Towards a Pricing Policy for Namibia's Game Parks

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Introduction

Namibia is a very young country with a great deal of promise. Independent from South Africa only since 1990, it is well-endowed with natural resources, is stable socially, and appears committed to policies aimed at improving social welfare and equality over time. Among African nations, its natural resource wealth and human capital position it better than most to achieve prosperity.

To the recent visitor, a striking observation is the relative underdevelopment of Namibia's tourism and park facilities. The country has robust populations of ungulates, black rhinos, hippos, elephants, and other species prized by eco-tourists and hunters, making for excellent viewing and hunting experiences. However, anecdotal information suggests that foreign tourism is comprised mostly of visits by South Africans and Germans. It seems that Namibia is not well-known among the larger tourism community as a premiere destination.

Even with visitation coming from a relatively small segment of the world's tourists, existing facilities at some of Namibia's game parks are oversubscribed. At Etosha National Park,
for example, the wait list for reservations may run from a few days to a few weeks in duration, depending on the time of year. Etosha is a crown jewel among African game parks, and appears to draw the lion's share of foreign visitation to Namibian game parks, compared to other parks such as Mahongo and Mamili, which have virtually no visitor facilities.

Even at Etosha, facilities for visitors are fairly limited. While the quality of accommodations is quite acceptable, visitors must overnight at one of only three rest camps near watering holes. Each rest camp is small to moderate in size, accommodating a few hundred visitors each, but the park itself is so vast that it is not common to encounter many other visitors during the course of a day's game viewing. The entrance price and overnight fees at rest camps are both quite modest by regional standards.

This combination of factors suggests that Namibia is standing at the brink of substantial growth in foreign tourism and faces important policy choices in deciding whether, and how, to accommodate this growth. In neighboring countries, such as Botswana, the government has substantially raised tourism fees at game parks and recoups significant revenues from its wildlife resources, while still receiving large volumes of tourist visits (Barnes et al). Some of the policy questions which arise, and will be dealt with either explicitly or by omission, include:

• Should Namibia raise gate and/or overnight fees at its parks to increase revenues, in light of the current excess demand at some parks?

• Should prices be raised uniformly at all parks, or should some parks be subject to larger price increases than others? What substitution effects among parks might be expected if relative prices change? How are they to be accounted for in the pricing strategy?

• Should capacity be increased to meet the potential increases in tourism demand? What would be the effect on viewing quality if there were substantially more tourists at some parks? How would this in turn affect visits to other parks? What effects might be expected through quality diminishment or congestion effects?
Each of these sets of questions speaks to the need for a parks pricing policy. Some aspects of this problem have been considered by Namibia's Ministry of Environment and Tourism (MET). In particular, the role of tourism and wildlife in community development (Ashley; Ashley and Garland; Ashley et al. 1997) and the contribution of tourism to the national economy (Ashley et al. 1997; Barnes 1995, 1998; Barnes and deJager), strategies for parks pricing is one area that has not been investigated much in Namibia. For instance, one strategy recently proposed for evaluating tourism potential of Northern Namibia parks is to take the number of miles of road system within each park and divide by a figure (e.g., 5 km) that would provide sufficient spacing of tourists so they would not encounter each other while viewing wildlife (MET).

This suggests a couple of things that will likely be important in designing parks pricing strategies. First, through use of an economic behavioral model, one can predict visitation under a variety of economic conditions, including parks prices and qualities, rather than relying on physical measures such as road miles. Such an approach makes explicit the policy objective and considers the efficacy of different instruments to achieve that objective.

The second point implicit in the proposed "road miles" strategy is the recognition that congestion may be an important quality element of the tourism experience. This could be because increased numbers of visitors make wildlife more shy and harder to see. Or it could be because of external effects visitors cause on each other, independent of any effects on animal densities and viewing success. In any event, it seems clear that congestion effects can play an important role in planning for tourism growth, along with the usual measures of quality such as abundance and diversity of wildlife populations.
This paper develops a simple model of Namibian parks as sources of inter-related consumption goods for visitors, both local and foreign. A revealed preference approach is used as it makes explicit the role that features of different parks play in tourists' demands for visits and, ultimately, their valuations of park services.\(^1\) To the extent that parks are unique, their demands will be less than perfectly elastic and there will be an opportunity for discriminatory pricing to capture rents from the underlying wildlife resources. Within a system of demands for different parks, the revenue-maximizing pricing rules are developed. These rules differ somewhat from the standard rules that apply for second- and third-degree pricing because of the demand interdependence. Optimal park entry prices are interdependent because a change in price at one park induces substitution effects among other parks and affects the optimal price at those parks. The effects of quality measures such as animal abundance and diversity, and congestion, on optimal prices and marginal rent are developed.

While empiricizing the model for policy work is still a ways off, by formalizing an economic model one can understand better the types of information that would be useful in developing pricing strategies. This can help to guide data collection efforts in the field, which will ultimately be needed to move pricing policies from the realm of the hypothetical to actual practice. Fortunately, methods for determining the parameter values in the parks model are standard, as the large literature on the travel cost method for estimating recreation demands (e.g., Clawson, Knetsch, Hausman \textit{et al}., Bockstael \textit{et al}., Morey \textit{et al}.) attests.

This type of policy evaluation has a significant international dimension, since the prime competing parks for Namibia's game parks are in neighbor countries-- Botswana, Zambia, South

\(^1\) In contrast, much of the existing valuation work for Namibia's wildlife resources uses stated preference techniques (e.g., Barnes, Barnes \textit{et al}.). These studies focus more on the value
Africa, and Zimbabwe. These parks and their characteristics--prices and wildlife viewing quality--provide backstops which Namibia must consider in its parks pricing and quality enhancement decisions. In fact, some empirical work has been done to derive estimates of tourism demand and willingness to pay for parks in Kenya and Zimbabwe (Brown and Henry; Brown et al. 1994; Brown et al. 1995). Pricing decisions made by these countries will have an impact on Namibia's opportunities and optimal prices. And because of trans-boundary movement of wildlife, their wildlife resources and management policies will play an important role in shaping Namibia's policies.

The Parks Model

The model developed here is perhaps the simplest possible framework that can allow for heterogeneous visitors and parks. Visitors differ in terms of the type of recreational experience they seek and how they value the components of the experience, and parks differ in the quality characteristics they offer to visitors.

The primary quality attributes of parks are related to both people and animals. The quantity and quality of wildlife are both important, with quality of wildlife being measured by a diversity index and quantity as the number of animals. The primary park characteristic related to people is congestion, which is a "bad": a more congested park, ceteris paribus, would be worth

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2 These empirical studies do not consider the potential interaction of demands among multiple parks; instead they estimate the demand for a single park or for generic wildlife viewing for the country as a whole.
less to a visitor than a park with fewer other visitors. The other principal characteristics that visitors respond to are the usual demand arguments for all consumption goods: own prices, substitute prices, and income.

Visitors to parks are either of two types. "Specialist" visitors value a specialized recreational experience characterized by the opportunity to view wildlife under conditions more primitive and with greater solitude than do "generalists." Wildlife viewing quality, including the presence of rare or hard-to-see animals, is more important to specialists than is the sheer abundance of animals. Congestion is a strong bad to this type of visitor, much more so than for generalist visitors. Generalist visitors also value wildlife encounters, but value abundance more than diversity or rarity. They also are not averse to encounters with other viewers, at least over the ranges of tourist densities likely to be encountered in Namibia's policy planning process.

One might also speculate about the effects of price and income on demand for the two parks, as well as the income levels of the two market segments. Ultimately, parameter estimates and variable levels are determined empirically based on field data and estimated demand models. As *a priori* hypotheses, though, it seems reasonable to expect that for specialized recreation, (a) willingness to pay (i.e., marginal consumer's surplus per unit of consumption) is higher; (b) unit cost of recreating is higher; and (c) income levels of participants in this market segment are higher. It also seems plausible that the income elasticity of demand is higher for specialized recreation.

To develop some basic intuition about parks pricing strategies, no attempt will be made to distinguish types of parks apart from types of people as things can get complicated in a hurry. Instead, we can consider two parks, one of which caters to specialists while the other attracts

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3 Which does not necessarily mean that revenue generated from the park is lower, since
generalists. Thus the demands for the parks themselves embody the characteristics of their consumers, in terms of the relative importance of congestion and types of animal contacts.

Congestion (C) is related to the aggregate number of visitors in a park, with a simple proportionality relationship used for convenience in deriving algebraic results. For park \( i \), the congestion relationship is

\[
C_i = \theta_i \cdot X_i, \quad \text{for } i = 1,2
\]

where \( X_i \) is the number of visitors to park \( i \) and \( \theta_i \) a parameter. Let park 1 be the park attracting specialists, while park 2 attracts generalists; the characteristics of these two types of recreationists then imply that \( \theta_1 > \theta_2 \); that is, a given number of visitors contributes much more to congestion at park 1 than at park 2.

Maintaining the linearity assumption for convenience in exposition, the aggregate demands for visits at the two parks can be written as

\[
X_1 = \alpha_1 + \gamma_{11} \cdot p_1 + \gamma_{12} \cdot p_2 + \gamma_{13} \cdot D_1 + \gamma_{14} \cdot N_1 + \gamma_{15} \cdot C_1 + \beta_1 \cdot M_1
\]

\[
X_2 = \alpha_2 + \gamma_{21} \cdot p_1 + \gamma_{22} \cdot p_2 + \gamma_{23} \cdot D_2 + \gamma_{24} \cdot N_2 + \gamma_{25} \cdot C_2 + \beta_2 \cdot M_2
\]

where \( D_i \) is the diversity index, \( N_i \) is the index of animal abundance, \( C_i \) is the congestion index, and \( M_i \) is the income level of each market segment. The discussion above suggests the following relationships among parameters:

the lower value per visitor is offset by the larger number of paying visitors.
In (4), $p_1$ and $p_2$ are marginal willingnesses to pay from the inverse demands, not to be confused with the optimal prices (which will be denoted $p^*_1$ and $p^*_2$) determined as a consequence of the parks pricing strategy.

**Effects of Different Congestion Sensitivities On Own-Price Elasticities**

Congestion has an interesting effect on the demand system, because of its close correlation with aggregate visits. In our simple model with proportionality between visits and the congestion measure, the congestion effect creates an endogeneity of aggregate visits, since it appears on both sides of the demand equations. This can be seen by substituting the congestion functions (1) into the aggregate demands (2) and (3), resulting in implicit functions in aggregate visits $X_i$.

In the linear case, the resulting expressions are easily rewritten in reduced forms for $X_i$, as

\[
X_1 = \alpha'_1 + \gamma'_{11} \cdot p_1 + \gamma'_{12} \cdot p_2 + \gamma'_{13} \cdot D_1 + \gamma'_{14} \cdot N_1 + \beta'_1 \cdot M_1
\]

\[
X_2 = \alpha'_2 + \gamma'_{21} \cdot p_1 + \gamma'_{22} \cdot p_2 + \gamma'_{23} \cdot D_2 + \gamma'_{24} \cdot N_2 + \beta'_2 \cdot M_2
\]

where $\alpha'_i = \alpha_i/(1-\gamma_{i5})$, $\beta'_i = \beta_i/(1-\gamma_{i5})$, and $\gamma'_{ij} = \gamma_{ij}/(1-\gamma_{i5})$, for $i = 1,2$, and $j = 2,\ldots,4$. Since $\gamma_{i5} < 0$ (presuming congestion is a bad rather than a good), the effect of increasing congestion sensitivity is to lower coefficient magnitudes in the reduce form demands. Thus one implication...
of high congestion sensitivity (e.g., at the specialist site) is to reduce own- and cross-price elasticities, as well as the quality and income elasticities.

"Optimal" Pricing Rules

With the reduced form demands (5) and (6) that account for congestion effects, we are in a position to consider pricing strategies for the parks. We assume that a reasonable goal for Namibian authorities is to capture monopoly rents from the park and wildlife resources it owns. While not optimal globally for standard reasons, such an approach makes sense given the Namibian accounting stance.

Let the marginal cost per visitor at each site be a constant, MC\(_i\), for i=1,2, again for simplicity. Then the pricing problem can be written as

\[
\text{(7) Max}_p \sum_i p_i \cdot x_i(p,D_i,N_i,M_i) - \sum_i MC_i \cdot x_i(p,D_i,N_i,M_i)
\]

where \( p \equiv (p_1,p_2) \). Assuming the second order sufficient conditions for a maximum hold, the necessary conditions are

\[
\text{(8)} \quad X_1(p^*_1,D_1,N_1,M_1) + (p^*_1 - MC_1) \cdot \gamma'_{11} + (p^*_2 - MC_2) \cdot \gamma'_{21} = 0
\]
\[
\text{(9)} \quad X_2(p^*_1,D_2,N_2,M_2) + (p^*_1 - MC_1) \cdot \gamma'_{12} + (p^*_2 - MC_2) \cdot \gamma'_{22} = 0
\]

which solve for
In (10) and (11), the terms \( \alpha_1 \equiv \alpha'_1 + \gamma'_1 \cdot D_1 + \gamma'_2 \cdot N_1 + \beta'_1 \cdot M_1 \) and \( \alpha_2 \equiv \alpha'_2 + \gamma'_3 \cdot D_2 + \gamma'_4 \cdot N_2 + \beta'_2 \cdot M_2 \) are the terms containing non-price arguments; i.e., quality and income. By the chain rule, once the effects of \( \alpha_i \) on \( p^*_j \) are known, the income and quality slopes of optimal prices follow immediately.

The simple analytics of this pricing mechanism can be seen in Figure 1. Essentially it is the standard monopoly pricing problem with the slight modification that control is exerted over two markets which substitute for one another in consumption. In Figure 1, the optimal prices \( p^*_1 \) and \( p^*_2 \) are determined off the respective demand schedules at quantities (numbers of visits in this context) which equate marginal revenue from the incremental induced visit to its marginal cost.
Several observations can be made about the optimal park prices in (10) and (11). First, it is clear that parameters of each park's demand affect both demands, through the cross-price substitution effects $\gamma_{12}'$ and $\gamma_{21}'$. Intuitively, this makes sense, because changes in the structure of demand for one park due to non-price adjustments (e.g., an investment in habitat that increases animal numbers at park 2) cause a change in the optimal price for that park. This in turn affects the demand for the substitute (or complement) park, park 2 in this case. The change in demand at park 2 then prompts an adjustment in the optimal price at park 2.

This inter-relatedness of park prices due to their substitution relationships in demand is an important, though perhaps sometimes overlooked, fact of optimal joint pricing. To capture fully the effects of an investment in habitat at park 1 (to continue the example from above),
managers must adjust all prices in response. This equilibrium path of park prices would occur, for example, with an increase in animal numbers at park 1, whose demand is highly inelastic and whose maximum willingness to pay (y-intercept) is substantially higher than for park 2. The increase in animal numbers shifts out demand at park 2, prompting an increase in \( p^*_2 \); this then shifts demand at park 1 out (presuming the parks are substitutes); and in turn the optimal price \( p^*_1 \) increases. If the price at park 1 were not increased, money would be "left on the table" in terms of maximizing rents from Namibia's wildlife resources.

How much money is foregone by not raising all prices is an empirical question, determined by the strength of the cross-price effects. The closer the two parks are as substitutes, the larger the amount foregone. Balanced against this are the costs of raising prices, which may involve administrative expense. Another cost may be the political cost of raising park prices, in particular if it is done sequentially rather than simultaneously for all parks which act as consumption substitutes. These must be factored into the policy equation for deciding a pricing strategy. However, it is interesting to observe that in the US, it is not uncommon for managers to raise prices broadly for all parks, as was done roughly 3 years ago when prices were quadrupled for National Parks. It may be that administratively and politically, it was easier to raise all prices rather than individual prices. The model of this paper suggests why it might be beneficial from a revenue standpoint as well.

To emphasize that it is price substitution effects that drive the jointness of the pricing decision, consider what happens to the optimal pricing rule when the parks are independent in consumption \( (\gamma'_{12} = \gamma'_{21} = 0) \). In this case, the optimal prices simplify to

\[
p^*_1 = \frac{(\alpha_1 - \gamma_{11} \cdot MC_1)}{\gamma_{11}}
\]
and
\[ p_2^* = \frac{(\alpha_2 - \gamma_{22} \cdot MC_2)}{-2 \cdot \gamma_{22}}, \]

which are the price rules obtained by setting prices separately for goods with linear demands.

**Comparative Statics of Viewing Quality and Income Changes**

As noted above, by defining the variables \( \alpha_1 \) and \( \alpha_2 \), one can concisely express the comparative statics of viewing quality and income changes. If recreation is a normal good, and viewing quantity and quality are economic goods, then the effects of each of these variables on the composite intercepts \( \alpha_1 \) and \( \alpha_2 \) will be positive. Thus, the sign of comparative statics results for \( \alpha_1 \) and \( \alpha_2 \) are the same as those for income and viewing quality measures.

From (10) and (11), the effects on optimal prices of a change in \( \alpha_1 \) are

\[ \frac{\partial p_1^*}{\partial \alpha_1} = -2 \cdot \frac{\gamma_{22}}{D}, \]

and

\[ \frac{\partial p_2^*}{\partial \alpha_1} = \frac{(\gamma_{12} + \gamma_{21})}{D}, \]

where \( D \equiv 4\gamma_{11} \cdot \gamma_{22} - (\gamma_{12} + \gamma_{21})^2 > 0 \) by the second order conditions for a maximum (Silberberg).

Since the congestion-adjusted own-price coefficient \( \gamma_{22} < 0 \), one can say unequivocally that the effects of quality and income increases, under the conditions noted above, will increase optimal
own-site prices. As for cross-prices, they depend on the substitution relationship: the effect on cross-price is positive under substitution, and negative under complementarity.

The symmetry of the problem assures parallel results for changes in $\alpha_2$. The relevant comparative statics derivatives are

$$\frac{\partial p^{*}_1}{\partial \alpha_2} = \frac{(\gamma_{12} + \gamma_{21})}{D},$$

and

$$\frac{\partial p^{*}_2}{\partial \alpha_2} = -2 \cdot \gamma_{11} / D,$$

with the same qualitative results just noted.

One can also note the effects on marginal net revenue of changes in viewing quality and income variables. From the envelope function applied to the pricing objective function (7), the change in net revenue (NR) with changes in $\alpha_1$ and $\alpha_2$ are

$$\frac{\partial NR}{\partial \alpha_1} = (p_1 - MC_1),$$

and

$$\frac{\partial NR}{\partial \alpha_2} = (p_2 - MC_2);$$

i.e., the profit margins from price discriminating are the marginal effects of increasing the composite intercept. Multiplying by the demand coefficient of each variable then gives the incremental benefits of changes in each variable.

These comparative statics results are of particular interest for variables over which Namibian managers have control, namely the viewing quality and abundance variables. (Incomes of visitors to each park are largely, if not wholly, exogenous to managers.) They raise the possibility of allocating fixed wildlife enhancement expenditures among parks according to which expenditures will give the largest return to the Treasury. This treatment is beyond the scope of the present version of the paper, but seems an appropriate avenue for additional characterization of model implications.
Comparative Statics of Differences in Congestion Sensitivity

It was noted earlier that congestion sensitivity appears in the denominator of all reduced form coefficients for demand, under the hypothesis of proportional (but differing) effects on demand. To investigate the effects of increasing disutility from congestion, the optimal pricing equations (10) and (11) are written to make the congestion terms $\gamma_{15}$ and $\gamma_{25}$ explicit, by replacing variables with primes with their counterpart that have congestion terms in the denominator. Dividing through the numerator and denominator of the the pricing equations by $(\gamma_{25})^2$, the resulting versions of the pricing equation for park 1 is

$$p^*_1 = \frac{(\gamma_{12} + \rho \cdot \gamma_{21}) \cdot (\rho \cdot \gamma_{22} - \gamma_{12} \cdot MC_1 - \rho \cdot \gamma_{22} \cdot MC_2) - 2 \cdot \gamma_{22} \cdot (\alpha_1 - \gamma_{11} \cdot MC_1 - \rho \cdot \gamma_{21} \cdot MC_2)}{4 \cdot \rho \cdot \gamma_{11} \cdot \gamma_{22} - (\gamma_{12} + \rho \cdot \gamma_{21})^2}$$

where $\rho \equiv \gamma_{15} / \gamma_{25} \geq 1$ is the relative congestion sensitivity of park 1. The comparative statics on an increase in congestion sensitivity at park 1 (as, for example, if visitors to park 1 have increased aversion to crowds) indicate that both optimal prices will fall. If the congestion sensitivity at park 2 increases (or, equivalently for purposes of the model, if congestion sensitivity at 1 falls) the result is an increase in optimal prices. Interestingly, if the congestion sensitivities are the same at both parks, congestion effects play no role in the parks pricing strategy, despite differences in all other characteristics of visitors to the two parks.
Conclusions

This paper has sketched out the basics of an optimal pricing strategy for wildlife parks that act as substitutes or complements in demand. The model highlights the key economic factors that influence the setting of parks prices designed to maximize national net benefit. All of these factors are, in principle, measurable using standard methods from recreation demand analysis combined with field collection of data from visitors.

The solution for optimal prices follows the same basic form as for standard discriminatory pricing models, though the economic substitution through relative price effects means that optimal park prices are inter-related. Further, for policy changes (as, for example, to enhance wildlife populations or habitat at a single park), the optimal net revenue-generating strategy requires that all park prices be adjusted even though only one is directly physically affected by the enhancement. It is noted that the strategy of jointly changing all prices may not be difficult administratively or politically, as there are recent precedents in U.S. park pricing policies.

Though simple, the model is rich enough to aid in the evaluation of a variety of issues concerning the management of wildlife parks. An issue not addressed here is how managers should best allocate limited budgets for parks enhancement across different parks, based on their knowledge of demand conditions and the costs of alternative enhancement strategies. The modeling framework can, in principle, also shed light on optimal levels of both abundance and diversity of animal populations, though putting the concepts into practice requires obtaining sufficiently robust empirical measures of the demand responses to these types of quality enhancements. The framework can also be used to evaluate a variety of other revenue-
maximizing strategies, such as the setting of differential fees for in-country versus regional and long-distance foreign visitors. It generalizes readily to systems on $n > 2$ parks with some additional costs of notation and less clear intuition about the direction of findings. Many of these issues are worth further exploration.

References


