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Rail bonus: An empirical study onto relative valuation of railways

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Abstract

The roll of railways in regional areas is a subject of wide range of arguments. Cost benefit analysis (CBA) gives us some quantitative indicators to discuss it, while social benefits estimated through CBA are currently not comprehensive. Some studies have shown the existence of the rail bonus, which leads to people's preference of rail-based transportation to bus-based transportation. Others have made attempts to quantify option values (OV) and non-user values (NUV), which excluded from conventional CBA. It is difficult to apply those studies to practical issues. In this paper, using contingent valuation method (CVM), an estimation of railways' additional relative values over buses in Austria, which are comparable and applicable to other cases, is made. The results show that premium rates obtained from the survey data from residents along two Austrian regional railways are around ten percent on average, which are similar to the results of prior researches in Japan. Those premium rates are recognized not only by frequent users but also by occasional users or non-users, which means that OV and NUV greatly contribute to the rail bonus. It is also found that the rail bonus could depend on geographical conditions, to some extent.

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Keywords: Rail bonus, Regional railways,Cost benefit analysis, CVM, Option value, Non-user value, Austria, Japan

1. Introduction

Under rapid motorization in the postwar period, especially in developed countries, a number of regional railway lines has been closed down and replaced by bus. For approximately two decades, this trend seems to have been gradually changing as a result of reevaluation of rail-based transportation as an environmental friendly mode; however, there still exist arguments over roles of railways in rural areas, where they cannot essentially serve themselves as "mass" transit systems that make use of the railway's high capacity. There are repeatedly discussed questions: is rail-based transportation cost-effective in those areas? Should governments spend a large amount of public money to keep railway operation?

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One of the criteria to answer such questions can be given by cost benefit analysis (CBA). CBA is widely used to provide a quantified indicator with a standardized calculation method, which is often given by the public authority. External effects of railways on environmental issues are nowadays included as social benefits in it. For example, in Japan, CBA is a mandatory tool to evaluate public investments including modernization of railway infrastructures. Nevertheless, social benefits calculated with CBA are not fully comprehensive because certain types of social or other benefits cannot be monetized. Previous studies show that option values (OV) and non-user values (NUV) of railways, which are seldom monetized factors considered in CBA, account for a considerable amount of money.

In general, people tend to prefer rail-based transportation to bus as a more reliable, recognizable, and symbolic mode even if the basic parameters as a transport service such as frequency and speed are the same. In policy discussions, such general preference is often referred as the *rail bonus*, as seen more in detail in the next section. As such, it is empirically known that the railway inherits more beneficial factors, while such factors are not considered in many of current practices that make use of CBA.

There is, however, one fundamental problem that, although prior studies show several evidences that the rail bonus do exist, it is not yet clear to what extent the rail bonus is on average in terms of monetary values. In order to fill the gap between the current incomprehensive practices in CBA-based appraisal of railway-related projects as described above and the empirical knowledge about *rail bonus*, we made an attempt to quantify rail bonus between railway and bus and tries to quantify the rail bonus. Utsunomiya (2018) has already developed a basic methodology to evaluate relative values of railways over buses using the contingent valuation method (CVM), and carried out several surveys in Japan. In the research presented this paper, we make use of this methodology to carry out two surveys in Austria.

The reason to carry out surveys in Austria is that this is one of the countries where local railways in rural areas have been, to a certain extent, successfully revived in the last decades. At the same time, the quality of bus services has been also improved. Nowadays timetables and other passenger information as well as tickets are integrated among various railway and bus services, and made available to the users via various channels. Around 90 % of vehicles of major rural operators are already barrier-free. At large, service level and barrier-freeness of rural bus services in Austria is not much inferior to railways. In this sense, the existence of rail bonus can be contested in more severe condition compared to Japan, where the differences in service level, accessibility and barrier-freeness between railways and buses still remain large.

The paper is structured as follows: in Section 2, prior research are briefly reviewed and then our methodology is explained in Section 3. Following this, we briefly present the surveyed areas in Section 4, and in Section 5 the results from survey research are discussed. Where possible in the discussion, comparison to the previous results from Japan is also made. The paper is concluded in Section 6.

2. Literature review

Discussion on the rail bonus is not new: already in the 1980s and the 1990s, improvement of existing railway system and introduction of new public transport systems in many of European countries resulted in more public transport users, and in this context the rail bonus was often referred to among policymakers. In academics, Hall and Hass-Klau (1985) carried out an early empirical research, which demonstrates the significant impact of the introduction of rail-based rapid transit in German and British cities. Several studies tried to prove the existence of the rail bonus at that time. For example, Kasch and Vogt (2002) conducted a before-and-after comparison in German cities, where some bus lines had been replaced by railways, and demonstrated that this change correlates with the increase in passengers. However, this type of studies does not much contribute to identify to what extent such increase of passengers is contributed by the rail bonus i.e. the general preference of railway to the other public transport modes. Kottenhoff and Lindh (1995), Axhausen, Haupt, Fel and Heidl (2001), and Schulz and Meinhold (2003), based on revealed preference (RP) and/or stated preference (SP) studies targeting specific lines, all demonstrated that rail-based service is preferred to bus-based service to a certain extent. Megel (2001) demonstrates the rail bonus in regional transport using a psychological method.

Since the middle of the 2000s, option values (OV) and non-user values (NUV) of public transportation gained more interests among scholars. OV and NUV have been discussed mainly in a context of environmental economics for a long time, while several authors applied SP method including CVM to quantify OV and NUV of railways. Among many research outcomes, Humphreys and Fowkes (2002), Kurokawa, Takase, and Koyama (2005), Geurs, Haaijer,

and van Wee (2006), Laird, Geurs, and Nash (2009), Matsunaka, Taniguchi, and Kataoka (2009), Fujii (2009), and Wallis and Wignall (2012) are typical ones. In these studies, specific railway lines are researched and the absolute values such as OV, NUV and total economic value (TEV) are estimated. For example, Humphreys and Fowkes (2002) focuses on a regional rail link connecting small towns to a major urban center in Scotland and, using CVM and stated choice experiment, estimates that the total of OV and NUV is GBP 190 per household on an annual average.

These existing studies certainly confirms various kinds of values not yet included in the conventional CBA, while the results are not in a practically usable form to guide real-world discussions on whether an existing railway line in a rural area should be invested more, kept as it is or replaced by an alternative bus. Because the data used in those research are calculated for specific railway lines with certain conditions, these existing researches are not directly applicable to other cases. In order to address this problem, Utsunomiya (2018) applied CVM to estimate a relative value of railways over buses that are assumed to be operated on the same conditions as the existing railway instead of estimating an absolute value of a specific railway. In this, three case studies were carried out in Japan: two of the three railways surveyed in it have their own additional value over buses of around 20 %, and the other one has around 10 %. This initial result is still not directly applicable to elsewhere; however, because the methodology itself is transferable to any railway lines, robust and applicable results are expected with an accumulation of a number of case studies.

3. Survey methodology

3.1. Application of contingent valuation method (CVM)

The contingent valuation method, often referred to with its acronym CVM, is a well-known approach for measuring economic value of non-market services, but at the same time has been the subject of criticism. CVM is based on questionnaire-based surveys asking sample persons about their willingness to pay (WTP) or willingness to accept (WTA). Consequently, the results unavoidably depend not only on sampling but also on various conditions related to the questioning process. A panel commissioned by the National Oceanographic and Atmospheric Administration (NOAA), an American governmental agency, published comprehensive guidelines for use of CVM in 1993-94, while this guideline is not easy to be applied to real-world research questions. Guidelines for the application of CVM in Japan are issued by the Ministry of Land, Infrastructure, Transport and Tourism in Japan (MLIT): it particularly recommends “cautious” application of CVM in appraising projects.

There are several other methods available for evaluating non-market services: however, railway project appraisal manual in Japan, MLIT (2012), recommends that CVM is regarded as the most suitable method for estimating option values (OV) and non-user values (NUV) of railways. MLIT (2012) points out that the other methods have certain difficulties in their applications as follows: The travel cost method is mainly applicable to one-off trips, mostly trips with recreational purposes; OV and NUV irrelevant to them are not estimated by the travel costs method. The hedonic price method is disadvantageous because consistent data for land prices and their explanatory variables are often not available. Even though some hedonic functions are formulated, it is difficult to abstract the effect of OV and NUV of railways from changes in land prices. The conjoint analysis, which evaluates attributes within a set of several substitutable attributes, cannot be easily applied to evaluating railways because it is difficult to specify a set of substitutable attributes that have influences on OV and NUV of railways. The benefit transfer method depends on prior studies, while in a practical sense, no applicable example exists. The substitute cost method is not realistic because there is no substitute service to OV and NUV of railways.

Following this, Utsunomiya (2018) applied CVM to obtain railway’s additional values over bus in Japan, which we call *premium rate* hereafter. This paper follows the same approach to ensure comparability of the results, while the survey method is slightly adapted as explained below. The survey was carried out to residents along two regional railway lines in Austria, Mariazell Railway (MR) and Pinzgau Railway (PR): in this, we limited our sample to the residents living along the railway lines. By doing this, we aimed at minimizing sample selection bias: the two railway lines are designated mainly for residents. In addition, respondents along the railway lines usually have basic information about railway such as fares and service frequencies, and thus they are able to understand the situation in our questionnaires even though they are not regular users. This enables our CVM to minimize information bias, which is a major problem when applying CVM to environmental issues such as clean air, beautiful scenery, diversity of life, etc.

3.2. Survey design

The survey was carried out as a CATI (computer-assisted telephone interview) by a specialized company in Austria so that the communication with respondents is made optimally: in this way, issues peculiar to the regional railways such as certain expressions in a dialect are well understood by surveyors avoiding misunderstanding. Sampling is based on a stratified random sampling method by age group and municipality. Along each railway lines, 400 valid answers are collected.

The questionnaire is designed in a way that the answers obtained from the CATI and the previous surveys in Japan are made comparable. The paper-based survey used in Japan as presented by Utsunomiya (2018) made it possible to formulate questions in a somewhat complicated manner: for example, two questions can be presented together so that respondents can have enough time to understand what questions are meant for. However, when the CATI is used, questions must be presented one by one in a sequential manner, and respondents tend to have less time to answer each question.

In the questionnaire, we set a certain railway fare as a benchmark and asked what discount rate would be acceptable in the case of replacement bus with the same service level as the existing railway. Of note, the NOAA guideline as well as other guidelines recommend to ask WTP instead of WTA: this comes out of a concern of the NOAA panel about environmental factors that are vague to the respondents. Nevertheless, our methodology is based on WTA. This is because railways do exist in the near proximity of the respondents and thus the respondents can recognize railway fares as benchmarks easily, and they can imagine differences between the railway and an alternative bus even if they do not use railways in their everyday lives.

In concrete, the surveyor asked respondents whether they possessed annual, seasonal or monthly public transport pass at the beginning. In case they are in possession of one of them, the question is formulated as follows: “If Mariazell Railway/Pinzgau Railway did not exist any longer and public transport were offered only by bus with the same service level, e.g. timetable, location of stations/stops same as the current Mariazell Railway/Pinzgau Railway, how much would you be ready to pay for your seasonal ticket?” If respondents are not able to answer to this question by an absolute value, the surveyor offers additional choices in percentages: the same price, 5 % discount, 10 % discount. 15% discount, 20%, discount, 25 % discount or less, or more than current price. When respondents possess no seasonal ticket, the surveyor first requests respondents to make an assumption that a return ticket for a journey with the railway costs EUR 10, and then ask respondents the same question as above. If respondents are not able to answer this question, the surveyor offers additional choices in an absolute value instead of percentage: the same price, EUR 9.50, EUR 9.00, EUR 8.50, EUR 8.00, EUR 7.50 or less, and more than EUR 10.00. By doing this, it is made possible to collect necessary data from the respondents while the questionnaire is made CATI-worthy so that respondents can answer easily to the questions.

4. Overview of the survey areas

4.1. Mariazell Railway

Mariazell Railway is a 84km-long narrow-gauge railway connecting St. Pölten in the Federal State of Lower Austria, which is located approximately 60 km west of Vienna, and Mariazell in the Federal State of Styria. At the first station St. Pölten, the line is connected to the national mainline network. The line consists of two parts with different characters: the first 48 km of this railway between St. Pölten and Laubenbachmühle goes through relatively flat agricultural area. The rest of 46km goes through mountainous area with few settlements along the railway, with an exception of a few that are close to Mariazell, the final station of the line. The entire line is electrified.

This railway used to be a part of the Austrian Federal Railway’s network. It was transferred to the Federal State of Lower Austria in 2010, and then modernization works and service improvement programs were carried out. This modernization and improvement programs included the replacement of rolling materials enabling higher passenger comfort and faster commercial speed, increase of the number of services, introduction of fixed-interval service, and so on. At present trains run every one hour between St. Pölten and Laubenbachmühle with additional trains in peak hours, and every two hours between Laubenbachmühle and Mariazell. Mariazell Railway carries c.a. 15 million passenger kilometers annually, which has increased by 64 % since 2012.

For the CATI survey, residents in the municipalities along the first 48 km of this railway between St. Pölten and Laubenbachmühle are considered as the sample population because this section has a certain level of service that can be used as a daily mode. The rest of 46 km goes through sparsely populated area with few settlements within an accessible area from stations, and has more touristic character compared to the first 48km: for these reasons, this part is excluded from the CATI survey. Of note, residents in the City of St. Pölten is excluded from the CATI survey, because the city has more than 50,000 inhabitants on a surface larger than 100 km^2, and they are not necessarily living along the Mariazell Railway: our sampling methodology based on the public telephone book does not allow the surveyor to distinguish the residents of the districts within the city along the Mariazell Railway. This does not cause any serious problems as mere the first few kilometer of the railway is within the City of St. Pölten.

Municipalities and their population in the surveyed area is summarized in Table 1.

Table 1. Municipalities and their population surveyed along Mariazell Railway

Municipality	Inhabitants [persons]	Area [km²]	Population density [inh./km²]
Ober-Grafendorf	4,611	24.6	187
Weinburg	1,337	10.4	129
Hofstetten-Grünau	2,647	36	74
Rabenstein an der Pielach	2,533	36.22	70
Kirchberg an der Pielach	3,224	63.41	51
Loich	610	24.58	25
Frankenfels	1,989	56.16	35
Total	16,951		

4.2. Pinzgau Railway

Pinzgau Railway is a 53-km non-electrified narrow-gauge railway that goes through Pinzgau Valley between Zell am See and Krimml. It was a part of the Austrian Federal Railway network until 2008. The line was severely damaged by a flood that hit Pinzgau Valley in 2005, with tracks and roadbeds destroyed. This led to a service suspension of approximately half stretch of the line. In order to restore the full service, large-scale civil engineering works were necessary, and the Austrian Federal Railway intended to close the entire line, while the Federal State of Salzburg, where the line is located, decided to overtake the line. Restoration was made, and in 2010 the entire stretch of the railway line was put back into the full service. Along with the restoration, modernization of railway infrastructure, acceleration of commercial speed, and modernization of rolling stock was made. Currently, trains run every one hour between Zell am See and Krimml with additional trains including one rapid train in peak hours. Pinzgau Railway carries c.a. 890.000 passengers annually, which has increased by 11 % since 2011.

For the CATI survey, residents in the municipalities along the entire stretch of the line are considered as the sample population. Similarly to the case of Mariazell Railway, the residents of the first municipality Zell am See was excluded for the same reasons. Table 2 shows the number of residents in the municipalities.

Table 2. Municipalities and their population surveyed along Pinzgau Railway

Municipality	Inhabitants	Area [km²]	Population density [inh./km²]
Piesendorf	3,778	50.93	74
Niedernsill	2,649	57.44	46
Uttendorf	2,931	167.75	17
Stuhlfelden	1,607	29.62	54
Mittersill	5,368	132.02	41
Hollersbach im Pinzgau	1,201	76.95	16
Bramberg am Wildkogel	3,963	117.27	34
Neukirchen am Großvenediger	2,523	165.98	15
Wald im Pinzgau	1,153	69.28	17
Krimml	827	169.46	4,9
Total	26,000		

5. Survey results and calculation of premium rates

5.1. Characteristics of the sample

In this section, we outline statistical features of the respondents, who are selected based on stratified sampling by age and municipality. By occupation, the share of office workers and pensioners are both around 30 % along both railways (Table 3). More than 85 % of respondents drive by themselves, and households without passenger car are only around 5 % (Table 4).

Table 3. Occupation of the sample

	Mariazell Railway		Pinzgau Railway	
	%	(n)	%	(n)
Pupil (elementary school to high school)	1.8	(7)	1.5	(6)
Apprentice	0.5	(2)	1.3	(5)
Student (university, university of applied science)	1.8	(7)	1.8	(7)
Office worker	33.5	(134)	29.8	(119)
Factory/field worker	8.5	(34)	8.0	(32)
Self-employed	6.5	(26)	12.8	(51)
Farmer	4.8	(19)	4.8	(19)
Pensioner	31.3	(125)	30.5	(122)
Unemployed	2.5	(10)	2.5	(10)
Maternity or parental leave	2.0	(8)	1.8	(7)
Housewife, Househusband	6.5	(26)	4.5	(18)
Others	0.3	(1)	0.8	(3)
N. A.	0.3	(1)	0.3	(1)
Total	100.0	(400)	100.0	(400)

Table 4. Availability of passenger car

	Mariazell Railway		Pinzgau Railway	
	%	(n)	%	(n)
Passenger car is available in my house and I drive myself.	87.3	(349)	86.3	(345)
Passenger car is available in my house and I am a passenger.	8.3	(33)	8.0	(32)
There is no passenger car in my house.	4.3	(17)	5.5	(22)
N. A.	0.3	(1)	0.3	(1)
Total	100.0	(400)	100.0	(400)

Regarding usage of railways, the total share of those who use railway "seldom" or "never" accounts for 32 % in case of Mariazell Railway and 49 % in case of Pinzgau Railway (Table 5). Frequent users are in the minority of respondents. To the question about main purpose, more than half of respondents answer "leisure" in both railways (Table 6). Less than 20 % of respondents use railways to commute to work and school. When they use railways, 61 % in Mariazell Railway and 85 % in Pinzgau Railway go to stations on foot: it is remarkable that 25 % of the respondents along Mariazell Railway drive to stations, which is greatly different from the case of Pinzgau Railway (Table 7). This is probably because Mariazell Railway has equipped park-and-ride facilities at 11 stations in the sections we surveyed.

Table 5. Travel frequency with Mariazell/Pinzgau railways

	Mariazell Railway		Pinzgau Railway	
	%	(n)	%	(n)
Daily	1.5	(5)	2.0	(8)
More than once a week	5.0	(17)	6.3	(24)
Once a week	7.3	(25)	4.5	(18)
Once a month or more, but less than once a week	13.5	(50)	12.8	(50)
Several times a year	41.3	(155)	26.0	(99)
Seldom	19.0	(63)	16.8	(63)
Never	12.5	(40)	31.8	(112)
Total	100.0	(355)	100.0	(374)

Table 6. Main trip purpose when using railway

	Mariazell Railway		Pinzgau Railway	
	%	(n)	%	(n)
Workplace	8.8	(21)	12.1	(24)
School, Educational Facility	3.6	(10)	4.9	(10)
Shopping	9.1	(22)	11.7	(24)
Hospital, Medical doctor	12.4	(32)	8.3	(17)
Leisure	60.6	(157)	51.5	(103)
Visiting/meeting relatives and friends	4.4	(8)	9.7	(17)
Others	1.1	(2)	1.9	(4)
Total	100.0	(252)	100.0	(199)

Table 7. Usual means of access to the railway station

	Mariazell Railway		Pinzgau Railway	
	%	(n)	%	(n)
On foot	60.9	(167)	84.5	(174)
Bicycle	7.7	(21)	1.5	(3)
Bus	0.7	(2)	0.0	-
Car as a driver (Park & Ride)	24.8	(68)	9.2	(19)
Car as a passenger	5.1	(14)	4.9	(10)
Taxi	0.7	(2)	0.0	-
Total	100.0	(274)	100.0	(206)

5.2. Data winsorization and calculation of premium rates

As mentioned in section 3.2, the CATI survey provided three different methods so that respondents can give an answer easily to the surveyor. The answer to the survey question about the discount rate of an alternative bus service with the same levels of service is given in three different types: (a) discount rate in %, (b) absolute value in relation to the current annual ticket or (c) an absolute value in relation to an imaginary 10 Euro ticket. There is a fundamental difference between the case (a) and the cases (b) and (c): the former is limited to a single-choice from discount rates of 0%, 5%, 10%, 15%, 20%, or 25% or more (case (a)), and the latter is open to any number given by the respondents without any comparable guidance (cases (b) and (c)). This type of the answers leads to some "outlier" discount rates embedded in the dataset.

In addition to this, as briefly mentioned in Section 3.1, the CATI survey presented in this paper is based on the previous paper-based surveys that was carried out in Japan. However, the paper-based questionnaire used in Japan offered a single choice of the discount rates 0%, 5%, 10%, 15% and 25% or more. Thus the comparability of the two surveys is not given.

To overcome these problems, a winsorized dataset of discount rates *dw* is prepared from the CATI result *d* using the following rules:

- "Outlier" discount rates of 25% or more are winsorized to be 25%.
- Negative discount rates i.e. answers evaluating bus higher than rail is winsorized to be 0%.

In this way, all the answers are converted into winsorized discount rate *dw*. Then, the average discount rate dw_{avg} is convertible to a premium rate pw_{avg} as defined with the following formula:

$$pw_{avg} = \frac{1}{1 - dw_{avg}}$$

Descriptive statistics and their distributions are as follows:

Table 8. Descriptive statistics of original and winsorized dataset

		Mariazell Railway		Pinzgau Railway	
		Original	Winsorized	Original	Winsorized
Discount rate	Average	22.3	11.6	15.2	8.5
	Median	10.0	10.0	0.0	0.0
	Maximum	100.0	25.0	100.0	25.0
	Minimum	-100.0	0.0	-100.0	0.0
	Standard deviation	32.5	11.8	27.5	11.3
Premium rate	Average	28.7	13.1	17.9	9.3
	Median	11.1	11.1	0.0	0.0

Table 8 and Fig. 1 show that, with the original dataset, the average premium rates is 28.7% for the Mariazell Railway and 17.9% for Pinzgau Railway respectively. Each distribution of original discount rate has a long tail on the right hand side with the median of 10.0 % and 0.0 % respectively. In the winsorized dataset, the average premium rates result in 13.1% and 9.3%, which are smaller than those in the original dataset. Since the distribution of winsorized discount rate shows a tendency of polarization rather than a skewed shape (Fig. 2), for the purpose of analyzing the rail bonus, it is reasonable to use average premium rates calculated from the winsorized dataset. Considering that the extent of winsorization might be too much for the responses of *d* being 30% to 40%, the analysis with the winsorized dataset may underestimate WTA of the respondents, and thus underestimate the average premium rate as a result.

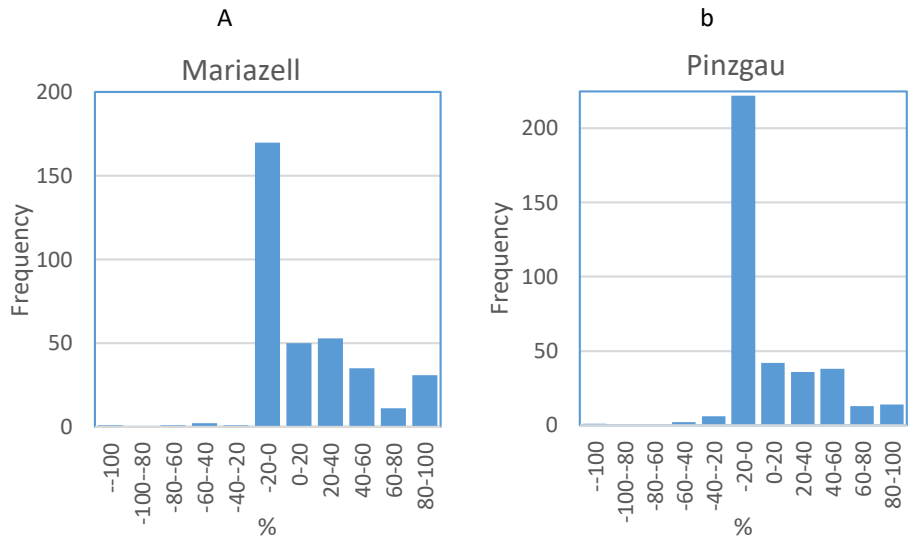

Fig. 1. Distribution of original discount rate *d*: (a) Mariazell Railway, (b) Pinzgau Railway

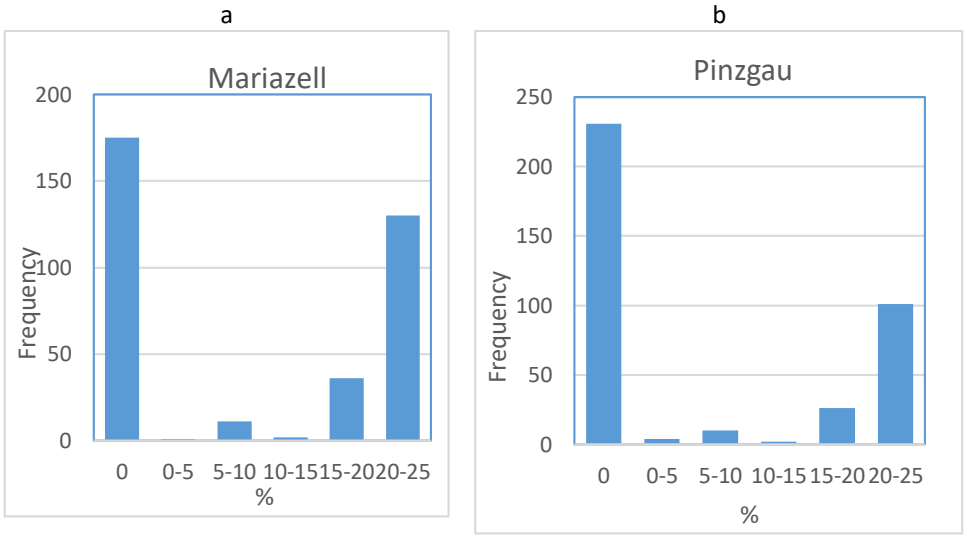

Fig. 2. Distribution of winsorized discount rate *dw*: (a) Mariazell Railway, (b) Pinzgau Railway

5.3. Discussion on premium rates subdivided by user groups

Regarding the average premium rate of the all respondents, 13.1 % (Mariazell Railway) and 9.3 % (Pinzgau Railway) are in a similar range to the premium rates from 10 to 20 % reported from the three previous surveys in Japan (Utsunomiya 2018). In this section, in-depth discussions are presented on the survey results, with the premium rates subdivided by different respondent groups.

Table 9 shows average premium rates subdivided by usage frequency. Respondents using the railway with a certain frequency, namely once in a month or more frequently, tend to evaluate the railway slightly higher than non-frequent users. However, such tendency is not always obvious: in case of Mariazell Railway, there is a weak correlation

observed between the usage frequency and the premium rate (of note, the Pearson correlation coefficient is 0.31), while such correlation is not observed with the dataset from Pinzgau Railway at all (Pearson correlation coefficient is 0.00). Same applies to the Japanese dataset, too. What is more interesting here is that, even if respondents use trains less frequently such as less than once a month, they still show a certain level of premium rates. The average premium rates of non-users, who never use the railways, are 10.2 % in Mariazell Railway and 8.8 % in Pinzgau Railway respectively. Of note, the premium rates of less frequent users in cases of two railways in Japan are rather higher than frequent users by around 2 or 3 %.

Table 9. Average premium rate by usage frequency based on winsorized dataset

Country	Austria				Japan					
Railway	Mariazell Railway		Pinzgau Railway		Toyama Light Rail		Ohmi Railway		Wakasa Railway	
	pw_{avg}	N	pw_{avg}	N	pw_{avg}	N	pw_{avg}	N	pw_{avg}	N
Everyday	16.3	(5)	4.6	(8)						
2-4 times / week	18.9	(17)	10.3	(24)	22.3	(56)	17.6	(25)		
Once / week	14.2	(25)	8.7	(18)					9.1	(37)
Once / month but less frequently once / week	16.4	(50)	10.3	(50)	19.4	(94)	16.8	(60)		
Few times / year	12.1	(155)	10.7	(99)	20.3	(108)	20.2	(151)		
Seldom	12.9	(63)	7.9	(63)	15.2	(33)	19.7	(200)	11.2	(690)
Never	10.2	(40)	8.8	(112)						
Total	13.1	(355)	9.3	(374)	19.9	(300)	19.2	(443)	11.1	(727)

We also asked how respondents recognize the roll of the respective local railways. As shown in Table 10, although the premium rates among the respondents who finds the railway as important parts of their daily lives are relatively higher (14.7% for Mariazell Railway, 9.7% for Pinzgau Railway), those who do not recognize the railway in this way still report a certain level of premium rates (11.9% and 9.1% respectively). Premium rates by the recognition of railway's roll do not varies so much.

Table 10. Average premium rate by importance recognition based on winsorized dataset

		Mariazell Railway		Pinzgau Railway	
		pw_{avg}	N	pw_{avg}	N
MR/PR plays an important role in my daily life.	Yes	14.7	(157)	9.7	(137)
	No	11.9	(198)	9.1	(237)
MR/PR plays an important role because the availability of it matches to my needs.	Yes	13.5	(157)	9.7	(124)
	No	12.9	(197)	9.1	(249)
MR/PR will play an important role in my everyday life in the future.	Yes	14.0	(194)	8.8	(163)
	No	11.9	(159)	9.9	(209)
MR/PR plays an important role for the persons who do not or cannot drive cars for various reasons.	Yes	13.1	(334)	9.5	(350)
	No	13.5	(21)	8.0	(23)
MR/PR plays an important role as a regional symbol or a characteristic.	Yes	13.1	(345)	9.2	(330)
	No	12.4	(10)	10.1	(43)
MR/PR does not play an important role in our region.	Yes	13,1	(334)	9.7	(336)
	No	12.6	(21)	6.8	(36)
Total		13.1	(355)	9.3	(374)

In order to check the effects of option values (OV) or non-user values (NUV) on premium rates, we divided the respondents into two groups, one being those who recognize Mariazell/Pinzgau Railway playing an important role in their daily lives, and the other who do not recognize so, based on the result presented for the first statement in Table 10. In Table 11, their answers to the third, fourth and fifth statements as listed in Table 10 are subdivided into these two groups.

While the first group reports relatively higher premium rates as a whole, even the latter group i.e. respondents who do not recognize the importance of the railway in their daily lives recognize the importance of their local railways in the future e.g. when they are getting older, for those who do not or cannot drive by themselves, and as a regional symbol are well recognized. These groups prefer railways to bus with higher premium rates larger than 10% in case of Mariazell Railway and that value between 5% and 9% in case of Pinzgau Railway. This implies that OV of the railway is higher than that of the bus (importance in the future), and the NUV of the railway is also higher than that of the bus (importance for those who do not or cannot drive, regional symbol).

Table 11. Average premium rate by importance recognition among the respondents who find the railway an important part of their daily lives

Questions about option values and non-user values	This statement	Important role in daily life	Mariazell Railway		Pinzgau Railway	
			pw_{avg}	N	pw_{avg}	N
MR/PR will play an important role in my everyday life in the future.	Yes	Yes	15.3	(142)	10.2	(118)
	Yes	No	10.4	(52)	5.3	(45)
MR/PR plays an important role for the persons who do not or cannot drive cars for various reasons.	Yes	Yes	14.8	(152)	9.6	(133)
	Yes	No	11.7	(182)	9.4	(217)
MR/PR plays an important role as a regional symbol or a characteristic.	Yes	Yes	14.9	(155)	9.7	(131)
	Yes	No	11.7	(190)	8.9	(199)
Total			13.1	(355)	9.3	(374)

The premium rate by different age classes shows different tendencies in Austria and in Japan (Table 12). In both of the surveys in Austria, the premium rates of the respondents between 30 and 59 are relatively lower compared to the young generation under 30 and older generation over 60. The dataset from Japan shows that the premium rates reported by the respondents between 30 and 59 tend to be higher than that of older generation. It is not easy to clarify the difference between Austira and Japan, but the influence of age is explained by our multivariate analysis later.

Table 12. Average premium rate by age class based on winsorized dataset

Country	Austria				Japan					
Railway	Mariazell Railway		Pinzgau Railway		Toyama Light Rail		Ohmi Railway		Wakasa Railway	
Age class	pw_{avg}	N	pw_{avg}	N	pw_{avg}	N	pw_{avg}	N	pw_{avg}	N
15 - 29	16.8	(72)	10.0	(69)	9.1	(3)	24.4	(13)	14.9	(67)
30 - 39	10.3	(55)	8.2	(65)	22.0	(5)	19.4	(48)	12.9	(67)
40 - 49	12.5	(66)	9.1	(77)	22.8	(28)	20.6	(61)	17.0	(81)
50 - 59	10.2	(64)	7.4	(58)	25.8	(61)	20.2	(90)	16.6	(113)
60 - 69	14.3	(42)	11.7	(53)	20.8	(105)	18.1	(119)	8.6	(231)
70 -	14.6	(56)	10.1	(52)	14.5	(89)	17.6	(89)	6.4	(152)
Total	13.1	(355)	9.3	(374)	19.9	(300)	19.2	(443)	11.1	(727)

Table 13 shows different premium rates by main trip purposes. The premium rates for those using the railway mainly for commuting (workplace) and leisure tend to be higher at large, and there is no big difference between the two railways. In contrast, those using the railway mainly for shopping, healthcare (hospital, medical doctor) and going to schools report largely different premium rates on average between Mariazell and Pinzgau Railways. This is probably because of the existence of such facilities at the first station. In case of Mariazell Railway, the first station St. Pölten station is located in a regional center, and thus such public and shopping facilities are available in its near proximity. On the contrary, in case of Pinzgau Railway, the first station is not in such a regional center, and the same applies to the other stations along the line. Such public and shopping facilities are not available along the line in a comparable manner to Mariazell Railway, and the visitors to these will have to go elsewhere in the area not covered by this railway. This result demonstrates that, in spite of the assumption in the questionnaire that replacement bus

would provide the same service level as existing railway such as timetable and stations, preference to railways may depend on geographical conditions. Inversely, the result also implies that, when public and shopping facilities are located conveniently along railway lines, recognized values of railways become much higher than the bus. From a spatial-planning perspective, this confirms that strategic land use and location of such facilities in a near proximity of railway will result in a higher valuation of railway, which leads to an investment of railway more efficient compared to the case without such strategic land use and location.

Table 13. Premium rates by main trip purpose with railway based on winsorized dataset

	Mariazell Railway		Pinzgau Railway	
	pw_{avg}	N	pw_{avg}	N
Workplace	12.9	(21)	12.1	(24)
School, Educational Facility	25.8	(10)	4.7	(10)
Shopping	12.5	(22)	8.1	(24)
Hospital, Medical doctor	15.9	(32)	5.3	(17)
Leisure	13.2	(157)	11.2	(103)
Visiting/meeting relatives and friends	9.6	(8)	11.0	(17)
Others	0.0	(2)	14.3	(4)
Total	13.6	(252)	10.1	(199)

As for the premium rates subdivided by main access mode to the railway (Table 14), those coming to the railway station by car as a driver reports higher premium rates than those coming on foot. This is more particular in the case of Mariazell Railway, where much more people drive to stations. This result implies that the people using park-and-ride facilities to use the railway instead of driving thoroughly to the final destination although they are living in the outside of the spatial catchment area of railway accessible on foot recognizes the value of the railway higher than those who lives within an accessible area to the railway station on foot.

It has to be noted that Mariazell Railway made many park-and-ride facilities available on the course of the modernization and service improvement, enabling inhabitants in the outside of the area accessible on foot or by bicycle to be potential railway customers. On the contrary, Pinzgau Railway does not offer such park-and-ride facilities in a comparable manner to Mariazell Railway, and inhabitants in the outside of the foot-and-bicycle accessible area do not recognize the value of the railway as their peers along Mariazell Railway do. Together with the higher premium rate of Mariazell Railway, this implies that the enlargement of catchment areas from the railway stations by means of park-and-ride makes the value of the railway higher. This will probably apply to an emerging access mode such as e-bikes – for example, a secure bike parking at railway station to store them safely will increase the value of railway itself.

Table 14. Premium rates by main access mode based on winsorized dataset

	Mariazell Railway		Pinzgau Railway	
	pw_{avg}	N	pw_{avg}	N
On foot	13.2	(153)	9.8	(169)
Bicycle	10.1	(19)	30.4	(3)
Bus	14.3	(2)	-	(0)
Car as a driver (Park & Ride)	15.2	(62)	10.8	(19)
Car as a passenger	16.7	(14)	8.8	(8)
Taxi	11.1	(2)	-	(0)
Total	13.6	(252)	10.1	(199)

Lastly, as a very first attempt, we analyse the relationship between the premium rates and various attributes of respondents using logistic regression model. As shown in figure 2, the distribution of winsorized discount rates, *dw*, is, by and large, divided into two clear poles, 0 % and 25 %. Therefore, we try to estimate discrete choices on a binary logit model and on an ordered logit model, where each dependent variable is designated as follows:

$$y_b = \begin{cases} 0: dw = 0 \\ 1: 0 < dw \leq 0.25 \end{cases}$$

$$y_o = \begin{cases} 0: dw = 0 \\ 1: 0 < dw < 0.25 \\ 2: dw = 0.25 \end{cases},$$

In case of Pinzgau Railway, where more than half of respondents answer 0 as *dw*, no significant model is obtained, while there are some interesting results estimated by stepwise method in case of Mariazell Railway. Backward elimination of explanatory variables leads to such significant models as shown in Table 15 and 16. Having a job or not is a significant explanatory variable at the level of 1 percent and 5 percent in the two models respectively, and the age is negative at a significance level of 5 percent in our binary model. The tendency shown in Table 12 that people over sixty years old in Austria indicate relatively lower premium rates, which shows a clear contrast to the studies in Japan, may partly be explained not by their ages but by their job statuses. It is also noted that, when frequency is added as an explanatory variable in the models above, it has no significant effect on choice of discount rate.

Table 15 Results of binary logistic regression (Mariazell Railway)

	coefficient	S.E.	Wald	p-value
Age	-0.159	0.079	4.010	0.045
Job	-0.757	0.274	7.640	0.006
Constant	1.735	0.635	7.463	0.006
Number of observation		355		
chi-square, p-value	8.141		0.017	

Table 16 Results of ordered logistic regression (Mariazell Railway)

	coefficient	S.E.	Wald	p-value
Age	-0.096	0.073	1.749	0.186
Job	-0.533	0.252	4.475	0.034
Threshold (y_o=0)	-1.170	0.579	4.083	0.043
Threshold (y_o=1)	-0.587	0.577	1.035	0.309
Number of observation		355		
chi-square, p-value	4.699		0.095	

6. Concluding remarks

In the research presented in this paper, applying contingent valuation method to the residents along two regional railways in Austria, we estimate the rail bonus as railway's additional value over bus, which we call premium rate. The research results show that, to put it in a conservative way, the premium rate of regional railways is estimated to be approximately 10 %. This value does not vary much by the frequency of usage, while higher values of the railway over buses are acknowledged not only by regular users but also by residents who consider the regional railway as a regional symbol, as an optional transportation mode in their future or for other people. This indicates that the rail-based transport has higher option values and non-user values than bus-based transport.

The method used in this research deals with relative differences between railways and buses instead of absolute values, and it makes easy to compare the result from anywhere else. In comparison with Japanese case studies, the results above are in line with the case of a regional railway, Wakasa Railway. Among the three case studies in Japan, Wakasa Railway is the most similar to the two Austrian railways in that it runs through a sparsely-populated rural area: the other two are different from it in terms of their primary roles as an urban trunk line in a mid-sized city and

as am interurban mode. Thus the result from the case studies in Austria confirms the result from Japan as for railways in sparsely populated area.

As the two case studies in Austria are compared, a certain extent of differences in premium rates is observed. For example, premium rates are highly evaluated by people going shopping or to hospital by train in Mariazell Railway, but not in Pinzgau Railway. This is probably because of locations of stations, and land use around them. Higher premium rates observed in Mariazell Railway are also contributed by those who use cars to get to train stations. At stations along Mariazell Railway, many park and ride facilities are provided.

Despite the fact that rail bonus has long been recognized in practice, it has been long overlooked when decision-making with help of quantifiable indicators is made, such as to decide rail-based mode or bus is implemented or to decide a railway line to be replaced by an alternative bus. Cost-benefit analysis has widely been used as a quantifiable method, while it has not incorporated option value and non-user value in it. The result of this research, as well as the previous case studies in Japan, indicates that, conservatively estimated, the regional railway has premium rate of c.a. 10 % including option value and non-user value. The result also indicates that improvement of railways together with land use in favor of railway and improvement of intermodal connection such as park-and-ride will enhance their option value and non-user values for potential users, leading to an extra “bonus” of railway compared to bus services. It has to be noted that, in case of railway-related decision-making, it is important to understand such potential values of railways that are enhanced by integrated land use and other investments in railway facilities: when a decision is made about railway, these aspects has to be taken well into account.

The premium rate estimated in this research is not yet still complete to be used to adjust social benefits of railways calculated through cost-benefit analyses because the recognized rail bonus may include some factors that are incorporated in conventional cost-benefit analysis such as CO_2 emissions, higher level of safety, lower risk of delay, etc. When we adjust social benefits of railways calculated through cost-benefit analyses for the purpose of comparing two modes, such factors needs to be carefully eliminated so that they are not double-counted. In addition, premium rates could be influenced by social structures of respondents like age and job status. For these, further research will be needed.

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