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Full Length Research Paper

Modeling an increase in recreation specialization investments as a strategy to grow a tourism destination

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This paper explores the question of how recreation specialization affects the development of a tourism destination over time. We formulate the development process as an optimal control problem by adjusting specialization investments for the purpose of either attracting more tourists or discouraging tourists from visiting. Our research suggests investment strategies for two types of tourism destination consistent with the intensity of correlation between recreational activities and degree of specialization. Our data show that when the influx of tourists exceeds the carrying capacity of a destination, tourism companies will reduce investment to avoid congestion. Otherwise, companies will increase expenditures to maximize profits.

Key words: Recreation specialization, investment strategy, tourism destination, optimal control.

INTRODUCTION

Tourism companies often make invest to increase the appeal of a destination. For example, they set budgets for facility construction and offer training courses to allow staff to better meet tourists' needs. The positive effect of these expenditures is that more tourists visit a particular region. However, this also creates negative impacts, such as overcrowding, which in turn reduce the appeal of a given tourism destination. In this research, we focus on recreation specialization investment. We explore the notion that a tourist's personal input can transform him from a novice tourist into a seasoned traveler and increase his willingness to participate in related activities. Therefore, frequently revisited make this place flourishing.

Recreation specialization was originally conceptualized by Bryan (1977), who defined it as "a continuum of behavior from the general to the particular, reflected by equipment and skill used in the sport and activity setting preferences." Leisure researchers have paid significant attention to the degree to which recreation specialization can help with recreation management. Most recreation specialization research focuses only on behavioral and cognitive dimensions (McFarlane, 2004). Researchers use indicators such as years of experience and skill development to measure the level of recreation specialization and then explore the implications of leisure resource management. Few of these researchers, however, have explored tourist self-development as a dynamic process. Repeated experience with a recreation activity leads to skill improvement, knowledge accumulation, elaborate mental representations of tour activities and the development of more refined preferences. In general, we note that more frequent participation in an activity increases the level of specialization, which in turn becomes part of the available human capital. However, in order to meet tourists' needs, tourism companies have to build facilities, offer training courses and provide other services appropriate to a specific recreational activity. More generally, the number of tourists visiting a destination is a function of companies' investment practices. Based on specialization framework theory, we develop a dynamic system under which companies make major investments to attract tourists.

Because of the limited carrying capacity of a particular tourism destination, as tourists crowd into the local area, dense congestion can often lead to tourist discomfort and may contribute to symptoms of depression. This may diminish tourists' willingness to take part in a tourist activity.

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This paper focuses on identifying optimal investments that can help avoid overcrowding at a given tourist destination.

LITERATURE REVIEW

Bryan (1977, 1979) originally introduced the concept of recreation specialization to researchers in the context of leisure behavior studies. Bryan regarded specialization as a developmental process that entails a progression in behavior, attitudes and preferences.

Based on Bryan's work, researchers began to investigate and measure other aspects of specialization, such as experience use history, centrality to lifestyle, and social setting. Researchers also expanded the specialization framework to include a number of outdoor recreation activities, including canoeing and white water activities (Bricker and Kerstetter, 2000; Kuentzel and Heberlein, 1997, 2006), hiking and backpacking (Shafer and Hammit, 1995; Virden and Schreyer, 1988; Watson et al., 1994), fishing (Choi et al., 1994; Ditton et al., 1992), camping (McIntyre, 1989), hunting (Kuentzel and Heberlein, 1992), rock climbing (Ewert and Hollenhorst, 1994), birdwatching and wildlife watching (Cole and Scott, 1999; Martin, 1997) and contract bridge (Scott and Godbey, 1994). In addition, Needham et al. (2007) measured different epidemic levels of chronic wasting disease, an illness that primarily affects deer but can be transmitted to humans, and probed the disease's impact on hunters' willingness to stay in the infected area.

In past research, recreation specialization has been measured in various ways. However, these measures are mostly three dimensions, as confirmed by Buchanon (1985). One of these dimensions includes consistent or focused behavior. For this dimension, specialization can be measured in terms of frequency of participation, years of experience, and number of trips taken during a given year (Donnelly et al., 1986; Virden and Schreyer, 1988). The second dimension includes affective attachment. Indicators such as centrality to lifestyle and intensity of involvement are used to measure specialization (McIntyre, 1989; McIntyre and Pigram, 1992). The third dimension includes the number of "side bets" accrued from sustained participation in a given activity. Side bets, just like investments, can be accumulated from sustained participation or may be lost when one ceases participation (Becker, 1960; Virden and Schreyer, 1988). Accordingly, we regard specialization as a kind of human capital that can be improved by tourism companies' investments and can accrue as a result of increasing personal input from tourists.

Most of the leisure studies mentioned above used statistical analysis. This approach ignores one of the most important characteristics of recreation specialization, which can be defined on the basis of development frameworks. Applying the framework developed by Feichtinger et al. (2001), we discuss investment strategies under different situations to explore the dynamics specialization and its influence on the growth of a tourism destination,

MODEL FORMULATION

Suppose that tourism companies invest the total amount of money $I(t)$ in order to attract tourists and to encourage a tourist to expend personal resources $E(t)$, such as time, money, etc., to participate in a recreation activity. Let $N(t)$ be the number of tourists who visit a specific destination. In general, we omit the time argument t if no ambiguity arises. The level of specialization, K, as defined by the stock of human capital, will be a function of both the tourist personal input (E) and the number of tourists who visit a specific location, N. Note that K is measured in the interval $[K_{\min}, K_{\max}]$, where $K_{\min} \leq 0 \leq K_{\max}$. We denote $f(E,N)$ as the function that influences the variation of K. It seems reasonable to assume that $f(E,N)$ satisfies the following inequalities:

$$f_E > 0,\ f_{EE} \leq 0,\ f_{EN} < 0,\ f_N < 0,\ f_{NN} \leq 0 \quad (1)$$

The first and second inequality in Equation 1 suggests that specialization increases in a non-convex way with tourist personal input for a given N. The third and fourth inequality together imply that the crowding effect negatively impacts specialization effort for a given E. The last inequality signifies that the positive effect of personal input on specialization decreases with increasing congestion. Let $\delta > 0$ be a constant and represent the decay rate of K. Then, the dynamic progression of specialization over time is given by the differential equation:

$$\dot{K} = f(E,N) - \delta K \text{, with initial condition } K(0) = k_0 \quad (2)$$

In addition, we define $g(I)$ and η as the impacts of investment in attracting tourists and the percentage of tourists who decide not to revisit the tourist spot because of overcrowding. Notation τ represents the influence of specialization on the number of tourists. We assume that $g' > 0$ and $g'' > 0$. Thus the development of the destination over time in term of number of visitors is given by the following:

$$\dot{N} = \tau K - \eta N + g(I) \text{, with initial condition } N(0) = 0 \quad (3)$$

Assuming an infinite horizon, we note that α, μ and ϕ

are the transition rates for the level of specialization, number of tourists and the firm's investments, respectively. We also define $h(E)$ to represent the margins of tourist personal input. There are economies of scale with respect to personal input so that

$$h' > 0 \text{ and } h'' < 0 \quad (4)$$

Suppose that the preference of every tourist is identical. We can establish the utility function for a tourist in the context of participation in a specific activity:

$$U(K, N, I, E) = \alpha K + \mu N + \phi I + h(E) \quad (5)$$

This paper aims to maximize utility through participation in a recreational activity over infinite time horizon. That is

$$\underset{I,E}{Max} \; Z = \int_0^{\infty} e^{-\rho t}[U(K, N, I, E) - \theta E^2]dt \quad (6)$$

Where ρ is the discount factor. Taking Equation 6 to be the objective function of the model and subjecting to Equations 2 and 3, the entire model is constructed.

STABILITY

Necessary conditions for a saddle point equilibrium and an attracting limit cycle

The current value Hamiltonian of the model is

$$H = \alpha K + \mu N + \phi I + h(E) - \theta E^2 + \lambda_1 (f(E, N) - \delta K) + \lambda_2 (\tau K - \eta N + g(I)) \quad (7)$$

Where λ_1 and λ_2 are costate variables that represent the shadow prices of specialization and the number of tourists, respectively.

Equation 7 leads to the following first-order conditions

$$\frac{\partial H}{\partial I} = \phi + \lambda_2 g'(I) = 0 \quad (8)$$

that I is a function of λ_2, that is $I = I(\lambda_2)$. Since corporate investments positively impact the number of visitors, we conclude that $\phi > 0$, which implies that the shadow price of number of tourists is negative. This may be the result of overcrowding. Taking the derivation of I with respect to λ_2, we obtain

$$I_{\lambda_2} = -\frac{g'(I)}{\lambda_2 g''(I)} < 0 \quad (9)$$

Equation 9 can be explained as follows. An increasing λ_2 implies that the effect of congestion is becoming more significant. Hence, firms have to cut down on expenditures that may initially have been used to help attract tourists. The other necessary condition is

$$\frac{\partial H}{\partial E} = h'(E) - 2\theta E + \lambda_1 f_E(E, N) = 0 \quad (10)$$

which implies that $E = E(N, \lambda_1)$. Taking the derivatives of E with respect to N and λ_1, respectively, we have

$$E_N = \frac{-\lambda_1 f_{EN}}{h'' + \lambda_1 f_{EE} - 2\theta} < 0 \quad (11)$$

$$E_{\lambda_1} = \frac{-f_E}{h'' + \lambda_1 f_{EE} - 2\theta} > 0 \quad (12)$$

According to Equation 11, other tourists decrease their own input when one additional tourist visits the destination. Equation 12 means that the large shadow price of specialization results in more tourist personal input. The conditions for the development of λ_1 and λ_2 are given by

$$\dot{\lambda}_1 = \frac{\partial H}{\partial K} - \lambda_1 \rho = \alpha - \lambda_1(\delta + \rho) + \lambda_2 \tau \quad (13)$$

$$\dot{\lambda}_2 = \frac{\partial H}{\partial N} - \lambda_2 \rho = \mu + \lambda_1 f_N - \lambda_2(\rho + \eta) \quad (14)$$

Equations 2, 3, 13 and 14 lead to the following Jacobian matrix:

$$J = \begin{bmatrix} -\delta & f_E E_N + f_N & f_E E_{\lambda_1} & 0 \\ \tau & -\eta & 0 & g' I_{\lambda_2} \\ 0 & 0 & -(\delta + \rho) & \tau \\ 0 & \lambda_1 (f_{NE} E_N + f_{NN}) & f_N + \lambda_1 f_{NE} E_{\lambda_1} & -(\rho + \eta) \end{bmatrix} \quad (15)$$

Let $\Delta = |J|$ be the determinant of Equation 15, which is equal to

$$\Delta = -(\delta + \rho)[\delta g' I_{\lambda_2} \lambda_1 (f_{NE} E_N + f_{NN}) + (\rho + \eta)\tau(f_N + f_E E_N) - \delta\eta(\rho + \eta)] - \tau[\tau E_{\lambda_1} \lambda_1 (f_E f_{NN} - f_N f_{NE}) - \tau(f_N^2 + f_E f_N E_N) + \delta\eta(f_N + \lambda_1 f_{NE} E_{\lambda_1})] \quad (16)$$

$$\Omega = \begin{vmatrix} -\delta & f_E E_{\lambda_1} \\ 0 & -(\delta+\rho) \end{vmatrix} + \begin{vmatrix} -\eta & g' I_{\lambda_2} \\ \lambda_1 (f_{NE} E_N + f_{NN}) & -(\rho+\eta) \end{vmatrix} + 2 \begin{vmatrix} f_E E_N + f_N & 0 \\ 0 & \tau \end{vmatrix} \quad (17)$$

The value of Ω is defined by Equation 17.

This can be rewritten as

$$\Omega = \delta(\delta+\rho) + \eta(\rho+\eta) - g' I_{\lambda_2} \lambda_1 (f_{NE} E_N + f_{NN}) + 2\tau(f_E E_N + f_N) \quad (18)$$

According to Tahvonen and Kuuluvainen (1993), we derive the following proposition:

Proposition 1

Equation 1 When τ is sufficiently small, the necessary condition for the stationary point of this model to progress to the saddle point becomes $f_{NE} < \frac{-f_{NN}}{E_N}$. Equation 2 If $\tau \le \tau_{crit}$ and $\tau_{crit} > 0$, the necessary condition for the presence of a stable attracting limit cycle is $f_{NE} < \frac{-f_{NN}}{E_N}$.

Proof: If $f_{NE} < \frac{-f_{NN}}{E_N}$, then both the first and second terms of Equation 16 are positive. Therefore, we conclude that $\Delta > 0$.

In light of Equation 18, only when τ is sufficiently small can we conclude that $\Omega < 0$. Recalling Equation 21, if $\tau \le \tau_{crit}$ then $\Omega > 0$, and we can obtain two pure imaginary eigenvalues.

In order to generate further analytical results, we specify the functions as follows.

$$h(E) = a\sqrt{E} \quad (19)$$

$$f(E,N) = bE(N^c - N) \quad (20)$$

$$g(I) = cI^2 \quad (21)$$

Where a, b, c are all positive constants. N^c is the carrying capacity of a certain tourism destination.

Substituting these functions into Equations 2, 3, 16 and 17, we have;

$$\dot{K} = bE(N^c - N) - \delta K \quad (22)$$

$$\dot{N} = \tau K - \eta N + cI^2 \quad (23)$$

$$\Delta = (\delta+\rho)[4b^2\varpi\lambda_1(2bc\delta\varpi I^2\lambda_1\lambda_2^{-1} + N^c - N) + (\rho+\eta)(b\tau E + \delta\eta)] + \tau[\tau b^2 E(5b\varpi\lambda_1(N^c - N) + E) + b\delta\eta(b\varpi\lambda_1(N^c - N) + E)] > 0 \quad (24)$$

Where, $\varpi = (aE^{-\frac{3}{2}} + 8\theta)^{-1}$

$$\Omega = \delta(\delta+\rho) + \eta(\rho+\eta) + 8b^2 c\varpi I^2 \lambda_1^2 \lambda_2^{-1} - 2b\tau(4b\varpi\lambda_1(N^c - N) + E) \quad (25)$$

In light of Equations 24 and 25, when τ is sufficiently small (which would result in $\Omega < 0$), and if $\tau < \frac{\delta(\delta+\rho) + \eta(\rho+\eta) + 8b^2 c\varpi I^2 \lambda_1^2 \lambda_2^{-1}}{2b(4b\varpi\lambda_1(N^c - N) + E)}$, we have $\Omega > 0$, and Proposition 1 holds. The first-order conditions now become $\phi + 2c\lambda_2 I = 0$ and $\frac{a}{2\sqrt{E}} - 2\theta E + b(N^c - N) = 0$, which are equal to

$$I = \frac{-\phi}{2c\lambda_2} \quad (26)$$

$$E' = \left(\frac{\psi}{6\theta} + \frac{b(N^c - N)}{\psi}\right)^2 \quad (27)$$

with $\psi = \left((27a + 3\sqrt{3}\sqrt{\frac{27a^2\theta - 2b(N^c - N)^3}{\theta}})\theta^2\right)^{\frac{1}{3}}$

To find the stationary point, we solve the homogenous equations of Equations 13, 14, 22 and 23. This gives

$$K' = \frac{bE(\eta N^c + c)}{\tau bE + \delta\eta} \quad (28)$$

$$N' = \frac{\tau bEN^c - \delta c}{\tau bE + \delta\eta} \quad (29)$$

$$\lambda_1' = \frac{(\rho+\eta)\alpha + \tau\mu}{\tau bE + (\rho+\eta)(\delta+\rho)} \quad (30)$$

$$\lambda_2^{'} = -\frac{\alpha bE - \mu(\delta+\rho)}{\tau bE + (\rho+\eta)(\delta+\rho)} \quad (31)$$

Substituting Equations 24 into 26, we obtain I^*. Comparing Equations 28 to 31 indicates that tourist personal input may play a key role in the long term for this dynamic system. We then take derivatives of these functions with respect to E.

Proposition 2

$\frac{\partial K}{\partial E} > 0$, $\frac{\partial N}{\partial E} > 0$, $\frac{\partial I}{\partial E} < 0$, $\frac{\partial K}{\partial I} > 0$, $\frac{\partial N}{\partial I} > 0$.

Proof: The derivations directly result in the aforestated expressions. The signs of these derivatives can be easily observed.

Around the steady state of this system, both the number of tourists and the specialization level are positively influenced by tourism companies' investments and tourists' personal input. This offers evidence for the existence of some relationship between the development of a tourism and specialization level. Interestingly, the size of tourism companies' investments seems to be negatively related to tourist personal input. Therefore, a substitution effect may exist between these two factors.

ILLUSTRATION AND DISCUSSION

Because of the complicated function forms of these first-order conditions, it is quite difficult to obtain optimal growth trajectory for a tourism destination. We employ numerical methods to examine the qualitative properties of the model by normalizing certain parameters. To specify the functions as in the model, we assume the parameter values are;

$N^c = 3.81$, $b = 0.563$, $c = 0.431$ $\rho = 0.134$
$\mu = 0.232$, $\theta = 0.537$, $\alpha = 0.674$, $E = 0.82$
$I = 0.255$

Since we are interested in the impact of overcrowding on investment decisions made by tourism companies and tourists in this research, we set $\eta = 0$. In addition, because the value τ is the decisive factor in determining the dynamics between K and N as shown in Proposition 1, we choose τ as our bifurcation parameter.

Although bifurcations can be directly obtained by certain mathematical software packages, we conduct the process numerically to explore the transition from an asymptotically stable equilibrium to unstable saddle-node equilibrium in more detail. We used the Maple 11 software package to solve the dynamic system composed of Equations 22 and 23. We set up the value τ at the beginning of each iteration, and we also used Maple to plot the phase diagram in the $K - N$ plane. Furthermore, we divided the process into two parts and wished to identify relevant bifurcations in each part.

First, starting at $\tau = 0.2$ and then decreasing the value of τ, we note that as τ just barely crosses 0, the eigenvalues of the system switch to real numbers of opposite sign. As shown in Figure 1, unstable saddle-node equilibrium appears.

A small τ means that the development of the tourist spot is less correlated or even irrelevant to increases in recreation specialization investments. We define this as a Type I tourism destination.

Given Figure 1 and recalling Proposition 2, we obtain the following result: If an initial point $(K^{'}, N^{'})$ lies on the stable arm, it will move along the path and asymptotically approach the saddle point (K^*, N^*) as time goes to infinity. Otherwise, it will be repelled from the equilibrium point.

In the controllable case, if $N > N^c$, tourism companies will reduce the amount of investment and tourists will make the same decision to avoid over-crowdedness. In addition, when $N < N^c$, tourism companies tend to increase their investment levels to improve tourist specialization. Now we must deal with the second part of the process in order to demonstrate our mechanism for creating an attracting limit cycle.

Making use of the same parameter values as above and choosing an initial value of $\tau = 0.2$, we increment the value of τ by 0.0001 for each iteration. As τ reaches a critical τ_c, the phase as illustrated on the (*K* – *N*) plane will switch from a spiral to an attracting limit cycle. In addition, the Jacobian evaluated at the steady state possesses two purely imaginary eigenvalues for the critical value $\tau_c = 0.4416$. This result supports our finding from the numerical process. Using Maple 11, we plot the phase for the system that comprises Equations 22 and 23 as shown in Figure 2 to illustrate the dynamics between K and N.

A large τ means that the development of the tourist spot is highly correlated with increasing recreation specialization efforts. We term this a Type II tourism destination. Because of the presence of a stable attracting limit cycle, wherever the point (*K, N*) initially appears, it will approach the cycle and circle on it.

Furthermore, in Figure 2, we define a horizontal line $N = N^c$ that divides the cycle into two sections. We are then able to identify the following two development stages:

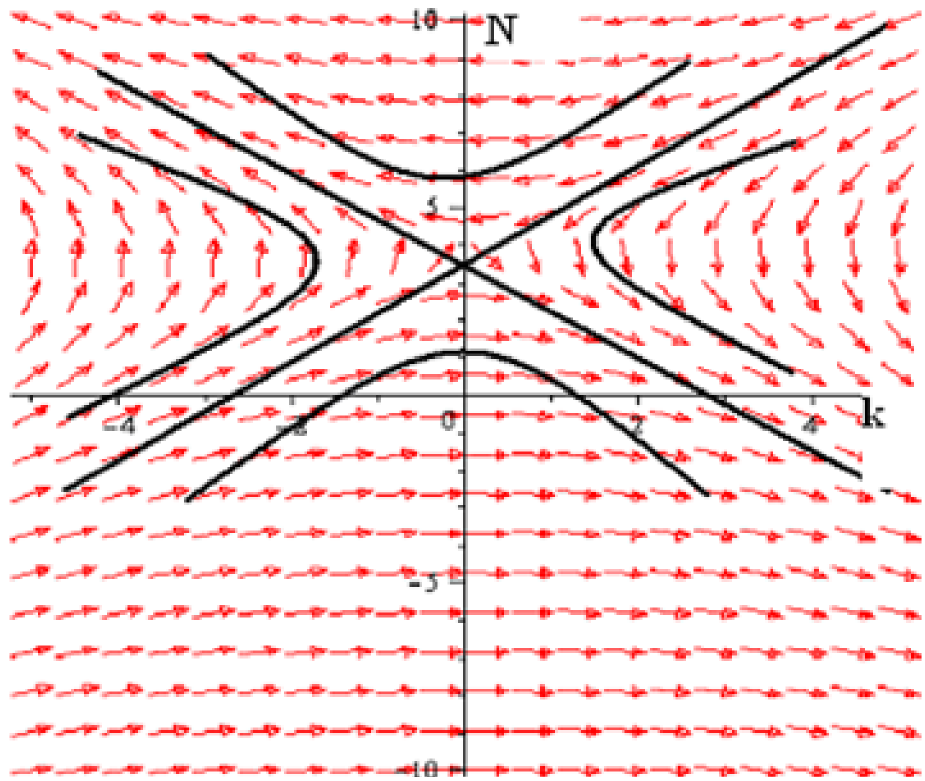

Figure 1. Saddle-node equilibrium as $\tau < 0$.

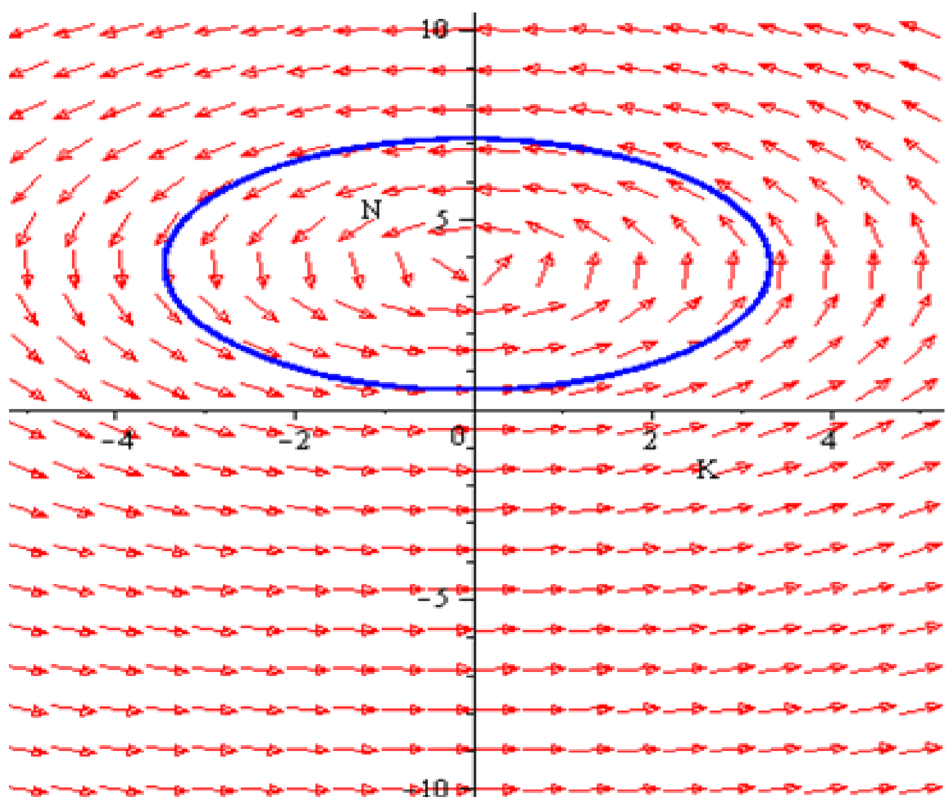

Figure 2. Attracting limit cycle at bifurcation: $\tau = 0.4416$.

Stage 1

Prosperity $(N \leq N^c)$: let us start at the point $(K_{\min}, N^c)$ associated with a situation in which fewer and fewer tourists visit a given destination due to insufficient investment. It is better for tourism companies to increase their investment in order to attract tourists. According to the dynamics of N, avoiding overcrowding can make a company's investment I inefficient, but these two factors start to elevate the specialization level. After a while, the number of tourists reaches a minimum, $N_{\min}$, and increases as a result of investment. Both K and N continue to increase until K reaches its maximum, $K_{\max}$. During the entire period, the tourist personal input E increases.

Stage 2

Congestion control $(N > N^c)$: when the specialization level cannot be further upgraded through additional investment, companies will essentially withhold development funds. Although the number of tourists may exceed the capacity of the destination, the foregoing investment extends its effect to this period and therefore tourists continue to visit in large numbers. When companies have to deal with the issue of overcrowding, they must reduce their investment. In addition, the tourists who detest crowding the most will also reduce their personal input. After a certain delay, N reaches its maximum, $N_{\max}$, and then decreases. This period ends at the point $(K_{\min}, N^c)$. We return to Stage 1.

Conclusion

The main goal of this paper is to investigate the connections between recreation specialization and two specified controllable factors, namely expenditure to attract tourist demand and tourist personal input. The model considered in this paper shows that increasing tourist personal input leads to a higher level of recreation specialization and improved expectations derived from participating in a specific activity. This in turn encourages a larger number of tourists to visit the destination. In addition, by employing a dynamic control model, we derive optimal investment strategies for two types of tourism destination.

As mentioned previously, the value of τ indicates the correlation between the growth of a tourism destination and the degree of tourist specialization. The larger the value of τ, the higher the correlation. Furthermore, we assume that the rate of deterioration for tourist recreation specialization is relatively small. We then offer the following optimal investment strategies for two types of tourism destination under different situations.

Type I

This destination type is characterized such that the development of the tourist spot is relatively less correlated with increasing investment. The phase portrait on the $K-N$ plane of the dynamic system in the model is unstable saddle-node equilibrium. Only those points that lie on the stable arm can approach the saddle point over time. Thus, companies and tourists are limited in terms of investment activities.

Type II

The most conspicuous characteristic of this destination type is that the development of the tourist spot is strongly correlated with increasing recreation specialization efforts.

The presence of the bifurcation and an attracting limit cycle makes this case controllable. This means that the effect of investment in terms of increasing the specialization and attracting tourists to a given destination will be limited in terms of the cycle. We partition the cycle into two segments according to whether the number of tourists exceeds the carrying capacity of a given destination. Companies and tourists increase the size of their investment to build a successful and prosperous destination. However, they reduce their expenditures in response to overcrowding when $N > N^c$. This result provides the evidence that congestion can be controlled by adjusting the level of investment at a given destination. It also has implications of the model of the lifecycle of a tourist destination proposed by Butler (1980).

Lastly, in this paper we focus on investigating the influence of increasing recreation specialization investments on the development of a single tourism destination. In reality, however, market structure has long been a very important factor that impacts a company's investment decisions. Various structures lead to different decisions. Given these conditions, how can we develop an optimal control procedure for better managing the resources on hand, this issue will be a subject of future research efforts.

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