Decision-making of Green Tourism Supply Chain Considering Risk Aversion under Government Subsidy

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Abstract. Based on Stackelberg game theory, a game model among the government, scenic spot and travel agency is established to address issues in the green tourism supply chain considering government subsidy and risk aversion. Equilibrium solutions for models under different circumstances are analyzed and compared, with numerical experiments conducted using MATLAB. The results of the study indicate that government subsidy have the power to mobilize enthusiasm within the scenic spot and further drive its development towards greener practices. Meanwhile, moderate government subsidies are advantageous in enhancing social welfare, but subsidy intensity must be cautiously controlled to avoid over-stimulation. Additionally, the enhancement of tourists' environmental awareness and the moderate increase in subsidy proportion both contribute to improving the greenness level of the scenic spot, bringing greater profits to the supply chain. Furthermore, the importance of risk aversion is evident in the decision-making process of supply chain management for the green tourism.

Keywords: Green tourism supply chain; Stackelberg game theory; Government subsidy; Risk aversion

1 Introduction

As China enters the 14th Five-Year Plan period, promoting high-quality development in the tourism industry has become a shared goal among regulatory bodies, businesses, and travelers. A key area of focus in this industry is green and sustainable development, as environmental pollution and protection costs increasingly constrain its healthy growth. The Chinese government has responded accordingly, with the issuance of the "Guiding Opinions on Promoting the Development of Panoramic Tourism" stressing the importance of localized and green development, strengthened environmental protection, and enhanced integration between tourism and environmental protection. This has opened new opportunities for green development in the tourism industry, which has consequently raised increased attention paid towards building a greener tourism supply chain.

Within academia, scholars have already explored green tourism development (see, e.g., Azam et al. 2018, Danish and Wang 2018, Paramati et al. 2017) [1-3]. Application of game theory models in green tourism supply chain have been explored in numerous

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studies (see, e.g., He et al. 2018, He et al. 2018, Ma et al.2021) [4-6], while more research focuses on the application of game model in green supply chain (see, e.g., Song and Gao 2018, Wang et al. 2019, Sheu and Chen 2012, Cohen et al. 2016, Barman et al. 2021, Kang et al. 2021) [7-12]. Some of these studies have also taken the influence of government subsidies into consideration (see, e.g., He et al. 2018, Sheu and Chen 2012, Cohen et al. 2016, Barman et al. 2021) [5,9-11].

Additionally, certain researchers have approached the topic of green[1] supply chains with a risk aversion lens (see, e.g., Kang et al. 2021, Cai et al. 2022, Bai and Wang 2022, Chen et al. 2023) [12-15].

Unlike the previous studies, this study aims to provide insights into tourism supply chains utilizing game theory with consideration of government subsidy and risk aversion. By introducing the greenness level of the scenic spot and consumers' environmental awareness level, we utilize Stackelberg game theory to explore the optimal decision-making involved in constructing a green tourism supply chain.

2 Model Construction and Solution

Assuming a green tourism supply chain consisting of a single scenic spot (S) and a single travel agency (T), where the former sells tickets via the latter. The scenic spot provides the travel agency with a contract unit price of w for the tickets, which are then sold to tourists at a price of p by the travel agency. For ease of computation and analysis in this study, the following assumptions are made.

The market demand q for tourism products conforms to the following equation:

$$q = m - bp + a\theta \tag{1}$$

where m denotes the limit of potential market demand, p represents the ticket price, and θ corresponds to the greenness level of the scenic spot. Furthermore, we denote b as the coefficient of influence that price exerts on demand and a as the coefficient of influence of the scenic spot's greenness level on demand, respectively. The latter variable aims to reflect consumers' preferences for the ecological friendliness level of the scenic spot or their environmental consciousness level. Considering that the market demand should be non-negative if the green level of the scenic spot is 0, it holds that $m - bp \geq 0$.

The environmental investment of the scenic spot and its ecological green level satisfy $U = I\theta^2$, where I $(I > 0)$ represents the cost coefficient of environmental investment. The marginal operating cost of each ticket is denoted as c.

To enhance the ecological quality of the scenic spot, the government offers a certain proportion of subsidies towards its environmental protection investments, specifically with a subsidy amount denoted as $kI\theta^2$, where k $(0 \leq k < 1)$ represents the coefficient of government subsidy.

Let π_T, π_S, π_R denote the profit of the travel agency, the profit of the scenic spot, and the total social welfare, respectively. The total social welfare is defined as the sum of the profits of the travel agency and the scenic spot as well as consumer surplus, minus the government subsidy. With reference to the pre-defined assumptions and parameter configurations, we obtain:

$$\pi_T = (p - w)(m - bp + a\theta) \tag{2}$$

$$\pi_S = (w - c)(m - bp + a\theta) - kI\theta^2 \tag{3}$$

At this point, the social welfare function is given by:

$$\pi_R = \pi_T + \pi_S + \frac{(m-bp+a\theta)^2}{2b} \tag{4}$$

2.1 Excluding Government Subsidy

In this scenario, where $k = 0$, a two-stage Stackelberg game exists between the scenic spot and travel agency. The decision-making order is as follows: In the first stage, the scenic spot decides its greenness level θ and the ticket contract price w; in the second stage, the travel agency determines the selling price p of tickets.

The equilibrium solutions of the model without government subsidy are displayed in Table 1. The derivation process is a simplified version of that in Section 2.2.

Table 1. The equilibrium solution of the model without government subsidy (i=1)

θ_i	w_i	p_i	π_{Ti}	π_{Si}	π_{Ri}
$\frac{a(m-bc)}{8bI-a^2}$	$\frac{4I(m-bc)}{8bI-a^2}+c$	$\frac{6I(m-bc)}{8bI-a^2}+c$	$\frac{4bI^2(m-bc)^2}{(8bI-a^2)^2}$	$\frac{I(m-bc)^2}{8bI-a^2}$	$\frac{I(14bI-a^2)(m-bc)^2}{(8bI-a^2)^2}$

2.2 Considering Government Subsidy

If $k \neq 0$, a three-stage Stackelberg model is established to assist the government, scenic spot, and travel agency in efficiently optimizing their decisions. This process includes three essential phases: In the first stage, the government sets the subsidy ratio k; in the second stage, the scenic spot establishes its desired environmental protection level θ as well as the optimal ticket contract price w in collaboration with the travel agency; in the final stage, the travel agency determines the ideal selling unit price p.

Firstly, according to Equation (2) and its first-order condition, the optimal price for the travel agency can be obtained by

$$p(w,\theta) = \frac{m+a\theta+bw}{2b} \tag{5}$$

By substituting Equation (5) into Equation (3), we obtain:

$$\pi_S = \frac{1}{2}(w - c)(m + a\theta - bw) + (k - 1)I\theta^2 \tag{6}$$

By computing the second-order partial derivatives of Equation (6) with respect to w and θ, we can derive the Hessian matrix:

$$H_1 = \begin{bmatrix} \frac{\partial^2 \pi_S}{\partial w^2} & \frac{\partial^2 \pi_S}{\partial w \partial \theta} \\ \frac{\partial^2 \pi_S}{\partial \theta \partial w} & \frac{\partial^2 \pi_S}{\partial \theta^2} \end{bmatrix} = \begin{bmatrix} -b & \frac{a}{2} \\ \frac{a}{2} & -2(1-k)I \end{bmatrix} \tag{7}$$

From Equation (7), it is apparent that $\frac{\partial^2 \pi_S}{\partial w^2} = -b < 0$. The matric is negative definite if $8b(1-k)I - a^2 > 0$. According to Equation (6) and its first-order condition, the level of greenness in the scenic spot and contract price can be determined as follows:

$$\theta(k) = \frac{a(m-bc)}{8bI(1-k)-a^2} \tag{8}$$

$$w(k) = \frac{4I(1-k)(m-bc)}{8bI(1-k)-a^2} + c \tag{9}$$

Substituting Equations (8) and (9) into Equation (5) yields:

$$p(k) = \frac{6I(1-k)(m-bc)}{8bI(1-k)-a^2} + c \tag{10}$$

Therefore, we arrive at:

$$\pi_T(k) = \frac{4bI^2(1-k)^2(m-bc)^2}{[8bI(1-k)-a^2]^2} \tag{11}$$

$$\pi_S(k) = \frac{I(1-k)(m-bc)^2}{8bI(1-k)-a^2} \tag{12}$$

$$\pi_R(k) = \frac{I[14bI(1-k)^2-a^2](m-bc)^2}{[8bI(1-k)-a^2]^2} \tag{13}$$

By taking the first-order optimality condition on Equation (13), we obtain that function π_R is strictly concave in terms of k if $32bI - 7a^2 > 0$. At this point, the optimal government subsidy coefficient $k = 3/7$. Upon substituting $k = 3/7$ into Equations (8) to (13), the optimal values for each decision can be obtained after the government determines the optimal subsidy ratio. The results have been compiled in Table 2.

Table 2. The equilibrium solution of the model with government subsidy (i=2)

θ_i	w_i	p_i	π_{Ti}	π_{Si}	π_{Ri}
$\frac{7a(m-bc)}{32bI-7a^2}$	$\frac{16I(m-bc)}{32bI-7a^2} + c$	$\frac{24I(m-bc)}{32bI-7a^2} + c$	$\frac{64bI^2(m-bc)^2}{(32bI-7a^2)^2}$	$\frac{4I(m-bc)^2}{32bI-7a^2}$	$\frac{7I(m-bc)^2}{32bI-7a^2}$

Proposition 1.

$\frac{\partial \theta(k)}{\partial k} > 0, \frac{\partial w(k)}{\partial k} > 0, \frac{\partial p(k)}{\partial k} > 0, \frac{\partial \pi_S(k)}{\partial k} > 0, \frac{\partial \pi_T(k)}{\partial k} > 0$; if $0 < k < \frac{3}{7}, \frac{\partial \pi_R(k)}{\partial k} > 0$; if $\frac{3}{7} < k < 1 - \frac{a^2}{8bI}, \frac{\partial \pi_R(k)}{\partial k} < 0$.

Proposition 2.

$\frac{\partial\theta_2}{\partial a} > 0, \frac{\partial w_2}{\partial a} > 0, \frac{\partial p_2}{\partial a} > 0, \frac{\partial \pi_{T2}}{\partial a} > 0, \frac{\partial \pi_{S2}}{\partial a} > 0, \frac{\partial \pi_{R2}}{\partial a} > 0.$

Proposition 3.

$\theta_2 > \theta_1, w_2 > w_1, p_2 > p_1, \pi_{T2} > \pi_{T1}, \pi_{S2} > \pi_{S1}, \pi_{R2} > \pi_{R1}.$

2.3 Considering the risk aversion of the scenic spot

The preceding two sections are premised on the assumption of risk neutrality. However, in real-world settings, the uncertainty of consumer behavior may result in the unpredictability of market demand. To address the uncertainty of market demand, members within a supply chain may resort to various measures for risk aversion. Therefore, Market uncertainty can be denoted as ϵ, with $\epsilon \sim N(0, \sigma^2)$ where σ^2 represents the variance. Meanwhile, the degree of risk aversion of the scenic spot and travel agency is represented by η_S $(0 \leq \eta_S < 1)$, with higher values indicating increased levels of risk aversion.

At this point, the market demand function can be derived as:

$$q = m - bp + a\theta + \epsilon \tag{14}$$

The profit functions of the scenic spot and travel agency can be obtained as follows:

$$\pi_S = (w - c)(m - bp + a\theta + \epsilon) - (1 - k)I\theta^2 \tag{15}$$

$$\pi_T = (p - w)(m - bp + a\theta + \epsilon) \tag{16}$$

The expected profits are:

$$E(\pi_S) = (w - c)(m - bp + a\theta) - (1 - k)I\theta^2 \tag{17}$$

$$E(\pi_T) = (p - w)(m - bp + a\theta) \tag{18}$$

The expected social welfare is given by:

$$E(\pi_R) = (p - c)(m - bp + a\theta) + \frac{(m-bp+a\theta)^2}{2b} + \frac{\sigma^2}{2b} - I\theta^2 \tag{19}$$

Utilizing the mean-variance theory, the utility function can be obtained as:

$$\begin{aligned} U(\pi_S) &= E(\pi_S) - \eta_S Var(\pi_S) \\ &= (w - c)(m - bp + a\theta) - (1 - k)I\theta^2 - \eta_S(w - c)^2\sigma^2 \end{aligned} \tag{20}$$

As travel agency is risk-neutral, its utility function can be expressed as:

$$U(\pi_T) = E(\pi_T) = (p - w)(m - bp + a\theta) \tag{21}$$

By substituting Equations (5) into Equation (20), we obtain:

$$U[\pi_S(k)] = \frac{1}{2}(w-c)(m-bw+a\theta) - (1-k)I\theta^2 - \eta_S(w-c)^2\sigma^2 \tag{22}$$

The Hessian matrix of Equation (22) can be obtained by:

$$H_2 = \begin{bmatrix} -b-2\eta_S\sigma^2 & \frac{a}{2} \\ \frac{a}{2} & -2I(1-k) \end{bmatrix} \tag{23}$$

It is evident that $-b-2\eta_S\sigma^2 < 0$. $U[\pi_S(k)]$ is a concave function with respect to both w and θ if $8I(1-k)(b+2\eta_S\sigma^2) - a^2 > 0$. Accordingly, by the first-order conditions of Equation (22), the greenness level and contract price are derived as:

$$\theta(k) = \frac{a(m-bc)}{8I(1-k)(b+2\sigma^2\eta_S)-a^2} \tag{24}$$

$$w(k) = \frac{4I(1-k)(m-bc)}{8I(1-k)(b+2\sigma^2\eta_S)-a^2} + c \tag{25}$$

By substituting Equations (24) and (25) into Equation (5), we obtain:

$$p(k) = \frac{2I(1-k)(m-bc)(3b+4\sigma^2\eta_S)}{8bI(1-k)(b+2\sigma^2\eta_S)-a^2b} \tag{26}$$

For simplicity, we use X, Y, Z, and M to represent $b+2\sigma^2\eta_S$, $b+4\sigma^2\eta_S$, $7b+12\sigma^2\eta_S$, and $m-bc$. It follows that the expected profits of both the scenic spot and travel agency as well as the social welfare can be expressed as:

$$E[\pi_S(k)] = \frac{I(1-k)M^2[8I(1-k)Y+a^2]}{[8bI(1-k)X-a^2]^2} + c \tag{27}$$

$$E[\pi_T(k)] = \frac{4I^2(1-k)^2M^2Y^2}{b[8I(1-k)X-a^2]^2} \tag{28}$$

$$E[\pi_R(k)] = \frac{IM^2[2I(1-k)^2YZ-a^2b]}{b[8I(1-k)X-a^2]^2} + \frac{\sigma^2}{2b} \tag{29}$$

The optimal subsidy rate is determined by the government based on the maximization of social welfare. By taking the first and second-order partial derivatives of Equation (29) with respect to k and setting the first-order derivative equal to zero, we obtain:

$$k_3 = \frac{YZ-4bX}{YZ} \tag{30}$$

By substituting Equation (30) into Equations (24)-(29) yields:

$$\theta_3 = \frac{aMYZ}{32bIX^2 - a^2YZ} \tag{31}$$

$$w_3 = \frac{16bIMX}{32bIX^2 - a^2YZ} + c \tag{32}$$

$$p_3 = \frac{8IMX(Z - 4X)}{32bIX^2 - a^2YZ} + c \tag{33}$$

$$E(\pi_{S3}) = \frac{(4bIM^2XY)(32bIX - a^2Z)}{(32bIX^2 - a^2YZ)^2} \tag{34}$$

$$E(\pi_{T3}) = \frac{64b^2I^2M^2X^2Y^2}{(32bIX^2 - a^2YZ)^2} \tag{35}$$

$$E(\pi_{R3}) = \frac{IM^2YZ^2}{32bIX^2 - a^2YZ} + \frac{\sigma^2}{2b} \tag{36}$$

Proposition 4.

$\frac{\partial k_3}{\partial \eta_S} > 0, \frac{\partial \theta_3}{\partial \eta_S} > 0, \frac{\partial w_3}{\partial \eta_S} < 0, \frac{\partial p_3}{\partial \eta_S} < 0, \frac{\partial E(\pi_{S3})}{\partial \eta_S} < 0, \frac{\partial E(\pi_{T3})}{\partial \eta_S} > 0, \frac{\partial E(\pi_{R3})}{\partial \eta_S} > 0.$

2.4 Considering the risk aversion of the travel agency

Let η_T $(0 \le \eta_T < 1)$ denote the degree of risk aversion of the travel agency. Since the model establishment and solution process are the same as that in Section 2.3, the equilibrium solutions of the decision model are presented directly. For the sake of simplicity, we use O, P, Q, and M to represent $b + \sigma^2\eta_T$, $b + 2\sigma^2\eta_T$, $7b + 6\sigma^2\eta_T$, and $m - bc$, respectively.

$$k_4 = \frac{Q - P}{2Q} \tag{37}$$

$$\theta_4 = \frac{aPQM}{32bIO^2 - a^2PQ} \tag{38}$$

$$w_4 = \frac{16IMO^2}{32bIO^2 - a^2PQ} + c \tag{39}$$

$$p_4 = \frac{8IMO(Q - P)}{64bIO^2 - 2a^2PQ} + c \tag{40}$$

$$E(\pi_{S4}) = \frac{4IM^2OP}{32bIO^2 - a^2PQ} \tag{41}$$

$$E(\pi_{T4}) = \frac{64Pb^2I^2M^2O^2}{(32bIO^2 - a^2PQ)^2} \tag{42}$$

$$E(\pi_{R4}) = \frac{IPM^2(Q-P)}{64bIO^2 - 2a^2PQ} + \frac{\sigma^2}{2b} \tag{43}$$

Proposition 5.

$\frac{\partial k_4}{\partial \eta_T} < 0, \frac{\partial \theta_4}{\partial \eta_T} > 0, \frac{\partial w_4}{\partial \eta_T} > 0, \frac{\partial p_4}{\partial \eta_T} < 0, \frac{\partial E(\pi_{S4})}{\partial \eta_T} < 0, \frac{\partial E(\pi_{T4})}{\partial \eta_T} > 0, \frac{\partial E(\pi_{R4})}{\partial \eta_T} > 0.$

3 Numerical Experiment

To further elucidate the influences of government subsidy, consumer green preference and risk aversion on decision-making and profits in the green tourism supply chain, numerical simulations are conducted using MATLAB R2023a in this section. Following previous research and considering the interrelations among various model parameters, we set $m = 10$, $c = 3$, $I = 2$, $b = 1$.

A preliminary analysis is conducted to elucidate the influences of government subsidy coefficient on decision-making in the green tourism supply chain. According to the parameter assignments and constraint $8b(1-k)I - a^2 > 0$ obtained from model solving, it is determined that $k < 0.98$. Setting the green preference coefficient of consumers, a, to 0.5 in this section, we analyze the changes in government subsidy coefficient k. The results are presented in Fig. 1.

From Fig. 1, it can be observed that government subsidy has the power to mobilize enthusiasm within the scenic spot and further drive its development towards greener

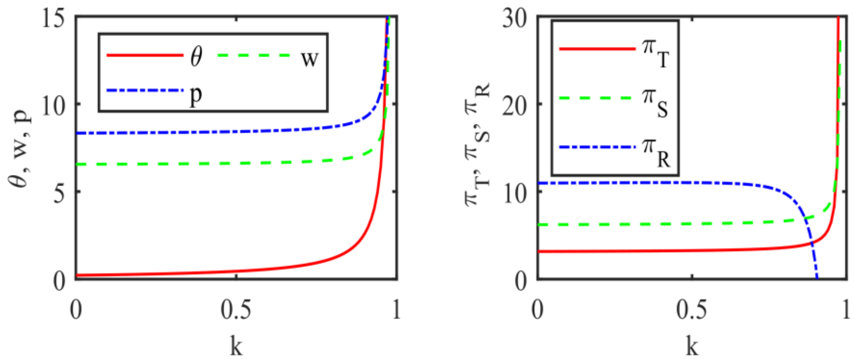

Fig. 1. The relationship of k to θ, w, p, πT, πS and π

practices. However, the increase also signals that the scenic spot requires more investment. Factoring in its own benefits, this cost is transferred to the travel agency through a rise in contract price, and the travel agency, who consider its own profits, then chooses to raise ticket price accordingly. Meanwhile, there is a sustained upward trend in the profit of the scenic spot and travel agency as the government subsidy coefficient increases. Furthermore, it can be noted that social welfare continually rises if $0 < k < 0.43$. If $0.43 < k < 1$, increasing government subsidy coefficients cause a reduction in social welfare values. This is primarily due to excessive government stimulation leading to excessive growth in ticket price, which in turn harms consumer interests. Although overall supply chain profit increases at this point, it does not outweigh the increasing expenditure on government subsidy and decreasing consumer surplus, leading to a decline in social welfare. Fig. 1 provides evidence for Proposition 1.

As previously mentioned, social welfare is maximized if $k = 0.43$. Subsequently, with a fixed government subsidy coefficient of $k = 0.43$, the variation in tourist green preference coefficient a is analyzed over the range [0.5, 1.5]. These values satisfy the conditions for the existence of equilibrium solutions. Refer to Fig. 2 for the results.

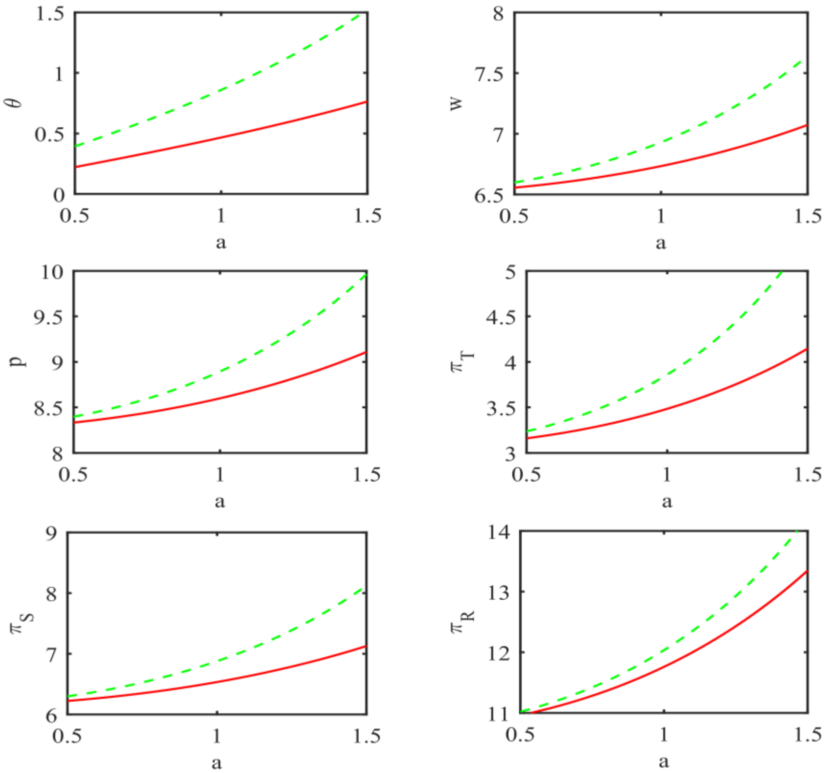

Fig. 2. The relationship of a to θ, w, p, π_T, π_S and π_R

The solid red curves represent excluding government subsidy, while the dashed green curves represent considering government subsidy. Adequate government subsidies to the scenic spot can further enhance the positive influence of green preferences among tourists. In response to the increasing awareness of environmental protection among tourists, the scenic spot will actively enhance its greenness level to meet tourist demands. At the same time, with moderate government subsidies for the scenic spot, the double incentives will prompt the scenic spot to raise its greenness level more proactively than under no subsidies. This also means higher costs, which leads to price adjustments by the scenic spot and travel agency in order to transfer costs and gain higher profits. Fig. 2 support the findings of Propositions 2 and 3.

Upon taking risk aversion into consideration, let $\sigma = 1$ and let η_S and η_T vary within the range of (0, 1). Let $E(\pi_{SC})$ denote the profit of the supply chain, which equals $E(\pi_S)$ plus $E(\pi_T)$. Following the determination of the optimal subsidy rate by the government, we investigate how decision-making, profits, and societal welfare correlate with risk aversion.

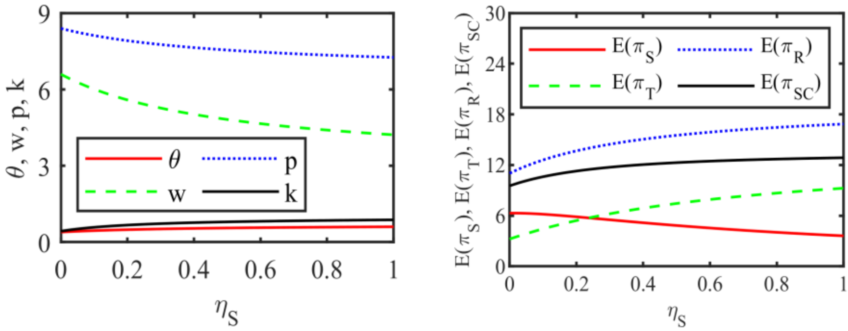

Fig. 3. The relationship of η_S to θ, w, p, k, $E(\pi_T)$, $E(\pi_S)$, $E(\pi_R)$ and $E(\pi_{SC})$

Fig. 3 confirms Proposition 4. As the scenic spot's level of risk aversion increases, the government subsidy also increases. This incentive motivates the scenic spot to strengthen their environmental protection efforts more actively. Additionally, both the scenic spot and travel agency decrease prices in order to stimulate market demand. The scenic spot’s consideration of risk aversion benefits the travel agency and supply chain, with greater benefit observed as risk aversion levels increase.

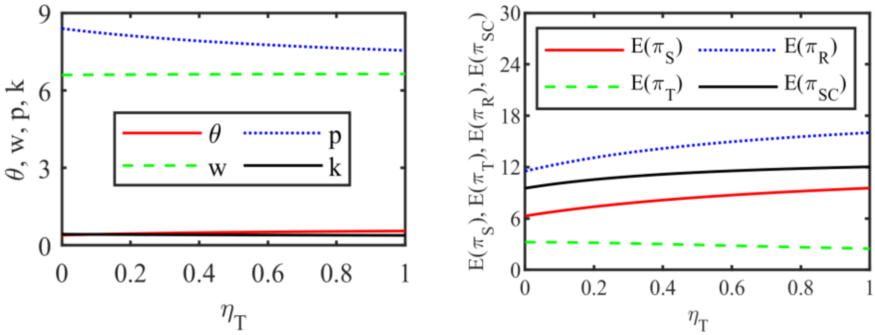

Fig. 4. The relationship of η_T to θ, w, p, k, $E(\pi_T)$, $E(\pi_S)$, $E(\pi_R)$ and $E(\pi_{SC})$

Fig. 4 validates Proposition 5. The risk-averse behavior of the travel agency leads it to mitigate risk by reducing ticket prices, while the scenic spot enhances its revenue by increasing the level of greenness and ticket contract prices. In this scenario, the profit of the scenic spot and supply chain increases while the profit of the travel agency decreases. Moreover, Fig.3 and Fig.4 show that taking risk aversion into account holds a positive effect on the social welfare.

4 Conclusions

Drawing upon Stackelberg game theory, we address the green tourism supply chain problem by considering government subsidy and risk aversion. A game model is constructed among the government, a scenic spot, and a travel agency to analyze equilibrium solutions under various scenarios. MATLAB is utilized for numerical experiments, yielding a series of conclusions. First, moderate government subsidies have a positive effect on enhancing the greenness level of the scenic spot, as well as improving profits for both scenic spot and travel agency, and societal welfare. Additionally, increased environmental awareness amongst tourists is conducive to promoting the greenness level of scenic spot, increasing the profit of both scenic spot and travel agency, and improving societal welfare. As the degree of risk aversion increases, the greenness level of scenic spot and social welfare are heightened. Conversely, both contract price and selling price of tickets are likely to decrease. The risk-averse behavior of the scenic spot or travel agency can enhance the other party's profits, which is unfavorable to their own profits. In the long term, moderate government subsidies should be provided while efforts to enhance tourists' environmental awareness should be prioritized to fundamentally promote the green development of the tourism industry.

However, we focus on the game model within a single-chain supply chain structure. In the future, it could be extended to network supply chain structures involving competition among multiple travel agencies or multiple scenic spots. Additionally, other behavioral characteristics such as fairness concern and cost sharing could be simultaneously considered in future studies.

References

1. Azam M, Mahmudulalam M, Hafeez M H. Effect of tourism on environmental pollution: Further evidence from Malaysia, Singapore and Thailand[J]. Journal of Cleaner Production, 2018, 190: 330-338.
2. Danish, Wang Z H. Dynamic relationship between tourism, economic growth, and environmental quality[J]. Journal of Sustainable Tourism, 2018, 26(11): 1928-1943.
3. Paramati SR, Alam MS, Chen CF. The Effects of Tourism on Economic Growth and CO2 Emissions: A Comparison between Developed and Developing Economies[J]. Journal of travel research: The International Association of Travel Research and Marketing Professionals, 2017, 56(6): 712-724.
4. He Y, He P, Xu F, et al. Sustainable tourism modeling: Pricing decisions and evolutionarily stable strategies for competitive tour operators[J]. Tourism Economics, 2018, 25(5): 779-799.

5. He P, He Y, Xu F. Evolutionary analysis of sustainable tourism[J]. Annals of Tourism Research, 2018, 69: 76-89.
6. Ma S G, He Y, Gu R. Joint service, pricing and advertising strategies with tourists' green tourism experience in a tourism supply chain[J]. Journal of Retailing and Consumer Services,2021, 61.
7. Song H, Gao X. Green supply chain game model and analysis under revenue-sharing contract[J]. Journal of Cleaner Production, 2018, 170: 183-192.
8. Wang J, Jiang H, Yu M. Pricing decisions in a dual-channel green supply chain with product customization[J]. Journal of Cleaner Production, 2019, 247.
9. Sheu J B, Chen Y J. Impact of government financial intervention on competition among green supply chains[J]. International Journal of Production Economics, 2012, 138(1): 201-213.
10. Cohen M C, Lobel R, Perakis G. The Impact of Demand Uncertainty on Consumer Subsidies for Green Technology Adoption[J]. Management Science, 2016, 62(5): 1235-1258.
11. Barman A, Das R, De P K, et al. Optimal Pricing and Greening Strategy in a Competitive Green Supply Chain: Impact of Government Subsidy and Tax Policy[J]. Sustainability, 2021, 13(16): 9178.
12. Kang K, Gao S, Gao T, et al. Pricing and Financing Strategies for a Green Supply Chain with a Risk-Averse Supplier[J]. IEEE Access, 2021, 9: 9250-9261.
13. Cai J, Lin H, Hu X, et al. Green supply chain game model and contract design: risk neutrality vs. risk aversion[J]. Environmental Science and Pollution Research, 2022, 29(34): 51871-51891.
14. Bai S Z, Wang Y G. Green Investment Decision and Coordination in a Retailer-Dominated Supply Chain Considering Risk Aversion[J]. Sustainability,2022,14(20).
15. Chen Z, Shao L S, Wang Y B. Pricing and coordination in a green supply chain with a risk-averse manufacturer under the reference price effect[J]. Frontiers in Environmental Science, 2023, 10.