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An estimation of the demand and supply for physician services using a panel data☆

Akbar Marvasti

NOAA, National Marine Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149, United States

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ABSTRACT

Using the single-equation and simultaneous equations methods, demand and supply for physician services at medical practices are estimated with panel data, which is primarily based on American Medical Association divisional surveys. Fixed effects and no-effects models are employed for estimation of the parameters of the simultaneous equations and their elasticities. The results suggest that the demand is highly income inelastic. However, private insurance and Medicaid raise the rate of utilization. The adverse effect of uninsured is also evident, though it is not as high as private insurance. Evidence also supports the demand inducement hypothesis and points to the rising demand for health care as the U.S. population is aging. The supply function parameters generally demonstrate their expected pattern. It is notable that the malpractice liability premiums exhibit a negligible effect on the supply of office visits.

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1. Introduction

We use a simultaneous system of equations to estimate demand and supply of the U.S. physician office visits and examine several important health care issues such as income elasticity of demand, significance of private health insurance, role of the uninsured, supplier's induced demand, and the effect of malpractice premiums on the supply of office visits. Decades ago, Paul Acton stated that the market for health care services deserves special attention because of its size, inflationary trend, and significance in public policy (Acton, 1975). This remains true to this day. Knowledge of the behavior of consumers and providers of health care services could play a valuable role in the national health insurance debate and legislative changes. Complexities of the health care market have been well documented where consumer behavior is influenced by various types of private and public health insurance programs, as well as by the unique ability of the suppliers of health care services to determine the demand. While studies of the health care market typically focus on one side of the market, the simultaneous equations estimation here uses more information and obtains more precise and meaningful parameter estimates than alternative estimation techniques. Also, presence of several variables in the system with policy implications provides useful information. We use a panel of U.S. divisional data and apply a battery of tests to find the most appropriate econometric model to fit demand and supply for office visits. The results from the demand function estimates indicate that the private and the government health insurance programs as well as ease of access in large metropolitan areas increase demand for office visits. We also find a positive effect of increase in physician fees on the supply of their services, which under certain conditions can be traced back to a backward-bending supply curve for physician services. However, malpractice insurance premium shows a negligible effect on the supply of office visits.

The remainder of the paper is organized as follows. First, a simple theoretical model, which motivates the empirical model, represents the behavior of the consumers and producers of health care services in the form of office visits. After describing the data and the empirical specification of the model, the parameter estimates and elasticities from single-equation and simultaneous equations frameworks estimators are compared. The final section includes the conclusions.

2. Literature review

Several studies in health economics have examined the demand and the supply functions for health care services. For example, Grossman (1972), in his theoretical analysis of the demand for health services, views health as a durable capital stock which produces healthy time. He argues that individuals can increase their initial stock of health, which normally deteriorates with age, by investing in the purchase of medical care. Dardanoni and Wagstaff (1990) expand Grossman's human capital model by introducing uncertainties with respect to the incidence of illness and the effectiveness of medical care. Their comparative static analysis show that, under the standard set of assumptions, an increase in uncertainty with respect to the incidence of illness results

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E-mail address: akbar.marvasti@noaa.gov.

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in an increase in the demand for medical care, while the opposite can be expected when uncertainty with respect to the effectiveness of medical care increases. Farley (1986), on the other hand, in his theoretical analysis of the demand and the supply of physician services, develops a model in which physicians replace the allocation mechanism of the market. Farley combines the theory of competitive markets with a target-income theory for the physicians and concludes that physicians, by maximizing their utility of the net of profit and patient satisfaction combined, consider their own welfare as well as the welfare of their patients.

Among empirical studies of the demand for health care services, Acton's (1975) analysis of the behavior of the users of outpatient departments and municipal hospitals in New York is most notable. In his estimate of the demand for medical care, he introduces monetary as well as non-monetary factors such as travel distance. The results of his study support his prediction that travel time, measured by distance, plays the role of price as a determinant of the demand for free medical services. Feldman (1979) estimates hedonic price functions for physician's office and hospital visits. He finds an unexpected positive sign for coefficients of the price of office visits and appointment delays. While he does not attempt to explain the sign of the coefficient for appointment delay, he argues that the demand inducement by the physicians explains the unexpected sign of the physician fees for an office visit.

In their estimate of the demand for various health services using data from the RAND Health Insurance Experiment, Phelps and Newhouse (1974) find a low price elasticity for a more time-consuming office visit and high price elasticity for a home visit with a physician. They also find that coinsurance is a significant factor as a determinant of the demand for medical care. McCarthy's (1985) investigation of the demand for the primary care physicians in metropolitan areas shows that this market is monopolistically competitive and the consumers are sensitive to the monetary price, time price, and the quality of individual physician's firms. Cauley (1987) focuses on the time price of medical care in his estimation of the demand for medical care among members of a prepaid group practice medical care program. He questions the equality between wages and marginal value of time, which is often assumed in the literature, and makes some adjustments for factors such as employment status, having sick leave, housewives, and taking children to a doctor. After making these adjustments, the coefficient for the value of time turns out to be significant in the demand function. Dowd et al. (1991) estimate the effect of health plan memberships by families on their demand for medical services. After controlling for differences in coverage between the health maintenance organizations and fee-for-services, they find that the number of physician services is the same in both plans, but families enrolled in health maintenance organizations use fewer inpatient days than the same families enrolled in a fee-for-service plan. Another study of the demand for medical care documents the importance of direct and indirect time costs in demand for pediatrics services (Vistnes and Hamilton, 1995).

More recent studies of the demand for health care include Deb and Trivedi (1997) where negative binomial model is used to estimate six measures of medical care demand by the elderly. Later, Deb and Trivedi (2002) use a two-part model to distinguish users and non-users of health care. They also use a latent class model to distinguish frequent and infrequent users of health care services representing ill versus healthy individuals, respectively. The two models created substantially different price elasticities. Some of the other recent estimates of demand for health focus on the markets in Europe. For example, Bago d'Uva and Jones (2009) use a latent hurdle model with panel data and compare it to the latent class negative binomial model. Applying pool models to European data, the authors find that as income rises, people tend to use more specialists. They also find higher income elasticity among high users than low users. Riphahn et al. (2003) examines adverse selection and moral hazard features of demand for health care and their estimated elasticity of demand for physicians confirm moral hazard effects in Germany. In a simultaneous equations model, Atella and Deb (2008) investigate whether primary care physicians and specialists in the private and public sectors in Italy are complements or substitutes. When unobserved heterogeneities are taken into account, the authors find that the two are substitutes. Martin et al. (2007) compare single equation estimates of demand and supply for elective surgeries with their joint estimation in a simultaneous equations system. While the authors find the results qualitatively similar, elasticity estimates for appointment delay, which appears to be the focus of the study, are lower from the simultaneous equations model than those from the single-equation estimates.

Supply of the physicians' services in terms of the hours of work and number of visits has also been the topic of some studies in health care. Feldstein (1970) produced one of the early studies of the physician services market using a very small sample, where he finds evidence of a backward-bending supply curve. Sloan (1975) and Vahovich (1977) have also estimated the supply of physician services focusing on the slope of the supply curve and effect of price control on physician services. More recently, Rizzo and Blumenthal (1994) analyzed the behavior of male and female physicians separately in a single equation model and discovered both income and substitution effects of wage change to be significant for both genders, but hours of work response to variations in their earnings is more severe for female physicians. Bradford and Martin (1995) use a simultaneous equation system, where the hours of work and number of visits are both choice variables. Their results support backward-bending labor supply and negatively sloped service supply curves.

3. The model

The objective function of a typical consumer, assuming a Neumann–Morgenstern utility function, can be written as:

$$Max.U = U\left[Y - F\left(P, T^0\right)\cdot(1-c)M,\ \left(l - T^0\cdot M\right), H\left(M, T^a\right)\right] \tag{1}$$

where Y refers to individual's income, $F(P, T^0)$ is nominal fees for medical care, c is coinsurance rate (i.e., percentage of health care costs paid by insurance company), M is the quantity of medical care received, $(l - T^0 \cdot M)$ is leisure time left for the individual considering the time spent at the medical practice, and $H(M, T^a)$ is the health status of the individual which is positively dependent upon the amount of health care received and adversely upon the length of waiting time to receive medical care because of appointment delay. Delays in the physician's office increases the real or full price of medical care for the patient where $P = F + w \cdot T^0$, and w is the opportunity cost of one unit of delay in the office. Here, medical care is assumed to be a normal good, i.e., $\frac{dM}{dY} > 0$, and demand curve is assumed to be downward slopping, i.e., $\frac{dM}{dP} < 0$. Assuming a linear utility function, the first-order condition with respect to M yields:

$$U_M = -F\left(P, T^0\right)\cdot(1-c) - T^0 + H_M = 0, \tag{2}$$

where demand is created to the point that the marginal utility of health care equals the marginal utility of additional working hours plus marginal utility of waiting time.

Thus, the individual's demand for medical care can be written as:

$$M^d = f\left(F, T^0, T^a, Y, c\right). \tag{3}$$

Next we focus on the supply side of the market. While the theory of owner–operator entrepreneurs was developed earlier based on the behavior of a utility maximizing firm (Auster and Silver, 1976; Ladd, 1969; Olsen, 1973; Scitovszky, 1943; Williamson, 1964), later other studies applied this model to physician services (Anderson and Ormiston, 1983; Brown and Lapan, 1979; Lapan and Brown, 1988). Following