AN ECONOMIC ANALYSIS OF CHILD HEALTH

by

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INTRODUCTION

This work focuses upon the family's use of pediatric services for the maintenance of its children's health. Continued disparities across socio-economic classes in indices of child health, as proxied by infant mortality and morbidity rates,[1] have led some observers to opposite policy considerations for the delivery of child health care. There are those who equate medical care with health in a one-to-one relationship, the implication being that the disparities are largely the outcome of differentials in the quantity and quality of medical services consumed across socio-economic classes.[2] Then there are those who see "disease as a way of life," as being the outcome of environmental forces largely beyond the influence of medical technology.[3]

If one starts with the assumption that limited child health services will be provided to the public, an overriding question concerns how these services can provide maximum efficiency in health maintenance for the population to which they are offered. This, in turn, requires an understanding of how the market for pediatric care functions. The research which follows is a modest contribution to that understanding.

The investigation begins in Chapter I with an overview of the supply side of the market for medical care, almost exclusively the offer of services by the physician population. Variations on the theme of the physician/population ratio are used to point out disparities in the physician stock across a variety of geographical areas within New York City. There is substantial variation among the boroughs of New York City in physician stock relative to population. When we focus upon the health districts within one borough, the Bronx, the disparities are more stark. Only in a crude sense, however, does New York City ("more abundantly 'doctored' than the rest of

the country"[4]) comprise a single market for physicians' services.

The choice of New York City and, in particular, the health districts of the Bronx as a point of departure becomes apparent in Chapter II. Introduced in this chapter is the primary source of data for the empirical work of Chapters II, III and IV, the Mindlin-Densen (M-D) study, titled Medical Care of Infants and Preschool Children. The data are based on a longitudinal and cross-sectional survey conducted in Mott Haven and Westchester, two contiguous health districts in the Bronx, during the period 1964-1966; they are described in Appendix A. Chapter II provides a detailed description of the interaction between the surveyed families and the characteristics of their sources of private pediatric care.

By linking each family with its individual sources of private pediatric care we are able to trace the spatial distribution of families across sources of care and across the characteristics of those sources. It is not surprising that in this sample the general practitioner and physicians with a primary practice in pediatrics account for 70% of the physician contacts. (The obstetrician/gynecologist accounts for another 9% of the contacts.) The physician sources are very different, however, when one compares their primary practice distribution by the family's health district of residence. Mott Haven families that remained within Mott Haven for pediatric services had twice as many general practitioner contacts as pediatrician contacts; they divided 57% to 43% in favor of physician not practicing a specialty. Westchester families that remained within Westchester had one and one-half as many visits to pediatricians as to physicians in general practice; and, 74% of their contacts were to physicians who were practicing a specialty. Each health district appears

to be a self-contained medical market. Although contiguous, more than 70% of the families remained within their health district of residence to obtain private pediatric care.

In Chapter III we present an analysis of the impact of quality differences among physicians on the pricing of their services. The analysis is developed within a hedonic pricing framework. That is, we disaggregate the "package" of physicians' services into component parts which are directly observable or available to the consumer. Then, price differences among physicians are accounted for by differences in the identifiable characteristics.

The two major categories which we focus upon are the physicians professional standing and personal characteristics. Following the hedonic price literature we distinguish age, model, and vintage effects. The age (or experience) effect is measured as the number of years since graduation from medical school. It captures the change in physician efficiency as the physician ages. The net effect of age on the efficiency with which medical services are rendered is uncertain. Aging or the "deterioration" of the physicians' stock of knowledge may be offset by accumulations of experience. The eventual "routinization" of a practice should, however, dampen the opportunities for accumulating experience.

The model effect refers to the physicians primary practice (e.g. general practitioners, pediatrician, internist, and so forth). Do specialists yield higher quality services than non-specialists? Our expectation is that given the patient population, children, the pediatrician and obstetrician/gynecologist provide "higher" quality services than the remaining categories. In addition, it is expected that residency training

in a specialty and subsequent passing of a licensing exam in that specialty will be construed as greater expertise and, thus, command a premium.

The vintage effect refers to the period of medical education. One expects that more recent medical education is superior to that of earlier periods. That is, a more sophisticated approach to physician aging recognizes that the aging process may differ across physician specialties and across a given specialty acquired at different points in time. In addition to age, model, and vintage effects, other quality proxies such as the number of memberships in special societies, faculty status, and place of medical education (foreign, New York City, other) are used as quality proxies.

Finally, personal characteristics of the physicians practice -- whether the physician speaks the mother's language, whether she talks enough to the physician, and whether it bothers her if she doesn't -- are used to proxy the amount of information provided by the physician. Here it is assumed that part of the demand for pediatric care is a demand for information by mothers about the health status of their child.

Our a priori expectations concerning the impact of the quality characteristics on the fee usually charged by the physician are, generally, borne out. The pediatricians and, especially, physicians board certified in pediatrics play the most powerful role among primary practices and certified specialties in accounting for physician price differentials. The effect of vintage in most primary practices is negative. Other findings are that more recent medical school graduates command a premium over earlier entrants into the medical care market; membership in special societies

does have a positive impact on price; and, the ability to gain information, from a subjective standpoint, is considered a positive, quality-enhancing characteristic.

In Chapter IV we set out a framework for analyzing the demand for pediatric services. The hedonic quality index is incorporated into an empirical strategy which permits estimations of both the demand for pediatric visits and the quality of pediatric care. This strategy, fitting separate demand curves for quantity (physician visits) and quality, has not been pursued in existing studies. In addition to fitting a demand curve for physician visits, separate demand curves are estimated for curative visits and preventive visits.

Using a model of constrained utility maximization the following equilibrium condition is derived,

$$\frac{U_q}{U_v} = \frac{\hat{p}v}{\hat{p}q + f} = \frac{\pi_q}{\pi_v}$$

where U_q, U_v are the marginal utility of quality and quantity, respectively; $\hat{p}$ is quality-adjusted price of pediatric care; v is pediatric visits; q is pediatric quality; f is the fixed costs of a pediatric visit, such as the value of time expended per visit plus travel costs; and, π_q and π_v are the shadow prices of pediatric quality and visits, respectively. Thus, an increase in the quality-adjusted price of pediatric services, $\hat{p}$, increases both the shadow price of quality and visits. Due to the presence of the fixed costs of a visit, f, the percentage increase in the shadow price of quality exceeds that of the shadow price of a visit. Thus, the relative price of quality would rise with an increase in $\hat{p}$ and consumers would substitute away from quality and toward visits. A rise in the fixed costs

of a visit would lead consumers to substitute quality for visits since the relative price of quality would fall with the rise of fixed costs.

These propositions are tested empirically by estimating the reduced form demand curves for quality and visits,

$$q = d_1(\hat{p}, f, s) \quad \text{and}$$

$$v = d_2(\hat{p}, f, s)$$

where s is family income and q and $\hat{p}$ are computed from the hedonic fee function estimated in Chapter III. Our predictions are borne out empirically. Quality-adjusted price is positive in the visits demand curves, price elasticities ranging from 0.084 to 0.112. It is negative in the quality demand curves, price elasticities stable at -0.020. Fixed costs coefficients are negative in all visits demand curves and positive in all quality demand curves. Fixed cost elasticities range from -0.069 to - 0.119 for visits and from 0.006 to 0.008 for quality.

The income elasticity of demand for visits ranges from 0.799 to 1.476, slightly higher than those reported in previous studies. Our measure of income, however, is predicted by regressing reported family income on selected socio-economic variables. Income elasticities based on estimations employing reported income, the measure almost exclusively used in previous studies, reduce our income elasticities by nearly a factor of three. Then, our results conform to previous findings. Income elasticities of demand for quality range from 0.022 to 0.047. This estimation is unique to this study and, consequently, we have no basis for comparison.

The price elasticity of demand for curative visits exceeds its preventive visit counterpart in all estimated demand curves. This is

interpreted to mean that curative visits are better substitutes for quality than are preventive visits. The price elasticities for curative visits range from 0.111 to 0.170; those for preventive visits range from 0.0 to 0.079. If, in fact, curative visits are better substitutes for quality than preventive visits, then the impact of an increase in fixed costs should be relatively greater in the curative visit equation. Our results are consistent with this hypothesis. Demand elasticities with respect to fixed costs range from -0.112 to-0.194 for curative visits and from 0.0 to -0.052 for preventive visits.

The income elasticities of demand for preventive visits are larger than those for curative visits. The average income elasticity for preventive visits is 1.5; that for curative visits is 0.8. These findings conform to the general notion that curative visits are a "necessity" and preventive visits a "luxury."

FOOTNOTES TO INTRODUCTION

1. Government Research on the Problem of Children and Youth, background papers prepared for 1970-71 White House Conference on Children and Youth, U.S. Government Printing Office, Washington, D.C., 1971, and Profiles of Children, 1970 White House Conference on Children, U.S. Government Printing Office, Washington, D.C., 1971.

2. See: "Research Issues in Child Health: A Head Start Research Seminar", Pediatrics, Vol. 45, Nos.4 and 5, April and May 1970.

3. "Disease as a Way of Life", Eric J. Cassell, Commentary, February, 1973.

4. Nora Piore and Sandra Sokal, A Profile of Physicians in the City of New York Before Medicare and Medicaid, Urban Research Center, Hunter College, 1968, p.3.

CHAPTER I

THE SUPPLY OF PHYSICIANS' SERVICES

The supply side of the market for medical care is almost exclusively the offer of services by the physician population. Licenced practitioners of medicine dominate nearly every phase and institutional setting in both the public and private provision of medical care. Their decisions range from prescription of drugs and medicine to hospital admissions. Indeed, it is virtually impossible to obtain either without physician approval.

The physician/population ratio is a popularly used bell weather of the supply of physicians' services. The link between the physician/population ratio and the offer of medical services is, itself, dependent upon behavioral relationships on the supply side of this market and upon the attendant variation in the quality and productivity of the stock of physicians. However, as Fein points out, the physician/population ratio is "a useful first approximation to the supply of physicians' services available."[1] Since this study is directed toward a local New York City market I shall begin by describing the physician stock which provided the potential for medical services.

In 1966, New York City was "more abundantly 'doctored' than the rest of the country" and, "though more than half the city's doctors practice(d) in Manhattan, the physician/population ratio (was) above the national average in every borough of the city."[2] Table 1 shows the distribution of the physician/population ratio across the boroughs of New York City, the health districts of the Bronx, New York and for the country as a whole. Also included are physician/population ratios for

TABLE 1

PHYSICIANS PER 100,000 POPULATION IN NEW YORK CITY, THE FIVE BOROUGHS, SELECTED AREAS OF THE BRONX, AND THE U.S.- 1966

Area	All Active Physicians	Patient-seeing Physicians		
		Total	Private Practice[3]	Salaried
U.S.[1]	130.5	119.4	84.8	34.6
New York[1]	277.8	251.2	163.5	87.7
Brooklyn[1]	189.6	180.5	118.8	61.7
Manhattan[1]	654.3	567.3	362.9	204.4
Queens[1]	152.3	145.7	107.9	37.8
Richmond[1]	135.3	124.6	95.2	29.4
Bronx[1]	190.3	173.4	97.5	75.9
Pelham Bay[2]			65.6	
Tremont[2]			150.1	
Fordham-Riverdale[2]			159.6	
Morrisania[2]			65.5	
Mott Haven[2]			41.0	
Westchester[2]			90.5	

1. SOURCE: Urban Medical Economics Research Project, Health Services Administration, New York.

2. SOURCE: Statistical Services Division, Health and Hospital Planning Council of Southern New York. Physician location is by address of office as of October 1967.

3. Coefficient of Variation:

All Boroughs	Boroughs excluding Manhattan	Bronx Health Districts
0.662	0.089	0.466

patient-seeing physicians and, within that category, differentiation between physicians in private practice and salaried physicians.

Patient-seeing physicians are those that are in private practice plus physicians salaried as full-time hospital staff, residents, fellows, or interns. The category excludes those physicians who are salaried as full-time medical school faculty or those engaged in administration, laboratory medicine, preventive medicine or research. Although the latter are part of the physician stock they do not contribute directly to the flow of services when such services are defined as the physician-patient contact.

There is substantial variation among the boroughs in physician stock relative to population, even when we exclude Manhattan, which serves as the major medical nerve center for the New York metropolitan area. Richmond, for instance, has a physician/population ratio which is only 2/3 as large as that of the Bronx. While this is true for both all active physicians and the patient-seeing physicians, the situation changes dramatically if we look within the group of patient-seeing physicians. More than 75% of the patient-seeing physician stock of Richmond is in private practice; the remainder are salaried. In comparison, the Bronx's split of patient-seeing physicians is more nearly even, with slightly over 55% in private practice. Thus, the physician/population ratios which were disparate for all patient-seeing physicians in these two areas, are nearly identical with respect to physicians in private practice. The real different is in the category "salaried physicians" which consists of full-time hospital staff, residents, fellows and interns. Since this group is employed, primarily, in a sector which is supposed to respond to "community needs" (via

voluntary and municipal hospitals) it would appear that initial differences in the physician/population ratios do not entirely point up the extent to which one area is "doctored" relative to another. Consider the hospital network through which the large majority of the salaried physician population supplies services. The Report of the Commission on the Delivery of Personal Health Services found that "(c)ontrary to the rather common characteristic shared by the other four boroughs, Richmond does not appear to be suffering an overcrowding of outpatient clinics and emergency services...The greatest need...was for an additional 50-70 medical-surgical beds..."[3] The same study begins its description of services in the Bronx by reporting that "(u)nfortunately, a description of "existing" health facilities in the Bronx can only reflect the scarcity of those facilities, and must dwell on future plans rather than present conditions...Some areas of the borough are completely without medical facilities."[4] The "better doctored" area does not appear to have fared well.

Within the Bronx the disparities in physician/population ratios are more stark. Westchester which is contiguous to Mott Haven has more than twice its rate of physicians <u>in private practice</u>. Fordham-Riverdale has a rate which is more than four times that of Mott Haven, 159.6 to 41.0 per 100,000 persons respectively. As shown in Table 1, there is a greater dispersion of physicians across the health districts of the Bronx than across the boroughs of New York City, excluding Manhattan.

The figures cited above are merely descriptive of relative physician stocks. There is no inference to be drawn with respect to these stocks and the levels of health of the respective populations. As an example, the non-white infant mortality rate for New York City in 1965 was 39.3

per 1,000 live births. This same figure held for non-whites in the Bronx. However, the number of physicians in private and salaried practices per 100,000 persons was greater throughout the city than the Bronx -- 70% and 15% greater respectively. Richmond, which we showed to be at parity with the Bronx with respect to the physician population ratio and which was cited as the "best" health care provider of the city's boroughs by the Report of the Commission on the Delivery of Personal Health Services, had the highest non-white infant mortality rate in the city -- 58.2 per 1,000 live births. This was also higher than that of any of the city's health districts; although it was followed closely (55.0) by Fordham-Riverdale, by far the best privately "doctored" area of the Bronx! The relationship between the physician stock and health of the population, however, is not well established. The physician must be contacted to have even the potential for an impact on health.

The above discussion neglects a further disparity -- what we may crudely call the "quality" adjusted physician stock. It has become commonplace to assume that specialists provide higher quality medical services than general practitioners.[5] In Table 2 the patient-seeing physician stock is dichotomized as specialist and general practitioner (non-specialist). When compared to the physician/population ratios in Table 1 we find a correspondence (although not perfect) between physician population ratio and the specialist/general practitioner ratio in the area. The Spearman rank correlations for the five boroughs and six health districts are +0.4 and +1.0 respectively.

Several studies of physician location decisions have shown population size to be an important determinant of the physician's location decision.

TABLE 2

PHYSICIANS PER 100,000 POPULATION IN NEW YORK CITY, THE FIVE BOROUGHS, AND SELECTED AREAS OF THE BRONX BY GENERAL PRACTITIONER OR SPECIALIST STATUS - 1966[1]

Area	Patient-seeing Physicians in Private Practice[2]	
	Specialist	General Practitioner
New York	115.8	47.7
Brooklyn	74.8	44.0
Manhattan	299.2	64.6
Queens	66.1	41.8
Richmond	67.6	26.5
Bronx	51.2	46.3
Pelham Bay	31.3	34.4
Tremont	88.6	62.4
Fordham-Riverdale	103.8	55.7
Morrisania	28.4	37.2
Mott Haven	12.6	28.4
Westchester	50.0	40.5

1. SOURCE: Urban Medical Economics Research Project, Health Services Administration, New York.

2. SOURCE: Statistical Services Division, Health and Hospital Planning Council of Southern New York. Physician location is by address of office as of October 1967.

Coefficient of Variation:

Specialists			General Practitioners		
All Boroughs	Boroughs excl. Manhattan	Bronx Health Districts	All Boroughs	Boroughs excl. Manhattan	Bronx Health Districts
0.841	0.118	0.631	0.272	0.196	0.279

Larger populations in a given geographic area provide a larger potential market for physicians' services. If there is a threshold effect of an absolute population size necessary to support a market for specialists' services, then absolute population size is acting as a mediating variable between the areal physician/population ratio and the areal physician speciality mix. That is, the larger the population in an area is, the greater are the opportunities (demand) for physicians in general and, as a consequence, differences in population between areas "explain" variation in the physician/population ratio. Concurrently, the larger the population is, the greater is the absolute size of the market for physicians' services and the likelihood that the more specialized physicians' services will be supported. It is also reasonable to expect that specialists gain relatively more than general practitioners (costs to locating in the area are lowered) from increases in population. This is because such increases are likely to bring about markets for inpatient and out-patient facilities (i.e., hospitals and attendant clinics and emergency rooms which probably complement specialist services and substitute for those of the general practitioner.

FOOTNOTES TO CHAPTER I

1. Rashi Fein, The Doctor Shortage, Brookings Institution, Washington,D.C., 1967, p.63.

2. Nora Piore and Sondra Sokal, A Profile of Physicians in the City of New York Before Medicare and Medicaid, Urban Research Center, Hunter College, August 1968, p.3.

3. Robert B. Parks, Community Health Services for New York City, Praeger Publishers, 1968, p.165.

4. Ibid, p.134.

5. We shall treat physician "quality" in more detail in Chapter III.

CHAPTER II

THE LOCAL MARKET FOR PEDIATRIC SERVICES

Only in a crude sense does New York City comprise a single market for physicians' services. It is our purpose in this chapter to look more closely at a microcosm of that market by describing in some detail the interaction of consumer and physician characteristics within two contiguous health districts in the Bronx, New York -- Mott Haven and Westchester. This would be of interest in its own right. In our case, it serves the added purpose of introducing the data set which will be used in the estimation of hedonic price functions and demand curves for the quantity and quality of physicians' services.

The primary source of data is the Mindlin-Densen (M-D) study, Medical Care of Infants and Preschool Children, a longitudinal and cross-sectional survey conducted in Mott Haven and Westchester during the period 1964-1966.[1] One feature of the study is that physicians identified as providers or "potential" providers of medical services were identified by name and address wherever possible. Consequently, we know, ex post, what constituted a local market since we are able to link the consumer with the provider.

The physician population which forms the basis of this section of the study consists of 798 physicians who were "usually" or "actually" used by the families sampled in the M-D study and for whom information was recorded in published directories of the American Medical Association (AMA). There were several occasions in the household interviews where the names of physicians or sources of medical care were solicited. The name of a "usual" source of care was predicated upon previous use and the

family's belief that this was a regular source of care; the name of an "actual" source of care was based upon use of that physician during an interview period.

The 798 physicians are the remainder from a recorded population of 1,143 sources of medical care. The largest single cause of attrition was due to the use of institutional care. In 113 instances the reported source of medical services ranged from traditional institutions, such as emergency rooms and outpatient clinics, to the unusual, such as the U.S. First Army General Dispensary and the Santucci Dispensary in Puerto Rico. Although the institution could be identified it was not possible to identify the individual personnel who provided the medical services. This left 232 persons not found in the directories and, probably, not on the roles used for their publication. The composition of this group is unknown. It may be that some practiced medicine without a licence, or made no claims to practicing medicine but were considered a source of medical care. In several instances they were identified as ranging from the exotic -- voodoo and nature healers -- to the more mundane -- chiropracters.

The Sources of Physician Care

The major sources of medical care for infants and preschool children are primary care physicians. These are the generalists, pediatricians, obstetrician-gynecologists, and internists of the physician population.[2] Table 1 shows the distribution by primary speciality[3] of the physician population of the M-D study.

Primary care physicians accounted for 73% of the private sources of medical care; the largest share of these, and nearly 30% of the total,

TABLE 1

PERCENT DISTRIBUTION OF PHYSICIANS INDICATED AS ACTUAL OR USUAL SOURCES OF CARE BY SELECTED PROFESSIONAL CHARACTERISTICS

	Primary Care						
	General Practice	Pediatrics	Obstetrics Gynecology	Internal Medicine	Surgery	Other	Sample Size
Primary Practice	29.6	18.4	14.5	10.4	11.8	15.3	798
Certification	-	9.3	6.4	1.3	3.1	5.1	
Certification as a % of Primary Practice							
M-D Study	-	50.3	44.0	12.0	26.6[1]	47.8	
Sloan Study	-	73.0	72.0	52.0	67.0[1]		5,085

SOURCES: M-D Study and Bruce Steinwald and Frank Sloan "Determinants of Physicians' Fees," Journal of Business, Vol. 47 No.4, Oct. 1974, p.504.

1. Sloan's figure is for general surgery. The M-D study includes all surgery.

were general practitioners. Surprisingly, 12% of all sources were recorded as having a primary practice in surgery, two thirds of this group giving general surgery as their specialty. Overall, 70% of the sources declared themselves to be primarily practicing a medical specialty.

There is, however, a considerable difference between the numbers declaring a primary practice in a specialty and those with board certification in that specialty. Thus, only 24% of the sources were certified in their primary practice although 70% practiced a specialty. This discrepancy is shown in Table 1. One of every two self-declared pediatric sources and only one of every eight internists were board certified.

These findings contrast sharply with Sloan's (also recorded in Table 1) which show higher rates of board certification in each specialty. Sloan's sample comes from a U.S. cross-section of "physicians who were indicated by AMA records to be engaged in non-governmental, patient care activity (excluding interns and residents) ...and physicians in nonsolo practice arrangements are overrepresented."[4] Since I will have occasion to compare my findings with Sloan's at several points in this study, it is instructive to note some differences and similarities in our samples. While his sample is national and stratified to overrepresent nonsolo practice arrangements, the M-D physician population is based on a local, urban market in contiguous slum and middle income areas. The M-D sample was developed approximately five years prior to Sloan's. Given the trend toward increased specialization and the likelihood, I suspect, that a greater proportion of specialists in nonsolo practices

are board certified relative to their counterparts in solo practice. I would expect a greater proportion of board certified specialists in Sloan's sample. Sloan's sample is based on the physician stock; the M-D data are "patient selected". Interns and residents are excluded from both samples. However, the M-D sample permits physicians in joint private practice/institutional activities, while Sloan's sample excludes those physicians engaged in governmental, patient-care activities. Finally, both samples utilize information from the AMA's biographical file on physicians.

The composite of usual and actual physician sources of Table 1 has some limitations. Each physician has an equal weight in determining the complexion of the distribution. If, for example, a family was referred by their family physician to a dermatologist for consultation, the dermatologist would have equal weight with the family's physician. Although any configuration of the physician sample will contain its own inherent biases, we may mitigate the more misleading, somewhat, by appropriately weighting the sample. Table 2 shows the distribution of physicians indicated as the usual source of care. Each physician is weighted by the number of families which considered that physician to be the usual source. Since the families in the M-D study were randomly chosen after stratifying for the presence of an infant or preschool child, the above strategy is better representative of the selected sources of physician care.[5]

Similarly, Table 3 describes the distribution of actual sources of care weighted by the number of families which contacted that physician for remedial child care.

TABLE 2

PERCENT DISTRIBUTION OF USUAL SOURCES OF CARE
BY SELECTED PROFESSIONAL CHARACTERISTICS

	Primary Care						
	General Practice	Pediatrics	Obstetrics Gynecology	Internal Medicine	Surgery	Other	Sample Size
Primary Practice	32.7	36.3	8.6	8.4	6.7	7.2	1,897
Certification	-	17.6	0.5	0.9	0.2	0.4	
Certification as a % of Primary Practice	-	48.5	5.5	2.2	3.1	17.6	

SOURCE: M-D Study

TABLE 3

PERCENT DISTRIBUTION OF ACTUAL SOURCES OF CARE
BY SELECTED PROFESSIONAL CHARACTERISTICS

	Primary Care						
	General Practice	Pediatrics	Obstetrics Gynecology	Internal Medicine	Surgery	Other	Sample Size
Primary Practice	30.6	34.4	8.5	8.8	8.0	9.8	1,610
Certification	-	17.4	1.3	0.8	1.5	2.8	
Certification as a % of Primary Practice	-	50.4	14.9	11.2	19.3	28.6	

SOURCE: M-D Study

If we now retrace our steps we find that primary care physicians provided 86% of both actual and usual physician contacts and the distributions across practitioners are nearly identical for each. The most obvious difference occasioned by the weighting scheme is the increase in emphasis on pediatricians and the concomitant decrease in the importance of remaining specialties. Pediatricians become the leading source of care and, together with general practitioners, account for just under 70% of all care.[6] Another difference is the decreased emphasis on board certification for specialists other than pediatricians. That is, although physicians practicing a specialty such as internal medicine were providers of care, they were rarely specialists by certification.

The distribution across primary practices is nearly identical for the usual and actual sources of care. However, an actual source of care -- one used in response to a perceived illness -- was more likely to be certified when practicing a specialty. The rates of board certification within specialties still fall substantially short of those in Sloan's sample.

The Spatial Distribution of the Sources of Care

The distribution of the physicians across the boroughs of New York City are shown in Table 4.[7] The market appears to be remarkably "compact", with nearly 90% of all usual and actual sources located in the Bronx. (From this point I will not discuss the unweighted sample of 798 physicians.) Even this does not point up the degree to which the markets are localized. Although Mott Haven and Westchester are contiguous, approximately 70% of the families remained within their health district

TABLE 4

DISTRIBUTION OF PHYSICIAN SOURCES BY BOROUGH

	Bronx	Manhattan	Queens	Brooklyn	Not in New York
798 Sample	65.2	23.6	3.3	1.3	7.7
Usual	88.0	9.5	0.7	0.5	1.3
Actual	85.2	10.4	1.0	0.6	2.8

SOURCE: M-D Study

of residence for their children's physician services. The distribution of physician sources by distance from health district of residence is shown in Table 5. Refer to Appendix C. Points M and W on the map represent an approximated center of population density within Mott Haven and Westchester, respectively. Iso-distance lines are drawn from these points and the location of physician sources cumulated over succeeding distances.[8] The iso-distance lines are drawn so that the distance from point M (or W) to any point on, say, line 1M (or 1W) is the same. Moreover, the iso-distance levels -- district, level 1, level 2, and, for Mott Haven only, level 3 -- are not arbitrary; rather, the "district" distance is set to cut as closely to the respective district boundaries as possible. Thereafter, the levels are drawn to cut the remaining area of the Bronx into equal segments.[9]

The residents of Westchester traveled further for physicians' services than those of Mott Haven. A greater proportion of actual and usual sources lie beyond distance level 1W than beyond level 1M. It is likely, however, that these proportions understate the extent of travel within Westchester. The area of the Westchester Health District is nearly three times as great as that of Mott Haven. Physician and population densities are greater in Mott Haven and tend to overlap, while the Westchester physicians and population are spread over a greater area. This does not prove the point, of course, since the Westchester families may remain within their immediate area of residence to obtain services. In any case, own health district and adjacent zip code areas account for approximately 90% of usual and actual sources for each group.

Earlier I mentioned that the physician/population ratio of Mott Haven was less than one-half that of Westchester and only a quarter of

TABLE 5

THE CUMULATIVE DISTRIBUTION OF PHYSICIAN SOURCES WITHIN THE BRONX BY DISTANCE FROM HEALTH DISTRICT OF FAMILY

	MOTT HAVEN			
	District[1]	Level One[1]	Level Two[1]	Level Three[1]
Usual	75.1	15.8	6.1	3.0
Actual	73.5	16.3	7.8	2.4
	WESTCHESTER			
Usual	71.2	15.7	13.0	-
Actual	68.5	15.1	16.4	-

1. For "distance" measures of district and levels one, two, and three refer to Appendix C.

SOURCE: M-D Study

Fordham-Riverdale. Yet the relative abundance of physicians in these health districts failed to have an impact on the choice of practitioners by the Mott Haven families. Less than 2% of the Mott Haven population traveled to Fordham-Riverdale and, as shown in Table 6, only 5% crossed over the boundary to Westchester. Similarly, the Westchester population was not attracted to the most "doctored" district in the Bronx, only 2% travelling to Fordham-Riverdale. In fact, 6% of the families crossed to the less heavily doctored Mott Haven for physicians' services.

It is not known whether the self-imposed isolation of these health districts from out-of-district care is particular to these health districts, the population which was sampled, or the physician choice decision in general. Nor is the impact of the transportation system known. The absence of "adequate" rapid transit was cited in the Commission Report,[10] and transportation was considered a serious problem even for those with automobiles. While the mechanism by which a relative abundance of physicians practicing in a nearby location will attract out-of-district residents is not obvious (shorter queues, greater "visibility"....?), it appears that gross measures of physician supply such as those examined earlier may submerge the character of local medical markets.

The Characteristics of the Physician Sources

The preceding picture is one of families remaining, for the most part, within their health district of residence for the utilization of physicians' services -- primarily those of the general practitioner and pediatrician. This section explores in more detail the professional characteristics of the physicians who provided services or the potential for them. We will be describing the supply side of the market from the perspective of the physician stock. Although the supply side is more

TABLE 6

PERCENT OF FAMILIES CROSSING OVER TO OPPOSITE HEALTH DISTRICT FOR PHYSICIAN SOURCE

	Mott Haven → Westchester	Westchester → Mott Haven
Usual	4.8	5.9
Actual	4.9	6.1

SOURCE: M-D Study

formally the flow of services, this information is not available.

Primary Practice. Nearly the entire stock of physicians in Mott Haven and 70% of those in Westchester were sources of care for the M-D families.[11] And, as we pointed out on page 28, just under 70% of the physician sources were general practitioners and pediatricians. The physician sources are very different, however, when one compares their specialty practice distribution by individual health districts, as displayed in Table 7. Usual and actual physician sources are recorded for both Mott Haven and Westchester. Within each health district the sources are divided by their location. Finally, within each location the sources are distributed across their primary specialty.

Although both health districts are similar in that they tend to provide their resident populations with a self-contained source of physicians, they differ considerably in the mix of primary specialties of these sources. The Mott Haven families divided 57 : 43% in favor of Mott Haven physicians not practicing a specialty, i.e., general practitioners; the Westchester families divided 26 : 74% in favor of Westchester physicians practicing some specialty. Newhouse has raised the question of what mechanism distributes patients among physicians. It is his belief that physician selection is largely a random process with patient loads equalized via the queuing process. That is, if the random selection of one physician results in a relatively large patient load, and a concomitantly long queue, some patients will switch to another, less utilized physician. Additionally, other non-price amenities, such as location and manner, influence the patient choice of physician.[12] According to this view, and under the assumptions that within each district physicians provide similar amenities and, further, that consumers

TABLE 7

PRIMARY PRACTICE BY LOCATION AND SOURCE OF C/

	Within District z[1]							Level One z[1]							
	N	GP	PED	OBG	IM	SUR	OTH	N	GP	PED	OBG	IM	SUR	OTH	I
MOTT HAVEN															
Usual	297	57.2	22.9	2.4	3.7	6.4	7.4	63	14.3	14.3	38.1	25.4	1.6	6.3	2
Actual	208	56.7	20.2	4.3	4.3	6.7	7.8	46	15.2	19.6	32.6	28.3	0.0	4.3	2
WESTCHESTER															
Usual	906	27.5	42.5	8.9	9.2	6.8	5.1	199	39.7	28.6	10.1	6.0	11.6	4.0	1
Actual	640	25.2	43.4	8.4	9.2	6.4	7.4	144	35.5	25.5	7.1	7.8	16.3	7.8	1

SOURCE: M-D Study data

1. See map and description in the text for definitions.

GLOSSARY

N	Sample Size
GP	General Practitioner
PED	Pediatrician
OBG	Ostetrician/Gynecologist
IM	Internist
SUR	Surgeon
OTH	Other Specialist

7

AND SOURCE OF CARE

%[1]				Level Two %[1]						Manhattan						
IM	SUR	OTH	N	GP	PED	OBG	IM	SUR	OTH	N	GP	PED	OBG	IM	SUR	OTH
25.4	1.6	6.3	24	12.5	58.3	4.2	8.3	4.2	12.5	77	35.1	39.0	3.9	9.1	1.3	11.7
28.3	0.0	4.3	22	9.1	40.9	18.2	4.6	9.1	18.1	56	39.3	33.9	1.8	8.9	5.4	10.7
6.0	11.6	4.0	168	26.8	31.0	10.7	8.3	8.3	14.9	103	15.5	54.4	6.8	9.7	1.0	12.6
7.8	16.3	7.8	153	25.5	26.1	9.2	9.8	10.5	18.9	92	12.0	38.0	14.1	9.8	7.6	18.5

are myopic to professional qualifications of physicians,[13] we should find a physician utilization ratio of generalist:specialist which approximates their relative presence in the physician populations of each district. Using the Health and Hospital Planning Council data as an indication of the physician stock in each district we can compare their generalist:specialist ratios of the usual and actual sources of physicians in the M-D data. These ratios are recorded in Table 8. In Mott Haven there were more than two general practitioners for every physician practicing a specialty; the Mott Haven families used proportionately more general practitioners. The majority of physicians in Westchester practiced a specialty; the generalist:specialist ratio was 0.81. The families in Westchester opted 3 to 1 for specialists. Other things equal, this suggests a relationship between physician "presence" and "use". But other things are not equal. It is very likely that a specialty practice is construed by consumers as higher "quality" practice. If physician quality is a normal "good" the differences we observe between Mott Haven and Westchester in the selection of physicians may be explained by income differences between the districts.[14] This point is examined in Tables 10 and 11.

Table 10 shows the distribution of physician sources across income classes for those families with within-district sources. The physician categories are general practitioner, specialist and, within specialist, pediatrician. Since travelling to out-of-district sources was such a small portion of usual and actual sources, the number of cells in income class has been reduced to two (family income under $5,000 and over $5,000) to examine the effect of income on physician choice for level one and level two travels. Table 11 presents the distribution of the

TABLE 8

RATIO OF GENERALISTS TO SPECIALISTS

	Mott Haven	Westchester
Health and Hospital Planning Council[1]	2.25	0.81
Usual[2]	1.34	0.38
Actual[2]	1.31	0.34

SOURCE: M-D Study

1. Health and Hospital Planning Council of Southern New York. Physician location is by address of office.

TABLE 9

CROSSOVER TO OTHER HEALTH DISTRICT FOR SOURCE OF CARE BY PRIMARY PRACTICE

	Mott Haven → Westchester						Westchester → Mott Haven					
	% of Total Sources	GP	PED	OBG	IM	SUR	% of Total Sources	GP	PED	OBG	IM	SUR
USUAL	4.4	1.6	6.6	6.3	6.9	4.8	4.5	9.9	2.8	10.1	1.8	6.1
ACTUAL	5.1	2.3	10.0	0.0	0.0	0.0	6.1	11.2	2.8	6.4	3.5	8.8

SOURCE: M-D Study

TABLE 10

SOURCE OF CARE BY PRIMARY PRACTICE, LOCATION OF SOURCE AND FAMILY INCOME

			MOTT HAVEN FAMILIES AND PHYSICIANS					
			Family Income (Dollars)					
		N	Under 3000	3000/ 4999	5000/ 6999	7000/ 8999	9000/ 10999	11000/ Over
General Practice	Usual	170	56.3	57.6	58.1	50.0	66.7	75.0
	Actual	118	60.3	59.8	48.6	42.1	62.5	75.0
Specialty Practice	Usual	127	43.8	42.4	41.9	50.0	33.3	25.0
	Actual	90	39.7	40.2	51.4	57.9	37.5	25.0
Pedia-trics	Usual	68	23.4	25.6	21.0	13.3	25.0	25.0
	Actual	42	17.2	22.0	21.6	15.8	25.0	25.0
N =	Usual	297	64	125	62	30	12	4
	Actual	208	58	82	37	19	8	4

TABLE 10 (Concluded)

SOURCE OF CARE BY PRIMARY PRACTICE, LOCATION OF COURSE AND FAMILY INCOME

			WESTCHESTER FAMILIES AND PHYSICIANS					
			Family Income (Dollars)					
		N	Under 3000	3000/ 4999	5000/ 6999	7000/ 8999	9000/ 10999	11000/ Over
General Practice	Usual	249	50.0	34.5	33.9	27.4	20.2	21.2
	Actual	161	50.0	38.6	28.6	26.0	18.6	17.6
Specialty Practice	Usual	657	50.0	65.5	66.1	72.6	79.8	78.8
	Actual	479	50.0	61.4	71.4	74.0	81.4	82.4
Pedia-trics	Usual	385	22.0	29.8	32.2	44.0	48.7	56.6
	Actual	278	16.7	28.1	33.0	43.5	51.7	56.0
N =	Usual	906	18	84	180	318	193	113
	Actual	640	12	57	112	223	145	91

SOURCE: M-D Study.

TABLE 11

SOURCE OF CARE BY PRIMARY PRACTICE, LOCATION OF SOURCE AND FAMILY INCOME

		MOTT HAVEN Family Income (Dollars)					
		District		Level One		Level Two	
		Under 5000	Over 5000	Under 5000	Over 5000	Under 5000	Over 5000
General Practice	Usual	57.1	57.4	16.7	12.1	TS	TS[1]
	Actual	60.0	50.0	16.0	14.3	TS	TS
Specialty Practice	Usual	42.9	42.6	83.3	87.9	TS	TS
	Actual	40.0	50.0	84.0	85.7	TS	TS
Pediatrics	Usual	24.9	19.4	10.0	18.2	TS	TS
	Actual	20.0	10.0	20.0	19.1	TS	TS

		WESTCHESTER Family Income (Dollars)					
		District		Level One		Level Two	
		Under 5000	Over 5000	Under 5000	Over 5000	Under 5000	Over 5000
General Practice	Usual	37.3	26.2	40.0	39.6	25.7	28.3
	Actual	40.6	23.3	25.8	38.2	28.0	25.0
Specialty Practice	Usual	62.7	73.8	60.0	60.4	74.3	71.7
	Actual	59.4	76.7	74.2	61.8	72.0	75.0
Pediatrics	Usual	28.4	44.3	22.2	30.5	14.3	33.8
	Actual	26.1	45.1	19.4	27.3	20.0	28.7

1. TS = Too small cell size to present meaningful results

SOURCE: M-D Study.

physician categories by these two income classes for within district sources as before (only this time for the two income cells) and the out-of-district sources of distance levels one and two.

The effect of income on the choice of physician specialty is pronounced within the Westchester health district. As income increases the Westchester families increasingly opt for specialists as opposed to general practitioners. This holds for both usual and actual sources and for the specialty category of pediatrician. In Table 11 we see that these results hold for the out-of-district pediatrician sources, but not all specialists. There is no clear choice of either specialist or generalist (as income increases) for those families travelling beyond their health district for a physician. If we net out pediatricians the families select against specialists relative to generalists! This may indicate that specialists other than "child" specialists are considered of lesser quality than the generalist which is, after all, a primary care physician. Then, the relative "shortage" of generalists in the Westchester health district may be leading those families which prefer a "quality" that is intermediate (e.g., the generalist) to travel out-of-district for those services.

These findings do not emerge when we examine the physician sources of the Mott Haven families. There is little discernible pattern between income class and specialty choice for any of the physician categories, either within the health district or for those families that travelled out-of-district.

We may also use Tables 10 and 11 to look for differences in specialty choice between the Mott Haven and Westchester families for given levels of family income. We find that at every level of income the

Westchester families used a greater proportion of specialty sources and, thus, fewer generalists when using sources from within their respective districts. This is true of the choice of pediatrician, as well, for all income classes but the lowest. Families of both districts having less than $3,000 annual family income used proportionately the same number of pediatrician sources. Then, as we have seen, as family income increased the Westchester families increased the use of pediatricians at the expense of generalists while the Mott Haven families altered neither.

The Mott Haven and Westchester families differed in their selection of out-of-district physicians. While relying heavily on general practitioners within Mott Haven, as shown in Table 7, over 85% of the Mott Haven out-of-district sources practiced a specialty. Of course, this is not surprising given the relative paucity of specialists within the district. On the other hand, the Westchester families faced a relative surfeit in the number of within-district specialists; they tended to select physicians in general practice when travelling out-of-district. This predilection was slight, however, and showed no clear pattern as the Westchester families travelled farther away from the Westchester health district. These findings hold for specialist choice given income classes; although, Westchester families still used proportionately more pediatricians.

One further point which is consistent with the above findings is the selection of physicians by those families crossing over into their neighboring district. (See Table 9.) Again, only approximately 5% of usual and actual sources derived from Mott Haven and Westchester

families crossing over into their respective neighboring districts. However, the Mott Haven families travelled to Westchester for physicians practicing a specialty while Westchester families sought physicians in general practice.

Certification. Earlier we discussed the extent of board certification among the usual and actual sources of care in the M-D study. Once again, aggregate figures across the two health districts prove misleading. In Tables 2 and 3 it was shown that 50% of all sources having a primary practice in pediatrics were board certified. The numbers for the remaining specialties were small, nowhere above 20%. But, the distribution of board certified sources differs substantially between the health districts. Since the number of sources in specialties other than pediatrics are small, I limit the discussion below to specialists in pediatrics.

The distribution by location of usual and actual sources which are board certified pediatricians (as a percentage of those sources having a primary practice in pediatrics within the locale) is shown in Table 12. The out-of-district levels have been aggregated and Manhattan sources presented as well. The picture which emerges is one of Mott Haven families travelling greater distances in order to obtain board certified pediatric care. Less than 10% of the within-district pediatric sources were certified. Yet, upwards of 75% of all out-of-district pediatric sources were board certified, the largest proportions being to those sources located in Manhattan. Mott Haven families were just as likely to travel to Manhattan for practicing pediatricians as to other areas of the Bronx.

TABLE 12

DISTRIBUTION OF BOARD CERTIFIED PEDIATRICIANS AS A PERCENT OF ALL SOURCES WITH A PRIMARY PRACTICE IN PEDIATRICS BY LOCATION OF PHYSICIAN AND HEALTH DISTRICT OF FAMILY

(Total families in a category in parentheses)

		District	Level one & Level two	Manhattan
Mott Haven	U[1]	5.9 (68)	73.9 (23)	76.7 (30)
	A1	9.5 (42)	66.7 (18)	73.7 (19)
Westchester	U[1]	54.3 (385)	47.7 (109)	35.7 (56)
	A[1]	56.1 (278)	48.7 (76)	42.9 (35)

SOURCE: M-D Study

1. U = Usual Source
   A = Actual Source

The Westchester families, in contrast, seldom travelled out-of-district for board certified pediatric care. When they did travel they were more likely to remain within the Bronx. (This is reasonable since Manhattan is farther from Westchester than Mott Haven; see map). Unexpectedly, the farther they travelled for a pediatrician the less likely it was that the pediatrician would be board certified. Given the considerable distance from Westchester to Manhattan, it is surprising that only about 40% of those pediatrician sources were certified.

As with primary specialty, it is reasonable to expect that board certification in a specialty is considered to be a quality indicator of a physician's services. Similarly, our initial hypothesis is that the comparative difference we observe in the proportion of Mott Haven to Westchester sources that are certified is due to income differences between the areas. This is examined in Table 13 where the percent distribution of certified pediatricians is shown across income classes for each health district. So few certified pediatricians were sources of physicians' services within the Mott Haven district that the distribution across income classes can only be taken as suggestive of a positive relationship between income and board certification. However, the direction of change is consistent by the three distance levels shown in Table 14. Also, the change is increasingly pronounced with distance. For residents of Mott Haven, then, it appears that while specialty choice and income are not systematically related, certification and income are positively correlated.

A u-shaped certification/income relationship is evident for Westchester. We may speculate that the high proportion of board certified

TABLE 13

PERCENT DISTRIBUTION OF CERTIFIED PEDIATRICIANS AS A SOURCE OF CARE BY LOCATION OF SOURCE, FAMILY INCOME AND HEALTH DISTRICT OF FAMILY

		N	Under 3000	3000/ 4999	5000/ 6999	7000/ 8999	9000/ 10999	11000/ Over
			MOTT HAVEN DISTRICT					
			Family Income (Dollars)					
	Usual	4	0.0	0.8	0.0	3.3	8.3	25.0
	Actual	4	0.0	1.2	2.7	0.0	12.5	25.0
N =	Usual	297	64	125	62	30	12	4
	Actual	208	58	82	37	19	8	4
			WESTCHESTER HEALTH DISTRICT					
	Usual	209	22.2	15.5	13.3	24.2	28.0	32.7
	Actual	156	16.7	14.0	13.4	24.7	33.1	30.8
N =	Usual	906	18	84	180	318	193	113
	Actual	640	12	57	112	223	145	91

Sample sizes below the distributions give the number of families in that cell, regardless of source of care. Thus, of 64 Mott Haven families with a usual source of care and family income > $3,000 none had a certified pediatrician as that usual source. Similarly, of 18 Westchester families in that same income cell, 22.2% had a certified pediatrician as their usual source.

SOURCE: M-D Study.

TABLE 14

PERCENT DISTRIBUTION OF CERTIFIED PEDIATRICIANS AS A SOURCE OF CARE BY LOCATION OF SOURCE, FAMILY INCOME AND HEALTH DISTRICT OF FAMILY[1]

		MOTT HAVEN								
		Family Income (Dollars)								
		District			Level One			Level Two		
		N	Under 5000	Over 5000	N	Under 5000	Over 5000	N	Under 5000	Over 5000
	Usual	4	0.5	2.8	7	3.3	18.2	10	0.0	58.8
	Actual	4	0.7	4.4	5	8.0	14.2	7	11.1	46.2
N=	Usual	297	189	108	63	30	33	24	7	17
	Actual	208	140	68	46	25	21	22	9	13
		WESTCHESTER								
	Usual	209	16.7	23.9	21	0.0	13.6	33	1.5	21.4
	Actual	156	14.5	27.0	12	0.0	10.9	27	12.0	17.7
N=	Usual	906	102	804	199	45	154	180	35	145
	Actual	640	69	541	141	31	110	161	25	136

1. See Table 13, Note 1 for an explanation of sample size rows.

SOURCE: M-D Study.

sources of usual and actual services stems from (1) the lower levels of child health at low levels of family income combined with (2) the greater accessibility of certified pediatricians within the Westchester health district.

A systematic comparison of Mott Haven with Westchester at given levels of income and distance from district results in findings similar to those for primary practice. Thus, while Westchester families use a greater proportion of certified pediatricians (at each income level) when using within district sources, the Mott Haven families which travel out-of-district are more likely to select a certified pediatrician. Once again, this probably reflects supply differences within the districts rather than a personal proclivity of Mott Haven families to seek certified physicians from without of their district of residence. Mott Haven simply does not have many board certified pediatricians.

Place of Medical Education. The M-D physicians received their medical education from a wide variety of medical schools. For our purposes we will concentrate on two categories of medical education, viz., education in a foreign medical school[15] and medical school education within New York City. Both categories constituted large numbers among the usual and actual physician sources and both are the source of hypotheses in the economics literature on physician location and the pricing of physicians' services.

The Mott Haven families which remained within their health district to obtain physicians' services saw predominantly foreign educated physicians. Over 60% of these sources received degrees in medicine from foreign medical schools as shown in Table 15. Slightly more than 10% of their physicians were graduates of New York City medical schools. The

TABLE 15

PLACE OF MEDICAL EDUCATION OF SOURCES OF CARE
BY LOCATION OF SOURCE AND HEALTH DISTRICT
OF FAMILY

	District				Level One				Level Two			
	N	Foreign	NYC	Other USA	N	Foreign	NYC	Other USA	N	Foreign	NYC	Other USA
MOTT HAVEN												
Usual	297	60.3	11.1	28.6	63	46.0	25.4	28.6	24	12.5	62.5	25.0
Actual	208	62.0	13.9	24.1	46	41.3	32.6	26.1	22	18.2	45.5	36.3
WESTCHESTER												
Usual	906	34.9	38.0	27.1	199	43.2	40.2	16.6	168	27.4	41.7	30.9
Actual	640	36.6	36.4	27.0	141	44.0	41.8	14.2	153	29.4	43.8	26.8

SOURCE: M-D Study

remainder were from American medical schools other than those of New York City. Within the Westchester health district the sources were more evenly split between New York City and foreign medical schools with slightly more than 35% each.

The families of both health districts favored New York City medical school graduates and the farther the distance travelled the more heavily they were favored; they were traded for foreign graduates. The proportion of other American medical school degrees remained relatively stable with distance.

The degree to which these relationships hold across income levels is shown in Table 16. A case for an inverse family income/foreign educated physician selection cannot be made for the Mott Haven families' usual, within-district physician sources. Nor do either of the other physician education categories show a consistent pattern for the usual source of care when physician selection is traced by distance for the Mott Haven group. However, when an actual source of care was sought, as family income increased New York City educated physicians were systematically selected in favor of those receiving their medical education abroad. The farther the Mott Haven families travelled for the actual source the stronger this relationship becomes.

On the other hand, the Westchester families do not appear to have had a preference for physicians by their place of medical education as income levels changed -- regardless of distance travelled to the physician or whether the physician was a usual or actual source of care.

Finally, for given income levels the Westchester families used proportionately more New York City educated physicians when families

TABLE 16

PLACE OF MEDICAL EDUCATION OF SOURCES OF CARE
BY LOCATION OF SOURCE, FAMILY INCOME AND
HEALTH DISTRICT OF FAMILY

	Under 3000	3000/ 4999	5000/ 6999	7000/ 8999	9000/ 10999	11000/ Over
			MOTT HAVEN DISTRICT			
			Family Income (Dollars)			
USUAL						
Foreign	60.9	61.6	58.1	50.0	83.3	50.0
NYC	6.3	10.4	9.7	23.3	8.3	50.0
Other USA	32.8	28.0	32.3	26.7	8.3	0.0
ACTUAL						
Foreign	65.5	62.2	48.6	63.2	87.5	75.0
NYC	12.1	13.4	21.6	5.3	12.5	25.0
Other USA	22.4	24.4	29.8	31.5	0.0	0.0
			WESTCHESTER DISTRICT			
USUAL						
Foreign	11.1	28.6	32.2	37.4	24.4	11.4
NYC	50.0	35.7	39.4	37.7	31.1	47.8
Other USA	38.9	35.7	28.3	24.8	29.0	20.4
ACTUAL						
Foreign	8.3	36.8	33.0	38.6	40.7	33.0
NYC	50.0	35.1	40.2	35.4	31.0	41.8
Other USA	41.7	28.1	26.8	26.0	28.3	25.2

SOURCE: M-D Study

remained within their district of residence. When they travelled outside their respective districts for physicians, the Mott Haven families increased the proportionate number of locally educated physicians relative to their Westchester income counterparts. This is shown in Table 17. The Westchester families did the opposite. They selected proportionately more foreign educated physicians vis-a-vis their Mott Haven income counterparts.

To the extent that we consider as higher quality a physician who has received a medical education within New York City (as opposed to medical education abroad), we would expect that increases in income or distance travelled to the physician source would result in the substitution of locally trained physicians for those that were foreign trained.[16] Moreover, we would expect the foreign trained physician to be traded for a locally trained physician since a New York City medical education is likely to be of higher quality than that provided within the rest of the nation's medical schools. Also, New York City medical school graduates are more likely to be attuned to the local market for physicians' services where they locate their practice. That Mott Haven families increasingly choose New York City medical school graduates as an actual source of care as family income rises and/or distance travelled to the source increases supports this contention. There are other plausible explanations as well, not the least of which is the numbers of foreign educated physicians located within Mott Haven relative to the other areas of the Bronx.

More curious, however, is selection of foreign medical school graduates by the Westchester families. Here the "relative numbers" explanation will not hold since crossing over to Mott Haven accounts for a negligible number of physician sources for these families. Also, it is

TABLE 17

PLACE OF MEDICAL EDUCATION OF SOURCES OF CARE BY LOCATION OF SOURCE, FAMILY INCOME, AND HEALTH DISTRICT OF FAMILY

	MOTT HAVEN					
	Family Income (Dollars)					
	District		Level One		Level Two	
	Under 5000	Over 5000	Under 5000	Over 5000	Under 5000	Over 5000
USUAL						
Foreign	61.4	58.3	43.3	48.5	0.0	17.1
NYC	9.0	14.8	30.0	21.2	57.1	64.7
Other USA	29.6	26.9	26.7	30.3	42.9	17.6
ACTUAL						
Foreign	63.6	58.8	36.0	27.0	22.2	15.4
NYC	12.9	16.2	32.0	33.3	33.3	53.9
Other USA	23.5	25.0	32.0	39.7	44.5	30.7
			WESTCHESTER			
USUAL						
Foreign	25.5	36.1	62.2	37.7	22.9	27.6
NYC	38.2	37.9	20.0	46.1	37.1	41.4
Other USA	36.3	26.0	17.8	16.2	40.0	31.0
ACTUAL						
Foreign	31.9	37.1	45.2	43.6	32.0	27.9
NYC	37.7	36.3	35.5	43.6	40.0	43.4
Other USA	30.4	26.6	19.3	12.8	28.0	28.7

SOURCE: M-D Study.

unlikely that the remaining areas of the Bronx proliferated in foreign trained physicians. It is more reasonable to expect that the foreign trained physicians provided characteristics that were construed as higher quality or, perhaps, a necessary concomitant of physicians' services. Here it should be noted that the foreign educated physician sources were less likely to be board certified, practicing a specialty, or have a primary practice in pediatrics. So, it is not likely that this is a spurious relationship occasioned by the positive income-specialty and income-certification relationships previously discussed.

A better explanation is that non-English speaking families seek medical sources with whom they may more easily communicate. This contention is supported,[17] in part, by Tables 18 and 19. The tables are for Spanish-speaking families and <u>all</u> foreign trained physicians, not solely the Spanish-speaking physicians and Spanish-trained. Thus, the tables most likely underestimate the extent of the relationship.

TABLE 18

PERCENT DISTRIBUTION OF FOREIGN TRAINED PHYSICIAN SOURCES OF SPANISH FAMILIES IN WESTCHESTER BY LOCATION OF SOURCE

	District	Level One	Level Two
USUAL	54.3	80.6	28.0
ACTUAL	45.8	73.7	30.0

SOURCE: M-D Study

TABLE 19

PERCENT DISTRIBUTION OF FOREIGN TRAINED PHYSICIAN SOURCES OF SPANISH FAMILIES IN WESTCHESTER BY FAMILY INCOME AND LOCATION OF SOURCE

	Family Income (Dollars)					
	District		Level One		Level Two	
	Under 5000	Over 5000	Under 5000	Over 5000	Under 5000	Over 5000
USUAL	25.0	69.6	83.3	77.8	28.6	27.3
ACTUAL	33.3	58.3	55.6	90.0	28.6	30.8

SOURCE: M-D Study

FOOTNOTES TO CHAPTER II

1. See Data Appendix for a description of the study.

2. Technical definitions of the composition of primary care physicians differ.

3. Information with respect to the physician's primary specialty of practice is solicited as the physician's "major practice in a given field". As such, it is independent of any certification process and is determined solely by the physician queried.

4. Frank Sloan and Bruce Steinwald, "Determinants of Physicians' Fees", Journal of Business, Vol.47, No.4, 1974, p.494.

5. See Data Appendix for a description of the data and sampling procedures. It should be noted that the samples contain study and control groups. No attempt has been made, here, to separate the physician sources by this characteristic. The study group had a greater opportunity to identify usual and actual sources because they were queried more frequently. Thus, the resulting distributions are more heavily weighted toward study group responses. This does not appear to be a serious problem, however, since both groups were randomly chosen from the same populations and are similar in socio-demographic characteristics.

6. I am using the term "care" loosely here since further adjustments could be made to reflect the number and type of contact of the actual sources.

7. Here I have a problem. The source of physician location is the AMA Directory of Physicians, which publishes the physician's professional mailing address. No distinction is made between this address and the physician's practice location. Thus I am assuming that they are the same and have no way to tell how fair an assumption this is. In what follows, I shall be referring to the professional mailing address as the practice location.

8. The cumulations are based upon zip codes of the physicians' professional mailing address. The shortcomings of this as indicating physician office location has been mentioned above. The zip codes do not fit "nicely" within iso-distance lines. Criteria for the selection of the lines were that they would run approximately near zip code boundaries when drawn from both Mott Haven and Westchester locii. Alternative selections for iso-distance lines had a negligible impact on the distributions since the large majority of sources were within the respective health districts.

9. The levels can be considered arbitrarily drawn to the extent that we could have had, say, twice as many by cutting the distances in half. The only restrictions I placed on the "levels" beyond the districts was that they had to be of equal distance from one another and the same distance for both Mott Haven and Westchester. That is, referring to Appendix C,

   level 1M = level 2M = level 3M = level 1W = level 2W.

   Preliminary work revealed too few physician contacts beyond the "district" iso-distance lines to warrant increasing the number of "levels".

10. Robert B. Parks, Community Health Services for New York City, Praeger Publishers, 1968.

11. Distribution of Physicians in Private Practice by Health District

	M-D Study	Health and Hospital Planning Council
MH	108	91
W	173	248

   These figures are not strictly comparable although they give a reasonable indication of the total stock of physicians in each health district and the percentage of that stock reported in the M-D Study. The Council's figures are for October 1967. The M-D Study took place from 1964-66. The socio-economic deterioration of Mott Haven during this period may have led to attrition of the Mott Haven physician stock. Another reason for the discrepancy may be due to our inability to "perfectly" meld health districts and zip codes so as to match up sources of care with office location.
   In any case, these figures do suggest that a substantial proportion of the within-health district physician stocks were reported as sources of care in the M-D Study. Thus, the discussion which follows is very likely to describe the supply of physicians.

12. Joseph P. Newhouse, "A Model of Physician Pricing," Southern Economic Journal, Vol.37, October 1970, p.175.

13. There are other assumptions implicit in the following "test" of Newhouse's hypothesis (such as those pertaining to the relative densities of the physician and family populations). Also, we are using a stratified population which mostly relies on primary care physicians for medical care. This group downplays the use of specialists. However, our intent is not to provide a rigorous test of Newhouse's hypothesis. The information at hand will not permit that. Rather, it is to suggest how the mere presence of a particular physician specialty mix may influence utilization.

14. Even if income is held constant a relationship between physician presence and use does not necessarily mean that supply creates demand. Greater numbers of specialists relative to generalists may lower the relative "full" price of specialists via a drop in travel and waiting times.

15. A third category which accounts for the remaining places of medical education is American medical schools other than those of New York City. This category includes Canadian medical schools but excludes that of Puerto Rico. The latter is included among foreign medical schools.

16. The responsiveness of the demand for physician quality to changes in family income and the full costs of travel to the physician are discussed in detail in Chapter IV.

17. Spanish-speaking families accounted for 391 observations in the usual source sample and 315 in the actual source sample. However, only 28.4% and 27.0% of these observations, respectively, were for the Westchester area.

CHAPTER III

THE QUALITY OF PEDIATRIC SERVICES

One of the least broached aspects of economic analyses of physicians' services is the impact of quality differences on the pricing of those services. There is good reason for this. Little information is available which can be construed as quality related. In fact, no concensus exists as to what constitutes "quality" in the provision of physicians' services. The socio-medical literature has kept the issue to the fore, and studies abound which distill quality from the not unrelated themes of medical process -- how well the physician does what he does -- and medical outcome -- how well the patient responded to what the physician did.

These points have conceptual analogues in the economics literature. "Process" and "outcome" are similar to the input-output relationship of production. Thus, few economists would quibble with one physician's assertion that "(s)ome outcomes are dependent totally on the quality of the performance of the physician/institution; others are principally dependent upon the behavior of the patient and his compliance with his proposed treatment regime."[1] This is simply the recognition that health is produced by a variety of inputs, one of which is medical services. And, since health is an amorphous concept, it is easy enough to accept that the output elasticities of physicians' services will vary with the way in which we define (and measure) health and physicians' services. Where "quality" is manifest in the diagnosis and treatment, higher physician quality would be tantamount to saying that a given amount of services results in more appropriate diagnoses and treatment and,

ceteris parabus, more units of "health". Alternatively, a given level of health would be reached with fewer units of services, if they are of higher quality.

However, in order to make the production framework operational (i.e., tractable from an empirical point of view) requires narrow concepts of health and physicians' services. Ultimately, there is some loss in our ability to relate these services to a "market" for physicians' services. As an example, reducing health to incidences of uncorrected herniated disks or levels of blood sugar removes from consideration those aspects of quality which are based on the total mix of the services provided, including the provision of information. For our purposes it is more fruitful to view quality differences in physicians' services from the demand side: quality commands a price in the market.

The efficacy of this approach, a dominant theme in the literature on hedonic price indexes, is summed up by Triplett:[2]

> "even if there is no objective phenomenon identifiable as 'quality', the employment of the notion of characteristics, and the idea that 'quality' involves the disaggregation of goods into constituent characteristics, permits us to say meaningful and useful things about situations which are usually felt to involve quality comparisons and which, without this approach, are difficult to subject to analysis."

And, as for the consumer's ability to distinguish the comparative productive capacities of goods and services -- an aspect of their quality -- Triplett offers the following:[3]

> "Imperfections caused by consumer ignorance may, and undoubtedly do, exist. But one cannot expect omniscient consumers, and therefore one cannot take

> the slightest shred of evidence on consumer ignorance as conclusive proof that market price differentials are meaningless as indicators of quality differences. ...(C)onsumers tend to feel that a higher price is a good indication of higher quality...(and)...this practice (when it exists) really indicates that -- through experience -- consumers have found the range of prices to be the lowest cost form of acquiring information about the relative quality of a particular product variety. If this information system were unreliable it would fall into disuse; the economist is only assuming that, if mistakes are made under this information system, consumers profit from their mistakes (or those of their neighbors), and resulting adjustments preserve the value of the system."

Assessing Physician Quality

The preceding discussion suggests that we disaggregate the "package" of physicians' services into component parts which are directly observable or available to the consumer.[4] Then, price differences among physicians in a particular market can be accounted for by identifiable characteristics of the physicians. Accordingly, we write a quality function as,

$$q_i = q(MDCHAR_i) \qquad (1)$$

where $MDCHAR_i$ is a vector of the characteristics of the i^{th} source of care and q_i is an index of quality for that source. Two major categories which we focus upon in examining the elements of MDCHAR are professional standing and personal characteristics. These are not necessarily independent of one another and merely provide a shorthand for discussing the concept of physician quality.

Professional standing represents aspects of the physician which link him to the medical profession. As an example, board certification in one or more specialty practices recognized by the American Medical Association is considered to be indicative of the quality of services

offered by the physician. Similarly, membership in professional organizations, such as the American Academy of Pediatrics or appointment to medical school faculty are characteristics of professional standing which are considered to be quality-related. These characteristics of the physician's professional career have no observable correspondence with quality, where quality is the efficiency with which the medical process is performed. Rather, they proxy those elements that do correspond to quality in process. The ability to pass a certification exam suggests the potential for applying that knowledge to medical practice. Appointment to medical school faculty suggests a recognition of ability which is at least operating at the "state of the art". Of course, a problem here is that the absence of these characteristics may not mean that a given physician is of lesser quality. Rather, it may imply taste differences among physicians or differentials in medical opportunities across medical markets. I make the strong assumption that there are returns to these characteristics which are sufficient to warrant their undertaking. Also, once these characteristics are realized, "forces" are set in motion which convert physicians of equal ability into physicians of differential quality. The physician who accepts a medical school appointment is now more likely to come into contact with better methods and information concerning medical care.

Personal characteristics pertain to the demeanor of the physician and his physical attributes. The ability to communicate with the physician, that is, speak his (or your) language and ask questions and exact information are considered part of personal characteristics. The physician's age would be indicative of experience and, concomitantly, technical obsolescence. Here we are on firmer ground vis-a-vis the

degree of correspondence between personal characteristics and quality of care. If a physician fails to communicate adequate information, especially where the demand itself is primarily for information rather than process,[5] this is equivalent to purchasing fewer units of physicians' services. That is, ceteris parabus, a physician contact yields fewer units of service and is, therefore, of lower quality. Age, too, is directly related to quality (independently of "vintage", i.e., older physicians are likely to be of an earlier vintage). It is reasonable to expect the aging process to result in, ultimately, a depreciation of human capital.

A full complement of variables which are used to proxy MDCHAR will be discussed in more detail later. First I consider some of the problems which arise when professional standing and personal characteristics are used as elements of physician quality.

Consider a cross-section of physicians' services being sold at different prices in the market; these price differentials may be attributed, in part, to what have been termed age, vintage, and model effects inherent in MDCHAR.[6] The age effect captures the change in physician efficiency as the physician ages. While this is generally considered to be deterioration for a capital good, the effect of age on the efficiency with which physicians' services are rendered is less certain. The early stages of the physician's career are likely to result in accumulations of human capital (experience) which far outweigh loss due to the physiological aging process. The experience is generated in both the medical and non-medical component of the services so that the physician's productivity will be effected in the delivery of services as well as medical process. However, it is reasonable to expect that the incremental gains from

experience rapidly diminish for both medical and non-medical components of physicians' services. Efficient organization of the medical practice should be reached rather early. At the same time more common patient presentations should be seen frequently enough to almost routinize the method by which process is administered. Although it is not clear how much opportunity the physician has to exercise discretion in process, one researcher reports that "50% of pediatricians time in his office is devoted to procedures that paramedical personnel can equally well perform."[7]

The vintage effect refers to the period of medical education. One expects that more recent medical education is superior to that of earlier periods. The ability to incorporate into a learning environment the latest advances in medical technology and the most recent findings in experimental work suggest that later periods of medical schooling are of higher quality. Although individual medical schools may have on occasion experienced losses in personnel or funding which detracted from or temporarily hampered the quality of education provided, it is difficult to imagine any decline in the quality of the majority of medical schools. However, quality differences may remain across medical schools.

This differs from the notion of vintage in the capital goods industry. There succeeding vintages do not necessarily lead to increased quality.[8] Several strong assumptions are tied up as a requisite ceteris parabus constraint for the above. We are assuming that at any point in time the medical school student population is "reasonably" homogeneous; this is being assumed over time as well. Finally, we are assuming that quality of medical education can be "embodied" in the medical student.

These points will not be pursued here except to comment that if there is heterogeneity in the quality of the medical student population and medical schools, it is likely that the qualities have an affinity for one another. It is less clear how the student quality has changed over time given the expansion of medical education and changing market conditions for physicians. Finally, the degree to which quality education is embodied is largely an unknown.

The physician specialty is what we have termed the model effect. There has been a dramatic change in the type of medicine being practiced, with consternation expressed over the rapid decline in the number of general practitioners. In 1965, 64% of all licensed physicians considered themselves to be practicing specialists -- up from 24% in 1940, 36% in 1950, and 56% in 1960.[9] Do specialists yield higher quality services than non-specialists? The general assumption in past studies of the economics of medical care has been that they do and it has been made consistently by the most authoritative writers in the field. Should a distinction be made between specialists certified as such upon passing a licensing exam and those who are self-avowed specialists? Following the arguments presented on quality of medical education, one expects that residency training in a specialty and subsequent passing of a licensing exam in that specialty would lead to greater "expertise" in the area. But, what returns to "expertise" are there to establishing oneself as a specialist and providing services to persons who respond to it? The question here concerns the relative efficiency of a formal learning program and environment versus a self-organized one. If there are perceivable quality differences, and we assume that they command a market price, the question becomes an empirical one. This still leaves open the

relative qualities of general practitioners (non-self-avowed specialists) and specialists, and quality differences among different specialties such as pediatrics and obstetrics-gynecology. Again, this is too incomplete. We must really ask this with respect to a patient population -- that is, Quality for whom? If an orthopedic surgeon is of "higher quality" than a general practitioner, will the surgeon offer "higher quality" care to a preschool child presenting for a common illness? Quality may depend upon demand considerations and adjustments for quality differences should reflect this. For example, quality in the provision of pediatric care (care to children under six years of age) is the relevant quality variable for the empirical work presented below. From this point of view orthopedic surgeons probably represent less quality than general practitioners.

The Hedonic Price Function and Physicians' Fees

The estimation of hedonic price equations provides a means of explaining how quality differences (or, at least characteristics differences) among physicians affects the pricing of physicians' services. The hedonic price function we employ is a regression equation of the general form

$$P_i = P\ (MDCHAR_i; U_i) \qquad (2)$$

where P_i is the price of the i^{th} sources services, $MDCHAR_i$ is defined as before, and U_i is a disturbance term. Prior to estimation one must select the appropriate characteristics and a functional form to relate price and quality. One pioneer in the development of the hedonic price approach, Griliches, considers these empirical questions;[10] others are less sanguine.

The traditional textbook theory of price determination posits price as the arbiter of market forces. The equilibrium market price obtains (with an equilibrium quantity) as the solution to a simultaneous system of demand and supply. As such, an equation designed to determine price is a reduced form of the structural equations which describe the market and, if completely specified, it will contain the shift parameters of both sides of the market. In what sense, then, may we pick and choose among these to select the characteristics which represent quality?

Since the demand for physicians' services is, itself, a derived demand in response to the more general demand for health,[11] the relevant characteristics are those that vary the productive capacity of the physician. Elements which are not descriptive of physician productivity, even though they contribute to production costs, should be excluded, while those that are, even though "costless", should be included. As an example, rent for office space is a cost of production; yet, it may have no direct bearing on quality. That is, the variables which are selected are assumed to be those which the consumer construes as affecting medical process.

A further consideration is that we wish to include direct characteristics of the good and not the market. Thus, shift parameters on the demand side such as family income and the coterie of taste proxies (i.e., sex, race, religion) are to be excluded.[12] Finally, Cowling and Cubbin suggest that direct characteristics that lack a "fairly constant relation" to the final demand should be avoided even if they are capable of explaining a large proportion of the variation in price.[13] Thus, race or sex of the physician may influence price without contributing quality and, therefore, should be excluded.[14] Whether the above methodology is what Griliches means by declaring the selection of relevant characteristics an empirical question is moot. It does set criteria which go beyond the conventional tests of

significance.

We cannot entirely avoid market influences by being "selective" in our choice of variables. The quality characteristics -- their combinations and amounts -- are likely to have been shaped by previous outcomes in medical markets. Even so, this is not likely to pose a formidable problem in our particular case. It is doubtful that the M-D physicians were influenced by the Mott Haven and Westchester markets for physicians' services in their choice of professional characteristics. On the other hand, their subsequent location decisions may have been influenced by these markets. But, the population dynamics of the areas, other intervening factors in the location decision, and the inability of physicians to swiftly change quality characteristics in response to market forces should serve to dampen this influence.

To what degree is the selection of a functional form an empirical question, as Griliches suggests? The quality characteristics of physicians have been cast into a framework of age, model, and vintage effects. If one draws parallels with the human capital literature, physician depreciation over time should require a non-linear specification. Although this is based on age-earnings profiles which are, themselves, empirical findings in the literature, the consistency of the findings and a logic which must admit to an increase and ultimate decline in quality with age fixes at least one aspect of the functional form. Also, as Lucas has demonstrated, the Lancastrian consumer theory may be used to derive both linear and non-linear specifications of the hedonic price function under assumptions of competitive markets and a linear consumption technology.[15] But, this does not provide a realistic framework for

analysing the market for physicians' services given the extent to which this market departs from the competitive ideal. It appears that little can be inferred from economic theory with regard to the appropriate functional form of a hedonic price function for physicians' services.

Measurement of Variables

In this section we discuss the variables which enter the estimation of the hedonic price function. They are recorded in Table 1 along with their definitions. The most general version of the hedonic price function that is estimated is,

$$\begin{aligned}\text{In USUPRICE} = {} & \alpha_0 + \alpha_1 \text{EXP} \qquad (3)\\ & + \alpha_2 \text{EXPSQ} + \alpha_3 \text{PRIMEPED} + \alpha_4 \text{PRIMEOBG}\\ & + \alpha_5 \text{PRIMEIM} + \alpha_6 \text{PRIMESUR} + \alpha_7 \text{PRIMEOTH}\\ & + \alpha_8 \text{CERTPED} + \alpha_9 \text{CERTOBG} + \alpha_{10} \text{CERTSUR} + \alpha_{11} \text{CERTIM}\\ & + \alpha_{12} \text{CERTOTH} + \alpha_{13} \text{PEDEXP} + \alpha_{14} \text{IMEXP} + \alpha_{15} \text{OBGEXP}\\ & + \alpha_{16} \text{SUREXP} + \alpha_{17} \text{OTHEXP} + \alpha_{18} \text{MEMBER} + \alpha_{19} \text{PROF}\\ & + \alpha_{20} \text{NYCEDUC} + \alpha_{21} \text{FOREDUC} + \alpha_{22} \text{TKL} + \alpha_{23} \text{TKE} + \alpha_{24} \text{TB}\\ & + \alpha_{25} \text{BLACK} + \alpha_{26} \text{SPANISH} + \alpha_{27} \text{AREA}.\end{aligned}$$

The dependent variable, In USUPRICE, is the natural logarithm of the fee usually charged for a visit to the particular physician. Our measure offers several advantages over the measures used in other studies of physicians' fees.[16] As an average assessment of the fee per visit it is not tied to a particular procedure or illness episode. Since this is the "usual" fee to the "usual" source of care it is unlikely to be

TABLE 1

DEFINITION OF VARIABLES IN HEDONIC PRICE FUNCTION

Variable	Definition
USUPRICE[a]	Usual price charged by physician for an office visit
EXP	Number of years since physician graduated from medical school
EXPSQ	Square of EXP
PRIMEPED[b,c]	Primary practice in pediatrics = 1
PRIMEIM[b]	Primary practice in internal medicine = 1
PRIMEOBG[b]	Primary practice in obstetrics-gynecology = 1
PRIMESUR[b]	Primary practice in surgery = 1
PRIMEOTH[b]	Primary practice in another specialty = 1
CERTPED	Board certification in pediatrics = 1
CERTIM	Board certification in internal medicine = 1
CERTOBG	Board certification in obstetrics-gynecology = 1
CERTSUR	Board certification in surgery = 1
CERTOTH	Board certification in another specialty = 1
PEDEXP	PRIMEPED multiplied by EXP
IMEXP	PRIMEIM multiplied by EXP
OBGEXP	PRIMEOBG multiplied by EXP
SUREXP	PRIMESUR multiplied by EXP
OTHEXP	PRIMEOTH multiplied by EXP
MEMBER[a]	Number of memberships in recognized special societies

TABLE 1 (concluded)

Variable	Definition
PROF	Appointment on medical school faculty = 1
NYCEDUC	Medical education received in New York City = 1
FOREDUC	Medical education received in a foreign county = 1
TKL	Physician does not talk to mother in her own language = 1
TKE	Mother usually does not talk enough to physician = 1
TB	Mother bothered that she usually does not talk enough to physician = 1
BLACK	Mother is black = 1
SPANISH	Mother is Puerto Rican or Latin American = 1
AREA	Mother resides in Mott Haven = 1

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[a] See text for a more detailed definition.

[b] Omitted class is primary practice in general practice.

[c] Dummy variables take the value zero (0) when not set to one (1).

influenced by anomalous physician pricing practices. That is, the start-up costs of an initial visit, the reduced price of a third contact which was solely to assess the progress of previous medication, the brief contact sans child to get advice on bed-wetting or eating problems, and so on, should not unduly influence the reported fee.

The usual fee solicited was, specifically, "net of shots" and probably net of laboratory tests, as well, since they are not likely to accompany a usual visit. Whether the families were able to respond with a usual fee net of shots is, of course, open to question. However, given the frequency of physician visits for this age group and the multiple interviews, which should have raised the awareness of the respondents to physician-related matters, we expect that the usual fee is well-measured. Further, the primary source of the data in the other "physician pricing" studies[17] was the physician. Here the reported usual fee averages over the patient mix, the imputed value of physician produced laboratory tests, physician behavior with respect to price discrimination, and the effect of a below unity collection ratio on pricing practices.[18] The resulting measurement error increases the standard errors and, worse yet, if systematically related to the explanatory variables, biases their coefficients. The fees which were recorded in the M-D data are unencumbered by these problems and represent marginal user cost, the appropriate measure for our hedonic price study.

Excluded from the sample are those persons for whom physician fees were covered by insurance. The M-D study did not provide for a fee response independently of insurance coverage. Families that were insured were not asked to indicate the nature of the coverage since coverage for

private office visits was rare in the mid-1960's. As a result, 210 of the 1897 observations (11½%) were lost to the analysis. The M-D study was pre-medicaid. As such it did not influence the demand price for physicians' services. However, physicians may have changed their fee structures in expectation of the offering of medicaid. Whether they did is, of course, not known and there is no reason to expect that this possibility will have had much effect on USUPRICE; at worst it should be "averaged in" with previous fees or lead to a change of physician.

The independent variables in the equation are designed to capture age (experience), vintage and model effects. Rather than enter the physician's age, however, we enter the physician's experience in medical process (EXP).[19] This is measured as the number of years since the physician graduated from medical school. More recent graduation implies a later vintage physician, one whose training, hence quality, should be superior to earlier vintages. Thus, price should fall with vintage. Earlier graduation implies a greater time in practice or, the accumulation of experience via on-the-job training. Here we expect price to rise with experience and offset the vintage effect. The square of experience (EXPSQ) is entered to capture non-linearities in EXP.

The simplicity of the human capital empirical schema is lost, however, since we are not dealing with earnings. Rather, the analogue would be with a wage-experience profile. Even this is a poor comparison. Wages are given per unit time ($/hr) where the time unit is fixed and independent of age.[20] Physicians' fees are given per contact and the time per contact may vary with age quite independently of the accompanying quality change due to experience or obsolescence. Consequently, while

there is no a priori reason to expect a particular sign on the age-related variables our interpretation of the resulting sign as quality enhancing or quality depreciating will be unambiguous only under the following assumptions: Either the consumer of services must be myopic with respect to physician time consumed per contact, or physician time provided per contact must be independent of the physician's age.

The effect on USUPRICE of different physician specialties is the model effect. There are two aspects of physician specialty which we wish to consider. As discussed above, physicians may practice a specialty without obtaining additional training in that specialty or, given the additional training, without acquiring certification; this is a physician's self-avowed primary practice. The major sources of physicians' services for infants and pre-schoolers are the general practitioner and pediatrician, although all primary care physicians (which add obstetrics-gynecology, internal medicine and family medicine to the generalist and pediatrics categories) are considered appropriate. In order to test for differential impacts among several of the primary practices, dummy variables are introduced into the hedonic equation. They take on the value one if the physician engages in the particular primary practice and zero otherwise.

The primary practices which are treated in this fashion are pediatrics (PRIMEPED), obstetrics-gynecology (PRIMEOBG), internal medicine (PRIMEIM), surgery (PRIMESUR) and all other types of primary practice (PRIMEOTH). The excluded category is general practice. Pediatricians are expected to provide relatively higher quality services to infants and preschoolers than would physicians in general practice. If the general practitioner has a younger patient load he may provide relatively more quality than the remaining specialties -- PRIMEOBG, PRIMESUR, PRIMEIM, and PRIMEOTH.

However, non-board certified pediatricians, internists, and obstetricians probably have more training in pediatric care or school than general practitioners, so that the regression coefficients of PRIMEOBG and PRIMEIM may be positive. It is not clear whether surgeons or other specialists are considered by consumers to provide more quality as the usual source of child care than general practitioners. Therefore, the signs of the regression coefficients of PRIMESUR and PRIMEOTH are ambiguous, a priori.

The link between certification in a medical specialty and the quality of care provided by a physician practicing that specialty is stated by the American Board of Medical Specialties. Their statement of purpose, according to the American Board, is "improvement in the quality of medical and health care provided to the public by medical specialists...The primary purpose of each approved specialty board is to determine the competence of candidates in its field who appear voluntarily for examination and to certify as diplomates those who are qualified."[21] As an example of the requirements for admission to the two-part examination (written and oral), the specialty board in pediatrics requires: (1) graduation from a medical school which has been approved by the specialty board in pediatrics, (2) three years of hospital based training in a program approved by the American Medical Association for internship and residency training, (3) two years of additional practice or further training in pediatrics following the hospital based training.[22] Upon completion of the prerequisites for admission to the various certification examinations a physician is considered "board eligible". Data on board eligibility are not readily available. Consequently, we

do not distinguish eligibility status of those physicians who are otherwise not board certified.

The board certification dummy variables which correspond to their primary practice counterparts are for pediatrics (CERTPED), obstetrics-gynecology (CERTOBG), internal medicine (CERTIM), surgery (CERTSUR) and other specialties (CERTOTH). They take on the value one when appropriate, zero otherwise. Since board certification in a specialty denotes more training and higher quality relative to non-board certification, the coefficients of all the board certification variables should be positive.

The quality inherent in a physician's practice may be considered a partial reflection of his period of medical education. Earlier we termed this a vintage effect. The longer a physician has been practicing a particular primary specialty, the earlier the vintage. If medical education has consistently improved over time, earlier vintages are of lesser quality, and it is expected that they will be valued as such by consumers. To test this hypothesis an experience times primary practice interaction term is included in the regression equation for each of the primary practice dummy variables. Since age and model effects are being held constant, the vintage effect should be negative. The interaction variables are, symbolically, PEDEXP, OBGEXP, IMEXP, SUREXP, and OTHEXP.

In addition to the age, model and vintage effects other professional characteristics are included as elements of the MDCHAR quality vector. These are the place of medical education, membership in professional societies, and faculty standing. Place of medical education is reduced to three categories: education in a foreign medical school (FOREDUC),

including that of Puerto Rico but excluding Canadian medical schools, education in a medical school located in New York City (NYCEDUC). The excluded category is education in a North American medical school (USAEDUC) other than those in New York City. The variables are entered as dummies, taking on a value of one when conforming to one of the categories and zero otherwise.

It is our prior belief that physicians education in foreign medical schools will be perceived as lesser quality than those from North American medical schools. Hence, we would expect a negative relationship between USUPRICE and FOREDUC. The coefficient on NYCEDUC reflects the relative impact of a New York City medical education and is expected to be positive on two counts. First, on average, New York City medical school students are likely to receive better training than those of the remainder of the country. Secondly, having spent these several years of their training within the city, one expects that the NYCEDUC physicians are better attuned to the individualities of the local New York City medical markets. A conscious (or unconscious) matching of their abilities and preferences with the perceived preferences of the local markets should result in individual location decisions which, ceteris parabus, provide greater quality services to the indigenous population.

A major shortcoming in our empirical specification of MDCHAR is our inability to measure post-graduate medical education. Continued medical education of a formal or informal nature is likely to be quality enhancing and, thus, positively related to USUPRICE. In an attempt to control for this we include the number of memberships in "recognized special societies" (MEMBER) such as the American Academy of Pediatrics and the American Society of Internal Medicine. The AMA directory of

physicians considers a special society to be one that is scientific in nature, with at least 66% of the membership holding the MD degree, and national in scope, with members in at least 50% of the states. As we have argued before with respect to certification, the absence of the characteristic does not deny the presence of the quality which it proxies. Nor does the presence of the characteristic demand the presence of the quality. Physicians who do not belong to special societies may attend medical conferences, read professional journals and contribute to their literature, and consult frequently with colleagues. Just as easily, those who do belong may do none of these. However, on average we expect that MEMBER will show concern for developments in the medical fields and an accompanying learning process.

Similarly, we include a medical faculty status dummy variable (PROF) which takes a value of one if the physician holds an appointment to a medical school faculty, and zero otherwise. We are on firmer ground in expecting this variable to signal continued medical education. Indeed, appointment involves peer review of credentials and an ability which is close to, if not at, the state of the medical art.

Part of the demand for pediatric care is a demand for information by mothers about the state of health of their children. Therefore, mothers should be willing to pay price premiums to physicians who convey relatively large amounts of information to them. Proxy variables for the amount of information received are whether the physician talks to the mother in her own language (TKL), whether the mother feels that she does not talk enough to the physician (TKE), and whether the mother is bothered very much that she does not talk enough to the physician (TB).

Only mothers who do not speak English were asked whether the physician talks to them in their own language. Mothers who responded that they do not talk enough to the physician were asked whether this bothers them a little, somewhat or very much. The variable TKE compares those who are bothered a little or somewhat to those who talk enough, and the variable TB compares those who are bothered very much to those who are bothered a little or somewhat. According to the way these variables are coded, positive values indicate less information. Therefore, each one should be negatively related to usual fee.

The coefficients of the three final variables in the regression (BLACK, SPANISH, AREA) are assumed to reflect differences in the quality-adjusted price of pediatric care. It is hypothesized that blacks, Puerto Ricans, and Latin Americans pay higher prices than whites because they have less knowledge about the medical care market or because physicians discriminate against certain groups in the population. It is also hypothesized that quality-adjusted price is higher for Westchester residents than for Mott Haven residents because each district constitutes a local market for medical care. Although the physician-population ratio in Westchester exceeds that in Mott Haven, quality-adjusted price would be larger in the former area if the shift to the right in the "local market area supply curve" were more than offset by a shift to the right in the "local market area demand curve."

Regression Results

The results of regressing ln USUPRICE on the variables shown in the hedonic price function (equation 3) are discussed in this section. Table 2 contains summary statistics of all variables in the price function.

Table 3 contains the results of the estimation. Separate estimates for Mott Haven and Westchester are shown in Appendix B along with their summary statistics.[23] It is the coefficients of the regression shown in Table 3 which are used in Chapter IV to develop an index of the quality of pediatric care and a measure of the quality-adjusted price of those services.

The sample for the regressions is derived by linking all the usual sources of private pediatric care as reported by the mothers in the study and control samples with their characteristics as obtained from medical directories.[24] If each mother reported a single usual source and each mother used a different physician, the number of usual sources, number of physicians, and number of families in the regression all would be equal. In fact, these three variables are not equal because some mothers indicated more than one usual source and different mothers took their children to the same physician. There are 1687 units of observation based upon 798 physicians.

The empirical relationship between a physician's experience and usual fee is, we said earlier, the net effect of experience and technical obsolescence. Our results indicate a net decline in fee as the physician ages.[25] However, the decline is at a decreasing rate and at later years it bottoms out and turns upward. This can be seen from the coefficients on the experience (EXP) and experience squared (EXPSQ) term. The coefficient on EXP is -0.009. It is 0.0002 for the EXPSQ term.[26] Both are highly significant by conventional standards.[27] The negative term dominates the earlier years of experience. Then as experience increases the net imputed value of experience becomes less "negative". That is,

TABLE 2

MEANS AND STANDARD DEVIATIONS OF VARIABLES
IN HEDONIC PRICE FUNCTION

	COMBINED SAMPLE	
Variable	Mean	Standard Deviation
EXP	26.345	10.698
EXPSQ	808.445	551.623
PRIMEPED	.335	.472
PRIMEIM	.086	.280
PRIMEOBG	.094	.292
PRIMESUR	.074	.262
PRIMEOTH	.068	.251
CERTPED	.155	.362
CERTIM	.002	.042
CERTOBG	.005	.069
CERTSUR	.002	.049
CERTOTH	.010	.100
PEDEXP	8.344	13.666
IMEPX	2.350	8.430
OBGEXP	2.660	8.736
SUREXP	2.171	7.990
OTHEXP	1.666	7.015
MEMBER	.364	.550

TABLE 2 (concluded)

MEANS AND STANDARD DEVIATIONS OF VARIABLES
IN HEDONIC PRICE FUNCTION

	COMBINED SAMPLE	
Variable	Mean	Standard Deviation
PROF	.075	.264
NYCEDUC	.352	.478
FOREDUC	.340	.474
TKL	.028	.165
TKE	.122	.327
TB	.031	.174
BLACK	.082	.274
SPANISH	.213	.410
AREA	.267	.443
ln USUPRICE	1.738	.263

TABLE 3

ORDINARY LEAST SQUARES ESTIMATES OF HEDONIC PRICE FUNCTIONS FOR PEDIATRIC CARE[a]

	COMBINED SAMPLE[b]	
Variable	Regression Coefficient	t-Ratio
EXP	-.009	-3.27
EXPSQ	.0002	3.65
PRIMEPED	.193	4.77
PRIMEIM	.039	0.64
PRIMEOBG	.165	2.33
PRIMESUR	.073	0.79
PRIMEOTH	.006	0.10
CERTPED	.162	5.47
CERTIM	.022	0.15
CERTOBG	-.069	-0.76
CERTSUR	.274	2.13
CERTOTH	.114	1.74
PEDEXP	-.006	-3.98
IMEXP	.001	0.38
OBGEXP	-.005	-2.22
SUREXP	-.002	-0.57
OTHEXP	.002	0.82
MEMBER	.025	1.90

TABLE 3 (concluded)

ORDINARY LEAST SQUARES ESTIMATES OF HEDONIC PRICE FUNCTIONS FOR PEDIATRIC CARE[a]

	COMBINED SAMPLE[b]	
Variable	Regression Coefficient	t-Ratio
PROF	-.022	-0.73
NYCEDUC	.017	1.08
FOREDUC	.023	1.41
TKL	-.064	-1.74
TKE	.005	0.22
TB	-.045	-1.15
BLACK	.048	1.99
SPANISH	-.004	-0.20
AREA	-.121	-6.73
CONSTANT	1.781	
R^2	.148	
F Statistic	10.631	

[a]Dependent variable is natural logarithm of usual fee. R^2 is unadjusted coefficient of multiple determination. See Table 1 for definitions of all variables.

[b]Sample size is 1,687.

there is a point at which another year of experience can be construed as neither a contribution nor a detraction to physician quality.

The impact of experience on the physician's usual price contains one additional element -- the physician's specialty. Taking the partial derivative of equation 3 with respect to experience yields,

$$\frac{\partial \text{ USUPRICE}}{\partial \text{ EXP}} = \alpha_1 + 2\alpha_2 \text{ EXP} + \sum \beta_i X_i \qquad (4)$$

where X_i denotes the i^{th} primary practice and β_i denotes the i^{th} coefficient (i = PRIMEPED, PRIMEOBG, PRIMEIM, PRIMESUR, PRIMEOTH).

We have recognized the heterogeneity of the professional services which physicians provide and attempted to capture these differences via a model effect. Vintage, we said, is the different ages of each model. An experience x model interaction term was entered to capture the vintage effect. That is, a more sophisticated approach to physician aging recognizes that the aging process may differ across physician specialties and across a given specialty acquired at different points in time. Physicians in the primary practice of pediatrics, obstetrics/gynecology, and surgery show a negative effect of vintage. The PEDEXP and OBGEXP coefficients are significant; SUREXP's is not. The IMEXP and OTHEXP coefficients are positive but not significant.

In Table 4 we present the net impact of physician experience on changes in physicians' prices. We begin with ten years of experience and move by increments of five years to a total of forty years. It should be remembered that this is based upon a sample of infant and preschooler-oriented consumers in a locale with a particular supply configuration. Looking across rows for given primary practices we see that in all cases the net effect of experience is that less experienced

TABLE 4

NET IMPACT OF PHYSICIAN EXPERIENCE ON PERCENTAGE CHANGES IN PHYSICIAN PRICE FOR SELECTED PRIMARY PRACTICES[a,b]

Specialty	Experience (years)							Experience at the Turning Point (years)
	10	15	20	25	30	35	40	
PRIMEPED	-	-	-	-	-	-	+	37.5
PRIMEOBG	-	-	-	-	-	0	+	35.0
PRIMEIM	-	-	0	+	+	+	+	20.0
PRIMESUR	-	-	-	-	+	+	+	27.5
PRIMEOTH	-	-	+	+	+	+	+	17.5

a. See text and Table 1, Chapter II for explanation of specialties.

b. Signs and turning points calculated using equation 4 and coefficients in Table 3, Chapter III for combined sample.

(younger) physicians command a premium. According to our framework this implies that for a given primary practice "newer" physicians are of higher quality. However, the premium falls with age and in all categories a turning point is reached where increases in experience (age) command a premium.[28]

There are several plausible explanations for the u-shaped relationship. One which we suggested earlier and which Steinwald and Sloan offer is that more recent medical school graduates, and hence younger physicians, receive better training at a more advanced state of the art. Barzel estimates that for the period 1949-64 physician productivity increased at a rate of 0.6 percent per year [29] -- entirely consistent with gradual improvement in the additions to the physician stock. This explanation is reasonable for a decline in fees with increases in age; but why the upturn? It is unlikely that experience increases at an increasing rate with age. The opposite is more likely. Fein suggests that later entrants to the physician stock charge higher prices because they have yet to establish a practice price and are more in touch with "what the market will bear". Increases in insurance coverage over time makes them less reluctant to quote higher prices for an office visit. This, of course, is not an argument which is quality-related. Steinwald and Sloan, on the other hand, hypothesized that newer entrants are "expected to be in the process of building their practices and, consequently, would tend to charge relatively low fees in order to attract patients".[30] We offer a variant on the Steinwald and Sloan theme. Younger physicians would not only be building a practice but trying to fill out office hours as well. And,

Sloan's study of physicians' hours of work decisions concludes that young physicians work longer.[31] As a result, they are likely to be providing more process time per visit than older, established physicians -- and, we may add, charging for it, too. Reinhardt offers evidence that the physician's fee is positively and significantly related to physician time per visit.[32] Consumers are likely to consider increased process time per visit higher quality rather than greater quantity if their frame of reference is the visit. As physicians' age and professional schedules become more crowded process time per visit is likely to fall while price remains relatively stable, rising less rapidly than that of the newer entrants.[33]

Why does price turn upward? Following this reasoning, older physicians may perform more slowly and diligently resulting, once again, in increased process time per visit -- and increased price per visit. Two other possibilities would reinforce this. As physicians age a selection process may "weed" out the less efficient, lower quality physician, leaving those with correspondingly higher opportunity costs of retirement or leisure. Or, if physicians choose increased leisure to accompany aging, higher prices may be used to ration the fewer practice hours or, in fact, to reduce practice hours. Finally, physicians who intend to sell their practices may increase the value of the practice by raising practice revenues via price increases. The relatively low price elasticities reported in the literature, not to mention Feldstein's contention that the market is one of excess demand, suggest the ease with which this could be accomplished. Again, the latter two points do not provide quality-related arguments for the upturn.

We turn now to the effect of primary practices and certification on physicians' fees -- the model effect.

The set of variables that indicate primary practice specialty and board certification in that specialty are PRIMEPED, PRIMEOBG, PRIMEIM, PRIMESUR, PRIMEOTH, CERTPED, CERTOBG, CERTIM, CERTSUR and CERTOTH. Since the omitted class is general practice and since dummy variables for board certification in each of the five specialties are included in the regression, the coefficient of PRIMEPED, for example, shows the percentage difference between the price charged by a non-board certified pediatrician and the price charged by a general practitioner. Similarly, the coefficient of CERTPED shows the percentage difference between the price charged by a board certified pediatrician and the price charged by a non-board certified pediatrician.

In Table 5 we set out a framework for interpreting our results. As we expected, physicians with a primary practice in pediatrics had the largest percentage difference between their price and that of the general practitioner. All specialties had positive coefficients when compared to general practice. However, the percentage differences in price between internal medicine (PRIMEIM), surgery (PRIMESUR), and other specialists (PRIMEOTH) and the general practitioner were not significant. Examining the effect of board certification in a specialty on the percentage difference in price, we find that only board certified obstetrician/gynecologists did not register an increase over the non-certified counterpart. However, this finding is not significant; nor was the increase registered by board-certified internists. Since board certification in a specialty denotes more training and, thus, higher quality relative to non-board certified physicians in the same

TABLE 5

PERCENTAGE DIFFERENCES IN PRICES CHARGED BY SELECTED BOARD CERTIFIED AND NON-BOARD CERTIFIED SPECIALISTS[a]

	(1) Specialty and Certification	(2) Coefficients[b]	(3) Percentage[c] Difference
1	PRIMEPED - GP	α_3	.193 (.035)
2	CERTPED - PRIMEPED	α_8	.162
3	CERTPED - GP	$\alpha_3 + \alpha_8$	.355
4	PRIMEOBG - GP	α_4	.165 (.033)
5	CERTOBG - PRIMEOBG	α_9	-.069*
6	CERTOBG - GP	$\alpha_4 + \alpha_9$	.096
7	PRIMEIM - GP	α_5	.039* (.065)*
8	CERTIM - PRIMEIM	α_{10}	.022*
9	CERTIM - GP	$\alpha_5 + \alpha_{10}$	.061
10	PRIMESUR - GP	α_6	.073* (.021)*
11	CERTSUR - PRIMESUR	α_{11}	.274
12	CERTSUR - GP	$\alpha_6 + \alpha_{11}$	.347
13	PRIMEOTH - GP	α_7	.006* (.058)*
14	CERTOTH - PRIMEOTH	α_{12}	.114
15	CERTOTH - GP	$\alpha_7 + \alpha_{12}$	.120

a. See Table 1, Chapter II for definitions of variables.
b. Coefficients are from equation 3.
c. Based upon Combined Sample estimates, Table 3.
* Not significant at .05% level.

specialty, we are not surprised by the generally positive and significant differences.

What we have been examining is the families imputation of the relative values of primary practices and certified specialties. Thus, we would expect that for our sample the coefficients of PRIMEPED and CERTPED would dominate the others in size and significance. PRIMEPED is larger in size than its counterparts relative to general practice. Those physicians who are board certified in surgery register a larger gain over non-certified surgeons than board-certified pediatricians as compared to non-certified pediatricians. The over-all impact of a certified pediatric practice relative to general practice is slightly higher than that of certified surgery and "substantially" larger than the others. Moreover, the findings for pediatric practice are more highly significant than those of the other practices.

Steinwald and Sloan report an insignificant effect of board-certification status on physicians' prices. Their findings prompt them to state that "to the extent that BD (board certification) and FAC (faculty standing) are quality indicators, these findings have two primary implications. First, quality may fail to be reflected in price in the presence of consumer ignorance. Second, if quality has an impact on physician decision-making, it may be manifested in product mix rather than fees."[34] Their findings were reinforced in a later study by Sloan (1974). The latter point may find some truth among the more selective specialists, especially surgeons -- an example they use for the "product mix" argument. Although, our results contradict this for those board-certified surgeons providing a usual source of care for small

children. However, it is difficult to imagine primary care physicians altering their product mix since routine procedures form the bulk of their practices. Also, the widely cited consumer ignorance hypothesis is more likely to obtain for medical process and the efficacy of treatment for reasons which Pauly has pointed out.[35] Consumers of physicians' services are apt to grasp any information available with bearing on professional qualifications and none is more easily obtained -- or more obviously displayed by physicians -- than specialized training certificates and specialty shingles. The very nature of consumer ignorance with respect to the product in the bottle should lead to decisions based on the label.

The results which we have reported in Table 5 and discussed above can be termed a "gross" model effect. We have consistently pointed out that models "produced" at different points in time should contain a vintage effect. Just as we suggested that the imputation of quality which families attach to experience (or aging) ought to be examined in a way which permits valuations of experience to vary across models, so we suggest a symmetical argument: the valuations of models should be permitted to vary across periods. To accomplish this we entered a vintage interaction term in equation 3. Let SPECIALTY_i represent the primary specialties of equation 3, where i ranges across PRIMEPED, PRIMEOBG, PRIMEIM, PRIMESUR and PRIMEOTH. The change in ln USUPRICE with respect to a change in model is

$$\frac{\partial \text{ ln USUPRICE}}{\partial \text{ SPECIALTY}_i} = \alpha_i + \alpha_i \text{ EXP} \qquad (5)$$

where the α_i are the coefficients of the i^{th} specialty in equation 3. Computations based upon equation (5) yield a net model effect. That is,

the α_i (gross model effect) are adjusted for their vintage. In Table 5, column 3 we show the results of these computations, in parentheses, next their gross model counterparts. They are calculated at the sample mean of EXP, 26.3 years. Evidently, when we account for vintage effects the differences among specialties is greatly reduced. Specialties other than PRIMEPED and PRIMEOBG did not show significant differences in their gross valuation relative to general practice and, as shown in column 3, their relative net valuations do not differ. The relative decline of pediatrics and obstetrics/gynecology would have been expected on the basis of results presented in Table 4. The "baby" doctors show a net "depreciation" of their model beyond the years of mean experience, (26.3 years) and do not begin "appreciation" for another decade -- the turning points for PRIMEPED and PRIMEOBG are 37.5 years and 35.0 years, respectively. We calculated the number of years of practice it would take before the greater valuations of pediatrics and obstetrics/gynecology relative to general practice (and, given significance levels, the other categories) are no longer present as 32.2 and 33.0 years, respectively. Since other physician categories may be the source of care for multiple members of the family, their quality relationships may be somewhat subdued. That is, in the case of pediatric care we may be witnessing the result of a "nothing but the best for my baby" syndrome.

Memberships in special societies appear to proxy quality. The coefficient is positive and significant. The mechanism by which this operates is not clear. We have indicated that this may be a proxy for post-graduate medical education. Faculty status, however, did not significantly affect physicians' fees. Since faculty appointment requires

peer review and up-to-date understanding with respect to medical process we expected the coefficient on PROF to be positive and significant. It was neither. It may be that physicians with a faculty appointment trade pecuniary interests for "interesting" cases.

It was our prior belief that medical education in a New York City medical school (NYCEDUC) would be construed as superior to education in the remaining U.S. medical schools while a foreign medical education (FOREDUC) would be considered inferior. The positive coefficient on NYCEDUC is consistent with the former hypothesis.[36] However, the FOREDUC coefficient was significantly positive, contrary to our expectations that such training would be considered of lesser quality.

With this hindsight, mitigating circumstances may well outweigh the quality of education argument and lead to uncertainty in our expectation of the sign on FOREDUC.[37] Physician/patient relationships encompass a complicated set of social interactions. Even if we limit these to simply a demand for and supply of medical care, cross-cultural differences in the perception and treatment of illnesses will influence the relative compatability of physician/patient pairs. Do Hispanic families consider Hispanic physicians to be more knowledgeable in the diagnoses and treatment of the illnesses which beset their children? Are they better able to prescribe medication, physical therapy, or diet? Would a Jewish physician prescribing a light liquid diet for a Hispanic child with a gastro-intestinal disorder recommend soups or tell the mother to avoid heavy, chick pea and garlic soups, standard Spanish fare? Would he expect mothers to act identically to the recommendation, "Avoid spices"? The "socio-cultural" aspects of physician/patient relationships could lead the consumer to distinguish among otherwise similar physicians

independently of economic motivation.[38] Placing these into our quality characteristics framework would require a measure of physician ethnicity to separate out the effects of cultural insight and foreign medical education. Since this is not available we are unable to predict the sign on FOREDUC or interpret it as other than a composite of these factors.[39]

We gain some insight from our measure of the mother's ability to converse with the physician in her own language (TKL) given that she does not speak English. The mother's feeling of whether she talks enough to the physician (TKE) and, given that she does not, whether it bothers her (TB) were entered as proxies for the amount of information gained from the physician. If the TKE and TB variables are picking this up, the TKL variable may be picking up the coterie of physician/patient cultural differences discussed above. The TKE variable is insignificant and the wrong sign. TB, however, has the expected sign and a t-value greater than one. With these held constant we find a significant negative effect of TKL.

In an effort to control for areal differences in medical markets and capture the effects of race and ethnicity on physicians' pricing practices -- a major theme in the socio-medical literature[40] -- BLACK, SPANISH, and AREA were entered into the regression. BLACK had a positive and significant effect on price; SPANISH had a negative but insignificant effect. The greatest impact, however, was that of AREA. Being a Westchester resident led to a 12% increase in price. As our "spatial" analysis of Chapter II suggests, Mott Haven and Westchester may be two distinct markets for pediatric services.

FOOTNOTES TO CHAPTER III

1. Charles Lewis, "The State of the Art of Quality Assessment - 1973," Medical Care, Vol.12, No.10, October 1974, p.805.

2. Jack E. Triplett, The Theory of Hedonic Quality Measurement and Its Use in Price Indexes," Bureau of Labor Statistics Staff Paper #6, United States Department of Labor, 1971, p.14.

3. Ibid, pps.33-34.

4. This will be discussed in more detail later in the Chapter.

5. See Mark V. Pauly, Information And The Demand For Medical Care, National Bureau of Economic Research, mimeo, November 1973.

6. The following parallels Hall in Zvi Griliches (ed.), Price Indexes And Quality Change, Harvard University Press, Cambridge, Mass., 1971.

7. Rashi Fein, The Doctor Shortage, Brookings Institution, Washington,D.C., 1967, p.126.

8. Hall calculated a quality index for pickup trucks and found that "the quality index rises rapidly from 1955 to 1960 and falls slightly from 1961 to 1966...(and these findings are) in conformity with Triplett's results for automobiles." See Hall in Griliches, op.cit., p.241.

9. Fein, op.cit., p.69.

10. See Griliches' "Hedonic Price Indexes Revisited" and "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change" in Griliches, op.cit.

11. For a discussion of this, see Michael Grossman, The Demand for Health : A Theoretical and Empirical Investigation, unpublished doctoral dissertation, Columbia University, 1970.

12. Griliches, op.cit., p.5.

13. Keith Cowling and John Cubbin, "Price, Quality, and Advertising Competition: An Econometric Investigation of the United Kingdom Car Market", Economica, Vol.38, Nov.1971, p.384-385.

14. One may want to argue that race and sex are proxies for ability. If blacks and women have been discriminated against in admission to medical schools those that are admitted are likely to be above average in ability. On the other hand, quality may be affected if, say, blacks attend inferior medical schools or women work fewer hours than men, therefore investing less in on-the-job training.

15. Robert F.B. Lucas, Hedonic Price Functions, mimeo, UCLA, 1974.

16. I have in mind, particularly, the studies by Reinhardt (1970), Newhouse (1970), Steinwald and Sloan (1974) and Sloan (1974), cited in the bibliography.

17. See previous note for these.

18. See Frank Sloan "Physician Fee Inflation: Evidence from the late 1960s," Conference on the Role of Health Insurance in the Health Services Sector, National Bureau of Economic Research, New York, 1974, pps.10-11.

19. The terms "Age" and "Experience" are used interchangeably.

20. See footnote 26 for a discussion of physicians' wage-age profile as estimated by Sloan.

21. Directory of Medical Specialists, Marquis Who's Who, 200 E. Ohio Street, Chicago, Ill., 1974/75 edition, p.XVI.

22. Ibid, pp.1481-1483.

23. A test of the hypothesis that the coefficients of the hedonic price functions of the separate areas are the same and only the intercepts differ was rejected at better than the 17% level of significance. It is not obvious, however, how to interpret this finding. It may be signalling quality differences between the areas, differences in market structures and composition, or both.

24. This is discussed on page 25 , Chapter II.

25. Since the dependent variable is the logarithm of USUPRICE, unit changes in the independent variables should be interpreted as affecting percentage changes in USUPRICE.

26. Sloan used the 1/100 Public Use Sample of the 1960 U.S. Census of Population to estimate weekly and hourly wage equations for the 1800 physicians in that sample. His findings on the wage-age relationship are directly counter to our price-age findings. Thus, while we find a u-shaped effect his results indicate an inverted u-shape. In a later study of physician fee inflation (Sloan, op.cit.) he estimated a reduced form price equation for follow-up office visits aggregated over micro data for general practitioners, surgeons and internists so as to provide observations by state. A dummy variable measuring the percentage of physicians over 55 years of age was negative at conventional levels of significance. See Frank Sloan, "A Microanalysis of Physicians' Hours of Work Decisions," in Mark Perlman (ed.), The Economics of Health and Medical Care, London: MacMillan, 1974.

27. We shall refer to the coefficients of variables as significantly different from zero (or "significant") if they are at least within the .05 level of confidence on a two tail test. While the .05 level of confidence is conventionally employed as an arbitrary cut-off we shall, at times, treat coefficients that "approach" it as significant if they are "reasonable". Obviously, the reader may draw his own conclusions.

28. In a similar attempt to capture the net effect of experience and vintage, Steinwald and Sloan regressed the usual charge for an office visit (as reported by the physician) on physician age dummies. Their regressions are run within specialty categories. In almost every instance the coefficients were insignificant at conventional levels and in the one significant case it was positive! However, they also include a dummy variable for physicians receiving their license in the state within the last ten years. This is bound to be co-linear with the age variables. In addition, they enter variables to capture physicians' input costs and patient and community characteristics. From our earlier discussion, this is more a reduced form of demand and supply equations and one that is estimated across different markets. As a result, we do not consider their findings to be contradicting ours. See Bruce Steinwald and Frank Sloan, "Determinants of Physicians' Fees," Journal of Business, Vol.47No.4 , 1974.

29. Yoram Barzel, "Productivity and the Price of Medical Services", Journal of Political Economy, Vol.77, No.6, 1969, p.1023.

30. Steinwald and Sloan, op.cit., p.500.

31. Sloan, op.cit., p.324.

32. See Appendix A in Uwe E. Reinhardt, "An Economic Analysis of Physicians' Practices, Unpublished doctoral dissertation, Yale, 1970.

33. Once a practice is established and "usual" fees set a physician is likely to be reluctant to change it and Fein suggests that when market conditions change, price adjusts with a lag. "The lag in price response may be the result of tradition and the conflict between the physician's dual role as healer and entrepreneur." Fein, op.cit., p.15.

34. Steinwald and Sloan, op.cit., p.506.

35. Mark Pauly, op.cit.

36. Our arguments which suggest this finding are found on page 79 of this Chapter.

37. A variable indicating physicians born outside of the United States, other English speaking countries, and western Europe is entered into wage estimating equations by Sloan. He expected that foreign medical education and language difficulties of these physicians would reduce earnings. Of course, physicians conforming to his place of birth criteria may have neither of these "negative" characteristics. However, the variables performed as expected -- it was negative and significant, lowering weekly earnings $69.70/week and hourly earnings $1.70/hr relative to native born physicians. Since his data is from the 1960 1% sample of the population it cuts across a plethora of medical markets, perhaps one for each of the 1,800 physicians. Thus, there is a reduced likelihood that the foreign born physicians have located in a market which would offer a premium for their language capabilities and cultural background. Our rough analysis in Chapter II of place of medical education and physician location among the M-D physicians suggests the opposite for our sample. See Sloan in Pearlman, op.cit.

38. An extensive review of the burgeoning literature on the socio-cultural behavioral mechanisms in the utilization of health and medical care personnel can be found in John B. McKinlay, "Use of Services - An Overview," Journal of Health and Social Behavior, Vol.13, No.2, June 1972.

39. Nor would an ethnicity measure be entirely satisfactory since it would fail to indicate an awareness of cultural differences in medical care or that an appropriate response was known. There is no reason to believe that a physician is less perceptive than an anthropologist and the awareness and response may be quickly absorbed into a physician's practice.

40. See, for instance, David Elesh and Paul Schollaert, "Race and Urban Medicine," Journal of Health and Social Behavior, Vol.13, September 1972.

CHAPTER IV

THE DEMAND FOR PEDIATRIC SERVICES

Our intention in this chapter is to set out a framework for analyzing the demand for physicians' services. The hedonic quality index is incorporated into an empirical strategy which permits separate estimations of both the demand for pediatric visits and the quality of pediatric care. The strategy of fitting separate demand curves for quality and visits has not been pursued in existing studies of the demand for physicians' services. However, this was not the fault of earlier investigators since the detailed information which is needed for such an attempt was not available to them.

The theoretical basis for our work is developed within the spirit of a burgeoning literature on household production.[1] Here the family is assumed to be a producing unit as well as the consuming unit of standard economic theory. In contrast with the standard theory, the family does not directly consume the goods and services that it purchases in the marketplace. Rather, these enter into the production of more general commodities which are the source of household utility. For example, pediatric services are not desired for their own sake. They do not contribute directly to family satisfaction. Instead, they are an input in the production of a more "intangible" good, viz. child health, which does yield satisfaction directly.

To conceptualize this approach, let the utility function of the family be given by

$$\psi = \psi(h, z), \qquad (1)$$

where h stands for child health and z is a composite of all other commodities which enter the family's utility function.[2]

The production function of child health is assumed to depend upon physicians' services, conceptualized as the number of physician visits, v, and the quality of care per visit, q.[3] A vector of inputs, y, also enter the production function. These include characteristics as diverse as the genetic endowment of the child, the family's housing stock, parental characteristics such as years of formal schooling completed, and random variations in health due to illness.[4] Write the child health production function as,

$$h = h\ (v,\ q,\ y) \qquad (2)$$

Substitution of (2) into (1) yields an alternative utility function of the form,

$$U = U\ (v,\ q,\ z), \qquad (3)$$

where the y vector has been suppressed for simplicity.[5] It is assumed that q is constant for a given family but may vary across families.[6]

The family draws upon resources derived from non-earned income, labor market earnings, and the value of non-market time. These aggregate to the full income budget of the family and constrain expenditures for pediatric services and the composite good. To develop the nature of this constraint, let pv denote expenditures in terms of payment to the physician for pediatric services, where p is the average price of a visit. Define a price function

$$p = \hat{p}q \qquad (4)$$

with properties such that the first and second derivatives of the price function with respect to quality are $\partial P/\partial q = \hat{P}$ and $\partial^2 P/\partial q^2 = 0$, respectively, and where $\hat{p}$ is quality-adjusted price. Thus, the quality-adjusted price of one unit of pediatric services, $\hat{P}$, is

$$\hat{P} = P/q \qquad (5)$$

and we may write the total expenditures for pediatric services, MD, as

$$MD = \hat{p}vq. \qquad (6)$$

The outlays which are required to obtain pediatric care contain additional costs. For instance, the family incurs transportation costs (C dollars per visit) and expends travel time (t_1 hours per visit) in order to reach the physician's office. Waiting time (t_2 hours per visit) is expended in the office.[7] Since the mother typically -- or at least by social convention -- is responsible for taking the child to the physician, the opportunity cost of time expended in obtaining pediatric care is evaluated at her hourly wage rate, w.[8] The sum of forgone earnings per visit and transportation costs per visit are termed the "fixed" cost of a visit, f, and are written as,

$$f = c + w(t_1 + t_2) \qquad (7)$$

If we now add the simplifying assumption that the price of a unit of z is one dollar, we may write the budget constraint as,

$$S = z + \hat{p}vq + v(wt_1 + wt_2 + c) \qquad (8)$$

where S represents the family's full income.

The objective of the family is to maximize the utility function in equation 3 subject to the constraint posed in equation 8 that expenditures on q, v, and z exhaust full income.

The first-order conditions for the optimal selection of q, v, and z are

$$U_z = \lambda \qquad (9)$$

$$Uq = \lambda\hat{p}v \qquad (10)$$

$$U_v = \lambda\ (\hat{p}q + f), \qquad (11)$$

where U_i ($i = q, v, z$) is the marginal utility of the i^{th} argument in the utility function and λ is the marginal utility of income. Equations

10 and 11 may be interpreted as providing the shadow prices of the quality and the quantity of pediatric services, respectively. Letting π_q and π_v be these respective shadow prices we may rewrite equations 10 and 11 as,

$$\pi_q \equiv \hat{p}v \qquad (10a)$$

$$\pi_v \equiv \hat{p}q + f \qquad (11a)$$

It is evident from equations 10a and 11a that the shadow price of quality rises with the equilibrium number of visits, and the shadow price of visits rises with the equilibrium amount of quality. The economic interpretation of this as applied to the quantity and quality of pediatric services can be stated as follows: an increase in the quality of physician visits is increasingly more expensive as that quality increase has to be applied to more visits; similarly, an increase in the number of physician visits is more expensive for higher quality physicians since higher quality physicians cost more per visit.[9]

In equilibrium, the family equates the marginal rate of substitution between quality and visits with the shadow price of quality relative to the shadow price of visits,[10]

$$\frac{U_q}{U_v} = \frac{\pi_q}{\pi_v} = \frac{\hat{p}v}{\hat{p}q + f} \qquad (12)$$

An increase in the quality-adjusted price of pediatric service, $\hat{p}$, increases the shadow prices of quality and visits, as shown in equations 10a and 11a. However, it is evident from equation 12 that due to the presence of the fixed cost of a visit, f, the percentage increase in the shadow price of quality would exceed the percentage increase in the shadow price of visits. That is, the relative price of quality would rise with an increase in $\hat{p}$ and consumers would substitute away from quality (and toward visits). A

rise in the fixed costs of a visit would lead consumers to substitute quality for visits since the relative price of quality would fall.[11]

Now consider the reduced form demand functions for quality and visits,[12]

$$q = d_1 (\hat{p}, f, s) \qquad (13)$$

and

$$v = d_2 (\hat{p}, f, s) \qquad (14)$$

The variables f and $\hat{p}$ have opposite effects in the demand curve for quality; f is positively related to quality and $\hat{p}$ is negatively related to quality. They may also have opposite effects in the demand curve for visits; f is negatively related to visits and $\hat{p}$ may take on either sign. But, wherever both f and $\hat{p}$ are negatively related to visits, the reduction in visits caused by an increase in fixed costs should exceed the reduction caused by an increase in quality-adjusted price. This follows since any reduction in visits due to an increase in $\hat{p}$ will be offset, somewhat, by the substitution of visits for quality, while any reduction in visits due to an increase in f will be further reinforced by the substitution of quality for visits.

Reduced form income effects are not discernible in our analysis. Therefore, the responsiveness of quality to changes in income relative to that of visits cannot be predicted on <u>a priori</u> grounds and no predictions of the signs on quality or visits are made. Becker and Lewis (1973) assume that the pure income elasticity of quality of children exceeds that of number of children.[13] In our case both quality and quantity of pediatric services enter the production function of child health,

$$h = h (q, v, y) \qquad (2)$$

The pure income elasticity of quality would exceed that of quantity only

if an input subsumed in the y vector is fixed and q is a better substitute than v for that input.[14]

An Empirical Framework for the Measurement of Price and Quality

The M-D data provide information on visits, price per visit, physicians' characteristics, and the family characteristics of patients. This information is employed to construct measures of quality and quality-adjusted price and, therefore, to permit the estimation of the quality and visit demand curves which were emphasized in the preceding section.

We begin by defining quality-adjusted price, $\hat{p}$, as

$$\hat{p} = p/q \qquad (5)$$

where p is the price of a pediatric visit and q is an index of the quality of pediatric care. Taking logs and rearranging equation (5) yields

$$\ln p = \ln q + \ln \hat{p}. \qquad (15)$$

Following the development of physician quality in Chapter III, we let the natural log of the quality of pediatric care supplied by physicians be a linear function of MDCHAR, a vector of physician characteristics,

$$\ln q = \alpha \text{MDCHAR} \qquad (16)$$

Earlier we defined the elements of MDCHAR as those characteristics which affect physician productivity. They are identical to the characteristics which entered the hedonic fee function. (See Table 3, Chapter III.) Substitution of equation 16 into equation 15 yields the hedonic fee function of Chapter III,

$$\ln p = \alpha \text{MDCHAR} + \ln \hat{p} = \alpha \text{MDCHAR} + u. \qquad (17)$$

That is, $\ln \hat{p} = u$ where u is the disturbance term. If equation 17 is

estimated by an ordinary least squares regression, the natural log of quality and quality-adjusted price can be computed as $\ln q = \alpha$ MDCHAR and $\ln \hat{p} = u$. Or, q and $\hat{p}$ can be computed as $q = e^{\alpha}$ MDCHAR and $\hat{p} = e^{u}$, respectively.

Having obtained measures of quality and quality-adjusted price, we are able to estimate the reduced form demand curves of equations 13 and 14. For example, we may write them as linear equation,[15]

$$v = a_o + a_1\hat{p} + a_2 f + a_3 s \qquad (18)$$

and

$$q = b_o + b_1\hat{p} + b_2 f + b_3 s \qquad (19)$$

and estimate the parameters by ordinary least squares. However, implicit in this framework and several assumptions which, if not met, could introduce bias into the estimated regression coefficients.

Consider the construction of $\hat{p}$ and q. The quality of pediatric services supplied by physicians (or, at least, the characteristics which have been selected to proxy physician quality) must be independent of quality-adjusted price in the estimation of equation 17.[16] On the demand side, the consumption of relatively large amounts of quality or visits must not lead families to successfully search for lower quality-adjusted price. That is, causality must not run from v or q to $\hat{p}$ in equations 18 and 19. Given these conditions, the disturbance term in the hedonic fee function would be independent of the quality index. This does not mean that q and $\hat{p}$ should be unrelated in the quality demand function.

Since the variables which enter the hedonic fee function differ from those of the quality demand function, $\hat{p}$ is constructed in the absence of variables which may be correlated with it and are held constant in the quality demand curve. Family income is one example of such a

variable. It does not enter the hedonic fee function but does enter the demand function. If income is positively related to quality-adjusted price, q and $\hat{p}$ (independent in the hedonic fee function) may be negatively related in a demand function which holds income constant.

The measures, then, of quality-adjusted price (QUALPRICE) and an index of quality (QAVE), designated above as $\hat{p}$ and q, are computed from the hedonic price function shown as equation 3 in Chapter III. They are computed as,

$$\text{QUALPRICE} = e^{(\alpha_0 + \alpha_{25}\,\text{BLACK} + \alpha_{26}\,\text{SPANISH} + \alpha_{27}\,\text{AREA} + \hat{u})} \quad (17a)$$

$$\text{and} \quad \text{QAVE} = e^{\sum_{i=1}^{24} \alpha_i \text{MDCHAR}_i} \quad (17b)$$

where $\hat{u}$ is the residual associated with a given observation and MDCHAR_i denotes one of the first twenty-four variables in equation 3 in Chapter III. The coefficients, α_1 through α_{27}, which are used for the computations of QUALPRICE and QAVE are those shown for the Combined Sample regression, Table 3, Chapter III. The regression intercept, α_0, is included in the computation of QUALPRICE since it is preferable to express QAVE as a units-free index of quality and quality-adjusted price as having the same units as observed price.

Measurement of Price, Quality and Fixed Costs for Multiple Sources of Pediatric Care

The quantity of pediatric care (VISITS) is further subdivided into pediatric visits which were initiated for preventive purposes (PVISITS) and those initiated for curative purposes (CVISITS).[17] These three quantity variables and the quality variable (QAVE) are the dependent variables for which demand functions are estimated.

Typically, survey data generate information with respect to whether

a physician was seen during, say, the previous two weeks and, perhaps, the source of care for the visit or the usual source of care. Medical care consumption in the M-D study is based, in part, on the replies concerning illness behavior. If there "was something wrong" with the child a series of probes were designed to find out how long it lasted and how it was dealt with -- whose advice was solicited? What was the advice? Was a physician contacted? For every physician contact which resulted because something was wrong (a "condition") an illness supplement was used to accumulate extensive information on the course of medical care consumption.

For example, referrals to other physicians and hospitalizations are also recorded. Then, these contacts are followed. Also, information is elicited in response to whether the child received a "check-up." Finally, the family is asked whether the child has been seen by "any other physician" not previously mentioned, such as a school physician.

It follows from this that a variety of physicians may have been seen by a single study child. When this is the case, quality per visit is defined as a weighted average of the quality of each source, where the weights are the percentage of visits to that source. That is, QAVE is computed as

$$QAVE = \sum_{i=1}^{M} QAVE_i \cdot VISITS_i / \sum_{i=1}^{M} VISITS_i \qquad (20)$$

where i represents the i^{th} physician. Similarly, the quality-adjusted price of medical care rendered by multiple physicians is defined as a weighted average of the quality-adjusted price at each source. The weights are the product of quality and visits at the i^{th} source as a percentage of the product of quality and visits summed over all sources. Thus, we

compute quality-adjusted price as

$$\text{QUALPRICE} = \sum_{i=1}^{M} k_i \text{QUALPRICE}_i$$

where

$$k_i = \text{QAVE}_i \cdot \text{VISITS}_i / \sum_{i=1}^{M} \text{QAVE}_i \cdot \text{VISITS}_i \qquad (21)$$

QAVE and QUALPRICE are computed directly from the hedonic fee function in those cases where there is a single source of care. The fee at a given source was not obtained in the M-D survey if the mother said that it was covered by health insurance; nor were the conditions of the insurance, such as deductibles and coinsurance rates, recorded. Consequently, quality-adjusted price is set equal to zero at insured sources.[18]

Earlier it was shown how the value of time expended in accessing physicians' services would, together with transportation costs, influence the demand for the quantity and quality of pediatric care. These are termed fixed costs and are defined as

$$\text{FIXED} = W\ (TT+TW) + C \qquad (22)$$

where W is the mother's wage rate, TT and TW are travel time and queuing time in the physicians' office, respectively, and C is travel cost. Unfortunately, the queuing time variable in the M-D study was based upon a subjective evaluation and, consequently, not well-measured. As a result of preliminary work it was decided to drop that variable from the measure of fixed costs. Therefore, we define the fixed costs of travel as

$$\text{TRFIXED} = W \cdot TT + C \qquad (23)$$

and use TRFIXED, rather than FIXED, in the demand curve regressions.

In cases where the family travelled to more than one source of pediatric care during the year, TRFIXED is computed by using a weighted average of the travel time (TT) and travel cost (C) to each source. The

weights are the percentage of visits to that source. Thus, we compute

$$TRFIXED = W \cdot TT + C \tag{24}$$

where

$$TT = \sum_{i=1}^{M} TT \cdot VISITS_i / \sum_{i=1}^{M} VISITS_i$$

and

$$C = \sum_{i=1}^{M} C_i \cdot VISITS_i / \sum_{i=1}^{M} VISITS_i$$

and i represents the i^{th} physician.

Measurement of Family Income and the Mother's Wage

The income variable (FAMINC) which enters the demand equations is the predicted value of family income. It is based upon a regression of reported family income on selected socio-economic characteristics of the family. Specifically, the regression equation is given by

$$FAMINC = d_o + d_1 SF + d_2 BLACK + d_3 SPANISH + d_4 AREA + d_5 NF, \tag{25}$$

where SF is the years of formal schooling completed by the father and NF is a dummy variable which takes the value one if the father is absent from the household. Mothers may indicate that their spouse is not present, even if this is not the case, in order to receive welfare payments. However, that situation is likely to be indicative of the low earning capacity of the father and a relevant predictor of family income. The other variables in equation 25 are defined in Table 2 and the results of the estimation are presented in Table 1. By predicting family income and using it in the demand equations we avoid downward bias on the income coefficient which would result from measurement error in reported income. On the theoretical level, our measure comes closer to the conceptually appropriate variable -- permanent income. Below we will contrast income coefficients which were estimated using both predicted and reported income.

TABLE 1

ORDINARY LEAST SQUARES REGRESSION OF REPORTED FAMILY INCOME ON SELECTED SOCIO-ECONOMIC VARIABLES[a,b]

$$\begin{aligned} \text{INCOME} = 4990.242 &+ 220.815\ \text{SF} + 39.225\ \text{BLACK} + 1369.187\ \text{NF} \\ &\quad (26.012) \qquad (0.008) \qquad (4.351) \\ &- 1236.303\ \text{SPANISH} - 1908.118\ \text{AREA} \qquad R^2 = .306 \\ &\quad (13.563) \qquad (32.997) \end{aligned}$$

---

a. Definitions of variables are shown in Table 2 or discussed on page 113 in the text.

b. t-statistics in parentheses.

The M-D study does not contain information on mothers' wage rates. In order to derive this variable, the mothers were cross-classified by race, white or non-white (defined as SPANISH + BLACK), and formal years of schooling. Then, they were assigned wage rates based on Fuchs' calculations of hourly wage rates of women aged twenty to thirty-four.[19]

Measurement of the Remaining Explanatory Variables

Office visits to physicians in private practice constitute the largest percentage of all physician contacts in the United States. However, infants and preschool children have fewer office visits as a percent of their total physician contacts than any other age group. The percentage distribution of physician visits, as reported for the U.S., July 1963 - June 1964, the year prior to the M-D survey, shows that children under five years of age had 58.3% of their visits in the office; 4.2% were at home; 14.6% were in a hospital or emergency room; and 21.6% were by telephone.[20]

Physician contacts in the home, by telephone, and at public sources of care are likely to constitute relatively close substitutes for private office visits. However, there is no a priori reason why they could not complement the office visit. It is reasonable to expect, for example, that office visits and telephone contacts are used in tandem. Also, Davis and Russell present empirical findings which are consistent with the hypothesis that private physicians (hence, visits to them) complement outpatient care.[21]

The effect of alternative methods of physician contacts on the demand for the quality of pediatric care is also uncertain, a priori. Moreover, there have been no studies to provide empirical insight. It is

possible that with quality-adjusted money prices held constant, greater numbers of telephone and home contacts imply a reduction in quality-adjusted price in real terms. Then we can expect these variables to be positively related to the quality of pediatric care. With respect to public care, we may consider Davis' and Russell's suggestion that the outpatient department may serve to complement specialists' (therefore higher average quality) services by providing a setting for diagnostic tests.[22] This, too, would suggest a positive quality-public care relationship.

It is evident from the above discussion that the net effect of alternatives to the office contact is an empirical question. We will not attempt to exhaust the arguments which would provide a rationale for a particular relationship between visits in the physician's office and the alternative forms of physician contact. Rather, we enter these separately in the demand equations as home visits (HOME), telephone contacts (TELE) and visits to public sources of care (PUB) and discuss them further when the results are reported. While it is recognized that the appropriate explanatory variables are, in theory, the prices of HOME, TELE, and PUB, these prices are not available. The "quantities" are entered in place of the "prices" under the assumption that they are inversely related to their own price and the potential simultaneity problem is, in fact, minor.

Four socio-demographic variables of the family are entered as explanatory variables on the basis of their development in the health economics literature. Here, too, it must be stressed that exhaustive arguments to provide a rationale for a particular result are avoided

and the variables discussed further when the results are reported. The age of the child (AC) would be inversely related to the quantity and quality of pediatric care if, as Friedman and Leibowitz (1975) hypothesize, the returns to pediatric care decline as children grow older. A decline in the returns to pediatric care is equivalent to an increase in the real price of that care. Families would have an incentive to substitute away from pediatric services as an input in the production of child health and away from child health production, in general. Work by Grossman (1972, 1975) suggests that a reduction in the rate of depreciation on health capital at early stages in the life cycle will also lead to an inverse relationship between age and the quantity and quality of pediatric care.

These influences are reinforced by a medical protocol (supply influence) which suggests that physician visits be made on a monthly basis in the first year and less frequently thereafter. However, it is also current medical philosophy to encourage mothers to let minor childhood illnesses run their course, sans physician, so that the child will build up anti-bodies. This may lead toward a positive age-pediatric services relationship. Also, if visits in the early years serve to screen for chronic childhood illnesses and these require an increase in pediatric services via visits, then AC and VISITS would be positively correlated.

The relationship between the number of children in a family and the quality per child has played a prominent role in recent economic studies of fertility. Becker and Lewis (1973) show that the shadow price of child quality rises as the number of children in the family rises. Child health is one aspect of child quality, and pediatric services are

an input into the production of child health. Thus, the number of children in the family (NC) is entered into the demand equations, and, ceteris parabus, it should be inversely related to the quantity and quality of pediatric care. On the other hand, as the number of children increases the family may derive "economies" from the use of physicians' services. This would lower the real price of pediatric care and lead to a positive relationship between NC and the dependent variables. Or, random fluctuations in the health of a given child may be "communicated" to the other children so that greater numbers of children may increase the likelihood that pediatric care will be consumed.

Two measures of the health status of the child are entered into the demand equations. One is the mother's subjective evaluation of the child's health status. It is defined in dummy variable form as poor (HS1), fair (HS2), and good (HS3); the omitted class is excellent. When a particular status applies it is set equal to one and the others are set equal to zero. The other measure records whether the child was hospitalized (HO) during the year. HO, too, is a dummy variable which takes on the value one if the study child was hospitalized during the year, and zero otherwise.

Both Grossman (1972) and Phelps (1973) have shown that the quantity of medical care demanded will expand due to exogenous reductions in health. If, however, the consumption of pediatric services and the level of child health are simultaneously determined, estimating demand equations by ordinary least squares regressions is inappropriate. Fuchs and Kramer (1971) find no support for the hypothesis that health is endogenous in the demand for medical care and Leveson (1970), in discussing this issue, concludes

that "a substantial portion of health variation will still be predetermined." (p.19). On a somewhat different level, though, the hospitalization dummy, which is entered as a proxy for a current, serious illness, may be determined by an office visit. This is not considered to be an important problem in the quantity demand curves since the hospitalization decision could have been arrived at independently, say, at an alternative place of medical care. There is no reason to expect causality to run from the quality of pediatric care to hospitalization.

Finally, the number of years of formal schooling completed by the mother (SM) is entered as an explanatory variable. Friedman and Leibowitz (1975) and Grossman (1975) suggest that mothers' schooling is a positive correlate of efficiency in the production of healthy children. It is reasonable to expect that more educated mothers are better able to understand and follow the advice of the physician, identify and report symptoms, and "learn" from physician contacts. If increases in SM have a differential impact on the inputs in the production function of child health, say, one that increases the relative productivity of pediatric services, then pediatric care will be substituted for other inputs, ceteris parabus, and SM will be positively related to the quantity and quality of pediatric care. This would be offset, however, if the demand curve for child health is relatively inelastic.

Grossman (1972) has shown that increases in SM given an inelastic demand curve for health will lower the quantity of medical care demanded. Then, if mothers' schooling raises the productivity of the quality of pediatric care relative to the quantity (by, say, permitting more educated mothers to better coordinate the services of otherwise "fragmented"

specialists) there would tend to be a positive relationship between SM and quality and a negative one between SM and quantity. Consequently, we do not predict a sign on the SM variable.

Empirical Results of Demand Curve Estimations

The results of estimating demand curves of private pediatric care for the entire sample are shown below in Tables 4 through 8.[23] As an aid to interpreting these results definitions of the variables which enter the demand curves are provided in Table 2 and their summary statistics shown in Table 3. Linear specifications are used for all demand functions. The most extensive version is given by

$$\begin{aligned} \text{VISITS} = {} & b_o + b_1\text{QUALPRICE} + b_2\text{FAMINC} + b_3\text{TRFIXED} \\ & + b_4\text{AC} + b_5\text{NC} + b_6\text{HO} + b_7\text{HS1} + b_8\text{HS2} + b_9\text{HS3} \\ & + b_{10}\text{HOME} + b_{12}\text{TELE} + b_{13}\text{SM} \end{aligned} \qquad (1)$$

where the dependent variable, chosen for illustration, is VISITS. In Table 4 we present results of demand curves where the dependent variable is VISITS. The results when the dependent variable is QAVE are shown in Table 5. Estimates of demand curves for curative (CVISITS) and preventive (PVISITS) visits are presented in Tables 6 and 7, respectively.

It was shown earlier that an increase in quality-adjusted price (QUALPRICE) would raise the relative price of quality (QAVE) and lead to a substitution of quantity (VISITS) for quality. This is borne out empirically. The sign on the coefficient of QUALPRICE is positive in each of the VISIT equations and negative in each of the QAVE equations, results which are consistent with the theory.[24] QUALPRICE is significant at conventional levels in all QAVE equations. It borders on significance at the 5% level in equations 1 and 2 and the 15% level in equations 3 and 4.[25]

TABLE 2

DEFINITION OF VARIABLES IN DEMAND FUNCTIONS

Variable	Definition
VISITS	Annual number of pediatric visits to physicians in private practice by study child
QUAL	Quality per visit
QUALPRICE	Quality-adjusted price
FAMINC[a]	Predicted family income
W[a]	Potential hourly wage rate of mother
TT	Travel time per visit to usual source of private care
TW	Waiting time per visit at usual source of private care
C	Transportation cost per visit to usual source of private care
TRFIXED	Fixed costs of travel per visit: TRFIXED = C + W*TT
PUB	Annual number of visits to physicians in public care sources by study child
TELE	Annual number of telephone contacts to physicians in private practice
HOME	Annual number of visits by private physicians in child's home
AC	Age of study child
NC	Number of children in the family
HS[b]	Evaluation of study child's health by mother: HS1 = 1 if health is poor, HS2 = 1 if health is fair, HS3 = 1 if health is good
HO	Study child hospitalized during the year = 1
SM	Years of formal schooling completed by mother

[a]See text for a more detailed definition.

[b]Omitted class is health is excellent.

TABLE 3

MEANS AND STANDARD DEVIATIONS OF VARIABLES
IN DEMAND FUNCTIONS

Variable	Combined Sample[a]	
	Mean	Standard Deviation
VISITS[b]	6.620	6.001
CVISITS[b]	3.139	4.178
PVISITS[b]	3.481	3.471
QUAL	1.012	.093
QUALPRICE	5.500	2.978
TRFIXED[c]	1.684	1.132
FAMINC[d]	64.646	16.983
W	1.527	.279
TT[e]	31.632	22.542
TW[f]	42.535	26.210
C8	89.807	89.179
PUB	2.387	4.266
TEL	2.007	3.433
HOME	.824	1.365
AC	1.702	1.596
NC	1.725	.783
HS1	.011	.102
HS2	.076	.265

TABLE 3 (concluded)

MEANS AND STANDARD DEVIATIONS OF VARIABLES IN DEMAND FUNCTIONS

Variable	Combined Sample[a]	
	Mean	Standard Deviation
HS3	.310	.463
HO	.088	.284
SM	10.852	2.625

[a]Sample size is 568. See Table 2 in the text for definitions of variables.

[b]VISITS = CVISITS + PVISITS where CVISITS and PVISITS are the annual number of pediatric visits by the study child to physicians in private practice for curative and preventive purposes, respectively.

[c]$\text{TRFIXED} = \frac{C}{100} + (W)\ (\frac{TT}{60})$

[d]Hundreds of dollars.

[e]Round-trip travel time in minutes.

[f]Minutes.

[g]Round-trip travel cost in cents.

TABLE 4

ORDINARY LEAST SQUARES ESTIMATES[a] OF DEMAND CURVES FOR PHYSICIAN VISITS

Independent Variable	EQUATION 1 Regress Coef	EQUATION 1 t-value	EQUATION 2 Regress Coef	EQUATION 2 t-value	EQUATION 3 Regress Coef	EQUATION 3 t-value	EQUATION 4 Regress Coef	EQUATION 4 t-value
QUALPRICE	0.135	1.80	0.139	1.88	0.095	1.41	0.101	1.50
FAMINC	0.136	10.15	0.151	10.24	0.089	6.07	0.082	5.10
TRFIXED	-0.273	-1.35	-0.285	-1.43	-0.462	-2.56	-0.466	-2.58
AC	-1.245	-8.79	-1.246	-8.88	-1.062	-8.13	-1.061	-8.12
NC	-0.514	-1.79	-0.569	-2.00	-0.065	-2.37	-0.660	-2.35
HO			1.899	2.44	0.555	0.78	0.564	0.79
HS1			-0.014	-0.00	0.896	0.46	1.028	0.52
HS2			3.306	3.61	3.468	4.05	3.538	4.13
HS3			0.047	0.90	0.192	0.27	0.149	0.32
PUB					-0.214	-3.90	-0.210	-3.80
HOME					-0.266	-1.67	-0.261	-1.64
TELE					0.722	10.80	0.716	10.67
SM							0.101	1.10
CONSTANT	0.560		-0.768		2.894		2.213	
R^2	.234		0.264		0.412		0.413	

[a] Sample size is 568. See Table 2 for definitions of all variables.

TABLE 5

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR PHYSICIAN QUALITY[a,b]

Independent Variable	EQUATION 1 Regress Coef	EQUATION 1 t-value	EQUATION 2 Regress Coef	EQUATION 2 t-value	EQUATION 3 Regress Coef	EQUATION 3 t-value	EQUATION 4 Regress Coef	EQUATION 4 t-value
QUALPRICE	-0.377	-2.91	-0.371	2.85	-0.390	-2.97	-0.378	-2.87
FAMINC	0.071	3.05	0.061	2.34	0.046	1.60	0.033	1.05
TRFIXED	0.482	1.37	0.463	1.32	0.380	1.08	0.372	1.06
AC	0.098	0.40	0.158	0.64	0.283	1.11	0.286	1.12
NC	-0.099	-0.20	-0.127	0.25	-0.156	-0.31	-0.149	-0.30
HO			3.441	2.52	2.831	2.03	2.842	2.04
HS1			0.506	0.13	0.521	0.14	0.758	0.20
HS2			-0.133	0.08	-0.589	-0.35	-0.464	-0.28
HS3			-1.142	1.26	-1.271	-1.38	-1.235	-1.34
PUB					0.042	0.39	0.050	0.46
HOME					0.025	0.08	0.034	0.11
TELE					0.267	2.04	0.255	1.94
SM							0.182	1.02
CONSTANT	0.979		0.985		0.991		0.978	
R^2	0.039		0.052		0.060		0.062	

[a]Sample size is 568. See Table 2 for definitions of all variables.

[b]Regression coefficients are multiplied by one hundred.

TABLE 6

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR CURATIVE VISITS[a]

Independent Variable	EQUATION 1 Regress Coef	EQUATION 1 t-value	EQUATION 2 Regress Coef	EQUATION 2 t-value	EQUATION 3 Regress Coef	EQUATION 3 t-value	EQUATION 4 Regress Coef	EQUATION 4 t-value
QUALPRICE	0.097	1.66	0.089	1.56	0.063	1.18	0.072	1.34
FAMINC	0.033	3.17	0.056	4.91	0.029	2.45	0.019	1.48
TRFIXED	-0.210	-1.32	-0.225	-1.47	-0.355	-2.46	-0.361	-2.51
AC	-0.305	-2.75	-0.311	-2.88	-0.102	-0.98	-0.100	-0.96
NC	-0.216	-0.96	-0.245	-1.12	-0.306	-1.50	-0.311	-1.48
HO			1.959	3.27	0.896	1.57	0.908	1.60
HS1			1.535	0.92	1.615	1.04	1.793	1.15
HS2			3.593	5.10	2.906	4.25	3.000	4.39
HS3			0.831	2.08	0.667	1.78	0.695	1.85
PUB					0.044	1.00	0.050	1.14
HOME					-0.112	-0.88	-0.105	0.83
TELE					0.492	9.20	0.483	9.02
SM							0.137	1.88
CONSTANT	1.701		-0.340		0.717		-0.209	
R^2	0.033		0.101		0.225		0.230	

[a]Sample size is 568. See Table 2 for definitions of all variables.

TABLE 7

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR PREVENTIVE VISITS[a]

Independent Variable	EQUATION 1		EQUATION 2		EQUATION 3		EQUATION 4	
	Regress Coef	t-value	Regress Coef	t-value	Regress Coef	t-value	Regress Coef	t-value
QUALPRICE	0.038	0.99	0.050	1.32	0.031	0.91	0.029	0.84
FAMINC	0.103	15.07	0.095	12.57	0.060	7.96	0.063	7.58
TRFIXED	-0.063	-0.62	-0.060	-0.58	-0.106	-1.14	-0.105	-1.13
AC	-0.941	-13.05	-0.935	-12.95	-0.960	-14.22	-0.961	-14.22
NC	-0.298	-2.04	-0.323	-2.21	-0.298	-2.26	-0.300	-2.27
HO			-0.060	-0.15	-0.341	-0.93	-0.344	-0.93
HS1			-1.550	-1.39	-0.719	-0.71	-0.766	-0.76
HS2			-0.287	-0.61	0.562	1.27	0.537	1.21
HS3			-0.784	-2.94	-0.538	-2.22	-0.546	-2.24
PUB					-0.258	-9.09	-0.260	-9.12
HOME					-0.154	-1.87	-0.156	-1.90
TELE					0.231	6.69	0.233	6.73
SM							-0.036	-0.77
CONSTANT	-1.141		-0.429		2.177		2.421	
R^2	0.408		0.418		0.531		0.532	

[a]Sample size is 568. See Table 2 for definitions of all variables.

TABLE 8

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND[a,b]
CURVES FOR PEDIATRIC SERVICES

Dependent Variable	VISITS		QAVE		CVISITS		PVISITS	
Independent Variable	Regress Coef	t-value	Regress Coef	t-value	Regress Coef	t-value	Regress Coef	t-value
QUALPRICE	0.106	1.56	-0.367	-2.80	0.075	1.39	0.032	0.89
FAMINC	0.030	4.12	0.034	2.43	0.011	1.86	0.019	5.03
TRFIXED	-0.412	-2.27	0.357	1.02	-0.355	-2.48	-0.057	-0.59
AC	-1.067	-8.08	0.238	0.93	-0.109	-1.05	-0.958	-13.76
NC	-0.566	-2.20	-0.146	-0.29	-0.295	-1.45	-0.272	-2.01
HO	0.581	0.81	2.747	1.98	0.894	1.57	-0.312	-0.83
HS1	0.948	0.48	0.880	0.23	1.801	1.16	-0.853	-0.82
HS2	2.712	3.01	-0.712	-0.44	2.824	4.23	-0.111	-0.25
HS3	-0.261	-0.56	-1.273	-1.43	0.622	1.70	-0.882	-3.63
PUB	-0.246	-4.52	-0.059	-0.56	0.046	1.06	-0.292	-10.18
HOME	-0.235	-1.47	-0.005	-0.00	-0.106	0.84	-0.129	-1.53
TELE	0.739	10.99	0.238	1.83	0.483	9.10	0.255	7.21
SM	0.218	2.54	0.176	1.06	0.155	2.29	0.063	1.40
CONSTANT	4.358		0.010		0.161		4.197	
R^2	0.404		0.070		0.232		0.506	

[a]Sample size is 568. See Table 2 for definitions of all variables.

[b]When the dependent variable is QAVE all regression coefficients are multiplied by one hundred.

TABLE 9

PRICE AND INCOME ELASTICITIES OF DEMAND FOR PEDIATRIC SERVICES[a,b]

Dependent Variable	Independent Variable	Equation 1	Equation 2	Equation 3	Equation 4
VISITS	QUALPRICE	0.112	0.116	0.079	0.084
VISITS	TRFIXED	-0.069	-0.073	-0.118	-0.119
VISITS	FAMINC	1.327	1.476	0.869	0.799
QAVE	QUALPRICE	-0.021	-0.020	-0.021	-0.021
QAVE	TRFIXED	0.008	0.008	0.006	0.006
QAVE	FAMINC	0.047	0.040	0.030	0.022
CVISITS	QUALPRICE	0.170	0.156	0.111	0.126
CVISITS	TRFIXED	-0.112	-0.121	-0.191	-0.194
CVISITS	FAMINC	0.684	1.149	0.591	0.389
PVISITS	QUALPRICE	0.060*	0.079	0.050*	0.046*
PVISITS	TRFIXED	-0.031*	-0.029*	-0.052	-0.051
PVISITS	FAMINC	1.906	1.772	1.121	1.169

[a]All elasticities computed at mean values.

[b]Asterisk indicates t-value less than one in regression equation.

TABLE 10

INCOME ELASTICITY OF DEMAND FOR PEDIATRIC SERVICES WHEN INCOME IS REPORTED FAMILY INCOME[a,b,c]

Dependent Variable	Equation 1	Equation 2	Equation 3	Equation 4
VISITS	0.596	0.569	0.325	0.289
QAVE	0.081	0.027	0.024	0.022
CVISITS	0.442	0.498	0.271	0.217
PVISITS	0.736	0.633	0.373	0.353*

[a]All elasticities computed at mean values.

[b]Asterisk indicates significance at 6% level. All other coefficients significant at conventional levels.

[c]Regression coefficients not shown for Equations 1, 2 and 3. Those for Equation 4 are presented in Table 8.

Even if we reject the hypothesis that QUALPRICE is significantly different from zero in the VISITS equations, the findings will still support the theory as long as QUALPRICE in QAVE is less than QUALPRICE in VISITS. Thus, the test of the theory, given QUALPRICE in VISITS is considered to be zero, reduced to testing the hypothesis that QUALPRICE in QAVE is less than zero, a one-tail test. This hypothesis is accepted at the 0.5% level.

The price elasticities of demand for quantity and quality are shown in Table 9.[26] The price elasticity of demand for quantity exceeds its quality counterpart in each of the estimated equations[27] indicating a substitution toward VISITS when QUALPRICE rises. Price elasticities for quality are stable at -0.02; those for quantity range from about 0.08 to 0.12. We know of no other estimates of the price elasticity of demand for quality of medical care. Our estimates suggest that consumers do not greatly alter the quality of their pediatric care when the price of that care changes.[28]

Alternative explanations draw upon the observations of the more knowledgeable students of medical care markets. Reder, for example, feels that "(t)he cost of obtaining superior medical care is not primarily -- or perhaps not at all -- a matter of pecuniary expense, but the time, trouble and great difficulty in identifying it."[29] Fuchs and Kramer, on the other hand, suggest that there is little variation in the quality of medical care (across states, at least) because of the nature of medical education in this country and state licensing procedures. All recognized medical schools must be accredited by the American Medical Association and National Board Examinations are increasingly employed as a state

licensure requirement.[30] A more mechanical explanation of our finding rests with the "local market" aspect of our sample. Many families in the M-D survey used the same physician. Consequently, the variation in physician quality across families is substantially lower than what it might have been had the sample been drawn from a broader geographical area.

Our estimates of the price elasticity of demand for quantity compare favorably with those of previous investigators and this consistency of findings increases our confidence in the quality estimates. Several recent studies have placed the price elasticity of demand for visits in the range of 0.0 to -0.4.[31] The studies differ considerably with respect to specification of the model, estimation techniques, and the data employed. Our results conform to theirs. By now there is ample evidence that for the U.S. population, and the several subsets of it that have been the subject of study, physicians' services are relatively price inelastic. Fuchs and Kramer (1971) offer an explanation citing Grossman's (1970) findings that the price elasticity of demand for health is approximately -0.5, reasonable, they feel, in the absence of close substitutes for health. They argue that the price elasticity of demand for a derived input (physicians' services) for which there is little possibility for substitution must be lower than that for the commodity (health) which it is producing. Then they point out that medical care markets are organized within a framework of legal and psychological barriers to substitution for physicians' services.

Few empirical studies have distinguished between the demand for curative care and that for preventive care.[32] Inman (1974) found little

difference in their price elasticities of demand. Our findings are shown in Table 9. The price elasticity for CVISITS is greater than its PVISIT counterpart in each of the estimated equations. Moreover, they derive from regressions in which the CVISIT coefficients border on significance while the PVISIT coefficients are too low to be considered "possibly" different from zero.[33]

These results are contrary to what one would expect given the widely accepted notion that there are few substitutes for curative visits during an illness episode but excellent substitutes for preventive care. In this light Inman's findings appear more reasonable. However, we have stressed that a change in QUALPRICE leads to a change in the price of quantity relative to quality. Given an increase in QUALPRICE our results show that it is easier to substitute curative visits for quality than to substitute preventive visits. This could be due to the routine nature of preventive care in the early years. Immunizations are not repeated and one gains little from frequent measurements of weight, length and head circumference (other than a better fitting hat).[34]

Two distinctions between our estimates and Inman's are relevant. First, substantially more children in our sample are infants under one year of age. Second, his measure of curative visits is based on the families' response to ear, nose and throat infections as determined by a physician contact. Infants face a well-established protocol of preventive care which "may be defined as extending from the neo-natal period to the age of one year. Traditionally this period has included once-monthly visits . . . to detect abnormalities of growth and the manifestations of congenital defects which were not apparent at birth; and, immunizations against specific communicable diseases are administered."[35] Mindlin and

Densen have used the monthly-visit protocol, combined with immunizations, to examine the extent to which standards (that) have been formulated for the frequency and content of health supervision visits . . . have been met in various population groups."[36] Thus, health supervision -- preventive care -- is a strongly urged pediatric theme. Indeed, there are no obvious substitutes for the immunizations which are stretched across the year. Curative visits, in contrast, are seldom initiated with the knowledge that an illness "exists." Rather, the demand for physicians' curative services is likely to be based upon a perception of illness and contain, as a separate component, a demand for information. Inman's measure of physician visits is more restrictive than ours since he limits those visits to physician-designated ear, nose and throat infections. It is not surprising that he finds, as a response to these infections, a relatively lower price elasticity for physician visits. Thus, there is no real conflict between our results and Inman's. Furthermore, there is good reason to expect that for infants and, perhaps, preschoolers the demand for <u>all</u> curative visits will be more responsive to price than will be the demand for preventive care.[37]

It was assumed that a rise in fixed costs would raise the relative price of visits and bring about a substitution of quality for visits. At the empirical level we predict a negative sign for TRFIXED in the VISITS equations and positive ones in the QAVEs. Secondly, the reduction in visits due to an increase in TRFIXED should exceed any reduction due to an increase in QUALPRICE.

The results presented in Tables 4 and 5 provide some support for these hypotheses. TRFIXED is always negative in the VISITS equations,

bordering on significance in the first two equations and significant at conventional levels in equations three and four. The sign on TRFIXED is always positive in the QAVE equations. Although t-values remain above one in these equations they are too low for us to reject the null hypothesis that the coefficients are equal to zero.[38] Because the coefficients on QUALPRICE and TRFIXED are of opposite sign we are unable to confirm the second prediction -- that the reduction in visits due to an increase in TRFIXED should exceed any reduction due to an increase in QUALPRICE.

The TRFIXED elasticities with respect to VISITS and QAVE are reported in Table 9. They range from -0.07 to -0.12 for VISITS and from 0.006 and 0.008 for QAVE. Those for VISITS are somewhat lower than those reported by Inman (1974). His range from -0.12 to -0.22 based upon estimates where the time coefficient is significantly different from zero.[39] On the other hand, Acton's (1972) estimated "time-price" elasticities are never significantly different from zero when valued at "earned income per minute." His "time-prices" in natural units (minutes) have elasticities of -0.25 and -0.34. Evidently, time-price elasticities are of a relatively low order of magnitude as are those based upon physicians' fees. Our findings suggest that there is a response to an increase in the "time-price" of pediatric care which serves to decrease pediatric care visits and increase the average quality of that care.

Now consider the effect of fixed costs on the demand for curative and preventive care. The theory predicts that an increase in fixed costs raises the relative price of quantity and, concomitantly, leads to a substitution away from quantity and toward quality. If curative visits are better substitutes for quality than preventive visits, as we contend,

the impact of a change in fixed costs should be greater in the curative visits equations. Examining the CVISITS and PVISITS demand elasticities with respect to TRFIXED, shown in Table 9, we find that they are approximately four times greater for curative visits in each of the estimated equations. They range from -0.11 to -0.19 in the CVISIT equations, as compared to a range of -0.03 to -0.05 in the PVISIT equations. However, the differences are even greater since the TRFIXED coefficients are well removed from significance in the PVISIT equations, but significant at conventional levels in equations 3 and 4 (and at the 20% level in equations 1 and 2) in the CVISIT equations. Overall, it appears that curative visits are more sensitive than preventive visits to changes in the price of pediatric care and the time-price of that care.

It is common to group physicians' services with the category of consumption goods termed necessities. The general taxonomy is developed around the income elasticity of demand, an elasticity of less than unity flagging a necessity. The works which we have cited as perspective for our findings support that contention. In this respect, the present study differs from theirs. Encapsulating their results: Fuchs and Kramer estimate income elasticities of demand for physicians' services in the range of 0.04 to 0.57; Acton's (1972) range from 0.08 to 0.17 for earned income and are not significantly different from zero for non-earned income; Newhouse and Phelps (1974) find the elasticities of both wage and non-wage income to be insignificantly different from zero except for the 5% of their sample that had non-wage income exceeding $3,000 and subsequently, a non-wage income elasticity of 0.07; finally, Inman (1974) presents findings in the range of 0.20 to 0.55 for a "working mother"

sample, elasticities slightly higher for curative as opposed to preventive care, and an elasticity of 0.16 for a "non-working mother" sample, the elasticities by purpose of care being identical.

The income elasticities from the present study are shown in Table 9. In contrast to the works just cited they are substantially higher, ranging from 0.80 to 1.48 for VISITS. On the other hand, the income elasticities of demand for quality of pediatric care are quite low, ranging from 0.02 to 0.05. VISITS elasticities are always highly significant at conventional levels in equations 1 and 2; it approaches significance in equation 3 and has a t-value barely greater than one in the last equation. Thus, it appears that the response to an increase in income would be to leave the quality of pediatric care virtually unchanged while increasing pediatric office visits commensurate with the proportionate increase in income.

We pointed out earlier that there was no a priori reason why the income elasticity for quality should exceed that for quantity (or vice versa). Our surprise, then, is not that the opposite result was obtained, since the question of relative magnitudes is apparently an empirical one. Also, variation in quality may have been dampened due to the localized nature of the sample, an argument we offered in the interpretation of the price elasticity of quality. Rather, it is surprising that our estimated income elasticities for visits are so divergent from those of other studies given that all other findings are so consonant. There are, however, several reasonable explanations for this. Given the selection of a physician, the family's response to its changing economic circumstances may be to broaden (or curtail) the variety of services which it purchases, such

as medical information and child-rearing advice. This is even more likely under market conditions which permit both suppliers and demanders a modicum of discertion in the self-styling of the services that are provided. The relevance of this point can be seen in the nature of our sample selection -- families having at least one visit to a physician in private practice.

Yet, our measure of visits does not separate out the purpose of the visit beyond its primary function--curative or preventive care. Since the M-D families are not likely to have much experience with pediatric care,[40] face a physician recommended protocol of visits (just following, in the case of the infants, a physician-recommended protocol of prenatal visits), and are likely to be solicitous given the second-hand information they act upon, the consumption of pediatric services is not likely to have medical "process" as its sole purpose. Yet, physicians' services beyond the provision of medical care are not, we expect, a necessity.

Another explanation rests with our measure of family income. Economic theory suggests that families consume out of permanent income. That is, unanticipated swings in measured income which are transitory (positive or negative) should not affect consumption. Reported income is likely to be measured with an error component that is uncorrelated with the quantity or quality of medical care since it is a composite of both transitory and permanent elements. Consequently, studies which employ reported income in the estimation of demand curves for medical care are likely to bias the coefficient on income toward zero and, therefore, underestimate the income elasticity of demand.[41] This may explain why our income elasticities are substantially higher than those reported in

the previous studies. Our measure of family income is predicted, as discussed earlier, in order to provide a measure of permanent income; they enter reported income directly.[42]

In Table 8 we present regression equations which were estimated using measured family income (INCOME) rather than predicted family income (FAMINC). The coefficient on INCOME is reduced in each of the quantity estimations by a factor, on average, of 2.6; the INCOME coefficient in the quality equation is unchanged with respect to its FAMINC counterpart. If we now compare our income elasticities, derived from entering reported (rather than predicted) income, with those of the other studies we find little contrast in size. They are 0.29, 0.22 and 0.35 for VISITS, CVISITS and PVISITS, respectively, for the regression equations shown in Table 8. (Table 10 contains these elasticities as well as those for regression equations 1, 2 and 3, versions of demand estimates not reported in the text.) These are nearly identical to those estimated by Inman (1974) from a sample of children utilizing pediatric services.

The estimated income elasticities for curative and preventive visits require little explanation. We had no a priori reason to distinguish between them with respect to their magnitudes. Invoking common sense as a guide, one would expect curative visits to be less sensitive to changes in income than preventive visits. In addition, the demand for preventive visits may contain a substantial demand for information which is, itself, income elastic. Our results, presented in Table 9, match the conjecture. The income elasticities for curative care are substantially less than those for preventive care. CVISIT income elasticities average 0.70 and range from 0.39 to 1.15; PVISIT income elasticities average 1.49 and range from 1.12 to 1.91. While these results may appear to be high, it should be kept

in mind that they are based upon predicted family income. In regressions which entered reported family income the CVISIT income elasticites ranged from 0.22 to 0.50; the PVISIT elasticities ranged from 0.35 to 0.74.[43]

Again, our results are strikingly similar to Inman's when reported income enters the regression and several degrees larger when we employ predicted income. If permanent income is the appropriate variable, and predicted income the better proxy for it, then previous studies may have underestimated the responsiveness of physician contacts to changes in family income. However, given the highly selective nature of our sample -- infants and preschoolers from two health districts in the Bronx, N.Y. -- our findings are more on the order of an invitation to further research.

The socio-demographic variables which enter our demand equations do not figure predominantly in the development of the model. Also, their influence on demand is subject to a variety of interpretations. While they enter as explanatory variables and, in fact, past empirical work has suggested that they play a significant role in determining the demand for medical care, emphasis of their effect does not appear to be warranted.

The age of the child (AC) is inversely related to the quantity of pediatric care (VISITS) at very high levels of significance. It is positively related to the quality of those services (QAVE); however, the significance levels are never very high. If the returns to pediatric services decline as children grow older our findings may indicate that the decline is relatively greater for VISITS. That would lead to a substitution away from VISITS and toward QAVE.

The decreasing role of a medical care protocol as the child ages may also be the mechanism behind our findings. The protocol is "neutral" with respect to the quality of care. Hence, we wouldn't expect AC to

influence QAVE. We would expect VISITS to decline with AC. However, since the protocol is directed at preventive care, not curative care, we should find a greater decline in PVISITS than CVISITS. In Tables 6 and 7 we see that the decline in PVISITS with an increase in AC is substantially greater than the decline in CVISITS. One could argue, here, that this should be interpreted as indicative of a relatively greater decline in the returns to preventive care as children grow older and not supplier influence.

The number of children in the family (NC) is inversely related to VISITS, and at conventional levels of significance. It is not significantly different from zero in any of the QAVE demand curves; although, in each of these the coefficient on NC is negative. NC is inversely related to CVISITS and PVISITS. The coefficients are of similar size but only border on significance in the CVISIT equations. There may be several countervailing influences at work in the determination of these results. Earlier we mentioned some of them and there is little point in attempting to pidgeon-hole their interplay.

The measures of child health, a hospitalization during the year (HO) and the perceived health status of the child (HS1, HS2, HS3), are subject to several interpretations in their effect on the demand for pediatric services. We could stress, as Inman does, that a child with a history of past illness may warrant closer physician (and parent) monitoring.[44] Or, following Grossman's finding that the demand for health is inelastic we could argue that our measures are indicative of the "need" to replenish the child's stock of health. In either case we would expect that "less" health will lead to heavier consumption of health inputs and, consequently, a greater average quality of care and an increase in physician visits. A

first reading of the results would seem to support this.

The hospitalization dummy (HO) is positive in all VISIT and QAVE equations, maintaining conventional levels of significance in all of the QAVE demand curves and equation one of VISITS. The health status variables show mixed results. Except for one insignificant negative coefficient they are positive in the VISITS equation. Only HS2 (fair health) is significant. None of the health status variables are significant in the QAVE equations. Moreover, HS2 and HS3 have negative coefficients, with HS3's in the 20% confidence range. This is contrary to expectation and may be signalling differences in health production at different levels of the stock of health. It is instructive to consider the results of the CVISITS and PVISITS estimations before further discussion.

The health status coefficients are uniformly positive in the CVISITS equations. They are significant at conventional levels or border on it in most cases. In stark contrast, these coefficients are negative in all but two of the PVISITS equations! And, some are significant. Why should health status variables perform in opposite ways in curative visits and preventive visits demand equations? One explanation may lie with the function of curative and preventive visits in the production of health.

If families are poorly prepared to assess the child's stock of health the preventive visit may serve to identify health "problems" which would not otherwise be visible to the parents. The outcome of a preventive visit would, in some instances, be future curative visits. Thus, the negative coefficients on the health status variables could indicate a reverse causality--increased preventive visits lead to increased health by indicating the "need" for curative care. Another explanation is equally

attractive, however. While we have found that decrements in the level of health lead to an increase in curative visits, curative visits may be used, concurrently, to obtain preventive care. Our measure of curative visits would not reveal this joint consumption. Of course, one could argue the opposite. Faced with a perceived health problem the family may schedule a preventive visit and obtain curative care concurrently. This is likely to depend on the perceived "immediacy" of the problem. Neither of the latter two explanations gain support from the simple correlation of +0.23 between CVISITS and PVISITS. The earlier explanation, that preventive visits lead to supplier-induced curative visits, would suggest a positive correlation.

Alternatives to contacts in the physician's office were entered to capture the effect of substitute or complementary care on the demand for the quantity and quality of pediatric services. Public (PUB) and home (HOME) contacts were inversely related to VISITS. The coefficients on PUB are very significant; those on HOME are significant at the 10% level. For every five visits to public sources of care or four visits at home, the number of office contacts declines by one. Telephone contacts (TELE) are positively related to office visits at very high levels of significance, suggesting that these modes of care complement one another. These results hold up most strongly in the PVISITS equations. PUB and HOME are never significant in the CVISITS equations and, in fact, the PUB coefficients are positive. Only TELE maintains both the same signs and significant coefficients.

It is not easy to interpret these findings. Neither HOME nor TELE contacts can be for preventive purposes as they are reported in the M-D survey. Thus, we are observing the effects of TELE and HOME for curative

purposes as they influence the demand for PVISITS. It appears that an increase in HOME 9for curative purposes) leads to a decrease in PVISITS in the ratio of approximately six to one. Also, four additional TELE (for curative purposes) translate into one less PVISIT. Both results may be evidence that preventive care is performed, concurrently, during curative contacts, or that CVISITS and PVISITS substitute for one another. PUB has not been broken down by purpose of contact and, therefore, constitutes an admixture of preventive and curative services. If we accept the assumption that the sign reflects a substitute or complementarity status we must conclude that public sources of care function as substitutes for private, preventive office-based care. This is reasonable given that preventive care is characterized as "routine" and the City of New York provides a program of health maintenance through public well-baby clinics and child health stations.

We may either reject a role for PUB in the CVISITS equations, given the relatively low t-values, or we may accept the positive sign as weakly indicating that PUB and CVISITS are complements. In the latter case it is plausible that public care, available on a 24-hour basis, is used when the regular source of private care is not immediately available. Subsequent care during the illness episode would then be provided by the regular source. Or, a public visit may provide information which leads the family to consume private pediatric care.

Estimates of the CVISITS equations suggest that TELE complements private office curative visits. HOME substitutes for them if we consider sign and not the low level of significance. Neither result is surprising. Examining the impact of these variables on the demand for quality we find a positive, significant effect of telephone contacts on QAVE. It is most

likely that higher quality physicians, hence specialists, provide "packages" of office visit/telephone contacts care. Neither HOME nor PUB has an impact on QAVE.

The effects of mother's schooling (SM) on the demand for quantity and quality of pediatric care was, we reasoned, indeterminate. The coefficient on SM in the VISITS and QAVE equations is positive but not significant. It is positive and reaches the 6% level of significance in the CVISITS equation, but negative in PVISITS, though not significant.

Concentrating our discussion on the finding of a positive effect on curative visits, we may follow Inman's lead in suggesting that a better educated mother is "more likely to know the warning signals of illness."[45] Or, curative contacts may be a more productive input for more educated mothers if they are better able to follow directions, report health developments and so on. Finally, physicians may be inclined to attempt "one-shot" therapy when they feel the likelihood of a "needed" return visit is small.[46] SM may be used as a proxy for that likelihood.

FOOTNOTES TO CHAPTER IV

1. The following is based upon a more detailed development in The Demand for Pediatric Care: An Hedonic Approach, Fred Goldman and Michael Grossman, June 1975, mimeo.

2. z may be interpreted as the family's standard of living.

3. More properly, the services should be specified per period of time. The empirical work that follows takes the year as the reporting period.

4. The y vector subsumes inputs which could, more formally, be decomposed into inputs which enter in a "tangible" manner, such as nutrients and housing stock, and those which reflect the efficiency or state of technology with which the family produced child health, such as the formal schooling of the parents. We do not distinguish these aspects of production.

5. It is assumed that this function is differentiable in the arguments v, q and z, where $\partial u/\partial v$, $\partial u/\partial q$ and $\partial u/\partial z > 0$.

6. Then, the total consumption per family of pediatric services can be defined as the product of quality per visit and the number of visits, i.e., vq, the measure used most frequently in the previous literature.

7. We are primarily concerned with the "office" visit. Travel and queuing cost will vary with the type of physician contact. For example, it is obvious that a home contact eliminates the likelihood of a queue. However, this saving commands a market price. The travel costs expended by the physician as well as other "conveniences" (or inconveniences) which accompany a type of physician contact (office, home, telephone) are likely to be reflected in the price of the contact. Other aspects of the physician contact such as the ability to make an appointment, the potential hours of availability, the ability to extract information from the physician and so on are relevant characteristics of the overall package of physicians' services. For ease in exposition, however, they are not dealt with here.

8. If the mother does not participate in the labor force w is interpreted as her shadow price of time. Given a production function for y which depends upon inputs of goods (x) and time (1), and letting the price of x be one dollar, the shadow price of time would be the ratio of the marginal product of time devoted to the production of y to the marginal product of x.

9. This simply paraphrases a point stressed by Becker and Lewis in their discussion of the relationship between the quantity and quality of children. See Gary S. Becker and H. Gregg Lewis, "On the Interaction Between the Quantity and Quality of Children," Journal of Political Economy, Vol.81, No.2, March/April 1973, p.280.

10. This result is essentially the outcome of the assumption that quality and quantity are separate arguments in the utility function. Entering a single term, Q, where Q is quality adjusted visits (that is, $Q = qv$) yields a marginal rate of substitution of v/q.

11. Proofs of these points have been shown elsewhere. Suppose the utility function is $u = u(v,q,z)$. Becker and Lewis have shown that an increase in fixed costs, f, with utility held constant would lower v. That is, the pure (utility or real income constant) or compensated substitution effect must be negative. They also show that with utility constant, a rise in f would cause q to rise if q and v are net substitutes, i.e. if the elasticity of substitution in consumption between v and q is positive. See Becker and Lewis, op.cit., pps.285-288. As for the effect of variations in quality-adjusted price, $\hat{p}$, Rosen has shown that given a utility function $u = u(v,q)$, with utility held constant an increase in $\hat{p}$ would cause v to rise. See Sherwin Rosen, "Short-run Employment Variation on Class-I Railroads in the U.S., 1947-1963," Econometrica, Vol.36, No.3, July 1968, pps.515-516.
Our interest remains with v and q. Of course, an increase in p would also lead consumers to substitute z for v since the price of v would rise relative to the price of z. It is stated in the text that v/q should rise as $\hat{p}$ rises. This assumes that v and z are not very good substitutes. In particular, it assumes that v and z are not better substitutes than q and z.

12. The structural demand curves for quality and visits are,

$$q = D_1 (\pi q, \pi v, s)$$

and

$$v = D_2 (\pi q, \pi v, s)$$

The data at hand are not rich enough to permit the simultaneous estimation of this system. Therefore, we emphasize the properties of the reduced form.

13. Pure income elasticities are derived holding $\pi q/\pi v$ fixed.

14. There are several ways to discuss the issue of income elasticities for q and v. For instance, suppose we define

the structural full income elasticities of quantity (η_v) and quality (η_q) with the relative price of quality held constant. From equation 12 in the test

$$\frac{\Pi_q}{\Pi_v} = \frac{\hat{p}v}{\hat{p}q + f} \quad \text{so that}$$

$$\ln \left(\frac{\Pi_q}{\Pi_v}\right) = \ln \hat{p} + \ln v - \ln (\hat{p}q + f) \qquad (1n)$$

Differentiating $\ln \left(\frac{\Pi_q}{\Pi_v}\right)$ with respect to the natural log of full income (ln S) yields

$$\frac{\partial \ln \left(\frac{\Pi_q}{\Pi_v}\right)}{\partial \ln S} = \eta_v - \left(\frac{\hat{p} \cdot q}{\hat{p} \cdot q + f}\right) \cdot \eta_q \qquad (2n)$$

A change in the relative price of quality would accompany a change in income and be dependent upon the absolute size of

$$\eta_v, \eta_q \quad \text{and} \quad \frac{\hat{p} \cdot q}{pq + f}$$

If the righthand side of equation 2n was greater than zero, the relative price of quality would increase with an increase in full income. This would lead to a substitution away from q and toward v. Consequently, the reduced form income elasticity of v would overstate η_v, the reduced form income elasticity of q would understate η_q. Unfortunately, without more insight into substitution relationships in the production function of child health, we are not in a position to establish the net effect in equation 2n.

Alternatively, suppose the utility function was Cobb-Douglas,

$$U = q^{\alpha 1} \; v^{\alpha 2} \; z^{\alpha 3} \qquad (3n)$$

and the budget constant was

$$S = z + \hat{p}vq + vf \qquad (4n)$$

where the price of Z is one dollar. Maximizing equation 3n subject to equation 4n and solving first order conditions for the equilibrium value of q yields,

$$q = \frac{\alpha_{1f}}{(\alpha_2 - \alpha_1)\hat{p}} \qquad (5n)$$

where α_2 must be greater than α_1 or the equilibrium value of q will be negative. From equation 5n we see that q depends upon f and $\hat{p}$ but is independent of income so that the reduced form income elasticity of quality would be zero.

15. Disturbance terms are not shown.

16. To see the effect of violating this assumption, let the "true" specification of equation 16 be

$$\ln q = \alpha_0 \text{ MDCHAR} + \alpha_1 \ln\hat{p} \qquad (16')$$

so that the hedonic fee function becomes

$$\ln p = \alpha_0 \text{ MDCHAR} + \alpha_1 \ln\hat{p} + \ln\hat{p} \qquad (17')$$

Then, the residual in the misspecified equation 17 is $u = \alpha_1 \ln\hat{p} + \ln\hat{p} = (\alpha_1 + 1) \ln\hat{p}$. The residual in the misspecified equation would overestimate $\ln \hat{p}$ (while $\ln q = \alpha_0$ MDCHAR would be underestimated) if $\alpha_1 > 0$. For values of $\alpha_1 < 0$, $\ln \hat{p}$ would be underestimated while $\ln q$ would be overestimated.

17. The demand curves are restricted to study children who had positive visits to physicians in private practice. More formally, it was required that

$$\text{VISITS} = \text{CVISITS} + \text{PVISITS} \quad 0$$

where CVISITS and PVISITS are the annual number of pediatric visits for curative and preventive purposes, respectively, by the study child to physicians in private practice. It follows that either CVISITS or PVISITS could be zero for a given observation. However, that observation would still enter all of the demand estimates as long as VISITS was greater than zero. Five hundred and sixty-eight of the 941 study children met this criteria.

18. Fuchs and Kramer argue that "the impact of insurance can be entirely attributed to the reduction it affects in the net price of care." Victor Fuchs and Marcia Kramer, The Market for Physicians' Services in the United States, 1948-1968, National Bureau of Economic Research, October 1971, mimeo, p.69. Based upon their empirical work they report that the use of net price, a variable which embodies insurance and average price in a single measure, is "superior" to using average price and insurance benefits in the estimation of visit demand curves.

19. Fuchs' calculations are derived from the 1/1000 sample of the 1960 U.S. Census and are based on earnings in 1959. The age, race, and education cells are taken from Table A-1 in his Appendix A. Victor Fuchs, Differentials in Hourly Earnings by Region and City Size, 1959, Occasional Paper 101, National Bureau of Economic Research, 1967.

20. National Center for Health Statistics, Series 10, Number 18, U.S. Department of Health, Education, and Welfare, June 1965, p.24.

21. While the evidence is not overwhelming and Davis and Russell point out that their results may reflect problems of collinearity among the relevant independent variables, or that they are poorly measured, they do find in one case that "(private) doctors serve as a complement to outpatient services" and in another that there is "further evidence of the absence of a strong substitution effect." Karen Davis and Louise B. Russell,"The Substitution of Hospital Outpatient Care for Inpatient Care," The Review of Economics and Statistics, Vol.54, No.2, May 1972, p.113.

22. Ibid., p.110.

23. The infant study sample (N=486) and preschool study sample (N=455) are combined for a total of 941 observations. Those families whose child had at least one visit to a physician in private practice (N=568) form the sample for which demand curves are estimated. All children in the total sample of 941 had at least one physician visit during the interview period. However, a total of 373 families took their children to public sources of care exclusively. By excluding these families our sample is no longer "random." Also, by pooling the sample of infants and preschool children it is being assumed, implicitly, that their child health production functions do not differ.

24. We wish to garner support for the theory which was summarized earlier. For this reason results are often described as "consistent" or "inconsistent" with the theory. At the same time there is a real interest in the magnitude of the results since they will have further implications for policy-makers. Unfortunately, the results which pertain to the price variable are not entirely unambiguous for both purposes. The theory predicts that a rise in quality-adjusted price should have a larger negative effect on quality demanded than on quantity.

    In theory, the success of the prediction can be ascertained by comparing the coefficients of quality-adjusted price in separate demand curves for quantity and quality. At the empirical level, however, this comparison is empty since the coefficients are expressed in units which differ and are not comparable. Only in the case where the coefficients are of significantly different signs (or where one is significantly different from zero while the other is not) can it be said that the results support or contradict the theory. The results presented below and subsequent discussion of them should be taken in this light.

25. The interpretation of tests of significance and a definition of "conventional" are given in footnote 27, Chapter III.

26. All regression equations presented in this chapter are linear. Elasticities are computed at the means. For example, if $y = a + b\,x$ is the regression equation, the elasticity of x with respect to y (M_x) is given as

$$M_x = b \frac{\bar{x}}{\bar{y}}$$

where $\bar{x}$ and $\bar{y}$ are the means of x and y, respectively.

27. This is consistent with the analysis of Becker and Lewis, op.cit.

28. One tempting explanation for this finding is that an alteration in the quality of pediatric care, as it has been defined in this analysis, is tantamount to switching physicians. Substantial emphasis has been placed on the merits of continuity of medical care (i.e. remaining with a given source of medical care) by health professionals and students of health-related behavior. The success of this indoctrination may be manifest in our findings. In addition, one can tack on mental transactions costs which are involved in switching physicians. A person is unlikely to shop for a physician while "well;" and, when ill, discomfort and a sense of immediacy are likely to translate into a contact with a prior source of care.

    An attractive feature of this explanation is that it has behavioral content. It fuels the arguments of those who have suggested that the demand for medical care is, in part, supplier induced. At the same time; it implies that real costs are incurred when the quality of medical care is altered. The explanation, albeit reasonable, is inappropriate as an interpretation of our results, however, since our investigation is crossectional and does not trace out the variation in medical care for a given family.

29. Melvin Reder, "Some Problems in the Measurement of Productivity in the Medical Care Industry," in Production and Productivity in the Service Industries, Victor Fuchs (ed), Columbia University Press, 1969, p.114.

30. Fuchs and Kramer, op.cit., p.94.

31. Fuchs and Kramer report a range of -0.10 to -0.36 in demand specifications which employ "average price" and -0.06 to

-0.20 in those employing "net price," i.e. average price net of insurance benefits. Their estimates are based on information from 33 states for 1966. See Fuchs and Kramer, op.cit. Inman reports price elasticities in the range -0.07 to -0.09 for working mothers and 0.0 to -0.04 for non-working mothers. The estimates were made separately for curative and preventive visits. However, the results did not differ by these categories. His data was drawn from a 1971 household survey of children aged 6 months through 12 years. See Robert P. Inman, The Family Provision of Children's Health: An Economic Analysis, National Bureau of Economic Research, June 1974, mimeo.

Newhouse and Phelps used 1963 survey data on heads of households in order to estimate their demand for physician office visits. Price elasticities are based upon price net of insurance and range from 0.0 to -0.10. The elasticities of zero are due to those cases where the coefficient on price was not considered significantly different than zero. See Joseph P. Newhouse and Charles E. Phelps, New Estimates of Price and Income Elasticities of Medical Care Services, National Bureau of Economic Research, June 1974, mimeo.

It should be noted that Fuchs and Kramer;and Newhouse and Phelps use qv (in my symbols) as a dependent variable. Inman uses p, not $\hat{p}$, as his measure of the physicians' fee.

32. Andersen and Benham, in a study which emphasized the effect of family income on the consumption of medical services, enter a proxy for preventive care (whether at least one family member had not had a checkup within the past one year) as an explanatory variable. This measure was inversely related to both expenditures for physicians' services and physician services weighted by standard prices. However, they do not discuss this result. Ronald Andersen and Lee Benham, Family Income and Medical Care Consumption, paper presented at the Second Conference on the Economics of Health, Baltimore, Maryland, December 1968.

33. The confidence levels for CVISIT equations 1 through 4 are 10%, 12%, and 18% respectively.

34. There is little evidence that preventive care has an impact on health.

35. Correspondence from Nora Piore, Columbia University School of Public Health.

36. "Medical Care of Urban Infants: Health Supervision," Rowland Mindlin and Paul Densen, American Journal of Public Health, Vol. 61, No.4, April 1971, p.687.

37. That is, curative visits are better substitutes for quality than are preventive visits.

38. Again, this is based upon our use of "conventional" levels of significance.

39. To jump ahead, the TRFIXED elasticities are higher for curative visits than preventive visits. Inman found this as well.

40. The mean number of children per family is 1.7 and their mean age is 1.7 years. Inman's sample of children have a median age of approximately 7 years and there are about 2.8 children per family.

41. This contention and earlier empirical support for it are discussed by Andersen and Benham. However, their estimates with respect to physicians' services revealed little support for the permanent income hypothesis. They suggest that "the apparent increased effect of permanent income on physician expenditures can be largely accounted for by other components of the model." Andersen and Benham, op.cit.,p.18.

42. These comments do not apply to Fuchs and Kramer, op.cit., since "state data" is, in effect, a grouping of individuals. Thus, the positive and negative transitory components of the individual families will tend to cancel out.

43. The comparable income elasticities for equations 1 through 4 are:

    CVISITS - 0.44, 0.50, 0.27, and 0.22

    PVISITS - 0.74, 0.63, 0.37, and 0.35

    Comparing these to the income elasticities presented in Table 9, we see that using reported income increases the CVISIT and PVISIT elasticities by about a factor of 2 and 3 respectively.

44. Inman, op.cit., p.23.

45. Ibid, p.21.

46. This was suggested to me by Rowland Mindlin, principal investigator of the M-D survey.

APPENDIX A[1]

THE MINDLIN-DENSEN STUDY

The primary source of data is the Mindlin-Densen (M-D) study, Medical Care of Infants and Preschool Children, a longitudinal and cross-sectional survey covering twenty-one months in the period 1965-66. The study contains the most detailed and comprehensive information to date concerning child health problems perceived by the family, their reactions to the problems, and their sources of medical care. It was conducted by Dr. Paul Densen, then Deputy Administrator, Health Services Administration, City of New York, and Rowland L. Mindlin, M.D., then Assistant Commissioner of Health, Bureau of Maternal and Child Health, New York City Department of Health. The survey and coding were supervised by the National Opinion Research Center, University of Chicago. The sample sizes are presented in Table 1.

Geographically, the M-D study encompassed two contiguous health districts in the Bronx, N.Y.C., Mott Haven and Westchester. (see map) The districts were significantly different in socio-economic and health characteristics. Mott Haven was an urban slum; it was biracial and ethnically mixed. All of the usual health indices were worse than the city averages. Currently it has been cited as "not meeting a basic Federal criterion of one physician for every 1,500 people."[2] Westchester was a bulwark of the white middle class. Its live birth weights, average term and infant mortality rates were better than the city-wide averages. (see Table 2).

Interviews with the same mothers were conducted repeatedly during an entire year by trained, lay interviewers who were ethnically matched with the respondents. Mothers of newly-born infants were randomly

TABLE 1

SAMPLE SIZES OF THE MINDLIN-DENSEN STUDY

	Study Cases	Control Cases	Total
Infant (1)	486	2501	2985
Preschool (2)	456	1034	1489
Total	939	3535	4474

(1) Infant = 0-1 yr of age

(2) Preschool = 1-5 yrs of age

TABLE 2

SELECTED VITAL HEALTH STATISTICS 1965

	Mott Haven	Westchester	New York City
Population (Est.)	222,000	274,000	7,960,000
Live Births: No.	5,798	4,546	158,315
Rate	26.1	16.6	20.0
% to Puerto Rican	56.3	10.3	15.4
% to Non-white	30.2	11.4	25.8
% under 2501 gm.	12.1	6.8	10.1
% Late	39.9	12.0	23.1
Infant Mortality: No.	179	82	4,076
Rate	30.9	18.0	25.7

SOURCE: N.Y.C. Dept. of Health.

selected from the birth registrations of each district during a month. They were interviewed in their homes, first when the infants were one month old and then monthly. Four cohorts were chosen, one for each season of the year. Therefore, the interviewing continued for twenty-one months. Because of the mobility of this population, a different sampling procedure was used for preschool children. From an area probability sample of households in each district, the presence of preschool children was ascertained by doorbell-ringing. Interviews with these mothers were conducted bi-monthly for one year.

Different sampling plans were used for selecting the subjects of the infant and the preschool studies. The sampling frame for the infants was the file of birth certificates for all live births to women who gave an address in either district, with certain deletions noted below. These certificates were filed within 48 hours of birth in the borough office of the borough where the birth occurs. They are sent to the Health Department's central office where they are coded. District of residence of mother is one of the items. A punch card is made and the certificate itself is sent for filing to the borough where the mother lives. During the periods when samples were drawn for the study, duplicates of all cards coded for residence in each study district were made at the end of each day's punching. They were delivered the next day to the project field office in the same building in which the certificates were filed. In most instances, cards were received before the infants were two weeks old, occasionally as late as 18 days. The cards for multiple births and for infants known to have died prior to actual drawing of the sample were removed from the decks. Most of the deaths, of course, were neonatal deaths of infants

who never left the hospital. Interviews with their mothers would not have contributed to the present study. Multiple births were eliminated because of the concern for reliability of recall, and because they were considered not to be representative of infants generally. The remaining cards were randomly assigned into seven groups, one of which was then randomly selected to be the study group for the cohort. The other groups were designated control groups, numbers 1 through 6. The flow of birth cards was continued until the desired number of subjects was reached in each group.

The sampling frame for the preschool groups was a compilation of U.S. Census Bureau block statistics data supplemented by building occupancy permits issued since the census was made. From each district, blocks were sampled in proportion to the estimate of their size. The households in the sampled blocks were then listed in clusters of eight. A random selection of clusters was made. Each household in each selected cluster was contacted, and an interview conducted wherever screening questions indicated that there was a child aged one through five. Standard directions were followed by interviewers to validate the addresses in each cluster, to incorporate additional households within cluster limits that should have been included but were not, and to delete addresses that were vacant, demolished or non-residential. In many households there were two or more children of the right age for the study. Here the interviewers used a random selection procedure to eliminate bias in selection of the subject child within those households. It was found to be more economical to have the screening done by the interviewers rather than have separate screeners and interviewers. A positive screening could

than merge into the actual interview. As a result control subjects were selected later than study subjects rather than simultaneously as with the infant phase of the study.

Both infant and preschool samplings contained a control group. These groups were interviewed only once using the initial (main) questionnaire. The purpose of the control group was to ascertain the influence of repeated interviews, if any, upon the responses of the mothers. This has not been determined.

Background of Questionnaires

Seven different but related schedules were constructed: four for the infant phase of the survey, three for the preschool phase. There was a detailed initial interview, a short followup interview, and a final year-end interview, intermediate in length both for infants and for preschoolers. A different interview schedule for controls was used in the infant study because a number of pregnancy-related questions, appropriate for a mother of one month post partum, were included in the initial interview. For the preschoolers, the initial interview instrument served also for the control cases.

Questionnaires were pre-tested and pilot-tested before the actual field-work was begun. Final versions were printed both in English and in vernacular Spanish. Some of the questions were pre-coded; others were open-ended with space for interviewers to record responses verbatim. This proved necessary because the focus of the interview was on the health problems of the subjects, rather than on their doctor visits, which are usually the subject for household interviewing. Because the preliminary testing yielded a great variety in responses to some of the questions,

it was felt that pre-coding would require too much judgment from interviewers in the field.

Provision was made for asking about each condition a mother reported that her child had, how long it was present and what was done about it. An insert, "Illness Supplement", standard throughout the study, was devised, with a special set of questions concerning each condition for which a doctor was consulted during the recall period. If a doctor had not been consulted this "Illness Supplement" was not employed. However, in some cases, as many as eight or ten supplements accompanied a single interview.

Completed interview schedules were mailed back to NORC. Here each completed interview was reviewed by a field supervisor, gross inaccuracies and deficiencies were picked up, but this was not a detailed editing. Occasionally, respondents or interviewers were called to ask for missing information. All notes made as a result of this editing were entered in the questionnaire in green.

The first follow-up interview schedule for each study case was prepared by the medical editor from the initial interview. Carried over from the initial interview were "conditions" which seemed likely to need further medical care, dates of future appointments and names of sources of medical care that had been or were expected to be used. All these were written into the appropriate place in the follow-up. The same editing procedure and carrying over was used from follow-up interview to follow-up interview throughout the year. All of the completed interviews for each study case were reviewed for the preparation of the Final Interview schedule. Some conditions that had been recorded earlier and dropped were picked up again for a final inquiry.

Reliability of the data

Several aspects of the reliability of the M-D data have been explored. Mindlin used information drawn from birth certificates of the infant study group sample in order to compare selected characteristics of families that completed the scheduled interviews with those that were lost to the study. Table 3 shows the disposition of infant study group cases after the initial sampling of birth certificates. Attrition in the final sample size was due, primarily, to refusal to be interviewed and mobility (i.e., move not traced and moved out of the Bronx). Comparison of the completed cases with those lost to the study (shown in Table 4) suggests the degree of similarity between the completed and lost cases within each health district. Table 5 shows the disposition of preschool study group cases. As with the infant study group, attrition is the final sample size was due, primarily, to refusal to be interviewed and mobility. A comparison of selected characteristics was not undertaken for this group.

It was not always possible to adhere exactly to the schedule for follow-up interviews for the infant and preschool study groups. Interviews were delayed for various reasons: the respondent may not have been at home when the interviewer called; the respondent may have moved, in which case time was lost tracing the family; or the interviewer may not have been able to get out to make the interview. Schiff (1965) investigated how the pattern of reporting was affected by delayed interviews -- specifically, the relationship between the length of time between successive interviews and the number of reported conditions. Previous literature suggests that as the length of time between interviews increases, the rate

TABLE 3

COMPLETION OF INFANT STUDY

	Mott Haven		Westchester	
Birth certificate drawn	300		296	
Not included in sample		12		7
Died before interview		6		2
Non-resident		4		4
Adopted		2		0
Duplicate IBM card		0		1
Final sample size	288		289	
No initial interview		10		12
Never home		2		0
Lost in mail		0		1
No such address		1		1
Unknown at address		2		1
Moved not traced		2		0
Refused		3		9
Initial interviews	278		277	
Completed cases	242		244	
Attrition		36		33
Baby died		1		1
Never home		1		0
Adopted		1		0
Moved not traced		8		1
Moved out of Bronx		20		15
Refused		5		16

TABLE 4

COMPARISON OF SELECTED CHARACTERISTICS OF COMPLETED INFANT STUDY CASES WITH LOST INFANT STUDY CASES

	Mott Haven		Westchester	
	Completed	Lost	Completed	Lost
N	242	46	244	45
Ethnic				
% White	27	5	197	38
	11%	11%	81%	84%
% N-W	77	16	18	2
	32%	35%	7%	4%
% P.R.	138	25	27	5
	57%	54%	11%	11%
Age of Mother				
Mean	25.4 yr	24.8 yr	26.6 yr	26.5 yr
Parity				
% this is 1st child born alive (now living)	56	16	84	11
	23%	35%	34%	24%
% this is 2nd child born alive (now living)	74	10	68	20
	31%	22%	38%	44%
% General Service	221	38	55	15
	91%	81%	23%	33%
Male	127	25	135	27
	57%	54%	55%	60%

TABLE 5

COMPLETION OF PRE-SCHOOL STUDY

	Mott Haven		Westchester	
Development of Sample				
*D.U. to be screened	1,278		2,127	
Additional D.U.		14		14
Vacant D.U.		84		77
Net D.U.		1,208		2,064
Disposition of Sample				
Not eligible	866		1,739	
No report		6		2
Not screened		40		15
**Eligible		296		308
Disposition of Eligibles				
Interviewed	247		276	
Lost	49		31	
Not home		16		6
Refused		24		22
Other		7		3
Break-off		2		0
Completed Cases	213		243	
Attrition		34		33
Moved out of Bronx		16		8
Moved not traced		4		1
Never home		6		4
Refused		8		19
On infant study		0		1

*D.U.= Dwelling unit
**Eligible = household has a child 1 to 5 years of age.

of reported conditions (adjusted for the increase in conditions due to the wider reporting interval) will decrease due to recall failure. Schiff's investigation of the first eight (of twelve) interviews of the M-D infant study group revealed no support for this hypothesis. She suggests that this finding may be due to the concern which mothers have for the health of their young children, especially infants. Also, at the close of each interview the respondent was told that someone will be back next month to continue the study, i.e., re-interview the mother. Thus, familiarity with the questionnaire and the expectation of another interview may have facilitated recall by these mothers.

FOOTNOTES TO DATA APPENDIX

1. This paraphrases an unpublished manuscript by Rowland L. Mindlin.

2. New York Times, June 15, 1973.

APPENDIX B

AREA SPECIFIC HEDONIC PRICE REGRESSIONS

TABLE 1

MEANS AND STANDARD DEVIATIONS OF VARIABLES
IN HEDONIC PRICE FUNCTION

	Mott Haven		Westchester	
	Mean	Standard Deviation	Mean	Standard Deviation
EXP	25.962	10.221	26.485	10.868
EXPSQ	778.273	553.615	819.454	550.707
PRIMEPED	.246	.431	.367	.482
PRIMEIM	.084	.278	.087	.281
PRIMEOBG	.075	.264	.101	.302
PRIMESUR	.051	.220	.082	.275
PRIMEOTH	.082	.275	.062	.242
CERTPED	.084	.278	.180	.385
CERTIM	.004	.066	.001	.028
CERTOBG	.004	.066	.005	.070
CERTSUR	.007	.081	.001	.028
CERTOTH	.013	.115	.009	.094
PEDEXP	5.905	11.436	9.235	14.294
IMEXP	2.091	7.922	2.444	8.609
OBGEXP	1.794	7.150	2.976	9.230
SUREXP	1.308	6.108	2.485	8.554
OTHEXP	2.251	8.297	1.453	6.475
MEMBER	.288	.496	.392	.567

TABLE 1 (concluded)

MEANS AND STANDARD DEVIATIONS OF VARIABLES
IN HEDONIC PRICE FUNCTION

	Mott Haven		Westchester	
	Mean	Standard Deviation	Mean	Standard Deviation
PROF	.013	.115	.098	.297
NYCEDUC	.166	.373	.419	.494
FOREDUC	.503	.501	.280	.449
TKL	.071	.257	.012	.110
TKE	.135	.342	.116	.321
TB	.033	.180	.031	.173
BLACK	.191	.393	.042	.201
SPANISH	.588	.493	.077	.267
AREA				
ln USUPRICE	1.638	.343	1.775	.215

TABLE 2

ORDINARY LEAST SQUARES ESTIMATES OF HEDONIC PRICE FUNCTIONS FOR PEDIATRIC CARE

	Mott Haven[b]		Westchester[c]	
	Regression Coefficient	t Ratio	Regression Coefficient	t Ratio
EXP	-.012	-1.36	-.006	-2.28
EXPSQ	.0003	1.78	.0001	2.10
PRIMEPED	.066	0.54	.247	6.33
PRIMEIM	.023	0.16	.035	0.57
PRIMEOBG	.397	2.59	.033	0.42
PRIMESUR	-.032	-0.14	.095	1.04
PRIMEOTH	.183	1.05	-.035	-0.61
CERTPED	.229	2.75	.135	4.85
CERTIM	-.087	-0.35	.200	1.00
CERTOBG	-.016	-0.06	-.069	-0.80
CERTSUR	.183	0.82	.775	3.83
CERTOTH	.151	0.94	.102	1.51
PEDEXP	-.004	-0.76	-.006	-4.39
IMEXP	.003	0.68	.001	0.39
OBGEXP	-.016	-2.83	-.0002	-0.05
SUREXP	.001	0.15	-.002	-0.75
OTHEXP	-.002	-0.32	.002	1.16
MEMBER	.017	0.43	.028	2.24

TABLE 2 (concluded)

ORDINARY LEAST SQUARES ESTIMATES OF HEDONIC PRICE FUNCTIONS FOR PEDIATRIC CARE

	Mott Haven[b]		Westchester[c]	
	Regression Coefficient	t Ratio	Regression Coefficient	t Ratio
PROF	-.112	-0.75	-.034	-1.24
NYCEDUC	-.015	-0.36	.006	0.40
FOREDUC	.084	1.97	-.023	-1.33
TKL	-.121	-1.93	.038	0.74
TKE	.004	0.08	.007	0.36
TB	-.079	-0.77	-.016	-0.42
BLACK	.080	1.54	.060	2.12
SPANISH	.036	0.84	-.019	-0.84
AREA				
CONSTANT	1.616		1.770	
R^2	.099		.175	
F Statistic	1.800		9.886	

[b]Sample size is 451.

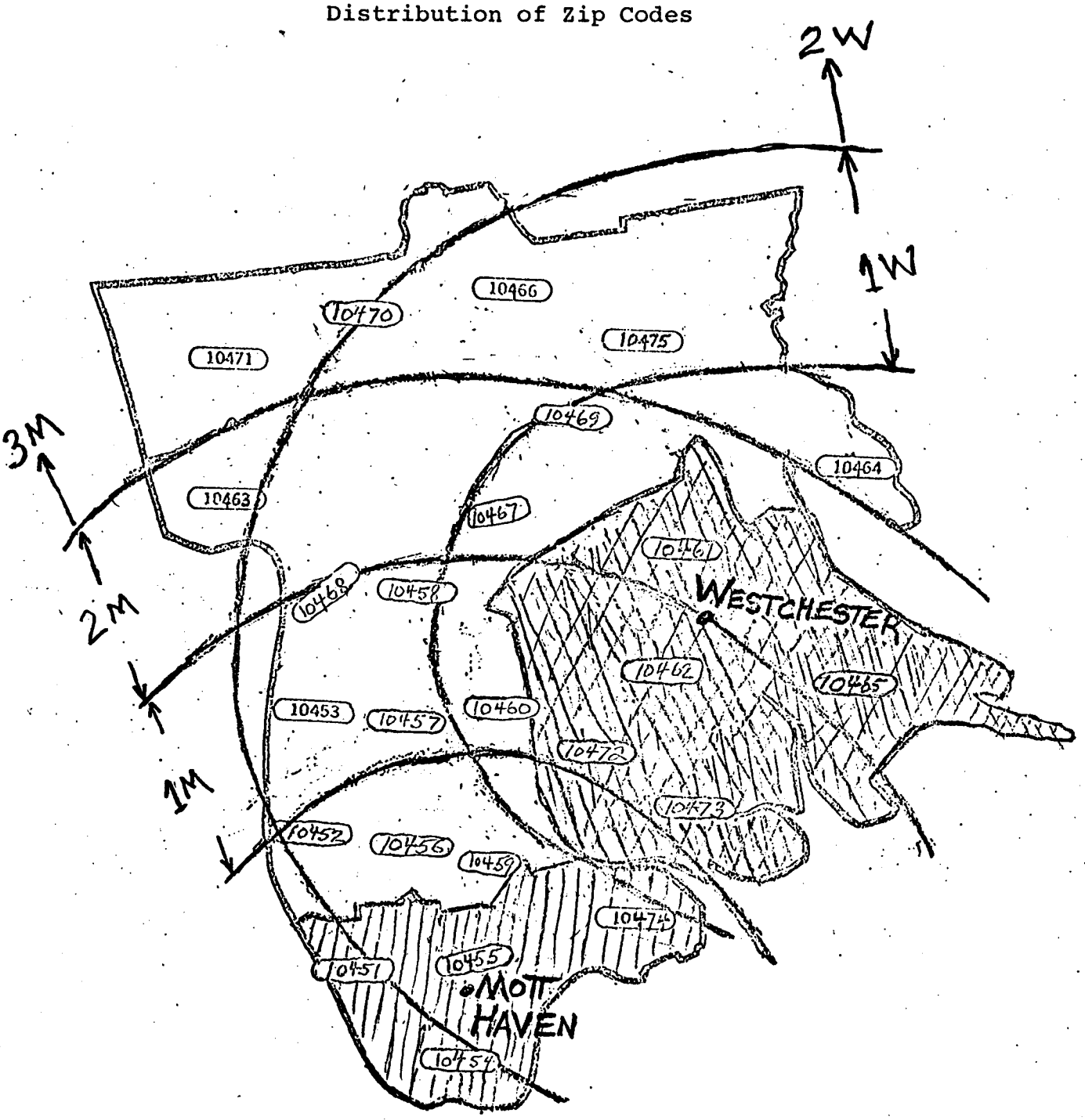
[c]Sample size is 1,236.

APPENDIX C

DISTRIBUTION OF ZIP CODES

TABLE 1

Distribution of Zip Codes



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