Topic：Health Care System as Social Common Capital

〈Review〉

Significance and Issues of Measuring the Benefit of Community Medical Service System by the Hedonic Price Method

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Abstract

Objectives: The purpose of this study was to focus on the "external effect" recognized as "security" or "peace of mind" of regional residents around medical facilities and to estimate it statistically by applying the Hedonic Approach to regional data on Kobe City.

Methods: Open data source on the public announcements of land price（Chika-Koji）was utilized to collect regional land-price data. Plural geographical information systems（GIS）were also utilized for the collection of data on the characteristics of social infrastructure and so on. In addition, information of regional medical systems was collected from public data sources managed by the "Medical Association of Kobe City". On gathering this information, the total volume of data consisted of 317 samples. Based on the hedonic-approach, the estimation model was constructed to regress land prices by various characteristics including the status of the regional medical service system. Finally, we discuss problems revealed by the analysis and the way to reflect these values to real policy.

Results: The results clearly show that not only does a strong correlation exist between land price and the number of medical facilities within 1 kilometer of a given point（$p<0.01$）,but a negative correlation also exists between land price and the distance of the nearest medical facilities from a given point（$p<0.01$）. The results also suggested that land price was increased marginally by adding the number of health care facilities near a given land point. Conversely, land prices tended to drop by prolonging the distance from the nearest healthcare facilities. Our estimation results also suggested that the coefficients of external effect, which reflected the benefit from the security residents felt from health service accessibility, was no less than that of other important characteristics related to infrastructure or convenience of daily life.

Conclusion: To summarize, health care facilities contribute to regional society by their existence as a supplier of a sense of security to neighborhoods. We should re-evaluate this aspect regarding benefit and reflect this in the planning of regional medical system as social common capital.

keywords: regional medical system, external effect, hedonic-approach, social common capital, sense of security

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Ⅰ．Introduction

It is a well known issue that community medical service delivery systems are said to be underfunded and collapsing; the lack of medical doctors and nurses in medical institutions is developing into a serious problem, more and more local medical institutions are being closed down or removed, and there is insufficient capacity of maternity divisions, pediatric divisions and emergency care services. It is not simple or easy to organize the causes of the problems within medical service delivery systems, since all cases have different local endemic contexts and original conditions. This report perceives an issue of value brought about by medical service delivery systems for

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which evaluation is insufficiently discussed or organized as a factor in the cause of these situations. Our purpose is to briefly describe the Hedonic Price Method and the significance of its application for evaluating community medical service delivery systems, and to highlight actual issues in its application by showing measurement examples of Kobe-City.

Firstly, what is the value of the community medical service delivery system and how are we to understand it? The values which community medical service delivery system brings about can be summarized into two areas as follows; 1) value that patients and visitors can benefit from; for example, health recovery and health maintenance supported by healthcare services like medical check ups, and medical services such as treatment for disease and injury, 2) value that is a "sense of security" for healthy local residents, brought about by the existence of a proper medical service delivery system in a community. The former can be referred to as "utility value" and the latter as "existence value".

These two values related to the medical service delivery system are regarded as difficult to evaluate for different reasons. The main reasons that make the evaluation of health care and medical services, such as health check-ups and treatments, in market difficult are; the existence of "asymmetry of information", that is, a gap of knowledge and information between patients/visitors and medical staff that can't be ignored, and the existence of "uncertainty" that individual diseases are unique in themselves and even if same treatment is administered to same disease, its effect and recovery process are not consistent through individuals. Both "asymmetry of information" and "uncertainty" are a required condition for "market failure", thus the evaluations in market are difficult.

With respect to the latter, when people live in an area where the necessary medical service delivery system is available, healthy people can also have a "sense of security" knowing it is there if they need it. This value is considered to be "a positive external effect" which a community medical service delivery system can create, if put into the context of economics.

External effect is such that activities of one economic entity affect another economic entity outside market activities. For example, if a factory emits sooty smoke because of its operation, making the environment of peripheral residents deteriorated, it's an example of "negative external effect". When the owner of the factory neglects paying enough attentions to the peripheral environment based on his selfish motive with regard to the operation of his factory, the cost curve of the company isn't

inclusive of social expense, which is air pollution. Therefore, it means its operating level is too high above the appropriate level, which is set from the social point of view. On the contrary, development of parks and greeneries in neighboring residential areas offers improvement of landscape, which consequently creates comfort for neighboring residents. But when seen from the purpose of an economic entity, social benefit, which is a positive external effect, is not fully reflected on the decision of the operating level (QF: Fig. 1), thus too low from the appropriate level set from the social point of view (QE: Fig. 1). This case creating such external effect is also a "market failure" in the sense that most appropriate level is not achieved.

As for the development of a community medical service delivery system, it can be considered that a similar positive external effect has occurred through the provision of a "sense of security" for local residents. However, in the process of having developed the medical service delivery systems in our country, there was no explicit discussion about the evaluation of values such as these, which are an "external effect". Considering that past investigations[1] indicated the "unavailability of a hospital in the neighborhood" as the most common answer to "what troubles or anxiety do you have in your life?", the community medical service delivery system which doesn't explicitly consider any social benefit such as "sense of security" of local residents, is possibly at a level lower than what is an appropriate social level. Moreover, recent developments such as the closing down of local medical institutions and the removal of clinical departments means that local residents lose a positive external effect which
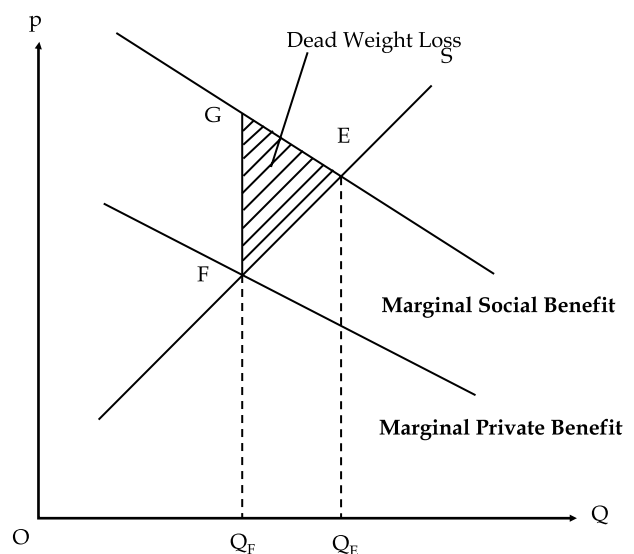

Fig. 1 . Positive Externality

they have benefited from up until now, suggesting a possibility that the gap from the most appropriate level may be increasing.

Regarding the reason that community medical services have become underfunded, it can be considered that there hasn't been enough discussion about the value that the community medical service delivery system creates, failing to raise methods or results that would have clarified them. Consequently, there has been a failure to show sufficient evidence that would have convinced local residents about the development of the community medical service system, and in addition, there has been insufficient investment corresponding to that value. Collapse of community medical service delivery systems not only creates trouble for on-going treatment of patients, but also threatens the peaceful life of the local people depriving them of a "sense of security". In this report, based on such an understanding with regard to the value of the "sense of security" (existence value) brought about by community medical service delivery systems, which is yet to be explicitly discussed, we'll use actual examples of the Hedonic Price Method of Kobe-City, widely used as a method to measure the "external effect". This report consists of the following. Chapter Ⅱ briefly describes the abstract of the Hedonic Price Method. Chapter Ⅲ shows the results of measurements made in Kobe-City, and a comparison is made between the value of benefits created by the medical service delivery system and that of other social benefits. Chapter Ⅳ is partly based on the already publicized measurements of Yokohama-City and the measurements conducted in Kobe-City, with description of several issues discussed during the measurement process. Chapter Ⅴ raises issues regarding the application of this evaluation for future policies. Chapter Ⅵ contains the conclusion.

Ⅱ. The Hedonic Price Method as an approach to the measurement of external effects

It is difficult to evaluate the value which community medical service delivery systems create, particularly its existence value for local residents on a market basis. For example, suppose a medical institution in a community is to be acquired by another institution. In this case, in order to decide the buyout price, a profitability evaluation would be made, including the current number of patients, the utilization ratio of beds, future business potential as well as a strict evaluation of its assets including equipment inside the facility. However, the values that are evaluated in such a scenario are limited to the values that belong to the medical institution as an enterprise, and patient benefits from treatment and the external effect that its existence provides

for the local residents are not taken into consideration. Therefore, in order to discuss benefits of medical service delivery system from the point of view of "the entire society", it is necessary to evaluate the areas which are yet to be evaluated. This chapter briefly explains the Hedonic Price Method, which is utilized as an approach to measure such external effects and the quality of environments.

The Hedonic Price Method is a general approach that considers the entire value of assets and services as a "bundle of attributes", and evaluates the values of these attributes by allocating a price to each attribute. The bundling of attributes, which are assets and services, is widely used in the case where they are bought and sold on a market using a price, but their values cannot be evaluated since there aren't any individual markets for individual attributes. Therefore, in this method, assets and services that are identified as the same, have homogeneous factors even if they are presented as different, which means there is a premise of understanding that they have a common price structure. The applicability of this method is wide. For example, it is used for making adjusted price indexes which consider influences of technology progress in products that change over time. However, here I shall limit the subject of the measurement method to the values of external effects created by a community environment.

When people choose a place of work or living, they take the surrounding environment into consideration. Under the circumstance that freedom of movement is guaranteed, they make their preferred choice after comparing land prices, rent and various related factors. Land is limited, so prices go up if there is large demand, and vice versa. In other words, there is no market for those related items on an individual basis (for example, availability of medical institutions, open spaces and parks, educational environment, etc.), but the price of land and rental houses, which are the result of a bundling of factors, are decided in the market. The Hedonic Price Method tries to determine the values which people give to individual surrounding items by focusing on the relation between price and the environment. Japanese are considered to have a strong attachment to land originally, and the "myth" that it is always safe to invest in land persisted until the bubble economy burst. Demand for land and people's interest in the surrounding environment of the land, are generally strong. In order for the Hedonic Price Method to be effective, there has to be demand for land, and consumers have to perceive a difference in the quality of different environments, so it can be said that the method is consistent with conditions in Japan.

As for the influences on local areas through the

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development of infrastructure and surrounding areas, they are indicated as being totally reflected in real-estate prices when satisfying the following conditions; (1) open area, (2) small area, (3) homogeneity of consumers, (4) free entry, (5) sound pricing. This hypothesis is usually known as the "capitalization hypothesis". This means that all changes in local resident benefits caused by changes in the surrounding environment are included in land prices[2], and based on such an understanding, ultimately the Hedonic Price Method is the same as analyzing the social benefits, although it appears to be analyzing land prices.

Under the conditions mentioned above, if we analyze land prices inclusive of entire social benefits by applying the Hedonic Price Method to get the values of individual attributes, what kind of theoretical meaning does each have? Rosen (1974)[3] gave a theoretical foundation to this point. A detailed explanation including a complicated formula is to be omitted here since they're described in preceding research[4], so only its framework is described here.

Various attributes related to land can be expressed as a characteristic vector $Z = (z_1, z_2, z_3, \cdots, z_n)$. These various attributes include accessibility to public transportation, convenience of local medical services, neighboring educational and natural environment, etc. In the market, land prices are decided according to their attributes, so the formula to express the relation between land price and various attributes are (1).

$$p(Z) = p(z_1, z_2, z_3, \cdots, z_n) \qquad (1)$$

Next, let's think about consumer behavior. Consumers purchase land with various attributes and all the composite commodities but the land (X), under the constraints of their income. When the utility function of a consumer is $U = (Z, X)$ and the income is I, the maximum utility under the constraint of income is (2).

$$\max_Z U = (Z, X)$$
$$s.t. \ I = X + p(Z) \qquad (2)$$

The behavior of the consumer is expressed by maximizing X and Z under this constraint. If it is X^*, Z^*, then this is the amount of his purchase, and his level of utility is decided depending on this. Defining a function with $\gamma(Z)$ that satisfies required conditions to achieve the utility level u^*, it is possible to define a bid function which indicates the maximum price that they are willingly to pay for obtaining land Z with various attributes $(z_1, z_2, z_3, \cdots, z_n)$ while maintaining the utility level. (Formula (3))

$$U(Z, I - \gamma(Z)) = u^* \qquad (3)$$

Also, this bid function can be defined at any utility level, so formula (4) can be set.

$$U(Z, I - \gamma(Z; I, u)) \equiv u \qquad (4)$$

Suppose consumer behavior is such that maximize the utility, and a bid function γ_i is the value γ differentiated with respect to z_i, this γ_i coincides with the marginal rate of substitution of specific attributes of land (i) and all the composite commodities of assets and service X. After all, a bid price, which consumers' willingness to pay is reflected on, and a market price coincide.

Also, the market land price function seen from consumers (Formula (1)) means the minimum price that they have to pay when they want to obtain certain attributes. So, when we hypothesize the existence of homogeneous consumers, the market land price function and the bid function coincide, and when there are heterogeneous consumers, the Hedonic land price function becomes the envelop of the bid function[5]. It is the theoretical conclusion that market land price function is a market equilibrium curve that satisfies supply-demand balance in the case where various environmental attributes including community medical service delivery system are dealt with in a virtual market, which does not exist in reality. The biggest advantage of this method is being able to fictitiously measure market prices in a virtual market, such as the sense of security created by a medical service delivery system.

Following on from that described above, consumer evaluation of individual attributes of land should normally be made based on the direct estimation of bid function. In Fig. 2, even if the value of bid function γ_1 rises from p_1 to p_2
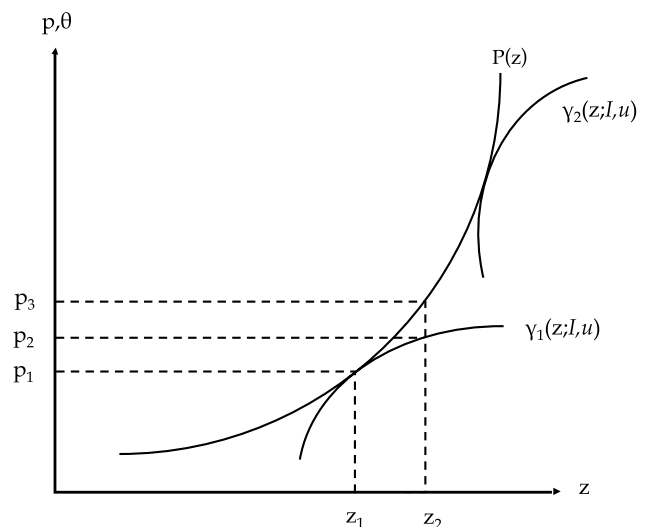

Fig. 2. Bid Function and Market Land Price Function

when certain environmental quality is improved from z_1 to z_2, this is movement on γ_1, so even if there is an additional payment of $p_2\text{-}p_1$ because of this improvement, the utilities of consumers stay constant. Therefore, from this it is possible to construe that $p_2\text{-}p_1$ is the willingness to pay for the environmental change from z_1 to z_2. Strictly speaking, as you can see from the form of each function indicated in this figure, the market land price function does not coincide with bid function, and evaluation using the market land price function to make $p_3\text{-}p_1 > p_2\text{-}p_1$ usually becomes too large. But in reality, it is difficult to identify and estimate bid functions, and in many cases, it is necessary to hypothesize homogeneity of consumers or to set a hypothesis that the gap between bid function and market land price function is small since the influence of environmental change is a minor one, in order to obtain the value of the environmental change through the use of market land price function, which makes it easier to make an estimation.

Ⅲ. Evaluation of community medical service system in Kobe-City

In this chapter, the abstract on the evaluation of the community medical service delivery system in Kobe-City is described using actual examples of the analysis discussed so far.

（1） Subject data

Kobe-City in Hyogo Prefecture, a government decreed city, was the subject for the analysis. With regard to information related to official land prices and land-price points, information on the official land prices of 2007 was obtained by specifying the "residential zone" from the areas covered in the "Information of Land Integrated System" in "Land and Real Property in Japan" run by the Ministry of Land, Infrastructure, Transport and Tourism. Information on medical institutions in surrounding areas was obtained from the "Medical Institution Information System" run by Kobe Medical Association. Information on convenience of living and social infrastructure in the area in question was collected from several free map retrieval internet sites by the author as an individual, non-profitable entity and data entered. Regarding information on income circumstances in the area, information was collected from the "Japanese High-income tax payer database" operated and published by a limited private company, Sogo Houmu Hosho (General Legal Work Security) which uses non-personal information and shows the amount of tax paid at a "town" level.

Characteristics of land point
1) Land price:

Annual national land price survey (Chika-Koji) in 2007 (Japanese Yen/m^2)
2) Space of the land (m²)
3) Price of floor space (%) / Rate of occupancy (%)
4) Information of connecting road:
width of road (m) / Ownership of road (Public: 1, Private: 0) / existence of other connecting road (exist: 1, not exist: 0)
5) Gas pipeline (exist: 1, not exist: 0) /Sewerage (exist: 1, not exist: 0)
6) Regulated land criteria for use:
first criteria for residence/ second criteria for residence / first criteria specialized for lower residence / second criteria specialized for lower residence / first criteria specialized for middle-higher residence / second criteria specialized for middle-higher residence / criteria for commercialized areas (falling into category: 1, not : 0)
7) Quasi fire prevention area:
city planning legal regulations (falling into category: 1, not: 0)

Medical system availability around land point
1) the number of medical facilities within 1 kilometer:
(Physician, Pediatrician, Obstetrics, Surgery, Otolaryngology, Dermatology, Orthopedics)
2) distance to the nearest medical facilities:
(Physician, Pediatrician, Obstetrics, Surgery, Otolaryngology, Dermatology, Orthopedics)

Convenience of daily life and other social infrastructure
1) distance to the nearest station from the land point
2) accessibility to the central area of Kansai
time from the nearest station to Osaka station, the number of transportation changes, total cost of access to Osaka station
3) distance to the nearest kindergarten ,primary school and junior high school
4) distance to the main head office of each ward
5) distance to the nearest shopping store
6) distance to the nearest post office
7) distance to the nearest large park or green field

Regional characteristics
1) the number of households by regional community
2) the population of each regional community
3) the population ratio of over 65 year olds in each
the number of persons in high income tax bracket by regional community

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(2) Basic amount of statistics of data set.

After collection of this information, the total sample number for analysis was 317. These basic statistics are shown from Table1 to Table4. Moreover, Table5 shows the correlation between land price and regional health status variables.

Table 1　Descriptive Statistics（1）.

	Frequency	Min	Max	Average	Std.Dev
Characteristics of Land Points					
Land Price in 2007	317	36400	430000	143652.05	75074.47
Space of the Land（m²）	317	51	798	186.17	89.51
Rate of floor space（%）	317	40	60	54.29	7.33
Rate of capacity（%）	317	80	300	151.51	56.81
Width of connecting road（m）	317	2	20	5.95	2.08
Ownership of connecting road（Public: 1 Privte: 0）	313	0	1	0.92	0.27
Gas pipeline（avail: 1 not avail: 0）	317	0	1	0.95	0.23
Sewerage（avail: 1 not avail: 0）	317	1	1	1	0

Table 2　Descriptive Statistics（2）.

Medical system availability around the Land Point	Frequency	Min	Max	Average	Std.Dev
No.of physicians within 1km	317	0	53	12.42	10.96
No. of pediatricians within 1km	317	0	18	5.06	3.66
No. of obstetrics within 1km	317	0	9	1.37	1.65
No. of surgery within 1km	317	0	20	4.77	4.06
No. of otolaryngology within 1km	317	0	8	1.82	1.82
No. of dermatology within 1km	317	0	13	2.62	2.78
No. of orthopedics within 1km	317	0	19	4.04	3.61
Distance to nearest physician	317	14	2189	307.78	233.42
Distance to nearest pediatrician	317	25	3461	440.98	358.64
Distance to nearest obstetrics	307	0	3870	995.76	740.41
Distance to nearest surgery	317	35	4150	466.38	358.25
Distance to nearest otolaryngology	317	45	4212	830.20	655.93
Distance to nearest dermatology	310	7	4322	764.10	614.27
Distance to nearest orthopedics	317	58	4150	553.14	441.63

Table 3　Descriptive Statistics（3）.

Daily life convenience and Other social Infrastructure availability	Frequency	Min	Max	Average	Std.Dev
Distance to nearest station	317	100	6300	1375.11	1165.56
Time from nearest station to Osaka station	317	21	81	46.66	10.84
Time of transit to Osaka station	317	0	3	1.08	0.59
Total fare to Osaka station	317	270	1290	740.69	256.77
Distance to nearest kindergarten	317	16	1300	308.64	218.39
Distance to nearest primary school	317	57	1300	396.49	226.76
Distance to nearest junior high school	317	55	2100	597.29	310.68
Distance to main head office of each ward	317	185	27800	3253.72	4274.40
Distance to nearest shopping store	317	47	2700	503.06	340.41
Distance to nearest post office	317	47	1700	420.90	295.40
Distance to nearest large park or green field	289	127	3700	1465.22	768.90

Table 4　Descriptive Statistics（4）.

Regional Characteristics	Frequency	Min	Max	Average	Std.Dev
No. of households by regional community	317	1	6634	493.82	837.17
Total population of each regional community	317	3	15846	1122.76	1989.01
Population ratio of over 65y.oin each regional community	317	0.05	0.67	0.25	0.08
No. of people high income tax bracket by each regional community	202	1	32	4.73	6.74

（3） Specification of function form

In this paper, we specified an estimation of function form using the following simple linear form.

$$p_i = \alpha + \sum_{k=1}^{K} \beta_k L_{ki} + \sum_{s=1}^{S} \gamma_s H_{si} + \sum_{j=1}^{J} \delta_j I_{ji} + \varepsilon_j$$

In this equation, p_i means land price (Yen/m^2), α is intercept, L_{ki} is characteristics of the land, H_{si} is status of the regional health care system, I_{ji} is various characteristics related to the land point including social infrastructure, daily convenience and regional status such as the income level of the community. β_k, γ_s, δ_j are estimated coefficients of characteristics respectively and ε_i is a statistical error term for presuming normal distribution.

Table 5 Correlation between Land Price and Regional Health Care System.

	Land Price in Kobe in 2007
No. of physician within 1km	.720**
No. of pediatrician within 1km	.628**
No. of obstetrics within 1km	.606**
No. of surgery within 1km	.698**
No. of otolaryngology within 1km	.568**
No. of dermatology within 1km	.681**
No. of orthopedics within 1km	.576**
Distance to nearest physician	− .376**
Distance to nearest pediatrician	− .333**
Distance to nearest obstetrics	− .505**
Distance to nearest surgery	− .320**
Distance to nearest otolaryngology	− .503**
Distance to nearest dermatology	− .484**
Distance to nearest orthopedics	− .356**

This number is pearson's correlation
**1% statistically significant

（4） Estimated results of land price function

Fig. 3 is the summary of the estimated values related to community medical service delivery systems obtained through the estimated results of the land price function. Each of them is shown as the estimated land price for 1m^2. Considering that the average land price in Kobe-City was 144,000 yen, these estimated values of individual clinical departments are about 4-5% of land price. Also, Fig. 4 shows a comparison with other surrounding attributes with regard to the influence of extending the distance from the land-price point over the estimated values. As far as the above mentioned shows, the evaluation of the local residents of the availability of community medical service delivery systems is at a noticeable level when compared with other surrounding attributes and convenience.
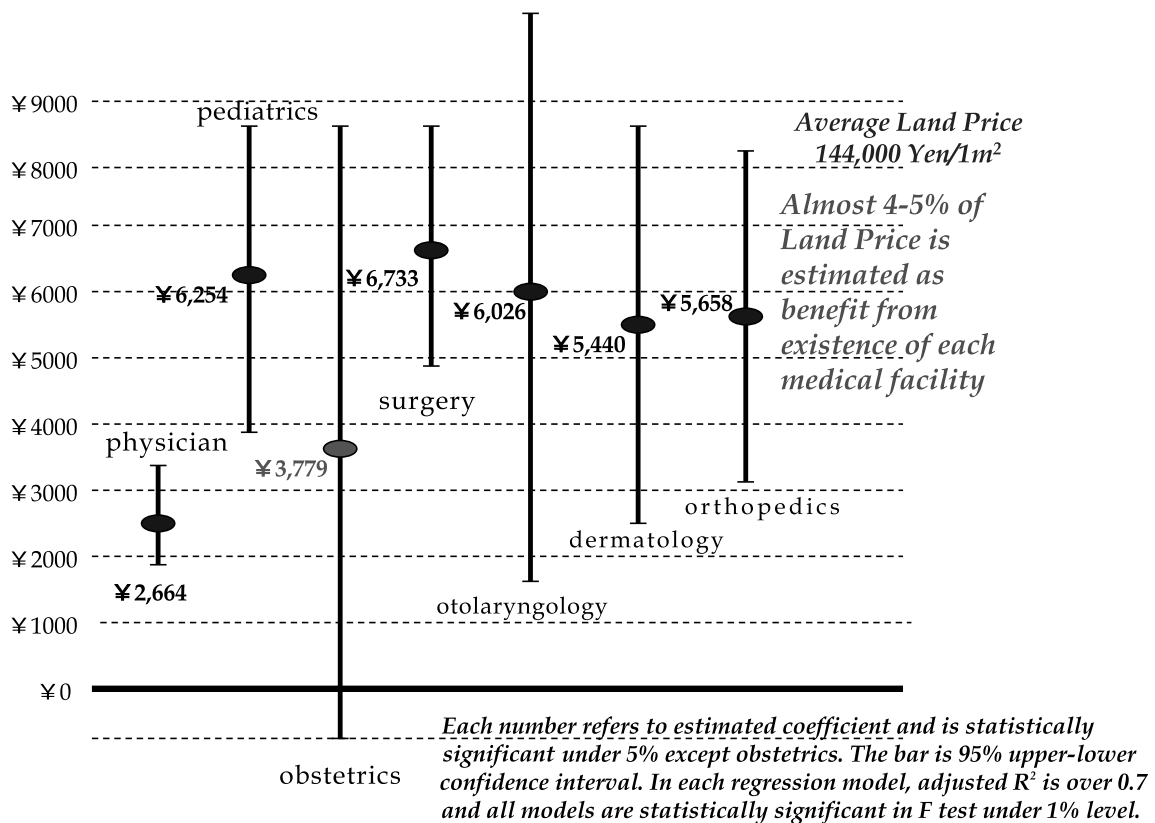

Each number refers to estimated coefficient and is statistically significant under 5% except obstetrics. The bar is 95% upper-lower confidence interval. In each regression model, adjusted R^2 is over 0.7 and all models are statistically significant in F test under 1% level.

Fig. 3 . Result of Estimation （1）

Each number is estimated coefficient and statistically significant under 5%. This bar is 95% upper-lower confidence interval. In each regression model, adj R^2 is over 0.7 and all models are statistically significant in F test under 1% level.
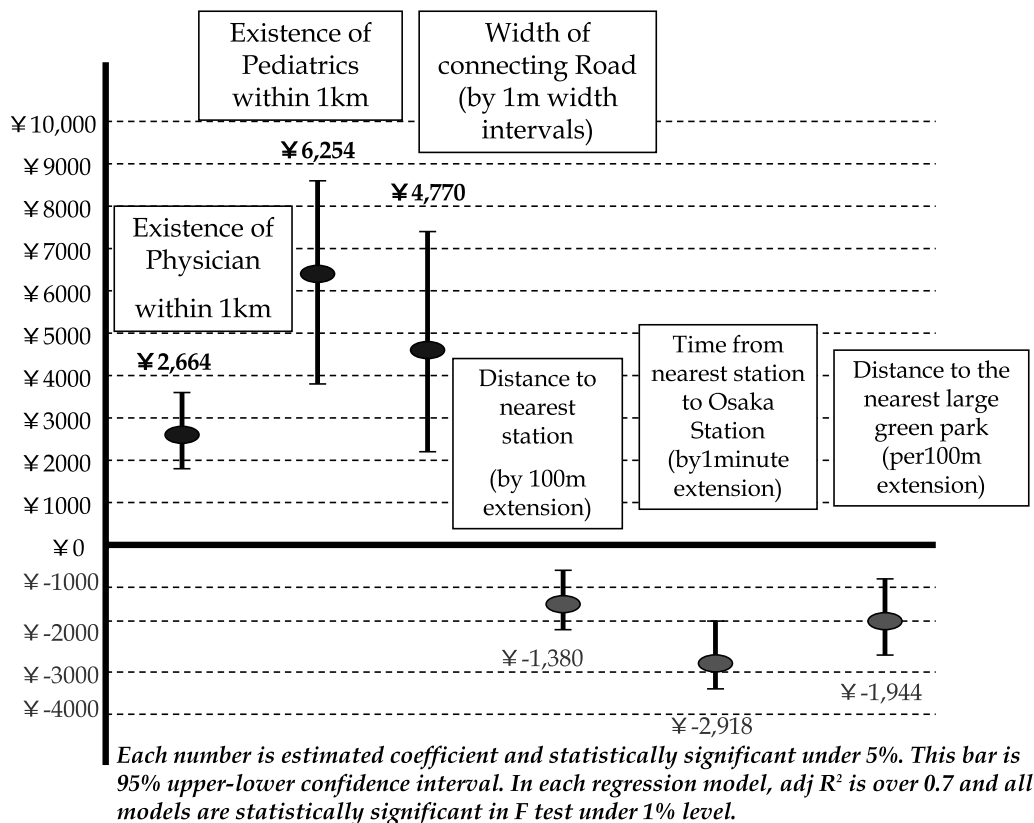
Fig. 4 . Result of Estimation (2)

Ⅳ. Actual issues for evaluating the community medical service system by the Hedonic Price Method

For local residents, the conditions of the community medical service delivery system should appear to be a difference in the quality of the environment of the communities. Therefore, by collecting information on community medical service delivery systems together with other aspects related to the surrounding environment, and examining the relationship between that information and land prices in the area, it is possible to estimate the value which local residents give to the existence of community medical service delivery systems, namely, the price which they are willing to pay. Here, the issues which need consideration for making an analysis with the Hedonic Price Method are discussed by separating them into issues of data and issues for making estimations.

＜Issues of data:＞
（1）Selection of land price
When estimating a bid function by the Hedonic Price Method, we need to consider which land price to use when there is more than one price available to use. The following

are examples.
① "Market price"
It is possible to collect this from the "General Information System on Land" linked to the "Information of Land Integrated System" operated by the Ministry of Land, Infrastructure, Transport and Tourism. When the level such as prefecture, city, town or zone is specified, market data in any specific area of Japan can be obtained. It is also possible to retrieve the information by business content such as market period（quarterly）or kind of land by specifying the method of retrieval, thus yielding a high retrieval performance. It is possible to obtain information on land attributes such as square footage, shape, distance from the nearest train station, width of the road in front, specified use, housing per hectare and plot ratio. These are actual market prices so they are supposed to be the most appropriate information for estimating a bid function. However, in actual use the following issues are encountered. 1) It is not openly publicized so address cannot be identified. Therefore it is not possible to precisely connect a land price to the surrounding environment. 2) It is possible that the prices are decided according to the personal reasons of buyers rather than sellers. 3) The market timing of the collected information is not at a specific point in time,

so it is necessary to adjust the prices by substantiating them.

② Official land price

Similar to market price, it is possible to collect this information from the "Official Land Price" linked to the "Information of Land Integrated System" run by the Ministry of Land, Infrastructure, Transport and Tourism. Data after 1970 in any specific area of Japan can be obtained by specifying a level such as prefecture and municipality. Official land price indicates the "normal price" in the market exclusive of any speculative element of the land. And, "standard land" in any area, which satisfies "representativeness", "moderation", "stability" and "certainty", are appraised by two or more real-estate appraisers using any necessary adjustments. It is possible to obtain information related to land attributes similar to those of "market price" as well as to specify address. This has the advantage that it is possible to make a precise connection with information on the surrounding environment and it can exclude influences caused by speculative elements, which do not reflect reality. On the other hand, however, it is necessary to note that this is the appraisal price of real-estate appraisers not the actual market price.

③ "Prefectural land price research: standard land price"

This announced each year by the Prefectural Governor based on appraisals made by one or more real-estate appraisers. The publicized information of attributes conform to the official land price, having common land-price points, and the price is a "standard price" Therefore, the points to note are the same as those of the official land price.

④ "Real-estate tax appraisal and asset appraisal standard for roadside land prices"

Each of these is an appraisal value for imposing inheritance taxes, gift taxes, or taxes on real-estate, etc. With regard to the real-estate tax appraisal, it is conducted based on about 70 percent of the official land price, and about 80 percent of the asset appraisal standard for roadside land prices. For the real-estate tax appraisal, the appraised prices of a standard year remain unchanged for three years in principal, but roadside land prices are renewed every year. Appraisal methods for both have many points in common, and they indicate the prices of one sq. meter of standard housing land facing a road. It is possible to collect research data from all over Japan, however, there is a problem that making a precise connection with surrounding areas becomes difficult because identically appraised areas become smaller since they are appraised by road. As indicated from the above, the organization and

publication of information by purpose have progressed, and the relationship between market price and individual land price are mostly clarified. Ideally, it is preferable to use market prices, but considering the connection with the surrounding attributes, under the current situation, it is highly convenient to use official land prices that can be identified by address.

(2) Data of community medical service institutions

When evaluating community medical service delivery systems, it is essential to obtain complete information about community medical service institutions. There is high demand from local residents for such kind of information, and many homepages of public administrations publish such information. Some of them have such high searching capabilities that it is possible to search the nearest medical institutions from home by specifying a clinical department. For example, at the homepage run by the Headquarter for the Promotion of Medical Institutions' Cooperation of Yokohama-City, it is possible to search using conditions such as details of medical service or by location such as the user's own location and obtain results grouped by distance. As far as the author could verify, Sapporo-City, Kobe-City and Fukuoka-City have similar systems for searching medical institutions, although not as advanced as Yokohama. In areas such as these, it is relatively easy to obtain information on what kinds of medical service delivery systems exist as features of these communities. However, in many local governments, information on community medical service delivery systems including clinics, is not easy to obtain for all people. Above all, accuracy, speed and coverage of information are hardly ensured. This may be the most serious issue for making an actual analysis using the Hedonic Price Method.

＜Theoretical issues and issues for making estimations＞

(1) Selection of function

In the Hedonic Price Method, there is no transcendental theoretical constraint for the function types of market land price function. Put differently, it is possible to specify the function type at any estimated time from a particular point of view. Therefore, it is always necessary to be conscious of arbitrariness of settings. Hidano (1997)[6], however, points out that this is not a big issue as long as the given subject is within the range of existing environmental standard or development standard of social infrastructure. Above all, obtaining values near an average level will not affect the result. Conversely, when evaluating individual attributes rather than near-average values, it is necessary to discuss such specification much more strictly. In the specification, the following points are usually considered; 1) suitability of

the estimation formula, 2) theoretical consistency of the estimation parameters, 3) simplicity of the estimation work, 4) simplicity for understanding the results of estimations[7].

（2）Issues of endogeneity and simultaneous decisions

Endogeneity of explanatory variables that are applied in relation to the specification of market land price functions becomes an issue. This is particularly true for "the number of medical institutions" which exist in peripheral areas as an environmental attribute of the medical service delivery system. If a phenomenon is observed where for some reason more medical institutions enter an area where land is expensive making that area full of them, or to the contrary, more institutions in an inexpensive area making that area full of them, this means that the land price itself is an influencing factor for the decision of the number of institutions, and "the number of medical institutions" given as an exogeneous variable does not satisfy the hypothesis of independency from land prices. It is a general understanding that the location of public medical institutions are decided by conditions of communities regardless of land prices. On the other hand, with regard to private medical institutions and clinics in particular, it is not transcendentally clarified whether the level of land prices affects their entry or not.

As for the eighteen wards of Yokohama-City which I have previously researched[8], the relationship between the number of hospitals and clinics and their increase/decrease, and the level of land prices was examined, suggesting no significant statistical relationship between them. However, in other areas, it is highly possible that issues of endogeneity and simultaneous decisions such as these do occur, so it is necessary to pay attention to this issue.

（3）Issues of multicollinearity

With regard to estimating market land price functions for which many local environmental attributes are allocated explanatory variables, strong connection occurs between the explanatory variables adversely affecting their independency, frequently causing the estimation to become unstable, making the dispersion of parameters bigger. As a fundamental counter action for multicollinearity like this, it is possible to maintain mutual independency by increasing the accuracy of explanatory variables themselves or making variables to indicators. Even having done so, variables with a strong correlation remain, but in such cases, coefficients of correlation need to be verified, and variables with strong explanatory ability which are impervious to multicollinearity are to be selected using indicators such as VIF（Variation Inflation Factor）, and applied as models. Or, it is also possible to make a principal component analysis of explanatory variables beforehand, sorting out common fluctuation and using them as variables.

Ⅴ. Suggestion for the re-construction of community medical service system as a social common capital

I perceive community medical service delivery system as a social common capital[9] with Commons-like character[10] for the following reasons. A community medical service delivery systems is a 1) common asset which is accessible（free access）for anybody in principal, 2) has become run-down due to surplus consumption of patients and their families with selfish motives, 3) the adverse affects from becoming run-down is affecting not only existing visitors but all residents in an area including potential visitors, 4) difficulty for restoring to its original state（irreversibility）after becoming run-down. In order to avoid a "Tragedy of Commons" of community medical service, what kind of countermeasures can we take to reflect the aforementioned values of external effects to reality? Lastly, let's touch upon the issues for reflecting such values in actual policies.

There are two main ways to solve the influence of the external effect; 1) private solution, 2) public solution. In private solution, there is a "change of allocated ownership" and "solution by negotiation".

Let's start with a "change of allocated ownership". When there is an external effect, its influence can be solved by enlarging the economic unit in question and integrating it into a unified unit, the influence can then be solved by being adjusted within the same economic unit. This is to say, it is "internalizing" the external effect. When we talk about the community medical service delivery system, the provider side of community medical service and the receiving side of the external effect such as the sense of security, are separated as different entities, but with local residents participating in the development of medical service delivery system of their community and sharing responsibility, including for its finance and management, it becomes possible to develop such a delivery system that is appropriately balanced between burden and benefit, including the establishment or removal of clinical departments. In reality, community medical service delivery systems are developed by many medical service institutions with different ownership entities, and it is not realistic for local residents to participate therein including responsibilities. However, when the number of community medical service institutions is small and their ownership is public, it is important that local residents get involved in management including responsibilities, since they adjust and consider the balance between benefits of the sense of security and the burden to develop a delivery system. Under certain conditions, "solution by negotiation" is also

possible for creating a favorable solution incorporating external effects. Achieving appropriate levels is theoretically possible if local residents fund their community medical service delivery system by negotiating with the provider side, or by having a framework that the provider side compensates residents in the case of closing down or reducing clinical departments from the level they should be at. However, this achievement is accompanied by reservations, which is "the case where no transaction cost occurs". In real negotiations, it will be difficult to grasp the correct information about the level of external effects. And representatives of the community spend lots of time and effort to fulfill their responsibility but its outcome affects other residents, therefore, there'll be a problem of "free riding" creating a "negotiation cost" which would make it difficult to maintain a community's solidarity. Although it is not realistic for residents to claim compensation from medical service institutions since they have no alternative to closing down or reducing departments, there is a possibility that increasing the retirement of baby-boomers, who are willing and capable of helping their communities, may contribute to solving this problem by reducing negotiation cost.

Next, let's think about the public solution to external effects. Application of the "pigovian tax" and "direct regulation" are to be discussed here with regard to the community medical service delivery system. As was shown in Fig. 1, personal marginal benefits and social marginal benefits become separated due to external effects. The solution using a pigovian tax enables a socially favorable level to be achieved by imposing a tax of the amount equivalent to this price difference (subsidy in the case of positive external effect). The evaluation in this report also indicated that the existence of each clinical department in communities has created a positive external effect to local residents. These evaluations were made per one sq. meter of housing, but by multiplying this by the area of housing sites in the community, for example, will make it possible to approximately calculate the benefits of the external effect, which is the aggregate sense of security provided by clinical departments in the community. The objective is to develop a medical service delivery system which satisfies the values of its benefits, which is the sense of security for residents', by subsiding a corresponding amount of money for establishing each clinical department. Direct regulations assume that authorities already know the value of benefits for residents regarding the availability of clinical departments, and that they establish clinical departments corresponding to the values of benefits in terms of their expense, and plan development in a single uniform way. In

this case, when the cost of the establishment by each owner are different and authorities cannot grasp such information completely, it can be pointed out that it may fail to be consistent with the values of benefits, causing a large social damage.

Ⅵ. Conclusion

This report, keeping in mind that re-structuring the underfunded community medical service delivery systems requires appropriate medical investments, explained that the objective and valid evaluation of the community medical service delivery system is necessary in order to realize such needs. Based on this, after gaining a full understanding of the aspects involved, which are "existence values" such as residents' "sense of security" created by the existence of the medical delivery system itself, as positive external effects as defined by economics, the Hedonic Price Method was used and the issues one would face when actually applying this method were discussed based on actual experiences of making estimations. Moreover, by providing actual examples from Kobe-City, it was indicated that the existence of community medical service systems like individual clinical departments have a value of themselves for local residents of a level up to 4 to 5 % of land prices. All of us are aware of such value, but it was hardly explicitly indicated in the past and never reflected in the policies of community medical service. However, if residents' evaluation is numerically expressed in this way, it will become the basis for seeking an appropriate responsibility from communities when re-structuring the community medical service delivery systems that possess aspects of a social common capital. Research on the evaluations of the values which community medical service system creates have just started, and there remain many points to be discussed with regard to their application for actual policies. However, in order to maintain community medical service delivery system and to keep providing a sense of security for residents, it is my conclusion that an approach like this is indispensable.

Technology to Hitotsubashi University on Economic Analysis of Intergenerational Issues.

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　目的：本稿の目的は神戸市を対象に，地域住民が地域医療機関の存在によって感じる安心感などの「外部効果」の価値をヘドニック法によって診療科ごとに明らかにしつつ，その分析上，政策適用上の課題を整理することである．

　方法：公示地価と土地属性，周辺地域の社会インフラの整備状況，周辺の医療提供体制に関わる項目を収集してデータセットを構築した．総サンプル数317のデータセットの基本統計量，相関分析をおこなった後，公示地価を被説明変数，諸特性を説明変数とするヘドニック法による回帰分析を実施し，その係数から診療科別に医療提供体制の価値評価を試みた．またその分析過程で問題となった事項について整理し，現実の政策的な反映に関する方策についても考察した．

　結果：相関分析の結果では，当該地点の地価と近隣に存在する各科診療機関数にはいずれも統計的に有意な正の相関が認められ，当該地価と最寄りの医療機関との距離にも統計的に有意な負の相関関係があった．ヘドニック地価関数の推定では，近隣に医療機関が増加することによる地価増加，或いは最寄りの医療機関までの距離が伸びることによる地価低下が各々確認された．

　結論：地域住民は近隣に医療機関の存在についてその外部効果の価値を認めている．社会的共通資本として地域医療提供体制のあり方を考えるにあたっては，地域に対する外部効果にあたる安心感の価値を評価，勘案し，政策立案に活かす必要があると考えられる．

キーワード：　地域医療提供体制，外部効果，ヘドニック法，社会的共通資本，安心感

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