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THE EFFECT OF PATIENT'S ASYMMETRIC INFORMATION PROBLEM ON MEDICAL CARE UTILIZATION WITH CONSIDERATION OF A PATIENT'S *EX-ANTE* HEALTH STATUS

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Abstract

Even if a patient's access to health information has been enhanced, a patient still doesn't have enough ability to utilize it. Therefore, a doctor's effort to sincerely communicate with a patient might affect the patient's use of medical care. This paper builds up the empirical model and found the effect of a doctor's effort on patient's medical care use was significant and according to the *ex-ante* health status of a patient, a doctor's effort influenced a patient's medical care use in different way.

Key words: asymmetry of information between doctor and patient; patient's medical care use; doctor's effort to effectively communicate with patients; patient's ex-ante health status
JEL Classification: I10, I11

I. *Introduction*

As a result of rapidly developing information technologies such as the Internet, patients are better provided with health information about their health status, as well as about the effectiveness of medical treatments. For example, a woman who is pregnant with her first child is likely to need information about the first trimester of pregnancy, such as morning sickness,

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home remedies, and when to call her physician. An email containing such information could show up on her desktop computer just before she gets morning sickness. During the third trimester, she is likely to experience swelling in her legs and pain in her lower back; thus, an email that provides this kind of information allows her to have a more comfortable experience with pregnancy. In addition, she is less concerned, makes fewer calls to her physician, and knows when she should call her doctor. Therefore, patients' efficient use of medical care through informed decision-making might have a role in suppressing rapidly increasing health care expenditures, which is the significant role of consumer health information (Brunt, 1998).

However, in order to support this view, in terms of the role of consumer health information, we need to consider that a consumer's ability to search, collect, interpret, and evaluate the quality of health information would play a more important role in his[1] decision-making process; more than just the amount of information. Even if enhanced access to health information might affect a patient's decision-making, it is uncertain how much information would induce a patient to efficiently use medical care (Culter, *et al*., 2004), which suggests that if a patient still has a problem with understanding and evaluating health information, his decision-making process might be more complicated. In other words, what a patient needs for informed decision making in using medical care is not just health information per se, but the ability to understand, interpret, and analyze the health information or medical knowledge (Lim, 2007).

For example, let's assume there is a patient who has a severe myopic vision problem that can easily be cured by wearing glasses. He is currently considering taking LASIK (Laser-Assisted *In Situ* Keratomileusis) surgery, which is a procedure that permanently changes the shape of the cornea (the clear covering over the front of the eye) using an excimer laser. This treatment is popular and has been regarded as one of the most effective surgical processes for reducing a person's dependency on glasses and contact lenses. However, according to the College of American Ophthalmology, the degree at which the patient recovers his sight would depend on his idiosyncratic properties, such as the shape and thickness of his cornea. Thus, it has been suggested that the averge probability of perfectly recovering a patient's sight as 20/20 is 67%. Hence, before surgery, his doctor should provide him this medical information and discuss his specific physical characteristics.

However, let's assume the communication between them on the effectiveness and limitation of this surgery is not enough for the patient to correctly understand. Based on this situation it is highly plausible that the patient would misevaluate the effectiveness of the LASIK surgery because his perception of its effectiveness is based solely on his subjective evaluation of the medical information. Unfortunately, if the result of surgery is below the patient's expectation for his eyesight, he might retake the surgery, which could be regarded as inefficient use of medical care.

Therefore, in this context, a doctor's provision of effort to closely communicate with a patient might affect the patient's use of medical care, by affecting the process in which the patient forms his or her perception of the effectiveness of medical care, based on the medical information provided by the doctor.

However, even if we might think the doctor's effort could affect the patient's use of medical care, the direction of the effect might be questionable. If one can set up the medically

[1] In this paper, we denote a patient as male and a doctor as a female for convenience.

appropriate amount of medical care, which can be defined as the amount that maximizes a patient's health status after medical care use, the doctor's effort would induce the amount of medical care use that is medically appropriate for the patient. For example, if a patient seems to overuse medical care, representing the quantity is greater than what is medically appropriate, a doctor would try to decrease the amount of care by providing the appropriate efforts mentioned above.

However, it is difficult to define the medically appropriate amount of care that can be generally accepted for all cases of patients, because each patient has his own idiosyncratic characteristics originating not only from his specific disease, but also from his medical history, and the effectiveness of medical care would be different from patient to patient.

Therefore, in this paper, we thought that the direction of the doctor's effort on a patient's use of medical care would be dependent upon the patient's *ex-ante* health, such as his pre-visit health status. When the patient is assumed to underutilize medical care, the marginal enhancement of his health status from consuming more medical care would be positive, which represents that the patient's *ex-post* health status improves with further consumption of medical care. For example, elderly people could be assumed to have fairly poor *ex-ante* health status because a considerable proportion of them have several chronic diseases, such as diabetes and hypertension. Therefore, continuous use of medical care is required to enhance their health status, and in this context, the interpersonal continuity between an elderly patient and the doctor would play an important role in inducing the patient to purchase more medical care (Lim, 2007).

Therefore, if a doctor tries to effectively communicate with an elderly patient whose health status is quite poor, it could be one of the primary means for making interpersonal continuity between the doctor and patient improved and longer. Furthermore, this improved interpersonal continuity would cause the elderly patient to better comply with the doctor's recommendations for medical treatment. Therefore, the doctor's effort would induce the patient to increase use of medical care.

On the opposite side, if a patient's ex-ante health status is fairly good, and a doctor's effort would work for increasing the patient's use of medical care, it could have a detrimental effect on the patient's trust in the doctor since consuming too much medical care by a patient with fairly good *ex-ante* health status would be, on the contrary, harmful to his *ex-post* health status. In other words, considering that the law of diminishing marginal returns could be applied to the health production function and that a patient's ex-ante health status is fairly good, the room of this patient's health status being enhanced after medical care use is comparatively smaller than the patient's health ex-ante heath status being poor. Hence, it is highly probable that a patient's use of medical care is located in a range beyond the medically appropriate amount, which represents the patient's marginal enhancement of health status from consuming more medical care might be negative, Based on this reasoning, our study empirically shows that a doctor's effort to closely communicate with a patient may affect the patient's use of medical care, by using a Community Tracking Study (CTS) dataset. And as mentioned earlier, this paper, based on the patient's *ex-ante* health status, investigates the direction of the effect of a doctor's effort on his patient's use of medical care.

The organization of this paper is as follows: Section II introduces the theoretical reasoning on the direction of a doctor's effort on a patient's medical care use, and Section III develops the empirical model for investigating the effect of the doctor's effort on the patient's use of medical

care. In Section IV, the empirical results are introduced. The conclusion follows in Section V.

II. *Theoretical Reasoning*

Concerning the effect of a doctor's effort to effectively communicate with a patient on his use of medical care, the direction of the effect can be analyzed by the following theoretical reasoning.

The simple health production function expressed by equation (1) shows the relationship between the health outcome and medical care.

$$H(M : s, T) = TM - sM^2 + s \tag{1}$$

In equation (1), T is the effectiveness of medical treatment (M), and s is the patient's *ex-ante* health status. This specific function is the one Lee (1995) employed in his model. It has the following several significant properties. The first property is that treatment beyond a certain level could be harmful. This property is captured by the quadratic health production function, and mathematically can be expressed as follows:

$$\frac{\partial H}{\partial M} = T - 2sM \leq 0, \text{ where } M \geq \frac{T}{2s} \tag{2}$$

In that expression, the level of $T/2s$ is the one maximizing a patient's ex-post health status, which is defined as the medically appropriate amount, and treatment beyond this level, representing overuse of medical care, could be harmful for the patient's *ex-post* health status.

Another property of this function is that the marginal benefit of medical care lowers as the individual consumes more medical care, because "the law of diminishing marginal returns" holds. Mathematically this can be described as follows:

$$\frac{\partial^2 H}{\partial M^2} = -2s \leq 0 \tag{3}$$

Finally, the patient's *ex-ante* health status affects the effectiveness of medical treatment, since a small enhancement from treatment would be enough when the individual is fairly healthy. This can be expressed as follows:

$$\frac{\partial^2 H}{\partial M \partial s} = -2M \leq 0 \tag{4}$$

Hence, if a patient is already fairly healthy in the pre-visit stage, the marginal enhancement of the patient's health status by using medical care would be smaller than that of other patients whose health status is quite bad.

The reasoning above, however, assumes that asymmetric information between doctor and patient doesn't exist, which suggests that a patient has enough ability of evaluating not only his

health status, *s*, but also the effectiveness of medical treatment, *T*. Furthermore, in the reasoning above, a doctor is supposed to act as perfect agent of patient, which indicates a doctor truly tries to inform a patient on *s* and *T*. However, considering the asymmetric information problem between patient and doctor, such as knowledge imbalance on *s* and *T*, it is plausible for a doctor to induce demand for unnecessary medical services from patient. Specifically, in equation (2), if a doctor provides downwardly biased information on *s* or upwardly biased information on *T*, a patient might think that the range of M showing positive marginal enhancement of health status becomes more wider, which induces a patient to demand more medical services than medically appropriate amount.

However, if a patient experiences exacerbated ex-post health status due to over-consumption of medical services, it would be harmful to a doctor's reputation, which causes a doctor's ability of inducing medical services to be limited. Specifically, if a patient's *ex-ante* health status is fairly good, leading this patient's marginal enhancement of health from medical care use to be smaller than another patient's whose ex-ante health status is quite bad, but if a patient over evaluates on *T*, it is very plausible that this patient might use more medical care than the medically appropriate amount. In this sense, we can infer that a doctor facing this comparatively healthy patient tends to recommend less medical care than what a patient expects, because a patient's aggravated *ex-post* health status due to the overutilization of medical care would discredit the patient's trust in the doctor, and this could be a detrimental means for a doctor's reputation causing a doctor's future practice revenue to be reduced. In this context, it is suggested that a doctor should have an incentive to closely communicate with the patient in order to correct this overvaluation of effectiveness, by which a doctor can easily induce a patient's compliance with her intent in decreasing the amount of medical care utilized by the patient.

Based on the same logic, if a patient's *ex-ante* health status is fairly poor, representing this patient's marginal enhancement of health status is comparatively larger than other patients, however, if a patient under evaluates on *T*, it is highly probable that this patient might use less medical care than the medically appropriate amount. So a doctor would recognize the patient's ex-post health status can be enhanced by utilizing more medical services and also think a patient's better health status might be fruitful to her reputation. In this sense, it is natural to infer that a doctor facing this comparatively unhealthy patient tends to recommend more medical care than what a patient expects. In this context, as the former case, it is also suggested that a doctor should have an incentive to closely communicate with the patient in order to correct this undervaluation on effectiveness in order to achieve her intent in increasing patient's use of medical care.

Therefore, based on the properties mentioned above, it is reasonable to think that the direction of the effect of a doctor's effort to effectively communicate with a patient on his use of medical care would be determined by the patient's ex-ante health status.

III. *The Empirical Model*

An individual's decision-making process of purchasing medical care could be regarded as a sequential process. Whenever he feels sick, he indeed has to make a medical decision of whether to consult a doctor. Once he decides to consult a doctor and visits, given information

on his ex-ante health status and on the effectiveness of medical treatment available for alleviating his health problem provided by doctor, he decides to comply with his doctor's opinion with purchasing medical care. Based on this sequential decision process, individual's medical care utilization is expressed by using two part model which consists of the equation representing individual's decision-making of visiting doctor, and of the equation expressing the patient's total use of medical care, conditional on any use.

Regarding the information about an individual's *ex-ante* health status, in the CTS dataset, the variable is constructed by combining the individual's proxy-reported and self-reported values of general health status. The variable has a 5-scale value from 1 (poor), 2 (fair), 3 (good), 4 (very good), and 5 (excellent)[2]. Hence, in this paper, the following empirical model is separately applied to each group according to the value of this variable that represents individual *ex-ante* health status.

1. The Empirical Model for an Individual's Medical Care Use

As we mentioned above, an individual's medical care use is formulated by using a two-part model. The equation (5) describes an individual i's probability of visiting doctor.

$$m_{1i}^{*}=\beta_1' Z_i+\beta_2 I_i+\varepsilon_{1i} \tag{5}$$

$$\begin{cases} d_i=1 & \text{if } m_{1i}^{*}>0 \\ d_i=0 & \text{otherwise } (m_{1i}^{*}\leq 0) \end{cases}$$

where m_{1i}^{*} is the latent variable that represents the patient's doctor-visit; d_i is the indicator of the existence of any doctor visit for purchasing medical care; Z_i is the vector representing an individual i's socio-demographic factors, such as age, sex, education, and income level as well as health status; I_i is the dummy variable representing whether an individual i has health insurance, the β_i's are the parameters; and ε_{1i} is the random term assumed to have normal distribution by $\varepsilon_{1i}\sim N(0, 1)$.

Regarding the variable I_i, as many health economists insist (Cameron, *et al.*, 1988; Norton, 2002), an individual's expected medical care utilization and expenditure for a given period could affect his decision on choice of health insurance, and various characteristics of the health insurance could affect his utilization of medical care, which suggest there is mutual interdependency between the decision of medical care use and health insurance purchase.

Hence, an individual's health insurance choice is specified by equation (6) below:

$$I_i=\omega_1' Z_i+\omega_2 R_i+v_i,\ I_i=\begin{cases} 1 \text{ Insured} \\ 0 \text{ Uninsured} \end{cases} \tag{6}$$

where R_i is the Health Maintenance Organization (HMO) penetration rate of each geographical area where an individual i resides, the ω_i's are parameters, and the error term v_i is assumed to follow a normal distribution. The HMO penetration rate of each area might play a role in

[2] The portion of each group out of the total sample was group 1 (poor, 3.79%), group 2 (fair, 10.21%), group 3 (good, 23.65%), group 4 (very good, 36.41%), and group 5 (excellent, 25.95%).

identifying equation (6). A similar identifying strategy can be found in the paper by Norton, *et. al.* (2002).

As the method for solving endogeneity problem of individual's insurance choice, the bivariate probit method is used for jointly estimating equation (5) and (6). Considering that unobserved individual heterogeneity might cause the two error terms to be correlated each other, which might be a source of endogeneity bias, it is very beneficial to perform joint estimation. This comes directly from the consideration of greater asymptotic efficiency in the Maximum Likelihood Estimation (MLE) context, in the case where the coefficient of correlation (ρ) between the error terms in these two equations is not equal to zero because of the statistical and structural endogeneity.

Conditional on a positive number of doctor visits, an individual i's total medical care use represented by a patient's total out-of-pocket medical care cost, is as follows:

$$\log(m_{2i} \mid d_i = 1) = \delta_1' Z_i + \delta_2 e_i + \varepsilon_{2i} \tag{7}$$

where m_{2i} is an individual i's total out-of-pocket medical cost during some time; e_i is the individual i's observation on his doctor's effort level of effective communication; the δ_i's are the parameters; and ε_{2i} is the random term assumed to have normal distribution and is expressed by $\varepsilon_{2i} \sim N(0, \sigma_2^2)$.

Because CTS dataset used in this paper does not include the information on individual total medical cost, an individual i's total out-of-pocket medical cost is used for representing total amount of medical care use. Total out-of-pocket medical cost, however, might be affected by the characteristics of health insurance, such as the size of deductible or coinsurance rate, so regarding the possibility of total out-of-pocket medical cost's representing true utilization of medical care, we investigated the correlation between total out-of-pocket medical cost and total number of doctor-visit or total number of hospitalization. The correlation coefficients were very high, such as 0.72 and 0.68 respectively, which might show the rationale of using it as a proxy of total medical care use.

The variable I_i is excluded in equation (7), but included in equation (5) for identifying the equation system. When it comes to an individual's use of medical care due to a health problem, it is reasonable to think the individual's health insurance would directly affect his decision of doctor-visit, even if one might think of the possibility of its indirect effects on the patient's total medical care use. Furthermore, we think that once a patient visits doctor, the effect of supply side, doctor, on patient's total medical care use might be more significant than demand side effect.

Regarding the doctor's effort level, we used the patient's evaluation of the doctor's effort (e_i) as a proxy variable for the doctor's true level of effort. The patient's evaluation of the doctor's effort level will at least to some degree be based on his observation of how well the doctor explains the effectiveness of medical treatment, such as whether the doctor uses plain language, and how eagerly the doctor tries to understand and answer questions. While it may be true that only the doctor knows her true level of effort, a reasonable indication of that effort might be a patient's evaluation of it, because except for the doctor, usually only the patient actually observes the doctor's level of effort, even if in some cases the patient goes in the company of one or more family members, friends, or paid care-givers.

TABLE 1. QUESTIONNAIRE FOR THE MODIFIED PICKER SURVEY

1. Does your physician give you enough time to explain the reasons for your visit?
2. When you ask questions, do you get answers that are understandable?
3. Does your physician take enough time to answer your questions?
4. Does your physician ask you about how your family or living situation might affect your health?
5. Do you get as much medical information as you want from your physician?
6. When you see your physician, do you have questions about your care that you want to discuss but do not?
7. Are you involved in decision about your care as much as you want?

Fortunately, in the CTS Household data, we have information on the patient's evaluation of the doctor's effort level during his most recent visit to the doctor. In this data, there are two questions about the patient's evaluation of the doctor's effort level to effectively communicate with him. The first question concerns the doctor's attitude on listening to the patient's health problems and questions concerning medical treatment. In the survey, a patient was asked, "how would you rate how well your doctor listened to you?" The patient's answer to that question is categorized by 5 scale measures ranging from 1 (poor) to 5 (excellent). The second question concerns the doctor's attempts to explain both the patient's health problems and the possible effectiveness of medical treatment, in order to aid the patient in understanding the medical situation and treatment options. The patient was asked, "how would you rate how well the doctor explained things in a way you could understand?" The patient's answer is again categorized by 5 scale measures ranging from 1 (poor) to 5 (excellent). Therefore, in this paper, by summing these two answers, an index of the doctor's effort level was produced, and based on the value of this index, we assume that as the patient's evaluation index value rises, the doctor in fact exerts more effort.

The validity of using these questions to measure the doctor's level of effort to closely communicate with the patient can be investigated by tracking the resemblance of these questions with the "Modified Picker Survey" questionnaire. The Modified Picker Survey is used to survey a patient's evaluation of the relationship with his doctor (Edgman & Cleary, 1996). This survey asks patients about the various aspects of doctor-patient interaction, in order to measure the patient's evaluation of the doctor's practice style. Among the question items in the Modified Picker Survey, questions 1, 2, 3, 5, and 6 can be regarded as items that also measure the patient's evaluation of the doctor's effort to effectively communicate with him. We can see these items are similar to the two questions in the CTS Household survey used in this paper. Table 1 includes the specific questions of the Modified Picker Survey.

2. Econometric Issue: Endogeneity of Doctor's Effort

Since the doctor's effort is measured by the patient's evaluation of it, we should consider the endogeneity of this variable. In this study, as the solution to this econometric issue, the 2SLS method was applied, and its predicted value was obtained by estimating the following equation (8).

$$e_i = \gamma_1' Z_i + \gamma_2' X_i + \varepsilon_{3i} \tag{8}$$

where X_i is a vector composed of the individual's attitude toward the doctor's practice style, and ε_{3i} is the error term described by $\varepsilon_{3i} \sim N(0, \sigma_3^2)$.

In the CTS Household data, we obtain information on the patient's attitude toward the doctor's practice style by asking two questions. The first question concerns the individual's level of agreement on the statement of "I trust my doctor to put my medical needs above all other considerations when treating my medical problems." And the second question is on the statement of "I sometimes think my doctor might perform unnecessary tests or procedures." The patient's answers to these questions are categorized by 5 scale measures ranging from 1 (strongly disagree) to 5 (strongly agree).

Considering that the doctor's effort to effectively communicate with the patient is measured by the patient's evaluation of it, the patient's idiosyncratic characteristics of thinking, in terms of his doctor's practice style, should be controlled in the estimation process, and additionally, those variables play a role in identifying equation (8) from the other equations. After estimating equation (8), the predicted value of e_i , $\hat{e}_i$ is used as regressor in the following equation (9).

$$\log(m_{2i} \mid d_i = 1) = \delta_1' Z_i + \delta_2 \hat{e}_i + \varepsilon_{2i} \tag{9}$$

In the process of performing 2SLS above, according to Murphy and Topel (1985), the second-step estimated standard errors and related test statistics based on these procedures might be incorrect. Hence in order to obtain robust test statistics, the method of estimating standard errors in equation (9) suggested by Murphy and Topel (1985) was applied in this paper.

IV. *The Empirical Results*

1. Data

As mentioned earlier, the data set used in this study came from the Community Tracking Survey (CTS). The CTS, sponsored by the Robert Wood Johnson Foundation, is a national study designed to track changes in the health care system as well as the effects of these changes on care delivery and on individuals (Center for Studying Health System Change, 2000). Central to the design of the CTS is its community focus. The survey was conducted in sixty randomly selected communities (sites) (51 metropolitan areas and 9 nonmetropolitan areas), to be representative of the nation as a whole. The CTS sites were selected using stratified sampling with probabilities proportional to population size. The supplemental sample, selected with stratified random sampling, was included in the survey to increase the precision of national estimates (Kemper, 1996).

Among the CTS data sets, the Community Tracking Study Household Survey (1996-1997) was used in this study. The primary purposes of the Household Survey are to track people's insurance coverage, access to care, medical service use, satisfaction with care, and health status. The total household sample size was 60,446 households. Individuals in the household were grouped into family insurance units (FIU). An FIU reflects family groupings that are typically used by insurance carriers. It includes an adult household member, his or her spouse (if any), and any dependent children 0 − 17 years of age. However in this study, we used only the

TABLE 2. DESCRIPTIVE STATISTICS OF VARIABLES USED IN THE ESTIMATION MODEL

Variables	Definition	Mean	S.D.	Min.	Max.
AGEX	Age	36.656	13.054	18	64
SEX	Sex (0 if male, 1 if female)	0.486	0.499	0	1
RACEX	Race (0 if white, 1 if nonwhite)	0.281	0.449	0	1
HIGRADX	Education (years of school)	13.448	2.522	6	19
FAMINCX	Income ($ of 1995 price level)	22,246.36	19,870.56	0	150,000
INDSTRY	Whether having a health related job (1 if he/she has, 0 if not)	0.067	0.250	0	1
PCS12	Physical health status	50.179	9.846	11.45	69.04
SMKNUM	Average number of cigarettes per day	4.765	9.836	0	96
INS	Whether to have health insurance or not (1 insured, 0 uninsured)	0.713	0.452	0	1
GEONE	Whether living in Northeast area (1 if yes, 0 otherwise)	0.229	0.420	0	1
GEOS	Whether living in South area (1 if yes, 0 otherwise)	0.312	0.463	0	1
GEOMW	Whether living in Midwest area (1 if yes, 0 otherwise)	0.217	0.412	0	1
GEOW	Whether living in West area (1 if yes, 0 otherwise)	0.240	0.427	0	1
EFFORT	The summation of scores of LSTLISN and LSTEXPL	7.953	2.012	2	10
LSTLISN	The patient's evaluation of the doctor's listening (5 if excellent, 4 if very good, 3 if good, 2 if fair, 1 if poor)	3.954	1.083	1	5
LSTEXPL	The patient's evaluation of the doctor's explanation (5 if excellent, 4 if very good, 3 if good, 2 if fair, 1 if poor)	3.997	1.055	1	5
HMORATE	The HMO penetration rate of the geographic area	0.276	0.129	0.01	0.53
SICK	Whether to visit doctor or not (1 if visit, 0 if not)	0.733	0.442	0	1
MEDCOST	The total individual out-of-pocket medical costs ($ of 1995 price level)	286.48	688.75	0	9,000
LOGMEDCOST	The value of the natural log of MEDCOST	5.113	1.344	2.302	9.104
DRMETND	The degree of patient's trust on doctor's practice style (5 if strongly agree, 4 if somewhat agree, 3 if neither agree/disagree, 2 if somewhat disagree, 1 if strongly disagree)	4.423	1.021	1	5
DRUNNEC	The degree of patient's trust on doctor's practice style (5 if strongly agree, 4 if somewhat agree, 3 if neither agree/disagree, 2 if somewhat disagree, 1 if strongly disagree)	4.324	1.191	1	5

sample of 1-person households, in order to avoid a family effect within family members. In other words, the family members might affect an individual's decision making for medical care use, so the unobserved heterogeneity from the effect among family members could threaten the robustness of estimates.

The sample size used in this study was 14,134 persons, each of whom formulated a 1-person household. Among them, persons whose ages were below 18 or above 64 were dropped out of this study; because it is plausible they were dependent on other persons for decision of medical care use, and may be affected by persons such as parents or siblings. Hence, the final total sample size was 8,153.

Table 2 shows the explanations for each independent variable and dependent variable of the estimation equations mentioned above. Also, Table 2 shows the descriptive statistics of independent and dependent variables. Among them, the variable PCS12 represents an individual's health status measured by using the SF-12 Physical Component Summary score, which is calculated based on the Health Institute's scoring algorithm. A higher score for this variable represents better health status. In considering an individual's health-related behavior, smoking habit was included as an explanatory variable. The individuals' geographical areas are categorized as the Northeastern area, Southern area, Midwest area, and Western area, according to the criteria made by the U.S. Census Bureau (2000).

Depending on which group an individual belongs to, the general socio-economic characteristics of each group are somewhat different. For example, as a group's health status becomes healthy, the average age decreases and the average income and education levels rise. Regarding medical care use, each group's average use of medical care proportionally increases as health status becomes unhealthy[3]. Hence, an individual's subjective evaluation of health status used in this paper could be applied as a criterion for dividing whole samples with each group, whose objective and medical *ex-ante* health status is differentiated by each group.

2. The Estimation Result: Effect of a Doctor's Effort on Patient's Medical Care Use

(1) The case of a patient's health status being excellent, very good, or good

The case of a patient's health status being *excellent*

The estimation results are shown at Table 3. At pre-visit stage, concerning a patient's decision on doctor-visit and on purchasing health insurance, the estimation results were derived by applying bivariate probit method and the results are shown at the first and second column of Table 3. First of all, regarding the possibility of individual insurance choice being endogenized variable, it proves to be nonexistent. The ρ, which represents the coefficient of correlation between the error terms in these two equations is shown to be insignificant based on Likelihood Ratio test of $\rho = 0$.

Concerning individual insurance choice, the estimation results are consistent with the previous research (Cameron *et al.*, 1988), which suggests that the older, male, the white and the more educated have higher probability of purchasing health insurance. Furthermore, the smokers seem to show lower probability of purchasing health insurance, which supports the view of insurance companies doing risk-selection by performing risk screening.

When it comes to individual decision on doctor-visit, the results are pretty coincident with

[3] The average out of pocket medical cost of the group whose health status was poor was above three times that of the group whose health status was excellent. Regarding the rate of doctor visits during some periods, the rate was 68.7% for the group whose health status was excellent; however it was 81.7% for the group whose health status was poor.

TABLE 3. REGRESSION RESULTS OF PATIENT'S MEDICAL CARE USE (HEALTH STATUS: EXCELLENT)

	Probability of purchasing Insurance		Probability of Visiting Doctor		Total Out-of-pocket Medical Cost(II)		Evaluation on Doctor's Effort	
Variable	Coefficient	s.e	Coefficient	s.e	Coefficient	m.s.e.[b]	Coefficient	s.e.
CONSTANT	−0.4844	0.3970	0.8754**	0.4018	6.5705***	0.5257	3.5214***	0.5841
Socioeconomic								
AGEX	0.0047*	0.0027	0.0067***	0.0024	0.0080**	0.0031	0.0150***	0.0041
SEX	0.2436***	0.0626	0.0844	0.0609	0.1797**	0.0705	0.1999**	0.0922
RACEX	−0.2586***	0.0683	−0.1585**	0.0704	−0.2210**	0.0867	−0.1807	0.1138
HIGRADX	0.0933***	0.0132	0.0300**	0.0150	0.0062	0.0152	0.0419**	0.0203
FAMINCX	2.17×10^{-5}***	1.85×10^{-6}	-1.96×10^{-6}	2.00×10^{-6}	1.39×10^{-6}	1.67×10^{-6}	1.06×10^{-6}	2.30×10^{-6}
INDSTRY	0.0679	0.1276	−0.1694	0.1033	0.0986	0.1200	−0.2366	0.1664
Health State and Health Related Behavior								
PCS12	−0.0102*	0.0060	−0.0158***	0.0059	−0.0175***	0.0058	−0.0014	0.0076
SMKNUM	−0.0202***	0.0037	0.0036	0.0042	0.0107**	0.0050	−0.0082	0.0065
Geographical Living Area								
GEONE	−0.0457	0.0988	0.0378	0.0783	0.0572	0.0932	0.0861	0.1281
GEOS	−0.1054	0.0839	0.0096	0.0748	0.2383***	0.0908	0.0542	0.1265
GEOMW					−0.0139	0.0988		
GEOW	−0.2824***	0.0995	0.1505*	0.0842			−0.0059	0.1323
Health Insurance								
INS			0.4405	0.3337				
Doctor's Effort Level								
EFFORT_HAT					−0.1613**	0.0765		
The Property of Health Insurance Market								
HMORATE	−0.4176	0.2938						
Patient's Attitude toward the Doctor's Practice Style								
DRUNNEC							0.2757***	0.0412
DRMETND							0.5345***	0.0474
ρ	−0.1275[c]	0.1971						
N	2115		2115		1454		1454	

* = statistically significant at the 0.1 level; ** = statistically significant at the 0.05 level; *** = statistically significant at the 0.01 level, [a] dropped due to collinearity , [b] standard error using Murphy and Topel method, [c] statistical significance is evaluated based on Likelihood Ratio test of ρ=0

previous researches (Grossman, 1972; Cameron *et. al*, 1988). For example, the white seems to show higher probability of visiting doctor and this result might be understood in the context of the positive relation between race and income. However, the age showed negative effect on the probability of doctor-visit with statistical significance which seems to be contradict with the previous research. It can be interpreted that people will consult doctors more frequently for prevention purposes, which might reduce the probability and prevalence of any acute and/or chronic diseases during the aging process. Additionally, in this paper, since an individual medical care use is restricted to curative care services, this result might be understood.

Concerning individual decision on the total medical care use at post stage, the estimation results shown at the third column of Table 3 indicate that the doctor's effort to closely

communicate with the patient has a negative effect on the patient's medical care use with statistical significance. This result suggests a doctor's effort should be utilized for decreasing amount of medical care used by patient. Since the patient's health status is fairly good, we can infer that a doctor who provides medical care to this patient group would have the intent to reduce the amount of medical care, because the overutilization of medical care would deteriorate the patient's *ex-post* health status causing a doctor's reputation to be hurt. This result is consistent with the expectation from the theoretical reasoning discussed in the previous section.

In this paper, the endogeneity problem of doctor's effort level was overcome by applying 2SLS and the estimation results of regressing covariates on doctor's effort are shown at the fourth column of Table 3. According to Bollen *et al*. (1995), in order for 2SLS to be regarded as appropriate method of correcting endogeneity problem, the R^2 in the regression equation that generates the predicted value should be greater than 0.1. The adjusted R^2 in regression equation of patient's evaluation on doctor's effort level was 0.1439, which was large enough to apply 2SLS method as a solution of correcting endogeneity problem.

Concerning the effect of other covariate, the older, female and the more educated comparatively seems to highly evaluate doctor's effort level. Especially, patient's attitudes toward the doctor's practice style are shown to have significant effect on patient's evaluation on doctor's effort level, and furthermore, when estimating regression equation of patient's total medical care use with these variables the effects of these variables were statistically insignificant.[4] Considering these variables are supposed to be used as identifying variables, the estimation results above suggest these variables work well as identifying variables.

The case of a patient's health status being *very good*

The estimation results in the case where a patient's health status is *very good* are shown at Table 4. As with the previous case, the estimation results on a patient's decision on doctor-visit and on purchasing health insurance were derived by applying bivariate probit method and the results are shown at the first and second column of Table 4. The possibility of individual insurance choice being endogenized variable is still proved to be nonexistent. We can't reject $\rho = 0$ based on Likelihood Ratio test. Concerning individual decision on insurance choice and on doctor visit, the estimation results are consistent with the former case. An individual age still shows negative effect on the probability of doctor-visit, but the effect is statistically insignificant. Though the estimates are insignificant, it is interesting to observe that "sex" had positive effects on the probability of doctor visit. According to the result, a male uses less medical care services than female which suggests a male tends to under-evaluate the benefits of medical services than a female does. And as expected, individual education level has a positive and significant effect on the probability of doctor-visit.

Concerning individual decision on the total medical care use at post stage, the estimation results are shown at the third column of Table 4. First of all, the doctor's effort to closely communicate with the patient had still a negative effect on the patient's medical care use with statistical significance. This result also suggests a doctor's effort should be utilized for decreasing the amount of medical care used by the patient and is consistent with the expectation from the theoretical reasoning.

[4] The estimation results are available on request from the authors.

TABLE 4. REGRESSION RESULTS OF PATIENT'S MEDICAL CARE USE
(Health Status: Very Good)

	Probability of purchasing Insurance		Probability of Visiting Doctor		Total Out-of-pocket Medical Cost(II)		Evaluation on Doctor's Effort	
Variable	Coefficient	s.e	Coefficient	s.e	Coefficient	m.s.e.[b]	Coefficient	s.e.
CONSTANT	−1.4336***	0.2941	0.4339	0.2687	5.8228***	0.3930	3.9921***	0.3922
Socioeconomic								
AGEX	0.0099***	0.0022	−0.0017	0.0021	0.0090***	0.0022	0.0147***	0.0027
SEX	0.2305***	0.0525	−0.0088	0.0509	0.2239***	0.0533	0.1834***	0.0676
RACEX	−0.1438**	0.0579	−0.2001***	0.0558	−0.2213***	0.0635	−0.2323***	0.0796
HIGRADX	0.0634***	0.0120	0.0206*	0.0120	0.0113	0.0121	−0.0070	0.0156
FAMINCX	$2.97\text{x}10^{-5}$***	$1.92\text{x}10^{-6}$	$8.52\text{x}10^{-7}$	$2.07\text{x}10^{-6}$	$1.91\text{x}10^{-6}$	$1.44\text{x}10^{-6}$	$5.62\text{x}10^{-7}$	$1.88.\text{x}10^{-6}$
INDSTRY	0.4022***	0.1111	0.0085	0.0911	0.0328	0.0909	0.1073	0.1179
Health State and Health Related Behavior								
PCS12	0.0050	0.0040	−0.0056	0.0038	−0.0137***	0.0037	0.0045	0.0048
SMKNUM	−0.0135***	0.0026	0.0001	0.0027	0.0063**	0.0029	−0.0017	0.0039
Geographical Living Area								
GEONE								
GEOS	−0.0277	0.0816	0.0322	0.0638	0.3504***	0.0698	0.0427	0.0904
GEOMW	0.0758	0.0834	0.0307	0.0685	0.0003	0.0740	0.0480	0.0946
GEOW	−0.0420	0.0724	0.0850	0.0669	−0.0392	0.0725	−0.0827***	0.0941
Health Insurance								
INS			0.4040	0.2696				
Doctor's Effort Level								
EFFORT_HAT					−0.1045**	0.0512		
The Property of Health Insurance Market								
HMORATE	−0.1298	0.2508						
Patient's Attitude toward the Doctor's Practice Style								
DRUNNEC							0.2520***	0.0309
DRMETND							0.5107***	0.0351
ρ	−0.1233[c]	0.1595						
N	2968		2968		2201		2201	

* = statistically significant at the 0.1 level; ** = statistically significant at the 0.05 level; *** = statistically significant at the 0.01 level, [a] dropped due to collinearity , [b] standard error estimates using Murphy and Topel method, [c] statistical significance is evaluated based on Likelihood Ratio test of ρ=0

Additionally, the estimation results of the regression equation that generates the predicted value of patient's evaluation on the doctor's effort level are shown at the fourth column of Table 4. The marginal effects of covariates were coincident with the former case, which suggest that the older, female and the more educated comparatively highly evaluated doctor's effort level. Furthermore, based on the method suggested by Bollen et al. (1995), the adjusted R^2 in regression equation of patient's evaluation on doctor's effort level was 0.1417, which was large enough to regard 2SLS method as appropriate method of correcting endogeneity problem.

Concerning the identification of the equations, the identifying variables, mentioned above were shown to have significant effect on patient's evaluation on doctor's effort level, and when

TABLE 5. REGRESSION RESULTS OF PATIENT'S MEDICAL CARE USE (Health Status: Good)

	Probability of purchasing Insurance		Probability of Visiting Doctor		Total Out-of-pocket Medical Cost(II)		Evaluation on Doctor's Effort	
Variable	Coefficient	s.e	Coefficient	s.e	Coefficient	m.s.e.[b]	Coefficient	s.e.
CONSTANT	−1.6364***	0.3368	0.5168*	0.2963	5.3228***	0.4616	4.3025***	0.4584
Socioeconomic								
AGEX	0.0119***	0.0026	0.0005	0.0028	0.0087***	0.0027	0.0144***	0.0034
SEX	0.3119***	0.0675	0.0943	0.0720	0.2185***	0.0696	0.1549*	0.0918
RACEX	−0.1395**	0.0698	−0.1160*	0.0677	−0.1268*	0.0746	−0.3030***	0.0963
HIGRADX	0.0879***	0.0150	0.0380**	0.0168	0.0378**	0.0154	−0.0167	0.0206
FAMINCX	$3.87\text{x}10^{-5}$***	$2.75\text{x}10^{-6}$	$5.30\text{x}10^{-6}$	$3.80\text{x}10^{-6}$	$3.09\text{x}10^{-6}$	$1.98\text{x}10^{-6}$	$5.03\text{x}10^{-6}$*	$2.66\text{x}10^{-6}$
INDSTRY	0.2778**	0.1274	−0.1589	0.1119	−0.0476	0.1124	−0.0495	0.1579
Health State and Health Related Behavior								
PCS12	−0.0061	0.0041	−0.0080**	0.0039	−0.0152***	0.0039	−0.0216***	0.0050
SMKNUM	−0.0109***	0.0031	0.0016	0.0032	0.0066**	0.0031	$8.80\text{x}10^{-5}$	0.0042
Geographical Living Area								
GEONE	−0.0329	0.0954	−0.1361	0.0900	0.0521	0.0977		
GEOS	0.1572	0.1080	−0.0236	0.0866	0.3519***	0.0906	0.2001*	0.1185
GEOMW	0.2631**	0.1094	−0.0161	0.0963	0.2281**	0.0969	0.1506	0.1264
GEOW							0.1663	0.1300
Health Insurance								
INS			−0.0696	0.3634				
Doctor's Effort Level								
EFFORT_HAT					−0.0989**	0.0504		
The Property of Health Insurance Market								
HMORATE	−0.1349	0.3306						
Patient's Attitude toward the Doctor's Practice Style								
DRUNNEC							0.2638***	0.0382
DRMETND							0.6093***	0.0447
ρ	0.1242[c]	0.2184						
N	1928		1928		1446		1446	

* = statistically significant at the 0.1 level; ** = statistically significant at the 0.05 level; *** = statistically significant at the 0.01 level, [a] dropped due to collinearity, [b] standard error estimates using Murphy and Topel method, [c] statistical significance is evaluated based on Likelihood Ratio test of $\rho = 0$

estimating regression equation of patient's total medical care use with these variables, the effects of these variables were still statistically insignificant, which suggests the restriction exclusion as a method of identifying equation system works well.

The case of a patient's health status being *good*

The estimation results in the case where a patient's health status is *good* are shown at Table 5. As with the previous two cases, the estimation results on a patient's decision on doctor-visit and on purchasing health insurance were derived by applying bivariate probit method and the results are shown at the first and second column of Table 5. The possibility of individual insurance choice being endogenized variable is still proved to be nonexistent based on Likelihood Ratio test of $\rho = 0$. Concerning individual decision on insurance choice and on

doctor visit, the estimation results have shown to be consistent with the former two cases.

Concerning individual decision on the total medical care use at post stage, the estimation results are shown at the third column of Table 6. The doctor's effort to closely communicate with the patient had still a negative effect on the patient's medical care use with statistical significance. As with the former two cases where a patient's *ex-ante* health status is fairly good, this result also suggests a doctor's effort should be utilized for decreasing the amount of medical care used by the patient and is still consistent with the expectation from the theoretical reasoning.

Additionally, the estimation results in the regression equation for obtaining the predicted value of patient's evaluation on the doctor's effort level are shown at the fourth column of Table 5. The adjusted R^2 in regression equation of patient's evaluation on doctor's effort level was 0.1779, which suggests 2SLS is appropriate method for solving endogeneity problem. Regarding the identification of the equation, the identifying variables, mentioned above were still shown to have significant effect on patient's evaluation on doctor's effort level, and when estimating regression equation of patient's total medical care use with these variables, the effects of these variables were still statistically insignificant, which still suggests the restriction exclusion as a method of identifying equation system works well.

Discussion on the estimation results of the above three cases

As mentioned above, the estimation results of the above three cases might confirm the expectation on the effect of doctor's effort on patient's total medical care use. Furthermore, in the estimation results shown in Table 3, 4, and 5, we can find the doctor's effort is more effective as a patient becomes healthy. The magnitude of the coefficient was -0.0989 with a patient's health status being just "good," -0.1045 with a patient's health status being "very good," and -0.1613 with a patient's health status being "excellent." It is natural to think a doctor's intent to reduce a patient's medical care use would increase as a patient becomes healthy, because the possibility of experiencing negative marginal enhancement of health status after consuming medical care services increases. Therefore, we can infer that a doctor would make more effort to closely communicate with a patient in order to correct the patient's misperception of the effectiveness of medical care, such as over-evaluation, which might result in this patient's overutilizing medical care.

(2) The cases of a patient's health status being fair or poor

The case of a patient's health status being *fair*

The estimation results of a case where a patient's ex-ante health status is *fair* are shown at Table 6. As with the former cases, the estimation results on a patient's decision on doctor-visit and on purchasing health insurance were derived by applying bivariate probit method and the results are shown at the first and second column of Table 6. First of all, regarding the possibility of individual insurance choice being endogenized variable, it still proves to be nonexistent. The ρ, which represents the coefficient of correlation between the error terms in these two equations is shown to be insignificant based on Likelihood Ratio test of $\rho=0$. Concerning individual decision on insurance choice and on doctor visit, the estimation results have shown to be consistent with the three different cases above where a patient's health status is pretty good.

TABLE 6. REGRESSION RESULTS OF PATIENT'S MEDICAL CARE USE (Health Status: Fair)

	Probability of purchasing Insurance		Probability of Visiting Doctor		Total Out-of-pocket Medical Cost(II)		Evaluation on Doctor's Effort	
Variable	Coefficient	s.e	Coefficient	s.e	Coefficient	m.s.e.[b]	Coefficient	s.e.
CONSTANT	−1.0267**	0.4220	0.4365	0.4079	5.6681***	0.6002	3.6058***	0.7085
Socioeconomic								
AGEX	0.0126***	0.0039	0.0130***	0.0044	−0.0007	0.0041	0.0103*	0.0057
SEX	0.1582	0.1066	−0.1617	0.1141	0.1422	0.1084	0.0645	0.1534
RACEX	−0.0542	0.1061	−0.3107***	0.1033	−0.2771**	0.1134	−0.4608***	0.1560
HIGRADX	0.0673***	0.0209	0.0424*	0.0240	0.0436**	0.0218	0.0049	0.0316
FAMINCX	$3.26\text{x}10^{-5}$***	$4.10\text{x}10^{-6}$	$1.54\text{x}10^{-6}$	$7.28\text{x}10^{-6}$	$3.28\text{x}10^{-6}$	$3.34\text{x}10^{-6}$	$4.84\text{x}10^{-6}$	$4.92\text{x}10^{-6}$
INDSTRY	0.4243	0.2634	0.1799	0.2409	0.0656	0.2256	0.2941	0.3263
Health State and Health Related Behavior								
PCS12	−0.0082	0.0052	−0.0073	0.0052	−0.0161***	0.0051	−0.0072	0.0074
SMKNUM	−0.0120***	0.0040	−0.0047	0.0047	0.0057	0.0043	−0.0079	0.0061
Geographical Living Area								
GEONE	0.0818	0.1728	−0.1682	0.1548				
GEOS	−0.1545	0.1396	−0.0297	0.1421	0.3941***	0.1497	−0.1383	0.2077
GEOMW					0.1293	0.1621	0.0676	0.2259
GEOW	−0.0924	0.1699	−0.1390	0.1502	0.0496	0.1598	−0.0725	0.2192
Health Insurance								
INS			−0.4523	0.6334				
Doctor's Effort Level								
EFFORT_HAT					0.0207	0.0681		
The Property of Health Insurance Market								
HMORATE	−0.6430	0.4760						
Patient's Attitude toward the Doctor's Practice Style								
DRUNNEC							0.1928***	0.0622
DRMETND							0.6994***	0.0704
ρ	0.3913[c]	0.3780						
N	834		832		623		623	

* = statistically significant at the 0.1 level; ** = statistically significant at the 0.05 level; *** = statistically significant at the 0.01 level, [a] dropped due to collinearity, [b] standard error estimates using Murphy and Topel method, [c] statistical significance is evaluated based on Likelihood Ratio test of $\rho = 0$

Concerning individual decision on the total medical care use at post stage, the estimation results are shown at the third column of Table 6. Unlike the case where a patient's *ex-ante* health status is fairly good, the estimation result shows that the doctor's effort to closely communicate with the patient on the patient's medical care use had a positive effect on his use of medical care, even if the statistical significance was not guaranteed. This result suggests a doctor's effort should be utilized for increasing a patient's use of medical care. Since, in this case, a patient is fairly unhealthy, we can infer that a doctor who provides medical care to this patient group would have the intent to increase the amount of medical care because the marginal enhancement of health from consuming medical care is likely to be positive. In other words, considering that relatively large gains to the health status of this patient group through medical care use can exist, this empirical indicates a doctor tries to increase the patient's use of

TABLE 7. REGRESSION RESULTS OF PATIENT'S MEDICAL CARE USE (Health Status: Poor)

	Probability of purchasing Insurance		Probability of Visiting Doctor		Total Out-of-pocket Medical Cost(II)		Evaluation on Doctor's Effort	
Variable	Coefficient	s.e	Coefficient	s.e	Coefficient	m.s.e.[b]	Coefficient	s.e.
CONSTANT	−3.1512***	0.9111	0.6326	0.7813	5.1975***	0.9749	4.0260***	1.0979
Socioeconomic								
AGEX	0.0386***	0.0088	0.0226***	0.0083	0.0093	0.0082	0.0031	0.0112
SEX	−0.1187	0.2042	−0.1004	0.1916	−0.0442	0.1828	0.0912	0.2490
RACEX	−0.1249	0.2228	−0.4765**	0.2099	−0.4796**	0.2124	−0.2616	0.2671
HIGRADX	0.1379***	0.0398	0.0648*	0.0359	0.0923***	0.0336	−0.0142	0.0448
FAMINCX	1.96×10^{-5}***	5.59×10^{-6}	1.56×10^{-5}***	5.80×10^{-6}	2.67×10^{-6}	4.96×10^{-6}	-3.26×10^{-7}	7.06×10^{-6}
INDSTRY	0.7457	0.6303	0.2289	0.5787	0.0189	0.8063	0.4532	1.0955
Health State and Health Related Behavior								
PCS12	−0.0066	0.0097	−0.0191**	0.0093	−0.0181*	0.0107	−0.0217	0.0140
SMKNUM	−0.0021	0.0060	−0.0013	0.0060	0.0075	0.0071	−0.0117	0.0091
Geographical Living Area								
GEONE			−0.2276	0.3307	−0.5669*	0.3021	−0.3449	0.3706
GEOS	−0.5193	0.3326	−0.6917***	0.2665	0.0808	0.2504	−0.3368	0.3255
GEOMW	−0.3185	0.3582						
GEOW	−0.2444	0.3364	−0.5379*	0.3054	−0.4127	0.2909	−0.1376	0.3767
Health Insurance								
INS			−1.6033***	0.1548				
Doctor's Effort Level								
EFFORT_HAT					0.0397**	0.0187		
The Property of Health Insurance Market								
HMORATE	0.4032	0.9292						
Patient's Attitude toward the Doctor's Practice Style								
DRUNNEC							0.2980***	0.0907
DRMETND							0.7798***	0.0945
ρ	0.9998**[c]	3.57×10^{-9}						
N	308		308		251		251	

* = statistically significant at the 0.1 level; ** = statistically significant at the 0.05 level; *** = statistically significant at the 0.01 level, [a] dropped due to collinearity, [b] standard error estimates using Murphy and Topel method, [c] statistical significance is evaluated based on Likelihood Ratio test of $\rho = 0$

medical care for obtaining better reputation from the patient's enhanced *ex-post* health status.

The estimation results in the regression equation that generates the predicted value of patient's evaluation on the doctor's effort level are shown at the fourth column of Table 6. The marginal effects of covariates were coincident with the former case, which suggest the older and the white comparatively highly evaluated doctor's effort level. Furthermore, the adjusted R^2 in this regression equation was 0.1695, which was large enough to regard 2SLS method as appropriate method of correcting endogeneity problem.

Concerning the identification of the equation, the identifying variables, such as patient's attitudes toward the doctor's practice style, were shown to have significant effect on patient's evaluation on doctor's effort level, and furthermore when estimating regression equation of patient's total medical care use with these variables, the effects of these variables were still

statistically insignificant, which still indicates the restriction exclusion works well as a method of identifying equation system.

The case of a patient's health status being *poor*

The estimation results of a case where a patient's ex-ante health status is *poor* are shown at Table 7. The estimation results on a patient's decision on doctor-visit and on purchasing health insurance were derived by still applying bivariate probit method and the results are shown at the first and second column of Table 7. The interesting point is that, unlike the former cases, an individual insurance choice is proved to be endogenized variable. The ρ representing the coefficient of correlation between the error terms in these two equations is shown to be significant based on Likelihood Ratio test of $\rho=0$. Hence, considering unobserved individual heterogeneity might affect the estimation process, individual decision on insurance choice and on doctor visit should be jointly estimated each other which might cause the estimation results of applying bivariate probit method to be robust one. Concerning individual decision on insurance choice and on doctor visit, the estimation results have shown to be consistent with the case where a patient's health status is *fair*.

Concerning individual decision on the total medical care use at post stage, the estimation results are shown at the third column of Table 7. The estimation results indicate that the doctor's effort to closely communicate with the patient on the patient's medical care use had a positive effect on his use of medical care and it was statistically significant. As with the former case, this result suggests that a doctor's effort should be utilized for increasing a patient's use of medical care and that the effect of doctor's effort is supported with sure in this case.

The estimation results in the regression equation of patient's evaluation on the doctor's effort level are shown at the fourth column of Table 7. The adjusted R^2 in regression equation of patient's evaluation on doctor's effort level was 0.2101, which was the large magnitude leading 2SLS method to be regarded as an appropriate method of correcting endogeneity problem.

The identifying variables were shown to have significant effect on patient's evaluation on doctor's effort level, and furthermore when estimating regression equation of patient's total medical care use with these variables, the effects of these variables were still statistically insignificant, which still suggests the restriction exclusion works well.

Discussion on the estimation results of the above two cases

In the cases where a patient's health status was fair or poor, the estimation result shows that the doctor's effort to closely communicate with the patient on the patient's medical care use had a positive effect on his use of medical care, even if the statistical significances of all cases were not guaranteed. This result suggests a doctor's effort should be utilized for increasing a patient's use of medical care and this empirical result is consistent with the expectation from the theoretical reasoning.

Furthermore, we found the doctor's effort to be more effective as a patient becomes unhealthy. The magnitude of the coefficient was 0.0207 with a patient's health status being "fair," and 0.0397 with a patient's health status being "poor." As mentioned in the previous case of patient's health status being good, it is natural to think a doctor's intent to increase a patient's medical care use would increase as the patient becomes unhealthy, because the

possibility of this patient experiencing a positive marginal enhancement of health after consuming medical care increases.

Therefore, we can infer that a doctor would provide more efforts to closely communicate with a patient, in order to correct the patient's misperception on the effectiveness of medical care, such as an under-evaluation of it which may be a reason for this patient underutilizing medical care. Based on this context, the effect of a doctor's effort on her patient's medical care use would increase as the patient becomes unhealthy.

3. The Sensitivity Check of Estimation Result: Effect of a Doctor's Effort on Patient's Medical Care Use

The pattern of estimation results in Table 3 through Table 7 might be more robust to a sensitivity check that explores several relevant issues.

The first issue is whether the patient's ex-ante health status could be represented by patient's self-evaluated health status. Even if sample's characteristics are different according to a patient's self-evaluated health status, the estimation results of this paper could be firmly supported with using more objective index of measuring a patient's health status.

Another issue is concerned with the sample size. Considering the total sample size used in estimating models is 8,153, the sample size of a group whose health status is excellent, very good or good is 7,011 is relatively larger than that of other groups, which is 1,142. Especially, the sample size of a group whose health status is poor, takes only 3.79% of total sample size. Hence this imbalance of sample might be a reason of obstructing to obtain consistent estimates.

Hence, in this paper, the sample is divided to two groups according to the value of PCS 12. As mentioned above, the variable PCS12 represents an individual's health status measured by using the SF-12 Physical Component Summary score, which is calculated based on the Health Institute's scoring algorithm. And a higher score for this variable represents better health status. It has been believed that the method using the SF-12 Physical Component Summary score can objectively represent individual health status (Kemper, 1996).

Therefore, in this paper the sample is divided by two groups depending on whether the PCS12 is greater than 50 or not. The reason why the value of 50 is used as a critical value is the average of PCS12 was 50.179 shown in Table 2. Even if the sample size of both groups is still imbalanced; 5,857 vs. 2,296, the degree of it has been enhanced. The same estimation process is applied to these two groups and the results of it are shown at Table 8.

In a group whose PCS12 is greater than 50, which suggests the health status of this group is fairly good, the doctor's effort has a negative effect on patient's medical care use with

TABLE 8. REGRESSION RESULTS OF PATIENT'S MEDICAL CARE USE (PCS)

	Health Status (PCS > 50)		Health Status (PCS < 50)	
Variable	Coefficient	c.s.e.[b]	Coefficient	c.s.e.[b]
Doctor's Effort Level EFFORT_HAT	−0.1126***	0.0311	0.0387**	0.0189
N	5,857		2296	

* = statistically significant at the 0.1 level; ** = statistically significant at the 0.05 level; *** = statistically significant at the 0.01 level; [a] dropped due to collinearity, [b] standard error estimates using Murphy and Topel method

statistical significance, which supports the main results introduced above. Furthermore, in a group whose PCS12 is lower than 50, which suggests the health status of this group is relatively poor, the doctor's effort has a positive effect on patient's medical care use with also statistical significance, which also supports the main results introduced above.

Therefore, with this finding, we can say that the robustness of the estimation results in this paper can be strengthened.

V. *Conclusion*

This paper investigated that a doctor's effort to closely communicate with a patient could affect the patient's use of medical care, and that the direction of this effect could be dependent on the patient's *ex-ante* health status.

However, the following points should be indicated as limits of this study, which will be left for future studies to resolve. The first is concerned with the method of measuring the doctor's effort level. In this paper, the patient's evaluation of the doctor's effort was used as a proxy variable to represent the doctor's true level of effort; thus, it needs to be measured based on more objective standards. However, if we consider that the only person who can observe a doctor's true level of effort is the patient, it might be less of a problem to use this as proxy variable.

Another limit is, in considering that an individual's decision making process for purchasing medical care use should be understood as a dynamic process, we need to make clear about the effect of the time factor on an individual's medical care use. In other words, an individual's health status might have characteristics of state variable, which represents that an individual's current health status should be dependent on how much medical care he used in previous periods. Hence, the appropriate data for this study might have the characteristics of a panel or as longitudinal one. The CTS dataset used in this study is, however, is cross-sectional. Yet, the CTS data is supposed to be created biannually, and so it supposedly has a longitudinal form; hence, if we can use that longitudinal form of the dataset, this limit might be lessened.

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