Consideration of Relation between Characteristic and Price of Land by Hedonic Approach: The Residential Quarter in Shiga Prefecture as a Case Study

Masaaki Tokuda*

Faculty of Economics, Shiga University

1-1-1 Banba, Hikone, Shiga 522-8522, Japan

1. Introduction

In this paper, we quantitatively arranges whether to become important for which factor how can able to catch real estate characteristic in which it has significant influence on price of land by hedonic approach through the observation of spatial distribution of the residential quarter price of land in Shiga Prefecture, and to be able concretely to decide the price difference.

The evaluation of value of the real estate is recorded according to the appraisal of real estate criterion of the Ministry of Land, Infrastructure and Transport (MLIT) as follows.

> The price of real estate is the one formed as a result of the interaction of many factors. Moreover, it has the tendency to which each factor always changes, too.
>
> Therefore, after real estate is appraised, it is necessary to understand the price formation factor from market participant's viewpoint clearly, to analyze the interrelation between the transition, a trend, and various factors enough, and to judge the influence on the above-mentioned three points (utility of real estate, relative scarcity and effectual demand to real estate). [MLIT (2002) p.6, in Japanese]

The overall price formation factor is assumed to incorporate a general factor, a regional factor, and an individual factor. The main one concerning the factor concerning the residential area in these is brought together in Table 1. It is thought that an individual factor has Correlation mutually rather than is independent.

Because it is such a lot of factors, it has the side that the real estate including the residential quarter price of land is a unique generally commodity. That is, the same real estate doesn't exist to have real estate as natural characteristic, reproduction impossibility, Individuality, such as a ground and its dimensional standard, and diversity of the use as cultural

* E-mail: m-tokuda@biwako.shiga-u.ac.jp

features, and it can be said that of each is a commodity in which it differentiates completely.

Table 1 Formation factor of property price

General factor	Regional factor	Individual factor
I Natural factor 1. Geological features and state such as the ground 2. State of soil and soil layer 3. State of topology 4. Geographic position 5. State of weather II Social factor 1. State of population 2. State of family structure and home separation 3. State of city formation and maintenance of communal facilities 4. State of education and social welfare 5. Practice about real estate deal and use earnings 6. State of style of architecture etc. 7. State of progress of informationization 8. State of lifestyle etc. III Economic factor 1. State of savings, consumption, investment, and balance of international payments 2. State of finance and banking 3. State of prices, pay, employment, and enterprise activities 4. State of tax burden 5. State of financial accounting system 6. State of technical improvement and industrial structure 7. State of traffic system 8. State of internationalization IV Administrative factor 1. State of plan and restriction concerning land use 2. State of restriction concerning structure of land and building and disaster preventions, etc. 3. State of action plan concerning housing lot and house 4. State of tax system concerning real estate 5. State of restriction concerning transactions of real estate	I Housing lot region 1. Housing area (1) State of weather in sunshiny, temperature, humidity, and wind direction, etc. (2) Affairs, such as width of a street, and structure (3) Distance with the center of a city and state of transportation facility (4) State of arrangement of commercial establishment (5) States of supply and disposing facilities of upper and lower water service and gas, etc. (6) State of maintenance of communication infrastructure (7) States of arrangement such as communal facilities and public facilities (8) Presence such as dislike facilities in sewage treatment plant etc. (9) Dangerousness where flood and disaster such as landslides occur (10) Level of occurrence of environment disruption, such as corruption of ambient noise and the air, and soil contamination (11) Acreage of division and state of arrangement and use (12) State of street in house, hedge, and street scenery, etc. (13) Qualities of naturalistic environments such as views and spectacles (14) Plan concerning land use and state of restriction 2. Commercial area abbr. 3. Industrial area abbr. II Farmland region abbr. III Woods region abbr.	I Housing area 1. residential quarter (1)Topology, geological features, and the ground, etc. (2) Sunshiny, ventilation, and dry and wet (3) Width, depth, acreage, and shape, etc. (4) Difference in height, relation between corner plot and other touching streets (5) State that is width of touching street and structural, etc. (6) Lineage and continuousness on touching street (7) Distance with transportation facility (8) Degree of approach with commercial establishment (9) Degree of approaches such as communal facilities and public interest facilities (10) Degree of approach with dislike facilities in community plant etc. etc. (11) Surrounding state like adjacent real estate etc. (12) Presence in supply and disposing facilities of upper and lower water service and gas, etc. and difficulties of the use (13) Difficulty of use of communication infrastructure (14) Presence of buried cultural property and underground installation and the states (15) Presence of soil contamination and the state (16) Regulation, Constraint, etc. on public law and private law 2. Commercial zone abbr. 3. Industrial zone abbr. II Agricultural area abbr. III Woods area abbr. IV Expected and transition area abbr.

Extract taken from Fudosan Kantei Hyouka Kijyun (2002) p.6 in Japanese

To quantify it after an importance each factor in Table 1 description is arranged again, hedonic approach is adopted in this paper. It thinks the value of the residential quarter to be synthetic things of "Characteristic" of the region amenity, environmental quality, convenience, and scale, etc. in hedonic approach. In this case, the amount of money conversion based on a common objective characteristic becomes possible from the idea that the residential quarter price of land is decided depending on the level of the characteristic in which a common objective character is shown.

Conceptual, the residential quarter demander selects land where the effect maximization can be attempted under a constant budget constraint

through information analysis that is possible to be observed or cannot observed. On the other hand, when an own profit maximization can be attempted, the residential quarter supplier supplies the residential quarter. It is hedonic approach to assume the equilibrium price approved as such a result[1]. Such an approach is a technique often used to analyze the property market. On the other hand, it is often used as a quality adjustment method such as non-market of infrastructure etc. economic valuations and BOJ, Research and Statistics Department (2007)[2].

2. Previous work and theoretical model in property market analysis that uses hedonic approach

2.1 Earlier study

Hedonic approach is method often used by property-market analysis. Although empirical analysis is already extensively conducted in Japan, thanks to fitting of geography and space data based on GIS[3] (Geographic Information System), or improvement in accessibility, the area used as the object has many things for a metropolitan area.

For example, Shimizu (2004) is estimating condo price function using the expunction day price information (proxy variable of transaction prices) in 1999 in "SYUKAN JYUTAKU JYOHO (weekly housing Information)" on Recruit CO.,LTD. publication. And it is checking that a discontinuous point exists in "actual age" and "distance to nearby station." Moreover, Kutsuzawa (2008) is verifying how much affection a criminal rate of occurrence has on a house prices using CHIKA-KOJI data (2005 year, residential quarter only) in Tokyo 23 wards. And it was shown that there is cost performance which depresses a land price in residential quarter with much burglary and non-burglary. Shimizu and Karato (2007) are examining the estimation result of land price function by CHIKA-KOJI in 2006 (residential quarter) in Tokyo 23 wards using the method of estimating several sorts for having gazed at spatial autocorrelation.

Recently, for the most efficient exploitation of CHIKA-KOJI data that can be used corresponding to flexible function form, the analysis that uses the

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[1] Refer to Shimizu (2004) for a more detailed and economic thesis backgrounds.
[2] In the case of the quality method of preparation, an article will be disassembled into characteristic which constitutes it, and it will think that a price tag is determined by performance, and an equivalent for the quality increase in the old item contrast of new item will be estimated using quantitative method.
[3] It touches as a problem by paragraph 4 conclusion about the view of the GIS use.

refined statistical technology such as nonparametric method and error correction term of spatial autocorrelation nature is done [Shimizu and Karato (2007)].

2.2 Theoretical model of hedonic approach

In advance of the empirical analysis, assuming the implicit market which trades in many characteristic of residential quarter land price, hedonic function as a market equilibrium value curve of demand and supply both sides is drawn along with the argument on Epple (1987).

N dimension vector of the characteristic in which the price of land is formed is assumed to be $\mathbf{z}=(z_1, z_2, \cdots, z_{nz})$. The hedonic price function is assumed to be $p(\mathbf{z})=p(z_1, z_2, \cdots z_{nz})$. Residential quarter demander's utility function is assumed to be $U(\mathbf{z}, x; \boldsymbol{\alpha})$. x is numeraire and $\boldsymbol{\alpha}=(\alpha_1, \alpha_2, \cdots, \alpha_{n\alpha})$ is a vector of a demander person's taste parameter. If a demander's income are expressed with y, a budget constraint type will be set to $y=p(\mathbf{z})+x$. In addition, the joint distribution function is expressed as $F(y, \boldsymbol{\alpha})$. Under budget constraint, if a demander takes utility maximization behavior about $\mathbf{z}$ and x, it will be formulized as follows.

$$\begin{aligned} &\max_{\mathbf{z}} U(\mathbf{z}, x) \\ &\text{s.t.} \quad y=p(\mathbf{z})+x \end{aligned} \tag{1}$$

In this case, the First Order Condition (FOC) for optimization can be expressed with the following formulas.

$$p_{\mathbf{z}}=\frac{U_{\mathbf{z}}(\mathbf{z}, y-p(\mathbf{z}); \boldsymbol{\alpha})}{U_x(\mathbf{z}, y-p(\mathbf{z}); \boldsymbol{\alpha})}=h(\mathbf{z}, y-p(\mathbf{z}); \boldsymbol{\alpha}) \tag{2}$$

$p_{\mathbf{z}}$ is a vector of the first degree differential of hedonic price function here. $U_{\mathbf{z}}, U_x$ expresses the first degree differential of the Characteristic vector and numeraire.

$U(\mathbf{z}, y-\theta)=u$ will be materialized if bid function in case a demander's utility level is u is set to $\theta(\mathbf{z}; u, y)$. The following formula is obtained by differentiating this. Bid function is an increasing concave function.

$$\begin{aligned} &\theta_{z_i}=U_{z_i}/U_x>0 \\ &\theta_{z_i z_i}=\left(U_{z_i}^2 U_{z_i z_i}-2U_{z_i}U_x U_{z_i x}+U_x^2 U_{xx}\right)/U_x^3<0 \end{aligned} \tag{3}$$

Since a demander's utility is maximized in the contact of hedonic function and bid function, the following formulas will be materialized.

$$\begin{aligned}\theta\left(\mathbf{z}^{*};u^{*},y\right)&=p\left(\mathbf{z}^{*}\right)\\ \theta_{\mathbf{z}}\left(\mathbf{z}^{*};u^{*},y\right)&=p_{z}\left(\mathbf{z}^{*}\right)\end{aligned}\tag{4}$$

Hedonic function serves as an envelope curve of bid function in figure.

Next, Behavior of the supply side is formulized. When Supplier opts for his supply behavior, in order to maximize profit π by making a residential-quarter land price given, he determines the bunch $\mathbf{z}=\left(z_1,z_2,\cdots,z_{nz}\right)$ of characteristic.

$$\max_{\mathbf{z},M}\pi=p\left(\mathbf{z}\right)M-C\left(M,\mathbf{z};\boldsymbol{\beta}\right)\tag{5}$$

Here, M expresses the number of the residential quarters to supply[4], and $\boldsymbol{\beta}=\left(\beta_1,\beta_2,\cdots,\beta_{n\beta}\right)$ expresses the parameter vector by which each supplier is characterized. And suppose that it has the distribution function $G\left(\boldsymbol{\beta}\right)$. $C\left(M,\mathbf{z};\boldsymbol{\beta}\right)$ is supplier's cost function. When the short-term economy for which supplier can control M and $\mathbf{z}$ is assumed, FOC for profit optimization is as follows.

$$\begin{aligned}p_{\mathbf{z}}&=C_{\mathbf{z}}\left(M,\mathbf{z};\boldsymbol{\beta}\right)\\ p\left(\mathbf{z}\right)&=C_{M}\left(M,\mathbf{z};\boldsymbol{\beta}\right)\end{aligned}\tag{6}$$

This means that the supply activity is done so that the supplier may equate marginal value of each characteristic and marginal cost of characteristic per residential-quarter 1 unit. Further, it means acting so that the market value of a residential-quarter may become equal to the residential-quarter feed marginal cost of supplier who has given character vectors. In addition, the maximum profit in this case will be dependent on $\boldsymbol{\beta}$.

When offer function is set to $\phi\left(\mathbf{z},\pi\right)$, $\pi=M\phi-C\left(M,\mathbf{z};\boldsymbol{\beta}\right)$ will be materialized. The following formula is obtained by differentiating this.

$$\begin{aligned}\phi_{\mathbf{z}}&=C_{\mathbf{z}}/M>0\\ \phi_{\pi}&=1/M>0\end{aligned}\tag{7}$$

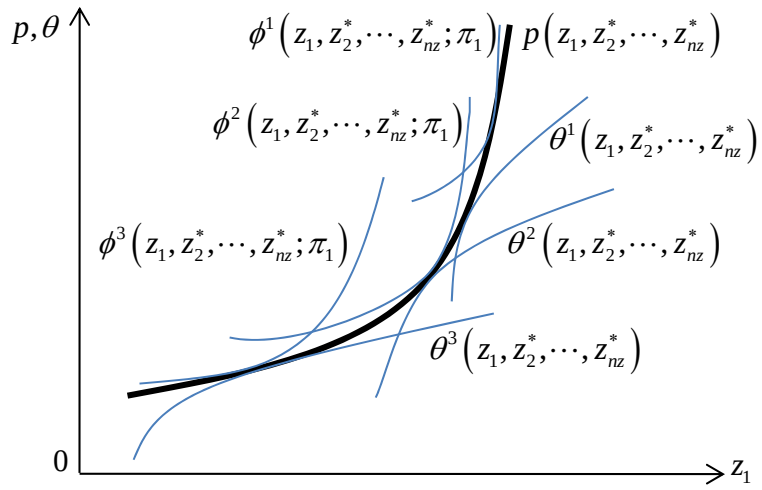
That is, the offer function is an increasing convex function. Market equilibrium serves as an envelope curve of following offer Function.

$$\begin{aligned}p\left(\mathbf{z}^{*}\right)&=\phi\left(\mathbf{z}^{*},\pi^{*}\right)\\ p_{\mathbf{z}}\left(\mathbf{z}^{*}\right)&=\phi_{\mathbf{z}}\left(\mathbf{z}^{*},\pi^{*}\right)\end{aligned}\tag{8}$$

[4] It will be easy to imagine the acreage estate company which does the considerable number owner of the building land of its company hands. It will be called provided that M= 1 which sells off the building land owned individually, of course.

When the demander agrees with supplier's condition, the bid function and the offer function place the hedonic function that the market becomes clear and will touch it. Figure 1 showed this.

Figure 1 Bid function, offer function, and market balance concerning characteristic z_1



Thus, in the hedonic approach, market equilibrium price is determined in the place where the demand and supply to the residential quarter which has characteristic of $\mathbf{z}=\left(z_1,z_2,\cdots,z_{nz}\right)$ agree. That is, hedonic price will be determined depending on $F\left(y,\boldsymbol{\alpha}\right)$ of the buyer, and $G\left(\boldsymbol{\beta}\right)$ of the seller.

However, if neither $F\left(y,\boldsymbol{\alpha}\right)$ nor $G\left(\boldsymbol{\beta}\right)$ is known, generally $p\left(\mathbf{z}\right)$ will be unknown and market equilibrium price will be drawn from the simultaneous estimation of demand and supply. In that case, the matter that consistency is not acquired by simultaneous equation bias, and various matters in the function type are pointed out by Shimizu and Karato (2007).

3. Empirical analysis

3.1 Empirical model of hedonic approach

As the preceding paragraph has examined, hedonic estimation does not assume even the specific Function form on the rationale. In order to secure objectivity as much as possible when choosing the function form in empirical analysis on it, (i) liner type, (ii) full log type, (iii) semi log type, (iv) both-sides Box-Cox type, and (v) one side Box-Cox type are often estimated about all the variable other than dummy variables. Here, (i) - (iii) can be regarded as the special case of a Box-Cox transformation term. By converting original data in various forms, the fit of estimation type becomes

good in many cases.[5] Such improvements occur, when data is converted and data approaches Normal Distribution more. It is especially because a lot of methods that cannot be analyzed that it is not data normally distributed exist in the technique of the statistics such as OLS. General empirical model becomes the following forms.

$$p_{it}^{(\theta)} = \gamma_0 + \sum_{j=1}^{l} \gamma_j z_{ijt}^{(\lambda)} + \sum_{j=l+1}^{n} \gamma_j z_{ijt} + \sum_{k=1}^{T} \delta_k d_{ikt} + u_{it} \qquad (i = 1, 2, \cdots, m)$$

$$p_{it}^{(\theta)} = \begin{cases} \left(p_{it}^{\theta} - 1 \right) / \theta & \theta \neq 0 \\ \ln p_{it} & \theta = 0 \end{cases} \tag{9}$$

$$z_{ijt}^{(\lambda)} = \begin{cases} \left(z_{ijt}^{\lambda} - 1 \right) / \lambda & \lambda \neq 0 \\ \ln \lambda_{ijt} & \lambda = 0 \end{cases}$$

Here, z_{ijt}, d_{ikt}, u_{it} shows the j-th characteristic of the residential quarter of the i-th point of t time, the time dummy of the k-th term, and an error term, respectively. It was from j=1 to l to perform Box-Cox transformation, and since l+1 to n was a qualitative dummy, it did not transform.

About the thing showing qualitative Characteristic, it will correspond with a dummy variable. Each variable of model is called hedonic variable and measures differences in price of appraisement point across boundaries, i.e., important differences in residential-quarter market. The impact of value of each hedonic variable will be determined under the affection which it has on the market equilibrium price per hedonic variable 1 unit. In adoption of an explanatory variable, what a sign condition does not suit from various specific values including a dummy variable, and the method of excepting a not significant thing one by one statistically are used together.

In addition, about u_{it}, some consideration is required. It is because it will be said that OLS based on the data is not what not necessarily means the minimum value of either residual term across boundaries purely or time residual term purely if it is a certain database by which the stated period backlog was carried out. However, probably, a time residual may think that the weight which poses a matter is small, since the data treated in this paper is appraisement data of CHIKA-KOJI and CHIKA-CHOSA (the former is at Jan. 1 and the latter is at the time of Jul. 1).

For analyzing all the patterns of (i) to (v) comprehensively, width of paper is insufficient. Moreover, since it has the advantage that usual OLS with

[5] Geltner and Miller (2001) ch.23.

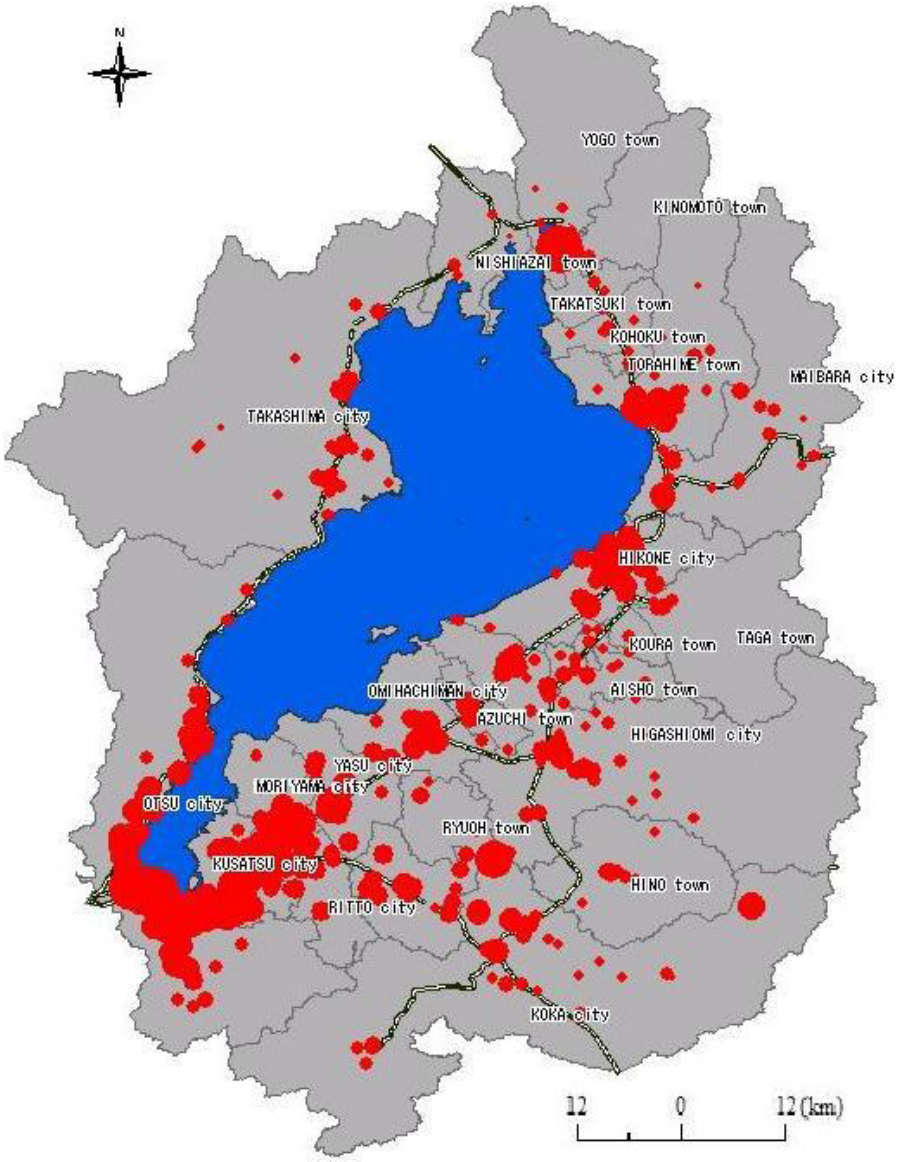
the easy function transformation can be used, after preparing five estimation models, the analysis using CHIKA-CHOSA data in Shiga Prefecture is conducted about the function form of (i), (ii), and (iii) , in the following paragraph.

3.2 Estimate of hedonic function by Shiga Prefecture residential quarter price of land data

The hedonic function that uses the price of land data in Shiga Prefecture residential quarter is estimated in this section. The data is the CHIKA-CHOSA data at the time of, July 1, 2009 acquired from Information of Land Synthesis system.[6] Figure 2 shows the investigation spot and the price of land distribution in Shiga prefecture. It is shown that the price of land per square meter is evaluated high by the point (round dot) big. To be easily imaginable, the part where the price of land is high is Otsu City that is the prefectural capital and Kusatsu City advanced by urbanization. Also in the Biwako Line (JR West) excellent in respect of the traffic volume, Hikone and Omihachiman which connect with Ohmi Railway at the station which Special Rapid Service stops have also received high Assessment. Moreover, in the area where it is a nearby station except JR, Yokaichi (in Higashiomi City) is comparatively high. It is the area too positioned as a terminal station of two or more lanes.

[6] Information of Land Synthesis system (http://www.land.mlit.go.jp/webland/)

Figure 2 Investigation spot (CHIKA-CHOSA) in Shiga prefecture and distribution of land price



(Source) Information of Land Synthesis system

The descriptive statistics of each data is shown in Table 2. About acreage, when the national Mean housing gross floor space was 140 sq m with Japan Federation of Housing Organizations given in report and appointment building coverage is made into 62.612% of Shiga data Mean, the acreage counted backward becomes 223.6 sq m. It can be said that 220 square meters of the median in the Shiga Prefecture survey are appropriate areas. That is, it is thought that the mean nature is secured for the point selection of CHIKA-CHOSA. Judging from skewness, a right skirt is long distribution

to any data. The outlier is looked in acreage, distance from the closest station, and specified floor-area ratio.

As well, in the meaning that the city block and the picture ground do in an orderly manner and it is easy to form an excellent neighbor environment because vegetation, the view, and the spectacle, etc. are excellent, the points where 60% or less of building coverage ratio and 100% or less of building floor ratio, and also width of frontal road fill 6m or more were 17 points (6.6%).

Table 2　Descriptive statistics of CHIKA-CHOSA data (Shiga Prefecture, Year 2009)

Variable	Mean	median	Maximum	Minimum	Std. Dev.	skewness	kurtosis
PLP: Residential quarter price(yen/m²)	48434.1	35650	136000	6200	32695.6	0.676	2.340
AC1: Acreage(m²)	293.703	220	1069	77	177.91	1.596	5.709
DS1: Distance from closest station(m)	2751.41	1800	15000	100	2617.79	1.928	7.166
BC1: Specified building coverage(%)	62.612	60	70	50	5.912	-0.143	2.475
FR1: Specified floor-area ratio(%)	189.347	200	300	80	36.992	-1.968	7.635
WIDTH: Width of frontal road(m)	5.557	6	12	2.5	1.446	0.462	4.515
DIST: Distance to Otsu Station(km)	38.850	39.45	93.9	0.8	23.482	0.332	2.149

Lifeline	GAF: Laid down rate of city gas		44.9%
	SEF: Laid down rate of sewerage		94.9%
CHOKU: Rate of non-urbanization area			23.0%
BIWAKO: Rate whose closest station is Biwako Line[7]			44.5%
RAPID: Rate whose closest station is station[8] of Special Rapid Service (Author calculation)			25.0%
Azimuth of road putting	N	:Ratio of north	9.8%
	N_E:	Ratio of northeast	13.3%
	E:	Ratio of east	11.7%
	E_S:	Ratio of southeast	12.5%
	S:	Ratio of south	8.2%
	S_W:	Ratio of southwest	19.1%
	W:	Ratio of west	13.7%
	N_W:	Ratio of northwest	11.7%
Kind of road	ROAD_CITY:	Ratio of city road	68.8%
	ROAD_PREF:	Ratio of prefectural road	8.6%
	ROAD_N:	Ratio of national road	0.4%
	ROAD_PRI:	Ratio of private road	5.1%
	ROAD_O:	Ratio of other road	17.2%

Note: sample number 256

(Source) Information of Land Synthesis system

Table 3 is the correlation coefficient table of the quantitive variable that can be extracted from CHIKA-CHOSA data in Shiga Prefecture. As long as this is seen, it seems that the thing in exceptionally strong correlation is not found about the Usage data, and there is no apprehension about

[7] Biwako Line is a nickname. The section of Maibara station to Kyoto station in the Tokaido Honsen line West Japan Railway (JR West) has jurisdiction, and the section of Maibara station to Nagahama station in Hokuriku Honsen line the company has jurisdiction are put.

[8] The stop stations of the Special Rapid Service train used as the object in estimation are ten stations (Maibara, Hikone, Notogawa, Omihachiman, Yasu, Moriyama, Kusatsu, Ishiyama, Otsu, Yamashina).

multicollinearity. Since quantitative data and qualitative data were contained in CHIKA-CHOSA data, in estimation, it distinguished to quantitative variable and a dummy variable suitably like Table 4.

Table 3 Correlation coefficient of data group (CHIKA-CHOSA in Shiga Prefecture)

	AC1	DS1	BC1	FR1	WIDTH	DIST
AC1	1	0.19	0.41	0.069	-0.26	0.458
DS1	0.19	1	0.13	-0.11	0.03	0.032
BC1	0.41		1	0.46	-0.24	0.42
FR1	0.07			1	-0.13	0.05
WIDTH	-0.26				1	-0.20
DIST	0.46					1

Table 4 Variable used to estimate

		Variable	Contents
Explained variable		PLP: Residential quarter price(yen/m2)	National land survey(CHIKA-CHOSA)[Residential quarter limitation] ※Transaction prices[Raw land for residence limitation]
Explanatory variable	Quantitive variable	AC: Acreage (m²)	Acreage of a land piece
		DS: Distance from closest station (m)	Distance from residential quarter to closest station
		BC: Specified building coverage (%)	The maximum value of ratio of permissible building area to residential quarter area
		FR: Specified floor-area ratio (%)	The maximum value of ratio of permissible total floor area to residential quarter area
		WIDTH: Width of frontal road (m)	Width of road that residential quarter faces
		DIST: Distance to Otsu Station (km)	DS + Route distance to Otsu Station
	Dummy variable	GAF・SEF: City gas and sewerage unlaid dummy	It is 1 if not laid down, and 0 if laid down.
		CHOKU: coordination area dummy	It is 1 if the quarter is in the coordination area, and 0 if not so.
		※FR_100: Superior living environment dummy	It is 1 which is the specified building coverage of 60% or less, and the floor-area ratio of 100% or less, and 0 if not so.
		※SHAPE: irregular shape dummy	It is 1 if the land shape is an irregular shape, and 0 if not so.
		BIWAKO: Biwako Line dummy	It is 1 if closest station is in Biwako Line (JR West Japan), and 0 if not so.
		RAPID: Special Rapid Service dummy	It is 1 if closest station is Biwako Line and the station is a stop station of Special Rapid Service.
		N, N_E, E, S_E, S, S_W, W: Road putting azimuth dummy	The road putting is divided into eight azimuths, and it makes it to the dummy variable. (north, northeast, east, southeast, south, southwest, and west)
		ROAD_i (i=CITY, PREF, N, PRI): Road kind dummy	The frontal road is divided into city road, prefectural road, national road, and private road, and it makes it to the dummy variable.

Table 5 Estimate result in CHIKA-CHOSA data set (2009)

Explained variable: PLP, samples 256

	Explanatory variable	Linear type all variable use			Linear type (one by one exclusion method)			Full log type			Semi log I type			Semi log II type		
		coefficient	t value		coefficient	t value		coefficient	t value		coefficient	t value		coefficient	t value	
	(Constant)	85061.190	6.110	***	69302.420	11.447	***	18.411	19.052	***	185367.800	9.433	***	12.346	55.286	***
Quantitive	AC	-13.518	-1.894	*	-16.031	-2.435	**	-0.368	-8.678	***	-11801.470	-5.931	***	-0.001	-5.876	***
	DS	-2.725	-6.197	***	-2.766	-6.611	***	-0.115	-5.643	***	-5925.583	-6.077	***	0.000	-7.435	***
	BC	-366.434	-1.338					-1.320	-4.209	***				-0.025	-5.288	***
	FR	98.656	3.078	***	75.130	3.224	***	0.214	2.453	**	5311.705	1.851	*	0.002	4.101	***
	WIDTH	1152.920	1.686	*	1011.953	1.645		0.143	2.298	**	6045.481	2.054	**	0.034	2.806	***
	DIST	-574.557	-11.728	***	-596.000	-13.017	***	-0.269	-11.242	***	-18191.760	-16.058	***	-0.011	-12.518	***
Dummy	GAF	-15901.340	-6.120	***	-17000.860	-7.153	***	-0.195	-4.113	***	-12056.860	-5.488	***	-0.287	-6.453	***
	SEF	-5795.398	-1.425													
	CHOKU	-17972.570	-6.246	***	-19550.420	-7.895	***	-0.212	-4.192	***	-15214.540	-6.987	***	-0.241	-4.771	***
	BIWAKO	20231.450	8.362	***	20754.900	8.878	***	0.307	8.248	***	17558.430	8.305	***	0.328	9.079	***
	RAPID	-6041.672	-2.315	**	-6925.265	-2.775	***				-4207.676	-1.921	*			
	N	-1703.591	-0.454													
	N_E	-4182.291	-1.227													
	E	306.213	0.086													
	S_E	-2972.513	-0.854													
	S	-771.784	-0.196					-0.095	-1.669	*						
	S_W	-4927.834	-1.571					-0.104	-2.642	***				-0.098	-2.548	***
	W	-1928.508	-0.533					-0.136	-2.730	***						
	ROAD_CITY	2448.501	0.896					0.155	3.5988	***						
	ROAD_PREF	2229.969	0.545											-0.116	-1.785	*
	ROAD_N	-555.328	-0.039													
	ROAD_PRI	3454.163	0.758					0.219	2.74042	***						
	Adjusted R^2	0.840			0.842			0.891			0.875			0.892		
	Log ikelihood	-2655.924			-2661.240			13.064			-2632.578			12.227		
	AIC	21.869			21.806			0.016			21.572			-0.002		
	SBIC	22.197			21.949			0.230			21.715			0.170		

(Note 1) ***(**)[*]denotes rejection of the hypothesis at 1%(5%)[10%].
(Note 2) Semi log I type has logarithm-ized only the quantitative explanatory variable, and Semi log II type has logarithm-ized only the explained variable.
(Note 3) Adjusted R^2 is an adjusted coefficient of determination, AIC and SBIC express Akaike's information criteria and Schwartz's Bayesian Information Criteria, respectively.

3.3 Estimate result

256 points were targeted in estimation. A use district is a point of a residential quarter among all the 390 points in Shiga Prefecture in 2009 CHIKA-CHOSA data (at the time of 7/1). The land price per sq m was made into the explained variable, and Variable (16 is a dummy among them) of 22 was performed as the explanatory variable. All data except DIST were acquired from Information of Land Synthesis system of MLIT. The five estimate results of containing the linear and the log type are published in Table 5. In the semi log I type, only the quantitative explanatory variable was logarithmic and the semi log II type has logarithmic only the explained variable. Below, the result about the liner type which uses the entire variable which may probably be considered to be basic models is mainly described.

According to the adjusted coefficient of determination (a table Adjusted R2), all estimation types achieve explanatory power of 80 to 90%, and it can be said that the overall result is valid.

AC: Acreage

A coefficient is -13.52 and is significant with the 10% level. It is understood to receive the evaluation discounted in land where the acreage is big, and to become a discount of 13.5 yen per sq m. Considering constructing a lifeline like electricity, gas, and water and sewage to a piece,

it can be said that it is the result of expecting dimensions because it leads to the reduction in the unit cost by the scale big.

DS: Distance from closest station

The coefficient is -2.73 and is significant at the 1% level. As expected, the price of land falls because the convenience of public traffic worsens by leaving from the station. As for the point drop, 2.73 yen per m on the average was shown. For example, if block acreage shall be 220 sq m of a data median, in case the space from a station will be 1m away, it is equivalent to a land price falling 601 yen.[9]

BC: Specified building coverage (%), FR: Specified floor-area ratio (%)

A significant coefficient was not obtained about the building coverage. Since it was expected that sunshine condition and greening rate were improved so that building coverage and floor-area ratio were low, the negative effect was expected, but a coefficient is not significant with the 10% average of what is minus, either. It is likely to have been counterbalanced to the effect of the plus in the meaning of effective use of the area of land. In addition, a result which became negative significantly and was expected was brought in the full log type and the semi log II type. On the other hand, about floor-area ratio, the coefficient is 98.66, and it became significant with the level 1%. It is shown that quotation becomes big-ticket, so that regulation of floor-area ratio is eased.

WIDTH: Width of frontal road

The coefficient is 1152.92 and it is significant in 10% level. Incomings and outgoings of the vehicles to a garage become easy, so that front width of street is wide. Moreover, it can be said that this result is appropriate because it is advantageous in respect of the lighting. By less than 4m, it is also considered as cause that the necessity for a setback must be taken into consideration in the future. For example, a 1799 yen difference will arise on the average per square meter compared with 5.56 meters of all point average (From Table 2) to 4 meters that are the set back boundary values. In addition, when width of street is too wide, the amount of passes of

[9] It is hard to assume that this variable has a simple alignment relation to a land price experientially. With a space belt which will go into the bus area if it separates from a station too much, probably, nonlinearity should be taken into consideration as a issue, since capability that a land price gradient will fluctuate is high. With Shimizu(2004) of Chapter 7, in order to estimate value function of used condo, after using constant term dummy and coefficient dummy and assuming two break cross sections, exploration analysis is conducted.

vehicles increases as an arterial road, and there may also be an angle of being subtracted in respect of living environment. However, when this residential quarter is targeted, it is thought that the weight of such a viewpoint is low.

DIST: Distance to Otsu Station

It is the variable which added the lane distance from there to the Otsu station to the distance from a sample point to the nearby station. It is thought the proxy variable of the accessibility to the center of the prefecture. The coefficient is -574.56 and it is significant in 1% level. In case the distance to the Otsu station separated 1km, it was shown that an average of 575 yen per sq m fall. Incidentally, it is from the following cause to have chosen not time but the space. That is, when considering the switching time in the case of using two or more lanes, and the passage dead time of Special Rapid Service in case of time, depending on departure time, it will change sharply. It is for avoiding such inconvenience.

GAF: City gas unlaid down dummy

It is about 45% in the point for the estimate that equips the gas supply facilities. The coefficient was -15901 and 1% level kept significant. For land where the gas that is one of the lifelines is supplied to receive the high appraisal is to be expected. As for unfinished ground, it was shown that 15901 yen evaluation was low on average square meter by this estimate. For example, when acreage is 220 sq m of a total point median it turns out that the land price difference of gas accommodation land and non-accommodation land amounts to 3,500,000 yen.[10]

SEF: Sewerage unlaid down dummy

It is expected that the non-accommodation land point of a sewage work receives low assessment compared with the improved point. Significance was not acquired although the coefficient was minus.

CHOKU: Coordination area dummy

The coefficient is -17973 and it is significant in 1% level. The price of land in the non-urbanization area has lowered for 17973 yen on the average per sq m compared with the price of land not so. This becomes the difference of 3.95 million yen when thinking about the acreage by 220 sq m of the median. In non-urbanization area building cannot be built newly, and a building cannot be extended. In addition, when land is bought, the borrowing in the

[10] The skirt of land price distribution was long on the right. In the arithmetic average, since it was pulled by some large-scale groundplots, it thought with the median. In addition, in an arithmetic average, it is 294sq m (Table 2).

financial institution is difficult. It is thought that these reasons become differences and it appears.

BIWAKO：Biwako Line (JR West Japan) dummy

There are nine railway routes where Tokaido Shinkansen is excluded in Shiga Prefecture.[11] It can be considered that the point whose Biwako Line which has many numbers of passengers and numbers of services overwhelmingly is a nearby station has big advantage by the convenience of rail availment. The result was as expected, the coefficient was 20231, and it was significant with the 1% level. The land price of the Biwako Line availment area is Assessment high an average of 20231 yen per square meter compared with the area which is not so. It becomes the difference of 4.45 million yen in the case to assume the acreage to be 220 sq m of the median.

RAPID: Special Rapid Service dummy

On the Biwako Line, Special Rapid Service makes it easy to access the Shiga prefecture's main region and the large cities Kyoto, Osaka, and Kobe. Besides enjoying the convenience of the Biwako Line, a community near a Special Rapid Service station has a further advantage that is reflected in land prices. However, the coefficient was minus and significant at the 5% level in the estimate. Although accounting for this result is difficult, it is not significant in a full log type and a semi log II type.

N, N_E, E, S_E, S, S_W, W: Road putting azimuth dummy

From an angle of sunshine, the accretion of a land price is expected, so that road attachment is close to south. The result in which any point is significant was not obtained though the azimuth dummy was prepared in this estimate after the direction was divided into eight. It was the same, and any type did not become significant though this result divided into four (north, south, east, and west) or divided the azimuth into two (south the north). It will be because unlike the big city that is overcrowded of the house the amount of sunshine is secured though road attachment is which direction.

ROAD_CITY, ROAD_PREF, ROAD_N, ROAD_PRI: Road kind dummy

Although the class of front road was divided into city road, prefectural road, national road, private road, and other (town roads, etc.) and the appropriate dummy was prepared, no significant result was obtained. As

[11] Nine lanes are as follows. They are Biwako Line, Kosei Line, Hokuriku Line, Kusatsu Line (above JR West), Ohmi Railway 3 line (the main line, Taga Line, and Yokaichi Line), Keihan rail Ishiyama Sakamoto Line, and Shigaraki Kogen Railway.

well, with the full log type, in the city road and the private road, it became significant by positive, and the thing with the coefficient of private road bigger moreover was shown. Considering abatement documentation cost in the case of being private road burden and positional specified type, this result is difficult to interpret.

3.4 Additional analysis

3.4.1 Comparison with other appraisement data

Although the preceding section has been analyzed about the estimation result of having used CHIKA-CHOSA data in 2009, CHIKA-KOJI data also exists as similar appraisement data.[12] Then, as additional Analysis, estimation model of five types will be verified in 2008 using CHIKA-CHOSA set and CHIKA-KOJI data set in 2009 and 2008, respectively.

Descriptive statistics in each data set is shown in Table 6. Recession from October, 2007 is reflected, and the price of land average in 2009 has fallen since the previous year.[13] Percent decrease was 1.38% in CHIKA-CHOSA and -1.40% in CHIKA-KOJI.

[12] The difference between CHIKA-KOJI and CHIKA-CHOSA is investigation point, at the time of evaluation (CHIKA-KOJI is at Jan. 1 of every year and CHIKA-CHOSA is at the time of Jul. 1 of every year), and law grounds and implementing agency. However, it will be regarded as the substantial almost same land valuation system. In addition, refer to "SHIGAKEN no CHIKA no GAIYO ni Tuite(the brief of the land price in Shiga Prefecture)" as what was summarized intelligibly. （http://www.pref.shiga.jp/c/tochitai/chika/chika_index.html）

[13] It is based on the provisional value that the Working Group of Indexes of Business Conditions of Cabinet Office announced.

Table 6 Descriptive statistics of CHIKA-CHOSA data and CHIKA-KOJI data(Year 2009 and 2008)

	Variable	PLP: Residential quarter price (yen/㎡)	AC1: Acreage (㎡)	DS1: Distance from closest station (m)	BC1: Specified building coverage (%)	FR1: Specified floor-area ratio (%)	WIDTH: Width of frontal road (m)	DIST: Distance to Otsu Station (㎞)
CHIKA-CHOSA	*Year 2009*							
	Average	*48434.10*	*293.70*	*2751.41*	*62.61*	*189.35*	*5.56*	*38.85*
	median	*35650*	*220*	*1800*	*60*	*200*	*6*	*39.45*
	Maximum	*136000*	*1069*	*15000*	*70*	*300*	*12*	*93.9*
	Minimum	*6200*	*77*	*100*	*50*	*80*	*2.5*	*0.8*
	SD	*32695.56*	*177.91*	*2617.79*	*5.91*	*36.99*	*1.45*	*23.48*
	Year 2008							
	Average	49109.84	292.65	2769.77	62.53	188.86	5.53	39.10
	median	36350	222	1850	60	200	6.00	40
	Maximum	138000	1069	15000	70	300	12	94
	Minimum	6300	77	100	50	80	3	0.80
	SD	33042.22	177.32	2611.86	5.95	37.64	1.45	23.55
CHIKA-KOJI	Year 2009							
	Average	51957.43	289.52	2310.08	62.66	195.24	5.45	35.46
	median	47000	221	1600	60	200	5.80	34
	Maximum	157000	1170	10700	80	600	10	93
	Minimum	9800	104	80	40	60	2	0.45
	SD	32912.32	167.04	2030.82	5.42	37.63	1.46	21.90
	Year 2008							
	Average	52694.39	286.04	2274.47	62.60	195.35	5.43	35.62
	median	47500	217	1600	60	200	5.70	34
	Maximum	158000	886	10700	80	600	10	93
	Minimum	9870	104	80	40	60	2	0.45
	SD	33142.86	159.20	2021.79	5.37	37.19	1.46	22.01

(Source) INFORMATION OF LAND SYNTHESIS SYSTEM

(Note 1) CHIKA-KOJI is an appraised price at the time of 1/1 of every year, and CHIKA-CHOSA is at the time of 7/1 of every year. In a sense, these data can be caught during half a year with the time series data.

(Note 2) CHIKA-KOJI and CHIKA-CHOSA extract only the data of the residential quarter. The number of samples of CHIKA-CHOSA of 2009 years is 256, and CHIKA-KOJI is 249. The number of samples of CHIKA-CHOSA of 2008 years is 256 and CHIKA-KOJI is 255.

(Note 3) CHIKA-KOJI in 2009 is published from Table 2 again(italic type).

Next, according to Table 5 each of the estimation result using the data set of CHIKA-CHOSA in 2008 and CHIKA-KOJI in 2008 and 2009 is shown in Table 7.

Table 7 Estimate result in CHIKA-CHOSA (2008) and CHIKA-KOJI (2009 and 2008) data set

Dataset: CHIKA-CYOSA(2008), Explained variable: PLP, samples 256

	Explanatory variable	Linear type all variable use			Linear type (one by one exclusion method)			Full log type			Semi log I type			Semi log II type		
		coefficient	t value		coefficient	t value		coefficient	t value		coefficient	t value		coefficient	t value	
	(Constant)	91096.730	6.393	***	91195.790	7.417	***	18.678	19.276	***	210265.800	17.951	***	12.192	51.270	***
Quantitive	AC	-14.081	-1.908	*	-14.336	-2.059	**	-0.365	-8.532	***	-11367.230	-5.940	***	-0.001	-6.339	***
	DS	-2.791	-6.126	***	-2.734	-6.285	***	-0.116	-5.637	***	-5699.865	-6.083	***	0.000	-7.584	***
	BC	-433.329	-1.531		-443.310	-1.680	*	-1.419	-4.485	***				-0.023	-4.880	***
	FR	99.788	3.033	***	107.404	3.372	***	0.238	2.735	***				0.002	3.809	***
	WIDTH	1183.472	1.680	*	1213.710	1.894	*	0.150	2.431	**	6677.957	2.250	**	0.032	2.802	***
	DIST	-579.413	-11.384	***	-599.796	-12.422	***	-0.268	-11.089	***	-18454.760	-15.611	***	-0.010	-12.273	***
Dummy	GAF	-16209.930	-6.121	***	-16973.530	-6.874	***	-0.206	-4.376	***	-12528.100	-5.606	***	-0.265	-5.976	***
	SEF	-3895.816	-0.956													
	CHOKU	-17995.000	-6.025	***	-17996.360	-6.287	***	-0.208	-4.078	***	-13981.200	-6.640	***	-0.259	-5.140	***
	BIWAKO	19417.450	7.559	***	19194.440	7.685	***	0.306	8.120	***	17048.630	7.631	***	0.312	8.638	***
	RAPID	-5420.346	-1.951	*	-5668.303	-2.128	**				-3982.045	-1.694	*			
	N	-2372.560	-0.605													
	N_E	-5834.218	-1.640													
	E	-1398.553	-0.380													
	S_E	-3262.080	-0.890													
	S	-1392.558	-0.346													
	S_W	-6206.783	-1.882	*	-3714.710	-1.700	*	-0.097	-2.425	**				-0.098	-2.565	**
	W	-3213.083	-0.870					-0.114	-2.365	**						
	ROAD_CITY	2924.205	1.039					0.157	3.614	***				0.144	3.381	***
	ROAD_PREF	2942.373	0.697													
	ROAD_N	-2128.395	-0.145													
	ROAD_PRI	6574.843	1.442					0.253	3.26087	***				0.216	2.88271	***
	Adjusted R^2	0.833			0.836			0.889			0.867			0.894		
	Log ikelihood	-2664.185			-2667.631			10.112			-2764.168			15.352		
	AIC	21.936			21.875			0.032			21.665			-0.019		
	SBIC	22.265			22.046			0.232			21.790			0.167		

Dataset: CHIKA-KOJI(2009), Explained variable: PLP, samples 249

	Explanatory variable	Linear type all variable use			Linear type (one by one exclusion method)			Full log type			Semi log I type			Semi log II type		
		coefficient	t value		coefficient	t value		coefficient	t value		coefficient	t value		coefficient	t value	
	(Constant)	66191.090	3.977	***	77473.360	15.706	***	18.106	17.931	***	240464.300	4.386	***	11.709	45.482	***
Quantitive	AC	-18.245	-2.450	**	-17.391	-2.411	**	-0.265	-6.222	***	-9735.794	-4.209	***	-0.001	-5.120	***
	DS	-3.370	-6.478	***	-3.176	-6.392	***	-0.148	-7.609	***	-7137.797	-6.745	***	0.000	-8.365	***
	BC	-74.681	-0.257					-1.173	-4.943	***	-13066.000	-1.014		-0.013	-3.251	***
	FR	44.240	1.409													
	WIDTH	2315.338	3.193	***	1927.349	2.844	***	0.270	4.574	***	12027.020	3.756	***	0.048	4.256	***
	DIST	-577.802	-9.547	***	-594.625	-10.868	***	-0.206	-9.338	***	-15250.840	-12.707	***	-0.010	-10.257	***
Dummy	GAF	-12690.650	-4.619	***	-13008.870	-4.972	***	-0.226	-4.982	***	-9977.882	-4.051	***	-0.241	-5.552	***
	SEF	-5700.201	-0.968													
	CHOKU	-21127.080	-6.746	***	-21432.140	-8.483	***	-0.299	-6.292	***	-16451.220	-6.386	***	-0.402	-8.417	***
	BIWAKO	14501.670	5.828	***	13796.550	5.637	***	0.298	7.326	***	12959.900	5.869	***	0.306	7.652	***
	RAPID	3145.536	1.195		4532.190	1.794	*	0.095	2.245	**	3389.809	1.475		0.095	2.297	**
	N	5004.908	1.038													
	N_E	2425.875	0.645													
	E	-368.170	-0.085													
	S_E	1692.655	0.445													
	S	5454.167	1.410													
	S_W	2135.676	0.572													
	W	5206.167	1.286													
	ROAD_CITY	3131.846	0.952					0.189	4.040	***	3448.115	1.361		0.186	3.995	***
	ROAD_PREF	-2570.904	-0.470													
	ROAD_PRI	8011.613	1.379					0.362	4.060	***	9035.579	1.864	*	0.342	3.893	***
	Adjusted R^2	0.802			0.799			0.879			0.838			0.882		
	Log ikelihood	-2719.041			-2739.168			4.446			-2699.299			7.946		
	AIC	22.105			22.074			0.061			21.865			0.033		
	SBIC	22.417			22.201			0.231			22.035			0.203		

Dataset: CHIKA-KOJI(2008), Explained variable: PLP, samples 255

	Explanatory variable	Linear type all variable use			Linear type (one by one exclusion method)			Full log type			Semi log I type			Semi log II type		
		coefficient	t value		coefficient	t value		coefficient	t value		coefficient	t value		coefficient	t value	
	(Constant)	119553.500	7.549	***	123860.800	8.804	***	21.022	22.718	***	396523.300	7.892	***	12.769	52.528	***
Quantitive	AC	-24.019	-2.880	***	-23.596	-2.929	***	-0.253	-5.776	***	-10301.300	-4.293	***	-0.001	-5.063	***
	DS	-3.636	-6.501	***	-3.556	-6.573	***	-0.152	-7.484	***	-8021.756	-7.457	***	0.000	-8.138	***
	BC	-1157.453	-4.325	***	-1123.835	-4.476	***	-2.276	-8.511	***	-48277.330	-3.970	***	-0.038	-9.175	***
	FR	108.994	3.335	***	104.497	3.317	***	0.294	2.996	***				0.002	4.534	***
	WIDTH	2725.837	3.505	***	2388.421	3.324	***	0.289	4.718	***	13430.850	4.001	***	0.052	4.362	***
	DIST	-490.602	-7.643	***	-484.736	-8.339	***	-0.193	-8.290	***	-15225.450	-12.168	***	-0.008	-7.834	***
Dummy	GAF	-16034.770	-5.479	***	-17478.000	-6.236	***	-0.294	-6.195	***	-13727.380	-5.308	***	-0.307	-6.610	***
	SEF	-10759.810	-2.163	**	-11593.570	-2.452	**				-9310.517	-2.185	**			
	CHOKU	2725.144	0.497													
	BIWAKO	14471.410	4.953	***	13927.900	6.246	***	0.317	8.544	***	13328.690	6.573	***	0.317	8.624	***
	RAPID	-1190.907	-0.366													
	N	2597.710	0.508													
	N_E	3524.451	0.869													
	E	-728.391	-0.157													
	S_E	2072.411	0.506													
	S	5174.897	1.263													
	S_W	940.977	0.237													
	W	3964.898	0.934													
	ROAD_CITY	1837.308	0.536					0.181	3.793	***				0.172	3.522	***
	ROAD_PREF	-6537.103	-1.159													
	ROAD_PRI	9708.989	1.589		8953.796	1.770	*	0.375	4.146	***	10614.460	2.331	**	0.340	3.730	***
	Adjusted R^2	0.768			0.773			0.868			0.816			0.860		
	Log ikelihood	-2807.060			-2810.333			-11.567			-2783.962			-13.797		
	AIC	22.276			22.215			0.178			22.000			0.195		
	SBIC	22.582			22.368			0.331			22.139			0.348		

(Note 1) ***(**)[*]denotes rejection of the hypothesis at 1%(5%)[10%].
(Note 2) Semi log I type has logarithm-ized only the quantitative explanatory variable, and Semi log II type has logarithm-ized only the explained variable.
(Note 3) Adjusted R^2 is an adjusted coefficient of determination, AIC and SBIC express Akaike's information criteria and Schwartz's Bayesian Information Criteria, respectively.

It is shown that the adjusted coefficient of determination is about 0.8 to 0.9 by any estimation type; thus, the data fit is good. When the estimation pattern of each year of CHIKA-KOJI and CHIKA-CHOSA was compared and AIC and SBIC estimate, the semi log I type is excellent in the type whose explained variable is original number. On the other hand, the semi log II type is excellent in that in which the explained variable is logarithmic except that the full log type will be supported by the data set of CHIKA-KOJI in 2008. [14]

Next, the estimation result of CHIKA-CHOSA in 2009 at Table 5 and in 2008 is compared by the linear all variable use model as well as section 3.3. About quantitative Variable, while, as for AC1, DS1, and DIST, the coefficient became large, FR1 and WIDTH became small. In the dummy variable, the coefficient of GAF, CHOKU, and BIWAKO became large, and RAPID became small. The weight about acreage, distance from closest station, floor-area ratio, distance to prefecture center, width of street, gas construction, and coordination area is falling. On the other hand, the weight about Biwako Line and Special Rapid Service is high. This result was almost the same also in the parallelism for 08 years and 09 years of CHIKA-KOJI, (weight became high conversely only the space to a prefectural core).

The quantitative explanatory variable which became significant by all model including each year of CHIKA-CHOSA and CHIKA-KOJI was three, acreage, distance from closest station, and distance to the Otsu station. About width of frontal road, it became significant at all except one estimation result. In the dummy variable, two, gas construction dummy and Biwako Line dummy, became significant at all the estimation model, and the coordination area dummy became significant at all except the estimation which used CHIKA-KOJI data set in 2008. As well, although it became significant by positive by many estimation models about the private road dummy, the construction is difficult in why assessment of private road is high.

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[14] As derivative Analysis, the point where 60% or less of building coverage and 100% or less of floor-area ratio are filled was defined as a superior living environment dummy, and was estimated. The estimation using CHIKA-CHOSA data set (2009 and 2008) became significant by minus. On the other hand, in CHIKA-KOJI data set (2009 and 2008), it did not become significant. In addition, after unifying the data in 2009 and 2008, estimation which added of the time dummy or the cross term that time dummy times quantitative explanatory variable was also performed, but the significant result was not obtained.

3.4.2 Estimate that uses transaction price data

Appraisement data is the amount appraised by an appraiser literally, and is not the quotation actually dealt in the market. It is describing as follows at the guideline by the Ministry of Land, Infrastructure and Transport. Namely, it is describing "It is very difficult for ordinary persons to find out the proper price of estate."[MLIT (2002) p.2], moreover, "(Appraisement work) will not be a possible affair without skilled expert."[MLIT (2002) p.3] Then, estimation using actual marketing data is performed as the last additional Analysis, and it compares with the result to the preceding sections. Data was acquired from the price of the transaction information retrieval of Information of Land Synthesis System (transaction data is called hereafter).

There are some points that should be noted upon the estimate. For one thing, the transaction data is data pooled for a certain period (three months) while there is judge data at arbitrariness time. Therefore, there is a possibility that a uniform definition of market participant's characteristic becomes difficult in a rapid economic fluctuation period. Another one, it comes out about the number of data. Within Shiga Prefecture, the transaction data before the 2007 the 2nd quarter decreases extremely, and will have 2006 at the oldest thing only till the 4th quarter (sample size 5). Thus, the uneven distribution of data will become a problem in verifying a time series change. Furthermore, the following things also differ. The point of that it is shown in not a space but the time to a nearby station, existence or nonexistence of gas and water service, and existence or nonexistence of "irregular form" display of the land shape are so.

In the following, the estimate that uses the transaction data in Shiga Prefecture residential quarter (raw land) pooled from the 4th quarter of 2006 to the 1st quarter of 2009 based on such respect is done.

Table 8 Estimate result in Transaction prices data set

Explained variable：PLP, samples 2155 (Pooled data from 2006Q4 to 2009Q1)

	Explanatory variable	Linear type all variable use		Linear type (one by one exclusion method)		Full log type		Semi log I type		Semi log II type	
		coefficient	t value	coefficient	t value	coefficient	t value	coefficient	t value	coefficient	t value
	(Constant)	48817.700	6.045 ***	54466.140	11.668 ***	17.360	20.249 ***	212172.100	28.922 ***	11.676	61.375 ***
Quantitive	AC	-12.553	-6.541 ***	-12.482	-6.527 ***	-0.144	-6.635 ***	-5859.765	-6.864 ***	-0.0003	-6.866 ***
	DS	-4.065	-13.377 ***	-4.034	-13.387 ***	-0.249	-13.651 ***	-10566.190	-15.134 ***	-0.0001	-15.600 ***
	BC	94.008	0.684			-1.368	-6.161 ***			-0.015	-4.603 ***
	FR	130.815	5.931 ***	138.709	7.259 ***	0.332	2.075 **			0.002	3.240 ***
	WIDTH	2141.371	8.938 ***	2107.783	8.945 ***	0.518	13.015 ***	18674.150	11.950 ***	0.048	8.882 ***
	DIST	-870.754	-27.368 ***	-861.233	-28.105 ***	-0.365	-18.656 ***	-24059.710	-31.001 ***	-0.014	-19.050 ***
Dummy	CHOKU	-23559.790	-13.789 ***	-23070.430	-16.150 ***	-0.313	-7.553 ***	-17052.230	-12.480 ***	-0.454	-11.130 ***
	FR_100	20747.280	7.058 ***	20700.930	7.079 ***	0.336	2.618 ***	7420.816	4.172 ***	0.301	4.271 ***
	SHAPE	-11457.750	-5.624 ***	-11491.580	-5.647 ***	-0.348	-7.102 ***	-13418.320	-6.974 ***	-0.327	-6.673 ***
	BIWAKO	24386.520	16.291 ***	24085.520	16.635 ***	0.507	16.507 ***	21677.350	18.566 ***	0.524	17.490 ***
	RAPID	-3232.632	-1.985 **	-3075.350	-1.902 *						
	N	3192.561	1.222								
	N_E	368.703	0.179			0.069	1.685 *				
	E	7091.344	2.804 ***	5609.325	2.532 **						
	S_E	3377.562	1.685 *			0.088	2.228 **				
	S	9269.234	3.838 ***	7542.838	3.614 ***			3949.109	2.034 **		
	S_W	7139.316	3.605 ***	5680.980	3.641 ***	0.125	3.245 ***	5168.899	3.575 ***	0.068	1.871 *
	W	5569.101	2.296 **	4113.873	1.965 **						
	ROAD_CITY	-414.480	-0.278					-2105.275	-1.685 *	0.076	2.531 **
	ROAD_PREF	-8449.427	-2.762 ***	-8306.542	-2.953 ***	-0.233	-3.465 ***	-10981.730	-3.949 ***		
	ROAD_N	-2452.937	-0.237			-0.411	-1.652 *				
	ROAD_PRI	2430.585	1.045								
	Adjusted R^2	0.593		0.593		0.554		0.622		0.557	
	Log ikelihood	-21725		-21728		-1713		-22110		-1709	
	AIC	23.099		23.095		1.836		23.021		1.829	
	SBIC	23.167		23.143		1.883		23.059		1.867	

(Note 1) ***(**)[*]denotes rejection of the hypothesis at 1%(5%)[10%].
(Note 2) Semi log I type has logarithm-ized only the quantitative explanatory variable, and Semi log II type has logarithm-ized only the explained variable
(Note 3) Adjusted R^2 is an adjusted coefficient of determination, AIC and SBIC express Akaike's information criteria and Schwartz's Bayesian. Information Criteria, respectively.

The same sign as appraisement data was obtained about AC, DS, FR, WIDTH and DIST which are quantitative Variable, and CHOKU, BIWAKO and RAPID which are a dummy variable. About the road putting azimuth dummy which did not become significant in the estimation by appraisement data, in all the direction that does not belong to north, such as the east, southeast, south, southwest, and the west, it became significant by positive. It is south that whose coefficient was the largest also in it, and it was shown that it is 9269 yen plus per sq m. Moreover, in road kind classification, the negative assessment about a prefectural road was checked by four estimation formulas. It is thought that the point with comparatively much traffic of vehicles was disappointed. As well, about ROAD_PRI, although it was significant to plus by many estimation formulas in appraisement data like CHIKA-KOJI or CHIKA-CHOSA, such a result was not found in transaction data.

It was shown also for dummy variable (FR_100) located as an excellent living environmental dummy to become significant in the transaction data, and to be had trading by the high price of 20747 yen per sq m. A 4,560,000 yen difference will arise in the case which was 220 sq m in acreage. The

affection which it has on a land price is great. Moreover, the irregular shape dummy (SHAPE) which did not exist in appraisement data was subtracted significantly. It was shown that the land of irregular shape is discounted and dealt with compared with the residential quarter which is not so. Thus, it became clear that many of factors expressed with a dummy variable had affected the land price significantly as compared with appraisement data. BIWAKO, CHOKU, FR_100, and SHAPE had especially a major impact in order.

As mentioned above, the result of the estimation using the variable same as much as possible after being based on difference between appraisement data and transaction data, The same sign was obtained with many quantitative and dummy variables. At this point, it may be able to be said that the purpose of advice data of "finding out the proper price of estate" is achieved synthetically. On the other hand, about the affection of road putting azimuth or superior living environment factor, it has made sure only by the estimation result using transaction data. A result in which the interrogatory how to have caught the weight of these assessments at the time of appraisement remains was brought.

Of course, although it is quotation, in practice, for the sake of participant's special causes (selling too hastily or buying progress etc.), the capability that the data of the case which divergence with a market equilibrium price produced is intermingled to some extent cannot be denied. About this point, it is necessary to wait for further data to be going to be accumulated in the future, and to go in addition in empirical analyses repeatedly.

4. Conclusions

In this paper, it has been analyzed empirically how much estate characteristic of having significant affection on land price is caught by hedonic approach to through observing spatial distribution of the residential-quarter land price in Shiga Prefecture. To simultaneous, it has been analyzed empirically whether it is important for which factor determining the spread concretely.

In section 3.3 to 3.4.1, the data set of CHIKA-CHOSA and CHIKA-KOJI which is appraisement data was used. Five type of model which includes liner and log linear, respectively was prepared, and it has estimated in exploration. It was shown that every estimation model is a good fit. As a factor which forms price, acreage, distance from closest station, distance to

Otsu Station, width of frontal road, gas unlaid dummy, and Biwako Line dummy are important, and quantification was made by each Model. In Section 3.4.2, same estimation was performed using the data dealt with in real estimate market. While the same result was shown with many of quantitative variables and dummy variables, the effective factor also became clear only with transaction data.

The sign condition which is in general theoretically compatible was acquired from these results, and also quantification was made. Such results are meaningful in the meaning that it can know the market price (or appraised value) even if it is not expert like an appraiser.

In this paper, GIS was utilized, data reduction is performed and the thematic map (Figure 2) made attribute information visualize has been created.[15] GIS is the system which had discovery and a search service so that map information and various additional information might be given on a computer, it might create, save, use and manage and geographic information could be referred to. Since access to space data, such as status of land use, shape of site, acreage, altitude, and inclination, is becoming easy, in the quantitative analysis of property market, exploitation is expected as very important tool.

Furthermore, recent years, while the treatment of a vast quantity of data became easy with development of a computer, download of bedrock map information was attained from the website of the Geographical Survey Institute in 2008. Such information is mainly used for administration of the geographic information of land, facility, or road, city planning project, etc. By the point about this paper, capability that the further advanced analysis, such as a space to a public institution or a park and network analysis, is attained, and a price formation factor can be derived is high. Such analysis serves as a future challenge.

GIS is used only in limited confines like the quantitative analysis of property market in economics. Then, I would like to grope for new analysis of introducing GIS into a macroeconomic model and a macro econometric model, and verifying the effect of the policy and the effect of feedback.

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[15] The GIS software used by empirical analyses of this thesis is SuperMap Deskpro of SuperMap Japan Co.,Ltd. (http://supermap.jp/index.html).

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