Estimating consumer surplus and elasticity of demand of tourist visitation to a region in North Queensland using contingent valuation

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Abstract

The Daintree Rainforest is a prime attraction for Tropical North Queensland as a tourist destination. Visitation of the rainforest, specifically the Cape Tribulation section, has increased rapidly as impediments to self-drive access have been removed. This paper examines the potential for the local council to manage the volume of self-drive access to the Cape Tribulation region by price mechanisms. The assessment is based on estimates of willingness to pay from a contingent valuation survey of self-drive tourists to the region, from which estimates of consumer surplus and demand elasticity are derived. A comprehensive discussion of the social and economic implications and transaction costs of price-based mechanisms is offered.

Keywords

contingent valuation, tourist management, recreation use fees, consumer surplus, elasticity of demand, Daintree rainforest

Introduction

The coastal rainforest area north of the Daintree River is an important destination for international and domestic visitors to Tropical North Queensland. A large proportion of the rainforest is part of the Wet Tropics World Heritage Area, which recognises the ecological significance of the area. Cape Tribulation, about 50 kilometres north of the river by road, is part of the World Heritage Area and contains some of the last remaining lowland rainforests in Australia. It is also a historically colourful area where Captain Cook was forced to land during his explorations of the Australian coastline. More recently, the area attracted significant attention in the 1970s when conflicts over logging arose, which ultimately led to the conservation of large sections of the area, and more recently about power supply and urban development in remaining freehold sections.

While there is tourist accommodation available in the Cape Tribulation area, most people visit the area for a day trip, either by organised tour or, increasingly, by self-drive. Sealing of the narrow and steep road between the Daintree River and Cape Tribulation in recent years has made the area accessible to sedans and hire vehicles. Most day visitors are based in Cairns or Port Douglas, the major tourist accommodation centers of Tropical North Queensland. The drive to Cape Tribulation from Cairns takes about 2½ hours.

Increasing self-drive visitation is causing serious management problems, similar to problems recorded in open-access national parks and other popular tourist destinations (Lindberg 1991) and management of visitation of ecologically sensitive areas being a key challenge to many tourist management agencies (Booselman et al, 1999). During the peak tourist season there are traffic issues associated with road leading to the area. Increased traffic causes social issues for local residents in the small communities north of the Daintree River and traffic fatalities pose an additional threat to endangered species such as the cassowary. Long waiting times exist at the Daintree Ferry, annoying tourists and locals alike. The Daintree River Ferry provides the only means of access across the Daintree River.

There is a complex management system in place for the Cape Tribulation area but management of road and ferry management and maintenance issues reside with the local municipality, Douglas Shire council. Given these access conditions, the Daintree Ferry could be used as a management tool for tourist access to the Cape Tribulation. The physical capacity of the ferry and the fact that a user charge applies for crossing the river already act as an access management tool to the Cape Tribulation area. However, additional price mechanisms offer themselves as one means of regulating the volume of traffic north of the Daintree river. Also, if a price increase for ferry crossings would generate additional revenue by capturing a proportion of current consumer surplus, this could make an important financial contribution to better management of this tourist destination area. To pursue this avenue of thinking, it is important to know the value of the benefits that visitors derive from visiting the Daintree Rainforest and estimate the consumer surplus that they derive as well as the elasticity of demand.

The research described in this paper sets out to measure the recreational use value that self-drive tourists derive from visiting the Daintree Rainforest north of the Daintree River and the price elasticity of demand. The study is based on a comprehensive contingent valuation survey with over 1000 surveys conducted at the Daintree Ferry. This research was part of a

larger research project into the management of tourism development in the Port Douglas – Daintree region during 1998-2000, which was funded by the CSIRO and supported by Douglas Shire Council and the regional tourism industry.

The paper is organised into five sections. Section 2 provides details of the valuation methodology. Section 3 analyses the results. Section 4 offers interpretation of the results. The paper concludes with recommendations as to how this data might be used for managing self-drive visitation of the area.

Methodology

Economic valuations of travel and tourist choices are a useful means of informing conservation and management of tourist destinations. The travel cost method is based on observed market behavior (revealed preference) while contingent valuation (CV) methods provide a stated preference framework by asking respondents' willingness-to-pay (WTP) or willingness-to-accept. In the case of tourists, this includes hypothetical 'what if' questions about specific fee types or amounts. There is ongoing debate about the biases inherent in CV methods but they have the advantage of having the potential to estimate both use and non-use values associated with environmental goods. Laarman and Gregerson (1996:248) stipulate CV to be the preferable method to guide pricing of a site. For this study CV is used to elicit one use value of the Cape Tribulation area – the recreational value of self-drive visitation – with the intention of informing decisions on price setting to manage traffic volumes in that area.

CV methods rely on surveys to elicit users' valuation of their particular resource use activities (eg. visit to the rainforest), and to collect demographic or activity information which might be used as predictors for these valuations. The questions directed toward users are "contingent" on there being a market for the good in question.

CV is ideally suited for the case of self-drive visitation of the Cape Tribulation area, as crossing the Daintree river via the ferry is a prerequisite for access. Also, the amount of money that travellers are prepared to pay for the river crossing provides a means for estimating the value of that aspect of the region's recreational value. The fundamental requirements for accuracy of the method are met in that respondents are familiar with the commodity being valued, tourists are used to making choices about destinations and there is little uncertainty associated with the choice.

Typically, CV methods employ either dichotomous choice or open ended approaches. Dichotomous choice CV approaches to elicit willingness to pay have the advantage of being simple for respondents and reduce the incentive of respondents to provide strategic responses (Hoehn and Randall, 1987) and the method is applied commonly (eg. Langford et al., 1998). However, there are several concerns with the approach, among the most important being that large sample sizes are required for a given level of estimation precision when compared to open-ended approaches (Bateman et al., 2001) and the high susceptibility to anchoring effects (Green et al., 1998). Open-ended CV approaches tend to include a significant proportion of responses that are considered too high to be reliable (Green et al, 1998).

Bateman et al. (2001) review a number of multiple-bound design examples, which seek to overcome those shortcomings. They also report on empirical data that reveals internal inconsistency of an elaborate multiple-bound CV design. Carson et al. (1999) suggest to practitioners to trade-off bias versus efficiency gains on a case-by-case basis.

CV is prone to various potential biases in estimating values. Design of the questionnaire and administration of the survey are critical in minimising biases. Two biases in particular need to be carefully addressed.

1. Estimates are subject to 'anchoring bias', also known as 'starting point bias': Higher bids lead to a higher estimated willingness to pay. This problem was addressed in this study in various ways. Respondents were familiar with the good to be valued and had a very good understanding of what to expect from a visit to the area. They were also familiar with the type of payment vehicle. They were informed of the current charge for a one-way ferry crossing (which at the time was $7) in case they did not know. 50% of respondents knew the price for the crossing and the. The issue was further addressed through the choice of 'referendum' or closed-ended format of CV, whereby bids were offered. In addition, all respondents were presented with an open-ended follow-up question, which allowed them to further refine their bid.

2. Estimates are susceptible to 'embedding': There is a common tendency of people to give similar willingness-to-pay responses to more or less inclusive goods. This was addressed in the questionnaire by taking respondents through a set of questions first, which isolated the Cape Tribulation visit aspect of their travel. Explanation as to the use of additional revenue generated was provided before the valuation question was asked.

For this study, a combination of double bounded dichotomous choice with additional open-ended question was chosen. Respondents were presented with an initial dichotomous choice as to whether of no they were willing to pay a specified amount to cross the ferry. Five "bids" were offered at random which were $20, $30, $50, $70 and $100 per vehicle for a one-way crossing. If respondents declined, they were offered a second bid at half the initial amount. In addition all respondents were asked what the maximum would be they would be prepared to pay. Figure 1 summarises the bidding sequence.
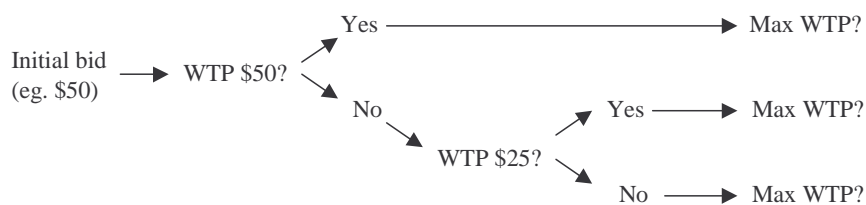

Figure 1: Bidding sequence

The survey was administered at the Daintree Ferry by face-to-face interview. Travel parties in cars were approached while they were waiting for the ferry to take them across the

Daintree river on their way to Cape Tribulation. After a pretest and pilot phase, four survey periods of one week each were conducted in July, September and November 1999 and April 2000, yielding a total of 1053 valid responses. The range and proportion of different visitor types interviewed can be regarded as representative of the total visiting population.

The survey collected a range of socio-economic and other variables that characterised self-drive visitors. These variables included the origin of visitors, how long they stayed in the country and/or in the Port Douglas – Daintree Region; whether their trip across the Daintree River was a day trip; whether they had a hire car and what type of car; size and type of travel party; what expectations they had, what their profession was, whether they were members of environmental organizations and the type of vehicle they drove. A background briefing on the use of additional revenue for the purpose of managing the destination provided further context for the question. Only then, the valuation question was asked.

Analysis of results

The data collected in the survey allows several different types of models to be estimated in order to estimate consumer surplus amounts. Following Bateman et al. (2002) the data can be categorised as continuous (open-ended questions), binary (single bounded discrete choice questions) or interval data (double bounded binary questions). With the data available, models can be estimated from the open-ended bids (continuous data) that were the culmination of the bidding process. Other models can be estimated from the binary responses to the first bid amount offered. As well, interval data can also be identified from the data set, and specific models estimated from this information. Results for these models are presented in turn.

Open ended bids

The first option is to estimate the demand function using the open ended bids. The data is summarised in Figure 2. It shows that a very small proportion of respondents are prepared to pay high bid levels, but that as bid levels fall, support increases. All respondents are prepared to pay $7 in ferry costs (the existing price level).

The average bid is $27.29, with a standard deviation of $25.24. The median bid is $20. For Australian residents, the average bid is $25.53, while for overseas residents the average bid is $29.87. For the purposes of estimating consumer surplus amounts, a bid function needs to be estimated. Regression analysis was used to estimate several different bid functions of different functional form.
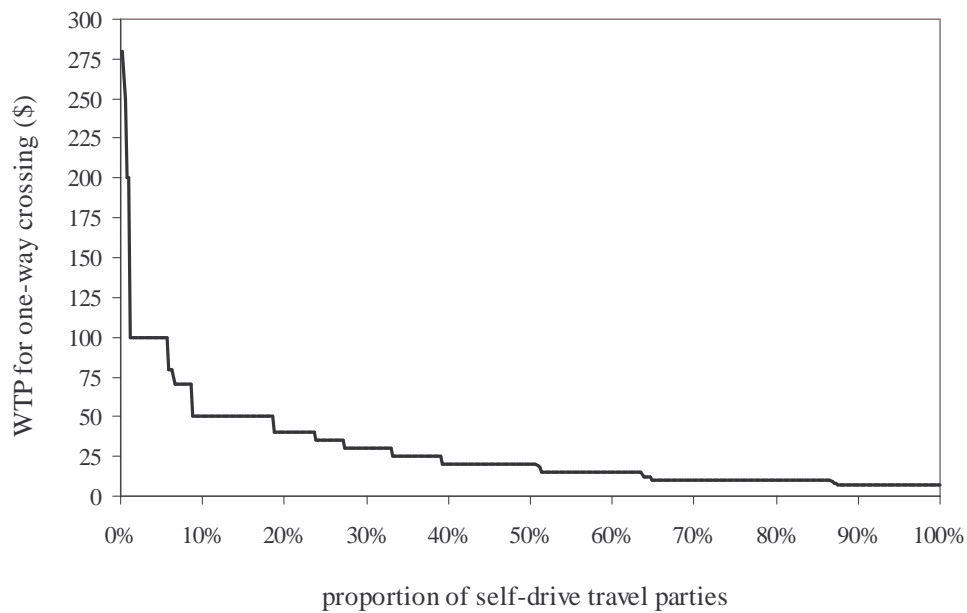
**Figure 2: Demand function of self-drive visitors to the Cape Tribulation area
established from open-ended bids for Daintree river crossing by car ferry**

On statistical grounds, the log-linear model (below) was superior. The following
relationship was estimated:

Bid amount = -24.793*Log (X) + 116.781   (adjusted R^2 = .938)   (1)

Where: X is the proportion of the population prepared to pay the bid amount.

The median bid value under this function is $19.79, while the mean bid amount is $39.60.
This form of model estimation is not very accurate because it allows unrealistic bid values
to be included within the model. These are bid values below $7, and those that are
negative. To avoid this problem, it is common to truncate the bid values in some way
(Haab and McConnell 2002, Bateman et al. 2002). In this case, the lower truncation needs
to be $7, while an upper truncation of $9999 is chosen to represent the estimated level of
disposable income per respondent. A tobit model can be utilised to estimate a bid function
that has been truncated in this manner. A model with significant variables is reported in
Table 1.

Table 1:   Tobit model with lower and upper truncations

	Coefficient	Standard.Error	Mean of X
<u>Primary index equation</u>			
Proportion prepared to pay amount	0.56***	0.01	
<u>Heteroscedasticity Terms</u>			
State of residence (Australian respondents)	-0.19***	0.01	2.00
Length of stay in Australia (overseas visitors)	-0.11***	0.02	1.13
Days in region	0.19***	0.02	1.39
Region where stayed the previous night	0.07***	0.02	2.05
Number of passengers in car	0.09***	0.02	2.76
Type of group	-0.06***	0.01	2.09
Rental car	-0.08**	0.03	1.41
Car size	0.11***	0.02	1.69
Reason for visit – rainforest	0.27***	0.05	0.85
Reason for visit – WHA	-0.13***	0.03	0.43
Reason for visit – wildlife	-0.20***	0.04	0.30
Reason for visit – remoteness	0.10*	0.06	0.18
Reason for visit – 4WD experience	0.57***	0.07	0.08
Reason for visit – getting away from people	0.13***	0.04	0.24
Reason for visit – travelling further north	-0.15**	0.06	0.07
Knew that ferry charge was $7/vehicle	0.05*	0.03	1.52
<u>Disturbance standard deviation</u>			
Sigma	8.62	1.08	
Model statistics			
# of observations	1053		
Log-Likelihood	-3624.806		

*** = significant at 1% level, ** = significant at 5% level, * = significant at the 10% level.

The model indicates that place of residence influenced the WTP amounts, and that overseas visitors on short rather than longer trips were prepared to pay higher amounts.   Visitors who were spending a greater length of time in the region, and those who had stayed further away the previous night were more likely to indicate higher amounts. Groups with more passengers, in their own vehicle, and in larger vehicles, were more likely to indicate higher amounts. Respondents who indicated that they wanted to visit the region because of the rainforest, remoteness and getting away from people were more likely to indicate higher amounts. Those who indicated that they were visiting the area because of the World Heritage Area status, wildlife, or because they were travelling further north, were less likely

to indicate a high WTP. Those who already knew the ferry charge was $7 were more likely to express a higher WTP.

Under the Tobit model, the median bid is estimated at $28.23, while the mean bid is estimated at $28.87. For Tobit models estimated for the sample of Australian visitors, the median bid is estimated at $17.51, while the mean is estimated at $18.43. For models estimated on the sample of overseas visitors, the median bid is estimated at $31.14 and the mean bid is estimated at $31.72.

Single dichotomous choice bids

The second way of analysing results is with a single dichotomous choice CV method, using only the answers to the first choice offered to respondents. The data is summarised in Table 2.

Table 2:   Results of first dichotomous choice bid in survey

Survey version	A	B	C	D	E
Bid level	30	40	50	70	100
Number of responses	211	213	211	209	209
% Yes	0.39	0.32	0.28	0.20	0.15

A logit model is reported in Table 3, with the natural log of bid value as a significant dependent variable. The number of days in the region, and planned number of days across the Daintree River were significant variables. This is in accordance with a priori expectations, because for visitors prepared to stay longer, the ferry cost would be a smaller proportion of their overall budget.

The survey asked the occupation of the main income earner of each travel party as a surrogate variable for income. *Occupation* was coded into four levels of different employment classes, and a fifth level representing non-employed (including retired, home duties and students). Coding was 'backwards', with persons in higher-income/higher-education jobs coded as low-values and people without work income coded as the highest category. The negative coefficient indicates that travel groups on higher incomes are prepared to pay more.

Other significant variables were the *place of residence*, and key reasons for visiting the region, including *Visiting Cape Tribulation*, and *Getting away from people*.

Table 3:   Logit model for first dichotomous choice bid

	Coefficient	Standard error	Mean in sample
Constant	3.089***	0.748	
Place of residence	-0.098**	0.039	2.005
Days in region	0.164**	0.074	2.474
Days across river	0.187***	0.069	1.390
Reasons for visit - Cape Tribulation	0.390**	0.174	0.740
Reasons for visit – getting away from people	0.348**	0.166	0.241
Occupation	-0.155***	0.049	2.808
Log of bid level	-1.186***	0.183	
No of observations	1053		
Log likelihood function	-567.5		
Chi Square (7 DoF)	90.73		
Median	$19.10		
Mean	$106.53		

*** = significant at 1% level, ** = significant at 5% level.

More information can be gained by looking more closely at the discrete variables. To examine how *place of residence* influenced choices, the Australian residents were sampled out of the respondents, and a separate variable created for each place of residence. One of these discrete variables has to be omitted to act as a base. The model for NSW as the base is reported in Table 4.

Table 4:   Logit model for Australian respondents

	Coefficient	Standard error	Mean in sample
Constant	2.820***	1.000	
Nights in region	0.050	0.099	2.474
Nights in Daintree	0.162*	0.096	1.390
QLD	-0.553**	0.252	0.214
SA	-1.125**	0.544	0.029
VIC	-0.248	0.257	0.152
WA	0.154	0.454	0.025
TAS	-1.211	1.077	0.010
Reasons for visit - Cape Tribulation	0.463**	0.231	0.740
Reasons for visit – getting away from people	0.309	0.219	0.241
Occupation	-0.068**	0.035	2.808
Log of bid level	-1.076***	0.242	
No of observations	625		
Log likelihood function	-325.86		
Chi Square (10 DoF)	46.2		
Median	$19.52		
Mean	$257.13		

*** = significant at 1% level, ** = significant at 5% level, * = significant at 1% level.

This shows that Queenslanders and South Australians are less likely than respondents from NSW to pay a higher ferry charge. There was no significant difference with residents from other states.

The same process can be followed to examine if there was a significant difference in WTP between residents from other countries. That sub-sample of respondents was selected, and country of origin was coded into six separate variables. One variable (North America) was dropped as a base, and the resulting model is reported in Table 5. The results show that there was no significant difference between European and North American visitors in their WTP to visit the Daintree region. Asian visitors had a higher WTP than North Americans, while New Zealanders and visitors from other countries were less inclined to pay.

Table 5:   Logit model for overseas visitors

	Coefficient	Standard error	Mean in sample
Constant	2.070*	1.254	
Nights in region	0.354***	0.126	2.474
Nights in Daintree	0.220**	0.111	1.390
Reasons for visit - Cape Tribulation	0.263	0.289	0.740
Reasons for visit – getting away from people	0.435	0.274	0.241
Occupation	-0.074	0.049	2.808
Europe	0.231	0.415	0.287
Asia	0.760**	0.321	0.925
New Zealand	-2.686***	1.028	0.037
Other Overseas	-2.973*	1.604	0.020
Log of bid level	-1.482***	0.298	
No of observations	428		
Log likelihood function	-227.82		
Chi Square (11 DoF)	68.25		
Median	$14.41		
Mean	$35.77		

*** = significant at 1% level, ** = significant at 5% level, * = significant at 1% level.

<u>Double bounded dichotomous choice bids</u>

The third option for estimating a model is to fit a double bounded CV model by identifying the intervals that bounded respondent bids. This is not straightforward, because the respondents who answered yes to the first dichotomous choice (DC) question were not offered a followup dichotomous choice, but simply the open-ended question. Out of the 1053 responses to the survey, 283 respondents answered yes to the first DC question, and then gave an open-ended bid response.

Double bounded models are analysed with a minimisation procedure, where the key variables are the minimum and maximum WTP amounts revealed. To generate the appropriate data, the open-ended response was used to identify how that group of

respondents would have answered a second DC question. The hypothetical bid levels used were double the value of the first DC bid. If the respondents would have answered Yes to the second DC bid, then their upper bound was identified as $9999 (an estimated income constraint). If they would have answered NO to the second DC bid, then their upper bound was set at the hypothetical bid amount. A summary of the coding into minimum and maximum bids is set out in Table 6.

Table 6:   Data for dichotomous choice model

First bid response	Second bid response	Minimum level coded	Maximum level coded	Number of responses
NO	No	$7	Second bid	503
	Yes	Second bid	First bid	267
YES	No	First bid	Second bid	271
	Yes	Second bid	$9999	12

Models with significant variables are reported in Table 7, 8 and 9. Mean values for the non-bid variables have been used to generate estimates of the mean and median bids.

Table 7:   Dichotomous choice model for all respondents

	Coefficient	Standard error	Mean in sample
Constant	8.510***	0.502	
Log of bid price	-2.649***	0.108	
Occupation	-0.066***	0.023	2.808
Australia/overseas	0.239*	0.128	1.406
Rented car	-0.337**	0.133	1.410
Nights in region	0.181***	0.059	2.474
Nights in Daintree	0.194***	0.057	1.390
Log likelihood	-1195.37		
Median	$ 28.78		
Mean	$ 36.82		

*** = significant at 1% level, ** = significant at 5% level, * = significant at 1% level.

Table 8: Dichotomous choice model for Australian respondents

	Coefficient	Standard error	Mean in sample
Constant	8.807***	0.600	
Log of bid price	-2.554***	0.142	
Occupation	-0.057**	0.027	3.0304
Rented car	-0.439***	0.160	1.5648
Nights in region	0.151**	0.077	2.4704
Nights in Daintree	0.067	0.074	1.3808
Log likelihood	-713.66		
# of observations	625		
Median	$ 26.95		
Mean	$ 35.16		

*** = significant at 1% level, ** = significant at 5% level, * = significant at 1% level.

Table 9: Dichotomous choice model for Overseas respondents

	Coefficient	Standard error	Mean of sample
Constant	9.128***	0.684	
Bid price	-2.849***	0.171	
Occupation	-0.075*	0.040	2.484
Rented car	-0.181	0.242	1.185
Nights in region	0.233**	0.094	2.479
Nights in Daintree	0.380***	0.091	1.404
Log Likelihood	-475.66		
# of observations	428		
Median	$ 31.63		
Mean	$ 39.08		

*** = significant at 1% level, ** = significant at 5% level, * = significant at 1% level.

Double bounded dichotomous choice models incorporating maximum WTP information

A further option for estimating a model is to incorporate the open ended bid amount where possible into the dichotomous choice data to set the maximum WTP. This should provide a more accurate estimate of the upper bound on the WTP function. However, a difficulty emerges in just substituting the maximum bid amount revealed under the DC approach with the open-ended bid results. A number of respondents appear to exhibit an anchoring effect in nominating a WTP bid equivalent to the DC amount that they had just accepted. In other words, many respondents did not offer to pay any more than the amount that they just indicated would be acceptable. This makes it difficult to fit an estimation function because the minimum and maximum bid amounts revealed are the same quantity.

To avoid this modelling problem, the open ended bid result was not substituted for maximum WTP when respondents appeared to exhibit an anchoring effect. This was because it was assumed that respondents did not reveal their true maximum WTP bid. For respondents who answered Yes to the first DC question, but then appeared to act

strategically by giving the same value for the open ended question, their maximum bid amount was set at $9999. For the respondents who answered No to the first DC question, but then exhibited strategic behaviour, their maximum bid amount was set at either the first or the second bid level. A summary of the coding into minimum and maximum bids is set out in Table 10.

Table 10: Data for dichotomous choice/open-ended model

First bid response	Second bid response	Anchoring identified?	Minimum level coded	Maximum level coded	Number of responses
NO	NO	Yes	$7	Second bid	165
		No	$7	Open-ended bid	338
	YES	Yes	Second bid	First bid	25
		No	Second bid	Open-ended bid	242
YES		Yes	First bid	$9999	240
		No	First bid	Open-ended bid	43

A model with the same variables as for the dichotomous choice model is reported in Table 11. All variables are highly significant, and mean and median WTP are higher than in the dichotomous choice model. The Australian and overseas respondent models are reported in Table 12 and 13.

Table 11: Dichotomous choice/open-ended model for full sample

	Coefficient	Standard error	Mean of sample
Constant	6.576***	0.411	
Bid price	-1.834***	0.080	
Occupation	-0.055***	0.021	-0.155
Australia/overseas	-0.395***	0.128	-0.555
Rented car	-0.376***	0.115	-0.530
Nights in region	0.164***	0.055	0.405
Nights in Daintree	0.153***	0.051	0.213
Log Likelihood	-1652.38		
Median	$25.71		
Mean	$44.46		

*** = significant at 1% level, ** = significant at 5% level, * = significant at 1% level.

Table 12: Dichotomous choice/open-ended model for Australian sample

	Coefficient	Standard error	Mean of sample
Constant	6.220***	0.479	
Bid price	-1.854***	0.106	
Occupation	-0.048*	0.025	3.030
Rented car	-0.483***	0.150	1.565
Nights in region	0.161**	0.071	2.470
Nights in Daintree	0.018	0.068	1.381
Log Likelihood	-981.56		
# of observations	650		
Median	$22.11		
Mean	$37.74		

*** = significant at 1% level, ** = significant at 5% level, * = significant at 1% level.

Table 13: Dichotomous choice/open-ended model for Overseas sample

	Coefficient	Standard error	Mean of sample
Constant	5.414***	0.547	
Bid price	-1.821***	0.122	
Occupation	-0.073**	0.035	2.484
Rented car	-0.154	0.218	1.185
Nights in region	0.153*	0.089	2.479
Nights in Daintree	0.389***	0.084	1.404
Log Likelihood	-667.82		
# of observations	428		
Median	$26.60		
Mean	$46.62		

*** = significant at 1% level, ** = significant at 5% level, * = significant at 1% level.

Discussion

The key model results for all data and with the bid price in log form are summarised in Table 14. This shows that the survey data can be used to identify a number of different models with corresponding values of consumer surplus estimates.

Table 14: Summary of model results

	All respondents		Australian respondents		Overseas respondents	
Model type	Median	Mean	Median	Mean	Median	Mean
Open-ended bid	$19.79	$27.00	$18.52	$24.93	$21.88	$29.26
Tobit model on open-ended bid	$28.23	$28.87	$17.51	$18.43	$31.14	$31.72
Single dichotomous choice	$19.10	$106.53	$19.52	$257.13	$14.41	$35.77
Double-bounded dichotomous choice	$28.78	$36.82	$26.95	$35.16	$31.63	$39.08
Double bounded/ open-ended model	$25.71	$44.46	$22.11	$37.74	$26.60	$46.62

There is no strong theoretical or practical basis for preferring one model to another, although the single dichotomous choice model suffers from a fat tail problem. The open ended model results give lower estimates of WTP than do the various dichotomous choice models. However, the standard set by the authorative NOAA panel (Arrow et al. 1993) was that CV surveys should employ the "close-ended" format rather than the open-ended ones.

Methodology

The accuracy of single choice dichotomous choice models

The mean WTP from the single dichotomous choice model is much higher than from the other models, suggesting that the logit distribution has a fat tail. When separate models were calculated for Australian and overseas visitors, the mean WTP amounts estimated were $257.13 and $35.57 respectively. This indicates that the problems of a fat tail distribution are centred on the Australian respondents .

The results indicate that the answers from the single dichotomous choice data are not as accurate as the double bounded or open-ended data[1]. There are three key reasons why this

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[1] The answers to the first dichotomous choice question can also be analysed as interval data using a minimisation procedure. This did not solve the fat tail problem for the model specified, although it did allow other better-fitting models to be generated.

might be the case. The first is that there may be learning effects inherent in a bidding model, so that responses to the subsequent dichotomous choice question and the open-ended question were more accurate. The second reason is that the two double bounded dichotomous choice models have the advantage of more data, and this may create more accurate models. The third reason is that the range of bid levels was necessarily smaller in the single bounded dichotomous choice model compared to the double bounded models, leading to smaller differences in the proportion of affirmative responses in the former. A more accurate comparison between single and double bounded models might involve similar ranges of bid prices. While the first two reasons suggest that double bounded or bidding formats might be preferred, the third reason suggests that differences could be caused by design issues.

The size of the anchoring effect

Evidence was found in the survey for anchoring in bid construction. This occurred when the open-ended bids that were offered were exactly the same as the minimum amount of payment agreed to in the dichotomous choice questions. For example, a respondent may have answered Yes to a $30 bid level, and then given the exactly the same amount as their maximum WTP in the open-ended bid. Reasons for this might include strategic behaviour as well as anchoring.

The bid amounts that were susceptible to anchoring were the open-ended bids. As well, the double bounded dichotomous choice model was influenced by anchoring problems because responses were estimated for some of the second bid levels. Anchoring effects were specifically removed from the combined dichotomous choice/open-ended model, thus allowing some comparisons to be made.

For the full sample, the difference between the means of the open-ended model and the double-bounded dichotomous choice models was $9.82/respondent. This should largely be attributed to the effect of anchoring. It is notable that the mean of the double bounded/open-ended model was $7.34 above the mean of the double-bounded model. This difference can be partly attributed to anchoring effects (as some still existed in the double bounded model), and also to more accurate specification.

The overall conclusion to be drawn is that bidding formats with open-ended WTP mechanisms may underestimate consumer surpluses because of the potential for strategic behaviour and anchoring to occur. The implications are that referendum formats should be preferred to bidding formats, as recommended by Arrow et al. (1993), or that welfare estimation should combine bidding information with the open-ended bid information. The results presented in this paper suggest that the latter alternative is a viable option.

Implications of results for self-drive access management

Consumer surplus

Increasing self-drive traffic to the Cape Tribulation area of the Daintree rainforest is causing a series of social and environmental problems. Access to the area is via the Daintree river ferry. A CV survey of 1053 self-drive travel parties was conducted during 1999/2000, which represents about 2% of total estimated visitation by this visitor segment. The one-way ferry price at the time of the survey was $7 per non-commercial non-resident vehicles. During 1998-99 approximately 110,000 full-paying car ferry crossings were made[2]. As vehicles need to cross the river twice this provides an estimated 55,000 trips by self-drive tourist vehicles to the Cape Tribulation area.

Based on a CV study of self-drive visitors to the area, the annual aggregate consumer surplus for recreational self-drive visitation of the Cape Tribulation area is estimated to be between $2.2 million based on the open-ended bid model and $4.1 million based on the double-bounded/open-ended model.[3] This constitutes a substantial aggregate consumer surplus. The average consumer surplus is estimated by the same models to be between $20.00 and $37.46 per travel party or between $7.23 and $13.53 per traveler (given an average of 2.76 persons per travel party). These values are low in comparison to estimates provided by Knapman and Stanley (1991) for Kakadu National Park, who estimated consumer surplus (in 1991 values) to be $384.18 per household visit and $37.05 per person per day.

Elasticity of demand

Elasticity of the demand curve determines how effective price mechanisms are in reducing visitation. According to Grandage and Rodd (1981) usage at sites having low elasticity of demand for access will not be reduced by pricing without additional more direct rationing methods. Typically, price elasticity of demand for access to national parks is very low – with many national parks rating around –0.07 (Grandage and Rodd, 1981). In these cases price mechanisms are ineffective in reducing access but highly effective in generating additional revenue.

The data from the survey as shown in generally convex bid function (Figure 2) suggest that demand is highly price-inelastic for a proportion of self-drive visitors but quite elastic for a majority of visitors. This would indicate that there may be substantial scope for the ferry to be used (1) as an access management tool to the Cape Tribulation area by increasing the price for a crossing as well as (2) as a means for generating additional revenue for the local council to finance better management of the area. Table 15 shows price elasticity along the demand curve and compares it with estimates obtained from the models.

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[2] Data kindly provided by Douglas Shire Council, 2000.

[3] The single dichotomous choice model provided a consumer surplus estimate of 10.9 million, however, for reasons stipulated above this model was deemed the least accurate.

Table 15: Price elasticity of demand

Price for a one-way ferry ticket ($)	Proportion of travellers willing to pay this price or more (%)	Price elasticity
Raw data (open-ended bid)		
10	85	-0.35
15	67	-0.29
20	54	-0.25
25	43	-0.22
30	36	-0.19
40	25	-0.16
50	19	-0.13
70	8	-0.10
100	4	-0.07
Open-ended bid (@ median)		-0.27
Tobit model on open-ended bid (@ median)		-0.16
Double-bounded dichotomous choice (@ median)		-0.16
Double bounded/ open-ended model (@ median)		-0.19

Calculated price elasticity at the median is between -0.22 and -0.25 for the data and between -0.16 based on the double-bounded dichotomous choice model and -0.27 based on the open-ended bid (Table 16). This is consistent with estimates of a large number of studies estimating price elasticity of demand for access to national parks, which was compiled by Grandage and Rodd (1981) but somewhat higher than more recent estimates for Kakadu and Hinchinbrook national parks by Knapman and Stoeckl (1995). The finding can be explained in that most national parks classify as destinations in themselves, whereas the Daintree National Park – and the Cape Tribulation area – are components of the destination Tropical North Queensland. Also, the Daintree National Park is a distributed national park with multiple access points, some of which lie south of the Daintree River and do not require crossing the Daintree river. Hence, the visitor experience 'Cape Tribulation' is to some extent substitutable.

The findings confirms the earlier observation of a comparatively high elasticity of demand for access for a majority of self-drive visitors, therefore suggesting that price increases at the ferry might be both effective in managing self-drive traffic volume and generating additional revenue.

Fee for ferry crossing as access management tool

Assuming that the double-bounded/open-ended model provides the most reliable WTP estimates, an increase of a one-way crossing to $25.71 would halve the self-drive traffic across the ferry. For reasons of operational feasibility, the following calculation assumes that to achieve a management target of halving traffic from self-drive tourists required the price for a crossing to be set to $25 per vehicle crossing ($50 return). Despite the reduced usage of the ferry, annual shire income from self-drive tourists using the ferry would rise by almost 80% of current levels, from approximately $0.77 million to $1.37 million. The additional income of $0.6 million per year represents additional rent by the region from its

environmental resources, and could support significant efforts into managing and preserving the heritage and environmental attributes of the Cape Tribulation area.

A frequently raised criticism of price-based access management instruments is that they are socially discriminatory and further disadvantage low-income segments of society. Contrary to this view, Knapman and Stoeckl (1995) argue that entry fees to national parks are not only a good potential source of revenues but also impose smaller efficiency costs than the income taxation system and that fees may well constitute a progressive tax, thus being relatively equitable.

The data, distributed across occupations, support the criticism of social disadvantage for the case of the Daintree river ferry (Table 16). Professionals had the highest mean (open bid) WTP with $30.11 followed by 'white collar workers' with $28.69 while the mean for retired persons was $23.33 and for unemployed persons $22.11. All four models show occupation negatively correlated with WTP. Specifically in the case of the dichotomous choice/open-ended model for the full sample, this correlation was significant at the 1% level.

Table 16: Willingness to pay and occupation of main income earner of travel party

Occupation	Mean amount willing to pay for one-way ferry crossing ($)
Professional	30.11
White collar	28.69
Skilled blue collar	24.91
Unskilled blue collar	19.50
Unemployed	22.11
School student	10.00
University student	24.09
Home duty	14.40
Retired	23.33
Unspecified	8.00
All Groups	27.79

Differential pricing systems can alleviate some of the social inequality, for example through pensioner and other discounts. Such equity measures, however, come at the expense of the effectiveness of the price mechanism in managing access.

Relatively more Australians than overseas visitors would decide not to visit the area. This is expected as the price increase for that segment is more significant in relation to the total cost of their travel. This finding is consistent with findings from other studies. Multi-tiered pricing systems can alleviate the 'disadvantage' of 'local' visitors. There is already a multi-tiered pricing system in place at the Daintree river ferry, which allows residents of the Douglas shire local government area to purchase an annual user pass quite cheaply and to obtain discounts for personal visitors.

Relatively more of the self-drive visitors to the Cape Tribulation area would stay there overnight. The mechanisms could thus create positive effects for tourist accommodation businesses in the area.

From the survey it is impossible to say what those potential self-drive visitors who decide not to drive to the Cape Tribulation area would do instead, as possible substitution effects are not explored in the questionnaire. Some might decide to join tour groups to the area. Others may visit alternative areas where the Daintree rainforest is accessible by car, such as the Mossman Gorge, therefore potentially shifting the problem of traffic volume to other areas. Others may opt for a 'rainforest experience' in a commercial rainforest set-up outside Port Douglas.

Conclusions

This paper presents an application of the contingent valuation method to a situation where one aspect of the recreation value of an ecologically sensitive area and price elasticity of demand are estimated. The question is whether raising the price for an already existing payment vehicle, which exists at a bottle neck that all travelers have to pass in the form of a river ferry, could be effectively employed to control self-drive traffic volume to the destination.

The results reveal a large consumer surplus and relatively high elasticity of demand for a majority of self-drive visitors. The findings support theoretical considerations that access fees – by way of an increased charge for and use of the Daintree river ferry – would indeed be an effective and efficient means of (1) reducing traffic volumes cause by self-drive visitors and thereby alleviating traffic-related social and environmental problems and (2) significantly increasing the resource rent which the municipality can draw from tourism, with additional revenue from the ferry being available for the improved management of this prime tourist destination. Issues of equity of access could be adequately addressed through multi-tiered pricing system. Careful consideration would need to be given to potential substitution effects and a shifting of traffic-related issues to other sensitive areas within the destination region.

Acknowledgements

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