employed persons are working full time.[29] Then the implied full wealth elasticity of demand is 0.202 for OPDC and 0.251 for private care in Red Hook.[30]

In discussing the remaining effects, I will concentrate on the specification with the time variables in natural units, equations (9)–(16).

## Age

The human capital formulation predicts a positive correlation of the demand for care and rate of depreciation on the health stock (if the price elasticity of demand for health is less than 1). We can infer where in the life cycle depreciation is greatest by examining the age coefficients. The age curve is either monotonically decreasing (equations (9) and (13)) or is an inverted U shape (equations (10), (11), (12), (15), and (16) all peak between thirty-two and thirty-six years). Both patterns support the conclusion that there are substantial decrements in health early in life for these populations. The only curve that is monotonically rising is the demand for private physician care in Bedford-Crown (equation (14)), and its coefficients are not significantly different from zero.

## Insurance

The greatest effect of insurance is seen in the demand for hospital care. In all cases, the estimated coefficients are positive, although the coefficients in the DAZPUB equations (equations (3), (7), (11), and (15)) are not statistically significantly different from zero in general. The significant effects support the popular image that Medicare and Medicaid caused an increase in the demand for private hospitalization. We cannot conclude, however, that this lowers demand for public hospital care (which should have produced significant negative coefficients in the DAZPUB equations). The picture with respect to insurance for ambulatory care is less certain, no doubt because of the imprecise definition of the explanatory variable NOAMB. The only statistically significant results (at 5 per cent or lower, equations (2) and (10)) show people with no ambulatory insurance demanding less care from private physicians.

## Hospitalization

By and large, people who reported being hospitalized were likely to be users of ambulatory facilities. As suggested, people who reported public hospitalization were more likely to use public ambulatory care than private ambulatory care (the coefficients for DAZPUB in the PRIV equations (2), (6), (10), and (14) were either negative or not significantly different from zero). Those who reported private hospitalization were significantly more likely to use both public and private ambulatory care.

## Health Status

The health status variables are the most consistently significant predictors of demand for care. Greater numbers of chronic health conditions produce higher utilization of all forms of medical services (with $t$ ratios ranging from 4 to over 16). We suggested that poorer health stock might produce an income effect, causing greater demand for free than for non-free care from those with chronic conditions. The evidence is consistent with this hypothesis.[31]

## Education

It was postulated that if educated persons were more efficient producers of health and the price elasticity of health is less than 1, then the coefficient on education would be negative. On the other hand, those with higher education might have developed a taste for more health services, particularly non-free services. The two effects together should yield a negative coefficient on EDUC in the OPDC and DAZPUB equations and coefficients biased upward in PRIV and DAZPRIV. This pattern is found in the estimated demand for ambulatory care. There is a significant negative coefficient on education in the demand for OPDC and clinic services. The mixed effect of efficiency and taste is shown by coefficients biased upward in equations (2), (6), (10), and (14). In the demand for inpatient care, education has a positive effect in all but one case, when its $t$ value is 0.84.

## Race

Generally, the coefficients on the race variables are very significant for ambulatory care but not significant for inpatient care. The relations are compatible with an interpretation that blacks and Puerto Ricans either have an aversion to private care or that they face discrimination in private ambulatory care. There are significant negative coefficients on both BLACK and PR in the PRIV equations and significant positive coefficients in OPDC. There is a definite substitution of public for private care, all other things held constant. The coefficients in the hospital equations are less significant, but when their $t$ value exceeds 1.96 they support the conclusion of substituting public for private care.

### Sex

Gross consumption figures lead us to expect a negative coefficient on the dummy variable for MALE in all demand equations. The possible exception would be a positive (or at least greater) coefficient in the DAZPUB equation if men had let their health stock deteriorate more and thus, once hospitalized, would be confined longer. These two expectations are supported in all the estimated relations, although the positive coefficient in the DAZPUB equations is not significantly different from zero.

### Household Size

Finally, all other things held the same, HSIZE should produce a negative coefficient in paid sources of care. For reasons that are not entirely clear, there is also frequently a negative coefficient on HSIZE in the public sources of care. It may be that the larger family size is increasing the opportunity cost of everyone's time (especially that of the parents) and thus reducing all use of services.

## 5. CONCLUSION AND SELECTED POLICY IMPLICATIONS

### Conclusion

The objective of this study was to measure the major factors influencing demand for medical services. In particular, we were looking for a mechanism that might replace money prices in determining demand as money price out of pocket diminished. There was considerable theoretical and empirical support for the suggestion that time prices would fill that role. Travel and waiting time appear to be operating as normal prices, producing a negative own-price elasticity and a positive cross-price elasticity of demand for medical services. As predicted, elasticities were greater with respect to times associated with free care than with times associated with non-free care. The magnitude of the own-elasticity with respect to travel time is −0.6 to −1.0 for public outpatient care and between −0.25 and −0.34 for private outpatient care. These elasticities are significantly greater than the money-price elasticities of about −0.15 over the range 0 to 25 per cent coinsurance reported by Phelps and Newhouse (1972) for a Palo Alto group and equal or exceed the higher values reported by Feldstein (1971), Davis and Russell (1972), and Rosett and Huang (1973). The estimated elasticities with respect to travel time weighted by earnings are in the order of −0.15 to −0.2 for OPDC care and nearly zero for private care but, as discussed, these estimates are biased significantly toward zero. Furthermore, as predicted, demand is more sensitive to changes in travel time than to changes in waiting time, producing elasticities several times as large for travel as for waiting time. The conclusion is clear that time is already functioning as a rationing device for demand in this New York population, and its importance seems to exceed that of money prices.

From the theoretical model, we derived a prediction of positive elasticity of demand with respect to non-earned income. A picture of mixed statistical significance was found, but when significant, elasticities were around 0.04 to 0.05 for ambulatory care and 0.15 to 0.20 for inpatient care. The sign of the earned income elasticity of demand could not be predicted *a priori* because of the offsetting income and price effects of a wage change, but a change in the wage rate was expected to act more like income effect on the demand for non-free care. In fact, negative elasticities were found for free care and positive elasticities for non-free care, roughly of the same absolute magnitude as the non-earned income elasticities.

## Selected Policy Implications

A number of policy considerations are suggested by the significant elasticities found for time prices and earned and non-earned income. The most important involves the distribution of medical services as out-of-pocket monetary expenses are reduced, either because of continued spread of health insurance or because of the enactment of some federal health insurance scheme. Persons with a lower opportunity cost of time will take more advantage of a reduction of out-of-pocket monetary costs than those with higher opportunity cost of time because their time prices are lower. This conclusion holds even with no differential subsidy of monetary costs and no supply response to an increase in demand. Moreover, there is likely to be a supply response to a shift in demand that increases the time needed to receive medical services (increased waiting time or perhaps increased travel time owing to more referrals).[32] This will increase further the relative shift in favor of those with lower opportunity cost of time (although the increase in the vector of time prices will reduce aggregate demand over what it would be with no supply response). In any case, the general effect of a reduction in personal monetary prices will be to shift the distribution of medical services.

Among the important additional policy considerations, if one wishes to increase aggregate demand for services, are shortening travel time to medical facilities, shortening waiting time, and considering the degree to which income subsidies might be substituted for subsidized purchase of medical services.

## Clinic Location

A significant own-time/price elasticity of demand was found for outpatient department and clinic services with respect to travel time. A number of policy options are available to the government for altering travel time, ranging from improved transportation facilities to the building of new clinics and health centers. The travel time elasticities show that moving centers "closer" in time will increase the demand for care at those centers. For instance, when the city, OEO, or another agency is thinking about opening a new clinic to serve a target population, it may want to consider building a number of smaller clinics that are substantially closer, on the average, to the individuals, rather than building one large clinic to serve the population.[33] Faster means of transportation to more distant facilities may achieve the same goal. This observation should not be interpreted as a recommendation to create more clinics or to create smaller clinics. Obviously the decision rests on a number of factors, such as the cost of building centers of various sizes, the benefit of serving additional persons, and the alternative means of achieving the same goals. One alternative means of achieving the goal of increased service is to reduce waiting time in existing and new facilities.

### Shorter Queues

There are two points to consider about waiting time and the demand for care. First, it is a popular impression that patients have to wait considerably longer in outpatient departments of hospitals than in private physicians' offices. The reported waiting times for 1968 show that, for this population, mean waiting time was less at OPD's and clinics than in private physicians' offices. The second point, however, is that longer waiting times do discourage use, and mechanisms that reduce waiting time should increase use. For instance, appointments rather than unscheduled visits in OPD's might prove successful in reducing waiting time. This implication is not limited to the city. Many hospitals across the nation use a system of giving all the patients a morning appointment (say 9:00) or an afternoon appointment (say 1:30). If this algorithm results in a wait, on the average, of ninety minutes and an alternative scheduling (say appointments on the hour for 9, 10, or 11) reduces the average wait to thirty minutes, the elasticities reported in table 3 suggest that this will increase demand approximately 12 per cent.[34]

### Tradeoffs of Subsidized Care and Income Supplements

Many people have expressed concern over the level of medical services consumed by the poor and conclude that a variety of measures are needed to improve access. In one form or another, most boil down to a subsidized provision of services, whether through social insurance schemes such as Medicaid or various national health insurance proposals, or through direct provision of care as in neighborhood health centers or the requirement that Hill-Burton hospitals provide charity care. Seldom considered is the extent to which changing the income distribution will meet the desire to subsidize the medical purchase (Davis, 1972).

The equations reported in tables 1 and 2 put us in a position to address this question of substituting income maintenance for subsidized medical care to achieve a given increase in health consumption. Although it will not meet the objective of risk spreading, income maintenance will increase aggregate medical care demand for the poor. Since income maintenance is a non-earned source of income, the elasticity of demand for medical care with respect to changes in non-earned income is used.[35] Two of the prominent health insurance proposals, the administration's comprehensive health insurance proposal (CHIP) and the Kennedy-Mills bill, have similar income-related coinsurance features and demonstrate the tradeoff with income maintenance. The Red Hook results in table 3 indicate that a $1,000 increase in non-earned income for a family with a current (1968) non-earned income of $450 and earned income of about $4,100 will produce a 6.3 per cent increase in the demand for private practitioners' care per member. This change is probably a lower bound on the increase, since the non-earned income elasticity may be biased downward by a transitory component. If the money-price elasticity of demand for ambulatory medical services is around −0.15 over the range under consideration,[36] and the out-of-pocket expenditure is reduced from 25 per cent of money price to 15 per cent (the upper limit on CHIP's coinsurance rate and the rate for a family with income of $2,500–5,000), then the demand for private care will increase by 8 per cent. Clearly, one means of achieving the objective of increased aggregate medical consumption by the poor is income supplementation, and the magnitude of the change may be very comparable over the range of subsidy and income guarantee under consideration.

## APPENDIX 1

### Definitions of Variables Used and Their Mean Values[37]

| | | |
|---|---|---|
| AGE | = | Age in years. Means = (27.3, 25.2). |
| AGE2 | = | $AGE^2$. Means = (1,200, 1,006). |
| ATOPDC | = | Waiting time, on the average, at municipal outpatient departments (MDOPD) or free-standing clinics (CLIN), in minutes. Available for Red Hook only. Mean = (59.1). |
| ATOPDC2 | = | $ATOPDC^2$. Mean = (3,717). |
| ATPRIV | = | Waiting time, on the average, in a private physician's office, in minutes. Available for Red Hook only. Mean = (73.7). |
| ATPRIV2 | = | $ATPRIV^2$. Mean = (6,530). |
| BLACK | = | Dummy variable equaling 1 if Negro or indeterminate, or other than Puerto Rican, Mexican-American, American Indian, or other white. Means = (0.30, 0.84). |

| | | |
|---|---|---|
| CAID | = | One if the person has Medicaid coverage and is under 65 years of age; zero otherwise. Means = (0.32, 0.36). |
| CARE | = | One if person has Medicare coverage; zero otherwise. Means = (0.07, 0.04). |
| C·TIME | = | For all time variables prefixed by C it is the corresponding variable without the prefix C multiplied by the opportunity cost of time. The opportunity cost of time is measured by the earnings per minute of family workers if the individual is working and is set to 1 cent per minute if the individual is not working or if there is no reported earned income for the family. |
| CATOPDC | | Mean = ($1.17). |
| CATOPDC2 | | Mean = ( 3.61). |
| CATPRIV | | Mean = ($1.39). |
| CATPRIV2 | | Mean = ( 5.32). |
| CTOPDC | | Means = ($1.42, $1.57). |
| CTOPDC2 | | Means = ( 5.46, 6.66). |
| CTPRIV | | Means = ($0.88, $1.24). |
| CTPRIV2 | | Means = ( 2.98, 6.76). |
| CHRON | | Number of reported chronic health conditions that limit activity. Means = (0.20, 0.21). |
| DAZPRIV | = | Number of days hospitalized in last year in a nongovernmental hospital. Means = (1.07, 0.69). |
| DAZPUB | = | Number of days hospitalized in last year in a city or other governmental hospital. Mean = (0.30, 0.50). |
| EARN | = | Earned family income in last year. Means = ($4,110, $4,532). |
| EARN2 | = | $EARN^2$. Means = (35388091, 45129544). |
| EDUC | = | Highest grade completed, in years. Means = (6.8, 7.3). |
| HSIZE | = | Number of persons in individual's household. Means = (4.7, 4.3). |
| MALE | = | One if male, zero if female. Means = (0.46, 0.44). |
| NEARN | = | Non-earned family income in last year. Means = ($920, $1,067). |
| NEARN2 | = | $NEARN^2$. Means = (3326386, 3996932). |

| | |
|---|---|
| NOAMB | = One if the person unambiguously has no insurance coverage for ambulatory care; zero otherwise. Means = (0.21, 0.23). |
| OPDC | = Number of visits in last year to a physician in outpatient department of a municipal hospital or to a clinic not connected to a hospital. Means = (1.68, 1.46). |
| PR | = One if Puerto Rican; zero otherwise. Means = (0.26, 0.07). |
| PRIV | = Number of visits in last year to a physician in his private office. Means = (1.83, 1.56). |
| TOPDC | = Travel time, on the average, to and from municipal outpatient department or free-standing clinic, in minutes. Means = (72.9, 64.0). |
| TOPDC2 | = $TOPDC^2$. Means = (6,085, 4,424). |
| TPRIV | = Travel time, on the average, to and from private physician's office (PRIV), in minutes. Means = (44.6, 48.8). |
| TPRIV2 | = $TPRIV^2$. Means = (3,096, 3,521). |

# APPENDIX 2

## Results of Ordinary Least Squares Estimation

### TABLE 1 OLS Regression Results with Time Weighted by the Wage Rate (C·Time)

| Independent Variables | Red Hook Dependent Variables | | | | | | | | Bedford-Crown Dependent Variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OPDC | | PRIV | | DAZPUB | | DAZPRIV | | OPDC | | PRIV | | DAZPUB | | DAZPRIV | |
| | Coef. | t val. | Coef. | t val. | Coef. | t val. | Coef. | t val. | Coef. | t val. | Coef. | t val. | Coef. | t val. | Coef. | t val. |
| CHRON | 2.27 | 17.27 | 1.37 | 11.22 | .495 | 4.65 | 2.70 | 17.30 | 2.52 | 17.71 | 1.95 | 14.43 | 1.08 | 6.80 | 1.14 | 7.42 |
| EDUC $\times 10^{-2}$ | −10.02 | 4.53 | −.262 | .128 | .783 | .413 | 4.24 | 1.53 | −4.62 | 1.91 | −1.27 | .550 | −3.58 | 1.26 | .0317 | 1.16 |
| MALE | −.137 | .949 | −.709 | 5.30 | .471 | 3.93 | .182 | 1.03 | −.259 | 1.72 | −.575 | 4.02 | .503 | 2.97 | −.0313 | .190 |
| PR | .556 | 2.96 | −.557 | 3.19 | .0803 | .497 | −.157 | .664 | .0829 | .220 | −1.33 | 3.73 | .552 | 1.29 | .672 | 1.62 |
| BLACK | .622 | 3.65 | −.473 | 3.00 | −.0348 | .240 | −.502 | 2.37 | .260 | .996 | −1.09 | 4.38 | .352 | 1.19 | .304 | 1.06 |
| HSIZE | −.076 | 1.99 | −.186 | 5.25 | −.062 | 1.94 | −.087 | 1.85 | −.0740 | 1.83 | −.028 | .724 | .087 | 1.88 | −.004 | .0903 |
| AGE | .062 | 3.85 | .0162 | 1.08 | .0112 | .711 | −.0179 | .772 | .0394 | 2.08 | .042 | 2.34 | .048 | 1.96 | .024 | .998 |
| AGE2 $\times 10^{-3}$ | −.818 | 3.92 | −.113 | .584 | −.0673 | .288 | .301 | .878 | −.540 | 2.13 | −.425 | 1.76 | −.418 | 1.14 | −.236 | .663 |
| CTOPDC | .124 | .565 | .081 | .399 | .621 | 3.41 | −.175 | .654 | −.246 | 2.09 | .062 | .552 | −.167 | 1.26 | −.148 | 1.15 |
| CTOPDC2 $\times 10^{-2}$ | −1.88 | .941 | −.247 | .133 | 4.41 | 2.65 | 1.17 | .482 | 1.65 | 1.77 | −.081 | .092 | 1.43 | 1.37 | .186 | .184 |
| CATOPDC | −.712 | 2.45 | −.053 | .196 | −.619 | 2.56 | .243 | .685 | | | | | | | | |
| CATOPDC2 $\times 10^{-1}$ | .716 | 2.20 | .0422 | .140 | .653 | 2.41 | −.192 | .483 | | | | | | | | |
| CTOPRIV | .224 | 1.99 | .135 | 1.30 | −.102 | 1.09 | .112 | .818 | .051 | .709 | −.153 | 2.25 | −.0276 | .344 | .0716 | .921 |
| CTOPRIV2 $\times 10^{-2}$ | −.854 | 1.24 | .139 | .217 | .313 | .544 | −.500 | .592 | −1.76 | .872 | .289 | 1.51 | −.024 | .105 | −.152 | .493 |
| CATPRIV | −.0020 | .017 | −.151 | 1.38 | −.197 | 2.01 | −.265 | 1.85 | | | | | | | | |
| CATPRIV2 $\times 10^{-2}$ | .0857 | .102 | .319 | .408 | .811 | 1.15 | 1.51 | 1.46 | | | | | | | | |
| NOAMB | −.234 | 1.35 | −.434 | 2.69 | | | | | .0647 | .369 | .012 | .071 | | | | |
| EARN $\times 10^{-4}$ | .0264 | .065 | .590 | 1.56 | −.075 | .221 | .0027 | .0053 | .0581 | .160 | 1.11 | 3.20 | .366 | .876 | .640 | 1.58 |
| EARN2 $\times 10^{-8}$ | −.151 | .577 | −.185 | .762 | .0737 | .338 | −.0596 | .186 | .0274 | .170 | −.309 | 2.01 | −.166 | .912 | −.084 | .473 |
| NEARN $\times 10^{-4}$ | 1.13 | .946 | .834 | .753 | 1.89 | 1.82 | −2.00 | 1.31 | 7.16 | 5.98 | −.277 | .244 | 1.24 | .883 | 2.89 | 2.12 |
| NEARN2 $\times 10^{-8}$ | −1.34 | .627 | −.153 | .077 | −2.07 | 1.14 | 4.31 | 1.62 | −10.73 | 5.18 | .075 | .038 | −2.35 | .992 | −4.48 | 1.95 |
| DAZPUB | .0299 | 1.80 | −.0278 | 1.81 | | | | | .059 | 4.52 | .0086 | .687 | | | | |
| DAZPRIV | .135 | 11.95 | .0285 | 2.72 | | | | | .0961 | 7.11 | .0898 | 6.99 | | | | |
| CARE | | | | | −.304 | .722 | .464 | .754 | | | | | −1.18 | 1.81 | .715 | 1.13 |
| CAID | | | | | .062 | .387 | .534 | 2.26 | | | | | .293 | 1.27 | .293 | 1.31 |
| CONST | 1.48 | 5.02 | 2.60 | 9.52 | .035 | .141 | .918 | 2.53 | .782 | 2.08 | 1.66 | 4.65 | −1.16 | 2.72 | −.780 | 1.89 |
| $R^2$ | .1316 | | .0647 | | .0128 | | .0734 | | .1187 | | .0866 | | .0165 | | .0190 | |

## TABLE 2 OLS Regression Results with Time Entered

| Independent Variables | Red Hook Dependent Variables | | | | | | | | Bedford-Crown Dependent Variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OPDC | | PRIV | | DAZPUB | | DAZPRIV | | OPDC | | PRIV | | DAZPUB | | DAZPRIV | |
| | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. | Coef. | *t* val. |
| CHRON | 2.27 | 17.40 | 1.34 | 11.17 | .476 | 4.50 | 2.69 | 17.26 | 2.53 | 17.81 | 1.98 | 14.71 | 1.08 | 6.83 | 1.14 | 7.43 |
| EDUC | −.099 | 4.53 | −.0076 | .378 | .011 | .562 | .042 | 1.52 | −.045 | 1.86 | −.020 | .853 | −.036 | 1.29 | .026 | .955 |
| MALE | −.289 | 2.09 | −.618 | 4.84 | .409 | 3.54 | .144 | .845 | −.304 | 2.05 | −.586 | 4.17 | .462 | 2.77 | −.068 | .422 |
| PR | .386 | 1.99 | −.472 | 2.64 | −.143 | .862 | −.358 | 1.46 | .047 | .126 | −1.22 | 3.42 | −.516 | 1.21 | .693 | 1.67 |
| BLACK | .505 | 2.92 | −.482 | 3.02 | −.200 | 1.36 | −.585 | 2.70 | .210 | .800 | −.893 | 3.58 | .319 | 1.07 | .371 | 1.29 |
| HSIZE | −.055 | 1.46 | −.186 | 5.36 | −.054 | 1.73 | −.080 | 1.72 | −.061 | 1.53 | −.027 | .704 | .093 | 2.04 | .0047 | .106 |
| ACE | .048 | 3.09 | .018 | 1.25 | .0047 | .303 | −.022 | .959 | .0302 | 1.65 | .039 | 2.28 | .043 | 1.77 | .020 | .852 |
| ACE2 $\times 10^{-3}$ | −.680 | 3.36 | −.112 | .600 | −.022 | .095 | .326 | .960 | −.432 | 1.75 | −.396 | 1.69 | −.365 | 1.00 | −.205 | .582 |
| TOPDC | −.046 | 4.90 | .028 | 3.20 | .0055 | .710 | .0094 | .821 | −.052 | 4.23 | .0434 | 3.72 | −.037 | 2.66 | −.0051 | .376 |
| TOPDC2 $\times 10^{-3}$ | .217 | 5.69 | −.119 | 3.37 | .037 | 1.16 | −.043 | .906 | .286 | 4.59 | −.237 | 4.00 | .151 | 2.14 | .033 | .481 |
| ATOPDC | −.046 | 2.56 | .017 | 1.05 | −.031 | 2.05 | −.012 | .551 | | | | | | | | |
| ATOPDC2 $\times 10^{-3}$ | .348 | 2.42 | −.175 | 1.32 | .323 | 2.68 | .196 | 1.11 | | | | | | | | |
| TOPRIV $\times 10^{-1}$ | .133 | 2.22 | −.178 | 3.21 | .0031 | .061 | .202 | 2.74 | −.0060 | .094 | −.300 | 4.96 | −.0036 | .050 | −.085 | 1.22 |
| TOPRIV2 $\times 10^{-4}$ | −.404 | 1.13 | 1.49 | 4.53 | −.114 | .383 | −1.08 | 2.48 | −.083 | .235 | 1.68 | 5.02 | .124 | .312 | .692 | 1.79 |
| ATPRIV $\times 10^{-2}$ | .624 | .688 | −5.90 | 7.24 | .319 | .421 | −2.13 | 1.91 | | | | | | | | |
| ATPRIV2 $\times 10^{-4}$ | −.234 | .378 | 3.89 | 6.84 | −.355 | .689 | 1.33 | 1.75 | | | | | | | | |
| NOAMB | −.151 | .876 | −.474 | 2.97 | | | | | .027 | .157 | .089 | .536 | | | | |
| EARN $\times 10^{-4}$ | −.588 | 1.73 | .531 | 1.69 | −.283 | .992 | −.191 | .455 | −.376 | 1.23 | .962 | 3.31 | −.0434 | .122 | .446 | 1.30 |
| EARN2 $\times 10^{-8}$ | .157 | .836 | −.147 | .845 | .168 | 1.07 | −.0037 | .016 | .188 | 1.48 | −.284 | 2.35 | −.0083 | .058 | −.105 | .748 |
| NEARN $\times 10^{-4}$ | .953 | .801 | .675 | .614 | 1.94 | 1.87 | −1.94 | 1.27 | 6.59 | 5.50 | −.039 | .034 | 1.15 | .818 | 2.81 | 2.06 |
| NEARN2 $\times 10^{-8}$ | −.763 | .358 | −.609 | .310 | −1.89 | 1.04 | 4.37 | 1.64 | −10.10 | 4.88 | −.628 | .320 | −2.29 | .964 | −4.58 | 1.99 |
| DAZPUB | .021 | 1.28 | −.018 | 1.20 | | | | | .058 | 4.45 | .0102 | .826 | | | | |
| DAZPRIV | .136 | 12.12 | .029 | 2.68 | | | | | .097 | 7.16 | .088 | 6.90 | | | | |
| CARE | | | | | −.251 | .602 | .513 | .835 | | | | | −1.10 | 1.68 | .810 | 1.28 |
| CAID | | | | | .088 | .547 | .542 | 2.29 | | | | | .274 | 1.18 | .288 | 1.28 |
| CONST | 4.19 | 5.67 | 3.04 | 4.46 | .116 | .188 | .622 | .684 | 2.96 | 4.31 | .675 | 1.03 | .543 | .698 | −.438 | .581 |
| $R^2$ | .1453 | | .0885 | | .0235 | | .0754 | | .1221 | | .0945 | | .0177 | | .0193 | |

# APPENDIX 3

## Detail of the Formal Model of Demand for Medical Services

The formal model is developed in terms of a two-good utility function, medical services, $m$, and a composite good, $X$, and has people pay in both money and time for each good. If the proportion of money and the price per unit of the good remains fixed and the full wealth assumption is used, the objective is to maximize

$$U = U(m, X) \tag{A-1a}$$

subject to

$$(p + wt)m + (q + ws)X \leq Y = y + wT \tag{A-1b}$$

where the variables are defined as on p. 167. I assume that all equations are twice differentiable and that the first derivatives of the utility function are positive, the second derivatives, negative, and the cross derivatives are positive.[38] The conditions for maximizing utility are found by forming the Lagrangian expression

$$L = U(m, X) + \lambda\left[m(p + wt) + X(q + ws) - y - wT\right] \tag{A-2}$$

Differentiating with respect to the three unknowns, $m$, $X$, and $\lambda$, and setting these equal to zero yields the first-order conditions for a maximization:

$$\frac{\partial L}{\partial m} = U_m + \lambda(p + wt) = 0 \tag{A-3a}$$

$$\frac{\partial L}{\partial X} = U_X + \lambda(q + ws) = 0 \tag{A-3b}$$

and

$$\frac{\partial L}{\partial \lambda} = m(p + wt) + X(q + ws) - y - wT = 0 \tag{A-3c}$$

where by definition

$$U_m \equiv \frac{\partial U}{\partial m} \text{ and } U_X \equiv \frac{\partial U}{\partial X}$$

### Effects of a Change in Price

To calculate the effect of a change in the out-of-pocket money price of $m$ on the demand for $m$, we must differentiate the system of equations (A-3) with respect to $p$, yielding:

$$\text{(A-4a)}\quad U_{mm}\frac{\partial m}{\partial p} + U_{mX}\frac{\partial X}{\partial p} + (p + wt)\frac{\partial \lambda}{\partial p} = -\lambda$$

$$\text{(A-4b)}\quad U_{Xm}\frac{\partial m}{\partial p} + U_{XX}\frac{\partial X}{\partial p} + (q + ws)\frac{\partial \lambda}{\partial p} = 0$$

and

$$\text{(A-4c)}\quad (p + wt)\frac{\partial m}{\partial p} + (q + ws)\frac{\partial X}{\partial p} = -m$$

If we designate the determinant of the matrix of coefficients $|D|$, then

$$|D| = \begin{vmatrix} U_{mm} & U_{mX} & (p + wt) \\ U_{Xm} & U_{XX} & (q + ws) \\ (p + wt) & (q + ws) & 0 \end{vmatrix}$$

(A-4d)

$$= U_{mX}(q + ws)(p + wt) + U_{Xm}(q + ws)(p + wt)$$
$$- U_{XX}(p + wt)^2 - U_{mm}(q + ws)^2$$

Assuming that $U_{XX}$ and $U_{mm} < 0$ and that $U_{Xm}$ and $U_{mX} > 0$, then $|D|$ is unambiguously positive. We can solve for $\partial m/\partial p$ by Cramer's rule:

$$\text{(A-4e)}\quad \frac{\partial m}{\partial p} = \frac{\begin{vmatrix} -\lambda & U_{mX} & (p + wt) \\ 0 & U_{XX} & (q + ws) \\ -m & (q + ws) & 0 \end{vmatrix}}{|D|}$$

$$= \frac{-mU_{mX}(q + ws) + mU_{XX}(p + wt) + \lambda(q + ws)^2}{|D|}$$

Since $\lambda$ is necessarily negative by (A-3a) and (A-3b), $\partial m/\partial p$ is unambiguously negative. Medical services, $m$, is acting as a normal good; with a higher money price, people demand less.

Similarly, we can calculate the effect of a change in the time price of $m$ on the demand for $m$. Differentiating with respect to $t$ yields

$$\text{(A-5a)}\quad U_{mm}\frac{\partial m}{\partial t} + U_{mX}\frac{\partial X}{\partial t} + (p + wt)\frac{\partial \lambda}{\partial t} = -\lambda w$$

$$\text{(A-5b)}\quad U_{Xm}\frac{\partial m}{\partial t} + U_{XX}\frac{\partial X}{\partial t} + (q + ws)\frac{\partial \lambda}{\partial t} = 0$$

and

$$\text{(A-5c)} \quad (p+wt)\frac{\partial m}{\partial t} + (q+ws)\frac{\partial X}{\partial t} = -mw$$

Using Cramer's rule again,

$$\text{(A-5d)} \quad \frac{\partial m}{\partial t} = \frac{\begin{vmatrix} -\lambda w & U_{mX} & (p+wt) \\ 0 & U_{XX} & (q+ws) \\ -mw & (q+ws) & 0 \end{vmatrix}}{|D|}$$

$$= \frac{-mw\,U_{mX}(q+ws) + mw\,U_{XX}(p+wt) + \lambda w\,(q+ws)^2}{|D|}$$

which is also unambiguously negative. That is, time is also functioning as a price in determining the consumption of $m$.

For reference, it is interesting to calculate the total price elasticity of demand for $m$. Differentiating equations (A-3) with respect to $(p+wt)$, we find

$$\text{(A-6a)} \quad U_{mm}\frac{\partial m}{\partial(p+wy)} + U_{mX}\frac{\partial X}{\partial(p+wt)} + (p+wt)\frac{\partial \lambda}{\partial(p+wt)} = -\lambda$$

$$\text{(A-6b)} \quad U_{Xm}\frac{\partial m}{\partial(p+wt)} + U_{XX}\frac{\partial X}{\partial(p+wt)} + (q+ws)\frac{\partial \lambda}{\partial(p+wt)} = 0$$

and

$$\text{(A-6c)} \quad (p+wt)\frac{\partial m}{\partial(p+wt)} + (q+ws)\frac{\partial X}{\partial(p+wt)} = -m$$

So,

$$\text{(A-6d)} \quad \frac{\partial m}{\partial(p+wt)} = \frac{\begin{vmatrix} -\lambda & U_{mX} & (p+wt) \\ 0 & U_{XX} & (q+ws) \\ -m & (q+ws) & 0 \end{vmatrix}}{|D|}$$

$$= \frac{-mU_{mX}(q+ws) + mU_{XX}(p+wt) + \lambda\,(q+ws)^2}{|D|}$$

Thus, we find that

$$\text{(A-6e)} \quad \frac{\partial m}{\partial(p+wt)} = \frac{\partial m}{\partial p}$$

The three price elasticities are related in the following manner:

$$\text{(A-7a)} \quad \eta_{m(wt)} = \eta_{mt} = \frac{wt}{(p + wt)} \eta_{m(p + wt)}$$

and

$$\text{(A-7b)} \quad \eta_{mp} = \frac{p}{(p + wt)} \eta_{m(p + wt)}$$

Consequently, it follows that

$$\eta_{mp} \gtreqless \eta_{mt}$$

as

$$p \gtreqless wt$$

## Effects of a Change in Income

The effects of a change in earned and non-earned income are systematically related, but they are not, in general, the same. The effect of a change in non-earned income is straightforward to calculate. Differentiating equations (A-3) with respect to $y$ yields:

$$\text{(A-8a)} \quad U_{mm} \frac{\partial m}{\partial y} + U_{mX} \frac{\partial X}{\partial y} + (p + wt) \frac{\partial \lambda}{\partial y} = 0$$

$$\text{(A-8b)} \quad U_{Xm} \frac{\partial m}{\partial y} + U_{XX} \frac{\partial X}{\partial y} + (q + ws) \frac{\partial \lambda}{\partial y} = 0$$

and

$$\text{(A-8c)} \quad (p + wt) \frac{\partial m}{\partial y} + (q + ws) \frac{\partial X}{\partial y} = 1$$

Thus,

$$\text{(A-8d)} \quad \frac{\partial m}{\partial y} = \frac{\begin{vmatrix} 0 & U_{mX} & (p + wt) \\ 0 & U_{XX} & (q + ws) \\ 0 & (q + ws) & 0 \end{vmatrix}}{|D|}$$

$$= \frac{U_{mX} (q + ws) - U_{XX} (p + wt)}{|D|}$$

which is unambiguously positive. The demand for medical services is normal; with more non-earned income, people demand more.

We can see the effect of a change in the earnings per hour by differentiating with respect to $w$:

$$\text{(A-9a)} \quad U_{mm}\frac{\partial m}{\partial w} + U_{mX}\frac{\partial X}{\partial w} + (p+wt)\frac{\partial \lambda}{\partial w} = -\lambda t$$

$$\text{(A-9b)} \quad U_{Xm}\frac{\partial m}{\partial w} + U_{XX}\frac{\partial X}{\partial w} + (q+ws)\frac{\partial \lambda}{\partial w} = -\lambda s$$

and

$$\text{(A-9c)} \quad (p+wt)\frac{\partial m}{\partial w} + (q+ws) = -mt - Xs + T$$

Cramer's rule yields:

$$\text{(A-9d)} \quad \frac{\partial m}{\partial w} = \frac{\begin{vmatrix} -\lambda t & U_{mX} & (p+wt) \\ -\lambda s & U_{XX} & (q+ws) \\ T-mt-Xs & (q+ws) & 0 \end{vmatrix}}{|D|}$$

$$= \frac{(T-mt-Xs)U_{mX}(q+ws) - (T-mt-Xs)U_{XX}(p+wt) - \lambda s(q+ws)(p+wt) + \lambda t(q+ws)^2}{|D|}$$

The effects of a change in the wage rate can be broken down into an income effect and substitution effect:

$$\text{(A-9e)} \quad \frac{\partial m}{\partial w} = (T-mt-Xs)\frac{\lambda m}{\partial y} - \frac{\lambda s\,(q+ws)\,(p+wt) - \lambda t(q+ws)^2}{|D|}$$

The first term, the income effect, is by assumption positive. The sign of the substitution effect depends on the relative time intensity of the goods $m$ and $X$. If the time component of total price is larger for $X$ than it is for $m$, there will be a positive substitution from $X$ to $m$. That is, the substitution term is positive if and only if

$$\text{(A-10a)} \quad \frac{ws}{(q+ws)} > \frac{wt}{(p+wt)}$$

It is easy to show that the substitution effect is negative if medical care is "free." Substituting $p=0$ into (A-10a), canceling common terms, and multiplying through by $(q+ws)$ yields

$$\text{(A-10b)} \quad ws < (q+ws)$$

Therefore, the substitution effect is negative.

## NOTES

1. See Newhouse and Acton (1974) for a discussion of this point.
2. See especially Davis and Russell (1972), Feldstein (1971), Phelps (1973), Phelps and Newhouse (1973), and Rosett and Huang (1973).
3. If demand increases in response to spreading insurance, in addition to increases in waiting and travel time, the supply responses may be to (1) increase the number of referrals to other providers, (2) cause a postponement in treating some conditions, or (3) change the quality of services being provided. Increased referrals and postponement are alternative forms of greater time costs. In this study, I am concentrating directly on the role of waiting and travel time. The importance of time in determining demand was explored by Becker (1965); its importance in medical care, by, among others, Leveson (1970), Holtman (1972), and Auster and Ro (1972). In her comments, Mrs. Campbell correctly points out that "waiting time" in this survey probably does not include the amount of time spent in an examination room unattended or the time in transit between different tests or parts of the facility. This more detailed information would be interesting to explore but was unavailable in this survey. If such additional "hidden" time charges are independent of or proportional to time in the waiting room, the elasticities are unaffected; if they are negatively correlated, then the empirical results are misleading. She also comments that increased referrals or postponement of appointments may be an important supply response to spreading coverage—with which I agree. I do not agree that its absence in these equations limits their value for policy assessment. Unless one can demonstrate that suppliers will discriminate systematically in their patterns of postponement and referrals, then the waiting time and travel time results reported below are partial effects that should be observed regardless of these other effects.
4. Similar models can be found in Grossman (1970), Becker (1965), and Acton (1973).
5. See Grossman (1972) for a formulation accommodating this feature.
6. See Phelps (1973) for a theoretical and empirical treatment with insurance endogenous.
7. See Lancaster (1966) for a similar formulation of demand in terms of the attributes of a good.
8. Although they are more restrictive than necessary, sufficient assumptions are that the first derivatives of the utility function with respect to a good are positive, that the second derivatives are negative, and that the cross-partial derivatives are positive.
9. As shown in Appendix 3, $\eta_{m(wt)} = \eta_{mt}$. These elasticities are approximate only in the long run if insurance premiums are adjusted to reflect the changes in utilization.
10. In the consumption model, given a neutral effect of education on all household activities, the elasticity with respect to wealth must also be less than 1 to have a negative effect on education; Grossman (1972a, pp. 36–37).
11. NORC conducted ten baseline surveys for OEO. The Bedford-Crown survey was the second survey and Red Hook the third. The survey instrument improved somewhat, so occasionally we have useful information on the Red Hook sample that is not available for Bedford-Crown. A description of the Bedford-Crown study, along with the survey instrument and selected findings, is available in Richardson (1969a). A similar report on the Red Hook study is

Richardson (1969b). Selected findings for the first three NORC studies (Atlanta and the two Brooklyn surveys) are presented in Richardson (1970).

12. Let $k$ proportion of the variable $x$ be reported, then the estimated (price) elasticity $\eta_{xp} = \partial kx/\partial p)(\bar{p}/k\bar{x}) = (\partial x/\partial p)\ (\bar{p}/\bar{x})$, the same elasticity that would have been estimated with correct reporting.
13. Conversations with OEO officials have indicated that the acceptance of the neighborhood health centers has been different from the two populations. The Red Hook population is changing its behavior by coming to the center for early care and preventive medicine. In Bedford-Crown, the population comes in chiefly for treatment of advanced and chronic conditions. There may be some persistent differences in the two populations that will be reflected in the analysis below. It could simply be a different acceptance of the neighborhood health centers. The Bedford-Crown center is located in a very rough neighborhood and, purportedly, taxi drivers refuse to travel there. This does not appear to be true for the Red Hook neighborhood.
14. The use of a mean value rather than zero for these nonresponses was necessary to avoid the implausible situation that higher own-time prices are associated with lower utilization except for zero utilization when own-time prices are zero. A predicted value of own-time price might have been used, but that option is deferred for further analysis. It was necessary to use the mean value for about three-fourths of the times associated with free care and about one-fourth of the times associated with non-free care in both samples.

    Using the mean to replace missing values reduced the efficiency in estimating that coefficient, but Charles Phelps demonstrated that use of the mean for some observations does not bias the remaining coefficients if the mean is uncorrelated with the remaining variables. Consider the bivariate case in which $m$ observations on $x_i$ are known and the next $p$ are replaced with the mean (their true value is $\bar{x}_1 + u_i$). The OLS estimator of $\beta$ is $b = \{\sum_m (xy) + \sum_p [(x + u)y]\}/[\sum_m x^2 + \sum_p (x + u)^2] = \{\sum_m [(xx\beta) + x\epsilon] + \sum_p [(x + u)\ (x\beta + \epsilon)]\}/[\sum_m x^2 + \sum_p (x + u)^2]$. The measurement error for the subset, $p$, of observation is $u_i = (\bar{x} - x_i)$ so that $\sigma^2_{u_p} = \sigma_{x_p}$ and $\sigma^2_{x + u_p} = 0$, where the subscripts on variances indicate the subsample to which they relate. The probability limit of $b$ can be shown to be plim $b = (\sigma^2_{x_m} + \sigma^2_{x_p} + \sigma_{xu_p})\beta/(\sigma^2_{x_m} + \sigma^2_{(x+u)_p})$. Since, in subsample of size $p$, $\sigma^2_{x_p} + \sigma^2_{u_p} + 2\sigma_{xu_p} = 0$ and $\sigma^2_{x_p} = \sigma^2_{u_p}$, it follows that $-\sigma_{xu_p} = \sigma^2_{x_p}$ and plim $b = (\sigma^2_{x_m} + 0)\beta/(\sigma^2_{x_m} + 0) = \beta$.
15. It is necessary to use a non-zero value for the opportunity cost of a unit of time if travel and waiting time are to play a role in determining demand for a specific provider by nonworking persons. Otherwise, we are assuming that, in effect, the person is indifferent whether he travels a short distance for care or travels a great distance. Furthermore, physician visits by children frequently cause an adult to spend time accompanying them. The value of 60 cents per hour for this group is arbitrary, but it can be motivated to some degree as a plausible value for the cost of hiring a babysitter. The value of 60 cents is lower than any observed value of earnings per hour in either sample (which was over $1 per hour). A number of researchers have taken a much more detailed look at valuing the time of persons out of the labor force (see, for instance, Gronau, 1973a and b, and references cited). I did not feel a more complicated approach was justified in the current application because of limited information about time allocation of individual family members.
16. I took the total reported income and subtracted the elements that were non-earned to create the earned income variable. In a few cases, the sum of

non-earned incomes exceeded the stated total income (typically, zero was recorded for total, but a monthly social security income was reported). In these cases, the amount created by summing up the components was used.

17. Ideally, health status lagged one period would be used. It was not available, but its absence is not too serious since the underlying stock of health is highly correlated from one year to the next.
18. In addition, people with more chronic health conditions probably have a lower stock of health to begin with, so that it takes more medical inputs to achieve a given replacement of health than it would if they had started with a greater stock. This argument assumes that the function transforming medical inputs to health has decreasing returns to scale.
19. To some degree, inpatient and outpatient care may be substitutes for each other, but I expect their complementary nature to dominate. I checked the sensitivity of the remaining coefficients to the inclusion and exclusion of these hospital variables and found the coefficients practically unchanged.
20. If everyone's insurance coverage were known in detail, this would not be a problem; but NOAMB is an imperfect measure, as indicated above.
21. The $t$ statistics are asymptotic tests in the tobit framework. With samples of 5,000, they probably are good guides to significance. Furthermore, the chi[2] statistics test the hypothesis that the vector of coefficients is zero; they, too, are highly significant.

    The reader should not attach too much importance to the equations for public hospitalization since the number of non-zero observations is very small.
22. Figure 1A shows the quantity of care demanded as a function of either $t$ or $wt$. People who appear to have high time inputs to the purchase of care (indicated on the line marked $t$) tend to have proportionately lower values of $wt$ because of the negative correlation of $w$ and $t$. Conversely, those who appear to have low time inputs tend to have higher opportunity costs of time and therefore proportionately higher values of $wt$. The same result holds for the cross-time prices indicated in Fig. 1B. Thus, the true elasticity with respect to $wt$ will be greater than that implied by the regression on $t$ alone.

**FIGURE 1a**
**Relation between own-time prices and quantity**

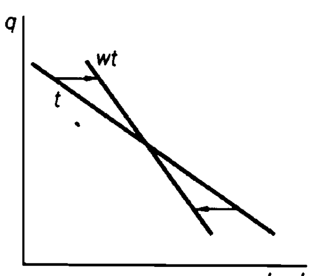
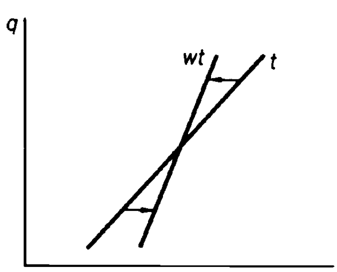



**FIGURE 1b**
**Relation between cross-time prices and quantity**



23. This apparent contradiction may be because the estimated maximum occurs where ATOPDC = 45 minutes. The mean, used for calculating the elasticity, is 59 minutes, which is one standard deviation above the critical point.
24. Using a 1965 survey of users of the municipal hospitals' OPDs (specifying a simultaneous equation system with public and private ambulatory care and public hospitalization all endogenous), I found complementarity in public ambulatory and inpatient care. See Acton (1973).
25. This comparison was carried out using OLS—whose results approach tobit asymptotically—because patterns of significance and collinearity were found to carry over well to tobit results.
26. These estimated elasticities may be biased downward by a transitory component in non-earned income. The negative elasticity for private hospital days, equations (4) and (12), is caused by the elasticity's being calculated at the mean of the data ($920), which was just to the left of the minimum of our estimated relationship ($939 in Equation (4) and $1,183 in Equation (12), which is within one-seventh of a standard deviation of the mean). For approximately half the sample, the non-earned income elasticity has the expected positive sign. For most other equations, the critical point is not within one standard deviation of the mean of the data.
27. Michael Grossman pointed out that, in general, we can expect to find lower elasticities with respect to earned income in equations (9)–(16) than in equations (1)–(8). Consider the simplified form of a demand equation,

(4a) $m = a + bp + cY$

where $p = wt$ and $Y = y + wT$. We expect $b < 0$ and $c > 0$. Substituting into (4a) yields

(4b) $m = a = bwt + cwT + cy$

similar to equations (1)–(8). With $wt$ held constant, the coefficient, $c$, on full earnings should be positive. When we estimate

(4c) $m = a' + b't + c'wT + dy$

the coefficient $c'$ could be negative. The elasticities reported in table 3 generally support this prediction that the earning elasticities in equations (9)–(16) are lower than those in equations (1)–(8).
28. Since $(\partial m/\partial Y) = (\partial m/\partial y)$, it follows that $\eta_{mY} = (\partial m/\partial Y)\ (\bar{Y}/\bar{m}) = (\partial m/\partial y)$ $(\bar{Y}/\bar{m}) \cdot (\bar{Y}/\bar{y}) = \eta_{my}\ (\bar{Y}/\bar{y})$.
29. If the reader wishes to make other assumptions about the definition of full wealth, then the elasticities can be adjusted accordingly. For instance, if $T$ is taken as referring to a twenty-four-hour day instead of a forty-hour work week, the full wealth elasticities reported here should be scaled up by 4.2.
30. The corresponding elasticities for the Bedford-Crown sample, 1.317 and −0.714, reflect the estimated coefficients on NEARN, and the comments made above apply.
31. It is probably not worth conducting a rigorous test of this hypothesis, which requires calculation of the covariance among equations, but it seems valid.
32. This supply response is likely for a number of reasons. First, it may be optimal from the point of view of the provider to have a queue to even out the variation in demand that he experiences, without having to invest in significant excess capacity. A shift in demand will generally cause the optimal queue length to change (for instance, the opportunity cost of an idle moment of the supplier's facility is higher). Second, the suppliers may not be profit maximizers, so that

they do not respond to a shift in demand by charging the highest possible monetary prices but instead allow time prices to increase. In particular, physicians may be income satisfiers rather than maximizers. See Newhouse (1970), Frech and Ginsburg (1972), and Newhouse and Sloan (1972) for a discussion of physician pricing behavior. Third, there may be a conscious attempt to redistribute services by discriminating in favor of those with a lower opportunity cost of time. See Nichols, Smolensky, and Tideman (1971) for a discussion of the first and third points.

33. One form might be for several satellite clinics to be associated with a more centrally located referral clinic.
34. This is an arc elasticity based on the elasticity calculated at the mean.
35. This calculation ignores substitution effects induced by changes in the marginal tax rate implicit in the income maintenance proposals.
36. The actual money-price elasticity may be even lower than this. See Newhouse and Phelps (1973) for a discussion of the price elasticities in several published reports.
37. The mean values are reported first for Red Hook and second for Bedford-Crown.
38. These assumptions are sufficient to imply that both goods are normal and that a rise in their price will reduce demand.

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# 5 COMMENTS

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As some of you may know, I have been involved in the public policy area in regard to the financing and delivery of medical care and am not an econometrician. I greatly appreciate, therefore, the efforts of econometricians, as represented by the paper of Jan Acton, and by others at this conference, to determine the effect of net price on the demand for health care.

Acton's econometric analysis and empirical data about the role of time as part of the net price paid by the consumer or potential patient, I feel, is long overdue in discussions about the allocation and quality of the delivery of medical care in the U.S. In other countries, where the financing and system of medical care are more nationalized, the role of "waiting" in allocation has been more obvious and is recognized. For example, Professor Spek of the University of Gothenburg defines "demand" for that portion of health care in Sweden that is completely free, as follows:

> *Demand* (active, effective) for public care is that part of the need for care which is represented by those individuals who come in touch with the system of public care with a desire for consultation and treatment, and who are willing to wait if this cannot be provided at once. In each period, demand takes the form of queueing or results in *consumption*. . . .[1]

This is a definition of demand wholly in terms of time.

When third-party payments cover two-thirds of the U.S. total personal health care bill, money price cannot be considered the primary allocation factor and especially not in those areas of care—hospital and surgical—wherein third-party payments are 92 per cent and about 70–75 per cent, respectively. In an earlier published discussion of methods other than a price to allocate medical care, I asked, "Would the distribution of scarce medical resources be more optimal if all financial barriers to securing care were removed and no special categories were set up?" and stated that "there is as much logic to implying a high correlation between income and need for medical care throughout the income distribution ranges as there is to implying a high correlation between a low opportunity cost of time and need for medical care."[2] It is with this public policy approach that I have read Dr. Acton's paper, which develops a consumption model and analyzes two sets of specific data re the urban poor to test his model, which includes as variables time prices, money prices, earned and unearned income, and as the outcome measure, physician visits.

To discuss the role of opportunity costs of time, it is necessary to consider all different kinds of time involved in consuming health care. Although Acton's model includes "waiting" and travel time,[3] it does not cover all forms of consumption of time involved in getting medical care nor does it distinguish between week days and weekends or after usual work hours.

In addition to the waiting time in a physician's outer office, there may be considerable waiting in the actual examination room before seeing an M.D. This "waiting" does not appear to be included—probably the data are unavailable—yet in some clinics and group practices it may be a sizable "hidden" form of waiting.

There is also the amount of time spent not in waiting but in consuming health care, such as is involved in having examinations, X-rays, tests, and the like. This consumption of time may be less important in initial decisions by the consumer to seek medical care, because he may be ignorant of the subsequent amount of time involved, which is largely controlled by the provider. The more knowledgeable consumer does, however, consider this potential "time" in deciding whether or not to have a postponable operation, or even more routine care, such as an eye examination. However, from an even broader point of view, and as stated by Michael Grossman in his *Demand for Health* (NBER Occasional Paper No. 119), although "a demand curve for the time spent producing health [by the consumer] could also be developed, data pertaining to this input are, in general, not available" (p. 41).

A third concept involving waiting is the time one has to wait for an appointment. To relegate to a footnote, as does Acton, suppliers' responses of "increased referrals and postponement" as an alternative form of greater time costs to the consumer is insufficient for public policy decision making. The quality of medical care and the resource costs of providing it are affected by structuring the demand for medical care through imposing long waits for appointments. For example, to the degree that HMO's or prepaid group practice use an appointment system, and most do, they can consciously curtail demand by delaying appointments six weeks or two months or more for check-ups and especially for specialists' care wherein explanations of delay may be more acceptable to the consumer, whose ignorance exceeds in this matter the physician's. The quality of care is less with long waits than with short waits. To the extent that the "waiting" induces subscribers to seek care elsewhere, total costs to a prepaid group are lowered. Data on voluntary outside utilization of physician services by members of a prepaid group are sparse and scattered and the reasons for the outside utilization are largely unexplored. To what degree outside use of services occurs, which otherwise would not require out-of-pocket expense to the patient because of various forms of waiting, I do not know.

Acton's paper does not incorporate into the analysis these various types of "time," probably because the empirical data are unavailable. Econometric modeling to encompass more kinds of waiting may encourage better data collection. From the point of view of public policy, the different types of waiting time cannot be ignored and some recognition should be given these variables even if they are not in the formal model.

Recent empirical studies emphasize the importance of these, possibly nonmeasurable, inputs as follows: "Patient waiting time was longer for nonwhites, females, poor people, and the elderly; waiting time was not related to practice size but varied proportionately with use of allied health personnel, . . ."[4] in the fee-for-service sector, solo and group.

To determine potential utilization, a state planning agency, New York,[5] recommends that a new prepaid group practice or HMO obtain answers to such questions as: "How many waiting rooms should there be and where should they be located? (1) What will be the average length of a patient visit? (2) How many people will there be at one time in each waiting area? . . ." and further, "How many consultation and examination rooms will be needed for each physician?" Obviously, HMO's, and for that matter any physician, can structure demand by the way they answer these and other questions. Additionally, HMO's decide how many physicians per 1,000 enrollees, number of hospital beds per 1,000 enrollees, and so on, will be provided.

An interesting evaluation of the California Medical Group (CMG) prepared for the Teamsters and Food Employers Security Trust Fund in Los Angeles[6] criticizes that group as having physician and hospital bed ratios far lower than Kaiser's, which are lower than the average in California, and comments, "over the years, Trust Funds have become increasingly aware of subscriber dissatisfaction with Kaiser services. Difficulties making appointments, lengthy waits to see physicians even with appointments, and hurried, impersonal physician contacts are common complaints" (p. 9). For those who are Kaiser supporters, the evaluation report recommended turning down CMG and retaining Kaiser because obviously CMG's proposed much lower physician and hospital bed enrollee ratios would increase complaints.

The general approach of quality control in prepaid groups has, in the past, relied almost entirely on providing the subscriber with an alternative choice at time of enrollment, and subsequently once a year. This works to control quality only if at least one of the alternatives provides an acceptable standard of quality of care. This may not always be the case and there is a need for some type of continuing review of ambulatory delivery of medical care as well as of in-hospital care. At a minimum is input control through careful assessment of the quantity of the medical care inputs in relationship to the anticipated demand and their quality; e.g., numbers of primary physicians and specialists, initial training and continuing education, and the like.

The Institute of Medicine's[7] proposal to use selected tracers, wherein medical inputs and health outcomes are directly related, as in iron-deficiency anemia or middle ear infection, is worth exploring by economists who are trying to develop better health outcome measures than mortality and morbidity rates or, as in Acton's study, the number of physician visits. The latter is used in this study without being subdivided into different types of visits nor qualified by number of minutes. The omission of any reference to the importance of the use of the telephone visit by persons in higher income levels as a means of avoiding waiting is disappointing.

Whether Acton's conclusions re the "urban poor" that "travel and waiting time appear to be operating as normal prices . . ." and that "time is already functioning as a rationing device for demand in this New York population, and its importance seems to exceed that of money prices, . . ." can be carried over to other sectors of society as defined by income levels in urban and suburban areas is doubtful, even if one accepts his fairly rigid assumptions. The percentage of third-party payments of total health care costs, levels and ratios of earned and unearned incomes, use of telephone and of appointment schedules, level of knowledge re medical care, and so on, differ at different income and educational levels.

Probably the most important policy inference discussed by Dr. Acton, and time limits my discussion of it, is under "Tradeoffs of Subsidized Care and Income Supplements," in which he states that "income maintenance will increase aggregate medical demand for the poor" because it is non-earned income, and concludes that "the magnitude of the change may be very comparable over the range of subsidy and income guarantee under consideration."

## NOTES


1. J. E. Spek, "On the Economic Analysis of Health and Medical Care in a Swedish Health District," in M. M. Hauser (editor), *The Economics of Medical Care,* University of York Studies in Economics, 7 (London: George Allen and Unwin, 1972), p. 265.
2. Rita R. Campbell, *Economics of Health and Public Policy* (Washington, D.C.: American Enterprise Institute, June 1971), p. 69.
3. Additionally, for a given person living in a city, travel time from home to the physician's office may vary greatly, depending on whether it is undertaken during rush hours or not and also whether one has available a private car or must depend on public transportation, with possibly inconvenient schedules and transfers.
4. The AMA and USC joint studies using AMA's data, as reported in *Health Services Research,* (Winter 1973), p. 326.
5. New York State Health Planning Commission, *Group Practice* . . . by Anne Bush, September 1971, pp. 39, 40.
6. California Council for Health Plan Alternatives, December 6, 1972.
7. National Academy of Sciences, *A Strategy for Evaluating Health Services*, D.M. Kessner, Project Director, Washington, D.C., 1973.



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I generally agree with Acton's arguments about the desirability of measuring the role of time in the demand for medical services. I also admire most of his econometric work. I do not, however, like his data, or the use to which he puts these data. I am therefore extremely uneasy about his findings, particularly his principal findings of fairly high time-price elasticities of demand and extremely low or nonexistent income elasticity of demand for medical services.

Measurement problems aside, casual empiricism suggests that the demand for medical services is a function of costs other than money prices, in addition to money prices. Even if we ignore the behavior of lower-income groups and concentrate instead on groups having completely free medical coverage as part of the pay package (families of military personnel are an example), we suspect that their demand for medical services are less than what they would be if they faced only zero money prices. For if the zero money prices represented the marginal costs, individuals facing such costs would increase the consumption of medical services until the value of the last unit consumed, say, the value of their last visit to the doctor, equaled zero. Since we do not observe such consumption behavior, it is reasonable to assume that the money prices do not represent the total cost of medical services.

It does not follow, however, that one can expect the time-price elasticities of demand to be much higher (by a factor of 4 or 5) than the money-price elasticities of demand. Moreover, the nonmonetary constraints need not be exclusively or even largely those imposed by the two specific variables used in this study, travel to and waiting time in the office. Other important variables that have been omitted from this study are waiting time for appointments (queuing time) and quality of medical services. I suspect that there is a positive correlation between the out-of-pocket costs and the quality of medical services. Furthermore, if queuing time were positively correlated with waiting time in the office, the time-price elasticities of demand would be biased upward, or away from zero, rather than downward, as claimed by Acton.

The travel and waiting time variables used in this study have the added deficiency of being endogenous to the equations. This is particularly true in the equations for the demand for private medical care.

Acton's data consist of questionnaire responses elicited from individuals and families living in two well-defined neighborhoods in New York City. These responses do not include information on money prices paid for medical services or on the quality of medical services received. They do show variability in travel and waiting time as well as variability in the number of visits to the doctor and in the number of days of hospital care. Acton expects and finds an inverse correlation between travel and waiting time and, say, the number of visits to the doctor. He reasons correctly that more time spent for medical care increases the time price of such care. He concludes from that, in my judgment incorrectly, that this negative correlation between time and use of medical care is a measure of the time-price elasticity of demand. This is an incorrect conclusion because the individuals in these neighborhoods have a choice of private physicians. This choice includes the location of the physician and therefore the distance and time of travel from home as well as the length of the waiting period. If an individual chooses a physician associated with more travel and waiting time over one requiring less travel time, it must mean that the total cost for this physician is lower, for a given quality, than is the total cost of the lower time-price physician. In the presence of voluntary choice, therefore, the negative relationship between time and quantity *cannot* be used, by itself, to estimate the time-price elasticities of demand.

Acton's arguments about the changing role of money versus time prices over time also ignore the secular increase in the amount of time available as sick leave, thereby reducing an individual's time costs of medical services. This trend is paralleled by a cross-sectional pattern of sick leave benefits opposite to that of opportunity costs. Therefore, his conclusions about the relative roles of time prices among income groups are probably also incorrect.

These several factors lead me to believe that his time-price elasticities of demand are, to say the least, extremely unreliable. His unstable but extremely low income elasticities of demand are also highly questionable. They are inconsistent with the rising demand for medical services over time as reflected in the behavior of price indexes, doctors' incomes, and the growth of employment in the medical services industry.

At fault here may be the poor quality of his dependent variable. In one case, this variable is simply the number of visits to a doctor. However, higher or rising income may have a greater effect on the quality of the doctor visited or on the quality of a visit to a given doctor than it does on the number of visits to a given doctor. This would be in line with the findings in a number of studies on the demand for durable goods, including the demand for children. All of these studies found a substantially higher quality income elasticity of demand than quantity income elasticity of demand.

To some extent the quality effects could have been reflected in a shift from free to non-free physician's services, with rising income. Acton's study finds no such income effect. However, it is my impression that his dependent variable does not truly differentiate, as claimed, between free and money-price services.