Distance Models for New Zealand International Tourists and the Role of Transport Prices

Susanne Becken
Lincoln University
susanne.becken@lincoln.ac.nz

Aaron Schiff
Covec Ltd
aaron@covec.co.nz

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ABSTRACT

We analyse data on the distances travelled using car and air transport modes in New Zealand by a large sample of international tourists from six different countries of origin. We use two-stage hurdle models to relate both the decision to use each mode and the distance travelled by a mode if used to visitor characteristics and prices. In general we find little evidence of price sensitivity for either decision, although older tourists, those with longer stays, and non-tour group travellers may be more price-sensitive. The most important characteristics for determining transport behaviour are shown to be length of stay, purpose of visit and travel style (tour vs non-tour).

1. Introduction

Tourism is an important economic activity in New Zealand. In 2007, there were about 2.3 million international visitors and 42 million trips by domestic tourists (Ministry of Tourism, 2008). Not surprisingly, tourism is a major user of transportation, with about 16% of all road passenger-kilometres travelled in New Zealand generated by international and domestic tourists (Cullen *et al*., 2005). Hence, tourism plays an important role in the context of transport, energy and climate change policies.

Travel distance is a useful variable to measure travel demand by tourists because it can be easily converted into energy consumption and carbon dioxide emissions. A greater understanding of the drivers of tourist travel behaviour would be very beneficial for policy makers and managers. One potentially important factor is the price of transport. Transportation costs, for example as a result of changes in oil prices and the emergence of low-cost airlines, have changed substantially in the last decade and influenced tourist behaviour (World Tourism Organisation, 2006; Gillen & Lall, 2004). Many potential policies that address transport are economic in nature and may lead to an increase in the cost of transportation and subsequent changes in travel patterns (Ubbels, *et al*., 2002; Fulton, 2005; Sterner, 2007; Mayor & Tol, in press).

In general, the cost of transport impacts how far people travel (Liddle, 2009), where they purchase fuel (Leal *et al*., 2009) and what kinds of vehicles or modes (e.g. public transport) they choose (Koetse & Rietveld, 2009). Tourists, just like other consumers, react to changes in price, both in relation to destination choice and consumption of tourism products on the ground (Jensen, 1998; Dwyer, Forsyth & Rao, 2001; Nicolau & Mas, 2006). Most research in this area focuses on aviation, with many studies estimating price elasticities of different types of tourists (e.g. Crouch, 1994). Brons *et al*. (2002), for example, established that long distance flights are less price-elastic than short distance flights because of a lack of substitution possibilities. Moreover, business class travellers are less price sensitive than economy class passengers; a result confirmed by Gillen *et al*. (2004) in their meta-analysis of aviation elasticity studies in North America. More recently, Njegovan (2006) found that factors such as exchange rates, price differentials, and prices of domestic leisure activities are more important than airfares.

Research on tourists' responses to the price of fuel for ground transport is scarce, although one study in the US established that the demand for hotel rooms drops when fuel prices increase (Canina *et al*., 2003). The authors also found that the location and the style of accommodation of hotels play an important role. In terms of changing transport behaviour, Palmer-Tous *et al*. (2007) found that tourists' response towards a congestion tax on rental cars in Spain was relatively inelastic. More generally, demand for car travel has been found to be inelastic, with short run price elasticities for the demand of automotive fuel of around -0.3 and long run elasticities of about -0.6 to -0.8 (Graham & Glaister, 2002). Tourist-specific price elastiticities for car travel are not known.

The purpose of this paper is to investigate the role of price, alongside other factors, in determining distances travelled by tourists in New Zealand. We hypothesise that tourists with different characteristics will display different behaviour in terms of distances travelled (Becken *et al*., 2003; Becken, 2005; Becken & Simmons, 2008), and their potential sensitivity to transport price changes. The analysis concentrates on tourists from the top six countries of origin for New Zealand – Australia, the UK, the USA, Japan, South Korea and China, and car and domestic air transport modes for visitors from each of these origins.

2. Methodology

2.1. The International Visitor Survey

The data on tourist behaviour stems from the New Zealand International Visitor Survey (IVS), which is run by the Ministry of Tourism as a continuous exit survey. The IVS sampling methodology is designed to capture a representative sample of international tourists in terms of country of origin and gender. Weightings are then applied to the respondents based on country of origin, gender, age group, purpose of visit, and length of stay. For the purposes of this paper, we have used the IVS data on all tourists from the top six countries of origin, between 1997 and 2007. In total, these top six origins comprise 71% of all international tourists to New Zealand (Table 1).

Table 1 Tourists and IVS sample size, 1997-2007, for the top six countries of origin.

Origin	**Total Tourists**	**IVS Sample**
Australia	6,736,224	12,576
United Kingdom	2,360,503	8,054
United States	1,958,678	6,579
Japan	1,603,393	6,324
South Korea	827,305	2,159
China	619,180	2,338
Total	**14,105,283**	**38,030**

IVS respondents are asked a number of questions to determine their characteristics. Table 2 shows the eight characteristics variables that we used in this study, the levels of each, and the unweighted percentage of tourists in the IVS sample dataset having each level of each characteristic.

Table 2 Characteristics variables and unweighted percentages of tourists with these characteristics in the IVS, for the top six origins, 1997 – 2007.

Interview Month		Party Relationship	
January	10.1	Travelled alone	36.5
February	10.9	Couple	28.4
March	10.4	Family or friends group	20.7
April	9.0	Tour group	9.3
May	7.4	Business associates	4.8
June	5.7	Other	0.4
July	7.2	**Purpose of Visit**	
August	7.8	Holiday	55.4
September	6.6	VFR	21.3
October	7.2	Business	16.0
November	9.3	Education	4.2
December	8.4	Other	3.2
Length of Stay		**Age Group**	
< 5 days	22.7	15 - 24	15.1
5 - 7 days	21.3	25 - 34	24.5
8 - 10 days	11.9	35 - 44	16.2
11 - 13 days	8.2	45 - 54	17.8
14 - 16 days	8.0	55 - 64	16.9
17 - 19 days	5.0	65+	9.6
20 – 29 days	10.1		
30+ days	12.9		
Kids		**Travel Style**	
Kids in party	7.8	Package tour	23.4
No kids in party	92.2	FIT / SIT	76.6
First Visit			
First visit to NZ	58.1		
Not first visit to NZ	41.9		

Each IVS respondent is asked about their itinerary within New Zealand, and the transport mode used for each leg of the journey. The analysis presented here focuses on car and air travel. It is likely that different transport modes will have different demand drivers. One data problem is that prior to 2005, for most IVS respondents the transport mode for the first and last legs of their itinerary is coded as 'unknown'. For this reason, the distance travelled by each respondent in this analysis excludes the first and last legs of their journey. The total distance travelled by each IVS respondent using each transport mode was calculated by applying a matrix of travel distances to the origin-destination pairs given for each leg of a respondent's itinerary (Becken *et al*., 2008).

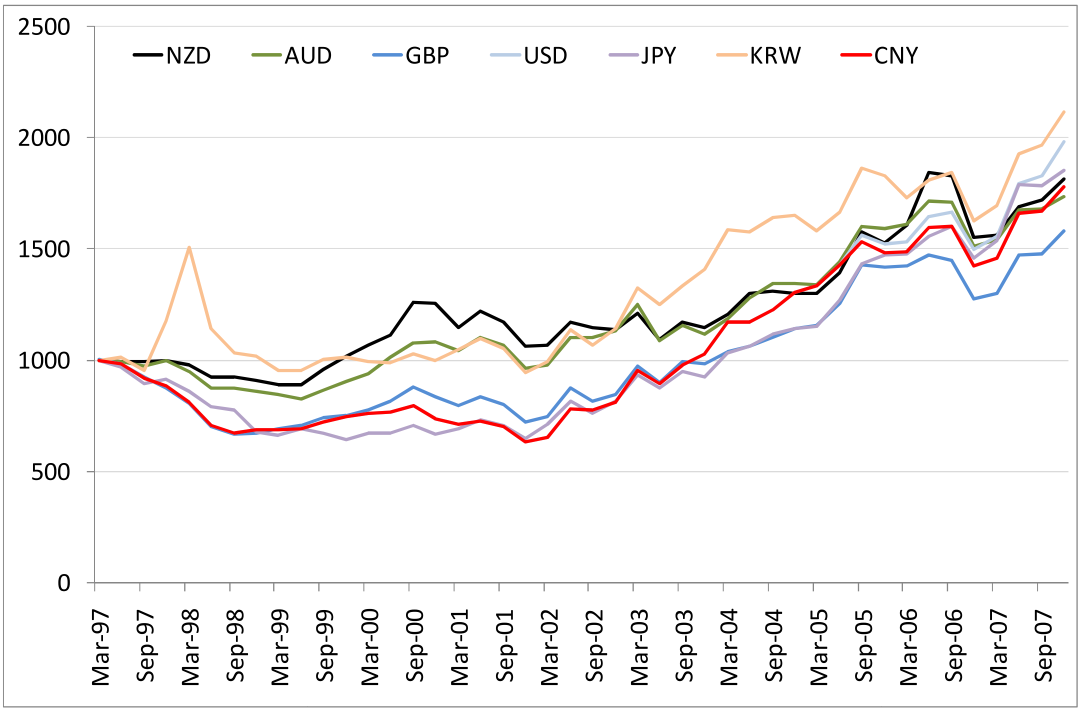
2.2. Price Data

We have obtained two price indices for the two transport modes. Figure 1 shows the quarterly petrol price index in New Zealand dollars obtained from Statistics New Zealand. We use the petrol price index to represent the cost of car transport within New Zealand. While other fuel types (e.g. diesel) may be used, their prices are highly correlated with the petrol price.

For international tourists, the relevant price should be expressed in terms of their home currency, as tourists will convert New Zealand dollar prices to foreign currency terms when making purchase decisions (Dwyer, Forsyth & Rao, 2001). The petrol price increased by 81% in New Zealand dollar terms over the 11 year period shown in Figure 1. In foreign currency terms, some of the increase in the petrol price was offset by the depreciation of the New Zealand dollar against most other currencies until mid 2001. Subsequently, the increase in the New Zealand petrol price together with the appreciation of the New Zealand dollar combined to generate a rapid increase in petrol prices in foreign currency terms (Figure 1).

The price of the air transport mode was measured by the quarterly domestic air transport price index obtained from the consumer price index (Statistics New Zealand, 2008) and converted into the different foreign exchange currencies. A similar pattern is observed as for petrol prices, although there has been a decline in this price index since mid 2006, possibly due to increased competition on domestic air routes.

Figure 1 Quarterly New Zealand petrol price index in domestic and foreign currency terms (March 1997 = 1000).



Source: Calculated from Statistics New Zealand petrol price data using exchange rates from the PACIFIC Exchange Rate Service.

2.3. Models

A tourist's transport choice can be modelled in two steps: one is the decision to use a transport mode, and the other is the distance travelled by that mode given it is used (Palmer-Tous, 2007). Hence, for any given characteristics and prices, we may observe some tourists who travelled a positive distance using a particular mode, as well as some who did not use that mode. This means there is a non-linear relationship between the distance travelled by a mode and potential explanatory variables such as characteristics and prices. In technical terms, the distance data is censored at zero.

One approach to modelling this type of data is to use a censored Tobit regression model (Wooldridge, 2002). This type of model assumes that the same process is responsible for both the decision to use a transport mode and the distance travelled by that mode. It is possible that the variables that affect these two choices are different, and to allow for this we have used a more flexible approach known as a hurdle model or two-tier model. Given that tourists who stay for longer will tend to travel greater distances in total, we use the distance travelled by each mode per night spent in New Zealand as the dependent variable. Car and air transport modes will be modelled separately for each of the six origins.

Let $y^i \geq 0$ $\mathbf{y^i \geq 0}$ be the distance travelled per night by a given mode for respondent i from a given origin, and let x^i be a matrix of explanatory variables including prices and dummy variables representing visitor characteristics. The first stage of the hurdle model specifies the probability of using the transport mode:

$\Pr(y^i > 0 | x^i) = \Phi(x^i \gamma)$

where Φ is the standard normal cumulative distribution function and γ is a vector of parameters to be estimated.

The second stage specifies a model for distance per night given that respondent i chooses to use the transport mode. Since such values of y^i can only be positive, a log-normal model is used:

$[\log(y^i) | (x^i, y^i > 0)] \sim \text{Normal}(x^i \beta, \sigma^2)$

where β is a vector of parameters to be estimated.

This type of model is more flexible than a standard Tobit model as there are two vectors of parameters (γ and β) that separately model the effects of the explanatory variables on the propensity to use a transport mode and the distance travelled by that mode if used. It can be shown (Wooldridge (2002), section 16.7) that the maximum-likelihood estimator of γ in this model is equivalent to estimating a standard probit model using an indicator variable $z^i = 1[y^i > 0]$ $z^i = 1[y^i > 0]$ as the binary dependent variable. The maximum-likelihood estimators of β and σ^2 can be obtained from an ordinary least squares regression of $\log(y^i)$ on x^i, using only the observations for which $y^i > 0$.

The potential explanatory variables that we have considered for inclusion in the matrix x in both stages of the model are:

1. Dummy variables representing the visitor characteristics shown in Table 2.
2. The relevant quarterly price indices in foreign currency.
3. Interactions between the characteristics dummy variables and the price indices.
4. A deterministic linear time trend.

The dummy variables (1) capture the possibility that tourists with different characteristics may have different propensity to use a transport mode and/or may travel different distances per night by the modes they use. The price variables (2) capture the basic effects of prices on mode choice and mode usage. The price-characteristics interactions (3) capture the possibility that the price sensitivity of mode choice and/or usage may differ across tourists with different characteristics. Finally the time trend (4) captures the possibility that mode choice and/or usage may be changing over time due to external factors unrelated to characteristics or prices.

In terms of the price-characteristics interactions, recall that the price faced by tourists from a given origin varies on a quarterly basis. If the number of respondents with a given characteristic is low, it is possible that the coefficient on the interaction between that characteristic and price could be heavily influenced by changes in the number of respondents with that characteristic from quarter to quarter due to random sampling variation. These variations would be attributed to the interaction between price and that characteristic, but are not indicative of genuine price effects.

For example, as shown in Table 2, only 7.8% of all IVS respondents travelled with children. The number of respondents from a given origin in a given quarter who travelled with children is generally less than ten. The number of respondents from a given origin with children in a quarter can change by a relatively large amount, say from one to five, simply because of random sampling variation. Thus the relatively large random variation in the characteristics dummy variable may result in price-characteristics interaction variables appearing artificially important.

To attempt to minimise the severity of this problem, we only included price-characteristics interactions variables where the number of respondents from an origin with each level of the characteristic was at least 20 in most quarters. In some cases we redefined characteristics variables with fewer discrete levels, so as to meet this requirement. To avoid introducing too many variables into the models, we also did not interact the interview month characteristic with price. Table 3 shows the characteristics variables that we have and have not interacted with price for each of the origins, and the redefinitions of the characteristics variables that were applied where necessary. For each of the two transport modes, we included the prices of both modes, to capture potential substitution between modes in response to price changes. Only the own price of each mode was interacted with characteristics as shown in Table 3.

To summarise and illustrate the form of the models used, consider the following example. Let y^i be the distance travelled per night by respondent *i* by car. Suppose tourists have a single characteristic that takes three levels, represented by the two dummy variables D_1 and D_2. Let p^i be the price in foreign currency faced by respondent *i* for car transport, and let r^i be the price for air transport. Let t^i indicate the quarter in which respondent *i* visited New Zealand. Then, the OLS equation for the second stage of the hurdle model given that $y^i > 0$ can be written as:

$$\ln(y^i) = \alpha + \beta_1 D_1^i + \beta_2 D_2^i + \beta_3 D_1^i \ln(p^i) + \beta_4 D_2^i \ln(p^i) + \beta_5 \ln(p^i) + \beta_6 \ln(r^i) + \beta_7 t^i + \varepsilon^i$$

This equation includes a constant term, the characteristics dummy variables, interactions between the characteristics dummies and the car price, the car price, the air price, and the time trend. The models we estimated have this type of form, where the actual interactions between characteristics and prices are as given in Table 3.

Under this model specification, the hurdle models for each transport mode and visitor origin contain a large number of variables. For example, the models for tourists from Australia contain 40 variables. The large sample sizes (see Table 1) mean that there is no degrees of freedom problem, however in the estimation results of the full models, many estimated coefficients are statistically insignificant. Accordingly, we have used a process of general-to-specific model selection to determine the explanatory variables that have a statistically significant relationship with mode choice and distance per night. Starting from the most general model in each case, we successively eliminated the least statistically significant variable until only variables that were significant at the 5% level remained. This process was conducted independently for the two stages of the hurdle model for each origin and mode, to allow for the possibility that the significant variables for mode choice may differ from those for mode use. Following the model selection procedure, we checked that the explanatory power of the reduced model was not greatly less than the full model, using the log-likelihood statistic for the probit models and the adjusted R^2 statistic for the log-normal models.

As will be demonstrated in the results below, in many cases the price and price-characteristics interaction variables were statistically insignificant and did not survive the model selection process. Since some of the characteristics variables were redefined with fewer categories in order to include interactions with price in the model, we also estimated a second set of models where no price variables were included, but all possible levels of the characteristics variables shown in Table 2 were used.

Table 3 Price-characteristics interactions variables.

Interacted with price	Not interacted with price
Australia	
Purpose of visit[(1)] Length of stay[(2)] Age group[(3)] First visit to NZ	Party relationship Kids in party Travel style Interview month
UK	
Length of stay[(2)] Age group[(3)] First visit to NZ	Party relationship Kids in party Travel style Purpose of visit Interview month
USA	
Purpose of visit[(1)] Length of stay[(2)] Age group[(3)] Travel style First visit to NZ	Party relationship Kids in party Interview month
Japan	
Purpose of visit[(1)] Length of stay[(2)] Age group[(3)] Travel style First visit to NZ	Party relationship Kids in party Interview month
South Korea	
Travel style	Party relationship Kids in party Interview month Purpose of visit Length of stay Age group First visit to NZ
China	
Travel style	Party relationship Kids in party Interview month Purpose of visit Length of stay Age group First visit to NZ

(1): Redefined as Holiday, VFR, Business/Education/Other
(2): Redefined as <= 7 days, 8 – 19 days, >= 20 days
(3): Redefined as 15-24, 25-34, 35-44, 45-54, 55+

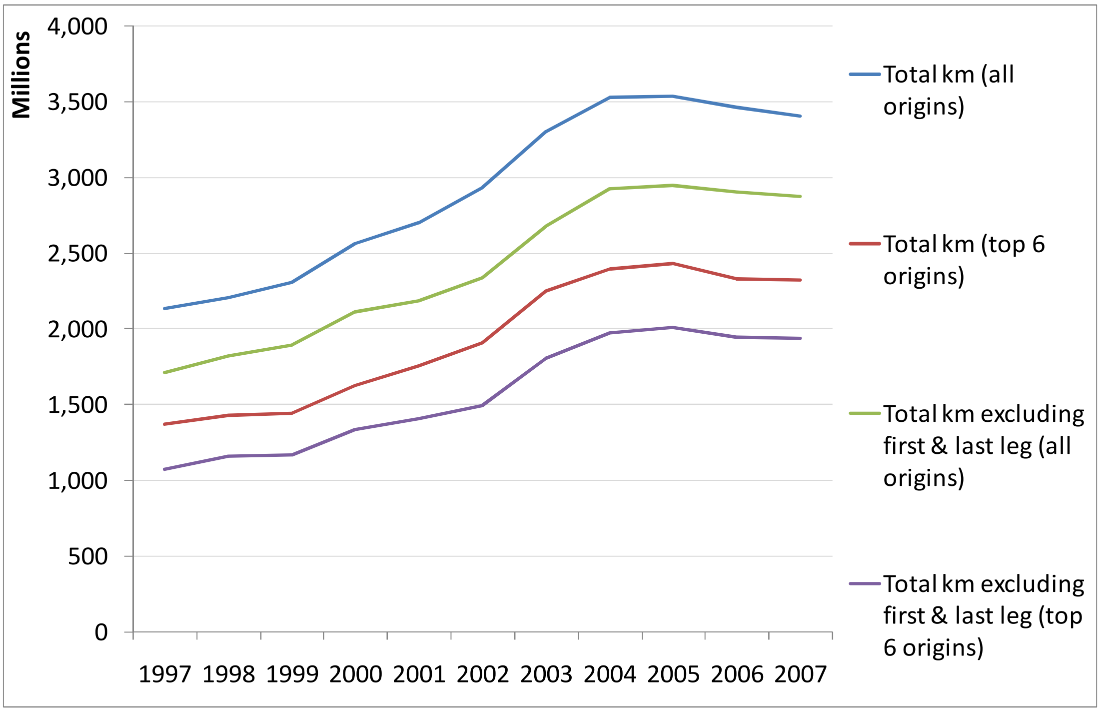
3. Results

This section first presents some basic patterns and trends of travel distance amongst the modelled segments. We then provide results of the 24 different sets of hurdle models, defined by the six origins, two transport modes for each origin, and two types of model (with and without prices) for each origin-mode combination.

3.1. Travel distance results

Travel distance by international tourists to New Zealand across all transport modes reached a maximum in 2005 and decreased slightly since then (Figure 2). In 2007, tourists from the top six origins represented about 68% of the total kilometres travelled by international tourists. For all origins and the top six origins, the distance travelled in the first and last leg represented about 15% and 17% of the total distance respectively.

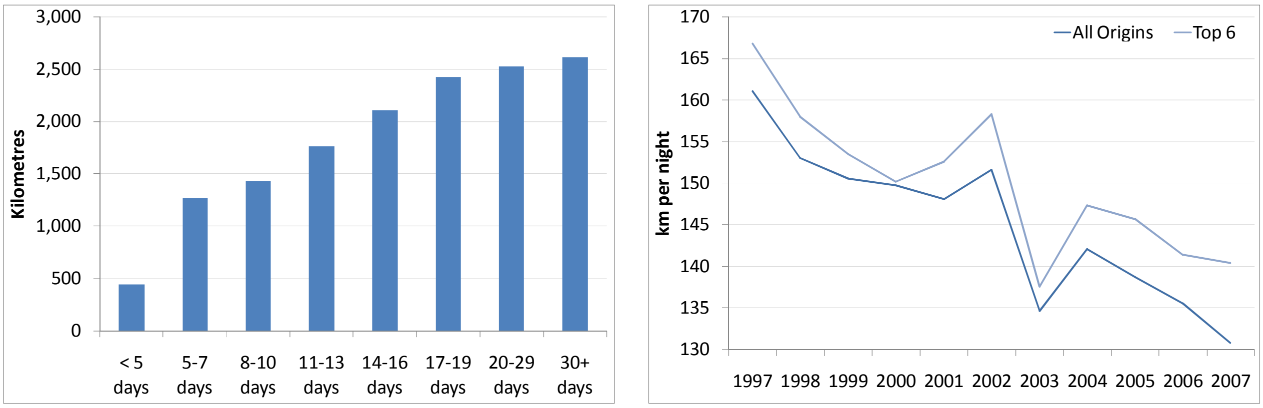
Figure 2 Total kilometres travelled by international tourists in New Zealand across all transport modes.



On average, international tourists with longer lengths of stay in New Zealand tend to travel total greater distances during their stay (Figure 3). The annual average distance per night across all transport modes is also shown in Figure 3.[1]

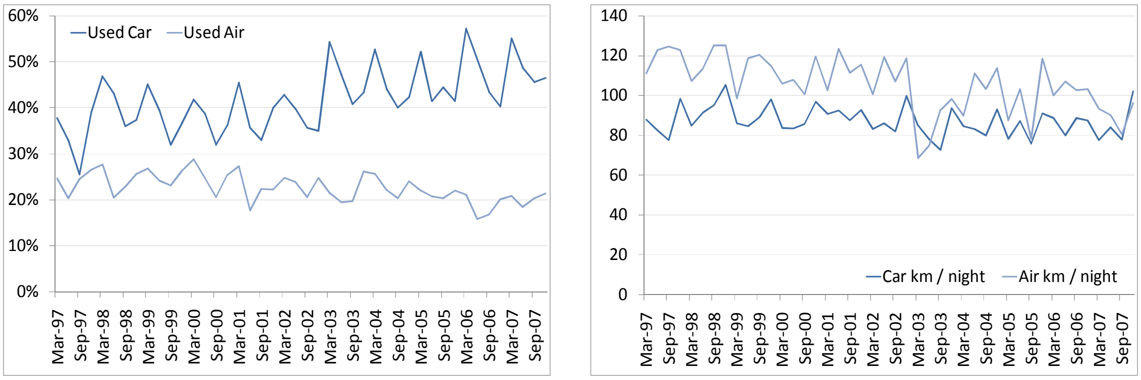
[1] The decrease in kilometres per night in 2003 is attributable to a large temporary increase in education tourists in that year, who have long lengths of stay but travel relatively little within New Zealand.

Figure 3 Left: Average kilometres travelled per visitor versus length of stay (top six origins). Right: Average kilometres travelled per night in New Zealand (all transport modes).



Cross-tabulations of the propensity to use each mode and distance by mode per night against origin and the characteristics variables shown in Table 3 indicated potential explanatory power of these drivers. For example, VFR tourists are most likely to use car, while business tourists travel relatively high distances per night by air, although the use of domestic car and air transport by business tourists is relatively low, suggesting that they tend to use international flights directly to their main destination. Also, there seems to be a clear seasonal pattern in the propensity to use car transport, with use increasing in the summer. Propensity to use air transport and distance by each mode does not have a very clear seasonal pattern. We can also observe a general increase in the propensity to use car over time, and a decrease in the propensity to use air. The average distance travelled by car per night has remained relatively constant, while there has been a slight decrease in the distance travelled by air (Figure 4).

Figure 4 Weighted percentage of tourists by quarter of interview using car and air transport modes (left) and weighted average distance travelled per night by tourists who used each mode (right).



3.2. Models with Prices

Table 4 and Table 5 show the estimated coefficients for the selected probit models of car use and log-normal models of car distance per night when price and price-characteristics interactions variables were included in the model selection process. An 'n.a.' represents a variable that did not survive the model selection process, while '---' represents a price-characteristics interaction variable that was not included in the model selection, for the reasons discussed above. Explanatory power of the car models is relatively good, as measured by the pseudo R^2 for the probit models and the adjusted R^2 for the log-normal models.

It can be seen in Tables 4 and 5 that the relationships between price and propensity to travel by car and distance travelled are generally not significant or ambiguous. Theoretically plausible price results are only obtained for the Australia propensity model (Table 4) and the UK and Japan distance per night models (Table 5). In the latter cases, the results indicate distance price elasticities of -0.175 and -0.357 respectively, indicating that, of those tourists who choose to use car, the distance travelled per night is relatively insensitive to price. These values confirm short-term elasticities presented in earlier studies (Graham & Glaister, 2002). Most of the price-characteristics interactions variables are not statistically significant. One of the few exceptions are non-tour group tourists who are more price sensitive in terms of the decision to use car, for the US and Japanese segments (Table 4). Also, tourists who stay longer seem to be more sensitive to changes in petrol prices in terms of travel distance compared with those who stay less than one week (Table 5).

The pure characteristics variables in these models pick up a variety of effects. For Australian and British visitors, the propensity to use car seems to decrease in winter months. Couples and family and friends groups are more likely to use car, while tour groups are less likely, relative to those who travelled alone. VFR tourists are more likely to use car compared to holiday tourists, and middle age groups are more likely to use car than young, while older groups are less likely (Table 4). Distance travelled by car per night is also higher for couples and family and friends groups compared to those who travelled alone, while VFR tourists travel shorter distances than those on holidays (Table 5). For some origins there is a reduction in distance per night for those with longer stays compared with shorter stays.

Table 4 Car mode: Estimated probit models for propensity to use car (with prices).

Variable	Australia	UK	USA	Japan	S. Korea	China
Constant	0.850	-1.674	-4.779	-6.082	-5.590	-2.449
Time trend	0.007	n.a.	0.007	n.a.	n.a.	0.013
ln(petrolprice)	-0.318	n.a.	0.451	0.604	0.517	n.a.
ln(airprice)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Purpose of visit x ln(petrolprice) (relative to Holiday)						
VFR	n.a.	---	n.a.	---	---	---
Business/Education/Other	-0.073	---	n.a.	---	---	---
Length of stay x ln(petrolprice) (relative to <= 7 days)						
8-19 days	n.a.	0.137	0.106	0.090	---	---
>= 20 days	0.136	0.160	0.170	0.156	---	---
Age group x ln(petrolprice) (relative to 15-24 years)						
25-34	n.a.	n.a.	n.a.	n.a.	---	---
35-54	n.a.	n.a.	n.a.	n.a.	---	---
55+	n.a.	n.a.	n.a.	n.a.	---	---
Travel style x ln(petrolprice) (relative to Package Tour)						
FIT/SIT	---	---	-0.286	-0.396	n.a.	0.123
First visit to NZ x ln(petrolprice) (relative to Yes)						
No	0.497	n.a.	-0.014	0.028	---	---
Month (relative to January)						
February	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
March	-0.095	n.a.	0.134	n.a.	n.a.	n.a.
April	n.a.	n.a.	n.a.	n.a.	0.378	n.a.
May	-0.107	n.a.	n.a.	n.a.	n.a.	n.a.
June	-0.197	-0.263	n.a.	n.a.	n.a.	n.a.
July	-0.139	-0.317	n.a.	n.a.	n.a.	n.a.
August	-0.171	-0.194	n.a.	-0.176	n.a.	n.a.
September	-0.254	n.a.	n.a.	n.a.	n.a.	n.a.
October	-0.140	n.a.	n.a.	n.a.	n.a.	n.a.
November	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
December	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Party relationship (relative to 'Travelled Alone')						
Couple	0.540	0.377	0.539	0.466	0.465	0.518
Family or Friends	0.448	0.288	0.499	0.433	0.310	0.219
Tour Group	-0.490	-0.960	-0.213	n.a.	n.a.	n.a.
Business Associates	n.a.	n.a.	n.a.	0.350	n.a.	0.419
Other	-0.661	n.a.	n.a.	n.a.	n.a.	n.a.
Kids (relative to no kids)						
Yes	n.a.	n.a.	-0.284	n.a.	n.a.	0.449
Purpose of visit (relative to Holiday)						
VFR	n.a.	0.379	0.181	0.388	0.219	n.a.
Business/Education/Other	n.a.	n.a.	-0.262	n.a.	n.a.	n.a.
Length of stay (relative to <= 7 days)						
8-19 days	0.670	n.a.	n.a.	n.a.	0.595	0.812
>= 20 days	n.a.	n.a.	n.a.	n.a.	0.811	1.003
Age group (relative to 15-24 years)						
25-34	n.a.	0.359	0.221	0.196	n.a.	n.a.
35-54	n.a.	0.414	0.282	0.204	n.a.	n.a.
55+	-0.075	0.334	n.a.	n.a.	-0.310	n.a.
Travel style (relative to Package Tour)						
FIT/SIT	0.628	0.656	2.806	3.537	1.253	n.a.
First visit (relative to Yes)						
No	-3.224	n.a.	n.a.	n.a.	n.a.	n.a.
Diagnostic Statistics						
Pseudo R^2	0.172	0.125	0.212	0.254	0.299	0.253
Log likelihood	-7178.010	-4701.614	-3579.507	-2357.982	-804.441	-955.680
Log likelihood (full model)	-7166.241	-4687.028	-3570.277	-2346.075	-790.082	-939.621

Table 5 Car mode: Estimated log-normal models for kilometres per night (with prices).

Variable	Australia	UK	USA	Japan	S. Korea	China
Constant	3.559	5.456	4.360	6.097	4.897	4.494
Time trend	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ln(petrolprice)	0.122	-0.175	n.a.	-0.357	n.a.	n.a.
ln(airprice)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Purpose of visit x ln(petrolprice) (relative to Holiday)						
VFR	-0.092	---	-0.067	---	---	---
Business/Education/Other	-0.683	---	n.a.	---	---	---
Length of stay x ln(petrolprice) (relative to <= 7 days)						
8-19 days	-0.033	n.a.	-0.031	-0.034	---	---
>= 20 days	-0.140	n.a.	-0.141	-0.239	---	---
Age group x ln(petrolprice) (relative to 15-24 years)						
25-34	n.a.	n.a.	n.a.	0.534	---	---
35-54	0.039	0.047	n.a.	0.055	---	---
55+	n.a.	n.a.	n.a.	n.a.	---	---
Travel style X ln(petrolprice) (relative to Package Tour)						
FIT/SIT	---	---	n.a.	0.034	n.a.	n.a.
First visit to NZ x ln(petrolprice) (relative to Yes)						
No	-0.056	n.a.	n.a.	-0.030	---	---
Month (relative to January)						
February	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
March	n.a.	n.a.	n.a.	0.195	n.a.	n.a.
April	0.104	n.a.	n.a.	n.a.	n.a.	n.a.
May	n.a.	-0.126	n.a.	n.a.	n.a.	n.a.
June	n.a.	n.a.	-0.197	n.a.	n.a.	n.a.
July	n.a.	-0.166	n.a.	n.a.	-0.363	n.a.
August	-0.113	n.a.	-0.160	n.a.	n.a.	n.a.
September	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
October	n.a.	n.a.	n.a.	n.a.	-0.376	n.a.
November	0.112	0.129	n.a.	n.a.	n.a.	-0.510
December	n.a.	n.a.	n.a.	n.a.	-0.418	-0.299
Party relationship (relative to 'Travelled Alone')						
Couple	0.513	0.434	0.372	0.334	n.a.	0.417
Family or Friends	0.438	0.361	0.382	0.364	n.a.	0.248
Tour Group	n.a.	-0.584	n.a.	n.a.	n.a.	n.a.
Business Associates	0.444	0.448	n.a.	0.440	n.a.	0.717
Other	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Kids (relative to no kids)						
Yes	-0.103	n.a.	n.a.	n.a.	n.a.	n.a.
Purpose of visit (relative to Holiday)						
VFR	n.a.	-0.460	n.a.	-0.249	-0.353	-0.388
Business/Education/Other	3.942	-1.024	-0.653	-0.702	-0.876	-0.975
Length of stay (relative to <= 7 days)						
8-19 days	n.a.	-0.212	n.a.	n.a.	-0.728	-0.700
>= 20 days	n.a.	-0.866	n.a.	n.a.	-2.058	-2.192
Age group (relative to 15-24 years)						
25-34	0.139	0.158	n.a.	-3.173	n.a.	0.410
35-54	n.a.	n.a.	n.a.	n.a.	n.a.	0.426
55+	0.278	0.307	n.a.	0.474	n.a.	n.a.
Travel style (relative to Package Tour)						
FIT/SIT	n.a.	-0.38	0.249	n.a.	n.a.	n.a.
First visit (relative to Yes)						
No	n.a.	n.a.	-0.422	n.a.	n.a.	n.a.
Diagnostic Statistics						
F-stat	149.270	137.480	136.960	85.410	69.010	88.720
Adj. R^2	0.305	0.306	0.310	0.501	0.497	0.635
Adj. R^2 (full model)	0.305	0.306	0.310	0.478	0.496	0.633

Models for domestic air transport are shown in Table 6 and Table 7 (with prices included). Compared to the car models, the pseudo R^2 statistics for the air probit models indicate that explanatory power of these models is poor with the exception of Japan. On the other hand, the log-normal models for air distance per night generally perform better than the models for car distance per night.

As with the car models, most of the price and price-characteristics interactions variables did not survive the model selection process, while some of those that are significant have the wrong sign. Of the plausible results, older travellers from the USA seem to be more sensitive to air prices in terms of their propensity to use air, as do those with longer stays from Australia, the US and Japan (Table 6). Tourists in the business/education/other category from Australia and the USA are more price sensitive than holiday tourists from the same countries in terms of their distance travelled by air per night (Table 7).

The characteristics variables show that couples and family and friends groups from Australia and the UK are less likely to use air transport, while the same types of tourists from Japan and China are more likely to use it. VFR tourists from all countries except Australia and the UK are less likely to use air, while Business/Education/Other tourists from Australia and the UK are more likely to use air (Table 6) and travel greater distance per night (for the Australian and USA segments) (Table 7). There is a general trend for tourists with longer stay to use air transport, as well as older age groups (Table 6).

For some countries, older age groups also travel greater air distance per night than younger groups (Table 7). Non-tour travellers are less likely to use air than tour travellers, with the exception of tourists from Korea and China. While air distance per night is negatively affected by length of stay, there does not seem to be a strong effect of month of visit (Table 7). Tourists for whom it is not the first visit to New Zealand are more likely to use air if they come from Australia or the UK, but less likely if they come from the USA or Japan. There is no significant effect of first visit on air distance per night.

Table 6 Air mode: Estimated probit models for propensity to use air (with prices).

Variable	Australia	UK	USA	Japan	S. Korea	China
Constant	-1.438	-0.966	-0.723	0.102	-0.973	-1.209
Time trend	0.004	n.a.	n.a.	-0.005	0.025	n.a.
ln(petrolprice)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ln(airprice)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Purpose of visit x ln(airprice) (relative to Holiday)						
VFR	n.a.	---	n.a.	---	---	---
Business/Education/Other	-0.475	---	n.a.	---	---	---
Length of stay x ln(airprice) (relative to <= 7 days)						
8-19 days	0.058	n.a.	0.090	n.a.	---	---
>= 20 days	n.a.	n.a.	0.514	n.a.	---	---
Age group x ln(airprice) (relative to 15-24 years)						
25-34	0.019	0.012	n.a.	n.a.	---	---
35-54	n.a.	n.a.	-0.398	n.a.	---	---
55+	-0.506	n.a.	-0.684	n.a.	---	---
Travel style x ln(airprice) (relative to Package Tour)						
FIT/SIT	---	---	n.a.	n.a.	-1.638	n.a.
First visit to NZ x ln(airprice) (relative to Yes)						
No	n.a.	n.a.	n.a.	0.289	---	---
Month (relative to January)						
February	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
March	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
April	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
May	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
June	n.a.	-0.172	n.a.	-0.204	-0.393	n.a.
July	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
August	0.166	n.a.	n.a.	-0.150	-0.281	n.a.
September	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
October	n.a.	n.a.	n.a.	n.a.	n.a.	-0.333
November	n.a.	n.a.	n.a.	n.a.	n.a.	-0.238
December	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Party relationship (relative to 'Travelled Alone')						
Couple	-0.133	-0.103	n.a.	0.453	n.a.	0.355
Family or Friends	-0.174	-0.171	n.a.	0.322	n.a.	n.a.
Tour Group	-0.311	n.a.	n.a.	n.a.	n.a.	n.a.
Business Associates	n.a.	n.a.	n.a.	0.375	n.a.	0.249
Other	n.a.	n.a.	-0.790	n.a.	n.a.	n.a.
Kids (relative to no kids)						
Yes	n.a.	-0.179	n.a.	n.a.	n.a.	n.a.
Purpose of visit (relative to Holiday)						
VFR	n.a.	n.a.	-0.212	-0.321	-0.527	-0.265
Business/Education/Other	3.585	0.294	n.a.	-0.328	n.a.	n.a.
Length of stay (relative to <= 7 days)						
8-19 days	n.a.	0.591	n.a.	n.a.	0.332	0.559
>= 20 days	0.528	0.613	-2.890	n.a.	0.217	0.285
Age group (relative to 15-24 years)						
25-34	n.a.	n.a.	0.194	0.500	n.a.	n.a.
35-54	n.a.	0.132	2.913	0.484	n.a.	0.208
55+	3.296	n.a.	4.927	0.707	n.a.	n.a.
Travel style (relative to Package Tour)						
FIT/SIT	-0.238	-0.404	-0.534	-0.934	10.554	n.a.
First visit (relative to Yes)						
No	0.140	0.074	-0.135	-1.853	n.a.	n.a.
Diagnostic Statistics						
Pseudo R^2	0.038	0.030	0.089	0.199	0.073	0.031
Log likelihood	-4669.415	-4078.808	-3692.202	-3498.751	-1082.746	-1043.236
Log likelihood (full model)	-4226.449	-4067.050	-3684.466	-3486.126	-1072.219	-1024.560

Table 7 Air mode: Estimated log-normal models for kilometres per night (with prices).

Variable	Australia	UK	USA	Japan	S. Korea	China
Constant	4.539	4.837	5.016	5.110	5.114	4.570
Time trend	n.a.	n.a.	n.a.	-0.003	n.a.	0.007
ln(petrolprice)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ln(airprice)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Purpose of visit x ln(airprice) (relative to Holiday)						
VFR	-0.023	---	n.a.	---	---	---
Business/Education/Other	-0.481	---	-0.576	---	---	---
Length of stay x ln(airprice) (relative to <= 7 days)						
8-19 days	-0.132	n.a.	-0.098	-0.076	---	---
>= 20 days	-0.299	n.a.	n.a.	n.a.	---	---
Age group x ln(airprice) (relative to 15-24 years)						
25-34	0.787	n.a.	n.a.	n.a.	---	---
35-54	n.a.	n.a.	n.a.	n.a.	---	---
55+	n.a.	n.a.	n.a.	n.a.	---	---
Travel style X ln(airprice) (relative to Package Tour)						
FIT/SIT	---	---	-0.035	-0.030	n.a.	n.a.
First visit to NZ x ln(airprice) (relative to Yes)						
No	n.a.	n.a.	n.a.	n.a.	---	---
Month (relative to January)						
February	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
March	n.a.	n.a.	n.a.	n.a.	n.a.	-0.378
April	-0.169	-0.175	n.a.	n.a.	n.a.	n.a.
May	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
June	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
July	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
August	n.a.	n.a.	n.a.	n.a.	-0.192	0.264
September	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
October	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
November	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
December	0.168	n.a.	n.a.	n.a.	n.a.	n.a.
Party relationship (relative to 'Travelled Alone')						
Couple	n.a.	n.a.	n.a.	0.046	n.a.	n.a.
Family or Friends	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Tour Group	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Business Associates	0.230	0.924	0.401	0.261	n.a.	0.221
Other	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Kids (relative to no kids)						
Yes	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Purpose of visit (relative to Holiday)						
VFR	n.a.	n.a.	-0.166	n.a.	0.294	n.a.
Business/Education/Other	3.523	-0.325	3.567	-0.241	-0.280	-0.463
Length of stay (relative to <= 7 days)						
8-19 days	n.a.	-0.979	n.a.	-2.348	-0.830	-0.755
>= 20 days	n.a.	-2.008	-1.890	n.a.	-2.919	-2.393
Age group (relative to 15-24 years)						
25-34	-5.287	n.a.	n.a.	n.a.	n.a.	0.450
35-54	n.a.	0.249	n.a.	n.a.	n.a.	0.524
55+	n.a.	0.194	0.101	n.a.	n.a.	0.559
Travel style (relative to Package Tour)						
FIT/SIT	n.a.	-0.165	n.a.	n.a.	n.a.	n.a.
First visit (relative to Yes)						
No	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Diagnostic Statistics						
F-stat	185.120	129.320	249.230	993.910	368.190	116.170
Adj. R^2	0.530	0.371	0.497	0.673	0.786	0.740
Adj. R^2 (full model)	0.530	0.371	0.496	0.674	0.787	0.738

3.3. Models without Prices

In response to the weak explanatory power of prices, models were constructed that did not contain price, but higher levels of details for the other characteristics variables. The car models shown in Table 8 and Table 9 therefore only include dummy variables representing different levels of the various characteristics, and a deterministic time trend. As above, 'n.a.' indicates a variable that did not survive the model selection process.

These results show a positive trend exists in the propensity to use car for tourists from all origins (Table 8). There is no general trend observed in the distance travelled per night, although tourists from Japan exhibit a slight decreasing trend (Table 9). As in the models with prices, there is a tendency for tourists from Australia and the UK to reduce the propensity of using car transport in the winter months, but this effect does not show up strongly in the distance per night. However, tourists from Korea travel shorter distances per night in late winter and spring.

Couples and family or friends groups are more likely to use car for all origins (Table 8), and travel greater distances per night for all origins except Korea and China, relative to those who travelled alone (Table 9). Purpose of visit also has a strong influence on the car distance per night, with all purposes from almost all origins travelling shorter distances per night than holiday tourists.

The other main driver of car travel behaviour is length of stay. Those with longer stays are significantly more likely to use car transport compared to those with shorter stays, but those with longer stays travel shorter distances per night. Age group also has an effect for some origins, with older tourists more likely to use car, and to travel a greater distance per night. As in the models with prices, non-tour group tourists are more likely to use car. Those for whom it is not their first visitor to New Zealand travel shorter distances per night by car for all origins except Korea and China (Table 9).

Table 8 Car mode: Estimated probit models for propensity to use car (no prices).

Variable	Australia	UK	USA	Japan	Korea	China
Constant	-1.660	-2.285	-2.314	-2.744	-2.516	-2.632
Time Trend	0.008	0.004	0.013	0.009	0.011	0.015
Interview Month (relative to January)						
February	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
March	n.a.	n.a.	0.119	n.a.	n.a.	n.a.
April	-0.091	n.a.	n.a.	n.a.	0.382	n.a.
May	-0.095	n.a.	n.a.	n.a.	n.a.	n.a.
June	-0.170	-0.281	n.a.	n.a.	n.a.	n.a.
July	-0.155	-0.316	n.a.	n.a.	n.a.	n.a.
August	-0.185	-0.193	n.a.	n.a.	n.a.	n.a.
September	-0.265	n.a.	n.a.	n.a.	n.a.	n.a.
October	-0.121	n.a.	n.a.	n.a.	n.a.	n.a.
November	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
December	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Party Relationship (relative to 'Travelled Alone')						
Couple	0.518	0.369	0.555	0.396	0.340	0.513
Family or Friends	0.408	0.290	0.496	0.380	0.219	0.215
Tour Group	-0.519	-0.974	-0.216	-0.195	-0.410	n.a.
Business Associates	n.a.	n.a.	n.a.	0.387	n.a.	0.449
Other	-0.717	n.a.	n.a.	n.a.	n.a.	n.a.
Kids in Party (relative to no kids)						
Yes	n.a.	n.a.	-0.221	n.a.	n.a.	0.470
Purpose of Visit (relative to Holiday)						
VFR	n.a.	0.347	0.142	0.377	n.a.	n.a.
Business	-0.387	-0.183	-0.260	n.a.	n.a.	n.a.
Education	n.a.	0.594	n.a.	n.a.	n.a.	n.a.
Other	-0.480	0.221	n.a.	n.a.	n.a.	n.a.
Length of Stay (relative to < 5 days)						
5-7 days	0.781	0.902	0.600	0.442	0.423	0.483
8-10 days	1.056	1.236	0.754	0.778	0.784	0.931
11-13 days	1.153	1.424	1.105	1.041	0.747	0.934
14-16 days	1.125	1.427	1.349	0.949	0.849	1.319
17-19 days	1.020	1.472	1.265	1.006	1.101	1.099
20-29 days	1.303	1.469	1.374	1.057	0.832	1.161
30+ days	1.286	1.589	1.422	1.416	1.052	1.238
Age Group (relative to 15-24 years)						
25-34	n.a.	0.365	0.192	0.234	n.a.	n.a.
35-44	n.a.	0.350	0.220	0.193	n.a.	n.a.
45-54	n.a.	0.534	0.260	0.359	n.a.	n.a.
55-64	n.a.	0.440	n.a.	0.146	n.a.	n.a.
65+	-0.277	0.208	-0.232	n.a.	n.a.	n.a.
Travel Style (relative to Package Tour)						
FIT/SIT	0.667	0.645	0.926	1.002	1.211	0.701
First Visit to NZ (relative to Yes)						
No	n.a.	0.087	n.a.	0.142	n.a.	0.151
Diagnostic Statistics						
Pseudo R^2	0.199	0.145	0.232	0.264	0.305	0.260
Log likelihood	-6940.241	-4593.785	-3485.675	-2325.554	-798.156	-947.439
Log likelihood (full model)	-6928.068	-4584.274	-3474.642	-2317.617	-781.383	-932.741

Table 9 Car mode: Estimated log-normal models for kilometres per night (no prices).

Variable	Australia	UK	USA	Japan	Korea	China
Constant	4.658	4.611	4.476	4.284	4.798	4.410
Time Trend	n.a.	n.a.	n.a.	-0.005	n.a.	n.a.
Interview Month (relative to January)						
February	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
March	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
April	0.110	n.a.	n.a.	n.a.	n.a.	n.a.
May	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
June	n.a.	n.a.	-0.174	n.a.	n.a.	n.a.
July	n.a.	-0.181	n.a.	n.a.	-0.486	-0.374
August	-0.127	n.a.	-0.148	-0.238	-0.392	n.a.
September	n.a.	n.a.	n.a.	n.a.	-0.325	n.a.
October	n.a.	n.a.	n.a.	n.a.	-0.364	n.a.
November	0.108	0.120	n.a.	n.a.	n.a.	-0.427
December	n.a.	n.a.	n.a.	n.a.	n.a.	-0.335
Party Relationship (relative to 'Travelled Alone')						
Couple	0.515	0.406	0.362	0.325	n.a.	n.a.
Family or Friends	0.403	0.331	0.357	0.270	n.a.	n.a.
Tour Group	n.a.	-0.712	n.a.	n.a.	n.a.	n.a.
Business Associates	0.301	n.a.	n.a.	n.a.	n.a.	0.365
Other	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Kids in Party (relative to no kids)						
Yes	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Purpose of Visit (relative to Holiday)						
VFR	-0.579	-0.462	-0.459	-0.283	-0.351	-0.487
Business	-0.338	-0.567	-0.539	-0.283	n.a.	-0.671
Education	-0.801	-0.576	-0.345	-0.784	-0.986	-0.891
Other	-0.850	-1.072	-0.591	-0.593	-0.967	-0.984
Length of Stay (relative to < 5 days)						
5-7 days	-0.289	-0.324	-0.209	-0.374	n.a.	n.a.
8-10 days	-0.339	-0.297	-0.283	-0.326	-0.443	n.a.
11-13 days	-0.388	-0.390	-0.301	-0.542	-0.642	-0.645
14-16 days	-0.387	-0.426	-0.385	-0.686	-0.598	-0.492
17-19 days	-0.662	-0.568	-0.466	-0.871	-1.317	-1.152
20-29 days	-0.769	-0.704	-0.615	-1.071	-1.203	-1.267
30+ days	-1.592	-1.435	-1.491	-2.142	-2.092	-2.253
Age Group (relative to 15-24 years)						
25-34	n.a.	0.103	n.a.	0.180	n.a.	0.464
35-44	n.a.	0.167	n.a.	n.a.	n.a.	0.502
45-54	0.115	0.185	n.a.	0.296	n.a.	0.632
55-64	0.177	0.290	n.a.	0.331	n.a.	0.771
65+	n.a.	0.136	n.a.	0.361	n.a.	n.a.
Travel Style (relative to Package Tour)						
FIT/SIT	n.a.	n.a.	0.271	0.269	n.a.	n.a.
First Visit to NZ (relative to Yes)						
No	-0.352	-0.352	-0.409	-0.154	n.a.	n.a.
Diagnostic Statistics						
F-stat	148.360	127.620	97.330	73.34	45.720	68.780
Adj. R^2	0.340	0.360	0.351	0.546	0.547	0.675
Adj. R^2 (full model)	0.341	0.360	0.349	0.547	0.546	0.674

Finally, Table 10 and Table 11 show the estimated models for air travel behaviour including only characteristics variables and trends. As with the price models, the pseudo R^2 values for the probit models for propensity to use air are relatively low for Australia, the UK and the USA, however there is a large improvement for the Asian origins. This suggests that the additional levels of the characteristics variables included in these models are quite important for explaining the propensity to use air transport in the Asian markets. The adjusted R^2 values of the log-normal models for distance per night are also relatively high, and indicate that these models perform somewhat better than the previous set of models with prices included.

There is no clear trend in the propensity to use air transport as there was for the propensity to use car transport; the propensity to use air is decreasing for tourists from the USA and Japan, but increasing for Korean tourists (Table 10). Air distance per night is slightly increasing for tourists from the UK and China, but decreasing for tourists from Japan (Table 11).

Again, length of stay is a key driver of air transport behaviour, with those on longer stays having greater propensity to use air, but travelling shorter distances per night. There is no clear effect of month of interview on the propensity to use air or air distance per night. As in the price models, couples and family and friends groups may be more or less likely to use air transport than those who travelled along, depending on the country of origin. Business associates are more likely to use air for tourists from the USA, Japan and China. For most origins, VFR tourists are less likely to use air transport (Table 10), and those that do travel shorter distances per night than holiday tourists (Table 11).

For the USA and Japan, there is a strong relationship between age group and propensity to use air, with older tourists more likely to use air than younger tourists, but there is no significant effect of age on air distance per night. For all origins, non-tour tourists are less likely to use air than tour tourists. The effect of first visit on propensity to use air is mixed across origins, while there is no effect of first visit on air distance per night.

Table 10 Air mode: Estimated probit models for propensity to use air (no prices).

Variable	Australia	UK	USA	Japan	Korea	China
Constant	-1.606	-1.280	-1.103	-0.402	-1.497	-1.808
Time Trend	n.a.	n.a.	-0.004	-0.004	0.006	n.a.
Interview Month (relative to January)						
February	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
March	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
April	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
May	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
June	n.a.	n.a.	n.a.	n.a.	-0.499	n.a.
July	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
August	0.181	n.a.	n.a.	n.a.	-0.350	n.a.
September	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
October	n.a.	n.a.	n.a.	n.a.	n.a.	-0.312
November	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
December	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Party Relationship (relative to 'Travelled Alone')						
Couple	-0.141	-0.109	n.a.	0.433	n.a.	0.255
Family or Friends	-0.161	-0.210	n.a.	0.307	n.a.	0.251
Tour Group	-0.282	n.a.	n.a.	n.a.	n.a.	0.338
Business Associates	n.a.	n.a.	0.256	0.458	n.a.	0.498
Other	n.a.	n.a.	-0.882	n.a.	n.a.	n.a.
Kids in Party (relative to no kids)						
Yes	n.a.	n.a.	n.a.	n.a.	n.a.	-0.307
Purpose of Visit (relative to Holiday)						
VFR	n.a.	0.488	-0.225	-0.258	-0.544	-0.411
Business	0.541	0.624	n.a.	-0.158	0.357	-0.518
Education	n.a.	n.a.	n.a.	-0.481	n.a.	n.a.
Other	n.a.	n.a.	-0.222	n.a.	n.a.	n.a.
Length of Stay (relative to < 5 days)						
5-7 days	0.352	0.497	0.718	0.763	2.131	1.629
8-10 days	0.542	0.829	1.157	0.707	1.589	1.508
11-13 days	0.525	0.895	1.067	0.350	1.658	1.716
14-16 days	0.611	0.942	0.933	0.236	1.477	1.475
17-19 days	0.741	0.931	0.935	0.362	1.560	1.403
20-29 days	0.740	0.973	0.931	0.421	1.386	1.732
30+ days	0.764	0.894	1.039	0.647	1.563	1.398
Age Group (relative to 15-24 years)						
25-34	0.154	n.a.	0.185	0.416	-0.171	n.a.
35-44	n.a.	n.a.	0.216	0.458	-0.251	n.a.
45-54	n.a.	n.a.	0.307	0.253	n.a.	0.181
55-64	n.a.	n.a.	0.389	0.617	n.a.	n.a.
65+	n.a.	n.a.	0.414	0.668	n.a.	n.a.
Travel Style (relative to Package Tour)						
FIT/SIT	-0.203	-0.357	-0.486	-0.952	-0.812	-0.272
First Visit to NZ (relative to Yes)						
No	0.138	0.083	-0.113	n.a.	n.a.	-0.175
Diagnostic Statistics						
Pseudo R^2	0.046	0.034	0.102	0.234	0.305	0.166
Log likelihood	-4629.929	-4064.613	-3635.899	-3338.832	-812.446	-898.736
Log likelihood (full model)	-4620.218	-4046.254	-3629.266	-3347.112	-802.997	-888.249

Table 11 Air mode: Estimated log-normal models for kilometres per night (no prices).

Variable	**Australia**	**UK**	**USA**	**Japan**	**Korea**	**China**
Constant	4.797	4.954	5.200	5.336	5.323	5.157
Time Trend	n.a.	0.005	n.a.	-0.003	n.a.	0.008
Interview Month (relative to January)						
February	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
March	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
April	-0.165	-0.144	n.a.	n.a.	n.a.	n.a.
May	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
June	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
July	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
August	n.a.	-0.255	n.a.	n.a.	n.a.	n.a.
September	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
October	-0.142	n.a.	n.a.	n.a.	n.a.	n.a.
November	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
December	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Party Relationship (relative to 'Travelled Alone')						
Couple	n.a.	n.a.	n.a.	0.068	n.a.	n.a.
Family or Friends	n.a.	n.a.	n.a.	0.049	n.a.	n.a.
Tour Group	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Business Associates	n.a.	0.631	n.a.	0.087	n.a.	n.a.
Other	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Kids in Party (relative to no kids)						
Yes	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Purpose of Visit (relative to Holiday)						
VFR	-0.149	n.a.	-0.162	-0.108	n.a.	n.a.
Business	0.358	n.a.	n.a.	n.a.	n.a.	-0.148
Education	n.a.	n.a.	-0.263	-0.294	-0.443	-0.829
Other	n.a.	-0.610	-0.524	-0.393	-0.569	-0.515
Length of Stay (relative to < 5 days)						
5-7 days	-0.474	-0.484	-0.295	-0.316	-0.282	-0.305
8-10 days	-0.860	-0.701	-0.585	-0.631	-0.694	-0.721
11-13 days	-1.106	-1.083	-0.929	-0.993	-0.996	-1.034
14-16 days	-1.281	-1.373	-1.100	-1.221	-1.664	-0.998
17-19 days	-1.485	-1.561	-1.429	-1.182	-1.556	-1.255
20-29 days	-1.825	-1.824	-1.730	-1.702	-1.983	-1.657
30+ days	-2.699	-2.733	-2.562	-2.994	-3.219	-2.862
Age Group (relative to 15-24 years)						
25-34	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
35-44	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
45-54	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
55-64	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
65+	n.a.	0.141	0.108	n.a.	n.a.	n.a.
Travel Style (relative to Package Tour)						
FIT/SIT	n.a.	n.a.	-0.126	-0.168	n.a.	n.a.
First Visit to NZ (relative to Yes)						
No	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Diagnostic Statistics						
F-stat	215.000	130.350	218.080	658.940	276.020	142.210
Adj. R^2	0.591	0.491	0.579	0.745	0.832	0.794
Adj. R^2 (full model)	0.590	0.490	0.579	0.745	0.829	0.795

3.4. Simulation of Goodness of Fit

In order to further evaluate the above models in their ability to explain the observed travel behaviour of international tourists within New Zealand, we have calculated some pseudo time series that can be compared with the actual data. Figure 5 shows the actual and estimated quarterly average propensity to use car and the average car distance per night. For the propensity to use car, the probit models estimate for each visitor the probability that they use car. We multiplied this probability by the visitor's sample weight in the IVS to determine the estimated number of tourists who used car transport in each quarter. We then divided this by the total number of tourists in that quarter to estimate the quarterly car propensity. Similarly, the estimated quarterly average car kilometres per night are weighted averages, using the IVS sampling weights.

Figure 5 Actual and fitted values of quarterly weighted average propensity to use car (left) and log of car kilometres per night among tourists who used cars (right).

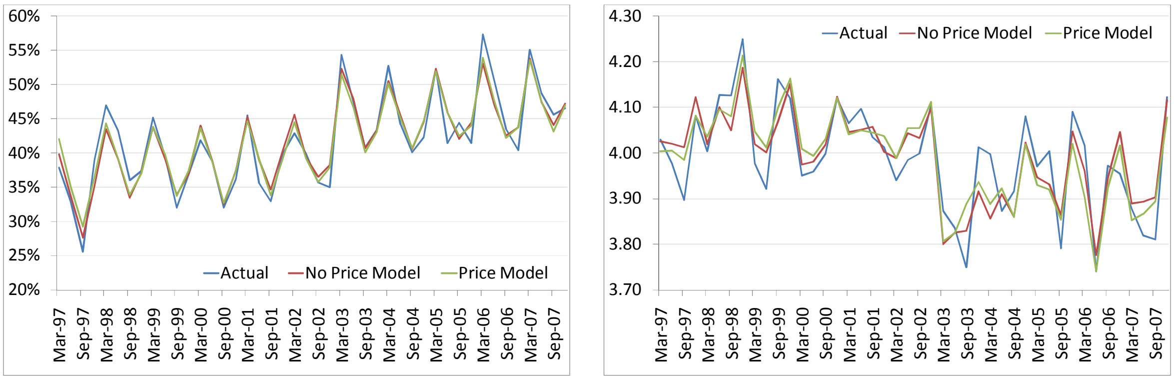
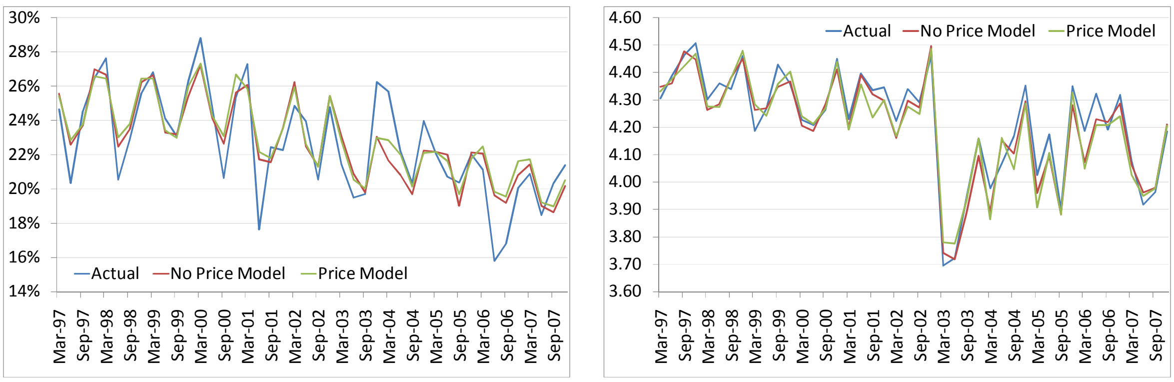


Figure 5 shows that the models explain the propensity to use car transport on a quarterly basis quite well. The fit of the kilometres per night for car transport is not quite as good, but still relatively close. In contrast, Figure 6 shows that for air transport, the models do a better job of explaining air kilometres per night compared to the propensity to use air transport. Nevertheless, in all cases, the explanatory power of the estimated models is relatively high.

Figure 6 Actual and fitted values of quarterly weighted average propensity to use domestic air transport (left) and log of air kilometres per night among tourists who used air (right).



4. Discussion

This paper presented distance models for tourists to New Zealand from six major markets of origin. Models for the propensity to use car or air transport within New Zealand and the distance travelled by these modes were constructed, including price of transport as a factor alongside tourist characteristics such as purpose of visit, length of stay, age group, and month of visit.

The modelling presented in this paper indicates that price is not a major driver of transport decisions amongst visitors to New Zealand from Australia, the UK, the USA, Japan, South Korea and China. Only the propensity to travel by car for Australians and travel distance by car by British and Japanese tourists seem to be significantly negatively affected by petrol prices. The models also indicated that tourists who stay longer are more sensitive to petrol prices, and free independent travellers are more sensitive compared with tour group visitors in terms of the propensity to use cars and the distance travelled by air.

Apart from this, the tourist characteristics variables, particularly length of stay, age, travel party relationship and purpose of travel proved better explanatory power in relation to mode choice and distance travelled. For example, couples and family groups use car more often and travel further distance than other travel parties, and they are also less likely to travel by air. Business travellers have a higher propensity to use air transport while in New Zealand. As already shown in earlier work (Becken *et al*., 2003), tourists who come to New Zealand to visit friends and relatives are more likely to use car (and less air than other visitors), but they travel less distance per day. This is partly explained by relatively long stays.

The longer tourists stay in New Zealand the more likely they are to use car, but the less distance they travel per day. The same pattern applies to air transport. Similarly, repeat visitors tend to travel fewer kilometres per day compared with first-time visitors. The winter months are characterised by lower car usage for some markets, but season does not affect the distance travelled by those who chose cars. Lower propensities to use car, for example for the Australian market, may be explained by a higher proportion of winter packages such as those for skiing holidays.

The results presented in this paper indicate that policies seeking to manage tourism transport should consider the characteristics of tourists, rather than rely on price alone. An environmental tax on transport (Ubbels *et al*., 2002), for example, is not likely to have major effects, whereas changes in the market composition or tourists or seasonality could have potentially larger impacts on modal choices and overall travel distance. Australian tourists, for example, already have a high propensity to travel by car, and if arrivals from Australia increase, especially in the older age brackets, car travel distance is likely to increase. On the other hand, Australians are often repeat visitors, which has a negative effect on travel distance.

The New Zealand Ministry of Tourism, in combination with their tourism forecast, is in a position to better understand likely decreases or increases in travel distance as a result of this research. This is, among other things, important in discussions around the 'carbon footprint' of tourism (Becken, 2008) and also how tourism might be affected by climate change policies. Tourist operators around the country will be concerned if travel distances decreases and destinations that are further away from the main centres are visited less frequently by tourists.

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