Comparative Analyses of High-Speed Railway Fare in Thailand

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Abstract

Recently, Thailand government has announced the plan to construct High-speed Railways (HSR) between Bangkok and Chiang Mai, proposing the ticket fare of about 1,200 Baht.However, it is not sure if the fare is the optimal fare for both passengers and Railway Company. The object of this paper is to investigate the optimal fare between Bangkok and Chiang Mai and also to investigate the effect of CO_2 emission of each transportation modes. Kishi's Logit PSM and the multinomial logit model were applied to those analyses. The questionnaire survey was conducted at train station, bus terminal and airport terminal in Bangkok in 2012. About 350 samples werecollected from both Thai people and foreignersin order to compare the optimal fare for both of them. It was found that the optimal fare for Thai people was lower than 1,200 Baht that was originally proposed fare by Thai government. On the other hand, the optimal fare for foreigners was higher than it. From the multinomial logit model analyses, it was also found that the emission of CO_2 had less influence on the selection of transportationmodes. For Thai people, the optimal fare for passengers is fairly lower than the optimal fare for the railway company. But, foreigners are willing to pay much more than the optimal fare for the railway company. The results of this study wouldprovidesome usefulinformation for Thai government when they consider the optimalHSR fare.

Keywords: High-speed Railway fare, Kishi's Logit PSM (KLP), CO_2 emission.

1. Introduction

In Southeast Asia,including Thailand,railways had played an important rolefor the passenger transport between cities, when railways were a leading system of landtransport. However, due to the improvements of the highway system for the several decades, automobiles became more advantageous than railways in intercity transport in terms of travel time and operation frequency.Moreover, railway companies have to compete withthe low cost carriers (LCC) thathave grown up quickly since early 2000s. The railway fare of 1st and 2nd class used to be more expensive than that of LCC.

The railway system of Thailand is unique in the world because of its meter gauge. But, it has a drawback that the speed rapidly falls down in mountain areas. Besides, fairly long waiting time used tooccur at railway stations due to poor control and management. In this way, Thai railway is required to improve in many aspects, particularly in travel speed in order to compete with automobiles and airplanes.

Thailand government plans to construct High-speed Railway system between Bangkok and Chiang Mai. At present, intercity busses and airplanes are the majortransportation meansin the section. It is expected that there could be a large change in the share of transportation modesafterthe high-speed railway opened.The government set the fare between Bangkok and Chiang Mai to be1200 Baht, simply assuming that it would costs 1.5 Baht per a kilometer. However, it is not clear whether the fare of 1200 Baht is optimum for both passengers and the railway company. On the other hand, from the environmental viewpoints, it is said that the CO_2emission of intercity busses and airplanes would be four and nine times as much as that of high-speed railway. In this sense, High-speed railway could be one of the solutions to reduce the overall CO_2 emission produced by the transportation system in Thailand.

The objective of this study is to investigate the optimal High-speed Railway fare between Bangkok and Chiang Mai for both users and the railway company.The optimal fare that would maximize the revenue was compared for both Thai people and foreigners.Also, this study aims to clarify the effect of HSR in CO_2 emission.

2. Literature review

Some studieshave been already conducted about the HSR in Thailand. OTP summarizes the master plan[1)2)] on the railway system, including the feasibility study for the prospective five routes of HSR in Thailand. They evaluated the demand of passenger and freight as well as the financial cost and return for each route.

Also, some studies focus on the route between Bangkok and Chiang Mai. For examples, CHANTRUTHAI[3)]indicated the time delay, rail accidents, lack of signaling equipment at junctions, insufficient number of locomotives, and low service quality of the existing railway system. He discussed the improvement of existing railway line by HSR. However, he did not treat the High-speed Railway between Bangkok and Chiang Mai.

KONGPRASERT[4)]predicted the number of passengers bythe HSR between Bangkok and Chiang Mai, mentioning that the number of passengerswould increase year by year. In the study, a questionnaire survey was conducted in Chiang Mai. It showed that 77% of the respondents approved forthe introduction of High-speed Railway project between Bangkok and Chiang Mai.Moreover, CHITRANUKROH[5)]overviewed the current situations of Thai railway system and presented the solutions by HSR.

3. Methodologies

3.1 Questionnaire survey

Questionnaire surveys were conducted in Bangkok for 2 weeks in October and November in 2012 for Thai and the foreigners living/traveling in Bangkok.The questionnaire sheets were distributed mainly at five spots: Hua Lamphong station, Mo chit bus terminal Nakhonchai Airbus Terminal, Don Muang Airport, Suvanabhumi Airport. The responders are required to answer the questions in an interview style either in Thai or English. Thai students of Asian Institute of Technology (AIT), King Mongkut's University of Technology Thonburi and Chulalongkorn University helped with the interview. Table 1 summarizes the questionnaire survey. In total, 247 of Thai people and 100 of foreigners responded to the interview, respectively.

Table1 Outline of questionnaire survey

Target	Foreigners	Thai user		
		Site 1	Site 2	Site 3
Sample	100	104	86	57
Data	October 30 – November 9 in 2012			
Method	Distributing by hand			

Site 1:Hua Lamphong station
Site 2:Mo chit bus terminal Nakhonchai AirbusTerminal
Site 3: Don Muang Airport, Suvanabhumi Airport

The questionnaireswere classified into three sections. The first section asks the respondents' attributes and the travel experience between Bangkok and Chiang Mai. The second sectionconsists of question about the fare of High-speed Railway between Bangkok and Chiang Mai. The section informed the respondents the distance, time andthe fare of High-speed Railway between Bangkok and Chiang Mai. The answers were analyzed by KLP(Kishi's LogitPSM). The third section is associated with the modal choice between Bangkok and Chiang Mai, expecting to analyze using Disaggregate Multinomial Logit model. Respondents are required choose either of High-speed Railway, intercity bus or Airplane for various the stated preference situations on ride time, fare and CO_2 emission for each transportation mode.The income is so diverse among Thai people. In order to

avoid the bias by the income level, thesurveys were conducted in various transportation facilities.

3.2 KLP(Kishi's Logit PSM)

PSM (Price sensitivity Measurement) is a method of measuring consumers' perceptions to price. PSM surveys ask respondents theprices at four different levels: "reasonable", "expensive", "too expensive to be willing to buy", and "too cheap to be willing to buy" as shown in Figure 1.

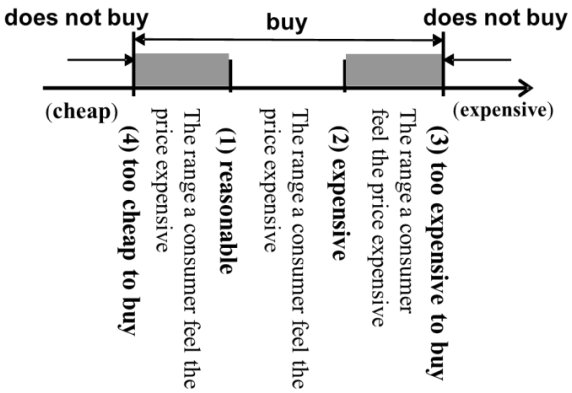

Figure 1 Four prices of PSM

KLP (Kishi's Logit PSM) improves PSM by applying the logit regression to represent the relative cumulativefrequencies as shown in Figure 2. Consequently, KLP gives four indicators: "Minimum Price", "Maximum Price", "Standard Price" and "Reasonable Price"

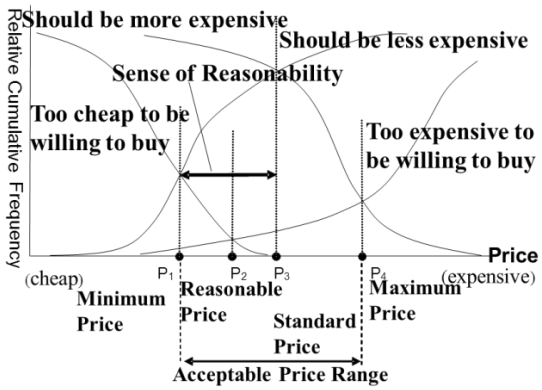

Figure 2 Logit regression of KLP

Inthis questionnaire survey, the question of asking the price whether they feel "too cheap to be willing to use" was excluded, because it is not appropriate to the fare of high-speed railway. Consequently, out of four indicators, Maximum price and Standard price can be obtained.

3.3 Modal choice model for CO_2 emission

The disaggregate multinomial logit model was applied to describe mode choice behavior between Bangkok and Chiang Mai. It was assumed that there are three alternative: High-speed Railway, intercity bus and airplane. Utility function of using airplane, intercity bus and high-speed railway are specified by Eq. (1) to (3). The each fare is used as the explanatory variable. Besides,CO_2 emission is used as dummy variable.

$$V_{air} = a_1 \times Fare_{air} + a_2 \quad (1)$$

$$V_{bus} = a_1 \times Fare_{bus} + a_3 \quad (2)$$

$$V_{HSR} = a_1 \times Fare_{HSR} + a_4 \times CO2_q \quad (3)$$

where,
V_i:deterministic term of utility function
air : airplane
bus: intercity bus
HSR: high-speed railway
$Fare$: fare of mode
$CO2_q$: dummy variable of CO_2 emission
a_1, a_4:parameters
a_2: constant of airplane
a_3: constant of intercity bus

The questionnaire has two types. In one type, not only fare and time but also the information on CO_2 emission was shown to respondents. On the other hand, in another type, only fare and time for each transportation mode was presented. In Eq.(3), the answers which CO_2 emission was shown was treated as $CO2_q$=0, while the ones which CO_2 emission were not shown was treated as $CO2_q$=1.

3.4 Modal choice for maximum revenue

In this section, disaggregate multinomial logit model is also applied to describe mode choice behavior between Bangkok and Chiang Mai.The utility function of using airplane, intercity bus and high-speed railway is specified by equation (4) to (6). The each fare is used as the explanatory variable. Besides, the samples are divided into three users based on which mode they usually choose. They are named as railway user, intercity user and airplane user. The mode choice is built in each user respectively.

$$V_{air} = a_1 \times Fare_{air} + a_2 \quad (4)$$

$$V_{bus} = a_1 \times Fare_{bus} + a_3 \quad (5)$$

$$V_{HSR} = a_1 \times Fare_{HSR} + a_4 \quad (6)$$

where,
V_i :deterministic term of utility function
air : airplane
bus : intercity bus
HSR: high-speed railway
Fare : fare of mode
a_1 : parameters
a_2: constant of airplane
a_3 : constant of intercity bus

4. Analytical Results

4.1 Questionnaire survey

Among the Thai respondents, 63 percent are female. In terms of age, 43 percent are in range of 20-29 years old. Approximately three forth of the total respondents have traveled between Bangkok and Chiang Mai. On the other hand, among the respondents of foreigners, 53 percent are male and 43 percent are in range of 20-29 years old. Nearly one third of the foreign respondents have travelled between Bangkok and Chiang Mai.

4.2KLP Analyses

Table 2 shows the maximum price and the standard price for each transportation mode by the KLP analyses for Thai people. For railway users, the standard price that was taken as "reasonable" was 814 Baht and the maximum price that was taken as "too expensive to buy" was 1086 Baht, respectively. Those prices are much lower than the fare planned by Thai Government, 1200 Baht, That is, railway users willingly pay at most 1086 Baht. It suggests thatthe railway users are not satisfied with the plan fare, feeling too expensive. Also, it can be seen some differences in the maximum price and standard price for each transportation mode. The parameters indicate reasonable signs and the coefficient of determination are large enough which means that they are significant. Therefore, this model is considered to be statistically valid.

Table 2. KLP analyses for Thai people

	airplane	intercity bus	railway
respondents	101	78	51
maximum price(Baht)	1503	1251	1086
standard price(Baht)	1089	954	814

In order to avoid the bias among the transportation modes by Thais, all Thai data were assembled into one group.And the KLP prices were estimated for all Thai data. Also, the KLP analyses were conducted for the foreigner data, too.Table 3 shows the KLPprices for both Thais and foreigners. There can be seen a large difference in both the maximum price and the standard price between the foreigners and the Thai people. It suggests that foreigners evaluate the value of High-speed Railway favorably compared with Thai people.

Table 3. KLP analyses for foreigners and Thais.

	foreigner	Thai
respondents	100	229
maximum price(Baht)	1,999	1,352
standard price(Baht)	1,547	1,001

4.3 Effects of CO_2 emission

In order to assess the effect of CO_2 emission in the modal choice between Bangkok and Chiang Mai, the multinomial logit analyses were conducted for Thai people using the utility functions of Eq.(1)-(3). The regression coefficients were identifiedby the free software R (Ver. 2.14.1). The dummy variable of $CO2_q$ depends on whether or not the respondents were providedthe information on CO_2 emission.Table 4shows the regression coefficients of the utility functions. The coefficients seem to be reasonable because the signs and t-value are large enough.Both the likelihood ratio and modified likelihood ratio are also large enough.

Table 4. Regression coefficientsfor Thais

	a1 fare	a2 cofficient of airplane	a3 cofficient of intercity bus	a4 dummy variable of CO2
parameter	-3.028	1.359	-2.922	-0.226
t value	-20.94	11	-20.48	-1.81
sample	225			
likehood ratio	0.227			
modified likehood ratio	0.225			

Substituting the regression coefficients in Table 4 into the utility functions of Eq. (1) to (3), we can estimate the share of high-speed railway using the multinomial logit model. The share of HSR is 0.67 with the information on CO_2 emissionwhile 0.62 without it. The difference is not

so large. It suggests that Thai people do not seem to be so sensitive to the environmental aspects in modal choice. Actually, railways are not popularin Thailand and High-speed rail is not realized yet. That is the reason why the difference is not so large as expected. For foreigners, there is no difference in the HSR share. That is because the respondents are most young Europeans.

4.4 Optimal fare maximizing revenue

The prices in Table 4 can be interpreted as the optimal fare to passengers, both Thai people and foreigners. They are not always optimal to the Thai railway company. In order to compare the optimal fare for the railway company with the one for passengers, we estimated the optimal fare for the railway company as follows:
First, the modal choice models of Eq. (4) to (6) were applied to both Thais and foreigners.Next, the revenue of High-speed Railway was defined by the following equation:

$$Revenue = Fare \times Share \qquad (7)$$

where the share of HSR was estimated by the multinomial logit model along with the utility functions of Eq.(4)-(6). That is, the optimal fare for the railway company was estimated so as to maximize the revenue when the share is changed with the fare.Table 5presents the regression coefficients of the utility functions for both Thais and foreigners.The parameters indicate reasonable signs and t-values of those parameters are large enough which means that they are significant. Besides, the likelihood ratio are large enough. Therefore, this model is considered to be statistically valid.

Table 5. Regression coefficients for maximum revenue

	foreigner		Thai	
	parameter	t value	parameter	t value
a1 fare	-2.168	-10.88	-3.037	-22.19
a2 coefficient of airplan	0.624	4.07	1.458	23.58
a3 coefficient of bus	-3.075	-15.41	-2.789	-22.31
sample	95		225	
likehood ratio	0.145		0.226	
modified likehood ratio	0.139		0.224	

Table 6exhibits the optimal fare maximizing the revenue of Thai railway company for both Thas and foreigners.

Table 6. Result of the fare for maximum revenue

	foreigner	Thai
respondents	100	229
fare for maximum revenue(Baht)	1,405	1,105

The comparison of the results in Table 6with the ones in Table 4 provides some insights on the optimal fare of High-speed Rail in Thailand. For Thai people, the optimal/standard fare for passengers is fairly lower than the optimal fare for the railway company. But, for foreigners, the optimal fare is much higher. That is, they are willing to pay much more than the optimal fare for the railway company. Moreover, the maximum fare for Thai passengers is not so different from the optimal fare for the railway company, whereas the one for foreigners are almost double. It suggest that Thais cannot afford to pay more but foreigners can pay more even if the fare is almost double as the optimal one for the railway company.

5. Discussion and conclusion

In the case of Thai, the fare for maximum revenue and standard price is lower than plan fare, 1200 Baht. Therefore, it is suggested that the high-speed railway fare for Thai is set lower than plan fare, 1200 Baht. On the other hand, in case of foreigners, the fare for maximum revenue and standard price is higher than plan fare, 1200 Baht. Therefore, it is suggested that the high-speed railway fare for foreigners is set higher than plan fare, 1200 Baht. Foreigners highly evaluated the use value of high-speed railway compare with Thai.

Second, It is difficult to consider CO_2 emission as the factor of mode choice between Bangkok and Chiang Mai. However, it is expected that use of high-speed railway is promoted by advertisingamount of CO_2 emission in high-speed railway.
These findings help policy maker set up the fare for Thai and Foreigner between Bangkok and Chiang Mai.

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