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# PHYSICIAN-INDUCED DEMAND FOR MEDICAL CARE*

JERRY GREEN

## *ABSTRACT*

This paper addresses the theoretical models designed to ascertain the existence of a variable level of physicians' activity in shifting the demand of their patients. Two basic approaches are followed: equilibrium models of the demand for health care, and disequilibrium models. Within the former category, both competitive and monopolistic behavior are studied. Using the monopolistic model, a statistical test of the hypothesis of "no induced demand" is constructed, and fails to reject it. The disequilibrium analysis of other writers is analyzed and alternative specifications of such a model are set out.

## *INTRODUCTION*

Looking for the effects of availability on the utilization of medical resources is similar to tracking the abominable snowman. The evidence is fragmentary, and though the search is exciting and fraught with danger, no one is quite sure what to do were the beast ever confronted face to face. There are many theories about what type of creature it is: a statistical mutant, a disequilibrium phenomenon, or the product of informational asymmetry. Different explorers recount various attributes. There is no doubt that each of their stories has a germ of truth. But how important are these pieces to the mystery as a whole?

This paper does not claim to provide a general treatment of these issues. It contrasts alternative explanations of the evidence, concentrating on the assertion that physicians do exert a significant impact on the level of demand

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that they face. The style is rather taxonomic, but that is unfortunately the state of the art. Most of the argument is theoretical. One piece of empirical evidence has been examined in the light of the theory, however, and bits and pieces of others' research have certainly played a role in shaping the models considered. I have tried to point out some empirical analyses that would be useful, in my opinion, along the way. In doing so, I have restricted attention to studies utilizing market data, either national or regional aggregates. Obviously much more is possible with micro evidence, but this would take me too far afield.[1]

Two basic approaches are followed. In the next section we consider models all of which are characterized by the equilibrium hypothesis. Markets clear, but the mechanisms that effect this clearing and the behavioral assumptions under which they operate differ from one system to the next.

In the final section, the disequilibrium hypothesis is studied. There, markets fail to come into equilibrium because prices are insufficiently flexible. The actual quantity transacted depends on one's assumptions about the market-clearing process. We treat several possibilities, exploring their econometric implications and relationship with earlier research.

## *EQUILIBRIUM APPROACHES*

Recent studies have shed light on the issue of physician-induced demands, both theoretically and empirically. This section is devoted to the alternative explanations of the evidence that are consistent with the basic hypothesis that there is no imbalance between supply and demand given the values of variables as determined by the behavioral structure. Even under the equilibrium hypothesis, there is a wide variety of possibilities. Basically, we shall classify these along two lines: assumptions concerning the form of the physician's utility, and those related to the variables at his discretion.

We first have the case of competitive behavior by physicians. They choose their quantity to supply, assuming that prices are independent of the decision and without taking any other market action. Next we treat the monopolistic and monopolistically competitive theories. Here physicians behave as rational price-setters whose utility depends on income and their workloads. Under this hypothesis we derive a qualitative relationship that serves as the basis for an econometric test of the model. The alternative hypothesis is the same on the price side, but allows physicians discretion over the intensity with which they influence their patients' demands for medical care. We show that the derived conclusions from the "no-

1 The recent studies by Pauly [13, Ch. 5] and Newhouse-Phelps [12] are excellent examples of the value of more detailed information.

inducement" monopolistic model may not hold in this more general system, and therefore may be useful for distinguishing between the two. The econometric test employed fails, however, to reject the "no-inducement" hypothesis.

A different type of explanation for some empirical results is that a physician's utility depends on something like the average severity of the cases he encounters, rather than the discretionary influence he exerts over demands. This can be treated in a variety of ways: It may be a parameter in the supply relation, or it may be consciously controlled by the physician when he selects his price, and indirectly his caseload. We will argue that aggregative data cannot identify the parameters necessary to distinguish this effect from the "inducement" model with a homogeneous caseload or the disequilibrium models of the next section.

*Competitive Models*

The natural starting point for any study of market interaction is the hypothesis that suppliers neglect the influence of their chosen quantities on the prices they face. The qualitative implications of this model have been treated by Reinhardt [15][2] in the physician-patient context.

Under the assumption that the equilibrium is stable and that demand is downward sloping, one has straightforwardly the results that when the population/physician ratio rises, prices rise and the quantity of services consumed per patient falls. Whether the workload of a typical physician rises depends on the nature of supply. A rising supply curve implies increasing workload; a backward-bending supply curve implies a decreased workload.

Whether the shift in market demand arises from the population/physician ratio, as discussed above, or from the determinants of per capita demand, such as income, demographics, or insurance, the qualitative response of price and workload would be the same. Quantity per patient, however, would necessarily rise only if the response of supply to higher prices were positive.

There appears to be substantial doubt about the nature of the supply curve, even among those who adhere to a basically competitive model. Without specifying the sign of its slope, the only unambiguous relations emerging from the competitive model are that (1) price increases in either the population/physician ratio or "income,"[3] and (2) quantity per patient decreases with the population/physician ratio.

2 Actually, Reinhardt covers this case in the text of his paper in Section II and switches to the monopolistic model of Sloan-Feldman [16] in the appendix.

3 We will use "income" as a shorthand for all exogenous determinants of per capita demand throughout.

The temptation is clearly to test the model by examining whether these two statements stand up to the empirical evidence. Reinhardt, for example, has given a duly cautious and precise evaluation of some earlier studies [17, 6, 16] as well as an analysis of some new Canadian[4] and German data. If one maintains the basic assumption that price is freely flexible and closely approximates market clearing, then there is good reason to reject the simple neoclassical model above for many, but not all, specialties.

Somewhat unfortunately, there are many alternative hypotheses waiting in the wings. Rejecting the neoclassical, competitive story does not necessarily mean that one should accept a provider-inducement effect. As Reinhardt has pointed out, *any* qualitative response of price to the population/physician ratio is consistent with the provider-inducement model. There is no way to test such a model on this basis alone.

It is useful to note in passing that other theories of the supply side—for example, that supply depends on the "quality" or urgency of the average case—have the same implications as the neoclassical model and would be rejected in favor of an inducement model under the same circumstances. Since all of the implications of the neoclassical model arise from the assumption of a fixed, downward-sloping curve, competing alternative hypotheses must have to do with the nature of demand. Including the cost of patients' time in the price of care is a possibility explored by Newhouse and Phelps [12]. But market data alone will never be able to separate the "shifts" in demand that are really responses to changes in time cost from those that are true shifts, induced by the direct action of physicians.

### *Monopolistic and Monopolistically Competitive Models*

Here we consider models in which the physician perceives some definite influence of his price-setting behavior on the level of demand he faces. We will see that the qualitative comparative statics of the market equilibrium is likely to be similar to that of the competitive model. Nevertheless there are some interesting possible differences.

The physician's utility is assumed to depend upon his income, $Y$, and workload, $W$. Equivalently, one can write utility as a function of price, $P$, and workload, since income can then be computed straightforwardly as $Y = P \times W$. If, as usual, we assume that utility is quasi-concave in $Y$ and $W$, it does not follow that this property is retained in $P$ and $W$. Monopolistic equilibrium can be interpreted diagrammatically as a tangency between the physician's indifference curve and the demand curve he faces. In a

4 The Canadian data use a period (1970–76) during which prices were fixed by a provincial reimbursement scheme. These data therefore seem inappropriate for a test of the "no demand shifting" hypothesis in a competitive model, but they may shed light on it in a different specification.

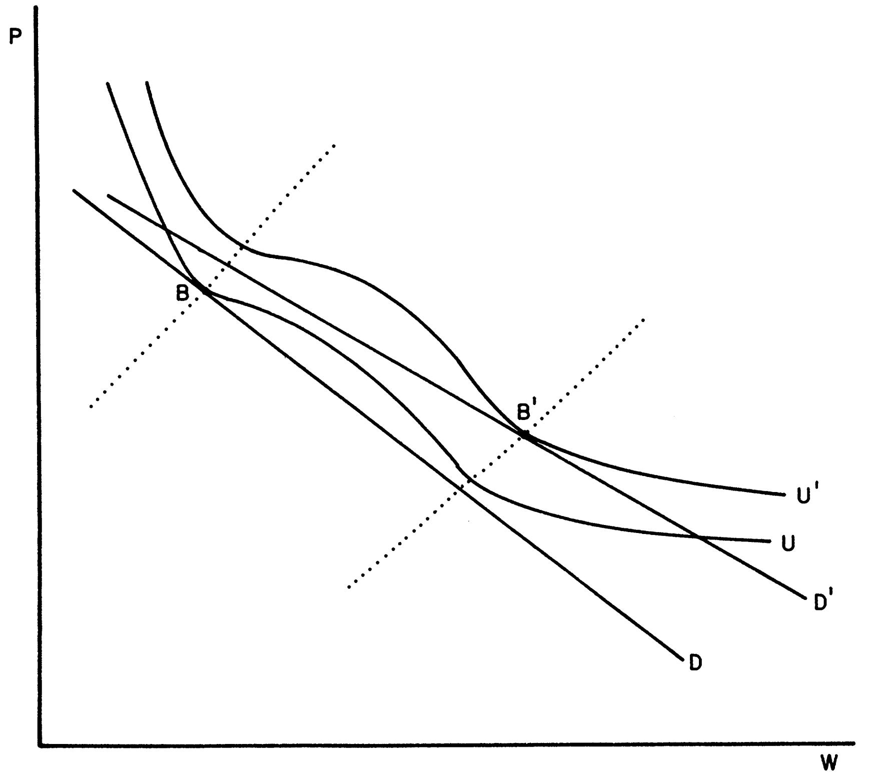


FIGURE 1

monopolistically competititve model, this is the physician's demand curve, holding the "market" price fixed. It may, therefore, be rather elastic.

Utility must be increasing in price for each fixed level of workload, but it can either increase or decrease in workload. This may give rise to a pattern of indifference curves as shown in Figure 1. The demand curves D and D′ correspond to the same income level, but different population/physician ratios. Note that because of the nonconvexity discussed above, the equilibrium price may *fall* when the population/physician ratio rises. This is impossible under a competitive regime.

It is useful to note that it would not be found in the usual comparative static analysis which presumes that movements from one equilibrium to another take place as local adjustments around the initial point. The relevance of this for empirical analyses is as follows: In comparing similar regimes where movements in the physician/population ratio induce shifts along the "expansion" paths around *B* and *B′*, a small positive influence on price will be observed. But if the sample bridges points on different sides of the discontinuity, then a regression of price on this ratio, and other variables, may find a negative coefficient overall.

On the whole, however, monopoly and monopolistic competition with a homogeneous population of demanders is likely to produce qualitatively the same results as a competitive market model. Actually, the implications of the monopolistic model are even stronger than those of the competitive model. If the demand curve is iso-elastic in price and income, qualitative restrictions can be placed on the comparative statics independent of the form of the utility (assuming that this nonconvexity is not a problem in the relevant region) which could not be imposed under a competitive structure. The next two sections utilize these restrictions to test the "no-inducement" hypothesis.

Before leaving the monopolistic models, we comment upon an alternative hypothesis within this framework that has been studied by several authors.[5] This is the idea that supply is influenced by the "quality" of the caseload. Presumably more serious cases will elicit a higher desired competitive supply from physicians; or, in the monopolistic model, the marginal rate of substitution between income and workload will increase.

In a competitive framework, the implications of this system are the same as in the ordinary case. To construct the supply curve, one proceeds as follows: At each price, the quantity demanded consists of a case mixture that is treated parametrically by physicians. The optimizing quantity of supply is then computed at this price and the corresponding "quality" of case. In this way, a supply curve is traced out. If the supply curve for a constant quality were monotone increasing in price, and if the relatively more serious (higher quality) cases are less elastic, then the positive effect of price on supply will be reinforced. Even a backward-bending supply curve could be transformed into a rising one by this effect.

Now assume that the population/physician ratio rises. The demand curve shifts out but, holding demographic and other demand parameters fixed, the average quality at each price remains the same. Therefore the supply curve is unaffected, and, whether it is backward bending or not, price must still rise and per capita utilization fall. Since these testable implications all rest on the downward-sloping character of the demand curve, they are unaltered by the quality-of-caseload effect in the competitive framework.

One can view this effect as the analog of that in Akerlof's "lemons problem" [1], but with the roles of supply and demand reversed. There, however, higher price induced *higher* quality supply, so the derived market demand curve might rise rather than fall, introducing the possibility of multiple equilibria and other phenomena not ordinarily possible. Here,

5 See Feldtstein [8] and a more detailed theoretical discussion in Pauly [13, Ch. 5].

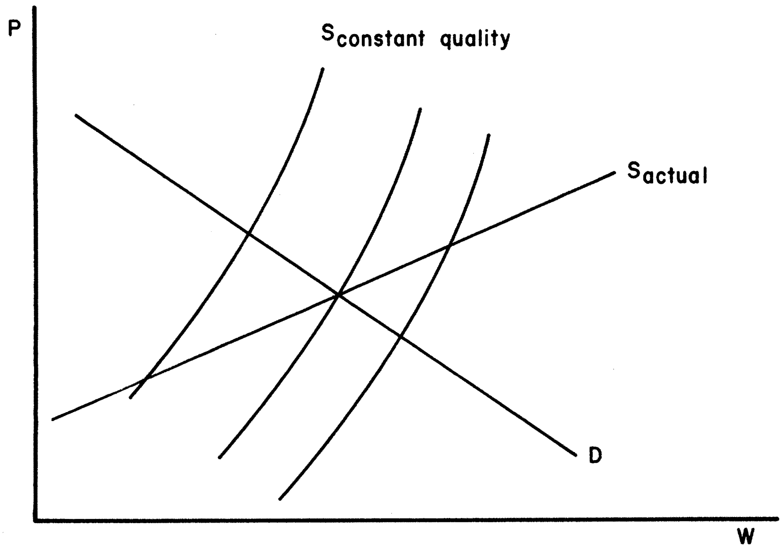


FIGURE 2

however, the influence of price on demand quality is *negative,* so that no pathologies not already present in the constant-quality model can be introduced.

The situation is rather different with respect to the quantitative implications of the monopolistic model discussed in the next section. One can show, in that context, that if quality enters the utility function parametrically, and physicians attempt to control both quantity and quality by setting price, the relation (9) that forms the basis for the econometric test of the "no-inducement" hypothesis is invalidated, in general, just as if there were some possibility for demand manipulation.

### *Testing the No-Inducement Hypothesis*

We have seen that the competitive and monopolistic theories of price determination have largely the same implications for qualitative comparative statics. In this section we discuss a test of the no-inducement hypothesis based on the maintained assumption that the demand curve can be adequately represented in an iso-elastic form.

The basis for the analysis is the workload relationship

$$W = R\phi \tag{1}$$

where $R$ is the population/physician ratio, and $\phi$ is per capita demand. The no-inducement hypothesis is that the arguments of $\phi$ consist of observable exogenous variables, such as income, and observable endogenous variables, such as price, but no unobservable endogenous variable—for example, a shift term under the control of the physician. Let us write per capita demand in the form

$$\phi(P,I) = P^{\epsilon}I^{\eta} \tag{2}$$

Differentiating (1) with respect to $R$ and $I$, we have

$$\begin{aligned} dW/dR &= \phi + R(d\phi/dR) = \phi + R\phi_P(dP/dR) \\ dW/dI &= R\phi_I + R(d\phi/dI) = R\phi_I + R\phi_P(dP/dI) \end{aligned} \tag{3}$$

The comparative statics of $P$ is determined by the monopolistic equilibrium as follows:

The physicians are assumed to maximize a utility that depends on income and workload.

$$U = U(PR\phi, R\phi) \tag{4}$$

The first-order condition for a maximum is

$$(R\phi + PR\phi_P)U_Y + R\phi_P U_W = 0 \tag{5}$$

This can be differentiated totally with respect to $P$, $R$, and $I$ to obtain the comparative statics of the system.

$$\begin{aligned} \Delta \cdot dP/dR = {} & (R\phi + PR\phi_P)(U_{YY} \cdot P\phi + U_{YW} \cdot \phi) \\ & + R\phi_P(U_{YW} \cdot P\phi + U_{WW} \cdot \phi) \end{aligned} \tag{6}$$

$$\begin{aligned} \Delta \cdot dP/dI = {} & (R\phi + PR\phi_P)(U_{YY} \cdot PR\phi_I + U_{YW} \cdot R\phi_I) \\ & + R\phi_P(U_{YW}PR\phi_I + U_{WW} \cdot R\phi_I) \\ & + U_Y(R\phi_I + PR\phi_{PI}) + R\phi_{PI}U_W \end{aligned} \tag{7}$$

where $\Delta < 0$ by the second-order conditions. Utilizing the iso-elastic form of $\phi$ which implies that $\phi/R\phi_I = \phi_P/R\phi_{PI}$, we see that the last two terms in (7) sum to zero, by the first-order condition. The ratio $(dP/dR)/(dP/dI)$ is therefore just $\phi/R\phi_I$.

Using this relation and substituting in (3) we have

$$\begin{aligned} dW/dR &= \phi + R\phi_P/R\phi_I \cdot \phi(dP/dI) = \phi[1 + (\phi_P/\phi_I)(dP/dI)] \\ dW/dI &= R\phi_I + R\phi_P(dP/dI) = R\phi_I[1 + (\phi_P/\phi_I)(dP/dI)] \end{aligned} \tag{8}$$

or

$$(dW/dR)/(dW/dI) = \phi/R\phi_I = (dP/dR)/(dP/dI) \tag{9}$$

In summary, we have that the ratio of the coefficients of $R$ and $I$ in the two equations for $P$ and $W$ should be equal, under these hypotheses. This relation forms the basis for the test we perform.

In estimating price and workload equations, it is important to treat physician's location decisions endogenously. For this reason, both equations were estimated by two-stage least squares, using a structural model for $R$ as in Fuchs-Kramer [9]. Using the data from that study, the predicted value of physician's per capita in each state, $R^*$, was used in a regression of price and workload per physician.

The resulting coefficients[6] are

| | *Constant* | $R^*$ | *Income* | *% of Pop. Insured* |
|---|---|---|---|---|
| *Workload Equation* | 3.37 | .598 | −.118 | .665 |
| *Price Equation* | −7.19 | .151 | .977 | 1.78 |

One should note in passing that the price responds positively, but rather weakly, to the physician/population ratio. On qualitative grounds, the evidence is consistent with either an inducement theory or a standard monopolistic or competitive theory.

At first glance, however, the ratio of the $R^*$ and income coefficients across the equations seems rather different. This suggests that there is some factor entering the per capita demand function that is not controlled in these equations. An inducement effect is not a necessary conclusion, but it is one possibility. To examine this more closely, it is necessary to look at the variance-covariance matrix of the relevant coefficients

| | *$R^*$ in Workload* | *Income in Workload* | *$R^*$ in Price* | *Income in Price* |
|---|---|---|---|---|
| *$R^*$ in Workload* | .0134 | .0150 | −.0145 | −.016 |
| *Income in Workload* | | .021 | −.016 | −.023 |
| *$R^*$ in Price* | | | .047 | .053 |
| *Income in Price* | | | | .074 |

Using the asymptotic normality of the two-stage least squares estimators and these variances and covariances, one would not reject the hypothesis that the ratio of coefficients across the equations is equal. The monopolistic theory without provider-inducement is not rejected by these data.[7]

The strength of this method as a test of the "no-inducement" hypothesis is that it is a valid implication of the theory for any utility function. One can demonstrate that, under the alternative hypothesis where

$$U = U(Y, W, Z) \tag{10}$$

and

$$\phi = \phi(P, I, Z) = P^{\epsilon} I^{\eta} Z^{\delta} \tag{11}$$

the quality between these ratios fails, in general.

This test is based on the maintained hypothesis that per capita demand, $\phi$, has an iso-elastic form. Good fits to detailed micro data have been

6 The equation is written in log linear form, which does not alter the test of the no-inducement effect (9), where derivatives can also be written as elasticities.

7 An alternative form of this test using nonlinear restrictions on the parameters and three-stage least square estimation also failed to reject the equality-of-ratios hypothesis.

obtained by Phelps and Newhouse [14] using a linear demand curve. It is of interest, therefore, to explore the implication of this specification for the test derived above. Reexamining (7), we see that the last two terms can be rewritten as

$$[(\phi_{PI}/\phi_P) - \phi_I/\phi]R\phi_P(U_Y P + U_W) \tag{12}$$

using the first-order condition, but not the iso-elastic specification. If the change in demand is linear in price, $\phi_{PI} = 0$, then (12) is unambiguously positive. We know that $U_Y P + U_W$ is just the change in utility with respect to workload. In general, this can have either sign, but at an optimal choice of $P$ it must be positive, for otherwise a higher $P$, lowering workload, would be desirable.

Therefore, comparing (6) and (7), we find that

$$(dP/dR)/(dP/dI) < \phi/R\phi_I \tag{13}$$

A more precise quantitative relationship cannot be stated since the form of the utility function enters these relationships explicitly. Nevertheless, (13) can be used to explore the empirical results above qualitatively. Substituting (13) into (3), we find that

$$(dW/dR)/(dW/dI) > (dP/dR)/(dP/dI) \tag{14}$$

The regression results presented above are in accord with this bias. Indeed, the linearity of the demand curve provides a reason why the estimated ratios of these regression coefficients differ systematically from equality. In summary, therefore, the no-inducement hypothesis cannot be rejected under the maintained assumption of a constant elasticity form for per capita demand, or under alternative maintained hypotheses that the elasticity is an increasing function of price, as it would be under a linear specification.

## *DISEQUILIBRIUM APPROACHES*

In each of the models of the previous section, we have maintained the assumption that the price that is observed represents an equilibrium, whether monopolistic or competitive. In a market as highly decentralized as that for medical care, however, this presumption deserves careful scrutiny. At the opposite extreme, one might suppose that, in the short run at least, prices are fixed. In a monopolistic model, providers of care may simply not have had sufficient time to adjust fully to the optimal price; in a competitive model, one side or the other faces the problem of not being able to fully realize their desired transaction.

Throughout the literature on disequilibrium analysis of markets, the hypothesis is prevalent that the "short-side" realizes its planned trade, while the "long-side" is constrained.[8] Feldstein [8] utilizes this hypothesis in an aggregative time-series study of medical care by private physicians. He argues that rising prices are a sign of excess demand, and therefore that the observed quantity has arisen as a point on or near the supply curve—the parameters of demand remaining underidentified unless some more specific hypotheses are employed.

Feldstein tries the hypotheses that price adjusts in the direction of the equilibrating price[9] and that it increases in response to excess demand. But independent of the details of the specification, the estimated price-change equation combined with the supply equation has yielded results that are incompatiable with the theory of demand and price adjustment.

We believe that these conclusions should be reevaluated using a theory of quantity determination more sophisticated than simply that observed quantity is the minimum of desired demand and supply. (We would maintain the hypothesis that supply consistently falls short of demand in the aggregate, though a more complex construction can be estimated via newly developed maximum likelihood techniques.[10]) It is natural to assume that it lies between demand and supply and that the excess of quantity over supply increases with the extent of excess demand. Two possible functional forms for this relation are:

$$Q = S + (D - S)^{\alpha} \qquad 0 < \alpha < 1 \tag{15}$$

$$Q = aS + (1 - a)D \qquad 0 < \alpha < 1 \tag{16}$$

The first of these is somewhat more likely on economic grounds. It says that physicians will satisfy some excess demand, but that as excess demand grows, less of it is realized on the margin. Presumably the reason for this is that out of social conscience, or perhaps simply as a result of the direct pressure of his patients, the physician works harder than he would if he could choose his income-workload pair in a completely unconstrained way. The effectiveness of these pressures diminishes as the marginal utility loss of deviating further and further from the unconstrained optimum becomes progressively more severe.

Equation (16) is of the same general nature, but does not embody the increasing marginal cost of deviating from the optimum. Over the range of observation, however, it may be just as good, and it is easier to implement econometrically.

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8 In the macroeconomic literature, it is utilized by Clower [5], Benassy [4], Barro-Grossman [3], and many others. It also underlies the nontatonnement adjustment process of Hahn-Negishi [10].

9 It is hard to see the rationale for this assumption on the level of the individual price-setter. As Feldstein himself points out, a backward-bending supply curve plus a relatively less elastic demand curve would imply that price falls when there is excess demand.

10 See Amemiya [2], Fair-Jaffe [7], and Hartley and Mallela [11].

Underlying supply and demand equations are specified in the usual way, quantities being defined per physician.

$$(17)\qquad \begin{aligned} D &= \beta_X X_D + \beta_R R + \beta_P^D P \\ S &= \beta_X X_S + \beta_P^S P \end{aligned}$$

where $X_D$ and $X_S$ are exogenous variables specific to demand and supply, and the population/physician ratio, $R$, has been singled out for special attention in the demand equation.

To identify parameters in the demand equation, we specify that prices adjust according to

$$(18)\qquad P_{t+1} - P_t = \beta_\Delta X_\Delta + \gamma(D - S)$$

where $X_\Delta$ is a vector of exogenous variables such as general inflation and inflation in costs of health services other than physicians (which are, of course, not really exogenous).

By estimating the reduced form for $Q$ and $P_{t+1} - P_t$, one can identify the parameters of the underlying supply and demand equations. In this way one can test whether $\beta_R = 1$, which is related to the hypothesis that there is no demand being induced by the physicians.

In this context it would also be extremely interesting to disaggregate the market for medical care by specialty. It is clear that for some specialties there is excess demand, while in others the state of the market is less certain, and perhaps there is even general excess supply.

When the direction of the disequilibrium is in doubt, recently developed econometric techniques may be very valuable. The realized quantity is no longer assumed to arise from (15) or (16), when the market is in excess supply. However, rather than merely interchanging the roles of $D$ and $S$ in this relation, the nature of the medical services market suggests a different specification for the excess supply case. Physicians can be expected to respond positively to the pressure of excess demand, but patients should not respond to conditions of excess supply by accepting a higher level of care. Thus, under the no-inducement hypothesis, we would expect realized quantity to be well approximated by

$$(19)\qquad Q = \begin{matrix} S + (D - S)\alpha & D > S \\ D & D < S \end{matrix}$$

This suggests a second method of testing for the presence of some physician-induced demand. If the time-series sample can be separated into excess supply and excess demand regimes, the estimated value of $\alpha'$ in the specification

$$(20)\qquad Q = \begin{matrix} S + (D - S)\alpha & D > S \\ D + (S - D)\alpha' & D < S \end{matrix}$$

should be zero, even if $\beta_R$ is constrained to be equal to one.

As a practical matter, the problem is likely to be rather difficult to approach in this way. Price data are often the least accurate, and price changes are therefore very unreliable. As a result, it is unrealistic to think of separating the sample into regimes of excess demand and excess supply on a deterministic basis unless there is no doubt that the specialty under consideration always has remained in either one phase or the other.

There are two ways to handle errors in the price equation when the form of disequilibrium is unknown. One can neglect any information conveyed by the price adjustment process and treat each observation separately with prices exogenous. In this case the likelihood of the observation $(Q, X_D, X_S, R, P)$ is the likelihood that it arose from the regime $D > S$, plus the likelihood that it arose from $D < S$, each of which can be obtained directly from the specification (19) and the underlying behavioral relations (17) when an error process (such as normal, independent, and identically distributed) has been assumed. The maximum likelihood estimators are consistent, but they will tend to be difficult to compute and relatively unreliable in time series over short intervals.

Retaining price-change information but introducing an error term may improve the efficiency of the estimates, but will be even more difficult in small samples. Further, specification errors in the price-change equation may seriously bias the results. On the whole, although disequilibrium methods may be useful in principle, they are unlikely to be of practical relevance with annual time-series data unless the nature of the imbalance between supply and demand can safely be assumed and its magnitude accurately measured.

## *REFERENCES*


1. George A. Akerlof. "The Market for Lemons: Qualitative Uncertainty and the Market Mechanism." *Quarterly Journal of Economics* 84 (August 1970): 488–500.
2. Takeshi Amemiya. "The Nonlinear Limited-Information Maximum-Likelihood Estimator and the Modified Nonlinear Two-Stage Least Squares Estimator." *Journal of Econometrics* 3 (November 1975): 375–86.
3. R. Barro and H. Grossman. *Money, Employment and Inflation.* Cambridge: Cambridge University Press, 1976.
4. J.-P. Benassy. "Disequilibrium Theory." Ph.D. dissertation, University of California, Berkeley, 1973.
5. R. Clower. "The Keynesian Counterrevolution: A Theoretical Reappraisal." In *The Theory of Interest Rates*, eds. F. H. Hahn and M. Brechling. London: Macmillan, 1965.
6. Robert G. Evans. "Supplier-Induced Demand: Some Empirical Evidence and Implications." In *The Economics of Health and Medical Care*, ed. Mark Perlman. London: Macmillan, 1974.

7. Ray C. Fair and Dwight M. Jaffee. "Methods of Estimation for Markets in Disequilibrium." *Econometrica* 40 (May 1972): 497–514.
8. Martin Feldstein. "The Rising Price of Physicians' Services." *Review of Economics and Statistics* 52 (May 1970): 121–33.
9. Victor Fuchs and Marcia J. Kramer. *Determinants of Expenditures for Physicians' Services in the United States 1948–1968*. New York: National Bureau of Economic Research/HEW, 1973.
10. Frank H. Hahn and Takashi Negishi. "A Theorem on Non-Tatonnement Stability." *Econometrica* 30 (July 1962): 463–69.
11. M. Hartley and P. Mallela. "The Asymptotic Properties of a Maximum Likelihood Estimator for a Model of Markets in Disequilibrium." *Econometrica* 45 (September 1977): 1205–20.
12. Joseph P. Newhouse and Charles E. Phelps. "New Estimates of Price and Income Elasticities of Medical Care Services." In *The Role of Health Insurance in the Health Services Sector*, ed. Richard Rosett. Universities-National Bureau Conference Series No. 27. New York: National Bureau of Economic Research, 1976.
13. Mark V. Pauly. "Doctors and the Workshops: Physician Influence on the Use of Medical Resources." Northwestern University, 1977, manuscript.
14. Charles E. Phelps and Joseph P. Newhouse. "Coinsurance, the Price of Time, and the Demand for Medical Services." *Review of Economics and Statistics* 56 (August 1974): 334–42.
15. Uwe Reinhardt. "Parkinson's Law and the Demand for Physicians' Services." Princeton University, 1977, mimeo.
16. Frank Sloan and Roger Feldman. "Monopolistic Elements in the Market for Physicians' Services." Paper presented at the Federal Trade Commission Conference on Competition in the Health Care Sector, June 1–2, 1977, Washington.
17. Bruce Steinwald and Frank A. Sloan. "Determinants of Physicians' Fees." *Journal of Business* 47 (October 1974): 493–511.

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## References

[1] **The Market for "Lemons": Quality Uncertainty and the Market Mechanism**
George A. Akerlof
*The Quarterly Journal of Economics*, Vol. 84, No. 3. (Aug., 1970), pp. 488-500.
Stable URL:
http://links.jstor.org/sici?sici=0033-5533%28197008%2984%3A3%3C488%3ATMF%22QU%3E2.0.CO%3B2-6

[7] **Methods of Estimation for Markets in Disequilibrium**
Ray C. Fair; Dwight M. Jaffee
*Econometrica*, Vol. 40, No. 3. (May, 1972), pp. 497-514.
Stable URL:
http://links.jstor.org/sici?sici=0012-9682%28197205%2940%3A3%3C497%3AMOEFMI%3E2.0.CO%3B2-W

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[14] **Coinsurance, The Price of Time, and the Demand for Medical Services**
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[17] **Determinants of Physicians' Fees**
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*The Journal of Business*, Vol. 47, No. 4. (Oct., 1974), pp. 493-511.
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