Do Physicians Induce Patient Demand for Medical Care?:

An Empirical Analysis*

Bong-min Yang**

I. Introduction

The issue that physicians exert influences over the patient demand for medical services has been debated frequently in published literatures. Yet the issue is far from settlement due to its complex nature in terms of model specification and of data observations. Whether or not physicians can create demand for their services is important in several respects. First, increased physician supply would not necessarily improve physician availability and access to medical care in many rural and inner-city areas if physicians can generate sufficient demand, and consequently income, at desirable urban locations. The issue, therefore, bears important implication on public policies concerning the training of health manpower. Second, upon facing the exceptionally rapid rates of increase of medical costs, the public is deeply concerned about the government's policy to contain cost. If, as will be argued in this study, unnecessary generation of demand were feasible by physicians, it has inflationary impact on costs to patients. This occurs because demand curve shifts outward by induced demand which would not have shifted otherwise. Govern-

* This is an extended version of an earlier draft which was presented at the American Economic Associations Meetings in New York, December 1985. The author thanks Professor T.W. Hu for his encouragement and comments.
** Assistant Professor of Health Economics at the Graduate School of Public Health, Seoul National University, on leave from University of Lowell, Lowell, MA 01854, USA.

ment regulations on utilization might therefore be legitimate components of cost-containment strategy.

Many studies including those by Feldstein, Evans, Sloan and Feldman, Green, Auster and Oaxaca, and Rossiter and Wilensky have investigated this controversy but only with mixed conclusions. Numerous empirical works have examined the demand for physician services during the past 15 years. But few studies have combined a demand analysis with a supply analysis. Because of the interrelationships between the supply and demand for physician services, a single equation approach will probably have a simultaneous equation bias.

Almost all simultaneous equation analyses of the supply and demand for physician services have used the assumption of an equilibrium condition in the physician services market. The assumption of an equilibrium market for physician services may not be realistic. Different equilibrium market assumptions will result in different model formulations and model estimations, with different empirical implications of the estimated results.

A disequilibrium condition may exist in the physician services market, at least in the short-run, because the prices of physician services are insufficiently flexible for the market to come into an equilibrium condition. This could be explained either by the "shortage of physicians" during the 1960s, the monopolistic power of physician services, or by the induced-demand on the part of physicians. Past historical data seem to indicate that physicians' service fees are often downward rigid. It would be useful to test the hypothesis and to measure the price and quality relationship under a disequilibrium model.

The major focus of this study is twofold; (i) to test the empirical acceptability of a disequilibrium model specification for the physician services market (ii) with a special emphasis on the demand inducement by physicians. U.S. aggregate time-series data (1950-1980) will be used to estimate the demand and supply relationship, using the disequilibrium maximum likelihood estimation technique. Section II describes the basic disequilibrium model (BDM) and the disequilibrium model with physician-induced demand considered (PIDM). Data, estimation procedures, and empirical results are presented in Section III. Some concluding comments are made in Section IV.

II. Disequilibrium Physician Services Market

A. Disequilibrium Model

Models of markets in disequilibrium have been discussed fairly often in recent economic theory and in econometrics. Earlier economic theory depended largely on equilibrium market models where market clearing prices were established by the presence of auctioneers or similar mechanisms. In recent years, however, several macro- as well as micro- models have departed from the traditional hypothesis that prices always clear all markets.

In a number of papers, economic researchers have studied the significance of market disequilibrium dynamics along with the problems of estimating demand and supply functions for disequilibrium markets. The pioneering article of Fair and Jaffee was followed by studies by Fair and Kelejian, Maddala and Nelson, Goldfeld and Quandt, Quandt, Rosen and Quandt, and Maddala.

In studies of physician services, the idea of disequilibrium has been adopted by a few researchers. But the estimation results were sometimes unobtainable because of the way the model was specified (Sweeney) or because of econometric problems (Green). The price and income elasticities were obtained in one of the disequilibrium models (Feldstein) but were contrary to what conventional economic theory predicts.

Disequilibrium represents a state in which the quantities demanded(D) and the quantities supplied(S) are not equal to each other and in which the transacted quantity(Q) is given by the short side of the market $Q = \min(D,S)$. Since disequilibrium implies inequality between the quoted price and the *ex ante* market equilibrium price, a price adjustment equation need to be introduced to observe how quickly the market adjusts to the conditions of disequilibrium.

Econometrically, the inclusion of price equation is justified because there would be a fundamental identification problem when the endogeneity of price variable is not taken into consideration. Thus, the basic model consists of the four equations, damand equation, supply equation, minimum quantity restriction, and price adjustment equation. The demand and supply equations are based upon choice theoretic considerations and the price adjustment mechanism follows from standard Walrasian analysis.

B. Demand Generation by Physicians

The hypothesis of physician-induced demand (PID) has been under investigation by many researchers for a long time. To verify the proposed issue, some researchers used time-series data and the others used cross-sectional data. Other kind of unique technique is also used to investigate the existence of physician inducement of patient demand. Hay and Leahy examined the hypothesis by using a model where variation in consumer information affects health care utilization, with theoretical assumption that demand-inducing physicians will provide more services to their medically uninformed patients. Rossiter and Wilensky analyzed differences in the use of physicians for ambulatory care and the extent to which these differences were attributable to the physician, the patient, or both. They used multivariate analysis to estimate two disaggregated demand equations; a physician-initiated demand equation and a patient-initiated demand equaion for ambulatory care.

Generally accepted conclusion, however, has yet to be made. The hypothesis is supported by the observed evidence that over time both the frequency of physician services utilization and the real price of physician services have gone up continuously. In identifying PID effect in the physician services market, four issues should be considered. First, demand relationship only is not sufficient to identify the PID effect. Since the price variable which responds to physicians supply as well as to consumers' demand is an endogenous variable, ignoring supply relationship will result in simultaneous system bias. Second, illustrating a positive correlation between more physician services consumed and larger number of physicians is not enough to prove the PID effect. In a competitive market, shift in supply would imply a higher usage rate but a lower price. Therefore, a price relationship should be introduced to observe the sources of direction and strength of price movement. Third, as Newhouse and Sloan and Feldman point out, ever when the coefficient of the physician-population ratio(R) in demand relationship and that in price relationship are positive, that may not be a definite proof for PID effect because price increase may have been caused by quality enhancement in physician services. Fourth, when there is insurance variable in demand equation, the price variable is supposed to be average price but not net price. As insurance coverage increases or as real income rises over time, even with increase in R, average price may go up. In other words, demand shift may be caused by other shifting factors such as income and/or insurance, not by suppliers' demand creation. However, this issue can be easily settled by statistically examining the significance of individual coefficient in demand relationship.

Result of any empirical study should be interpreted with caution, considering all possible occasion. This is why the issue is live and unsettled even though many empirical works were performed with some successes. Whether or not a physician can shift the demand curve of his services bears importance in public policy implementation by health authority. If he could shift, he possesses considerably more market power than the conventional monopolist. This necessitates the use of government regulation on physician services market in order to alleviate inefficiencies and all other undesirable outcomes stem from providers' monopoly power.

C. Statistical Model for Estimation

Having considered all the issues evolved so far, we could set up two basic models of price and quantity determination under a disequilibrium market assumption; a basic disequilibrium model (BOM) without PID effect considered; and a PID disequilibrium model (PIDM).

1. Basic Disequilibrium Model

The log-linear formulation of the BDM of the following form;

$$(1)^{1} \quad \ln(Q_t^D / POP_t) = a_0 + a_1 \ln AP_t + a_2 \ln INC_t + a_3 \ln INS_t + a_4 \ln GOVD_t + u_{1t}$$

[1] Sociodemographic factors such as age, sex, and racial composition of the population may be a significant element in explaining the fluctuations in physician services demand when cross-sectional data are used for estimation. With annual time-series data, however, this factor can be ignored on the ground that it is not one of the major factors contributing to the growth of demand for physician services over time. See Feldstein (1970) for the relevance of this argument.

$$(2) \quad \ln (Q_t^S / N_t) = b_0 + b_1 \ln AP_t + b_2 \ln INP_t + b_3 \ln T_t + b_4 \ln GOVS_t + u_{2t}$$

$$(3) \quad \ln Q_t = \min (\ln Q_t^D, \ln Q_t^S)$$

$$(4) \quad \ln AP_t - \ln AP_{t-1} = c_0 + c_1 (\ln Q_t^D - \ln Q_t^S) + u_{3t}$$

Equation (1) expresses the physician services demand relation, in which Q_t^D stands for physician services measured in number of visits made, POP_t is population size, thus, Q_t^D/POP_t is per capita physician services; AP_t is average price per visit measured in real terms, INC_t is real per capita disposable income, INS_t is per capita insurance expenditure in real terms, $GOVD_t$ is government provision (expenditure in real terms) of physician services per capita. We expect a_1 to be negative, a_2 to be positive, a_3 to be positive, and a_4 to be positive in its sign.

Equation (2) expresses the physician services supply relation, in which Q_t^S stands for physican services supplied measured in number of services performed by physicians, N_t is number of physicians, thus, Q_t^S/N_t is per-physician services supplied; AP_t stands for average fee per visit in real terms, INP_t is inputs per physician (such as paramedical personnel and supplies) necessary to the provision of physician services, T is time trend to measure the rate of productivity increase in the production of physician services, and $GOVS_t$ is government provision (expenditure in real terms) of physician services per physician.

The sign of b_1 is expected to be positive, that of b_2 to be positive, that of b_3 to be positive, and that of b_4 to be positive, indicating that the supply of physician services is encouraged when government-sponsored expenditures for physician services are increased.

Since physician services demanded and supplied are not assumed to be equal, Equation (3) expresses the minimum quantity restriction that actually perceived quantity in the market is equal to the minimum of quantity demanded and supplied at the current average price.

The focus of this model lies principally in the joint determination of physician services demand, supply, and price. For this purpose, we assume that the forces of demand and supply tend to move the price towards its equilibrium level, but the speed of adjustment may be such that the market is not completely cleared during any given period.[2] This price adjustment is expressed by equation(4) in which $Q_t^D$and Q_t^Shave the same meaning as before, AP_1 stands for one-lagged average price per visit measured in real terms, and u_t is the disturbance term for all of the omitted explanatory variables in the equation. The stability condition requires that prices will adjust upward in times of excess demand and downward with excess supply.Therefore, c_1 is expected to be positive in sign.

The vector of disturbance terms (u_{1t}, u_{2t}, u_{3t}) is normally distributed with mean zero and variance-covariance matrix Σ; Q_t^D and Q_t^S are unobserved quantities of physician services demanded and supplied but Q_t and AP_t are observed quantity and price of services; INC_t, INS_t, $GOVD_t$, INP_t, T_t, and $GOVS_t$ exogenous variables; and a_i, b_i, and c_i are parameters to be estimated. In this basic model, the quantity demanded, quantity supplied, and price are endogenous variables, and all others are exogenous.

As Goldfeld and Quandt have pointed out, only the maximum likelihood (ML) method is available for estimating stochastic price models in which the change in price, ΔAP_t, is not only influenced by excess demand, $Q_t^D - Q_t^S$, but is also affected by the unexplained disturbance term.[3] Given that the disturbance terms are normally distributed, equations (1), (2), and (4) define the joint density function of the endogenous variables Q_t^D, Q_t^S, and AP_t. Let this

[2] This assumption can be justified by referring to the unique characteristic of the physician services market on the supply side. Considering the number of years involved to be a medical doctor, one could easily understand the difficulty of quantity adjustment in supply side. Therefore, short-run adjustment in the physician services market will be largely in the form of price adjustment rather than that of quantity adjustment. This does not imply the nonexistence of quantity adjustment. Both price and quantity adjustments take place simultaneously, but price adjustment will be stronger than quantity adjustment in physician services market.

[3] The ML method for a model with a stochastic price equation was explored by Fair and Kelejina, Maddala and Nelson, and Quandt.

joint density function be denoted by $f_t(Q_t^D, Q_t^S, AP_t \mid X_t, Y_t)$, where X_t and Y_t stand for vectors of exogenous variables in demand and supply equations, respectively. The joint probability density function, f_t, can be derived from the joint density of the structural disturbances, u_{1t}, u_{2t}, and u_{4t}.

Since the minimum quantity restriction, equation (3), embodied in the disequilibrium model allows the observation of only one of the two endogenous variables, Q_t^D and Q_t^S, the joint density itself, f_t, cannot be used as an estimating equation. Thus, the model should be arranged in terms of the observable endogenous variables, Q_t and AP_t, in the model. Let the joint probability density of the observable endogenous variables be denoted by $F_t(Q_t, AP_t \mid X_t, Y_t)$. By using the conditional joint density rule, Madala and Nelson show that F_t can be expressed in terms of f_t, as follows;

$$F_t(Q_t, AP_t \mid X_t, Y_t) = \int_{Q_t}^{\infty} f_t\,(Q_t^D, Q_t^S, AP_t \mid X_t, Y_t)\,dQ_t^S + \int_{Q_t}^{\infty} f_t(Q_t^S, Q_t^D, AP_t \mid X_t, Y_t)\,dQ_t^D,$$

where for the first term on the right hand side, it is assumed that $Q_t^D = Q_t$, for the second term, $Q_t^S = Q_t$ is assumed. This is the disequilibrium likelihood function for time t. The likelihood function for all periods can be written as

$$l = \prod_{t=1}^{T} F_t\,(Q_t, AP_t \mid X_t, Y_t),$$

and the corresponding disequilibrium log likelihood function can be stated as

$$(5) \qquad L = \sum_{t=1}^{T} \log F_t\,(Q_t, AP_t \mid X_t, Y_t).$$

Maximization of L will yield maximum likelhood estimates for the parameters of the model.[4]

The final equation for estimation can be obtained by solving equations (1), (2), (3), and (4) for structural disturbances and substituting them into equation (5).

2. Physician Induced Demand Model

The log-linear formulation of the PIDM is much alike that of the BDM except that an addition factor, R, is singled out for special attention in the demand and price equation. Three slightly diferentiated versions of this model are estimated and statistically tested to find out which of the two factors, R and/or quality variable, plays significant role in explaining the variation in average price, given data.

Specifically, the demand and the price equation with PID effect considered can be represented as follows;

$$(6)\ \ln (Q^D_t / POP_t) = a_0 + a_1 \ln AP_t + a_2 \ln INC_t + a_3 \ln INS_t + a_4 \ln GOVD_t + a_5 \ln R_t + u_{1t}$$

$$(7)\ \ln AP_t - \ln AP_{t-1} = c_0 + c_1 (\ln Q^D_t - \ln Q^S_t) + c_2 \ln R_t + u_{3t}$$

We expect the coefficient of R in both demand and price equation, a_5 and c_2, to be significantly positive in the presence of supplier-induced demand. The induced demand hypothesis is denied when the coefficient of R is insignificant in the price equation but that of the quality variable is significantly positive; in that case, it is the enhancement of quality in physician services, but not the PID effect, that contributes to the rising price of health services. In order to see all these possible cases, slightly differentiated versions of PIDM are assumed with different variables in demand and/or price equations.

4 Asymptotic properties of the disequilibrium ML estimator are considered in Hartley and Mallela.

The first of these (PIDM1) is the model with physician-population ratio (R) variable in both demand and price equations. Equations (6), (2), (3), and (7) constitute this model. The second version of PIDM (PIDM2) is the model with R in demand equation and the quality variable (QLT) in price adjustment equation.[5] Compared to PIDM1, QLT is substituted for R in price equation. This specification enables us to identify whether variations in price change are attributable to quality changes or not. A positively significant coefficient of QLT would imply that quality enhancement contributed significantly to the increase in average price levels of physician services. However, it is also conceivable that variations in prices are attributable to both quality change and change in physician density. This possibility is modeled as the third version of PIDM(PIDM3), having both R and QLT in the price equation and R in the demand equation. Under this specification, positively significant coefficients of R and QLT in the price equation would indicate that both the physician-population ratio and the quality of care influence the change in prices. The strength of influence of each of the two variables on price change depends upon the magnitude of coefficient of each variable.

In sum, there are four different models of disequilibrium physician services market introduced in this study. Each model has its own conceptual base. Which of the models is appropriate as an analytical framework for physician services market is yet to be judged based upon the estimation results and their corresponding statistical tests.

III. Empirical Results

A. Data and Estimation Procedure

To obtain parameter estimates, the annual data for the period 1950-1980 are used (see Appendix for data sources and ad-

[5] If the time variable is taken to stand for quality change (QLT), the sign on its coefficient would indicate quality progress or regress. However the time variable may stand for other influence on the change in real price, which varied smoothly over time, and for which no specific allowance has been made in the price equation. In this case, the coefficient on QLT would not yield useful information regarding quality change.

justments). All price and income variables are expressed in real terms.

The expressions for the first and second derivatives of likelihood function will be complicated, but iterative procedures can be used by evaluating these derivatives numerically. Several maximization techniques can be used with a number of initial starting values for the parameters to confirm that a maximum has been reached. In this study, the numerical nonlinear optimizations are performed using the Davidson-Fletcher-Powell algorithm (DFP).

The asymptotic standard errors of the estimates are computed by taking the square roots of the diagonal elements of the negative inverse Hessian matrix of the log likelihood function. The parameter estimates from the relevant two-stage-least-squares (2SLS) technique and their nearby values are used as starting values. The resulting maximum likelihood estimates obtained are consistent and asymptotically efficient.

B. Estimates of Disequilibrium in the Physician Services Market

1. Basic Disequilibrium Model (BDM)

The parameter estimates are shown in Table 1. In the demand equation estimation, every estimated parameter is significant. The elasticity of quantity demanded with respect to the real average price is -0.92. A consumer pays not the average price charged by physician, but the net price, which is the average price net of payments made by an insurance company. The coefficienets of AP and INS variables, as a result, imply that the net price elasticity of demand is less than that of average price, generating a more inelastic demand curve for the physician services. As expected, increases in per capita disposable income have had a positive impact on the demand for physician services. The insurance variable has a significant positive coefficient, confirming the conventional view that extensive insurance coverage has played an important role in augmenting the demand for physician services. Increased per capita governmental spending for physician services has had a small, but positively significant, impact on demand by consumers. In the supply equation estimation, every estimated parameter has the expected sign except that of the time

Table 1

DISEQUILIBRIUM ESTIMATES

	Demand Equation						Supply Equation					Price Equation				log L*	
	C (a_0)	AP (a_1)	INC (a_2)	INS (a_3)	GOVD (a_4)	R (a_5)	C (b_0)	AP (b_1)	INP (b_2)	T (b_3)	GOVS (b_4)	C (c_0)	ED (c_1)	R (c_2)	TEC (c_3)		Iteration Count
BDM	-4.303	-0.929	0.810	0.245	0.087		-11.232	1.164	0.494	0.528	0.003	0.026	0.586			128.44	25
	(0.688)	(0.147)	(0.113)	(0.023)	(0.013)		(0.373)	(0.305)	(0.163)	(0.238)	(0.024)	(0.066)	(0.187)				
PIDM1[1]	-5.400	-1.231	0.215	0.363	0.082	0.493	-11.215	0.639	0.570	-0.077	0.015	-0.063	0.512	0.060		155.90	22
	(0.738)	(0.148)	(0.094)	(0.028)	(0.013)	(0.042)	(0.471)	(0.267)	(0.187)	(0.290)	(0.017)	(0.510)	(0.112)	(0.035)			
PIDM2[2]	-10.186	-0.619	0.447	0.201	0.060	0.541	-9.557	1.470	0.593	-1.285	0.003	0.792	0.390		0.157	140.54	30
	(1.053)	(0.181)	(0.096)	(0.029)	(0.001)	(0.050)	(1.344)	(0.992)	(0.280)	(0.801)	(0.039)	(0.957)	(0.284)		(0.206)		
PIDM3[3]	-5.178	-1.209	0.209	0.373	0.085	0.490	-11.226	0.636	0.566	-0.070	0.015	-0.587	0.491	0.031	0.033	156.03	23
	(0.895)	(0.188)	(0.091)	(0.032)	(0.015)	(0.046)	(0.449)	(0.285)	(0.165)	(0.294)	(0.016)	(0.973)	(0.113)	(0.100)	(0.126)		

1. PID model with R in price equation
2. PID model with TEC in price equation
3. PID model with both R and TEC in price equation
4. Maximum value of disequilibrium log-likelihood function
5. Other note: number in parenthesis under each coefficient is standard error of the coefficient.

variable. The elasticity of supply with respect to the real average price is 1.16, which implies that physicians have been sensitive to average price changes in determining the level of service provision. The result also suggests that the supply of physician services has responded to some extent to changes in the input (auxiliaries) variable. Auxiliaries have been complementary to the physician services supply, as expected.[6] The estimate of GOVS parameter indicates that increases in governmental expenditures for physician services have had a small positive impact on the supply of physician services, but insignificantly so. Troubling however, is the fact that the coefficient of the time variable does not have the expected sign. One would expect the time variable coefficient, which is included as a proxy for technical progress, to be positive, but it is negative and significantly so. This suggests that, with real price and everything else held constant, there has been a decrease in the number of per-physician services over time. The aggregate number of physician services provided has gone up with the increased number of physicians. But, each physician may have been working less hours (if there is a one-to-one relationship between number of hours and number of services supplied), or because of competition as the number of physicians grew, physicians may recently have been spending more time with their patients than before, holding prices constant.[7]

In the price adjustment equation, the estimated coefficient of adjustment speed, which measures the degree of drag in market clearing, is significantly different from zero and possesses the expected sign. The positive value of c_1 implies rising real prices of physician services in time of excess demand and falling prices with excess supplies. It is an empirical evidience that the market for physician services is self-equilibrating in the usual sense. The small size of the coefficient, however, indicates the slow adjustment speeds of the price variables. Prices are not highly flexible

[6] For a discussion of optimal (cost-minimizing) input use, see Uwe E. Reinhardt, who estimated a production function for physician services. He argues that physician services could be expanded more efficiently by adding paramedical personnel than by adding physicians.

[7] One would suggest that this result might be an indication of backward bending supply function in the observed range. However, since no price variation is assumed with the interpretation of the time variable coefficient, negativity of the coefficient cannot be regarded as a sign of a backward-bending physician services supply curve. In fact, the supply function is found to be positively sloped with elastic price elasticity.

and thus provide a crucial source of disequilibrium in the physician services market. The simultaneous adjustment of price and quantity to their equilibrium values (i.e., the mean time lags for adjustment) is estimated to be around 1.96 years.

2. *Physician Induced Demand Model (PIDM)*

The first PIDM model with the physician-population ratio variable (R) in both demand and price equation shows a result which is consistent with a priori expectation of induced demand. Significantly positive coefficient of R in the demand equation ($dQ^D/dR > 0$) implies physician density as a shifting factor of patient demand for physician services. The elasticity of this response is of the order of 0.49, indicating that 10 percent increase in the physician-population ratio would increase 4.9 percent of per-patient visits to the doctors.

However, the mere positive association between R and quantity demanded is not sufficient as an evidence for physician inducement of demand. As previously noted, one has to look at the effect of R on price movement. The coefficient of R in the price equation which is significant at 90% level of confidence illustrates upward pressure on prices form increased density of physicians ($dP/dR > 0$). Put demand and price equations together, we see both the price and quantity of physician services consumed increase with an increase in the supply of physicians per capita. Theoretically this could be seen as an increase in both demand and supply, with the shifts in demand greater than that in supply.

Comparison of estimates from the two models, BDM and PIDM1, reveals the following points. The disequilibrium model with physician induced demand considered is better than the basic disequilibrium model. Since the density variable is found to be statistically significant in PIDM1, BDM which does not include R in the model is econometrically deficient and the estimates from this are supposed to be biased, where bias is caused by the omitted relevant independent variable. However, people against the PID hypothesis often insist that (dp/dR) could be positive not because of the demand creation by physicians but because of the enhancement in the quality of physician services (QLT) provided over time. If this assertion were correct, the test of PID hypothesis based on demand and price would fail.

To answer this question, a second version of PIDM(PIDM3) with both R and QLT in the price equation is set up and estimated. Measuring the quality of physician services is not a simple task. We assumed a steady increase in quality over time, using time variable as a proxy for quality in medical services. The empirical result with PIDM3 show that the coefficient of R in the demand equation is still significantly positive, but both R and QLT are no longer significant variables in the price equation. Considering a continuous increase in the physicians — population ratio over time in the past three decades,[8] we suspect the problem of multicollinearity between R and QLT as a source for high standard errors of the two coefficients.

To avoid the possibility of multicollinearity and, at the same time, to investigate the importance of quality variable in the price equation, a third version of the PID model (PIDM2) is constructed and estimated. The parameter estimates obtained from this model is somewhat bizzare in their natures, showing an insignificant and, even worse, a negative coefficient of QLT in the price equation.

The empirical results from both PIDM3 and PIDM2 indicate that the quality variable could not do much in explaining the fluctuations in price of physician services over time. The hypothesis that it is the quality of services, not the physician density variable, that contributed to the rising price of physician services can now be rejected on a statistical ground. In sum, among the three versions of the PIDM, PIDM1 with R in the demand and the price equation is the most reasonable choice as a disequilibrium model for physician services.

IV. Concluding Comments

The initial decision to seek a treatment is made by the patient but the physician will prescribe the treatment and will control the number of successive visits made by the patient. Physician's dual role as a supplier of services and as an agent of the patient is the

[8] Due to a physician shortage existed in the 1950s and 1960s, the federal government through HPEAA (Health Professions Educational Assistance Act, 1963) began to provide federal support for medical schools to increase class size.

underlying reason for demand generation by physicians. Whether the hypothesis of PID is truly acceptable or not is an empirical question to be answered. The issue has been tested by many researchers in the past, but the results were not convincing either because of the incomplete nature of data used (mostly cross-sectional data) or because of the difficulty in finding a suitable model specification.

This study has attempted to provide answers for the raised issue whether physicians create unnecessary demand to achieve their monetary objective. The empirical results obtained from four different models can be summarized as the followings. First, disequilibrium econometric model is found to be an appropriate choice as a model for physician services market. Unlike previous empirical works including Feldstein's, this study using aggregate time-series annual data found a downward sloping demand curve and an upward sloping supply curve in all of the four models estimated. As far as public health policy is concerned, this result implies that regulations that suppress the physicians' price will decrease the quantity of services supplied and increase the quantity of services demanded, thus widening excess demand in times of shortage or narrowing excess supply in times of surplus. Adding physicians would raise the quantity of medical services, lower their price, and relocate resources toward health sector. Physicians provide a greater amount of serivces when fees rise, or when more inputs are used for production. Consumers visit physicians more often when fees fall, incomes rise, insurance coverages are better, or when governmental spending for physician services is increased.

Second, the PID hypothesis is empirically tested. Comparison of the maximum likelihood estimates in the two principal models, BDM and PIDM1, indicates the rejection of the model which ignores the aspects of physician inducement of demand, and, conversely, the acceptance of the PID hypothesis. It suggests that physicians in medical care market are found inducing demand at the expense of consumers.

The policy implications of this study are twofold. First, if the disequilibrium hypothesis is indeed acceptable, it is conceivable that failure to take into account disequilibrium characteristics, such as the minimum quantity restriction and the price adjustment aspect, may create serious specification errors, and that using previously obtained equilibrium price and income elasticities as a basis for health policy implementation may be misleading.[9]

Second, if physicians, not patients, are major controllers over demand for physician services, service utilization will not be much affected by economic incentives provided to consumers. Rather, incentives aimed at physicians will be much more effective tools in managing price and quantity of physician services through market economy.

An attempt was made in this study to detect the effect of service quality change on price movement. The attempt was a mere failure. It is not known whether the failure attribute to the defects of data used or to the model specification. Further research should pay particular attention to quality variable.

An empirical evidence supporting the existence of demand inducement is found in this study. However, one should be cautious in claiming that this is the very evidence supporting for PID hypothesis. The evidence is convincing only if the econometric tools and the specified model used in our analysis assumed right. Another issue is whether physician-induced demand represents a major demand determinant. If it is, the rationale for government regulation would be strengthened because it is bad news for almost everyone. What one can do to deal with the problem of physician-induced demand is beyond the scope of the present study, and thus, merits further analysis.

[9] In their experimental study, Goldfeld and Quandt showed the consequences of using a misspecified model when the truth is different. By using the mean absolute deviation (MAD) statistics in measuring the effects of misspecification on the parameter estimates, they argued that using an equilibrium model when a disequilibrium model is appropriate is substantially more costly than vice versa.

APPENDIX

Data Sources for Variables

Q	:	The quantity of physician services is aggregate expenditures on physician services divided by the CPI for physician services (Health Care Financing Review, Fall 1983, and Social Security Bulletin, January 1966).
AP	:	The price of physician services is proxied by the CPI for physician services, 1967 = 100 (Statistical Abstract of the U.S., various issues).
INC	:	Per capita disposable income (Statistical Abstract of the U.S., various issues).
INS:	:	Per capita amount of health insurance expenditures for physician services (Health Care Financing Review, Fall 1983), and social Security Bulletin, January 1966).
GOV	:	Government expenditures for physician services (Health Care Financing Review, Fall 1983) for 1965-1980. For 1950-1964, government expenditures were total payments minus total private payments.
POP	:	Total population (Statistical Abstract of the U.S., 1984).
N	:	Total number of physicians (Health Manpower Data Book, AMA Center for Health Services, and Statistical Abstract of the U.S.).
GOVD	:	GOV per capita, i.e., GOV/POP.
GOVS	:	GOV per physician, i.e., GOV/N.
CPI	:	Consumer price index, 1967 = 100 (Survey of Current Business, Bureau of Economic Analysis, Department of Commerce, various issues).
INP	:	Total number of registered nurses as a proxy for auxiliary (Facts about Nursing, American Nursing Association, various issues, and Statistical Abstract of the U.S., 1984).
R	:	Physician per capita, i.e., N/POP.

References

Auster, R. and R. Oaxaca, "Inentification of Supplier Induced Demand in the Health Care Sector," *Journal of Human Resources,* 16, 3, 1981.

Brown, D.M., Feldstein, M.S., and H.E. Lapan, "The Rising Price of Physicians' Services: A Classification," *Review of Economics and Statistics,* 1974, 396-398.

Evans, R.G., "Supplier-Induced Demand: Some Empirical Evidence and Implications," Parlman, M., ed., *Economics of Health and Medical Care,* Halsted press Book, 1974.

Fair, R.C. and D.M. Jaffee, "Methods of Estimation for Markets in Disequilibrium," *Econometrica* 40, 3, 1972, 497-514.

Fair, R.C. and H.H. Kelejian, "Methods of Estimation for Markets in Disequilibrium: A Further Study," *Econometrica,* 42, 1, 1974, 177-190.

Feldstein, M.S., "The Rising Price of Physicians' Services," *Review of Economics and Statistics,* May 1970, 121-133,

Goldfeld, S.M. and R.E. Quandt, "Single Market Disequilibrium Models; Estimation and Testing," *Journal of Econometrics,* May 1981, 157-172.

Green, J., "Physician-Induced Demand for Medical Care," *Journal of Human Resources,* 13 (Supplement), 1978, 21-34.

Hartley, M.J. and P. Mallela, "The Asymptotic Properties of a Maximum Likelihood Estimator for a Model of Markets in Disequilibrium," *Econometrica,* 45, 5, 1977.

Hay, J. and M. Leahy, "Physician-Induced Demand; An Empirical Analysis of the Consumer Information Gap," *Journal of Health Economics,* 1, 1982.

Hu, T.W. and B.M. Yang, "Demand for and Supply of Physician Services," presented at the American Economic Associations Meetings, New York, Dec. 27, 1985.

Maddala, G.S., "Methods of Estimation For Models of Markets with Bounded Price Variatioin," *International Economic Review,* June 1983, 361-378.

———, "Disequilibrium, Self-Selection and Switching Models," Social Science Working Paper 303, Californian Institute of Technology, Feb. 1980.

Maddala, G.S. and F.D. Nelson, "Maximum likelihood Methods for Models of Markets in Disequilibrium," *Econometrica, 42,* 6, 1974, 1013-1030.

Newhouse, J.P., "A Model of Physician Pricing," *Southern Economic Journal,* Oct. 1970, 174-183.

Newhouse, J.P., Phelps, C.E. and M.S. Marquis, "On Having Your Cake and Eating It Too: Econometrics Problems in Estimating the Demand for Health Services," *Journal of Econometrics,* Aug. 1980, 365-390.

Phelps, C.E. and J.P. Newhouse, "Coinsurance, The Price of Time, and the Demand for Medical Services," *Review of Economics and Statistics,* Aug. 1974.

Quandt, R.E., "Tests of the Equilibrium vs. Disequilibrium Models," *International Economic Review,* June 1978, 435-452.

Reinhardt, V.E., *Physician Productivity and the Demand for Health Manpower,* Ballinger, Cambridge, Mass. 1974.

Rosenthal, G., "Price Elasticity of Demand for Short-Term General Hospital Services," *Empirical Studies in Health Economics,* John Hopkins University Press, Baltimore, 1970.

Rossiter, L. and G. Wilensky, "A Reexamination of the Use of Physician Services. The Role of Physician-Initiated Demand," *Inquiry,* Summer 1983.

Sloan, F.A., "Physician Fee Inflation: Evidence From the Late 1960s", *The Role of Health Insurane in the Health Services Sector,* Rosett, R., ed., National Bureau of Economic Research, New York, 1976, 321-354.

Sloan, F.A. and R. Feldman, "Competition Among Physicians," Greenberg, W., ed., *Competition in the Health Care Sector,* Aspen Publishing Co., 1978.

Sweeney, G.H., "The Market for Physicians' Services: Theoretical Implications and Empirical Test of the Target Income Hypothesis," *Southern Economic Journal,* Jan. 1982, 594-613.

Yang, B.M. and T.W. Hu, "Gasoline Demand and Supply Under a Disequilibrium Market," *Energy Economics,* Oct. 1984, 276-282.