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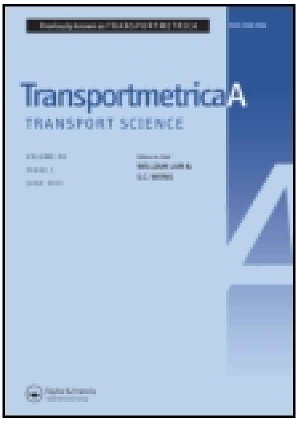

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Intertemporal demand for international tourist air travel

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This study investigated dynamic international tourism travel demand by constructing an intertemporal travel choice model. In the model, the utility functions comprise two factors: individuals' ability to travel and external environmental factors in different years. Individuals are assumed to pursue a maximised aggregated utility, with various discounts on past and future years subject to time and budget constraints. A questionnaire was designed to calibrate and explore individuals' preferences for international tourism travel from Taiwan. The study collected historic data over the past decade to estimate parameter values for the external environmental factor. The variables, such as travel budget, holiday and vacation days, travel expense and number of travel days are shown to significantly affect individual travel demand. The results support the argument that negative external events, such as an emerging influenza pandemic or economic crisis, have an adverse impact on international travel demand. Moreover, the utility of past travel experience declines at a slower rate than that of expected future travel. The findings imply that past travel experience has an unexpectedly strong impact on future travel decisions. The results also show that travellers tend not to travel until their saving budget has accumulated enough to cover travel expenses. Travellers with high incomes in Taiwan could undertake outbound international travel almost every year.

Keywords: intertemporal model; time preference; tourism demand

1. Introduction

Individuals make choices about which goods or services to purchase based on their consumption of goods or services that yield the greatest amount of satisfaction or utility. Considering budget and time constraints, most previous studies have dealt with decisions regarding tradeoffs between time and money occurring at the same time. However, in reality, many decisions involve tradeoffs between present and future payoffs (i.e. intertemporal choices). Travellers may decide between travelling abroad in the current year versus postponing the decision to the next or future years. In addition to expected future travel, the current travel behaviour is affected by past travel experience (Sönmez and Graefe 1988, Garín-Muñoz and Montero-Martín 2007, Tsekeris 2009). Having not travelled in the previous year may increase a traveller's tendency toward travelling in the

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current year due to accumulated travel budget and desire. The optimal intertemporal travel choice is made based on the extent to which travellers perceive and weigh utility as they approach a temporal horizon; past, present and future. In this study, we formulate a theoretical model and design a questionnaire to investigate international tourists' travel behaviours in order to explore the dynamics of how current choice regarding outbound travel is affected by past travel experiences, future travel expectations and external environmental events.

In addition to individuals' abilities to travel, international air travel tourism demand is also affected by external environmental events, such as an influenza pandemic, natural disasters, economic crises and government policies. For example, in November 1987 the government in Taiwan adopted a policy to allow residents to visit their relatives in Mainland China. As a result, the growth rate of outbound departures increased substantially from 30.2% in 1987 to 51.36% in 1988 (Taiwan Tourism Bureau 2006). This travel was not limited to visiting relatives, but many travellers from Taiwan went to Mainland China to pursue business opportunities or simply to visit tourist sites. Then, the outbreak of Severe Acute Respiratory Syndrome (SARS) in March 2003 had a profoundly negative impact on international arrivals to Asian countries, including China, Hong Kong, Singapore and Taiwan. On 5 July 2003, the World Health Organization (WHO) removed Taiwan from the list of areas with local transmission of SARS; however, total visitor arrivals that year dropped by about 1.4 million in comparison with the previous year. This scenario shows that external environmental events can not only have immediate impact on travel demand, but also have an impact that can last months or years. Thus, it is important this study investigates and quantifies how air-borne tourism demand is affected by external environment events.

When considering an intertemporal dynamic choice, the utility theory is used to find an optimal choice within the time frame being considered, where future values of the utility function are discounted exponentially. The dynamic concept for the intertemporal choice can be explained as follows. In addition to external environment events, an individual's decision to travel abroad in the near future is affected by past travel experiences and by future travel expectations. Moreover, the extent of the accumulated travel budget at present is the result of the decisions on travel over the past years. That is, the optimal choice at present will change dynamically based on the decisions made in other years.

Frederick *et al.* (2002) reviewed empirical research on intertemporal choice. The review noted that, in 1834, Rae was the first to propose intertemporal choice in the literature. The study sought to determine why wealth differed among nations and discovered that 'the effective desire of accumulation' was an important factor in determining a society's level of saving and investment. Intertemporal choice (i.e., time preference) is widely discussed in many fields of literature, such as health problems (e.g. Fuchs 1982, Bleichrodt *et al.* 1996, Komlos *et al.* 2004) and loan durations (e.g. Samuelson 1958, Overton and MacFadyen 1998). The discounted utility (DU) model plays a dominant role in economic analyses of intertemporal choice, and many studies have formulated different forms of the discounted utility functions (e.g. Loewenstein and Prelec 1992, Lázaro *et al.* 2002, Ebert and Prelec 2007). Other empirical studies have estimated individual discount rates with respect to various choice behaviours (e.g. Hausman 1979, Gately 1980, Kula 1984, Warner and Pleeter 2001). However, and in particular, the discount rate of international tourists towards past experiences and future expected choices has not yet been explored.

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Studies have proven that past travel experiences affect future travel decisions. Garín-Muñoz (2006) and Garín-Muñoz and Montero-Martín (2007) presented dynamic models of the demand for international tourism to the Canary Islands and the Balearic Islands, respectively. The results show that consumer loyalty is an important factor in determining the demand for international tourism. Tsekeris (2009) presented a dynamic model of passenger demand for air travel in the regional market of the Aegean islands. The results emphasised the need to consider past travel experiences when attracting new and repeated air passengers and to manage the current demand.

There have been many studies focusing on forecasting international tourist arrivals and travel demand. Song and Li (2008) reviewed the published studies on tourism demand modelling and forecasting since 2000 and identified that events' impact assessment is new research directions. Among the forecasting techniques, the exponential smooth method is widely applied to investigate problems due to its simple and straightforward application (e.g. Geurts and Ibrahim 1975, Choy 1984, Lim and McAleer 2001). Hsu and Wen (1998) applied Grey theory in Deng (1989) to forecast airline passenger traffic by using an improved single variable first-order Grey model, i.e. GM(1, 1) time-series model. Qu and Lam (1997) used an ordinary-least-squares multiple regression method to identify the exogenous variables that best explained travel demand for Mainland Chinese tourists to Hong Kong. The results showed that disposable income per capita is a very important determinant. Wong (1997) incorporated a linear trend and sine function to forecast international tourist arrivals in Hong Kong and compared the forecasting accuracy of the developed model with other approaches. Chen *et al.* (2009) used Holt–Winters method, the seasonal ARIMA model and the GM(1, 1) grey forecasting model to replicate monthly inbound air travel arrivals to Taiwan and to compare the model's forecasting performance. However, few studies in tourists' travel demand concern variables affecting individual decisions using intertemporal utility concepts.

In the field of tourism, studies have discussed the impact of disasters and crises on tourism. Goodrich (2002) described the impact of the September 11 terrorist attacks on the travel and tourism industry in the USA. Sloboda (2003) employed an autoregressive moving average model with exogenous variable (ARMAX) models to evaluate the impact of terrorism on tourism for various European nations and the USA. Kuo *et al.* (2008) investigated the impact of infectious diseases, including Avian Flu and Severe Acute Respiratory Syndrome (SARS), on international tourist arrivals in Asian countries using both single datasets and panel data procedures. The results showed that Asian tourism demand was significantly reduced by about 403 arrivals for each additional person probably infected by SARS. Although the impact of external events on international air demand has been discussed, the formulation of a theoretical model based on intertemporal utility has not been made. This study investigates how individual air travel demand is affected by external environmental factors. In the study, an external environmental event affects outbound travel behaviour in such a way that the utility of travel decreases with the impact of the event, and the extent of the decrease depends on the duration and magnitude of the effects.

Past studies have employed intertemporal choice to investigate the individual discount rate toward different decisions in which the timeframe involves mainly the present and future. This study investigates intertemporal choice on outbound travel behaviour problems by incorporating not only time preference but also external environmental events. The parameters of time preference towards past travel experience and expected

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future travel are also estimated. This study defines the external environmental factor as a major variable affecting travellers' intentions towards outbound travel. An increased positive effect of the external environmental factor will result in increasing intentions of individuals toward outbound travel. The study assumes individuals aim to maximise the aggregated utility, with various discounts on different years subject to budget constraints. Furthermore, optimal timing for future travel is explored and determined while considering time discount and external events. Moreover, the years within which individuals' past and future travel behaviours do impact their current travel decisions are explored.

The remainder of this article is organised as follows. Section 2 formulates the theoretical model. Section 3 presents the design of the questionnaire and summary statistics on questionnaire results. Section 4 provides a case study to illustrate the application of the model, where the parameters of individual time preference and external environmental factors are estimated. Finally, Section 5 presents a summary of the findings of the study.

2. Theoretical model

This study employs the binary choice model to investigate the travel choice behaviour of international air travel. The Cobb–Douglas function form was applied in this study because it is widely used in the literature to describe the utility functions when the variables are related and dependent. Let us denote the time unit by year in the study and t represent a specific year. Current travel choices include travel and non-travel alternatives, in which travel alternative refers to travellers' going abroad for vacation in the current year. Also, instead of travelling in the current year, the travel decision can be postponed to future years in which the decision is denoted as a non-travel alternative. According to the Taiwan Tourism Bureau (2006), the influence of individuals' intentions of going aboard include total expenses on travel, travel time length and travel companions. To simplify the problem, travel expense and travel time length are main variables affecting travel utility in this study. The other influence affecting tourism demand is leisure time availability (Lim 1997). Ryan (2003) stated that the growth of tourism demand has been fuelled by the increased in leisure time permitted. Under constant travel expense and length, an increased travel budget enables individuals more capable of affording the expense, plus an increased number of days off provides more flexibility to arrange the travel. Note that the number of days off represents the allowance of annual leave. The travel budget in this study is defined as the total amount of funds that can be allocated to vacation travel within a 1-year period. Travel budgets are different between individuals with different socioeconomic characteristics. Retired individuals may have low working earnings but may have a surplus travel budget due to saving and pension. On the other hand, individuals that work may have a high income, but may not have much left over for travel due to heavy taxes and a consumption of other goods. This study focused on the intertemporal choice of international air tourism. To simplify the study, individual socio-demographic variables were not included. However, the impact of the individual's socioeconomic characteristics and the age of the individuals on travel demand behaviour were determined by employing the travel budget in the utility model. In the study, travel budget and number of days off are included in the function to capture an individual's ability to travel abroad. Then, the indicators representing an individual's ability, in terms of money and time, to travel in year t, m_t and n_t, can be expressed as follows:

$$m_t = \frac{C^p}{\bar{B}_t} \tag{1a}$$

$$n_t = \frac{E^p}{l_t} \tag{1b}$$

where superscript p denotes travel route and $\bar{B}_t$ and l_t represent available travel budget and number of days off in year t, and E^p and C^p are average travel time length and total expense on vacation travel with respect to route p, respectively. As shown in Equations (1a) and (1b), decreased values of m_t and n_t imply that an individual is more capable of travel. Namely, for given E^p and C^p, individuals with larger travel budgets and numbers of days off in year t have a greater ability to travel in that year. The utility function of a travel alternative includes the individual's ability in terms of money and time to travel. The purpose of including expense/travel budget and travel time length/number of days off in the utility functions is to investigate how individual intention to travel is affected by travel cost in relation to their socioeconomic characteristics. An individual's non-travel utility involves travel budget and number of days off. The deterministic utility functions of non-travel and travel alternatives, U_0 and U_1, are formulated as

$$U_0 = A_{t,0}(\bar{B}_t)^{\alpha_0}(l_t)^{\beta_0} \tag{2}$$

$$U_1 = A_{t,1}(m_t)^{\alpha_1}(n_t)^{\beta_1} = A_{t,1}\left(\frac{C^p}{\bar{B}^t}\right)^{\alpha_1}\left(\frac{E^p}{l_t}\right)^{\beta_1} \tag{3}$$

where α_0, β_0, α_1 and β_1 are parameters to capture effects due to variables that describe the choice alternatives. The expected sign on the estimates of parameter α_0 and β_0 is negative as increased travel budget and number of day offs would make the non-travel alternative less attractive. And $A_{t,0}$ and $A_{t,1}$ reflect the impact of factors other than money and time on the utilities of travel and non-travel alternatives, respectively. Moreover, the expected sign on the estimates of parameters α_1 and β_1 is negative due to the ability to travel declines as travel time and expense increase. As shown in Equation (3), a travel package with great expense and an increased time length results in decreased utility as a travel alternative, thus a decreased choice probability. However, the negative effects of the above travel package as a travel alternative will be offset by an increased travel budget and days off.

Let binary variable k_t represent an individual's optimal choice in year t, then $k_t = 0$ for non-travel, and $k_t = 1$ for travel alternatives, respectively. Furthermore, the variable representing the impact of factors other than money and time on the utilities, A_{t,k_t} can be expressed as

$$A_{t,k_t} = e_{k_t} \times f_t \tag{4}$$

where e_{k_t} reflects alternative-specific constant and f_t is an external environmental factor in year t representing the impact of external environmental events on traveller intention towards outbound international travel. Assume that the impact of external environmental factors on the non-travel alternative is 1, meaning once travellers decide not to travel outbound, their utilities will not be affected by external environmental events.

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This study also takes past travel experiences and future travel expectations into consideration and investigates how they influence an individual's current travel choice. According to Frederick *et al.* (2002), the general discounted utility model, $\bar{u}_t$ can be described by the following special functional form:

$$\bar{u}_t = \sum_{s=0}^{\infty} K(s) u_{t+s} \tag{5}$$

where u_{t+s} is interpreted as individual's utility function in year $(t+\mathrm{s})$, s is index of summation of general discounted utility and $K(s)$ is the discounted function, which is the relative weight the individual attaches in year t to well-being in year $(t+s)$, respectively. $K(s)$ can be further expressed as

$$K(s) = \left(\frac{1}{1+\rho}\right)^s \tag{6}$$

where ρ represents the rate of time preference. Let ρ_P and ρ_F represent the rate of time preference toward past and future years, respectively. The utility of current year t can be converted by using time preferences ρ_P and ρ_F. The maximisation of the aggregated utility function of year t, $\bar{U}_t$, by considering budget constraint, can be expressed as follows:

$$\text{Max } \bar{U}_t = \sum_{a=1}^{Q} \left(\frac{1}{1+\rho_P}\right)^a U_{t-a}(k_{t-a}) + \sum_{d=0}^{t+D} \left(\frac{1}{1+\rho_F}\right)^d U_{t+d}(k_{t+d}) \tag{7a}$$

S.t.

$$G_t + B_t = I_t \tag{7b}$$

$$W_t + l_t + q_t = T \tag{7c}$$

$$\bar{B}_t = \sum_{a=1}^{Q} (\bar{B}_{t-a} - k_{t-a} C_{t-a})(1+r)^a + B_t \tag{7d}$$

$$l_t \geq E^p \tag{7e}$$

where Q and D denote the yearly range in which individuals' travel behaviour within these years (i.e. from year $(t-Q)$ to year $(t+D)$) impacts their travel choice decisions in year t. In other words, the utilities brought by travel behaviour beyond these years will be discounted to zero as they are converted to the current year. The values of Q and D can be estimated by the time preference rates of past travel experience and expected travel. The symbols a and d in Equation (7a) represent the indexes of summation of the converted utilities toward past and future years, respectively. G_t and I_t in Equation (7b) represent the consumption of goods other than vacation travel and average personal income of year t. Moreover, W_t, q_t and T in Equation (7c) express total working hours, the remainder of time other than work and travel of year t and total time length of an individual, respectively. Equation (7d) considers the characteristics of deferral to consume. Equation (7d) explains that the available travel budget in year t is the sum of the present value of the remaining travel budget in past years, as well as the travel budget of current year t, B_t.

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C_{t-a} in Equation (7d) represents total expense on vacation travel in year $(t-a)$. (Note r in Equation (7d) is the average interest rate.) Equation (7e) shows that travel time length is constrained by number of days off in year t. The decision variable in the mathematical model is k_{t+d}, the optimal timing for travel.

3. Questionnaire design and survey results

For this study, we designed a questionnaire and obtained data regarding individual characteristics and preferences in international outbound tourism travel from Taiwan. The questionnaire consists of three sections. The first section asked respondents several questions related to socioeconomic data such as age, gender, income, average number of days off, etc. In the second section, respondents were asked to report information about their travel characteristics and leisure activities. The third section asked respondents three-part questions to obtain information about their travel choice behaviour and time preference.

The first part of the three-part questions was designed to collect data for estimating the time preference rate of past travel experience. This study employs choice tasks, the most common experimental method for eliciting discount rates, to design the experiments. In a typical choice task, respondents are asked to choose between a smaller, more immediate reward and a larger, more delayed reward (Frederick *et al*. 2002). Titration procedures are used to minimise the anchoring effect in which respondents are asked subsequent questions, where the first choice they face may influence subsequent choices. In the choice experiment, respondents are asked to choose between receiving a reward of current year or a larger reward of the next year. There are 12 questions for the respondents where the reward of current year is a constant number and the larger rewards of the next year are different in the 12 questions. In the second part, respondents were asked to choose between going abroad in the current year and postponing the travel plan to the next year based on different values for various attributes of the two alternatives, such as travel length, total expense of travel, etc. Base values for parameters in the utility function, i.e. e_{k_t}, α_0, α_1, β_0 and β_1 were obtained via the collected data from this part. In the third part, information about past travel experiences can be seen in Table 1, which lists the content of the questionnaire.

This study uses the stated preference methods and designs an experiment for Q19 in Table 1. As for setting the values of attribute-levels for travel expense and time length, there are numerous travel packages in terms of sightseeing spots, travel expenses and numbers of days. To simplify the study, the attribute-level values are collected and differentiated between Asian and non-Asian areas. Travel packages to Asian areas are characterised by less travel expense and fewer days due to being a shorter distance from Taiwan to these areas, as compared to the non-Asian areas. In addition to travel expenses and days, different travel areas have various levels of attraction based on the quality of sightseeing. Individuals may be willing to pay more for travel packages with unique and/or popular scenery. In order to focus on the travellers' choice-making behaviours regarding timing, the impact of destination attraction on travel choice was limited in this study. Therefore, specific tourism spots are not shown in the questionnaire. Instead of specific tourism spots, this study determined the spatial influences on tourism demand on a regional level. For example, when an environmental event happens in a region, e.g. SARS

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Table 1. The content of the questionnaire.

Set	Description	Content
1	Socioeconomic data	Gender (Q1) Age (Q2) Occupation (Q3) Flexibility in working hours (Q4) Whether having a second job (Q5) Household size (Q6) Economic source of family (Q7) Household income (Q8) Proportion of personal income to household income (Q9) Average number of days off (days/year) (Q10)
2	Travel characteristics and leisure activities	Travel companion (Q11) Source of travel expense (Q12) Frequency of travel (Q13) Yearly travel budget (Q14) Preferred travel package (Q15) Action when travel plan is unexpectedly terminated (Q16) Activities of daily living (Q17)
3	Travel choice behaviour and time preference	Choice tasks for time preference (Q18) Individual travel choice behaviour (Q19) Past travel experience (Q20)

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or a tsunami in Asia, or 911 in the USA, it decreases the intention of travellers to travel to those regions.

The survey was administered for four weeks in April 2006. After eliminating incomplete questionnaires, 300 complete questionnaires remained. The majority of respondents are ranging from 19 to 29 years old, approximately 25% of total respondents, while those under 18 account the least, i.e. 4%. This study collects data of population distribution from National Statistics, R.O.C. (2007a) and compares of distributions by age between the respondents and Taiwan's actual population in 2006. There are significant differences in the distributions of ages for those under 18 and over 65 between the survey respondents and the population data, i.e. 3.67% versus 25.69% and 15.67% versus 9.74%, respectively. The reason is that interviews were conducted mainly at airports and hospitals during the daytime, at which time the majority of those under 18 are at schools. Moreover, the outbound travellers' distributions by age (i.e. under 14, 15–64 and over 65) are 5.54%, 87.84% and 11.47%, respectively (National Statistics, R.O.C. 2007b). The sample can be treated as a representative subset of the potential air travel tourists in Taiwan. This study further investigates whether individual socioeconomic and travel characteristics are related by conducting a chi-square test of independence. Table 2 shows the contingency table for the chi-square test of independence with individual socioeconomic characteristics on rows and travel characteristics on columns. Note that the number in Table 2 is the chi-square correlation coefficient and the number in the parenthesis shows the Cramer contingency coefficient as a percentage.

As shown in Table 2, travel companion selection (Q11) is related to age (Q2) and occupation (Q3). The reason for this is the tendency towards choosing family members as travel companions increases for aged and middle-aged individuals, while those in younger

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Table 2. Contingency table for chi-square test of independence.

Travel characteristics	Socioeconomic characteristics									
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Q11	5.9	79.0**	37.4*	8.2	2.6	8.3	5.4	19.2	24.2	16.2
	(8.5)	(23.4)	(15.1)	(8.1)	(5.6)	(7.1)	(8.1)	(10.8)	(12.1)	(9.9)
Q12	2.4	83.9**	81.0**	6.0	0.4	0.5	19.1**	12.8	13.8	19.5**
	(5.9)	(30.0)	(29.9)	(9.1)	(4.9)	(7.6)	(16.8)	(11.7)	(15.3)	(15.2)
Q13	4.6	15.1	34.0*	10.0	3.5	8.9	9.7**	36.5**	64.3**	10.2
	(8.9)	(13.2)	(17.9)	(12.6)	(7.9)	(9.7)	(13.1)	(16.4)	(21.7)	(10.0)
Q14	5.5	35.0	71.4**	24.5**	5.7	16.3	10.8*	42.7*	47.0	34.9*
	(9.5)	(13.9)	(18.4)	(16.5)	(9.8)	(11.7)	(13.4)	(15.4)	(15.0)	(15.3)
Q15	1.3	11.2	20.7	6.3	1.4	7.9	0	14.5	18.9	3.9
	(7.8)	(12.5)	(14.1)	(10.4)	(7.5)	(9.1)	(11.9)	(13.1)	(15.5)	(7.5)
Q16	1.8	10.5	15.4	3.8	0.7	12.8**	4.8*	37.4**	20.5	8.3
	(5.4)	(10.5)	(12.7)	(6.3)	(3.4)	(11.6)	(8.7)	(19.9)	(14.7)	(9.3)
Q17	4.6	36.2**	43.3*	14.6*	8.0*	5.2	7.6	14.6	39.5	44.5*
	(7.5)	(12.9)	(18.6)	(11.7)	(10.5)	(11.5)	(13.3)	(8.8)	(13.8)	(15.0)

Notes: *significant at $p < 0.1$; **significant at $p < 0.05$.

Table 3. The results of Q18.

Range of time preference rate	Chosen frequency	Percentage
$\rho > 9$	1	0.34
$7 \leq \rho < 9$	6	2.06
$4 \leq \rho < 7$	11	3.75
$2 \leq \rho < 4$	8	2.74
$1 \leq \rho < 2$	9	3.07
$0.8 \leq \rho < 1$	19	6.48
$0.6 \leq \rho < 0.8$	32	10.92
$0.5 \leq \rho < 0.6$	44	15.02
$0.3 \leq \rho < 0.5$	41	13.99
$0.15 \leq \rho < 0.3$	49	16.72
$0.05 \leq \rho < 0.15$	47	16.04
$0.001 \leq \rho < 0.05$	26	8.87
Total	293	100

groups tend to go abroad with colleagues or friends. Regarding occupations, students and volunteer groups prefer more independent travel, as opposed to travelling with companions. The source of payment for travel expenses (Q12) is strictly related to age (Q2) and occupation (Q3), in such a way that young and jobless travellers rely heavily on subsidies from someone else. Since groups with increased days off are probably jobless and/or undertaking volunteer work, the results suggest that their travel expenses are paid from personal savings and/or relatives' financial assistance. Table 2 also shows that frequency of travel (Q13) is related to traveller's economic status, such as occupation, economic status of family, household income, proportion of personal income to household income, etc.

The results also show that yearly travel budget (Q14) is dependent on occupation, flexibility in working hours, and average number of days off. It is fair to say that a traveller's occupation influences yearly travel budget since occupation is associated with personal income level, which further affects the travel budget. In the questionnaire, there are four different travel packages in terms of travel expenses and travel days. Most of the respondents preferred a bargain travel package over a long travel length and high-expense luxury package. Therefore, there is no significant correlation between preferred travel package (Q15) and traveller's socioeconomic characteristics. Also as shown in Table 2, action when travel plan is unexpectedly terminated (Q16) is significantly correlated with household size, economic status of family, and household income, while activities for daily living is significantly correlated with age, occupation, etc.

This study further estimates the value of time preference rate towards past travel experiences. For this part of survey, there were 293 complete questionnaires. There are 12 questions for the respondents regarding time preference rate. Table 3 shows the results of Q18. The value of time preference rate is estimated using the weighted average method based on the median of different ranges of time preference rates and the number of them chosen. The average time preference rate of past travel experience is 0.879. The results imply that the utility brought by accumulated travel budget will be discounted by 53% to convert to the present value. This study further examines the correlation between the time preference rate and individuals' socioeconomic characteristics. Table 4 lists the variables significantly correlated with time preference rate.

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Table 4. Variables significantly correlated with time preference rate.

Content	Description	Correlation coefficient
Q1	Gender	0.396
Q13	Frequency of travel	−0.411
Q16	Action when travel plan is unexpectedly terminated	
2	Home travel instead	−0.326
Q17	Activities for daily livings	
1	Effectively utilise the leisure time	−0.353
2	Stay at home	0.338
5	Rare leisure time due to work pressure	−0.404

Table 5. The values of the model parameters.

Variable name	Coefficient estimate	Standard error	*t*-statistics
Constant	5.82592	1.0244	5.6873
Available travel budget	1.21542	0.2069	5.8747
Number of off-days	−2.30261	0.3807	−6.0482
Ratio of travel expense to travel budget	−2.31404	0.2099	−11.0239
Travel length	1.01901	0.2676	3.80848

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As shown in Table 4, gender and the variable 'stay at home' are positively correlated with time preference rate. The results imply that the time preference rate for females and individuals who prefer staying at home is high. In other words, the influence of past travel experiences on present travel decisions in the female group and individuals who prefer staying at home is negligible and the utility brought from past travel experience decays rapidly over time. The explanations could be that females are often responsible for the household chores and they may prefer to stay at home during their days off. For stay-at-home individuals, they would rather stay at home and take a rest than travel aboard. Table 4 also shows that the time preference rate for frequent travellers is low, meaning they value past travel experiences a lot so as to influence their present travel decisions. The results imply that frequent travellers may be fond of travel or travel for business purposes and, therefore, there are many travel experiences accumulated and they decay at a slow rate.

4. Case study

Data collected from the survey was further used to calibrate the parameters in Equations (2) and (3). The estimations of values for time preference rates and external environmental factors were also calculated. With regard to travel choice behaviour, the commercial software package LIMDEP (Econometric Software 1996) was used to calibrate the parameters in Equations (2) and (3). Table 5 shows the values of the model parameters.

As shown in Table 5, the *t*-statistics have been reduced $(\sqrt{4})^{-1}$ times smaller than the original values due to repeated samples from individual respondents using stated preference data (Louviere and Woodworth 1983, Wardman 1988). The parameters in the utility function of non-travel alternative, α_0 and β_0 are significant at the 5% level. As Equation (2) shows, parameter β_0 reflects the influence of changes in days off on the utility of the non-travel alternative. Though individuals could utilise their leisure time in activities other than tourism, such as home chore and study etc., a negative value of β_0 indicates that increased days off leads to a decreased utility of the non-travel alternative, thus yielding a high probability of choosing the travel alternative. The above results confirm the findings of the Taiwan Tourism Bureau (2006) that individuals with more days off are more likely to travel more often than those with fewer days off. As shown in Equation (3), the utility of the travel alternative is affected by two indicators representing individual ability to travel (i.e. the ratios of travel expense to travel budget and travel days to the number of days off). This study performed a pre-test to examine the significance of variables and found the parameter associated with the ratio of travel days to the number of days off is not statistically significant at the 5% level. Therefore, this study modified the utility function of the travel alternative in Equation (3) and, instead, used travel day as a variable. According to Table 5, the utility functions of the non-travel and travel alternatives can be rewritten as

$$U_0 = e^{5.82592} \cdot \left(\bar{B}_t\right)^{1.21542} \cdot (l_t)^{-2.30261} \tag{8}$$

$$U_1 = \left(\frac{C^p}{\bar{B}_t}\right)^{-2.31404} \cdot (E^p)^{1.01901} = \left(\frac{\bar{B}_t}{C^p}\right)^{2.31404} \cdot (E^p)^{1.01901} \tag{9}$$

Short-haul travel usually involves less number of days and a lower expense travel package compared with long-haul travel, i.e. travel within Asia versus world travel. The different impact of short-haul versus long-haul trips on travel choice behaviour is captured in terms of travel time and total expense with respect to the routes. As shown in Equation (9), travel time, i.e. E^p has a positive parameter. This result implies that long-haul travel with corresponding increased travel days leads to an increased utility value of the travel alternative. However, the rate of increase decreases significantly with the increase in travel days for long-haul travel. On the other hand, short-haul travel with corresponding decreased travel days leads to a decreased utility value of the travel alternative. The rate of increase declines insignificantly with a raise in travel days for short-haul travel. The choice probability of travel alternative, P_1, can be estimated as

$$P_1 = \frac{e^{U_1}}{e^{U_0} + e^{U_1}} = \frac{e^{U_1 - U_0}}{1 + e^{U_1 - U_0}} \tag{10}$$

The utilities of travel alternatives are reduced with consideration of external environmental events, as shown in Equation (3), which further alters the probabilities of choosing the alternatives. The inputs in Equations (8) and (9) (i.e. average yearly travel budget, days off, travel expense and travel days) were collected through a government report (Taiwan Tourism Bureau 2006) and the survey. Then, the value of the external environmental factor, f_t could be estimated by a comparison with the probability of

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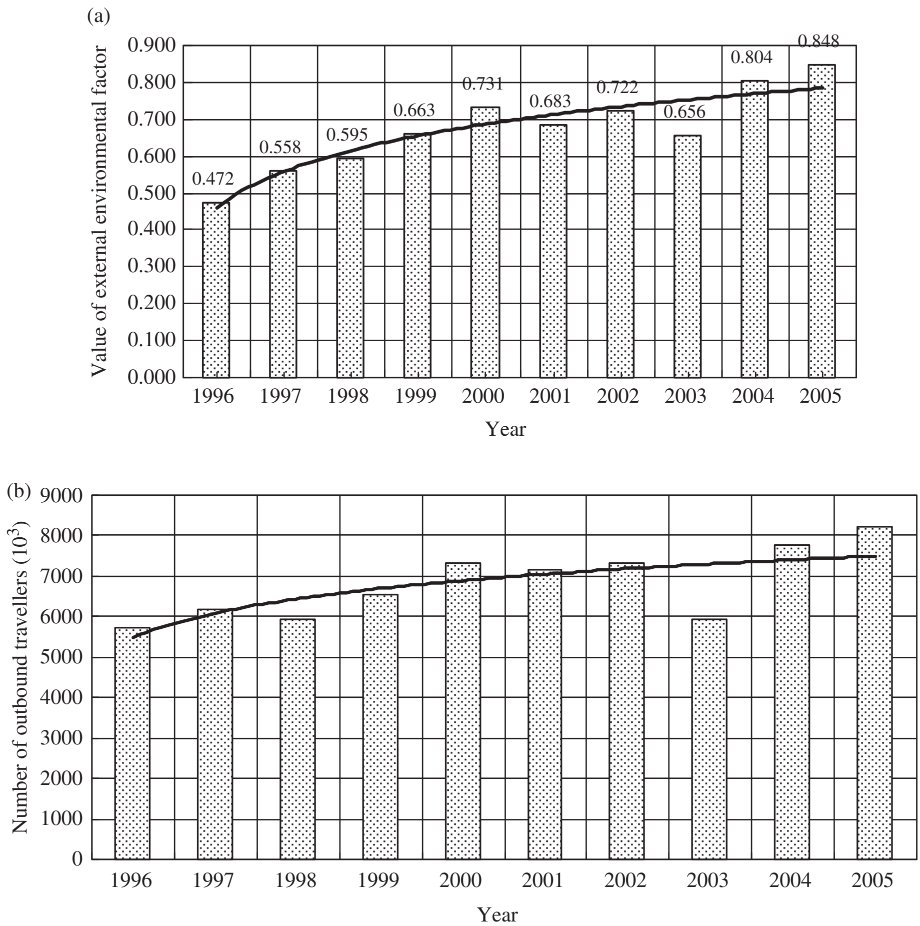

Figure 1. The values from 1996 to 2005 for: (a) external environmental factors; (b) number of outbound travellers.
Source: Taiwan Tourism Bureau (2006).

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outbound travel choice obtained by Equation (10) and the average outbound choice probability indicated in the government report. This study takes data from 2005 as an example to estimate the value of the external environment factor in that year, thus the basic input values of parameters in Equations (8) and (9) are $\bar{B}_t = 26{,}637$, $C^p = 40{,}917$, $l_t = 11.97$ and $E^p = 7$.

The probability of choosing the travel alternative is calculated as 0.4014 by Equation (10). However, the average outbound choice probability given in the government report is merely 0.3623. Thus, the impact of external environmental factors on travel choice behaviour should be included as Equation (3). The external environmental factor in 2005 is estimated as 0.848. The values of the external environmental factor and actual number of outbound travellers from 1996 to 2005 are further estimated and collected as shown in Figure 1. Note that the number with the bar chart in Figure 1(a) and 1(b) shows the

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estimated study results and actual number, while the solid line is the regression line of the external environmental factor and predicted number of outbound travellers, respectively.

The relationships between the value of external environmental factor and year and between the predicted number of outbound travellers and year can be calibrated, respectively, as[1]

$$y = 0.1407 \ln(x) + 0.4607 \tag{11a}$$

$$z = 873.84 \ln(x) + 5486.1 \tag{11b}$$

where y and z denote the value of the external environmental factor and the number of outbound travellers and x represents the sequence of the year, such that $x = 1$ for 1996. As shown in Figure 1(a), the estimated values from 2001 to 2003 are smaller than the results predicted by Equation (11a), such as 0.683 and 0.713 in 2001 and 0.656 and 0.753 in 2003; the years in which the September 11 attacks happened in 2001 and the SARS outbreak occurred in 2003. The estimated and predicted values of the environmental factor are 0.683 and 0.713 for 2001, and 0.656 and 0.753 for 2003. The results support the argument that negative external events have an adverse impact on international travel demand, and these events affect outbound travel demand continuously during these years.

As shown in Figure 1(a), the values of the external environmental factor in 2004 and 2005 exceeded the results predicted by Equation (11). The results imply that potential demand toward outbound travel may be realised after negative events subside. By comparing those in Figure 1(b), there was a boom of outbound travellers in 2004 and 2005. That may have resulted from a low level of travel in 2003 due to the SARS outbreak, followed by the realisation of potential travel demand. However, there are also positive external environmental events that boost outbound travel (e.g. the Aichi Expo in Japan and the opening of Disneyland in Hong Kong in 2005). We cannot conclude that the 2003 SARS outbreak was the entire reason that the actual number of travellers exceeded those predicted in 2004 and 2005. However, it is evident that potential demand is accumulated and realised in future years if there is a negative external environmental event in current year. In sum, the optimal timing of travel is the current year. Nevertheless, there may be a deferral of travel behaviour when travel expense exceeds the budget or there are negative external environmental events.

Discussions so far have dealt with individual travel behaviour with respect to travel and non-travel alternatives. Intertemporal choice is further explored and the third alternative is considered as a postponement of travel plan to the next year. The utility of the postponement alternative involves the same variables as the travel alternative (i.e. the ratios of travel expense to travel budget and travel length). However, the expected utility generated by future outbound travel will be discounted so as to transform to its current value. Assume that the travel budget of the current year is t, $\bar{B}_t$ will be accumulated to the next year $(t+1)$ if travellers postpone their travel plans to year $(t+1)$. The utility function of the postponement alternative, U_2 can be formulated as follows

$$U_2 = \left(\frac{1}{1+\rho_F}\right) \cdot f_{t+1} \cdot \left(\frac{\bar{B}_{t+1}}{C^p}\right)^{2.31404} \cdot (E^p)^{1.01901} \tag{12}$$

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Where $\frac{1}{1+\rho_F}$ represents the discount rate (i.e., the relative weight the travellers attach in year t to their satisfaction in year (t+1)). Table 6 shows the procedure for solving the discount rate.

As shown in Table 6, because the travel budget has been accumulated, the utilities of the postponement alternative exceed those of the non-travel and travel alternatives without considering a time discount. The increased utility of the postponement alternative yields an increase in choice probability (i.e. 45.94%). The result is unreasonable since the probability of choosing the travel alternative is merely 21.79% by comparing 36.23% of actual number reported by the Taiwan Tourism Bureau (2006) in Table 6. That is, the total probability that travellers decide not to travel abroad in the current year must equal 63.77% (i.e. $P_0 + P_2 = 0.6377$, where P_0 and P_2 represent the choice probabilities of the non-travel and postponement alternatives, respectively). By adjusting the choice probabilities, the discount rate is 0.13232, as shown in Table 6, and the value of time preference rate toward expected travel in the future, ρ_F, is 6.557, which is larger than 0.879 of the average value towards past travel experience, ρ_P. The results imply that the utility of past travel experience declines at a slower rate than that of expected future travel. The findings imply that past travel experiences impact more than expected future travel in individuals' travel decisions.

According to the time preference rate towards expected future travel, the expected utility toward future travel will be discounted by about 90% only after 1.14 years. To simplify the problem, this study considers two years of expected future travel and 4 years of past travel experiences (i.e. $D=2$ and $Q=4$ in the intertemporal choice). Then, the maximisation of the aggregated utility function of the current year t, $\bar{U}_t$ in Equation (7a) can be rewritten as

$$\text{Max } \bar{U}_t = (0.5322)^4 U_{t-4}(k_{t-4}) + \cdots + U_t(k_k) + \cdots + (0.13232)^2 U_{t+2}(k_{t+2}) \qquad (13)$$

The decision variable in Equation (13) is k_t, which expresses the optimal timing for outbound travel. Since past travel experiences are known, the influence of the utilities on optimal timing for outbound travel lies in whether the travel budget is large enough. In the case study, the optimal timing for outbound travel involves the determination of which year to take outbound travel between the current, next, and next two years.

Let us first consider a two-period travel behaviour to examine the impact of external events on choice behaviour and assume a travel package with 5 days of travel and NT$26,000 of travel expense. Travellers have to decide whether to travel in the current

Table 6. Procedure for solving the discount rate.

		Results without considering time discount			
Alternative	External environment factor	Utility	Choice probability (%)	Revised choice probability (%)	Discount rate
Non-travel	1	3.6733	32.27	53.66	1
Travel	0.847515	3.2807	21.79	36.23	1
Postponement	0.798084	4.0265	45.94	10.11	0.13232

Table 7. Values of utilities under different scenarios.

	Scenario 1		Scenario 2	
Decision	Utility, U_t	Discount utility	Utility, U_t	Revised utility
$k_t = 1$	3.411	3.411	3.411	2.954
$k_{t+1} = 1$	16.963	2.245	16.963	2.245
Choice probability, P_1	0	0.76	0	0.67

Note: Discount utility $= \frac{1}{1+\rho_f} U_t$; Revised utility $= \frac{1}{1+\rho_f} \cdot f_t \cdot U_t$.

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year or to postpone the plan to the next year. A scenario analysis is employed to investigate the changes in the utilities and optimal travel timing under the occurrence of external environmental events in the current year. Table 7 lists the values of the utilities under different scenarios, where Scenario 1 assumes the effect of an external environmental events does not exist, while Scenario 2 assumes a pandemic outbreak in the current year and $f_t = 0.866$.

As shown in Table 7, when time preference is not considered, outbound travel demand in the current year has a choice probability of 0, which is unreasonable. After introducing the rate of time preference, the results show that travellers are likely to travel abroad in the current year at a choice probability rate of 0.76. As the results of Scenario 2 in Table 7 shows, the tendency toward outbound travelling in the current year will decrease from a choice probability of 0.76–0.67. The results imply that willingness to travel in the current year will be reduced once a negative external event occurs, which may further lead to an increased demand for travel in the next year due to accumulated budget and desire.

There are various combinations of travel decisions, depending on the length of the timeframe. In this study, $2^3 = 8$ possible outcomes exist since the discussion of travel behaviour is from the current through the future two years. A numerical example and enumeration method are further employed to explore individual travel demand during these three years with and without considering external environmental factors. In the numerical example, the average travel time length and expense are 4 days and NT$15,664, respectively. Assume that the individual yearly travel budget exceeds travel expenses. This study takes year 2003, 2004 and 2005 as an example in which the current year is 2003 and the external environmental factors in these years are 0.656, 0.804 and 0.848, respectively. The result is shown as Table 8. Note that the binary variables represent the optimal decisions for travel and non-travel alternatives. For example, the first outcome (1, 1, 1) represents that the travellers traveller in these 3 years.

As shown in Table 8, the total utilities of all outcomes are smaller for results with considering external environmental factors than for those without considerations. When external environmental events are not considered, the maximised utilities result from travel every year; in other words, individuals will travel every year if they can afford the travel expense. However, when the external environmental factor is considered, the maximised converted utility lies in the forth outcome, $(0, 1, 1)$, meaning travellers will not travel abroad until the next and next two years, i.e. 2004 and 2005 due to the environmental event in 2003. The result shows that the external environmental events do affect traveller optimal timing for travel. In the scenario, the choice probabilities of the travel alternative

Table 8. Results of eight possible outcomes without and with considering external environmental factor.

Eight Possible outcome	Travel decision: Current year	Next year	Next 2 years	Total utility: Without considering external environmental factor	With considering external environmental factor
1	1	1	1	12.38	2.64
2	1	1	0	11.96	2.65
3	1	0	1	11.25	2.90
4	0	1	1	10.60	5.13
5	1	0	0	10.21	2.82
6	0	1	0	9.55	5.04
7	0	0	1	6.14	4.61
8	0	0	0	4.13	4.13

Note: 1 for travel and 0 for non-travel alternatives.

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in the year with respect to different combinations of travel demand can be estimated by the binary logit model in Equation (10). The numbers in the following matrixes represent the eight possible outcomes and the utility differences between travel and non-travel alternatives with considering external environmental factor, $(U_1 - U_0)$, respectively.

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \Rightarrow \begin{bmatrix} -0.54 & -0.62 & -0.61 \\ -0.54 & -0.62 & -0.61 \\ -0.54 & -0.62 & 5.36 \\ -0.54 & 8.30 & 5.66 \\ -0.54 & 0.62 & 5.36 \\ -0.54 & 8.30 & 5.66 \\ -0.54 & 8.30 & 30.63 \\ -0.54 & 8.30 & 30.63 \end{bmatrix}$$

The choice probabilities of the travel alternative in the year with respect to different combinations of travel demand are estimated and shown in the following matrix.

$$\begin{bmatrix} 0.37 & 0.35 & 0.35 \\ 0.37 & 0.35 & 0.35 \\ 0.37 & 0.35 & 1 \\ 0.37 & 1 & 1 \\ 0.37 & 0.35 & 1 \\ 0.37 & 1 & 1 \\ 0.37 & 1 & 1 \\ 0.37 & 1 & 1 \end{bmatrix}$$

Available travel budget is directly related to individual income. Other things being equal, travellers with a higher income are more capable of affording the expense of travel and, moreover, total travel budget will be an increased accumulation if a postponement

Table 9. Results under different values of travel budget.

Eight possible outcome	Travel decision			Total utility	
	Current year	Next year	Next 2 years	Under $\bar{B}_t = 15{,}500$	Under $\bar{B}_t = 48{,}700$
1	1	1	1	10.28	62.21
2	1	1	0	8.21	57.38
3	1	0	1	7.29	48.33
4	0	1	1	15.42	41.23
5	1	0	0	4.11	41.77
6	0	1	0	12.21	34.62
7	0	0	1	8.31	19.20
8	0	0	0	3.70	10.54

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decision is made. This study further explores the influence of travel budget on optimal travel demand during three years by assuming two groups of travellers with travel budgets of NT$15,500 and NT$48,700, respectively, and the travel package is for 6 days and NT$21,900 expense. Table 9 shows the results under different values of average travel budget.

As shown in Table 9, the optimal outcomes for the two groups of travellers are different. The optimal timing of travel for a traveller with a lower income (i.e. $\bar{B}_t = 15{,}500$) is (0, 1, 1), which indicates the traveller will not travel in the first year and may accumulate the budget for travel in the next two years. However, travellers' with a higher income will choose to travel every year. In the numerical example, the travel expense is beyond the budget of the first group of travellers, but that is under the budget of the second group of travellers. The results suggest that travel in the current year is not likely for the low income group until the budget has been accumulated enough to cover the expense of travel. For travellers with high incomes, they could have outbound travel every year.

5. Conclusions

This study aimed to investigate the impact of a time factor and external environmental events on air-borne tourism demand by formulating a series of models. The model differentiates time preferences among current, past and future travel, and further uses time preference to convert utility in different years into the current year. The value of external environmental factors is estimated by a comparison between the probability of an outbound travel choice estimated by the study and average outbound choice probability given in a government report. Furthermore, optimal timing for travel in future years is explored by considering time discounts and external events. The study also estimates the yearly range within which individuals' travel behaviour does impact their travel decisions in the current year.

A questionnaire was designed for the study and data were obtained regarding individual characteristics and preferences in international outbound tourism travel from Taiwan. The result indicated that the tendency towards choosing family members as travel

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companions increases for aged and middle-aged individuals while younger groups tend to go abroad with colleagues or friends. The results show that yearly travel budget is dependent on occupation, flexibility in working hours and average number of days off. It is fair to say that a traveller's occupation influences yearly travel budget since occupation is associated with personal income level, which further affects the travel budget.

The results imply that the utility brought by accumulated travel budget is discounted by 53% to convert to the present value. The results show the influence of past travel experience on present travel decisions in the female group and by individuals who prefer staying at home is negligible, and the utility brought from past travel experience decays rapidly over time. The results also show that the time preference rate for frequent travellers is low, meaning they value past travel experiences a lot so as to influence their present travel decision, and are likely to travel almost every year.

The negative value of β_0 indicated that more days off leads to a decreased utility of the non-travel alternative, thus raising the probability of choosing the travel alternative. The above results confirm the findings of the Taiwan Tourism Bureau (2006) that individuals with more days off travel more often than those with fewer days off. The results imply that the utility of past travel experience declines at a slower rate than that of expected future travel. The findings also suggest that past travel experience impacts more than expected future travel on travellers' current travel decisions. The results also show only expected travel in the next two years influences individuals' travel decisions in the current year.

The result shows that the external environmental events do affect traveller optimal timing for travel. The results also imply that willingness to travel in the current year is reduced if a tremendous negative external event occurs, which may lead to an increased demand of travel in the following year. The relationship between value of an external environmental factor and year is calibrated as a regression line. The estimated values of the environmental factor are lower than the predicted ones for both 2001 and 2003, the years in which the September 11 attacks happened and the SARS outbreak occurred, respectively. The lower estimated values in 2001 and 2003 led to lower utilities of the travel alternative than predicted, yielding a decreased probability of choosing the travel alternative. The results support the argument that negative external events have an adverse impact on international travel demand, and these events affect outbound travel demand continuously during these years.

It was also found that travel in the current year is not likely until the budget has accumulated enough to cover the expense of travel. Travellers with high incomes in Taiwan could undertake outbound travel every year. In sum, the optimal timing of travel is in the current year. Nevertheless, there may be a deferral of travel behaviour when travel expenses exceed the budget or there are negative external environmental events. Consequently, the results of this article not only provide effective tools to examine the influence of external events on tourism demand, but also verify time preference on tourism demand.

The study findings provide potential benefits to the overseas air travel industry in Taiwan. It would be mainly the sectors that engaged in Taiwan outbound travel, i.e. Tourism Bureau, airlines and tourism agencies. First, there should be an upsurge in the total tourism demand after recovering from a negative external event. The suppliers of tourism products and services, i.e. tourism agencies and airlines can plan in advance to attract the attention of travellers and enhance air travel tourism demand. Second, past travel experience has an unexpectedly strong impact on future travel decisions. This is especially true for frequent travellers who are influenced by their travel experiences. The elderly and middle-aged individuals tend to travel overseas with their family member, while students and volunteer groups prefer more independent travel. The tourism agencies in Taiwan could design various travel packages and promote products to meet the wants and needs of these different groups.

The attractions of tourism areas are not included in the study to reduce their influences so as to focus on travellers' choice behaviours of timing. Future studies may apply the model to different travel areas and routes. Such studies would need to examine the impact of external environmental events on choice probability of travel with respect to specific travels areas. Moreover, this study has shown that negative external events will lead to a decreased outbound tourism demand, using the collected data during periods of September 11 attacks happened and the SARS outbreak. However, the air-borne tourism demand could be raised by positive external events. For example, an investment in tourism infrastructure could attract more tourists and thus an increased demand. Future studies could investigate how other environmental variables such as infrastructure provision and competition with domestic tourism affect the travel demand.

The total amount of the travel expense is affected by the currency exchange rate in that when the exchange rate for the domestic dollars increases it also increases the travel expense. As a result, travellers might decide to travel within their own country rather than make an international trip. However, using only the exchange rate in the international tourism demand function can be misleading, because even though the exchange rate in a destination may become more favourable, this might be counterbalanced by a relatively high inflation rate in the destination (Witt and Witt 1995). To simplify this study, the exchange rate variable is not considered in the utility function. A sudden shock as a result of economic variables can be treated as an external event. Future studies may apply the model to investigate how external economic events affect air travel tourism demand.

The utility function in this study takes into account travel expenses, travel time, budget and the number of days off, etc. Numerous tourism studies have found that travel is strongly influenced by personal characteristics, income, education level and even the national GDP. Regarding the utility function it should be noted that there might be some gain if the socio-economic-demographic data of respondents were included in utility modelling. Future studies may improve the results by including those variables in the model.

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Note

1. A *t*-test was applied to test the hypothesis to determine whether there is a significant linear relationship between independent variable x and dependent variables y and z in Equations (11a) and (11b). The *t*-statistic values for the constants in Equations (11a) and (11b) are 1674.1 and 19.7, while those for coefficients are 5.7 and 3.2, respectively, and are significant at the 5% level.

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The results imply that the variable x, i.e. year explains the variability of the external environmental factor and the number of outbound travellers.

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Appendix

Notation	Definition
A_{t,k_t}	parameter representing the impact of factors other than money and time on the utilities
a	index of summation of the converted utilities toward past years
$\bar{B}_t$	available travel budget in year t
B_t	travel budget of current year t
C^p	total expense on vacation travel with respect to route p
C_{t-a}	total expense on vacation travel in year (t-a)
D	yearly range toward future years in which individuals' travel behaviour within the years impacts their travel choice decisions in year t
d	index of summation of the converted utilities toward future years
E^p	average travel time length on vacation travel with respect to route p
e_{k_t}	alternative-specific constant
f_t	external environmental factor in year t
G_t	consumption of goods other than vacation travel of year t
I_t	average personal income in year t
$K(s)$	discounted function
k_t	an individual's optimal choice in year t, then $k_t = 0$ for non-travel, and $k_t = 1$ for travel alternatives, respectively
l_t	number of days off in year t
m_t	individual's ability in terms of money to travel in year t
n_t	individual's ability in terms of time to travel in year t
P_1	choice probability of travel alternative
P_0	choice probability of non-travel alternative
P_2	choice probability of postponement alternative
p	travel route
Q	yearly range toward past years in which individuals' travel behaviour within the years impacts their travel choice decisions in year t
q_t	remainder of time other than work and travel of year t
r	average interest rate
s	index of summation of general discounted utility
T	total time length of an individual
t	a specific year t
U_0	deterministic utility functions of non-travel alternative
U_1	deterministic utility functions of travel alternative
U_2	utility function of the postponement alternative
$\bar{U}_t$	aggregated utility function of year t
$\bar{u}_t$	general discounted utility model
u_{t+s}	individual's utility function in year (t+s)
W_t	total working hours in year t
x	sequence of the year
y	value of the external environmental factor
z	number of outbound travellers
α_0, α_1, β_0, β_1	parameters to capture effects due to variables that describe the choice alternatives
ρ	rate of time preference
ρ_P	rate of time preference toward past years
ρ_F	rate of time preference toward future years