Memoirs of the Faculty of Engineering,Okayama University,Vol.27, No. 1, pp.81-92, November 1992

The Impact of JR Seto Ohashi Line on Residential Land Value

Hirofumi ABE *

(Received September 30 , 1992)

SYNOPSIS

This paper aims to examine the impact of JR (Japan Railways) Seto Ohashi Line on residential land value. First, the study examines the trends in land value in the area along JR Seto Ohashi Line by applying the area comparison method. The method estimates the effect of JR Seto Ohashi Line on residential land value by comparing land values between the study area and the Okayama Metropolitan Area. Second, the property value method is applied to measure the effect of railroad construction. The effect is estimated with a residential land-value regression, which is calibrated using land value data along the Seto Ohashi Line. Finally, the results are compared with the empirical studies in the Greater Tokyo Region, and various features of the impact of railroad construction on land value are identified.

1. INTRODUCTION

The Seto Ohashi Bridge which was completed in April 1988 was the biggest project in Japan during the past decade. The bridge passes over the 13.1 km straits in the Seto Inland Sea, and

* Department of Civil Engineering

links Honshu and Shikoku Islands by the group of double-decked expressway-railroad bridges. A new railroad line, JR Seto Ohashi Line was opened between Okayama and Takamatsu Cities with the completion of Seto Ohashi Bridge.

This paper aims to examine the effect of JR Seto Ohashi Line on residential land value. The land value data for 1975 to 1990 are used for the analysis. First, the study examines the trends in land value in the area along the Seto Ohashi Line by applying the area comparison method. The method estimates the effect of JR Seto Ohashi Line on residential land value by comparing land values between the study area and the Okayama Metropolitan Area. Second, the property value method is applied to measure the effect of railroad construction. The effect is estimated with a residential land-value regression, which is calibrated using land value data along the Seto Ohashi Line. Finally, the results are compared with the empirical studies in the Greater Tokyo Region, and various features of the impact of railroad construction on land value are identified.

2. IMPACT OF RAILROAD CONSTRUCTION ON LAND VALUE

The construction of a new railroad brings about the reduction of travel time and travel cost in the area along the railroad line. It improves the locational attractiveness in the area, especially as a residential area. As a result, new housing locations occur along the railroad, and the new residents gain user benefits from the new railroad. If the housing demand is large in the area, it leads to the increases in land value and the user benefits from the new railroad are transferred to the property value in the area. The new residential location prompts the retail and service locations. Their benefits are also transferred to the property value through the increases in land value.

As explained above, all user benefits, which are generated by the railroad construction, are transferred to the property value in the long run. The conditions on the complete transference of user benefits to the property value have been examined in the field of urban economics. According to the result of theoretical studies [1)2)3)], if the land market is perfect competitive, and if the study area is small enough and the migrations between areas occur freely, all user benefits from the railroad construction are completely transferred to the property value.

Therefore, the total benefits from the railroad construction can be estimated by examining the property values before and after the railroad construction. However, if various other factors affect the property value in the land market, it is not easy to measure the total benefits.

3. THE SETO OHASHI PROJECT

The Seto Ohashi Bridge is a group of large bridges over 13.1 km straits of Seto Inland Sea. It is the first route to be completed of the three Honshu-Shikoku Bridge Project routes; Kobe-Naruto, Kojima-Sakaide and Onomichi-Imabari routes. The bridge provides new traffic facilities to link Honshu and Shikoku Islands by both expressway and railroad. Fig.1 shows the location of Kojima-Sakaide route.

The construction work was begun in October 1978, and the route was completed in April 1988 at a construction cost of about 1,130 billion yen. Table 1 shows the details of construction cost. The Seto Ohashi Bridge is a total of six individual structures, which links Okayama and Kagawa Prefectures. The six consist of three suspension bridges, two cable-stayed bridges and one truss bridge. All of these bridges are the world's longest in each respective type as combined expressway and railroad bridges.

Table 1 Outline of the Seto Ohashi Project

Facility	Section	Length (km)	Construction cost (million yen)
Seto Chuo Expressway	From Hayashima Town in Okayama Prefecture to Kawazu Town in Kagawa prefecture	24.2	183,100
JR Seto Ohashi Line (railroad)	From Chayamachi in Kurashiki City to Obatake in Kurashiki City (Okayama Prefecture)	14.9	57,800
	From Kawasaki in Sakaide City to Utazu Town in Kagawa Prefecture	4.4	45,200
	Additional facilities for opening of railroad	–	14,300
Seto Ohashi Bridge (expressway & railroad)	From Obatake in Kurashiki City to Kawasaki in Sakaide City	13.1	823,000
	Additional facilities for opening of railroad	–	8,500
Total construction cost	Expressway subtotal		640,400
	Railroad subtotal		491,500
	Project total		1,131,900

Source: Honshu-Shikoku Bridge Authority.

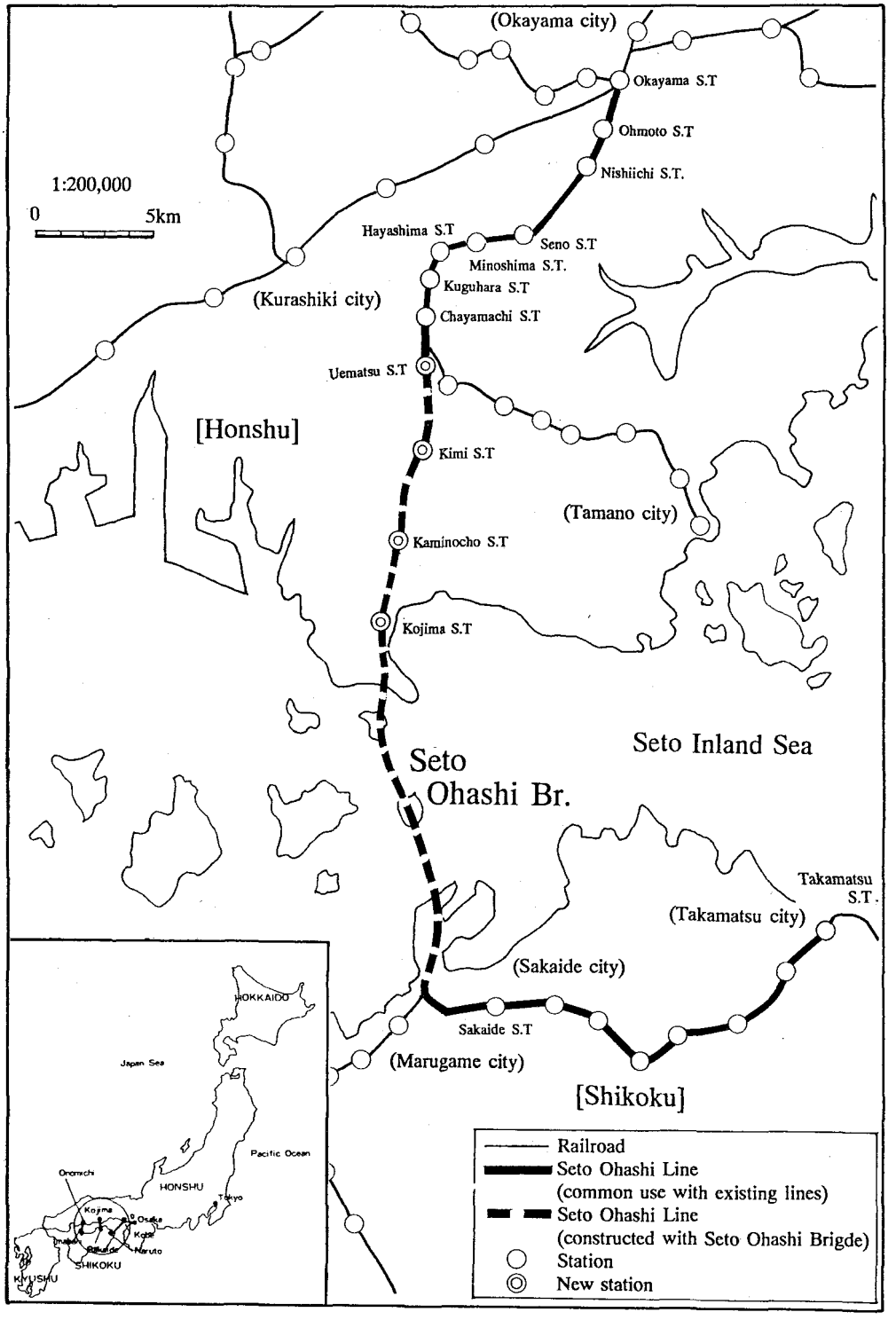

Fig.1 Location of Kojima–Sakaide route and JR Seto Ohashi Line

The 37.3 km expressway, Seto Chuo Expressway links up with National Highway No.2 and Sanyo Expressway in Okayama Prefecture, and with National Highway No.11 and Shikoku Expressway in Kagawa Prefecture. The expressway is classified with a design speed of 100 km/h, and has four lanes with three interchanges along its route.

The 72.1 km railroad, Seto Ohashi Line links Okayama City with a population of 600,000 and Takamatsu City with a population of 330,000. Twenty-two stations are located along the line. Before the construction of Seto Ohashi Line, a railroad-boat line linked Okayama and Takamatsu Cities by way of Tamano City. The travel time between two cities has been shortened from 100 minutes to 60 minutes by the express train, Marine Liner of the Seto Ohashi Line. The train stops at seven stations; Okayama, Seno, Hayashima, Chayamachi, Kojima, Sakaide and Takamatsu. The section between Uematsu Station and Seto Ohashi Bridge is a new railroad line which was constructed with the Seto Ohashi Bridge.

4. OUTLINE OF THE STUDY

4.1 Study area and data base

The purpose of this paper is to examine the impact of JR Seto Ohashi Line on residential land value. The study area includes the Seto Ohashi Line in Okayama Prefecture. The section between Uematsu and Kojima Stations was opened in April 1988 with the completion of Seto Ohashi Bridge. Before the construction of Seto Ohashi Line, no rail service was provided in the area. Therefore, it is an appropriate study area to examine the impact of railroad construction on land value.

Table 2 shows the change in travel time from Okayama Station to each station along the Seto Ohashi Line. The travel time by car is shown for the section between Uematsu and Kojima Stations before the opening of JR Seto Ohashi Line. As already mentioned, the express train, Marine Liner stops at Seno, Hayashima, Chayamachi and Kojima Stations. The residential land value data for 1976 to 1990 are taken from the Public Announcement of Land Price published by the National Land Agency and the Prefectural Land Value Survey published by the Okayama Prefectural Office.

Fig.2 shows the trends in annual growth rate of residential land value in Okayama, Tokyo and Osaka Prefectures. The growth rate in Okayama Prefecture showed a stable trend until 1988. However, a sharp increase in land value occurred in 1989-1991. As clearly shown in Fig.2, it was due to the spread of land value increases from Tokyo and Osaka to major local cities.

Table 2 Changes in the travel time from Okayama Station to stations along JR Seto Ohashi Line

Station	Railroad distance (km)	Road distance (km)	Travel time from Okayama Station (minutes)		
			Before opening	After opening	Reduction in time
Okayama	0.0	0.0	0.0	0.0	0.0
Ohmoto	2.4	2.3	4.0	3.0	1.0
Nishiich	4.5	4.3	7.0	6.0	1.0
Seno	8.3	8.4	11.0	7.0	4.0
Minoshima	10.2	10.2	14.0	12.0	2.0
Hayashima	11.9	12.6	17.0	14.0	3.0
Kuguhara	13.2	14.7	20.0	16.0	4.0
Chayamachi	14.9	16.5	15.0	13.0	2.0
Uematsu	17.8	17.5	23.3	21.0	2.3
Kimi	20.5	20.5	27.3	24.0	3.3
Kaminocho	24.6	25.2	33.6	29.0	4.6
Kojima	27.8	28.0	37.3	25.0	12.3

Note: The travel time by car is shown for the Uematsu-Kojima section before the opening of JR Seto Ohashi Line.

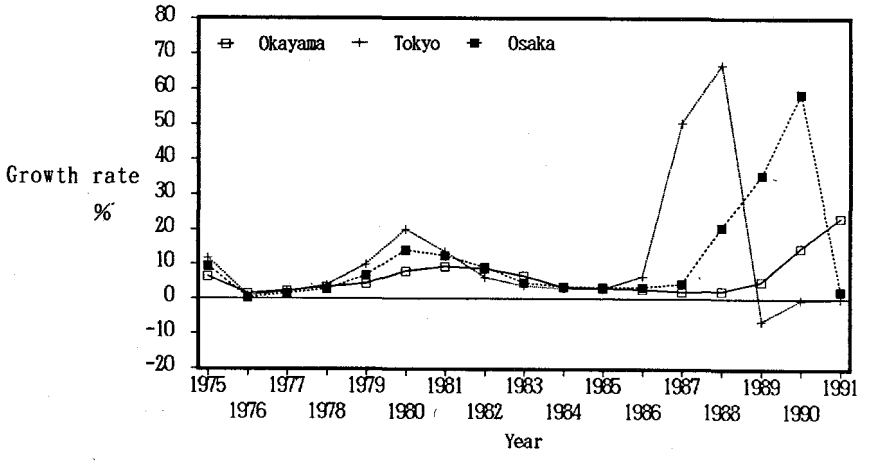

Fig.2 Trends in the average growth rate of residential land value

4.2 Framework of the analysis

In this paper, the following analyses are applied to examine the impact of JR Seto Ohashi Line on residential land value.

(1) The area comparison method

(2) The property value method

The first method estimates the effect of railroad construction by comparing the trends in land values between the study area and the control area. The control area is defined as the Okayama Metropolitan Area which comprises 4 cities, 6 towns and 2 villages, and has a population of about one million. The expected land value is calculated by multiplying the average growth rate of land value in the control area by the land value in the study area. The effect of railroad construction is estimated by subtracting the expected land value from the actual one:

$$DP_i(t-1,t) = P_i^t - P_i^{t-1} * MP^t / MP^{t-1} \quad (1)$$

Where, P_i^t is the land value at observation point i in year t, MP^t is the average land value in the Okayama metropolitan area, and $DP_i(t-1,t)$ is the effect of Seto Ohashi Line on land value. If $DP_i(t-1,t)$ is positive, it means that the effect of railroad construction exists at observation point i in the period between t–1 to t.

In the second analysis, a land–value estimation function is estimated for the study period. The function is defined by a linear multiple regression equation, and estimates the land value at each observation point with various factors on residential attractiveness. The effect of railroad construction is measured by calculating land value with the function using data before and after the construction. The property value method is based on the theory of urban economics, which has proved theoretically that all benefits from a railroad construction are finally transferred to the property value.

5. RESULT OF THE ANALYSIS

5.1 Result of the area comparison method

Table 3 shows the effect of JR Seto Ohashi Line on residential land value, which is estimated with the equation (1). Fig.3 shows the average effect along the Seto Ohashi Line during the study period, which is shown in Table 3. The expected land value exceeded the actual one in the section between Nishiichi and Kojima Stations during 1984 to 1986. The fact shows that a clear

Table 3 The difference between the actual and the expected land values by station for 1976 to 1990

Station	Number of observations	Period										Summation of 1984-86
		1976-1978	1978-1980	1980-1982	1982-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	
Okayama	3	n.a.	n.a.	n.a.	-18876	-1111	-1310	-774	-2528	99	5679	n.a.
Ohmoto	1	-2360	-1295	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Nishiich	8	-2470	-1406	-7612	-4654	741	278	-848	1326	10132	56230	1019
Seno	7	-1721	-2139	-5020	-4061	311	171	-471	-1135	-4474	-3788	482
Minoshima	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Hayashima	6	-1458	-1614	-3280	-4233	660	341	241	-598	-2289	-10749	1242
Chayamachi	5	-1343	-1528	n.a.	-4862	271	90	-277	-577	-270	-12254	361
Uematsu	3	-1772	-1515	-3212	n.a.	104	243	-126	-590	-3591	-11329	346
Kimi	2	n.a.	-1454	-3514	n.a.	331	446	64	-995	-4002	-12805	842
Kaminocho	7	-1399	-1318	n.a.	-5876	793	341	-387	-1453	-5270	-15116	1134
Kojima	4	n.a.	-2642	-5240	-5386	586	348	-310	-1403	-5692	-17639	934
Average	—	-1815	-1659	-4644	-7102	415	156	-364	-664	-1520	-5688	571

Note: n.a. (not available)

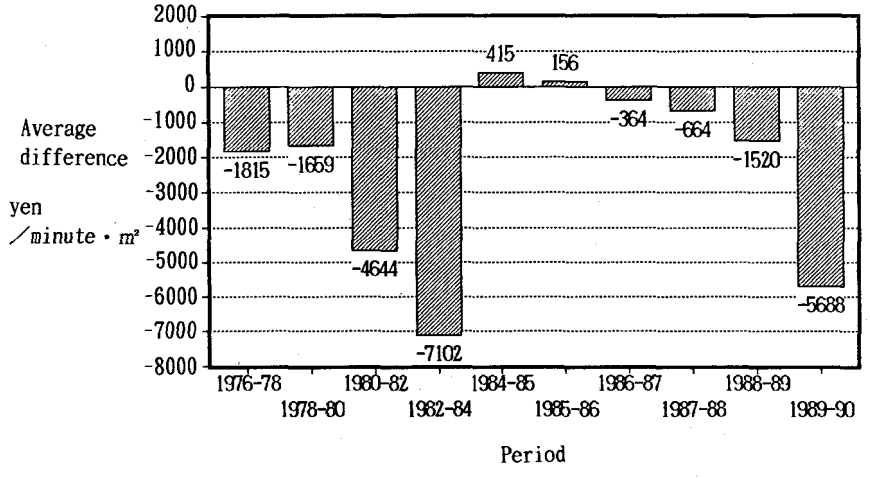

Fig.3 Average difference between the actual and the expected land values

effect on land value occurred during the construction period of Seto Ohashi Line. However, the effect is not very large, and turned to be negative at most of the stations in 1986–1987.

Large positive effect existed at Nishiichi Station in the period 1987–1990. However, it was due to the spread of land value increases from large cities to the central part of Okayama City, and was not directly related to the construction of JR Seto Ohashi Line.

5.2 Result of the property value method

The land–value estimation function is calibrated by applying the multiple regression analysis to the pooling data for 1976 to 1990. Table 4 shows the result of calibration. The travel time from Okayama Station is the most significant factor among the explanatory variables. The fact means that the travel time has a great influence on the property value along the Seto Ohashi Line.

The parameter of time distance from Okayama Station shows that the land value per one minute of travel time to Okayama Station is 1,373 yen/m^2 (in 1990 price). That is, if the time distance to Okayama Station is reduced by one minute, it increases the property value in a residential area by 1,373 yen/m^2.

5.3 Comparison of the results with other studies

Table 5 and Fig.4 show the comparison of the effect on residential land value at each station, which is estimated by the two methods in this study. There is a significant difference between the results. For example, the travel time from Kojima Station to Okayama Station has been shortened by 12.3 minutes. According to the result of property value method, the residential land value at Kojima Station is expected to increase by 16,888 yen/m^2. However, the area comparison method estimates that the effect was 934 yen/m^2.

Hidano et al. [4] examined the impact of railroad construction on land value in the Greater Tokyo Region. They applied the area comparison method and the property value method to three railroad lines. According to the results, the effect estimated by the former method exceeds the one by the latter method. However, compared with the results in this study, the difference between the results of two methods is small. It is probably due to the differences of population density and the housing demand between Okayama City and the Greater Tokyo Region. As the area along the Seto Ohashi Line is not very urbanized, the housing demand has not become large enough to increase the actual land value.

Table 4 Residential land-value regression using the pooling data for 1976 to 1990

Explanatory variable	Unit or values of explanatory variable	Estimated parameter (T-statistics)
Travel time to Okayama Station	Minutes	-1373 (-6.8)
Width of facing road	Meter	1801 (2.1)
Dummy variable on gas supply	Yes = 1 No = 0	4502 (1.5)
Dummy variable on sewage supply	Yes = 1 No = 0	13179 (3.8)
Dummy variable on Kojima area	Kojima area = 1 Others = 0	23559 (5.8)
Dummy variable for year 1976	1976 = 1 Others = 0	-48786 (-11.6)
Dummy variable for year 1978	1978 = 1 Others = 0	-47104 (-11.3)
Dummy variable for year 1980	1980 = 1 Others = 0	-43966 (-10.4)
Dummy variable for year 1982	1982 = 1 Others = 0	-35416 (-8.4)
Dummy variable for year 1984	1984 = 1 Others = 0	-25385 (-6.1)
Dummy variable for year 1985	1985 = 1 Others = 0	-26054 (-6.5)
Dummy variable for year 1986	1986 = 1 Others = 0	-23038 (-5.6)
Dummy variable for year 1987	1987 = 1 Others = 0	-21882 (-5.3)
Dummy variable for year 1988	1988 = 1 Others = 0	-18200 (-4.4)
Dummy variable for year 1989	1989 = 1 Others = 0	-19375 (-4.8)
Constant		90424 (15.7)
Adjusted R^2		0.606
Number of observations		320

Table 5 Comparison of estimated effects of Seto Ohashi Line on residential land value by station

Station	Distance from Okayama Station (km)	Travel time from Okayama Station (minutes)			Estimated effect on land value (yen/m²)	
		Before opening	After opening	Change in time	Area comparison method	Property value method
Okayama	0.0	0.0	0.0	0.0	n.a.	n.a.
Ohmoto	2.4	4.0	3.0	1.0	n.a.	1,373
Nishiichi	4.5	7.0	6.0	1.0	1,019	1,373
Seno	8.3	11.0	7.0	4.0	482	5,492
Minoshima	10.2	14.0	12.0	2.0	n.a.	2,746
Hayashima	11.9	17.0	14.0	3.0	1,242	4,119
Kuguhara	13.2	20.0	16.0	4.0	n.a.	5,492
Chayamachi	14.9	15.0	13.0	2.0	361	2,746
Uematsu	17.8	23.3	21.0	2.3	346	3,158
Kimi	20.5	27.3	24.0	3.3	842	4,531
Kaminocho	24.6	33.6	29.0	4.6	1,134	6,316
Kojima	27.8	37.3	25.0	12.3	934	16,888

Note: n.a. (not available)

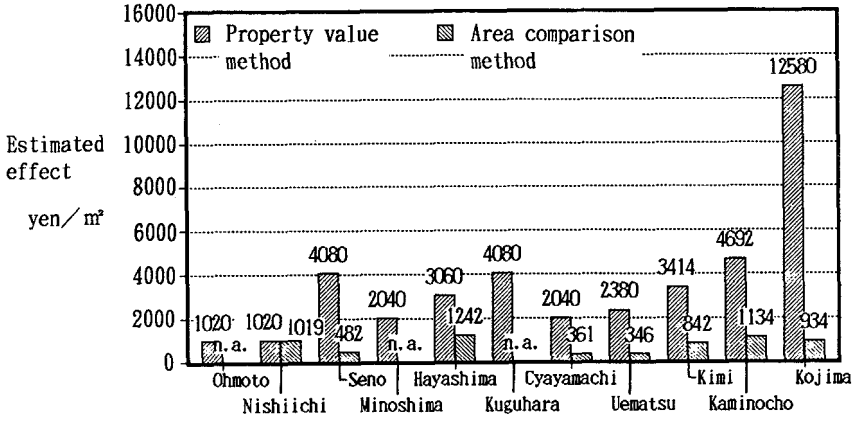

Fig.4 Comparison of estimated effects by station

6. CONCLUSIONS

The fact findings in this study have revealed that the impact of JR Seto Ohashi Line on residential land value is rather small, compared with other cases in the Greater Tokyo Region. Furthermore, there is a significant difference between the results of the area comparison method and the property value method. The latter method estimates the effect at the equilibrium stage, where the effect of railroad construction is completely transferred to the property value. In the area along the Seto Ohashi Line, the level of urbanization is not very high, and the housing demand is not very large. Therefore, the increases in property value did not immediately lead to the rises in actual land value.

REFERENCES

(1) Polinsky, A.M. and Rubinfield, D.L., Property values and the benefits of environmental improvements, theory and measurement, Public Economics and the Quality of Life, Wingo, L. and Evans, A., Eds., John Hopkins Univ. Press (1977).

(2) Wheaton, C., Residential decentralization, land rents, and the benefits of urban transportation investment, The American Economic Review, Vol.67 (1977), pp.138–143.

(3) Starrett, A., Land value capitalization in local public finance, Journal of Political Economy, Vol.89 (1981), pp.308–327.

(4) Hidano, N., Nakamura, H., Aratsu, Y. and Nagasawa, K., The estimation of capital gains of property value for equitable cost bearing of urban railway improvement, Proceedings of the Japan Society of Civil Engineers, No.365 (1986), pp.135–144. (in Japanese)