ESTIMATING THE VALUE OF TASMANIAN NATIONAL PARKS TO PARK VISITORS

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EXECUTIVE SUMMARY

Tasmania's national parks and wilderness areas are important attractors of tourists to the state. The main aims of this project were to quantify the value that visitors to certain Tasmanian national parks placed on those sites, and the responsiveness of park visitation rates to changes in park entry fees. To undertake this task the project employed a widely-used method for estimating the value of recreational sites, known as the Clawson-Knetsch or travel-cost method (TCM).

The TCM was employed because there was insufficient variation in park-entry fees across time to carry out a conventional econometric estimation of demand curves for the parks. The TCM recognises that there are a number of costs involved in visiting a park, not just the entry fee, and that total costs vary across individuals. Under the assumption that consumers would behave in the same way in response to a dollar increase in entry costs as they do for a dollar increase in associated travel costs a demand curve for a national park can be constructed.

In order to obtain the required data to undertake the TCM, a survey was undertaken of visitors to two Tasmanian national parks: Freycinet National Park and Mt Field National Park. The former is situated at Freycinet Peninsula on Tasmania's east coast and features the peaks of the Hazards and the beautiful Wineglass Bay. The latter features Russell Falls and Lake Dobson with its adjoining ski fields. Both sites were surveyed from April to June 2000, and for Mt Field the survey was continued through to October of that year. Useable responses for 856 travel groups (comprising around 2000 individuals) visiting Freycinet were collected. For Mt Field there were 984 group responses covering around 1900 individual park visitors.

Data of the type required for making TCM estimates was also available from an earlier (1999) survey of visitors to nine parks and historic sites including the two surveyed in 2000. However, due to the low number of respondents for individual parks and the nature of the questions in the 1999 survey, which was designed for another purpose, only limited estimates could be made with the earlier data.

The particular variant of the TCM which we used in this study involved grouping survey respondents into several zones depending on the distance of the trip's origin from the park. Average data for zones were then used to estimate an equation in which the visitor rate (the proportion of the zone population which visits the facility) depended on the average cost of visiting the park from the zone in question. Visitors surveyed were allocated into one of 16 zones: four for Tasmania, two for each of the mainland states, one for the ACT and one for overseas visitors.

The most valuable of the TCM estimations were for Freycinet National Park. For Freycinet it was found that:

- A useful distinction could be made between endogenous and exogenous travel costs. The former include costs which are subject to considerable choice, while the latter are subject to little choice once the decision to undertake the trip has been made.

- The preferred equation was one which was non-linear and related the visitor rate to the log of exogenous travel costs.

- The estimated version of the preferred equation was used to predict the effect on visitor numbers of a $1 increase in the park entry fee. The overall effect was a fall of approximately 6% with the largest absolute falls being predicted for visitors from the Mainland states and overseas.

- The estimated equation was also used to compute the use value of the park based on a measure of consumer surplus. Calculations were based on visitor numbers in 1999 and produced a figure of approximately $14 million which is equivalent to $83 per visitor. Of the $14 million approximately $10 million was found to accrue to mainland visitors, and $2 million each to users from Tasmania and overseas.

For the Mt Field estimations, the relationship between the visitor rate and travel costs proved to be difficult to establish. Some evidence was found that the response of visitors from the Tasmanian zones differed considerably from that of Mainland and overseas visitors.

A single preferred equation was not chosen for Mt Field, but various alternatives were used to investigate the effect on visitor numbers of a $1 increase in the park entry fee. The results were found to be sensitive to whether separate equations were used for Tasmanian and other visitors and, to a much lesser extent, to the form of the equation. If different responses were permitted for Tasmanian and non-Tasmanian visitors, the overall effect of the fee increase was found to be a fall in visitor numbers of the order of 5%, with much of the reduction in visitors being those from Tasmanian zones. If a common equation was used for all visitors, the overall effect was much larger – of the order of 20% – with most of it being felt in visitors from the mainland states and overseas.

In order to study the impact of national park tourism on the economy as a whole, a multiregional computable general equilibrium model, FEDERAL, was used. Expenditure by national park visitors was seen to have a significant impact on the size of the Tasmanian economy. Real gross state product was estimated to be around $120 million higher than would be the case if no park users visited Tasmanian PWS sites. PWS tourism was estimated to contribute 4,200 full and part-time jobs to the Tasmanian economy.

A small across-the-board increase in park entry fees (by $1 per person-visit) is likely to have little adverse effect on the Tasmanian economy. An outside estimate of the negative effects on the Tasmanian economy was computed with the aid of the FEDERAL model as a loss in Tasmanian gross state product of $2.8 million and 89 jobs, a significant proportion of them part-time.

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1. INTRODUCTION

1.1 The Aims of the Study

There is an apparent strong relationship between Tasmanian tourism and the State's natural beauty and its historic sites. Tourism would seem to depend to a substantial degree on unpriced (or largely unpriced) resources such as national parks, wilderness areas and the like.

The major purpose of this study was to obtain a measure of the value that tourists place on some of these natural assets. In particular, the primary objective of this study has been to estimate the value of certain Tasmanian Parks and Wildlife Services (PWS) localities as recreational sites, i.e. their use value.

The valuation of these sites can be important for a number of reasons, such as:

- in devising methods to avoid congestion costs (say on popular walking tracks within particular parks);
- in ascertaining the correct allocation of resources in supplying public goods to service the parks (for instance, access roads and park rangers); and
- in determining whether the allocation of resources to these areas reflects their value to park visitors.

In addition to providing the first estimates of the use value of some key Tasmanian national parks, the study also had a number of secondary aims. The first of these was to determine, to the extent that the data permitted, the degree to which use value varies between user groups, and between Tasmanian and others.

The other major objective relating to park entrance fees was to estimate the consequences for Tasmanian tourism and the Tasmanian economy of changes to national park fees.

1.2 Structure of the Report

The research carried out in this report contains three main elements:

i) the collection of survey data;

ii) the econometric estimation of demand functions for park visits; and

iii) simulations of the economic impact of changes in park fees.

The first part of this report (Chapter 2) discusses the methods used to carry out these three major tasks. This is followed by a discussion in Chapter 3 of the results of the econometric estimation and in Chapter 4 of the computation of the use values. The question of the parks fee structure is then considered in Chapter 5, with a discussion of the nature of the model simulations and the results. The final chapter provides a summary and conclusions.

2. STUDY METHODS

2.1 Introduction

The major method of analysis used in the study was the travel cost method (TCM). The method has become a standard tool for estimating the use value of unpriced recreational facilities since it was developed by Clawson and Knetsch (1966)[1] . TCM is one of the two main methods used by economists, sociologists and other researchers in the recreational and environmental fields to quantify the benefits of non-market goods in terms of monetary values.[2]

In section 2.2.1 we outline the broad features of TCM. The next two sections are concerned with the data used in our TCM study. Section 2.2.2 looks at existing data from a previous survey of visitors to certain Tasmania national parks. In section 2.2.3 we describe the travel-cost survey carried out for the current study. Some matters relating to the details of implementing the TCM for the current study of Tasmanian national parks are discussed in section 2.2.4.

The method used for the final part of the study, examining the wider economic consequences of the park fee regime, is multiregional computable general equilibrium modelling. Section 2.3 describes the particular model used, which was the FEDERAL model.

2.2 The Travel-Cost Method

2.2.1 Outline of the TCM

The aim of the TCM component of this study is to estimate demand curves for certain Tasmanian national parks. A demand curve relates the quantity demanded for a particular good (in a particular time period) to various prices of the good.[3] It is not possible to undertake this estimation directly for many outdoor recreation sites as they are

[1] Clawson and Knetsch, first separately and then together, developed the TCM from an idea first advanced by Hotelling (1947). TCM is often called the Clawson-Knetsch method, or sometimes the Clawson technique.

[2] The other non-market valuation method is contingent valuation (Cummings, et al. 1986).

[3] With all other factors influencing demand, apart from the (own) price, held constant.

often unpriced. While Tasmanian PWS sites are subject to an entry fee, there is insufficient variation in the entry price across individuals or across time to carry out a conventional econometric estimation of the demand function.

The TCM overcomes this difficulty by observing that entry cost is just one component of the total cost of visiting the park and that total costs do vary across individuals. Hence we can use cross-section survey data to estimate the sensitivity of park-use to variation in total costs so that, if we assume[4] that consumers behave in the same way in response to a unit increase in entry fees as they do to a similar increase in other costs, we can make use of the sensitivity to variations in the latter to infer the sensitivity to variations in the former. This estimated sensitivity can then be used in, for example, the calculation of consumer surplus as a measure of the use-value of the park, or in the simulation of the effects on the number of park-visits of policy shocks which affect the park-entry fee.

As the name of the method suggests, the other costs are largely travel costs which vary across individuals although the term "travel costs " is interpreted broadly to include costs such as food and accommodation as well as the park entry fee. There are two basic versions of the TCM, one of which uses individual records on travel costs (the Individual Travel Costs Method, ITCM) and the other of which aggregates visitors according to zones of origin (the Zone Travel Cost Method, ZTCM).

The ITCM is most suited to the situation where many respondents are multiple users of the facility during the period being analysed. If this is not the case the dependent variable in the demand equation (the number of trips per respondent) is the same for all or nearly all respondents which makes the demand curve difficult or impossible to estimate. Since in the data used in the present analysis repeat visits during the survey period are rare we use the ZTCM.

In the ZTCM the survey respondents are grouped into several zones of origin depending on distance from the park, the idea being that travel

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[4] This follows from a standard household maximization problem where the cost of park-entry will be simply a component of the overall cost per visit to the park.

costs will vary systematically with this distance. The dependent variable in the regression in this case is the visitor rate, i.e. the proportion of the zone population which has visited the facility during the survey period. It is predicted that the visitor rate will be inversely related to the average cost of travelling from the zone to the facility. Average travel costs are calculated for each zone on the basis of the survey-responses. Finally, it is assumed that the sensitivity of the visitor rate to a unit change in travel costs is also the sensitivity of the visitor rate to variations in the park entry fee. Then combining this sensitivity and the zone populations we can predict the effect on visitor numbers of changes in park entry fees.

2.2.2 Existing travel cost data

Certain travel-cost data for some Tasmanian national parks was available to us at the commencement of this study. This data was collected in a sample survey of nine Tasmanian PWS sites conducted by the PWS in two sessions in January 1999 and March/April 1999. A component of this survey comprised additional questions designed by the Centre for Regional Economic Analysis (CREA). The data collected in this component was chosen principally to enable an assessment of the economic contribution of the PWS sites to the economy of Tasmania. However, the questionnaire elicited sufficient information to allow a TCM analysis of some of the PWS sites surveyed.

Details of the 1999 survey can be found in Annex I of Thapa, *et al*. (2000), while the CREA component of the questionnaires are provided in Annex II of that publication. Only brief details are given here. The PWS survey involved two parts, an interview and a mail-back questionnaire. While 3,862 respondents were interviewed, only 1,713 were handed the CREA questionnaire (the remainder took an alternative PWS questionnaire or refused to take any form home). Only 1,002 CREA questionnaires were returned. As the returns were spread over nine PWS sites the number of returns for any one site was quite low. Only Lake St Clair with 258 returns and Freycinet with 200 returns had a sufficient sample size to contemplate carrying out any TCM analysis.[5]

[5] The next highest number of returns were for Cradle Mountain (184) and Mount Field (106).

The main travel-cost data collected by the survey were home postcode or home country (from the PWS interview), amount spent on trip (by commodity groups), trip time (by major travel legs), other purposes of trip (including other PWS sites, by site), main reason for trip, annual income (group) and opportunity cost of time.

2.2.3 Travel-cost survey

Given the low sample size for the 1999 PWS survey it was necessary to undertake further work for the current project. Initial analysis of the 1999 data was undertaken in order to ascertain where best to place the current study's survey resources. The nature of possible additional surveys was also constrained by the time surveying had to be completed and the sites for which PWS park rangers were available to distribute survey forms.

It was decided that the additional travel-cost survey should be restricted to just two sites. These were Freycinet National Park on the east coast and Mount Field National Park in southern Tasmania. Both of these sites had the required park rangers during the survey period. Freycinet is one of the most popular of the PWS sites[6] and visited by a high proportion of inter-state and overseas visitors. Mt Field is also a very popular site, with visits continuing into the winter as a result of the park including Southern Tasmania's main skiing site and an all-weather rainforest walk at Russell Falls.

While there were certain obvious advantages in leaving the questionnaire unchanged from the 1999 form, except for the addition of one or two questions from the PWS interview, it was decided to review all questions in the light of experience with the 1999 survey. Given that the new survey form was to be merely handed out to park visitors without the interview step, it was decided that there would be an improvement in response if the form were more streamlined. Questions unnecessary for the TCM study were removed, and certain questions were reworded to improve their clarity. Copies of the

[6] There were an estimated 170,000 visitors to Freycinet in 1998/99. Estimates for other popular sites were Cradle Mountain (185,000), Mount Field (141,000) and Lake St Clair (105,000). See Thapa *et al.* (2000) Table 2.2.

questionnaires for the Freycinet and Mt Field sites are provided in Appendix A.

Due to the one-year nature of the TCM project, surveying could only be undertaken over a few months. Also it was not possible to commence surveying until April. The survey forms were distributed at Freycinet over a four-month period from April to July 2000. A smaller daily visitor rate at Mt Field in those months meant that it was necessary to extend the survey period for that national park until October 2000.

The CREA survey forms were handed out to all visitors to these two parks over the specified survey period by the PWS park rangers at the time that visitors entered the park. One form was distributed to each car. The survey form elicited travel cost information at the level of an individual or a travel group, where the latter was defined as a number of persons travelling together in a single vehicle, who were sharing costs and who usually resided in the same postcode area.

Survey forms were issued with a pre-paid addressed envelope. Around 8,000 forms were handed out at each site. The response rate was low and compared very unfavourably with the response rates for the 1999 survey of 64 per cent at Freycinet and 49 per cent at Mt Field.[7] Out of approximately 8,000 forms distributed at Mt Field approximately 1,000 were mailed back, and 984 of these were in a useable form (i.e. contained sufficient valid responses). There were also around 8,000 forms distributed at Freycinet and 856 forms with valid responses were returned. The overall valid response rate was only 11.5 per cent of all survey forms distributed.

Table 1 gives a summary of the number of visitors, broken down by their normal place of residence, for the number of people recorded in the valid survey forms returned for each survey site. In the 984 valid forms received from Mt. Field, there were a total number of 1,896 persons (including children) recorded as visitors to the site over the 7-month survey period (April to October). Approximately one third of these (642 out of 1,896)

[7] The 1999 response rate are for those who, after the initial interview, agreed to also take a mail back form with additional questions. At Freycinet 5 per cent refused to be interviewed and 17 per cent of those interviewed refused to take home a form. The corresponding Mt Field numbers were 9 per cent and 9 per cent.

were Tasmanian residents, the overwhelming majority of whom were from the Greater Hobart area. About 12% of the visitors to Mt Field were from overseas countries. For Freycinet, the valid survey forms recorded a total number of 2,009 visitors over the 4-month survey period. About 19% of this total were Tasmanian residents (375 out of 2009) while another 12% were from overseas.

Table1: The Number and Place of Origin of Visitors Recorded in the Survey

ZONE/ORIGIN	VISITOR NUMBERS	
	MT FIELD NP	FREYCINET NP
ACT	23	8
NSW-country	95	144
NSW-capital city	172	259
Queensland –country	45	56
Queensland – capital city	56	77
SA - country	40	32
SA – capital city	108	72
Tasmania- Greater Hobart	511	212
Tasmania – Mersey Lyell	18	46
Tasmania – Northern	32	100
Tasmania –Southern	81	17
Victoria – country	138	155
Victoria – capital city	250	440
WA – country	21	20
WA –capital city	58	63
Overseas	248	308
TOTAL	**1896**	**2009**

2.2.4 Implementing the TCM

In this section we discuss some general issues which had to be resolved in applying the TCM to Tasmanian national parks and then describe the variables used in the econometric analysis in detail. The first issue is the choice of zone size. There is a conflict in this choice between having a few zones with many observations in each or relatively many zones with few observations in each. The former provides too few degrees of freedom in the subsequent econometric analysis and the latter provides many observations with relatively large sampling errors and therefore noisy observations. The survey records had information on postcodes of the respondent's home address so that the most disaggregated zones that could be used correspond to postcodes. However, this provides too few observations per zone; indeed many Australian postcodes had no visitors at all. This was clearly too disaggregated. We therefore experimented with two alternative definitions. The first defined a zone for each of the mainland States (including the ACT), one zone for all overseas visitors and four zones for Tasmania, giving 11 zones. The alternative was to split each of the mainland States (but not the ACT) into two zones – the capital city area and the remainder. This scheme provided observations for 16 zones with a reasonable number of observations in each zone for at least some of the parks.

The second problem which had to be addressed was that of jointness of travel costs. This affected the data in two dimensions. First, there was the problem that many visitors travelled in groups and cost data were reported only for the group, since in most cases the members of the group shared costs. Second, the survey collected only trip costs and many trips had multiple objectives. Thus there was jointness in costs of various activities carried out during the one trip. There is some argument in the literature that the relevant cost in the case where joint costs are incurred is that of marginal costs.[8] However, in the case of jointly incurred group costs it is not clear what the marginal unit is (and whether this is the relevant costs from the point of view of household decision-making) and in the case of joint costs for multiple activities, sufficient information to calculate marginal costs was not available. We, therefore, used an average cost measure in each case. The relevant cost for members of a group was the average across all members of the group and the cost attributable to visiting a particular attraction was a share of the total trip cost, where the share depended in the proportion of the total trip time used for visiting the facility, including travel time.

[8] See, e.g., Cheshire and Stabler (1976)

Consider now the definitions of the variables used in the regression analysis. In all equations estimated the dependent variable was the zone visitor rate calculated as the number of visitors (including children) divided by the zone population. To calculate the zone population, we took the population of all the postcodes in the whole of the zone rather than only those postcodes from which visitors actually came. Zone population figures were obtained from ABS census data.

In each case the explanatory variable was the cost per person attributable to visiting the facility in question. This was calculated as the total trip cost for the group divided by the number of persons in the group multiplied by the proportion of the trip allocated to visiting the particular park being analysed. In the base case the cost of time was not included.

We also analysed a number of variations on the base case for each park. One variation was to include the cost of time in the total cost rather than only out-of-pocket costs. The cost of time was calculated in two alternative ways – at an hourly opportunity cost rate obtained from the survey and at the hourly equivalent of the respondent's annual income.

Another variation was to adjust costs for obvious outliers. An important source of outlying costs was that some respondents reported a very long time travelling from the previous facility, indicating a misinterpretation of the question. This, particularly for large groups, increased the proportion of total costs attributable to the park in question and therefore the value of the cost variable. The travel times were adjusted to either the average for the zone or an arbitrary maximum of 24 hours.

A third variation on the base case was to calculate the travel cost independently of the respondent's cost information. This follows an observation by Crombie (1996) that information provided by respondents on their costs was highly unreliable and in many cases implausible. Thus as an alternative we calculated travel costs directly on the basis of distance of the respondent's home from the facility and outside travel costs per kilometre. We also experimented with this approach and found that both approaches produced comparable results, providing us with some assurance of the plausibility of our cost data. More details are provided below.

A fourth variant was to disaggregate costs into endogenous and exogenous costs. This follows an argument in a recent paper by Fix *et al*. (2000) that a failure to distinguish between endogenous and exogenous costs biases the estimate of the crucial sensitivity parameter. The data allow us to disaggregate costs into a number of categories and we assume that some are taken as parameters by the household making the travel decision while other costs are themselves the outcome of this choice process and, therefore, should not be used as explanatory variables in the travel demand equation.

2.3 The FEDERAL Model

While the econometric component of the present study uses the TCM to ascertain the sensitivity of national park visits to a change in the entry fee, and the use-value of the two national parks, another method is required to study the wider economic impact of national park visits. The method used for this latter task involves simulations with a two-region version of the FEDERAL model, with the two regions identified being Tasmania and the rest of Australia (or RoA).

FEDERAL is a large-scale computable general equilibrium (CGE) model of the Australian economy and its regions. A defining feature of the FEDERAL model is its detailed treatment at the regional level of the behaviour of economic agents. Five broad types of agents are identified in each region. Firms are assumed to maximize profits, a representative household in each region is assumed to maximize a utility function subject to an income constraint, and investors are assumed to allocate available investment among regional industries on the basis of their rates of return. Government demands are determined so as to balance government budgets (at given tax rates) in the reported simulations.[9] Demands by foreigners for goods sourced from a region are assumed to be inversely related to the foreign currency supply price of the goods. Markets are assumed to be competitive and demand and supply are equated for all commodities, and regional industry capital stocks and land. In the

[9] Except for the RoA government which balances its budget by changing its payroll tax rate.

long-run simulations reported in this study, the aggregate level of employment for Australia as a whole is assumed to be unaffected by changes in the level of expenditure on Tasmanian national parks.
Interaction between regions, and with the rest of the world, is modelled via a complex pattern of trade flows, migration, capital ownership, taxes and transfers, and intergovernmental grants. Economic agent's decisions are affected, inter alia, by changing patterns of demand, relative prices, tax rates, changes in technologies and tasks, and resource constraints. The model simulations provide results for the output of fifty industries, household consumption, investment, employment by occupational skill categories, tax revenue, government expenditure, exports, imports, price levels and numerous other variables for each of the two regions and for the nation as a whole.

A more substantial overview of the FEDERAL model can be found in Madden (1996). For a full description of the model see Madden (1989 and 1992).

The detail and size of FEDERAL makes it a very adaptable model, suitable for addressing a wide range of questions. Over the last 12 years FEDERAL has been put to work on many topics such as tax policy, fiscal federalism issues, major resource developments, transport policy and electricity pricing. A tourism version of the Tasmanian version of the model has been used to analyse the contribution of the industry to the state. In 1999 a special version of the model incorporated three national-park-tourism-related industries into the Tasmanian component of the model. It is that version of FEDERAL which is employed here. Details of the PWS version of the model can be found in Thapa *et al*. (2000).

3. DEMAND FOR TASMANIAN NATIONAL PARKS

3.1 Introduction

In this chapter we provide details of our results for the economic estimation of the demand functions for three national parks: Lake St Clair, Freycinet and Mt Field. The Lake St Clair estimates were undertaken on the basis of the 1999 survey, while the estimates for the other two parks were undertaken with data from the 2000 survey. The interested reader can find a discussion of earlier estimates that we undertook for these latter two parks on the basis of the 1999 data, in Appendix B.

3.2 Lake St Clair National Park

Case 1: 11 zones, total costs

In this case we used data based on 11 zones (one for each of the mainland States, including the ACT, four Tasmanian zones and one overseas zone). The estimated linear demand equation is as follows:

(1) $VR_i = 187.86 - 0.6223\,C_i$, $R^2 = 0.2044$
(3.18) (1.52)

where VR_i is the visitor rate for zone i and C_i is the cost per person attributable to Lake St Clair. Figures in parentheses are t-ratios. The value of R^2 is low and the slope coefficient is only marginally significant but it is of the expected sign. A plot of the data shows that the observation for the ACT is a very substantial outlier. We experimented with various ways of dealing with this. An examination of the underlying data showed that a large group of visitors had obviously misinterpreted a crucial question on the survey form – a group of five claimed to have taken 144 hours travelling from their previous destination to Lake St Clair which is greatly in excess of any others and completely dominates the ACT observation as well as making it quite out of line with that of other zones. We therefore used adjusted cost figures based on a limit of 24 hours travel from the previous destination and to the next destination. We made similar adjustments to the data for all zones except the overseas zone. The estimated equation based on the adjusted costs is:

$$\text{(2)} \qquad VR_i = \underset{(3.96)}{2690.00} - \underset{(2.50)}{1.8943}\, AC_i, \qquad R^2 = 0.4058$$

where AC_i denotes adjusted cost for zone i. Clearly the equation fits much better and the slope coefficient is significant at the 1% level. The magnitude of the coefficient has changed considerably. The magnitude of the coefficient is similar to that obtained when the ACT observation is omitted altogether and so seems more plausible than that in the previous equation.

We also experimented with a cost figure based solely on distance from the origin of the trip to Lake St Clair. Appendix C provides details of its calculation. It follows arguments in Crombie (1996) who found that costs given by survey respondents were implausible and often inconsistent. He therefore discarded his survey data on costs altogether in favour of a cost figure based on distance and externally provided costs per kilometre. When we used a similar method for our analysis, we obtained the following results for the 11-zone case:

$$\text{(3)} \qquad VR_i = \underset{(4.43)}{220.78} - \underset{(2.71)}{0.1756}\, DCi\,, \qquad R^2 = 0.4489$$

where DC_i represents the cost per person based on distance rather than the respondent's information. Clearly the value of R^2 and the t-ratio for the slope coefficient are comparable to those for the previous equation. The magnitude of the slope coefficient is, however, quite different but this is almost certainly accounted for by the fact that the magnitude of DC has not been adjusted by the proportion of the total trip time attributable to visiting Lake St Clair. This proportion is of the order of 10% on average although it varies from zone to zone. Adjusting the coefficient by this rough adjustment would provide a coefficient magnitude of a similar size to that obtained when using AC. Hence, in contrast to Crombie, we find that the two methods give similar results. This gives us more confidence in the adjusted cost figures, AC, and we proceed with the use of them rather than continuing with the distance-based cost estimates.

A RESET test for functional form for equation (2) showed significant evidence of non-linearity. It is not uncommon, in view of this, to estimate these equations in semi-log form and we experiment with this next:

(4) $$VR_i = 729.17 - 149.78 \ln(AC_i), \quad R^2 = 0.5782$$
$$(4.17) \quad (3.51)$$

The value of R^2 indicates a better explanatory power compared to equation (2), as does the higher t-ratio on each of the coefficients. The non-linear form is therefore statistically superior to the linear form. It provides an estimate of the effect of a unit change in AC on VR at the sample mean for AC of –2.0921 (=-149.78/71.594 where 71.594 is the sample mean of AC) which is quite similar to the slope coefficient in equation (2). Thus equation (4) is our preferred equation for this case. We now proceed to assess the sensitivity of these results to some of the assumptions underlying the construction of the variables.

Case 2: 16 zones, total costs

We consider first the effect of changing the number of zones from 11 to 16 where we now have two zones for each of the mainland States (except the ACT), one including all the postcodes for the capital city area, following the ABS's classification, and the other the remainder. In linear form with unadjusted costs, we estimated the following equation:

(5) $$VR_i = 147.75 - 0.4988\, C_i, \quad R^2 = 0.1414$$
$$(3.18) \quad (1.52)$$

which is similar to the results for the corresponding 11-zone case; the slope coefficient is marginally significant and of the "correct" sign but R^2 indicates a modest level of explanation of the variation in the visitor rate. Thus it appears that moving to the greater number of zones has not introduced a substantial amount of noise into the observations. Also in this case there a two substantial outliers and if we adjust the costs as previously, we obtain:

(6) $$VR_i = 195.14 - 1.2941\, AC_i, \quad R^2 = 0.2666$$
$$(3.70) \quad (2.26)$$

which is similar to that for the 11-zone case although of poorer statistical quality, reflecting the greater noise in the observations. Non-linearity was also evident in this case so that the equation was re-estimated in semi-log form:

$$(7) \qquad VRi = 573.01 - 115.89 \ln(AC_i), \quad R^2 = 0.4197$$
$$(3.76) \qquad (3.18)$$

which implies a value for $\partial VR_i/\partial AC_i$ of –115.89/77.26 = -1.4885 at the sample mean of AC which is of a similar order of magnitude to that derived from the linear form of the equation with adjusted costs as the explanatory variable. Thus both forms of the equation produce similar slopes but the statistical quality of the semi-log form is better, as in the previous case.

Thus, on the whole, the results from the 16-zone data are similar although the explanatory power of the equation is slightly less, reflecting greater sampling variability. The magnitudes of the slope coefficients are similar although the absolute value is somewhat lower for the 16-zone case.

Case 3: 11 zones, disaggregated costs

We now turn to the use of extra cost information. The equations estimated so far are based on a cost figure which includes all costs included in the survey. The cost categories covered are the following 13: package costs, air-ticket costs, ferry costs, hire-car costs, petrol costs, coach costs, other travel costs, accommodation costs, food and drink costs, entrance fees, personal items, gifts and souvenirs, social activities and other expenditure. We begin by aggregating these into five categories, viz. travel costs being the sum of the first seven categories (package costs,…, other travel costs), accommodation costs, food and drink, entry fees and other (comprising the last four categories (personal items,…, other expenditure). We then distinguished between endogenous and exogenous costs following the terminology of Fix *et al*.(2000) where endogenous costs are those which are largely subject to consumer choice and exogenous costs are those necessarily incurred if the trip is undertaken. There are clearly elements of both in all the categories so that a tight distinction is not possible. Nevertheless, we experimented with the allocation of travel costs and entry fees to the exogenous category and the food, accommodation and other costs to the endogenous category, reflecting the judgment that the latter are subject to greater choice than the former.

Then the argument of Fix *et al*. is that only exogenous costs ought to be included in the explanatory variable since the endogenous costs will themselves be a function of exogenous costs and so their inclusion will bias the coefficient on the exogenous cost variable. In the case with 11 zones, we have the following estimated equation if we include only exogenous costs, EXC:

$$(8) \qquad VR_i = \underset{(3.66)}{203.63} - \underset{(2.00)}{1.5017}\ EXC_i, \qquad R^2 = 0.3085$$

The relevant comparison is with equation (1), the levels equation using unadjusted costs for 11 zones. Clearly, excluding endogenous costs improves the statistical quality of the equation: both R^2 and the t-ratio for the slope have increased substantially. We can test the specification more formally by including both EXC and endogenous costs, ENC, in the same equation in which case we get:

$$(9) \qquad VR_i = \underset{(4.23)}{202.57} - \underset{(2.75)}{4.7147}\ EXC_i + \underset{(2.02)}{3.4644}\ ENC_i, \qquad R^2 = 0.5427$$

The inclusion of both costs has increased the value of R^2 and resulted in all three coefficients being significant. However, the coefficient of the endogenous component is of the wrong sign. Hence, although it is significant its sign is inconsistent with theory underlying the TCM. Further, the restriction implied in the use of total costs, that the coefficients of the two components are equal is rejected at the 5% level. Indeed we cannot reject the hypothesis that the coefficients are of equal magnitude but opposite sign at the 5% level. Finally, presuming that equation (8) is the correct form, the inclusion of both components of cost separately greatly distorts the coefficient of endogenous costs although the distortion is not so great when compared to the equation where total costs are used as a single variable, equation (1) above.

An inspection of the plot of V against C indicates large outliers, particularly for the ACT. After adjustment of the cost variable as described above, we obtained the following using just exogenous costs:

$$\text{(10)} \qquad VR_i = \underset{(5.47)}{279.49} - \underset{(3.72)}{4.1893}\ AEXC_i\ , \qquad R^2 = 0.6055$$

where the adjustment has resulted in a substantial improvement in the fit of the equation – we are now able to explain over 60% of the variation in V. Note, though, that the magnitude of the coefficient of the cost variable has increased considerably following the adjustment. Hence the adjustment is very important for the value of the slope coefficient. The inclusion of both endogenous and exogenous costs again results in the endogenous cost variable having the wrong sign and we can reject the hypothesis that the cost variables have equal coefficients.

A test of equation (10) for appropriate functional form using a RESET test shows that there are significant non-linearities so that we re-estimated the equation in log form:

$$\text{(11)} \qquad VR_i = \underset{(7.51)}{528.82} - \underset{(6.02)}{125.62}\ \ln(AEXC_i), \qquad R^2 = 0.8008$$

There has been a considerable increase in explanatory power both in comparison to the level form of the equation with adjusted exogenous costs, equation (10), and to the log form of the equation with total costs, equation (4). A RESET test applied to equation (11) indicates no problem with functional form and the equation produces a value for $\partial VRi/\partial AEXCi$ of –3.3928 at the sample mean for AEXC. If the adjusted endogenous cost variable is added to equation (11) its estimated coefficient is of the wrong sign and insignificant thus providing further support for the form of equation (11).

Case 4: 16 zones, disaggregated costs

Recall that the move to 16 zones involves splitting each of the mainland State observations into two, one for the capital city area and the other for the remainder. If this is done using only exogenous costs, we obtain the following estimated equation:

$$\text{(12)} \qquad VR_i = \underset{(3.61)}{161.26} - \underset{(1.97)}{1.1508}\, EXC_i, \qquad R^2 = 0.2173$$

where we have achieved some increase in explanatory power compared to the 16-zone total cost equation, (5), and the slope coefficient is significant and of the correct sign. The addition of an endogenous cost variable to equation (12) results in this added variable being insignificant and of the wrong sign. If we adjust the cost variable as before to remove implausible values for travel time to and from the facility, we obtain the following:

$$\text{(13)} \qquad VR_i = \underset{(4.47)}{205.61} - \underset{(2.93)}{2.6297}\, AEXC_i, \qquad R^2 = 0.3802$$

thus achieving a considerable improvement in explanatory power and in the size of the t-ratio for the slope coefficient. The application of a RESET test to equation (13) indicates significant functional-form problems and, as in previous cases, we re-specify the cost variable in log form:

$$\text{(14)} \qquad VR_i = \underset{(5.47)}{419.70} - \underset{(4.40)}{96.494}\, \ln(AEXC_i), \qquad R^2 = 0.5808$$

which represents an improvement in statistical quality and, when tested, proved to be free from functional-form mis-specification. The value of $\partial VRi/\partial AEXC_i = -2.298$ at the sample mean of AEXC which is of a similar magnitude to that obtained from the corresponding levels equation, (13). The addition of the log of the endogenous cost variable to equation (14) produced an insignificant coefficient and the wrong sign thus pointing to equation (14) as the preferred form of the equation.

Case 5: 11 zones, aggregated costs with group size correction

There is reason for concern that the group size underlying the calculations above may be affected by mis-interpretation on the part of many respondents of the question regarding group size in the 1999 survey form.[10] In particular, some respondents appear to have been confused as to whether the person answering on behalf of the group was included in the group or not. In the calculations above it was assumed that they were not, so that one person was added to arrive at the number for the group size. However, this resulted in almost no groups of two whereas casual observation suggests that there should be a good number of these. Some checking of group size was possible from other information in the survey responses. More details are provided in Appendix C of Groenewold (2000). Such a check suggests systematic bias in the calculation of group size on the basis of the 1999 questionnaire and we experimented with costs and visitor rates calculated using alternative estimates of group size. This was done only for the 11-zone aggregate cost case and we obtained the following equation using unadjusted costs and an equation in levels form:

$$(15) \qquad VRN_i = \underset{(3.17)}{155.01} - \underset{(1.63)}{0.4437}\, CN_i, \qquad R^2 = 0.2279$$

where VRN and CN are the counterparts to V and C but using the new group-size figures. Equation (15) should be compared to equation (1) which is the corresponding equation with the original group size. Clearly the equations are quite similar although the new equation is somewhat better in statistical terms. The estimated slope coefficient is smaller when the new group sizes are used. The equation with adjusted costs and new group sizes is as follows:

$$(16) \qquad VRN_i = \underset{(4.17)}{224.17} - \underset{(2.79)}{1.3265}\, ACN_i, \qquad R^2 = 0.4631$$

where the relevant comparison is with equation (2) which shows that here too the statistical quality of the equation is slightly improved by using the new group sizes and that the magnitude of the slope

[10] The question was revised for the 2000 survey so as to remove this problem.

coefficient is has fallen. A plot of VRN against ACN shows some evidence of non-linearity suggesting the use of a semi-log form of the equation which produces the following estimates:

$$(17) \qquad VRN_i = \underset{(4.10)}{649.32} - \underset{(3.54)}{126.66} \ln(ACN_i), \qquad R^2 = 0.5814$$

A comparison to the corresponding equation based on the original group sizes, equation (4), shows a modest improvement in statistical properties of the equation and a fall in the absolute value of the slope coefficient. The value of $\partial VRNi/\partial CAN_i = -1.3101$ at the sample mean for CAN compared to a figure of –2.0921 based on the original group sizes.

Thus the method of calculating group size affects the statistical quality of the equation only marginally but has a more important effect on the estimate of the slope coefficient.

3.3 Freycinet National Park

As with the Lake St Clair estimates, various alternative forms of the variables were examined, as were different specifications of the visitor-rate equation and the different degrees of aggregation, both with respect to costs and with respect to definition of zones. As in the earlier exercise, it was found that the disaggregation into 16 zones (in preference to 11 zones), the use of exogenous costs (rather than total costs) and the log-linear form of the equation produced the best statistical results.

The preferred estimated equation explaining the visitor rate, VR, in terms of adjusted exogenous travel costs, AEXC, was as follows:

$$(18) \qquad VR_i = \underset{(3.82)}{1036.2} - \underset{(3.07)}{236.27} \ln(AEXC_i), \quad R^2 = 0.4019, \quad i = 1,\ldots,16$$

The implied value of $\partial VR/\partial AEXC = -5.5462$ at the sample mean of AEXC. This is somewhat higher than estimates from a similar equation using the 1999 data for Freycinet; see equation (27) of Groenewold (2000), p.15 which has an associated response of VR to a unit change in AEXC of –2.5712, less than half of that above. The statistical quality of the estimated equation is adequate – the estimated coefficients are both significant at the 1% level, the value of R2 is reasonable (although less than for the comparable equation estimate from the earlier data set) and the slope of the coefficient has the expected sign.

3.4 Mt Field National Park

Alternative forms of variables and different equation specifications and degrees of aggregation were again examined. However, the results for Mt Field were not so unequivocal as for the other national parks. The various alternatives are considered below.

We begin with a form of the equation which is identical to that used in the calculations for Freycinet: one using exogenous costs and a non-linear form. It explains the visitor rate, VR, in terms of the log of adjusted exogenous travel costs, AEXC, was as follows:

$$(19) \qquad VR_i = \underset{(2.52)}{2218.7} - \underset{(2.12)}{584.93} \ln(AEXC_i), \quad R^2 = 0.2435, \quad i = 1,\ldots,16$$

The implied value of $\partial VR/\partial AEXC = -20.9577$ at the sample mean of AEXC and elasticity of VR with respect to AEXC at the sample means is –1.4738. The statistical quality of the estimated equation is adequate – the estimated coefficients are both significant at the 5% level, the value of R^2 is acceptable (although markedly less than for the comparable equation estimated from the Freycinet data set) and the slope coefficient has the expected sign.

An inspection of the residuals suggests that the estimated equation is importantly dependent on two outliers – one for the Greater Hobart zone and one for the Southern Tasmania zone, both of which have very high visitor rates. It is possible that separate equations ought to be estimated for Tasmania and the remainder of the sample. If this is done for equations in non-linear form, the equation for non-Tasmania has a positive but insignificant slope. We therefore report instead equations in linear form. Using just the Tasmanian observations, we get:

$$(20) \qquad VR_i = \underset{(2.52)}{4975.8} - \underset{(2.12)}{309.79}\, AEXC_i, \quad R^2 = 0.5851, \quad i = 8,\ldots,11$$

and for non-Tasmania:

$$(21) \qquad VR_i = \underset{(1.31)}{66.893} - \underset{(0.02)}{0.0309}\, AEXC_i, \quad R^2 = 0.0001, \quad i = 1,\ldots,7,\ 12,\ldots,16$$

Thus both slopes are negative and although that for the non-Tasmanian case is insignificant, the relative magnitudes are plausible. The elasticities are –2.5797 and –0.0156, respectively.

An alternative formulation which produced superior results for the Mt Field data is an equation in linear form based on total rather than exogenous costs. Combining all 16 observations, we get:

$$(22) \qquad VR_i = \underset{(3.11)}{1306.0} - \underset{(2.42)}{15.742}AC_i, \quad R^2 = 0.2942, \quad i = 1,\ldots,16$$

Using just the Tasmanian observations:

$$(23) \qquad VR_i = \underset{(8.42)}{3582.0} - \underset{(5.82)}{60.923}\, AC_i, \quad R^2 = 0.9442, \quad i = 8,\ldots,11$$

and the non-Tasmanian observations:

$$(24) \qquad VR_i = \underset{(1.41)}{80.392} - \underset{(0.28)}{0.2235}\, AC_i, \quad R^2 = 0.0076, \quad i = 1,\ldots,7,\ 12,\ldots,16$$

The elasticities for these three equations are –2.2905, -1.5769 and –0.2206 respectively.

4. PARK FEES AND USE-VALUE

4.1 Introduction

In this chapter we first consider the effect on park visitor numbers of an increase in the cost of entry which increases the per person cost by \$1. This exercise is done just for the two parks surveyed in 2000, Freycinet and Mt Field. We then compute the consumer surplus for Freycinet national park. In view of the problems associated with the estimated demand functions for Mt Field, we did not compute an estimated value for consumer surplus for this site.

4.2 Response of visitor numbers to a \$1 rise in entry costs

4.2.1 Freycinet

Since the cost of entry into the park is part of the (adjusted) exogenous cost, AEXC, a \$1 increase in the entry fee per person will increase AEXC by \$1. The effect of this on the visitor rate is given by the coefficient of AEXC in the estimated equation. Given that the coefficient is negative, an increase in the entry fee will reduce the visitor rate. The fall in the number of visitors is then obtained by applying this predicted fall in the visitor rate to the zone populations on which the visitor rates are based.

When equation (18) is used for this purpose, the result is dominated by overseas visitors. This reflects the fact that the visitor rate for overseas visitors is very small but the travel costs are not so large as to be commensurate with this small visitor rate. Hence the predicted visitor rate is not as small as the actual and this, combined with the very large base population for this zone, results in a predicted number of visitors very much larger than actual. We therefore suppress this effect but include the overseas zone nevertheless (since it supplied approximately 15% of all visitors in the survey) by assuming that its proportional response to an increase in the entry fees is the same as the average for all other zones. Under these assumptions the following are the results, by zone, of an increase in the entry fee by \$1.

Table 2: The Effect on Freycinet Visitor Numbers of a $1 Increase in the Entry Fee

ZONE	VISITOR NUMBERS	
	ACTUAL	PREDICTED CHANGE
ACT	8	-5.3
NSW Country	144	-11.0
NSW City	259	-8.2
Vic Country	155	-4.4
Vic City	440	-8.6
QLD Country	56	-8.9
QLD City	77	-12.1
SA Country	32	-13.5
SA City	72	-1.5
WA Country	20	-1.0
WA City	63	-12.5
Tas. Greater Hobart	212	-4.1
Tas. Mersey Lyell	46	-1.8
Tas. North	100	-3.5
Tas. South	17	-0.8
Overseas	308	-17.6
TOTAL	**2009**	**-114.8**

Overall the equation predicts that there will be a 5.7% fall in the number of visitors resulting from a $1 increase in the entry fee. Note that the overall effect is very unevenly spread across the zones. This reflects both the different base populations of the zones and also the non-linearity of the relationship relating the visitor rate to travel costs which imply that a $1 increase in fees will have a larger effect the smaller is the total travel cost. Thus the effect on the number of visitors from country SA is very much larger than from city SA, both absolutely and proportionately. This reflects the higher per person travel costs obtained from the survey for the latter than for the former. The opposite is true for visitors from WA.

It is interesting that despite the non-linearity of the equation, the overall effect on visitor numbers is very similar to that obtained from evaluating the effect at the mean of AEXC. Thus, it was reported above that the partial derivative ∂VR/∂AEXC has a value of –5.5462 at the mean of AEXC which translates into a change in the number of visitors (excluding overseas) of -98.7 which, adding a fall of 17.6 from overseas makes for a total fall in the number of visitors of 116.3, which is very close to the total in Table 2. This suggests that the non-linearity of the equation is not very important, at least when it is used for the computation of the effects of a small change in the explanatory variable.

Finally, note that the fall of 114.8 in the number of visitors is relative to the number of visitors included in the survey. If we wish to estimate the effect on annual visitor numbers, we must multiply this effect by the number of annual visitors. From Thapa, *et al*. (2000) the estimated number of visitors to Freycinet in 1999 was 170,000 so that a 5.7% fall in visitors is translated into an annual fall of 9,714.

4.2.2 Mt Field

Again we consider the effect on visitor numbers of an increase in the cost of entry which increases the per person cost by $1. The effects corresponding to the various equations presented in section 3.4 are reported in Tables 3 to 6 below. In each case we have assumed that the effect on the number of foreign visitors is proportionally equal to the average of the other zones – this is to avoid the very large population base for the overseas visitors producing results which completely swamp those for other zones.

Table 3: The Effect on Mt Field Visitor Numbers of a $1 Increase in the Entry Fee Based on equation (19)

ZONE/ORIGIN	VISITOR NUMBERS	
	ACTUAL	PREDICTED CHANGE
ACT	23	-24.2179
NSW-country	95	-38.6247
NSW-capital city	172	-63.1639
Queensland – country	45	-19.6522
Queensland – capital city	56	-25.1916
SA – country	40	-14.8212
SA – capital city	108	-9.03908
Tasmania – greater Hobart	511	-11.8655
Tasmania – Mersey Lyell	18	-3.65526
Tasmania – northern	32	-6.60103
Tasmania –southern	81	-1.85589
Victoria – country	138	-10.0731
Victoria – capital city	250	-52.5659
WA – country	21	-49.5775
WA – capital city	58	-41.9177
Overseas	248	-56.1043
TOTAL	**1896**	**-428.927**

Table 4: The Effect on Mt Field Visitor Numbers of a $1 Increase in the Entry Fee Based on equations (20) and (21)

ZONE/ORIGIN	VISITOR NUMBERS	
	ACTUAL	PREDICTED CHANGE
ACT	23	-0.02148
NSW – country	95	-0.0724
NSW – capital city	172	-0.1156
Queensland – country	45	-0.03674
Queensland – capital city	56	-0.05806
SA – country	40	-0.03232
SA – capital city	108	-0.0118
Tasmania – greater Hobart	511	-58.8601
Tasmania – Mersey Lyell	18	-32.8377
Tasmania – northern	32	-40.2727
Tasmania – southern	81	-10.2231
Victoria – country	138	-0.0381
Victoria – capital city	250	-0.09696
WA – country	21	-0.01486
WA – capital city	58	-0.03844
Overseas	248	-21.4788
TOTAL	**1896**	**-164.209**

The noteworthy feature of these results is the relatively large effects for non-Tasmanian regions and the relatively small effects for the Tasmanian zones. Overall the equation predicts that there will be a 22.6% fall in the number of visitors resulting from a $1 increase in the entry fee. If we estimate separate equations for Tasmania and non-Tasmania, we obtain the results in Table 4 based on equations (20) and (21).

When we allow for separate elasticities for Tasmanian and non-Tasmanian zones, the effects are much more strongly concentrated in the Tasmanian zones and the overall effect is smaller – less than 9% compared to a fall of over 22% when a common elasticity is enforced.

If we estimate linear equations using total costs we obtain the results in Tables 5 and 6. The results in Table 5 are based on a single equation for all zones while those in Table 6 are derived from separate equations for Tasmania and non-Tasmania.

Table 5: The Effect on Mt Field Visitor Numbers of a $1 Increase in the Entry Fee Based on equation (22)

ZONE/ORIGIN	VISITOR NUMBERS	
	ACTUAL	PREDICTED CHANGE
ACT	23	-10.9407
NSW – country	95	-36.8835
NSW – capital city	172	-58.8908
Queensland –country	45	-18.7172
Queensland – capital city	56	-29.5792
SA – country	40	-16.4661
SA – capital city	108	-6.01344
Tasmania – greater Hobart	511	-2.99098
Tasmania – Mersey Lyell	18	-1.66865
Tasmania – northern	32	-2.04646
Tasmania – southern	81	-0.51949
Victoria – country	138	-19.4099
Victoria – capital city	250	-49.3984
WA – country	21	-7.5719
WA – capital city	58	-19.583
Overseas	248	-42.2382
TOTAL	**1896**	**-322.918**

In this case the overall change is approximately 17% of total which is smaller than that in Table 3 but considerably larger than effects based on separate equations. The effects are heavily concentrated in non-Tasmanian zones. If we split the zones into Tasmanian and non-Tasmanian zones but continue to use total costs (and a linear visitor rate equation) we obtain the effects reported in Table 6.

Table 6: The Effect on Mt Field Visitor Numbers of a $1 Increase in the Entry Fee Based on equations (23) and (24)

ZONE/ORIGIN	VISITOR NUMBERS	
	ACTUAL	PREDICTED CHANGE
ACT	23	-0.15533
NSW – country	95	-0.52366
NSW – capital city	172	-0.83611
Queensland – country	45	-0.26574
Queensland – capital city	56	-0.41996
SA – country	40	-0.23378
SA – capital city	108	-0.08538
Tasmania – greater Hobart	511	-11.5754
Tasmania – Mersey Lyell	18	-6.45784
Tasmania – northern	32	-7.91999
Tasmania – southern	81	-2.01046
Victoria – country	138	-0.27558
Victoria – capital city	250	-0.70134
WA – country	21	-0.1075
WA – capital city	58	-0.27803
Overseas	248	-4.79237
TOTAL	**1896**	**-36.6384**

Again, in this case we obtain very much smaller overall effects (less than 2% of total visitor numbers) which are concentrated in Tasmanian zones.

4.3 The Consumer Surplus Associated with Use of Freycinet National Park in 2000

To compute consumer surplus, CS, we need a demand function relating the number of visitors to the fee payable for entry into the park. This may be derived from the information we have in a number of ways.

First, we may assume that the demand curve is linear with its slope given by the effect of a $1 increase in the entry fee derived above and an intercept determined in such a way that the demand curve passes through a point corresponding to the known entry fee and visitor numbers in the survey period. This method was not used since all the empirical work points to a strongly non-linear relationship between visitor numbers and travel costs (of which the entry fee is a part). While the non-linearity may be relatively unimportant for small changes in the entry fee, the calculation of CS requires the integration of the entire demand curve in which case non-linearity can be expected to have an important effect on the final result.

Second, we may use the fact that V, the number of visitors, is equal to the visitor rate, VR, multiplied by the total source population, POP:

$$\begin{aligned} V_i &= VR_i . POP_i \\ &= POP_i \, [1036.2 - 236.27 \ln(AEXC_i)] \end{aligned}$$

using the estimated VR function. Then use the fact that

$$AEXC_i = F + NFC_i$$

where F denotes the entry fee and NFC_i represents the non-fee cost of travel from zone i, to write:

$$V_i = POP_i \, [1036.2 - 2236.27 \ln(F+NFC)]$$

which can then be linearised in terms of F and NFC, using a first-order Taylor's series approximation, after which POP and NFC can be set at their historical values to obtain a linear equation explaining V in terms of F, as required. However, this linear equation has the same drawback as discussed above and was not used.

The third way is to linearise the above equation for Vi in terms of ln(F) and ln(NFC). This will permit the calculation of CS while preserving the non-linearity of the relationship between V and F. This is the method used and we proceeded as follows. The function ln(F+NFC) is non-linear in ln(F) and ln(NFC) and can be linearised as follows, using a method derived by Campbell and Schiller (1987):

$$\ln(F+NFC) = A + (1-\mu) \ln(F) + \mu \ln(NFC)$$

where A is a constant to be determined and μ is given by:

$$\mu = 1/[1+\exp(\ln(F^*)-\ln(NFC^*))]$$

where F* and NFC* are the sample means of F and NFC respectively.

Since visitors from all zones pay the same entry fee, F*=F, so that the linearisation requires the computation of the entry fee per person. Unfortunately, this is not a straightforward matter since the entry fee per person depends on the type of entry pass which is purchased and the number of people in the group for which the pass is used. There are three types of pass – a day pass costing $9.00 for groups of up to 8 people and $3.00 for single visitors, a holiday pass (valid for up to two months) at a cost of $30.00 for a group of up to eight people and $12.00 for a single visitor, and an annual pass (valid for up to one year) costing $42.00 for a group of up to eight for all parks and $18.00 for a group for multiple entry to a single park. It is clearly impossible to calculate a single per person entry fee from this information and an approximation needs to be used. Various possibilities are available.

One is to use the average per person entry fee attributable to visiting Freycinet from the survey data since the survey asked respondents about expenditure on entry fees. The advantage of this approach is that it is in keeping with the way in which other costs have been calculated. It results in a figure of $2.21 per person which is plausible in the light of the structure of entry fees but probably on the low side given that many visitors visit the park only once in relatively small groups.

An alternative is to use our survey information on group size. If we take account of the average group size of 2.19 in our survey and assume that all groups entered by paying the $9.00 daily entry fee for a car (with up to 8 occupants) the result is a per person fee of $4.11 which is no doubt on the high side because some visitors will have used holiday passes or entered as single visitors.

A third method is to use the total amount spent on entry fees by those surveyed ($69,683), divided by the total number of people surveyed

[11] Prices quoted are pre-GST.

(2009). This, however, includes entry costs into venues other than the park in question so that we scale the resulting figure of $34.69 per person by using the ratio of total costs attributed to visiting Freycinet, the average "attribution ratio" for Freycinet of 0.1178 to get a figure of $4.08. This is comparable to the figure of $4.11 derived above. It is probably too high because visitors would have paid entry fees to venues other than national parks, but too low because the attribution ratio implies that the total entry fees paid would be spread over 8.5 venues during a trip which seems too high. Hence, we settle on a figure of $4 as being consistent with our data and with the structure of entry fees and average group size in the survey.

Returning to the linearised demand function above, we set F* = F = 4 and NFC* = AEXC* - 4, where AEXC* is the average of exogenous costs across the 16 zones. The demand function then has the form:

$$V_i = B - 435.5226 \ln(F)$$

where B is a constant to be determined. To determine B, we force the demand curve through the point (V,F) = (2009,4) where 2009 is the total number of visitors in the survey. The resulting numerical version of the demand function is then:

$$V_i = 2612.765 - 435.5226 \ln(F)$$

which we invert and integrate to get the following expression for CS:

$$CS = \int_0^{2009} \exp(5.9992 - (1/435.522)V_i)\,dV_i - (4)(2009)$$

Evaluating the integral produces the following figure for CS:

$$CS = \$167{,}476$$

which amounts to a figure of $83.33 per visitor which is of the same order of magnitude, although smaller than figures obtained by Fix *et al.* (2000). To convert this to an annual figure and to take account of the fact that only a small proportion of all visitors to Freycinet were surveyed, we can multiply the CS per visitor by the total number of visitors, which for 1999 was 170,000 (see Thapa *et al*., 2000) resulting in a total annual CS of $14,166,610.

The consumer surplus calculated above accrues to residents of the mainland states and visitors from overseas as well as to Tasmanian residents. It may be desirable for policy purposes to calculate separate consumer surplus figures for each of these groups of visitors. For this we can use the proportions of visitors from each of these composite zones from Table 2. They are as follows: Tasmania 0.19 (375/2009), mainland Australia 0.66 (1326/2009) and overseas 0.15 (308/2009). Applying these proportions to the aggregate annual consumer surplus figure of $14,166,610, we obtain the following values for each of the three composite zones:

Tasmania	$2,691,656
Mainland Australia	$9,349,962
Overseas	$2,124,992

5. THE IMPACT OF NATIONAL PARK VISITORS ON TASMANIAN ECONOMIC ACTIVITY

5.1 Introduction

In the previous chapter we examined the question of the impact on visitor numbers to a particular national park of a change in that park's entry fee. In this chapter we consider the question of the effects of national park visitor expenditure on the wider Tasmanian economy and the consequences for those estimated economic impacts of a general change in park entry fees.

This section of the report builds on previous economic modelling work we have undertaken on the contribution of the PWS estate to the Tasmanian economy (Thapa, *et al*., 2000). In the next section we outline the general approach taken to FEDERAL model simulations in both the previous and the current study. We then summarize the main results of our earlier simulations of the effects of expenditure by visitors to PWS sites on the Tasmanian economy. We then report on simulations of the effects of a general change in national park fees.

5.2 General Approach to the Simulations

In the FEDERAL model simulations, the treatment of the expenditure incurred by local Tasmanian visitors to PWS sites requires some additional adjustments. In the normal framework of the FEDERAL model, extra expenditure by Tasmanians on goods and services associated with visits to PWS sites in Tasmania will simply result in lower consumption expenditure on other categories of goods and services since household budget constraints have to be satisfied. This will mean that expenditure on visits to PWS sites by Tasmanian residents will have only a marginal impact on aggregate state economic activity. While the commodity composition of household expenditure will have changed, the aggregate level of household consumption expenditure on Tasmanian-sourced goods is likely to be largely unchanged. However, it is reasonable to assume that visits to PWS sites by Tasmanian residents act as a substitute, if only in part, for travel by Tasmanians to national parks and other holiday destinations on the mainland and, possibly, overseas. In the absence of the PWS sites in Tasmania, local residents would be inclined to travel to a greater extent to the mainland and other destinations for their holiday trips and this would reduce their expenditure on Tasmanian sourced-goods and services.

FEDERAL does not model substitutability between visits by Tasmanians to local national parks and parks in other states. To implement this substitution in the present simulations, we make a simple ad hoc assumption that approximately one-third of the expenditure made by Tasmanians in visiting PWS sites would have been diverted to the mainland, in the absence of the PWS sites in Tasmania.

The simulations reported here have been conducted under a "long-run closure" of the model, which is an appropriate closure for determining the enduring economic consequences of an ongoing and relatively stable activity such as visits to PWS sites. The chief characteristic of the long-run scenario is that economic actors have had sufficient time to adjust to the stimulus under examination. This is reflected in the model by a number of choices regarding the manner in which the values for certain variables are determined.

In particular, we allow the model to determine capital stocks in each industry on the basis of the demands for capital by those industries. The model determines real Tasmanian government and Commonwealth government consumption expenditure on the assumption that the net borrowing requirements of both governments will be unaffected by the simulation. Similarly, we allow the model to determine the average rate of payroll tax prevailing on the mainland, again given an assumption that aggregate mainland government borrowing requirements will be unaffected by the simulation. Real private economy-wide investment expenditure is determined by a requirement that the foreign currency balance of trade deficit remains unaffected by the simulation. The economy-wide real wage is determined by the model, and acts to ration a level of employment which is fixed at the national (Australia-wide) level. Labour, however, is free to move between regions in response to changes in regional labour market conditions.

5.3 Current Economic Impact of PWS Visitor Expenditure

Thapa *et al*. (2000) estimated the total tourist expenditure related to PWS visits in 1998/99 was $145.2 million. This was comprised of $20.5 million by overseas visitors, $111.6 million by interstate visitors, and $13.1 million by Tasmanian visitors.[12] The indirect economic effects of these expenditures were estimated using the FEDERAL model. The total effects on the Tasmanian economy are described below.

The main macroeconomic results are shown in Table 7. Thus real gross state product is estimated to be 1.26 per cent larger than it would have been if there were no expenditure associated with PWS site visits. This translates to approximately $126.2 million in extra wages, profits and rents in Tasmania. The contribution to Tasmanian employment was estimated as 1.11 per cent when measured in terms of hours and 2.16 per cent when measured in terms of persons employed. The latter percentage increase in employment translates to approximately 4,200 positions. Over two-thirds of these positions are in wholesale and retail trade, restaurants and hotels, and entertainment and recreation industries. These industries have a high proportion of part-time workers; while they account for approximately 12 per cent of all wages, they account for approximately 28 per cent of all persons employed.

The level of consumer prices in Tasmania is estimated to be largely unaffected by the level of PWS visitor expenditure. Tasmanian exports are estimated to be around 0.9 per cent higher than they would be otherwise. These extra exports are by way of foreign visitors' expenditure. Expenditure by interstate and intrastate PWS site visitors has a small negative effect on overseas exports, due to crowding-out effects on other industries.

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[12] Thus while intrastate visitors account for almost 45 per cent of all person trips they account for less than 10 per cent of total expenditure due to the much lower average expenditure of Tasmanian visitors compared with visitors from outside the State..

Table 7: Contribution of PWS Visitor Expenditure to Selected Tasmanian Aggregates

VARIABLE	OVERSEAS	INTERSTATE	INTRASTATE	TOTAL
In percentage change terms				
Real gross state product	0.19	1.05	0.02	1.26
Real consumption	0.08	0.47	0.05	0.60
Employment (hours)	0.16	0.92	0.03	1.11
Employment (persons)	0.30	1.74	0.11	2.16
Real private investment	0.28	1.59	0.02	1.89
Consumer price index	0.00	0.00	0.00	0.01
Real exports	1.01	-0.08	-0.00	0.92
In terms of level of change				
Gross state product ($m)	18.8	105.6	1.8	126.2
Real consumption ($m)	6.0	33.9	3.3	43.3
Employment (persons)	591	3,388	215	4,194
Real private investment ($m)	5.5	31.0	0.3	36.8
Consumer price index (% points)	0.0	0.00	0.00	0.01
Real exports ($m)	19.1	-1.5	-0.1	17.6

Detailed employment and value-added effects by 37 industries are shown in Tables 4.7 and 4.8 of Thapa, *et al*. (2000). The industries that are major beneficiaries of the PWS related visitor expenditure are restaurants and hotels, transport and storage, and entertainment and recreation. This reflects the commodity composition of visitor expenditures. By far the largest contribution is made to the activity of the restaurants and hotels industry. This industry is projected to be approximately 19% larger than it would otherwise be in the absence of such visitors. This translates to approximately 1,860 extra jobs and $ 49.1 m. of extra value added. The next major beneficiary is the entertainment and recreation industry, with an estimated extra 543 jobs, and $13.5 m. of value added. Wholesale and retail trade, and transport and storage are projected to gain 528 and 407 employed persons respectively. Value added is projected to be approximately $18 m. higher in the wholesale and retail trade sector, and approximately $22 m. higher in the transport and storage sector.

Section 4.4 of Thapa *et al*. (2000) provides a comparison of the part played by PWS-related expenditure in the overall economic contribution made by all tourism expenditure for all purposes in Tasmania. Direct tourism expenditure for 1998/99 was estimated at $745.9 million of which overseas visitors accounted for $85.5 million, interstate visitors accounted for $466.3 million, and Tasmanian travellers accounted for $194.1 million. The respective economic contributions are summarised in Table 8.

Thus according to Table 8, PWS visitor expenditure accounts for about a quarter of all tourism-generated jobs in Tasmania. PWS visitors share of tourism generated GSP is about a fifth, but its share of the estimated contribution to Tasmanian household consumption is between a sixth and a seventh.

Table 8: Contribution of PWS & Total Tourism Expenditure to Selected Tasmanian Aggregates

VARIABLE	PWS EXPENDITURE	TOTAL TOURISM EXPENDITURE
Real gross state production ($m)	126.2	633.4
Real consumption ($m)	43.3	294.1
Employment (persons)	4,194	15,783
Real Exports ($m)	17.6	66.5

Source: Thapa *et al.* 2000 (Table 4.12)

5.4 Economic Impacts of a Change in Tasmanian National Park Entry Fees

In estimating the economy-wide impacts of a change in park entry fees we need to make certain assumptions about the formation of demand for national park visits that were not required for our analysis in section 4.2.

The model simulations undertaken in this section are confined to those involving a general increase in park fees. It is assumed that park visitors, prior to commencing their journey, decide on the activities they will undertake while away from their usual place of residence. It is also assumed that those national-park tourists who have multiple-purposes for their trips wish to consume the broad trip activities in fixed proportions according to their individual tastes. This implies that an increase in park entry fees will not cause visitors to substitute, say, attending a business convention for bushwalking in a national park. However, an increase in park entry fees may discourage some visitors at the margin from taking the whole recreation experience that involves the national park visit(s). Also if the fee increases on one park and not on another similar park we assume that this could cause some substitution between parks.[13] However, as we are simulating only an across-the-board increase in park fees, this last point is of no practical relevance.

In order to strictly model the precise effects of a general Tasmanian PWS fee rise, we would need to have estimated visitor demand functions for all Tasmanian national parks. Here we undertake a largely illustrative experiment by assuming that the national park visitors' demand for the entire trip displays the same price responsiveness (own-price elasticity) as that estimated for Freycinet.

The predicted change for a $1 increase in the Freycinet entry fee is shown in Table 2 (Chapter 4). If we assumed that there was an increase in all other (non-park-visit-related) costs in proportion to the park fee rise, we could make direct use of Table 2. However, as this is not the case we must adjust the percentage increase in total trip costs by the share of costs associated with park visits. If all park visitors visited only one national park on any given trip, the appropriate attribution of costs for visitors from a particular zone would be that used in computing the cost per person visiting Freycinet from that zone. However, Thapa *et al*. (2000) note that the estimated average value for visits to multiple sites (for the nine PWS sites surveyed) on any single trip was 2.35 sites for overseas visitors, 2.31 sites for interstate visitors and 1.1 sites for Tasmanian visitors. The attribution rates for each set of zones were scaled up by the appropriate multiple-sites number to reflect more fully the total proportion of trip costs attributable to visiting national parks.[14]

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[13] The demand system thus described is similar to the nested choice of Australian tourism products, depicted in Figure 1 of Giesecke et al. (1997). In their case, there is a Leontief choice between broad tourism goods, but a CRESH function governing the choice between accommodation in different localities.

[14] This scaling indeed only captures the cost attributable to the surveyed parks

On applying the adjusted percentage changes in costs to the estimated Freycinet demand function, a new set of predicted changes in visitor numbers was computed by zone. The overall drop in the number of trips involving visits to Tasmanian national parks was estimated at only 6,945.

It will be noted that this is a smaller fall than was estimated for just the Freycinet national park in section 4.2.1. This reflects our assumption in this section that visitors make their decision on whether they take their trip before leaving home, and that they maintain the same expenditure pattern on broad classes of activities as before the price rise.

However, the effects on the Tasmanian economy of interstate and overseas visitors deciding not to come to Tasmania is likely to be considerably greater than a decision by them simply not to visit a single national park. The estimated gross fall in expenditure on national park related trips was $3.8 million or 2.6 per cent of total expenditure of this sort ($145.2 million; see Thapa *et al*. (2000), Table 3.2). Of this, the fall in overseas-visitor expenditure was $0.3 million, the fall in interstate-visitor expenditure $3.3 million and in Tasmanian visitor expenditure $0.2 million.

The across-the-board entry fee increase of $1 would result in an estimated net increase in PWS revenue of $0.84 million. Thus the net decrease in expenditure is estimated as $ 2.96 million, with overseas, interstate and Tasmanian visitor expenditure decreasing by $0.15 million, $2.76 million and $0.05 million respectively.

The estimated effects of these expenditure declines on the Tasmanian economy are presented in Table 9. As can be seen the impacts are small, with a total decrease in GSP of $2.8 million and a loss of 89 jobs in the State. These results should be treated with some caution and could be considered to be outside estimates. Two reasons lie behind this. Firstly the estimated elasticity for Freycinet was the highest for those sites for which demand functions were estimated, and secondly the assumption we have used that visitors choose broad components of expenditure in fixed proportions is very likely to be too strong an assumption.[15] If substitution between expenditure on broad classes of activity were allowed, the elasticity for Tasmanian trips, by those currently visiting PWS sites as part of their trip, would be lower.[16]

Table 9: Effect of $1 Across-the-board Increase in Tasmanian National Park Entry Fees on Selected Tasmanian Aggregates

VARIABLE	OVERSEAS	INTERSTATE	INTRASTATE	TOTAL
In percentage change terms				
Real gross state product	0.00	-0.03	0.00	-0.03
Real consumption	0.00	-0.01	0.00	-0.01
Employment (hours)	0.00	-0.02	0.00	-0.02
Employment (persons)	0.00	-0.04	0.00	-0.05
Real private investment	0.00	-0.04	0.00	-0.04
Consumer price index	0.00	0.00	0.00	0.00
Real exports	-0.01	0.00	0.00	-0.01
In terms of level of change				
Gross state product ($m)	-0.1	-2.6	0.0	-2.8
Real consumption ($m)	0.0	-0.8	0.0	-0.9
Employment (persons)	-4	-84	-1	-89
Real private investment ($m)	0.0	-0.8	0.0	-0.8
Consumer price index (% points)	0.0	0.0	0.0	0.0
Real exports ($m)	-0.1	0.0	0.0	-0.1

[15] Indeed our analysis also implies an assumption that a particular type of activity requires a fixed pattern of commodities. Again this leads to an estimated greater decline in Tasmanian economic activity than if substitution were allowed.
[16] However, the estimated decline in park visits by this group of travellers is likely to be greater in these circumstances, as other trip activities would be substituted for park visits.

6. CONCLUSIONS

The main purpose of this study was to estimate the value that visitors to certain Tasmanian national parks placed on those parks. The project employed a widely-used method for estimating the value of recreational sites to users of the sites. This method is known as the travel-cost method. Travel cost data was used from a previous study and supplemented by large-scale surveys of two Tasmanian national parks (Freycinet and Mt Field). A secondary component of the study was the modelling of the impact of a change in park entry fees on the number of park visitors and on the Tasmanian economy.

The major features of the travel cost study were:

- A survey was undertaken of visitors to two national parks; Freycinet National Park (April-June 2000) and Mt Field National Park (April-October 2000).

- Econometric applications of the travel cost method to the estimation of the demand functions for entry into the Freycinet National Park and Mt Field were undertaken using data from the above-mentioned survey. The TCM method was also applied to limited travel-cost data available from an earlier (1999) survey.

- The TCM enables the use of cross-section data with no variation in observed price to estimate the demand for park entry as a function of price, by observing that entry cost is just one component of the total cost of visiting the park and that total costs do vary across individuals.

- The particular variant of the TCM which we use, the zone TCM, is based on grouping survey respondents into several zones depending on the distance of the trip's origin from the park. Average data for zones are then used to estimate an equation in which the visitor rate (the proportion of the zone population which visits the facility) depends on the average cost of visiting the park from the zone in question.

- It is assumed that the sensitivity of the visitor rate to a unit change in travel costs is also the sensitivity of the visitor rate to variations in the park entry fee. Under this assumption the estimated sensitivities and the zone populations are combined to predict the effect on visitor numbers of changes in the entry fees.

- We experimented with various alternative forms of the variables used in the regression equations, different specifications of the visitor-rate equation and different degrees of aggregation, both with respect to costs and with respect to definition of zones.
- Usable responses for 856 groups (comprising around 2000 individuals) visiting Freycinet were used. The corresponding numbers for Mt Field were 984 groups (around 1900 visitors).

- Visitors surveyed were allocated into one of 16 zones: four for Tasmania, two for each of the mainland states, one for the ACT and one for overseas visitors.

For the Freycinet estimations:

- A distinction between endogenous and exogenous travel costs was made, with the former including costs which were subject to considerable choice and the latter subject to little choice once the decision to undertake the trip had been made.

- The preferred equation was one which was non-linear and related the visitor rate to the log of exogenous travel costs.

- The preferred estimated equation was used to predict the effect on visitor numbers of a $1 increase in the park entry fee. The overall effect was a fall of approximately 6% with the largest absolute falls being predicted for visitors from the Mainland states and overseas.

- The estimated equation was also used to compute the use value of the park based on a measure of consumer surplus. Calculations were based on visitor numbers in 1999 and produced a figure of approximately $14 million which is equivalent to $83 per visitor. Of the $14 million approximately $10 million was found to accrue to mainland visitors, and $2 million each to users from Tasmania and overseas.

For the Mt Field estimations:

- The relationship between the visitor rate and travel costs proved to be difficult to establish. Some evidence was found that the response of visitors from the Tasmanian zones differed considerably from that of Mainland and overseas visitors.

- A single preferred equation was not chosen but various alternatives were used to investigate the effect on visitor numbers of a $1 increase in the park entry fee. The results were found to be sensitive to whether separate equations were used for Tasmanian and other visitors and, to a much lesser extent, to the form of the equation. If different responses were permitted for Tasmanian and non-Tasmanian visitors, the overall effect of the fee increase was found to be a fall in visitor numbers of the order of 5%, with much of the reduction in visitors being those from Tasmanian zones. If a common equation was used for all visitors, the overall effect was much larger – of the order of 20% – with most of it being felt in visitors from the mainland states and overseas.

Expenditure by national park visitors has a significant impact on size of the Tasmanian economy. Real Gross State Product is estimated to be around $120 million higher than would be the case if no park users visited Tasmanian PWS sites. PWS tourism is estimated to contribute 4,200 full and part-time jobs to the Tasmanian economy.

A small across-the-board increase in park entry fees (by $1 per person-visit) is likely to have little adverse effect on the Tasmanian economy. An outside estimate of the negative effects on the Tasmanian economy was computed as a loss in GSP of $2.8 million and 89 jobs, a significant proportion of them part-time.

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APPENDIX A: THE SURVEY QUESTIONNAIRES

The survey questionnaires developed to collect travel-cost information from visitors to Freycinet and Mt Field national parks are provided in this appendix. The only difference of substance between the two forms relates to question 7.

THE UNIVERSITY OF TASMANIA

Centre for Regional Economic Analysis

Survey of
Visitors to Tasmanian Parks and Wildlife Reserves

SITE: FREYCINET DATE: / / 00

Thank you for taking the time to answer this questionnaire. Your replies will give the Parks and Wildlife Service important information on the areas they manage.

Please complete this form as soon as possible and post it in the post-paid envelope provided.

1. You can answer this form as an individual or on behalf of a group.

Persons travelling in a group which is sharing its expenses and living in the same postcode area (or the same country, if you are from overseas) may answer as a GROUP, otherwise you should answer as an INDIVIDUAL.

I am answering this form:

☐ As an individual (tick if yes)

☐ On behald of a group (tick if yes)

Please indicate below the NUMBER in your group (including yourself)

Number of Adults (18 years and over) ☐

Number aged 15-17 years ☐

Number aged 3-14 years ☐

Number under 3 years ☐

2. What is your (group's) home country? ☐

3. If you answered Australia to 2, what is your postcode? ☐

4. How long are you (your group) spending away from your usual place of residence?

	Months	Weeks	Days
On your entire trip away from home			
In the State of Tasmania (if you're not from Tasmania)			

5. What was the main reason for you (your group) visiting Freycinet?

Tick one box only

Day Walking ☐ Overnight walking/camping ☐ Fishing ☐

Picnic/socialising ☐ Sightseeing ☐

Other (please specify) ☐

6. Please list the main activities for which you came on this Tasmanian trip:

Please show TOTAL TIME involved in each major activity, including travelling time

	Time involved	
MAJOR ACTIVITIES:	DAYS	HOURS
Visiting Freycinet National Park		
Visiting other nature reserves/historic sites /buildings/museums		
General sightseeing		
Visiting friends and relatives / Social activities		
Sporting or special events		
Business / convention / education / training		
Other (please specify)		

In the next three questions we are seeking more detailed information on your visit to this site.

7.1 How long are you spending AT Freycinet National Park?

Please do not include travelling time ☐ *Days* ☐ *Hours*

7.2 How long are you spending just outside freycinet National Park (eg. Coles Bay, Swanwick?

Please do not include travelling time ☐ *Days* ☐ *Hours*

8. How long did you spend travelling TO Freycinet National Park from your previous location?

Your previous activity location is defined as the last place you undertook one of the major activities shown in question 6, or the place in Tasmania where you commenced your trip (if this is your first major activity).

☐ *Days* ☐ *Hours*

9. How much time will you/did you spend travelling FROM Freycinet National Park to your next acitvity destination?

Your next activity destination is defined as the next place you will undertake/undertook one of the major activities shown in question 6, or where you complete your Tasmanian trip (if no further major activities after this).

☐ *Days* ☐ *Hours*

10. How lmuch will you/did you (or your group) spend on the following items on your entire trip away from your usual place of residence?

Please indicate, as best as you are able to at the moment, the amounts you expect to spend for the entire time you (or your group) are/were away from home. If you cannot give separate amounts for each item, put a total estimate in the total box. Please note, if you are answering as an individual, you should show only your own expenditure, including just your portion of any shared expenditure

	Amount spent $ (Australian)*
Holiday package	
Air fares / ferry tickets	
Hire car rental fees	
Petrol and other motor vehicle expenditure	
Tours/ bus fares / taxis / other transport not shown elsewhere	
Accommodation	
Food and drinks	
Entrance fees	
All other expenditure (including personal items, gifts and souvenirs)	
Total amount (if details not known)	

* *If you give any expenditure in a currency other than Australian dollars, please indicate the currency used.*

The next question is a hypothetical one, but your answer will provide valuable information for analysis.

11. If someone had offered you an additional financial incentive to work instead of coming on this Tasmanian trip, what hourly rate (before tax) would they have had to pay for you to accept the offer?

Individuals *– please indicate your choice by putting the NUMBER, 1, in the appropriate box.*

Group representatives *– please show the NUMBER of persons in your group who chose each wage category. If you are a group representative filling out this form after the trip and can't contact one or more of your travelling companions, then you should include such persons in the "can't say" box*

Less than $20	☐	$20 - $30	☐	$31 - $40	☐	$41 - $50	☐
$51 - $100	☐	Over $100	☐	Can't say	☐		

No amount anyone could offer would be enough to stop me coming on this trip ☐

We should be grateful if you would answer the following questions relating to income. Please note that this information will be kept CONFIDENTIAL to staff of the Centre for Regional Economic Analysis. It will not be revealed to any Government Department, nor will it be shown to any other organisation or individual.

12. What is your approximate annual income?

Income refers to personal annual income form all sources before any tax is paid.

Individuals *– please place the NUMBER, 1, in the appropriate box.*

Group representatives *– please show the NUMBER of persons in each income category. If you don't know the income of some members of your group, include them in the "can't say" box.*

No income	☐	*$50,000 - $65,000*	☐
Less than $20,000	☐	*Above $65,000*	☐
$20,000 - $34,999	☐	*Can't say*	☐
$35,000 - $49,999	☐		

For further information on this questionnaire, please telephone Kaye on (03) 6226 2269

Thank you for completing this questionnaire. Please mail it in the attached post-paid envelope.

THE UNIVERSITY OF TASMANIA

Centre for Regional Economic Analysis

Survey of Visitors to Tasmanian Parks and Wildlife Reserves

SITE: MOUNT FIELD DATE: / / 00

Thank you for taking the time to answer this questionnaire. Your replies will give the Parks and Wildlife Service important information on the areas they manage.

Please complete this form as soon as possible and post it in the post-paid envelope provided.

1. You can answer this form as an individual or on behalf of a group.

Persons travelling in a group which is sharing its expenses and living in the same postcode area (or the same country, if you are from overseas) may answer as a GROUP, otherwise you should answer as an INDIVIDUAL.

I am answering this form:

☐ As an individual (tick if yes)

☐ On behald of a group (tick if yes)

→ *Please indicate below the NUMBER in your group (including yourself)*

Number of Adults (18 years and over) ☐

Number aged 15-17 years ☐

Number aged 3-14 years ☐

Number under 3 years ☐

2. What is your (group's) home country? ☐

3. If you answered Australia to 2, what is your postcode? ☐

4. How long are you (your group) spending away from your usual place of residence?

	Months	Weeks	Days
On your entire trip away from home			
In the State of Tasmania (if you're not from Tasmania)			

5. What was the main reason for you (your group) visiting Mt Field?

Tick one box only

Day Walking ☐ Overnight walking/camping ☐ Fishing ☐

Picnic/socialising ☐ Sightseeing ☐

Other (please specify) ☐

6. Please list the main activities for which you came on this Tasmanian trip:

Please show TOTAL TIME involved in each major activity, including travelling time

	Time involved	
MAJOR ACTIVITIES:	DAYS	HOURS
Visiting Mt Field National Park		
Visiting other nature reserves/historic sites /buildings/museums		
General sightseeing		
Visiting friends and relatives / Social activities		
Sporting or special events		
Business / convention / education / training		
Other (please specify)		

In the next three questions we are seeking more detailed information on your visit to this site.

7. How long are you spending AT Mt Field National Park?

Please do not include travelling time ☐ *Days* ☐ *Hours*

8. How long did you spend travelling TO Mt Field National Park from your previous location?

Your previous activity location is defined as the last place you undertook one of the major activities shown in question 6, or the place in Tasmania where you commenced your trip (if this is your first major activity).

☐ *Days* ☐ *Hours*

9. How much time will you/did you spend travelling FROM Mt Field National Park to your next acitvity destination?

Your next activity destination is defined as the next place you will undertake/undertook one of the major activities shown in question 6, or where you complete your Tasmanian trip (if no further major activities after this).

☐ *Days* ☐ *Hours*

10. How lmuch will you/did you (or your group) spend on the following items on your entire trip away from your usual place of residence?

Please indicate, as best as you are able to at the moment, the amounts you expect to spend for the entire time you (or your group) are/were away from home. If you cannot give separate amounts for each item, put a total estimate in the total box. Please note, if you are answering as an individual, you should show only your own expenditure, including just your portion of any shared expenditure

	Amount spent $ (Australian)*
Holiday package	
Air fares / ferry tickets	
Hire car rental fees	
Petrol and other motor vehicle expenditure	
Tours/ bus fares / taxis / other transport not shown elsewhere	
Accommodation	
Food and drinks	
Entrance fees	
All other expenditure (including personal items, gifts and souvenirs)	
Total amount (if details not known)	

* *If you give any expenditure in a currency other than Australian dollars, please indicate the currency used.*

The next question is a hypothetical one, but your answer will provide valuable information for analysis.

11. If someone had offered you an additional financial incentive to work instead of coming on this Tasmanian trip, what hourly rate (before tax) would they have had to pay for you to accept the offer?

Individuals *– please indicate your choice by putting the NUMBER, 1, in the appropriate box.*

Group representatives *– please show the NUMBER of persons in your group who chose each wage category. If you are a group representative filling out this form after the trip and can't contact one or more of your travelling companions, then you should include such persons in the "can't say" box*

Less than $20 ☐ $20 - $30 ☐ $31 - $40 ☐ $41 - $50 ☐

$51 - $100 ☐ Over $100 ☐ Can't say ☐

No amount anyone could offer would be enough to stop me coming on this trip ☐

We should be grateful if you would answer the following questions relating to income. Please note that this information will be kept CONFIDENTIAL to staff of the Centre for Regional Economic Analysis. It will not be revealed to any Government Department, nor will it be shown to any other organisation or individual.

12. What is your approximate annual income?

Income refers to personal annual income form all sources before any tax is paid.

Individuals *- please place the NUMBER, 1, in the appropriate box.*

Group representatives *- please show the NUMBER of persons in each income category. If you don't know the income of some members of your group, include them in the "can't say" box.*

No income ☐ *$50,000 - $65,000* ☐

Less than $20,000 ☐ *Above $65,000* ☐

$20,000 - $34,999 ☐ *Can't say* ☐

$35,000 - $49,999 ☐

For further information on this questionnaire, please telephone Kaye on (03) 6226 2269

Thank you for completing this questionnaire. Please mail it in the attached post-paid envelope.

APPENDIX B TCM ESTIMATES FOR FREYCINET AND MT FIELD ON THE BASIS OF 199 SURVEY DATA

B.1 Freycinet

Discussion in this sub-section will be brief since the analysis replicates that reported for Lake St Clair in Section 3.2 of Chapter 3.

Case 1: 11 zones, aggregate costs

In levels the estimated equation is:

(A1) $VR_i = 178.63 – 0.5556\ C_i$, $R^2 = 0.1466$
(2.77) (1.24)

These results are remarkably similar to the corresponding equation for LSC reported as (1) in section 3.2 – signs, magnitudes and degree of explanatory power. This provides some basis for confidence in our results and also suggests that results for one park may be applicable for another. Use of adjusted costs produces the following estimated equation:

(A2) $VR_i = 197.51 – 1.0148\ AC_i$, R2 = 0.1715
(2.77) (1.37)

which represents only a marginal improvement over the previous equation and is, in this sense, a contrast to the corresponding comparison for LSC. A plot of AC against VR shows significant non-linearity so that the equation was re-estimated in semi-log form to give:

(A3) $VR_i = 563.76 – 111.48\ \ln(AC_i)$, R2 = 0.2984
(2.47) (1.96)

where the slope coefficient is now significant but the statistical quality of the equation still falls short of the corresponding one for LSC. The value of $\partial VR_i/\partial AC_i = -1.5893$ at the sample mean for AC which is somewhat lower than the corresponding figure for LSC.

A plot of the data for ln(AC) against VR shows that the cost observation for the Greater Hobart zone is a significant outlier relative to the other

Tasmanian costs which is surprising considering Hobart's relative proximity to the Freycinet National Park. If this is treated as the result of measurement error and an ad hoc adjustment is made to set it equal to the lowest of the costs for the remaining Tasmanian zones ($16.40 per person), the equation becomes:

(A3') $VR_i = 654.18 - 137.22 \ln(AC_i^*)$, $R^2 = 0.5284$
(3.85) (3.18)

which represents a substantial improvement in both R^2 and the t-ratio for the slope coefficient. While this is not sufficient reason to use this estimated equation, it does highlight the important effect that a single outlying observation may have in a case where there are relatively few degrees of freedom.

Case 2: 16 zones, aggregate costs

The estimated levels equation using unadjusted costs is:

(A4) $VR_i = 149.65 - 0.4761\ C_i$, $R^2 = 0.1329$
(2.89) (1.41)

which is again very similar to the corresponding equation for LSC, equation (5) in section 3.2. Adjustment of the cost figure results in the following equation:

(A5) $VR_i = 162.25 - 0.7444\ AC_i$, $R^2 = 0.1510$
(2.91) (1.52)

which represents only a small improvement although a substantial increase in the magnitude of the slope coefficient. If we use the cost variable in log form to account for non-linearity we get:

(A6) $VR_i = 423.33 - 79.753 \ln(AC_i)$, $R^2 = 0.2311$
(2.52) (1.98)

which implies that $\partial VR_i/\partial AC_i = -0.9332$ at the mean value of AC which is a value comparable to the estimated slope coefficient in equation (A5).

Case 3: 11 zones, disaggregated costs

We now proceed to disaggregate costs into exogenous and endogenous components. In levels, the equation with unadjusted exogenous costs:

(A7) $VR_i = 176.85 - 0.9667\ EXC_i,\quad R^2 = 0.1802$
$\quad\quad\quad(2.95)\quad(1.41)$

which is an improvement on equation (A1), the comparable equation in terms of total costs. If we add an endogenous cost variable it is significant but incorrectly signed. We can reject the hypothesis (implied by the use of total costs) that the coefficients of the two cost variables are equal.

If we adjust the cost variable we obtain:

(A8) $VR_i = 194.55 - 1.7988\ AEXC_i,\quad R^2 = 0.2331$
$\quad\quad\quad(3.13)\quad(1.65)$

in which the slope coefficient is only marginally significant although it has a higher t-ratio than in the equation using unadjusted costs. Equation (A8) fails the RESET test for functional form so we re-estimated it using the log of the cost to obtain:

(A9) $VR_i = 418.72 - 97.509\ \ln(AEXC_i),\quad R^2 = 0.5397$
$\quad\quad\quad(4.32)\quad(3.25)$

which is clearly a considerable improvement on the linear equation both in terms of R^2 and the significance of the slope coefficient. The value of $\partial VR_i/\partial AEXC_i = -2.5712$ at the sample mean value of AEXC, a value which is comparable to but somewhat larger (in absolute value) than the corresponding coefficient in equation (A8).

Case 4: 16 zones, disaggregated costs

Using observations for 16 zones, the visitor-rate equation using unadjusted exogenous costs is:

(A10) $VR_i = 148.70 - 0.8447\ EXC_i,\quad R^2 = 0.1588$
$\quad\quad\quad(3.06)\quad(1.57)$

If the endogenous cost variable is added, both cost variables are insignificant and the endogenous component is of the wrong sign. If we use adjusted costs:

$$\text{(A11)} \quad VR_i = \underset{(3.21)}{162.56} - \underset{(1.79)}{1.3641}\, AEXC_i\,, \qquad R^2 = 0.1973$$

This equation fails the RESET test so it was re-estimated with the log of exogenous costs as the explanatory variable:

$$\text{(A12)} \quad VR_i = \underset{(4.43)}{366.96} - \underset{(3.46)}{82.814}\, \ln(AEXC_i), \qquad R^2 = 0.4789$$

which is clearly a substantial improvement on the levels equation and the non-linear equation in terms of total costs. Hence, as in previous cases, it appears that the non-linear form of the equation using adjusted exogenous costs is the preferred form.

B.2 Mt Field

For Mt Field we used only 11 zones since there were too few observations to disaggregate to 16 zones.

Case 1: 11 zones, aggregate costs

Using unadjusted, aggregate costs in a linear equation, we obtained the following estimation results:

$$\text{(A13)} \quad VR_i = \underset{(2.21)}{263.19} - \underset{(1.41)}{2.0093}\, C_i, \qquad R^2 = 0.1993$$

This equation is similar in statistical quality to the basic equations for the Lake St Clair and Freycinet cases although the magnitude of the slope coefficient is higher. Using adjusted costs, we obtained:

$$\text{(A14)} \quad VR_i = \underset{(2.27)}{98.20} - \underset{(1.52)}{3.5145}\, AC_i, \qquad R^2 = 0.2235$$

which has a somewhat greater explanatory power than equation (A13) but still has an insignificant slope coefficient. If we use the cost variable in log form:

(A15) $VR_i = 950.33 - 228.20 \ln(AC_i)$, $R^2 = 0.4305$
(2.82) (2.46)

which has a significant coefficient for the cost variable and implies a value for $\partial VR_i/\partial AC_i = -5.0042$, which is large in absolute value compared to all previous cases estimated.

Case 2: 11 zones, disaggregated costs

Using unadjusted exogenous costs as the explanatory variable:

(A16) $VR_i = 295.86 - 4.4697\ EXC_i$, $R^2 = 0.2482$
(2.39) (1.63)

which is an improvement over its total cost counterpart but still has an insignificant cost coefficient although the coefficient has the correct sign. Using adjusted costs instead, produces the estimated equation:

(A17) VR_i- $= 336.03 - 7.5539\ AEXC_i$, $R^2 = 0.2734$
(2.46) (1.74)

which is a marginal improvement and has a considerably larger cost coefficient in absolute value. If the cost variable is used in log form:

(A18) $VR_i = 849.78 - 235.22 \ln(AEXC_i)$, $R^2 = 0.4656$
(3.07) (2.64)

in which case the cost variable is of the correct sign and significant and the equation has a reasonable explanatory power. The implied value of $\partial VR_i/\partial AEXC_i = -8.9662$ is, however, very high in magnitude compared to other cases reported, although comparable to the value of the slope coefficient in the linear form of the equation, (A17).

APPENDIX C: THE CALCULATION OF DISTANCE-BASED TRAVEL COSTS

Travel costs were also calculated independently of the solicited figures in the survey. Generally these calculated costs were based on the cost of: airfare to Hobart, and travel from Hobart to the specific park.

The cost of airfare to Hobart was separated into the following: one cost from each state and one from overseas. The interstate costs were based on flying from the capital of the state to Hobart directly. The ticket prices were given by an Ansett travel agent for an economy class return trip in peak season with two weeks advance booking. The overseas airfare costs was an average of the cost of a return trip from London and a return trip from Los Angeles. The same conditions were assumed for this cost.

The travel cost of getting to the park was determined by multiplying the shortest distance to the park by a cost per kilometre. The distance was determined from a road map of Tasmania and the cost per kilometre used was $0.51. This figure is the same as quoted by the ATO for calculation of vehicle costs for a moderate size car. The distances were taken to start from Hobart for all interstate and overseas visitors as well as visitors from the greater Hobart area. Visitors from other parts of Tasmania were assumed to leave from:

Mersey Lyell – Devonport
North – Launceston
South – Huonville.

Identifiable assumptions taken in the calculations were:

- All interstate and overseas visitors travelled directly to Hobart rather than to Melbourne and then to Tasmania on one of the ferries.

- Visitors from regional New South Wales flew out of Sydney ratherthat Melbourne even if Melbourne was closer. (i.e. they all flew from the capital city rather than the closest one)

- Transport from visitors place of residence to the airport was free.

- All visitors flew into Tasmania.
- All visitors travelled in separate cars.
- All visitors travelled by themselves and not as part of a tour.
- No visitors were on package deals where flights and transport were included.
- Visitors didn't go to the parks on buses for day trips.

An attempt was made to account for the assumption that each person travelled in a separate car by assuming that each group travelled in a separate car. To this end the cost of travelling to the park for one car was multiplied by the number of groups and divided by the number of visitors.

$$\text{average\_cost} = \frac{\frac{\text{cost}}{\text{car}} \times \left(\text{no.\_of\_groups (= no.\_of\_cars)}\right)}{\text{no.\_of\_visitors}}$$

$$= \text{cost/person}$$

This procedure was repeated for each zone.

Dr John Madden

Dr Madden has been the Director of the Centre for Regional Economic Analysis at the University of Tasmania since 1991. Prior to that he was the Centre's Deputy Director. His major achievement is the construction of the large-scale multi-regional computable general equilibrium model, FEDERAL, which has been used extensively over the past decade in work for government and industry. The FEDERAL model technology has been transferred to a number of Australian institutions. Madden has over two decades' experience in applied economics and has directed around eighty major commissioned studies for the Commonwealth Government, all Australian state governments and private firms and organisations. His current research is mainly in the areas of political-economic CGE models of federal systems, regional adjustment costs and national competition policy, and the economics of tourism and special events. He is currently part of a Stanford University project team researching fiscal federalism, globalisation and policy reform.
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Dr Prem Thapa

Dr Thapa was a Research Fellow at the Centre for Regional Economic Analysis at the University of Tasmania from July 1999 until December 2000, and a Senior Research Fellow at the Centre during 2001. In January 2002 he joined the Centre for Economic Policy Research at the Australian National University. Before joining CREA he was, between 1994 and June 1999, a doctoral student and Research Officer at ANU. From 1981 to 1992 he worked as a research economist at The Institute for Integrated Development Studies (IIDS) in Kathmandu, Nepal. IIDS is a well-reputed non-governmental organisation for research on economic policies and development issues in Nepal. While at IIDS Prem was involved in the development of Nepal's first computer general equilibrium model, collaborating with a team from the Free University, Amsterdam. Prem has conducted economic research in many areas including agricultural, forestry, and energy economics, labour econometrics and population studies. His work at CREA was mainly on the economic modelling of tourism, the economic impact of the Very High Speed Train, and the price effects of the GST

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