Australian Journal of Agricultural Economics, Vol. 21, No. 2 (August 1977), pp. 97-110.

THE MILFORD TRACK: VALUATION ESTIMATES OF A RECREATION GOOD*

ALAN WOODFIELD

The Flinders University of South Australia

DON COWIE

Monetary and Economic Council, Wellington

This paper uses observations on visitation rates to estimate Clawson demand functions for a non-priced recreation commodity, namely, the Milford Track located in the Fiordland National Park of New Zealand. Different classes of user with potentially different demand elasticities are identified, and shadow prices consistent with revenue maximization of a discriminating and non-discriminatory monopolist tourist authority are estimated. Alternative maximum revenue and consumers' surplus valuations are presented which correspond to different concepts of measures of willingness to pay for use, including travel costs and the opportunity cost of time.

According to the Official Yearbook,[1] 'New Zealand has often been described as "the world's most exciting travel package". With features such as the amazing thermal areas, magnificent lakes and fiords, glaciers, alpine regions, and unrivalled hunting, fishing, and other sporting opportunities, New Zealand combines in a relatively small area a host of attractions.' A quadrupling in international tourist levels over the last decade suggests that such a boast may not be entirely idle. Yet in the face of rapidly growing domestic and international demand for New Zealand's recreational offerings, the supply of these resources appears, especially to conservationists, to be dwindling at a dangerously rapid rate.

To the economist, this trend is not necessarily inconsistent with long-run efficient resource utilization. What is of concern, however, is that recreational resources are being diverted for industrial, agricultural and urban purposes without appropriate valuation of these resources always being taken into account. Because recreational goods are not generally priced in the market, they are frequently transferred to private or public sector use at a zero price, which is generally an inappropriate policy for resources with alternative uses.

The object of this paper is to estimate the value of the Milford Track, an internationally recognized tourist feature located in the Fiordland National Park in the South Island of New Zealand. In addition, we discuss and estimate a set of prices for rationing the Track's services on the alternative strong assumptions that the tourist authority operating the Track wishes to act as (i) a discriminating monopolist, or (ii) a

* We offer thanks to two referees for their very detailed and helpful comments on an earlier draft of this paper.

[1] New Zealand Government Department of Statistics, 1974, p. 962.

non-discriminating monopolist, maximizing profits in each case. In principle, the value estimates are especially important in that they give magnitudes to the contribution to national welfare of a particular recreation good, and suggest that consumers' valuation of specific recreation areas may be far from trivial, an important issue when decisions on alternative resource use are made. Further, we see the estimates as timely; for over two decades there has raged a debate over the possible reallocation of Lake Manapouri from its supposedly protected recreation function to become the source of a storage facility for electricity generating capacity in connection with the establishment of New Zealand's first aluminium smelter. Manapouri, quite reasonably argued to be 'New Zealand's loveliest lake', is located thirteen miles from Lake Te Anau, from which head the Milford Track begins. It is of interest to note that the smelter project was the subject of a cost/benefit study which specifically excluded the recreation value of Manapouri from its terms of reference.[2]

The Milford Track as an Economic Good

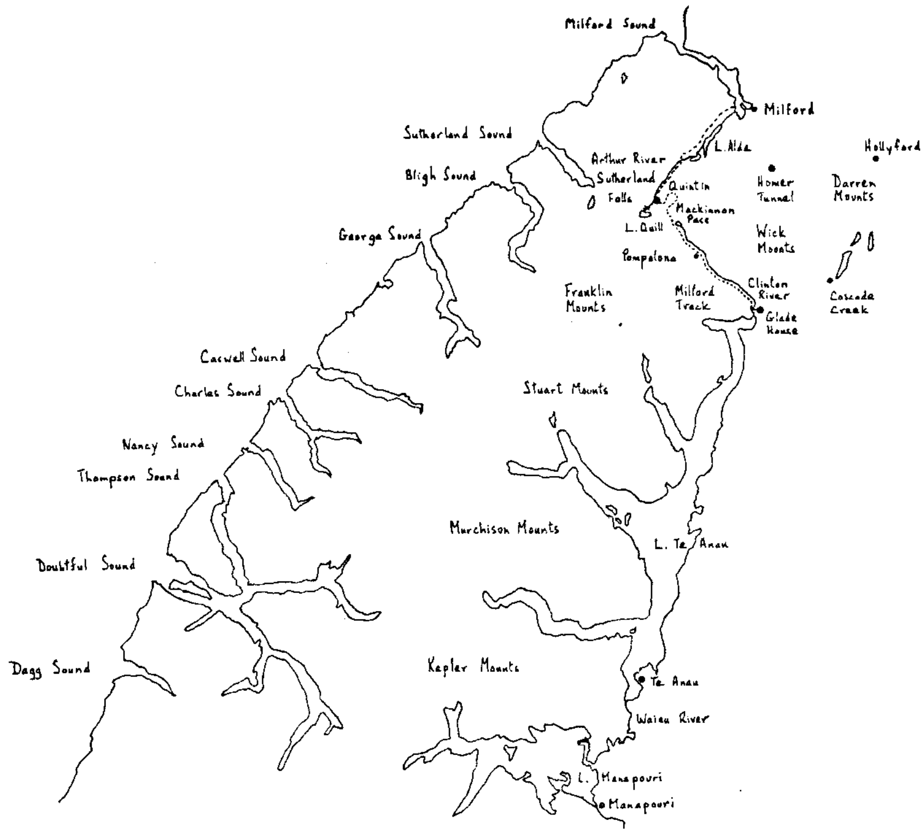
The Milford Track is 33 miles in length, running from the northern shores of Lake Te Anau through beech forest alongside the Clinton River, crossing the MacKinnon Pass and skirting the famed Sutherland Falls (1904 feet) and passing through the Arthur Valley into Milford Sound, itself a tourist attraction in its own right. The Track is normally walked in three days, plus an additional day for sightseeing *en route.* Interested readers may consult the area map provided below.

The Track may be walked in either of two ways. First, the Tourist Hotel Corporation offers guided tours and accommodation for persons with relatively little tramping experience. These people we have termed 'tourist walkers' and they are catered for in groups of up to 40 persons per trip. They carry basic clothing and personal effects, but neither food nor bedding, and are accommodated in Tourist Hotel Corporation lodges. The second group are called 'freedom walkers' and are usually trampers of some experience who carry their entire equipment and are accommodated in National Park Board huts offering bedding and cooking facilities. They are restricted to 16 persons per party.

To each group, walking the Track is a somewhat different experience, although we have not treated it as such. Freedom walkers must bear the costs of carrying food, sleeping gear, excess clothing and less comfortable accommodation, but pay only a nominal Track and accommodation fee. Tourist walkers also pay the nominal $4 Track fee, but pay considerably more for accommodation and guiding. To economize on fees, however, tourists would have to bear additional costs of training in tramping, while, for freedom walkers, marginal equipment costs may be trivial with respect to any individual tramping experience.

We are advised by the National Parks Board that the Track fee is essentially a contribution to Track maintenance, the accommodation fees are contributions to long-run capacity costs, and that no plans exist for extending capacity because of the high marginal congestion costs that would be involved. There is little evidence that walkers pay any direct charge for the privilege of observing the scenic attractions

[2] New Zealand Institute of Economic Research, 1971.



The Milford Track: Fiordland National Park, South Island of New Zealand.

found adjacent to the Track. Since the supply of these attractions is fixed, the tourist authority is forgoing rent in failing to price them. In addition, the authority uses a non-price rationing system during seasonal peaks which result from excess accommodation demand. This appears to operate on a first come-first served basis, which makes worse off those potential walkers who have to transfer to an off-peak time of the season (and suffer rather worse weather conditions, on average), or who have to transfer to a later season, or who forgo the walk altogether in spite of being willing to pay at least the current price.

Of course, since the authority is a public corporation, it may wish to treat the Track essentially as a merit good. A substantial proportion of tourists, however, are international, and the authority may be caught between the Scylla of encouraging through subsidization the use of the Track by residents and the Charybdis of forgone revenue by similarly subsidizing outsiders. There are grounds for arguing that if it so wished, the authority could improve its profitability by employing a peak-load pricing policy for all its users, or maintain the domestic merit-good component by extracting some of the consumers' surplus currently enjoyed by international tourists. We do not, however, pursue these aspects further.

What we shall estimate are the prices appropriate to the authority's acting *as if* it were (i) a profit-maximizing non-discriminating monopolist, and (ii), a profit-maximizing discriminating monopolist. For the latter, since the commodity purchased is a non-transferable flow of services to a set or readily-identifiable consumers, a necessary condition for the practice of discriminating monopoly is present. In principle, a different price could be charged to each consumer group possessing different price elasticities of demand. Data considerations, however, only permit us to distinguish between tourist and freedom walkers. *A priori*, one might expect demand elasticity to be greater for freedom walkers, since they are generally younger (often, students) recipients of lower incomes and face a wider set of low-priced close substitutes for this type of recreation good. On the other hand, they are often more dedicated and environmentally oriented. In the empirical section, we test the null hypothesis of no significant difference between the price elasticities of the two groups, and find that, in general, it cannot be rejected.

Finally, in this section, we add two notes of caution. First, it is always tempting to apply empirical results directly to policy purposes. The assumptions underlying the analysis, however, are strong and somewhat arbitrary. We shall, therefore, attempt to give some account of the degree of sensitivity involved in the assumptions chosen. Secondly, if the authority were to apply the estimated prices, could the revenue be appropriated? As with many recreation goods, the Milford Track possesses some characteristics of a public good. We argue, however, that to all intents and purposes, the Track may be considered a private good, so that the authority could gain from applying the shadow prices that we derive. Public goods are usually characterized by (i) non-rivalry in consumption, and (ii) prohibitively costly exclusion of potential consumers. For the first, we have already alluded to the high marginal congestion costs which prevent capacity extension, so that rivalry exists at the margin at least. Secondly, entry and exit points are well-defined and easily policed, while alternative points require users to bear additional transport charges and to arrange for their own (illegal) accommodation in a 300 inch per year rainfall zone. Free riders, beware!

Demand Functions for the Milford Track

We now discuss and present estimates of demand functions under alternative specifications for tourists, freedom walkers, and, assuming similar demand structures, for the two groups in combination. In what follows, we assume zero marginal costs to operators up to capacity, so that profit and revenue-maximizing prices are assumed to coincide. The demand functions are similar to those first suggested by Marion Clawson (Clawson 1959). This well-known technique estimates demand indirectly first by relating *per capita* visitation rates to a recreation area to costs of travel to that area from successively more widespread geographical zones. One then derives a set of points in price/quantity space (which are related to the travel costs) by introducing hypothetical entrance fees and by imputing desired quantities demanded at these fees. Essentially, if a group of persons will pay, say, \$100 in travel costs to consume a recreation good at zero market price, and a more distant group will pay \$200 for the same services, the willingness to pay \$100 entrance fee plus \$100 travel costs by the first group is assumed appropriately measured by the observed quantity demanded and costs expended by the second group. Points on the Clawson demand curve are then obtained by summing visitation rates over those groups willing to pay both travel costs from their regions plus the hypothetical entrance fee. As the latter is raised, consumers from more distant areas who derive zero consumers' surplus at current travel costs plus entrance fee will no longer be willing to consume at all. Thus, we may map from a well-behaved relation between visitation rates and travel costs into a Clawson demand function with qualitatively similar properties.

The assumptions of this approach, which have been critically analysed in some detail (Pearse 1968), include (i) each tourist is indifferent between paying one dollar for travel or for entrance to the recreation area, (ii) recreationists in different travel zones possess identical preferences, (iii) travel costs to and from the recreation area are specific to the consumption of its services, and (iv) the most distant users receive zero consumers' surplus.

Regarding the applicability of the Clawson assumptions, we first note that the geographical zones referred to in our empirical section include 12 for New Zealand, plus Australia and also North America. This form of aggregation and grouping of the data, forced upon us by the form in which data were made available, is unfortunate for many reasons, not least in that it reduces efficiency of estimation (Brown and Nawas 1973; Martin, Gum and Smith 1974; Sublette and Martin 1975).[3] Next, we confess that we have no way of telling whether or not visitors are indifferent between travel costs and entrance fees of the same dimension, or whether or not there are substantive interzone differences in recreationists' preferences. We acknowledge that the international observations in particular may belong to a different demand structure altogether, and may be responsible for some rather surprising negative income elasticities with which we have not persevered. On the other hand, the closeness of fit of the estimates reported in Table 1 does not suggest any important specification error of this type.

Further, the hypothesis that travel costs to and from the Milford Track are specific to the use of the Track is a crucial assumption on which we have at least some evidence. First, a travel survey conducted by the New Zealand Government Tourist and Publicity department in 1972 estimated the average length of pleasure trips involving more than three nights away from home for New Zealanders as 10 days. If it takes two days on average to reach and return from Lake Te Anau, then a package tour of five-six days from Te Anau to Milford and return appears to be the overriding purpose of the visit. This argument also applies to freedom walkers. For Australians, where the average length of visit is 16 days, the chief purpose assumption appears invalid. But for North American tourists, the average length of stay for whom is eight days for Canadians and 12 days for U.S. citizens, its validity appears stronger. There is, however, the important reservation that Milford Track users are not representative tourists so that average tourist duration is a biased estimate of the touring time spent by the typical Track user. Later, we consider the (approximate) impact of an alternative assumption, namely, that one half of travel costs are assigned to the Milford Track. Given that Australia provides the most visitors from any zone, this may be a more appropriate assumption.

[3] In particular, multicollinearity may have been responsible for instability in our estimated time cost coefficients, details of which we report later.

Another qualification is that we are implicitly assuming that actual and desired quantities are one and the same. In the present context, it might be argued that since the Tourist Hotel Corporation operates a non-price rationing device at peaks, potential visitors who are unable to tour at their desired dates substitute some alternative date during the current season. But it is evident that some may switch away from the commodity altogether, while others may switch to a different season. If so, our desired visitation rates will be understated in general, and these effects may well be non-neutral across groups.

Thirdly, we have been forced to exclude the possibility of positive option demand for the Track. Walking the Track is often a family affair, and there do exist constraints on trampers' ages. Individuals with young families may well be prepared to pay positive amounts in current periods in order to keep the Track in existence because their children are too young to use the service, or might not even be in existence. And even if Track consumption is often non-recurring, some individuals may have a positive option demand if they wish to walk the Track more than once, but where the visits are several years apart. The implication of these factors is to bias downwards our value estimates by an unknown magnitude.

Other qualifications to the use of the Clawson technique have been pointed out (Knetsch 1963). First, it is evident that differences in regional income levels may be expected to lead to inter-regional differences in quantities demanded. In addition, demand may depend on intra-regional income dispersion; in particular, since travel costs are very substantial for international tourists, indivisibility and distance may combine to make the market price of the Track in excess of the reservation price for many potential international tourists who receive relatively low incomes. Inclusion of income variables and dummies to capture the major effects of dispersion did not yield very sensible results, and we ignore these issues in what follows.

Another important consideration concerns the treatment of time costs. It may be argued that the Clawson demand curve will be biased con-consistently to the left of the true position because no account is taken of the valuation of travel time required to reach the recreation site from each distance zone. If we ignore for the moment the valuation of time in particular uses, the positive valuation of time in general suggests that as the time requirement per unit consumed of a commodity rises, consumers will economize on their use of this good, preferring to substitute others, which, although perhaps ranked lower in their preference structures, impose lower time costs. Even if recreationists possess identical preferences, those from more distant areas would be expected to consume fewer recreation services than those from adjacent areas even if they were exactly compensated for the travel cost differential. Thus, when Clawson constructs a demand schedule by postulating an additional monetary cost in the form of an entrance fee to the relatively low time and money cost group, he alters only a single decision factor. Although the group visitation rate from each zone will fall with an increased entrance fee, it will not necessarily fall to the rate of a zone having higher money and time costs.

There appear to be two empirical methods of dealing with this problem. The first, which is used in a study of the demand for sport fishing (Brown *et al.* 1964), is to include a time cost variable in addition to the travel cost variable in the demand function specification. In fact, Brown *et al.* use distance as a proxy for time cost, but this would appear to be inappropriate where alternative techniques for travelling a given distance are available, and where consumers from different zones choose different techniques in response to different relative prices of time and travel. In what follows, we have attempted to estimate time costs appropriate to the assumed dominant mode of travel from each zone. In addition, we would wish to include the value of time forgone while the Track is being walked, and this is unrelated to distance travelled to reach the recreation zone.

A second procedure, and one which we have also followed, is to construct a composite price by summing travel and time costs from each zone, and then introduce the hypothetical entrance fee by assuming that consumers are indifferent between an entrance fee of a given value and an equal-weighted combination of time and travel costs of a similar value. Now it is by no means innocuous to assume that time and money costs are perfect substitutes, as the substantial literature on the role of time in the static theory of the consumer makes evident (Becker 1965, Cicchetti and Smith 1973, Evans 1972, Flemming, 1973, Linder 1970, Schelling 1973). For our purposes, however, we have assumed that time costs are appropriately measured by the product of the average market wage and the normal working time forgone in travelling to and from the Track, plus the time forgone during the walk itself. If positive utility is gained during travel, this procedure will assign too great a willingness to pay for the services yielded by the Track, and our value estimates will be biased upwards by an unknown magnitude. We shall return to this problem in the empirical section.

From each zone, we have first estimated the average time required to complete the visit using the dominant mode of travel. These modes were assumed to be by surface in New Zealand and by aircraft otherwise. Departure points were assumed to be the relevant zone's largest urban area (for New Zealand), Sydney (for Australia) and Los Angeles (for North America). These unit travel time requirements (in hours) were then multiplied by the average regional hourly wage converted to New Zealand dollars at current exchange rates, times one-third, the latter factor to correct for average daily non-working time. The time cost variable is then (we hope) an appropriate measure of the opportunity cost in time of making the visit to the Track, and is a function of both time requirements and the shadow price of time. For visitors who are not normally labour force participants, and who may value the use of travel time positively at the margin, this cost may be wide of the mark. In addition, for international tourists, we have valued travel and time costs from the nearest major urban area in Australia and North America, which may be very conservative estimates. Some of these biases are clearly offsetting, but it would be stretching matters to argue that they were exactly so. Without inclusion of time costs, however, any estimate of the value of recreational resources is likely to be substantially biased downwards.

The demand functions estimated were of two general forms. The first set were linear in all variables, while the latter were constant elasticity functions, that is, linear in the logarithms of the explanatory variables. The estimated versions of the latter dominated the former in every case on the conventional statistical criteria, so we report only our estimated versions of the following.

$$Q_j = \sum_{i=1}^{p} a_0 D^{a_i} u \qquad j = A, T, F$$

where Q_j is the per capita visitation rate for the jth group of visitors, A, T and F refer to aggregate, tourist and freedom walkers, respectively, D is a p-component vector of exogenous explanatory variables including travel, walking and time costs, and income, and u is a random error term assumed lognormally distributed with unit mean and constant variance. Logarithmic transformation of the demand function yields the estimating version.

$$\ln Q_j = \ln a_0 + \sum_{i=1}^{p} a_i \ln D_i + \ln u$$

In all cases, ordinary least squares is the estimator used. As we have no variable to measure money or time costs of substitutes, we cannot discount the possibility of specification bias, but, on the other hand, since supply in the present case is completely inelastic, we may have avoided certain problems of simultaneity.

We now define the variables to be used, and refer the reader to the data appendix for details regarding derivation. Q_j = visitation rate per 10,000 population for group j. RTC = return travel costs. TTC = tourist time costs, JWC = joint walking costs, FTC = freedom time costs. TWC = tourist walking costs. FWC = freedom walking costs. $FTWC$ = freedom time and walking costs. $ATWC$ = aggregate time and walking costs. $TTWC$ = tourist time and walking costs. Y = regional income.

The regional zones refer to Te Anau, Invercargill, Dunedin, Christchurch-Timaru, Nelson-Marlborough, Wellington, New Plymouth-Wanganui, Rotorua-Taupo, Napier-Gisborne, Hamilton-Tauranga, Auckland, Northland, Australia and North America, giving 14 observations on the data, apart from tourists located at Te Anau of which there were none.

Finally, point i on an estimated Clawson demand function using visitation rate function j and a given entrance fee E_i is defined by

$$Q_i = \sum_{k=1}^{n} \{P_k X \exp [\hat{C}_j + \hat{a}_{1j} \ln(E_i + R_k)]\}$$

where k runs across regions, P_k is population per 10,000 in region k, $\hat{a}_{1j}$ is the estimated price elasticity of demand from equation j, R_k is return visit cost from region k, and

$$\hat{C}_j = \ln\hat{a}_0 + \sum_{m=2}^{p} \hat{a}_m \ln \bar{D}_m$$

where the barred variables refer to sample means. Letting E_i take values in the range {0, $E_i$max} where $E_i$max refers to that hypothetical entrance fee which would choke off all demand apart from that of the user who was willing to pay the greatest amount, it is possible to construct a *ceteris paribus* demand curve for the Milford Track.

For purposes of Track valuation, we have approached the problem from three different points of view. First, as suggested in the previously cited paper by Clawson, we have interpreted gross annual benefits yielded by the Track to be measured by potential extractible maximum revenue of a non-discriminating monopolist. This involves finding the price/quantity combination for a Clawson demand curve for tourist and freedom walkers combined where price elasticity of demand equals unity (implying that marginal revenue equals zero).

Secondly, one can measure gross benefits by calculating zero marginal revenue price/quantity combinations for tourists and freedom walkers separately, and summing the resulting maximum revenues for each group. Thirdly, an analagous procedure, again on the assumptions of non-discriminating and discriminating monopoly, is to estimate Marshallian consumers' surplus by integrating the demand functions over the range of potentially chargeable entrance fees. Each of these three procedures is followed below. Further, since we are considering some alternative methods of measuring 'price', it should be of some interest to note whether or not these estimates are sensitive to the inclusion of user and time costs along with travel costs.

On the assumption of stable demand functions (or including forecasts of secular growth in demand), one can estimate the present value of the Milford Track by subtracting from the revenue or consumers' surplus measures the annual costs of operation and depreciation, and then sum over the indefinite future the stream of (appropriately discounted) net benefits.

Empirical Results

The estimated relations between visitation rates per 10,000 population and the various explanatory variables are presented in Table 1. First, we note that attempts to include separate measures of time and travel costs were not successful. In no case was the time cost variable significant when included with other price variables. In the aggregate equation, it was not significant even by itself, while in the remaining two, it was highly significant and with the expected negative sign. When included with other price variables, the determinants of the associated matrices of zero-order correlation coefficients tended to vanish, suggesting that multicollinearity may have precluded efficient estimation of the time cost coefficients. Of course, if time and money costs are very close substitutes, we can usefully include them in a single variable, and we have proceeded in this manner in what follows.

Secondly, although not reported, we introduced a distance variable (linearly) into the regressions. The coefficient estimates were uniformly negative, highly significant, and virtually identical. In each case, however, the associated coefficient of determination was less than with the price variables, and hence the distance variable was not persisted with on this account. Also, for valuation purposes, to use the distance variable would require some method of converting distance into prices. It is, however, of interest to note how well the distance variable performs, since it is probably measured with less error than travel and time costs, and could be interpreted as a suitable proxy variable for both of these.

Now consider the estimates reported in Table 1, which provides in addition the estimated optimal prices, revenue and consumers' surpluses implied by the associated Clawson demand functions. The first set of

TABLE 1

Estimated Visitation Rate Functions and Associated Optimal Prices, Total Revenues and Consumers' Surpluses

Logarithm of Dependent Variable	Regression Coefficients	R^2	Optimal Price ($)	Total Revenue ($)	Consumers' Surplus ($)
Q_A	11·375—2·2612 ln*RTC* (0·2439)	0·87	340	193,596	860,323
Q_T	11·491—2·3434 ln*RTC* (0·3192)	0·82	310	125,897	694,584
Q_F	10·843—2·4861 ln*RTC* (0·1795)	0·94	270	25,734 (Σ = 151,631)	161,541 (Σ = 856,125)
Q_A	12·386—2·4604 ln*JWC* (0·2324)	0·90	280	140,706	817,902
Q_T	19·375—3·6894ln*TWC* (0·3285)	0·91	75	51,539	451,840
Q_F	12·656—2·8162 ln*FWC* (0·1972)	0·94	200	18,036 (Σ = 69,575)	133,584 (Σ = 585,424)
Q_A	14·437—2·3879 ln*ATWC* (0·4134)	0·71	540	850,014	3,179,981
Q_T	19·283—3·2925 ln*TTWC* (0·5336)	0·76	250	189,665	1,082,728
Q_F	14·104—2·6917 ln*FTWC* (0·2790)	0·88	380	75,692 (Σ = 265,357)	364,282 (Σ = 1,447,010)

Legend: The numbers in parentheses beneath the regression coefficients are estimated standard errors of the coefficients. R^2 is the coefficient of determination. The regression coefficients may be interpreted as elasticities of visitation rates with respect to the alternative measures of costs involved in walking the Milford Track.

estimates refer to the use of three different types of price variable, each used as the sole explanatory variable in their respective regression equations. Certain uniformities are readily apparent. First, all estimated price elasticities of per capita visitation rates are negative, highly significant, and greater than unity in absolute value. In all cases, the highest price elasticities are associated with walking costs, the lowest with travel costs, although most estimates are not significantly different from each other both within and among the three classes. For the tourist-freedom walker comparison, it is evident that for travel costs, price elasticity is greater for freedom walkers and the corresponding optimal price is lower. But for walking costs and time plus walking costs, the opposite result holds, which is of some surprise. Moreover, optimal prices under non-discriminating monopoly turn out to be higher in all cases than is suggested by the tourist-freedom walker dichotomy, and total revenue and consumers' surplus are also uniformly higher.[4] Together with the insignificant differences in the intergroup elasticity estimates, these results suggest that nothing is to be gained by attempting to discriminate among users in this fashion.

Now consider the alternative estimates of gross annual benefits yielded by the Milford Track. Two points deserve special mention. The first is that benefits, however measured, are substantially greater when time costs are included in the unit price of the Track's services. Comparing the aggregate results, we find that annual benefits are approximately four times as great when the implicit price of time is counted than when it is neglected. Since the amount of time on the Track (although not travel time) is 'technologically given' rather than chosen, the importance of forgone time and earnings is of sufficient magnitude to suggest that substantial biases in valuation would be introduced if consideration of the time cost variable was omitted. Studies which compare benefits from alternative uses of a given resource in which substantial time costs are involved for use of the resource for, say, recreation, and which ignore these time costs, may be loading the dice substantially in favour of uses for which time costs may be trivial. Considerable controversy surrounds current diversion of recreational waterways for electric power generation in New Zealand, and it might be pointed out that time costs involved in throwing switches might be somewhat different from time forgone in travelling to and spending time at recreation areas. Alternatively, it must be allowed that travel time may be pleasurable as well as costly.

The second substantive difference concerns the relative values of revenue and consumers' surplus, the latter being greater by factors varying from about four to nine. It is, however, well to remember that these measures are independent of one another. The revenue figures refer to the estimated amounts that the tourist authority could collect if it engaged in profit-maximizing pricing. Consumers' surplus does not refer to

[4] Optimal prices and revenues were obtained using the following iterative procedure. First, the behaviour of the total revenue function was examined over an arbitrary interval of prices. If it possessed a local maximum in this interval, it was assumed that this was also global. Compressing the interval and continuing the iterations led to optimal prices and revenues to the nearest five dollars. If no local maximum existed in the chosen interval, successively larger intervals were chosen until a local maximum was found. Further iterations proceeded therefrom to determine the (approximate) optimal prices and revenues.

the willingness to pay in excess of these prices, but instead refers to estimated intra-marginal valuation of the Track's services if these were provided at a zero price. Consumers' surplus *may* then be interpreted as the maximum amount that users would be willing to pay on an annual basis in order to preserve the Milford Track from destruction independently of any positive option demand that might exist.[5]

Conclusions

As mentioned, it would be useful to use the results of this paper directly for purposes of policy, but it is clear that there exist a number of sources of bias of known direction, but of unknown magnitude. Assuming that most distant consumers receive zero surplus, ignoring option demand, and estimating travel and time costs from the nearest urban zones for the international observations all bias the valuation estimates downwards. On the other hand, assuming that Track visitors engage in travel and time expenditures in travelling just to walk the Track and engage in no other recreation activity is rather far-fetched, as is the assumption of zero utility from travel time (at least in terms of surface travel in New Zealand) and the assumption that each zone's average wage rate is the appropriate measure of the implicit price of time.[6] For policy purposes, a lower bound on the valuation estimates is probably more useful. To produce really useful lower bound estimates would require much more information on location, total time spent in the entire recreation experience (including the Track walk as a partial rather than total component), and some measure, perhaps by questionnaire, of the valuation of travel time.

The present paper, then, is probably best thought of as a reconnaissance exercise and novel application of methodology, rather than providing directly applicable lower-bound estimates of the value of the Milford Track. We could, perhaps, get better lower-bound estimates by making some further strong assumptions. We could suppose, for instance, that only one-half of return travel costs for each visitor group were assigned to walking the Track. This would not change the slope relation between visitation rates and travel costs, since we are effectively changing the units in which travel costs are measured. It is easily checked that in this case, the area under the visitation rate function is reduced by three-quarters, and if the area under the Clawson demand curve is reduced by a roughly proportional amount, consumers' surplus associated with the aggregate visitors case would fall from $860,323 to around $215,000. If three-quarters of travel costs were assigned to the Track, consumers' surplus would be around $670,000. Clearly, the valuation estimates are highly sensitive to the assumptions regarding the

[5] A referee has noted that some of the surplus accrues to foreigners and not to residents, and should be excluded from estimates of surplus used when considering the gains to New Zealanders of possible alternative uses of the recreation area. This is a valid point in general, but must be qualified by noting that New Zealand residents may gain surplus from foreigners' use of the Track if the welfare levels of non-resident Track users enter the utility functions of New Zealanders. Since there appear to be grounds for accepting the view that merit good pricing constitutes current policy, this point may not be trivial.

[6] Certainly, the optimal prices reported in Table 1 appear surprisingly high. But it must be remembered that the number of international visitors exceeds domestic visitors, and a price of $200-$300 would only be about 25-30 per cent of travel, accommodation and implicit time costs of present international visitors.

proportion of travel costs to be assigned to the Track.

As far as time costs are concerned, an alternative polar assumption would be to suppose that all travel time in New Zealand involved zero opportunity cost. This will change time costs non-uniformly across groups, and we cannot really consider its impact without completely re-estimating the system. On average, the assumption would require reducing implicit time costs by about one-sixth.

At present, the authors are in the process of acquiring detailed information of the type described above, relating to use of the Heaphy Track (the most extensive family walking track in New Zealand), the existence of which is threatened by a proposed roading development. We hope to provide valuation estimates in a future paper, and to use the information used in the estimation to give some insight into the appropriate assumptions necessary to obtain a more useful lower-bound estimate of the value of the Milford Track.

DATA APPENDIX

Here we describe the construction of variables used in the empirical section of the study. All data, and details of derivation, are available from the authors upon request.

Regarding visitation rates, the numbers of visits by tourists and freedom walkers from each zone were generously supplied by the New Zealand Government Tourist Bureau and the Fiordland National Park Board respectively. We acknowledge our appreciation for their co-operation. For return travel costs, for New Zealand we estimated the appropriate rail, road and sea transport costs that would minimize travel costs from each zone, while for Australia and North America standard and group package airfares, respectively, were used. Joint walking costs are derived as return travel costs plus Track fees in common to tourists and freedom walkers. Tourist and freedom walking costs are return travel costs plus Track fees plus relevant accommodation charges for each group. Time and walking costs are the sum of relevant walking costs for each group, plus common time costs. The latter, for which we made no distinction between tourists and freedom walkers, was measured by the value of estimated working time forgone in travelling to and from the Milford Track. An average hourly earnings variable was constructed to provide a measure of the opportunity cost of time. We might note that estimates of current regional incomes were unavailable, and we were forced to utilize data from the 1968-69 period as a proxy, assuming that regional income differences are constant over time. Official Government and United Nations publications were used for this purpose.

References

Becker, Gary S., 'A Theory of the Allocation of Time'. *Economic Journal* 75: pp. 493-517, 1965.

Brown, W. G. and Farid Nawas, 'Impact of Aggregation upon the Estimation of Outdoor Recreation Demand Functions'. *American Journal of Agricultural Economics* 55: pp. 246-249, 1973.

Brown, W. G. *et al.*, *An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery*. (Corvallis, Oregon, Oregon State University, Agricultural Experiment Station Technical Bulletin No. 78, 1964.)

Cicchetti, Charles J. and V. Kerry Smith, 'Interdependent Consumer Decisions: A Production Function Approach'. *Australian Economic Papers* 12: pp. 239-252, 1973.

Clawson, Marion, *Methods for Measuring the Demand for and Value of Outdoor Recreation*. (Washington, D.C., Resources for the Future Inc., Reprint No. 10, 1959.)

Evans, Alan W., 'On the Theory of the Valuation and Allocation of Time'. *Scottish Journal of Political Economy* 19: pp. 1-19, 1972.

Flemming, J. S., 'On the Theory of the Valuation and Allocation of Time: Some Comments'. *Scottish Journal of Political Economy* 20: pp. 65-72, 1973.

Knetsch, Jack L., 'Outdoor Recreation Demands and Benefits'. *Land Economics* 39: pp. 387-396, 1963.

Linder, Staffan B., *The Harried Leisure Class*. (New York, Columbia University Press, 1970.)

Martin, W. E., R. L. Gum and A. H. Smith, *Values for Hunting, Fishing, and General Rural Outdoor Recreation in Arizona for 1970*. (Tucson, Arizona, University of Arizona, Tucson, Agricultural Experiment Station Technical Bulletin No. 211, 1974.)

New Zealand Government Department of Statistics, *New Zealand Official Yearbook*. (Wellington, Department of Statistics, 1974.)

New Zealand Institute of Economic Research, *The Manapouri/Bluff Aluminium Industry: An Economic Appraisal*. (Wellington, Institute of Economic Research, 1971.)

Pearse, Peter H., 'A New Approach to the Evaluation of Non-Priced Recreational Resources'. *Land Economics* 44: pp. 86-99, 1968.

Schelling, Thomas C. (ed.), 'Symposium on Time in Economics'. *Quarterly Journal of Economics* 87: pp. 627-675, 1973.

Sublette, W. J. and W. E. Martin, *Outdoor Recreation in the Salt-Verde Basin of Central Arizona: Demand and Value*. (Tucson, Arizona, University of Arizona, Tucson, Agricultural Experiment Station Technical Bulletin No. 218, 1975.)