A Study of Economical Valuation of a Passenger Boat Line in deficit - Case Study of Rapid Boat between the Osaki-Kamijima Island and the Main Land in Japan -

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Abstract: Many of the rural areas in Japan, especially small islands, have suffered from depopulation and population ageing. These depopulation and population ageing have caused various problems. In the small islands, one of most important problems is a decrease in the number of the people who use passenger boat lines that connect between these islands and the mainland. The decrease in the users of these lines has made the lines fall into the verge of closing their services. Because of this, some of them are already given subsidy from the local governments, many of which have financial difficulties, in order to maintain their services. Validity of such a subsidy and an amount of it has to be investigated on the basis of contribution of the line to the areas and its economical valuation. The rapid passenger boat line connecting the Osaki-Kamijima Island and the mainland, which is the target of this study, has been in deficit and operated by being given the subsidy from the local government. In this study, economical valuation and contribution of this line to the island are analyzed on the basis of a questionnaire survey we carried out. From these results, validity of this subsidy to the line is examined.

Keywords: Rural Area, Passenger Boat, Economical Valuation, CVM (Contingent Valuation Method)

1. INTRODUCTION

There are many small islands in Seto-Inland Sea in Japan. Most of these islands have suffered from depopulation and population aging. The depopulation and population ageing of these islands have caused the number of the people who use passenger boat lines which connect between these islands and the mainland to decrease dramatically. Because of this, some of the lines have been on the verge of closing their services and some of them are already given subsidy from the local government in order to maintain their services. Most of the local governments of these islands have had financial difficulties and the subsidy has been one of the important problems. For these reasons, validity of such a subsidy and an amount of it has to be considered.

The Osaki-Kamijima Island, which is the study area, is located in the middle of the Seto-Inland Sea in Japan and has suffered from depopulation and population aging. There are three ferry lines and one rapid passenger boat line that connect the Osaki-Kmijima Island with the mainland. The depopulation and the population ageing of this island have caused the number of the users of these lines to be decreased. Especially, the company of the rapid passenger boat line went into deficit due to decrease in its users and it was discussed whether the service of the rapid passenger boat should be stopped or not. Consequently, the line has been maintained by being given a subsidy from the local government and this subsidy
amounts to about as much as 36 million yen a year (about 300.0 thousand us$ a year) at present. However, this subsidy is often criticized by some of the islanders because the local government has financial difficulties. For these reasons, it is said that validity of this subsidy and an amount of it have to be examined.

In this study, a questionnaire survey was carried out to the people who live in the Osaki-Kamijima Island. The contribution of the rapid passenger boat line to the island, its necessity and economical valuation are analyzed on the basis of this questionnaire survey. From these results, validity of the subsidy to the line and an amount of money for it are discussed. The content of this paper is as follows.

First, outline of the Osaki-Kamijima Island that is the study area and the rapid passenger boat is introduced.

Second, the outline of the questionnaire survey that was carried out in this study is explained. Then, gender, age and so on of the data obtained from this survey are compared with the actual ones of the island and the accuracy of the data is checked.

Third, by analyzing this data, what kinds of things in the island the line contributes to is revealed. In addition, the necessity of the line and the reasons why the line is necessary are analyzed. Through the analyses of this section, it is shown that this rapid boat line contributes to various things of the island, as well as means to go to the mainland.

Next, economical valuation of the rapid passenger boat line is analyzed by employing CVM (Contingent Valuation Method). Through this analysis, validity of the subsidy to the line is discussed.

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

There are several studies on economical valuation of public transportation like this study because many of the public transportation in Japan, especially the public transportsations which are operated in rural areas, are in deficit and have already received a subsidy from local governments. Ohno et al. (2006) analyzed economical valuation of the regular bus in Maebashi City. Oh-i et al. (2000) analyzed that of the regular bus in Asahikawa City. Okayama et al. (2012), who is one of the authors, researched the community bus run in the Osaki-Kamijima Island which is the same study area as this study. In these studies, the economical valuation of the bus services that have been deficit are measured by employing CVM or PSM (Price Sensitivity Measurement) and the validity of the subsidy to the services and factors that influence their economical valuation are analyzed on the basis of the economical valuation. In addition to these studies about bus services, Matuda et al. (2008) analyzed the economical valuation of the LRT that was introduced for urban revitalization by employing CVM.

Although these studies are similar to this study in respect of analyzing the economical valuation of the public transportation, all of these studies targeted land transportation, not sea transportation like this study. Thus, this study is unique in terms of targeting sea transportation like the passenger rapid boat line. In general, it is more expensive to maintain the service of sea line than that of land transportation. Moreover, if a sea line used in daily life is stopped, it is more difficult to find alternative transportation and to reintroduce the sea route. For these reasons, economical valuation of the sea transportation can be different from that of land transportation.

In addition, deficit of the sea lines caused by depopulation and population ageing and the subsidy to them have been very serious problems in small islands of Japan. The results of this study can contribute to the discussion about the validity of such a subsidy to the deficit lines.
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 mainland (Honshu) to the island. Table-1 indicates an outline of the Osaki-Kamijima Island. The population of the Osaki-Kamijima Island is 8,474 in 2011. 43.7% of the people in the island are more than 65 years old. Its area is about 43km².

Although the private bus service and the community bus service have been run on the island, few people except for some elderly people and some high school students have used these bus services because of few services of them. Almost all people on the island depend on a car for the travels in the island.

Figure-2 indicates an outline of the ferry lines and rapid passenger boat lines between the island and other areas including the mainland. As this figure shows, there are three ferry lines between the island and the mainland. Two of them link two ports on the island, which are called the Shiromizu port and the Tarumi port, and the Takehara port of the mainland. These two ferry lines run 32 services a day in total. The other one runs 16 services a day between the Onishi port in the island and the Akitu port in the mainland. All ports of the island side of these three ferry lines are located on the mainland side in the island.

![Figure-1 Study Area](image)

<table>
<thead>
<tr>
<th>Table-1 Outline of Osaki-Kamijima Island</th>
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<tbody>
<tr>
<td><strong>Location</strong></td>
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<tr>
<td><strong>Gross Area</strong></td>
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<tr>
<td><strong>Population</strong></td>
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<tr>
<td><strong>Percentage of the People Who Are More Than 60 Years Old</strong></td>
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<td><strong>Public Transportation</strong></td>
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There is one rapid passenger boat line that links the Osaki-Shimojima Island and the mainland through the Osaki-Kamijima Island, which is the target of this study. It runs 7 services a day. There are 5 ports for this line on the Osaki-Kamijima Island. They all are located on far side of the mainland in the island. By the boat, it takes 37 minutes from the Akashi port that is the furthest port in the island from the mainland to the Takehara port in the mainland and it costs 1,350 yen (about 11.3 us$). It takes 11 minutes from the Mebaru port that is nearest from the mainland and the fare for this is 410 yen (about 3.4 us$). On the other hand, it takes 25 minute by ferry boat from the Tarumi port that is near the Mebaru port to the Takehara port and it costs 320 yen (about 2.7 us$).

According to the announcement made by the local government of the Osaki-Kamijima Island, the number of the users of the rapid passenger boat is 100/day to 120/day and has been decreasing. This decrease in the users has caused a deficit of the company of the rapid passenger boat line. Because of this, it was discussed whether the service of the rapid passenger boat should be stopped or not. The line has been maintained by being given a subsidy consequently. This subsidy amounts to about as much as 36 million yen a year (about 300.0 thousand us$ a year) at present. The local government of the Osaki-Kamijima island has been assessed about 6 million yen (about 50.0 thousand us$) for this subsidy and the government of Hiroshima prefecture to which the government of the island belongs has paid about 30 million yen (about 250.0 thousand us$). It is thought that this subsidy will increase in the future because of the further decrease in its user, caused by the depopulation and population ageing of the island. In addition, the local government of the Osaki-Kamijima Island will have further financial difficulties due to its depopulation and population ageing. For these reasons, it is said that the validity of this subsidy and an amount of it have to be 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 section.

We carried out the questionnaire survey to all the households in the Osaki-Kamijima Island, which are 3,901 in total, with cooperation of the Community Union of the Island in November 2011. In this survey, two questionnaire sheets were distributed to each household: one is for the head of a household and the other is for another member. The reason why two sheets were distributed to each household is that the average of the number of members of a household in the island is about 2.02. The purpose of this survey is to examine an actual use situation of the rapid passenger boat and opinions about its contribution to the island. The main contents of the questionnaire for the head of a household are as follows.

(1) Profile of the respondents (gender, age, residential area and so on)
(2) an actual use situation of the rapid passenger boat, such as frequency in use and purpose of use
(3) Opinions to contribution of the rapid passenger boat line to the Osaki-Kamijima Island and necessity for the line
(4) Economical evaluation of the household of the respondents about the rapid passenger boat line

There are (1), (2) and (3), except for (4), in the questionnaire sheets for another member. In this study, (3) and (4) are analyzed mainly.

3.2 Data

In the questionnaire sheets which were collected, 958 sheets of the respondents who were responded to all items used in the analyses of this study, which are including 630 sheets that are for the head of a household, are analyzed in this study. In this section, we examine characteristics and the reliability of the obtained data by comparing gender ratio, ratio of the people who are more than 60 years old and ratio of the areas of the respondents’ residence from obtained data with these actual stats from the population of the Osaki-Kamijima Island. Figure-3 to 6 indicate the results of these analyses. These figures also show 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 ones of the island or not.

![Figure-3 Data Characteristic (Gender)](image-url)
Figure-4 Data Characteristic (Age)

Chi-Square/Degree of Freedom=3.303/1
Observed Significance Level=0.069

Figure-5 Data Characteristic (Residential Areas (Respondent))

Chi-Square/Degree of Freedom=3.388/3
Observed Significance Level=0.297

Figure-6 Data Characteristic (Residential Areas (Head of the Household))

Chi-Square/Degree of Freedom=1.451/3
Observed Significance Level=0.0694
Figure-3 shows the result of the analysis about these gender ratios. This figure indicates that the percentage of male of the data is 47%, which is very close to the percentage of male of actual stats, which is 45%.

According to Figure-4 which shows the analysis of the ratio of the people who are more than or equal to 60 years old, the percentage of more than or equal to 60 years old respondents is 67%. The percentage of more than or equal to 60 years old people who live in the Osaki-Kamijima Island is 64%. Thus, the percentage of more than or equal to 60 years old respondents is close to the actual percentage.

The Osaki-Kamijima Island consists of three areas: one is Higashino, another is Osaki and the last is Kinoe, which has 4 ports of the rapid passenger boat. In addition, we can divide Higashino into two areas: one is East-Higashino which includes the Mebaru port which is one of the ports of the rapid passenger boat, the other is West-Higashino which is located in the side where two ferry ports are placed. In this study, the Osaki-Kamijima Island is divided into these 4 areas: East-Higashino, West-Higashino, Osaki and Kinoe. In Figure-5, the percentages of the respondents who live in each area are compared to those of the island. In Figure-6, the percentages of the head of a household of each area in the data are compared to those of the island. Both of these figures show that the percentages of the data obtained from the survey aren’t significantly different from the actual percentages from the island.

In addition to these results, the significance probabilities of the Tests of Goodness of Fit of all analyses above are more than 5%. For this reason, the statistical differences between these stats from obtained data and actual stats from the island aren’t found.

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

4. ATTITUDE ANALYSIS OF CONTRIBUTION OF THE RAPID BORT LINE TO THE ISLAND AND ITS NECESSITY

4.1 Contribution of the Rapid Boat Line to the island

In this section, we analyze what kind of things in the island the rapid passenger boat line contributes to. In the questionnaire sheets we distributed, ten items to which the rapid passenger line may contribute and the item to ask about degree of the contribution of the line to the island in 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-7 shows the result from analysis of these items. This figure indicates that more than 65% of the respondents responded “Large Contribution” or “Contribution” to the items of “As a Means of Transportation to Go to Hospital”, “As a Means of Transportation to Commute or Go to School” and “As a Means of Transportation to Go Shopping”. It is also shown that more than or nearly 60% of them responded “Large Contribution” or “Contribution” to the items of “To Give Relief to the Islanders’ Lives”, “To Liveliness of the Island” and “To Slow Progress of Depopulation or Population Ageing”. From these results, it is found that the rapid passenger boat not only contributes to going to the mainland as means of transportation but also contributes to a variety of things such as giving relief to the islanders, liveliness of the island. 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 rapid passenger boat to the island.
From these results, the contribution of the line to giving relief to the islanders or liveliness of the island, as well as the number of its users, should be considered in discussing about whether its service should be stopped or not.

4.2 Necessity for the Rapid Boat Line and Reasons for the necessity

In this section, the necessity for the rapid passenger boat and the reasons for its necessity are analyzed. Figure-8 shows about the necessity of the line. In this figure, only 12% of the people responded that the line was unnecessary due to its large deficit. Thus, many islanders admit that the rapid passenger boat line is necessary in the Osaki-Kamijima Island. However, more than 50% of the respondents think that the line is necessary but on the other hand its service should be changed in order to decrease its deficit. It is found that many of the islanders admit the necessity for the rapid passenger boat line but are concerned about the increase in its deficit. Because of this, measures to decrease the deficit of the line should be
found in order to clear up the islander’s concerns about it.

Figure-9 indicates the result of the analysis of the reasons why the rapid passenger boat is necessary. The respondents who answered that the rapid passenger boat is unnecessary are removed from the data of this analysis. In this figure, it is found that 31% of the respondents answered “Because the people who think it is necessary exist” and this is the largest percentage in this figure. But the percentages of the other items are less than 20%. Thus, the islanders feel that the rapid passenger boat line is necessary due to a variety of reasons.

5. ANALYSIS OF ECONOMICAL VALUATION OF THE RAPID BOAT LINE

5.1 Survey for Economic Valuation by Employing CVM

In this section, an economical valuation of the rapid passenger boat line is analyzed by employing CVM (Contingent Valuation Method). On the questionnaire sheets, there are the questions to examine an economical valuation of the line, which are designed in order to analyze by employing CVM. In the questionnaire sheets for the head of a household, under the assumption that the operation of the rapid passenger boat line will be stopped, how much money each household which responded to the survey is willing to pay to maintain the service of the line (Willingness to pay: WTP) is asked, showing that 36 million yen a year (266.7
thousand US$ a year) is needed in order to maintain the service of the line. 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 that 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 or not 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 or not is asked. And if the respondent can’t pay the first price, whether the respondent can pay lower price or not is asked. In actual survey, several patterns of questionnaire sheet including 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 this Double-Bounded Dichotomous Choice Method. Table-2 indicates the question items of each pattern that are designed. Figure-10 shows the percentage of each pattern in all collected sheets. According to this figure, the percentage of each pattern is close to 25% and it is shown that every pattern was collected nearly equally.

5.2 Economical Valuation of the Rapid Boat Line by Employing CVM

Next, economical valuation of the rapid passenger boat line is analyzed by employing CVM. In CVM, economical 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, these two methods are employed because of accurate analysis. Table-3 and 4 show the results of the models estimated by Logistics Regression Analysis and Weibull Regression Analysis. In Table-3, the results from T-Test of the parameter of log(Asking Price) show that it is significant at 1% of a significance level. In Table-4, T-Test of the Location Parameter and the Scale Parameter show that these parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(Asking Price)</td>
<td>-1.93</td>
<td>-9.27**</td>
</tr>
<tr>
<td>Constant</td>
<td>16.10</td>
<td>9.22**</td>
</tr>
<tr>
<td>Log-Likelihood</td>
<td>-575.7</td>
<td></td>
</tr>
<tr>
<td>AIC</td>
<td>1155.4</td>
<td></td>
</tr>
</tbody>
</table>

Note: "**" means significant at significance level 1%
Table-4 Weibull Regression Model for CVM

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>8.67</td>
<td>15.8**</td>
</tr>
<tr>
<td>Scale</td>
<td>0.95</td>
<td>9.8**</td>
</tr>
</tbody>
</table>

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

Table-5 Mean and Median of WTP

<table>
<thead>
<tr>
<th></th>
<th>Logistic Regression</th>
<th>Weibull Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4,949.8Yen/Year</td>
<td>4,647.0Yen/Year</td>
</tr>
<tr>
<td>Median</td>
<td>4,209.4Yen/Year</td>
<td>3,908.9Yen/Year</td>
</tr>
</tbody>
</table>

are significant at 1% of a significance level. From these results, we decide that these estimated models are useful to analyze the economic valuation of the rapid passenger boat line.

The means and medians of the price each household is willing to pay (WTP) are estimated from the results of these estimated models and are shown in Table-5. This table indicates that the mean of WTP is from 4,647.0 yen/year (38.7 us$/year) to 4,949.8 yen/year (41.2 us$/year) for each household and the median is from 3,908.9 yen/year (32.6 us$/year) to 4,209.4 yen/year (35.1 us$/year) for each household.

The total of the economical valuation of the rapid passenger boat line can be estimated on the basis of the mean of WTP of the previous analysis, which is from 4,647.0 yen/year (38.7 us$/year) to 4,949.8 yen/year (41.2 us$/year) for each household. The number of the households in the Osaki-Kamijima Island is 3,901 in 2011 when the survey was carried out for the study. Therefore, the total of the economical valuation of the rapid passenger boat line is from 18.1 million yen/year (15,083.3 us$/year) to 19.3 million yen/year (16,083.3 us$/year). The subsidy to the rapid passenger boat line has been about 36 million yen/year (300.0 thousand us$) for the last several years. The total of economical valuation of the line, which is from 18.1 million yen/year (15,083.3 us$/year) to 19.3 million yen/year (16,083.3 us$/year), is less than the subsidy to the line for the last several years.

As described above, the local government of the Osaki-Kamijima Island and the government of Hiroshima Prefecture have shared this subsidy and the local government of the island has been assessed about 6 million yen for this subsidy. The total economical valuation of the line is about three times as large as this assessment of the local government of the island. From these results, as far as the point of view from the islanders is considered, the service of the line should be maintained if an amount of the subsidy remains unchanged or is less than 18 million yen/year (15,000us$/year) at most.

6. SUMMARY

In this study, contribution, necessity and economical valuation of the rapid passenger boat line were analyzed on the basis of the questionnaire survey that was carried out to the people living on the Osaki-Kamijima Island. The main findings of this study are as follows.
1) Contribution of the rapid passenger boat line to the island was analyzed. From this result, it is recognized that the rapid passenger boat not only contributes to going to the mainland as means of transportation but also contributes to various things, such as giving relief to the islanders, liveliness of the island and so on. As the result, the contribution of the line to giving relief to the islanders or liveliness of the island, as well as the number of its users, should be considered in discussing about whether its service should be stopped or not.

2) We analyzed the necessity and its reasons of the line. From these results, it is shown that many of the islanders admit the necessity for the rapid passenger boat line but are concerned about the increase in its deficit. For this reason, measures to decrease the deficit of the line should be found.

3) Economical valuation of the rapid passenger boat line was analyzed by employing CVM. This result showed that the mean and median of its WTP were about 4,800 Yen/Year for each household and about 4,000 Yen/Year for each household. Moreover, the total of the economical valuation of the line was estimated. The total of the economical valuation of the line was shown to be smaller than its total subsidy but to be much larger than the assessment of the local government of the Osaki-Kakimijima Island. This means that as far as the point of view from the islanders is considered, the service of the line should be maintained if an amount of the subsidy is less than 18 million yen/year.

The validity of the subsidy to the line 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 Island for the further research. Moreover, although many of the islanders admit the necessity for the line, they are concerned about its deficit. We need to study the way to decrease the deficit of the rapid passenger boat line.

REFERENCES