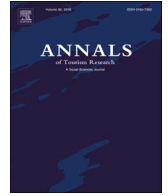


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Evolutionary analysis of sustainable tourism

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ABSTRACT

This paper aims to explore an effective green incentive mechanism for government to develop traditional tourism into green tourism by establishing a dynamic evolutionary game model among governments, tourism enterprises, and tourists. We first discuss the evolutionary stable strategy (ESS) regarding green innovation and its corresponding conditions for each stakeholder, and then analyze the ESS between tourism enterprises and tourists, with and without consideration of government green supervision. The optimal green incentive condition for driving all stakeholders to conduct green behavior is identified. More importantly, we advise the government to first implement green incentive mechanism in the areas where the tourism market scale is relatively small. Additionally, we utilize numerical examples to illustrate the findings and provide some managerial insights.

Introduction

In recent decades, protecting the environment, improving the utilization rate of natural resources, and achieving the sustainable development of humans and nature have attracted enormous attention among people throughout the world (Buckley, 2012). China is no exception to this trend. China's economic development, over the last decades, has accelerated and also produced a negative impact on the ecological environment (Simões, 2016). From the report released by Asian Development Bank, < 1% of the 500 largest Chinese cities meet the air quality standards suggested by the World Health Organization, and 7 of its cities are in the list of the 10 most polluted cities in the world (Zhang & Crooks, 2012). As an important part of China's tertiary sector, the tourism industry, which witnessed a rapid growth in 2010 with 935 million international and 2103 million domestic tourist arrivals (Yan, 2013), has been growing rapidly. Meanwhile, the tourism industry has consumed a considerable amount of water, energy, and disposable products owing to the nature and characteristics of its services, resulting in serious contamination of the atmosphere, oceans, soil, biota, freshwater, etcetera; besides, the purchase of raw materials, manufacture of tourism products, and disposal of used products has also damaged the ecological environment (Chu & Chung, 2016; Gössling et al., 2012; Han & Haejin, 2015). Although the Chinese government has paid much attention to environmental protection since 1995, the trade-off between environmental problems and economic growth is still the most delicate question that it currently faces (Chen, Yang, & Wang, 2016).

With the popularization of environmental protection, consumers are increasingly willing to change their consumption lifestyles by exhibiting more eco-friendly behavior and willingness-to-pay for green products to reduce environmental pollution. For example, consumers in the United Kingdom (U.K.), spent GBP 38 billion in their pursuit of green alternatives¹. As indicated by Budeanu and Chesworth (2007) and Su and Swanson (2017), tourists' demands for green tourism have been growing in the past few decades. This

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implies that the green operation of firms is becoming essential to maintaining enterprise competitiveness or capturing a greater market share and many tourism enterprises have been striving to invent new eco-friendly products to attract and target more tourists (Chen & Chai, 2010; Han & Haejin, 2015). However, green tourism enterprises face a significantly higher investment and a longer payback period than traditional ones. Additionally, some local governments have paid more attention to economic indicators than environmental impact. Consequently, it is a matter of utmost urgency for the Chinese government to make sure that the public responds positively to the sustainable development policies by coming up with some effective mechanisms. Considering this background, this paper is dedicated to answering the following research questions:

- (1) How does the central government motivate tourism stakeholders to select green tourism?
- (2) Under what conditions does each stakeholder have a stable strategy from a long-term perspective?
- (3) What are the evolutionary stable strategies and corresponding conditions of the dynamic system, with and without government green supervision?
- (4) How would the factors, such as green incentive intensity of local governments, brand benefit of tourism enterprises, and green preferences of tourists affect the decision of each stakeholder?

This paper proposes a dynamic evolutionary game model to address the above questions. Evolutionary game theory is the self-organization process by which a population of individual evolves into the expected distribution of individual behaviors based on participants learning (Weibull, 1997). The pivotal concept of evolutionary game theory is the evolutionary stable strategy (ESS) first proposed by Smith and Price (1973), which can be defined as a strategy S^* satisfying two conditions: (1) $E(S^*, S^*) \geq E(S, S^*)$ for all $S \neq S^*$ and (2) $E(S^*, S) > E(S, S)$, where E denotes the payoff function and S represents the possible strategy other than S^* (Barari, Agarwal, Zhang, Mahanty, & Tiwari, 2012). The replicator dynamic proposed by Taylor and Jonker (1978) is a dynamic differential analysis method, which is widely used to investigate the long-term strategic stability of stakeholders. The core idea of replicator dynamic analysis is that if one strategy gains more than the average income of other strategies during the game process, it indicates that the strategy is suitable for the evolution of the group. In other words, the strategy has stability as an invasion strategy and can evolve into a stable strategy through repeated games.

Based on the evolutionary game theory, we first discuss the ESS concerning green innovation for each stakeholder. Then, we analyze the ESS between tourism enterprises and tourists, with and without consideration of the local governments' green supervision policy. The research results show that the decisions of stakeholders can interact with each other under certain conditions. It is worth noting that local governments' supervision behavior cannot directly affect the purchasing decision of tourists, but it can indirectly drive tourists to accept the green tourism pattern by encouraging tourism enterprises to sell green products. The findings also highlight that enhancing brand benefit of tourism enterprises and/or green preference of tourists is an extremely useful method to stimulate stakeholders to adopt green tourism. Through the numerical experiment, we conclude that the initial states of stakeholders taking part in green activities can only affect the short-term decisions of all participants, whereas the evolutionary stable conditions can determine the decision making of each stakeholder from a long-term perspective. Moreover, we propose a green incentive mechanism and identify the optimal conditions of green incentive intensity to achieve the ideal green tourism pattern. We further suggest that the government should first implement green incentive mechanism in the areas where the scale of tourism is relatively small. The management implications could benefit the development of modern tourism industry, as well as promote the implementation of the government's sustainable development policies.

The paper starts with a review of relevant literature on sustainable tourism and dynamic game theory. The second part describes the basic model and its corresponding assumptions. The third part presents the ESS for each stakeholder and its corresponding stable conditions, and numerical examples are employed to discuss the impacts of some key parameters. The conclusions and managerial insights for sustainable tourism development are proposed in the final section of the paper.

Literature review

This paper draws on, and contributes to, two distinct streams of literature — sustainable tourism and dynamic game theory.

Sustainable tourism

Since China vowed to incorporate sustainable development into its policies in 1995, it has become a buzzword in the operational management field on which many researchers have focused (Huang, Deng, Li, & Zhong, 2008; Liu, Zhou, Wennersten, & Frostell, 2014; Lu & Nepal, 2009). As one of the main driving forces of China's economic development, tourism has led to some environmental issues (Tang, Zhong, & Cheng, 2011). Some researchers have investigated green consumption from the perspectives of tourists, firms, and society, and suggested that tourism enterprises should shift their focus from the supply side to the demand side for sustainable development (Budeanu & Chesworth, 2007; Kastenholtz, 2004; Swarbrooke, 1999). With the general trend of sustainable development, the tour operators have faced enormous pressure related to environmental protection in the past ten years, exerted by government, economics, culture, and society (Chu & Chung, 2016). Roberts and Tribe (2008) indicated that small tourism enterprises automatically contribute to sustainable tourism development by offering personalized tours. Some scholars (Saarinen, 2014; Zhao, Chen, & Liu, 2015) have confirmed that government regulation is a useful method that encourages civil enterprises to turn traditional tourism into sustainable tourism to a large extent. A large number of studies have investigated the characteristics of green guests, motivations for green consumption, and the impacts of green attributes on tourist satisfaction (Kasim, 2004; Peattie, 2010). Jinsoo,

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