Scenic Spot Entrance Fee Pricing in Tourism Supply Chains

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Abstract: Based on review of relevant researches on scenic spot entrance fee, this paper establishes scenic spot entrance fee pricing models for resource protection. These models includes five ones: the first one pricing to individual tourist; the second one pricing to local tour operator who provides two products "pure-tour" and "regular-tour"; the third one pricing to tour operator in intergraded tourism supply chain; the forth one pricing to individual tourist and local tour operator; the fifth one pricing to individual tourists, local tour operator and tour operator in intergraded tourism supply chain simultaneously. We get the analytic solutions for the all models. The commissions charged from local tour operators to tour agencies are also discussed.

Keywords: resource protection; tourism supply chain; entrance fee; tour commissions

I. Introduction

Pricing of scenic spots (protected areas) relates to ethics, fairness, tradition and other issues. Papers on how to price scenic spots can be divided into two parts, namely pricing based on the value of scenic spots and pricing based on profit maximization (or welfare maximization).

WTP(Willingness To Pay)is the theoretical underpinnings based on the value of scenic spot , also the theory of environmental assessment. WTP is the monetary measure which is willing to be paid based on the constant individual utility after the change of environment. Applications of these methods have been described in [10] [2] [3].

Literatures on pricing based on profit maximization(or welfare maximization)-oriented are relatively small and usually appear in the traditional economics and management science journals. Literature [12] analyzed the optimal reserve capacity and optimal pricing problem of package demand and spot demand for a fixed service capacity company. Literature [5] gave the optimal pricing model whose objective function was welfare maximization after consideration of positive and negative ecological effect, which also can divide tourists into nationals and foreigners charging different prices.

The second pricing method was mainly used to discuss how to price entrance fee to maximize their profits and control flow of tourists for those enterprises and agents who have the operational right of scenic spots based on natural resources. This pricing can coordinate the public and private benefits. Thus, the equity about tourism resource use between generations and maximization of Scenic spot's profit can realize simultaneously.

However considering that a considerable part of tourists (mainly refers to the group tourists)got service through tour operator and other distribution, this paper establishes scenic spots pricing model in tourism supply chain system in the case of game between local tour operator and tour operator, pricing model after vertical integration between local tour operator and tour operator; and pricing model including individual tourist and group tourists, giving the optimal price. Models in this paper all assumed that tour operators provide two products "pure-tour" and "regular-tour" in order to be more in line with the features of Chinese tourism.

The official use of tourism supply chain concept was no more than five or six years. Literature [11] reviewed some literatures in depth relating to tourism supply chain in the mainstream of the international tourism research journals, pointing that the research of tourism supply chain was an important direction in tourism area.

The study of this paper is different from that of previous ones. This paper takes the whole tourism supply chain as a complete system consisting of resources production and tourism distribution channels of scenic spots(protected area)---core attraction, establishing optimal pricing model of systematical entrance fee by using game theory for the first time, while using people flow instead of goods flow, revealing the interactions among tourism supply chain elements such as the protection of tourism natural resources, scenic spots pricing, distribution channel, tourism shopping, tourists' preference and so on.

II. Model

Review of pricing model to individual tourist

According to literature [8], assuming there are n kinds of tourism resources in scenic spots. Where r_i is the regeneration coefficient of NO. i tourism resource, l_i is vulnerability coefficient, $i = 1,2,\cdots n$. Here regeneration coefficient refers to the after growth rate of tourism resource after breakage. Vulnerability means the breakage extent caused by the tourism activities from individual tourist Assuming that $R^0(R_1^0, R_2^0, \cdots R_n^0)$ is the origin total of all. kinds of tourism resources before the arrival of tourists. Sustainable use of resources calls for constant total of all resources at least. Then we assume that $Q = a(V - u)$ is the number of tourists during the time T ,where u is the entrance fee, a is the maximum capacity of tourists in the period, V is the value of scenic spot. The conditions for all kinds of tourism resources keeping $R_i^1 \geq R_i^0, i = 1,2,\cdots n$ from the beginning to the end of the period is

$r_i T \geq l_i Q$

The maximum capacity of tourists is

$$Q^* = T \min[\frac{r_i}{l_i}] \quad (1)$$

Here $Q = a(V - u)$

It is impossible to price entrance fee for every tourism resource, so here we pick the tourism resources whose $\frac{r_i}{l_i}$ is minimum as the price baseline in order to get every tourism resource into sustainable use.

Then we can get the protective pricing of scenic spots resources

$$\underline{u} = V - \frac{T}{a}\min[\frac{r_i}{l_i}],\ i = 1,2,\cdots n \quad (2)$$

As indicated from the equation, protective pricing depends on the ration $\frac{r_i}{l_i}$ between breakage and recovery of the most vulnerable resource, if the regeneration rate of this resource is high, or vulnerability rate is low, then the corresponding pricing level will be relatively low, pricing level will be high inversely. Besides, the number of the maximum potential consumers a will alter in the same direction with the value of scenic spots V .

In real operation, enterprise of scenic spots often price based on profit maximization, if profit-maximizing pricing is higher than protective pricing, the problem of sustainable use of resources will be solved by the market mechanism automatically. If not, the relevant government department can directly intervene in pricing setting.

Assuming short-term lease of scenic spots, one should price based on current profit maximization. Assuming the marginal cost of tourism is zero, scenic spots will face the following decision problem:

$$\max \quad \pi = uQ$$
$$s.t. Q = a(V - u)$$

According to first-order conditions, the optimal pricing

$$u^* = \frac{V}{2}$$

If $u^* \geq \underline{u}$, profit-maximizing pricing is no less than the protective pricing, the requirement of protective pricing can be met by market mechanism easily. if $u^* < \underline{u}$, profit-maximizing pricing is less than the protective pricing, the relevant government department should consider raising the guided pricing to control the flow of tourists.

Model of Tourism Supply Chain Structure

The above model solves the problem of how to use protective pricing to control the tourists' flow if we only consider direct access to scenic spot by individual tourist. However, lots of tourist still buy tourism products from tour operators traditionally namely Group Package out of asymmetric information, risk, additional services and so on from home and abroad. Being similar to the case of individual tourist, scenic spots should consider how to use pricing to control the tourist flow brought by tour operator (tourism supply, tourism consumption).

According to the features of tourism supply chain and fact of tourism service, we establish the following model:

We assume that there is a tourism scenic spot U, a tour operator A, a local tour operator B and a tourism shopping enterprise C in tourism supply chain. Local tour operator has two kinds of products b1 and b2: b1 adopted the strategy to combine with shopping enterprise C, shopping activities included in the course of travel, while b2 only provides "pure-tour". Tour operator A sets p_1 as unit pricing for "regular tour" b1 and p_2 as unit pricing for "pure tour"b2. Tour operator B sets w_1 and w_2 for the b1 and b2 as the average unit price (price of receiving group) to tour operator. Tourism shopping enterprise C sets k for the product as unit price whose cost is h ,and returns n as per capital to local tour operator B1 according to the number of visiting tourists. Because of the intangible tourism receiving service, the fixed cost of tour operator is relatively low, here we assume fixed cost to be zero without loss of generality.

Assuming c_a is the variable cost of receiving a single tourist for tour operator A, tourism products b1and b2 have the same cost structure for local tour operator, c_b is the variable cost for every tourist, u is the per capital paid to scenic spot. Tourists of tour operator choose b1 or b2 freely according to p_1 and p_2. Hence, the profit functions for A and B are:

$$\pi_A = d_1(p_1 - w_1) + d_2(p_2 - w_2) - c_a(d_1 + d_2) \quad (3)$$

$$\pi_B = \pi_{b1} + \pi_{b2} \quad (4)$$

Where

$$\pi_{b1} = (w_1 + n - c_b - u)d_1 \quad (5)$$

$$\pi_{b2} = (w_2 - c_b - u)d_2 \quad (6)$$

Assuming neutral utility of tourists, then the utilities of b1 and b2 for tourists are

$$V - p_1 - r(t + s)$$

$$V - p_2 - rt$$

The above $t > 0$ is the consuming energy or time in the course of tourism, $s > 0$ is the additional time or energy for shopping, V is the expected value of tourists for this tour, equaling the sum of the service value provided by tour operator A. V_a , the expected value (assuming the same expected value of services from product b1 and b2) of service provided by local tour operator V_b and the value of scenic spot V_e , we assume every tourist has the same V and $V-c_a-c_b > 0$. This is the necessary condition for "pure tour" market exist. r is the cost of unite time and energy of tourist, and this cost is different to every tourist. H.R.Varian(2001) in MIT conclude that U.S. Internet users per unit time cost is $ 0.60 / h through experiment, we also can obtained the per unit time cost of Chinese tourists. We assume that r even distributed in $[0, R]$, R is a large enough number. Noting $p_1 < p_2$, or local tour operator B1will receive no tourist.

We assume Z is the total potential market, so the expected number of tourists who choose "regular tour" is

$$d_1 = \frac{Z}{R}\int_0^{\frac{p_2-p_1}{s}} f(x \mid r)dx = \frac{Z}{R}\frac{p_2-p_1}{s} \tag{7}$$

the expected number of tourists who choose "pure tour" is

$$d_2 = \frac{Z}{R}\int_{\frac{p_2-p_1}{s}}^{\frac{V-p_2}{t}} f(x \mid r)dx = \frac{Z}{R}\left(\frac{V-p_2}{t} - \frac{p_2-p_1}{s}\right) \tag{8}$$

substituting the above equations into equation(1), (2) and (3) ,we obtain the expected profit of enterprise A and B

$$\pi_a = \frac{Z}{R}\left[\left(\frac{p_2-p_1}{s}\right)(p_1-w_1) + \left(\frac{V-p_2}{t} - \frac{p_2-p_1}{s}\right)(p_2-w_2) - c_a\left(\frac{V-p_2}{t}\right)\right] \tag{9}$$

$$\pi_b = \pi_{b1} + \pi_{b2} \tag{10}$$

Where

$$\pi_{b1} = \frac{Z}{R}\left(\frac{p_2-p_1}{s}\right)(w_1+n-c_b) \tag{11}$$

$$\pi_{b2} = \frac{Z}{R}\left(\frac{V-p_2}{t} - \frac{p_2-p_1}{s}\right)(w_2-c_b) \tag{12}$$

Pricing of scenic spot under the tourism supply chain in the case of Stackelberg game theory

Generally speaking, local tour operators are the assemblers of tourism product, owning the advantage of information. Local tour operator will evolved into tourism wholesalers in developed countries in Europe and America. therefore, we assume that local tour operator is in a relatively strong position, which boasts better commitment. Local tour operator B is the leader in the Stackelberg game theory, tour operator A will be the follower. While scenic spot U boasts the best advantage for being the value of tourism products. Local tour operator B will be the follower in the game theory with scenic spot; scenic spot U will be the leader. Because the stronger position, scenic spot sets the unit pricing u , and local tour operator can only set w_1 and w_2 as prices of receiving group according to u in order to maximize profits. Tour operator A can only set p_1 and p_2 as retail prices according to the prices of receiving group w_1 and w_2 to maximize profit. Model is as follows

$$\max_u \pi_u = ud$$
$$s.t.\begin{cases} d \le Q^* = T\min[\frac{r_i}{l_i}] \\ \max_{w_1,w_2} \pi_b \\ s.t. \max_{p_1,p_2} \pi_a \end{cases} \tag{13}$$

We can get the answer in inverse inductive method.

π_a has a continuous first –order derivative and second-order partial derivatives in the value range, and can prove its Hessematrix is positive definite, therefore , π_a gets the maximum according to the first –order conditions. Let

$$\pi_a{}'_{p1} = 0 \tag{14}$$

$$\pi_a{}'_{p2} = 0 \tag{15}$$

After the simultaneous solution we can obtain

$$p_1^* = \frac{1}{2}(c_a + V + w_1) \tag{16}$$

$$p_2^* = \frac{1}{2}(c_a + V + w_2) \tag{17}$$

Local tour operator fully understand the best response of tour operator A, and it can confirm its own optimal decision w_1^* and w_2^* according to the optimal decision p_1^* and p_2^* of tour operator A.

Substitute equation (16) (17)into equation(11)(12),we can obtain

$$\pi_{b1} = \frac{Z}{R}\frac{(c_b-n-w_1)(w_1-w_2)}{2s} \tag{18}$$

$$\pi_{b2} = \frac{Z}{R}\frac{(c_b-w_2)(c_a s - Vs - tw_1 + tw_2 + sw_2)}{2st} \tag{19}$$

$$\pi_b = \pi_{b1} + \pi_{b2} \tag{20}$$

π_b has a continuous first-order derivative and second-order partial derivatives in the value range of equation (20), and can prove its Hessematrix is positive definite, therefore , π_b gets the maximum according to the first-order conditions. Let

$$\pi_b{}'_{w1} = 0$$

$$\pi_b{}'_{w2} = 0$$

After the simultaneous solution we can obtain

$$w_1^* = -\frac{1}{2}(c_a - c_b + n - u - V) \tag{21}$$

$$w_2^* = -\frac{1}{2}(c_a - c_b - u - V) \tag{22}$$

The price of “regular tour “will decline if the shopping rebates and unit cot of tour operator are relatively high from equation (21).

Theorem 1: when tour operator presents "regular tour" and "Pure Tour" at the same time under the condition of market demand, price of receiving group w_1 for "regular tour" may be less than zero, while the "pure tour" is impossible.

Proof: because c_a , c_b , n , V are all greater than zero , if we want w_2 less than zero , there must be $c_a > V + c_b + u$, so there is no market for "Pure Tour" ; when $n > c_b + V + u - c_a$, price of receiving group w_1 for "regular tour" is less than zero.

Theorem1 explains the common phenomenon of zero or negative fare in Chinese package tours. Zero or negative fare means that local tour operators make compensation of group fare and get profit through tourists’ consumption in tourism destination instead of the receiving fare which comes from the tour operator. Negative fare is a worse situation where local tour operators give money to the tour operator. Literature [7] explains the zero or negative fare issue of China outbound travel by using a simple prisoner's dilemma game and Bayesian game. The conclusion we get here explains that zero or negative fare may be reasonable in a sense, the key is how to create a competitive environment for shopping enterprises to reduce the trade information asymmetry of tourism goods by the government, as well as to monitor tour operator to prevent them from deliberately reducing the expectation of time or energy s , which are necessary to tourism activities . According to [9], tour operators do have the incentives to reduce the expectation.

Substituting equations (21) and (22) into equations (16)and(17) , we obtain the optimal pricing decision according to the optimal decision of local tour operator B:

$$p_1^* = \frac{1}{4}(c_a + c_b + 3V + u - n) \tag{23}$$

$$p_2^* = \frac{1}{4}(c_a + c_b + 3V + u) \tag{24}$$

Then substitute equations (23) and (24) into equations (7) and (8), we can get total tourists who purchased two kinds of products

$$d_1 = \frac{Z}{4R}\frac{n}{s} \tag{25}$$

$$d_2 = \frac{Z}{4R}\left(\frac{Vs - c_a s - c_b s - us - nt}{st}\right) \tag{26}$$

$$d = d_1 + d_2 = \frac{Z}{4R}\left(\frac{V - u - c_a - c_b}{t}\right) \tag{27}$$

From equation (26), we can obtain:

When, $u < V - c_a - c_b - n\frac{t}{s}$, there could be market for pure tour.From equation (27), we can obtain

Theorem 2: when the tour operator presents "regular tour" and "Pure Tour" at the same time, there is no relationship among shopping time, total number of effective tourists and shopping rebates.

According to the previous requirements, scenic spot should set the right price u , making the total visitors to meet the requirements of resource and environmental constraints. So

$$d \le Q^* = \min[\frac{r_i}{l_i}]T \tag{28}$$

From （27）and (28) we can obtain

$$u \ge \underline{u} = V - c_a - c_b - \frac{4RTt}{Z}\min[\frac{r_i}{l_i}] = V - c_a - c_b - \frac{4Rt}{Z}Q^* \tag{29}$$

This is the scenic spot protective pricing formula for tourism supply chain under the decentralized decision-making in the case of Stackelberg game.

According to the profit maximization, the pricing of scenic spot can maximize the profit

$$\max_{u^*} \pi_u = du$$

The optimal pricing is

$$u^* = \frac{1}{2}(V - c_a - c_b) \tag{30}$$

Just like the situation of individual tourist, if the profit-maximizing pricing u^* is higher than the protective pricing $\underline{u}$, the problem of sustainable use of resources will be solved by the market mechanism automatically. If not, the relevant government department can directly intervene in the price setting in order to make profit-maximizing pricing higher than the protective pricing $\underline{u}$.

Substituting equation(29)back into equations(21)and(22),we can obtain the receiving group fare of two kinds of tourism product under the condition of scenic spot protective pricing.

$$w_1 = V - c_a - \frac{1}{2}n - \frac{2Rt}{Z}Q^* \tag{31}$$

$$w_2 = V - c_a - \frac{2Rt}{Z}Q^* \tag{32}$$

Receiving group fare of two kinds of tourism products has nothing to do with the cost of local tour operator when scenic spots adopt protective pricing.

Scenic spot pricing after the integration of tourism supply chain

After many years of exploration, Chinese tour operator began to combine local tour operator with wholesalers to create a new model of tour operator, there have been some good examples, such as Minjian in Haikou and Xindongfang in Yunnan, the combination of local tour operator and wholesales eliminates the intermediate links ,and saves cost, what is more ,ensures the local tour operator quality ,improves honesty, able to win more business from the same tourists.

Some areas have enacted some related policies to break regional monopolization and promote tourism development, prevent discrimination to tour operators in local place. Taking the current "Hainan Provincial Tourism Bill," as an example, it allows tour operator in other place of the China to organize group and travel in Hainan directly, breaking the regional monopolization in the form of law. Since then, barrier-free travel gradually becomes popular in the major tourism plates across the country. Literature [9] proved that the efficiency of tourism supply chain will increase after the integration of local t tour operator e and tour operator.

In order to analyze the scenic spot entrance fee protective pricing of the above situation, we establish the following model.

Assuming the new tour operator C comes from the combination of local tour operator and tour operator, we can

get the expected profit of tour operator C:

$$\pi_c = d_1(p_1 + n) + d_2 p_2 - (c_a + c_b + u)(d_1 + d_2) \quad (33)$$

Substituting equations (7) and (8) into equation(33), π_c has a continuous first-order derivative and second-order partial derivatives in the value range, and we can prove its Hessematrix is positive definite, therefore , π_c gets the maximum according to the first-order conditions. Let

$$\pi_c{}'_{p1} = 0$$

$$\pi_c{}'_{p2} = 0$$

After the simultaneous solution we can obtain

$$p_1^{**} = \frac{1}{2}(c_a + c_b + u + V - n) \quad (34)$$

$$p_2^{**} = \frac{1}{2}(c_a + c_b + u + V) \quad (35)$$

Substituting equations(34) (35)into equations (7) (8), we get the number of tourists after the integration of decisions

$$d_1^{**} = \frac{Z}{R}\frac{n}{2s} \quad (36)$$

$$d_2^{**} = \frac{Z}{R}\frac{s(V - c_a - c_b - u) - nt}{2ts} \quad (37)$$

Theorem 3 whether the tourism supply chain is distributed or integrated, there is no market for" pure tour" when

$$u < V - c_a - c_b - n\frac{t}{s}$$

From theorem 3, we can enlarge "pure tour" market by increasing tourism value, reducing cost and lessening shopping rebate.

Re-analyzing the total tourists after integration

$$d^{**} = d_1^{**} + d_2^{**} = \frac{Z}{2R}\left(\frac{V - c_a - c_b - u}{t}\right) \quad (38)$$

There are more tourists after integration than that of before (two times) from the contrast between equations (38) and (27).

Similar to the previous section, scenic spot should set the right price u , making the total visitors to meet the requirements of resource and environmental constraints. The requirement here is

$$d \le Q^* = \min[\frac{r_i}{l_i}]T$$

We obtain

$$u \ge \underline{\underline{u}} = V - c_a - c_b - \frac{2RTt}{Z}\min[\frac{r_i}{l_i}] = V - c_a - c_b - \frac{2Rt}{Z}Q^* \quad (39)$$

From comparison, we can get,

Theorem 4: the number of integrated tourism supply chain is more than that of distributed tourism supply chain, and scenic spot protective pricing of integrated tourism supply chain should also be more than that of distributed tourism supply chain.

Efficiency of integrated tourism supply chain has obviously increased as well as the number of tourists for overcoming the Double Marginalization, so scenic spot protective pricing is higher than that of simple local tour operator.

According to the profit maximization, the pricing of scenic spot can maximize the profit

$$\max_{u^*} \pi_u = du$$

We obtain the optimal pricing

$$u^* = (V - c_a - c_b) \quad (40)$$

Similar to the above section, if profit-maximizing pricing u^* is higher than the protective pricing $\underline{\underline{u}}$ in the integrated tourism supply chain, the sustainable use of resources problem will be solved by the market mechanism automatically. If not, the relevant government departments can directly intervene in the price setting to make it not higher than protective pricing $\underline{\underline{u}}$.

Ⅲ. Conclusions and Prospects

Through the establishment of game model of tourism supply chain system, we analyze the interactions of scenic spot pricing, tour commissions and tourists' options under three scenarios in tourism supply chain, summarizing the pricing of scenic spot and local operator in Table I.

The analysis we made has basically covered the scenarios in tourism supply chain. In further study, we can consider pricing model of three basic tourist markets, as well as the pricing model after adopting the coordinative mechanism of tourism supply chain and the contrast of supply chain profit or social welfare change.

Moreover, Literature [8] analyzed the multi-stage protective pricing model combined busy season and free season directly for individual tourists. This model is very different from that of single-stage for considering growth buffering of resource in multi-stage. We also will develop the protective pricing of scenic spot in tourism supply chain into multi-stage.

Table 1. The results of scenic spot entrance fee for resource protection and commissions charged from local tour operators in tourism supply chains under three circumstances

Scenario	Individual tourist	Local tour operator in the case of Stackelberg game theory	Integrated tour operator
1	$\underline{u} = V - \frac{T}{a}\min[\frac{r_i}{l_i}]$		
2		$\underline{u} = V - c_a - c_b - \frac{4Rt}{Z}Q^*$	
		$w_1 = V - c_a - \frac{1}{2}n - \frac{2Rt}{Z}Q^*$ $w_2 = V - c_a - \frac{2Rt}{Z}Q^*$	
3			$\underline{u} = V - c_a - c_b - \frac{2Rt}{Z}Q^*$

Scenario 1: scenic spot only prices for the individual tourists; Scenario 2: scenic spots only price for decentralized tour operator; Scenario 3: scenic spot only prices for the integrated tour operator; Scenario 4: The scenic spot prices both for individual tourists and decentralized tour operator; Scenario 5: The scenic spot price for individual tourists and decentralized tour operator, and integrated tour operator

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Qiang Guo received the PH.D. degree from University of Science and Technology of China. Now, he is an associate professor and the vice dean of the Tourism College of Hainan University, PR China. His research interest is applying operations management tools to the area of tourism and service management, especially in tourism supply chain management.