

A Study of Economic Valuation of a Community Bus Service Operated in an Island - Case Study of “The Oto-Hime Bus” in the Osaki-Kamijima Island in Japan -

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Abstract: In many of the rural areas in Japan, community bus services have been operated to improve the mobility of elderly people. However, many of them are in deficit and are operated by receiving a subsidy from the local government. This subsidy has given the governments financial difficulties. Because of this, it is necessary to examine validity of the subsidy to the service by analyzing economic valuation of the service and so on. In this study, the community bus of the Osaki-kamijima Island called the Oto-Hime Bus is analyzed on the basis of the questionnaire survey we carried out. Through the analyses, economic value of the bus and degree of its contribution to various things of the island are revealed. It is also shown that contributions of the bus to various things like vitalization of the island can influence its economic valuation.

Keywords: Rural area, Community Bus, Economic Valuation, CVM (Contingent Valuation Method)

1. INTRODUCTION

Many of the rural areas in Japan have suffered from depopulation and population aging. In some of these areas, the percentages of the people who are more than or equal to 65 years old have already been more than 40% and will be increasing more in the future. When elderly people will age more, it will be very difficult for many of them to drive a car and the people who can't drive a car will increase. Because of this, it will be very important to improve the mobility for them in the rural areas. In order to improve the mobility for elderly people in the rural areas, community bus services have begun being operated in some areas. However, many of these bus services have been used by few people and have been operated in deficit. For these reasons, these services have been operated by being given a subsidy from the local governments.

Many of these local governments have difficulties to give the subsidy to their community bus services because they are in financial difficulty. Because of this, they have to examine the validity of the subsidy for their community bus services, such as whether they should give the subsidy to the service or not, or how much subsidy they should give to them.

In general, the validity of the subsidy to public transportation like community bus service should be considered on the basis of degree of contribution of the service to the area and its economic valuation. Then, in this study, the Oto-Hime Bus, which is operated in the Oaki-Kamijima Island in Japan, is taken for an example, and degree of its contribution to the island and its economic valuation from point of view of the islanders is analyzed on the basis of the questionnaire survey we carried out to the people who live in the Osaki-Kamijima

Island. In addition, effect of contribution of the bus to the island on its economic valuation is also analyzed.

The Osaki-Kamijima Island that is the study area is located in the middle of the Seto-Inland Sea in Japan and has suffered from depopulation and population aging. In this island, the Oto-Hime bus has been operated to improve the mobility of the elderly people. The Oto-Hime bus service has been operated by being given the subsidy of 18.5 million to 19 million yen a year (205 thousand to 220 thousand us\$ a year) because of few users of the bus. This subsidy to the service has been criticized because it is said that many islanders have never used this service. Because of this, examination of the validity of the subsidy is required and this validity is discussed as follows in this paper.

First, outline of the Osaki-Kamijima Island which is the study area and the Oto-Hime Bus are given.

Second, the questionnaire survey which was carried out in this study is explained and characteristics of the data obtained from this survey are discussed.

Third, we analyze to what the bus contributes in this island and also reveal the necessity for the bus. On the basis of this analysis, we try to extract latent factors lying behind an evaluation of degree of contribution of the bus service to the island by employing Factor Analysis. In general, validity of subsidy to public transportation tends to be decided by the number of the users but public transportation often contributes to various things other than improvement of the mobility for the people in the area and it is necessary to consider these contributions when validity of subsidy to public transportation is examined. Through the analyses of this section, it is shown that Oto-Hime Bus contributes to some things other than improvement of the mobility and the islanders have latent factors to evaluate contributions other than as means of transportation.

Next, economic valuation of the Oto-Hime Bus service is analyzed by employing CVM (Contingent Valuation Method). Through the analyses, validity of the subsidy to the Oto-Hime Bus is considered and we also examine effect of the extracted factors lying behind an evaluation of degree of contribution of the bus service on its economic valuation by the islanders. From this analysis, it is shown that contributions other than as means of transportation can give an effect to the economic value of the Oto-Hime Bus.

Finally, the results from this study are summarized and further research is described.

Some researches for economic valuation of public transportation like this study have existed because many of the public transportation that are operated in rural areas or cities in Japan are in deficit and have been given a subsidy from local governments. Ohno *et al.* (2006) analyzed economic valuation of the regular bus in Maebashi City. Oh-I *et al.* (2000) analyzed that of the regular bus in Asahikawa City. Both of them targeted the regular bus of the nucleus city in the local area and are different from this study the target of which is a community bus in the small island the population of which is less than 10 thousand. In addition, not only economic valuation of the community bus but also effect of contribution of the bus to the island on its economic valuation is analyzed in this study. Academic contribution and distinctions of this study is these analyses that weren't analyzed in previous two researches.

2. OUTLINE OF THE STUDY AREA

Figure-1 shows the location of the Osaki-Kamijima Island that is the study area. The Osaki-Kamijima Island is located in the middle of the Seto-Inland Sea in Japan, about 10km off the coast of Takehara City that is the nearest city in the main island to the island. Table-1 indicates an outline of the Osaki-Kamijima Island. The population of the Osaki-Kamijima

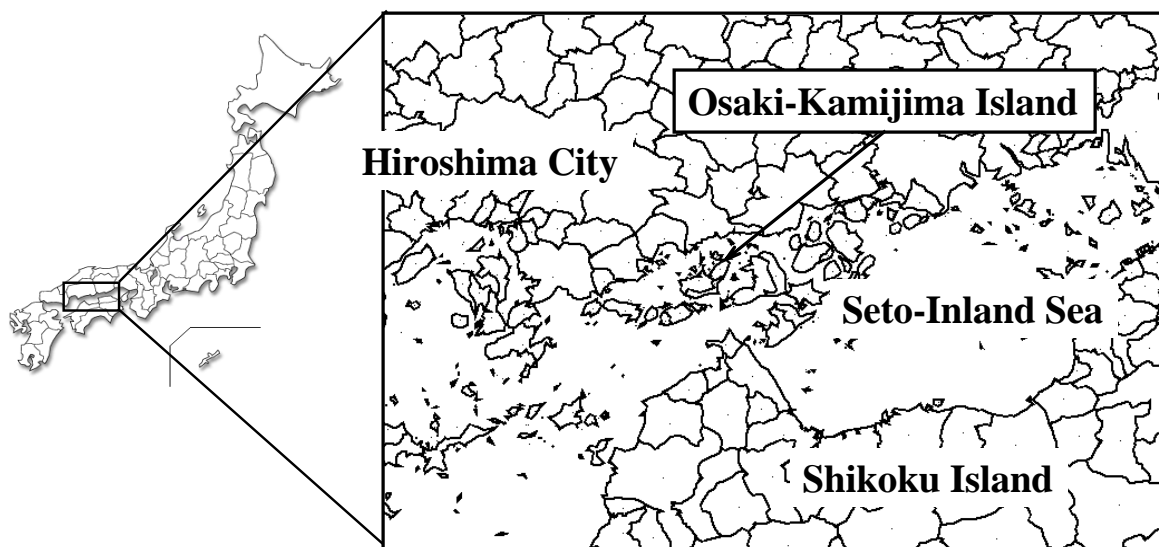


Figure-1 Study Area

Table-1 Outline of the Osaki-Kamijima Island

Location	The middle of the Seto-Inland Sea
Gross Area	43.3km ²
Population	8,474 (in 2011)
Percentage of the People Who Are More Than or equal to 65 Years Old	43.7% (in 2011)
Public Transportation	Bus Services, Community Bus Services, Ferry Lines and Rapid Boats

Island is 8,474 in 2011. 43.7% of the people in the island are more than or equal to 65 years old. Its area is about 43km².

Although the private regular bus service is operated in the island, many people don't use this bus because of its expensive fare and few services. For this reason, almost all people depend on cars for the mobility in the island. In addition to this situation, there is possibility that this bus service will be stopped because the subsidy to the bus will be stopped

In this island, the percentage of the elderly people is increasing dramatically and the elderly people for whom it is difficult to drive a car for their aged are also increasing. For a measure for these problems, especially in order to retain the mobility of the elderly people, the community bus service called 'The Oto-Hime Bus' has begun operating in 2005. The Oto-Hime Bus consists of 6 routes. Some of these routes are same as those of the private bus service but some are different in order to link to some areas the private bus does not service. 6 services a day are operated for the route that has the most frequent services. Its fare is uniformly 200 yen (2.2 us\$). Except for Saturday, about 75 people a day use the bus service. On Saturdays, about 112 people a day use it. Almost all passengers of the bus are elderly people who are more than or equal to 65 years old. More than 30% of the passengers use the bus to go shopping and more than 20% of them use it to go to hospital. On the other hand, it is said that more than 90% of the islanders have never used the Oto-Hime Bus. Moreover, while it costs more than 24 million yen a year (266.7 thousand us\$ a year) to operate the Oto-Hime Bus, the receipt from its fare is no more than 6 million yen a year (66.7 thousand us\$). Under this situation, the local government in the island gives a subsidy of nearly 18.5 million to 19

million yen a year (205 thousand to 220 thousand us\$ a year) to the Oto-Hime Bus service. This situation requests that the validity of the subsidy to the Oto-Hime Bus service, whether they should give the subsidy to the service or not and how much subsidy they should give are examined.

3. QUESTIONNAIRE SURVEY AND DATA

3.1 Outline of the Questionnaire Survey

In this study, a questionnaire survey was conducted on the Osaki-Kmijima Island. The outlines of the survey and characteristics of the data obtained from the survey are explained in this chapter.

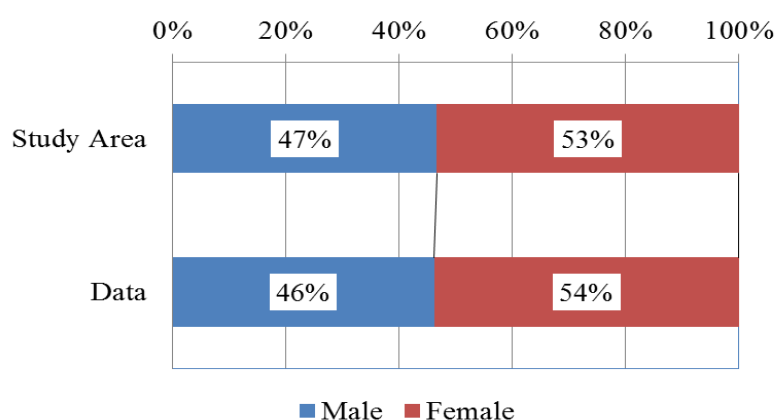
We carried out the questionnaire survey to the people who live in the Osaki-Kamijima Island with cooperation of the Community Union of the Island in November 2009. The questionnaire sheets were distributed by the representatives of each community to 300 people who were chosen from each community at random. The purpose of this survey is to examine attitude of the people toward The Oto-Hime Bus and travel behavior of the people to the outside of the island. The main contents of the questionnaire are as follows.

- (1) Profile of the respondents (gender, age, residential area and so on)
- (2) Travel behavior to the outside of the island, such as frequency of leaving the island and means of transportation which is used in going out of the island
- (3) Evaluation of the respondents about the ferry boat services and rapid boat service which run between the island and the main island
- (4) Degree of the contribution of 'The Oto-Hime Bus' to the Osaki-Kamijima Island
- (5) Economic evaluation of the respondents about 'The Oto-Hime Bus'

In this study, (4) and (5) are analyzed mainly.

3.2 Data

282 of questionnaire sheets were collected and 231 sheets of the respondents who are more than 18 years old and responded to all items used in the analyses of this study are analyzed in



Chi-Square / Degree of Freedom = 0.003 / 1
 Observed Significance Level = 0.950

Figure-2 Data Characteristic (Gender)

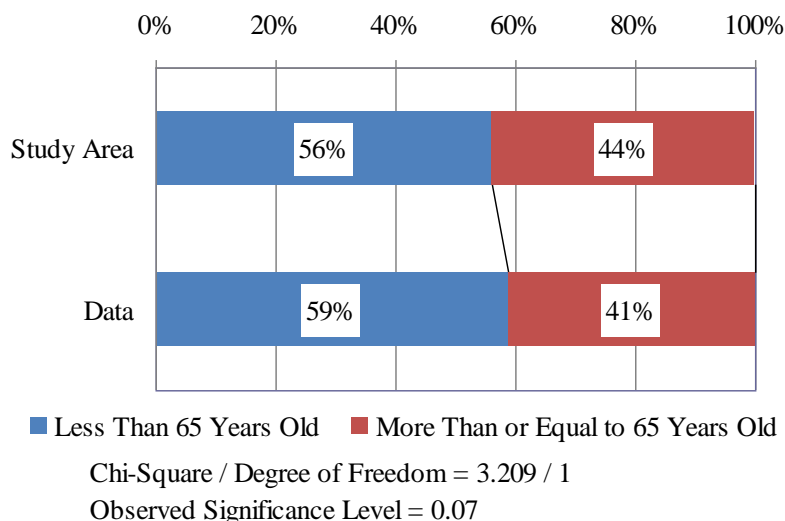


Figure-3 Data Characteristic (Age)

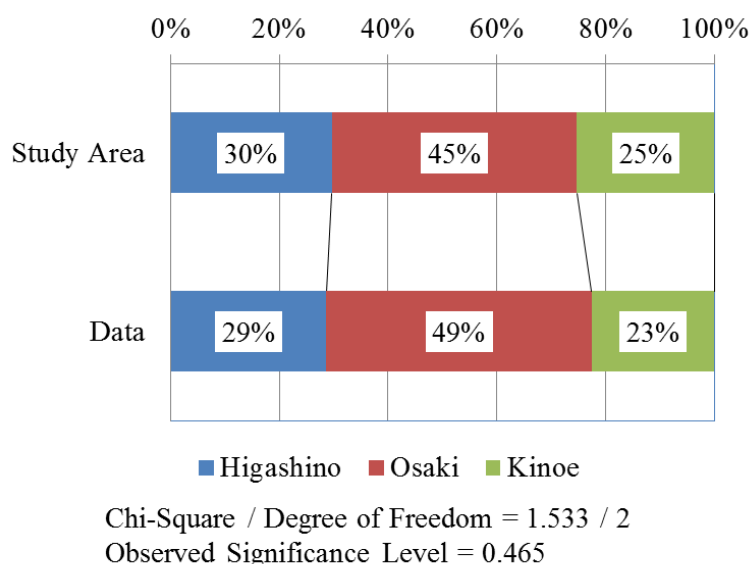


Figure-4 Data Characteristic (Residential Areas)

this study. In this section, we examine characteristics of the obtained data by comparing a gender ratio, ratio of people who are more than or equal to 65 years old and place of respondents' residence from obtained data with these actual stats from the population of more than 18 years old in the Osak-Kamijima Island. Figure-2 to 4 shows the results from these analyses. In these figures, the results of the Tests for Goodness of Fit to examine whether there are statistical differences between the stats from the obtained data and actual stats of the island are also shown.

Figure-2 shows the result from the analysis about these gender ratios. This figure indicates that the percentage of male of the data is 46%, which is almost same as the percentage of male of actual stats, which is 47%.

According to Figure-3 that shows the analysis of the ratio of people who are more than or equal to 65 years old, the percentage of more than or equal to 65 years old respondents is 41%. The percentage of more than or equal to 65 years old people who live in the Osaki-Kamijima Island is 44%. Thus, the percentage of more than or equal to 65 years old respondents is almost same as the actual percentage.

The Osaki-Kamijima Island consists of three areas: one is Higashino, another is Osaki and the last is Kinoe. In Figure-4, the percentages from each area are compared. 30% of the people in the island live in Higashino. 45% of the people are in Osaki. 25% live in Kinoe. 29% of the respondents of the questionnaire survey live in Higashino. 49% and 23% of the respondents are from Osaki and Kinoe.

In addition to these results, the significance probability of the Tests of Goodness of Fit of all analyses above indicates more than 0.05. For this reason, the statistical differences between these stats from obtained data and the stats from the island aren't recognized.

From these results, the data obtained from the questionnaire survey doesn't have a bias and also has the same characteristics as the population of the Osaki-kamijima Island has. In this study, we analyze the data as described above.

4. ATTITUDE ANALYSIS OF CONTRIBUTION OF THE BUS SERVICE TO THE ISLAND AND NECESSITY

4.1 Contribution of the Bus Service to the island

In this section, we analyze to what of the island the Oto-Hime Bus contributes. On the questionnaire sheets we distributed, ten items the Oto-Hime Bus may contribute to and the item to ask degree of contribution of the bus as total of these ten items are designed. On all of these items, degree of the contribution is rated into five levels like "Large Contribution", "Small Contribution", "neutrality", "Little Contribution" and "No Contribution"

Figure-5 shows the results from analysis of these items. This figure indicates that more than 50% of the respondents answered "Large Contribution" or "Contribution" to the items of "As a Means for Elderly People and Handicapped People", "As a Means of Transportation to Go to Hospital and Public Facilities" and "As a Means of Transportation to go shopping". It is also shown that more than or nearly 50% of them answered "Large Contribution" or "Contribution" to the items of "To Improvement of Impression of the Island", "To Reduction of Burden of Driving Their Family Member To and Fro" and "To Vitalization of the Island". From these results, it is recognized that the Oto-Hime Bus not only contributes to improvement of mobility as means of transportation but also contributes to

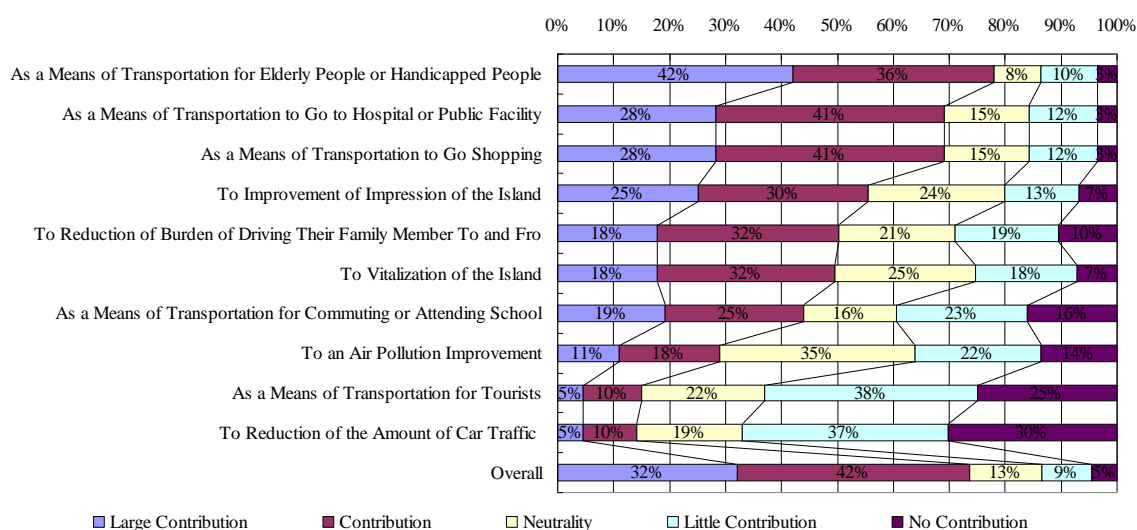


Figure-5 Analysis of the contribution of the Oto-Hime Bus

various things, like the vitalization, improvement of the impression of the island and so on, other than as means of transportation.

In addition, the percentage of the respondents who responded “Large Contribution” or “Contribution” to “Overall” is more than 70%. Thus, many of the respondents recognize contribution of the Oto-Hime Bus to the island.

4.2 Extracting Latent Factors for Evaluation of Contribution of the Bus Service

Next, we try to extract latent factors lying behind an evaluation of degree of contribution of the bus service to the island by employing Factor Analysis. In this analysis, ten items except for “Overall” analyzed in Figure-5 are used. Table-2 shows Factor Analysis of Contribution of the Oto-Hime Bus

As the result, two factors, Eigen Values of which are more than 1.0, are extracted, and the total contribution ratio of these two factors amounts to about 56.4%. Table-2 indicates the factor loading obtained from this analysis. Although there is an idea that factor loading which are more than 0.3 or 0.4 should be considered as meaningful, loading scores that are more than 0.5 were considered as meaningful in this analysis because we thought that correlation coefficients between extracted factor and the variables (or items), which mean factor loading, are too small at less than 0.5. From this result, in the Factor-1, “As a Means of Transportation to Go to Hospital and Public Facilities”, “As a Means for Elderly People and Handicapped People” and “As a Means of Transportation to go shopping” have large factor loadings which are more than 0.5. From this result, the Factor-1 is thought to mean “contribution as a means of transportation”. And the Factor-2 can be recognized to mean contribution to vitalization and improvement of impression of the island, which is not contribution as means of transportation the Oto-Hime Bus originally has, because “To Improvement of Impression of the Island” and “To Vitalization of the Island” have large factor loadings that are more than 0.5.

Thus, the islanders have the factor to evaluate the Oto-Hime Bus by degree of contribution to vitalization and improvement of impression of the island, as well as the factor to evaluate the Oto-Hime Bus as means of transportation.

Table-2 Factor Analysis of Contribution of the Oto-Hime Bus

Items	Factor 1	Factor 2
As a Means of Transportation to Go to Hospital or Public Facility	0.836	0.290
As a Means for Elderly People or Handicapped People	0.828	0.288
As a Means of Transportation to Go Shopping	0.732	0.274
To Reduction of Burden of Driving Their Family Member To and Fro	0.509	0.501
To an Air Pollution Improvement	0.277	0.761
As a Means of Transportation for Tourists	0.148	0.681
To Vitalization of the Island	0.493	0.648
To Improvement of Impression of the Island	0.486	0.564
As a Means of Transportation for Commuting or Attending School	0.414	0.468
To Reduction of Car Traffic Volume	0.194	0.425
Contribution Ratio (%)	29.7	26.7
Cumulative Contribution Ratio (%)	29.7	56.4

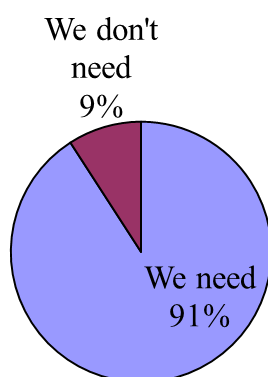


Figure-6 Necessity of the Oto-Hime Bus

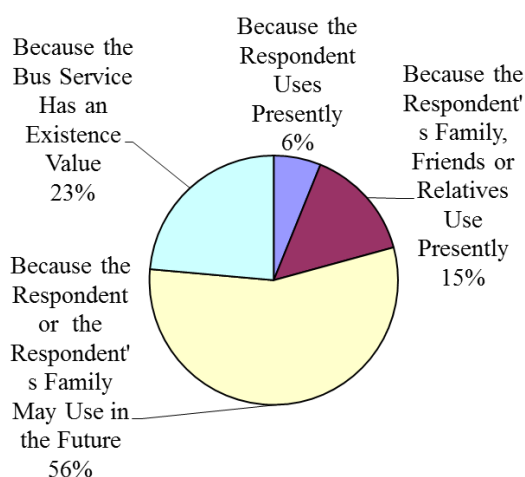


Figure-7 Reasons for Necessity of the Oto-Hime Bus

4.3 Necessity for the Bus Service

In this section, the necessity for the Oto-Hime Bus service and the reasons for its necessity are analyzed. Figure-6 shows about the necessity of the bus service. In this figure, more than 90% of the people responded that the bus service was necessary. It is shown that almost of the islanders understands the necessity for the Oto-Hime Bus service.

Figure-7 indicates the result from the analysis of the reasons why the bus service is necessary. The respondents who answered that the bus service was necessary in the analysis above are targeted at this analysis. In this figure, it is found that as many as 56% of the respondents answered “Because the Respondent or the Respondent's Family May Use in the Future” while the percentage of the respondents who answered “Because the Respondent Uses Presently” or “Because the Respondent's Family, Friends or Relatives Use Presently” is only 21%. Thus, many of the islanders think the Oto-Hime Bus is necessary in the island because of their future use rather than because of their present use. In addition, it is recognized that the Oto-Hime Bus has not only the utility value described above but also an

Table-3 Patterns of Asking Price Designed for CVM

	The First Asking Price	The Asking Price in Case That the First Price Was Refused	The Asking Price in Case That the First Price Was Accepted
Pattern 1	¥1,000	¥500	¥2,000
Pattern 2	¥2,000	¥1,000	¥3,000
Pattern 3	¥3,000	¥2,000	¥4,000
Pattern 4	¥4,000	¥3,000	¥5,000

existence value because 23% of the respondents answered “Because the Bus Service Has an Existence Value”.

5. ANALYSIS OF ECONOMIC VALUATION OF THE BUS SERVICE

5.1 Survey for Economic Valuation by Employing CVM

In this chapter, an economic valuation of the Oto-Hime Bus is analyzed by employing CVM (Contingent Valuation Method). On the questionnaire sheets, there are the questions to examine an economic valuation of the bus, which are designed in order to analyze by employing CVM. On the questionnaire sheets, under the assumption that the operation of the Oto-Hime Bus service will be stopped, how much the respondents are willing to pay to keep operating the bus service are asked (Willingness to pay : WTP), showing 24 million yen a year (266.7 thousand us\$ a year) is needed to operate the bus service. The Double-Bounded Dichotomous Choice Method was adopted for the questions for CVM. In the Double-Bounded Dichotomous Choice Method, the questions about the price the respondents are willing to pay are divided into two stages: at the first stage, whether a respondent is willing to pay the price set in advance is asked. At the second stage, if the respondent can pay the first price, whether the respondent is willing to pay the higher price than the first one is asked. And if the respondent can't pay the first price, whether the respondent can pay lower price is asked. In actual survey, several patterns of questionnaire sheet that has the questions set in this way were designed and were distributed at random. In this study, four patterns of the questionnaire sheets and the questions of each pattern were designed by following the Double-Bounded Dichotomous Choice Method. Table-3 indicates the question items by the pattern that are designed and Figure-8 shows the percentage of each pattern in all collected sheets. According to this figure, the percentage of each pattern is about 25% and it is

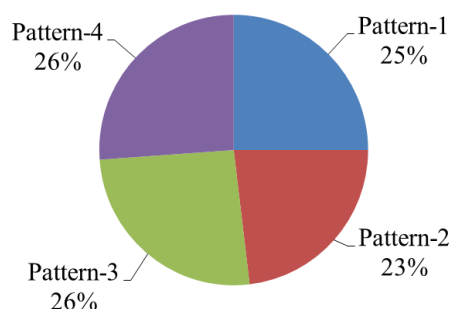


Figure-8 Percentage of Each Pattern of Asking Price

Table-5 Weibull Regression Model for CVM

Parameter	Estimate	T-Value
Location	7.86	129.0**
Scale	0.79	11.8**
Log-Likelihood	-317.74	
AIC	639.47	

Note: “**” means significant at significance level 1%



Figure-9 Percentage of Each Pattern of Asking Price

recognized that every pattern was collected about equally.

In addition to this, it was found that no respondents who answered that we don't need the bus on the analysis of Figure-7 answered that they pay the money designed in these question items for keeping operation of the bus. This result shows the validity of data obtained from the questionnaire survey.

5.2 Economic Valuation of the Bus Service by Employing CVM

Next, economic valuation of the Oto-Hime Bus service is analyzed by employing CVM. In CVM, economic valuation is analyzed by building a model to estimate the probability of the people who are willing to pay an asking price designed for the survey (Prob(WTP>Asking Price)). In general, Logistics Regression Analysis or Weibull Regression Analysis is used to build this model. In this study, Weibull Regression Analysis was used because of its ease to build a model that fits the data.

Table-5 indicates the results of the built model and the curve of Prob(WTP>Asking Price) is shown in Figure-9. According to this table, the results from T-Test of Location Parameter and Scale Parameter show that these parameters are significant at 1% of a significance level and the signs of these parameters are suitable.

From the result of this built model, the mean and median of the price the respondents are willing to pay (WTP) was calculated and are shown in Table-6. This table indicates that

Table-6 Mean and Median of WTP

Mean	Median
2247.6Yen/Year	1944.3Yen/Year

the mean of WTP is 2247.6Yen/Year (25.0 us\$/year) for each person and the median is 1944.3Yen/Year (21.6 us\$/year) for each person.

These results are compared with the cases of other bus services, one of which is the case of the bus service in Asahikawa City in Japan (Oh-i *et al.*, 2000) and another case is the bus service in Maebashi City (Ohno *et al.*, 2006). In the case of Asahikawa City, economical valuation of the regular bus service was analyzed by using PSM (Price Sensitivity Measurement). From this result, the Indifferent Price of the bus service was about 3,200 yen/year (35.6 us\$/year) for each household. In the case of the Maebashi City, the regular bus service was analyzed by using CVM. This result indicated that the economical valuation of the bus service except for the people who think subsidy was unnecessary to maintain the bus service was from 2,600 yen/year (28.9 us\$/year) for each household to 3,000 yen/year (33.3 us\$/year) for each household.

The average household size of the Osaki-Kamijima Island is about 1.99 and the mean of the value of the Oto-Hime Bus was 2247.6Yen/Year (25.0 us\$/year) for each person from the previous analysis. Then, the mean of the economic value for each household of the Oto-Hime Bus is calculated at 4671.7yen/year (51.9 us\$/year). This value is larger than the value of the bus of Asahikawa City and Maebashi City. Thus, it can be recognized that the people of the Osaki-Kamijima Island rate the Oto-Hime Bus highly although there are some different parts between the Oto-Hime Bus and the cases of Asahikawa City and Maebashi City, such as the situation where these bus services are operated and the analysis method.

The total of the economic value of the Oto-Hime Bus can be calculated on the basis of the mean of WTP, which is about 2247.6Yen/Year (25.0 us\$/year) for each person from the previous analysis. The number of the people who are more than 18 years old in the Osaki-kamijima Island, who can work and can pay tax, is less than 7,900. Therefore, the total of the economic value of the Oto-Hime Bus is about 17.8 million yen/year (197.8 us\$/year). The subsidy to the Oto-Hime Bus was 18.5 million yen/year to 19.0 million yen/year (205 thousand to 220 thousand us\$ a year) for the last some years. The total of economic value of the bus, which is about 17.8 million yen/year (197.8 us\$/year), is less than the subsidy to the bus for the last some years although the islanders have a high valuation to the bus. Thus, the subsidy to the Oto-Hime Bus that was carried out at present is slightly expensive for the island. Because of this, they need to cut down the cost of the bus or review its operation such as fare and the number of the services to increase the users or the profits.

5.3 Evaluation of Contribution of the Bus Service and Economic Valuation

Next, influence of evaluation of contribution of the Oto-hime Bus on its economic valuation is analyzed. In this analysis, a new model is built by adding the factor scores that are

Table-7 Weibull Regression Model Including the Extracted Factors

Parameter	Estimate	T-Value
Location	7.84	131.0**
Scale	0.77	11.9**
Factor 1	0.18	2.65*
Factor 2	0.11	1.99*
Log-Likelihood	-294.96	
AIC	597.92	

Note:*** means significant at significance level 1%

calculated on the basis of the two factors extracted by factor analysis of Table-2 as the independent variables to the model built in analysis of Table-5.

Table-7 shows the model built in the way to describe above. In this table, both of the estimates of Factor-1 and Factor-2 are shown to be significant at 5% of a significance level and also positive number. From this result, it is recognized that both of Factor-1 and Factor-2 can give a positive influence to economic valuation of the Oto-Hime Bus. Factor-1 means “contribution as a means of transportation” from the analysis above. Then, the more highly people rate the Oto-Hime Bus as a means of transportation, the more highly they value the bus economically. In addition to this, a high opinion of contribution to vitalization and improvement of impression of the island can make an economical value of the Oto-Hime Bus high because Factor-2 means “contribution to vitalization and improvement of impression of the island”. Thus, not only contribution of the bus as a means of transportation but also contribution to vitalization of the island and so on that are not as a means of transportation can give a positive influence to its economic valuation. This result shows that amount of the subsidy to the bus shouldn't be evaluated on the basis of only the number of the users

6. SUMMARY

In this study, on the basis of the questionnaire survey that was carried out to the people living on the Osaki-Kamijima Island, contribution, necessity and economic valuation of the Oto-Hime Bus were analyzed. The main findings of this study are as follows.

- 1) Contribution of the Oto-Hime Bus to the island is analyzed. From this result, it is shown that the Oto-Hime Bus not only contributes to the island as a means of transportation but also contributes to revitalization and improvement of the impression of the island. And we extracted two latent factors lying behind an evaluation of degree of contribution of the bus by employing Factor Analysis: one is the factor that means degree of the contribution as a means of transportation and another is the factor that means contribution to vitalization and improvement of impression of the island.
- 2) We analyzed the necessity and its reasons of the Oto-Hime Bus. From these results, it was shown that many of the islanders thought that the Oto-Hime Bus was necessary in the island because of rather its future use than the present use.
- 3) Economic valuation of the Oto-Hime Bus was analyzed by employing CVM. This result showed the mean and median of its WTP are 2247.6Yen/Year for each person and 1944.3Yen/Year for each person. Although these values were higher than other cases, the total of the economic value of the bus was shown to be smaller than its subsidy.
- 4) Using CVM and two factors extracted by the previous factor analysis, influence of evaluation of contribution of the bus service on its economic valuation was analyzed. This result revealed that not only contribution of the bus as a means of transportation but also contribution to vitalization of the island and so on could affect its economic valuation.

For the further research, it is necessary to find out an operation of the Oto-Hime Bus that corresponds to its economic value, such as fare and the number of services. The validity of the subsidy to the bus was analyzed from a point of view of the islanders in this study but it also should be analyzed from a point of view of the finances of the Osaki-Kamijima Town. For this reason, it is expected that the validity of the subsidy to the bus is examined from this point of view by comparing its importance with that of other infrastructure and measures to support the island.

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