Analysis of Regional Tourism Strategy Cooperation Based on the Evolutionary Game Theory

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This paper uses evolutionary game theory to analyse regional tourism cooperation. Asymmetric evolutionary game model is established to explore the intrinsic motivation of regional tourism cooperation, and we via rigorous mathematical reasoning to prove a series of proposition. At the same time, through numerical simulation on each proposition by the MATLAB software, it vividly reflects the evolution process of the regional tourism cooperation. The results show that, first, it is necessary to cooperate, which is the inevitable trend in the development; Second, we shall specify the necessary condition to maintain cooperation, when the no-cooperative party can obtain additional benefit of free-riding from the cooperation party, and the additional benefit is greater than the benefit from bilateral cooperation, cooperation will ultimately fail; third, we must focus on the sufficient conditions to guarantee cooperation, which mainly reflected on the utilization of shared resources, cooperation cost, the benefit of "free-riding" etc.. In view of the results, we propose some suggestions to promote regional tourism cooperation from the regulations of regional tourism cooperation, government and the utilization of shared resources.

INTRODUCTION

China is the largest tourism market and international tourism consumption country all over the world. Tourism, as a strategic pillar industry of national economy, has fully integrated into the national development strategy in China. By 2017, the comprehensive contribution of Chinese tourism to national economy and social employment has exceeded 10%, which is higher than the world average level. Tourism has become the main investment market and large-scale comprehensive industry. Based on close geographical location, cultural connection and convenient transportation, regional tourism forms a limited tourism space with independent characteristics among each tourism element (Jackson, 2006; Zheng, 1997). With the progress of science and technology, and the construction of information channels and transportation facilities, the space-time distance between regions has been substantially reduced, and the links between various regions become closer. The process of regional economic integration has been accelerating, and cooperation becomes the mainstream trend of tourism economy.

In recent years, the construction of regional tourism cooperation circles, such as “Yangtze River Delta”, “Pearl River Delta”, “Circum-Bohai-Sea”, “Circum-Taihu-Lake”, “the new Three Gorges”, “Lantsang-Mekong River” and “Fujian-Guangdong-Jiangxi”, indicates that China’s tourism industry has entered into the era of regional tourism cooperation. Saxena (2005) considered that regional tourism cooperation can promote the resource sharing, resolve competition conflicts, and improve the overall tourism brand and tourism image of cooperative tourism areas. From a macro perspective, Joppe (1996) argued that regional tourism cooperation can ease regional and inter-state tensions, and adjust resource redistribution between different regions within a country. Considering the spatial distribution of tourism resources, the relationship between various regions, tourist experience and brand image of tourism regions, the establishment of inter-regional tourism cooperation relationship can not only integrate and optimize the tourism resources of various regions, but also promote the sustainable development of regional tourism economy (Li and Chen, 2014; Li, 2014; Zhang et al., 2010). However, the fact of actual cooperation effect of regional tourism cooperation is unsatisfactory. There is even the phenomenon of “pseudo-cooperation”, such as repeated construction of public facilities, waste of public resources, competition for customer market and resources. The vicious circle of excessive competition compresses the profit space and hinders the further development of the tourist area, and decreases the tourist experience, which negatively influence the overall tourism image of the cooperative region (Hu et al., 2011).

One of the reasons for this phenomenon is that most regional tourism cooperation is realized under the leadership of the government, instead of the exchange of market elements by tourist areas (Jin et al., 2006). Trust and communication are the problems existing in this cooperation pattern. Under the guidance of the government, there is not enough trust between the cooperative tourist areas because of the insufficient information exchange and the obstructed information channels in the market. However, the mutual trust between tourist areas significantly influences the effectiveness of cooperation. In order to achieve a long-term stable state of cooperation, a high trust degree is needed for both cooperation parties (Czernek and Czakon, 2016). Another problem is the vague objectives and operations in regional tourism cooperation agreements. It causes the emergence of superficial cooperation that is not based on reality and cannot effectively address the existing obstacles to cooperation (Wong et al., 2011; Zou, 2015).

Tourism resources are usually public, which demonstrates that regional tourism has positive external effects in cooperation. Therefore, the “free-riding” phenomenon in cooperation is noteworthy. “Free-riding” can be divided into “internal free-riding” and “external free-riding” (Fischbacher and Gächter, 2010; Khalilzadeh and Wang, 2018; Nicolau and Mas, 2015). “Internal free-riding” generally means that some enterprises sell defective products in market through good industry reputation, thus obtaining excess profits (Lian et al., 2013). Also, in open regional cooperation process, some cooperation partners obtain unequal benefits by reducing investment (Bao, 2009). “External free-riding” indicates a non-cooperation partner obtains benefits from other partners. For example, the increase of tourists in tourist destinations will enhance the income of the private sector like local hotels (Yu et al., 2006), and exhibition can increase business investment in neighboring areas (Luo and Jin, 2012). Both external and internal free-riding can negatively influence cooperation and disintegrate the established cooperation. Studies have shown that punishing free-rider and increasing the cooperation benefits can reduce or even eliminate the “free-riding” phenomenon (Cubitt et al., 2011; Ye, 2012).

In regional tourism cooperation, free-riding means that one party has invested cooperation cost when choosing the cooperation strategy, while the other party does not invest or reduces investment but enjoying the external positive effect brought by the investment party. The amount of cooperation cost invested by the investment party can influence the cooperation. In the case of low cooperative investment cost in the early stage, even if cooperation fails, the loss has little effect on the investment party, and the investment party may continue to choose cooperation strategy in the next period. In contrast, each of parties will be very cautious about early investment, which reduces their cooperation willingness.

According to the above research on regional tourism cooperation, many scholars have achieved abundant regional tourism cooperation research results, which involve the social and economic impacts of cooperation and the obstacles to the success of cooperation. However, the existing research generally focuses on few influencing factors and fails to cover more important influencing factors. Moreover, these factors are not integrated for the dynamic analysis of regional tourism cooperation. This paper suggests that regional tourism cooperation is essentially a game between potential parties. The game player's choice depends on the difference of payoff between the strategies of cooperation and non-cooperation. Based on evolutionary game theory as the basic model theory, this paper studies the internal operating mechanism of the strategy choices of the game players in regional tourism cooperation, and puts forward relevant suggestions to promote regional tourism cooperation.

EVOLUTIONARY GAME MODEL

Evolutionary game theory combines game theory with biological dynamic evolution process. Different from the hypothesis of homo economicus in game theory, evolutionary game theory holds that players are bounded rationality. This means that game players may not find the optimal strategy immediately or hold the optimal strategy from beginning to end. However, players can learn and imitate successful strategies and adjust their strategies and learning to maximize their payoffs. which calls the dynamic learning and imitation process. Based on Darwinian evolution and Lamarckian evolution, evolutionary game theory regards the adjustment process of player behavior as a dynamic system. The formation mechanism from individual behavior to group behavior and the influence factors are integrated into the evolutionary game model to construct the differential equation model and predict the changing process of long-term economic relations.

Model Hypothesis and Establishment

In this paper, an asymmetric evolutionary game model for regional tourism cooperation was established. There are two strategies for different regions A and B: Strategy 1 (cooperation) and Strategy 2 (non-cooperation). The benefits of two regions in independent operation (both regions choose strategy 2) are R_1 and R_2, respectively. In the case of cooperation strategy choosed by both regions, the benefit from resource sharing through cooperation is U $(U > 0)$, and the abilities of both regions to utilize the shared resources is α_1, α_2 $(0 \le \alpha_1, \alpha_2 \le 1)$. After reach cooperation, the establishment and maintenance costs of bilateral cooperation are C_1, C_2 $(C_1, C_2 > 0)$. In the strategic space where one partner chooses to cooperate and the other partner chooses non-cooperation, the corresponding early investment cost is paid by the partner who chooses cooperation in order to reach cooperation. The losses of unsuccessful cooperation are $L_1, L_2 (L_1, L_2 > 0)$. The partner rejecting cooperation can enjoy the free-riding benefits from the other partner, which are $\mathrm{f}_1, \mathrm{f}_2$ $(\mathrm{f}_1, \mathrm{f}_2 \ge 0)$. The payoff matrix for Strategy 1 (cooperation) and Strategy 2 (non-cooperation) adopted in two different tourism regions (A and B) can be obtained (see Table 1).

TABLE 1
GAME PAYOFF MATRIX OF TOURISM COOPERATION IN DIFFERENT REGIONS

1 \ 2		Region B	
		1 (Cooperation)	2 (non-cooperation)
Region A	1 (Cooperation)	$R_1+\alpha_1 U-C_1$, $R_2+\alpha_2 U-C_2$	R_1-L_1, $R_2+\mathrm{f}_2$
	2 (non-cooperation)	$R_1+\mathrm{f}_1$, R_2-L_2	R_1, R_2

Model Analysis

Assume that p is the share that tourist resorts in region A take Strategy 1 (cooperation) and q is the share that tourist resorts in region B take Strategy 1 (cooperation). The unite square $s=\{(s_1^1,s_2^1),(s_1^2,s_2^2)\}=\{(p,1-p),(q,1-q)\}$ can be described through a point (p,q) in region $S=[0,1]\times[0,1]$, where $s_1^1=p, s_1^2=q$. Therefore, $s_2^1=1-p$, $s_2^2=1-q$. $r^1=(1,0)$ means that all tourist resorts in each region A choose Strategy 1 (cooperation). Analogously, $r^2=(0,1)$ indicates all tourist resorts in each region B choose Strategy 2 (cooperation).

According to Table 1:

The fitness that Region A takes Strategy 1 is:

$$f_A\left(r^1,s\right)=q\left(R_1+\alpha_1 U-C_1\right)+\left(1-q\right)\left(R_1-L_1\right) \tag{1}$$

The fitness that Region A takes Strategy 2 is:

$$f_A\left(r^2,s\right)=q\left(R_1+f_1\right)+\left(1-q\right)R_1 \tag{2}$$

The average fitness of Region A is:

$$\overline{f_A}\left(p,s\right)=pf_A\left(r^1,s\right)+\left(1-p\right)f_A\left(r^2,s\right) \tag{3}$$

Similarly, the average fitness of Region B is:

$$\overline{f_B}\left(q,s\right)=qf_B\left(r^1,s\right)+\left(1-q\right)f_B\left(r^2,s\right) \tag{4}$$

According to the equations (1), (2) and (3), the replication dynamic equation that region A chooses Strategy 1 (cooperation) can be written as follow:

$$F_A\left(p\right)=p\left(f_A\left(r^1,s\right)-\overline{f_A}\left(p,s\right)\right)=p\left(1-p\right)\left[(\alpha_1 U-C_1+L_1-f_1)q-L_1\right] \tag{5}$$

Similarly, the replication dynamic equation that region B selects Strategy 1 (cooperation) is as below:

$$F_B\left(q\right)=q\left(1-q\right)\left[(\alpha_2 U-C_2+L_2-f_2)p-L_2\right] \tag{6}$$

From the equation (5) and (6), we can form a two-dimensional dynamic autonomous system. To solve the stable state of the system, there should be a point (p_0, q_0) which makes the right sides of equations (5) and (6) equal to zero. The following system can be written as follow:

$$\begin{cases} p_0\left(1-p_0\right)\left[(\alpha_1 U - C_1 + L_1 - f_1)q_0 - L_1\right] = 0 \\ q_0\left(1-q_0\right)\left[(\alpha_2 U - C_2 + L_2 - f_2)p_0 - L_2\right] = 0 \end{cases} \tag{9}$$

Assuming (p_0, q_0) is the balance point, thus there are a total of five balance points in the system:

$$E_1\left(0,0\right)、E_2\left(0,1\right)、E_3\left(1,0\right)、E_4\left(1,1\right)、E_5(p^*, q^*)$$

where $E_5(p^*, q^*) = E_5\left(\frac{L_2}{\alpha_2 U - C_2 - f_2 + L_2}, \frac{L_1}{\alpha_1 U - C_1 - f_1 + L_1}\right)$

According to the method proposed by Friedman (1991), the stability of the balance points of a group dynamic described by a differential equation system is obtained by the local stability analysis of the Jacobian matrix obtained by the system. Jacobian matrix is gotten from equation (9):

$$J = \begin{bmatrix} \frac{\partial F_A(p)}{\partial p} & \frac{\partial F_A(p)}{\partial q} \\ \frac{\partial F_B(q)}{\partial p} & \frac{\partial F_B(q)}{\partial q} \end{bmatrix} = \begin{bmatrix} (1-2p)\left[(\alpha_1 U - C_1 + L_1 - f_1)q - L_1\right] & p(1-p)(\alpha_1 U - C_1 + L_1 - f_1) \\ q(1-q)(\alpha_2 U - C_2 + L_2 - f_2) & (1-2q)\left[(\alpha_2 U - C_2 + L_2 - f_2)p - L_2\right] \end{bmatrix}$$

The determinant of Jacobian matrix is

$$\begin{aligned} \det J = {} & \left(1-2p\right)\left[(\alpha_1 U - C_1 + L_1 - f_1)q - L_1\right]\left(1-2q\right)\left[(\alpha_2 U - C_2 + L_2 - f_2)p - L_2\right] \\ & -p\left(1-p\right)\left(\alpha_1 U - C_1 + L_1 - f_1\right)q\left(1-q\right)\left(\alpha_2 U - C_2 + L_2 - f_2\right) \end{aligned}$$

The trace of the Jacobian matrix is:

$$trJ = \left(1-2p\right)\left[(\alpha_1 U - C_1 + L_1 - f_1)q - L_1\right] + \left(1-2q\right)\left[(\alpha_2 U - C_2 + L_2 - f_2)p - L_2\right]$$

Shantou University Based on the stability analysis of differential equation system, the following propositions can be raised.

Proposition 1: When $\alpha_1 U - C_1 < f_1$ and $\alpha_2 U - C_2 < f_2$, $E_1\left(0,0\right)$ is progressively stable, and the evolutionary stable strategy (ESS) is (non-cooperation, non-cooperation).

Proof: When $\alpha_1 U - C_1 < f_1$ and $\alpha_2 U - C_2 < f_2$, the differences between cooperation benefits and cooperation costs in both game players are less than their free-riding benefits. The determinant $\det J$ of Jacobian matrix J at the balance point $E_1\left(0,0\right)$ is positive, and the trace trJ is negative. Therefore, balance point $E_1(0,0)$ is evolutionary stable strategy (ESS). The results of local stability analysis for all balance points are shown in Table 2.

TABLE 2
LOCAL STABILITY ANALYSIS OF BALANCE POINTS IN PROPOSITION 1

Balance points	$\det J$	trJ	Results
$E_1(0,0)$	+	−	Balance point
$E_2(0,1)$	−	±	Saddle point
$E_3(1,0)$	−	±	Saddle point
$E_4(1,1)$	+	+	Unstable point

Proposition 2: When $\alpha_1 U - C_1 < f_1$ and $\alpha_2 U - C_2 > f_2$, $E_1(0,0)$ is progressively stable, and evolutionary stable strategy (ESS) is (non-cooperation, non-cooperation).

Proof: When $\alpha_1 U - C_1 < f_1$ and $\alpha_2 U - C_2 > f_2$, the difference between cooperation benefit and cooperation cost of region A is less than its free-riding benefit, and the difference between cooperation benefit and cooperation cost of region B is greater than its free-riding benefit. The determinant $\det J$ of Jacobian matrix J at the balance point $E_1(0,0)$ is positive, and the trace trJ is negative. Therefore, balance point $E_1(0,0)$ is evolutionary stable strategy (ESS). The results of local stability analysis for all balance points are shown in Table 3.

TABLE 3
LOCAL STABILITY ANALYSIS OF BALANCE POINTS IN PROPOSITION 2

Balance points	$\det J$	trJ	Results
$E_1(0,0)$	+	−	Balance point
$E_2(0,1)$	−	±	Saddle point
$E_3(1,0)$	+	+	Unstable point
$E_4(1,1)$	−	±	Saddle point

Proposition 3: When $\alpha_1 U - C_1 > f_1$ and $\alpha_2 U - C_2 < f_2$, $E_1(0,0)$ is progressively stable, and evolutionary stable strategy (ESS) is (non-cooperation, non-cooperation).

Proof: When $\alpha_1 U - C_1 > f_1$ and $\alpha_2 U - C_2 < f_2$, the difference between cooperation benefit and cooperation cost of region A is greater than its free-riding benefit, and the difference between cooperation benefit and cooperation cost of Party B is less than free-riding benefit. The determinant $\det J$ of Jacobian matrix J at the balance point $E_1(0,0)$ is positive, and the trace trJ is negative. Therefore, balance point $E_1(0,0)$ is evolutionary stable strategy (ESS). The results of local stability analysis for all balance points are shown in Table 4.

TABLE 4
LOCAL STABILITY ANALYSIS OF BALANCE POINTS IN PROPOSITION 2

Balance points	$\det J$	trJ	Results
$E_1(0,0)$	+	−	Stable point
$E_2(0,1)$	+	+	Unstable point
$E_3(1,0)$	−	±	Saddle point
c	−	±	Unstable point

According to propositions 1, 2 and 3, it can be find that if one region condition is $\alpha_1 U - C_1 < f_1$ or $\alpha_2 U - C_2 < f_2$, that is, when the difference between cooperation benefit and cooperation cost of one region is less than its free-riding benefit. The final result of the game is that both regions choose strategy 2 (non-cooperation) despite the benefit of independent operation or the loss of unsuccessful cooperation.

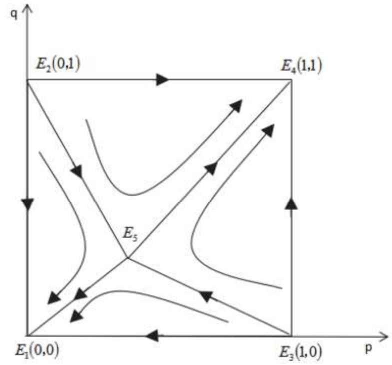
Proposition 4: When $\alpha_1 U - C_1 > f_1$ and $\alpha_2 U - C_2 > f_2$, $E_1(0,0)$ and $E_4(1,1)$ are progressively stable. The evolutionary stable strategy (ESS) is (non-cooperation, non-cooperation). The corresponding phase diagram is as shown in Figure 1.

Proof: When $\alpha_1 U - C_1 > f_1$ and $\alpha_2 U - C_2 > f_2$, the difference between cooperation benefits and cooperation costs of both regions are greater than their free-riding benefits. The determinants $\det J$ of Jacobian matrix J at the balance points $E_1(0,0)$ and $E_4(1,1)$ are positive, and the traces trJ are negative. Therefore, balance points $E_1(0,0)$ and $E_4(1,1)$ are evolutionary stable strategy (ESS). The results of local stability analysis for all balance points are shown in Table 5.

TABLE 5
LOCAL STABILITY ANALYSIS OF BALANCE IN PROPOSITION 4

Balance points	$\det J$	trJ	Results
$E_1(0,0)$	+	−	Balance point
$E_2(0,1)$	+	+	Unstable point
$E_3(1,0)$	+	+	Unstable point
$E_4(1,1)$	+	−	Stable point
$E_5(p^*,q^*)$	−	0	Saddle point

FIGURE 1
SYSTEM DYNAMIC EVOLUTIONARY PHASE FIGURE OF PROPOSITION 4



As shown in Figure 1, the position of E_5 can influence the areas of $E_1E_2E_3E_5$ and $E_2E_3E_4E_5$, which represent the probability that the points in the corresponding area converge to balance points $E_1(0,0)$ or $E_4(1,1)$. Namely, The possibility that the both regions eventually converge to the balance point $E_1(0,0)$ (non-cooperation, non-cooperation) or $E_4(1,1)$ (cooperation, cooperation) is affected by E_5. The different initial states of players in two regions will influence players converge to different stable points eventually.

Proposition 4 shows that when the differences between cooperation benefits and cooperation costs of both regions are greater than their free-riding benefits, the strategy choices of players in two regions will vary with the parameters. Whether the game players in both regions will choose Strategy 1 (cooperation) or Strategy 2 (non-cooperation) need further parameter analysis.

PARAMETER ANALYSIS

According to proposition 4, the initial state of players in both regions directly determines the evolutionary stable strategy of the game. In other words, the position of $E_5(p^*, q^*)$ influences probability of the players in both regions converge to balance points $E_1(0,0)$ or $E_4(1,1)$. Therefore, the parameters of $E_5(p^*, q^*)$ in initial state directly influence the final evolution results. The change on the player behavior is discussed by analyzing the parameters' change.

Parameters α_1 and α_2

As both α_1 and α_2 increase, it means that the abilities of both regions to utilize the shared resources are constantly enhanced. Under given condition of the benefit of shared resources through cooperation is constant, point E_5 moves lower left, and the area of $E_1E_2E_3E_5$ decreases while the area of $E_2E_3E_4E_5$ increases. This shows that the increase in the utilization of shared resources in different regions can enhance the probability that all players choose Strategy 1 (cooperation), that is, the cooperation willingness is enhanced. In contrast, weaker utilization can lower the probability that all players choose Strategy 1 (cooperation), namely, the cooperation willingness is decreased. Figures 2a, 2b and 2c are the corresponding simulation diagrams. Let $U = 10, C_1 = 3, C_2 = 2, f_1 = 2, f_2 = 1, L_1 = 1, L_2 = 1$. α_1=0.51 and α_2=0.35 in Figure 2a. α_1=0.6 and α_2=0.4 in Figure 2b. α_1=0.7 and α_2=0.6 in Figure 2c. We can find that with the enhancement of the usage abilities of players in both regions, the increase of α_1 and α_2, the probability that all players converge to Strategy 1 will increase gradually, while the probability evolving to Strategy 2 will decrease. This demonstrates that α_1 and α_2 can positively promote the cooperation of players in both regions.

FIGURE 2a

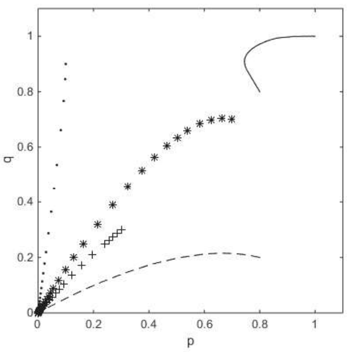


FIGURE 2b

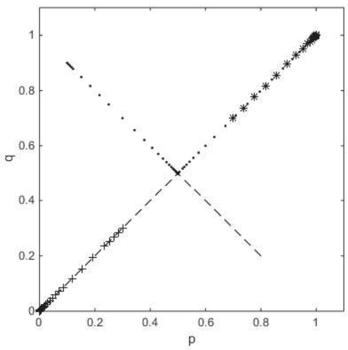
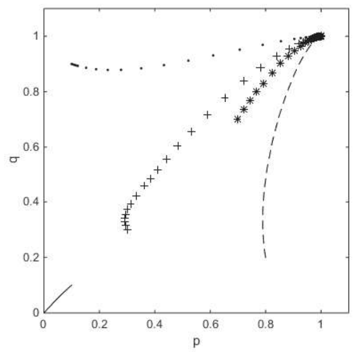


FIGURE 2c



When α_1 increases and α_2 decreases (or α_2 decreases and α_2 increases), the usage ability of one region is enhanced, while the ability of the other region decreases. Point E_5 moves lower right (or upper left). This indicates the players in one region with higher usage ability has stronger cooperation willingness, and the cooperation willingness of players in other region is decreased. In this case, the area of $E_1E_2E_3E_5$ is unknown. it means the probability that the game players converge to $E_1(0,0)$ or $E_5(1,1)$ cannot be determined directly because the change of this area is also affected by other parameters.

When α_1 increases and α_2 is constant (or α_1 is constant and α_2 increases), point E_5 moves upper vertically (or moves right horizontally), then the area of $E_2E_3E_4E_5$ increases. This indicates that the probability that players choose Strategy 1 increases, and their cooperation willingness is enhanced, and vice versa.

Parameter U

Under given condition of α_1 and α_2 are constant, as U is increases, point E_5 moves lower left, then the area of $E_2E_3E_4E_5$ increases. This indicates that the increase of the benefit of resource sharing through cooperation can increase the probability of choosing strategy 1 (cooperation) for all players, and the cooperation willingness of players in both regions is enhanced. Figures 3a and 3b are the corresponding simulation diagrams. Let α_1=$0.6, \alpha_2 = 0.4, C_1 = 3, C_2 = 2, f_1 = 2, f_2 = 1, L_1 = 1, L_2 = 1$. $U = 8.5$ in Figure 3a, and $U = 13$ in Figure 3b. According to Figures 3a and 3b, when the value of U increases from 8.5 to 13, the probability that the players converge to Strategy 1 has a significant increase which indicates that U has positive effect on the cooperation.

FIGURE 3a

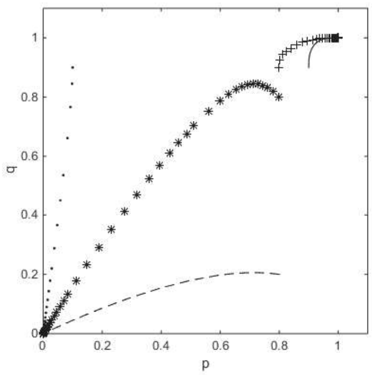
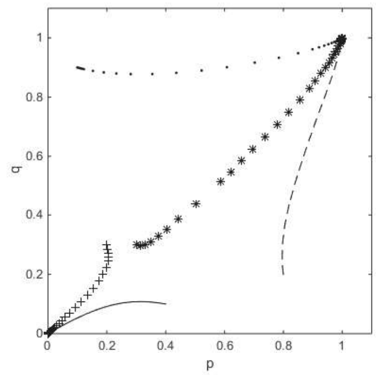


FIGURE 3b



Parameters C_1 and C_2

As the cooperation costs C_1 and C_2 increase, under given condition of other parameters are constant, point E_5 moves upper right, and the area of $E_1E_2E_3E_5$ increases. This shows that the increase in the costs of tourism cooperation in different regions can enhance the probability of choosing Strategy 2 (non-cooperation), and increase the willingness to choose non-cooperation. Figures 4a and 4b are the corresponding simulation diagrams. Let $\alpha_1=0.6, \alpha_2=0.4, U=10, f_1=2, f_2=1, L_1=1, L_2=1$. Where, $C_1=2$ and $C_2=1$ in Figure 4a, $C_1=3.5$ and $C_2=2.5$ in Figure 4b. According to Figures 4a and 4b, when the values of C_1 and C_2 increase, the high probability that players choose Strategy 1 turns to the high probability of choosing Strategy 2. This indicates that C_1 and C_2 have negative effects on the cooperation.

FIGURE 4a

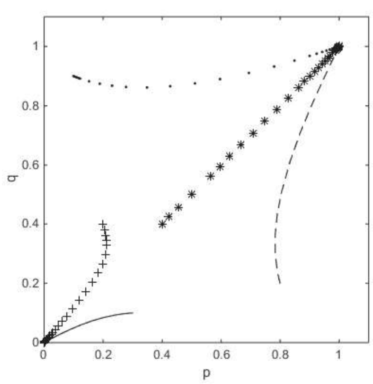
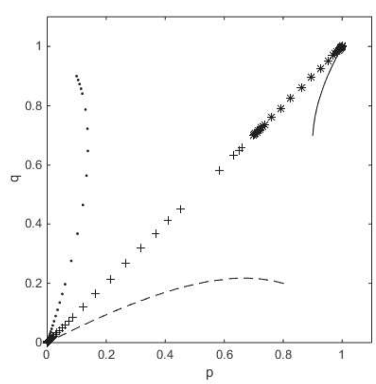


FIGURE 4b



Parameters L_1 and L_2

As loss L_1 (L_2) increases, under given condition that other parameters are constant L_1 (L_2) vertically (horizontally) approaches to $q=1$ ($p=1$), and the area of $E_1E_2E_3E_5$ increases. This shows that the increase in loss can decrease the probability of choosing Strategy 1 (cooperation), and enhance the willingness to choose Strategy 2 (non-cooperation). Figures 5a and 5b are the corresponding simulation diagrams. Let $\alpha_1=0.6, \alpha_2=0.4, U=10, C_1=3, C_2=2, f_1=2, f_2=1$. $L_1=1$ and $L_2=0.5$ in Figure 5a. $L_1=2$ and $L_2=1$ in Figure 5b. As shown in Figures 5a and 5b, as the values of L_1 and L_2 increase, the high probability that players choose Strategy 1 turns to the high probability of choosing Strategy 2. This indicates that L_1 and L_2 have negative effects on the cooperation.

FIGURE 5a

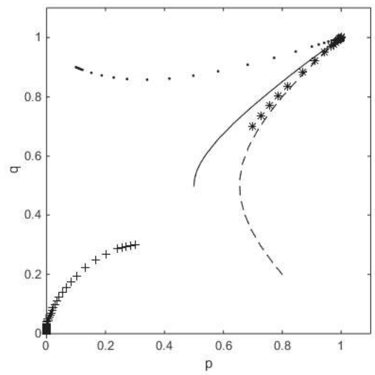
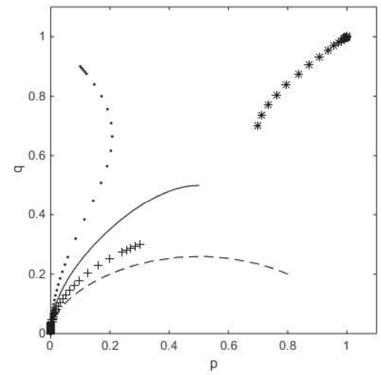


FIGURE 5b



Parameter f_1 and f_2

As the free-riding benefit f_1 (f_2)increases, under given condition that other parameters are constant, point E_5 vertically (horizontally) approaches to $q=1$ ($p=1$), and the area of $E_1E_2E_3E_5$ increases. This shows that the increase in free-riding benefit can decrease the probability that the game players choose Strategy 1 (cooperation), and have stronger willingness of choosing Strategy 2 (non-cooperation). Figures 6a and 6b are the corresponding simulation diagrams. Let α_1=0.6, $\alpha_2=0.4, U=10, C_1=3, C_2=2, L_1=1, L_2=1$. $f_1=0.6$ and $f_2=0.6$ in Figure 6a, and $f_1=2.6$ and $f_2=1.6$ in Figure 6b. As shown in 6a and 6b, with the increase of f_1 and f_2 , the high probability that players choose Strategy 1 turns to the high probability of choosing Strategy 2. This indicates that f_1 and f_2 have negative effects on cooperation.

FIGURE 6a

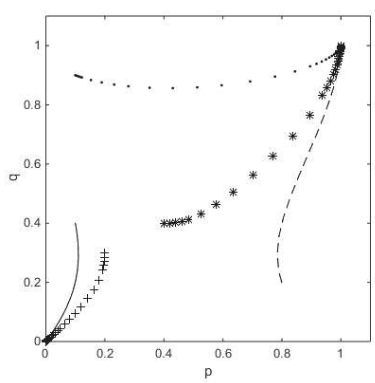
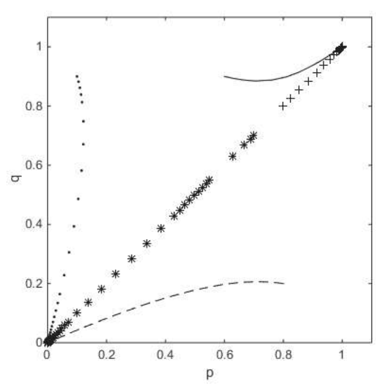


FIGURE 6b



CONCLUSIONS AND RECOMMENDATIONS

Regional tourism cooperation is influenced by not only the government but also the strategic benefit of game players. The important influencing parameters include: the benefit of sharing resources, usage ability of shared resources, cooperation cost, early cooperation investment and free-riding benefit. Based on the evolutionary game theory, this paper studies the problems existing in regional tourism cooperation and establishes an asymmetric evolutionary game model to analyse the evolutionary stable strategy of this model. The following conclusions are drawn:

Firstly, while some groups will choose to cooperate initially and others choose non-cooperation in regional tourism cooperation, the evolutionary stable strategy is all players choose cooperation or non-cooperation. When regional cooperation is reached, the benefit of each region is greater than that of independent operation. This is a "win-win" state that can promote regional tourism cooperation. In addition, there is no direct correlation between the earning situation of each region in the independent operation and the successful cooperation.

Secondly, the usage abilities of shared resource of both regions are noteworthy. The stronger the usage abilities of both regions, the higher the utilization rate, players in both regions have stronger cooperation willingness. The cooperation probability is enhanced when the utilization rate of one region increases and the other region remains unchanged. However, when the utilization rate of one region increases and the other region decreases, the cooperation willingness cannot be determined.

Thirdly, lower cooperation maintenance cost and more benefit of shared resource, players in both regions have stronger cooperation willingness. When one region invests more costs to reach cooperation, the loss is greater, and the free-riding benefit of the other region is greater. Thus, players have weaker cooperation willingness.

Through the above analysis results, the following recommendations are proposed:

1. Government should establish and perfect regional tourism cooperation regulations, promote the construction of relevant laws and regulations, remove obstacles to regional tourism cooperation, break down local protectionism, enhance the circulation of tourism resources and capital, and encourage tourism cooperation among different regions. Specifically, regional tourism cooperation should be comprehensively planned and developed so as to reduce similar projects, avoid vicious competition among regions, and facilitate the development of inter-regional tourism integration process. Meanwhile, attention should be paid to the tourism cooperation between undeveloped and developed regions. There are more modern attractions (such as amusement parks, universities and museums) in regions with better economic development, while undeveloped regions have more natural and historical attractions (such as mountains, gorges, historical and cultural monuments and ancient village buildings). Therefore, different scenic spots should strengthen tourism cooperation and complement resources. Creating a number of tourism routes that cover diversified tourist attractions with nice landscapes are needed to strengthen the links between the cooperation regions so as to enhance the overall tourism competitiveness. During cooperation, developed and undeveloped regions can exchange tourist resources to enhance and stabilize the annual passenger flow of various scenic spots. Through the green development mode of tourism cooperation, undeveloped regions not only can promote economic development and increase the income level of the local people, but also narrow the economic gap and achieve joint development.
2. Government should transform from the role of promoting cooperation to providing services and set up regional tourism associations and other non-profit organizations to expand financing channels for tourism enterprises, realize self-government of tourism enterprises and tourism associations, promote market integration and optimize resource allocation. The associations can promote information exchange among the tourism regions, governments and markets, coordinate the relations among the regions, and standardize the service behavior of the tourism industry as the link between the government and enterprises. The government gradually relaxes administrative control and strengthens the allocation of market resources by "invisible hand". For example, regional tourism areas should independently select cooperation partners according to the market competitive environment; coordinate management and improve cooperation efficiency by regional tourism associations. As for non-standard cooperative behaviors, the regional tourism association should take

corresponding punishment measures to maintain the regional tourism cooperation and avoid the "pseudo-cooperation", so that both regions can reasonably and effectively use the shared tourism resources to achieve win-win cooperation state. In addition, government should attach importance to the supervision and management of regional tourism associations, overcome the disadvantages of market regulation and control, avoid opportunism, and ensure the healthy development of the regional tourism association.

3. In cooperation process, both tourism regions should enhance the utilization of shared tourism resources, perfect the infrastructure construction of scenic resorts, enhance the reception capacity, service quality and tourism brand awareness, strengthen the development and innovation of tourism products and establish tourism network marketing system. Further, each scenic resort, regional tourism association and government should communicate and formulate a tourism development strategy considering the differences in geographical and spatial characteristics, explore local culture, strengthen the cultural influence, define the market orientation and development direction, extend the tourism product chain and enhance the diversity of tourism products. Moreover, the government should enhance infrastructure construction between regional tourist destinations, especially transport network and public facilities. As we know, road transport system plays an important role in economic development, it can not only improve the traffic convenience and promote the development of a single scenic spot, but also enhance the utilization ability of the shared tourism resources and the economic efficiency of tourism cooperation. In another hand, it is necessary to enhance the communication quality of the whole tourist area and expand the signal coverage, especially in the mountainous scenic spots. Standardizing food and accommodation industry is needed. The construction of hotels should be coordinated with the environment of the tourist area while regulating the hygiene quality and prices. Finally, it is known that tourism environment is an important factor in the development of scenic spots, thus tourist areas should protect ecological environment while actively developing tourism resources and promote the sustainable development of man and nature.

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