REVENUE SHARING CONTRACT OR WHOLESALE PRICE CONTRACT?
ANALYTICAL RESULTS FROM VARIOUS CHANNEL POWER ARRANGEMENTS IN A TOURISM SUPPLY CHAIN

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ABSTRACT

Tourism supply chain management is a burgeoning field drawing great research attention and increasingly well-applied to practice recently. We analyze a tourism supply chain containing a theme park, local hotels, and multiple travel agents using a game theoretic approach in four scenarios: Nash equilibrium, Stackelberg-theme park leader equilibrium, Stackelberg-the set of travel agents leader equilibrium, and full cooperation. The theme park offers wholesale price contract and revenue sharing contract to the travel agents under each scenario. We find only in the Stackelberg-the set of travel agents leader scenario, travel agents would accept the revenue sharing contract and make different pricing strategies in order to gain higher profits.

Keywords: Supply Chain Management, Tourism, Revenue Sharing, Channel Powers

INTRODUCTION

Package holiday is becoming increasingly popular in many countries (Yang et al. 2009). Travel agents and related companies form a tourism supply chain (TSC) by bundling multiple tourism features into such packages. A typical TSC involves suppliers and retailers who provide tourism goods, services, and tourists to whom the services are delivered. Downstream players include travel agents and tour operators that provide products and services to tourists. Midstream enterprises provide tourist facilities such as hotels, restaurants, transportation, and shopping facilities. Upstream members provide materials to the midstream enterprises and also include customer destinations such as theme parks (Huang et al., 2012).

Integration of tourism distribution channels can increase profits for members in the TSC (Ford et al., 2012), indicating the importance of tourism supply chain management (TSCM) (Song et al., 2013). TSCM, which can be defined as the management of tourism supply chain operations with the objective of satisfying tourists’ demands and companies economic goals (Zhang et al., 2009), is an emerging field that has been receiving great attention. However, research in this area in still in the infant stage.

Coordination among the stakeholders is among the most efficient ways to manage any type of supply chain. Contract is generally considered as a useful tool to coordinate stakeholders in supply chain operation (Ouardighi & Kim, 2010). Our paper examines the role of revenue sharing contract, which is a valuable alternative to the wholesale price contract (Cachon & Lariviere, 2001), in coordinating the tourism supply chain.
Revenue sharing has been widely applied in tourism industry. For example, airlines use revenue sharing to assess collaboration among independent carriers in the airline alliance to increase total revenue (Cetiner & Kimms, 2013). National park uses revenue sharing to divert some conservation benefits to communities living near to the protected high-biodiversity areas to implement sustainable tourism (Ahebwa et al., 2012). However, revenue sharing contract among theme park and travel agents, which aims to increase tourists’ demand and the stakeholders’ profits, has been rarely discussed in tourism from a supply chain perspective. Our paper examines the mechanism of revenue sharing contract and wholesale price contract among theme parks and travel agents under four different channel power arrangements: (1) the theme park has greater decision power than that of travel agents; (2) the travel agents has greater decision power than that of the theme park; (3) the theme park and the travel agents have the same decision power; and (4) full cooperation among the theme park and the travel agents. Our research question is: Under which channel power arrangement(s) the travel agents would accept revenue sharing contract (instead of wholesale price contract) offered by the theme park and make different pricing strategies to enhance profits?

Overall, this paper contributes to the extant literature in the following ways. First, the models in this study extend the number of retailers (travel agents in our example) to \( n \) instead of only 1 or 2 as seen in most of the current revenue sharing literature. Second, another supply chain level (containing the hotels) is added in our model. Third, this is one of the first papers to explore the mechanism of revenue sharing contract and wholesale price contract using a game theoretic approach in the TSC.

LITERATURE REVIEW

TSC is a very complex context with distinctive features from traditional manufacturing supply chain. For the supply aspect, it is a mixture and combination of products and services that are more various and perishable than in manufacturing supply chain (Zhang & Murphy, 2009) and therefore the suppliers need to be highly connected to and coordinated with retailers (Zhang et al., 2009). From the demand aspect, it is difficult to forecast and thus need to be carefully managed using insightful knowledge (Piboonrungroj & Disney, 2009). Thus, TSCM plays an essential role in tourism industry.

TSCM is a burgeoning field drawing increasing research attention recently. Most of the papers in TSCM are either empirical or qualitative, and only a few publications take a modeling approach (Pairach & Michael, 2009). To the best knowledge of the author so far, revenue sharing contract is mainly discussed in manufacturing supply chain context nowadays (e.g. Krishnan & Winter, 2011). Specifically, previous literature focuses on using revenue sharing contract to coordinate a single manufacturer-retailer channel (e.g. Kunter, 2012) or one manufacturer and two competing retailers (e.g. Yao et al., 2008). However, practically, there are multiple retailers competing for market share in the market. They may have the same supplier or different. Also, more parties (e.g. distributors) would involve in various contracts to participate in the channel coordination. These have been discussed little in previous studies when emphasizing on revenue sharing contract. Our paper extends previous analysis to incorporate multiple retailers (travel agents) and to include information about the third party: hotels (also known as accommodation provider).
Specifically, different from previous studies focusing on manufacturing supply chain context, we explore the mechanism of revenue sharing and wholesale price contract to coordinate a TSC under four channel power arrangements since revenue sharing phenomenon is common in TSC but academic exploration is rare.

**MODELS**

**Notation**

Table 1 provides the notation used in this paper.

**Table 1 – Notation of the Models**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Notation</th>
<th>Meaning</th>
<th>Notation</th>
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<tr>
<td><strong>Parameters</strong></td>
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<tr>
<td>( \alpha )</td>
<td></td>
<td>The primary demand of each travel agent</td>
<td>( q_1^j )</td>
<td>Demand of holiday package for travel agent ( j )</td>
</tr>
<tr>
<td>( \beta )</td>
<td></td>
<td>Store-level factors of each travel agent that influence consumers’ sensitivity to price</td>
<td>( q_2^j )</td>
<td>Demand of rooms for accommodation provider ( i )</td>
</tr>
<tr>
<td>( r )</td>
<td></td>
<td>Competitive factors that influence consumers’ sensitivity to price</td>
<td>( p_2 )</td>
<td>Retail price of rooms for each accommodation provider</td>
</tr>
<tr>
<td>( \pi_1^j / \pi_2^i )</td>
<td></td>
<td>Profit for travel agent ( j / ) accommodation provider ( i )</td>
<td>( Q )</td>
<td>Quantity of arrivals at the theme park</td>
</tr>
<tr>
<td>( \pi_3 )</td>
<td></td>
<td>Profit for theme park</td>
<td>( \varphi_j )</td>
<td>Revenue sharing proportion ((0 \leq \varphi_i \leq 1)) of each travel agent ( j )</td>
</tr>
<tr>
<td>( c_1^j / c_2^i )</td>
<td></td>
<td>Cost for travel agent ( j / ) accommodation provider ( i )</td>
<td>( c )</td>
<td>Operational cost for the theme park</td>
</tr>
<tr>
<td>( u_1^j )</td>
<td></td>
<td>Marginal profit of the travel agent ( j )</td>
<td>( U_3^j = U_3 / U_3^j )</td>
<td>Marginal profit of the theme park under wholesale price contract / revenue sharing contract from each travel agent ( j )</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Decision Variables</th>
<th>Notation</th>
<th>Meaning</th>
<th>Notation</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>Wholesale Price Contract Scenario</td>
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<td>Revenue Sharing Contract Scenario</td>
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<tr>
<td>( p_1^j )</td>
<td></td>
<td>Retail price of holiday package from travel agent ( j ) under wholesale price contract</td>
<td>( p_1^{jr} )</td>
<td>Retail price of holiday package from travel agent ( j ) under revenue sharing contract</td>
</tr>
<tr>
<td>( w = w_j )</td>
<td></td>
<td>Ticket wholesale price offered by theme park to each travel agent (the same) under wholesale price contract</td>
<td>( w_j^r )</td>
<td>Ticket wholesale price offered by theme park to each travel agent (may be different) under revenue sharing contract</td>
</tr>
</tbody>
</table>
Demand Function

We generate the following functions. Under the wholesale price contract, the profit for each stakeholder is:

\[ \pi_1^j = (p_1^j - c_1^j - w - p_2)q_1^j, \text{ where } q_1^j = \alpha - \beta p_1^j + \sum_{i=1,i\neq j}^n r p_i^j \]  \hspace{1cm} (1)

\[ \pi_2^j = q_2^j(p_2^j - c_2^j) \]  \hspace{1cm} (2)

\[ \pi_3 = Q(w - c) \]  \hspace{1cm} (3)

When offering the revenue sharing contract, the theme park offers \( w_j^j = \varphi_j c \) wholesale ticket price to each travel agent \( j \) and shares \( (1 - \varphi_j) \) of the revenue from each travel agent. We consider four scenarios of different channel power structures and determine the pricing strategy of each travel agent and the theme park under wholesale price contract and revenue sharing contract, respectively.

The Theme Park Dominates the Tourism Supply Chain

Theme park, such as Disneyland, Universal Studio, and so on has strong channel powers considering its world-wide brand reputation and great investment. In this section, the relationship between theme park and travel agents is modeled as a sequentially non-cooperative game, where the theme park is the leader and the travel agents are the followers. Now, we solve for the Stackelberg-theme park leader equilibrium. The theme park makes the decision first followed by travel agents who make their respective decisions based on the theme park.

Proposition 1 predicts the optimal pricing strategy of each travel agent and the theme park under the wholesale price contract.

Proposition 1: Under the wholesale price contract, the Stackelberg-theme park leader game has the following unique equilibrium:

\[ p_1^j = \theta + \frac{\theta}{2k_2} \left( c - k_i - k_i^c \right) + (1 - \theta_i)c_i^j + w + p_2 \]  \hspace{1cm} (4)

\[ w = (nk_i c - nk_i^c) / 2nk_2 \]  \hspace{1cm} (5)

For interpretations of variables, please refer to Appendix A.1.

Proof: see Appendix A.1.

Proposition 2: Given the voluntary option of the revenue sharing contract, the equilibrium of the Stackelberg-theme park leader game is the same as that under the wholesale price contract.

Proof: see Appendix A.2.

The Set of Travel Agents Dominates the Tourism Supply Chain

Travel agents, such as Expedia and Orbitz, have strong channel powers considering their multiple branches and high customer loyalty. In this section, the relationship between theme park and travel agents is modeled as a sequentially non-cooperative game, where the set of
travel agents is the leader and the theme park is the follower. Now, we solve for the Stackelberg-the set of travel agents leader equilibrium. The set of travel agents makes the decision first followed by the theme park who makes decision based on the set of travel agents.

**Proposition 3:** Under the wholesale price contract, the Stackelberg- the set of travel agents leader game has the following unique equilibrium:

\[
p_i^l = \frac{B + t}{A - (n-1)t} - \theta c_i + c_i^l + w + p_2
\]

\[
w = D - \frac{B - \theta c_i}{2(A - (n-1)t)}
\]

For interpretations of variables, please refer to Appendix A.3.

**Proof:** see Appendix A.3.

**Proposition 4:** Given the voluntary option of the revenue sharing contract, the Stackelberg- the set of travel agents leader game has the following unique equilibrium:

\[
p_i^{l'} = \frac{\theta_i + c_i + \theta n c_i}{1 - \theta_i (n-1)}
\]

\[
w_j^{l'} = \left(1 - \frac{D - \frac{B - \theta c_i}{2(A - (n-1)t)} - c}{p_i^{l'} - c} \right)c
\]

For interpretations of variables, please refer to Appendix A.4.

**Proof:** see Appendix A.4.

From proposition 4, we know each travel agent \( j \) shares \( 1 - \varphi_j = \frac{D - \frac{B - \theta c_i}{2(A - (n-1)t)} - c}{p_i^{l'} - c} \) proportion of its revenue to the theme park in compensation for its received lowered wholesale price \( w_j^{l'} \) from the theme park.

**Travel Agents and the Theme Park Have the Same Channel Powers in the Tourism Supply Chain**

When the set of travel agents and the theme park have the same or similar channel powers, we model their relationship as a Nash Game. In the next model, we find the Nash equilibrium under the condition that the stakeholders make their strategies independently and simultaneously. Proposition 5 indicates the optimal pricing strategy of each travel agent as well as the theme park under the wholesale price contract.

**Proposition 5:** Under the wholesale price contract, the Nash game has the following unique equilibrium:
\[ p_i' = \theta_i + \theta_2 \left( D - \frac{\theta_1 + \theta_2 D - \theta_1 \bar{c}_i}{2(1+n\theta_2 k)} \right) - \theta_2 c_i' + w + p_2 \]  
\[ w = D - \frac{\theta_1 + \theta_2 D - \theta_1 \bar{c}_i}{2(1+n\theta_2 k)} \]  

For interpretations of variables, please refer to Appendix A.5. 

Proof: see Appendix A.5.

**Proposition 6**: Given the voluntary option of the revenue sharing contract, the equilibrium of the Nash game is the same as that under the wholesale price contract. 

Proof: see Appendix A.6.

**Full Cooperation in the Tourism Supply Chain**

The previous subsections discussed three non-cooperative games. However, nowadays competition exists among supply chains instead of individual companies (Zhang et al., 2009). The stakeholders in the TSC may cooperate with each other to take actions to improve profits for the entire chain. Next, we model the travel agents – theme park relationship as a cooperative game.

**Proposition 7**: The cooperation game has the following unique solution: 
\[ p_1' = \frac{\theta}{2n(r(n-1)+\beta)} + c_i' + w + p_2 \]  
\[ w = \frac{\theta}{2n(r(n-1)+\beta)} + c \]  

For interpretations of variables, please refer to Appendix A.7. 

Proof: See Appendix A.7.

**NUMERICAL EXAMPLE**

In this section, we introduce a numerical example to show how the numbers change under each scenario. The numerical results suggest the profits of stakeholders are different under various channel power arrangements. In the scenario of the set of travel agents dominating the TSC, compared with wholesale price contract, revenue sharing contract increases the tourists’ demand by 7.13\% (e.g. from 1.066 \times 10^5 to 1.142 \times 10^5) by lowering the retail price of holiday package. As a result, the profit of each stakeholder increases. The profit of theme park increases by a larger proportion compared with each travel agent due to the non-decreased marginal profit. The profits increase by 3.58\% for the whole TSC. Therefore, revenue sharing contract appears to be particularly effective in increasing tourists’ demand and the theme park’s profit when the set of travel agents dominates the TSC. Due to the length limitation, details are available upon request.

**CONCLUSIONS AND EXTENSIONS**

Conclusions  

Four scenarios are examined in this research: Stackelberg-theme park leader equilibrium,
Stackelberg-the set of travel agents leader equilibrium, Nash equilibrium, and cooperative game equilibrium. We found a unique equilibrium for each scenario under the wholesale price contract and the voluntary option of revenue sharing contract, respectively. With regard to our research question, the answer is only when the set of travel agents dominates the TSC, travel agents would accept the revenue sharing contract offered by the theme park and make different pricing strategy in order to obtain higher profits. Our results are consistent with that of Pan et al. (2010) who compare the mechanism of revenue sharing and wholesale price contract based on one supplier and two retailers in a manufacturing supply chain. In addition, our numerical example shows revenue sharing contract could increase the demand and the profit for the entire TSC dominated by the set of travel agents, as could be seen from the particular increase of the profit for the theme park.

Managerial Implications and Implications for Future Research

Our paper contains both the strengths and limitations of revenue sharing contract. On the one hand, when the set of travel agents dominates the TSC, our numerical example shows the benefits of revenue sharing contract to increase profit for each stakeholder. Considering the theme park and the hotels obtains more proportions of the increased profits than that of travel agents due to the increased demand and the non-decreased marginal profit, the theme park and hotels could offer more motivations to make travel agents accept the revenue sharing contract. On the other hand, revenue sharing contract has the same effect with that of wholesale price contract under other scenarios. This is another extension of the limitation of revenue sharing contract based on the discussion of Cachon and Lariviere (2005). Since the administrative cost of revenue sharing contract is greater than that of wholesale pricing contract due to the information asymmetry (Cachon and Lariviere, 2005), in practice, only when the set of travel agents have more decision powers than the theme park and the enhanced profits could offset the increased administrative cost, revenue sharing contract could be used in TSC.

Three principle implications are proposed for further research. First, quantitative models, which have not been widely applied to the field of TSCs so far, should raise more attention in future research in that they reflect the essence of stakeholder theory and predict future actions for relevant stakeholders in a mathematical way. Second, further quantitative research of revenue sharing mechanism on TSCs could extend our model by adding more variables, including the hotels as decision makers, running numerical simulations, and discussing more scenarios. Finally, other contracts, such as buy-back contract and quantity discount contract which are widely used in manufacturing supply chain, could also be theoretically applied to TSC to discuss their effects on tourists’ demand and stakeholders’ profit. This would be another extension for TSCM research.

APPENDIX

Appendices are available upon request.

REFERENCES

References are available upon request.