Recreation Demand and Optimal Pricing for International Visitors to Kruger National Park

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Abstract

Sustainable financing of conservation is a key challenge in developing countries, due to competing needs. Increasingly, national parks are expected to undertake local community development – at a time when the conservation mandate and threats to conservation have increased significantly, while traditional transfers from the State have been declining. We demonstrate the potential of park pricing for generating funds for conservation and benefit sharing with adjacent local communities. We estimate recreation-demand models and derive welfare measures for international tourists to a popular African national park. Lastly, we formulate a pricing framework with revenue maximization as an objective. Our results suggest significant underpricing.

Key Words: access value, benefit sharing, non-market valuation, optimal pricing, recreation demand, sustainable financing

JEL Codes: C24, Q26, Z30

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1 Introduction

Over the past six decades, tourism has become one of the largest and fastest-growing economic sectors in the world (UNWTO, 2011). The United Nation's World Tourism Organization (UNWTO) forecast international tourist arrivals to reach nearly 1.6 billion by 2020, increasing to 1.8 billion by 2030 (UNWTO, 2011). According to UNWTO data for international tourist arrivals in emerging economies, the gap between emerging- and advanced economy tourist arrivals has continued to shrink. Emerging-economy tourist arrivals are set to surpass advanced-economy tourist arrivals before 2020 (UNWTO, 2011, 2017). In Africa, tourist arrivals will increase from 53.5 million in 2015 to 85 million in 2020, and to 134 million by 2030 (UNWTO, 2017). African tourism is based largely on wildlife and wilderness resources, the conservation of which requires significant funding. However, despite the surge in tourism in Africa over time, national parks and other protected areas have remained financially strained, and continued to rely on fiscal transfers from the State to fund conservation activities (Inamdar et al., 1999; McRae, 1998; Whitelaw et al., 2014). Such a funding model for conservation constrains the development of the requisite tourism infrastructure for taking advantage of the upcoming opportunities. There is a need to generate sustainable financing, both from the State and from park users, for supporting conservation activities within the park and in the adjacent areas forming part of the broader park ecosystem.

There has been a rise in calls for African governments to focus more on people-oriented national objectives, such as access to education, energy, water and sanitation, and health; and to tackle the high levels of unemployment and poverty in their countries. Even though most parks are not wholly funded by the State, this has diminished the priority given to protected areas in State funding models. In some cases, this disadvantage has been reinforced by increasing contestation of the existence of protected areas in land-scarce economies (Dikgang and Muchapondwa, 2012). The result has been a general decrease in funds for conservation. This threatens the existence of protected areas (see McRae, 1998), as well as associated opportunities for social progress through job creation, enterprise development, infrastructure development, and export earnings.

One important conservation cost relates to local communities' conservation roles in and around protected areas. In many African contexts, these roles – whether direct or indirect – are critical for the effectiveness of protected areas. Authors such as Hansen and DeFries (2007) observe that many protected areas are not successfully conserving biodiversity, often despite adequate management within their borders, because of the expansion and intensification of land use in the adjoining areas. Land-use at the periphery of protected areas can alter ecological functions inside protected areas and result in biodiversity loss, given that a protected area is almost always part of a larger ecosystem (Muchapondwa et al., 2012). Given competing livelihood options, local communities must be incentivized to be proactive about the conservation of protected areas.

In many cases, there have been no schemes to compensate local communities for their proactive role in conservation or their losses from conservation, leading increasingly to apathy towards conservation activities. In the few cases where attempts at compensation have been made through benefit-sharing schemes, inadequate financing has meant the level of incentive has been negligible (Fischer et al., 2011; Adams and Infield, 2003). Therefore, there is a need for adequate outlay of funds to share with local communities – some of which have formally reclaimed ownership of portions of protected areas, while agreeing to maintain conservation as the primary land use (e.g. contract parks, as discussed in Dikgang and Muchapondwa (2017b) and Reid et al. (2004)). In fact, when local communities benefit from their conservation efforts, there is a double dividend: conservation wins, and so do sustainable rural livelihoods. As such, the call for sustainable financing for protected areas is in many ways a call for more action on the people-oriented national objectives to which African governments are increasingly paying more attention.

The key ingredient in securing sustainable financing for protected areas from the State, civil society organizations and park users is knowledge of the use and non-use values of these estates (Voltaire et al., 2017). The economic literature has increasingly attempted to generate these values using stated and revealed preference methods. These methods enable the marginal valuation of visitors to adjust depending on current and intended trip commitments in valuing non-marginal policy changes in recreational opportunities. However, use values tend to present easier entry points in public policy. As such, special attention has been given to deriving use values from revealed preference valuation methods such as travel-cost models, albeit with the prime aim of demonstrating the recreational value of these spaces. What is lacking in the literature is the economic valuation that should accompany a holistic analysis of the prospects for generating sustainable financing for national parks and protected areas from both institutional players and park users, for use in financing conservation activities both within and outside the park's estate. This paper closes that gap, using a case study of Kruger National Park (KNP) in South Africa.

Given the high levels of poverty, inequality and unemployment in South Africa (and Africa in general), increasing national parks' reliance on user charges could free government resources for these urgent priorities. In some ways this is already happening, as fiscal transfers to the environment have declined over time. In South Africa, increasing revenue from user charges – particularly since 2003, when the South African National Parks (SANParks) adopted a new pricing policy – have helped plug the funding gap for conservation in SANParks estates, and have even subsidized previously land-dispossessed local communities. South Africa is not distinct from other developing countries when it comes to wildlife management, and this study aims to advance discussions about raising sustainable financing for national parks through user charges by investigating the scope for park entry-fee increments.

In this paper, we use the individual travel cost method to estimate the recreational value (consumer surplus) of KNP to international tourists. Our results suggest consumer surplus is large, given the (usually) low access fees. The park agency may therefore be forgoing potential revenue. The paper also discusses the potential role of appropriate entrance fee pricing for enabling the sustainable financing of parks in the face of declining fiscal transfers and increasing mandates.[1] The rest of the paper is arranged as follows: Section 2 presents some background material, while Section 3 briefly describes the methodology and estimation procedure. The model specification and variable definitions are presented in Section 4, and Section 5 presents our results, the derivation of welfare measures, and a discussion of revenue maximizing entrance fees. Section 6 concludes, and the Appendix contains additional supporting evidence relating to increasing mandates and declining transfers.

2 Background

The South African national park system is one of the cornerstones of South Africa's tourism economy. SANParks manages a system of 21 national parks with a total area of just over four million hectares, comprising 67% of the protected areas under state management. The conservation mandate is funded through a combination of government grants and self-generated funds, with the latter comprising 80% of the operating budget. SANParks is the biggest tourism-product owner in the country, and manages tourism and conservation infrastructure of close to R10 billion.[2] The financial performance of SANParks is crucial, both to the sustainability of SANParks and to its ability to fulfill its conservation obligations. Accordingly, maximizing revenue is an important objective (SANParks, 2016).

According to a 2016 internal assessment, the performance of SANParks in the management of protected areas has been above the minimum required standard. Despite this success, wildlife crime continues to be SANParks' major challenge. While rhinoceros poaching has been a growing challenge for over a decade, a resurgence in elephant poaching is exacerbating the problem. It is instructive to note that organized poachers exploit the alienation of local communities who fail to access full conservation benefits. Organized poaching may therefore be disrupted by creating opportunities for local communities through more equitable benefit-sharing initiatives (SANParks, 2016).

KNP is a world-renowned park, established in 1898 to protect the wildlife of the South African lowveld. The park is the SANParks flagship, covering nearly two million hectares (SANParks, 2015). It offers a unique wildlife experience, and is popular among tourists for its big-game sightings and large expanses of wilderness. KNP offers game drives, bush walks (including

[1] Several African governments such as Botswana, South Africa and Zimbabwe are reducing funding to national parks (see Child, 2017; Nkala, 2017; Hwari, 2017).

[2] US$1 = South African Rand (R) 10.66 at the time of the survey in July 2014.

rhinoceros, elephant and lion tracking on foot), foot safaris and wilderness trails. The park is home to the "big five" game animals, namely lion, leopard, elephant, buffalo, and rhinoceros. It contains nearly 2 000 plant species, about 150 species of mammals (including many large and charismatic predator and grazing species), 50 fish species, over 500 bird species, 34 amphibian species and 116 reptile species (SANParks, 2008). Owing to its large geographical size, the park consists of several ecosystem zones. KNP offers a rare opportunity to see animals in their natural habitat, given its isolation from major developments – a big pull factor for tourists. KNP is significant for conservation, and is part of the Kruger to Canyons Biosphere designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as an International Man and Biosphere Reserve (UNESCO, 2015).

In terms of tourism KNP has developed a significant profile over time, with visitors surpassing 1.7 million in 2015/16; around 26% are classified as international tourists (SANParks, 2016).[3] The park's existence is important beyond conservation, as it supports a variety of tourism-related economic activities in the surrounding areas. It is also important to note that KNP is only one of five SANParks-managed parks currently generating a surplus (SANParks, 2014). The park is therefore also important for its potential to cross-subsidize other national parks that are currently financially unviable, but which encompass important biodiversity.

3 Methodology

The individual travel cost method (TCM) proposed by Brown and Nawas (1973) is one method frequently used for the valuation of non-marketed environmental goods and services. Due to the lack of variation in entrance fees in South Africa, it turns out to be convenient for our purposes also. In South Africa, entrance fees are gazetted periodically by the park agency, and usually go unchanged for a number of years except for small inflation related adjustments on an annual basis. To get around this, we use the individual TCM to derive a demand curve from which to estimate the economic benefits received by site visitors. The general idea is that when the price of access to a recreational site is minimal, individual travel costs to the site may be used to approximate the surrogate price for the recreation experience. The TCM therefore makes use of an individual's participation in a recreational activity to reveal his or her preference for the recreation site. Park tourists are assumed to respond to variations in travel cost in much the same way they would respond to changes in park entrance fees. As travel cost and other factors that add to total recreation cost increase, therefore, we expect a decrease in participation level. The socio-economic characteristics of the individual, information regarding substitute sites, and quality indicators for the environment may also be added to the demand function. TCM is based

[3]Despite the small size of the international tourist market relative to the domestic market, the international market is important, given its relative maturity. Moreover, it accounts for a disproportionate share of total revenue in relation to its size (Dikgang and Muchapondwa, 2017a).

on information regarding the individual visitor, and therefore derives the Marshallian consumer surplus for the individual visitor. Our model can be specified as follows:

$$d_i = f(tc_i, \mathbf{x}_i, \epsilon_i) \tag{1}$$

where d_i is the number of recreation days on the current trip for the ith visitor, and tc_i is the cost of traveling to the park. $\mathbf{x}_i$ is a vector of visitor-specific factors that influence the number of days spent at the site, and ϵ_i is an independent random disturbance term. The set $\mathbf{x}_i$ captures various socio-economic and demographic variables of the participants, namely age, gender, education, annual household income and other variables, such as the quality of the recreational experience as perceived by the tourist. Equation 1 is derived from a utility-maximization problem in which individuals choose the total number of days at a recreation site. According to Larson and Shaikh (2004), the recreation choice is assumed to be made conditional on an individual's labor-supply decision. Recreation demand then arises from the allocation of earnings from the labor market across a range of consumption activities.

The standard practice in the literature is to use the number of past trips to the park as the dependent variable (see for example Englin and Shonkwiler, 1995a; Hellerstein, 1991; Shrestha et al., 2002). In this paper, we follow (among others) Bell and Leeworthy (1990); Burt and Brewer (1971); Hof and King (1992); Kealy and Bishop (1986); and Mendes and Proença (2011), who use the number of days on site as the dependent variable. Traditional TCM is only applicable where visits to the site are of the same duration (Kealy and Bishop, 1986; Smith and Kopp, 1980). Trip length is nonhomogeneous in cases where visitors travel substantial distances, and thus spend more time on site compared to visitors staying closer to the site (Smith and Kopp, 1980). Equation 1 therefore has the advantage that it represents a homogeneous recreation demand relationship, in that the dependent variable is a single recreation day as opposed to trips of different lengths (Mendes and Proença, 2011). Recreation days will tend to be much more homogenous across different recreationists than trips would (Hof and King, 1992). McConnell (1975) shows that the use of recreation days as the dependent variable is consistent with utility-maximization theory, if one estimates the relationship as a function of net variable costs per day, including the opportunity cost of on-site time.

An important issue when dealing with the individual TCM is how individuals coming from a great distance are to be treated (Bell and Leeworthy, 1990). According to Font (2000, p. 98), "... the paucity of multiple observations in the demand curve econometrically estimated from data on visitors, because individuals often visit the recreational area once ..." is a major deficiency of the individual TCM based on trips. In our case, the great majority of recreationists (265 out of 300) had not been to KNP during the five years preceding the survey (see Figure 1). There would thus be a lack of variation in the dependent variable if the number of past trips is used. The number of recreation days, on the other hand, is likely to vary across recreationists.

According to Smith and Kopp (1980), a suggestion related to this is that as distance from the recreation site increases, tourists may substitute length of trip (measured in days) for number of trips.

Lastly, an important objective of the current paper is to derive revenue maximizing daily entrance fees for the recreational park to finance conservation and benefit sharing with local communities. As a daily entrance fee is standard practice in many African parks, the current formulation of the TCM allows us to easily compute the revenue maximizing daily entrance fee. A related aspect is that domestic tourists usually make repeat trips more frequently. As stated previously, due to the distance involved in international tourism the majority of tourists only visit the site once. For a park manager studying recreation demand for the purposes of setting an appropriate entrance fee, repeat trips within an economically meaningful time horizon are unlikely. In this case, an analysis based on recreation days is more informative for the task of computing a revenue maximizing entrance fee.

3.1 Valuing Recreation Time

An important issue and arguably the most difficult to estimate in travel cost studies is the measurement and treatment of the opportunity cost of time. There is substantial literature on how to incorporate the opportunity cost of time spent traveling to a recreational site (see for example Cesario, 1976; Feather and Shaw, 1999; Fezzi et al., 2014). In recreation studies, it is crucial to note that time can be as important as monetary costs in the decision to engage in recreational activities (Feather and Shaw, 1999). According to Cesario (1976), opportunity cost reflects the value placed on alternative uses of leisure time; therefore, it is appropriate to value travel time at only a fraction of the going wage rate.

In order to arrive at an accurate measure of the recreation cost for each day of stay, we add the opportunity cost of travel time to the out-of-pocket travel cost. The opportunity cost is calculated as a fraction ($0 < \varphi \leq 1$) of the wage rate multiplied by the round-trip travel time (see Amoako-Tuffour and Martínez-Espiñeira, 2012; Englin and Shonkwiler, 1995a; Fezzi et al., 2014). While it can be argued that the last part of the trip from Johannesburg to KNP may yield some positive utility, we follow Fix and Loomis (1998) by assuming consumptive benefits from this part of the trip are zero on average; otherwise, the estimated benefits would be amplified.[4]

On-site time is also important, and researchers have tried to incorporate this into travel cost studies in several ways (see Amoako-Tuffour and Martínez-Espiñeira, 2012). In the current study, we assume the opportunity cost of time spent on site is the same as that of time spent traveling, even though this may vary across individuals (Cesario, 1976; Mendes and Proença,

[4]One must also consider that for international tourists, this last part of the journey to KNP is completed after a long international flight. Therefore, while most visitors are likely to engage in a few other activities on their way to KNP, we argue that these other activities are incidental.

2011). Amoako-Tuffour and Martínez-Espiñeira (2012) further note that, unlike travel time, on-site time is endogenous, as it is chosen by the tourist.

Englin and Shonkwiler (1995a) show that the often-used rule of thumb of setting the fraction of the wage rate to one third when valuing travel time is a close approximation to measuring the opportunity cost of time. However, a recent contribution by Fezzi et al. (2014) shows that valuing travel time at one third of the wage rate generates downward bias, and that three quarters represents a reasonable approximation. Feather and Shaw (1999) argue that handling the opportunity cost of leisure time this way has limitations where individuals are not in the labor force for some reason.

3.2 Truncation, Endogenous Stratification and Overdispersion

A number of issues have emerged in the literature regarding the estimation of recreation-demand models. Firstly, the dependent variable can only take non-negative integer values, which restricts the analysis to the use of maximum likelihood estimators. Secondly, the sampling procedure naturally introduces truncation. Only those who have undertaken a visit to the recreation site are sampled, and therefore the sample is truncated at zero. The estimated demand function would therefore be too steep, resulting in biased parameter and welfare estimates unless corrected (Parsons, 2003). Furthermore, in our case, tourists who stay at the site for many days have a higher chance of being sampled than those who stay for fewer days. In the literature, the oversampling of tourists who stay longer (or visit frequently, when the dependent variable is trips) is called endogenous stratification (Creel and Loomis, 1990; Grogger and Carson, 1991; Shaw, 1988). Endogenous stratification introduces bias, which the estimation strategy must correct. Lastly, recreation demand data is characterized by overdispersion, where the conditional mean number of days spent on the site is less than the conditional variance. This is because a few enthusiastic recreationists undertake longer stays, while the majority of visitors only stay at the site for a few days. Related to this is what Sarker and Surry (2004) term the 'fast decay process'. In this case, a majority of the visitors stay for one or two days and the number of participants who stay more than two days decreases rapidly, giving rise to an extreme form of overdispersion and a long-tailed distribution.

Given overdispersion, truncation and endogenous stratification, the best model turns out to be the truncated and endogenously stratified negative binomial model and its generalized version. These models are especially appropriate when the data exhibits fast decay and associated long-tailed distribution (Martínez-Espiñeira and Amoako-Tuffour, 2008). The density of the zero-truncated negative binomial distribution in the presence of endogenous stratification has been derived by Englin and Shonkwiler (1995b).

3.3 Data Description

We make use of primary data collected through on-site sampling of international tourists at KNP in July 2014. The questionnaire was piloted in March and April 2014, and subsequently modified. Daily during the survey, a team of interviewers would randomly approach tourists at the different campsites of the park – usually after breakfast or lunch, to minimize disruption of participants' activities.[5] Interviewed visitors had spent at least a day in the park, such that they had actual experience of the recreational activities. Visitors were briefly interviewed, mainly about their country of residence, and then asked to participate in the entire survey if they were not local or regional tourists.[6] While the sampling was random, those who stayed longer had a greater chance of being sampled.

The data collected includes round-trip travel cost, other trip-related costs, total number of people from the same household traveling together, country of origin, and a number of demographic variables. The survey also included questions on the visitors' views about the protection of wildlife and its habitat by public authorities around the world, the duration of the current visit, income, and other sites visited during the same trip. Generally, tourists tend to visit more than one tourist site or national park when vacationing. In our case, tourists tended to visit neighboring countries such as Botswana, Mozambique, Swaziland, Zambia and Zimbabwe, which offer complementary recreational activities as part of the same trip. Locally, they also visit other places, in Cape Town or Johannesburg, for example. Because travel cost models assume single-purpose trips, respondents were asked if they were visiting any other places either within or outside South Africa, including the recreation days spent in each of these places or countries. In our case, visitors reported having visited or having planned to visit sites other than KNP. Respondents were also explicitly asked about the round-trip travel cost to KNP.

Respondents were also specifically asked to state the percentage of total trip enjoyment or utility derived from visiting KNP as well as other sites visited on the current trip. Multiple-site visitors pose a challenge when single-site travel cost models are employed. Researchers have dealt with these issues differently. Navrud and Mungatana (1994) calculate the recreational value of flamingo viewing in Lake Nakuru National Park in Kenya based on the proportion of time spent viewing and photographing flamingos. They follow a three-step procedure. First they calculate recreational value per visitor and per visitor day for an entire trip in Kenya, using the estimated demand functions. Next, using the portion of time spent in the park under consideration, they derive the recreational value of the visitors' stay in that park. Following this, they calculate the

[5]While it is ideal to sample visitors when they depart the recreational site (Mendes and Proença, 2011; Parsons, 2003), this was not practical in our case because the majority of international visitors were on tours, leaving little time to interview them while they were leaving the park.

[6]Regional tourists are classified as those coming from the 15 Southern African Development Community countries. In terms of entrance fees, they pay twice the R70 tariff levied on local residents, while all other nationalities pay an entrance fee that is four times that charged to local residents. However, regional tourists constituted only 1% of visitors to the park in 2014.

recreational value of flamingo viewing in the park based on the portion of time spent viewing and photographing flamingos. Rather than considering a multi-destination model, we instead ascertain the proportion of the round-trip travel cost (or consumer surplus) attributed to visiting KNP based on the percentage of total trip enjoyment derived from visiting KNP as captured in the variable *pleasure*, as well as the number of days spent at KNP. On average, respondents attribute about 48% of total trip enjoyment to the KNP visit.

Table 1 presents the summary statistics. The sample includes tourists from 18 different countries, including Europe, the United States, Canada and Australia, with 35% coming from the Netherlands, 21% from the US, 9% from Germany, 8% from the United Kingdom (UK), 6% from Belgium, 5% from France, and 3% each from Australia and Spain. The other countries in the sample have fewer than 3% respondents each. The sample is representative, as it is in line with official tourist statistics for KNP available from the SANParks guest demographics gate access system (SANParks, 2013). Looking at highest level of education attained, 18% of the tourists identified themselves as having a primary or high school education, 18% had a college certificate or diploma, 32% had an undergraduate degree and 32% had a postgraduate degree. The mean household income in the sample is $96 917,[7] with a standard deviation of $57 912. In terms of household income, 19% had an annual household income between zero and $50 000, 46.67% had income between $50 001 and $100 000, 28.67% had income between $100 001 and $200 000, and 5.67% had income above $200 000. The average respondent age in the sample is 41 years.

[Insert Table 1 Here]

Figure 2 shows the distribution of the dependent variable, the number of recreation days at KNP. We note the majority of tourists stay at KNP between one and four days. We also note from Table 1 that the average number of days the visitor spends at the recreational site is 3.23, with a variance almost three times the mean. This suggests the data may be overdispersed, although we need to consider all the covariates before reaching a conclusion. From Figure 2, we note that even though the data appears to have a slightly long-tailed distribution because a few tourists stay for an exceedingly large number of days, the data do not exhibit a quick process of decay, characterized by a sharp fall in frequencies after two days. A fast decay process gives rise to extreme overdispersion that would otherwise be difficult to handle using most traditional count data models (Sarker and Surry, 2004).

[Insert Figure 2 Here]

[7]Unless otherwise indicated, all '$' amounts are in United States Dollars.

4 Model Specification and Variable Definitions

In this section, we present the travel cost model, and discuss in detail how each of the variables in our model is constructed. We assume that participation in recreation entails two distinct types of cost. The first component of cost is the travel cost (*travcost*), which is an upfront cost before the consumption of any recreation activity. The upfront cost can be treated as a kind of long-run capital cost. In the case of international tourists travelling long distances, it might be expected, as in Smith and Kopp (1980), that the length of the trip and travel cost will be positively related. However, this contradicts the traditional TCM, which hypothesizes an inverse relationship between travel cost and participation in recreation. The second type of cost is the on-site cost per day (*expenses*) which can also be treated as the marginal cost of each recreation day. This way of classifying the costs associated with participating in recreation goes back to Pearse (1968), who viewed recreation costs as composed of a fixed component and a variable component, which varies with respect to the number of days at the recreation site.[8] We therefore estimate the following recreation demand model:

$$
\begin{aligned}
RDAYS \;=\; & f(travcost,\ expenses,\ age,\ age^2,\ gender,\ income,\ education, \\
& package,\ party\ size,\ satisfaction,\ wildlife\ interest) \qquad (2)
\end{aligned}
$$

where $RDAYS$ is the number of recreation days spent at KNP on the current trip. The variable *travcost* in Equation 2 represents explicit and implicit travel costs for each recreation day, while *expenses* represents explicit and implicit on-site costs for each recreation day. The total recreation cost per day for individual i ($TCOST_i$) is then given as the sum of *travcost* and *expenses*:

$$
TCOST_i = \underbrace{\frac{\mathrm{RCT_i}}{\mathrm{RDAYS_i}}\gamma_{\mathrm{KNP_i}} + \frac{\mathrm{TTC_i}}{\mathrm{RDAYS_i}}\gamma_{\mathrm{KNP_i}}}_{\zeta} + \underbrace{\frac{\mathrm{OCS_i}}{\mathrm{RDAYS_i}}\gamma_{\mathrm{KNP_i}} + \mathrm{STC_i}}_{\xi} \qquad (3)
$$

The first term on the right-hand side (RHS) in Equation 3 is the out-of-pocket round-trip travel cost per day for KNP. RTC_i is the out-of-pocket round-trip travel cost paid by the tourist to get to South Africa from where their vacation trip started. This is divided by $RDAYS$, and then scaled by γ_{KNP_i} (the self-reported subjective utility or enjoyment derived from visiting KNP – $0.05 < \gamma_{KNP_i} \leq 1$) to derive the portion of the travel cost for KNP, since respondents report visiting other sites.[9] The self-reported subjective utility is constructed such that it sums up to

[8] There is also a transaction cost, associated with making a decision on the recreation site to visit. However, we ignore such costs, as they are most likely to be negligible, and also hard to quantify.

[9] We note that trying to retrieve the KNP portion of the recreation cost through scaling RCT by γ_{KNP} can result in very low values for the first RHS term, in cases where a respondent reports a low value of subjective utility for the park. An alternative would be to consider scaling RCT by the fraction of days at KNP. However, many respondents who visit KNP plan the trip as part of an extended tour that usually includes other countries

1 ($\gamma_{KNP_i} + \gamma_{SA_i} + \gamma_{Other_i} = 1$, where γ_{SA} is enjoyment from other sites within South Africa and γ_{Other} is enjoyment from sites outside South Africa).

The second RHS term in Equation 3 is the opportunity cost of travel time per day (TTC_i), scaled by days at KNP and enjoyment at KNP. The term ζ therefore represents both explicit and implicit travel costs (*travcost*) for each recreation day. The third RHS term in Equation 3 captures the explicit on-site cost per day for KNP. This includes lodging, food, meals and entrance fees, and OCS_i is taken as the total expenditure on the whole trip less the round-trip travel cost. The last RHS term captures the opportunity cost of on-site time per day (STC_i). The term ξ therefore represents both explicit and implicit on-site costs (*expenses*) for each recreation day.

The opportunity cost of travel time is calculated as:

$$TTC_i = \varphi w_j h_T$$

where w_j is the average hourly wage in country j (or state j, in the case of the US) and h_T is the round-trip travel time in hours. The value of travel time is taken as a fraction ($0 < \varphi \leq 1$) of the wage rate. The opportunity cost of on-site time (STC) is constructed similarly, with h_T denoting the recreation time spent on site. We impute the hourly wage by dividing annual income by the number of hours worked in the year 2013. The annual hours worked and annual income data for Europe are obtained from the Organization for Economic Co-operation and Development (OECD), while the corresponding US data for each state is obtained from the US Bureau of Labor Statistics. We make a simplifying assumption that all the visitors from the same country (or state, for the US) work the same number of hours annually; and even if they are paid different amounts, we assume they are paid in the same manner.

In order to calculate the round-trip travel time h_T from the city of residence to KNP, we use the shortest flight path from the city of residence to KNP. This rules out any individual inclination for a specific itinerary, as in Mendes and Proença (2011). An obvious weakness with this approach is that the shortest flight path implies taking the most direct flight; in most cases, this tends to be more costly. The typical tourist would possibly consider the travel time as well as seeking to avoid costly direct flights, but there are limits to their ability to do so. In trying to get an accurate measure of travel time, we also approximate the distance traveled by the tourist from his place of residence to the nearest airport. This is then converted into time, at an assumed average driving speed of 80km/hour. For time spent on site, we make use of the

in southern Africa, as well as other sites within South Africa. The trip would therefore most often tend to be much longer than usual, resulting in very low values of travel cost. Another weakness is that the travel cost allocated this way assumes that a day in KNP is the same as a day at any other site, since all days are assigned similar weights.

reported number of recreation days the tourist is staying at the park, after considering that in a typical day at KNP, one is normally awake for about 16 hours (Mendes and Proença, 2011).[10]

The *income* variable is taken as the mid-point of the annual household income bracket. In most travel cost studies, *income* often has a weak effect. Many studies find it negative and significant (Creel and Loomis, 1990; Grogger and Carson, 1991) or insignificant (Englin and Shonkwiler, 1995a), while in other studies it is positive and significant (Amoako-Tuffour and Martínez-Espiñeira, 2012; Egan and Herriges, 2006; Englin and Shonkwiler, 1995b; Martínez-Espiñeira and Hilbe, 2008). In Sarker and Surry (2004), *income* has a positive sign but is insignificant. We expect income to have a positive effect on international tourist visits, given the distance, planning and hence cost involved in visiting an international recreation site. Furthermore, since recreation is a normal good (see Simões et al., 2013), we expect the number of recreation days spent at the site to increase with income.

The level of educational attainment (*education*) is a categorical variable that ranges from 1 (primary and high school) to 4 (postgraduate degree). We expect the effect of the level of *education* to be positive *a priori*, even though Englin and Shonkwiler (1995a) and Shrestha et al. (2002) find a negative effect. We also make use of the information regarding the number of accompanying household members on the trip (*party size*). Additional variables are *package*, which is a dummy variable controlling for whether the trip is part of a tour package or self-organized, and *satisfaction*, which measures the tourist's tour experience on a scale from 1 (much worse than expected) to 7 (much better than expected).[11] The variable *wildlife interest* ranks the views of the respondents on wildlife protection on a scale from 1 (not at all interested) to 7 (greatly interested). The variable *age squared* is a quadratic term for age.

Equation 2 is estimated with both $\varphi = 1/3$ and $\varphi = 3/4$ where φ is the fraction of the wage rate used to value recreation time. We also estimate Equation 2 using $TCOST$ as the variable of interest in place of *travcost* and *expenses*. We present these results in Table A1 in the Appendix.

5 Results

The recreation model presented in Equation 2 was estimated using negative binomial models that account simultaneously for truncation, overdispersion and endogenous stratification. The models are estimated valuing travel time using both 1/3 of the wage rate, which is standard in the travel cost literature, and 3/4 of the wage rate, as recommended by Fezzi et al. (2014). Table

[10] There are also park-imposed constraints on movement outside the designated campsites between 6pm and 6am. However, tourists staying within the park can undertake tourist activities during these times by making use of the exclusive SANParks guided tours offered during these times.

[11] This variable captures a number of site-specific characteristics, such as wildlife diversity, tourism infrastructure, accessibility and price. For the purposes of analysis of this variable and also the variable *wildlife interest*, we combine the first five categories into a single category as they have fewer observations in them.

2 presents estimates for the different models. Results in Table 2 (columns I and II) use 1/3 of the wage rate while those in columns III and IV use 3/4 of the wage rate. Judging by the signs and magnitudes of the coefficients presented in Table 2, the different models appear highly robust. There are no sign changes across the specifications, and only the statistical significance and goodness of fit change. The overdispersion test also supports our use of the negative binomial class of models. From Table 2, the generalized negative binomial specifications controlling for truncation and endogenous stratification, while simultaneously allowing for a flexible form of overdispersion have the highest log likelihood, confirming a significantly better fit.

From the generalized negative binomial model controlling for truncation, overdispersion and endogenous stratification (GTSNB) in Table 2, we note that *travcost* has the expected negative sign and is significant at the 1% level. The variable *income* has a positive sign as expected and is statistically significant at the 5% level. The education variables are insignificant. Often education has a positive sign. Martínez-Espiñeira and Amoako-Tuffour (2008) find a positive but insignificant effect, while others such as Shrestha et al. (2002) find a negative significant effect. Higher levels of reported satisfaction are associated with longer stays at the site while the level of wildlife interest has no impact on the duration of the visit. In theory, we would expect tourists who care more about wildlife protection and habitats to engage in longer visits at the site.

[Insert Table 2 Here]

The binary variable *package* has a negative sign and is significant at the 1% level. The sign of this variable indicates the restrictions imposed on tourists when they opt for a package, in which case they cannot alter the package offered by the tour operator. The variable *party size* has the expected negative sign, and is statistically significant at the 1% level. We interpret this as indicating that – since a large party size is likely to cost significantly more, and is also possibly more complicated to plan – a much larger party size will therefore tend to lower the duration of the visit.

5.1 Welfare Calculations and Discussion

The ultimate objective in recreation-demand analysis is to compute welfare measures that can be fed into policy analysis (Yen and Adamowicz, 1993). The Marshallian consumer surplus – defined as the integral of the area under the demand curve between an individual's current price (travel cost) and the choke price – is widely recognized as one way of estimating the benefits of recreational sites (Cesario, 1976; Parsons, 2003). The choke price is the price in the model at which visits are zero. We therefore report the consumer surplus per recreation day associated with each of the estimated models. The consumer surplus per recreation day (cs_D) is found by integrating Equation 1 between the two prices:

$$cs_D = \int_{tc^0}^{tc^1} f(tc_i, \mathbf{x}_i, \epsilon_i) dtc \tag{4}$$

where tc^0 is the individual's trip cost and tc^1 is the choke price. Equation 4 is therefore a measure of the average visitor's monetary benefit from visiting the site. Following Yen and Adamowicz (1993), the consumer surplus per day can be computed as $cs_D = -1/\widehat{\beta}_{tc}$, where $\widehat{\beta}_{tc}$ is the parameter estimate on the travel cost variable. If one has data for all international visitors to KNP, then the consumer surplus results can be extrapolated to the entire population of users. Figures on total international visitors to KNP can easily be obtained from the park agency.

The consumer surplus estimates are given in Table 3, along with the 95% confidence intervals. The individual consumer surplus per day is $450, and ranges from $346 to $644 for the preferred specification, with travel time valued at 1/3 of the wage rate. When travel time is valued at 3/4 of the wage rate, the consumer surplus per day is $481. For all our model specifications, the consumer surplus estimates are higher with travel time valued at 3/4 of the wage rate. Our estimates of individual consumer surplus per recreation day may seem slightly high, but they compare well to the consumer surplus of other recreation activities in South Africa. Du Preez and Hosking (2011), for example, report a consumer surplus per day of $334 for the Rhodes trout fishery in South Africa. However, their sample is made up largely of domestic visitors. The total number of international visitors to KNP for 2014 was 165 020. Assuming that our sample is representative of all international tourists, the annual recreational value for international visitors to KNP is $240 million, and ranges from $185-$343 million ($257 million and ranging from $200-$360 million when travel time is valued at 3/4).[12]

[Insert Table 3 Here]

Our consumer surplus estimates are also in line with most of the literature for southern and eastern African national parks. Krug (2000) reviews empirical studies in eastern and southern Africa and finds large aggregate estimates of consumer surplus, which he attributes to low entrance fees for most national parks. The consumer surplus for unique recreational sites for which no close substitutes exist is shown to be even larger in the literature. For example, Hatfield and Malleret-King (2007) use the TCM to derive the consumer surplus of Mountain Gorilla tourism in the Virunga Volcanoes Massif and Bwindi Impenetrable Forests in central Africa. They report a mean consumer surplus of $1 314. For comparison purposes, it is important to note that the consumer surplus estimate presented by Hatfield and Malleret-King (2007) is for a one-hour activity tracking Mountain Gorillas.

[12] If we restrict the analysis to only the countries in our sample in 2014 (they provide 68% of total international tourists to KNP), the annual recreational value for international visitors is $164 million and ranges from $126-$235 million (or $176 million, ranging from $136-$246 million when travel time is valued at 3/4).

KNP is representative of a number of big national parks in Africa that are endowed with highly valuable wildlife and attract a large number of international and domestic visitors. Such parks have high scarcity value. The potential contribution from charging appropriate entrance fees is therefore large, as these parks are among the most visited parks in Africa. The high consumer surplus also reflects the presence of a variety of natural and man-made attractions that interact to determine the level of satisfaction derived by the recreationists. Because the use value is only part of the total economic value, the use values reported here provide rather a low, conservative estimate of the probable magnitude of the total economic value.

While consumer surplus represents benefits accruing to consumers, it is important to note that in our case, it also reveals the extent of the potential surplus that could be captured by the park agency at the optimal set of entry fees. If the park agency does not capture much of this surplus rent, as in the current case, it is unnecessarily sacrificing potential revenue crucial for funding conservation. However, the uncaptured surplus rents will end up being extracted by the private-sector tourism players, at the expense of the park agency. For example, restaurants, hotels and tour operators may overprice the complementary services that help to enhance a tourist's experience. However, these actors do not have an incentive to use the captured surplus for conservation in the park. Furthermore, since national parks are funded through the national treasury, charging lower entrance fees to foreign tourists also implies that effectively, tourists from wealthy nations are being directly subsidized (Whitelaw et al., 2014).

5.2 Calculating the Revenue-Maximizing Price

Traditionally, national parks were formed solely for conservation. However, conservation requires the support of financial resources, and protected areas have therefore been forced to gain extra income. The major sources of income are allocations from the national treasury, concessions, conservation (entrance) fees, accommodation, game drives, trails and other tourism-related activities. Because funding from the national government is only partial, entrance fees have been an important income source for conservation in developing countries. Yet entrance fees are frequently pegged below the levels international visitors are willing and able to pay (see Walpole et al., 2001; Naidoo and Adamowicz, 2005; Pandit et al., 2015). At the same time, parks continue to be underfunded, and are unable to fully cover their operational budgets (Walpole et al., 2001; McRae, 1998; Inamdar et al., 1999).

When considering optimal park pricing for international tourists, the starting point should be a market-driven framework that pays attention to recreation demand and supply to arrive at revenue-maximizing entrance fees. In addition, the appropriate entrance fee must also incorporate a certain degree of revenue capture. Another crucial aspect in deciding the appropriate entrance fee is the inter-relatedness of parks within South Africa and the region. A change in the entrance fee at KNP may induce substitution effects among other local or even regional parks, unless the park offers a unique tourist experience. Chase et al. (1998) and Dikgang et al. (2017) recognize this aspect, and consider multiple national parks simultaneously in order to arrive at optimal entrance fees.

There are three main ways to think about entrance fees. Their objective could be efficiency, as in Mendes (2003); or it could be revenue maximization (see Alpízar, 2006; Chase et al., 1998; Walpole et al., 2001; Dikgang et al., 2017); and at times it can be equity, where domestic tourists form the bulk of the visitors.[13] The main justifications for an entrance fee in many public national parks are rationing (given the uneven demand that characterizes recreation demand), equity (an application of the 'user pays' principle), and financial considerations. The financial reason is especially important in South Africa and many other developing countries, where international tourists constitute a substantial proportion of the total number of tourists. With sufficient revenue from international tourists, the park agency can invest more in protecting the natural resources; extend free or subsidized access to more marginalized local groups; and finance benefit-sharing schemes.

We focus on entrance fees for international visitors, since charging lower entrance fees to locals in a developing-country context can be justified on the grounds that locals – especially those living in the vicinity of parks – already bear a huge portion of the cost of the parks' existence in terms of forgone alternative productive uses, such as agriculture or logging (Lindberg, 1991). Furthermore, many African national parks were created by the direct displacement of local communities. In addition, locals as a group pay domestic taxes. In this regard, parks can be used by governments as a tool to attain multiple objectives, such as inclusiveness when it comes to local communities.

We can take an extra step towards determining the revenue-maximizing fees, given that we now have some reliable estimates of consumer surplus. We develop a pricing mechanism with revenue maximization in mind. We start by rewriting the demand function as Equation 5, where the travel cost (tc_i) is used as a proxy for the entrance fee as before.

$$d_i = \exp(\alpha + \psi \mathbf{x}_i + \beta tc_i) \tag{5}$$

where $\mathbf{x}_i$ is a vector of explanatory variables and β is the parameter attached to the travel cost variable. From Equation 5, the total revenue function can be written as $\frac{1}{\beta}(\log d_i - \rho) \cdot nd_i$ where $\rho = \alpha + \psi \mathbf{x}_i$. Maximizing the total revenue function with respect to d_i yields $d_i^* = \exp(\rho - 1)$ and using this expression together with Equation 5 yields $tc_i^* = -1/\beta$ which is the same as the consumer surplus per day (cs_D). From this, it turns out that the park can charge an entrance fee that extracts the entire consumer surplus. The current daily entrance fee at the time of the survey was \$23 and the estimated fee ranges from \$346 to \$674 per international visitor per day depending on the opportunity cost of recreation time. At this entrance fee, $d^* = 1.2$ (1.4 with

[13]See Laarman and Gregersen (1996) for an overview of pricing policies in nature-based tourism.

time valued at 3/4 of the wage rate) with $\widehat{\rho} = 1.19$ (1.32 with time valued at 3/4 of the wage rate) using the data in Table 1 and parameter values in columns II and IV of Table 2. We note that the decline in recreation days per visit is small relative to the price increase. Recreation demand tends to be price inelastic (see also Dikgang et al., 2017; Simões et al., 2013; Pandit et al., 2015). The impact of changes in entrance fees on revenue depends on the price elasticity of demand (e_p). With a semi-log demand function, $e_p = \beta_{tc} \cdot \overline{tc}$ where $\overline{tc}$ is the average round-trip travel cost per day (*travcost*). When the opportunity cost of recreation time is taken as 1/3, price elasticity of demand ranges from -0.94 to -0.95 indicating demand is inelastic (raising fees will raise revenue). However, when the opportunity cost of recreation time is taken as 3/4, price elasticity of demand ranges from -1.07 to -1.09 indicating demand is unit elastic (raising fees has no effect on revenue).

The optimal price presented here however, only maximizes revenue from entrance fees. National parks provide various other tourist services and generate considerable revenue from all these activities. The desired optimal entrance fee therefore need to maximize joint revenue from all the park's revenue-earning activities. Such a fee is likely to be significantly lower than the suggested fee but above the current entrance fees. However, we lack the ingredients required to compute such an entrance fee at the park level.

5.3 The Political Economy of Entrance Fees

Park pricing as a tool for natural resource management is still under-utilized. This is partly because revenue-maximizing behavior is not the usual culture of park administrators, as most professional rewards are tied instead to program development (Laarman and Gregersen, 1996). Yet international tourists are often willing to pay higher entrance fees (Naidoo and Adamowicz, 2005; Pandit et al., 2015), provided these are earmarked for conservation and park management (Dikgang et al., 2017). According to Mabunda (2004), prior to 2003 there was no pricing policy for SANParks. Consequently, many of the tourist products offered have been mispriced. At the same time, we acknowledge that a number of national parks in developing countries cannot become self-financing even under the most well-designed pricing strategies (see Walpole et al., 2001). In our analysis, we have made a number of simplifying assumptions to arrive at the revenue-maximizing entrance fee suggested by our models. However, there is also an international public good aspect attached to national parks, for which parks are unable to charge. The existence value of wildlife is enjoyed by citizens of all countries. Charging international tourists a much higher fee could therefore be justified as a way of capturing this aspect.

In order to maintain visitation rates in line with revenue-maximizing fees, it is important to invest in the resource over time.[14] Measures need to be taken to curb destructive activities such

[14] The estimated fee will maximize revenue for the park assuming that the recreation services and wildlife experience provided by the park do not deteriorate.

as illegal harvest of resources; through poaching, for example. This study shows the economic potential of national parks, and demonstrates how this potential can be realized through converting part of the consumer surplus into producer surplus that can be used for conservation. Since tourism demand has been shown to be highly price inelastic (see Dikgang et al., 2017; Simões et al., 2013); therefore, increasing entrance fees would yield higher revenues. Historically, entrance fees in developing countries have remained low, with discussions to increase entrance fees often correlating with periods of falling budget appropriations. Unfortunately, the context within which such discussions arise reduces the possibility that they will translate into long-term and sustained policy efforts (Laarman and Gregersen, 1996).

6 Conclusion

This paper sets out to conduct an economic valuation to accompany a holistic analysis of the prospects for generating sustainable financing for national parks, from both institutional players and park users, for use in financing conservation activities, both within and outside the estate of the park studied. We estimate recreation-demand models for KNP using on-site survey data, from which we derive estimates of the consumer surplus. Our welfare measures are large, suggesting that (*i*) national parks are highly valuable resources in need of State support for greater protection, and (*ii*) by charging relatively low entrance fees to international tourists, national parks in Africa are potentially forgoing substantial revenue crucial for conservation. In the face of increasing mandates and declining transfers, part of the demonstrated surplus can be extracted by charging appropriate entrance fees.

In this regard, we formulate a simple revenue-maximization problem to calculate the optimal entrance fees. We estimate such a daily entrance fee to be significantly above the current levels. Our results have important implications for protected areas because popular nationals parks may be able to charge more thus providing a mechanism for sustainably funding conservation. For sustainability, it is important that park revenue covers all costs associated with conservation, including those costs associated with the participation of local communities. This could reduce reliance on fiscal transfers and enhance sustainability, in the face of increasing mandates and declining transfers. The existence of an advanced gate-access system for SANParks and many African parks means the park agency has access to important historical data to fine-tune entrance fees in response to changes in tourist demand. This offers the potential to maximize revenue at any given time. One limitation of the current study is that we are unable to compute an optimal price that would maximize joint revenue for the park given that national parks provide various other tourist services and generate significant revenue from these activities.

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Figure 1: Frequencies for past trips

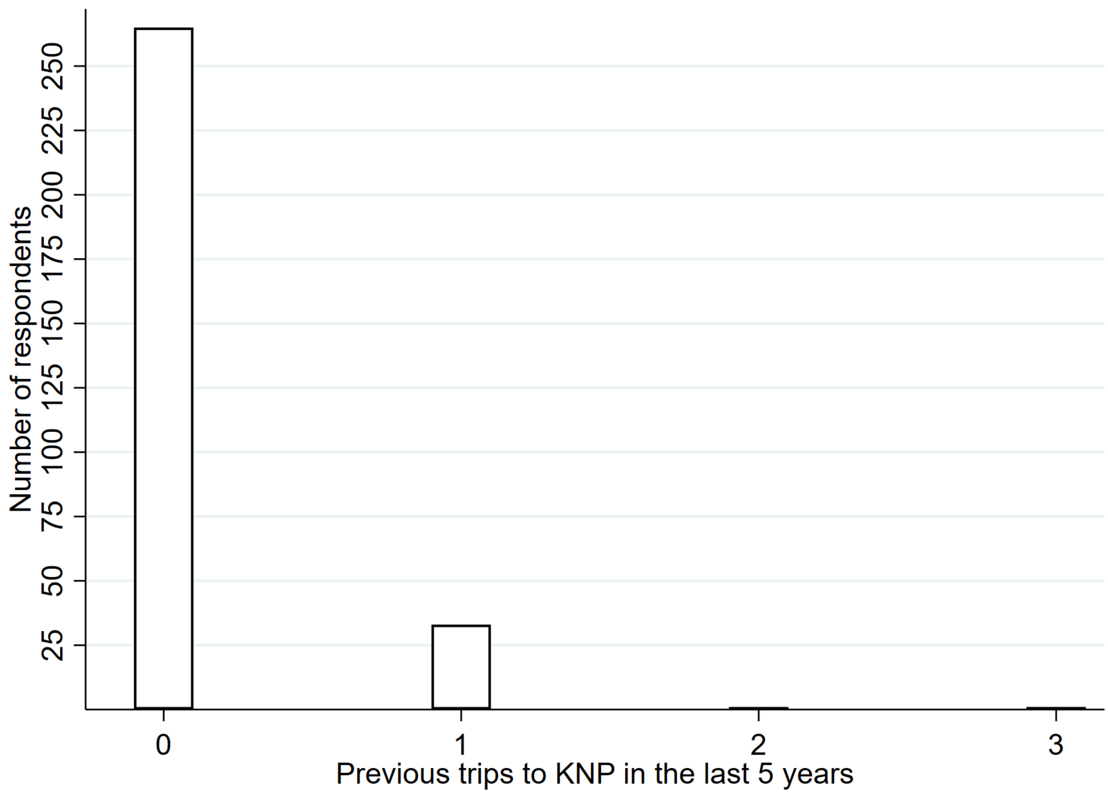


Table 1 shows the summary statistics of variables used in the econometric model. A total of 385 questionnaires were administered. Of these, hourly wage data is not available for 37 observations. Five of the observations are missing one of *age, wildlife interest, income* or *pleasure* (percentage of total trip enjoyment derived from visiting KNP). In addition, for seven observations, the total cost of the trip was less than the round-trip travel cost, and we drop these inconsistent observations from our sample. We also drop 23 inconsistent observations who reported they were only visiting KNP but attributed part of their enjoyment to other sites they had not visited. A further 15 observations are omitted from the analysis because the days reported spent at KNP are greater than the total reported trip duration. The majority of the observations dropped are from Latin America and Asia, which are not major tourist markets for South Africa. Only 40 of the observations dropped are from Europe or North America. The final analysis is done using 300 observations.

Table 1: Summary statistics of variables used in the econometric model ($n = 300$)

Variable description	Mean.	Std. Dev.	Min.	Max.
Number of recreation days on current trip (*RDAYS*)	3.23	3.04	1	27
Total trip cost including travel	4 207	2 399	980	25 200
Round-trip travel cost	1 584	898	335	8 500
Round-trip travel cost per day in US$ (*travcost*) ($\varphi = 1/3$)	430	431	38	2 988
On-site expenses per day (*expenses*) ($\varphi = 1/3$)	705	505	179	3 305
Round-trip travel cost per day in US$ (*travcost*) ($\varphi = 3/4$)	525	504	46	3 372
On-site expenses per day (*expenses*) ($\varphi = 3/4$)	929	507	314	3 437
Age[a]	41	16	16	81
Mid-point of household income brackets (*income*)	96 917	57 912	25 000	250 000
Gender (=1 if male)	0.49	0.50	0	1
Primary and high school	0.18	0.38	0	1
College certificate/diploma	0.18	0.38	0	1
Undergraduate degree	0.32	0.47	0	1
Postgraduate degree	0.32	0.47	0	1
Wildlife interest: between 1 – 5	0.12	0.32	0	1
Wildlife interest: interested	0.22	0.41	0	1
Wildlife interest: greatly interested	0.66	0.47	0	1
Reported tour satisfaction: between 1 – 5	0.25	0.44	0	1
Reported tour satisfaction: better than expected	0.38	0.49	0	1
Reported tour satisfaction: much better than expected	0.37	0.48	0	1
Package (=1 if on tour package)	0.67	0.47	0	1
Accompanying household members (*party size*)	1.73	1.67	0	8

US$ – United States Dollars.

[a]It can be argued that adults are more realistic in their personal valuations of their recreational experiences given their budget constraints, because only adults have income. However, we believe that children also have preferences for recreational value. Navrud and Mungatana (1994) argue that excluding children would result in underestimation of the recreational value of the park.

Figure 2: Frequencies of recreation days at KNP

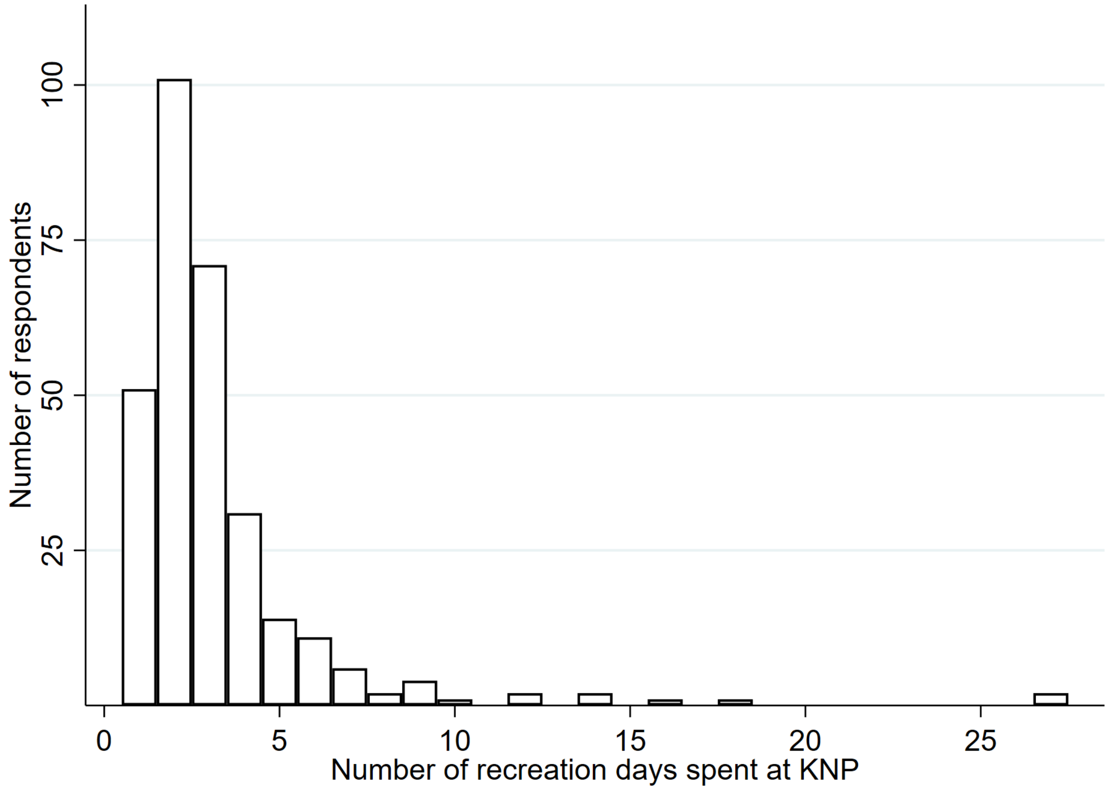


Table 2: Negative Binomial Estimates

	(I) TSNB	(II) GTSNB	(III) TSNB	(IV) GTSNB
travcost	-2.181^{***}	-2.221^{***}	-2.037^{***}	-2.079^{***}
	(0.337)	(0.341)	(0.293)	(0.304)
expenses	-0.328^{*}	-0.301	-0.160	-0.126
	(0.199)	(0.197)	(0.171)	(0.173)
age	-0.011	-0.012	-0.009	-0.010
	(0.017)	(0.017)	(0.016)	(0.016)
age squared	0.0002	0.0002	0.0002	0.0002
	(0.000)	(0.000)	(0.000)	(0.000)
gender	-0.198^{*}	-0.143	-0.199^{*}	-0.154
	(0.112)	(0.131)	(0.111)	(0.129)
income	0.183^{**}	0.236^{**}	0.167^{**}	0.216^{**}
	(0.085)	(0.116)	(0.084)	(0.105)
college certificate/diploma	-0.051	-0.064	-0.048	-0.058
	(0.153)	(0.155)	(0.148)	(0.149)
undergraduate degree	0.023	0.019	0.037	0.032
	(0.152)	(0.156)	(0.150)	(0.153)
postgraduate degree	-0.038	-0.064	-0.026	-0.050
	(0.161)	(0.166)	(0.158)	(0.162)
wildlife interest: interested	-0.029	-0.048	-0.034	-0.056
	(0.168)	(0.166)	(0.167)	(0.166)
wildlife interest: greatly interested	0.205	0.189	0.196	0.179
	(0.155)	(0.157)	(0.153)	(0.156)
satisfaction: better than expected	0.001	0.001	0.007	0.006
	(0.119)	(0.120)	(0.116)	(0.117)
satisfaction: better than expected	0.317^{**}	0.319^{**}	0.325^{**}	0.325^{**}
	(0.141)	(0.144)	(0.138)	(0.141)
package	-0.539^{***}	-0.528^{***}	-0.533^{***}	-0.523^{***}
	(0.111)	(0.109)	(0.107)	(0.106)
party size	-0.071^{***}	-0.075^{***}	-0.069^{***}	-0.073^{***}
	(0.027)	(0.028)	(0.026)	(0.027)
Constant	1.662^{***}	1.686^{***}	1.684^{***}	1.720^{***}
	(0.409)	(0.454)	(0.405)	(0.443)
α	0.158^{***}		0.150^{***}	
	(0.057)		(0.054)	
age		0.021		0.023
		(0.023)		(0.025)
gender		-0.442		-0.400
		(0.876)		(0.882)
income		-0.374		-0.358
		(0.746)		(0.680)
Constant		-2.248		-2.437
		(1.822)		(1.915)
AIC	1000	1005	995	1000
BIC	1063	1079	1058	1074
Chi-squared	189	168	191	178
Log lik.	-483	-483	-481	-480
Observations	300	300	300	300

Note: Dependent variable is $RDAYS$. TSNB – Truncated and endogenously stratified negative binomial, GTSNB – Generalized truncated and endogenously stratified negative binomial. The parameter α shows the presence of overdispersion. Columns I and II show results when the opportunity cost of recreation time is taken as 1/3 while columns III and IV use 3/4. Robust standard errors in parentheses. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The variable *income* is divided by 100 000 while the variables *travcost* and *expenses* are divided by 1000.

Table 3: Consumer surplus (US$) per day estimated from recreation-demand models

	$\varphi = 1/3$			$\varphi = 3/4$		
Model	Mean CS	Lower 95% CI	Upper CI	Mean CS	Lower 95% CI	Upper 95% CI
TSNB	459	352	658	491	383	684
GTNSB	450	346	644	481	374	674
Access value (Millions US$)	240	185	343	257	200	360

Note: This table presents the consumer surplus when the opportunity cost of recreation time is taken to be either 1/3 or 3/4. The 95% confidence intervals are also presented and are calculated as $1 \Big/ \left[\widehat{\beta}_{tc} \pm 1.96(se)\right]$. The table also presents the access value for the preferred generalized truncated and endogenously stratified negative binomial models. TSNB – Truncated and endogenously stratified negative binomial; GTSNB – Generalized truncated and endogenously stratified negative binomial.
US$ – United States Dollars.

Appendix to

Recreation Demand and Optimal Pricing for International Visitors to Kruger National Park

FOR ONLINE PUBLICATION

A Appendix

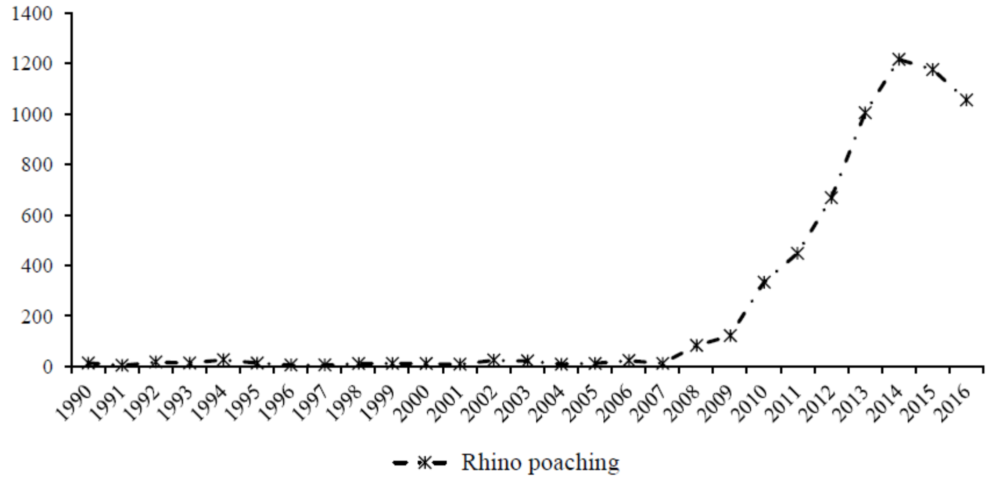
This section presents the increases in the conservation mandate for the park agency, as well as evidence of declining fiscal transfers. Both pose challenges for conservation.

A.1 Increasing Mandates and Declining Transfers

SANParks has the mandate to carry out conservation in the 21 national parks under its control. However, the park agency also faces a number of challenges. As has often happened elsewhere in Africa, in South Africa national parks were created by directly displacing local residents. As such, national parks must demonstrate that they can bring economic benefits to the locals, who shoulder the opportunity cost of land not used in agriculture and who suffer crop and livestock damage caused by wild animals, yet are excluded from utilizing natural resources in the park (see McRae, 1998; Inamdar et al., 1999). This requires additional financial resources.

In addition, the increase in poaching activity within national parks has further increased pressure on financial resources (see Figure A.1), including those required for law enforcement. KNP has been affected more than any other African park by rhinoceros poaching. The importance of tourism in generating financial resources needed for anti-poaching enforcement, therefore, cannot be underestimated. In addition, the size of the national park estate has been increasing over time, in line with the South African government's objective to increase the total size of protected areas (see Figure A.2). While SANParks land acquisition is funded through a land acquisition grant from the State, the resultant large size of the park estate gives rise to higher operating expenses. Increases in the budget allocation for operating expenses have not kept pace with the increase in size of the park estate. Transfers from the State thus remain an important source of additional funding for SANParks conservation activities.

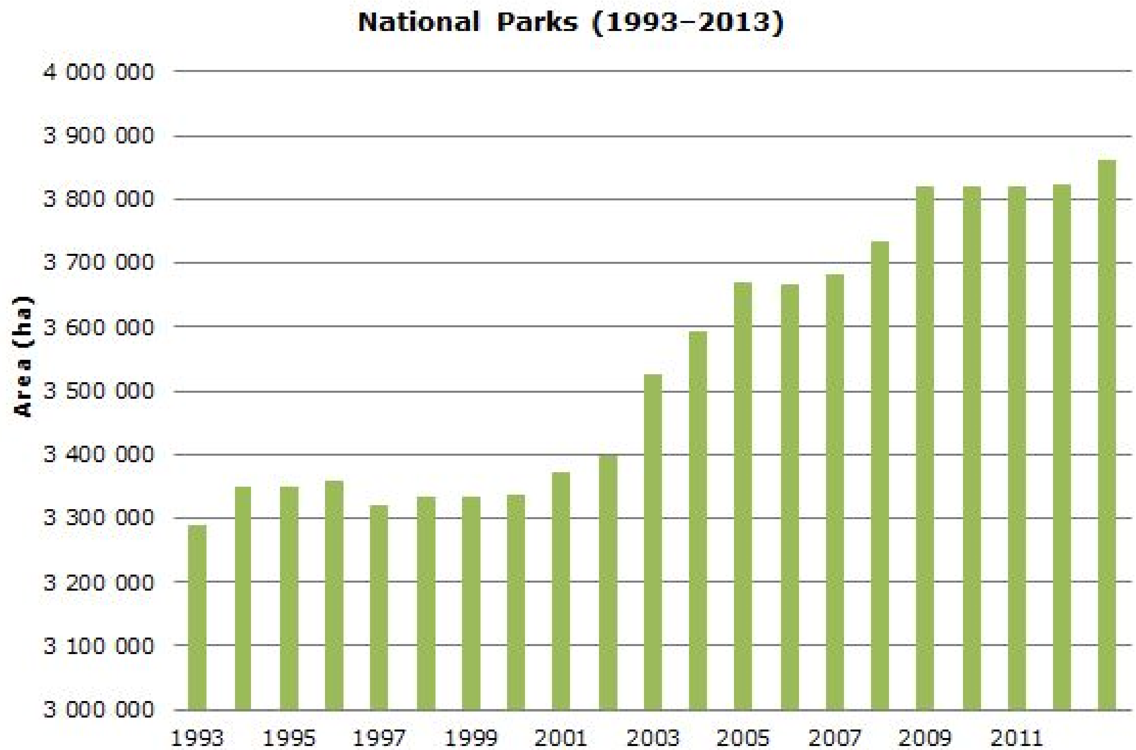
Figure A.1: Rhino poaching trends in South Africa



Source: Department of Environmental Affairs and Tourism.

Note: Figure A.1 shows the number of rhinoceros poached from parks in South Africa. SANParks has been the most affected by poaching; private game reserves and Ezemvelo KZN Wildlife (KwaZulu-Natal province's park agency) have been affected to a lesser extent. Elephant, another key species, has also been under sustained threat from poaching. While the number of rhinoceros poached (as shown in Figure A.1) appears to have been going down recently, it is still unsustainably high. The decline could be a result of successful anti-poaching efforts, dwindling stocks in traditional poaching areas making poaching more difficult, or a combination of both.

Figure A.2: Increasing national park estate in South Africa since 1993

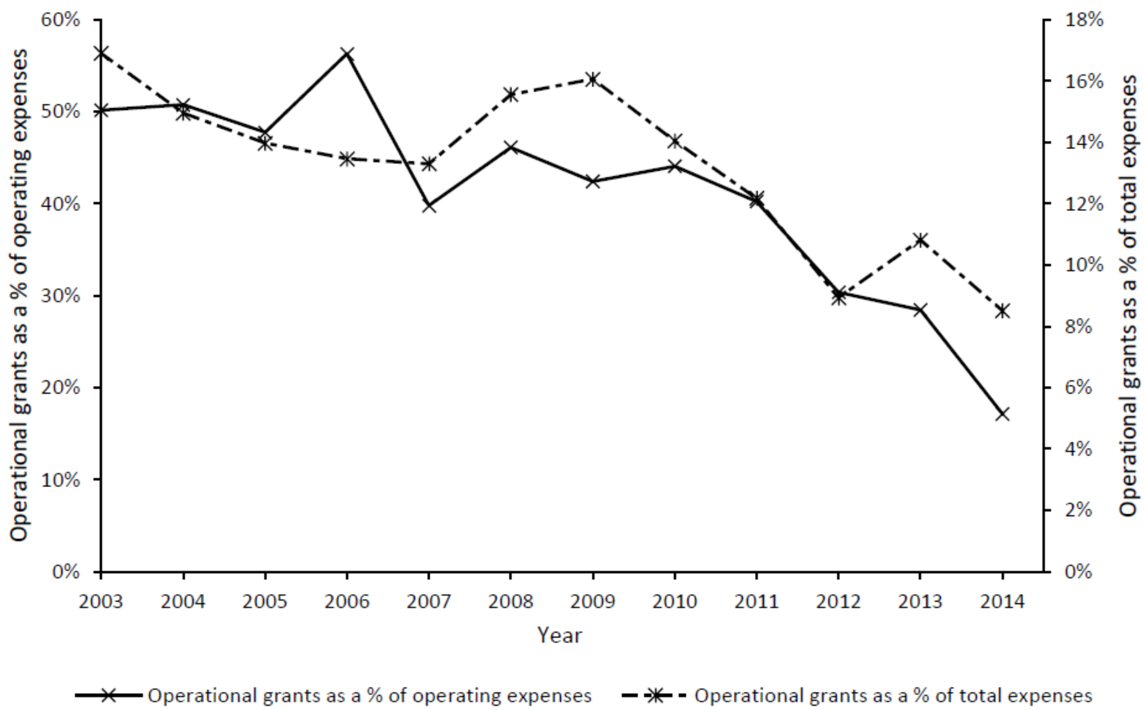


Source: Department of Environmental Affairs (`http://soer.deat.gov.za/593.html#16628`).

Note: Figure A.2 shows an increase in the size of the park estate under the SANParks. Two processes drive this increasing size over time: (*i*) expansion of existing parks, and (*ii*) the proclamation of new parks. The funding for park expansion comes from the State, through the land acquisition grant.

SANParks also receives an operating grant to cover some of the operating expenses. In the past, the park agency has experienced operational budget cuts (see Figure A.3). The operating budget is important, affecting anti-poaching efforts, biodiversity conservation, park management and tourism. Cuts in the operating grant also affect the park agency's ability to contribute towards the betterment of local communities in terms of employment creation and general development. At the same time, revenue shares from conservation levies and entrance fees remained roughly constant between 2004 and 2017 (see Figure A.4). Entrance fees as a percentage of tourism revenue have remained at approximately 32%. (Direct tourism revenue comprises revenue from accommodation, conservation levy and entrance fees, game drives, trails and other tourism-related activities.) The flat-lining of revenue in the face of declining transfers has created a growing funding gap, which if not funded by alternative sources will compromise the ability of the park agency to fulfil its conservation mandate over time.

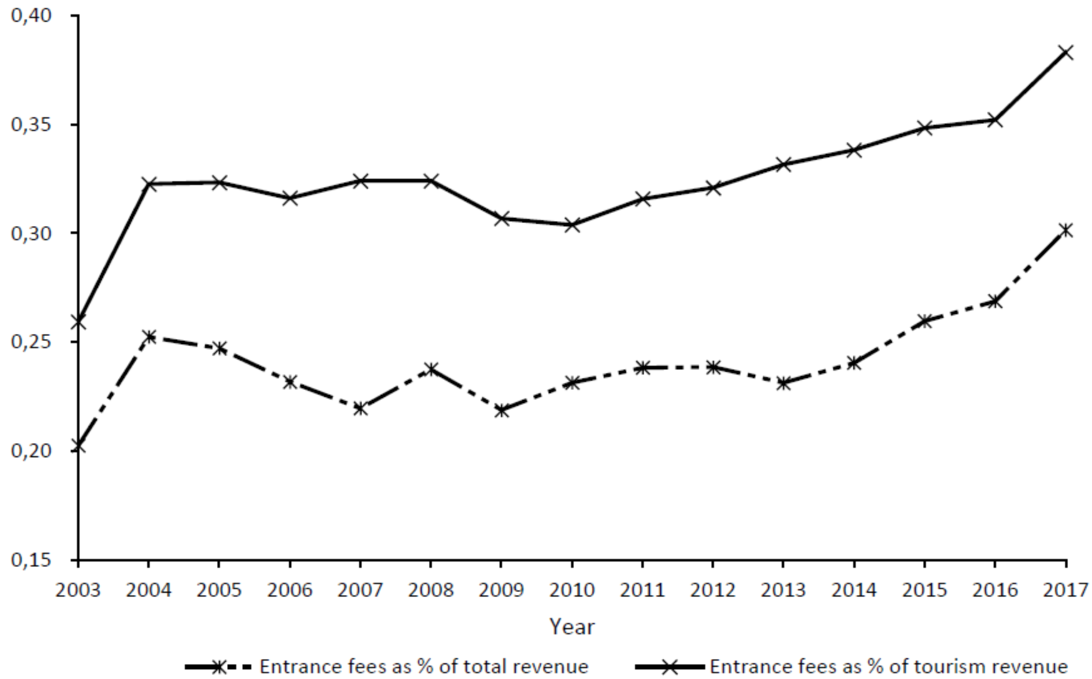
Figure A.3: Declining transfers



Source: SANParks Annual Reports (`https://www.sanparks.org/about/annual/`).

Note: Figure A.3 shows operational grants as a percentage of operating expenses and total expenses. Total expenses are measured as the sum of operating expenses, administration expenses, compensation of employees, and expenses relating to special project grants. Operating grant comes from two sources, namely the Department of Environmental Affairs and Tourism, and local authorities.

Figure A.4: Entrance fees as a percentage of revenue



Source: SANParks Annual Reports (`https://www.sanparks.org/about/annual/`).
Note: Entrance fees as a percentage of tourism revenue have remained at roughly 32%. Direct tourism revenue comprises revenue from accommodation, conservation levy and entrance fees, game drives, trails, and other tourism-related activities.

A.2 Results Using a Different Measure of Travel Cost

In this section, we present results using an alternative measure for travel cost $TCOST$, which combines both explicit and implicit on-site and round-trip travel costs ($TCOST = travcost + expenses$):

$$\begin{aligned} RDAYS \;=\; & f(TCOST,\ age,\ age^2,\ gender,\ income,\ education,\ satisfaction, \\ & wildlife\ interest,\ package,\ party\ size) \end{aligned}$$

Table A1: Negative Binomial Estimates

	(I) TSNB	(II) GTSNB	(III) TSNB	(IV) GTSNB
TCOST	-1.02^{***}	-1.01^{***}	-0.92^{***}	-0.92^{***}
	(0.147)	(0.150)	(0.117)	(0.120)
age	−0.010	−0.0094	−0.0058	−0.0039
	(0.017)	(0.017)	(0.017)	(0.018)
age squared	0.00018	0.00017	0.00011	0.000099
	(0.000)	(0.000)	(0.000)	(0.000)
gender	−0.16	−0.066	−0.15	−0.048
	(0.113)	(0.142)	(0.113)	(0.139)
income	0.23^{**}	0.29^{**}	0.23^{**}	0.27^{**}
	(0.093)	(0.130)	(0.095)	(0.123)
college certificate/diploma	−0.075	−0.090	−0.085	−0.095
	(0.166)	(0.168)	(0.165)	(0.167)
undergraduate degree	−0.055	−0.049	−0.066	−0.052
	(0.160)	(0.161)	(0.160)	(0.161)
postgraduate degree	−0.11	−0.14	−0.13	−0.15
	(0.171)	(0.173)	(0.170)	(0.171)
wildlife interest: interested	0.059	0.056	0.076	0.075
	(0.170)	(0.167)	(0.171)	(0.170)
wildlife interest: greatly interested	0.31^{*}	0.30^{*}	0.33^{**}	0.32^{**}
	(0.161)	(0.161)	(0.161)	(0.161)
satisfaction: better than expected	−0.0069	−0.0027	0.000085	0.0053
	(0.129)	(0.127)	(0.129)	(0.127)
satisfaction: much better than expected	0.26^{*}	0.27^{*}	0.25^{*}	0.27^{*}
	(0.152)	(0.150)	(0.152)	(0.150)
package	-0.52^{***}	-0.51^{***}	-0.50^{***}	-0.50^{***}
	(0.115)	(0.113)	(0.115)	(0.112)
party size	-0.064^{**}	-0.065^{**}	-0.063^{**}	-0.062^{**}
	(0.030)	(0.031)	(0.030)	(0.031)
Constant	1.57^{***}	1.46^{***}	1.69^{***}	1.53^{***}
	(0.426)	(0.493)	(0.431)	(0.503)
α	0.181^{***}		0.192^{***}	
	(0.059)		(0.060)	
age		0.0044		−0.0021
		(0.019)		(0.019)
gender		−0.58		−0.59
		(0.823)		(0.783)
income		−0.36		−0.23
		(0.763)		(0.707)
Constant		−1.27		−1.05
		(1.464)		(1.365)
AIC	1017.2	1022.3	1018.3	1023.5
BIC	1076.4	1092.7	1077.6	1093.8
Chi-squared	175.4	144.8	179.2	148.4
Log lik.	−492.6	−492.2	−493.2	−492.7
Observations	300	300	300	300

Note: Dependent variable is $RDAYS$. TSNB – Truncated and endogenously stratified negative binomial, GTSNB – Generalized truncated and endogenously stratified negative binomial. The parameter α shows the presence of overdispersion. Columns I and II show results when the opportunity cost of recreation time is taken as 1/3 while columns III and IV use 3/4. Robust standard errors in parentheses. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The variable *income* is divided by 100 000 while the variable TCOST are divided by 1000.