AN ECONOMIC ANALYSIS OF THE UTILIZATION OF MEDICAL SERVICES BY MEDICARE PATIENTS

by

NINA PASCAL

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Charlotte Muller — Chairman of Examining Committee

9/14/79 — date

[signature] — Executive Officer

Professor Charlotte Muller

Professor Michael Grossman

Professor Harold M. Hochman

Supervisory Committee

The City University of New York

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Abstract

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Advisor: Professor Charlotte Muller

This paper develops a framework for estimating demand for medical care, extending Goldman and Grossman's "quantity-quality substitution model" to the Medicare market. The empirical work is based on a sample of Medicare beneficiaries residing in Queens, and is limited to patients with private office visits during 1976 to Queens providers.

The measure of utilization of physician services is the annual number of visits to private offices. It is argued that medical services are not homogeneous commodities but can be viewed as a bundle of characteristics. What are ostensibly the same medical services can be found at different prices. Hence it is misleading to measure their consumption in terms of quantity alone. The paper for this reason is organized into two parts: the first seeks to estimate the "true" price adjusted to quality, and the second uses these prices in estimating demand curves.

In the first part a hedonic approach is used to estimate the true value of medical services by examining the relationship between fees and physician characteristics which are assumed to reflect differences in

quality or productivity. The novelty of this study is that it focuses on differences in performance among physicians and their attitude toward the Medicare program. Performance variables have not been used before as explanatory in physicians' price functions.

This study does not pretend to develop indexes of quality by means of which physicians can be compared. All that is done is to measure to what extent variations among physicians with respect to such factors as the number of services per patient, procedure mix, availability of the physician in both hospital and office and acceptance of assignment, affect prices.

The hedonic price functions are estimated separately for routine follow-up and initial comprehensive visits. The analysis is performed first for all physician specialty types, and second, for each specialty type separately. The resulting hedonic indexes are then used to construct measures of quality per visit and quality-adjusted price which are used to estimate separate demand curves for visits (quantity) and quality of visits.

The second part of this paper employs multiple regression techniques to examine three measures of medical care utilization: the number of office visits to physicians in private practice, the average quality of those visits, and the number of months with physician contact. The first two measures are derived separately for the two kinds of office visits. Demand curves for visits and quality are estimated for all patients with office visits regardless of physician specialty type. Factors such as type of services, frequency of services, procedure mix and provision of general care were found to influence fees. The direction of influence and its intensity vary by specialty. To capture these effects on the utilization of medical services, separate demand curves by physician specialty type are estimated.

The study shows that: Specialists charge higher prices for an office visit than do general practitioners, but board certification in a specialty does not necessarily lead to higher fees. Other physicians' decisions which influence prices include procedure mix, the number of services rendered per patient, the number of diagnostic services performed in the office, acceptance of assignment etc. Visits are more sensitive than quality per visit to changes in net price. The patient's decision to contact a physician is less sensitive to changes in quality-adjusted price than is the patient's decision to continue seeing a physician thereafter. An increase in the number of diagnostic services per visit generates additional cost which leads to substitution of quality for visits. An increase in quality per visit was found to be inversely related to the number of physician contact months. The demand for visits is more sensitive to a change in the net quality-adjusted price after the deductible has been met than before. Patients with no assigned claims are more sensitive to changes in the net price than other patients.

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CHAPTER I

INTRODUCTION

The aim of this study is to measure the most important determinants influencing the demand for medical services by the aged population. The analysis refers to patients under Medicare[1] residing in Queens. The Medicare and Medicaid programs, initiated in 1966 under the Johnson Administration, are designed to help the poor and the elderly to improve their well-being by subsidizing the purchase of health services. The aim of the Medicare program is to increase the accessibility of quality medical care to the elderly. Part B of the Medicare program covers all "medically necessary" services subject to a $60 annual deductible and a 20 percent coinsurance rate. The Medicare program is implemented by 61 carriers (private insurance companies and non-profit organizations). The administration of the Medicare program in Queens is handled by Group Health, Incorporated, New York.

President Carter's national health plan legislation aims to achieve a universal, comprehensive plan for the aged, the disabled, and the poor. The proposed "Healthcare" will consolidate Medicare and Medicaid in a single administrative structure. While at present, the aged must pay a coinsurance rate of 20 percent on all physician services after the deductible has been met, under this plan the patient's out-of-pocket expenses may not exceed $1,250. And further, while at present physicians treating Medicare patients may ask for more than the allowed charge - and, in fact, about half do so - under this new proposal aged patients will not face physicians' bills beyond those covered by Healthcare.[2]

In this context it is important to provide a theoretical and empirical framework that will contribute toward an understanding of the most important determinants of the utilization of medical services by the elderly. The analysis is based on the assumption that since individuals make their own decisions concerning whether, when,and where to seek medical care, Government policy can only affect their decisions by manipulating some of the variables which influence demand. An understanding of the demand for medical care is of particular interest because of the rapid increase in its price and its share in national income. The impact of inflation has a more harmful effect on the elderly who live on a fixed income than on other population groups with more flexible incomes. The effectiveness of both present and proposed programs will depend on the ability of policy makers to predict the impact of changes in different variables on the demand for medical care.

The empirical work is limited to a sample of beneficiaries (enrolled under Medicare) who reside in Queens. I have used as a data source the claims history files of Group Health, Incorporated (GHI), New York - the carrier which administers the Medicare program in Queens. The claims represent medical services rendered to individuals under the Medicare program during 1976 by physicians located in Queens. Although the data have the advantage of providing objective measures of the utilization of medical services, they do not provide information on patient income, educational level, or additional costs incurred in getting care. Once such information has been obtained, the methodological framework employed here can be used as a point of departure for future research. The results of this study can provide relevant information for government policies for the aged, because they can be generalized on a national level based on a comparison between GHI and US data.

This study takes an analytical approach to the utilization of medical services by the aged Medicare population. Viewing such utilization primarily from the demand side, it treats the demand for medical services as a demand derived from their use as inputs into the production of a more basic commodity, good health. The utilization of physicians' services by non-hospitalized patients is measured by the annual number of visits to physicians in their private offices during 1976. However, this poses a problem since office visits are offered at different prices, prices which vary with the physician's specialty and even between physicians in the same specialty. Therefore, the first problem which arises is to establish the relevant price to be used in estimating the demand curves for office visits. In recent economic literature it has been recognized that differences in quality are distinguishing features of the market for physicians' services. Quantity in physical units may be a very misleading measure of the total consumption if the quality component is ignored (Goldman and Grossman, 1976,1978).[3] According to the hedonic hypothesis different versions of the same commodity are found at different prices because they contain differing quantities of specific characteristics; the ability to disaggregate a commodity and to price its components facilitates the construction of price indexes. The hedonic approach provides an implicit price for each of the characteristics. Then, by valuing the quantity of each characteristic by its implicit price and combining the results, one can obtain the market valuation for that particular commodity.[4] Goldman and Grossman applied this hypothesis for the first time to the medical care market (pediatric care). The quality of medical services was explained by differences in characteristics among physicians, which in turn reflect differences in productivity or efficiency in the production of health. Therefore, by examining the relationship between physicians' characteristics and prices the "true" price adjusted for quality can be established. The present study extends Goldman and Grossman's model to the Medicare market. Chapter II presents the analytical framework of the quantity-quality substitution model that has guided this empirical investigation.

The analysis begins in Chapter III with the "detection" of relevant characteristics. These characteristics are assumed to represent quality and therefore to explain price variation among physicians. In selecting these characteristics the specific features of the Medicare market and the data available for this study are taken into account. The arguments are supported by statistics which are presented in Appendix A.

These characteristics can be grouped into two major categories: first, physicians' professional standing as measured by their specialty type and board certification status; and second, their performance in the Medicare market during 1976 as measured on the one hand by procedure mix, services per patient, capacity to provide diagnostic services, and availability in both hospital and office, and on the other hand, by their attitude toward the Medicare program as revealed in their rate of assignment and their Medicare revenue. Acceptance of assignment is a decision of the physician that affects beneficiary burden and access to care. Assignment occurs when a patient transfers his/her right to reimbursement from Medicare to a provider who accepts the reasonable charge as full payment for a service.

Performance characteristics and physicians' attitudes towards the program have not been used before as explanatory variables in price functions. Our empirical findings show that there are significant differences among physicians with regard to their performance not only across different specialties but also within the same specialty. In selecting performance variables the following aspects were considered: quality differentials, specialty related differentials and whether a specialist provided general care services to his/her patients. No attempt has been made to rate a certain level of performance as higher in "quality" than another. All that I have done is to observe and determine the extent to which performance variation among physicians affect prices. One of the major limitations placed on the research which should be kept in mind, however, is that one cannot isolate the effect of quality on physician performance from other factors. Physicians may perform differently not because they are more efficient or productive, but because they aim to achieve a certain revenue target.

The hedonic price functions are estimated separately for the two kinds of office visits - routine follow-up and initial comprehensive ones. The analysis is performed first by aggregating the data over all physicians' specialty types, and second, aggregating it by specialty type. The hedonic approach is used as an econometric tool which is helpful in detecting relevant characteristics and then in estimating their market valuation. The statistical analysis is designed first, to determine which of these characteristics and performance variables are relevant to explaining the differences in office visit prices; second, to estimate implicit prices for these characteristics; and third, to use the implicit prices to estimate the quantity and quality-adjusted price for office visits.

In Chapter IV the resulting hedonic indexes are used to construct measures of quality per visit and quality-adjusted prices. Then, these measures are used to estimate two separate demand curves for quality and visits. This strategy of fitting separate demand curves for quality and visits was applied for the first time by Goldman and Grossman, 1976, to the pediatric market. Their model provides a framework for demand analysis whenever the market for a good is distinguished by a quality component. In this study I use multiple regression techniques to examine three measures of medical care utilization: first, the number of office visits to physicians in private practice by Medicare patients with positive office visits; second, the average quality of these visits; and third, the number of months with physician contacts. The first two measures are derived separately for the two kinds of office visits: initial comprehensive office visits and routine follow-up office visits.

The main independent variables in the regression are grouped into five categories: price and related variables, physician contacts other than office visits, surgical and diagnostic services received in the physician's private office, patient characteristics, and indirect costs.

Some of the aspects emphasized in our analysis are: the effect of physicians' capacity to provide diagnostic services in their private offices upon the number of visits and the average quality of those visits; the effect of changes in the net price adjusted for quality on visits and the average quality per visit; and the effect of the deductible and of the the acceptance of assignment upon the price elasticities for visits and quality. In discussing the results I focus first on the basic hypothesis derived from the quantity-quality substitution model; second, on specific findings regarding the effects of explanatory variables on the utilization of medical services; and third, on the patient's decision to contact a physician as compared to his or her decision to follow the treatment suggested by the physician.

The most important regression results are as follows. Specialists charge higher prices for an office visit than general practitioners. A board certified internist charges on the average higher prices for follow-up office visits than his non-board counterpart. In addition to specialty status variables, performance variables provided a considerable contribution in explaining price variation among physicians. By including performance variables, it is possible to explain 41 percent of variation in prices among physicians in the case of follow-up office visits and 30 percent in the case of initial comprehensive ones. A better understanding of the role played by performance variables in determining price variation is provided by separating the claims into four groups: general practitioners, internists, surgeons and "other" specialists. Five our of the six performance variables which were chosen as explanatory in our hedonic price function had significant coefficients. The degree of significance and the direction of influence varied by specialty type. The most striking findings were: physicians' availability in both hospital and office was found to play a significant role in explaining price differences in the case of internists and surgeons. However, the direction of influences differs. The coefficient is negative for internists and positive for surgeons. Physicians' versatility in providing different procedures has a positive and significant effect on fees charged by internists. Services per patient have a negative and significant effect on fees charged by all physicians except those in "other"specialties.

The acceptance of assignment plays a positive and significant effect on prices charged by all physicians but those in "other" specialties.

Although the impact of Medicare policy is to reduce an elderly patient's financial burden by altering the price at which medical services are available, the net quality-adjusted price still plays a significant role in the patient's decision to continue treatment. The own price elasticity of demand for routine follow-up office visits is significantly negative. Visits are more sensitive than quality per visit to changes in net price. The price elasticity of visits exceeds that of quality in absolute value (-0.41 versus -0.005 for follow-up office visits, and -0.03 versus -0.01 for comprehensive office visits). The patient's decision to contact a physician is less sensitive to changes in quality-adjusted price than is the patient's decision to continue seeing a physician thereafter. This suggests that the "fixed" non-reimbursable cost plays a greater role in the decision to follow a treatment ("number of visits") than in the decision to contact a physician in the first place. In general Medicaid patients do not differ from others in their initial decision to contact a physician, but they do not continue seeing their physician to the same extent. In the case of elderly patients HOME visits and follow-up office visits are complements. The HOME variable has a positive and highly significant influence on the number of follow-up office visits demanded. Male patients demand fewer visits than do female patients and use them over a smaller number of months.

A particularly striking finding is that a physician's high rate of diagnostic services to visits in his/her private office has a positive impact on the patient's decision to contact a physician in the first place but a negative one on the decision to continue seeing any physician thereafter.

An increase in the number of diagnostic services per visit (compared to other doctors) generates additional costs which give rise to a trade-off between visits and quality in favor of the latter. An increase in quality per visit was found to be inversely related to the number of physician contact months. Higher quality per visit may lower costs to the patients and to the program as well. The demand for visits is more sensitive to a change in the net quality-adjusted price after the deductible has been met than before. Patients with a zero rate of assignment are more sensitive to changes in the net price than are those with a positive rate. The demand for surgeons is highly inelastic as compared to that for general practitioners and internists.

A more extensive summary of what I believe I have accomplished in this work is presented at the end of both Chapters III and IV.

NOTES TO CHAPTER I

1. The analysis includes the utilization of medical services by aged Medicare enrollees who are also under Medicaid.

2. National Health Plan Legislation - Phase I of the President's National Health Plan - from President Carter's message to Congress, June 12, 1979, and summary of the Carter Health Plan issued by the White House on June 12, 1979, Challenge (July/August 1979), Vol.22, No. 3, pp. 11-14.

3. Goldman, Fred and Grossman, Michael, "The Demand for Pediatric Care: An Hedonic Approach". National Bureau of Economic Research Working Paper No. 134, April 1976, p. 1 and Goldman and Grossman "The Demand for Pediatric Care: An Hedonic Approach," Journal of Political Economy, (1978), Vol. 86, No. 2,Pt. 1, pp. 259-260.

4. Ohta, Makoto and Griliches, Zvi, "Automobile Prices Revised: Extensions of the Hedonic Hypothesis," In Household Production and Consumption, edited by Neslov E.Terleckyj: New York Columbia University Press (for National Bureau of Economic Research), 1975, pp. 325-326 and Triplett E. Jack comments on "The Concept and Measurement of Product Quality,"in Terleckyj, opus cit., p. 568

CHAPTER II

THE MODEL AND THE DATA SOURCE

The Model

The analysis is developed within the household production framework of consumer behavior and assumes that medical services are purchased as inputs in an individual's production function of the commodity "good health".[1] That is, the production function can be expressed by:

$$h = h(v, q, \gamma) \,, \qquad (1)$$

where: h, the output, stands for an individual's health, which depends upon the quantity of medical services used, and the quality of care.

Therefore; v = number of visits to physicians,

q = quality of care per visit,

γ = a vector of additional variables: age, sex, education, income, health endowment, etc.

Quality and visits are separate arguments in the production function. The quality variable is assumed to measure variations in productivity among physicians. (See Goldman and Grossman, 1976,1978).[2] If we let the utility function of an elderly individual be given by

$$U = U(h, z) \,, \qquad (2)$$

where: h = individual's health

z = vector of all other commodities

then, by substituting equation 1 into equation 2, one can obtain an alternative utility function, "derived utility function", which is expressed by:

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

where: v = medical services, specifically, office visits to a physician in private practice

q = quality per visit

z = all other commodities purchased in the market place

γ = vector of exogenous variables such as age, sex, education, income, etc.

Therefore, v and q are separate variables in the derived utility function because they are separate arguments in the health production function.

If the traditional approach to consumer behavior is applied, each individual faces a budget constraint which can be expressed as

$$S = z + \hat{p}vq + wFC, \qquad (4)$$

where: S, stands for full income. The resources available to an individual household are non-earned income, participation in the labor market, and the value of non-market time. It is assumed that the entire income is exhausted on outlays for v, q and z. For simplification, the price for all other commodities is assumed to be equal to $1.00.

The expenditures for medical services can be expressed as pv - where p is the average price of a visit. Then, the price function is defined as:

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

where: $\hat{p}$ = price adjusted for quality,

q = quality per visit

then the derivatives with respect to quality are:

$$\frac{\partial p}{\partial q} = \hat{p} \quad \text{and} \quad \frac{\partial^2 p}{\partial q^2} = 0 \, , \qquad (6)$$

$\hat{p}$ the quality-adjusted price per visit is:

$$\hat{p} = \frac{p}{q} \, , \qquad (7)$$

then the expenditures for medical care are equal to:

$$Ex = \hat{p}vq \, . \qquad (8)$$

That is, the expenditure on medical care, $\hat{p}vq$, depends on quality of the visit and number of visits.

In addition to those expenditures (money price), there are other costs involved in obtaining medical care - the so called fixed cost (FC). This is independent of the quality of visits and can be expressed by:

$$FC = TR\_C + w(wait + travel)\ 1/60 , \qquad (9)$$

The fixed cost includes the cost of travel to the medical care source (TR_C) and the price of time spent on traveling to the physician's office, waiting time in the office and searching time. These costs in general are estimated in terms of foregone earnings (actual or potential), Newhouse and Phelps, 1974; Acton, 1965; Goldman and Grossman, 1976.

If an individual maximizes utility (equation 3) subject to an income constraint (equation 4), then using the Lagrangian function

$$L = u(v,q,z) + \lambda(S - \hat{p}vq - wFC) , \qquad (10)$$

The first order conditions of optimal choice of v,q and z are:

$$U_z = \lambda , \qquad (11)$$

$$U_q = \lambda \hat{p}v , \qquad (12)$$

$$U_v = \lambda(\hat{p}q + FC) . \qquad (13)$$

where: U_z, U_q and U_v = marginal utilities of z, q and v and λ = the marginal utility of income.

In equilibrium an individual equates the marginal rates of substitution between quality and visits with prices of quality relative to prices of visits:

$$\frac{U_q}{U_v} = \frac{\hat{p}v}{\hat{p}q + FC} = \frac{p_q}{p_v} , \qquad (14)$$

letting πq and πv be the shadow prices for quality and quantity of medical services. The interpretation of equations 12 and 13 provides the shadow prices for medical services (visits and quality)

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

$$\pi v = \hat{p}q + FC \qquad (16)$$

Then, equation 14 can be expressed as:

$$\frac{U_q}{U_v} = \frac{\pi_q}{\pi_v} = \frac{p_q}{p_v} , \qquad (17)$$

In equilibrium an individual equates the ratio of marginal utilities of quality to visits (MRS_{qv}) with the shadow price of quality relative to visits.

From this the following implications can be derived:

. In terms of income effects:

The presence of the fixed cost component in total cost of medical care causes the relative price of quality to rise with income. That is, if visits (v) and quality (q) have the same income effect (v and q increase by the same percentage as income increases), then $\hat{p}v$ (π_q) increases by a greater percentage than $\hat{p}q + FC$ (π_v). Therefore the ratio of shadow prices $\frac{\pi_q}{\pi_v}$ increases as income increases.

. In terms of quality-adjusted price effect:

As quality-adjusted price ($\hat{p}$) increases, both the shadow price of quality (π_q) and the shadow price of visits (π_v) increase. But the percentage increase in shadow price of quality is greater than that of the shadow price of visits. Thus an increase of quality-adjusted price ($\hat{p}$) will increase the relative price of quality and there will be a substitution towards visits and away from quality (the ratio of visits to quality v/q will increase).

. In terms of the fixed cost effect:

As fixed cost (FC) increases, the price of quality decreases relative to the price of visits. Therefore, the ratio of the shadow price of quality to the shadow price of visits (π_q/π_v) decreases. The increase in fixed costs will give rise to a substitution toward quality.

The Data

The data set for this study are the sample of Queens beneficiaries used by the project on Physician Reimbursement under Medicare and Medicaid conducted under a contract with the Health Care Financing Administration of the Department of Health, Education, and Welfare.

Obtaining the Initial Sample

A sample of Queens beneficiaries 65 years and over (as of 1976) was selected from the BEST Alpha file.[3] There were 234,335 enrollees in 1975 under Supplementary Medical Insurance (SMI) residing in Queens.

Selecting every 36th beneficiary, a total of 4,095 beneficiaries were drawn. Due to the fact that, before sampling, the Queens beneficiaries were listed in their ascending order of zip code residence, they are distributed along all zip codes in Queens county. The beneficiaries' ID's (HIC)[4] numbers were then matched against all the Medicare claims for Part B services for 1976, submitted to Group Health, Incorporated of New York for payment.

Beneficiaries found to have at least one claim were considered "users". 45.6 percent of beneficiaries are in this category. In addition, Nassau providers' claims were searched for utilization by Queens residents. When services in either county are taken into account, 50.2 percent of Queens beneficiaries used Part B services. The 49.8 percent found with no claims were considered as "non-users" (see Table 1).

The division of Queens beneficiaries into "user" and "non-user" groups should be considered with caution. It is based exclusively on the existence of claims for services from physicians in their county of residence. Information about services received by Queens residents outside of their county of residence was not available (except for those traveling to Nassau for care).

In the Physician Reimbursement project, Medicare claims for 1976 submitted to GHI for Queens were used to study beneficiaries' utilization level, physician workload and other features of their behavior in the Medicare market of Queens. For this study the sample of 4,095 Queens Medicare beneficiaries was organized as follows:

The first group, identified as "users" of Medicare Part B services, was partitioned into three subsamples:

a) beneficiaries using services provided by Queens physicians only (37.2 percent).

b) beneficiaries using services provided by Queens and Nassau doctors (9.4 percent). (For Nassau, claims were handled by Blue Cross/Blue Shield of Greater New York.)

c) beneficiaries using services provided by Nassau physicians only. There were 3.6 percent of the Queens beneficiaries in this situation.

The second group, "non-users", refers to those beneficiaries (49.8 percent) found with no claims.

The question then arose, why are almost 50 percent of beneficiaries not using any Queens medical services? There are many reasons:

- traveling to receive care in another borough of New York City
- using services not covered by Medicare for which no claim was submitted
- lack of Medicare coverage

Due to special conditions in New York City, such as public transportation facilities, the place where doctors' services are received is not determined by patient residence. This is especially true where a certain specialist is needed. An individual is more likely to search for medical care in other boroughs of New York City. By examining claims received by BC/BS for Nassau county, it was possible to determine which Queens beneficiaries travel to Nassau county for care.

The present study will refer only to the first subsample, "users", Queens Medicare beneficiaries using Queens doctors only. Beneficiaries using services of both Queens and Nassau are excluded from the analysis because they are not comparable with the first group. The information available for them refers only to that part of medical services received from Queens doctors.

For similar reasons the third subsample of users is excluded from analysis. The only information established was that they had received services from Nassau doctors.

The object of the present study is to determine the most important factors influencing the demand for ambulatory medical services under Medicare.

The empirical analysis is restricted to utilization of physicians' ambulatory services by Medicare beneficiaries residing in Queens from providers practicing in Queens. Specifically, the patterns of utilization of beneficiaries with office visits are analyzed.

The location for ambulatory practice is private physicians' offices located in Queens. The analysis of demand for office visits was done separately for routine follow-up office visits and comprehensive office visits.

<u>How is the Final Sample Organized?</u>

Considering all the above, the sample is reduced to 1,523 user beneficiaries. Table 2 contains the distribution of Queens Medicare beneficiaries using services provided by Queens doctors only, by place of service.

To obtain homogeneous groups, "users" were partitioned with regard to the type of service and the place at which doctor visits were received.

1. "Users" with one or more office visits (routine follow-up and/or comprehensive) consisted of 84.7 percent of the sample. Persons in this group could also have hospital or home visits.
2. "Users" with hospital visits but no office visits made up 4.3 percent. Persons in this group could also have home visits.
3. "Users" with home visits but no office visits or hospital visits made up 1.2 percent.
4. "Users" with other types of services than all the above. 9.8 percent of "users" did not fall into any of the above categories. This group included patients receiving services at independent laboratories, extended care facilities or other places.

Forty-six percent of users in the 4 subgroups used the physician's office for services other than office visits, such as diagnostic laboratory services.

As mentioned, the present study is restricted to those beneficiaries who were users of Queens doctors with one or more office visits in the year studied. Therefore the sample is reduced to 1,291 patients. All services received by these patients during 1976 are included regardless of place. Their distribution by type of service received is presented in Table 3,and by place of service in Table 4.

TABLE 1

DISTRIBUTION OF QUEENS MEDICARE BENEFICIARIES ACCORDING TO USE OF SERVICES BY QUEENS PHYSICIANS IN 1976

Location of doctors used	Queens beneficiaries Number	Percent	Number of claims for service by Queens physicians
Total	4,095	100.0%	x
Users	2,056	50.2	14,443
Queens only	1,523	37.2	11,197
Queens and Nassau	385	9.4	3.246
Nassau only	148	3.6	x
Not using services of Queens or Nassau doctors	2,039	49.8	x

TABLE 2

DISTRIBUTION OF QUEENS MEDICARE BENEFICIARIES USING ONLY QUEENS DOCTORS BY TYPE OF SERVICE (1976)

	Beneficiaries		Claims	
	Number	Percent	Number	Percent
Total "Users"	1,523	100.0%	11,197	100.0%
1. With office visits[a]	1,291	84.7	10,185	91.0
2. With hospital visits[b] (but no office visits)	65	4.3	424	3.8
3. With home visits[c] (but no office or hospital visits)	18	1.2	42	0.4
4. With other types[d] of services than all the above	149	9.8	546	4.8
out of which services in the physician's private office were:	(68)	(46.0)		

a,b,c,d See text pp.17,18 for definitions

TABLE 3

DISTRIBUTION OF QUEENS MEDICARE BENEFICIARIES BY TYPE OF SERVICE RECEIVED [a]

Service type	Queens Beneficiaries Number	Percent
1. Medical care	1,291	100.0%
2. Surgery	338	26.2
3. Consultation	146	11.3
4. Diagnostic X-ray	411	31.8
5. Diagnostic Lab	688	53.3
6. Radiation therapy	14	1.1
7. Anesthesia	72	5.6
8. Assistance at surgery	3	x
9. Other medical services	29	2.2

N = 1,291

a/ Services rendered by Part B providers (MD's and non-MD's)

TABLE 4

DISTRIBUTION OF QUEENS MEDICARE BENEFICIARIES
BY PLACE OF SERVICE

Place	Queens beneficiaries with services [a] Number	Percent
Office	1,291	100.0%
Home	117	9.1
Inpatient Hospital	215	16.7
Extended Care Facility	16	1.2
Outpatient Hospital	13	1.0
Independent Lab	116	8.9
Other	33	2.6
Nursing Home	-	-

N = 1,291

a/ Services rendered by Part B providers (MD's and non-MD's)

NOTES TO CHAPTER II

1. See Grossman, Michael. The Demand for Health: A Theoretical and Empirical Investigation. Columbia University Press, New York, for National Bureau of Economic Research, 1972, p. xiii.

2. For detailed discussion see Goldman and Grossman, "The Demand for Pediatric Care," opus cit., pp. 5-10, and Goldman and Grossman, "The Demand for Pediatric Care," opus cit., pp. 260-263.

3. Beneficiary Eligibility Status Tape.

4. Health Insurance Claimant.

CHAPTER III

PRICE FUNCTIONS AND QUALITY OF MEDICAL SERVICES

The theory developed in the previous chapter provides a framework for demand analysis in cases where the market for a good is distinguished by a quality component. This is based on a quantity-quality substitution model developed by Goldman and Grossman. This model is used in the next chapter to study the utilization of medical care - physicians' services rendered to Medicare patients. The measure of utilization of physicians' services is the annual number of visits to physicians in their private offices. The price of office visits, however, varies. Why do prices differ among physicians? Why is the same commodity, "office visit", sold at different prices in the market? The answer to this question is the object of the present chapter. The hedonic approach is used to estimate price functions for office visits. Quality-adjusted price is then used as an independent variable in estimation of the demand functions.

In the first section of this chapter, the relevant characteristics which are assumed to explain price variation among physicians are discussed in detail. Statistics are presented to support the arguments. All the tables containing the relevant statistics appear in Appendix A. The detection of the relevant characteristics does not pretend to be exhaustive but rather attempts to select the major characteristics which represent quality. Because the demand for physicians' services is a derived demand - derived from the demand for a more common commodity "good health", the relevant characteristics are those which are descriptive of physicians' productivity, or ability to produce "good health". The second section presents the specification and estimation of hedonic price functions. Then the measurement of independent variables is described, the data source from which those measures are obtained is discussed, and comments on the independent variables that enter into the multiple regression estimates of the system are presented. In the third section, the empirical estimates of the hedonic price functions for the two kinds of office visits - routine follow-up and initial comprehensive - are discussed in detail. The results are presented by type of independent variable, that is, professional characteristics, performance variables and interaction terms. Additional empirical results are presented in Appendix B. In the fourth section, a microanalysis by type of physician specialty is presented. The analysis was undertaken in an attempt to shed light on the role of performance variables for each type of physician specialty.

1. The Detection of Relevant Characteristics

The empirical work of this paper is concerned with the study of the utilization of medical care - physician services rendered to a sample of the elderly population (over 65 years of age), Queens residents under Medicare. As discussed earlier, the utilization of physicians' services is measured by the annual number of visits to physicians at their private offices. However, Table A.1 illustrates, that the price[2] of an "office visit" (follow-up or comprehensive) varies widely both among physicians of the same specialty and across different specialties. It can be found, for example, that prices for a follow-up office visit vary from as low as $10.00 to as high as $35.00, while comprehensive visits vary from $19.45 to $96.25; that is, different versions of the same commodity "office visit", are found at different prices.

Under such circumstances, the first issue which arises is the determination of the relevant price to be included among explanatory variables in estimating the demand for office visits. If variation in prices among physicians reflects váriation in quality, one cannot ignore this, because then the true quantity of medical services would not be accurately measured. If quality differences determine prices this, in turn, will affect the demand for medical services and finally the individual's health, since medical services are assumed to be inputs into the individual's health production function (Grossman, 1972).[3] The hedonic hypothesis has served as a rationale to estimate the quality of durable goods such as automobiles and houses, goods which can be viewed as a bundle of characteristics or attributes. It was shown that different versions of the same commodity have different prices because they contain different levels of specific characteristics.

As shown by Griliches, the construction of price indexes depends on the ability to disaggregate a commodity and price its components. This poses the following questions: a) What are the relevant characteristics of the commodity bundle "office visit? b) How are the implicit prices to be estimated from the available data? c) How can the resulting estimates be used to construct price or quality indexes of an office visit?[4] The answer to the first two questions is the object of this chapter, while the third is the object of the following chapter.

Goldman and Grossman, applied this hypothesis for the first time to the medical care market (pediatric care). Quality of medical services was explained by differences in characteristics among physicians, which these authors assumed reflected differences in productivity or efficiency. Therefore, by examining the relationship between physicians' characteristics and prices the "true" price adjusted for quality was established.[5]

The present study will extend this model to the Medicare market. The specific nature of the "Medicare market" and of the information available to analysis will be considered. Using the hedonic approach to the price indexes, the "true" adjusted-quality price is established. This price then is used as an independent variable in estimating the demand functions, which is the object of the next chapter.

In answer to the first question, variables used as explanatory in hedonic functions can be classified into two broad groups: first, those which affect physician cost of producing medical services but do not enter the utility function of the consumer directly. Physicians' professional characteristics, that is, their specialty type and board certification status in practicing a specialty can be viewed as inputs into the physician's production function; second, performance variables which presumably enter the patient's utility function directly. Examples of performance variables are procedure mix, services per patient, percentage of diagnostic services per office visit, rate of assignment and others.

Doctors' professional characteristics (inputs) will produce their performance levels as outputs. Professional status can be viewed as the potential of producing a certain performance level, and performance variables determine prices. This follows the two-stage hypothesis applied by Ohta and Griliches in 1975,[6] to estimate the quality of cars.

> We postulate a two-stage hypothesis which asserts that the physical characteristics of a car produce its performance. ...Experienced and inexperienced drivers may get different performances from a car with the same physical characteristics.

By analogy, I will consider both professional characteristics and doctors' performance levels as explanatory variables in hedonic price functions. The first group of explanatory variables designed to measure physician inputs in the production function are physicians' professional characteristics measured by such variables as physician specialty type and board certification status. Are services provided by a specialist of a higher quality than those of non-specialists? Or can one assert that a board certified specialist yields higher quality services than his non-board counterpart? Put differently, does the inclusion of those variables among the explanatory variables capture the quality differences among physicians?

In the past studies of the economics of medical care, physician specialty was termed as a potential of providing higher quality services than non-specialists. Specialists who are certified in practicing a certain specialty were considered to have a higher potential of applying medical knowledge. It was shown that with the type of care held constant, the average quality or productivity of a visit might vary among physicians. (Newhouse and Phelps,1974,1976; Feldman,1975; Goldman and Grossman,1978.)[7] Quality differences can be explained by different levels of investment in human capital by physicians. For example, a specialist who is board certified in a specialty needs additional training in order to be "board eligible and to pass the required examinations. Medical schooling, internships and residency programs can differ in quality.

This study is concerned with the empirical question that as long as there are perceivable quality differences among physicians of different specialties - one can assume that they command market prices. However, this does not provide the complete answer;quality may also depend upon demand considerations. That is, whether surgeons or other specialists are considered by their patients to provide higher quality services may depend on the physicians' ability to provide them with general care which would eliminate referrals to other specialists (for example, the majority of comprehensive visits were rendered by surgical specialists. This will be further discussed in this paper). More insights can be provided by looking at which physician specialties were most used by patients in the sample, and for which services they were used.

There were 1,106 Part B providers who provided services to Medicare patients under the study. After excluding non-MD's (podiatrists, chiropractitioners, therapists etc., see Table A.2), there remained 961 physicians.

The data available for this study (claims records) have the advantage of providing the relevant information related to physician specialty type and board certification. For more accuracy, all the information was checked against the A.M.A's physician master file. In case of discrepancies, the physician master file data were used. All medical specialties were grouped into four broad groups: General Practitioners, Surgical Specialties, Medical Specialties and Other Specialties (see list A1 in the Appendix).

Table A.2 shows that out of the total 961 MD's, internists and general practitioners had the largest share (30.5 percent and 29.6 percent, respectively), followed by surgeons (25.9 percent). Services of other specialties, were used to a lesser extent (14.0 percent of the total physicians studied were from other specialties). Only 25 percent of physicians represented in the present study were board certified in specialty practiced; the highest percentage with board certification was found for surgical specialties (62.7 percent).

Table A.3 provides some idea of the use of physicians of different specialties for some of the most frequently used procedures.

For example, follow-up office visits were mostly rendered by internists, who saw 47 percent of patients, and general practitioners, who saw 43 percent of patients.

In the case of comprehensive visits, however, the majority of patients (58.9 percent) were seen by surgeons, while internists saw only 33.5 percent of patients with such visits. Home visits were rendered to a larger extent by general practitioners, who saw 69.2 percent of patients with such visits. In the hospital, internists saw twice as many patients than general practitioners did. Internists provided to a larger number of patients such services as electrocardiogram, radiology and urine tests.

However, the above variables will capture only some of the aspects of differences in quality of services provided by the physicians. As stated before those characteristics are considered as a potential of providing higher levels of physician performance.

The second group of explanatory variables, the performance variables, are used in addition to professional characteristics to determine the prices which physician services can command. Quality differences can be perceived as differences in diagnosis and treatment for a particular disease. A more qualified physician implies a smaller number of services and fewer referrals will be needed to achieve an improvement in the individual's health. Quality is reflected in the physician's ability to combine different inputs available by using his/her knowledge, and experience.

In their study of "The Demand for Pediatric Care," Goldman and Grossman attribute the price differential among physicians to variations in productivity or in the quality of medical services produced. Productivity differences are traced in turn to experience (age), vintage (period of medical education) and model effect (physician's specialty).[8] Another attempt to capture the effects of experience and vintage was carried out by Steinwald and Sloan in "Determinants of Physicians' Fees". Among other variables they used AGE - physician's age dummies - and LICIO -

dummy variable for physicians who received their licence within the last 10 years in the State of their current mailing address.[9] In this study I do not use a physician's experience or vintage as independent variables in the price function. As defined above, I focus instead on the physician's performance in the whole Queens Medicare market. This is based on the assumption that a physician's performance reflects, in fact, his/her experience, vintage, know-how and knowledge of the local market.

Considering data available and the specific nature of the Medicare market, the performance variables can be divided as follows:

a) those related directly to professional characteristics, such as procedure mix (PROC_KT), services per patient (SER-PPAT), services rendered in both places, doctor's office and hospital (OFFICE_H), and diagnostic services per visit (PRCT_DIAG).

b) those related to the physician's attitude toward the program, such as acceptance of assignment (PRCT_ASS) and revenue from Medicare patients (REVENUE).

The first group of the performance variables is discussed next. Physician providers vary as to the number of different procedures performed.

PROC_KT variable (procedure mix), is designed to measure the doctor's ability to use or to combine different procedures. It was done by counting different procedures codes into which services reported by each doctor are classified for reimbursement purposes. The number of procedures varies among physicians within a specialty as well as among different specialties. To what extent a certain procedure mix can be identified with "quality" is hard to establish. The comparison should be done within a specialty rather than for all specialties together, because the potential number of procedures is influenced by specialty. In other words, differences across specialties can be explained by differences in the very nature of each specialty. It is reasonable to assume that a general practitioner, for example, will use a less diversified combination of medical services as compared to an internist or surgeon. The findings confirm this (See Table A.4).

But how can one explain the wide variety of procedure mix for doctors within the same specialty? Can this be attributed to better medical knowledge? If the answer is yes, then can one conclude that an internist who used 78 different medical procedures, for example, provides a better quality of care than another internist who had used only 10 or fewer procedures? To what extent can a combination of a particular set of procedures be called "quality"? And to what extent is this just a manipulation of language on claims so as to achieve a certain revenue target? This study does not intend to pursue this kind of investigation. All that can be said is that doctors do vary with respect to the number of different procedures used in their treatment. The concern then is to establish whether there is any meaningful relationship between prices and procedure mix. Table A.4 offers some additional insights into this. The comparison is made by specialty type and within the same specialty. Because of sampling techniques, physician activity is presented under two alternatives: the number of different procedures provided to the patients who fall in the sample (S), and their performance in the total Queens Medicare market (Q). When the behavior in the Queens market is taken into account, comparison of procedure variety reveals that general practitioners and internists rendered a maximum of 89 and 78 different procedures, respectively, while surgeons and other specialties rendered as many as 154 and 156, respectively. The same physicians rendered a considerably less diversified procedure mix to patients who fall in the present study. The number of different procedures varies from a minimum of 14 (other specialties) to a maximum of 17 (surgeons and internists).

Table A.4 presents the distribution of physicians according to the number of different procedures performed in their whole Queens Medicare practice and in the User sample, as well. It shows that 50 percent of general practitioners rendered 14 or fewer different procedures, the following 25 percent between 15 and 25, while the last 25 percent rendered between 26 and 89 different procedures. The internists in general present the same pattern as general practitioners. However, internists have a slightly higher number of different procedures performed. The maximum number of different procedures was 78 while for general practitioners the maximum was 89. The number of different procedures performed varies in a range of 1 to 154 for surgeons while for other specialists the range is 1 to 156. The median of the distribution, however, is at 22 different procedures for surgeons and 31 for "other" specialists. The top 25 percent of surgeons performed between 39 and 154 different procedures, while "other" specialists performed between 53 and 156.

Variability among doctors as to the number of services per patient constituted another characteristic of physicians' performance which is taken into account to establish the relationship with fees. That is, the services per patient (SER_PPAT) variable, was designed to measure doctors' efficiency in providing medical care. It is established as a ratio of total services, regardless of type, rendered by a physician to all patients seen during the year 1976.[10] It is based on the assumption that for a given patient condition differences among physicians with respect to the number of services used per patient are explained by a "quality differential". A more qualified physician can achieve an improvement in patient health using fewer services. SER_PPAT is a gross measure of doctors' efficiency, however, and is not intended to assess a particular ratio of SER_PPAT as being indicative of higher quality. All that is done is to observe and determine to what extent variation among physicians with respect to the number of services used per patient affects prices.

Before making any assessments with regard to quality, there are two other aspects which should be discussed. The first is the specialty related differential. As in the case of procedure mix analysis, services per patient are indicative of quality within a specialty only. A surgeon, for example, needs fewer services to achieve a certain outcome than an internist or a general practitioner. Also surgeons provide a greater proportion of services that can be performed only once.[11] The second aspect one should consider is to what extent specialist physicians provide general care services to their patients. It is expected that the specialty differential will be narrowed to a great deal in such cases (see Table A.7 - the case of internists will be discussed later in the paper).

In support of the above, the analysis by specialty type is presented in Table A.6, while the distribution of physicians by number of patients seen within each specialty is presented in Table A.8.

Table A.6 shows that a higher percentage of surgeons performed only one service per patient (18.9 percent) as compared to internists (7.6 percent) and general practitioners (8.5 percent). The contrast is even greater for physicians practicing one of the "other" medical specialties; 43.5 percent ot those rendered only 1 service per patient.

More insights can be gained by comparing physicians of different specialties from the point of view of the total number of services performed and number of patients seen. Table A.9 shows that although surgeons saw a larger number of patients than general practitioners and almost as many as internists, they rendered considerably fewer services overall. That is, 16.0 percent of all services were rendered by surgeons as compared to 43.0 percent and 35.0 percent rendered by internists and general practitioners, respectively.

When analyzing Table A.7 it can be seen that 50 percent of general practitioners performed up to 6.5 services per patient, the next 25 percent performed between 6.6 and 11, while the last 25 percent at the top of the distribution performed between 11.1 and 57. A similar distribution can be found when the activities of internists are analyzed. The maximum of services per patient was smaller, however (48), as compared to 57 for general practitioners; that is, the similarity between general practitioners and internists can be explained by the fact that internists are more likely to provide their patients with general care than surgeons or "other" specialists. The first 50 percent of surgeons rendered up to 2 services per patient while "other" specialists rendered up to 1.5. The next 25 percent rendered between 2.1 and 4 and "other" specialists between 1.6 and 3 services per patient. The last 25 percent at the top of the distribution rendered up to 41 services per patient in the case of surgeons and 25 for "other" specialists.

Next, differences among physicians with regard to diagnostic services performed at their private offices are considered in the process of selecting the relevant characteristics for the price functions. The PRCT_DIAG variable refers to the number of total diagnostic services (laboratory and X-ray) rendered by a physician at his private office as compared to the total office visits (follow-up and comprehensive) by the patient. The variable was designed to capture differences among physicians with regard to their capacity and ability to perform such services in their private offices. It is assumed that a physician can provide more prompt and efficient services if he has the necessary equipment and knowledge to perform such services as electrocardiograms, blood tests, urine tests, and radiology tests in his private office.

From the patient's point of view quality can be determined by convenience, reduction of referrals, reduction in time spent with the physician and possibly a lower cost: the shadow price of care is reduced by minimizing such costs as transportation and time spent getting to and waiting in the physician's office.

Significant differences among physicians of the same specialty or across different specialties with regard to this aspect are found at the empirical level. The question then arises to what extent this can be termed "quality" differences and to what extent it can be explained by other factors? Specifically, differences can be attributed to: a) specialty differential (one should assume that PRCT_DIAG is indicative of quality only within the same specialty); b) disease differential; c) the extent to which a physician specialist provides general care services; and finally d) under certain circumstances, an attempt to achieve a certain revenue target. (Quality may not be reflected in price if a low price is used under certain regulations.) The Medicare program establishes criteria for calculation of so-called "allowed charges" by the carriers.

A physician may charge a lower price for office visits and compensate by producing and selling ancillary services such as laboratory tests, and X-rays. Medicare reimbursement policy allows physicians to bill the program for tests performed in their offices. Additional revenue may be generated in one practice by the provision of ancillary services which another practice routinely sends to outside facilities.

Additional insight can be gained by considering the following aspects: 31.8 percent of patients with positive office visits had diagnostic X-ray and 53.3 percent diagnostic laboratory services performed in the physician's private office (see Table A.10). Not all specialties rendered diagnostic services to the same extent. Table A.10 shows that an internist performed 1 diagnostic service for every 2 office visits (follow-up and comprehensive), a general practitioner 1 for every 3 visits and a surgeon 1 for every 6 visits.

The most frequent diagnostic services performed in the physician's office are illustrated in Table A.3. The majority of radiology chest services were performed by internists. Internists provided twice as many radiology chest services as general practitioners and three times as many as "other" specialists. Surgeons, however, only provided such services occasionally. The most expensive services were those provided by "other" specialties ($26.30 per service as compared to $19.90 charged by GP's). 50.3 percent of urine tests were performed by internists and 33.6 percent by general practitioners.

Surgeons and "other" specialists provided urine tests to fewer patients but they charged more for them as compared to GP's and internists.

Electrocardiagraphy services were provided by all specialties. Again, the highest proportion was rendered by internists (65.5 percent) and general practitioners (32 percent). Surgeons and "other" specialists provided EKG's only occasionally. Internists charged more than others ($24.60).

Physicians vary in their use of hospitals and office locations. The OFFICE_H variable measures the physician's availability in both places. The purpose of selecting the OFFICE_H variable as one of the characteristics designed to represent "quality of care" is that it provides continuity of care. It also shows a certain established relationship between physician and Medicare patient. Because it also constitutes convenience to the patient seeking care, it might be perceived as a quality indicator and thus used as a criterion in the patient's decision to choose the services of a particular physician.

Physicians vary with respect to their revenue derived from the Medicare market. During 1976, 43 percent of physicians who provided services to Queens Medicare patients earned between $1,000 and $19,999 while 6.2 percent earned $60,000 or more.[13]

Physician revenue from Medicare patients can be used as indicative of his/her participation and dependency on the Medicare market. The variable REVENUE was designed to measure this. It was established as a dummy variable which takes the value of 1 if the revenue derived from the Medicare market during 1976 was $60,000 and over and 0 otherwise. A more direct measure would have established the share of the revenue derived from Medicare patients in the physician's total practice. However, given data limitations, this was not possible. Information about the physician's non-Medicare practice was not available so a comparison could not be made.

A revenue smaller than $60,000 may suggest that a physician depends more on non-Medicare practice. This is based on the following considerations:

The physician's revenue from Queens Medicare patients is measured by the amount paid by the Medicare program to the physician, which is equivalent to 80 percent of the allowed charge for the services rendered to a patient after the deductible has been met. Therefore, it is an under-estimate of physician revenue, because, in addition to that, he presumably collects the coinsurance and, of course, the payment for all services rendered to the beneficiary until the deductible is met. According to the AMA - Profile of Medical Practice 1977, the average net income for a physician was $51,997 and average professional expenses were $33,985, gross income being about $86,000. $60,000 gross revenue from Medicare is equivalent to about 70 percent of the national mean gross revenue of $86,000, and indicates extensive dependence.

Therefore, it was decided to use the annual gross income of $60,000 as a limit in partitioning physicians into two classes. The first includes those physicians whose annual revenue was $60,000 and greater; the second includes those whose revenue was smaller than $60,000.

Acceptance of assignment and physician income derived from Medicare patients constitute the second group of performance variables.

Physicians vary with respect to acceptance of assignment. This factor influences the amount of health insurance protection that is afforded by the Medicare beneficiary. Table A.11 shows that 63.1 percent of physicians never accepted assignment while 14.9 percent accepted it all the time. Those aspects will be discussed further in Chapter IV. The PRCT_ASS variable was entered into the price function as indicative of physician attitude toward the program. It is the claims for which a physician accepted assignment as a percentage of the total claims submitted for serviced rendered by that physician during 1976 to Queens Medicare patients. Patients view this as an advantage because it lessens their burden and improves financial access to care. Under the Medicare reimbursement method an enrollee receives 80 percent of reasonable charges for covered services, after the first $60 in any year. In addition to the coinsurance and deductible, the beneficiary burden also includes the difference between the physician's charge and the reasonable or allowed charge.

Two types of financial transactions take place between beneficiaries and physicians.

1. Either the patient is permitted by the physician to assign payment rights to the physician, who accepts the allowed charge as full payment; the carrier reimburses the physician directly for 80 percent of the allowed charge.

<u>or</u>

2. The physician bills the beneficiary for any "desired" charge, in which case the beneficiary is responsible for paying the physician's bill and then claims reimbursement from the carrier of 80 percent of the allowed charge. A physician accepting assignment thus agrees to limit his or her fee to the allowed charge, foregoing the option to charge the patient anything more, while gaining certainty of payment.[14]

In conclusion, in the process of detecting the relevant characteristics two major limitations were placed on the research:

First, one cannot isolate the effect of quality on physician performance from other factors. That is, the empirical findings just discussed show that there are significant differences among physicians with regard to their performance, not only across different specialties but also within the same specialty. Some support was found for a narrowing of the specialty differential when specialist physicians provide their patients with general care services. It should be kept in mind that neither a high ratio of diagnostic services or of services per patient, nor a larger number of procedures performed necessarily indicates a higher level of productivity. Physicians may perform differently not because they are more efficient or productive, but because they aim to achieve a certain revenue target.

Second, due to the sampling technique physician activities in the entire Queens Medicare market during 1976, but not in the User sample, are used as indicative of their performance. That is, their performance characteristics were computed from data available in all claims for services rendered by them to their Queens Medicare patients. This strategy was undertaken for the purpose of obtaining a more accurate measure of their performance. As was shown, a physician might have seen only two patients who fell into the present study while he or she actually might have seen as many as 800 Medicare patients in Queens.

The detection of relevant characteristics expected to explain price variation among physicians suggests that performance variables in addition to specialty status should be used as explanatory variables in the hedonic price functions. The list of chosen variables (characteristics) does not aim to be exhaustive. Rather, the variables are assumed to be the major ones in explaining price differences, letting the rest be impounded in the constant term.[15]

2. Specification and Estimation of Hedonic Price Functions

This section will discuss the variables which are used to estimate the hedonic price functions. To estimate the hedonic price functions, a subsample of patients with private office visits was selected.[16] There are two different kinds of "office visits": one is a routine follow-up office visit established patient procedure 9000 (termed VISIT9 in the Tables); the other is an initial comprehensive office visit procedure 9019 (termed VISIT19 in the Tables).[17] These two medical services should be considered as separate commodities. There are significant differences with respect to the inputs necessary for their production, their prices, and their frequency of performance. Therefore separate hedonic price functions are estimated for routine follow-up office visit (PRICE9) and comprehensive office visit (PRICE19); i.e. different quality-adjusted prices are derived for the two kinds of office visits under the study. The hedonic price indexes can be used to explain how differences in physicians'characteristics affect the pricing of physicians'services.

The hedonic price function can be expressed as a regression equation of prices on physician characteristics:

$$P_i = P(X_i, Y_i, U_i),$$

where P_i is the price (submitted charge) of the i^{th} physician, X_i a vector of physicians' professional status measures, Y_i measures physicians'performance, and U_i is the disturbance term.

The general form of hedonic price function which is fitted to the Queens sample can be expressed as:

$$\begin{aligned} LNPRICE = \; & a_0 + a_1 MED + a_2 SURG + a_3 OTHR + a_4 MEDB + a_5 SURGB \\ & + a_6 OTHRB + a_7 PROC\_KT + a_8 SER\_PPAT + a_9 PRCT\_DIAG \\ & + a_{10} OFFICE\_H + a_{11} REVENUE + a_{12} PRCT\_ASS \end{aligned}$$

The first six independent variables are measures of physicians'professional status while the last six measure their performance and participation in the Medicare program. The definitions of the variables are presented in Table 1 and their means and standard deviations in Table 2.

The dependent variables, LNPRICE9 and INPRICE19, are the natural logarithm of the fee charged for a routine follow-up visit and a comprehensive visit to a particular physician, respectively. The fee is measured by the submitted charge. For reasons explained below, the submitted charge is used to measure the price for which a physician is willing to render his/her services by performing a given medical procedure.

In case of acceptance of assignment, the submitted charge can be viewed as an upper bound because the carrier reimburses the physician directly for 80 percent of the allowed charge and the beneficiary will be responsible for the remaining 20 percent of the allowed charge (coinsurance). In fact, we can regard the acceptance of assignment by a physician as an agreement to limit his or her fees to the allowed charge, foregoing the option to charge the patient anything more, while gaining certainty of payment. In case of non-acceptance of assignment, the submitted charge can be viewed as the supply price. The physician bills the beneficiary directly for any desired charge and the beneficiary is responsible for paying the physician's bill, and then claims reimbursement from the carrier (80 percent of the allowed charge).[18]

The fee is the weighted average of submitted charges per visit by physicians who rendered routine or comprehensive office visits, respectively. For example, the general form can be expressed as follows:

$$\text{PRICE} = \frac{\sum_{i=1}^{n} (\text{SC} \times \text{NUM\_SER})_i}{\sum_{i=1}^{n} (\text{NUM\_SER})_i} \qquad (3)$$

where:

PRICE is the weighted average submitted charge for routine office visit charged by physician i.

SC is the submitted charge per service of physician i to beneficiaries seen during the year 1976.

NUM_SER is number of visits rendered by physician i, to beneficiaries seen during the year 1976.

The regression is run across all physicians who provided routine office visits and separately for those who provided comprehensive office visits in their

TABLE 1

DEFINITION OF VARIABLES IN HEDONIC PRICE FUNCTIONS

Variable	Definition[a]
I. Dependent Variables	
1. PRICE9	Average price charged by physician for a routine follow-up office visit
2. PRICE19	Average price charged by physician for a comprehensive office visit
II. Independent Variables[c]	
1. MED[b]	Primary practice in internal medicine = 1
2. SURG[b]	Primary practice in surgical specialties = 1
3. OTHR[b]	Primary practice in other specialties = 1
4. MEDB	Board certification in internal medicine = 1
5. SURGB	Board certification in surgical specialty = 1
6. OTHRB	Board certification in other specialties = 1
7. PROC_KT	Number of different procedures (procedure mix)
8. SER_PPAT	Services per Medicare patient
9. PRCT_DIAG	Ratio of the total diagnostic services (laboratory and x-ray) rendered by a physician at his private office to the number of total office visits (follow-up and comprehensive)
10. OFFICE_H	Physician rendered care in both places - the hospital and his office = 1
11. REVENUE	Physician revenue from Medicare during 1976 $60,000 ≥ 1
12. PRCT_ASS	Percentage of claims assigned

TABLE 1 (continued)

Interactions between physician specialty and performance variables:

13.	MED_PRO	=	MED x PROC_KT
14.	SURG_PRO	=	SURG x PROC_KT
15.	OTHR_PRO	=	OTHR x PROC_KT
16.	MED_SPAT	=	MED x SER_PPAT
17.	SURG_SPAT	=	SURG x SER_PPAT
18.	OTHR_SPAT	=	OTHR x SER_PPAT
19.	MED_DIAG	=	MED x PRCT_DIAG
20.	SURG_DIAG	=	SURG x PRCT_DIAG
21.	OTHR_DIAG	=	OTHR x PRCT_DIAG
22.	MED_ASS	=	MED x PRCT_ASS
23.	SURG_ASS	=	SURG x PRCT_ASS
24.	OTHR_ASS	=	OTHR x PRCT_ASS

[a] See text for more detailed definitions
[b] The omitted class is general practitioners
[c] Dummy variables take the value of 1 or zero otherwise

TABLE 2

MEANS AND STANDARD DEVIATIONS OF VARIABLES IN HEDONIC PRICE FUNCTIONS

VARIABLE	MEAN	STANDARD DEVIATION
LNPRICE9	2.839	0.344
LNPRICE19	3.456	0.361
MED	0.306	x
SURG	0.259	x
OTHR	0.139	x
MEDB	0.099	x
SURGB	0.100	x
OTHRB	0.052	x
PROC_KT	24.927	19.784
SER_PPAT	6.259	4.449
PRCT_DIAG	39.859	87.891
OFFICE_H	0.825	x
REVENUE	0.132	x
PRCT_ASS	26.864	29.965
MED_PRO	7.260	13.415
SURG_PRO	6.950	15.542
OTHR_PRO	4.96	16.946
MED_SPAT	2.513	4.536
SUR_SPAT	0.932	2.176
OTH_SPAT	0.396	1.630
MED_DIAG	19.890	68.294
SUR_DIAG	6.270	30.221
OTH_DIAG	3.252	37.026
MED_ASS	8.858	21.779
SUR_ASS	7.682	19.843
OTH_ASS	5.345	17.893

N = 961

[x]Dummy variables

private office. There are 750 physicians who rendered follow-up routine office visits to 1,224 patients and 137 who rendered comprehensive office visits to 181 patients.

Office visits were also rendered by non-MD providers; those are excluded from the present study (see Table A.2). The data show visits to podiatrists. The activities of these providers are not included in the hedonic price function. However, a separate analysis can be done. Their mean price for a visit is almost the same as of general practitioners (see Table A.1). The use of the physician as the unit of observation in the hedonic price function is the only possible approach given the data available for this study.[19]

The Queens sample comprises 4,095 beneficiaries who are proportionately distributed along the zip codes. Almost 50 percent of physician providers who rendered services to Queens Medicare patients during 1976 rendered services to those patients who fell into the sample.[20] The frequency distribution of doctors by the number of patients seen reveals that the following aspects: 42.8 percent of all doctors saw only one patient; another 22.8 percent, two patients; and 13.4 percent, three patients only. The maximum number of patients seen by a doctor was 18 and only one doctor was in this category. From the patient point of view, the distribution of patients with office visits by the number of doctors seen, 41.2 percent saw only one doctor, 29.0 percent, two different doctors, 14.4 percent, three different doctors, 6.4 percent, four different doctors. The maximum number of different doctors seen was 12, again, only one patient being in this category (see Table A.14).

The data do not provide any information about contacts with doctors located outside of Queens. I investigated the possibility of establishing the usual source of care for patients with office visits. The results were not satisfactory, however. The distribution of patients by

Queens physicians seen during the year 1976 shows that in general, physicians tended to see patients whose residency was within the same zip codes (Table C.1). Although of interest, it is beyond the scope of the present study to establish the relationship between physician office location and beneficiary residence.

The independent variables in the regression are designed to measure variations in performance among physicians, variations which are assumed to determine differences in prices.

As discussed previously, the two major groups considered as explanatory variables in the hedonic price function are:

. Those designated to measure physicians' professional status such as primary practice in specialties MED, SURG, OTHR, and board certification in specialty practiced MEDB, SURGB AND OTHRB. Primary practice in general practice is considered as a base class therefore omitted from regression. Information about physicians' professional status is available in claim records. In case of missing data, the physicians' masterfile was used.

. In addition to the above, performance variables are entered into the regression. The performance variables are of two kinds. The first group relates to the physician's specialty, such as a) PROC_KT (procedure mix) which measures the physician's versatility in combining and performing different procedures; b) OFFICE_H which measures the physician's availability in both places of service - his office and the hospital; c) SER_PPAT, the number of services rendered per patient (regardless of type) used as a measure of the physician's intensity; d) PRCT_DIAG, the number of laboratory and X-ray services rendered by a doctor in his private office as a ratio to the total office visits by the patient. Performance variables in the second group are designated to link physician professional practice with the Medicare market. This group of variables will reflect the physician's attitude toward the program and, given the assumption of profit or utility maximizing behavior, a physician will participate in the Medicare market only if his/her profit or utility is maximized. These variables are: a) REVENUE, a dummy variable which takes the value of 1 if the revenue derived from the Medicare market during 1976 was $60,000 and over, and a value of 0 if revenue was under this amount. The variable was designed to measure a physician's participation in the Medicare program and his dependence on the Medicare market; b) PRCT_ASS, the percentage of claims for which assignment was accepted by the physician.

Since the physician's performance may differ by specialty type, the interactions between performance variables (PROC_KT, PRCT_DIAG, PRCT_ASS, SER_PPAT) and specialty are entered into regression as independent variables. These interaction terms, created by multiplying the set of three dummy variables (MED, SURG and OTHR), which measure specialty type, by physician performance variables, are designed to capture the joint effect of specialty and physician performance.

3. Empirical Findings

A. Regression Results for Follow-up Office Visits

Table 3 shows the results of ordinary least square estimates of hedonic price functions for follow-up office visits in semilog form[21] (referred to as LNPRICE9).

In the first equation, the average submitted charge is regressed against six explanatory variables, which are measures of physician professional status. The explanatory variables are expressed in dummy form. This technique is applied to distinguish among different classes of physician specialties: medical (MED), surgical (SURG), "other" (OTHR) and general practitioners (GP).

TABLE 3

Ordinary Least Squares Estimates of Hedonic Price Function:

Dependent Variable LNPRICE9

Variable	Equation (1)		Equation (2)		Equation (3)		Equation (4)		Equation (5)		Equation (6)		Equation (7)	
	Reg. Coeff.	t-ratio	Reg. Coeff.	t-ratio	Reg. Coeff.	t-ratio	Reg. Coeff.	t-ratio	Reg. Coeff.	t-ratio	Reg. Coeff.	t-ratio	Reg. Coeff.	t-ratio
R^2	0.3259		0.3875		0.4054		0.4306		0.4215		0.4191		0.4082	
$\bar{R}^2$	0.3204		0.3792		0.3965		0.4125		0.4080		0.4031		0.3969	
F	60.36		42.38		41.81		22.8		29.55		24.97		33.71	
INTERCEPT	2.5917	150.6050	2.6528	72.1189	2.6558	73.2180	2.5970	54.3460	2.5974	54.5674	2.6534	64.6123	2.6582	70.0978
MED	0.2809	10.1900	0.2556	9.3214	0.2458	9.0616	0.2556	4.0210	0.2796	4.6049	0.1916	3.9048	0.2283	6.7891
SURG	0.4565	14.6120	0.3634	10.9664	0.3658	11.1945	0.5642	9.2070	0.5420	9.1100	0.4350	8.9321	0.3857	9.6173
OTHR	0.5228	7.5810	0.4144	5.9501	0.3869	5.6130	0.4281	3.2950	0.3355	2.9756	0.4042	3.3021	0.2958	2.9673
MEDB	0.1213	3.2820	0.1230	3.3975	0.1133	3.1695	0.1028	2.8580	0.1183	3.3130	0.1025	2.8507	0.1156	3.2205
SURGB	-0.0093	-0.2220	-0.0021	-0.0531	-0.0021	-0.0518	-0.0321	-0.7890	-0.0347	-0.8500	-0.0113	-0.2790	-0.0122	-0.2984
OTHRB	-0.0489	-0.4740	0.0082	0.0793	-0.0134	-0.1311	0.0642	0.5360	-0.0116	-0.1081	0.0904	0.7655	0.0089	0.0858
OFFICE-H			0.0185	0.5621	0.0278	0.8537	0.0187	0.5760	0.0193	0.5955	0.0289	0.8854	0.0276	0.8462
PROC-KT			0.0007	1.0330	-0.0002	-0.3260	0.0001	0.0880	-0.00001	-0.0183	0.0009	0.7749	-0.00007	-0.1017
SER-PPAT			-0.0156	-5.7300	-0.0173	-6.3880	-0.0092	-1.8250	-0.0093	-1.9767	0.0193	-6.9978	-0.0175	-6.4548
PRCT-DIAG					0.0001	4.7081	0.0005	1.9390	0.0005	4.4709	0.0050	2.1912	0.0006	4.8017
REVENUE			-0.0133	-0.3968	-0.0167	-0.5040	-0.0108	-0.3170	-0.0185	-0.5571	-0.0046	-0.1348	-0.0162	-0.4876
PRCT-ASS			0.0021	5.7961	0.0021	6.0659	0.0019	2.8460	0.0019	2.8539	0.0019	2.7676	0.0019	2.8030
MED-ASS							0.0007	0.8130	0.0006	0.7228	0.0008	0.8838	0.0006	0.7358
SUR-ASS							-0.0004	-0.4080	-0.0006	-0.6210	-0.0003	-0.2887	-0.0006	-0.5960
OTHR-ASS							0.0008	0.5250	0.0017	1.1353	0.0011	0.6551	0.0019	1.2398
MED-DIAG							0.0025	0.8621			0.0002	0.6497		
SUR-DIAG							-0.0006	-1.5461			-0.0007	-1.6254		
OTH-DIAG							0.0003	0.6752			0.0002	0.4676		
MED-SPAT							-0.0100	-1.5470	-0.0061	-1.0293				
SUR-SPAT							-0.0287	-3.6430	-0.0293	-3.9110				
OTH-SPAT							-0.00001	-0.0012	-0.0009	-0.0879				
MED-PRO							0.0017	0.9410			-0.0022	-1.3944		
SUR-PRO							-0.0006	-0.3941			0.0008	0.4451		
OTH-PRO							-0.0050	-1.2900			-0.0055	-1.4364		

N = 755

Variables MEDB, SURGB, and OTHRB are entered into regressions to distinguish between board and non-board certification status within each specialty.

General practitioners are the omitted class. Therefore, all the coefficients attached to one of the remaining specialties are interpreted in relation to the general practitioner as the base class. The coefficient of MED, for example, shows the percentage difference between the price charged by a non-board certified physician in internal medicine and the price charged by a general practitioner. The coefficient of MEDB, shows the percentage difference between the prices charged by a board internist and a non-board internist.

The results show that non-board certified physicians in medical, surgical, or "other" medical specialties charge higher prices per office visit than general practitioners. These explanatory variables are individually statistically significant, which means that we reject the null hypothesis that there are no differences in prices charged by different specialties for the same commodity, office visits. The interpretations of the results shown in Table 3, equation 1 are the following:

. The percentage difference between the price charged by physicians with a primary practice in internal medicine and that of general practitioners is 28 percent; that of physicians with a primary practice in surgery is 46 percent; and for those practicing "other" medical specialties the percentage difference is 52 percent. All specialties had positive coefficients when compared to general practitioners. The percentage differences in price are highly significant when compared to general practice.

. The analysis of the effect of board certification within a specialty on the percentage difference in price shows that a board certified internist charges, on the average, 12 percent more for a visit than his non-board certified counterpart. This difference is significant.

This is not true, however, for board certified surgeons (SURGB), who charge less than their non-board certified counterparts (-0.0093 percent) and the board certified MD's in "other" specialties (OTHRB), who charge less than their non-board counterparts (0.0489 percent). A board certified surgeon may charge more for a big operation, making office visit a trivial revenue source. However, the percentage differences in price for surgery and "other"specialties were not significant.

Therefore, one cannot assume that board certification implies higher prices for all specialties. There must be other factors which influence price variation.

To test these findings the following question can be raised:

. Are there other aspects of price variation that can be explained by considering other explanatory variables, such as performance variables? Put differently, is there anything left in the residuals from the first regression (equation 1) using physician specialty characteristics as explanatory variables?

The answer to this question is illustrated in equations 2 and 3 of Table 3. In equation 2, the first five performance variables are added to those in equation 1,PRCT-DIAG[22] is added to those in equation 3. By adding performance variables to professional characteristics the goodness of fit is improved. Whether professional characteristics leave much to be explained by the performance variables can be found by interpreting the following results:

. Comparing equations 2 and 3 with equation 1 where only the physician's professional status was used as explanatory variable, the explanatory power of variables is enhanced significantly from an R^2 of 33 percent in equation 1 to

39 percent in equation 2 and 41 percent in equation 3.

. The significance of the intercept term is reduced from 150.61 in equation 1 to 73.22 in equation 3. This supports our argument that performance variables provide an additional explanation of the impact of physician's efficiency on price differences among physicians.

. Another way to determine the influence of the performance variables is to compare the coefficients of professional status of equation 1, where the performance variables are omitted, to those of equation 3, where all performance variables are included. In each case, the coefficients of professional status variables (MED, MEDB, SURG, SURGB, OTHR and OTHRB) are smaller and the direction of the impact on prices is stable. This means that variables in equation 1 pick up some of the effects of performance variables. The same variables are individually statistically significant in equation 1 and equation 3.

Looking at the performance variables it is found that:

. Three out of six performance variables added are statistically significant at the 5 percent level: services per patient (SER_PPAT), assignment rate (PRCT_ASS), and diagnostic services per office visit (PRCT_DIAG). Their coefficients are positive, except for SER_PPAT. PROC_KT (procedure mix), although positive, was not significant at the 5 percent level.

. The other two performance variables which are found not statistically significant are in dummy form:

. OFFICE_H, for example, divides the sample into two groups: the first includes physicians who were available in both the hospital and their office; the second, those who are not available in both places of service. It was expected that physicians' availability in both places would command higher prices. The coefficient of OFFICE_H variable is positive and the percentage difference in prices is 2 percent when compared to those not available in both places. However, this finding is not significant.

. REVENUE, the other dummy variable, divides the sample of physicians into two groups: first, those who had a Medicare revenue of $60,000 or more and those who had less than $60,000. It was believed that physicians who are more dependent on the Medicare market will charge a lower price than those who provide fewer services to Medicare patients. The allowed charge constraints faced for Medicare have less influence on prices charged by providers who only occasionally provide services to this category of patients. The prices in the non-Medicare market are higher than those allowed by the Medicare program. When compared to the rest of physicians, those with a revenue over $60,000 charge less as expected, but the percentage differences are rather small (1 percent) and statistically insignificant.

Interaction Variables

The impact of physicians' professional status or specialty on price charged was studied in equation 1 of Table 3, and the impact of performance variables was studied in equations 2 and 3 where performance variables are entered in addition to professional characteristics. The findings confirm the assumption that performance variables contributed to an explanation of price variation among physicians. It is unlikely, however, that the relationship between prices of visits and physician performance measured by procedure mix, services per patient, diagnostic services per office visit and rate of assignment is the same across all specialties.

To capture these effects, interaction variables are created. The interaction terms are obtained by multiplying the dummy variables which measure physician professional status (MED, SURG, OTHR) by physician performance variables (PRCT_DIAG, SER_PPAT, PROC_KT, PRCT_ASS). In each case, the general practitioner is the base class and the regression coefficients for this class are the performance variables PRCT_DIAG, SER_PPAT, PROC_KT, and PRCT_ASS. The regression coefficients for the remaining classes specialty (interaction terms), represent differences of the coefficients from the base class, which can be established by taking the algebraic sum of regression coefficients for that class and regression coefficients of the base class.

In Table 3, equation 4, the interaction terms are entered into the regression, in addition to the professional specialty and performance variables of equation 3. When the results of equation 4 are compared to 3, the following aspects are of interest: the explanatory power is enhanced, all variables included in equation 4 explained 43 percent of price variation as compared to 41 percent of those in equation 3.

The first group of interaction terms are those between specialty and assignment rate. The coefficients are positive except for SUR_ASS. The percentage assignment for GP, the base group, is positive (.0019) and statistically significant. The interactions between the rate of assignment and the remaining specialties are not significant. The low significance levels can be explained by the fact that the introduction of the interaction variables results in significant multicollinearity.[23]

The second group, the interaction between medical specialties and services per patient, has a significant effect for surgical specialties only (SUR_SPAT). The coefficients of medical and other specialties are not significant at the traditional level. For all specialties, however, services per patient are negatively related to price level.

The third group, the interaction between specialties and percentage of diagnostic services per office visit (PRCT_DIAG) is significant at 6 percent for general practitioners and insignificant for all other specialties. Except for physicians with a primary practice in surgery, all other coefficients are positive.

The last group of terms measures interactions between medical specialties and procedure mix. The coefficients are not significant for any of the specialties. The coefficients are negative for OTHR_PRO and SURG-PRO.

Upon entering the interaction terms, the magnitude of the regression coefficients of other explanatory variables changes as compared to equation 3, where only professional status and performance variables were considered. The changes are rather small,however, except for surgical specialties (SURG and SURGB) and "other" specialties (OTHR and OTHRB). The sign changes for OTHRB and PROC_KT, both being negative in equation 3. The same variables remain significant after entering the interaction terms. The degree of significance is diminished to some extent but the same variables are still significant at 5 percent except SER_PPAT (at 10 percent). The significance of the intercept is reduced, which again may suggest that the interaction terms are capturing some additional dimension of price variation among physicians. Another aspect is that the standard errors do not increase in equation 4 as compared to equation 3. In order to reduce collinearity and raise significance, equations 5, 6 and 7 were run,in which interaction terms were entered separately or in different combinations. If these interaction coefficients are not changed significantly as compared to equation 4 (where all interaction terms are entered), we may conclude that omission of one set does not bias our estimates.

Looking at other regression coefficients, the introduction of interaction terms does not bias the specialty characteristics variables. The same ones are individually statistically significant and the direction does not change.

The significance of performance variables, however, is decreased when interaction terms are introduced. For example, SER_PPAT regains its significance when the interaction with specialties and SER_PPAT is omitted.

For PRCT_DIAG, in equation 5 when the interaction terms for specialty and PRCT_DIAG are omitted, the level of significance is increased almost at the same level as in equation 3 where none of the interaction terms were entered. In equation 6 the interaction terms for PRCT_DIAG were entered again, while those for SER_PPAT were omitted; PRCT_DIAG still remains significant at 5 percent (t-ratio drops from 4.7 to 2.19).

When comparing the interaction terms in equations 4 - 7, we may conclude that in general the coefficients are stable and maintain their signs. When comparing the specialty variables across all the equations (1-7), the same ones are significant. The sign changes, however, only for OTHRB (board certified physicians practicing "other" specialties); it becomes positive in equations 4, 6 and 7 when the interaction terms are entered.

The performance variables PRCT_ASS, PRCT_DIAG and SER_PPAT are stable and play a significant role in price variations of routine follow-up visits. As expected the impact varies among specialties.

B. Regression Results for Comprehensive Office Visits

Table 4 shows the results of ordinary least square estimates of hedonic price functions for comprehensive office visits in semilog form (referred to as LNPRICE19). The same approach as for follow-up office visits was applied. Table 4 presents parameter estimates of the price-equation regressions. The seven equations presented explain between 16 and 42 percent of the variance in fees. When the adjustment for the number of explanatory variables is taken into consideration the coefficients of multiple determination ($\bar{R}^2$) vary between 13 and 31.

The interpretation of results by type of variables used as explanatory are the following:

TABLE 4
Ordinary Least Squares Estimates of Hedonic Price Function:
Dependent Variable LNPRICE 19

Variable	Equation (1) Reg. Coeff.	Equation (1) t-ratio	Equation (2) Reg. Coeff.	Equation (2) t-ratio	Equation (3) Reg. Coeff.	Equation (3) t-ratio	Equation (4) Reg. Coeff.	Equation (4) t-ratio	Equation (5) Reg. Coeff.	Equation (5) t-ratio	Equation (6) Reg. Coeff.	Equation (6) t-ratio	Equation (7) Reg. Coeff.	Equation (7) t-ratio
R^2	0.1613		0.2854		0.2866		0.4215		0.3045		0.3823		0.2877	
$\bar{R}^2$	0.1293		0.2287		0.2239		0.3038		0.205		0.2758		0.2060	
F	4.168		4.503		4.118		3.369		2.846		3.360		3.231	
INTERCEPT	3.0354	32.3727	2.6564	16.4331	2.6554	16.3725	2.9709	8.3233	2.7702	8.1471	2.8176	9.5198	2.6712	13.7925
MED	0.5032	4.4997	0.5067	4.6557	0.4930	4.3475	0.3817	1.0464	0.4671	1.13.27	0.5032	1.7710	0.4495	2.9000
SURG	0.4643	4.2601	0.5356	4.1926	0.5268	4.0632	0.2323	0.6521	0.3256	0.9515	0.3874	1.3663	0.5065	2.9195
OTHR	0.6535	1.8263	0.7922	2.3372	0.7687	2.2342	-8.7503	-1.9601	0.7707	1.5998	2.7429	2.4555	-0.7530	1.8711
MEDB	0.0046	0.0476	0.0628	0.6741	0.0688	0.7286	0.0522	0.5677	0.0670	0.6847	0.0570	0.6093	0.0751	0.7690
SURGB	-0.0781	-0.9499	-0.0608	- 0.7771	-0.0600	-0.7635	-0.0603	-0.7950	-0.0716	-0.8893	-0.0556	-0.7239	-0.0605	-0.7564
OTHRB	-0.1449	-0.3912	-0.2981	- 0.8250	-0.2770	-0.7578	1.0276	1.500	-0.4114	-1.0463	1.3658	1.9898	-0.2769	-0.7369
OFFICE_H			0.0667	0.6101	0.0819	0.7131	-0.0274	-0.2286	0.0917	0.7377	0.0220	0.1825	0.0907	0.7462
PROC_KT			0.0029	1.4189	0.0027	1.2985	0.0050	0.4703	0.0012	0.5159	0.0034	0.3334	0.0025	1.1318
SER_PPAT			0.0128	1.2435	0.0111	1.0067	-0.0009	-0.0286	0.0056	0.1862	0.0129	0.9199	0.0119	0.9491
PRCT_DIAG					0.0002	0.4481	-0.0035	-1.0091	0.0001	0.3356	-0.0030	-0.8830	0.0002	0.04802
REVENUE			-0.0337	-0.4328	-0.0349	-0.4462	-0.0573	-0.7317	-0.0102	-0.1244	-0.0671	-0.8667	-0.0309	- 0.3852
PRCT_ASS			0.0036	3.9659	0.0036	3.9755	0.0032	1.2200	0.0026	1.0137	0.0031	1.1768	0.0028	1.1157
MED_ASS							0.0003	0.1140	0.0011	0.3630	0.0004	0.1421	0.0013	0.4179
SUR_ASS							-0.0001	-0.0255	0.0008	0.2671	0.0002	0.0821	0.0008	0.2819
OTH_ASS							0.1555	1.8969	-0.0045	-0.5635	-0.0534	-2.5697	0.0005	0.0869
MED_DIAG							0.0032	0.9204			0.0027	0.8094		
SUR_DIAG							0.0043	1.2066			0.0039	1.1252		
OTH_DIAG							-0.0353	-1.1700			0.0362	2.8225		
MED_SPAT							0.0171	0.4959	-0.0024	-0.0703				
SUR_SPAT							-0.5392	-2.5344	0.0553	1.0615				
OTH_SPAT							0.0420	0.7889	0.0330	0.7977				
MED_PRO							-0.022	-0.2002			-0.0038	-0.3546		
SUR_PRO							-0.0054	-0.4863			-0.0001	-0.0098		
OTH_PRO							0.5891	1.8003			-0.2305	-2.3171		

N = 137

. Professional status variables

In equation 1 professional status variables are the only explanatory variables used. All variables together explained 16 percent of the variation in prices. It was found that physicians with primary practice in medical, surgical and "other" specialties charge higher prices relative to general practitioners. The highest percentage difference (65 percent) was found for "other"specialties, which was significant at 6 percent level. The percentage difference for prices charged by internists was 50 percent, while for surgeons the percentage difference was 46 percent,both being highly significant.

The analysis of the effect of board certification in a specialty on the percentage difference in price shows that the differences between prices charged by board certified specialists and their non-board counterparts were not significant. The coefficient signs are the same as those found when follow-up office visits were analyzed; that is, the coefficient was positive for board certified internists (MEDB) and negative for surgeons (SURGB) and "other" specialists (OTHRB).

. Performance variables

In equations 2 and 3 the introduction of performance variables enhanced the explanatory power of variables from 16 percent (equation 1) to 29 percent (equation 3). The entrance of performance variables reduced the significance of the intercept term from a t-value of 32.4 in equation 1, to 16.4 in equation 3. The coefficients of the professional status variables are not biased when the performance variables are added. The same ones are significant and maintain their signs of influence. All those facts confirm the argument that performance variables provide an additional explanation of price variation among physicians.

The rate of assignment (PRCT-ASS) has a positive and statistically significant coefficient at the conventional level. The rest of the performance variables were not significant. The coefficients are positive except for the REVENUE variable, which has the expected negative sign, as was found in the case of follow-up office visits. The services per patient (SER_PPAT) variable has a positive effect on fees for comprehensive visits and a negative coefficient in the case of follow-up office visits.

. Interaction terms

In equation 4 the interaction terms between medical specialties and performance variables are entered. The explanatory power of the variables is enhanced to 42 percent. As in the case of follow-up office visits (in equation 4) the only significant interaction variable was that between services per patient and surgical specialties (SUR_SPAT). However, the inclusion of interaction terms biased some of the coefficients. For example, the coefficients of professional status variables SURG and MED lose their significance, while OTHRB becomes positive (in equation 4). It seems that the introduction of the interaction variables results in some multicollinearity. In order to reduce the collinearity and raise the significance, equations 5, 6 and 7 were run, in which the interaction terms were entered separately or in combinations. In equation 7, where only the interaction terms with percentage assignment were included, the coefficients of MED and SURG regained their significance and OTHRB regained its sign of influence.

4. An Analysis of Physicians' Pricing Behavior by Specialty Type

In this section the hedonic price functions for follow-up and comprehensive office visits is presented separately for general practitioners, internists, surgeons and "other" specialists. In previous sections, the hedonic price functions for the two kinds of office visits were run by aggregating the data over all physician specialty types.

Of special concern was the determination of the effect of performance variables on price variations among physicians. To capture the effect of specialty type on performance variables, the interaction terms between medical specialty and performance variables were created. Three of the performance variables were found significant at the conventional level (services per patient, diagnostic services per office visit and rate of assignment) in the case of follow-up office visits. Only one variable (rate of assignment) was significant in the case of comprehensive office visits. The rest of the performance variables, although not significant, had the expected sign of influence (see equation3 in Tables 3 and 4). When interaction variables were entered into the regressions (equation 4 of Tables 3 and 4), only one, SUR_SPAT, interaction between surgical specialty and services per patient) was found significant at the 5 percent level. The other interaction terms, were found significant in equations 5 - 7 of Tables 3 and 4 when some of the terms were omitted.

As discussed previously, one possible reason for the low significance levels is that the introduction of interaction variables results in significant multicollinearity.

The present section describes the analysis done by each type of medical specialty separately in order to shed light on the effect of specialty type on the performance variables.

The reasons for undertaking a micro analysis by specialty type are:

. General practitioners and internists are more likely to provide their patients with general care services.

. Internists are more likely to use a different procedure mix.

. Surgeons provide very different services than the other specialties.

. Frequency of performance constituted another reason. Follow-up office visits were rendered by all specialties but to a greater extent by internists and general practitioners. In the case of comprehensive office visits the difference is even greater: about 81 percent of visits were rendered by surgeons and internists.

Table 5 presents ordinary least squares estimates of price functions. The regression results are as follows:

A. Follow-up office visits

The price equations explained between 7 percent and 23 percent of variations in physicians' fees. The lowest coefficient of determination was found for general practitioners and the highest was for internists and surgeons.

OFFICE_H was found to play a significant role in explaining price differences in the case of internists and surgeons. The direction of the influence, however, differs. The coefficient is negative for internists and positive for surgeons. This is plausible since office visits make up a smaller part of the surgeon's practice and revenue and are therefore less susceptible to competition from physicians providing more general care.

PROC-KT was found significant for internists only. The coefficient is of borderline significance (6 percent). The coefficients are positive for general practitioners and internists, and negative for surgeons and "other" specialists. This seems to indicate that physicians who provide general care are more likely to manipulate claims language in order to increase their revenue.

SER_PPAT was found significant for all but "other" specialties. The highest t-ratio was found for SURG followed in order by internists and general practitioners. The direction of the influence is negative for all specialties. This may suggest that those MD's who have to charge

TABLE 5

ORDINARY LEAST SQUARES ESTIMATES OF HEDONIC PRICE FUNCTIONS BY SPECIALTY TYPES

Independent variables	Dependent variable LNPRICE9				Dependent variable LNPRICE19			
	GP	MED	SURG	OTHR	GP[a]	MED	SURG	OTHR[a]
Board certified in specialty practiced	x	0.1009 (2.7473)	-0.0373 (-0.9020)	-0.0036 (-0.0176)		0.0491 (0.4940)	-0.0605 (-0.8125)	
OFFICE_H	0.0004 (0.0089)	-0.1657 (-2.6281)	0.2042 (2.9969)	0.2589 (1.2741)		-0.1570 (-0.6640)	0.0195 (0.1399)	
PROC_KT	0.0001 (0.0850)	0.0027 (1.8553)	-0.0014 (-1.1851)	-0.0098 (-1.3120)		-0.0015 (-0.3576)	0.0013 (0.4132)	
SER_PPAT	-0.0090 (-1.9861)	-0.0166 (-3.8426)	-0.0390 (-6.3653)	-0.0142 (-0.9349)		0.0234 (1.2797)	0.0470 (1.0990)	
PRCT_DIAG	0.0004 (2.0874)	0.0002 (4.3332)	-0.0002 (-0.5104)	0.0011 (1.5159)		-0.0004 (-0.9283)	0.0008 (1.0101)	
REVENUE	0.0669 (0.5575)	-0.0264 (-0.5521)	-0.0232 (-0.4230)	0.3277 (0.9060)		-0.1972 (-1.4452)	0.0174 (0.1767)	
PRCT_ASS	0.0019 (3.0051)	0.0022 (4.0156)	0.0020 (2.9221)	0.0030 (1.1141)		0.0032 (1.8468)	0.0032 (2.4536)	
CONSTANT TERM	2.6123 (55.1515)	2.9912 (43.8335)	3.0128 (43.0272)	2.9618 (11.5128)		3.4159 (12.7699)	3.1649 (22.2821)	
R^2	0.07	0.23	0.23	0.21		0.36	0.24	
N =	270	262	192	31	13	50	68	6

t-ratios in parentheses

a the number of observations is too small lower prices because of competition make up for it by increasing the number of services.

PRCT_DIAG has a significant role in explaining price differences for internists and general practitioners only. Although the magnitude of the coefficients is rather small they are highly significant and have a positive influence on price charged for an office visit.

PRCT_ASS, the acceptance of assignment, plays a significant role in explaining price differences among physicians. The coefficients are highly significant for all except "other" specialties. The direction of the influence is positive. This could mean that higher priced MD's, for example, surgical subspecialists have to have some assigned patients to complete their practice.

REVENUE was not found significant for any of the specialties as was found when the analysis was performed for all specialties together.

B. Comprehensive office visits

In the case of comprehensive office visits only the acceptance of assignment was found to play a significant role in explaining price variation among physicians. The coefficients were significant for surgeons and bordered on significance for internists (7 percent). The explanation lies in the fact that the majority of comprehensive visits were rendered by surgeons and internists. See text for more details.

Summary and conclusions

The analysis developed within a hedonic pricing framework starts by selecting the relevant characteristics which are assumed to explain price variations among physicians. The selected characteristics can be grouped into two major categories: first, those measuring the physician's professional status; and, second, those measuring the physician's performance in the Medicare market during 1976 as well as those measuring his/her attitude toward the program. The relationship between a physician's fees and the vector of selected characteristics is then examined in order to estimate both the quality-adjusted price paid by Queens Medicare patients and the average quality of those visits. Multiple regression techniques have been employed to estimate hedonic price functions for the two types of visits - follow-up and initial comprehensive ones. The above findings are summarized in Tables 6 and 7 and can be interpreted as follows:

1. Specialists charge higher prices for an office visit (follow-up and comprehensive) than general practitioners. The percentage difference in price is highly significant for all specialties.

2. Board certification in a specialty, however, does not imply higher prices across all specialties, as one would expect. Only board certified internists were able to charge higher prices for follow-up office visits than were their non-board counterparts. This can lead to the conclusion that having attained a higher credential through board certification need not lead the physician to charge higher fees. There are other other physician's decisions which may influence prices, such as: the physician's availability in both hospital and office, the number of services rendered per patient, the number of diagnostic services performed in the office, and acceptance of assignment, and his/her versatility in performing different procedures. Any one or a combination of these may affect the patient's cost of getting care as well as the physician's revenue without necessarily showing up in a higher unit price.

3. Performance variables are capturing some additional dimension of price variation among physicians. The explanatory power of variables is considerably enhanced when the performance variables are entered into

the regressions. The coefficient of determination (R^2) increases from 33 to 41 percent in the case of follow-up office visits and from 13 percent to 30 percent in the case of comprehensive office visits.

4. The explanatory power in both hedonic price functions (follow-up and comprehensive office visits) is even more enhanced when the interaction terms between performance variables and specialties are entered into the regressions.

5. Performance variables provide an additional explanation of the impact of physician efficiency on price differences. In the case of follow-up office visits, three of them - services per patient, ratio of diagnostic laboratory and x-ray services performed at physician's private office to total office visits, and acceptance of assignment - were found to be the most influential in explaining price differences. In the case of comprehensive office visits the acceptance of assignment was found to be the most influential performance variable.

6. When the hedonic price functions are derived by specialty types between 7 percent and 23 percent of the variation in physicians' fees is explained. The lowest percentage is found for general practitioners and the highest for surgeons and internists.

7. Analysis by physician's specialty type allows us to gain additional insights into the role played by performance variables in determining price variation among physicians. Five out of the six which were entered as explanatory in our hedonic price function had significant coefficients. Indeed, the degree of significance and the sign of influence varied by specialty type. When all the specialty types were considered together, only three were found to be significant (SER_PPAT, PRCT_DIAG, PRCT_ASS). When the analysis by specialty type was performed, in addition to these variables, OFFICE and PROC_KT were found significant in the case of internists and surgeons.

TABLE 6

SUMMARY OF THE REGRESSION RESULTS FOR HEDONIC PRICE FUNCTIONS

— LNPRICE9 —

	All Specialties		GP		MED		SURG		OTHR	
	Sign	Significant coefficient[a]	Sign	Significant coefficient[a]	Sign	Significant coefficient[a]	Sign	Significant coefficient[a]	Sign	Significant coefficient[a]
I. Specialty characteristics										
MED	+	*								
MEDB	+	*			+	*				
SURG	+	*								
SURGE	−						−			
OTHR	+	*								
OTHRP	−								−	
II. Performance variables										
PROC_KT	+		+		+	b	−		−	
SER_PPAT	−	*	−	c	−	*	−	*	−	
PRCT_DIAG	+	*	+	*	+	*	−		+	
OFFICE_H	+		+		−	*	+	*	+	
REVENUE	−		+		−		−		+	
PRCT_ASS	+	*	+	*	+	*	+	*	+	
III. Interaction terms										
SUR_SPAT	−	*								

[a]Significant at traditional level of 0.05

[b]Significant at 6 percent

[c]Significant at 7 percent

Source: Table 3

TABLE 7

SUMMARY OF THE REGRESSION RESULTS FOR HEDONIC PRICE FUNCTION
- LNPRICE19 -

	All Specialties		GP		MED		SURG		OTHR	
	Sign	Significant coefficient	Sign	Significant coefficient	Sign	Significant coefficient	Sign	Significant coefficient	Sign	Significant coefficient
I. Professional character variables										
MED	+	*								
MEDB	+				+					
SURG	+	*								
SURGB	-						-			
OTHR	+	*								
OTHRB	-									
II. Performance variables										
PROC-KT	+				-		+			
SER-PPAT	+				+		+			
PRCT_DIAG	+				-		+			
OFFICE_H	+				-		+			
REVENUE	-				-		+			
ASS	+	*			+	*	+	*		

*Significant at 0.05 percent

Source: Table 4

NOTES TO CHAPTER III

1. See Grossman, The Demand for Health, opus cit., p. xiii.

2. This is a weighted mean of the submitted charge and is computed by physician specialty type:

$$\text{Price} = \frac{\sum_{i=1}^{n} SC \times NUM\_SER}{\sum_{i=1}^{n} NUM\_SER}$$

where: n = number of physicians in a particular specialty
SC = submitted charge per service by physician i
NUM_SER = number of services rendered by physician i to beneficiaries in the User sample during 1976.

3. See Grossman, opus cit., p. xiii.

4. See Ohta and Griliches, "Automobile Prices Revised," opus cit., p. 326

5. See Goldman and Grossman, "The Demand for Pediatric Care," opus cit., p.1.

6. See Ohta and Griliches, opus cit., p. 327

7. See Newhouse, Joseph, and Phelps, Charles E., "Price and Income Elasticities for Medical Care Services", in The Economics of Health and Medical Care, edited by Mark Perlman, London; MacMillan, o974, p. 145 and "New Estimates of Price and Income Elasticities of Medical Care Services", in The Role of Health Insurance in the Health Services Sector, edited by Richard Rosett. New York; Neale Watson Academic Publications for the National Bureau of Economic Research, 1976, p. 262. Goldman and Grossman, "The Demand for Pediatric Care," opus cit., pp. 260-261.

8. See Goldman and Grossman, "The Demand for Pediatric Care," opus cit., 1978, pp. 276-278.

9. See Heinwald, Bruce and Sloan, A. Frank, "Determinants of Physician's Fees" in The Journal of Business, Vol. 47, No. 4, 1974, pp. 500-501.

10. $$SER\_PPAT = \frac{\sum_{i=1}^{n} \sum_{j=1}^{R} NUM\_SER \times Patients}{\sum_{i=1}^{n} Patients}$$

where: n = number of patients seen by physician i
NUM_SER = number of services rendered by physician i
Patients = patients j seen by physician i

11. For example, note: the following procedures, number of patients undergoing them, and the submitted charge in dollars:

GHI Code	Procedure Definition	Number of Patients	Submitted Charge
883	Fracture, Femur, hip or shaft (open)	3	$3,625
1149	Hip - complete arthroplasty by Charnley procedure, or McKee-Tarrar procedure	1	2,500
1150	Arthroplasty hip	2	3,120
2335	Insertion pacemaker (permanent)	2	2,520
3178	Large bowel resection	3	3,200
3495	Gall bladder surgery with choledochostomy	3	2,693
3631	Hermioplasty	5	2,610
3709	Repair of diaphragmatic hernia	1	1,000
4316	Prostatectomy, supra pubic, one or two stages	4	3,450
4221	Transurethral electroresection of prostate and vesicle neck including control of post-operative bleeding	5	4,850

12. See Steinwald, Bruce, and Sloan, A. Frank. "Determinants of Physician's Fees", opus cit.. p. 506.

13. See Muller, F, Charlotte and Otelsberg, Jonah, Study of Physician Reimbursement under Medicare and Medicaid, Final Report to Health Care Financing Administration pursuant to contract, No. 600-76-0145, December 29, 1978, pp.12 - 3 12 - 9.

14. Explanation adapted from HIBAC Report, The Effect of the Medicare Method of Reimbursement on Physicians' Fees and on Beneficiaries' Utilization, Robert R. Nathan Associates, (April 1973).

15. Ohta and Griliches, "Reply to Yoram Barzel's Comments on 'Automobile Prices Revised: Extensions of Hedonic Bypothesis'," in Household Production and Consumption, opus cit., p. 368.

16. A private office visit is defined as a service rendered by a physician in private practice, to an independent individual seeking personal health services, who is neither bedridden nor currently admitted to any health care institution on the premises, the place of service being the physician's office identified as location for his/her ambulatory practice. The definition is used by the Department of Health, Education and Welfare in their vital and health statistics.

17. 9000 and 9019 are GHI procedure codes used in pricing and paying Medicare claims.

18. Therefore, in the case of acceptance of assignment, beneficiary out-of-pocket expenditures are: the deductible ($60) and 20 percent of the allowed charge for all services purchased thereafter. In the

case of non-acceptance of assignment, along with the above the patient is more likely to pay the difference between the allowed and the submitted charge for all services received. In both cases, however, there are so-called "fixed costs" which are not reimbursed at all by the program, yet, nonetheless, increase the shadow price of medical care.

19. The usual source of care was used as a unit of observation by Goldman and Grossman in their study, "The Demand for Pediatric Care: an Hedonic Approach", opus cit. The regression coefficients obtained were almost identical to the ones obtained with physician used as a unit of observation, each observation being weighted by the square root of the number of patients who saw a given physician.

20. There were 2,294 physician providers in Queens who had one or more Medicare claims; for more details see Muller and Otelsberg, opus cit., p. 12 - 4.

21. The dependent variable LNPRICE is in logarithm form; thus, a unit change in the independent variable should be interpreted as affecting a percentage change in LNPRICE9, or LNPRICE19, respectively.

22. The PRCT_DIAG was entered separately to test two aspects: First, that a doctor's ability to provide different services complementary to visits is viewed by the patient as quality of care which can be obtained. Second, this performance variable was derived from the sample under study and not from the entire population.

23. For more details see the detection of multicollinearity in Appendix B and Table B.1.

CHAPTER IV

DEMAND FUNCTION

The purpose of the empirical work of the last chapter was to develop a hedonic fee function which provides estimates of the quality and quality-adjusted prices paid by Queens Medicare patients for office visits. In the present chapter, the resulting hedonic "indexes" are used in the estimation of demand curves for visits and separately for quality of care.

In the first section of this chapter, the computation of quality per visit and quality-adjusted price for office visits is discussed within a hedonic price index framework. In the second section, the empirical framework is described, followed by the estimation techniques, the measurement of the variables employed in the demand equations, and their expected sign. In the third section, the empirical results for the two kinds of office visits (follow-up and comprehensive) are presented. The discussion of the results focuses on the effect of the 11 independent variables on the five dependent variables: VISIT9, VISIT19, QUAL9, QUAL19, and CARE. The responsiveness of the quantity (visits) and quality per visit demanded to changes in net price is also discussed in detail. Then the effects of the deductible and of acceptance of assignment on price elasticities for visits and for quality per visit are discussed. In the fourth section, separate demand curves are estimated by type of specialty (general practitioners, internists and surgeons). In the final section a summary and conclusion are presented.

From Hedonic Indexes to Quality

The concept of quality that underlines the hedonic method is that "quality itself is not a measurable concept, in the sense of obtaining a scalar, non-monetary indicator" (Triplett, 1975).[1] The hedonic view provides a "characteristic approach" to consumer behavior and to the interpretation and measurement of "quality". Further, he shows that under the "hedonic view" the word "quality" refers to several quantities in a vector of characteristics. Therefore, quality cannot be measured as such because it is not possible to combine directly the various elements of the characteristics vector.

The hedonic approach provides an implicit price for each of the characteristics. Then, one can obtain a measure of the value of the vector by valuing the quantity of each characteristic by its implicit price and combining the results. The simplest way of doing so is to add them up.

Goldman and Grossman (1976) applied the hedonic approach in a study of determinants of the demand for pediatric care. Differences in characteristics among physicians are assumed by them to reflect differences in quality or productivity. Therefore, by examining the relationship between fees and these characteristics, one can estimate the quality of care received by each patient in the sample and the "true" (quality-adjusted) price paid by them. The strategy of fitting separate demand curves for quality and visits was applied for the first time by Goldman and Grossman, (1976) in pediatric care. Their findings suggest that there are significant variations in parameters between the two demand curves and therefore it is crucial to obtain separate estimates for quality and quantity (visits).[2]

In the present study, their model is extended to the Medicare market. In determining the relevant characteristics our analysis focuses on differences in performance among physicians and in their attitude toward the Medicare program. Performance variables have not been used before as explanatory variables in price functions. In this study, the performance variables are assumed to measure variations in productivity, or in the quality of medical services.

Results of the previous chapter show that there are significant differences among physicians who provided services to Medicare patients. They differ in their professional characteristics, their performance and their attitude toward the Medicare program. Prices charged by specialists in general are higher than those charged by general practitioners. It was found that performance variables such as SER_PPAT, PRCT_DIAG and PRCT_ASS play an important role in explaining price variation among different types of doctors' specialties.

The analysis was developed within a hedonic pricing framework; that is, following the hedonic hypothesis it was assumed that the characteristics and performance variables are "packaged" into the physician service "office visit" before they are sold. Those characteristics and performances are identified by consumers and according to their needs and perceptions different valuations are attached to them. Therefore we disaggregate "the package" of physicians' services into its component parts which are directly observable by the patient to explain price differences among physicians.

That is, the quality function can be expressed as:

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

where: q_i = index of quality for the i^{th} physician in the sample,

X_i = a vector of identifiable characteristics and performance of the i^{th} physician in the sample.

The hedonic approach was used as an econometric tool which was helpful in detection of the relevant characteristics and then in estimating their market valuation. The statistical analysis was designed:

. first, to determine which of those characteristics and performance variables are relevant to explaining the differences in prices for the commodity under study (office visit).

- second, to estimate implicit prices for those characteristics.
- third, to use the implicit prices to estimate quality and quality-adjusted price for office visits.

Econometrically implicit prices are estimated by the first step regression analysis. Product price is regressed on characteristics (Rosen, 1974).[3] Therefore one can express the hedonic price function by a regression of the form:

$$p = f(X) \tag{2}$$

where: p = a vector of observed prices of different versions of a commodity (office visit) rendered by MD's of four different specialty types and with differences in performance and attitudes toward the Medicare program.

X = a vector of physician characteristics and performance variables.

Then, quality-adjusted price $\hat{p}$ is defined as:

$$\hat{p} = p/q \tag{3}$$

Taking logs and rearranging the terms, one derives:

$$Lnp = Lnq + Ln\hat{p} \tag{4}$$

According to the above, quality of care received by Medicare patients can be expressed as a linear function of physicians' characteristics and performance variables:

$$Lnq = \alpha X \tag{5}$$

Substituting (5) into (4) yields

$$Lnp = \alpha X + Ln\hat{p} \tag{6}$$

The explanatory variables which entered into the hedonic price function of chapter III (2) are identical with elements of the X vector defined as affecting physician productivity and, therefore, differences in prices charged by them.

If equation 6 is estimated by an ordinary least squares regression, the natural logarithm of quality can be computed as:

$$\text{Lnq} = \alpha' X \tag{7}$$

while the quality adjusted price is:

$$\text{Ln}\hat{p} = u \tag{8}$$

where: $\alpha' X$ is the predicted price of the hedonic price function, and $\text{Ln}\hat{p} = u$, is the disturbance term of the regression.

The empirical framework and the measurement of variables

The data available for the present study (Medicare claims) provide information on: a) place of service; b) different types of services; c) the submitted charge for a service; d) the amount reimbursed to the patient when assignment is not accepted by the physician; e) the amount paid to the physician when he or she accepts assignment; and f) certain physician and patient characteristics.

This information was used to construct measures of quality per visit and quality-adjusted prices, which were used to estimate the demand for visits and quality as discussed in the previous section. The estimated hedonic price functions for routine office visits (LNPRICE9) and comprehensive office visits (LNPRICE19), are shown in Tables 3 and 4 (chapter III).

The regression function of equation 4 of Table 3 for example, can be expressed as:

$$\text{LNPRICE9} = \alpha_o + \sum_{i=1}^{24} \alpha_i X_1 \tag{9}$$

where: α_i = regression coefficients of characteristics and performance variables,

X_i = one of the 24 explanatory variables in equation 2 of chapter III.

As mentioned above, the estimated regression coefficients are interpreted as implicit prices for characteristics and performance variables and are employed to compute the logarithm of quality (QUAL9 or QUAL19) and quality-adjusted price (ADJP9 or ADJP19) as:

$$\text{LNADJP9} = \alpha_0 + u \qquad (10)$$

$$\text{LNQUAL9} = \sum_{i=1}^{24} \alpha_i X_i \qquad (11)$$

In equation 10, u is the residual associated with a given observation (physician) and is obtained after regressing the observed prices (submitted charges) on the explanatory variables of the hedonic price function (equation 4, Tables 3 and 4, chapter III).

α_0 = the constant term of equation 4 (as expressed in 9); that is, quality-adjusted price has the same units as the observed price.

In equation 11, QUAL is obtained by summing up the regression coefficients (implicit prices) of characteristics and performance variables from the hedonic price function of equation 2, chapter III: i.e., quality is the predicted price of equation 4 (Tables 3 and 4, chapter III), when the intercept is restricted to 0. This is consistent with the view that quality is a unit free index.

. If a patient saw only one physician, quality (LGQUAL) and quality-adjusted price (LGADJP) are obtained directly from the hedonic price function as above (10,11).

. If a patient saw more than one physician during the year then:

a) quality per visit (LGQUAL9 or LGQUALk9) is computed as a weighted average of the quality of each doctor. The weights are the percentage of visits to that physician. Equation 11 takes the form of:

$$LGQUAL9 = \sum_{i=1}^{n} QUAL9.K_i \qquad (12)$$

where: $$K_i = \frac{(VISIT9_i)}{\sum_{i=1}^{n} (VISIT9_i)} \qquad (13)$$

where: K_i = the weighted average,

n = number of different doctors seen by a patient for office visits,

i = the i^{th} physician in the sample.

QUAL9 = the predicted price obtained from the hedonic fee function when the regression constant is restricted to 0 (equation 11).

VISIT9 = annual number of routine follow-up visits to the i^{th} doctor in the sample.

b) quality-adjusted price (LGADJP9 and LGADJP19) equation 10 takes the form of:

$$LGADJP9 = \sum_{i=1}^{n} ADJP9_i.K_i \qquad (14)$$

that is, quality-adjusted price (ADJP9) obtained from the hedonic fee function (see equation 10) is weighted by the percentage of quality of visit to that physician.

$$K_i = \frac{(QUAL9)(VISIT9_i)}{\sum_{i=1}^{n} (QUAL9_i)(VISIT9_i)} \qquad (15)$$

Again the weights are intended to represent the relative importance assigned to each physician in the sample.

The above measures of quality per visit and quality-adjusted price are used in the subsequent section to estimate the demand curves for visits and quality. Expressed as linear equations, they take the following forms:

$$\text{Visit} = a_0 + a_1\hat{p} + a_2 f + a_3 OTH + a_4 CH \quad (16)$$

$$\text{Quality} = b_0 + b_1\hat{p} + b_2 f + b_3 OTH + a_4 CH \quad (17)$$

The parameters are estimated by ordinary least squares

where: $\hat{p}$ = the quality adjusted price,

q = average quality per visit.

f = fixed cost,

OTH = the other doctors' contacts, and

CH = patient characteristics

that is, p, the quality-adjusted price, LGADJP, is obtained from equation 14, and q, the average quality per visit (LGQUAL) is obtained from equation 12. The LGADJP, however, can be viewed as a gross quality-adjusted price. Following Newhouse and Phelps(1974,1976), and Ann D. Colle and Grossman (1978),[4] the relevant price in the demand function is the quality-adjusted net price.

The next step is to estimate the net price paid by Medicare patients, that is, to consider the coinsurance rate.

Under the Medicare program there is a uniform rate of coinsurance. Medicare reimburses 20 percent of the allowed charge for each additional service after the $60 deductible is met.

The NETP; that is, the quality-adjusted price (net of insurance) is the relevant price to be entered in the regressions and is computed in three ways as follows:

1. Before the deductible is met:

$$\text{NETP} = \text{LGADJP} \quad (18)$$

The net price equals the quality-adjusted price estimated from equation 14 for all services rendered to a patient until the deductible is met.

2. <u>After the deductible is met</u>:

$$NETP = LGADJP \times .20 \qquad (19)$$

The net price equals the quality-adjusted price estimated according to equation 14 times the 20 percent coinsurance rate, for all visits rendered to a patient after the deductible was met.

3. <u>Medicaid recipients</u>:

$$NETP = 0 \qquad (20)$$

If a patient is also under Medicaid the net price is 0. The deductible and the coinsurance are paid by the State, if the patient is a "state buy-in".

The data available do not identify the reimbursable services not applied to meeting the deductible. As mentioned previously, a patient under Medicare pays 20 percent of the allowed charge while the remaining 80 percent is paid by Medicare. Medicare reimburses the patient if assignment was not accepted by the physician for a particular service. If the physician accepts assignment then it is the physician who is reimbursed by Medicare. In order to analyze the impact of insurance on utilization of Medicare services, all services were partitioned into two groups.

- The first contains all services received before the deductible was met, those for which the amount paid to the beneficiary or to the physician equals zero. In this case the net price (NETP) was established as shown in equation 18.

- The second contains all services received after the deductible is met, those for which the reimbursement is a positive amount. The net price in this case is established as indicated in equation 19.

As mentioned previously the NETP equals zero for those patients who are also under Medicaid whether or not the deductible is met (equation 20).

As in the case of hedonic price functions, demand curves were restricted to beneficiaries who had positive office visits to a physician in private practice. This was defined as including at least one routine follow-up office visit (VISIT9) and/or one comprehensive office visit (VISIT19) during the year 1976:

Office visit = VISIT9 + VISIT19

Out of 1,523 "users", 1,291 patients had positive office visits. When services provided by non-MD providers were excluded only 1,263 remain. Therefore, the demand for visits and quality are estimated for: 1,224 patients who had follow-up office visits (VISIT9), and separately for 181 patients who had comprehensive office visits (VISIT19). In fact, all but 39 patients under the present study had follow-up office visits, while comprehensive visits are rendered to a smaller proportion of the aged under Medicare.

For each of the two types of office visits two separate demand functions are estimated: one for quantity (VISIT9) and (VISIT19) measured in terms of annual number of visits, and another for quality (QUAL9) and (QUAL19).

As was mentioned previously, the argument stands if visits and quality are separate variables in the production function of an individual's health (Goldman and Grossman, 1976, 1978).[5]

The present study aims to analyze the accessibility and quality of services rendered to Medicare patients. Medical care rendered by physicians in the private office is the object of this study.[6]

Table 4 of Chapter II reports the distribution of Queens Medicare patients with office visits by place of service. The data show that

16.7 percent of those with office visits were hospitalized; 9.1 percent had home visits, while 8.9 percent received services in independent laboratories. A small percentage was in extended care facilities (1.2 percent) or had out-patient services at hospitals (1.0 percent). A linear specification of demand functions is given by:

$$\begin{aligned} \text{VISIT} = \; & b_0 + b_1\text{NETP} + b_2\text{MEDICAID} + b_3\text{AGED2} \\ & + b_4\text{AGED3} + b_5\text{MALE} + b_6\text{WAGE} + b_7\text{HOME} \\ & + b_8\text{HOSP} + b_9\text{ECF} + b_{10}\text{H\_PROB} + b_{11}\text{SERVIS} \end{aligned} \tag{21}$$

TABLE 1

DEFINITION OF VARIABLES IN DEMAND FUNCTIONS

Variable	Definition
I. Dependent variables[a]	
1. VISIT9	Annual number of follow-up office visits to physicians in private practice
2. VISIT19	Annual number of comprehensive office visits to physicians in private practice
3. QUAL9	Average quality of a follow-up visit to physicians in private practice
4. QUAL19	Average quality of a comprehensive visit to physicians in private practice
5. CARE	Number of months during which a patient had any physician contacts
II. Independent variables	
1. LGADJP9[c]	Gross quality-adjusted price of a follow-up visit to a physician in private practice
2. LGADJP19[c]	Gross quality-adjusted price of a comprehensive office visit to a physician in private practice
3. NETP9	Net quality-adjusted price of a follow-up visit to a physician in private practice:
	If deductible has been met
	a. NETP9 = LGADJP9 x coinsurance rate
	If deductible has not been met
	b. NETP9 = LGADJP9
	If Medicaid recipient
	c. NETP9 = 0

Variable	Definition
II. Independent variables (continued)	
4. NETP19	Net quality-adjusted price of a comprehensive office visit to a physician in private practice: defined as NETP9, above
5. MEDICAID	= 1 if Medicaid patient
6. AGED2[b]	= 1 if patient's age is 75-84
7. AGED3[b]	= 1 if patient's age is 85+
8. MALE	= 1 if patient is male
9. WAGE	= 1 if patient's eligibility identified as wage earner
10. HOME	Annual number of visits by private physician to a patient's home
11. HOSP	= 1 if patient was hospitalized during the year
12. ECF	= 1 if patient was in an extended care facility during the year
13. H_PROB	= 1 if a patient had surgery performed in the physician's private office
14. SERVIS9	Ratio of the number of diagnostic services rendered in the physician's private office to the total routine follow-up office visits to that patient
15. SERVIS19	Ratio of the number of diagnostic services rendered in the physician's private office to the total initial comprehensive office visits to that patient
16. PR459	The monetary value of SERVIS9 variable is the ratio of total expenditures on diagnostic services rendered in the physician's private office to the total expenditures on follow-up office visits to that patient. Where the total expenditures are the sum of submitted charges (net of insurance).

Variable	Definition
II. Independent variables (continued)	
17. PRCT_ASN[c]	The proportion of services for which assignment was accepted
18. LNNETP9[c] LNNETP19	Log of net quality-adjusted price of a follow-up office visit and of a comprehensive office visit, respectively. Used for computation of price elasticities
19. PRAG2 PRAG3	Interactions between price elasticities of demand for visits and quality and patient age group: <u>For follow-up office visits</u> PR9AG2 = LNNETP9 x AGED2 PR9AG3 = LNNETP9 x AGED3 <u>For comprehensive office visits</u> PR19AG2 = LNNETP19 x AGED2 PR19AG3 = LNNETP19 x AGED3
20. PRSURG PRHOSP PRECF	Interactions between price elasticities of demand for visit and quality and different health problems experienced by the patient: <u>If follow-up office visits</u> PR9SURG = LNNETP9 x H_PROB PR9HOSP = LNNETP9 x HOSP PR9ECF = LNNETP9 x ECF <u>If comprehensive office visits</u> PR19SURG = LNNETP19 x H_PROB PR19HOSP = LNNETP19 x HOSP PR19ECF = LNNETP19 x ECF

Variable	Definition
II. Independent variables (continued)	
21. PRMALE	Interactions between price elasticities of demand for visits and quality and sex: <u>For follow-up office visits</u> PR9MALE = LNNETP9 x MALE <u>For comprehensive office visits</u> PR19MALE = LNNETP19 x MALE
22. PRWAGE	Interaction between price elasticities of demand for visits and quality and patient eligibility as wage earner: <u>For follow-up office visits</u> PR9WAGE = LNNETP9 x WAGE <u>For comprehensive office visits</u> PR19WAGE = LNNETP19 x WAGE

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a See text for more detailed definitions

b The base class is 65-74

c Intermediate variable

TABLE 2

MEANS AND STANDARD DEVIATIONS OF VARIABLES IN DEMAND FUNCTION

VARIABLE	MEAN	STANDARD DEVIATION
VISIT9	5.708	5.883
VISIT19	1.127	0.381
QUAL9	2.751	0.516
QUAL19	3.433	0.345
CARE	5.286	3.516
NETP9	1.176	0.860
NETP19	1.161	0.574
MEDICAID	0.067	x
AGE	73.952	6.354
AGED2	0.352	x
AGED3	0.063	x
MALE	0.354	x
WAGE	0.717	x
HOME	0.302	2.096
HOSP	0.169	x
ECF	0.011	x
H_PROB	0.141	x
SERVIS9	0.687	1.225
SERVIS19	0.339	1.345

N = 1263

[x]Dummy variables

Definition of the variables which enter the demand curves are provided in Table 1 and their summary statistics are reported in Table 2. The dependent variables are VISITS, QUAL and CARE. Separate demand curves are estimated for routine follow-up office visits (VISIT9, QUAL9) and for comprehensive office visits (VISIT19, QUAL19).

The dependent variables, VISIT and QUAL, were discussed in the previous section, as well as the measurement and computation of the quality-adjusted price. The dependent variable CARE and the remaining explanatory variables are discussed in the subsequent section.

. CARE, a numerical variable, refers to the number of months during which a Medicare patient, falling under our study, had at least one "physician contact". "Physician contact" is defined as having had at least one claim during a certain month, regardless of the type or place of service. Used as a dependent variable, CARE allows us to gain some additional insight with regard to: a) an individual's health status; b) patient access to care (number of months that a patient under Medicare can afford physician care). Therefore, the CARE variable is expected to be directly related to the quantity and inversely to the quality of office visits demanded. The frequency distribution of patients by number of months under care is presented in Table A.15. It shows that 16.6 percent of all patients with positive office visits had "physician contact" for only one month; another 14.1 percent for two months; and another 8-9 percent are added for each additional month up to five months. Thereafter the percentage of patients decreases (between 4.9 and 6.5 percent) as the number of months increases. Only 6.3 percent of all patients received care in each of the 12 months of the year. The median of the distribution of patients by number of months is 5 months. The results should be interpreted with caution, however.

The variable CARE is not a perfect measure of individual health status or access to care. A patient might have had fewer than 12 months of "physician contact". If, for instance, he moved out of the area, or died during the year; or if the physician himself decided that a certain interval between medical services was acceptable.

Equation 21 illustrates the linear specification for the demand for VISIT in its general form. The same explanatory variables are used when the dependent variables are QUAL, or CARE.

The explanatory variables which are entered into demand equations can be classified as follows:

1. Those related to the price of office visits, quality-adjusted price: the net price (NETP), and the price paid by Medicaid recipients (MEDICAID).

2. Those measuring physician contacts other than office visits (HOME, HOSP, ECF).

3. Those measuring the effects of other services received in the physician's office on quantity and quality per visit demanded (H_PROB, SERVIS9 and SERVIS19).

4. Patient characteristics (AGE, SEX, WAGE).

5. Cost of obtaining medical care - "indirect costs" and "fixed costs".

The role and measurement of the independent variables influencing demand is discussed next.

1. The Net Price and Medicaid Variables

From the first group of explanatory variables the NETP was discussed in the previous section.

. MEDICAID, a proxy for an individual's welfare status, can be regarded as an individual's permanent income. The variable is employed in dummy form and takes the value of 1 if the aged patient is under Medicaid. The use of this variable allows grouping of individuals under the study into two income classes; a lower level of income being represented by the patients with Medicaid, and a higher income class including the rest of the patients who are only under Medicare. The expected sign cannot be predicted a priori for the following reasons: first, according to literature and previous research (Grossman,1972; Linda Edwards and Grossman, 1977),[7] a poorer individual is expected to have a lower state of health based on past living patterns so a positive correlation with number of visits is expected; a poorer individual is expected to have a lower state of health because his education level is also usually lower, resulting in less efficiency in the production of health (Grossman, 1972).[8] Therefore, considering those aspects a direct relationship with VISITS is expected; second, the increase in the cost of obtaining care may discourage the utilization of medical services. As mentioned previously, the Medicare program offers a uniform program in the sense that it provides the same set of benefits to all beneficiaries. However, for the elderly who are also under Medicaid, the deductible and coinsurance are paid by the State. Under those circumstances the costs of obtaining medical care such as transportation cost, travel time, and waiting time (which are not reimbursable) may replace money prices as the chief determinant of demand. Because these are a greater percent of total price, it is expected that changes in price of obtaining medical care will have a greater effect on demand for free medical services than on demand for non-free services (Acton, 1975).[9]

This has another implication, however. An increase in the cost of obtaining medical services relative to the money price will lead to the substitution of quality for visits. Therefore a positive effect of MEDICAID on demand for quality can be predicted. To what extent a Medicare patient can use the services of a more qualified specialist is still an open question - it depends on physician willingness to accept a Medicaid patient.

2. The Explanatory Variables Designed to Measure Physician Contact Other than Office Visits

. HOME, measures the annual number of home visits. Physician visits to the home or to nursing homes can be viewed as substitutes for private office visits, but they may also be complements under certain circumstances. It is expected that as an individual grows older the number of office visits decreases in favor of home visits.[10] An office visit can be used as a complement to a home visit if certain tests are necessary. The net effect is still an empirical question and will be discussed in the subsequent section where the regression results are presented. Therefore, the effect on quantity of office visits demanded is difficult to ascertain a priori. There are arguments which can provide a rationale for a direct relationship between the price of an office visit and the quantity of home visits demanded - if home and office visits are regarded as substitutes for each other. However, there are plausible arguments for an inverse relationship if they are viewed as complements, and this is more likely to be expected in the case of aged patients. A decrease in the price of office visits will increase both home and office visits.

. HOSP, a dummy variable, which takes the value of 1 if a patient was hospitalized during 1976, and 0 otherwise. The variable can be used as a proxy for current patient health status. If being hospitalized is an indication of depreciation of the stock of health, then an increase in quantity of medical services demanded is expected (Grossman, 1972; Phelps, 1973).[11] The direction of causality can go from more office visits to hospitalization, as well as in the inverse direction since a patient hospitalized for surgery is more likely to require follow-up care. It is also possible, however, that the hospitalization decision could have been taken at another place than the physician's office. So in this case, a direct relationship would be expected. The effect of HOSP on the demand for quality of medical services demanded is uncertain a priori.

. ECF, a dummy variable, which takes the value of 1 if a patient was in an extended care facility during the year. It is also used as a proxy for the current health status of the aged patient. An exogeneous reduction in health is expected to increase the quantity of medical care demanded (Grossman, 1972; Phelps,1973). Therefore, a direct relationship with quantity of office visits demanded can be predicted. It is hard to assess a priori whether there is any causality. This depends on the time of occurrence of this event relative to the decision to demand care in the physician's office. As in the case of HOSP, the effect of ECF on quality of care demanded cannot be predicted a priori.

3. Other Services Received in the Physician's Private Office and Their Effect on Quantity and Quality per Visit Demanded

. H_PROB, a dummy variable, which takes the value of 1 if a patient had surgery performed in the physician's office during 1976. Less serious cases can be solved in the physician's office. H_PROB is entered into the regression based on its demand creating characteristics.

The following aspects should be noted with regard to such patients: first of all they are sicker than other patients who have not had surgery in the physician's office, and are therefore expected to require more medical services both before and after surgery; and secondly, they dread hospitalization and seek to obtain a less impersonal care which is also perceived by them to be of a higher quality. As such, a direct relationship with both follow-up office visits and the quality of those visits is expected. Those who received surgery services in the physician's private office are more likely to seek private care, all other things being equal. The effect on comprehensive visits and on the quality of such visits is uncertain, however. These assumptions are in fact supported by the empirical evidence. 13.9 percent of patients with positive office visits had received surgery services in the physician's private office. The majority of those services were rendered by surgeons and internists. Out of the 341 surgery services performed in the physician's private office, 40.5 percent were diagnostic in character such as: procto-sigmoidoscopy (14.5 percent), cystoscopy (5.5 percent), proctoscopy (2.3 percent) etc.,which are now customarily done in the physician's office. The remaining 59.5 percent include: dilatation of urethral stricture (11.4 percent), intra-articular injections (9.4 percent), fractures (2.1 percent), electrocauterization of local lesion (5.8 percent), etc.

. SERVIS9 and SERVIS19, is defined as a ratio of the number of diagnostic x-rays and diagnostic laboratory services rendered in the physician's office to the total number of office visits of that patient. SERVIS9 (follow-up office visits) is entered as an explanatory variable when VISIT9 is the dependent variable, and SERVIS19 (comprehensive office visits) is entered when VISIT19 is the dependent variable.[12]

In addition to office visits, diagnostic laboratory services (e.g. blood tests, urine tests), or diagnostic x-ray services (e.g. chest x-rays), were provided in the physician's office (see Tables A.3 and A.10). The majority of those services were rendered by internists and general practitioners (for more details see chapter III). These variables are entered into regressions as explanatory because of their demand generating characteristics. Below they are used as proxies for "indirect costs".

The effect of SERVIS on the number of office visits demanded cannot be ascertained a priori. The following reasons can be mentioned: a doctor's capacity to provide patients with diagnostic services in his/her private office is expected to speed up the solution to the health problem. The patient may perceive this as "quality" of care. It provides a prompt diagnosis, reduced referrals, and reduces all additional costs involved in obtaining those services somewhere else (e.g. at an independent laboratory). Therefore, all other things being the same, a smaller number of follow-up office visits may be necessary to achieve an improvement in a patient's health. The reverse, however, can also be true: in the case of particular diseases or lower health status, more diagnostic services may be needed. Therefore, the number of visits would increase as well.

The effect of SERVIS on quality per visit is also difficult to assess a priori. As discussed earlier, this aspect may provide patients with more efficient care, therefore reducing the number of visits. However, two reasons may lead a patient to substitute quality for visits. First, a physician may aim to achieve a certain revenue target by increasing the number of ancillary services. Second, a doctor may be less experienced and therefore needs more tests to achieve a certain conclusion. Under those circumstances a trade-off between visits and quality in favor of the latter is expected.

4. The Group of Expanatory Variables Designed to Capture Patients' Characteristics

. AGE, patient's age. A positive effect on the number of visits is expected as AGE increases. If the price elasticity of demand for health is less than 1, then the quantity of medical care demanded will increase due to deterioration in the stock of health over the individual's life cycle (Grossman, 1972).[13] The effect of age on quality of visits demanded depends on individual income and the opportunity cost of time, and cannot be predicted a priori. An increase in demand for medical services may increase the fixed costs of a visit and therefore a positive effect on demand for quality and a negative effect on number of visits is expected. If depreciation rates are fully captured in health status variables, age should have no effect (Joseph Newhouse and Charles Phelps, 1975).[14] In the medical and economic literature individuals aged 65 and over are treated in general as a single group. This, however, does not take into account the significant health, psychological, social and wealth transformation which takes place in someone's life after age 75, for instance. Those changes ultimately affect the individual's health status as he/she grows older. For further discussion see Charlotte Muller, 1978.[15] For the purpose of this study, it is of particular interest to capture those effects on an individual's health stock and therefore on his/her utilization of medical services. In general, the time just after the retirement age can be viewed as an adjustment period to a new life status and the effects of past activities as well as of past health investments are stronger in the earlier age 65-74 as compared to the rest of his/her life cycle. Therefore, as an alternative, AGE will be entered as a dummy variable. The patients with positive office visits were divided into 3 groups: AGED1 = 65-74; AGED2 = 75-84; and AGED3 = 85 and over. The base group which includes those aged 65-74, is omitted from the regression.

. MALE, a dummy variable, takes a value of 1 if a patient is male, 0 otherwise. This makes it possible to compare the utilization of medical services between sexes.

The data available for this study do not provide any information about an individual's income or level of education. The important role played by these in determining the demand for health care has been recognized in the economic literature: Becker, 1965; Grossman, 1972; Karen Davis and Roger Reynolds, 1975; Goldman and Grossman, 1976; and Linda Edwards and Grossman, 1977. However, two of the variables - WAGE and MEDICAID - can be employed as proxies for educational level and welfare status. The variables are entered in dummy form and their expected sign cannot be predicted because of offsetting effects.

. WAGE takes the value of 1 if an aged patient was eligible for Medicare benefits as a wage earner. The variable can be used as a proxy for individual's income and education. As a proxy for income, it is assumed that an individual who becomes eligible for Medicare benefits as a result of his participation in the labor force is more likely to have accumulated more earning assets as compared to those who do not work. So from this point of view we may expect a positive relationship with quantity and quality of office visits demanded. As a proxy for individual education, it is assumed that an individual who was in the labor force has a greater endowment of human capital derived from a higher level of education, and experience accumulated over a lifetime. More education means more efficiency in combining medical inputs to produce health, and if the price elasticity of the demand for health is less than 1, then a negative relation between education and the amount of medical services demanded is expected, all other things being equal (Grossman, 1972).

5. The Total Cost of Obtaining Medical Care - "Indirect Costs" and "Fixed Costs"

Seeing a doctor for an office visit generates two types of additional costs which increase the total cost of a visit. The first are the so-called "indirect costs", that is, the cost of diagnostic services provided at the physician's private office in addition to the office visit per se. The variable SERVIS and its alternative monetary value PR459 were used as proxies to measure the effect of these "indirect costs" on the number of visits and the quality per visit demanded. (For more detailed discussion see group 3 in this Section and note 12). In this study it is assumed that the physician's capacity to provide diagnostic services in his private office is perceived by the patient as a sign of quality when the decision to contact a physician is first considered. However, the doctor's tendency to further increase these services will increase the total cost of each visit even as a larger number of visits is required. This factor will lead the patient to substitute quality for visits, since a more "qualified" physician is expected to provide more efficient diagnostic services. Therefore, while in the case of follow-up office visits "indirect costs" will have a negative effect on the number of visits and a positive effect of the quality of those visits, in the case of comprehensive visits a positive effect is expected.

The second are the so-called "fixed costs". It has been recognized by economists studying utilization of medical care that the fee paid by the patient represents only a portion of the total cost incurred in visiting a physician (Becker, 1965; Acton, 1975, Goldman and Grossman,1976, 1978).[16] There are other expenses incurred in obtaining medical care: they include transportation costs and time costs (time necessary to reach the physician and return home, and waiting time in the physician's office). The sum of foregone earnings per visit and the transportation cost per visit are interpreted as the "fixed cost" of a visit by Goldman and Grossman, 1976,1978). Furthermore, they show that the presence of a fixed cost component in the total cost of a unit of medical service has a very important impact on demand for medical service, as it gives rise to trade-offs between quality and visits (quantity). "Fixed cost" was entered as an explanatory variable in estimation of demand curves for pediatric office visits (see Goldman and Grossman, 1978). Their empirical investigation in a sample of New York City (pediatric patients) indicates that the "fixed cost" of a visit has a negative effect on the number of pediatric visits and a positive effect on the quality per visit. For the purpose of the present study, this aspect is of particular interest, especially concerning policy decisions. The introduction of the Medicare program reduces the dollar fee paid by a beneficiary out of his pocket, and at the same time increases the relative role of the fixed cost in demand for medical services by the elderly, the impact being even greater for beneficiaries who are also under Medicaid. The demand for medical services becomes relatively more elastic with regard to changes in the fixed cost because the fixed cost is a greater proportion of total price paid for a visit; that is, if p equals the out-of-pocket expenditures for a unit of medical services (when the deductible and coinsurance are considered), and WFC is the value of the fixed cost (transportation, time for traveling and waiting, etc.), then π is the total price per unit of medical service, the shadow price: $\pi = p + WFC$. Then the elasticity of the demand for medical services with respect to money price (p) is:

$$\eta_{mp} = \frac{p}{\pi} \eta_{m\pi}$$

and the elasticity with respect to the "fixed cost" is:

$$\eta_{mFC} = \frac{WFC}{\pi} \eta_{m\pi}$$

That is, the elasticity with respect to one component of the price equals the elasticity with respect to the total price (shadow price) weighted by the share of that component in the total price (Acton, 1976).[17]

The comparison of these elasticities leads to the conclusion that

$$\eta_{mFC} \gtreqless \eta_{mp} \quad \text{as } WFC \gtreqless p \;.$$

The introduction of the Medicare program reduces the out-of-pocket expenditures per unit of medical services (p) while the value of fixed cost remains non-reimbursable. Therefore if WFC exceeds p then $\eta_{mFC} > \eta_{mp}$. That is, the demand for medical services becomes more sensitive to changes in the "fixed cost" because it is a greater proportion of the total price. At the extreme as p is reduced to zero - as it is in the case of the aged patient who is also under Medicaid - the demand for medical services is totally influenced by the WFC. The time spent to get medical care is in general evaluated in terms of opportunity cost. A major problem is to estimate this opportunity cost of time for individuals who are not in the labor force. For those individuals the value of time is not well defined. Some attempt to estimate the value of time for non-employed individuals was done by C. Ronal,1973; James Heckman, 1974; and Acton, 1975). However, this was not satisfactory since the value assigned to the time of non-workers was arbitrarily set at $1 (see Acton for example).[18] Even though aged patients are more likely to fall into the category of non-workers and as such do not forego earnings, there are other valued uses of time which should be taken into consideration. Unfortunately, the data available for the present study do not make possible the inclusion of the fixed cost in the total cost of getting medical care. From empirical evidence it can be expected that the "fixed cost" incurred would depend on the number of different doctors seen and on the specialty type of the doctor. (For more discussion see Appendix A, Tables A.13 and A.14, and Appendix C, Table C.1. Guided by the findings of other studies (Goldman and Grossman, 1976, 1978; Acton, 1976) and the empirical investigation of the present study, I will refer from now on to "fixed costs" in discussing the results although I do not have a direct measure of these costs since the total cost per visit used here equals the net quality-adjusted price ($\pi = \hat{p}$).

Empirical Findings

Ordinary least squares multiple regression equations for the dependent variables VISIT9, VISIT19, QUAL9, QUAL19, and CARE appear in Tables 3 through 8. In discussing these results we focus first on the basic hypothesis derived from the quantity-quality model; second, on the specific findings regarding the effects of explanatory variables on the utilization of medical services; and third, on the patient's decision to contact a physician as compared to his/her decision to follow the treatment suggested by the physician. This is accomplished by comparing the use of comprehensive office visits with the use of routine follow-up office visits; that is, the decision to continue seeing any physician.

The results are presented as follows:

Subsection A: For all patients with positive office visits taken together, the discussion of the results focuses on the effects of 11 independent variables on the five dependent variables. The independent variables are presented as classified in the two previous sections. The responsiveness of visits and quality per visit to the price changes is also discussed.

Subsection B: For the two samples: a) patients with claims for which the deductible has not been met, "before"; b) patients with claims for which the deductible has been met, "after", the discussion focuses on the effects of the deductible on price elasticities for visits and quality per visit.

Subsection C: For the two subsamples: a) patients for whom doctors did not accept assignment (ASS = 0); b) patients with positive rate of assignment (ASS > 0), the discussion focuses on the effects of acceptance of assignment on utilization of medical services. After the results are discussed, there is an analysis by type of physicians' specialty which is presented in the following section.

A. Overall Results for the Total Sample

1. Price and Related Variables

Table 3 contains the coefficients of NETP - defined as the gross quality-adjusted price multiplied by the coinsurance rate for all services received after the deductible was met - and the coefficients of the MEDICAID variable.

NETP has a negative and statistically significant regression coefficient in the equation for VISIT9, and a negative but insignificant coefficient in the equation for VISIT19. The same variable has an insignificant negative regression coefficient in both demand curves for quality QUAL9 and QUAL19. The magnitude of the regression coefficient in the demand curve for visits is greater than its counterpart, the coefficient in the equation for demand for quality, the difference being greater for follow-up office visits. The price elasticity of visits is -0.41 compared to that of quality, which is only -0.005 in the case of follow-up office visits. Comparable figures are -0.03 versus -0.01 for comprehensive office visits (see Panel B of Table 3). An increase in quality-adjusted price has a negative impact on demand for both visits and quality; however, the demand for visits is more responsive to changes in price than the demand for quality. Apparently the findings are not consistent with the predictions. An increase in quality-adjusted price was assumed to raise the price of quality relative to that of visits and cause the ratio of quality to visits to fall. This follows the Goldman and Grossman quantity-quality substitution model, which was discussed in the previous section and in Chapter II.

Specifically, an increase in quality-adjusted price induces consumers to substitute away from quality and toward visits. Although visits need not rise absolutely, the ratio of quality to visits is expected to fall as quality-adjusted price rises. That is, for the same percentage change in quality-adjusted price the demand for quality should decrease relatively more than the demand for visits. An increase in the number of visits implies, however, an increase in the "fixed cost" associated with a visit, and should lead patients to substitute quality for visits. Therefore, the ratio of quality to visits would rise as "fixed cost" rises. The final outcome depends on which of the components of the "total cost", money price or fixed cost, has a greater share in the patient's budget. The present study deals with patients likely to have a fixed income and a uniform insurance coverage for medical services. As discussed in the previous section, it is expected that the demand is more sensitive to

TABLE 3

COEFFICIENTS OF THE NET PRICE AND MEDICAID VARIABLES AND NET PRICE ELASTICITIES

Dependent Variable	Net Price	Medicaid[c]
A. Coefficients of Net Price[a] and Medicaid		
VISIT9	- 2.08 (-10.18)	-1.03 (-1.49)
VISIT19	- 0.04 (- 1.53)	0.01 (0.04)
QUAL9	- 0.01 (- 0.52)	0.14 (2.18)
QUAL19	- 0.03 (- 0.99)	0.10 (0.91)
B. Coefficients of Price Elasticities[b]		
VISIT9	- 0.41 (-10.52)	
VISIT19	- 0.03 (- 1.27)	
QUAL9	- 0.005 (- 0.34)	
QUAL19	- 0.01 (- 1.02)	

t - ratios are in parentheses

a Equations are presented in the Appendix, Table C.2

b Equations are presented in the Appendix, Table C.3

c See Table C.4 where the Medicaid variable was omitted changes in the fixed cost than to changes in money price because the fixed cost is a greater proportion of the total price of obtaining a unit of medical service. If we keep this in mind, our findings are consistent with the predictions.

The empirical results presented in Table 3 enable one to compare the effects of a change in quality-adjusted price on quantity (visits) and quality per visit demanded for the two types of office visits: VISIT9 (follow-up) and VISIT19 (comprehensive visits). The data show that the demand for follow-up office visits is more responsive to a change in quality-adjusted price than is the demand for comprehensive visits. That is, a one percent increase in quality-adjusted price would decrease by about 0.4 of a percent the number of follow-up office visits demanded and only by 0.03 of a percent those of comprehensive visits ($\eta_{v9} = -0.41$ versus $\eta_{v19} = -0.03$). While the coefficients for VISIT19 are insignificant, those for VISIT9 are highly significant.

In fact, we compare here the patient's decision to "contact a physician" with his/her decision with regard to the "number of visits" given a positive use. Because the physician may exert a greater influence upon the follow-up than upon the comprehensive decision, one would expect a less elastic demand with respect to VISIT9 than to VISIT19. The relatively higher elasticity of follow-up office visits can be explained as follows: a) the expenditures on follow-up office visits constitute a higher share of the patient's budget than do comprehensive visits. Patients made an average of 5.7 follow-up office visits as compared to 1.1 comprehensive visits. Therefore, although follow-up visits are less expensive than initial comprehensive ones, added together they cost more during the year; b) the shadow price of a follow-up office visit is higher than that of an initial comprehensive one. As the number of visits increases, the "fixed cost" increases as well. According to the quantity-quality substitution model this implies that visits would be more sensitive to a percentage change in fixed cost than to an identical percentage change in quality-adjusted price;

c) education and habit are other factors which have been found to be relevant to the patient's decisions, but the data for this study do not provide the necessary information to test their effects.

Therefore, the findings support our decision to estimate separate demand functions for the two types of office visits instead of lumping them together under the heading "office visits". There are significant variations in the parameters between the two demand curves. The responsiveness to a change in price will have a considerably larger impact on the demand for visits in the case of VISIT9 than in that of VISIT19.

Once we have seen the responsiveness of visits to price changes, we should also look at the responsiveness of quality per visit to price changes. The data show that the coefficients for both QUAL9 and QUAL19 are highly inelastic and insignificant at the traditional level. As was shown above, in the case of visits, there was a disparity in the magnitude of the elasticity coefficients; here, in the case of quality per visit the elasticity coefficients are somewhat higher for VISIT19 than for VISIT9 (η_{q9} = -0.005 compared to η_{q19} = -0.01).

MEDICAID, used as a proxy for an individual's welfare status, is entered into the regression as a dummy variable which allows us to compare the behavior of elderly Medicaid recipients (the poorest class) to that of the rest of the patients, who presumably have higher incomes. The results show that a patient under Medicaid made somewhat more initial comprehensive visits and fewer follow-up office visits as compared to the rest of the patients. There is a large negative visit differential in the VISIT9 equation, while there is a positive and rather small differential in that of VISIT19. The visit differentials are not statistically significant either in the VISIT9 or in the VISIT19 equations. Only this factor can lead to the conclusion that although Medicaid patients do not differ significantly from the rest of the patients in their decision to contact a physician, they are less likely to make the same number of routine follow-up office visits thereafter. The latter decision may depend to some extent upon the physician's willingness to receive Medicaid patients. However, a lower utilization of VISIT9 by Medicaid patients may be due to the submission of the first claims to Medicaid so that these claims may not be included in these data. Therefore the large negative VISIT9 differential may be overstated. To test this separate regressions were run with the Medicaid variable omitted held constant (see Appendix C, Table C.4). No effect on other regression coefficients was found, when the Medicaid variable was omitted. When the quantity-quality trade-off is analyzed, it can be found that there is a large negative visit differential and a positive and highly significant quality differential in the case of follow-up office visits. These results are consistent with the quantity-quality substitution model; that is, an increase in the number of follow-up office visits means at the same time an increase in the costs in getting care - transportation, travel time, waiting time. As predicted, changes in the price of obtaining medical care had a greater impact on the demand for free than for non-free medical services. Therefore, an increase in the shadow price of a follow-up office visit will lead Medicaid patients to substitute quality for visits. This trade-off in the case of VISIT19 is not so obvious, however.

2. Other Physician Contacts

Table 4 contains the coefficients of patient-physician contacts other than those in the physician's private office. These variables are: HOME (the annual number of home visits) and two dummy variables, HOSP (if patient was hospitalized during the year) and ECF (if patient was in an extended care facility). The variables HOSP and ECF were also identified as a proxy for health status.

The analysis is based upon the entire sample of 1,263 patients with positive office visits, as defined previously. 181 patients were found with home visits, 214 were hospitalized, and 35 were in an extended care facility.

. HOME has positive and statistically significant coefficients in visit equations for both follow-up and comprehensive visits. As expected, the magnitude of the coefficient in the demand equation for follow-up office visits is 4.5 times larger in absolute value than for comprehensive office visits. That is, for each unit increase in home visits the number of follow-up office visits demanded increases by a quarter of a visit while that of comprehensive visits by one-sixth of a visit. Therefore, for an aged Medicare patient, HOME and office visits are complements.

However, in quality per visit equations, the role and significance of HOME is changed. It has a positive and completely insignificant coefficient in the QUAL9 equation, while it is negative and significant at 8 percent in QUAL19 equation.

. The HOSP variable, in dummy form, permitted a comparison of the behavior of patients who were hospitalized, and assumed to have a lower health status than the rest of Medicare patients, with non-hospitalized beneficiaries.

TABLE 4

COEFFICIENTS OF VARIABLES MEASURING PHYSICIANS' CONTACTS OTHER THAN OFFICE VISITS

Dependent Variable	HOME	HOSP	ECF
VISIT9	0.26	2.07	1.51
	(3.43)	(4.87)	(1.01)
VISIT19	0.06	0.06	-0.16
	(2.63)	(0.93)	(-0.66)
QUAL9	0.00	0.09	-0.04
	(0.05)	(2.30)	(-0.30)
QUAL19	-0.04	0.02	0.06
	(-1.75)	(0.40)	(0.28)

t - ratios are in parentheses

Equations are presented in the Appendix, Table C.2

As expected, hospitalized patients demand more follow-up office visits and a higher average quality of such visits than do the rest of the patients. The differences are highly significant for both visits and quality. The visit differential is greater in absolute value than the quality differentiall In the case of comprehensive visits (VISIT19), however, the differential is still positive but rather small and not statistically significant.

Indeed, patients who were hospitalized are more likely to receive comprehensive visits in the hospital than in the physician's private office.

. The ECF variable, in dummy form, shows the differential in demand for visits and quality per visit of those patients who were in an extended care facility as compared to the rest of the patients. The coefficients in the VISIT9 and QUAL9 equations suggest that ECF patients demand more follow-up office visits but less quality per visit. In the case of comprehensive visits the reverse is true.

3. Diagnostic and Surgery Services Received in the Physician's Private Office

Table 5 contains the coefficients of those variables designed to measure the effects of other services received in the physician's private office on visits and quality per visit demanded. Those variables are: H_PROB and SERVIS9 or SERVIS19.

. The H_PROB variable, in dummy form, permitted a comparison of the behavior of patients who had surgery services performed in the physician's private office with those who did not have such experiences. As expected, the patients who had surgery made more follow-up office visits and demanded on the average a higher quality per visit. The

TABLE 5

COEFFICIENTS OF VARIABLES SERVIS AND H_PROB

Dependent Variable	H_PROB	SERVIS
VISIT9	1.49	-0.51
	(3.27)	(-3.92)
VISIT19	-0.02	0.03
	(-0.32)	(2.75)
QUAL9	0.06	0.05
	(1.42)	(4.14)
QUAL19	-0.07	0.02
	(-1.12)	(1.42)

t -ratios are in parentheses

Equations are presented in the Appendix, Table C.2

positive visit differential is highly significant. The positive quality differential is rather small and significant at 9 percent. In the case of comprehensive office visits, both the visit and quality differentials are negative and insignificant.

. The SERVIS variable, measuring the diagnostic services per office visit, has a negative and highly significant coefficient in the demand curve for visits (VISIT9), and a positive and significant coefficient in that for quality (QUAL9). As discussed in the previous section, SERVIS is used as a proxy for the "indirect costs" of a visit; that is, the physician's tendency to increase diagnostic services relative to the number of visits generates additional costs which give rise to a trade-off between visits and quality per visit. An increase in "indirect costs" would cause the relative price of quality to fall and lead patients to substitute quality for visits. Consequently, the variables SERVIS and NETP would have opposite effects on the demand for quality (see Goldman and Grossman, 1976, 1978). This was proved empirically. The regression results show that SERVIS has a negative effect on the number of visits and a positive effect on the quality per visit; that is, NETP9 (the net quality-adjusted price) and SERVIS - a proxy of indirect costs - have opposite effects on the demand for quality. In this light the results may be interpreted as follows: on the one hand, the physician's capacity to provide additional diagnostic services (x-ray and laboratory) increases the patient's convenience in getting care and may reduce the number of routine follow-up office visits necessary. On the other hand, it may increase the patient's out-of-pocket expenditures if there is a misuse of services. Under these circumstances, a patient will search for what he/she perceives to be a more "qualified" physician able to provide more efficient diagnostic services. For more discussion see text (p.79). While SERVIS has a positive and significant impact on the number of comprehensive visits, the impact on quality per visit is still positive but insignificant.

4. Patient's Characteristics Variables

Table 6 contains coefficients of patient's age (AGED2 and AGED3), patient's sex (MALE) and patient's eligibility based upon earnings recorded under Social Security (WAGE).

. AGE. There is a positive visit differential in the VISIT9 equation which is statistically insignificant for both groups of patients, AGED2 and AGED3, when compared to the youngest group AGED1. This is consistent with the hypothesis that as an individual grows older the quantity of medical care demanded increases because of depreciation in health stock (see Grossman, 1972). In the case of VISIT19, the visit differential is positive only for AGED2 and negative for AGED3. For both groups, however, the differential is not significant. The quality differential is negative and highly significant in the case of the QUAL9 equation for AGED2 patients. As an individual grows older not only does his health stock deteriorate, but also his wealth is substantially reduced. This gives rise to an income effect which may affect the substitution effect (replacing visits by quality).

. MALE patients tend to demand fewer follow-up and comprehensive visits than do female patients. The negative differential is statistically significant only in the VISIT9 equation however.

. The WAGE variable is designed to capture differences in the patient's behavior with respect to the use of medical services. It was assumed that having been in the labor force before retirement can be used as an indicator

TABLE 6

COEFFICIENTS OF PATIENTS' CHARACTERISTICS VARIABLES

Dependent Variable	AGED2	AGED3	MALE	WAGE
VISIT9	0.46	0.03	-0.96	-0.16
	(1.39)	(0.05)	(-2.67)	(-0.42)
VISIT19	0.04	-0.02	-0.01	-0.03
	(0.61)	(-0.13)	(-0.20)	(-0.35)
QUAL9	-0.10	0.01	-0.002	0.05
	(-3.09)	(0.14)	(-0.06)	(1.32)
QUAL19	0.01	-0.16	0.10	-0.07
	(0.17)	(-0.98)	(1.72)	(-0.98)

t - ratios are in parentheses

Equations are presented in the Appendix, Table C.2

of a superior income and education; such patients have better health and need therefore to consume fewer medical services. As predicted the direction of impact is negative for all equations but quality per visit of QUAL9 where the sign is positive. The differences, however, are not statistically significant.

5. Indirect Costs

The variable SERVIS was used as a proxy for "indirect costs". An alternative measure, PR459, was used to express this as a monetary value; that is, the ratio of expenditures (net of insurance) on diagnostic services to total expenditures on visits. When PR459 replaces variable SERVIS9 the same effect on quantity (visits) and quality per visit is found (see Appendix C, Table C.5). Although the results are preliminary, they are noteworthy. In the case of follow-up office visits, the increase in the "indirect costs" has a negative effect on the number of visits and a positive effect on the quality per visit; while in the case of comprehensive office visits it has a positive effect on both visits and quality per visit. Doctor's capacity to provide diagnostic services has a positive effect on the patient's decision to contact a physician in the first place but a negative one on his/her decision to return to the office. The tendency to further increase such services generates additional costs which lead to a trade-off of quality for visits.

Interaction Effects

Previously in Tables 3 - 6 the effects of different independent variables on the number of visits and the quality per visit demanded were presented. We are now assuming, however, that some variables in the regression equations might interact with each other. Therefore,we will focus on the effect of these interactions upon the net quality-adjusted price elasticity both for visits and for quality. The results for follow-up office visits and comprehensive office visits are presented in Table 7. The analysis emphasizes the effect of interactions on price elasticity for visits in equation 2 and on price elasticity for quality in equation 3. Equations 1 and 4 presenting the regression results without interaction terms are used as a basis of comparison.

The price interactions are created by multiplying the net quality-adjusted price in its log form by a set of the following dummy variables: HOSP, SURG, AGE, MALE, WAGE. Different regressions were run in which the interaction terms were entered separately (not shown). In all cases the interaction coefficients remained about the same as those which are presented in Table 7.

The first interaction represents the effect of the deterioration of an individual's health stock on price elasticity. Allowing the price variable to interact with the HOSP and H_PROB variables permitted us to test whether patients experiencing such health problems are more or less sensitive to price. In both the visit and quality equations those interaction terms were not significant. However, the direction of influence can provide some additional insights. Patients who were hospitalized exhibit positive price elasticities with respect to the number of follow-up office visits and negative price elasticities with respect to the average quality of these visits. The reverse is true for patients who had surgery in the physician's private office.

The second interaction represents the effect of age on price elasticities. Allowing the price variable to interact with AGED2 and AGED3 permitted us to test whether patients in the oldest group are more or

TABLE 7

COEFFICIENTS OF THE NET PRICE ELASTICITIES WITH AND WITHOUT INTERACTIONS

Dependent Variable	Without Inter-actions	With Interactions					
		PRHOSP	PRH_PROB	PRAG2	PRAG3	PRMALE	PRWAGE
VISIT9	- 0.406	0.017	-0.077	-0.010	-0.069	-0.014	0.015
	(-10.52)	(0.53)	(-1.84)	(-0.39)	(-1.69)	(-0.47)	(0.59)
VISIT19	- 0.034	-0.001	-0.009	-0.002	-0.534	-0.024	-0.035
	(- 1.27)	(-0.04)	(-0.47)	(-0.15)	(-3.23)	(-1.19)	(-2.18)
QUAL9	- 0.005	-0.003	0.014	-0.009	-0.010	-0.001	-0.011
	(- 0.34)	(-0.32)	(1.18)	(-1.28)	(-0.82)	(-0.08)	(-1.44)
QUAL19	- 0.013	0.002	0.007	-0.001	-0.127	0.007	-0.003
	(- 1.02)	(0.22)	(0.76)	(-0.09)	(-1.71)	(0.72)	(-0.48)

N = 1,263

t -ratios are in parentheses

less sensitive to price as compared to the youngest group, age 65-74. The only significant difference was in the case of the oldest group (PR19AG3): while patients in the oldest group exhibit lower price elasticities with respect to the number of comprehensive visits demanded, they exhibit higher price elasticities with respect to the quality of these visits.

The third interaction is that between price and the dummy variable MALE. The OLS results show that there is no significant difference in price elasticity between male and female patients. The negative difference suggests that male patients are more sensitive to changes in price than are female patients.

The fourth interaction is that between price and the dummy variable WAGE. The variables PRWAGE were entered into regression to test whether patients who were in the labor force before retirement are more or less sensitive to price. Again, only in the equation for comprehensive visits was the interaction term significant. This shows that patients who were in the labor force are more sensitive to changes in price with regard to the decision to contact a physician in the first place; the effect, however, is rather small.

CARE

The results of the regressions when CARE is the dependent variable are presented next. Table 8 contains ordinary least squares estimates of the CARE function. The empirical analysis contained in the regressions presented here permits us to examine the patient's current health status and his/her accessibility to physician services as measured by the number of months that the patient had at least one "physician contact" (see section 2 of this chapter for definitions). The results are considered preliminary because of the data limitation discussed in the previous section.

The analysis attempts to establish what are the most important determinants influencing the length of time used for medical care.

The NETP9 variable has a negative effect on number of months over which an individual can afford treatment. The coefficient of the NETP9 variable is negative and highly significant. The price elasticity with respect to contact months is -0.04. The coefficient is highly significant. The coefficient of the MEDICAID variable is negative and significant. This suggests that an aged patient who receives Medicaid will have fewer contact months than do other Medicare patients. This is consistent with our previous findings when the MEDICAID variable had a stable negative coefficient in all visit equations. The VISIT9 variable as expected, is directly related to the number of contact months. The coefficient is highly significant. The QUAL9 variable is negative and significant at an 8 percent level of confidence. The results are noteworthy; an increase in the quality per visit would decrease the number of months of contacts necessary to achieve an improvement in health. If this means fewer services, then higher quality implies lower costs to the patient and to the program as well. The coefficient of elasticity is -0.17 (see equation 3 of Table 8); that is, an increase in the quality per visit by 1 percent will reduce the number of contact months by 0.17 of a percent. If WAGE is a proxy for education, then the results are consistent with the prediction: a more educated people are more efficient producers of health. The WAGE coefficient is negative but not significant. As expected, patients who were hospitalized (HOSP) are likely to have more contact months. The same can be said for those with surgery in the physician's office (H_PROB), home visits (HOME) and care in an extended care facility(ECF). All coefficients are highly significant and positive as expected. MALE

TABLE 8

ORDINARY LEAST SQUARES ESTIMATES WITH CARE AS DEPENDENT VARIABLE

	CARE as dependent variable				LNCARE as dependent variable	
Independent	Equation 1		Equation 2		Equation 3	
variables	Regression Coefficients	t-ratio	Regression Coefficients	t-ratio	Regression Coefficients	t-ratio
NETP9	-1.16	-9.96	-0.80	-8.44	-0.040*	-3.68
VISIT9	-	-	0.36	28.42	-	-
LGQUAL9	-	-	-0.23	-1.65	-0.174*	-1.93
MEDICAID	-0.65	-1.62	-0.88	-2.86	-0.82	-2.60
HOME	0.22	4.97	0.10	2.99	0.04	3.77
HOSP	1.14	4.60	0.33	1.73	0.43	7.28
ECF	2.54	2.88	1.67	2.49	0.47	2.23
SERVIS9	0.14	0.71	-	-	0.03	1.61
H_PROB	1.14	4.27	-	-	-	-
AGED2	0.43	2.20	0.18	1.17	0.12	2.55
AGED3	0.79	1.99	0.75	2.45	0.12	1.22
MALE	-0.44	-2.08	-0.05	-0.32	-0.11	-2.06
WAGE	-0.01	-0.05	-0.02	-0.10	0.01	0.27
Intercept	6.18	24.09	4.74	10.65	1.42	14.22
R^2	0.17		0.52		0.09	

N = 1,263

* $\beta = \eta$ the coefficients are in log form

patients use fewer medical services and do so over a smaller number of contact months. To examine the effect of certain variables on CARE additional regressions were computed. The variables of equation 1 explained 17 percent of variation in the number of contact months when VISIT9 and QUAL 9 were entered; in equation 2, the explanatory power of variables increases to 52 percent. The directions of influence of the other regression coefficients were unaffected when the VISIT9 and QUAL9 variables were entered into the regression.

B.1 How the Deductible Affects the Demand for Office Visit of Aged Patient

In the present section, the effect of the deductible on the demand for office visits is explored. Both the deductible and coinsurance are part of the patient's out-of-pocket expenditures. It influences a beneficiary's decision to purchase care at a certain point in time. A higher deductible may discourage an individual from visiting a doctor today. A visit to a doctor may be postponed if an individual finds himself close to the end of the benefit year in which the deductible is valid. The existence of the deductible can be viewed as a factor which puts a kink in the individual's demand curve. Before meeting the deductible the demand should be more sensitive to price changes than it is after the deductible is met, since then the effective price of medical care is reduced. An initial outlay of $60 before insurance starts to operate is more of a burden for low income patients. After the deductible is met, the patient will be responsible for 20 percent of the allowed charge for each additional service received. Therefore a more intense use of medical services is expected after reaching this stage and this implies a less elastic demand. However, the reverse can also be true. The decision to purchase a medical service depends on the patient's expectations about his future illnesses and medical expenditures related thereto. If heavy expense is expected, purchasing a medical service today can be viewed as a way of getting closer to meeting the deductible. If a patient expects costly and long-term treatment, amounting, for example, to $1,000 or more, the deductible becomes a minor consideration. It is easier to meet the deductible through a higher bill than through many small ones. Moreover, there are fixed costs associated with every visit, such as travel time, waiting time and transportation cost. Those costs are not reimbursed by the program, and, therefore, increase the burden on the individual's expenditures. Under these circumstances, it is more plausible to think that demand is inelastic before the deductible is met and somewhat more elastic thereafter. One can derive a priori the existence of a kink in patient's demand curve due to the deductible but the difference in degree of responsiveness to price changes between the two segments of the demand curve is an empirical question. For a given health status and patient expectation, it depends on whether it is the deductible or, on the contrary, the expenditures after meeting the deductible which make up the greater share of the consumer's total cost for medical care during the year.

The purpose of this section is to explore this aspect empirically. To capture this aspect the demand for visits will be analyzed separately as follows: a) for patients with claims for which no money was paid by the program to either patient or doctor; and b) for patients with claims for which a payment was made to either beneficiary or supplier. Certain data limitations should be discussed, however, As previously mentioned, there is no way of knowing through which claims the deductible was met. Therefore, I decided to consider all claims which are not reimbursed by the program as "not meeting the deductible", and those where any amount is paid to "beneficiary" or "provider" as "having met the deductible". The assumption here is that there is no other complementary insurance which could have lessened the burden of meeting the deductible. Of course, patients under Medicaid have their deductible paid by the State.

As mentioned in Chapter II the total sample consisted of 9,149 claims for services during 1976 to 1,263 Medicare patients with positive office visits. Of these, 2,152 (23.5 percent) did not meet the deductible. This is the first subsample, henceforth referred to as the "before" subsample. The remaining 6,997 claims (76.5 percent) in which payments were made to either patient or physician were considered as meeting the deductible. They constitute the second subsample, henceforth referred to as the "after" subsample.

The "before" subsample contains 914 patients and the "after", 1,070. Put differently, 15.3 percent of those patients did not use medical services to the extent of meeting the deductible during 1976. Looking at the distribution of patients by type of service more insights can be gained:

Variable	Total	Number of Patients with claims for which the deductible was not met	Number of Patients with claims for which the deductible was met	Percent of patients meeting the deductible
Total	1,263	914	1,070	84.7%
VISIT9	1,224	741	980	80.1
VISIT19	181	54	133	73.5
HOME	107	29	87	81.3
HOSP	214	31	212	99.1
ECF	14	3	13	92.9

A relatively higher proportion of patients with comprehensive office visits as compared to follow-up office visits did not use enough services during the year to reach the deductible limit. This does not exclude the possibility of more intensive use in the previous year or of their entry in the Medicare market toward the end of the previous year, qualifying for the carryover of expense to meet the current year deductible. As expected, patients experiencing a deterioration in their health stock (i.e. HOSP, ECF), are more likely to use more services or more expensive ones, so that a greater proportion met the deductible.

Table 9 contains the net price elasticities of visits and quality for the two dependent variables VISIT and QUALITY. The data are reported separately for follow-up office visits (VISIT9 and QUAL9) and for comprehensive office visits (VISIT19 and QUAL19). Three different situations are taken into account:

1. The total sample of patients with positive office visits where all claims are taken together are presented in equation 1.

2. The subsample of patients with claims for which the deductible was not met are presented in equation 2.

3. The subsample of patients with claims for which the deductible was met are presented in equation 3.

If equations 2 and 3 are compared with each other, and then with equation 1, it appears that there are differences in the price elasticities between the two subsamples as well as in each of those compared with the total sample. They differ with respect to their absolute values as well as with regard to their significance.

The comparison of elasticities between the two segments of the demand curve of the "before" and "after" meeting subsamples suggests the following:

a) <u>the price elasticity for visits</u> is greater for the "after" subsample. In the case of VISIT9, the price elasticity for visits for the "after" subsample is -0.87, exceeding the absolute value of that for the "before" subsample, which is -0.61. The coefficients border on significance (7 percent) for the first group, equation 3, but are highly significant for the "before" subsample, equation 2. Both subsamples have higher elasticities than the full sample (-0.40), equation 1. In VISIT19, the same pattern is observed, but the coefficients are not significant.

b) The price elasticities for quality

The elasticities for QUAL9 are almost the same for both subsamples with regard to their statistical significance (8 percent and 7 percent), and to their magnitude. Both, however, exceed the coefficient of equation 1 for the total sample, which suggests that our breakdown of the sample has provided additional insights in our analysis. In the case of QUAL19, however, the picture is changed. The price elasticity of demand for quality for the "before" subsample is positive and exceeds in absolute value both the "after" subsample and the total sample. None of the coefficients are statistically significant. Generally, comprehensive visits are more expensive than routine follow-up visits, and a higher quality of those visits makes them even more expensive. Therefore, at this stage (before meeting the deductible), patients are more sensitive to changes in the price for quality.

B.2 The Effect of Assignment on Price Elasticity of Visits and Quality

In the present section the impact of acceptance of assignment on utilization of medical services will be explored. The impact of meeting the deductible was the subject of the last section. The acceptance of assignment influences the effectiveness of Medicare by enabling beneficiaries to meet their needs on a relatively fixed income. The present

TABLE 9

THE EFFECT OF DEDUCTIBLE ON PRICE ELASTICITIES FOR VISITS AND QUALITY

Dependent variable	Whole sample (1)	"Before" subsample Deductible not met (2)	"After" subsample Deductible met (3)
VISIT9	-0.41 (-10.52)	-0.61 (-2.31)	-0.87 (-1.83)
VISIT19	-0.03 (-1.27)	-0.21 (-1.46)	-0.25 (-1.09)
QUAL9	-0.005 (-0.34)	-0.07 (-0.64)	-0.17 (-1.71)
QUAL19	-0.01 (-1.02)	0.30 (1.66)	-0.02 (-0.21)

t-ratios are in parentheses

Equations are presented in Appendix (Tables C.6, C.7)

N = 1,263 Total sample

N_1 = 914 "Before" subsample

N_2 = 1,070 "After" subsample

The coefficients are in log form therefore interpreted as elasticities section follows an approach similar to the last section in studying the impact of assignment on the price elasticities of the demand for visits and quality. The sample is divided into two subsamples: the first contains patients who had a zero rate of assignment (ASS = 0); the second, those who had a positive rate of assignment (ASS > 0). The total sample was 1,263 patients. There are 898 patients in the first group, which means that for 71.2 percent of patients with office visits, doctors did not accept assignment. The second subsample includes the 365 remaining patients - those with partial assignment (19.5 percent) and a small group who had assignment accepted for all of their services (9.3 percent). It is surprising to find out that the majority of the patients did not benefit at all from this provision of the Medicare program. Why did some doctors never accept assignment while others always accepted it? And why was assignment always accepted for some of the patients and never or occasionally for the others? It has been argued in studies of carrier performance that among the most important factors that may influence the acceptance of assignment is the patient's ability to pay. If a patient appeared financially capable of paying the bill, the physician would be inclined to refuse assignment and to bill the patient directly for more than the allowed charge. Size of the bill and whether the patient is a Medicaid recipient were other criteria for accepting assignment.

Additional insight into the acceptance of assignment is gained by looking more carefully into distribution of patients in the two distinct subsamples according to their characteristics and type of services received.

	Total sample	Patients with: Assignment rate ASS = 0	ASS > 0	Percentage of patients with ASS = 0
TOTAL	1,263	898	365	71.2%
A. Patients' characteristics				
WAGE	906	660	300	72.8
MALE	447	320	127	71.6
FEMALE	816	578	238	54.3
MEDICAID	84	14	70	16.7
B. Type of services				
HOME	107	66	41	61.6
HOSP	214	84	130	39.3
ECF	14	3	11	21.4
H_PROB	178	98	80	55.1
VISIT9	1,224	874	350	71.4
VISIT19	181	107	74	59.1

If WAGE is a proxy for ability to pay (patients who were in the labor force were assumed to have accumulated more assets during their lives), then the findings support the predictions. For 72.8 percent of WAGE patients assignment was not accepted for any medical services during 1976. The same thing cannot be said, however, about Medicaid patients. Assignment was accepted for 83.3 percent. National statistics show that females are more likely to be poorer in their old age (Muller, 1978).[19] For 54.3 percent of females assignment was not accepted, as compared to 71.6 percent for MALE. Therefore the predictions are supported by our results.

Looking at the type of services received, we can find that patients hospitalized or in extended care facilities are more likely to get acceptance of assignment as compared to those with surgery at physicians' offices, or with home and office visits. The hypothesis that poorer patients and those with larger bills are more likely to get assignment is supported by my empirical findings: hospitalized or ECF patients are more likely to be needy with longer illnesses, larger bills, etc. In addition, physician specialty type should be considered since certain specialties tend to accept assignment when they need to fill up their practice.

In this study, it was assumed that the acceptance of assignment influences patients' decision to contact a physician as well as the decision to continue seeing the doctor thereafter. It is easier to pay out-of-pocket a smaller amount (20 percent of the allowed charge) than to pay the entire fee to the physician and then await reimbursement by the program (for more details see text Chapter III). It is assumed, therefore, that patients in the first subsample, those with ASS = 0 (assignment never accepted), will be more sensitive to price changes than those with a positive rate of assignment (ASS > 0), the second subsample. Table 10 contains coefficients of price elasticity for visits and quality. The results concerning the price elasticities for the zero assignment subsample are presented in equation 1 and for those with a positive rate of assignment in equation 2. As expected in case of VISIT9 the price elasticities of the demand for visits for patients with ASS = 0 (-0.40) exceed in absolute value that of patients with a positive rate of ASS(-0.27). Although both coefficients are highly significant, that of the ASS = 0 is one and one-half times greater. Price elasticities for visits in case of VISIT19 as well as those of quality (QUAL9 and QUAL19) remain fairly inelastic, and there is no difference between the two subsamples. The same

TABLE 10

THE EFFECT OF ASSIGNMENT ON PRICE ELASTICITIES OF DEMAND FOR VISITS AND QUALITY

PANEL A = COEFFICIENTS OF PRICE ELASTICITIES

	ASS = 0 Subsample (1)	ASS > 0 Subsample (2)
VISIT9	-0.40 (-8.69)	-0.27 (-2.98)
VISIT19	-0.01 (-0.24)	-0.01 (-0.39)
QUAL9	0.00 (0.24)	0.01 (0.33)
QUAL19	-0.01 (-0.62)	-0.00 (-0.41)

PANEL B = COEFFICIENTS OF PRICE ELASTICITIES WITH INTERACTIONS

	ASS = 0 Subsample			ASS > 0 Subsample		
	η PR	PRAG2	PRAG3	η PR	PRAG2	PRAG3
VISIT9	-0.42 (-9.14)	-0.03 (-0.74)	-0.19 (-2.62)	-0.27 (-2.98)	-0.01 (-0.20)	-0.05 (-1.23)
VISIT19	0.01 (0.28)	-0.02 (-0.41)	0.42 (2.64)	-0.01 (-0.39)	0.00 (0.15)	1.33 (0.65)
QUAL9	0.000 (0.007)	-0.01 (-0.65)	-0.01 (-0.70)	0.01 (0.33)	-0.01 (-1.70)	-0.02 (-1.78)
QUAL19	-0.01 (-0.62)	0.01 (0.46)	-0.99 (-1.02)	-0.00 (-0.41)	0.02 (0.35)	0.01 (-0.02)

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t-ratios in parentheses

$N_1 = 898$ if ASS = 0

$N_2 = 365$ if ASS > 0

pattern was noted when the total sample was analyzed.

Table 10, Panel B, shows the interaction of price elasticities among age groups for each of the two subsamples separately.

The interaction terms with AGED3 (the oldest group of patients) for both VISIT9 and VISIT19 are significant for subsample ASS = 0, while insignificant for subsample ASS $\succ$ 0. The burden of non-acceptance of assignment falls particularly on those who are the oldest and probably the poorest.

If one compares equation 1 with 2 in case of VISIT9, the interaction term has a considerable greater coefficient, namely -0.18 for ASS = 0 versus -0.05 for ASS $\succ$ 0. Again, the interaction terms with age groups do not present any additional insights for quality (QUAL9 and QUAL19). The coefficients are small and not significant.

B. A Microanalysis by Physician's Specialty Type of the Demand for Visits and Quality

In previous sections the demand curves for visits and quality were estimated for all patients with positive office visits regardless of the specialty type of the physicians who provided those visits. In Chapter III the estimation of hedonic price functions by physicians' specialty type reveals that their performance plays an influential role in their pricing behavior. The direction of the influence as well as its intensity varies by the physician's specialty. Factors such as type of service, frequency of service, procedure mix, and provision of general care were found to influence physicians' fees. For example, we have seen that internists available in both private office and hospital charged less for routine follow-up office visits than did surgeons for whom this availability did not constitute a reason to lower their generally higher fees. In the case of internists and general practitioners their capacity to provide diagnostic services in their private office has a positive and significant impact on the fees they charge. This is consistent with my view that those physicians who provide their patients with general care are more likely to use diagnostic services as a way to reach their revenue target. To capture all these aspects I have estimated separate demand curves for visits and for the average quality of these visits as well as price elasticities by physician's specialty type. Table 11 presents ordinary least squares estimates for dependent variables VISIT9 and QUAL9, while Table 12 presents the price elasticities of demand.

My interpretation of the results is as follows: once again, my prediction that performance variables influence prices and thereby the demand for medical services is supported by my results. The set of explanatory variables suggested by the model does succeed in explaining a significant position of the variance and especially that of the VISIT9 variable. R^2 in the surgeon equation is 46 percent while it is only 16 percent when all specialties are taken together. The comparable figures for QUAL9 are 6 percent and 4 percent respectively. When the effect of different explanatory variables on VISIT9 is considered, the following results are of interest: NETP9 has a negative and significant impact on price; however, in the case of surgeons, the magnitude of the regression coefficient is smaller than that of internists as well as GP's taken individually and all physicians taken together. The comparison of the use of follow-up office visits by different age groups shows a positive and significant differential in the GP equation for AGED2 and AGED3 groups when they are compared to the youngest group. This is of particular interest in that it suggests that the oldest, and probably the poorest patients cannot afford

TABLE 11

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES
FOR MEDICAL SERVICES BY PHYSICIAN SPECIALTY TYPES
- FOLLOW-UP OFFICE VISITS -

Independent variables	Dependent variable VISIT9 Total	SURG	GP	MED	Dependent variable QUAL9 Total	SURG	GP	MED
NETP9	- 2.08	-0.60	-1.49	-1.30	-0.01	-0.03	-0.03	0.01
	(-10.18	(-4.11)	(-6.19)	(-6.08)	-0.52	(-0.89)	(-1.06)	(0.24)
MEDICAID	- 1.03	-0.21	-0.47	-1.08	0.14	0.03	0.03	0.26
	(- 1.49)	(-0.33)	(-0.46)	(-1.32)	(2.18)	(0.19)	(0.23)	(2.54)
AGED2	0.46	0.52	0.96	0.09	-0.10	0.07	-0.05	-0.05
	(1.39	(1.68)	(1.99)	(0.22)	(-3.09)	(-0.99)	(-0.81)	(-1.08)
AGED3	0.03	-0.60	1.99	-0.41	-0.01	-0.12	0.18	-0.07
	(0.05)	(0.99)	(1.97)	(-0.46)	0.14	(-0.90)	(1.42)	(-0.62)
HOSP	2.07	1.60	2.51	1.38	0.09	0.29	0.28	-0.06
	(4.87)	(3.71)	(3.06)	(2.65)	(2.30)	(2.95)	(2.83)	(0.96)
ECF[a]	1.51	0.25			-0.04			
	(1.01)	(0.73)			(-0.30)			
SERVIS9	-0.51	-0.47	-0.72	-0.61	0.05	0.09	0.13	0.07
	(-3.92)	(-1.78)	(-2.78)	(-3.89)	(4.14)	(1.57)	(4.07)	(3.74)
MALE	-0.96	-0.52	-0.89	-0.44	-0.00	0.02	-0.02	0.04
	(- 2.67)	(-1.53)	(-1.66)	(-0.98)	(-0.06)	(0.17)	(-0.22)	(0.67)
WAGE	- 0.16	0.25	0.17	-0.00	0.05	0.18	0.09	-0.04
	(- 0.42)	(0.73)	(2.28)	(-0.01)	(1.32)	(2.28)	(1.21)	(-0.61)
HOME	0.26	9.67	1.12	0.22	0.00	-0.07	-0.01	0.01
	(3.43)	(18.39)	(-5.66)	(1.23)	(0.05)	(-0.55)	(-0.21)	(0.53)
H_PROB	1.49	0.11	2.62	-0.06	0.06	0.12	0.21	0.09
	(3.27)	(0.23)	(2.81)	(-0.09)	(1.42)	(1.19)	(1.78)	(1.22)
INTERCEPT	8.21	3.21	6.89	6.71	2.69	2.60	2.31	2.71
	(17.67)	(8.38)	(10.66)	(11.97)	(61.89)	(30.10)	(28.83)	(38.95)
R^2	0.16	0.46	0.17	0.10	0.04	0.06	0.06	0.04

t-ratios are in parentheses

[a]The number of observations is too small

TABLE 12

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR MEDICAL SERVICES

– BY PHYSICIAN SPECIALTIES –

Independent variables	VISIT19				QUAL19			
	All Specialties	GP	MED	SURG	TOTAL	GP[a]	MED	SURG
NETP19	-0.04 (-1.53)		-0.02 (-0.98)	-0.002 (-0.11)	-0.03 (-0.99)		0.01 (0.20)	-0.03 (-0.33)
MEDICAID	0.01 (0.04)		-0.09 (-1.03)	0.10 (1.38)	0.10 (0.91)		0.13 (0.44)	0.43 (1.07)
HOME[a]	0.06 (2.63)				-0.04 (-1.75)			
HOSP	0.06 (0.93)		0.07 (1.09)	0.08 (1.44)	0.02 (0.40)		0.14 (0.62)	0.11 (0.39)
ECF[a]	-0.16 (-0.66)				0.06 (0.28)			
IL_PROB	-0.02 (-0.32)		-0.07 (-1.18)	-0.03 (-0.53)	-0.07 (-1.12)		-0.17 (-0.87)	-0.26 (-0.88)
SERVIS19	0.03 (2.75)		0.012 (1.49)	0.07 (3.15)	0.02 (1.42)		0.08 (2.72)	0.20 (1.72)
AGED2	0.04 (0.61)		0.04 (0.81)	0.03 (0.87)	0.01 (0.17)		0.32 (-1.73)	0.04 (0.18)
AGED3	-0.02 (-0.13)		-0.10 (0.50)	0.00 (0.02)	-0.16 (-0.98)		-0.28 (-0.42)	-0.56 (-1.25)
MALE	-0.01 (-0.20)		-0.06 (-1.12)	0.03 (0.07)	0.10 (1.72)		-0.09 (-0.47)	0.29 (1.26)
WAGE	-0.03 (-0.35)		-0.04 (-0.60)	-0.00 (-0.07)	-0.07 (-0.98)		0.07 (0.31)	-0.14 (-1.06)
Intercept	1.11 (14.52)		1.08 (17.33)	0.95 (17.94)	3.47 (49.01)		3.28 (15.52)	3.25 (11.40)
R^2	0.11		0.13	0.22	0.08		0.21	0.08
N =	1,224		61	106	181		62	106

[a]The number of observations is too small

t-ratios are in parentheses

the services of specialists. The coefficients of the SERVIS9 variable are significant and negative in all follow-up visit equations and positive in QUAL9 equations. Again, this suggests a trade-off toward quality as the physician increases the number of services per visit. In the GP equation the negative coefficient is the largest in absolute value; this is consistent with previous findings. The positive coefficients for the WAGE variable suggest that patients who were in the labor force before retirement use more GP services than do the rest of the patients. Tables 11 and 12 show that the own price elasticity of demand for follow-up office visits is significantly negative and highly inelastic in the case of surgeons, as compared to both general practitioners and internists taken individually and all physicians taken together. In contrast, the price elasticity of demand for quality with respect to surgeons is twice as large in absolute value as it is with respect to general practitioners or all physicians taken together.

Summary and Conclusion

The objective of this study was to measure the most important factors influencing the demand for medical services. The analysis refers to patients under Medicare residing in Queens. Multiple regression techniques have been employed to examine three measures of medical care utilization. These measures are: the number of office visits to physicians in private practice by Medicare patients with positive office visits, the average quality of these visits, and the number of months with physician contact. The first two measures were derived separately for the two kinds of visits considered in the analysis - initial comprehensive office visits and routine follow-up office visits. The empirical investigation presented in this chapter - summarized in Tables 13 and 14 - suggests the following conclusions:

1. The net quality-adjusted price has a negative effect on both the number of visits and the average quality of those visits. However, the former relationship is statistically significant only for routine follow-up office visits. Visits are more sensitive to changes in the net price than is the quality per visit ($\eta_v > \eta_q$). A greater difference between visits and quality as to price elasticity is found for routine follow-up office visits than for comprehensive ones; that is, the price elasticity of visits exceeds the price elasticity of quality in absolute value -0.41 versus -0.005. The comparable figures for comprehensive office visits are -0.03 versus -0.01. Guided by the quantity-quality substitution model we expected to find that an increase in the quality-adjusted price would have a larger negative impact on quality than on visits. In the case of elderly patients, however, insurance reduced the role of money price as a chief determinant of demand; and, as a result, demand becomes relatively more sensitive to changes in fixed cost than to changes in money price. Fixed costs are not reimbursed by the program and therefore have a greater share in the patient's out-of-pocket expenditures. An increase in the average quality-adjusted price will lead finally to a substitution of quality for visits because an increase in visits increases at the same time the fixed costs associated with each visit, costs which are not reimbursed by the program. This leads to a substitution of quality for visits. If the aim of national health insurance is to increase access to care for the elderly population, these conclusions should be taken into account.

2. The patient's decision to contact a physician is less sensitive to changes in quality-adjusted price than is the patient's decision to continue seeing a physician thereafter. The net price has a negative impact on both the number of initial comprehensive office visits and the number of routine follow-up office visits; however, the price elasticity for follow-up visits exceeds in absolute value that for comprehensive ones ($\eta_{v19} > \eta_{v9}$). Again, the fixed non-reimbursable cost plays a greater role in the decision to follow a treatment ("number of visits") than in the decision to contact a physician in the first place.

3. For Medicaid patients the decision to "contact" and to "continue" seeing a physician are influenced to a greater extent by the presence of fixed costs.

4. Changes in the price of medical care have a greater impact on the demand for free than for non-free medical services. An increase in the number of visits necessary to improve health increases the shadow price for an aged Medicaid patient. On the average, patients under Medicaid demand higher quality per visit than the rest of Medicare patients. The positive quality differential is highly significant.

5. Hospitalized patients, assumed to have poorer health than other Medicare patients, demand more follow-up office visits and a higher average quality for those visits than the rest of the patients. The large positive differential in the equations for visit and quality is highly significant.

6. The same findings are recorded for patients with "surgery" in the physician's private office.

7. In the case of elderly patients HOME visits and follow-up office visits are complements. The HOME variable has a positive and highly significant influence on the number of follow-up office visits demanded.

8. As the individual grows older more medical services are necessary to improve his/her health. The older groups of Medicare patients were found to demand more follow-up office visits than was the younger group (65-74). The positive differentials, however, are not significant. Probably this is because some of these effects are captured by variables assumed to measure the individual's health status.

9. Male patients demand fewer visits than do female patients and use them over fewer months.

10. Patients who were in the labor force before qualifying for Medicare use fewer medical services but demand a higher quality per visit than other users.

11. A doctor's tendency to increase the number of diagnostic services in his/her private office has a positive impact on the patient's decision to contact a physician in the first place but a negative one on his/her decision to continue seeing any physician thereafter; that is, the coefficients of the SERVIS variable and of its monetary value PR459 are positive in the comprehensive "VISITS" equation and negative in the follow-up "VISITS" equation.

12. An increase in the number of diagnostic services per visit generates additional costs which give rise to a trade-off between visits and quality in favor of the latter. As predicted, in the case of follow-up office visits, the regression coefficients of the SERVIS variable and its monetary alternative PR459 are negative in the visit equation and positive in the quality equation. Both coefficients are highly significant. In the case of initial comprehensive visits the coefficients are positive in both the visit and quality equations, but are highly significant only in the visit equation.

13. An increase in quality per visit was found to be inversely related to the number of physician contact months. Higher quality per visit implies fewer services and therefore lower costs to the patients and to the program as well. In the CARE equation the price elasticity is lower in absolute value than that of the VISIT9 equation (-0.17 versus -0.41).

14. The demand for visits is more sensitive to a change in the net quality-adjusted price "after" the deductible has been met than "before". This relation holds in both visit and quality per visit equations. Aged patients are likely to need a large number of medical services. Therefore expenditures "after" the deductible has been met make up a greater proportion of their total expenditures on medical services than do those "before" the deductible. And further, as their health deteriorates with age, patients may need more expensive treatment such that the (marginal) cost of getting each additional unit of service (20 percent of allowed charges) becomes a greater and greater burden for them.

15. Patients with a zero rate of assignment are more sensitive to changes in the net price of follow-up office visits than are those with a positive rate. The decision to contact a physician in the first place, however, is less influenced by the acceptance or non-acceptance of assignment, the coefficient of elasticity being fairly inelastic in both cases.

16. An analysis of demand for visits and quality of these visits by physician specialty type reveals that the demand for follow-up visits is highly inelastic for surgeons as compared to that of general practitioners and internists ($\eta_{v9SUR} < \eta_{v9MED} < \eta_{v9GP}$), while the reverse is true of the demand for quality per visit ($\eta_{q9SUR} > \eta_{q9MED} = \eta_{q9GP}$).

TABLE 13

SUMMARY OF THE REGRESSION RESULTS FOR DEMAND CURVES OF VISITS AND QUALITY

Independent variables \ Dependent variables	VISIT9		VISIT19		QUAL9		QUAL19	
	Sign	Significant coefficient[a]	Sign	Significant coefficient[a]	Sign	Significant coefficient[a]	Sign	Significant coefficient[a]
NETP	-	*	-		-		-	
MEDICAID	-		+		+	*	+	
HOME	+	*	+	*	+		-	b
HOSP	+	*	+		+	*	+	
ECF	+		-		-		+	
H_PROB	+	*	-		+	c	-	
SERVIS	-	*	+	*	+	*	+	
AGED2	+		+		-	*	+	
AGED3	+		-		+		-	
MALE	-	*	-		-		+	c
WAGE	-		-		+		-	

[a]Significant at conventional level of 5 percent

[b]Significant at 8 percent

[c]Significant at 9 percent

Source: Table C.2

TABLE 14

SUMMARY OF THE REGRESSION RESULTS FOR DEMAND CURVES - THE "BEFORE" AND THE "AFTER" SUBSAMPLES

Independent variables \ Dependent variables	VISIT9			VISIT19			QUAL9			QUAL19		
	Total (1)	"Before" (2)	"After" (3)	Total (4)	"Before" (5)	"After" (6)	Total (7)	"Before" (8)	"After" (9)	Total (10)	"Before" (11)	"After" (12)
NETP	− *	− *	− *	−	−	−	−	−	−	−	+	−
MEDICAID	−	− *	−	+	−	−	+ *	−	−	+	+[a]	+
HOME	+ *		+ *	+ *	b	+	+		+	−	b	−
HOSP	+ *	+	+ *	+	b	+	+ *	−	+ *	+	b	+
ECF	+	b	b	−	b	b	+	b	b	+	b	b
H_PROB	+ *	− *	+ *	−	−	+	+	+	+	−	+	−
SERVIS	− *	− *	+ *	+ *	−	+ *	+ *	+	+ *	+	+	+
AGED2	+	+	+	+	+	+	− *	− *	− *	+	−	+
AGED3	−	+ *	−	−	+ *	−	+	+	−	−	− *	−
MALE	− *	− *	− *	−	−	−	−	+	−	+	+	+
WAGE	−	+	−	−	−	+	+	+	+	−	−	−

*Significant at .05

[a]Significant at .08

[b]Number of cases is too small, therefore omitted from regression

Source: Table C.6 and Table C.7

NOTES TO CHAPTER IV

1. For more detailed discussion see Triplett, E. Jack, comments of "The Concept and Measurement of Product Quality, Jack E. Triplett". In Household Production and Consumption, edited by Nestor E. Terleckyj: New York Columbia University Press (for National Bureau of Economic Research), 1975, pp. 567 - 568.

2. In their study Goldman and Grossman show that the comparative static analysis reveals that "the reduced-form demand curve for visits has very different properties than the rendered-form demand curve for quality. In percentage terms, the responsiveness of visits to income exceeds that of quality, visits fall and quality rises as the fixed cost of a visit rises, and quality-adjusted price increases have a larger negative impact on quality than on visits." See Goldman and Grossman "The Demand for Pediatric Care: An Hedonic Approach, " 1978, opus cit., p. 267.

3. See Rosen,Sherwin, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition", Journal of Political Economy 82, No. 1 (January/February 1974), pp. 34 - 36.

4. See Newhouse, Joseph P., and Phelps, Charles E. "Price and Income Elasticities for Medical Care Services".In The Economics of Health and Medical Care, edited by Perlman, London: MacMillan, 1974, p. 142, and "New Estimates of Price and Income Elasticities of Medical Care Services".In The Role of Health Insurance in the Health Services Sector, edited by Richard N. Rosett. New York: Neale Watson Academic Publications (for the National Bureau of Economic Research, 1976, and Colle, D. Ann, and Grossman, Michael, "Determinants of Pediatric Care Utilization", National Bureau of Economic Research, Working Paper No. 240, April 1978, pp. 5 - 6.

5. See Goldman and Grossman, "The Demand for Pediatric Care," opus cit. 1972, pp. 266.

6. It is assumed that the first physician-patient contact took place at the physician's private office. However, this is a rather drastic assumption since it excludes two sorts of cases: those in which the first contact occurred at the physician's office prior to 1976; and those in which the first contact took place elsewhere, i.e. the emergency room of a hospital, or an extended care facility. Although those contacts would add to an understanding of patient access to care, given the data limitations, this aspect will not be explored in the present study.

7. See Grossman, "The Demand for Health," opus cit., 1972, pp. 44 - 45.

8. Ibid.

9. For more discussion see Acton, Jon P. "Demand for Health Care Among the Urban Poor, with special Emphasis on the Role of Time". In The Role of Health Insurance in the Health Services Sector, edited by

Richard Rosett. New York: Neale Watson Academic Publications for the National Bureau of Economic Research, 1976, pp. 168-169.

10. See Coulter, Elizabeth J. Health Service Utilization and Charges Among Aged Persons of Selected Characteristics: U.S. Current Medicare Survey presented at the Annual Meeting of the American Public Health Association, October 19, 1976.

11. See Grossman, opus cit., 1972, pp. 11-21, and Phelps, Charles E., "Demand for Health Insurance: A Theoretical and Empirical Investigation", Santa Monica, California: The Rand Corporation, R-1054-OEO, July 1973.

12. $$SERVIS9_i = \frac{\sum_{i=1}^{n} (SER4 + SER5)}{\sum_{i=1}^{n} (VISIT9)}$$

$$SERVIS19_i = \frac{\sum_{i=1}^{n} (SER4 + SER5)}{\sum_{i=1}^{n} (VISIT19)}$$

where: n = number of physicians

SER4 = diagnostic x-ray services rendered in the physician's private office to i^{th} patient in the sample

SER5 = diagnostic laboratory services rendered in the physician's private office to i^{th} patient in the sample.

VISIT9 or VISIT19 as defined previously is the number of follow-up or comprehensive visits received by that patient during 1976.

13. See Grossman, opus cit., 1972, pp. 11-21

14. See Newhouse, Joseph and Phelps, Charles, opus cit., 1976, p. 267.

15. See Muller, Charlotte, "Economics of Aging," presented at Invitational Conference on Gerentology and Aging Research: Status of Art, September 1978, pp. 1 - 26.

16. See Becket, Gary, "A Theory of Allocation of Time", Economic Journal.75 (September 1965), pp. 493-517, Acton, opus cit., 1975, pp. 165-193, and Goldman and Grossman, opus cit., 1978, pp. 261-265.

17. See Acton, opus cit., 1976, pp. 168-170.

18. Ibid. pp. 165-177.

19. See Muller, Charlotte, opus cit., 1978, pp. 1 - 26.

20. See Huang, Lien-fu and Koropecky, Orest, "The Effects of the Medicare Method of Reimbursement on Physicians' Fees and on Beneficiaries' Utilization", Volume II, Part II of Health Insurance Benefits Advisory Council Report, Robert R. Nathan Associates, July 1973, pp. 51 - 63.

APPENDIX A
(Statistics Relevant to Beneficiary and Physician Profiles)

TABLE A.1

WEIGHTED AVERAGE SUBMITTED CHARGE BY SPECIALTY TYPE AND BOARD CERTIFICATION STATUS

Queens Specialties by Type		FOLLOW-UP OFFICE VISIT (PRICE9)		COMPREHENSIVE OFFICE VISIT (PRICE19)	
Specialty Type and Specialty	GHI CODE	BOARD	N-BOARD	BOARD	N-BOARD
I. General practitioner			13.77		19.45
General practice	01		13.57		19.45
Family practice	08		13.39		
Manipulative therapy[b]	12				
II. Medical specialties		18.12	17.23	35.00	34.87
Allergy	03	10.00	10.00		30.00
Cardiovascular diseases	06	19.20	18.20	33.33	35.00
Dermatology	07	18.52	21.33	31.67	37.50
Gastroenterology	10	15.00	-	35.00	-
Internal medicine	11	18.21	17.27	35.83	34.84
Pediatrics	37				
Pulmonary diseases	29		14.04		
III. Surgical specialties		19.65	21.17	32.39	33.78
General surgery	02	16.61	16.94	30.00	30.71
Neurological surgery	14				
Obstetrics and gynecology	16	21.97	22.28	35.00	35.00
Gynecology[b]	09				
Obstetrics[b]	15				
Ophthamology	18	22.58	24.22	27.46	28.90
Orthopedic surgery	20	23.90	24.04	43.93	44.71
Otolaryngology	04	18.55	18.71	29.17	28.13
Otolaryngology[b]	17				
Plastic surgery	24				30.00
Proctology	28		15.00	25.00	15.00
Thoracic surgery	33		15.00		
Urology	34	12.79	19.00	28.00	30.00
Hand surgery	40				

TABLE A.1 (continued)

Specialty Type and Specialty					
IV. Other specialties		18.62	21.89	62.22	40.00
Anesthesiology	05		15.0		
Neurology	13	29.17	35.00	55.00	40.00
Pathology	22	18.40	22.88	25.00	
Physical medicine and rehabilitation	25	13.20	16.79	15.00	
Psychiatry	26		20.00		25.00
Radiology	30	16.96	26.25	96.25	
Nuclear medicine	36	15.00			
Geriatrics	38				
Nephrology	39				
Miscellaneous physician	49	23.33	27.08		
Pathologic anatomy;clinical pathology[b]	21				
Peripheral vascular diseases or surgery[b]	23				
Psychiatric neurology[a,b]	27				
Roentgenology,radiology[b]	31				
Radiation therapy[b]	32				
Non-MD's					
Podiatry	48	13.77		18.93	

a weights are the number of visits
b osteopaths only

TABLE A.2

DISTRIBUTION OF QUEENS PART B MEDICARE PROVIDERS
BY SPECIALTY TYPE AND BOARD CERTIFICATION STATUS

	Number	Percent	Percent
I. Total MD's physicians	961	100.0 %	86.9 %
Board certified	241	25.1	
1. General practitioners	284	29.6	x
2. Medical specialties	295	30.5	x
Board	95	(32.2)	
Non-Board	200	(67.8)	
3. Surgical specialties	249	25.9	x
Board	96	(38.6)	
Non-Board	153	(61.4)	
4. Other specialties	134	14.0	
Board	50	(37.3)	
Non-Board	84	(62.7)	
II. Non-MD's*	145	100.0	13.1
Podiatry	98	67.6	
Chiropractor	9	6.2	
Independent laboratory	20	13.8	
Supply	16	11.0	
Radiation therapy	2	1.4	
III. Total providers Part B Medicare	1,106	x	100.0

* Excluded from the analysis

TABLE A.3

PROCEDURES FREQUENTLY PERFORMED BY SPECIALTY TYPE

(NUMBER OF PATIENTS SEEN, NUMBER OF SERVICES AND TOTAL EXPENDITURES IN DOLLAR SUBMITTED CHARGE)

GHI CODE	PROCEDURE AND PHYSICIAN'S SPECIALTY TYPE	PATIENTS		SERVICES		SUBMITTED CHARGE		$ PER PATIENT	$ PER SERVICE	SERVICES PER PATIENT
		Number (1)	Percent (2)	Number (3)	Percent (4)	$ (5)	Percent (6)	(7)	(8)	(9)
I.	Visits									
9000	Routine follow-up office visit	1,224	100.0%	7,000	100.0%	115,872.00	100.0	94.59	16.55	5.7
	GP	532	43.4	2,805	40.1	37,801.00	32.6	71.05	13.48	5.3
	MED	575	46.9	2,622	37.4	45,917.00	39.6	79.85	17.51	4.6
	SURG	486	39.7	1,398	20.0	28,682.80	24.8	59.02	20.51	2.9
	OTHR	44	35.9	175	2.5	3,471.00	3.0	78.89	19.83	4.0
9019	Initial comprehensive office visit	185	100.0	208	100.0	7,008.70	100.0	37.88	33.69	1.1
	GP	19	10.3	20	9.6	389.00	5.6	20.47	19.45	1.1
	MED	62	33.5	64	30.8	2,235.00	31.9	36.05	34.92	1.0
	SURG	109	58.9	113	54.3	3,743.70	53.4	34.34	33.13	1.0
	OTHR	10	5.4	11	5.3	640.00	9.1	64.00	58.18	1.1
9005	Follow-up hospital visit	172	100.0	3,124	100.0	60,706.00	100.0	352.94	19.40	18.2
	GP	58	33.7	1,000	32.0	17,290.00	28.5	298.10	17.29	17.2
	MED	113	65.7	1,801	57.7	37,096.00	61.1	328.30	20.56	15.9
	SURG	27	15.7	244	7.8	4,560.00	7.5	168.91	18.71	9.0
	OTHR	11	6.4	79	2.5	1,760.00	2.9	160.04	22.27	7.2
9012	Initial comprehensive hospital visit	88	100.0	102	100.0	3,994.00	100.0	45.40	39.22	1.2
	GP	16	18.2	18	17.7	487.00	12.2	30.41	27.06	1.1
	MED	56	63.6	61	59.8	2,532.00	63.4	45.23	41.50	1.1
	SURG	16	18.2	18	17.6	785.00	19.7	49.12	43.61	1.1
	OTHR	5	5.7	5	4.9	190.00	4.7	38.04	38.00	1.0

TABLE A.3 (continued)

GHI CODE	PROCEDURE AND PHYSICIAN'S SPECIALTY TYPE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
9024	Routine follow-up home visit	107	100.0	382	100.0	7,025.00	100.0	66.65	18.39	3.6
	GP	74	69.2	247	64.7	4,348.00	61.9	58.76	17.60	3.3
	MED	29	27.1	120	31.4	2,368.00	33.7	81.66	19.73	4.1
	SURG	5	4.7	11	2.9	215.00	3.1	43.00	19.55	2.2
	OTHR	3	2.8	4	1.0	94.00	1.3	31.30	23.50	1.3
II.	Diagnostic x-rays	411		643		21,920.00		53.33	34.09	1.6
7100	Radiology(chest Single PA,)	192	100.0	243	100.0	5,438.00	100.0	28.30	22.38	1.3
	GP	54	28.1	70	28.9	1,395.00	25.7	25.80	19.90	1.3
	MED	103	53.7	131	53.9	2,940.00	54.1	28.50	22.40	1.3
	SURG	2	1.0	2	0.8	50.00	0.9	25.00	25.00	1.0
	OTHR	34	17.7	40	16.4	1,053.00	19.3	30.97	26.33	1.2
7101	Radiology(chest complete)	84	100.0	93	100.0	2,685.50	100.0	31.98	28.88	1.1
	GP	19	22.6	21	22.6	561.00	20.9	29.53	26.71	1.1
	MED	44	52.4	49	52.7	1,435.00	53.4	32.60	29.29	1.1
	SURG	1	1.2	2	2.1	70.00	2.6	70.00	35.00	2.0
	OTHR	20	23.8	21	22.6	620.00	23.1	31.00	29.52	1.1
7215	Radiology (spine lumbo-sacral)	27	100.0	30	100.0	1,475.00	100.0	54.63	49.17	1.1
	GP	1	3.7	2	6.7	50.00	3.4	50.00	25.00	2.0
	MED	4	14.8	4	13.3	170.00	11.5	42.50	42.50	1.0
	SURG	1	3.7	1	3.3	75.00	5.1	75.00	75.00	1.0
	OTHR	21	77.8	23	76.7	1,180.00	80.0	56.19	51.30	1.1
7358	Radiology (upper gastro intestinal)	27	100.0	30	100.0	2,315.00	100.0	85.79	77.17	1.1
	GP	3	11.1	5	16.7	315.00	13.6	105.00	63.00	1.7
	MED	4	14.8	5	16.7	410.00	17.7	102.50	82.00	1.3
	SURG	–	–	–	–	–	–	–	–	–
	OTHR	20	74.1	20	66.6	1,590.00	68.7	79.50	79.50	1.0

TABLE A.3 (continued)

GHI CODE	PROCEDURE AND PHYSICIAN'S SPECIALTY TYPE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
7360	Radiology (colon)	19	100.0	23	100.0	1,585.00	100.0	83.41	68.91	1.2
	GP	1	5.2	5	21.7	165.00	10.4	165.00	33.00	5.0
	MED	6	31.6	6	26.1	525.00	33.1	87.50	87.50	1.0
	SURG	-	-	-	-	-	-	-	-	-
	OTHR	12	63.2	12	52.2	895.00	56.5	74.58	74.58	1.0
III.	Diagnostic Laboratory	688		2,237		26,449.00		38.44	11.82	3.35
8622	Blood test (hemoglobin determination)	42	100.0	67	100.0	231.00	100.0	5.50	3.45	1.6
	GP	20	47.6	32	47.8	95.50	41.34	4.78	2.98	1.6
	MED	21	50.0	34	50.7	130.50	56.50	6.21	3.84	1.6
	SURG	1	2.4	1	1.5	5.00	2.20	5.00	5.00	1.0
	OTHR	-	-	-	-	-	-	-	-	-
8628	Blood test (complete count)	62	100.0	110	100.0	800.00	100.0	12.90	7.27	1.8
	GP	26	42.0	43	39.1	302.00	37.7	12.30	7.02	1.7
	MED	32	51.6	59	53.6	446.00	55.8	13.94	7.56	7.6
	SURG	2	3.2	2	1.8	15.00	1.9	7.50	7.50	7.5
	OTHR	2	3.2	6	5.5	37.00	4.6	18.50	6.17	6.2
8720	Blood test (sedimentitiary rate)	53	100.0	68	100.0	313.00	100.0	5.91	4.60	1.3
	GP	13	24.5	17	25.0	66.00	21.1	5.08	3.88	1.3
	MED	38	71.7	49	72.0	239.00	76.3	6.29	4.88	1.3
	SURG	1	1.9	1	1.5	5.00	1.6	5.00	5.00	1.0
	OTHR	1	1.9	1	1.5	3.00	1.0	3.00	3.00	1.0
8726	Blood test (sugar)	79	100.0	245	100.0	1,209.50	100.0	15.31	4.94	3.1
	GP	44	55.7	144	58.8	754.00	62.4	17.14	5.24	3.3
	MED	35	44.3	96	39.2	428.50	35.4	12.24	4.46	2.7
	SURG	-	-	-	-	-	-	-	-	-
	OTHR	1	-	5	2.0	27.00	2.2	27.00	5.40	5.0

TABLE A.3 (continued)

GHI CODE	PROCEDURE AND PHYSICIAN'S SPECIALTY TYPE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8753	Blood test (SMA-12 profile)	31	100.0	44	100.0	771.00	100.0	24.87	17.52	1.4
	GP	10	32.3	19	43.2	284.00	36.8	28.40	14.95	1.9
	MED	20	64.5	23	52.2	445.00	57.7	22.30	19.35	1.2
	SURG	-	-	-	-	-	-	-	-	-
	OTHR	2	6.4	2	4.5	42.00	5.5	21.00	21.00	1.0
8754	Blood test health profile (SMA-2 plus CBC)	46	100.0	51	100.0	1,409.50	100.0	30.64	27.63	1.1
	GP	28	60.9	32	62.7	797.00	56.6	28.46	24.91	1.1
	MED	17	37.0	18	35.3	592.50	42.0	34.85	39.91	1.1
	SURG	-	-	-	-	-	-	-	-	-
	OTHR	1	2.1	1	2.0	20.00	1.4	20.00	20.00	1.0
8934	Urine test (complete routine)	274	100.0	583	100.0	1,951.50	100.0	7.12	3.30	2.1
	GP	98	35.8	196	33.6	590.50	30.3	6.03	3.01	2.0
	MED	149	54.4	293	50.3	975.00	50.0	6.54	3.33	2.0
	SURG	35	12.8	71	12.2	282.00	14.5	8.06	3.97	2.0
	OTHR	6	2.2	23	3.9	103.00	5.2	17.17	4.48	3.8
8983	Electrocardiogram or vector cardiogram (both)	413	100.0	674	100.0	16,062.00	100.0	38.90	23.80	1.6
	GP	135	32.7	217	32.2	4,818.00	30.0	35.69	22.20	1.6
	MED	271	65.6	442	65.6	10,894.00	67.8	40.10	24.65	1.6
	SURG	5	1.2	5	0.7	110.00	0.7	22.00	22.00	1.0
	OTHR	8	1.9	10	1.5	240.00	1.5	30.00	24.00	1.3
8800	Feces test	59	100.0	66	100.0	288.50	100.0	4.88	4.37	1.1
	GP	5	8.5	5	7.6	24.50	8.5	4.90	4.90	1.0
	MED	51	86.4	58	87.9	251.00	87.0	4.90	4.24	1.1
	SURG	1	1.7	1	1.5	5.00	1.7	5.00	5.00	1.0
	OTHR	2	3.4	2	3.0	8.00	2.8	4.00	4.00	1.0

TABLE A.4

PERCENT DISTRIBUTION OF QUEENS MEDICARE PHYSICIANS
BY NUMBER OF DIFFERENT PROCEDURES PERFORMED IN 1976
- BY SPECIALITY TYPE -

Percent of physicians	Maximum number of different procedures (PROC_KT)							
	GP		MED		SURG		OTHR	
	S[a]	Q[b]	S	Q	S	Q	S	Q
1 - 25.0%	1	9	1	13	1	11	1	11
25.1 - 50.0%	2	14	3	20	2	22	2	31
50.1 - 75.0%	4	25	5	31	4	38	4	52
90.1 - 100.0%	16	89	17	78	17	154	14	156

All physicians N = 961

GP (General practitioners) N_1 = 284
MED (Internists) N_2 = 294
SURG (Surgeons) N_3 = 249
OTHR (Other specialists) N_4 = 134

Note: Physicians' performance with respect to the number of different procedures (PROC-KT) is presented under two situations:

a) S = in the USER sample

b) Q = in their whole Queens Medicare practice

TABLE A.5

DISTRIBUTION OF QUEENS MEDICARE BENEFICIARIES BY
NUMBER OF DIFFERENT PROCEDURES RECEIVED

Number of different procedures	Queens beneficiaries Number	Percent
1	279	22.1%
2	243	19.2
3	173	13.7
4	145	11.5
5	101	8.0
6	95	7.5
7	71	5.6
8	51	4.0
9	37	2.9
10	24	1.9
11	11	0.9
12	16	1.3
13	5	0.4
14	7	0.5
15	2	0.2
16	3	0.2
17	1	0.1
20	1	0.1

N = 1,263

TABLE A.6

PERCENT DISTRIBUTION OF QUEENS MEDICARE PHYSICIANS BY SERVICES PER PATIENT AND BY SPECIALTY TYPE

Services per patient (SER_PPAT)	Percent of physicians (cumulative)			
	GP	MED	SURG	OTHR
Only 1	8.5%	7.6%	18.9%	43.5%
5	41.5	46.0	81.9	85.5
15	83.3	86.9	96.0	96.9
50	99.6	100.0	100.0	100.0
51 and over	100.0	-	-	-
Maximum services per patient	57	48	41	25

N = 961

TABLE A.7

FREQUENCY DISTRIBUTION OF QUEENS MEDICARE PHYSICIANS
BY SERVICE PER PATIENT
- BY PHYSICIANS' SPECIALTY TYPE

Percent of physicians	SERVICES PER PATIENT (SER_PPAT) FOR MDs AT UPPER END OF INTERVAL							
	GP		MED		SURG		OTHR	
	S[a]	Q[b]	S	Q	S	Q	S	Q
1 - 25.0%	3.0	5.6	2.9	4.8	1.4	1.8	-	-
25.1 - 50.0	6.5	7.8	6.5	7.8	2.0	2.6	1.5	1.5
50.1 - 75.0	11.0	10.2	11.0	10.7	4.0	4.0	3.0	2.6
75.1 - 100.0	57.0	26.6	48 0	26.1	41.0	22.2	25.0	22.1

N = 961

GP (General practitioners	N_1	=	284
MED (Internists)	N_2	=	294
SURG (Surgeons)	N_3	=	249
OTHR (Other specialists)	N_4	=	134

Note: Physicians performance with respect to the number of services per patient (SER_PPAT) is presented under two situations:

a) S = in the USER sample

b) Q = in their whole Queens Medicare practice

TABLE A.8

PERCENT DISTRIBUTION OF PHYSICIANS BY NUMBER OF PATIENTS SEEN

Queens Medicare Patients seen	PERCENT							
	GP		MED		SURG		OTHR	
Number	S	Q	S	Q	S	Q	S	Q
1	43.0	-	33.7	0.3	43.8	-	52.2	1.5
2	28.5	-	22.8	-	19.7	1.6	20.9	-
3	13.4	0.4	17.7	0.3	12.0	0.4	7.5	2.3
4	6.7	0.4	13.6	0.3	6.4	-	6.0	-
5	3.5	0.4	4.8	0.7	2.4	0.8	5.2	0.8
6	1.8	-	2.7	-	5.2	-	2.2	0.8
7	1.8	-	2.0	0.3	1.6	-	0.7	1.5
8	0.7	-	0.7	-	2.4	0.4	1.5	-
9	-	0.7	1.4	-	1.2	-	1.5	0.8
10	0.4	-	-	-	1.2	-	0.7	0.8
11	-	0.4	0.3	-	1.6	-	0.7	-
12	-	-	-	-	0.4	0.8	-	0.8
13	-	-	0.3	0.3	-	-	0.7	-
14	0.4	-	-	-	0.4	-	-	-
15	-	-	-	-	0.4	-	-	-
16	-	-	-	-	0.8	-	-	-
17	-	-	-	-	0.4	-	-	-
18	-	-	-	-	-	-	-	-
Maximum number of patients seen	14	806	13	1,835	18	1,610	13	1,980
N =	284		294		249		134	

TABLE A.9

NUMBER OF PATIENTS SEEN AND NUMBER OF SERVICES PER PATIENT BY PHYSICIAN'S SPECIALTY TYPE

		GP		MED		SURG		OTHR		TOTAL	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total number of physicians		284	29.6%	294	30.6%	249	25.9%	134	13.9%	961	100.0%
Total number of patients seen during 1976	S[a]	627	25.5	782	31.8	740	30.0	313	12.7	2,462	100.0
	Q[b]	47,433	22.4	74,588	35.2	62,350	29.4	27,452	13.0	211,823	100.0
Number of total services rendered during 1976	S	5,430	35.0	6,672	43.0	2,477	16.0	955	6.0	15,534	100.0
	Q	397,118	30.9	634,832	49.4	183,924	14.3	70,512	5.4	1,286,386	100.0
Service per patient (SER_PPAT)	S	8.7		8.5		3.3		3.1		6.3	
	Q	8.4		8.5		2.9		2.6		6.1	
Maximum number of patients seen by a physician during 1976	S	14		13		18		13		18	
	Q	806		1,835		1,610		1,980		1,980	
Maximum number of services rendered by a physician during 1976	S	176		141		123		63		141	
	Q	8,185		11,948		3,359		3,908		11,948	
Maximum number of services per patient	S	57		48		41		25		57	
	Q	26.6		26.1		22.2		22.2		26.6	
Maximum number of procedure mix (PROC_KT)	S	16		17		17		17		14	
	Q	89		78		154		156		156	

N = 961

a) S = physician performance in the USER sample
b) Q = physician performance in their whole Queens Medicare practice

TABLE A.10

DIAGNOSTIC LABORATORY AND DIAGNOSTIC X-RAY SERVICES[a] PERFORMED IN THE PHYSICIAN'S PRIVATE OFFICE AS A RATIO TO THE NUMBER OF OFFICE VISITS
- BY PHYSICIAN SPECIALTY TYPE -

I.

Specialty type	Office visits[b] Number	Diagnostic services Number	Ratio of diagnostic services to office visits
General practitioner	2,805	953	.34
Internal medicine	2,622	1,419	.53
Surgical specialties	1,398	250	.17
"Other" specialties	175	258	1.47
All specialties	7,000	2,880	.41

II.

Total patients with office visits (follow-up and/or initial comprehensive): 1,263

	Number	Percent
1. Patients with diagnostic X-ray services	411	31.8
2. Patients with diagnostic laboratory services	688	53.3

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a For more detailed definition see text
b Follow-up and/or initial comprehensive visits

TABLE A.11

DISTRIBUTION OF PHYSICIANS BY PERCENT OF CLAIMS ASSIGNED

PRCT_ASS	Frequency	Percent
0	606	63.1%
1 - 9	23	2.4
10 - 19	37	3.8
20 - 29	22	2.3
30 - 39	28	3.0
40 - 49	11	1.2
50 - 59	37	3.9
60 - 69	15	1.5
70 - 79	15	1.5
80 - 89	15	1.5
90 - 98	9	0.9
99 +	143	14.9

N = 961

TABLE A.12

DISTRIBUTION OF QUEENS MEDICARE BENEFICIARIES
BY PERCENT OF CLAIMS ASSIGNED

Percent assigned	Frequency	Percent
0	914	72.4%
1 - 9	24	1.9
10 - 19	48	3.8
20 - 29	39	3.1
30 - 39	30	2.4
40 - 49	9	0.7
50 - 59	23	1.8
60 - 69	21	1.7
70 - 79	17	1.3
80 - 89	13	1.0
90 - 98	7	0.6
99 +	118	9.3

N = 1,263

TABLE A.13

DISTRIBUTION OF PHYSICIANS BY NUMBER OF QUEENS MEDICARE PATIENTS SEEN DURING 1976

Number of Patients	Number of Physicians	Percent
1	412	42.8%
2	220	22.8
3	126	13.4
4	82	8.5
5	37	3.9
6	27	2.8
7	14	1.5
8	12	1.2
9	8	0.8
10	4	0.4
11	5	0.5
12	2	0.2
13	4	0.4
14	3	0.3
15	1	0.1
16	3	0.3
17	1	0.1

N = 961

TABLE A.14

DISTRIBUTION OF QUEENS MEDICARE PATIENTS BY NUMBER OF DIFFERENT DOCTORS SEEN

Number of Different Doctors seen	Number of Patients	Percent
1	521	41.2%
2	367	29.0
3	181	14.4
4	80	6.4
5	63	5.0
6	29	2.3
7	12	0.9
8	6	0.5
9	1	0.1
10	1	0.1
11	1	0.1
12	1	0.1

N = 1,263

TABLE A.15

DISTRIBUTION OF QUEENS MEDICARE PATIENTS WITH POSITIVE OFFICE VISITS BY NUMBER OF "PHYSICIAN CONTACT" [a]

Number of months with physician contact	Patients Number	Percent
1	210	16.6%
2	178	14.1
3	109	8.6
4	120	9.5
5	107	8.5
6	82	6.5
7	95	7.5
8	75	5.9
9	80	6.4
10	66	5.2
11	61	4.9
12	80	6.3

a See text for definition

APPENDIX B

(HEDONIC PRICE FUNCTIONS: ADDITIONAL RESULTS)

The Detection of Multicollinearity

The detection of multicollinearity was performed by regressing each of the explanatory variable on the remaining explanatory variables. The corresponding coefficients of determination (R_i^2) will show whether an explanatory variable is highly correlated with the rest of the variables in the model (see Domar Gujarati, 1978, p.188). The results are presented in Table B.1. They are the following:

TABLE B.1

	Explanatory variables used as dependent variables	F Test	R_i^2	Number	Explanatory variables significant at 5% in each equation NAME
1.	MEDB	21.7	0.28	4	MED,REVENUE,SER_PPAT,MED_ASS
2.	SURGB	29.2	0.35	3	SURG,REVENUE,SURG_ASS
3.	OTHRB	30.1	0.35	3	OTHR,OFFICE_H,OTHR_DIAG
4.	OFFICE_H	14.9	0.21	7	SURG,OTHR,OTHRB,PROC_KT, PRCT-ASS,SER_PPAT,MED-ASS
5.	REVENUE	20.47	0.27	8	MED,SURG,MEDB,SURGB,PROC_KT, SER_PPAT,SURG-DIAG,OTHR_DIAG
6.	SER-PPAT	36.99	0.40	9	PRCT-DIAG,SURG,OTHR,SURGB, MEDB,OFFICE-H,REVENUE, SURG-DIAG,PRCT_KT
7.	PRCT_KT	22.98	0.29	8	MEDB,OFFICE_H,REVENUE, OTHR-ASS,SER_PPAT,PRCT-DIAG, MED-DIAG,OTHR-DIAG
8.	PRCT_ASS	22.69	0.80	8	MED,SURG,OTHR,MEDB,OFFICE-H, MED_ASS,SURG_ASS,OTHR_ASS
9.	PRCT_ASS*	8.00	0.10	6	MED,SURG,OTHR,SURGB, OFFICE_H,MEDB

* The interaction terms were dropped from the regression (MED_ASS, SURG_ASS,OTHR_ASS)

As expected, the highest coefficient of determination (R_i^2) is found for equation 8, where PRCT_ASS is the dependent variable. By dropping the interaction terms (MED_ASS,SURG_ASS and OTHR_ASS) from equation 8 the R_i^2 is considerably reduced (from 0.80 to 0.10), see equation 9. The same variables remain significant as in equation 8, and in addition SURGB is significant.

Factor Analysis

Factor analysis was used as a guide toward the selection of variables for regression analysis. Forty-four (44) variables were considered - of which seven were measures of physician professional status, ten were measures of the physician's performance, and the remaining 27 were interaction terms which measured the joint effect of the physician's professional and performance characteristics. Out of the 44 variables included, eight factors were developed.

The variables selected for regression analysis were those with the highest factor loadings on the eight factors retained in analysis. The analysis was performed for all physicians who provided follow-up routine and/or comprehensive office visits.

The results of the factor analysis are reported in Table B.2.

The SAS Package with Varimax rotation was used.

1. The first factor extracted explained 27 percent of the variance in the system. The variables with higher loadings (45 percent and over) on this factor can be grouped as follows: those referring to medical or surgical specialties as well as to all of their interactions with performance measures and those referring to two general measures of physician's performance, SERV_KT (0.60) and SER_PPAT (0.58). The loadings are: MED (0.89) MEDB (0.51) MED_PRO (0.85) MED_DIAG (0.52) MED_SPAT (0.85)

TABLE B.2

FACTOR ANALYSIS

ROTATION METHOD: VARIMAX

ROTATED FACTOR PATTERN

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7	FACTOR8
PROC_KT	0.01368	-0.07104	0.03366	0.43117	-0.05675	0.02017	0.11284	0.82531
SERV_KT	0.59608	0.05862	0.29537	0.54415	0.23794	-0.06459	0.11429	0.13179
HIC_KT	-0.04590	-0.08739	-0.01602	0.26866	0.90865	-0.07551	-0.08699	0.02969
PRCT_ASS	-0.09803	0.14032	0.08751	0.13568	-0.09372	0.96469	-0.02460	-0.08986
SER_PPAT	0.58076	0.41015	0.31285	0.21351	-0.17567	-0.09011	0.23628	0.13096
PCT_DIAG	0.24114	0.17389	-0.01881	0.18361	-0.11910	0.03481	0.91148	0.23649
MED	0.88901	-0.14213	-0.26621	-0.08099	-0.11108	0.12258	0.11020	0.02633
SURG	-0.85049	-0.16567	-0.32856	0.14264	0.17686	-0.08465	-0.07637	-0.02164
OTHR	-0.01168	0.95035	-0.03917	-0.02616	-0.01750	0.01819	-0.03728	-0.00308
GP	-0.05214	-0.02465	0.93253	-0.08112	-0.09186	-0.06711	-0.03275	-0.00625
MEDB	0.50327	-0.07817	-0.16637	0.01597	-0.11123	-0.08399	0.00824	-0.03019
SURGB	-0.49098	-0.08775	-0.18083	0.04305	0.30468	-0.08158	-0.05588	0.10481
OTHRB	-0.01168	0.95035	-0.03917	-0.02616	-0.01750	0.01819	-0.03728	-0.00308
OFFICE_H	0.18552	0.05992	0.11176	0.03958	0.19258	-0.12411	0.03602	0.46296
REVENUE	0.02104	0.05106	-0.05740	0.93187	0.20355	-0.02291	0.04180	0.08589
MED_ASS	0.49266	-0.09025	-0.15349	-0.11394	-0.04970	0.56074	0.03453	0.02716
SURG_ASS	-0.60497	-0.12225	-0.22166	0.23351	-0.03584	0.26352	-0.04967	-0.06251
OTHR_ASS	-0.00923	0.92315	-0.01916	-0.01046	-0.01237	0.02957	0.01113	-0.00656
GP_ASS	-0.03403	-0.01979	0.68765	0.07367	-0.04198	0.18194	-0.03926	-0.08837
MED_PRO	0.86306	-0.12324	-0.21245	0.10298	-0.05444	0.08832	0.10246	0.19807
SURG_PRO	-0.72559	-0.13335	-0.26057	0.29533	0.03901	-0.01236	-0.00645	0.52168
OTHR_PRO	-0.01852	0.95280	-0.03186	0.09755	-0.04598	0.01582	0.05742	-0.00823
GP_PRO	-0.04496	-0.02234	0.89926	-0.05535	-0.06714	-0.09635	0.00123	0.08017
MED_DIAG	0.52175	-0.09835	-0.13494	0.06440	-0.02727	0.00722	0.73443	-0.04894
SUR_DIAG	-0.47272	-0.08101	-0.16226	0.22487	-0.14793	0.04133	0.16599	0.49985
OTH_DIAG	-0.01657	0.86621	-0.01830	0.12224	-0.04557	0.02211	0.09480	-0.00782
GP_DIAG	-0.04415	-0.02164	0.74561	-0.04327	-0.03832	-0.03756	0.04656	0.07953
MED_SPAT	0.85613	-0.12279	-0.21684	0.13440	-0.09439	-0.04899	0.24223	0.05475
SUR_SPAT	-0.76981	-0.14708	-0.30037	0.15252	0.01115	-0.03612	-0.04225	0.26040
OTH_SPAT	-0.01333	0.95227	-0.01773	0.05683	-0.02774	0.02804	0.05968	-0.00777
MED_HICK	0.86545	-0.12215	-0.21695	0.14652	-0.03319	-0.01201	-0.00583	0.10813
SUR_HICK	-0.46544	-0.08051	-0.16223	0.15019	0.83343	-0.06599	-0.04632	-0.02907
OTH_HICK	-0.01524	0.77832	-0.04846	-0.03127	-0.02467	0.00627	-0.06105	-0.00945
GP_HICK	-0.03606	-0.02691	0.96120	0.02815	-0.04153	0.03155	-0.03115	-0.00652
MED_SERV	0.83901	-0.11428	-0.18834	0.31698	-0.04697	-0.08227	0.13624	0.08254
SUR_SERV	-0.57072	-0.10005	-0.19808	0.23855	0.71677	-0.03223	-0.03224	0.12706
OTH_SERV	-0.01733	0.96540	-0.02643	0.09154	-0.04127	0.02020	-0.06560	-0.00868
GP_SERV	-0.02011	-0.02095	0.89452	0.11326	-0.03906	0.04676	-0.04462	-0.01456
REV_DIAG	0.15006	0.23183	-0.05683	0.62835	-0.09989	-0.10280	0.42609	0.14819
REV_ASS	-0.05868	0.14200	0.11440	0.75725	0.16034	0.26681	-0.03710	0.08427
REV_PRO	-0.04232	0.01846	-0.06570	0.89344	0.03583	-0.00328	0.10611	0.23977
REV_HIC	-0.05624	-0.04086	-0.04501	0.69112	0.52058	0.03209	-0.04084	-0.00836
LNPRICE9	-0.29364	0.09086	-0.42281	0.09403	-0.03325	0.34477	0.08396	-0.09230
LNPRIC19	-0.00358	0.23499	-0.48203	0.13641	-0.21267	0.26363	0.05184	0.23076

MED-ASS (0.49) MED_HIC (0.87) MED_SERV (0.84) and SURG (0.84) SURGB (0.48) SURG_PRO (-0.73) SURG_ASS (-0.62) SURG_SPAT (-0.79) SURG_DIAG (-0.47) SURG_HIC (-0.46) SUR_SERV (-0.57).

2. The second factor extracted explained 22 percent of the variance in the system; it represents professional status measures for "other" specialties and all of their interactions with performance variables. The loadings are: OTHR (0.95) OTHRB (0.95) OTHR_ASS (0.92) OTHR-PRO (0.95) OTHR_SERV (0.96) OTHR_SPAT (0.95) OTHR_HIC (0.78) OTHR_DIAG (0.89) OTHR_PRO (0.95).

3. The third factor extracted explained 18 percent of the variance in the system. The variables with high loadings on these factors are related to general practitioners and their interactions with performance variables. The loadings are: GP ().93) GP_ASS (0.69).GP_PRO (0.90) GP_DIAG (0.75) GP_HIC (0.96) GP_SERV (0.89).

4. The fourth factor explained 15 percent of the variance in the system. The variables with the highest loadings are REVENUE (0.91) and all of the interactions between REVENUE and performance measures REV_DIAG (0.62) REV_PRO (0.87) REV_ASS (0.77) REV_HIC (0.69).

5. Factor five explained an additional seven percent of the variance. Variables such as PROC_KT (0.81, OFFICE_H (0.44) SURG_PRO (0.51) and SURG_DIAG (0.49) have the highest loading.

6. Factor six explained five percent of the variance. The highest loading can be found for PRCT_ASS (0.86) and MED_ASS (0.69).

7. Factor seven explained three percent of the variance. The highest loading is found for PRCT_DIAG (0.93) and for its interaction with medical specialty MED_DIAG (0.74).

8. Factor eight explained an additional two percent of the variance.

The highest loadings are found for HIC_KT (0.89), SUR_HIC (0.83) and SUR_SERV (0.71).

Based on the above results, I have selected 24 variables for regression analysis. A definition of these variables is given in Table 1 of Chapter III.

Stepwise Regression

In addition to the OLS method of multiple regression, the method of stepwise regression was used as a guide toward selection of the "best" set of explanatory variables.

The first variable is selected by applying the criteria of highest correlation coefficient with fees on the zero-order matrix and of coefficient significance at 0.50. Each variable added and retained must not only contribute to the explanation of variance, but must have a coefficient signifiance at .05. Variables that lose their significance following the addition of subsequent variables meeting the stated criteria are deleted.

The results of stepwise regressions are reported in Tables B.3 and B.4. When LNPRICE9 was the dependent variable (see Table B.3), the following eight variables were significant in the last step:

. Specialty status: MED, SURG, OTHR AND MEDB

. Performance variables: PRCT_ASS and SURG_SPAT

. Interaction terms: SURG_SPAT, MED_SPAT and MED_DIAG

While for the first two groups (specialty status and performance variable) the same variables are always significant when performing the OLS multiple regression, for the interaction terms, this is not true, the reason being that the multicollinearity which is introduced when interaction terms are considered. When the LNPRICE19 (see Table B.4) is the dependent variable, only four variables are significant at the 5 percent level. MED was the only significant professional status variable. None of the performance variables was significant. Three of the interaction terms, PRCT_ASS, SURG_SPAT and OTHR_DIAG, are significant. Thirty percent of price variability is explained by this regression.

TABLE B.3

STEPWISE REGRESSION TECHNIQUE
DEPENDENT VARIABLE LNPRICE9

Step (8)

Dependent Variable	Regression Coefficient	Standard Error
MED	0.3572	0.041
SURG	0.5759	0.033
OTHR	0.4479	0.053
MEDB	0.1037	0.035
PRCT_ASS	0.0021	0.000
SUR_SPAT	-0.0377	0.006
MED_SPAT	-0.0177	0.004
MED_DIAG	0.0008	0.000
Constant	2.5534	
R^2	0.42	
F	66.27	

N = 755

TABLE B.4

STEPWISE REGRESSION TECHNIQUE

DEPENDENT VARIABLE LNPRICE19

Step (6)

Independent variable	Regression Coefficient	Standard error
MED	0.3981	0.073
PRCT_ASS	0.0028	0.001
SUR_ PAT	0.1136	0.023
OTHR_DIAG	0.0044	0.001
Constant	3.0485	
R^2	0.30	
F	14.19	

N = 137

APPENDIX C

The expenditures incurred by aged patients on "non-reimbursable fixed costs" are expected to play an influential role in their decision to see and to continue seeing a physician; however, the data available for this study do not provide the necessary information to measure this effect directly. Some of my data can be used, nonetheless, to provide additional information about patients' traveling costs. Although I did not have the physician's office location, I was able to establish the zip code of each of his/her patients. Therefore, by computing the distribution of patients' residential zip codes with respect to each physician, I could determine whether or not they tend to come from the same neighbourhoods. The following results are of interest (see Table C.1). The data show that for each of the 961 physicians providing services to patients who fall into User's sample, patients come from up to 10 different zip codes; the coefficient of variation (C.V.) with respect to the patient's zip code of residence is 72.2 percent. However, there are significant variations according to the doctor's specialty. The lowest C.V., 49.9 percent, is found for GP's and the highest, 83.3 percent, for other specialists. A general practitioner saw patients from up to 5 different zip codes, a specialist in internal medicine from up to 8 different zip codes, a surgical specialist, from up to 10 different zip codes, and "other" specialists from up to 9 different zip codes. From the above it can be concluded that patients who had a greater percent of their services rendered by an internist or surgeon are more likely to travel over greater distances to see their physician and therefore to incur higher shadow prices than are those who tended to use a general practitioner's services.

Another insight is provided by looking at the number of different doctors seen. 41.2 percent of patients with positive office visits saw only one doctor while 30 percent saw more than three doctors (see Table A.14). Although some MD's are located close to each other, one may expect patients who see a larger number of doctors to incur higher transportation costs.

Outside of my own analysis a source useful at this point is the National Ambulatory Medical Care Survey (NAMCS) 1975, which provides information about the duration of visits by specialty types.* Duration of a visit refers to the time the physician spent in face-to-face contact with the patient. Taking all specialties together, for the aged the average duration of a visit, 16 minutes, was not much different from that for patients under 65, 15 minutes. The mean duration of an office visit was found to vary appreciably among specific specialists, however; for example, for a GP it was 12.6 minutes, for an internist 18.2, for an opthamologist 20.3, for a general surgeon 12.7 etc.

Although these results are preliminary and somewhat indirect due to the nature of my data, they point out areas in which further research would be of vital interest to allow a more precise estimation of the total cost of getting care, that is, the non-reimbursable "fixed costs", which must be spent in addition to the money price. It would be of interest to supplement these information provided by the claims with a questionnaire survey of patients covering these additional aspects (time spent traveling, or in the physician's office, distance, etc.).

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*See Advance Data from Vital and Health Statistics, No. 12, October 12, 1977 and No. 22, March 22, 1978, published by U.S. Department of Health, Education and Welfare.

TABLE C.1

DISTRIBUTION OF PATIENTS SEEN BY PHYSICIANS' SPECIALTY TYPE AND PATIENTS' ZIP CODES OF RESIDENCE

Variable	GP	MED	SURG	OTHR	TOTAL
Number of physicians rendering office visits	284	294	249	134	961
Number of different zip codes of patients seen at physician's private office	5	8	10	9	10
Maximum number of patients seen by a physician in the User sample	14	13	18	13	18
Number of different zip codes	1.6	2.1	2.4	2.1	2.0
Average number of patients seen in the User sample	2.2	2.7	3.0	2.4	2.6
Patients' coefficient of variation	75.8	71.0	103.7	94.5	88.4
Zip codes coefficient of variation	49.9	58.7	82.1	83.3	72.2

TABLE C.2

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR PHYSICIAN VISITS AND QUALITY

- FOLLOW-UP AND INITIAL COMPREHENSIVE OFFICE VISITS -

Dependent Variable / Independent Variable	VISIT9		VISIT19		QUAL9		QUAL19	
	Regression Coefficient	t-ratio	Regression Coefficient	t-ratio	Regression Coefficient	t-ratio	Regression Coefficient	t-ratio
NETP	-2.08	-10.18	-0.04	-1.53	-0.01	-0.52	-0.03	-0.99
MEDICAID	-1.03	- 1.49	0.01	0.04	0.14	2.18	0.10	0.91
AGED2	0.46	1.39	0.04	0.61	-0.10	-3.09	0.01	0.17
AGED3	0.03	0.05	-0.02	-0.13	0.01	0.14	-0.16	-0.98
MALE	-0.96	-2.67	-0.01	-0.20	-0.002	-0.06	0.10	1.72
WAGE	-0.16	-0.42	-0.03	-0.35	0.05	1.32	-0.07	-0.98
HOME	0.26	3.43	0.06	2.63	0.00	0.05	-0.04	-1.75
HOSP	2.07	4.87	0.06	0.93	0.09	2.30	0.02	0.40
ECF	1.51	1.01	-0.16	-0.66	-0.04	-0.30	0.06	0.28
SERVIS9	-0.51	-3.92	0.03	2.75	0.05	4.14	0.02	1.42
H_PROB	1.49	3.27	-0.02	-0.32	0.06	1.42	-0.07	-1.12
Intercept	8.21	17.67	1.11	14.52	2.69	61.89	3.47	49.01
R^2	0.16		0.11		0.04		0.08	

N = 1,263

TABLE C.3

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR FOLLOW-UP AND COMPREHENSIVE OFFICE VISITS

LOG LINEAR

Independent variable	VISIT9 Reg. Coeff.	t	VISIT19 Reg. Coeff.	t	QUAL9 Reg. Coeff.	t	QUAL19 Reg. Coeff.	t
NETP9[a]	-0.41	-10.52	-0.03	-1.27	-0.005	-0.34	-0.01	-1.02
MEDICAID	-1.80	- 5.74	-0.13	-0.52	-0.05	-0.57	-0.06	-0.60
HOME	0.01	0.60	0.03	2.01	0.001	0.30	-0.01	-1.56
HOSP	0.28	4.20	0.04	1.01	0.05	2.36	0.01	0.46
ECF	-0.08	-0.27	-0.14	-0.52	-0.00	-0.01	0.07	0.59
H-PROB	0.21	2.90	-0.01	-0.28	0.04	1.65	-0.02	-0.78
SERVIS	-0.05	-2.67	0.02	2.99	0.02	3.88	0.00	1.21
AGED2	0.10	1.99	0.01	0.37	-0.04	-2.47	0.00	0.19
AGED3	0.00	0.02	0.03	0.23	-0.00	-0.06	-0.05	-1.00
MALE	-0.15	-2.73	-0.01	-0.16	0.00	0.11	0.03	1.69
WAGE	-0.01	-0.19	-0.04	-0.75	0.01	0.38	-0.02	-0.98
Intercept	1.33	23.18	0.05	1.19	0.96	55.13	1.23	59.06
R^2	0.14		0.10		0.03		0.07	

[a]The regression coefficients in log forms are the own price elasticities for visits and quality of those visits

TABLE C.4

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR PHYSICIAN VISITS AND QUALITY

- FOLLOW-UP OFFICE VISITS -

Independent variable	VISIT9: Variable Medicaid held constant — Regression Coefficient[a]	VISIT9: Variable Medicaid omitted — Regression Coefficient[a]	QUAL9: Variable Medicaid held constant — Regression Coefficient[a]	QUAL9: Variable Medicaid omitted — Regression Coefficient[a]
NETP9	- 2.08 (-10.18)	- 1.96 (-10.37)	- 0.01 (- 0.52)	(-0.03 (-1.44)
MEDICAID	- 1.03 (- 1.49)	x x	0.14 (2.18)	x x
HOME	0.26 (3.43)	0.27 (3.49)	- 0.00 (- 0.05)	0.00 (-0.03)
HOSP	2.07 (4.87)	2.12 (4.99)	0.09 (2.30)	0.09 (2.15)
ECF	1.51 (1.01)	1.28 (0.87)	0.04 (-0.30)	-0.01 (-0.08)
H_PROB	1.49 (3.27)	1.54 (3.36)	0.06 (1.42)	0.06 (1.30)
SERVIS9	-0.51 (-3.92)	-0.50 (-3.83)	0.05 (4.14)	0.05 (4.00)
AGED2	0.46 (1.39)	0.47 (1.42)	-0.10 (-3.09)	-0.10 (-3.13)
AGED3	0.03 (0.05)	-0.01 (-0.02)	0.01 (0.14)	0.01 (0.23)
MALE	-0.96 (-2.67)	-0.95 (-2.64)	-0.00 (-0.06)	x x
WAGE	0.96 (-0.42)	-0.07 (-0.19)	0.05 (1.32)	x x
Intercept	8.21 (17.67)	7.92 (18.78)	2.69 (61.89)	2.73 (69.13)
R^2	0.16	0.15	0.04	0.05

N = 1,263

a t-ratios in parentheses

TABLE C.5

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR PHYSICIAN VISITS AND QUALITY

- FOLLOW-UP OFFICE VISITS[a] -

Independent variable	VISIT9				QUAL9			
	Equation 1		Equation 2[a]		Equation 3		Equation 4[a]	
	Regression Coefficient	t-ratio	Regression Coefficient	t-ratio	Regression Coefficient	t-ratio	Regression Coefficient	t-ratio
NETP9	-2.08	-10.18	-2.28	-11.14	-0.01	-0.52	-0.01	-0.59
MEDICAID	-1.03	- 1.49	-1.63	- 2.36	0.14	2.18	0.14	2.17
HOME	0.26	3.43	0.27	3.51	-0.00	-0.05	-0.00	-0.08
HOSP	2.07	4.87	1.89	4.49	0.09	2.30	0.09	2.32
ECF	1.51	1.01	1.48	1.01	-0.04	-0.30	-0.06	-0.40
H_PROB	1.49	3.27	1.37	3.07	0.06	1.42	0.09	2.03
PR459	x	x	-0.62	-6.98	x	x	0.02	1.81
SERVIS9	-0.51	-3.92	x	x	0.05	4.14	x	x
AGED2	0.46	1.39	0.37	1.13	-0.10	-3.09	-0.09	-2.90
AGED3	0.03	0.05	0.07	0.10	0.01	0.14	0.01	0.23
MALE	-0.96	-2.67	-0.93	-2.62	-0.00	-0.06	-0.00	-0.04
WAGE	-0.16	-0.42	-0.14	-0.38	0.05	1.32	0.05	1.25
Intercept	8.21	17.67	8.59	18.66	2.69	61.89	2.72	61.78
R^2	0.16		0.18		0.04		0.03	

N = 1,263

a Variable SERVIS is replaced by PR459 in equations 2 and 4

b PR459 is the monetary value of SERVIS variable

TABLE C.6

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES
FOR FOLLOW-UP OFFICE VISITS

- THE "BEFORE" AND THE "AFTER" SUBSAMPLES -

Independent variables	VISIT9 Total Sample (1)	VISIT9 "Before" Subsample (2)	VISIT9 "After" Subsample (3)	QUAL9 Total (4)	QUAL9 "Before" Subsample (5)	QUAL9 "After" Subsample (6)
NETP9	-2.08	-0.64	-11.05	-0.01	-0.07	-0.68
	(-10.18)	(-2.66)	(-2.34)	(-0.52)	(-0.71)	(-1.66)
MEDICAID	-1.03	-1.51	-4.51	0.14	-0.16	-0.19
	(-1.49)	(-2.27)	(-1.75)	(2.18)	(-0.57)	(-0.83)
HOME	0.26		0.33	0.00		0.00
	(3.43)		(3.75)	(0.05)		(0.42)
HOSP	2.07	0.19	2.98	0.09	-0.06	0.11
	(4.87)	(0.40)	(6.29)	(2.30)	(-0.29)	(2.66)
ECF	1.51			-0.04		
	(1.01)			(-1.00)		
H_PROB	1.49	-0.52	2.27	0.06	0.10	0.06
	(3.27)	(-2.18)	(4.17)	(1.42)	(1.02)	(1.32)
SERVIS9	-0.51	-0.30	0.33	0.05	0.04	0.09
	(-3.92)	(-5.35)	(2.34)	(4.14)	(1.49)	(2.78)
AGED2	0.46	0.15	0.25	-0.10	-0.12	-0.08
	(1.39)	(1.48)	(0.63)	(-3.09)	(-2.89)	(-2.36)
AGED3	0.03	0.01	-0.15	0.01	0.09	-0.04
	(0.05)	(0.03)	(-0.15)	(0.14)	(1.10)	(-0.52)
MALE	-0.96	-0.26	-0.95	-0.00	0.00	-0.00
	(-2.67)	(-2.33)	(-2.19)	(-0.06)	(0.18)	(-0.08)
WAGE	-0.16	0.01	-0.07	0.05	0.01	0.04
	(-0.42)	(0.11)	(-0.15)	(1.32)	(0.20)	(0.94)
Intercept	8.21	3.93	10.74	2.69	2.95	3.03
	(17.67)	(6.12)	(4.29)	(61.89)	(11.07)	(13.74)
R^2	0.16	0.07	0.09	0.04	0.02	0.05

t-ratios in parentheses

Equations 1,4—Total sample N = 1,224

Equations 2,5—The "before" subsample N = 741

Equations 3,6—The "after" subsample N = 980

TABLE C.7

ORDINARY LEAST SQUARES ESTIMATES OF DEMAND CURVES FOR INITIAL COMPREHENSIVE VISITS

- THE "BEFORE" AND THE "AFTER" SUBSAMPLES -

Independent variables	VISIT19			QUAL19		
	Total sample Reg. Coeff. (1)	"Before" subsample Reg. Coeff. (2)	"After" subsample Reg. Coeff. (3)	Total sample Reg. Coeff. (4)	"Before" subsample Reg. Coeff. (5)	"After" subsample Reg. Coeff. (6)
NETP9	-0.04 (-1.53)	-0.13 (-1.63)	-0.65 (-1.07)	-0.03 (-0.99)	0.36 (1.74)	-0.10 (-0.15)
MEDICAID	0.01 (0.04)	-0.40 (-1.63)	-0.50 (-1.35)	0.10 (0.91)	1.29 (1.94)	0.07 (0.19)
HOME	0.06 (2.63)		0.03 (1.64)	-0.04 (-1.75)		-0.02 (-0.77)
HOSP	0.06 (0.93)		0.07 (1.19)	0.02 (0.40)		0.01 (0.20)
ECF	-0.16 (-0.66)			0.06 (0.28)		
H_PROB	-0.02 (-0.32)	-0.03 (-0.46)	0.004 (0.060)	-0.07 (-1.12)	0.17 (0.98)	-0.12 (-1.74)
SERVIS19	0.03 (2.75)	-0.01 (-10.59)	0.10 (5.58)	0.02 (1.42)	0.01 (0.10)	0.02 (1.42)
AGED2	0.04 (0.61)	0.03 (0.67)	0.04 (0.60)	0.01 (0.17)	-0.13 (-1.18)	0.05 (0.78)
AGED3	-0.02 (-0.13)	1.02 (6.88)	-0.03 (-0.22)	-0.16 (-0.98)	-0.84 (-2.09)	-0.13 (-0.83)
MALE	-0.01 (-0.20)	-0.00 (-0.01)	-0.02 (-0.36)	0.10 (1.72)	0.20 (1.50)	0.09 (1.27)
WAGE	-0.03 (-0.35)	-0.06 (-1.07)	0.03 (0.41)	-0.07 (-0.98)	-0.02 (-0.11)	-0.05 (-0.68)
Intercept	1.11 (14.52)	1.43 (5.93)	1.44 (3.98)	3.47 (49.01)	2.25 (3.45)	3.44 (8.71)
R^2	0.11	0.54	0.24	0.08	0.18	0.07

t-ratios in parentheses

Equations 1, 4 - Total sample N = 181

Equations 2, 5 - "Before" subsample N_1 = 54

Equations 3, 6 - "After" subsample N_2 = 133

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