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INTER-CITY PRE-TRIP INFORMATION IN TAIWAN AND ITS IMPACTS ON TRAVELERS' MODE CHOICE BEHAVIOR

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Abstract: The purposes of this study are to investigate how travelers use pre-trip information in aid of choosing public transport modes (train, bus and air) for their inter-city trips, and to explore the possible effects of the uses of such pre-trip information on travelers' mode choice behavior. The results show that travelers in Taiwan rely much on the Internet and telephone to help search for or inquire about the pre-trip travel information, and even make bookings. However, the information they inquire about is quite limited to that on time table and fare, the two most important attributes in mode choice models. The estimation results of mode choice models show that quite a few variables associated with the uses of pre-trip travel information have significant impacts on travelers' mode choice behavior, those associated with the Internet in particular.

Key Words: Traveler information system, Pre-trip information, Travel demand, Mode choice

1. INTRODUCTION

The impacts of information technology are so significant that even travelers rely much on traveler information system (TIS) to help them make suitable travel choices (Chatterjee and McDonald, 1999; Golob and Regan, 2001). Owing to the TIS advancements, travel demand patterns have greatly changed, and as a result a large number of research issues regarding the impacts of TIS on travel demands have also emerged (Jovanis, 1993; Mahmassani, 1999; Lyons, 2001). Nevertheless, it is still unclear to what extent TIS affects travel behavior.

The types of traveler information can be categorized as two: the traditional and the advanced. The former refers to those such as time tables, road maps, and traffic signs. Information gained from these traditional vehicles is generally static rather then interactive; i.e., travelers have to pick out the information they need all by themselves. For this reason, even the broadcasts on traffic condition are often classified as the traditional one, although it is based on telecommunication. On the other hand, the advanced one mostly refers to the information gained by using telecommunication tools such as telephone, the Internet, and mobile phone. The Internet and mobile phone are generally classified as advanced tools without doubt. Telephone is considered an advanced one because it can be used in an interactive way, remaining high penetration rate and high usage level. Consequently, more and more transportation agents establish telephone-based TIS to provide travelers with interactive information. A famous example is the National Public Transport Information System (NPTIS) set up by British agents, which integrated information on fare, time table and others across

train, bus, tram, subway, and ferry (Lyons, 2001).

Traveler information can also be divided into two categories: pre-trip and en route, according to the time it is provided. The former is that provided before travelers make trips, and the latter is during the trips. Polak and Jones (1993) further divide pre-trip information into two subcategories: in-home and non-home. The former refers to that travelers inquire about at home prior to their trips, and the latter is that outside their home. To transportation planners, the most significant difference between in-home and non-home information is that when travelers inquire about in-home information, they still can change their trip decisions (e.g., cancel the trips, or change the modes, destinations or routes). However, as they need non-home information, they are not able to change some of the trip decisions (e.g., not able to cancel the trips, or change the modes).

Though the impacts of TIS on travel behavior are foreseeable, there are still not many studies working on this area of researches (Mahmassani, 1999)). One of these is Golob and Regan (2001), who probed into the information technologies (IT) used in transportation area, and their possible impacts on travel demands. Up to now, however, rare empirical results have been found about how IT or TIS affects travel demands.

2. TIS AND TRAVEL DEMANDS

Traditionally, travel choice behavior includes four consecutive decisions: (1) trip generation, (2) destination choice, (3) mode choice, and (4) route choice. With the aid of TIS, travelers are generally more informed, and may as a result change their original travel choices with respect to the above four decisions. For example, when a traveler learns of the congestion around a shopping mall before making the trip (pre-trip), he may change his travel decisions such as:

(1) canceling his shopping trip, (canceling the trip generation)
(2) changing the activities (from shopping to seeing movies) (changing the destination choice),
(3) changing the mode (from car-driving to subway)
(4) changing the route

Of course there are certain types of TIS affecting travel choices to much smaller degree. For example, using in-vehicle or roadside TIS may only help travelers change their route choices.

Travel demands are derived demands, and generally induce disutility to travelers. Consequently, to transportation planners, the ultimate goal is to reduce the number of trip generation. If this can not be done, then they may try to guide travelers to change their modes (better to public transportation) or change their destinations (better to less crowded area). If all these can not be done, then the only hope is to guide drivers to change their route (better to less congested one).

To reduce the number of trip generation, there have been a number of ways raised, ranging from land use planning, a traditional one, to telecommuting and teleshopping, a relatively advanced ones. Telecommuting and teleshopping are two important ideas relating to TIS applications. There have also been quite a number of studies working on these areas of researches (e.g., Mokhtarian and Bagley, 2000; Ellen and Hempstead, 2002; Safirova, 2002; Nagurney et al., 2001; Polydoropoulou and Litinas, 2001). Moreover, researches on the

effects of TIS on drivers' route choices are also not uncommon. Works like Hato et al. (1999), Ben-Akiva et al. (1991), Polydoropoulou et al. (1994), Mahmassani and Liu (1999), and Lam and Chan (2001) are all involved in this area. Comparatively, studies on how TIS affects travelers' mode choices and destination choices are still very limited.

As a result, the purpose of this study is to survey how travelers in Taiwan use travel information before making trips, and then explore the resulting impacts on their mode choices. In this study, both the types of the traditional and advanced pre-trip travel information are concerned, but it will lay more emphasis on the advanced one. Moreover, this study concerns the inter-city mode choice behavior rather than the intra-city one.

3. DATA COLLECTION

This study surveys passengers traveling between Taipei and Kaohsiung, which are the two largest cities in Taiwan. The distance between the two cities them is about 350km and there are three types of public modes for passengers to choose: train, bus, and air.

The survey is conducted by face-to-face interviews with formatted questionnaire. The questionnaire includes four parts of questions:

(1) Modes' attributes: travel time and travel cost for the chosen mode and alternative modes.
(2) Trips' attributes: trip purposes and trip experiences of respondents.
(3) Uses of traveler information: e.g., whether travelers inquire about modes' information before their trips, how they inquire (by telephone or the Internet, for example), what kinds of information they inquire about (fare or time table, for example).
(4) Personal characteristics: sex, age, income, etc.

The survey was conducted from May to June in 2003. The choice-based sampling approach was used to survey train, bus, and air passengers while they were waiting at the terminals. A total of 536 effective samples are acquired; 249 for train, 138 for bus, and 149 for air. Of the samples, 28.4% are classified as business trips, and the other 71.6% are non- business trips.

4. SURVEY RESULTS

4.1 Traveler Information Inquired

Table 1 summarizes the ratio of passengers in the sample who did inquire about modes' information prior to their trips. Regardless of what modes respondents eventually choose, as high as 60.1% of them inquire about train information before making trips, which is much higher than those inquire about bus and air information (37.5% and 46.4%, respectively). This may partly be because the train industry in Taiwan is monopoly, and there is only one train route between Taipei and Kaohsiung, both making train information quite easy to find and read. Such a high inquiry rate also evidences that train is an important alternative mode to choose for travelers in Taiwan. As a matter of fact, nearly 94% of respondents consider train an alternative mode according to our survey.

For those who chose train, Table 1 shows that 72.3% of them have inquired about train information, but only 36.3% and 30.9% have inquired about bus and air information, respectively. For those who chose bus, 54.3% of them have inquired about bus information,

and also as high as 52.9% have inquired about train information, but only 30.9% have inquired about air information. Finally, for those who chose air, 78.9% of them have inquired about air information, but only 46.3% and 23.8% have inquired about train and bus information, respectively. Such results imply that train and air passengers are more concentrated on the information about the mode they intend to choose. Comparatively, bus passengers are not that concentrated, instead, more than half of bus passengers are also interested in train information.

Table 1 Ratio of Passengers Inquiring about Modes' Information before Trips

Chosen mode	Information			Total samples
	Train information	Bus information	Air information	
Train	180 (72.3%)*	90 (36.3%)	77 (30.9%)	249
Bus	73 (52.9%)	75 (54.3%)	55 (39.9%)	138
Air	69 (46.3%)	35 (23.8%)	116 (78.9%)	149
Total	322 (60.1%)	200 (37.5%)	248 (46.4%)	536

*: the percentages in the parenthesis are obtained by dividing the number of the samples in that cell by the total number of that chosen mode. For example, 72.3%=180/249, which means of the 249 passengers who chose train, 180 passengers, i.e., 72.3%, have inquired about train information.

4.2 Inquiry Tools

Table 2 summarizes the ratio of inquiry tools passengers used for those who did inquire about modes' information prior to their trips. As a whole, of 536 respondents, 62.1% of them have inquired over the Internet. Such a rate is quite high compared to those by telephone and mobile phone, which are only 19.0% and 9.4%, respectively. This may not be surprising if we know that the penetration rate of the Internet accessibility is more than 80% in Taiwan. It would be quite surprising though that the uses of telephone and mobile phone to inquire about mode information are so uncommon, if we know that the penetration rates of telephone and mobile phone are both exceed 97%.

Table 2 Inquiry Tools

Media	Information			Total
	Train information	Bus information	Air information	
The Internet	213 (66.1%)*	83 (41.9%)	182 (72.8%)	478 (62.1%)
Telephone	43 (13.4%)	34 (17.3%)	69 (27.5%)	146 (19.0%)
Mobile	20 (6.2%)	17 (8.6%)	35 (13.9%)	72 (9.4%)
Printed form	94 (29.2%)	20 (10.2%)	26 (10.4%)	140 (18.2%)
Terminal	133 (41.3%)	116 (58.9%)	66 (26.3%)	315 (40.9%)
Others	9 (2.8%)	6 (3.0%)	13 (5.2%)	28 (3.6%)
Total	322	200	248	770

*: the percentages in the parenthesis are obtained by dividing the number of the samples in that cell by the number of passengers who have inquired about the information. For example, 66.1%=213/322, which means of the 322 passengers who have inquired about the train information, 213 passengers, i.e., 66.1%, have inquired over the Internet.

Another noticeable figure in Table 2 is that there are as high as 40.9% of passengers go personally to terminals to check out the information, bus and train passengers in particular.

This may be because the main stations of train and bus in Taipei and Kaohsiung are both located in CBD, and are next to each other. As a result, it won't be much trouble for passengers to go to main stations for a check on information.

4.3 Information Contents

Table 3 summarizes the information contents passengers inquire about. As we expected, passengers are most interested in information on time table (92.7%) and fare (73.4%), reflecting passengers' concerns on the travel time and travel cost – the two most important attributes in mode choice models. This may be partly because the information provided by haulers is mostly limited to that on time table and fare; passengers don't really have much to choose.

Table 3 Information Contents

Information contents	Information			Total
	Train information	Bus information	Air information	
Time table	301 (93.5%)*	175 (88.8%)	238 (94.8%)	714 (92.7%)
Fare	234 (72.7%)	146 (74.1%)	185 (73.7%)	565 (73.4%)
Stops	112 (34.8%)	66 (33.5%)	NA	178 (23.1%)
Transfers	21 (6.5%)	12 (6.1%)	26 (10.4%)	59 (7.7%)
Terminals	35 (10.9%)	27 (13.7%)	38 (15.1%)	100 (13.0%)
Others	3 (0.9%)	4 (2.0%)	7 (2.8%)	14 (2.0%)
Total	322	200	248	770

*: the percentages in the parenthesis are obtained by dividing the number of the samples in that cell by the number of passengers who have inquired about the information. For example, 93.5%=301/322, which means of the 322 passengers who have inquired about the train information, 301 passengers, i.e., 93.5%, have inquired about the time table information.

4.4 Booking

Our sample also shows that more than half of the passengers (50.4%) booked tickets prior to their trips, for air and train passengers in particular. Specifically, air passengers have a booking rate of 66.4%, train passengers 53.0%, and bus passengers 28.3%. Moreover, of those who have booked, 44.3% of them did it by the Internet, 23.1% by telephone, and still 22.3% went personally to the terminals or travel agents to buy tickets.

4.5 Discussion

In summary, our data analysis results show that travelers in Taiwan rely much on the Internet and telephone to help search for or inquire about the pre-trip travel information, and even make bookings. Thanks to the high penetration rate of the Internet accessibility in Taiwan, most people are quite used to using the Internet to help them search for the information they need. It is a pity, however, that using mobile phones to inquire about the pre-trip travel information is still not very common despite the fact that the penetration rate of the mobile phone in Taiwan exceeds 100% already. On the other hand, although travelers are quite used to using telecommunication technology to help make mode choices, the information they inquire about is quite limited to that on time table and fare, the two most important attributes in mode choice models.

5. MODE CHOICE MODEL ESTIMATION

The choice model used in this study is Multinomial Logit (MNL). ALOGIT developed by HCG (1992) is used to estimate the parameters of choice models. It is well known that maximum likelihood procedure yields consistent estimates of all parameters except the constants with choice-based sample (Ben-Akiva & Lerman, 1985). The estimation results are shown in Table 4, where *LL(c)* is the log-likelihood of market share model (constant only) model, $LL(\hat{\beta})$ the log-likelihood at convergence, and $\bar{\rho}^2$ the rho squared index relative to market share model.

In Table 4, *Sex* is specific to train where 0 for male, and 1 for female. *Income* is the household income divided by household members, and is specific to air. Moreover, there are three groups of variables related to travelers' pre-trip information uses:
(1) The first group includes variables representing whether respondents inquired mode information before making trips or not. The variable 'Inquiring train information-train' is specific to train; if the respondent has inquired train information before making the trip, and if the alternative is train, then the value is 1, otherwise, 0. The other two variables in this group, 'Inquiring bus information-bus' and 'Inquiring bus information-bus', are both defined in the same way. The effects of these three variables are all significant. The coefficients of these three variables are all positive, which means if passengers inquire about the information on a specific mode, they tend to choose that mode.

(2) The second group includes variables representing the vehicles respondents inquire by. The only significant variable in this group, however, is 'Inquiring via Internet-train', which is specific to train; if the respondent has inquired information (either train, bus, or air) via the Internet, and if the alternative is train, then the value is 1, otherwise, 0. The coefficient of this variable is negative, which means passengers who inquire about the information over the Internet tend not to choose train.

(3) The third group includes variables representing how respondents book tickets. Three variables in this group are significant. The first one is 'Booking via Internet-train', which is specific to train; if the respondent has booked seats via the Internet, and if the alternative is train, then the value is 1, otherwise, 0. The second one, 'Booking via Internet-air', is defined in the same way. The third variable is 'Booking via telephone-train', which is specific to train; if the respondent has booked seats via telephone, and if the alternative is train, then the value is 1, otherwise, 0. The coefficients of these three variables are all positive and significant. The significance of the first two variables means that if passengers book tickets over the Internet, they tend to choose train and air, but if they book over telephone, they tend to choose train. The second variable is significant may largely because passengers who book air tickets over the Internet are generally entitled quite a discount rate on the fare. The first and third variables are significant may largely because the train hauler provides a very convenient way to help passengers book train tickets over the Internet, and telephone (by voice message).

Table 4 also shows that the coefficients of travel time and travel cost are negative and significant. All sample average of the value of travel time is around NT$610 (≈US$17.9), which is calculated by (-0.368/0.603)×NT$1,000=NT$610. This value is quite close to those in some other studies in Taiwan.

Table 4 Estimation Results of Mode Choice Models

Variables	All samples
	Coefficient (t statistics)
Bus constant	-1.198 (-4.2)
Air constant	-3.217 (-4.4)
Travel time (in hours)	-0.368 (-3.4)
Travel cost (in $NT1,000)	-0.603 (-1.8)
Sex-train (0 for male, 1 for female)	-0.773 (-3.0)
Income-air (in $NT1,000,000)	37.660 (2.5)
Inquiring train information(0 for no, 1 for yes)-train	1.722 (5.0)
Inquiring bus information(0 for no, 1 for yes)-bus	1.984 (5.8)
Inquiring air information(0 for no, 1 for yes)-air	2.210 (5.6)
Inquiring via Internet(0 for no, 1 for yes)-train	-0.697 (-2.0)
Booking via Internet (0 for no, 1 for yes)-train	1.328 (2.9)
Booking via Internet (0 for no, 1 for yes) -air	1.388 (2.7)
Booking via telephone (0 for no, 1 for yes) -train	1.282 (2.3)
Sample size	337
$LL(c)$	-318.09
$LL(\hat{\beta})$	-240.88
$\bar{\rho}^2$	0.2427
Value of Travel Time	NT$610 (≈US$17.9)

Note: 1US$=34NT$ in 2003.

6. CONCLUDING REMARKS

The purpose of this study is to survey how travelers in Taiwan use travel information to help make mode choices prior to their trips, and explore the resulting impacts on their mode choice behavior. The travel information types in the survey include both the traditional and advanced pre-trip ones, but more emphasis are laid on the latter. Moreover, the mode choice behavior this study concerns is the inter-city.

The survey results show that travelers in Taiwan rely much on the Internet and telephone to help search for or inquire about the pre-trip travel information, and even make bookings. Thanks to the high penetration rate of the Internet accessibility in Taiwan, most people are quite used to using the Internet to help them search for the information they need. It is a pity, however, that using mobile phones to inquire about the pre-trip travel information is still not very common despite the fact that the penetration rate of the mobile phone in Taiwan exceeds 100% already. On the other hand, although travelers are quite used to using telecommunication technology to help make mode choices, the information they inquire about is quite limited to that on time table and fare, the two most important attributes in mode choice models.

Finally, the estimation results of mode choice models show that quite a few variables

associated with the uses of pre-trip travel information have significant impacts on travelers' mode choice behavior. Among these, the Internet plays a particularly important role. Not only are passengers quite used to using it, they also tend to choose the mode they inquire about. Thanks to the convenience of the Internet, train and air passengers are rely much on it to make ticket booking, which turns out to have pronounced impacts on travelers' mode choice behavior.

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