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-

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** 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.

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

mand 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.

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^S have 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.

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;

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

$$(7)\quad \ln AP_t - \ln AP_{t-1} = c_0 + c_1 (\ln Q_t^D - \ln Q_t^S) + c_2 \ln R_t + u_{3t}$$

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.

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

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.

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.

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.

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