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Hospital Choice in Japan

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Abstract

We use newly released data on Japanese hospitals to explore patients' perceptions of hospital quality, the implications of these assessments for the structure of demand for hospital care, and the role of the availability and quality of hospital care in influencing access. We find that the primary influences on hospital choice for Japanese patients are interpersonal aspects of care, that Japanese hospital markets are not segmented, and that availability has no influence on access. These results are interpreted in light of institutional differences between the Japanese and American health care systems.

Introduction

Over the past several decades, there has been a great deal of interest in the health services research community over appropriate definitions of the quality of hospital care and the role of competition among hospitals in influencing the provision of quality care. As discussed by Donabedian (1987), hospital quality is a multidimensional attribute and no single statistic can capture it fully. Furthermore, hospital quality means different things to different people; physicians, patients, hospital administrators, and regulators all have different ideas of what constitutes high-quality care.

Since the patient is the ultimate consumer of care, the patient's perception of the quality of care is of particular interest. It is commonly believed that patients are best able to assess the interpersonal aspects of care and that they are less able to assess the technical aspects of their care. Using the case of Japan, our primary focus is to identify and measure the aspects of quality to which patients are sensitive. We explore three issues in this investigation. These are the determinants of Japanese patients' perceptions of hospital quality, the implications of these assessments for the structure of demand for hospital care and for the competitive environment faced by hospitals, and the role of the availability and quality of hospital care in influencing access to care.

There are important institutional differences between the United States and Japan which make Japan a particularly relevant context in which to ask these questions. In the United States, patients are highly heterogeneous and face very complicated decisions when choosing among health care providers. Conversely, Japanese patients are homogeneous in important ways and their decision-making environment is much simpler.

A number of factors combine to make the modeling of American patients' choices of providers difficult. First, different patients have different levels of insurance coverage, and considerations of co-insurance and deductibles have been shown to influence choice (Manning et al., 1987). In fact, Phibbs et al. (1993) and Dranove, White, and Wu (1993) both show that insurance coverage has a major impact upon choice of hospital. Second, there is wide variation in the fees charged by physicians and hospitals. Third, managed care plans often place constraints upon the patient's choice of provider and/or treatment. Finally, physicians typically hold admitting privileges at only a few hospitals, limiting the patient's choice even further. Burns and Wholey (1992) and Folland (1983) both document the influence of physicians upon hospital choice. These sources of heterogeneity—price variability, insurance variability, managed care restrictions, and physician practice and referral patterns—are unobservable or imperfectly observable, and they are, therefore, difficult to control for or analyze.

By contrast, the environment for Japanese patients is relatively simple. It is free from these confounding considerations, leaving patients free to choose their health care providers only upon the bases of convenience and perceived quality. Insurance coverage in Japan is universal and very similar across plans. All health insurance in Japan is fee-for-service; deductibles and copayments are low; and the conventional wisdom is that the effects of variations in these variables upon choice are modest (Okimoto and Yoshikawa, 1993). Prices for all health services in Japan are fixed by the government through the national fee schedule, which is set by the Ministry of Health and Welfare (Koseisho); thus, there are no differences, observed or unobserved, in fees among providers. Patients are free to choose any provider they like; indeed, it is sometimes suggested that Japanese patients have too much freedom of choice, as many patients go to university hospitals for relatively uncomplicated conditions. Finally, the role of physicians in directing patients among hospitals is very different in Japan compared with the United States. Community-based physicians in Japan, almost without exception, do not have admitting or other privileges to practice at hospitals. When patients go to hospitals, they are treated exclusively by physicians who are employees of the hospital. Conversely, physicians who practice in hospitals do not maintain practices outside the hospital. This division between community- and hospital-based physicians mitigates the confounding influence of physicians in Japan relative to the United States. These features together make Japan an attractive environment in which to answer questions about the determinants of perceived quality and its influence on patient choice.[1]

Two primary methodologies have been employed to explore the determinants and influence of quality on patient choice of hospital. The first is the use of patient surveys to elicit directly from them their perceptions of quality care. For example, Okorafor (1983) conducted a survey of several hundred patients and physicians in Indianapolis. Respondents were asked to rate the importance of several factors in influencing their choice of hospital. For both physicians and patients, the most important factors were reported to be the quality of nursing staff, availability of medical technology, and the quality/friendliness of non-nursing staff.

In the second methodology, patients' choices among providers are used to infer their preferences and thus their evaluations of quality. There have been a substantial number of studies in this vein. These studies rely upon a multinomial logit model of hospital choice (McFadden, 1973), and they are estimated either with maximum likelihood or minimum chi-square techniques.

The first wave of this work (Folland, 1983; Erikson and Finkler, 1985; McGuirk and Porell, 1984; Lee and Cohen, 1985) used a multinomial logit model of demand and estimate via various versions of Theil's (1969) minimum chi-squared estimator. These studies came to very similar conclusions regarding the important influences on patient choice. Distance or time from the patient's home to the hospital, availability of physicians, complexity of clinical services offered, and medical school affiliation all strongly influence patient choice. It is difficult to conclude from these studies whether the pattern of preferences exhibited is the result of patients' preferences or those of physicians.

A second wave of research (Adams et al., 1991; Burns and Wholey, 1992; Dranove, White, and Wu, 1993; Garnick et al., 1989; Luft et al., 1990; Phibbs et al., 1992) utilized maximum likelihood estimation of the conditional logit model. These studies explore a number of issues relating to patient choice. Several themes emerge: Patients are extremely sensitive to the distance between their residence and the hospital in their choices, and they prefer larger and more specialized hospitals. The effect of insurance on choice has been modeled as well. Dranove, White, and Wu (1992) and Phibbs et al. (1992) both find that Medicaid patients are significantly less likely to receive care in hospitals with highly specialized services than are privately insured patients. Several authors have explored the effect of charges and outcomes-based quality on choice of hospital, with mixed results.

In summary, survey evidence and common wisdom argue that both clinical and personal aspects of quality should have important influences on patient choice. To date, studies of patient choice in the United States have examined the effects of clinical outcomes and technological structure measures of quality on patient choice and have not examined personal aspects of quality. Also, the results on patient choice are difficult to interpret, given the important and unobserved, or imperfectly observed, influence of physician admitting privileges, insurance type, price, and managed care restrictions. The observed patterns of choice represent a complex interaction among these several influences and are not directly interpretable as representing patient preferences.

Our study seeks to extend previous work in this area in several ways. We are better able to isolate the influence of quality attributes from other determinants of patient choice because of the particular structure of the Japanese health care system. Due to our large sample of hospitals, we are able to identify the effects of a large number of variables, and we are able to include a number of variables which have shown evidence of being important in prior survey work, but which have, because of the limited number of hospitals in typical samples, been neglected since. We are also able to generalize to a larger patient population, since our data set covers the entirety of Japan, rather than a single county or state.

Data

The primary data source used in this study is the *1990 Facility Survey* (*Iryo Shisetu Chosa*). The Facility Survey is similar to the American Hospital Association Annual Survey; it contains data describing each hospital in Japan. It is collected in September of each year by the Ministry of Health and Welfare. Since it is mandatory, the survey contains full information for each of the 10,096 hospitals in Japan. A wide variety of information is contained in the facility survey, including data on size, ownership, number of inpatients and outpatients, measures of staffing, complexity of services, and utilization of services. We use information on the number of inpatients at each hospital, the number of beds at each hospital, staffing levels, and the availability of various equipment and specialized facilities.

The patient flow data used in our definition of markets (described below) are derived from the Ministry of Health and Welfare 1990 Patient Survey (*Kanja Chosa*). The patient survey is a random sample of inpatients and outpatients who are using the health care system at any clinic or hospital on the day of the survey. Data on population and age structure in the various markets for hospital care in Japan are derived from the

Management and Coordination Agency, *1990 Population Census of Japan*.

Two sources of supplementary data are used. Data on average revenue per patient are derived from the Ministry of Health and Welfare, *Chiiki Iryohi Soran* (Regional Health Care Costs, 1991). Data on wages are taken from the Ministry of Labor, *Chingin Sensasu* (Wage Census).

Method

Model. There are three aspects of demand for hospital care relevant to our research goals. To examine the influence of perceived quality on choice, we model patients' choices among hospitals. To examine the competitive structure of hospital markets in Japan, we model patient choice among different types of hospitals. Finally, to examine the impact of quality and availability on access, we model patients' decisions to seek care. A patient's decision to seek care depends upon the characteristics of the patient (health status) and upon the number and the quality of available hospitals in the patient's market. Having decided to seek care, the patient must decide what type of hospital (large, small, teaching or non-teaching) to choose. Again, the type of hospital chosen will depend upon the number and quality of the various types of hospitals available to the patient. For example, in a market with many high-quality teaching hospitals, one expects patients to be more likely to choose a teaching hospital. Finally, having decided, say, to seek care at a teaching hospital, the patient must determine which teaching hospital to use. To make this choice, the patient must weigh the characteristics of the various teaching hospitals and choose the one with the most desirable combination. We model the process in three stages in order to separate the effects of availability and quality on access (the first stage), the degree of market segmentation (the second stage), and factors influencing the determination of which hospital the patient perceives as the best (the third stage). This model explicitly incorporates the dependence of decisions in each of the early stages upon the choices available to patients in the later stages and upon heterogeneity in patient preferences over different hospitals and types of hospitals.

In order to estimate this staged choice, we utilize the nested logit model (McFadden, 1981). In our setting, the model is described by three conditional probabilities. The first of these is the probability of choosing a particular hospital, given that the patient has decided to seek care and given that the patient has chosen to use a hospital of a particular type. This probability is hypothesized to depend upon the characteristics of the hospitals available to the patient:

$$(1) \quad P(j \mid B_n) = \frac{\exp(X_j\beta)}{\sum_{j' \in B_n} \exp(X_{j'}\beta)}$$

The left-hand side is the probability of seeking care at hospital j, given that the patient has decided to seek care at a hospital of type n. Here, j is an index for the hospital, X_j are hospital j's characteristics, B_n is the set of all hospitals of type n, and β are parameters to be estimated. This part of the model is similar to what has been used in previous work on hospital choice. A patient's probability of choosing a particular hospital depends both on the characteristics of the hospital chosen and the characteristics of the hospitals rejected.

The second conditional probability is that of a patient choosing a particular type of hospital, given that the patient has chosen to seek care. This probability is:

$$(2) \quad P(B_n \mid \text{seek}) = \frac{a_n \left\{\sum_{j \in B_n} \exp(X_j\beta)\right\}^{\rho_n}}{\sum_{n'=1}^{N} a_{n'} \left\{\sum_{j \in B_{n'}} \exp(X_j\beta)\right\}^{\rho_{n'}}}$$

In this expression, the left-hand side is the probability that the patient chooses a hospital of a particular type (for example, a teaching hospital), given that the patient has chosen to seek care. The term in braces is essentially an index of the aggregate quality of the hospitals of a particular type. So a patient's probability of choosing a particular type of hospital depends upon the number and quality of the hospitals of that type and also upon the quality of the other types of hospitals. The a's and ρ's are parameters to be estimated. The parameters ρ_n deserve special attention. ρ_n is a measure of how similar or dissimilar the various categories of hospitals appear to patients. A ρ_n close to 1 indicates that patients perceive hospitals in different categories to be close substitutes for one another. Conversely, a ρ_n less than one indicates that hospitals in different categories are not close substitutes. Categories of hospitals which are close substitutes compete directly with one another for patients. In this context, the parameters ρ_n will enable us to examine whether or not, for example, teaching and non-teaching hospitals are viewed by patients as close or distant substitutes and, therefore, whether there are likely to be important competitive effects among the two groups.

The third probability is that a patient is seeking care. This probability is:

$$(3) \qquad P(\text{seek} \mid Y_i) = \frac{a_{seek}\left(\sum_{n'=1}^{N} a_{n'}\{\sum_{j\in B_{n'}} \exp(X_j\beta)\}^{\rho_{n'}}\right)^{\rho_{seek}}}{\exp(Y_i\theta) + a_{seek}\left(\sum_{n'=1}^{N} a_{n'}\{\sum_{j\in B_{n'}} \exp(X_j\beta)\}^{\rho_{n'}}\right)^{\rho_{seek}}}$$

Y_i is a vector of characteristics of an individual considering the decision to seek care. Again, the term in braces is effectively an index of the availability and quality of hospital care in the patient's market and a_{seek}, ρ_{seek}, and θ are parameters to be estimated. The parameter ρ_{seek} measures the responsiveness of access to the availability of care; a positive value indicates that a greater number of hospitals in a market enhances access. In our data, we do not observe individual decisions to seek care; we observe only aggregate counts. Thus, it is necessary to integrate equation (3) over the unobserved patient characteristics Y_i in each market in order to estimate the model:

$$(4) \qquad P(\text{seek}) = \int_Y P(\text{seek} \mid Y)\, dF(Y)$$

F(Y) is the distribution of Y in the population (in our case, the age distribution in each market for hospital care).

Estimation Technique. The estimation technique operates in two steps. In the first step, Theil's (1969) estimator is used to estimate the third stage of the model, choice of hospital within each category.[2] Observe that:

$$\ln(P(\text{hosp } j \mid B_n)) - \ln(P(\text{hosp } j' \mid B_n)) = (X_j - X_{j'})'\beta$$

To implement this model, the log of each hospital's market share within its category is taken. Then, within each category of each market, the median hospital (in terms of bed size) is chosen to be the contrast hospital. The difference of the log market share between each hospital and the contrast hospital is regressed upon the difference in characteristics between each hospital and the contrast hospital. Generalized least squares regression is used to account for the covariance among the choices. This produces a consistent, asymptotically normal, efficient estimate for β which is asymptotically equivalent to the (conditional) maximum likelihood estimate.

With the estimate of β in hand, the second step of the estimation algorithm proceeds to estimate the first and second stages of the demand model via maximum likelihood methods, after substituting the estimated value for β into the likelihood function. To wit, the contribution to the likelihood function of someone who chooses to seek care at a hospital in category n is:

$P(B_n \mid seek)\ P(seek)$

while the contribution of a person who does not seek care is:

$1 - P(seek)$

where the forms of these functions are given above. The distribution of ages in the population is modeled with a multinomial distribution having age categories 0-29, 30-44, 45-64, 65+ as points of support. The dependence on age in the decision to seek care is entered in our model via dummy variables for each of the four age categories; this functional form can be interpreted as a spline approximating the true age-response function. In equations (2) and (3) above, the estimated value for β is substituted in place of the true value. Using estimated values in this way does not affect the consistency of the estimates (McFadden, 1981).

Variables. As described above, the dependent variable in the third stage of the model is the difference between each firm's log-market-share and the log-market-share of the contrast firm in its category. For the upper levels of the analysis, the technique is maximum likelihood, so that the dependent variable is each patient's choice of hospital category. We construct five categories of hospitals: 20-49 beds, 50-99 beds, 100-199 beds, 200+ beds, and all teaching hospitals. Hospitals were divided on the basis of size because of the frequently reported result that patients are more likely to prefer large to small hospitals. Furthermore, teaching hospitals were put in a separate category since they have a different role than do non-teaching hospitals and there is a widespread perception in Japan that teaching hospitals provide higher quality care than do non-teaching hospitals.

The independent variables at each stage are the characteristics of the hospitals. We were guided in our choice of independent variables by a number of considerations. In previous work, such variables as the size, ownership, teaching status, and complexity of clinical services offered have been found to influence choice. The survey evidence we describe above indicates the importance of including measures of staffing, and the facility survey provides a number of such measures. We also solicited opinions from a number of Japanese physicians, administrators, health economists, and regulators. The most commonly mentioned influences on patient choice were reputation, level of personal service, comfort of surroundings, and possession of sophisticated clinical services.

To capture the effect of the level and quality of service on demand, we include a number of measures of staffing. These include RNs per bed, PNs per bed, nurse aids per bed, and other staff per bed. Of the quality variables we include, staffing levels are most easily and generally observable by patients. Another quality variable easily observed by individual patients is the size of their room. To capture patients' likely preference for hospitals with more comfortable rooms, we include a measure of the area of the wards divided by the number of beds in them. Reputation is captured, crudely, by variables measuring the teaching status, ownership, and number of beds in the hospital. The conventional wisdom is that public hospitals, teaching hospitals, and bigger hospitals have the best reputation. The complexity of the services offered at the hospital is modeled by including dummy variables for a wide variety of medical technologies. All of the continuous variables are entered in logs. The variables chosen for inclusion in the analysis are summarized in Table 1.

Market Definition. Since our approach depends upon identifying the differences in market share among competing hospitals, it is important that our definition of market include all of a hospital's competitors and not include extraneous, non-competing hospitals. Since distance has been shown, very robustly, to be a major determinant of hospital choice, a geographical definition of markets is the appropriate one here.[3]

To construct our markets, we use the algorithm introduced by Elzinga and Hogarty (1973). In this technique, product (in our case patient) flow data are used to construct markets. This algorithm constructs markets which have the property that few patients who live inside each market leave the market to seek care elsewhere. The algorithm operates as follows. We begin with a set of proposed markets and examine the number of patients who live in each one who seek care in their home market and the total number who seek care in that market; the ratio of the second to the first is LOFI ("little out from inside"). We also consider the ratio of the number of patients who live in each proposed market who seek care in their home market to the total number of patients who seek care from the market; this ratio is called LIFO ("little in from outside"). Any market for which either LIFO or LOFI is below 0.90 is too small, and is combined with adjacent markets. This process of making markets larger proceeds until no market remains with either LOFI or LIFO less than 0.90. This algorithm, then, produces a set of markets with the property that very few patients who live in one market seek care in any other market.

The Ministry of Health and Welfare has divided Japan into 345 "medical zones." These are administrative areas intended to represent markets for hospital care; they are used in order to regulate such things as hospital bed supply and ambulance service. The patient flow data we have access to via the patient survey is based upon medical zones; consequently, medical zones were our proposed markets for the first iteration of the

Elzinga-Hogarty algorithm. At the termination of the algorithm, we were left with 61 markets for inpatient medical services in Japan. Within these markets, the Japanese equivalent of community hospitals were selected for analysis.[4]

Results

The results of the hospital level regressions (stage 1) appear in Table 2. Across the top of the table are the various categories of hospitals, and down the side of the table are the various included variables. Positive coefficients indicate that an increase in the variable increases the hospital's market share.

The first interesting result is the effect of ownership on market share. Looking across the rows, it is apparent that public ownership of small hospitals is associated with low market share while public ownership of larger hospitals is associated with higher market share. This accords well with intuition. The large, public teaching hospitals and large public non-teaching hospitals in Japan enjoy the best reputation, while the smaller public and private hospitals have weaker repute.

The next rows down from the ownership rows are beds and area/bed. As expected, both of these variables enter strongly and significantly positive. Patients prefer larger hospitals, either because they prefer larger hospitals per se or because size and reputation are related as discussed earlier. The results for the area variable also accord well with our intuition. Patients are very sensitive to the size (and by extension quality) of their accommodations while in the hospital.

The next group of variables is the staffing group. As with area, there is a positive relationship between staffing ratios and demand: patients prefer hospitals with high staff per bed and thus more intensive personal services. The striking thing about the staffing variables is the uniformity with which they are positive and significant. We found this result, that staffing was very strongly positive and significant in its effect on demand, in every specification of the model that we estimated. This result can also be seen in the third to last row of the table, where the χ^2 statistic for the joint null that all staffing variables have coefficients of zero, is reported.

The pattern of the coefficients as one moves across the table is also interesting. The ratio of the coefficient on RN to the coefficient on PN is low for the smaller hospitals and high for the larger hospitals. This says that patients have a stronger preference for being served by RNs (relative to PNs) in larger hospitals and a weaker preference for such service in smaller hospitals. This is likely reflective of the higher marginal value to the patient of the RNs additional training when the patient is more ill; since sicker patients go to larger hospitals and to teaching hospitals, it is natural that patients would express stronger preferences for skilled staffing at these hospitals. It is further interesting to note that the larger hospitals and teaching hospitals employ more RNs relative to the number of PNs, reflecting the demands of a more severely ill patient population.

We turn now to the technology variables in the bottom portion of Table 2. In sharp contrast to the results with staffing, there is no clear and consistent positive relationship between possession of medical technology and demand for the hospital. In many cases there are positive coefficients; MRI, microsurgery, and EEG show positive coefficients more often than they do negative ones. But there is no overall pattern of positive influence of technology possession upon demand. Although the joint null hypothesis that the technology variables do not enter can be rejected for most of the models, comparing the magnitudes of the staffing and technology χ^2 statistics reveals the greater explanatory power of the staffing variables. Of course, hospitals with a large investment in high-tech equipment do have, on average, much greater market share than do their competitors; however, after controlling for the influence of size, staffing, and ownership, the relationship between medical technology and demand disappears. At first blush, this result is quite surprising, given our review of the literature and discussions with Japanese researchers and health care experts. However, since the technical aspects of quality are more difficult for patients to observe and to evaluate and given the smaller role played by physicians in directing patients to hospitals in Japan, it is perhaps not so surprising that demand is more responsive to the interpersonal aspects of care than to the possession of medical technology.

In Table 3, the coefficient estimates for the market demand structure, equations (2) and (3), appear. The coefficients ρ_1 through ρ_t reveal that the various types of hospitals are close substitutes for one another. This means that changes in behavior by hospitals in any of the categories we consider will affect the decisions of each of the other types of hospitals—i.e., there are competitive interactions among the decisions of firms in these different categories. The coefficient ρ_{seek} is small and negative, indicating that the availability of hospitals in a market does not have any large influence upon access. This is largely as one would expect, given the universality and relative homogeneity of health insurance coverage and of prices in Japan. The coefficients on the age categories are all of the expected sign. Negative coefficients for the age categories indicate that people in those categories are more likely to seek care. The largest negative coefficient is for people aged 65 years and over, yielding the intuitive conclusion that demand for medical care is highest for that group. The coefficients for age categories 45-64 and 30-44 are lesser in magnitude than the coefficient for the elderly category, as one would also expect.

Table 4 contains the median estimated value of the demand elasticities with respect to each of the inputs and the median estimated value for the marginal (monthly) revenue associated with increasing each of the inputs.[5] We find that demand is fairly responsive to the size of the hospital, with a median elasticity of 0.72. Each of the labor inputs has substantially lower elasticities, ranging from 0.03 to 0.17.

The second column of Table 4 reports the (monthly) marginal revenue associated with an increase in the level of each of the inputs.[6] From these figures, we can assess the degree to which hospitals can influence their revenues by creating the perception of high quality in consumers' minds. By adding a bed, a hospital expects a demand increase equivalent to about ¥65,000; whereas, the marginal revenue associated with increasing the amount of space around a bed by one square meter is approximately ¥280 per month. The cost of building a square meter of hospital floor space is estimated at ¥240,000 on average. The revenue associated with hiring additional RNs and PNs is approximately ¥34,000 and ¥51,000, respectively. These compare with monthly wages of about ¥315,000 and ¥263,000 respectively.

Conclusion

In this study, we estimate a model of demand for inpatient care in Japan. Our principal findings are that patients in Japan are consistently sensitive to the interpersonal and physical aspects of quality of care, and also that they are sensitive to the size of the hospital (which we interpret as a proxy for reputation). We find much less evidence that they are sensitive to more technical aspects of care. The magnitudes of the effects in the case of staffing are large enough that staffing strategies should be expected to be important variables of these firms; that is, quality competition should be expected to be mediated at least in part through staffing levels. We also find that markets for inpatient hospital care are not segmented to a significant degree; different categories of hospitals are substitutes for one another.

Finally, we find that the availability of hospital care in a market is not an important determinant of access to care.

These findings have several implications for health policy in Japan. Access is not significantly affected by availability of care: controlling for the age of the population indicates that rural patients are not greatly underserved. This is likely due to the success of Japan's policy of universal insurance. Second, the finding that hospitals have strong and consistent incentives to compete on the interpersonal aspects of the provision of care has implications for regulatory policies. Japan has relatively low hospital nursing staff levels, in comparison with other countries, and some policy measures have been taken in order to raise these levels (Okimoto and Yoshikawa, 1993). Our results indicate that it may be worthwhile to explore the possibility of raising these staffing levels by fostering competition among hospitals on this basis. One possible policy instrument available for this purpose is revising the restrictive limitations on hospital advertising now in place.[7] By selectively relaxing these restrictions, Japanese policy makers may be able simultaneously to increase staffing levels, improve the public's information regarding health care options, and improve the public's satisfaction with its quality of care.

Notes

[1] For a more complete description of the Japanese health care system, see Okimoto and Yoshikawa (1993). There are several caveats pertinent to our discussion of the differences between Japan and the United States in financing regimes and institutional structures. Although patients in Japan are free to choose any hospital at which to consume care, their particular condition and the facilities available at hospitals affect their choices. By our use of the nested logit model, we control for this confounder; by separating hospitals on the basis of complexity (size and teaching role), we allow sicker patients to have higher valuation for more complex hospitals, through the correlation in the structural utility function errors (McFadden, 1981). Also, some physicians in large public hospitals do "moonlight" in community clinics. However, this exception to the general rule of separation between hospital and community practice applies to relatively few hospitals and physicians. Finally, in some cases there are (illegal) payments from patients to physicians and to hospitals; however, this practice is prevalent to a much greater degree in geriatric hospitals (removed from our sample) than in others.

[2] Garnick et al. (1989) provide a discussion of issues of estimation technique in hospital choice models. They point out that Theil's estimator, like other minimum chi-squared estimators for discrete data, suffers from considerable difficulties when there are cells with no observations. Our data do not suffer from this problem, as our data are aggregated to a level precluding zero observations in any cell.

[3] Market definition has been discussed extensively in the health services research literature. Previous market definitions have been based upon United States counties, SMSA's, fixed radii around hospitals, ZIP codes, and patient flows. Our market definition technique is most similar to that used in Garnick et al. (1989). Our markets, however, are smaller in size than are those constructed therein.

[4] Our goal in selecting hospitals is to restrict our analysis to short-term general hospitals, similar to the set of community hospitals defined in the United States by the AHA and frequently used for analysis in similar studies. To select for the equivalent of community hospitals in Japan, we begin with the full sample of 10,096 hospitals and eliminate all tuberculosis and leprosy hospitals. To eliminate hospitals whose primary patient load is psychiatric, we select out all hospitals whose case load is comprised of more than 50% psychiatric patients. Also, many hospitals in Japan are effectively nursing homes. To eliminate these, we remove all hospitals

which have allocated more than 50% of their beds for geriatric care. This selection leaves a sample of 7,599 hospitals.

[5] Medians rather than means were used because of the skewed distribution of these variables. Since the inputs were log-transformed, very small values of an input lead, in several cases, to very high estimates for the elasticities and for the marginal revenues.

[6] The data on marginal revenue are constructed by multiplying the derivative of each hospital's demand function by the average inpatient reimbursement for the prefecture in which the hospital is located.

[7] Japanese hospitals are currently forbidden to advertise any aspect of their services other than their hours of operation.

Table 1: Variable Definitions

Variable	Definition
c	constant term
Pub	1 if the hospital is owned by the government
NPO	1 if the hospital is owned by a charitable institution
Ins	1 if the hospital is owned by an insurance society
Prv	1 if the hospital is privately owned (omitted contrast)
bed	natural log of the number of beds
area	natural log of ward area per bed
RN	natural log of the number of RNs per bed
PN	natural log of the number of PNs per bed
NA	natural log of the number of nurse aides per bed
oth	natural log of the number of other staff per bed
labs	the numer of laboratory facilities the hospital reports
fiber	1 if the hospital provides gastrointestinal endoscopy
CT	1 if the hospital has a body CT scanner
MRI	1 if the hospital has an MRI machine
MCR	1 if the hospital performs microsurgery
ESWL	1 if the hospital has an ESWL
EEG	1 if the hospital has an electroencephalograph
ICU	1 if the hospital has an intensive care unit

Table 2: Hospital Level Market Share Regressions

	20-49	50-99	100-199	200+	Teaching
c	-0.013	0.002	-0.012	0.006	-0.059
Pub	-0.109 *	-0.183 **	-0.118 **	0.014	0.066
NPO	-0.256 **	0.036	-0.024	0.017	N/A
Ins	-1.053 **	-0.312 **	0.023	0.077 **	N/A
bed	1.384 **	1.264 **	1.050 **	0.982 **	1.086 **
area	0.141 **	0.059 **	0.113 **	0.049 **	0.035 **
RN	0.132 **	0.056 **	0.034 **	0.073 **	0.231 **
PN	0.233 **	0.173 **	0.110 **	0.008	0.027 **
NA	-0.009	0.042 **	0.029 **	0.056 **	0.020
oth	0.165 **	0.192 **	0.040 **	-0.078 **	0.137 **
labs	-0.002	-0.007	-0.020	0.081	-0.315 †
fiber	0.037 *	0.017	-0.113 **	-0.106 **	-0.024
CT	0.033	-0.002	0.099 **	-0.100 **	-0.053
MRI	0.189 *	-0.015	0.040 *	0.051 **	-0.009
MCR	-0.148 **	-0.037	0.030 †	0.082 **	0.049 †
ESWL	-0.319 †	-0.062	0.044 †	0.001	-0.017
EEG	0.179 **	0.034 **	0.027 **	-0.083 **	-0.055
ICU	-0.104 **	-0.012	-0.029 **	0.052 **	-0.010
R^2	0.372	0.593	0.576	0.878	0.959
staff $\chi^2(4)$	295.5 **	543.5 **	166.4 **	131.4 **	77.6 **
eqpt $\chi^2(8)$	107.5 **	18.7 *	137.8 **	244.6 **	10.1
N	1763	2088	1717	1503	235

** $p < 0.01$
* $p < 0.05$
† $p < 0.10$

Table 3: Market Demand Structure

Parameter	Estimate	Std error
ρ_1	0.955	0.004
ρ_2	0.945	0.003
ρ_3	0.962	0.002
ρ_4	0.956	0.002
ρ_t	0.977	0.002
ρ_{seek}	-0.032	0.001
θ_{65}	-3.097	0.013
θ_{45}	-0.272	0.018
θ_{30}	-0.129	0.035

Table 4: Median Elasticities and Marginal Revenues

	Elasticity	Marginal Revenue
beds	0.7237	¥ 65,464
area	0.0486	280
RN	0.0561	34,418
PN	0.1723	51,018
NA	0.0295	27,629
oth	0.1640	28,592

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