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LAND USE CHANGE IN OUTDOOR PARKING LOTS AND ITS INFLUENCE ON LAND PRICE IN CENTRAL AREAS OF JAPANESE LOCAL CITIES

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ABSTRACT

Outdoor parking lots have increased in central areas in Japanese local cities, and it has become a serious problem in recent years. It would appear that increases in underused land including outdoor parking lots have negative effects on land price in central areas and cause the decline of those areas. In this study, we built a detailed database of land use in 1985 and 2005, and analysed the influence of land use changes in outdoor parking lots on land price, focusing on the influence of land cover in surrounding railway stations.
As a result, land price in central areas in 2005 has a low level in cities which contain a large area of outdoor parking lots. In contrast, land price was generally high in cities where railway stations were constructed near the point of highest land prices. Furthermore, focusing on land use change, we find that transformations to outdoor parking lots have a negative influence on land price. Additionally, construction of railway stations close to central areas has a positive effect for not only transformation from outdoor parking lots, but also increase of land price.

Keywords: Outdoor parking lots, Central area, Land price, GIS

INTRODUCTION

In recent years, outdoor parking lots have increased in central areas of Japanese local cities. Outdoor parking lots are included in underused lands such as low-use lands and unused lands;

material storing sites, vacant areas and vacant houses. At a glance, development of parking lots has the potential to promote business activity and affect a rise in land price with growth of motorization. In opposite, an increase of such lands causes a serious problem in Japan. For instance, business activity is decline in the central area of cities where underused land has increased compared with the other cities where underused land has decreased (Abe et al., 2011). However, influences of outdoor parking lots exist in central area have never been clarified by quantitatively analysis on detailed database.

For evaluating the impact of land use, land price would become a key value. It was said that official land price in Japan have decreased since 1991, because of Japanese asset price bubble. This trend has made it easier for developers to develop the underused lands, but the land price in suburban area has also decreased. It is well known that suburban development have expanded in Japanese local city. As a result, land development has not occurred in central areas, and it would appear that increases in underused lands have negative effects on land price in central areas and cause the further decline of those areas.

There are some previous studies focusing on the impact for land price by land use change. It is well known that the famous model for analysing the influence of land use change on land price is hedonic regression model. There have been many models about hedonic approach, and recently, land use data used in model became more precise. Gao et al. (2007) showed the influence of lot size and shape based on the hedonic model of housing land price. In addition, there are mixed model of land use model and land price model based on bid rent (Okumura et al., 2002; Iwahashi et al., 2006). Moreover, there is not only multiple linear regression model, but also another hedonic models such as structural equation modeling (SEM), because the factors that were considered as what compose land price have relation to each other. For instance, Yai et al. (1992) used LISREL model based on the regression model for analyzing the effect to land price from commercial location and traffic demand as well as mutual relations between commercial location and traffic demand.

In recent years, by the increased availability of GIS, more detailed land use data are built and used in analyze of economic influence of land use. However, there is few study focusing the diseconomy of underused lands include outdoor parking lots and land use change of it. Davis et al. (2010) measured excessive parking space and effect of developing outdoor parking lots on calculation of ecosystems service value. Tanaka et al. (2003) indicated that underutilized land had negative effect to land price and transformation from underutilized land to other lands had positive effect to increase of land price. However, this study used mesh data and not divided outdoor parking lots from underutilized lands.

From these previous studies, it is need to analyze the diseconomy of underused land by detail data for showing the importance of decrease outdoor parking lots and other underused lands in central area.

Thinking about land use change and also land price, it is also important to consider the impact of transportations. Dabinett et al. (1999) showed a positive effect of construction of railway for transformation from vacant area and houses.

In this study, we built a detailed database of land use and land price by each roadside, and analysed the influence of outdoor parking lots on land price focusing on the cover ratio from railway stations in central area. Findings from our study indicate outdoor parking lots carry an economic disadvantage.

BUILDING A DATABASE

Research areas and time period

In this study, we defined local cities as those that have over three-hundred thousand people, excluding several large cities in Japan, as of October 2005 and selected 37 core cities. Figure 1 shows 37 core cities in Japan. We also defined the central area which is a 500 m radius around the highest point of official land price in 2005. Then we built a database of land use in 1985 and 2005 using housing maps in GIS to analyze the transformation of underused land in central areas. We designated 1985 as the time of the occurrence of underused lands resulted in suburbanization and 2005 as the time of present condition. Additionally, land price data in central areas in Japanese local cities were aggregated. Afterward, we could see the actual status of outdoor parking lots such as changes in quantity and area. Lastly, we analysed the effect of land use changes in outdoor parking lots on land price.

Building GIS database

Underused lands database

We focused on underused lands in central area of 37 core cities and discriminate between outdoor parking lots and other underused lands. Other underused lands include material storing sites, unused lands and lands which have vacant housing. In this study, underused lands are at least some or all included within the central area excluded parking structures such as multilevel car parking towers and parking lots for bicycles. We built multiple polygon data by using housing maps on GIS, which include spatial information such as the area and location. Lot was defined as 'divided land by property lines or block lines in housing map'. In

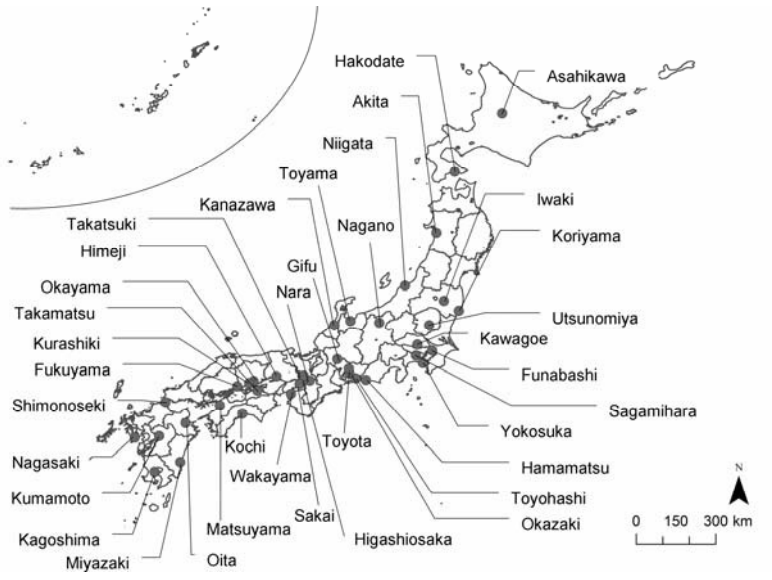

Figure 1 – 37 Core cities in Japan

the cases where property lines or block lines do not exist on land which have many structures, we composed lot data by 30cm mesh data including the quality of the nearest structure. Initially, we built underused lands data based on property lines or block lines. Then, we also built other land use data included in central areas at least 1985 or 2005.
To get an overview of changes in land use, we classified the quality of land use into eleven categories listed in Table 1 based on utilization purpose and service delivered in each lot or structure. For data example, the change in land use in Oita is shown in Figure 2.

Land price data

There are some data of land price such as official land price and roadside land price in Japan. In order to analyze the impact of land use change in central areas, we built the database of land price on GIS based on roadside land price in 1986 and 2006. Roadside price is also selected as land price at least some or all included within the central area excluded the roadside which include the lands located outside of central area.

CHANGES IN UNDERUSED LANDS IN CENTRAL AREA

Figure 3 shows the total area of underused lands in all of 37 cities and changes in the average

Table 1 –Type of land use

1	Residential land	5	Public service land	9	Natural land
2	Mixed residential land	6	Outdoor parking lots	10	Railway land
3	Business-use land	7	Other underused lands	11	The rest
4	Industrial land	8	Other parking lots		

Figure 2 – Secular change in spatial distribution of underused lands in Oita

area of lot size. The area of outdoor parking lots increased by 1.3 times from 1985 to 2005. About other underused lands, it is the opposite, decreased by half during the same period. Values of average area of each lot on outdoor parking lots and other underused lands in 2005 are larger than that of 1985. This result indicates large outdoor parking lots have increased during two decades, and small lots of other underused lands have decreased.

This trend is also shown in Figure 4 and Figure 5, these figures show the changes in the number of underused lands focusing on the lot size in 1985 and 2005. 100-200m^2 is the most common size on outdoor parking lots. Less than 100m^2 of outdoor parking lots decreased between 1985 and 2005, but lot size of more than 100m^2 increased in 20 years. Especially 100-300m^2 size had the biggest increase in all of lot sizes. On other underused lands, the reduction is the largest on 50-100m^2 size, followed in order by 0-50m^2 and 100-200m^2. The other sizes also decreased, but these are not observable changes.

Figure 6 shows the average area of transformation from underused land to other lands and from other lands to underused lands between 1985 and 2005. Looking at nine segments of land use regarding transformation of outdoor parking lots, the rate of change is high on business-use land, and second is residential land. The average area of transformation from outdoor parking lots to other parking lots also indicate high rate. In addition, the rate of transformation regarding public service land and transformation from other parking lots to outdoor parking lots indicate high value. On other underused lands, the rate of transformation is similar to that of outdoor parking lots; rate of transformation regarding business-use land shows the highest value in all of land use, followed residential land and other parking lots.

The reason of why business-use land and residential land indicate the high rate regarding the transformation of underused lands is that the rate of land use in central area is high on business- use land (average: 0.30) and residential land (average: 0.17).

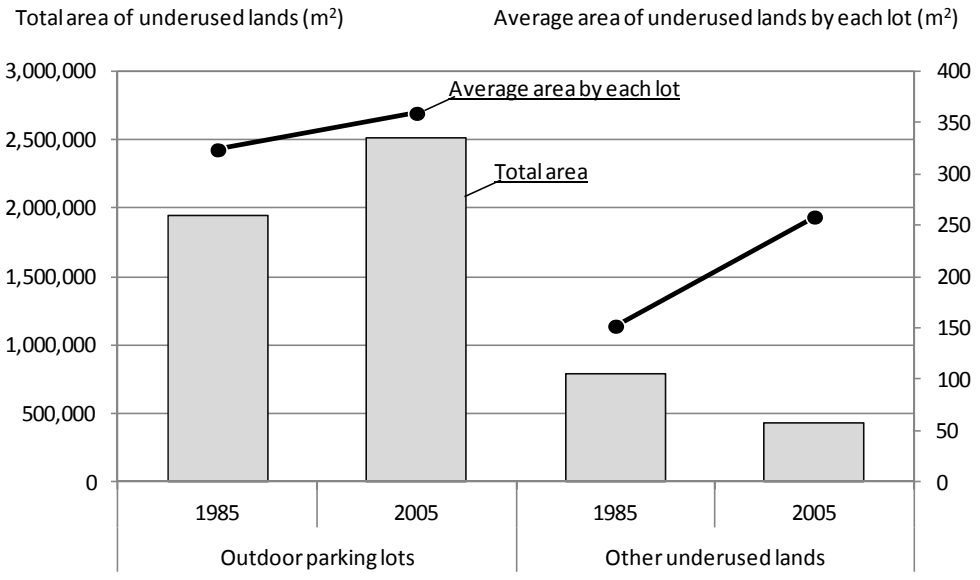

Figure 3 – Total area and average lot size of underused lands

RELATIONSHIPS BETWEEN LAND PRICE AND UNDERUSED LANDS

The secular changes in land price on the basis of roadside types

In this chapter, we focused land price and relationship between change in land price and underused lands in central area focusing on the rate of sphere from railway station. Two city groups are divided with the cover ratio of sphere that is 0-200m radius from railway stations included in each city. 0-200m means the length people can walk with ease. The method of

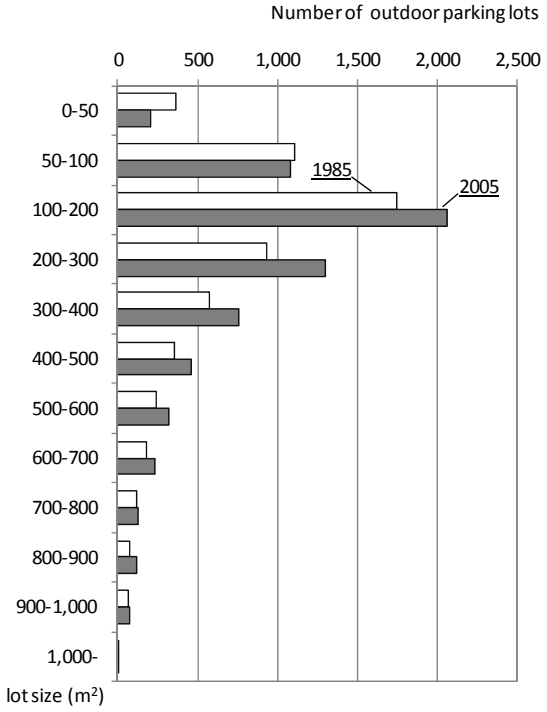

Figure 4 – Number of outdoor parking lots by size

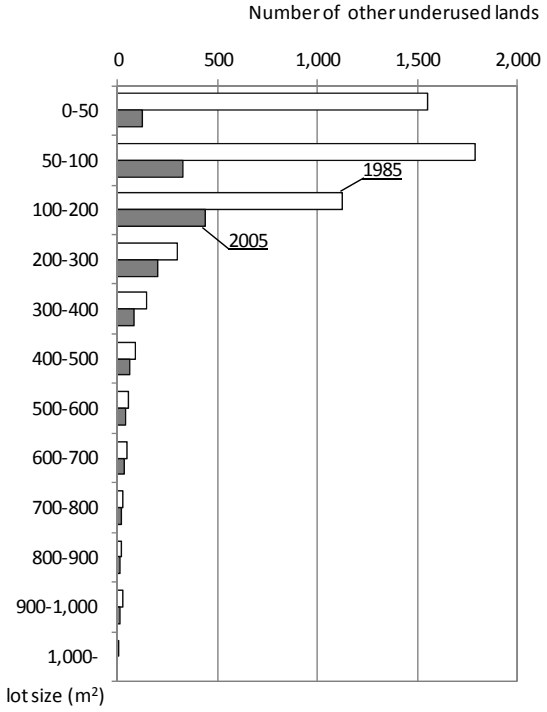

Figure 5 – Number of other underused lands by size

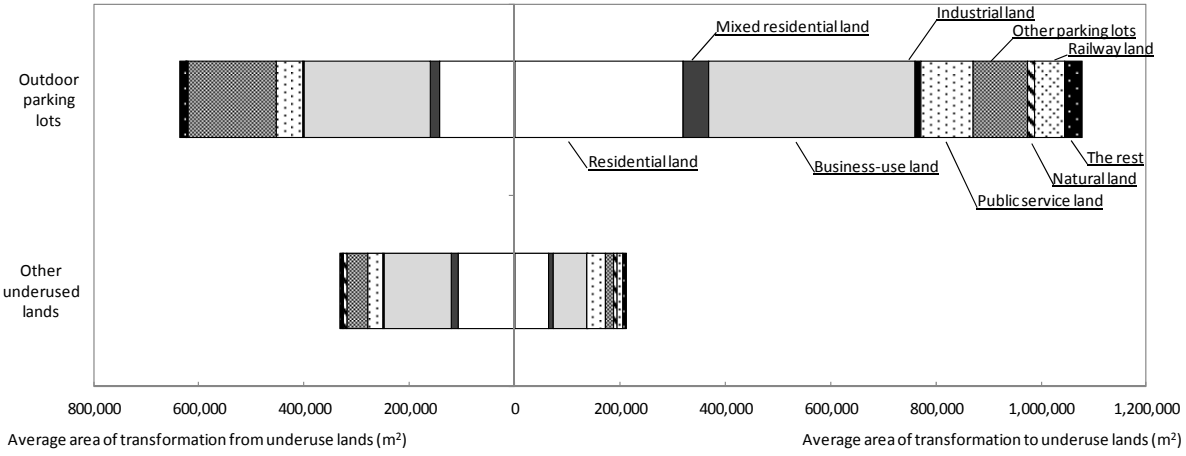

Figure 6 –Rate of transformation from or to underused lands

division is that if the ratio of 0-200m radius to the central area is greater than 0.16, these cities are 'high covered city', and if the ratio is less than 0.16, these cities are 'low covered city'. 0.16 is in case of that central area completely include a circle with radius of 200m. Table 2 shows the city groups based on cover ratio of 0-200m radius. The following passages, analysis are based on these two groups.

Figure 7 shows the average of land price in two groups by 4 categories of roadside; with outdoor parking lots, other underused lands, both of outdoor parking lots and other underused lands and without underused lands. All of land price decreased between 1985 and 2005. In high covered city and low covered city, the average of land price of roadside with both of underused lands is lowest values in 4 categories at two points in time. Roadsides with outdoor parking lots are the second, and roadsides with other underused lands are followed. The highest value of land price is shown in roadsides without underused lands; this is almost double that of roadside with both of underused lands in two groups. Then, according to statistical, we compared with the average of land price by roadside types. Table 3 shows the results of multiple comparison of average land price according to roadside type in each city group. In 1985, there are significant differences between all of road side types in high covered

Table 2 – City classification according to cover ratio of 0-200m from railway stations

High covered city : the ratio of 0-200m radius to the central area is higher than 0.16 23 cities					
Hakodate	Koriyama	Kawagoe	Funabashi	Niigata	Toyama
Nagano	Gifu	Hamamatsu	Toyohashi	Toyota	Takatsuki
Higashiosaka	Himeji	Wakayama	Okayama	Kurashiki	Fukuyama
Matsuyama	Kochi	Nagasaki	Kumamoto	Kagoshima	
Low covered city : the ratio of 0-200m radius to the central area is lower than 0.16 14 cities					
Asahikawa	Akita	Iwaki	Utsunomiya	Yokosuka	Sagamihara
Kanazawa	Okazaki	Sakai	Nara	Shimonoseki	Takamatsu
Oita	Miyazaki				

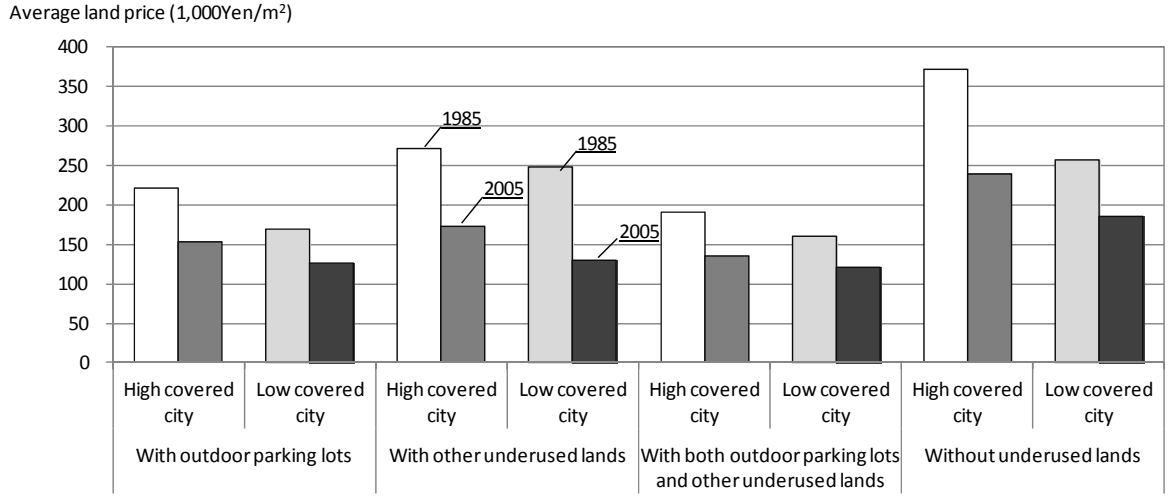

Figure 7 – Changes in average of land price on two groups in 1985 and 2005

city, but in low city, there are no significance between roadside with outdoor parking lots and both of all and between roadside with other underused lands and without underused lands. In 2005, there are also significant differences in high covered city exclude the difference between road side with outdoor parking lots and other underused lands. It means land price of roadsides with underused lands is lower than roadside without underused lands, and the land price of roadside with outdoor parking lots is lower than the roadside with other underused land in high covered city. However, in low covered city, there are no differences between the roadside with outdoor parking lots and other underused lands.

Table 3 – Results of multiple comparison

1985	P-value		With outdoor parking lots	With other underused lands	With both outdoor parking lots and other underused lands	Without underused lands
	High covered city	With outdoor parking lots	-	0.0000 **	0.0155 *	0.0000 **
		With other underused lands	-	-	0.0000 **	0.0000 **
		With both outdoor parking lots and other underused lands	-	-	-	0.0000 **
		Without underused lands	-	-	-	-
	P-value		With outdoor parking lots	With other underused lands	With both outdoor parking lots and other underused lands	Without underused lands
	Low covered city	With outdoor parking lots	-	0.0000 **	0.9057	0.0000 **
		With other underused lands	-	-	0.0000 **	0.9430
		With both outdoor parking lots and other underused lands	-	-	-	0.0000 **
		Without underused lands	-	-	-	-
2005	P-value		With outdoor parking lots	With other underused lands	With both outdoor parking lots and other underused lands	Without underused lands
	High covered city	With outdoor parking lots	-	0.3017	0.0434 *	0.0000 **
		With other underused lands	-	-	0.0093 **	0.0000 **
		With both outdoor parking lots and other underused lands	-	-	-	0.0000 **
		Without underused lands	-	-	-	-
	P-value		With outdoor parking lots	With other underused lands	With both outdoor parking lots and other underused lands	Without underused lands
	Low covered city	With outdoor parking lots	-	0.9558	0.8874	0.0000 **
		With other underused lands	-	-	0.8019	0.0000 **
		With both outdoor parking lots and other underused lands	-	-	-	0.0000 **
		Without underused lands	-	-	-	-

*** : $p < 0.01$, ** : $p < 0.5$, * : $p < 0.1$

One reason of why there are such differences between high covered city and low covered city is that outdoor parking lots and other underused lands distributed close to each other in the area of which have low cover ratio from railway station in low covered city, and land price of that area also indicate low value. As shown in Table 4, the result of multiple comparison of average distance from railway station in each road side focusing on two city groups in 2005. This table indicated distance of roadside with underused land is longer than that of roadside without underused land and similar significances of the comparison of average land price in 2005, and we can also confirmed the similar difference of two city groups.

Changes in land price and transformation of underused land

Figure 8 shows the average land price of roadside which include the transformation regarding underused lands and average ratio of transformational area to sum of roadside area in 2005. Focusing on the business-use land, in two city groups, the value of land price with transformation from underused land to business-use land is larger than the land price on roadside with business-use land to underused lands. However, there is little difference in average values of land price with transformation from residential land to underused land and from underused land to residential land.

Comparison of the ratio of the area of transformation from underused lands and transformation to underused lands, the ratio on transformation to underused lands is larger than transformation from underused lands in both of business-use land and residential land excluded the transformation between residential land and other underused lands in high covered city. In central area, we could not found the direct effect of transformation between

Table 4 – Results of multiple comparison of average distance from railway station in 2005

High covered city	Type of roadside	Average distance from railway station (m)	P-value and significance of multiple comparison			
			With outdoor parking lots	With other underused lands	With both outdoor parking lots and other underused lands	Without underused lands
	With outdoor parking lots	244	-	0.6149	0.0271 *	0.0000 **
	With other underused lands	244	-	-	0.0291 *	0.0532
	With both outdoor parking lots and other underused lands	281	-	-	-	0.0000 **
	Without underused lands	215	-	-	-	-
Low covered city	Type of roadside	Average distance from railway station (m)	P-value and significance of multiple comparison			
			With outdoor parking lots	With other underused lands	With both outdoor parking lots and other underused lands	Without underused lands
	With outdoor parking lots	531	-	0.9156	0.1564	0.0000 **
	With other underused lands	512	-	-	0.2312	0.4956
	With both outdoor parking lots and other underused lands	578	-	-	-	0.0000 **
	Without underused lands	469	-	-	-	-

*** : p < 0.01, ** : p < 0.5, * : p < 0.1

residential land and underused lands.

As shown in Table 5, there are results of t-test on the differences of average land prices in each roadside with transformations of underused land in high covered city and low covered city. These results also showed average of land price in high covered city is larger than in low covered city excluded the land price on roadside with transformation from other underused lands to residential lands. One reason of this difference is transformation from other underused land to residential land is occurred in residential area, and residential area is located far from centre of central area in high covered city. It showed the average land price of roadside which include transformation from other underused land to residential land in high covered city is close to the average of low covered city, in spite of that the average land price of high covered city is larger than average land price of low covered city. Additionally, the ratio of transformational areas regarding residential land and underused lands did not indicated the statistically significance between high covered city and low covered city; as shown in Table 6 which is the results of t-test on the differences of average ratio of transformational area in high covered city and low covered city. In contrast, there are statistically significant differences in transformation from business-use land to outdoor parking lots and to other underused lands. This result indicates increase of cover area from railway station has a negative effect for transformation business-use land to underused lands. The reason of why statistically significant differences is only confirmed in transformation

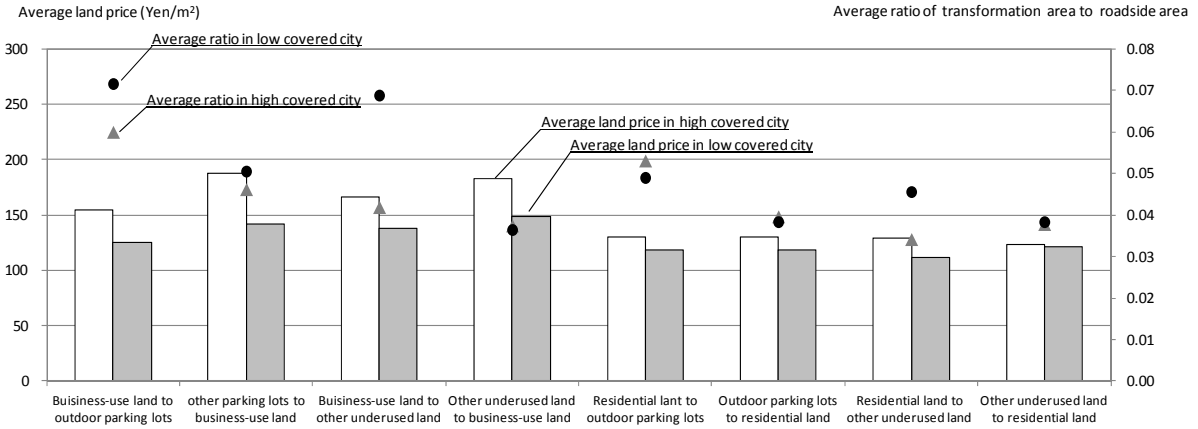

Figure 8 – Average land price in each roadside with transformation of underused lands and ratio of transformational area to sum of roadside area.

Table 5 – Comparison of land price focusing transformation of underused lands in two city groups

Road side with	to outdoor parking lots	from outdoor parking lots	to other underused lands	from other underused lands
Business-use land	***	***	***	***
Residential land	***	***	***	-

*** : p < 0.01, ** : p < 0.5, * : p < 0.1, - : p > 0.1

Table 6 – Comparison of the ratio of transformational area in two city groups

Average ratio of	to outdoor parking lots	from outdoor parking lots	to other underused lands	from other underused lands
Business-use land	**	-	**	-
Residential land	-	-	-	-

*** : p < 0.01, ** : p < 0.5, * : p < 0.1, - : p > 0.1

from business-use land to underused land is thought to be due to that transformation from business-use land to underused land occurs close to each other in low covered city.

IMPACT FOR LAND PRICE BY CHANGES IN OUTDOOR PARKING LOTS

Analytical method

In this study, we focused the cover ratio from railway station and the influence of transformation of outdoor parking lots in central area of Japanese local city. Obviously, land use change not only affect the land price, but also land use of central area. There are many other relationships. For instance, thinking the influence of railway station, we can see the influence in the land price and land use change. The purpose of this section is to clarify the influences between construction of railway station, land use and land price based on the analysis of structure of factors, and not to construct the land price model. For analyzing these relationships and the effects for land price, we selected the structural equation modelling (SEM), because SEM is a method for measuring relationships among observed variables (Shah et al., 2006).
In the model, we assumed two city groups based on the ratio of covered area from railway station have different features on such as the effect from land use change to land price. As a result, we applied a simultaneous analysis of several groups. At first, we constructed the causal structure model based on variables listed in Table 7. On constructing the model, we expected the influences that have no statistically significance. Then, we test the adaptability of constructed model in each group; high covered city and low covered city. Finally, we constructed following 4 models for test of heterogeneity between high covered city and low covered city.

Table 7 – List of variables

Variable	Definition
Land price in 2005	Land price of each roadside in 2005
Area ratio of business-use lands	Ratio of total business-use land area to sum area of roadside
Area ratio of outdoor parking lots	Ratio of total outdoor parking lots area to sum area of roadside
Area ratio of other underused lands	Ratio of total other underused lands area to sum area of roadside
Ratio of net increase on the area of outdoor parking lots to other lands	Ratio of net increase on the area of outdoor parking lots to other lands for sum area of roadside
Ratio of net increase on the area of other underused land to other lands	Ratio of net increase on the area of other underused land to other lands for sum area of roadside
Ratio of net increase on the area of outdoor parkin lots land to business-use land	Ratio of net increase on the area of outdoor parkin lots land to business-use land for sum area of roadside
Ratio of net increase on the area of other underused land to of business- use land	Ratio of net increase on the area of other underused land to of business- use land for sum area of roadside
Ratio of net increase on the area of outdoor parking lots to residential land	Ratio of net increase on the area of outdoor parking lots to residential land for sum area of roadside
Ratio of net increase on the area of other underused land to residential land	Ratio of net increase on the area of other underused land to residential land for sum area of roadside
Distance from railway stations	Distance from railway stations [m]

1. Model 1; there is no limitation between high and low covered city groups.

2. Model 2; unstandardized coefficient is equal between high and low covered city groups.

3. Model 3; unstandardized coefficient and variance of an observation variable are equal between high and low covered city groups.

4. Model 4; unstandardized coefficient, variance of an observation and error variable are equal between high and low covered city groups.

We selected the model based on the following fit index (Hooper et al., 2008).

1. Goodness-of-fit statistic (GFI); the GFI was created as an alternative to the Chi-Square test and calculates the proportion of variance hat is accounted for by the estimated population covariance. This statistic ranges from 0 to 1 with large samples increasing its value. Traditionally a omnibus cut-off point of 0.90 has been recommended for the GFI however, simulation studies have shown that when factor loadings and sample size are low a higher cut-off 0.95 is more appropriate.

2. Adjusted goodness-of-fit statistic (AGFI); AGFI adjusts the GFI based on degrees of freedom, with more saturated models reducing fit. AGFI tends to increase with sample size. Values for the AGFI also range between 0 and 1 and it is generally accepted that values of 0.90 or greater indicate well fitting models.

3. Root mean square error of approximation (RMSEA); the RMSEA tells us how well the model, with unknown but optimally chosen parameter estimates would fit the populations covariance matrix. the RMSEA in the range of 0.05 to 0.10 was considered an indication of fair fit and values above 0.10 indicated poor fit.

Result of the influence of changes in outdoor parking lots

Table 8 shows the results of fit index on the test of each city group and each model. GFI and AGFI were larger than 0.9 in each model and showed the highest value in Model 1. Additionally, all values of RMSEA in each test were smaller than 0.10 and also showed the

Table 8 – Results of fit index

	GFI	AGFI	RMSEA
High covered city	0.961	0.928	0.077
Low covered city	0.952	0.915	0.086
Model 1	0.958	0.923	0.057
Model 2	0.946	0.921	0.058
Model 3	0.905	0.863	0.079
Model 4	0.878	0.842	0.085

smallest value in Model 1. As a result, we selected the Model 1, Figure 9 shows the result of SEM.

The biggest value of effects for land price is area ratio of business-use land, and this trend is shown in two city groups because it is thought as increase of ratio of business-use land equal bid rent marks high value. In contrast, the effect from area ratio of outdoor parking lots to land price showed negative value in each city group. This result also mean transformations to outdoor parking lots have a negative effect on land price. Additionally, there is no statistically significance on effect from area of other underused land.

Relationship between distance to railway station and land price is negative relation. It is identified by previous study, land price of area close to station is high and it decline further apart from railway station.

Sign conditions from each variable of net increase regarding outdoor parking lots and other underused lands to each ratio of area of business-use land, outdoor parking lots and other underused lands indicate assumed sign.

Looking at the coefficient of distance from railway station and focusing on difference of coefficients between high covered city and low covered city, effect to each area of business-

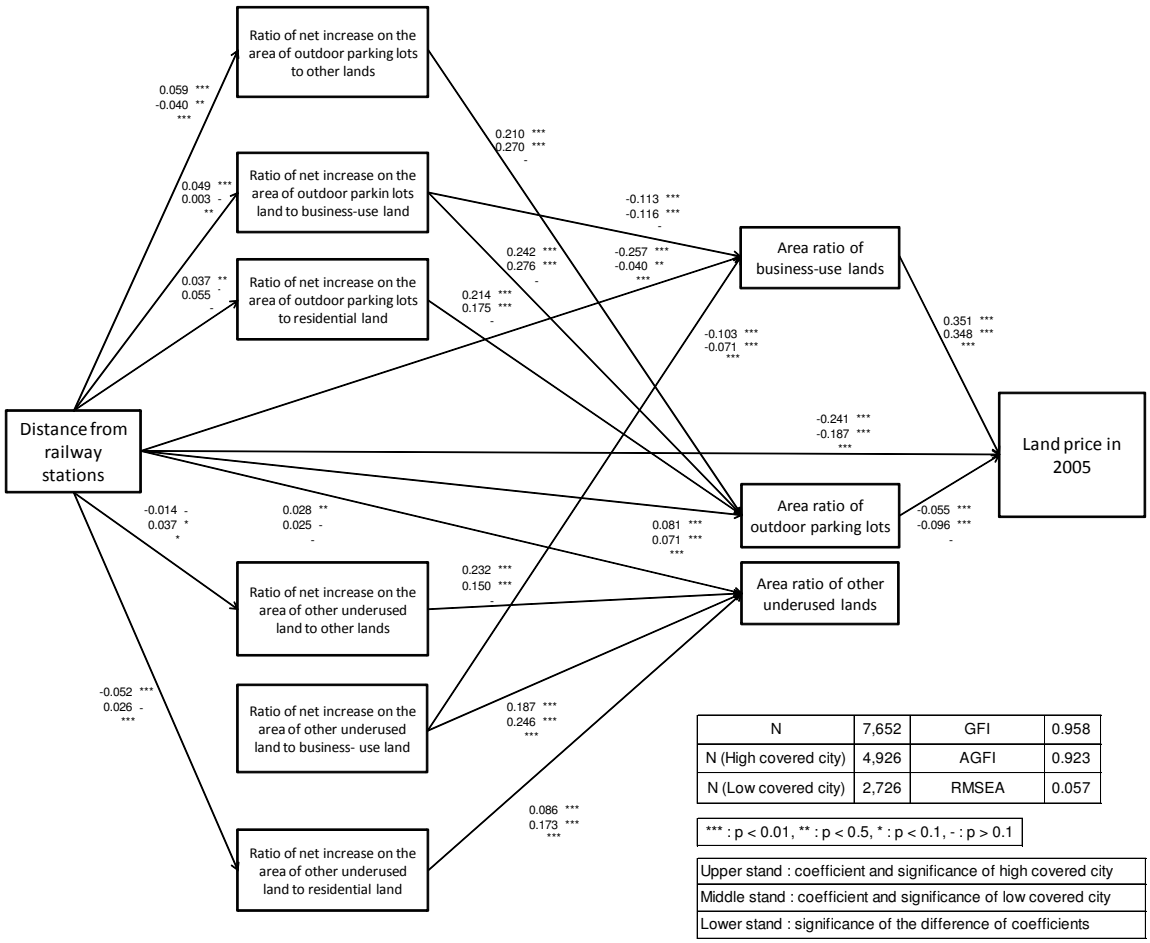

Figure 9 – Result of SEM on two city groups

use land, outdoor parking lots and other underused lands are same between two city groups, the area ratio of business-use land is high in the area close to railway station. On the other hands, the area ratio of outdoor parking lots and other underused lands decreased in this area. In high covered city, values of these effects are bigger than in low covered city, and these differences indicate statistically significances. Regarding net increase of outdoor parking lots, transformation from outdoor parking lots to business-use lands and also other lands increased compared to outdoor parking lots in the area close to railway station in high covered city, but in low covered city, there is not only no effects of distance from railway station to transformation between business-use land and outdoor parking lots, but also coefficient of effect of distance from railway station to net increase of outdoor parking lots showed negative value.

CONCLUSION

Currently, outdoor parking lots have increased in Japanese local cites. It was true that increase of outdoor parking lots have advantage to promote car use and business activity, but it also have a disadvantage such as decrease of business-use land and decline the central area. However, the relationship between land use change in outdoor parking lots and land price are not quantity clarified by detailed database. In this study, we built a database of land use and land price in 1985 and 2005 using housing maps in GIS. Then, we analysed the effect of land use changes in outdoor parking lots on land price focusing the influence of land cover in surrounding railway stations.

Results showed that, the area of outdoor parking lots increased by 1.3 times from 1985 to 2005, especially 100-300m^2 size had the biggest increase in all of lot sizes. Additionally, focusing on the transformation of outdoor parking lots, the rate of change is high on business-use land, and second is residential land. From analysis regarding land price, the value of roadsides with underused lands is lower than roadside without underused lands, and the land price of roadside with outdoor parking lots is lower than the roadside with other underused land in high covered city. The average value of land price is higher in cities where cover ratio of 0-200m from railway stations is high than that of cities where cover ratio of 0-200m from railway stations is low in 1985 and 2005. Focused relationship between land use change and land price, the value of land price with transformation from underused land to business-use land is larger than the land price on roadside with business-use land to underused lands. From analysis of effect for land price, outdoor parking lots have negative effect for increase of value of land price. Furthermore, increase of cover ratio of 0-200m radius from railway station has a positive effect for increase of land price because net increase of transformation to outdoor parking lots has decreased.

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