This PDF is a selection from an out-of-print volume from the National Bureau of Economic Research

Volume Title: Determinants Of Expenditures For Physicians' Services In The United States 1948-68

Volume Author/Editor: Victor R. Fuchs and Marcia J. Kramer

Volume Publisher: NBER

Volume ISBN: 0-87014-247-X

Volume URL: http://www.nber.org/books/fuch72-3

Publication Date: 1972

Chapter Title: Differences Across States, 1966: An Econometric Analysis

Chapter Author: Victor R. Fuchs, Marcia J. Kramer

Chapter URL: http://www.nber.org/chapters/c2551

Chapter pages in book: (p. 21 - 42)

2
Differences Across States, 1966: An Econometric Analysis

2.1 Introduction

Part 1 has suggested the importance of advances in medical technology in explaining postwar trends in expenditures, utilization, and physician productivity. In order to gain an understanding of physician and patient behavior net of technological change, we now turn to a cross-sectional model. By examining differences across states at a single point in time we are in effect holding medical technology fairly constant. There may be some lag in the spread of new knowledge from one state to another, but the difference between the frontier of knowledge in the most and least advanced states in any given year is far less than the change that occurred between 1948 and 1968 in the United States as a whole.[1]

Another advantage of the cross-sectional approach is that it provides an opportunity to learn something about the factors influencing the supply of physicians. It is widely recognized that there are substantial barriers to entry into medicine. These are partly financial and partly caused by the reluctance of organized medicine to expand the volume of training facilities to the point where all applicants with an ability to pay would be accepted. Moreover, it takes a long time to establish a new medical school, and there is a lag of five or more years between the time a student enters medical school and the time he begins to practice. It follows that the total number of practicing physicians in the country cannot be responsive to any important degree to annual changes in price or other market conditions. By contrast, the potential elasticity of physician supply going to any one state is very great. Previous investigators have already demonstrated that licensing procedures pose no significant impediment to interstate migration of physicians. (See [7], [24].) With entry into the total market effectively limited, the geographical distribution of physicians has become a matter of particular concern.

2.2 A Framework for Analysis

Per capita expenditures for physicians' services vary considerably across states. In 1966, such expenditures were $68.68 in California compared with $26.42 in South Carolina.[2] This is a greater variation than the change that occurred in the national average between 1948 and 1965.

How are we to explain such large variations in expenditures? By definition, expenditures are equal to quantity multiplied by price. More fundamentally, then, our task is to explain interstate variations in price and quantity. To do this economists employ a general model of demand and supply. In such a model the quantity demanded by consumers depends upon price and many other variables, some of which are applicable to any commodity, e.g., per capita income, and others that may be relevant only to one or a few commodities, e.g., health insurance. The quantity provided by suppliers is also treated as a function of price and other variables. In equilibrium, the quantity demanded is exactly equal to the quantity supplied; hence, actual quantity and actual price are simultaneously determined through the interaction of the demand and supply functions.

Specification of a model for physicians' services establishes a general framework within which a broad range of hypotheses regarding the behavior of patients and physicians can be investigated. Each structural equation of the model offers an explanation for the determinants of a particular aspect of the market for

[1] Differences in actual medical practice across states are undoubtedly larger than differences in the frontier of medical knowledge. Our interpretation of the technological factor in demand, however, is predicated upon the assumption that the demand for physicians' services increases with an expansion in the range of services physicians are *technically* able to offer. Variations in actual medical practice across states are viewed primarily as the consequence of variations in demand rather than as their cause.

[2] The range of variation in per capita disposable income was substantially less in that year for the thirty-three states in our sample, having a high value of $3,185 in Connecticut and a low of $1,586 in Mississippi. The coefficients of variation for per capita physician expenditures and per capita income were 24.0 per cent and 16.0 per cent, respectively. State data for 1965 and 1967 show about the same degree of variation as in 1966.

physicians' services. Our model has one equation dealing with variations in demand, one for the number of physicians, one for physician productivity, and one for the amount of insurance coverage.

Because the variables we wish to explain are not determined independently of one another, it is not possible to test our behavioral hypotheses accurately with ordinary least-squares regression equations. For example, one clear implication of the interdependency among these variables is that we cannot discover the true influence of price on physicians' locational choice by simply relating the total number of physicians practicing in a state to the observed price of physicians' services there. Possibly a demand-induced rise in price does tend to attract many physicians to a state; but this increase in supply will serve to depress price back towards its original level if the population can only be induced to purchase the additional services at a somewhat reduced price.

To cope with this problem we estimate each of the structural equations of our model by means of two-stage least squares. This procedure allows one to statistically disentangle the web of mutual causality in order to isolate the specific effect of one variable on another. The method consists of obtaining predicted values for each endogenous variable by regressing it on all of the exogenous variables in the model.[3] This is the first stage. The structural equation for each endogenous variable is then estimated by regressing the actual value of that variable on the predicted values of appropriate endogenous variables and on relevant exogenous variables. This is the second stage. With endogenous variables represented by their predicted values, the estimated regression coefficients are not biased by any effect that the dependent variables may have on them.

When employing this two-stage procedure for estimating relationships involving simultaneously determined variables, *only those exogenous variables that appear in the model should be used in estimation of the first stage.* Use of any other exogenous variables may improve the fit in a given sample, but this improvement is spurious because the additional variables play no independent role in the system. A priori considerations can suggest which variables, endogenous and exogenous, are potentially important in explaining the variation we observe, but the final determination of which variables to include in the model is itself an empirical question. Once experimentation with a preliminary, large-scale model determines that certain exogenous variables are actually of no value in the second-stage equations, a new set of first-stage endogenous variable estimates should be formed, based only on the more restricted set of exogenous variables that have been shown to bear a significant relation to the supply-demand mechanism.[4] The rejected hypotheses of the initial model are, of course, an integral part of the conclusions of such an analysis.

The model we present in the following section excludes many variables that one might reasonably expect to affect the demand for, or supply of, physicians' services. The reason for their omission is that tests based upon a preliminary model employing seventeen exogenous variables revealed that only five of these did, in fact, appear in the system.[5] On these grounds we excluded the other twelve exogenous variables from the condensed version of the model presented below, which alone can be considered to possess an unbiased set of first-stage (predicted) endogenous variables. Discussions of the excluded variables and their role in the original model are incorporated into section 2.3, under the appropriate subheadings. A complete list of the variables appearing in each model is presented in Table 16.

2.3 Specification of the Model

The interrelationships among the six endogenous and five exogenous variables of our final model can be summarized by four structural equations and two identities:[6]

(1) $Q^*_D = Q^*_D(\hat{AP} \text{ or } \hat{NP}, \hat{BEN}^*, \hat{MD}^*, INC^*, BEDS^*)$.

(2) $MD^* = MD^*(\hat{AP}, \hat{Q/MD}, MED\ SCLS, BEDS^*, INC^*)$.

---

[3] Endogenous variables are determined within the system ("jointly determined"), while exogenous variables are determined outside the system ("predetermined").

[4] We are indebted to Christopher Sims of the National Bureau for bringing this to our attention.

[5] Some of the excluded exogenous variables were significant in equations in which they appeared, e.g., race as a determinant of health status, but because the endogenous variable health was found to be insignificant in the demand equation, both health and race factored out of the system.

[6] The circumflex (∧) over a variable indicates that its predicted value is used in estimating the equation. An asterisk (*) indicates that the variable is phrased in per capita terms.

TABLE 16

List of Variables

Final Model	Preliminary Model	Full Title of Variable (Units)
		Endogenous
Q*	Q*	Quantity per capita (visits)[a]
MD*	MD*	Private physicians per 100,000 population
Q/MD	Q/MD	Quantity per private physician (visits)[a]
AP	AP	Average price (dollars)
BEN*	BEN*	Insurance benefits per capita (dollars)
NP	NP	Net price (dollars)
	INF MRT	Infant mortality rate per 1,000 live births
	DTH RT	Crude death rate per 1,000 population
		Exogenous
INC*	INC*	Disposable personal income per capita (dollars)
BEDS*	BEDS*	Short-term hospital beds per 1,000 population
MED SCLS	MED SCLS	Number of medical schools
PRM/BEN	PRM/BEN	Ratio of health insurance premiums to benefits
UNION*	UNION*	Union members per 100 population
	EDUC	Median years of education, persons 25 and over
	%BLK	Per cent black
	%AGED	Per cent 65 and over
	%URB	Per cent urban
	BRTH RT	Births per 1,000 population
	TEMP	Mean temperature, average of major cities (degrees F.)
	S&L GOV*	State and local government expenditures for health per capita (dollars)
	HOSP MD*	Hospital staff physicians per 100,000 population
	ΔINC*	Change in disposable personal income per capita 1960-66 (dollars)
	%PART	Per cent of private physicians in partnership practice
	%SPEC	Per cent of private physicians who are specialists
	MD ORIG*	Physicians originating per 100,000 population[b]

[a] G.P. outpatient visit equivalents.
[b] Total of six sample years.

$$\text{(3)}\quad Q/MD = Q/MD\,(\hat{AP}, \hat{MD}, BEDS^*).$$

$$\text{(4)}\quad BEN^* = BEN^*\,(\hat{Q}^*, \hat{AP}, UNIONS^*, PRM/BEN, INC^*).$$

$$\text{(5)}\quad Q^*_D \equiv (MD^*)\,(Q/MD) \equiv Q^*_S.$$

$$\text{(6)}\quad NP \equiv \frac{\text{Expenditures} - \text{Benefits}}{\text{Expenditures}}\,(AP)$$

$$\equiv \frac{AP \cdot Q^* - BEN^*}{AP \cdot Q^*}\,(AP)\,.$$

These relationships are presented diagrammatically in Figures 1 and 2.

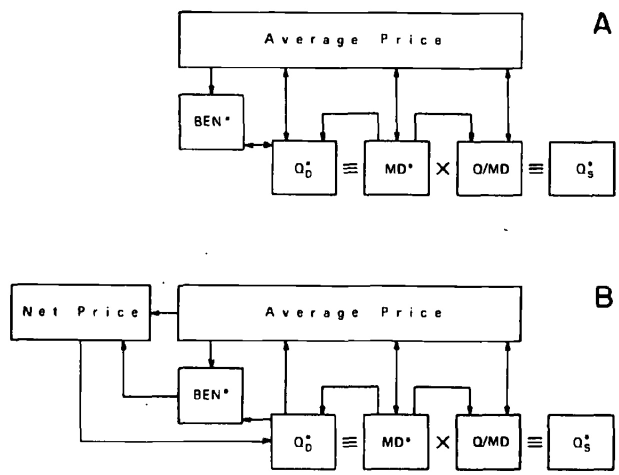


Figure 1.—Relationships Among Endogenous Variables, Alternate Specifications

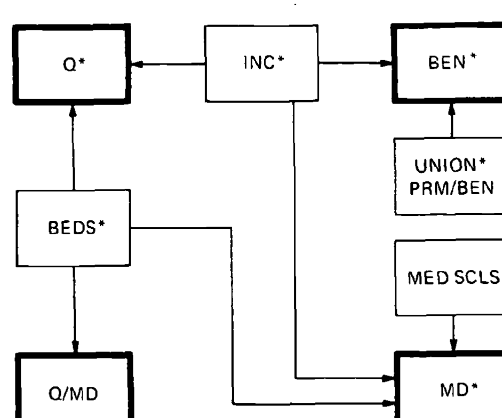


Figure 2.—Effects of Exogenous Variables on Endogenous Variables

In this equilibrium model of the market for physicians' services, the quantity of service demanded per capita (Q^*_D) is identically equal to the product of the two supply variables, number of physicians per capita (MD*) and quantity of service per physician (Q/MD).[7] Because it seems unreasonable to suppose that purchases of medical insurance are unrelated to the price and quantity of the physicians' services covered, medical insurance benefits appear endogenously in the model. Price is represented by two variables: the average price received by physicians for their services (AP) and the net price paid by consumers (NP), which AP exceeds according to the degree to which insurance benefits pay for the cost of the average visit. AP and NP are thus comparable to the time series variables of the same name discussed in Part 1. The exogenous variables in this system are per capita income (INC*), number of medical schools (MED SCLS), hospital beds per capita (BEDS*), labor union members per capita (UNION*), and the ratio of health insurance premiums to health insurance benefits (PRM/BEN).

Both the demand for and the supply of physicians' services are thought to be subject to special forces. Whenever possible, we have attempted to incorporate the unique features often attributed to this market into our model. The following equation-by-equation discussion of the four structural equations listed above considers these issues and indicates the range of questions that can be illuminated by a cross-sectional analysis.

Demand (Q^*_D)

Prices and income are the customary economic determinants of market demand. How important are these financial considerations to consumers in determining their demand for physicians' services? Is the quantity of service demanded at all sensitive to its own price, and if so, to what extent? Does the quantity demanded vary with income? What is the income elasticity?

What is the role of medical insurance in demand? Some investigators believe that it is a major influence on the quantity of care purchased, yet our analysis of the time series data yields no evidence indicative of a systematic relationship between changes in benefit levels and changes in Q*.

A related question concerns the mechanism by which insurance operates on demand (if, indeed, it does). In one specification of the model, NP replaces AP as the relevant demand price variable. The argument for so doing is that the impact of insurance can be entirely attributed to the reduction it effects in the net price of care. The substitution of NP for AP also implies that patients are indifferent to variations in the average amount collected by physicians so long as they are not personally responsible for financing the differentials. A less restrictive test of the role of insurance in demand retains AP as the price variable and adds to the equation the benefits variable, BEN*. This specification leaves open the manner in which insurance affects demand. It also allows for the possibility that consumers are influenced even by those variations in AP which do not translate into variations in NP. If price-consciousness is a firmly ingrained consumer trait, changes in the institutional arrangements governing a particular market may not be strong enough to suppress altogether the usual behavior mechanism whereby low cost goods and services are sought out, regardless of who gets the bill.

Certain services provided by private practice physicians can only be consumed in hospitals: intensive diagnostic work-ups and most surgical procedures are common examples. To a limited extent, then, the services offered by hospitals and by private practice physicians constitute a joint consumption product, hospitalized medical care. If for any reason the supply of hospital beds influences the quantity of hospital care people purchase, an increase in BEDS* may affect the demand for physicians' services as well.

The market for physicians' services is characterized by a high degree of consumer ignorance concerning the need for services and the central role of the physician as an authoritative advisor regarding their use. Given these circumstances, we hypothesize that physicians are able to *generate* a demand for their services without lowering price; we therefore include MD* in the demand equation. When physicians are abundant in a state, they may order care which is not medically indicated (e.g., unnecessary surgery) or of only marginal importance (e.g., cosmetic procedures, numerous postoperative visits, overzealous well-baby care). Alternatively, when physicians are very scarce, patients may lower their

[7] It would, of course, be possible to combine the two dimensions of supply into one overall supply equation, but to do so would be to discard much valuable information regarding the behavior of physicians.

expectations and handle minor complaints with a minimum of physician intervention. There is also another reason why the supply of physicians might exercise a direct influence on the demand for physicians' services. A significant part of the cost incurred by the patient is in the form of time spent in travel and in waiting rooms. A reduction in the relative scarcity of physicians is usually associated with both an improvement in their locational distribution and a decrease in waiting room time. To the extent that the ease or difficulty of seeing a physician is a determinant of demand, we have a second justification for including MD* in the demand equation.

The independent variables in our demand equation thus fall into two categories: economic variables common to any demand analysis (price, income) and institutional factors peculiar to this market (insurance, hospital bed supply, physician supply). Ten additional variables—most of which fall under the heading of "taste" factors—were tested in the preliminary version of the model (see section 2.2). Because none proved to be statistically significant or measurably improved the fit of the equations, these were omitted from the final version of the model presented here, inasmuch as their inclusion would have injected a bias into the first-stage endogenous variable estimates. The rejected demand variables are: education (median years of school of persons 25 and over), urbanization, two measures of health status (the infant mortality rate and the crude death rate), per cent black, per cent aged, the birth rate, mean annual temperature, per capita state and local government expenditures for physicians' services, and number of hospital staff physicians per capita. The last two variables attempted to measure the availability of alternative sources of supply of physicians' services (services by physicians other than private practitioners, who alone enter our study).

Supply of Physicians (MD)*

It is hypothesized that one variable influencing physician location is price. AP is clearly the relevant supply price variable, since it is of little import to the physician whether payment originates with his patients or with insurance companies.[8] To what extent is the present level of inequality in the distribution of physicians—the number of private practitioners per 100,000 ranges from sixty in Mississippi to 134 in New York—attributable to differences in price?

With price held constant, per capita income serves as a taste factor in this equation. Specifically, INC* is here a proxy for the level of cultural, educational, social, and recreational opportunities which a state has to offer. Because physicians as a group are very high earners, nonpecuniary factors of this sort may be a major consideration in their location decision.

Another possible influence on physician distribution is the quality and availability of complementary medical facilities. As a test of this hypothesis we include MED SCLS and BEDS* in the MD* supply equation.

Finally, we investigate the possibility that physicians are disinclined to open a practice in states where the average workload of their would-be colleagues is high. We should observe a negative sign on the endogenous variable $\widehat{Q/MD}$ if it is true that physicians shun areas where they might feel under pressure to work long hours and/or spend less time per patient than they deem optimal.

Originally, we hypothesized that physicians would show some partiality toward their state of origin prior to entry into medical school, but tests with this variable in the preliminary model led to its rejection. Also, no support was found for the view that physicians are drawn to practice in the medically neediest states, with medical need being measured by infant mortality (an endogenous variable), and therefore health, too, was excluded from this equation in the final model.

Quantity of Service per Physician (Q/MD)

The real quantity of services provided by individual physicians varies considerably across states, the coefficient of variation being 15.4 per cent. These productivity differences are an important factor in the interstate variations in physician gross income, which are quite large in view of the fairly high uniformity of skill among physicians.

Three factors are considered as possible influences on physician productivity. As with the supply variable, the relationship with price is an important matter to investigate. Do physicians respond to higher prices by

[8] Physician behavior might conceivably be affected if the source of payment were governmental, because of the consequent red tape and the physician's personal political philosophy. However, only private insurance is considered in this analysis; data on governmental expenditures for physicians' services are unavailable on a state basis.

working more hours and by seeing more patients per hour, or do they display a backward-bending supply curve, cutting back on their workload and maintaining their income while gaining the benefits of additional leisure and a less hectic pace of activity?

An increase in the supply of hospital beds should raise Q/MD if physicians have a tendency to hospitalize more readily whenever the necessary facilities are available.[9] This behavior might arise if there is a technological imperative on the part of physicians to practice the most up-to-date medicine within their grasp.

One of the most critical matters to be investigated is whether areas with a relative scarcity of physicians are partly relieved by enjoying higher physician productivity. It is our hypothesis that the average physician, because of the nature of his professional training, feels under some ethical and social compulsion to supply additional services, even at the same rate of remuneration, when he is in an area poorly endowed with physicians. Thus, we anticipate a negative sign on the $\hat{MD}^*$ variable in the Q/MD equation.

Two other variables were initially tested in this regression: the degree of physician specialization and the extent of partnership (as opposed to solo proprietorship) practice. As neither proved to be significant, the two were omitted from the final model now under consideration.

Insurance (BEN)*

The argument for treating insurance as an endogenous phenomenon can be made on two grounds. The first is that the amount of insurance purchased depends upon the expected level of outlays people are insuring against. Assuming a generally risk-averse population, an increase in expected outlays should call forth the purchase of additional insurance protection. Expected outlays will be highly dependent upon expenditures in the recent past, and the best proxy for this in our model is expenditures in the present. The predicted values of both expenditure components, price and quantity, appear as explanatory variables in the insurance equation as a test of this hypothesis. If it is correct, the estimated coefficients of both variables should be (approximately) equal when the regressions are estimated in double-logarithmic form. If risk aversion itself rises (is constant, or falls) with the level of expected loss, the coefficients will exceed (equal, or fall short of) 1.0.

The other rationale for regarding insurance as endogenous lays stress on the cost of insurance itself rather than on the perceived need for the financial protection it offers. The cost of insurance is defined by the relation PIV = (PRM/BEN) (AP) − AP. PRM/BEN is the ratio of health insurance premiums to benefits, i.e., the average price of purchasing one dollar of health insurance benefits (a figure greater than one). PIV thus represents the average price of insuring one G.P. visit equivalent over and above the price of purchasing it directly. The reason for carrying insurance is that, in the event of extraordinary medical expenses, the return to an individual who expends PRM/BEN will be many times greater than one. Of course, there is also the inherent chance that the return will be as low as zero, but that is the gamble an insured person takes. On the average, an insurance payment of PIV is the nonrecoverable price one pays to be reimbursed for one G.P. visit equivalent. The cost of insuring a given number of visits is thus seen to depend on two factors, the "fairness" of insurance policies and the price of physicians' services.

PRM/BEN is exogenous in our model, being dependent upon such factors as the extent of group coverage compared with individual coverage, and the relative importance of policies issued by nonprofit insuring organizations such as Blue Shield. AP, by contrast, is endogenous. If PIV is found to influence the consumer's willingness to insure, insurance itself is endogenous as a result of this dependence. Because PIV is the price of insuring one visit equivalent and not the price of a dollar's worth of insurance benefits, the dependent variable in this specification should really be the number of insured visit equivalents, or BEN*/AP. For consistency with the financial protection theory of insurance, which demands a dollar measure of benefits, we maintain the BEN* form throughout. When we wish to interpret the price coefficient as the price elasticity of demand for insured visits, however, we must first subtract 1.0 from its estimated value.

In addition to PRM/BEN, two other exogenous variables enter the insurance function: per capita income and the degree of unionization. The potential effectiveness of unions derives from their role in winning fringe benefits in the form of health insurance policies (particu-

[9] Our measure of physician output weights hospital inpatient visits higher than outpatient visits because of differences in their relative prices.

larly desirable because of their untaxed status). Unionization should raise the percentage of the population covered by insurance, since the decision to insure is no longer left to the discretion of the individual, and may also increase the mean level of benefits per insured.

In the preliminary version of our model we tested the hypothesis that people are differentially inclined to insure a newly acquired standard of living as compared to one which has been long held. The change in per capita income over the previous six years proved insignificant in the benefits equation, however, and so was dropped from the final list of exogenous variables. Also rejected on the basis of these early tests was the level of education as a determinant of BEN*.

2.4 The Data

The data used in this analysis come from a variety of sources and are of varying reliability. The critical expenditures and visit series regrettably are not of a kind in which we can place a high degree of confidence. Because interstate variations in these quantities are substantial and move in directions that remain fairly consistent from one year to the next, empirical analysis of the available data does seem justifiable. Nonetheless, until such time as a better data base has been established, conclusions derived from this study can only be suggestive of the true underlying relationships.

Expenditures

Our study population consists of the thirty-three states for which expenditures data are available for 1966.[10] Most of the omitted states have small populations; their absence does not have much effect on the results because each observation in our model is weighted by the square root of the state population. The thirty-three states accounted for 90 per cent of the total U.S. population. The expenditures data come from the Internal Revenue Service and represent the reported gross receipts from medical practice of all self-employed physicians. Thus, this series is comparable to the expenditures data examined in the section on time trends (Part 1).

Availability of expenditures data was one of the key factors in our selection of a year for the cross-sectional analysis. As of this writing, state data on the gross business receipts of "offices of physicians and surgeons" have been published for only five other postwar years. With the exception of 1949 (for which these figures are obtainable for forty-eight states), the size of the sample has been limited (twenty-seven states for fiscal 1960-61, twenty-two for 1963, twenty-eight for 1965, and twenty-six for 1967). The other controlling factor in our decision was the availability of data on physician visits from the National Health Survey. The choice here was between 1957-59, 1963-64, and 1966-67. 1966 was chosen because the requisite expenditures data were available for a relatively large number of states and visit data were also specific to that year.

The accuracy of the expenditures series is not easy to check. The possibility of some underreporting of income is suggested by the fact that the IRS data imply average gross receipts per physician of $46,600, compared with a median of $49,000 reported in *Medical Economics* for the same year. On the other hand, at least some of this disparity is explainable by the fact that *Medical Economics* only surveys full-time, self-employed physicians under the age of sixty-five, while the IRS total includes the smaller average receipts of older physicians and of hospital staff and faculty physicians who devote just a fraction of their working time to private practice. Furthermore, only if the degree of underreporting varied significantly across states would this factor impair the validity of an analysis of variations in expenditures.

Far more serious is the distinct possibility that errors in this series are not uniform across states but have a sizable random component. Our suspicions on this count are based upon intertemporal correlations of expenditures per capita across the twenty-six states for which these data are available for 1965, 1966, and 1967. The correlation coefficient for the 1965-66 comparison is 0.863, and for 1966-67, 0.912.[11] While these figures are high enough to show that there is *something* systematic worth investigating in the pattern of variation in 1966 expenditures, they compare unfavorably with the (weighted) correlation coefficients for per capita disposable income in these states from one year to the next: 0.998 for 1965-66 and 0.997 for 1966-67. Closer examination of the official expenditures data reveals that states with the most extreme jumps in expenditures had parallel shifts in the number of physicians said to be

[10] All series refer to 1966 unless otherwise indicated.

[11] These correlations are weighted by 1966 state population. The unweighted correlations are 0.760 and 0.824, respectively.

filing business income tax returns. These reported shifts in the number of physicians filing returns show virtually no correspondence to changes in the number of physicians practicing in each state, a statistical series kept by the American Medical Association.[12] To cite two of the most extreme examples, the IRS figures show a gain of 45.1 per cent from 1966 to 1967 in the number of physicians filing returns in Wisconsin, and a fall of 25.8 per cent in the number filing in Louisiana. According to the AMA, however, the number of practicing physicians in these two states rose by 1.2 per cent and 2.0 per cent, respectively, over this period.[13] It is apparent that official statistics on health care expenditures are in much need of improvement. Changes in nationwide expenditures totals over long periods no doubt provide a fairly accurate indication of changes actually taking place. For specific years or specific states, however, deficiencies in the statistical data now constitute a major impediment to serious research.

Physicians

The scope of the market for physicians' services relevant to our study does not extend beyond the bounds of private practice. As the official expenditures series is limited to physicians' gross receipts from self-employment practice, so the MD series we have chosen (our source is the American Medical Association) is restricted to private practitioners.

Unlike the IRS count of physicians filing business income tax returns, the AMA data have the conceptual advantage of including salaried physicians in private practice, whose services go to meet the same demand as those of the self-employed and whose contribution to gross receipts may be considerable. The fact that the AMA bases its count on the results of routine questionnaires sent annually to all physicians while the IRS estimate derives from a sample of physicians filing a rather unpopular tax report makes the AMA series superior from a statistical viewpoint. Also, as noted above, the extreme instability of the IRS figures calls into question that data-gathering process itself. Unfortunately, neither the AMA nor the IRS series permits us to calculate precisely the number of full-time equivalent physicians in private practice; the former covers physicians whose *principal* mode of employment is private practice, while the latter covers all physicians with some self-employment income, no matter how small a fraction of their professional time is involved. On balance, however, the AMA series probably more closely approximates the desired figure of full-time equivalent physicians, since it includes some but not all part-timers and since it is not restricted to the self-employed.

Quantity and Average Price

Two of the most important series, quantity of service and average price, are not directly available and must be estimated. The quantity series we estimate is a measure of "general practitioner (G. P.) outpatient visit equivalents," a fairly homogeneous unit across states. Dividing expenditures by quantity then gives us an implicit price series, which represents the average price of a G. P. outpatient visit equivalent.

The quantity series is derived in the following way. The National Center for Health Statistics has published data on home and office visits per capita for the four census regions in 1966-67 and for the nine census divisions in 1957-59. We assume an intraregion per capita visit distribution of the 1966-67 data based on the distribution that prevailed in the earlier period. The resulting home and office visit figure for each division is then attributed to each state within that division.

---

[12] Simple regressions across states of the annual change in total expenditures $\frac{EXP_{t+1}}{EXP_t}$ on the annual change in physicians filing returns $\frac{IRS_{t+1}}{IRS_t}$ show the independent variable to be highly significant and the explanatory power of the equation fairly high. $\frac{IRS_{t+1}}{IRS_t}$, however, bears almost no relation to the percentage change in private practitioners $\frac{MD_{t+1}}{MD_t}$, as recorded by the AMA, even though the correlation between IRS and MD for any given year is on the order of .99.

Dependent Variable	Independent Variable	Coefficient (Standard Error)	R^2
$\frac{EXP_{67}}{EXP_{66}}$	$\frac{IRS_{67}}{IRS_{66}}$	.50 (.13)	.40
$\frac{EXP_{66}}{EXP_{65}}$	$\frac{IRS_{66}}{IRS_{65}}$	.66 (.10)	.63
$\frac{IRS_{67}}{IRS_{66}}$	$\frac{MD_{67}}{MD_{66}}$	1.82 (1.99)	.03
$\frac{IRS_{66}}{IRS_{65}}$	$\frac{MD_{66}}{MD_{65}}$	1.09 (2.69)	.01

[13] The AMA figures refer to private practice physicians only.

Next, the number of hospital visits is estimated for each state from the number of patient days spent in nonfederal short-term hospitals. Our assumption of one visit for each day of stay is supported by *Medical Economics*, which reports that the median number of hospital visits made by private practitioners in 1966 was twenty-two per week and that the median number of weeks worked per year was forty-eight. If private practitioners in the thirty-three states of our study conformed to the *Medical Economics* medians, they would have made 177 million hospital visits. In fact, the total number of patient days in these states was very close to this, 185 million. Combining these disparate visit series, hospital inpatient visits are given a weight of 1.71 relative to home and office visits, this being the national ratio of average charges for the two categories of visits, according to Department of Health, Education, and Welfare statistics.[14]

A final adjustment takes account of the fact that the distribution of total visits between G. P.'s and specialists varies across states. A visit to a specialist is accorded a weight of 1.93 relative to a G. P. visit, based on the ratio of average gross receipts per visit. In estimating the percentage of total visits made by specialists in each state, we, of course, make an allowance for the smaller visit load of specialists (.63 as many visits as G. P.'s).[15]

There undoubtedly are some errors in the resulting quantity series and the price series derived from it, but we are not aware of any systematic biases. Some confirmation of the validity of the overall approach may be found in the fact that the resulting average price for a G. P. visit in our series is $5.75, which is very close to the $5.48 implicit in *Medical Economics* data for the same year.

Other Variables

All series pertaining to insurance are based upon data in the *Source Book of Health Insurance*, an annual publication of the Health Insurance Institute. The two endogenous insurance variables, BEN* and NP, refer only to insurance coverage for physicians' services, i.e., surgical, regular medical, and a share of major medical. The exogenous PRM/BEN variable pertains to all forms of health insurance (physician, hospital, and disability).

Information regarding the number of medical schools in each state (MED SCLS) is taken from the annual education issue of the *Journal of the American Medical Association*. BEDS* represents the bed capacity of short-term, general, and other special hospitals, a series made available by the American Hospital Association. Figures on per capita disposable personal income in each state (INC*) are published in the *Survey of Current Business*. The *Statistical Abstract of the United States* provides data on labor union membership (UNION*).

Summary statistics for all variables are presented in Table 17. A complete description of the method developed to estimate Q* and the details of all other calculations may be found in Appendix C, which also includes specific source references, data tables listing the most important series, and a correlation matrix.

2.5 Regression Results

Table 18 presents the results of the second-stage regressions. All of the equations are estimated in double-logarithmic form, the estimated coefficients thus representing elasticities.[16] To avoid problems of heteroscedasticity, each observation is weighted by the square root of the state's population.[17] In computing the t statistics for each variable, we have made those adjustments appropriate for two-stage estimation.[18]

---

[14]Office of Research and Statistics, Social Security Administration, U.S. Department of Health, Education, and Welfare, "Current Medicare Survey Report," *Health Insurance Statistics*, CMS-12, January 27, 1970.

[15]Both figures are derived from survey data published in *Medical Economics* (see Appendix C).

[16]The one exception applies to MED SCLS, which is phrased as a linear variable because it sometimes takes on the value zero.

[17]Plots of the residuals from unweighted regressions demonstrate an inverse relationship between population and the size of the unexplained residual.

[18]t statistics are ordinarily obtained by dividing each coefficient by its standard error, but this procedure is not valid when the predicted values of endogenous variables appear on the right-hand side of an equation. In such cases the following adjustment is necessary: (1) Recompute the residuals for each observation by applying the estimated second-stage regression coefficients to the *actual* values of the included endogenous variables. (2) Obtain the ratio of the sum of squared residuals from the recomputed equation to the sum of squared residuals from the estimated regression. (3) Multiply each of the original t statistics for a particular regression equation by this factor (which may be equal to, greater than, or less than, 1.0) in order to arrive at a set of adjusted t statistics applicable to the second-stage regression. We are most grateful to Christopher Sims for bringing this to our attention.

TABLE 17

Summary Statistics, Thirty-three States, 1966

Symbol	Full Title of Variable (Units)	Mean[a]	Standard Deviation[a]	Coefficient of Variation (Per Cent)
EXP*	Expenditures per capita (dollars)	44.49	10.66	24.0
Q*	Quantity per capita (visits)[b]	7.71	.72	9.4
AP	Average price (dollars)	5.75	1.16	20.1
NP	Net price (dollars)	3.70	1.16	31.4
BEN*	Insurance benefits per capita (dollars)	16.00	4.29	26.8
MD*	Private physicians per 100,000 population	95.4	22.6	23.6
EXP/MD	Expenditures (gross income) per private physician (dollars)	47,003	5,900	12.6
Q/MD	Quantity per private physician (visits)[b]	8,354	1,290	15.4
DTH RT	Crude death rate per 1,000 population	9.42	.93	9.9
INF MRT	Infant mortality rate per 1,000 live births	23.7	3.2	13.6
INC*	Disposable personal income per capita (dollars)	2,605	418	16.0
MED SCLS	Number of medical schools	3.62	2.82	77.9
UNION*	Union members per 100 population	9.5	4.0	42.4
BEDS*	Short-term hospital beds per 1,000 population	3.78	.53	14.1
PRM/BEN	Ratio of health insurance premiums to benefits	1.27	.08	6.6
%SPEC	Per cent of private physicians who are specialists	64.9	5.9	9.0
ΔINC*	Change in disposable personal income per capita, 1960-66 (dollars)	663	89	13.4
EDUC	Median years of education, persons 25 & over	10.5	.98	9.3
%AGED	Per cent 65 and over	9.5	1.4	14.7
%BLK	Per cent black	11.2	8.7	78.3
%PART	Per cent of private physicians in partnership practice	24.1	8.6	35.5
BRTH RT	Birth rate per 1,000 population	18.5	1.17	6.3
MD ORIG*	Physicians originating per 1,000 population[c]	2.08	.61	29.4
S&L GOV*	State and local government expenditures for health, per capita (dollars)	34.26	11.41	33.3
HOSP MD*	Hospital staff physicians per 100,000 population	28.4	13.9	49.1
TEMP	Mean temperature, average of major cities (degrees F.)	56.3	7.1	12.5
%URB	Per cent urban	70.6	13.8	19.5

[a] Each observation weighted by square root of population of state.
[b] G. P. outpatient visits equivalents.
[c] Total of six sample years.

TABLE 18

Results of Weighted, Logarithmic Regressions, Second Stage, Interstate Model, 1966 (N=33)

Equation	$\bar{R}^2$	INC*	$\hat{AP}$	$\hat{NP}$	$\hat{BEN}$*	$\hat{MD}$*	BEDS*
			Part A: Q* (Quantity per Capita)				
A.1	.515	0.412[b] (5.92)					
A.2	.578	0.571[b] (9.25)	-0.290[b] (-3.58)				
A.3	.588	0.269 (1.64)	-0.205[a] (-2.25)		0.177 (1.99)		
A.4	.585		-0.104 (-1.65)		0.313[b] (9.97)		
A.5	.566	0.449[b] (9.94)		-0.153[b] (-3.24)			
A.6	.732	0.199[a] (2.54)	-0.356[b] (-5.28)			0.388[b] (6.28)	
A.7	.727	0.042 (0.61)		-0.200[b] (-5.55)		0.397[b] (6.90)	
A.8	.735			-0.201[b] (-5.63)		0.428[b] (15.10)	
A.9	.715		-0.297[b] (-4.16)			0.507[b] (11.22)	
A.10....	.746			-0.059 (-0.69)		0.359[b] (7.34)	0.193 (1.95)
A.11....	.752					0.335[b] (12.01)	0.252[b] (6.06)

Equation	$\bar{R}^2$	MED SCLS[c]	INC*	$\hat{AP}$	BEDS*	$\hat{Q/MD}$	
		Part B: MD* (Physicians per 100,000 Population)					
B.1	.521	0.059[b] (5.99)					
B.2	.754	0.036[b] (4.37)	0.750[b] (5.51)				
B.3	.731	0.050[b] (8.46)		0.828[b] (6.40)			
B.4	.509	0.061[b] (5.63)			-0.107 (-0.48)		
B.5	.775	0.040[b] (4.16)	0.490[a] (2.21)	0.419 (1.64)			
B.6	.784	0.036[b] (8.54)	0.071 (0.40)	1.052[b] (4.26)	0.492[b] (2.86)		

(Continued)

TABLE 18–Concluded

Equation	$\bar{R}^2$	MED SCLS[c]	INC*	$\hat{AP}$	BEDS*	$\hat{Q/MD}$
		Part B: MD* (Physicians per 100,000 Population)–Continued				
B.7......	.791	0.037[b] (10.34)		1.144[b] (14.64)	0.550[b] (7.04)	
B.8......	.755	0.039[b] (4.47)	0.759[b] (5.57)		-0.161 (-1.02)	
B.9.	.783	0.032 (0.69)		0.994 (0.71)	0.528[a] (2.35)	-0.199 (-0.11)
B.10.....	.776	0.027 (0.36)	0.080 (0.27)	0.752 (0.31)	0.443 (0.92)	-0.382 (-0.13)

Equation	$\bar{R}^2$	$\hat{AP}$	BEDS*	$\hat{MD}$
		Part C: Q/MD (Quantity per Physician)		
C.1......	.420	-0.828[b] (-3.84)		
C.2......	.603			-0.622[b] (-3.25)
C.3......	.622	-0.297 (-0.57)		-0.494 (-1.50)
C.4......	.622	0.012 (0.01)	0.259 (0.39)	-0.672 (-1.21)
C.5......	.635		0.252 (0.71)	-0.665[b] (-2.80)

Equation	$\bar{R}^2$	INC*	UNION*	PRM/BEN	$\hat{AP}$	$\hat{Q}$*
		Part D: BEN* (Physician Insurance Benefits per Capita)				
D.1......	.735	1.442[b] (9.47)				
D.2......	.812	0.761[b] (3.39)	0.254[b] (3.70)			
D.3......	.819	1.465[b] (10.89)		-1.576[b] (-5.04)	-0.739[b] (-4.26)	
D.4......	.754	1.270[b] (3.62)			-0.259 (-0.93)	0.761 (1.43)
D.5......	.814	1.605[b] (6.66)		-1.691[b] (-5.04)	-0.838[b] (-3.87)	-0.277 (-0.68)
D.6......	.823	1.060[b] (3.28)	0.130 (1.48)	-1.116[a] (-2.22)	-0.430 (-1.42)	
D.7......	.820	0.513 (0.77)	0.201 (1.82)	-0.596 (-0.82)	-0.030 (-0.06)	0.634 (0.91)

Note: Adjusted t statistics appear in parentheses.

[a] Significant at .05 level. [b] Significant at .01 level. [c] Linear variable.

Part A: Demand (Q*)

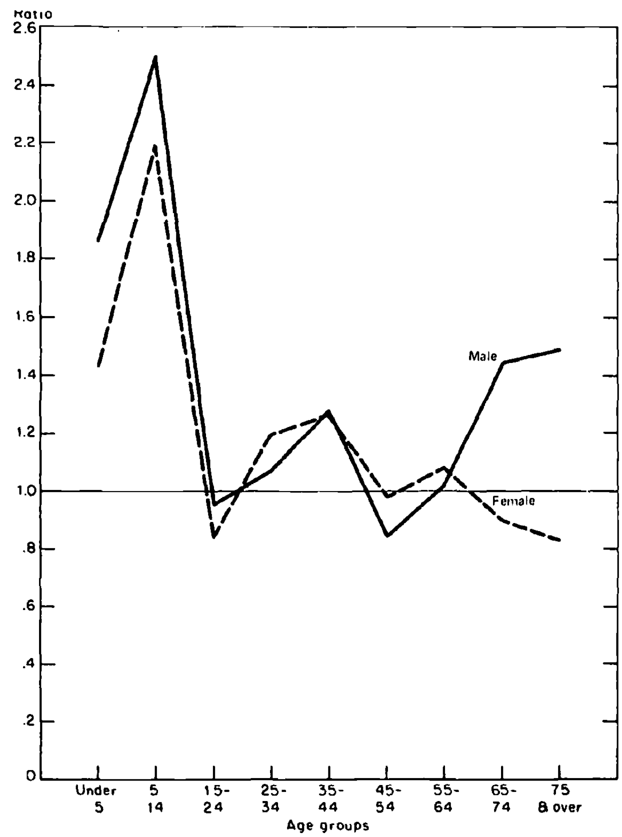
Income. Estimates of the income elasticity of demand vary over a wide range (0.04 to 0.57), but, taken together, the equations support the findings of previous investigators that physicians' services are considered to be very much of a necessity, with an income elasticity substantially below 1.0. Our results correspond particularly closely with those of Andersen and Benham [4], even though the units of observation are quite different (1966 state averages in one instance, 1964 family units in the other).[19] Simple regressions with income as the sole independent variable produce elasticities of 0.41 and 0.31, respectively, both coefficients significant at the 0.01 level. The results for multiple regressions are also similar. In our more successful demand equations (A.6-A.11) we observe considerably lower and much less significant income coefficients (0.20 in A.6, 0.04 in A.7), when indeed income appears at all. Andersen and Benham report a statistically insignificant income elasticity of 0.01 in multiple regression.[20]

It should, of course, be stressed that all of these values refer to the responsiveness of quantity–not of expenditures–to changes in income. The difference between the two is not trivial, given the tendency of AP to rise with income. A simple regression with per capita expenditures as the dependent variable yields an income coefficient of 0.96.

One factor that might possibly contribute to the very low income elasticity of demand is the high correlation of income with earnings, which, in turn, is a good indication of the price of time. Physicians' services are usually time-intensive, and this means that they are more costly to those with high earnings. Had we estimated the effect of income with earnings held constant, it is likely that a higher elasticity would result.[21] Unfortunately, the requisite state data are not available.

Chart 4

Ratio of Number of Physician Visits by Persons with Family Income Greater than $10,000 to Visits by Persons with Family Income Less than $3,000, by Age and Sex, 1966-67



Source: U.S. Department of Health, Education, and Welfare, "Volume of Physician Visits, United States, July 1966-June 1967," *Vital and Health Statistics,* Series 10, No. 49, November 1968, p. 19.

The importance of the earnings factor can be appreciated from Chart 4, which shows, for various age and sex classes, the 1966 ratio of per capita physician visits made by persons with family incomes over $10,000 to those made by persons with family incomes under $3,000.

[19] Andersen and Benham, in their calculations for physician use, employ an estimate of "permanent income" as the independent variable rather than measured income, but this does not imply incomparability with our results since the transitory component of income is largely eliminated by using grouped data.

[20] Other demand elasticities reported in the literature are 0.62 and 0.21, respectively, in Feldstein [17] and Fein [15]. The elasticity implicit in Fein's book was computed by Herbert Klarman [27].

[21] Morris Silver postulates a *positive* relationship between earnings and *expenditures* for physicians' services, and his results bear this out [40]. But such a finding can be readily explained by the close association between earnings and price. It does not necessarily contradict our view that high earnings have a negative impact on the quantity component of expenditures.

Both sexes under the age of fourteen display very high visit-relatives; the same holds true for males aged sixty-five and over. In essence, earnings are held nearly constant (at approximately zero) as family income rises for these groups, allowing us to observe the effect on demand of income alone. The implicit income elasticities of demand are still less than 1.0, but hardly negligible. By contrast, income exerts no systematic influence upon visits of persons aged fifteen to sixty-four; the positive effect of income on demand, we believe, is nullified by the negative effect of earnings (i.e., the price of time). Also in accord with our expectations is the fact that among the twenty-five to sixty-four age group, where male labor-force participation rates are roughly twice as large as those for females, income exerts somewhat more of an influence on visits by females than visits by males. Indeed, only two of the eighteen age-sex categories behave in a contrary fashion to what we would expect under our hypothesis if it were the sole means of explaining age-sex differences in the effect of income on demand.[22]

Omission of quality differences from our quantity measure may also be exerting a downward bias on the estimated income elasticity, but the nature of medical education in this country (all recognized schools must have AMA accreditation, and National Board Examinations are increasingly employed as a state licensure requirement) makes it unlikely that state-to-state quality differences among physicians are an important factor. On balance, we believe that variations in earnings, on the one hand, and patients' *belief* in the essential nature of physicians' services, on the other, are responsible for the low income elasticity of demand.[23]

We should emphasize that problems of multicollinearity prevent any firm conclusions regarding the exact magnitude of the income coefficient. Thus, our income elasticities are consistently larger and generally more significant in the equations that do not consider MD* as a variable than in those that do. The great improvement in explanatory power which results with the introduction of MD* (A.6 versus A.2, A.7 versus A.5) and the consistently high t statistic attaching to the physician variable lend credence to the latter specification. It is clear that, of the two variables, MD* is dominant, with income playing a comparatively minor role. These qualifications notwithstanding, there is nothing in these equations—regardless of what combination of variables we consider—to suggest an income elasticity even approaching 1.0. All of the evidence indicates that the demand for physicians' services is quite income-inelastic, though precisely to what degree we cannot accurately say.

Price and Insurance. The price elasticity of demand for physicians' services appears to be unusually low. None of the equations reported in Table 18.A show AP or NP coefficients exceeding (in absolute value) −0.36. The t statistics on the price variables indicate that a high degree of confidence can be placed in this finding. Our result parallels Paul Feldstein's finding [17] of a low demand price elasticity of −0.19, also significantly different from zero.[24]

There are three principal explanations for the relative insensitivity of demand to changes in price. First, it should be remembered that the demand for physicians' services is derived from the consumer's demand for health. Michael Grossman has estimated the price elasticity of demand for health at −0.5 [22], which seems reasonable, given the absence of any close substitutes for health. The price elasticity of demand for a derived input must be lower than for the final commodity unless there are important possibilities of substitution with other inputs. This leads to the second explanation, namely, that there are many legal and psychological barriers against the substitution of persons without the M.D. degree in the physicians's role, even though such persons might be good substitutes in a technical sense. Similarly, there are many factors other than medical manpower that contribute to the individual's production of health, including diet, housing, recreation, and education. These may, in fact, be excellent alternatives to physicians' services in the long run, but may not be so regarded by the patient.[25]

Finally, it should be noted that the price paid is only part of the total cost of physicians' services to the

[22] Visit-relatives for women sixty-five to seventy-five and seventy-five and over rise rapidly, as predicted, over low income classes, but then fall even more steeply, for some unknown reason, over high income classes.

[23] This is not to say that all, or even most, physicians' services are technically essential for health. To *believe* in their efficacy is sufficient to make the average individual treat them as a necessity in his budget.

[24] Feldstein's study pertained to physician visits by families in 1953.

[25] The same argument can be made with regard to "negative inputs" in the production of health, including such consumption items as tobacco, alcohol, narcotics, and (occasionally) motor vehicles.

patient. In addition to possible inconvenience, the patient must reckon with costs of transportation and, more important, time spent in travel, waiting, and during the visit itself. These indirect costs (IC) vary greatly from individual to individual, though in general we would expect a positive association between them and the direct cost of a visit (AP) because IC is closely dependent upon the price of time, AP varies with income, and both income and the price of time are highly correlated with earnings. In the event that IC and AP are perfectly correlated, variations in AP are exactly proportional to variations in the total price of a visit and the AP coefficients we estimate are not biased, despite the omission of an IC variable. If, however, IC tends to rise faster than AP, we are underestimating the true interstate variation in price and thereby overestimating the price elasticity of demand, and vice versa. The direction of possible bias from this source is not ascertainable.

The relevance of insurance to demand is tested in two ways. We first investigate the role of insurance using the BEN* variable. Unfortunately, strong multicollinearity between income and benefits prevents any conclusions on this score. The $\bar{R}^2$ is essentially unchanged, whether we employ income, benefits, or both in the demand regression (A.2-A.4); while either variable alone is highly significant, both show much lower t values when they appear jointly. It is impossible to infer how much of the observed variation in Q* is attributable to each of these variables, or what the true coefficients of each are.

NP is superior to BEN* as a measure of insurance because of its much smaller correlation with INC* (0.14 versus 0.86). Using NP we may consider all economic influences on demand simultaneously (i.e., income, average price, and insurance, the latter two embodied in the NP variable). With insurance thus accounted for, we observe a somewhat smaller but still very significant income elasticity as compared to the case of income and average price considered alone (A.5 versus A.2). The high correlation between AP and NP nonetheless complicates the critical judgment as to whether insurance per se is important to demand. In some instances AP is the stronger variable (A.6 versus A.5), while in others the situation is reversed and NP is stronger (A.8 versus A.9). But in any case, the price elasticity of demand is not much affected by the choice between these two price variables.

What we can say with assurance concerning the role of insurance in demand is that the elasticity of Q* with respect to BEN* is, at most, fairly low. That is, even under the extreme assumption that INC* is of *no* real importance in this relation, the elasticity with respect to BEN* is only 0.31. The very large t statistic on BEN* in A.4 indicates not only that this coefficient is significantly greater than 0, but also that it is significantly less than 0.4. Such a finding is not in line with our prior notions concerning the effect of insurance, despite the fact that in at least one instance comparable findings have been reported in the literature.[26] Some discussion of possible explanations is, therefore, in order.

First, the prevailing impression about insurance is that it induces higher utilization by lowering the price faced by the consumer. Yet if this is the mechanism through which insurance operates on demand, and if demand is price-inelastic, as we have found the case to be, it is to be expected that demand will also be insurance-inelastic. For example, if benefits initially reimburse 40 per cent of average price, a 1 per cent rise in BEN* will produce a 0.67 per cent fall in NP (from 0.60 AP to 0.596 AP). With a (net) price elasticity of −0.20, this will result in only a 0.13 per cent rise in Q* (close to the 0.18 rise shown by A.3). On the other hand, if demand were highly responsive to price changes, say with an elasticity of −1.5, the same 1 per cent rise in BEN* would call forth a 1.00 per cent rise in Q*. It should be noted that we would expect the effect of insurance on demand to be greater among persons with a very low or negligible price of time (the young, the elderly, the unemployed), because incremental insurance benefits for them result in a much larger percentage change in the full price of a visit.

A second factor is that private insurance for physicians' services is usually heavily biased toward coverage of relatively nondiscretionary care. Surgical procedures and in-hospital care are far more likely to be reimbursed than routine office visits or preventive services [34]; This restriction in coverage may greatly reduce the impact of insurance relative to what it might have been.

Physicians. The highly significant role of MD* in the demand equation requires some discussion. It cannot be attributed to a supply-induced fall in the

[26] Paul Feldstein [17] uses an insurance variable (the ratio of benefits to expenditures) in his demand analysis. Contrary to his expectations, the elasticity is negative, though insignificant. Regrettably, no discussion of this finding appears in the text.

physician's fee because price (AP or NP) is already held constant. Rather, it seems to be the result of the following forces.

First, an increase in MD* is likely to reduce the average distance separating patient and physician, as well as the average waiting time. The consequent saving in time and transportation expense lowers the total cost of a visit to the patient even if fees are held constant. Given a low price elasticity of demand, however, this factor alone is insufficient to account for the magnitude of the MD* coefficient.

A second possibility is that physicians themselves inflate demand whenever the supply of medical manpower is relatively slack. This thesis is put forth persuasively by Eli Ginzberg: "... the supply of medical resources has thus far effectively generated its own demand.... Much unnecessary surgery continues to be performed.... There is substantial overdoctoring for a host of diseases, including, in particular, infections of the upper respiratory tract.... [physicians] usually have wide margins of discretion about whether to recommend that a patient return to the office for one or more follow-up visits [21]."

A supply-induced demand change is fully sufficient as an explanation for the role of MD* in the Q* equations of Table 18.A; if verified, its implications for policy are profound. Evidence that the additional physicians' services provided under loose supply conditions are, in fact, of a marginal nature is presented in the discussion of the effect of physicians' services on health in section 2.6. This much is to be expected if, as Ginzberg also suggests, physicians gravitate towards the more serious cases as their supply becomes taut.

A third possible explanation for the importance of MD* is the existence of permanent excess demand for physicians' services. This is the thesis advanced by Martin Feldstein [16], whose time series analysis of this market yielded positive demand price elasticities (as high as 1.67), inconsistent with an equilibrium hypothesis. Feldstein's negative and significant insurance elasticities and his occasionally negative income elasticities are likewise inexplicable under normal market conditions. In our view, a much simpler interpretation of Feldstein's results is the failure to take account of technological change, which shifted the demand curve to the right over time, and not at a constant rate. Since the cross-section regressions, which essentially hold technology constant, are readily interpretable under the assumption of market equilibrium, we see no reason to substitute either here or in the time series the less defensible explanation of permanent excess demand.

Hospital Bed Supply. Introducing BEDS* into any of the demand equations discussed above seriously affects the conclusions to be drawn regarding price (either AP or NP). A.10 is illustrative: The price coefficient approaches zero (in some equations it actually becomes positive) and the variable loses all statistical significance. Indeed, the "best" demand equations, in terms of sheer explanatory power ($\bar{R}^2$), is one in which price, income, and insurance have all been dropped and only MD* and BEDS* appear (A.11).

Accepting the results of A.11 on face value may nonetheless be seriously misleading. To be sure, a rationale is advanced here in support of a causal relationship running from bed supply to demand for physicians' services. That is, the services of hospitals and of physicians are in many ways a joint consumption item, and thus an increase in the former serving to meet a backlog in *its* demand will permit an expanded consumption of physicians' services, desired but technically unfeasible previously due to the unavailability of the requisite hospital facilities. Beyond this, if the frequent allegation is true that the supply of hospital beds tends to create its own demand, it follows that any increase in BEDS*, even if wholly unrelated to the prevailing demand for hospitalization, will (indirectly) raise Q* as well.

The trouble with this explanation for the role of BEDS* in the Q* equation is that it takes no account of the fact that the relationship between these two variables is inherently biased by the very method used to construct Q*. Hospital days per capita comprise one of the three components of the quantity series, and because there is so little interstate variation in occupancy rates, days are almost entirely proportional to bed capacity. In our judgment, BEDS* is probably significant in the Q* equation not so much because it bears a causal relationship to the dependent variable but rather because of the statistical dependence of Q* upon BEDS*. Equations in section A that do not include BEDS* are probably more accurate indications of the true determinants of demand for this reason.

Part B: Supply of Physicians (MD*)

Medical schools, price, hospital bed supply, and per capita income are the principal factors influencing physicians' locational decisions (Table 18.B). Collinearity among the last three of these variables makes it difficult to determine precisely the specific effect of each, but the four together account for about 78 per cent of the variation in MD*.

The role of the medical school in physician location is twofold. As a center of education it draws doctors-to-be to the state, and its affiliated hospitals attract interns and residents. Professional contacts are established, and young families take root. As a major medical center, it generally promises superior staff and facilities in its teaching hospitals. Regardless of where they trained, physicians may find it advantageous to have such a complex within close proximity of their practice, for it allows them to arrange referrals and consultations while maintaining contact with the patient. Our estimated coefficient, highly significant in all but two cases, indicates that on the average one additional medical school in a state raises the number of physicians practicing there by about 4 per cent.

A glance at equations B.2-B.8 makes apparent the presence of collinearity among the three other important location variables. Price is highly significant, with coefficients ranging from 0.83 to 1.14, in those equations where it appears alone with MED SCLS or where BEDS* is also present (B.3, B.6, B.7), but with BEDS* dropped and INC* retained, the price coefficient falls considerably and loses its significance (B.5). In like fashion, INC* is a significant variable, with an elasticity of 0.49 to 0.76, when it appears alone with MED SCLS or in conjunction with either AP or BEDS* (B.2, B.5, B.8), but both its coefficient and its adjusted t statistic plummet when all four variables enter the equation (B.6). Similarly, BEDS* is significant if, and only if, AP also appears in the equation (B.6 and B.7, but not B.4 or B.8). It is with caution, therefore, that we proceed to a discussion of these results.

Our average price measure is clearly superior as a supply variable in this context to physician gross income, the monetary incentive variable employed by Benham, Maurizi, and Reder [7]. In their analysis the two-stage least squares method was utilized to estimate demand and supply equations for the number of physicians in each state in 1950, but, while physician income had a positive sign in the supply equation, it was not statistically significant. This is as expected: business receipts are positively related to workload as well as to price, and it is surely unreasonable to expect doctors to be attracted to states where they can anticipate little leisure time. If anything, the opposite hypothesis merits consideration, and we investigate this possibility. Unlike the demand equations, where there was some question regarding the specification of the relevent price variable itself (AP or NP), AP is obviously the correct choice in this case, since it matters little, if at all, to the supplier of services who is paying the bills he sends out.

INC* serves in the physician supply equation as a general taste variable rather than as an indication of financial inducements to settlement, since price is also held constant. As predicted, the life style available in high-income states does appear to exercise some influence over the location of physicians.[27] Hospital bed supply—which is probably a proxy in a more general sense for the whole range of medical facilities and auxiliary personnel—also appears to be an important nonpecuniary consideration in physicians' location decisions.

No support is found for the view that physicians actually shun states where the average physician workload is high. The endogenous $\hat{Q}$/MD variable bears the anticipated negative sign but never approaches significance, and its inclusion, in fact, only serves to reduce the adjusted R^2 of the regression (B.9 versus B.7, B.10 versus B.6). That certain areas, both rural and urban

[27] Because the total number of practicing physicians in the country (MD_t) is constant in cross-section, an analysis such as this can only throw light on the reasons for geographic variation in this total. Given the presence of substantial barriers to entry into medicine, it is wholly unwarranted to conclude that the same behavioral patterns observed for physicians in cross-section will also apply over time in the determination of MD_t. In all probability, a proportional change in INC* across all states would have no effect on MD_t or on the particular state levels of MD^*_{it}. It follows that only variations in *relative* income are potentially influential in determining the geographic distribution of a given number of physicians. The relative attractiveness of a state is best represented by $\frac{INC_i^*}{\overline{INC^*}}$, where the denominator represents mean per capita income for the sample. Replacing our INC* variables with this relative income measure would have no effect on the estimated elasticities because the corresponding values of both variables are proportional in any one year. But it is best kept in mind that the INC* variable of Table 18.B should only be interpreted in a relative sense.

ghetto, are unpopular with physicians is indisputable, but fear of overwork does not appear to be a factor in their judgment.

Part C: Quantity per Physician (Q/MD)

The number of physicians per capita is the only variable tested that clearly has a significant impact on physician productivity. It alone accounts for 60 per cent of the variation in Q/MD. The coefficient of the $\hat{MD}^*$ variable indicates that about two-thirds of the incremental supply of physicians' services that might be expected to ensue with an increase in the number of physicians practicing in a state will be effectively nullified by a reduction in output of the average practitioner. These results suggest that increases in the number of physicians in a state, whether resulting from shifts in distribution or expansion of the total stock, may actually result in *higher* prices for physicians' services. According to the regressions, a 10 per cent rise in MD* will lead to a 4 per cent rise in demand as the new physicians create a market for their services, but the supply of services may rise by as little as 3 1/3 per cent once resident doctors have adjusted to the decreased urgency of unattended cases and opted for a reduction in their activity.

The price elasticity of supply per physician is probably low. Only a very small degree of confidence can attach to the initial finding of a negative price elasticity. Some collinearity between AP and MD* is present, as demonstrated by the reduced t statistic of each when they appear jointly (C.1 and C.2 versus C.3); although C.3, with price included, is superior to C.2, C.4 is inferior to C.5. These results are not unlike those reported by Martin Feldstein [16]: price coefficients in his supply-per-physician equations range from −0.28 to −1.91, with only the higher (absolute) values achieving significance at the 5 per cent level. In any case, we find no support for the hypothesis that higher prices induce *additional* services from physicians already located in a state.

Adding BEDS* to the productivity equation with only MD* in it increases the explanatory power by a fair amount (C.5 versus C.2), but the BEDS* coefficient is statistically insignificant and of a low magnitude.

Part D: Insurance (BEN*)

The purchase of physician insurance by consumers, as distinct from physician care itself, appears to be very sensitive to variations in personal income. We find elasticities ranging from 0.76 to 1.61, and in all cases but one they are significant at the 1 per cent level (the exception is D.7, where the simultaneous presence of so many independent variables cancels the significance of each and also lowers the INC* elasticity).

Three other hypotheses are investigated relating to the determinants of BEN*. Again, because of high correlations among the independent variables, we test these theories one at a time before assessing their effects in combination.

The degree of unionization has a small but important effect on BEN*, raising the $\bar{R}^2$ from 0.74 in D.1 to 0.81 in D.2. This conclusion is weakened when PRM/BEN and AP also appear in the equation, but even then the $\bar{R}^2$ is improved by inclusion of UNION* (D.6 versus D.3).

The purchase of insurance seems to be very responsive to its price, PIV. This composite variable is dependent both upon the average price of physicians' services and upon the cost of one dollar of insurance benefits. As predicted by this hypothesis, the coefficients of AP and PRM/BEN are each negative and highly significant in D.3. Deducting 1.0 from the estimated AP coefficient allows us to interpret the equation as a representation of the demand for insured visit equivalents (i.e., BEN*/AP). We see that the price elasticity of demand, as indicated by both PIV components, appears to be quite high, on the order of −1.58 to −1.74.[28] Apparently, the decision to purchase medical insurance is influenced much more by income and price than is the decision to purchase physicians' services.

We find no support for the financial-protection theory of insurance, which holds that the amount of insurance people wish to carry varies directly with the level of anticipated expenditures they are insuring against. This theory predicts equal, positive coefficients of approximately 1.0 for both AP and Q*,[29] yet we find

[28] Because of some collinearity between these variables and UNION*, the significance level of each of the three is diminished in D.6, and the coefficients somewhat lower as well.

[29] It may be argued that insurance purchases are sensitive both to their price and to anticipated expenditures levels, and that AP therefore serves in a dual capacity in the BEN* regression. If this is correct, the AP coefficient we observe should be on the order of -0.6(+1.0 for the expenditures theory and -1.6 for the price theory). This possibility is tested and rejected in D.5, for the PRM/BEN and AP coefficients are essentially unchanged from their values in D.3, while Q* is now negative.

in D.4 that the coefficient of AP is negative, while that of Q* is positive but not statistically significant. Dropping Q* from the regression brings about a slight improvement in the $\overline{R}^2$ (D.7 versus D.6, D.5 versus D.3) and permits a much less ambiguous interpretation of the role of AP in insurance purchases. It is only because of its dependence upon AP that insurance is endogenous to this system.

Because of the many ambiguities complicating the interpretation of most of these regression equations, we feel it wisest to refrain from presenting a reduced-form version of the model.[30] We have seen that two of the exogenous variables—BEDS* and INC*—lend themselves to more than one interpretation, depending upon the equation in which they appear, but such distinctions would be lost in a reduced form. More serious is the problem of multicollinearity. The consequent instability of coefficient estimates is troublesome enough in the interpretation of individual regression equations, but then at least it is known which variables must be approached with caution. In a reduced form, because of the intricate pattern of substitutions, this instability may be magnified manyfold and its repercussions felt throughout the entire system. Depending upon the choice of equations to represent the model, numerous versions of the reduced form are possible, some with sharply contrasting implications. Under the circumstances, it seems preferable to state the limitations of our knowledge rather than compound the possibility of error.

2.6 The Effect on Health

The degree to which variations in the quantity of physicians' services consumed affect health status, i.e., Health = f(Q*, . . .), is a matter of prime concern. A priori considerations suggest that causality might run in the reverse direction as well, from health to demand [Q* = g(Health, . . .)]. If so, two-stage least squares would be the recommended method for determining the effect of quantity on health, with the predicted value of the endogenous Q* variable entering the health regressions and vice versa. In the preliminary large-scale model described in 2.2, this procedure was adopted. As noted earlier, however, tests based upon this model lent no support to the hypothesis that variations in health contribute to interstate variations in the demand for physicians' services. Hence, coefficients obtained from ordinary least squares regressions of health on Q* should not be biased.[31]

Two dependent variables have been chosen to represent health status in these regressions: the crude death rate (DTH RT) and the infant mortality rate (INF MRT). The independent variables include factors of a general nature—income, education, per cent black, and per cent aged (this last only in the DTH RT equations)—and factors specifically related to the consumption of physicians' services. In addition to Q*, we test MD* and per capita expenditures for physicians' services (EXP*) in this equation. The first of these is, theoretically, the desired variable, but because of possible measurement errors we do not rely upon it exclusively. No two of these physician variables rely upon the same data base.

The most important conclusion we can draw from the regressions of Table 19 is that, other things being equal, variation in the consumption of physicians' services does not seem to have any significant effect on health, as measured by either the crude death rate or the infant mortality rate. This finding is consistent with the work of previous investigators concerning the relative unimportance of medical care (not restricted to physicians' services) as a determinant of interstate variations in death rates [5].

Higher educational levels are very strongly associated with lower crude death rates. Education is also negatively related to infant mortality, but not statistically significant.[32] Contrary to what many would expect, per capita income is positively related to the crude death rate after controlling for the effect of education. It is, however, negatively related to infant mortality. These results for education and income confirm the findings of

[30] In a reduced form, individual regression equations are solved so that Q* and AP can be expressed wholly in terms of the exogenous variables.

[31] Two-stage regressions with health as the dependent variable are not feasible within the context of the present model. This is because the exogenous determinants of health do not appear in the model. Their exclusion was based upon the insignificance of health itself in the demand equation. To reintroduce health would necessitate bringing back into the model several exogenous variables that bear no demonstrable relationship to the market for physicians' services, and, as explained in 2.2, this, in turn, would impart a bias to all of the first-stage predicted endogenous variables.

[32] Our analysis implicitly assumes causality to run only from education to health, but this is not necessarily the case. See the forthcoming paper by Victor Fuchs and Michael Grossman [20].

TABLE 19

Results of Weighted, Logarithmic Health Regressions, Ordinary Least Squares, Interstate Model, 1966 (N=33)

(*t* values in parentheses)

Equation		$\bar{R}^2$	%AGED[a]	INC*	%BLK[a]	EDUC	Q*	MD*	EXP*
Part A									
DTH RT	DR. 1	.560	0.055[b] (6.41)	-0.008 (-0.12)					
	DR. 2	.679	0.061[b] (8.25)			-0.364[b] (-3.33)			
	DR. 3	.814	0.060[b] (10.71)	0.333[b] (4.79)		-0.823[b] (-6.49)			
	DR. 4	.811	0.062[b] (9.90)	0.354[b] (4.68)	0.001 (0.73)	-0.780[b] (-5.54)			
	DR. 5	.804	0.062[b] (9.31)	0.347[b] (3.67)	0.001 (0.71)	-0.779[b] (-5.42)	0.016 (0.13)		
	DR. 6	.811	0.062[b] (9.93)	0.404[b] (4.44)	0.001 (0.87)	-0.739[b] (-5.04)		-0.057 (-0.99)	
	DR. 7	.815	0.059[b] (8.95)	0.391[b] (4.85)	0.001 (0.88)	-0.658[b] (-3.86)			-0.079 (-1.24)
Part B									
INF MRT	IM. 1	.796		-0.144 (-1.68)	0.011[b] (6.47)				
	IM. 2	.787			0.011[b] (6.33)	-0.196 (-1.19)			
	IM. 3	.791		-0.122 (-1.22)	0.010[b] (5.55)	-0.083 (-0.44)			
	IM. 4	.785		-0.089 (-0.73)	0.010[b] (5.43)	-0.090 (-0.47)	-0.079 (-0.50)		
	IM. 5	.783		-0.132 (-1.08)	0.010[b] (5.38)	-0.090 (-0.46)		0.011 (0.14)	
	IM. 6	.787		-0.152 (-1.38)	0.010[b] (5.10)	-0.172 (-0.75)			0.056 (0.69)

[a] Linear variable.
[b] Significant at .01 level.

Fuchs [19], Grossman [22], and Auster, Leveson, and Sarachek [5]. The per cent black is positively associated with both death variables, but the effect is much greater with respect to infant mortality.

2.7 Conclusion

In Part 2 we have presented a formal econometric model of the market for physicians' services in 1966, using cross-sectional data for our estimates. The findings, which must be regarded as tentative because of the limited quantity and uneven quality of available data, tend to be consistent with, and give support to, the inferences drawn from the time series examined in Part 1.

The demand for physicians' services appears to be significantly influenced by the number of physicians available. The effect exerted on demand by supply appears to be stronger than that of income, price, or insurance coverage. Physician supply, across states, is positively related to price, the presence of medical schools and hospital beds, and the educational, cultural, and recreational milieu. The quantity of service produced per physician is negatively related to the number of physicians in an area. It does not increase in response to higher fees. The demand for medical insurance, unlike the demand for physicians' services, does appear to be quite sensitive to differences in income. It is also significantly related to the price of insurance and to unionization. Finally, interstate differences in infant mortality and overall death rates are not significantly related to the number of physicians, to the quantity of their services, or to expenditures.

If subsequent research should confirm these findings, the implications for public policy are substantial. According to a widespread view, large increases in the number of physicians will drive down the price of, and expenditures for, physicians' services, will diminish the inequality in their location, provide a proportionate increase in the quantity of services, and make a substantial contribution to improved health levels. The model and data we have examined do not provide any support for this view.