Valuing Ecotourism in Madagascar

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Travel cost analysis of foreign visitors is used to determine the value per visitor of tropical biological reserves in Madagascar. The value per visitor is estimated to be between $276 and $360.

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1. Introduction

As the world’s tropical forests continue to shrink it is ever more pressing to measure the value of preserving the remaining forest. One potentially important service that tropical forests provide is ecotourism. Yet, there are very few studies which have attempted to value ecotourism. The only published study valuing tropical forest ecotourism we are aware of is the study of Monteverde in Costa Rica by Tobias and Mendelsohn (1991).

In this paper, the value per visitor of a sample of foreign visitors coming to a tropical forest reserve in Madagascar is measured. In the process we address a difficult methodological issue, valuing foreign visitation. Foreign visitation is difficult to value because these tourists usually visit multiple sites upon reaching a distant country. However, in Madagascar, nature preserves and their unique inhabitants, such as lemurs, are the primary attraction for the tourists. While it is difficult to assign a value to each specific preserve, travel cost analysis of foreign visitors can measure the overall value of ecotourism in a case such as Madagascar.

Using the travel cost technique (see Clawson and Knetsch, 1966; or Freeman, 1979), we estimate the value of ecotourism from visitors’ observed behavior. These estimated ecotourism values provide managers and policy makers with information they sorely need to allocate scarce land and budgets effectively (McNeely et al., 1990).

2. Travel cost method

The travel cost method measures the demand function for visits to a site. A demand function is an empirical relationship between the price of a good and the quantity purchased:

\[ V = f(P, X), \]  

(1)
where \( V \) is the quantity purchased (number of trips taken), \( P \) is the price and \( X \) includes a number of socio-economic variables which might shift the demand function, such as income or age. Economic theory suggests that demand curves slope downwards (\( \frac{dV}{dP} < 0 \)). As prices rise, people purchase less of a good. Hundreds of empirical studies of markets have confirmed this theory of consumer behavior.

The travel cost demand function is a specific application of demand functions to recreational trips. The travel cost demand function describes how many times people purchase trips depending upon the price of a trip. As with market goods, theory predicts that with higher prices per trip, people will tend to visit less often; the travel cost demand function should be downward sloping.

At any given price, the demand function reveals the quantity a consumer would purchase. The demand function also reveals the price a consumer would pay for any specific quantity. For example, suppose, at a price of $300 per trip, the consumer is observed to make five trips a year. This implies that he would pay $300 to make the fifth trip. If the price doubled to $600 per trip, the demand function may suggest the consumer would take only three trips. Thus, the consumer would pay $600 for the third trip. For each trip, the demand function reveals what the consumer would pay to take that specific trip.

One can use demand functions for trips to measure the ecotourism value of a site. For each consumer, the value of the ecotourism is the loss from not being able to visit the site. This loss is the difference between what the tourist would have paid for the trip minus what the trip actually cost. For example, in Figure 1, a group of 10 million tourists who face a price of $700 to visit the site would come nine times. The ninth trip would have been worth $700, which was its cost. The net value for the ninth trip is zero. However, for the eighth trip, this group would have paid almost $900. The net value of the eighth trip would be $200 (900 – 700). The seventh trip, in turn, would have been worth $1050 and so would have a net value of $350 for the people who are $700 away. Summing the net value across all the trips would give an estimate of the net value of the site.
Using the demand curve to value each trip, one would take the sum of the values for trips one through nine minus the transportation costs. Note that traditional applications of travel cost have used distance as a proxy for costs. This is appropriate for private automobile travel. However, if commercial airlines are used, the transportation costs, the airfare costs, become a better measure than distance as a price of a trip.

Graphically, the loss of the site is the loss of the area underneath the demand function but above the price (the shaded area in Figure 1). More formally, the annual value of losing the site is in the integral under the demand function:

\[ CS_s = \int_{P_0}^{\infty} f(P,X) \, dp, \]  

where \( P_0 \) is the initial price of a trip. The area underneath the demand function but above the price is called "consumer surplus" and it measures the net value of making large changes in quantities purchased.

The consumer surplus for each individual will depend upon her socio-economic characteristics \( X \) and her travel cost per trip \( P_0 \). Individuals with a higher demand function will visit the site more often and have a larger consumer surplus, all other factors held constant. Individuals who face a lower initial price to visit the site will also have a higher consumer surplus. This latter observation leads to an anomaly. People from further away place a higher value on their trip but place a lower value on the site. Because of the high price of trips, people from further away take far fewer trips and so value highly the few trips taken. However, if the site is lost, for example through deforestation, the tourists will not go and therefore will save the high transportation costs of those few trips and so have little net loss.

The annual consumer surplus from a site depends upon the aggregate demand curve for trips to that site, the sum of the values that all consumers place upon that specific location. Sites which are commonplace tend to have demand curves which are relatively flat, there are a lot of use but few people come from far away to see the site. The consumer surplus underneath relatively flat demand curves tends to be small. On the other hand, sites which are unique, such as sites which are the focal point of international travel, tend to have relatively steep demand curves. In this case, consumer surplus per person can be large, especially for people who happen to live nearby the site. However, if most visitors must travel great distances to see a site, the net value of the site may be low, because in the absence of the site the visitors save all the travel costs.

Note that the analysis presented here relates to a single site. In visiting a foreign country, most tourists will go to more than one site. Several authors (Haspel and Johnson, 1982; Clough and Meister, 1991) have suggested ad hoc ways to allocate trip costs or consumer surplus across visited sites on a multiple-destination trip. However, in order to estimate site values correctly on multiple-destination trips, one must engage in multiple-site demand equations (see Mendelsohn et al., 1992). Although thorough, this procedure is complicated and requires complete information about all visited sites on traveler itineraries. The alternative raised in this paper is to value the set of sites visited by foreign tourists. In Madagascar, the primary attraction is nature reserves so that the measured value is for ecotourism in general.

The travel cost of an international visit to a tropical reserve will depend upon international airfares. These airfares are generally correlated with distance but can vary substantially between countries. Potential visitors who face a much higher price per visit
are expected to visit less often. By examining the number of trips taken by people who face different airfares, one can estimate the demand for visits to the country and thus estimate values per visitor.

3. Methodology

Because of its highly diverse flora and fauna, Madagascar has been labeled a megadiversity country (Mittermeier, 1988). The Beza Mahafaly Special Reserve (Beza) is a protected forest of about 640 ha in south-west Madagascar. This reserve includes spiny forest vegetation endemic to southern Madagascar (McNeely et al., 1990) as well as perhaps 10% of southern Madagascar’s remaining riverine forest (WWF-US, 1988). Despite its small size it contains large numbers of relatively easy to view lemurs (Richard et al., 1987), other wildlife and some of Madagascar’s biological importance make Beza a prime tourist stop, as reported by Bradt (1990).

To visit Beza most tourists either fly on the national airline, or drive by rented vehicle, to the provincial capital, Toliara. From Toliara they drive, again by rented vehicle, the 4 to 6 hours to Beza. Road travel tends to be rigorous in Madagascar, so most visitors spend at least one night at the reserve.

Visitation was studied from 1 July 1990 to 30 June 1991. Tourists arriving at Beza supplied the following information: total international airfare, country of origin, total trip length, time in Madagascar and time at Beza. Complete data were collected on 52 tourists out of 79, and 70 supplied at least country of origin data. This total does not include tour groups.

Nine of the 11 visiting countries of origin are officially classified as “industrialized” by the International Monetary Fund (1990). The remaining two countries, Reunion and South Africa, are unique in that they are close and, at least with respect to South Africa, they contain regions which are clearly industrialized. From these results, we conclude that the potential source of visitors was all industrialized countries. We consequently include all industrialized countries (defined by the IMF) in the sample, even though some countries had no observed visitors. All industrialized countries, Reunion and South Africa result in a sample size of 25 countries.

Airfare data were aggregated by country and converted to United States dollars (USD) using the arithmetic average of the daily exchange rate for August 1990 (International Monetary Fund, 1990). Airfares for countries with zero visitation were calculated using the least expensive airfares from the individual capitals to Antananarivo. With few direct flights to Antananarivo, this calculation usually required ticketing by the respective national airlines to an intermediate country and then obtaining a second fare to complete the trip. When a single airline was used to ticket the entire trip, the price quotes tended to be much higher than when the individual national airlines ticketed their own portions of the trip.

To estimate the demand function, the regression of visitation rates per 1000 people was calculated on average airfares for each country of origin. The population value used for South Africa represents the white minority—18% of the total population. We include only whites to represent the industrialized section of South Africa.

Both a linear and an inverse log model were estimated:

\[ V = a - bP \]

\[ V = a - b \ln P. \]
The coefficients of price in Table 1 are negative, as expected in both models. Foreign visitation to this reserve is thus consistent with expected behavior. Examining the results in Table 1, the inverse log model outperforms the linear model. The inverse log model fits the data more closely, as judged by the \( r^2 \) statistic. Further, the coefficients in the inverse log model are more statistically significant, implying the results of the inverse log model are more reliable than the linear model.

Consumer surplus was estimated by integrating between the average airfare of each country and the airfare that would drive visitation to zero. The airfare that would drive visitation to zero in the linear equation is $2241, and it is $2097 in the inverse log equation. Average airfares of countries less than the maximum cost for the linear equation were $1544, and they were $1537 for the inverse log equation. Countries whose airfares exceed these amounts were excluded. The formulas for consumer surplus are, respectively:

\[
CS = (a - bP_0) / (2b)
\]

\[
CS = b(e^{ab} - P_0) - aP_0 + bP_0 \ln P_0.
\]

Dividing these estimates by the visitation rate gives an average consumer surplus per visitor:

\[
CS/V = (a - bP_0) / 2b
\]

\[
CS/V = b(e^{ab} - P_0) / (a - b \ln P_0) - P_0.
\]

Substituting the estimated coefficients from Table 1 for each parameter into equation (6) and calculating yields the following estimates of average consumer surplus per person: $349 for the linear model and $265 for the inverse log model. The entrance fee of approximately $11 per visitor should be added to consumer surplus for total value. The resulting average value per visitor is between $276 and $360.

4. Discussion

This study examines foreign visitors and estimates average consumer surplus values for ecotourism in Madagascar using the travel cost method. Total travel costs to Madagascar are used as the price of a visit. The analysis indicates an average consumer surplus of between $276 and $360 per visitor. A fee of $11 is actually charged at this site. It would appear that Madagascar could raise its fees substantially in light of foreign demand. If
some of this increased fee were given back to local people, it could substantially raise local interest in conserving these sites.

The biggest problem facing evaluation of foreign visitation is the multiple destination quality of most tourist travel. People generally visit many different kinds of sites while in a distant country. In this analysis, we take a sample of Madagascar tourists who visit the Beza Reserve. Assuming that most foreign visitors came to Madagascar for ecotourism, the international travel costs paid by these tourists enables them to buy the entire ecotourism package of this country. The numbers estimated thus represent the value that these tourists place on this opportunity. In alternative settings, where tourists are drawn by more than ecotourism destinations, it is necessary to employ more sophisticated techniques to measure ecotourism values. For example, Mendelsohn et al. (1992) propose a multiple-site approach which can measure the value of individual reserves.

There are a few additional caveats one must consider in using these numbers. Tourists arriving in large groups were excluded from the analysis. The study ignored 42 tourists who visited as part of a tour package. These people could not be included because they were charged a single price for the entire package, making it impossible to evaluate their airfare. Other problems include the small sample size, the lack of domestic travel expenses and possible complications introduced by the Persian Gulf war.

Valuing foreign visitation is a priority of many tropical biological reserves. Thoughtful applications of travel cost analysis based on airfares is appropriate and essential.

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References