Game-Theoretic Approach to Competition Dynamics in Tourism Supply Chains

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March 2008

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ABSTRACT

This article considers two tourism supply chains (TSCs). Each TSC is assumed to consist of three sectors with the following service providers - a theme park operator, accommodation providers, and tour operators. Game theory is used to investigate the cooperation and competition between these two TSCs, between the three sectors within each TSC and between the enterprises within each sector when configuring and marketing package holidays. Two research questions are of particular interest: (1) How do the tour operators and accommodation providers determine the optimal number of tourists they served, and how does the theme park optimize its admission prices? (2) How do the factors like supply chain membership, supply chain preference and strategic integration affect supply chain members' decisions, as well as their performances? Several important findings are obtained. First, a larger membership in each of the TSC sectors strengthens the sector's overall capacity and intensifies the internal competition, thus reducing members' profits while other sectors benefit from this internal competition. Second, decision-makers of the two competing TSCs should adopt appropriate product differentiation strategies by carefully positioning their package holiday products in order to optimize their performance. Third, the theme park would benefit from integration with the accommodation provider. There exists a win-win situation in which the performances of both TSCs could be improved, if the integration adequately increases the TSCs' preference.

Keywords: tourism supply chain; package holidays; game theory; competition; supply chain dynamics.

1. INTRODUCTION

Package holidays or all-inclusive travel has been very popular and is likely to maintain its popularity in many countries such as Japan, Ireland, the UK and China (Nozawa 1992; Corcoran, Gillmor and Killen 1996; Taylor 1998; Wang, Hsieh and Huan 2000). According to the European Union's Package Travel Regulations (1992), "package" means the pre-arranged combination of at least two of the components (transport, accommodation, and other tourist services) when sold or offered for sale at an inclusive price and when the service covers a period of more than 24 hours or includes overnight accommodation. For example, a package holiday to Hong Kong marketed and operated by travel agents and/or tour operators usually consists of overnight accommodation in Hong Kong, visits to one of the two theme parks and other tourist attractions, shopping and of course the use of transportation services.

Different types of tourism components (activities) in package holidays are provided by specific agents and enterprises that form a *tourism supply chain* (TSC). A TSC comprises the suppliers of all the goods and services that go into the delivery of the tourism products to tourists (Tapper and Font 2007). Among these suppliers, tour operators play a principal role as the intermediaries that bring buyers and sellers together, package different tourism products/services into a single product, and market the product to the targeted tourist segments (Tepelus 2004).

Enterprises in a TSC, on the one hand, benefit from providing components of the package tours, as a consistent demand for these products/services could be maintained

(Aguiló, Alegre and Sard 2003). On the other hand, the performance of one service provider in the TSC depends on the performance of the others (Swaminathan, Smith, and Sadeh 1998), as each of the TSC enterprises influences tourists' experiences as well as the payoff behavior of all enterprises within the TSC. The interactions (collaboration and competition) among the firms within a TSC and between TSCs suggest that tourism enterprises are no longer autonomous entities, but rather they are parts of the TSCs. (Lambert and Cooper 2000).

TSC collaboration and competition issues are challenging not only for practitioners but also for academic researchers. Little analytical work has been reported in the literature on TSC management although game theory has been widely applied for manufacturing supply chain management (SCM) (Zhang 2006). Although it is relatively complex to formulate a theoretical model for TSC collaboration and competition related to a particular tourism industry, it becomes increasingly important to identify the distinctive features of TSCs for efficient and effective tourism supply chain management (TSCM).

In this paper, we investigate the competition dynamics of two TSCs for package holidays. We consider a tourist destination that is dominated by two theme parks. Each theme park works closely and exclusively with its business partners; tour operators and accommodation providers. As a result, two TSCs are formed at this destination. These two TSCs provide package holidays with different theme parks. One TSC focuses on package holiday products exclusively with a "fantasy" theme park and the other TSC with a "variety" theme park. Tourists only choose one of the two types of package holidays. Therefore, they are substitute products for each other.

A TSC is a network where each sector is represented as a node. The three sectors are arranged into two layers or echelons. The upstream layer contains the accommodation providers and theme park operators. The downstream layer has one sector consisting of only tour operators. Tour operators are responsible for configuring and marketing the package holidays according to tourists' requirements from the component options that are provided by the upstream sectors. In this paper, travel agents and tour operators are used interchangeably. In order to simplify the theoretical model, sectors such as transport, bars and restaurants, etc. are not included. Instead, they are implicitly assumed to be within the accommodation sector.

The purpose of this research is to provide a comprehensive analysis of competition dynamics of the TSC for package holidays. *Competition dynamics* here is considered as the influence and reaction of interdependent and self-interested tourism businesses (e.g. theme park operators, accommodation providers, and tour operators) within a TSC in the presence of changes in such competition environments as new entrance of competitors, changes in supply chain preference, and strategic integration.

Several types of competition are discussed. One is the *intra-sector* competition between enterprises within a sector such as the accommodation sector or the sector for travel intermediaries. The second is the *inter-sector* competition in the same layer of a TSC. An example is the competition between theme park operators and accommodation providers. The third is the *cross-sector* competition between sectors (and their member firms) located in different layers of a TSC. Examples include competition between theme parks and tour operators, and between accommodation providers and tour operators. The last is the *chain* competition between two TSCs. It is presented by substitute package tours sold by tour operators in the same market.

In this theoretical research, such questions as how many tourists the tour operators and accommodation providers should ideally serve, and at what level the theme park operators should charge the visitors for admission to the parks, can be answered. Furthermore, we are more interested in knowing: (1) how are the market equilibriums (price, demand quantity, and the profits of sectors and the TSC) influenced by factors like supply chain membership and preference? (2) what is the impact of strategic integration in TSC and how does TSC response to such integration? The findings of this research should be of interest to decision makers of the service providers within the TSCs, and to policy-makers of local governments.

This paper proposes a game-theoretic framework in order to address these research questions. Simultaneous non-cooperative games are used to analyze the intra-sector and the chain competitions, while the leader-follower games are used to investigate the cross-sector competition between sectors in different layers of TSCs. The inter-sector competition is an indirect competition reflected by two cross-sector competitions. The games are static with full information for simplicity. Equilibriums of the multi-stage games are solved through backward induction. The intra-sector games are first solved before cross-sector games are considered jointly to coordinate the demand (quantity) within each TSC. The two TSC games are finally solved for equilibriums for each of the individual enterprises, sectors and TSCs.

In this research, game theory is chosen for examining the competition dynamics of TSC for package holidays for several reasons. First, game theory is a powerful tool for analyzing situations in which the decisions of multiple agents affect each agent's payoff

(Cachon and Netessine, 2003). Secondly, the equilibriums of games could allow tourism enterprises to predict the actions of their opponents and react with optimal responsive strategies. Thirdly, although game theory has been successfully applied in production supply chain management (Carr and Karmarkar 2005; Netessine and Shumsky 2005), little research has been done in applying game theory to the tourism and hospitality industry. Wie (2003) and Garcia and Tugores (2006) represent a few early explorations. The findings of this research will make significant theoretical and practical contributions to the supply chain management in the tourism and hospitality industry.

The rest of the paper is organized as follows. After a review of the literature in Section 2, Section 3 presents a game model with three competition types and illustrates the equilibrium solution. Section 4 provides the theoretical results of competition dynamics. Several management implications are also presented in this section. General conclusions and directions for future work are presented in Section 5. All proofs of results are given in the Appendix[1].

2. LITERATURE REVIEW

Two groups of published studies are relevant to this research. One is the TSC specific literature while the other relates to general discussions on game theory and its application to supply chain management.

The ways in which different businesses in a supply chain compete, coordinate, and/or cooperate in providing products and/or services to customers have been widely studied. Tourism products, services or experiences involve a wide range of suppliers.

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[1] The appendix is available through a URL: http://www.digiprise.org/tourism/jbr.htm

Page (2003) illustrates a typical TSC for package holidays. Principal elements of a TSC include tour operators (or travel agencies), accommodation providers, attractions and activities suppliers, etc. He emphasizes that a successful business should be able to understand how business conditions can impact upon its business operations, how it should respond to the opportunities, threats and shortcomings in the organization, and how to manage its relationship with competitors.

Visiting theme parks is a main motivation and attraction for tourists to choose a package holiday. Braun and Soskin (1999) observe substantial changes over time in both market structure and overall market environment in the theme park industry in Central Florida. They found that the market structure had changed from monopoly to oligopoly. Moreover, the prices of theme parks became more stable when the industry continued to mature. Wong and Cheung (1999) argue that theme parks could provide unique and memorable experiences that differentiate from other types of entertainment. Therefore, package holiday products with strategic themes would be more competitive.

Tour operators play an important role in providing package holidays, as they have a direct influence on tourism volume. Based on the econometric analysis of a panel-data set, Davies and Downward (1998) conclude that the UK. package tour industry can be best characterized as an oligopoly and reject the contestable market hypothesis. Aguiló, Alegre, and Sard (2002) analyzed the pricing strategies of the package holiday providers in Germany and the UK. and asserted that the tour operator market possesses typical oligopolistic features.

Accommodation is a fundamental element of any package holiday product (Sharpley 2000). Hence, it attracts much attention of researchers. For example, Baum and

Mudambi (1995) argue that the Bermuda hotel market is oligopolistic and prices of the hotels are well-behaved when excessive supply of hotel accommodation exists. Chung (2000) found that the deluxe hotel market in Seoul is a continuum of an oligopoly suggesting that the hotel market competition is interdependence.

The success of tourism enterprises in a TSC often depends on their mutual collaborations as they tend to provide complementary or substitute products/services. For example, a theme park needs to coordinate with tour operators, hotels, transportation providers, and other tourism facilities in order to increase its visitor volume. Tourists' experiences depend on the quality of all these services (Kemperman 2000). Moreover, accommodation providers offer a product of strategic interest to tour operators as it determines to a great extent the cost of a package holiday (Medina-Munoz, Medina-Munoz, and Garca-Falcon 2003). Therefore, tour operators usually exercise some control over the accommodation providers with whom they deal (Bastakis, Buhalis, and Butler 2004; Medina-Munoz, Medina-Munoz, and Garca-Falcon 2003). In extreme cases, enterprises attempt to achieve more flexible and stable coordination by directly integrating suppliers that provide complementary services. For example, a few large tour operators in Europe are the result of vertical integration, as they operate their own travel agencies, provide chartered flights and run their own hotels (Theuvsen, 2004). These tourism businesses are inter-related and form complex TSCs. The goal of the TSC management is to achieve a total business success through managing these inter-related businesses (Lambert and Cooper, 2000).

Game theory has been widely used in SCM research. A variety of game models have been proposed according to different supply chain structures. The simplest supply chain has a serial structure and contains two enterprises. This structure is popular with different game models for theoretical analysis. For example, the Nash Games (Huang and Li 2001), Stackelberg Games (Ertek and Griffin 2002), and Bargaining Games (Sucky 2005) are based on such supply chains. Supply chains with more complex structures may involve multi-stage games. For example, in the two-echelon supply chain with a tree structure, Tsay and Agrawal (2000) characterize the competition within an echelon by a Nash (simultaneous non-cooperative) Game and the competition between echelons by a Stackelberg (leader-follower) Game. Using the same approach between echelons, Yang and Zhou (2006) compare three scenarios in which two homogeneous enterprises play the Nash Game, the Stackelberg Game, and cooperated, respectively, within the downstream echelon.

The literature on game theory in tourism and hospitality research has been very limited. Using the game-theoretic approach, Aguiló, Alegre and Sard (2002) examine an oligopoly tourism market, and conclude that the tour operators tend to have market power and are able to charge higher prices for their products without losing the market shares that they occupy. Candela and Cellini (2003) argue that a differentiated oligopoly model is more appropriate for studying tourism development strategies. Taylor (1998) develops a model with a view to analyzing the pricing strategy behavior in the UK package tour industry. Wie (2005) builds an N-person non-zero-sum non-cooperative dynamic game to investigate the strategic capacity investment in the cruise industry. García and Tugores (2006) apply a vertical differentiation duopoly model to explain the reasons why the high quality and low quality hotels could co-exist. These research efforts generally focus on the behavior of individual tourism enterprises or sectors, rather than in the TSC context

(Tapper and Font 2007).

3. RESEARCH METHOD

The tourism system considered here consists of two competitive TSCs. Each includes multiple tour operators (TOs), multiple accommodation providers (HAs), and one theme park operator (TP). TOs and HAs in the same TSC are grouped into sectors, and all entities within a sector are assumed to be identical. The TSC is represented as a network where each sector is represented as a node (see Figure 1). The three sectors are arranged into two layers or echelons. TP and HAs in the upstream layer are suppliers of package tour components or options of package holiday products. TOs in the downstream layer are responsible for the configuration and promotion of the package holidays according to tourists' demand for the services provided by the upstream sectors. The prices charged by TOs include the payments to the TP and HAs. The two substitutive TSCs provide package holidays with two different TPs. Tourists are assumed to choose only one of the two package holidays. For the sake of simplicity, we only consider the situation where all tourists join the TP through the package holidays. Therefore, those tourists who buy admission tickets directly from the TP are not included in our model.

Several relationships can be defined in the game. One is the intra-sector competition between enterprises within a sector. It is illustrated by the quantity competition in the TO and HA sectors. The second type of relationship is the cross-sector competition which is between sectors in different layers, e.g. between the TP and TO sectors, and between the HA and TO sectors. The cross-sector competition takes the form of coordination in the sense that sectors coordinate the demands. The third type is the inter-sector competition between sectors in the same layer, e.g. between the TP and HA sectors at the level below the TO sector. The fourth type is the chain competition between the two TSCs. They supply substitute package tours and therefore directly compete with each other on the target market.

A normal game consists of three components: (1) players, (2) strategies available to each player, and (3) payoffs received by each player (Cachon and Netessine 2003). In our model, all the entities (TPs, TOs, and HAs) in the TSCs are game players, and profits are their payoffs. There are two models of determining players' strategies. One model is that the TP takes admission quantity as its strategy, while the TOs and HAs adopt prices as their strategies. This model is useful in studying the market dynamics of price-sensitive package holidays. The other model is that the TP takes admission price as its strategy, while the TOs and HAs adopt quantity as their strategy. This latter model is useful in studying the pricing dynamics of the TP over market demand. While the former model will be studied in the future,this study is focused on the latter model. This study is particularly relevant when TOs and HAs contract and distribute their capacities to their service consumers (Lee and Ng, 2001). For example, the tour operator, such as Airtours, quantities are determined one season ahead through long-term contracts. Also, it is not unusual for Hong Kong hotels to set aside some of their rooms for tour operators one month in advance (Choi and Cho, 2000).

Competitions in the market are described in the following multi-stage game. In the first stage, the TP determines the admission price, and the HA sector achieves its market clearing prices through quantity competition among HAs. In the second stage, each TO receives the prices of the TP and HA and determines the number of tourists they plan to serve, then allows the market to determine the final price of the package holiday.

Insert Figure 1 here.

In the formulation, TSC_A and TSC_B represent the two TSCs, respectively. Subscripts A and B are omitted when a single chain is discussed, and subscript -1 represents the rival (competing) TSC. There are *N* TOs and *M* HAs in a TSC, indexed by $s = 1...N$ and $t = 1...M$. Variable unit costs of TP, HA, and TO are c, c_2 and c_1, respectively. We assume a linear inverse price function for TO_i as

$$p_1^s = \alpha - Q - \mu Q_{-1} \tag{1}$$

where p_1^s is the price of a package holiday product, Q and Q_{-1} are the total tourists in the two TSCs. The decision variable is tourist quantity q_s for TO_s. Here, α represents the market reservation price or the market size (Carr and Karmarkar, 2005). Parameter μ captures the cross-quantity sensitivity or supply chain preference of tourists. Supply chain preference measures the willingness of tourists to substitute their choice of package holiday products from one TSC to the other. This concept is associated with product differentiation, i.e. the difference between the two tourism products. It is plausible to assume that μ increases while the supply chain preference decreases. We limit our attention to $0 < \mu \le 1$, which means that the two TSCs are substitutes of each other. Specifically, if $\mu = 1$, the two package holidays are perfect substitutes. Note that we assume homogeneity among the service providers (TOs or HAs) within a sector. One reason for this assumption is to control the model complexity that over-shadows the research focus. More importantly, the theme park is often a major differentiation factor between package holidays as compared with the hotel. The overall inter-chain differentiation better reflects the tourist’s choice behavior between the two package holiday products provided by the two TSCs.

Price is a fundamental element of economic theory and the law of tourism demand (Crouch 1996). The linear inverse price function is selected here for the following reasons. Firstly, the linear form of demand function has been broadly used in game-theoretic research in the manufacture supply chain (Carr and Karmarkar 2005; Xiao and Yu 2006), as well as in tourism and hospitality literatures (Zheng 1997; Wie 2005), mainly for its analytical simplicity. Secondly, the relationship between price and quantity demand in most of the tourism literatures has been identified to be log linear (exponential) (Song and Witt 2000, 2006; Garín-Munoz 2006). This paper focuses on the TSC dynamics, especially the impact of systemic parameter changes on the demand for tourism, and a linear function would be appropriate to depict exponential function when the parameters change slightly within small ranges. Thirdly, the sensitivity of tourists' quantity in the TSC to changes in price is normalized to "1" in the model, as in Ingene and Parry (1995).

Backward induction is used to solve this multi-stage game. The last stage of the game is to allow the TOs to decide the quantities of tourists simultaneously in a competitive environment. Given the prices p and p_2 for TP and HA, respectively, the profit function for TO_s is:

$$\pi_1^s = q_1^s(p_1^s - p - p_2 - c_1) \tag{2}$$

Taking the first-order condition with respect to quantity, and then summing up the equations for all TOs in the TSC, the total demand for the package holiday is measured by the total number of tourists as:

$$Q = \frac{N(\alpha - c_1 - p - p_2 - \mu Q_{-1})}{N+1} \tag{3}$$

The profit functions for HA_t and the TP are $\pi_2^t = (p_2 - c_2^t)q_2^t$ and $\pi_3 = Q(p-c)$, respectively. Solving p_2 and p from (3), then substituting the results into the profit functions of HA_t and the TP, we can find optimal quantities for HA_t and the TP, respectively. Combining these optimal quantities, we get the total number of tourists of the TSC as below:

$$Q = \frac{NM(\alpha - c_1 - c_2 - c - \mu Q_{-1})}{(N+1)(2M+1)} \tag{4}$$

Equation (4) is the best response function of a TSC with regard to its rival TSC. Solving (4) for both TSCs, we have the sub-game perfect Nash equilibrium of the total tourist numbers for the two competing TSCs as follows:

$$Q_i = \frac{m_i n_i(\alpha_i - C_i) - \mu m_i n_i m_j n_j(\alpha_j - C_j)}{1 - \mu^2 m_i n_i m_j n_j} \tag{5}$$

where $n_i = \frac{N_i}{N_i + 1} \in [\frac{1}{2}, 1)$, $m_i = \frac{M_i}{2M_i + 1} \in [\frac{1}{3}, \frac{1}{2})$, and $C_i = c_{i1} + c_{i2} + c_i$, $i, j = A, B$.

From (5), we have $Q_A < 0$ if $\delta < \mu m_B n_B$ where $\delta = \frac{\alpha_A - C_A}{\alpha_B - C_B}$. That is, TSC_A has to withdraw from the market if its product loses market attraction due to cost disadvantage(s), and TSC_B will dominate the package holiday market as a monopoly.

To simplify the discussion throughout the article, we additionally assume that $\frac{1}{\mu m_A n_A} > \delta > \mu m_B n_B$ to ensure that the demand for each TSC at its equilibrium quantity is positive. More equilibrium results are summarized in Table 1.

Insert Table 1 here.

Equation (5) clearly shows that the equilibrium quantity of TSC_i is an increasing function of its market size α_i and the rival TSC's unit cost C_j, but a decreasing function of the rival TSC's market size α_j and its unit cost C_i. The profits of TO, HA, and TP are influenced by the market sizes and unit costs in the same way as the quantity, because these profits are all proportional to the square of the quantity (see Table 1)

4. FINDINGS AND IMPLICATIONS

A TSC is a dynamic system. Its performance is determined not only by system parameters or variables such as supply chain membership and supply chain preference, but also by the supply chain structure and decision principle. This section presents several main results from the theoretical analysis.

Impact of Tourism Supply Chain Membership

The number of members in a TSC determines its capability and the intensity of the competition. This is illustrated by the following proposition.

PROPOSTION 1. (1) An increase in the membership in one sector of the TSC benefits the profits of enterprises in other sectors of the same TSC, but adversely affects the profits of enterprises in the corresponding sector and enterprises in its rival TSC. (2) Such an increase also leads to an increase in the total surplus of the TSC but a decrease in the total surplus of the corresponding sectors. (3) Such an increase leads to a decrease in prices of package holidays of both TSCs.

Increased competition is reflected in an increased number of tourism enterprises (Banker, Khosla, and Sinha 1998). Proposition 1 has three implications. Firstly, from the

TP's perspective, attracting more TOs and HAs to join the TSC could gain a higher market share and profits. Secondly, increased competition within a sector reduces the prices of the package holidays and thus increases tourists' welfare. Thirdly, a sector's surplus will be maximized if the sector is dominated by a single firm (monopoly). An example in Table 1 is developed to give the intuitive illustration of our findings. The figures in the table are percentage changes compared with the benchmarks listed in Table 1.

Insert Table 2 here.

In this example, we are more interested in the impact of membership on the types of competitors. In our model, the competitors are divided into two different types: direct and indirect ones. The direct competitors refer to the members in the same sector of the same TSC, while the indirect competitors are the members in the corresponding sector of the competing TSC. According to Proposition 1, new entrances in a specific TSC decreases the profits of incumbent firms in the corresponding sector of the competing TSC, while the entrance of new firms in the competing TSC also result in its profit decrease. From Table 1, we observe that the influence of a new direct competitor on the sector's performance is greater than that of a new indirect competitor in a given sector. Another important observation is that the negative influence of the entrance of direct competitors on the profits of the TSC members would also increase along with the decrease in μ. That is, the supply chain preference or the quantity-sensitivity could serve as a buffer to reduce the intensity of the competition.

Impact of tourism supply chain preference

As defined previously, supply chain preference measures the willingness of tourists to substitute one product from a TSC with that from another TSC. The preference is mostly determined by the product differentiation between the two theme parks, as the theme parks are the main motivation and attraction for tourists to choose package holidays. The supply chain has a higher preference if the level of it's μ in our model is lower. Because of symmetry, we only concentrate on one TSC, for example, TSC_A. The following proposition gives the impact of supply chain preference on the system equilibriums:

PROPOSITION 2. Suppose that the TSC preference increases,

(1) If $\delta < \frac{1}{2}(\mu m_B n_B + \frac{1}{\mu m_A n_A})$, the quantities, prices, and profits of all members in TSC_A increase. (2) The opposite is true if $\delta > \frac{1}{2}(\mu m_B n_B + \frac{1}{\mu m_A n_A})$.

Proposition 6 shows that an increasing supply chain preference does not necessarily improve the performance of the TSC. The following analysis further explains the two opposite scenarios.

Porter (1980) states that two generic alternative strategies could be adopted to expand a firm's market share. The first strategy is product differentiation. The purpose of this strategy is to create something that is perceived as being unique, and provide insulation against rivalries. In our model, the supply chain preference (negative μ) is associated with product differentiation. If a TSC provides a unique experience (product) for tourists, the tourists would not easily substitute this product/experience with that from other TSCs. Therefore, implementing a product differentiation strategy within a TSC indicates an increase in the TSC preference in our model.

The second generic strategy is to achieve overall cost leadership through technological innovation and economies of scale (Porter, 1998). In our model, the ratio $\delta = \frac{\alpha_A - C_A}{\alpha_B - C_B}$ captures the relative levels of both cost and market size between the two TSCs. A larger value of δ implies TSC_A has lower supply chain costs when the two TSCs' market sizes are the same, and vice versa. Evidently, it would be more profitable for TSC_A to adopt the cost leadership strategy against its rivals.

Since the two generic strategies are alternative strategies, a business should adopt one or the other in order to achieve a superior performance against its competitors. (Amoako-Gyampah and Acquaah, 2007).

Under the condition of $\delta < \frac{1}{2}(\mu m_B n_B + \frac{1}{\mu m_A n_A})$, the overall performance of TSC_A increases along with the decrease in μ. This tendency implies the differentiation strategy is feasible to TSC_A. Meanwhile, the small value of δ indicates TSC_A does not have cost or market size advantage. The best strategy for TSC_A is therefore to adopt the differentiation strategy. Not only does tourism product differentiation increase (unit) profit, but it also avoids the need for a low cost position. Notice that a continuous decrease in μ does not necessarily change this unequal relationship (see appendix).This indicates that the differentiation strategy is effective in the long run.

Under the condition $\delta > \frac{1}{2}(\mu m_B n_B + \frac{1}{\mu m_A n_A})$, TSC_A could not improve its performance by product differentiation (decreasing μ). The differentiation strategy is not profitable and should not be adopted. However, the cost advantage or market size advantage could motivate TSC_A to practice a cost leadership strategy in the long run. A low-cost position places TSC_A in a favorable position vis-a-vis substitutes relative to its rival (Porter 1998).

Impact of tourism supply chain integration

Operations of tourism supply chain members can be strategically integrated and managed as a single entity or system. This section discusses two types of integration in TSCs (see figure 2). One is cross-sector integration, in which a tour operator integrates with an accommodation provider. The other is inter-sector integration, in which the theme park integrates with an accommodation provider. In order to simplify the analysis and provide useful managerial implications, we assume that there is only one tour operator and one accommodation provider in each TSC.

Insert Figure 2 here.

If the tour operator integrates with the accommodation provider, the profit of the integrated tour operator is $\pi_{12} = Q(p_1 - p - c_2 - c_1)$. From (1) and this profit function, the optimal quantity of package holidays is $Q = \frac{\alpha - \mu Q_{-1} - p - c_2 - c_1}{2}$, which is also the demand curve for the theme park. Substituting Q into the profit function of the theme park, it is easy to calculate the optimal quantity of tourists as $Q = \frac{\alpha - C - \mu Q_{-1}}{4}$. If the rival TSC is not integrated, its response function is (4). Otherwise if the rival TSC is cross-sector integrated, it has the same form of response function $Q_{-1} = \frac{\alpha_{-1} - C_{-1} - \mu Q}{4}$. Combining the two response functions for each TSC, we can obtain the equilibrium quantities for the two TSCs, as well as the profits of TSC members[2]. Proposition 3 shows the main conclusions of the impact of cross-sector integration on the profits of the service providers in the TSCs.

PROPOSITION 3: The total profit of the tour operator and the accommodation provider decreases after cross-sector integration. Cross-sector integration decreases the rival TSC members' profits but increases the TSC's volume, as well as the profits of the theme park and the supply chain as a whole.

Proposition 3 shows that cross-sector integration could improve the TSC's market share irrespective of whether the rival TSC is integrated or not. After the integration, the tour provider can serve more tourists with a lower price of the package holiday, thus increasing the consumer surplus. But the input price of the theme park also increases due to the absence of inter-sector competition. Despite achieving a lower price of accommodation service and a larger volume, the tour operator's marginal profit reduces and profit drops. Without inter-sector competition and having a dominant position in the chain, the theme park benefits from the cross-sector integration. Notice that cross-sector integration changes the TSC structure. In this situation, the tour operator has no incentive to integrate with the accommodation providers. But there are still other factors that could influence the integration decision of the tour operator. Such factors include high priority access to services, increased market share, and an enhanced long-run competitive advantage, etc. The influences of these factors on the tour operator's willingness to integrate with other service providers are possible topics for further research.

Another type of inter-sector integration is that the theme park integrates with the

[2] The results are illustrated in the Proof of Proposition 3.

accommodation provider. The tour operator buys both the accommodation and park services from the theme park and changes p_{23}. The decision process of the tour operator does not change and the optimal quantity is $Q=\frac{\alpha-p_{23}-c_1-\mu Q_{-1}}{2}$. For the integrated theme park, the demand curve is $p_{23}=\alpha-\mu Q_{-1}-c_1-2Q$ and the profit function is $\pi_{23}=Q(p_{23}-c-c_2)$. Thus, the optimal tourist quantity is $Q=\frac{\alpha-C-\mu Q_{-1}}{4}$. The best response functions of the rival TSC are (4) if it is not integrated or $Q_{-1}=\frac{\alpha_{-1}-C_{-1}-\mu Q}{4}$ if it is integrated, respectively. Therefore, the equilibrium quantities are derived by jointly solving the response functions of the two TSCs[3]. Proposition 4 presents the main conclusions about inter-sector integration.

PROPOSITION 4: All sectors (i.e. the theme park, the accommodation provider and tour operators) benefit from the inter-sector integration between the theme park and the accommodation provider. The volume of the integrated TSC increases. The rival TSC members' profits decrease.

This proposition suggests that inter-sector integration is the optimal strategy for the theme park if the rival TSC does not integrate. On the other hand, if the rival TSC is also inter-sector integrated, the inter-sector integration is still the best response strategy for the TSC. The tour operator benefits from the lower theme park price and large tourist volume after the inter-sector integration. Moreover, the theme park consolidates its dominant position by offering a more attractive price.

Proposition 4 can be used to explain the recent developments in the Hong Kong

[3] The results are illustrated in the Proof of Proposition 4.

theme park industry. Before 2005, the theme park industry in Hong Kong was dominated by the Ocean Park. However, the entry of Disneyland Hong Kong has changed the market structure from monopoly to duopoly. Different from Ocean Park, Disneyland Hong Kong has two hotels: the Disneyland Hotel and the Hollywood Hotel. Ocean Park has recently announced a redevelopment master plan to redevelop the park in order to effectively compete with Disneyland Hong Kong. Investment of three themed hotels is an important part of the HK$5.5 billion plan. It is hoped that this investment will attract more overseas tourists to Ocean Park.

Proposition 4 implies that both theme parks in the TSCs would like to be integrated with the accommodation providers. But inter-sector integration does not guarantee the increase of the total profit for the theme park and the tour operator when compared with the scenario in which both TSCs are not integrated. Table 3 illustrates three possible outcomes: the total profits of TP and HA increases in both TSCs (Case 1), the profits of integrated TP increase in one TSC and decrease in the other (Case 2), and the profits of the integrated TP decrease in both TSCs (case 3). In particular, Case 3 is more interesting because the optimization of each TSC results in worsened performances of both TSCs.

Insert Table 3 here.

The above analysis has assumed that the inter-sector integration does not affect the TSC preference. However, the hotel operated by the theme park is often elaborately designed with the same or similar themes as the park. It offers a differentiated experience for tourists besides visiting the park, and therefore enhances visitors' recreational experience. As a result, inter-sector integration not only changes the TSC structure, but also differentiates the package holidays supplied by the two TSCs. In our model, the differentiation reflects the increase of TSC preference. Under this condition, it is found that inter-sector integration improves the tourists' volume as well as TSC members' profits[4]. If the package holiday products are adequately differentiated through integration, the performance of the rival TSC would not necessarily be adversely affected by the inter-sector integration. This is somewhat different from the finding obtained from Proposition 4. For example, if $\mu = 0.6$, $\alpha_A - C_A = 10$, and $\alpha_B - C_B = 12$, the tourists quantity of TSC_A is 1.48 when both TSCs are not inter-sector integrated. If TSC_B is inter-sector integrated and μ changes to 0.5, the quantity of TSC_A would decrease to 1.43. If inter-sector integration changes μ to 0.3 (implying a larger differentiation), the quantity of TSC_A would increases to 1.52. It is clear that the inter-sector integration of TSC_B with an increased product differentiation would improve the performances of both TSCs. In summary, if both TSCs adequately differentiate their products through inter-sector integration, they would achieve a win-win outcome.

5. CONCLUSION

This paper formulates a multi-stage game framework for studying the collaboration and competition dynamics in TSCs for package holidays. Three sectors are considered. They are tour operators, accommodation providers, and theme park operators. Four types of relationships are analyzed theoretically. They are the intra-sector competition between suppliers within a sector, the inter-sector competition between sectors in a certain supply chain, cross-sector coordination between sectors in different layers, and the chain

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[4] The proof can be found in the Appendix.

competition between two TSCs. Backwards induction is proposed to solve this game. The theme park sector and the accommodation sector make their moves first to determine the theme park admission price and the accommodation market clears its price through quantity competition,. In the second stage, each tour operator receives the prices of the theme parks and accommodation providers and determines the number of tourists they plan to serve. Finally the prices of the package holidays are determined by the market.

Based on the equilibrium results, the impacts of the two system parameters (i.e. supply chain membership and supply chain preference) and strategic integrations are studied. Several managerial implications can be derived from this study. Firstly, more members in a TSC strengthen its overall capacity. However, increased competition due to increased TSC membership in a sector reduces the profit for each service provider as well as the sector profit, while the service providers from other sectors benefit from the increased competition within this sector. Secondly, the increasing supply chain preference does not necessarily improve the performance of a TSC. When a TSC does not have cost or market size advantage as compared to its rival, this TSC should consider the product differentiation strategy in the long run. However, a cost leadership strategy would be the optimal choice for supply chains. Thirdly, it is unprofitable for tour operators to integrate with the accommodation providers. However, the theme park has incentive to integrate with the accommodation providers. If the theme parks can effectively differentiate themselves from their competitors through strategic integration with the accommodation providers, both TSCs would benefit.

The current research can be extended further in several directions. Firstly, the model could be directly related to multiple sectors, not only the tour operators, accommodation providers, and theme park operators, but also transportation, restaurants and retail shops, etc. The government could also be recognized as a player who has an interest in societal welfare or overall economic profit in the analytical framework. Secondly, in this paper, the price and quantity are the only two decision variables for tourism enterprises. However, others factors such as the service quality and advertising may also influence the performance of TSCs. Multiple dimensions of the enterprise decision model in the context of a TSC could be discussed in further research. Thirdly, the analyses could be undertaken under different coordination schemes. For example, there could be a dominant tour operator and a follower, or some tour operators vertically integrating with the accommodation providers.

ACKNOWLEDGEMENTS

The authors are grateful for the support received from NSFC (70525001) and NSFC (70629002). The third author would also like to thank for the financial support of The Hong Kong Polytechnic University Niche Area Research project (1-BB08).

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Captions for Figures and Tables

Figure 1 Two competing tourism supply chains in a tourist destination

Figure 2 Cross-sector integration and inter-sector integration in a TSC

Table 1 Sub-game perfect Nash equilibriums of TSC_i

Table 2 Influence of a new entrant

Table 3 Total profits of the theme park and the tour operator before and after inter-sector integration

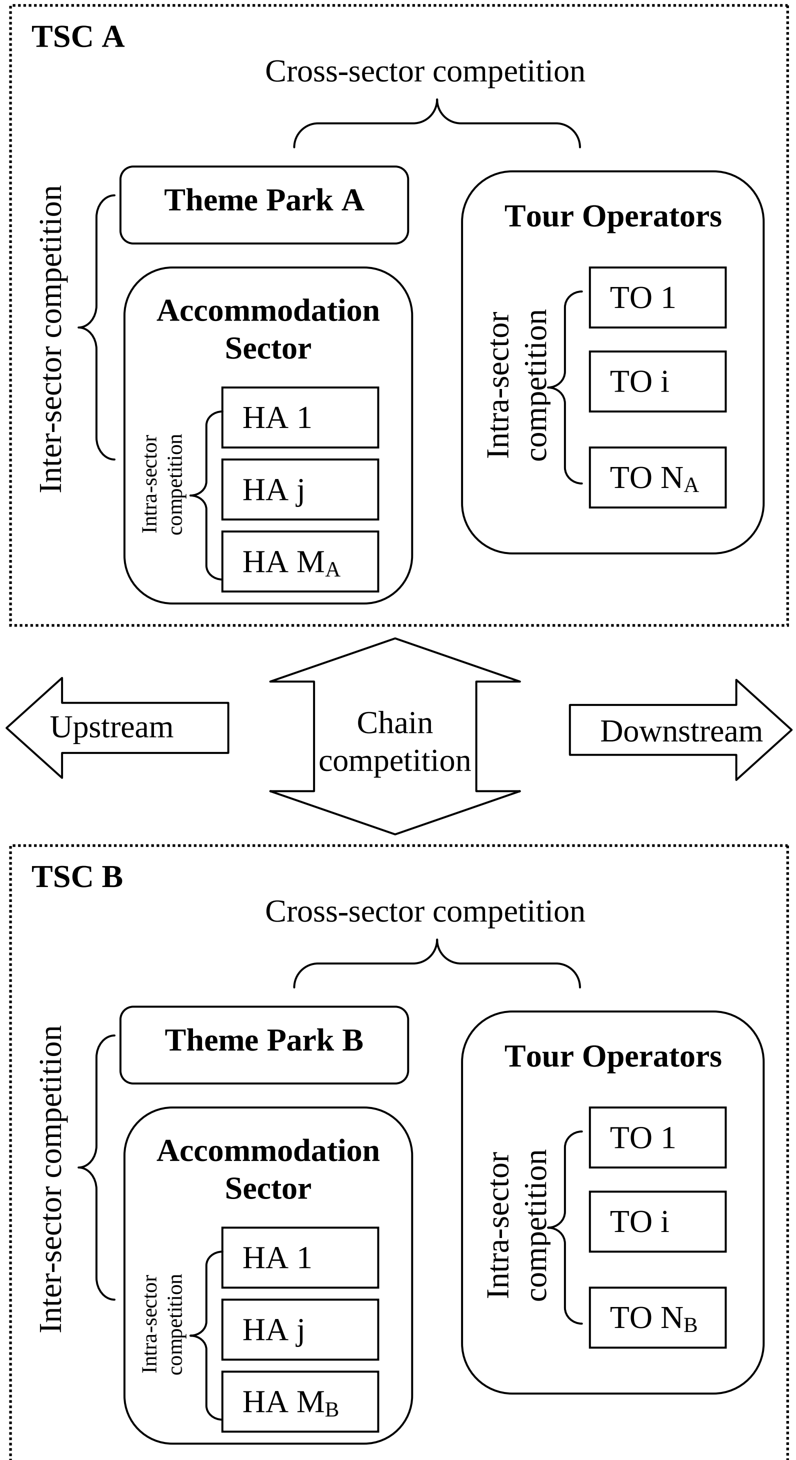

Figure 1 Two competing tourism supply chains in a tourist destination

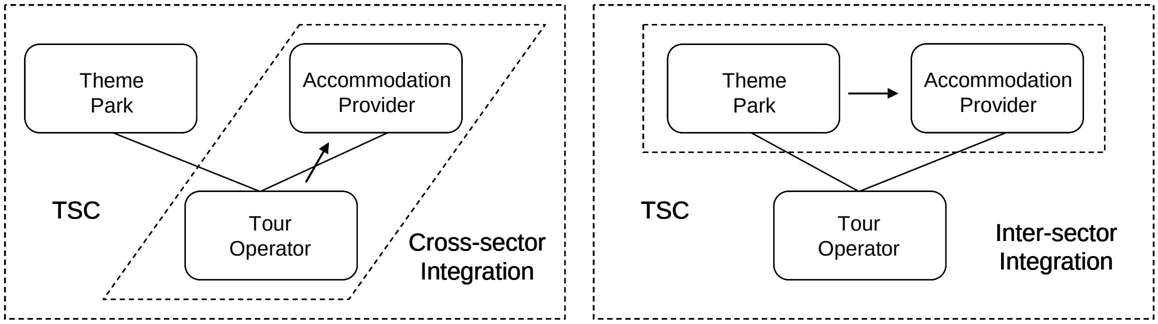

Figure 2 Cross-sector integration and inter-sector integration in a TSC

Table 1 Sub-game perfect Nash equilibriums of TSC_i

	Quantity	Price	Profit
TO	$\frac{Q_i}{N_i}$	$(\frac{1}{N_i}+\frac{N_i+1}{N_iM_i}+\frac{N_i+1}{N_i})Q_i+C_i$	$(\frac{Q_i}{N_i})^2$
HA	$\frac{Q_i}{M_i}$	$\frac{N_i+1}{N_iM_i}Q_i+c_{i2}$	$\frac{N_i+1}{N_i}(\frac{Q_i}{M_i})^2$
TP	Q_i	$\frac{N_i+1}{N_i}Q_i+c_i$	$\frac{N_i+1}{N_i}Q_i^2$

Table 2 Influence of a new entrant

Profit	$\mu=1$				$\mu=0.75$			
(TSC_A)	N_A+1	N_B+1	M_A+1	M_B+1	N_A+1	N_B+1	M_A+1	M_B+1
TO	-15.68	-0.87	2.71	-1.32	-15.82	-0.61	2.48	-0.94
TO sector	-7.25	-0.87	2.71	-1.32	-7.40	-0.61	2.48	-0.94
HA	1.18	-0.87	-24.54	-1.32	1.01	-0.61	-24.71	-0.94
HA sector	1.18	-0.87	-11.97	-1.32	1.01	-0.61	-12.16	-0.94
TP	1.18	-0.87	2.71	-1.32	1.01	-0.61	2.48	-0.94
TSC	0.57	-0.87	0.76	-1.32	0.40	-0.61	0.54	-0.94
Profit	$\mu=0.5$				$\mu=0.25$			
(TSC_A)	N_A+1	N_B+1	M_A+1	M_B+1	N_A+1	N_B+1	M_A+1	M_B+1
TO	-15.91	-0.40	2.34	-0.60	-15.96	-0.20	2.26	-0.30
TO sector	-7.50	-0.40	2.34	-0.60	-7.55	-0.20	2.26	-0.30
HA	0.91	-0.40	-24.81	-0.60	0.85	-0.20	-24.87	-0.30
HA sector	0.91	-0.40	-12.28	-0.60	0.85	-0.20	-12.35	-0.30
TP	0.91	-0.40	2.34	-0.60	0.85	-0.20	2.26	-0.30
TSC	0.30	-0.40	0.40	-0.60	0.24	-0.20	0.32	-0.30

(Benchmark data: $N_A=10$, $M_A=6$, $\alpha_A-C_A=1000$, $N_B=9$, $M_B=5$, $\alpha_B-C_B=950$)

Table 3 Total profits of the theme park and the tour operator before and after integration

Case	μ	α_A-C_A	α_B-C_B	Total profit of TP and HA before integration		Profit of integrated TP	
				TSC_A	TSC_B	TSC_A	TSC_B
1	0.5	10	12	0.91	1.41	0.93	1.50
2	1	10	18	0.58	3.14	0.43	3.42
3	1	10	10	0.82	0.82	0.80	0.80