Study on the Optimal Selection of Online Travel Agency to Cooperate for Hotels

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Abstract: This paper studies the cooperation contract between tourism hotels and OTAs from the perspective of partner selection using the agent model. We give the decentralized decisions of hotel and OTA, and mainly discuss the effects of OTA's market share and market impact on the cooperative relationship between them. We find that there is a positive correlation between effort level and the maximal additional sales, and cooperation is conditionally profitable for hotels. If the hotels cooperate with OTAs that have very small or excessive market share, the profits will lower than the profits obtained without cooperation. In practice, the hotel can appropriate to reduce the commission fee, if the OTA has a strong market impact. While if the OTA's market impact is weak, the hotel need to charge a relatively high commission fee for each room sold through OTA. Additionally, hotels should select the most appropriate OTA to cooperate on the basis of the market environment and their own attributes.

1. Introduction

Along with the growth of e- and m-commerce, more and more consumers are willing to buy product and service online or through mobile handsets. Especially in the tourism and hospitality industry, most consumers book hotel rooms online. For reducing marketing cost and improving revenue, hotels begin to sell rooms to customers by using two online channels, i.e. their own official website and online travel agency (OTA), such as Expedia (http://www.expedia.com), Kuoni (http://www.kuoni.com) and Ctrip (http://hotels.english.ctrip.com), eLong (http://www.elong.net), Qunar (http://www.qunar.com), etc.

In recent years, cooperating with OTA to sell rooms has become a major distribution channel for hotels. The data from STR Global and HSMAI show that more than 76 percent rooms booked from OTA. Therefore, hotels need to make tradeoff between these two online distribution channels. In our study, we adopt the agent model to describe the cooperative relationship between them. As shown in Figure 1, the room prices charged with different channel are the same, since the information online can be searched and confirmed conveniently. Similar with the sequence introduced in [1], the hotels determine the commission fee of each sold room for OTAs, and then OTAs determine the effort cost, including but not limit to the ranking position on the webpage, picture views and video shows, etc., which influences the room sales directly.
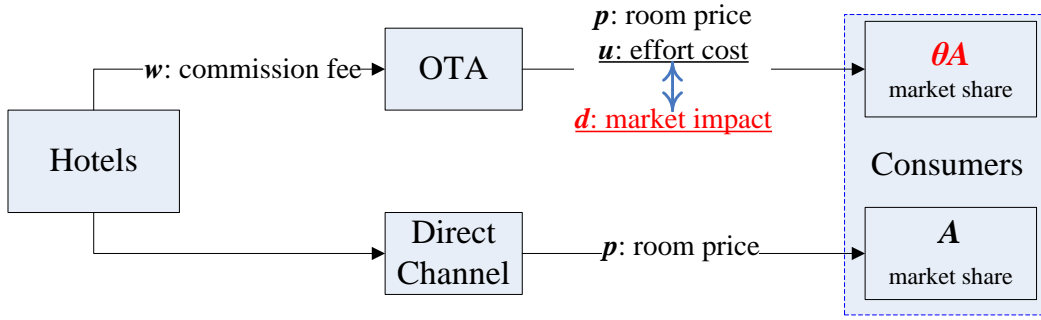
Figure 1: Two distribution channels for hotels

In this paper, we focus on the selection of OTA from the perspective of hotels. In other words, that is what type of OTA is profitable for hotels. In order to study this issue clearly, we analyze it mainly from two aspects.

The first one is the market share of OTA. As shown in Figure 1, there are two ''sources'' of consumers, the consumers booking from official website (e.g. VIP or members of the hotel) and the consumers preferring OTA, for the hotels under the cooperation. If the market share of OTA is very small, the consumer source increased will be limited. While if the market share of OTA is very big, the bargaining power of the OTA will be stronger, since the hotel is more dependent on the cooperation with OTA. Then how the market share of OTA influences the cooperation between them and which is the optimal market share of OTA for the hotel, will be interesting and worthwhile. The second one is market impact of OTA. The cooperative OTA will make effort to increase the room sales by some marketing methods, and the effort will generate additional sales which are independent of the room price and the market share. In our study, we use the maximal additional sales to describe the market impact, i.e. d shown in Figure 1.

For these two attributes of OTA and this cooperative relationship, this paper focuses on the following questions. Study the trade-off between two online channels, and get the equilibrium of the cooperation between the hotels and OTA, including the commission fee, room price and the effort cost, etc. From the perspective of "supplier selection", there are many OTAs, what type of OTA is profitable for hotels to cooperate, and what are the primary factors influenced the formation of cooperation. Cooperate with OTA increases hotel occupancy rate, but does it improve hotel profit?

Through using agent model to describe the cooperative relationship between hotels and OTAs, we give the decentralized decisions of hotel and OTA, and mainly discuss the effects of OTA's market share and market impact on the cooperative relationship between them. With numerical analysis, we find that there is a positive correlation between effort level and the maximal additional sales, and cooperation is conditionally profitable for hotels. If the hotels cooperate with OTAs that have very small market share and excessive market share, the profits will lower than the profits obtained without cooperation. In practice, the hotel can appropriate to reduce the commission fee, if the OTA has a strong market impact. While if the OTA's market impact is weak, the hotel need to charge a relatively high commission fee for each room sold through OTA. Additionally, hotels should select the most appropriate OTA to cooperate on the basis of the market environment and their own attributes.

The rest of this paper is organized as follows. After reviewing some related literature in the next section, we present the analytical model afterwards. A numerical study is presented to explain the decision process of the players, and to show how our model can be applied in practice. Finally, in the conclusion section we summarize the managerial implications of our model and present the further research issues.

2. Literature Review

The research about the cooperative relationship between hotel and the third party (especially OTA), mainly focus on three areas, that is (1) OTA and comparison among distribution channels, (2) formation of cooperation between them, (3) cooperation contract and pricing strategy.

2.1. OTA & Comparison

The rapid development of e-commerce and the growth of e-consumers, more and more hotels set up their own online distribution channel to sell rooms. Although their own official website is helpful to improve market share and revenue for hotels, they still need to depend on the cooperation with the third party, especially OTA, TA (Travel Agency) and TO (Tour Operator), for the competition among multiple channels, lack of visitors, complex corporate and public relations, quick delivery, etc [1].

OTAs, which emerged in the 1990s (e.g. Expedia, Ctrip, Priceline), play a crucial role in online distribution. They have become increasingly more powerful than hotel from the perspective of internet. Carroll and Siguaw pointed that third party companies put hotels in the disadvantaged position [2]. The advantages of OTAs compared with hotels' official websites, mainly are offering to consumers a one-stop-shop for book hotel rooms and even buying the entire holiday [3], mostly at a convenient price [4]. In addition, the formation of scope economy makes OTAs costless in providing the service [5], and OTAs can push travel products to consumers in different ways by profiling the consumers with the methods of data mining, direct mail and loyalty programs [6].

However, in practice, although OTAs use some methods, such as member integral and returning cash, the prices of most rooms charged with different channel are the same, since the information online can be searched and confirmed conveniently. Additionally, few papers research the impact of OTAs' attributes on the cooperative relationship, including the profit and occupancy rate.

2.2. The formation of cooperation

Cooperate with third parties is benefit for the hotels' development and the importance of cooperation has long been recognized by hotel industry. Schulz points out that hotel and travel agency or other third party companies are coming to recognize the advantages of collaboration over competition [7]. In order to extend sales, hotels depend heavily on package tour operators/travel agency. Meanwhile, travel agencies are willing to cooperate with the hotels since they could get rooms with lower prices [8]. The cooperation between hotels and travel agencies, i.e. travel packages, is popular nowadays, and it is of great significance.

From the perspective of buyer–supplier relationships, hotels are seeking ways to develop long-term relationships and to increase their revenue by collaborating with travel agencies and contract companies [9]. The determinants of successful relationships between hotels and travel agencies includes trust, commitment, coordination, communication quality, information exchange, participation, use of constructive resolution techniques, and similar relative dependence.

These previous papers emphasize the great profitability of cooperation as well as the feasibility to cooperate between third parties and hotels. However, the obtaining of conditions for cooperation is also an important issue for hotels. In other words, is cooperation always profitable for hotels? And hotels should select what kind of partners. This paper will study this issue by considering the OTA's attributes.

2.3. Contract and pricing

Pricing is not only a key strategic lever deployed by hotels to manage revenue, but also an important tool to build and enhance cooperation. Many studies focus on the pricing strategy under cooperative situation in tourism industry, involving many methods, such as game models [1][10], bidding process [11], and from multiple dimensions, for instance, different travel packages [11], the contract for cooperation [1][10][11], long term cooperation [12].

Additionally, several papers give some suggestions about the selection of hotels and third parties. Travel agency and other third party companies enjoy low room rate from their cooperative hotel. The website prefers to cooperate with hotels with high capacity and low occupancy rate and provides them high effort levels even a low commission is paid, and hotel managers should decide the commission for the cooperative website considering both the average room price and the available capacity for the tourists making reservations from the third party [1].

Even so, few papers focus on the selection of OTA from the perspective of hotels with considering the OTA's attributes. In other words, that is what type of OTA is profitable for hotels, and which one is best. Our study tries to fill this gap to research the conditions for cooperation and selection of partners.

3. Analytical Model

3.1. Model descriptions

In order to improve their occupancy rate and profit, hotels cooperate with online travel agencies. In this paper, we propose a framework which is composed one hotel and one OTA. The hotel with a capacity C sells its rooms at a standard room rate p. Without affecting the conclusions drawn herein, we further suppose that the C rooms are identical and one room accommodates one customer. The daily variable cost of each occupied room is c. We ignore the fixed cost of hotel, which has no effect on the outcome of our model.

3.1.1. Demands

As mentioned before, there are two "sources" of consumers, the consumers booking from official website (e.g. VIP or members of the hotel) and the consumers preferring OTA.

In order to study the impact of market share on the cooperative relationship between them clearly, we assume that the maximal demand faced by hotel's official website is A, while the maximal demand faced by OTA is θA. If $0 < \theta < 1$, it means the OTA's market size is smaller than the hotel's, that is, more consumers prefer to book hotel rooms through the official website directly, or the hotel has a large membership. If $\theta \geq 1$, it indicates that the OTA has great market potential, and a strong consumers attraction.

Furthermore, for OTA, as discussed before, the sale effort will generate additional sales which are independent of the room price and the market share. In reality, with the increasing of effort cost, the additional sales will increase but limited to a maximal value. In our model, we use the function $d(1-e^{-u})$ to describe the additional sales, here u is the sale effort cost, and d is the maximum additional sales by effort, and represents the power of the OTA. This function is reasonable

According to the descriptions and assumptions, the demand function faced by hotel's official website is $q = A - p$, meanwhile the demand function of OTA is $m = \theta A - p + d(1-e^{-u})$, here q is the number of rooms sold through official website, m is the number of rooms sold through OTA, and p is the room price.

3.1.2. Sequence of events

The model of this paper aims to exploring impacts of OTA's attributes on the cooperative relationship between hotel and OTA. To give a clear understanding of the models in this paper, the sequence of the events is given as follows:

(1) The hotel determines the room price, the commission for each room sold through OTA and the number of rooms reserved for OTA, and then offers the contract to OTA. (2) The OTA makes decision whether to cooperate with this hotel. If it accepts the contract, it will decide the effort cost respect to its maximal total profit.

3.2. Decentralized decisions with cooperation

According to the sequence introduced in previous section, the OTA' decision is based on the contract proposed by the hotel, i.e. the OTA will decide the effort cost according to the commission fee. Then the hotel should determine the room price and commission fee with considering the response of OTA. Therefore, we should analyze the decision of OTA at first.

3.2.1. The decision of Online Travel Agency

The OTA determines the effort cost by solving $\max_{u} \pi_t = wm - u$ in order to obtain maximal profit. On the basis of the demand function, the OTA's response (the optimal effort cost) to the commission fee is $u = \ln(wd)$. Then we get the following proposition.

Proposition 1. *OTA's optimal effort cost is proportional to the commission fee and the maximal additional sales by effort.*

Proposition 1 shows the factors influencing the OTA's effort level. Intuitively, OTA will make greater effort with the increasing of commission fee. However, through the analysis, we see that there is a positive correlation between effort level and the maximal additional sales. In practice, the hotel can appropriate to reduce the commission fee, if the OTA has a strong market impact. While if the OTA's market impact is weak, the hotel need to charge a relatively high commission fee for each room sold through OTA.

3.2.2. The decision of Hotel

The hotel determines the room price and commission fee simultaneously to obtain the maximal profit by solving $\max_{p,w} (q+m)(p-c) - wm$. According to the response of OTA and the demand functions, we get the commission fee and room price are respectively,

$$w^* \approx \frac{1}{4}(3\theta A - A + 3d - 2c) \tag{1}$$

$$p^* = \frac{1}{16}[(3+7\theta)A + 6c + 7d - \frac{16}{(3\theta-1)A - 2c + 3d})] \tag{2}$$

From formula (1), we see that the commission fee is related to the market share and market impact of OTA. If $\theta \leq \frac{2c - 3d + A}{3A}$, the commission fee is negative, then OTA will not cooperate with the hotel.

Then with cooperation, the total number of rooms sold is,

$$m^* + q^* = \frac{1}{8}((5+\theta)A - 6c + d - \frac{16}{(3\theta-1)A - 2c + 3d})$$

(3)

Due to the limited room capacity, the total number of rooms is smaller than the capacity C, i.e. $m^* + q^* \leq C$. Since the total number is related to the market share of OTA (θ), then we get the critical point of θ to make all the rooms being occupied, that is,

$$\theta^* = \frac{4\sqrt{3 + (2A - 3C - 2c)^2} + 10c + 12C - 3d}{3A} - \frac{7}{3}$$

(4)

For the different cooperative strategies under different situations, we discuss the issue by dividing into two cases, i.e. $\frac{A + 2c - 3d}{3A} < \theta < \theta^*$ and $\theta \geq \theta^*$, since

$$\theta^* > \frac{4\sqrt{(2A - 3C - 2c)^2} + 10c + 12C - 3d - 7A}{3A} = \frac{A + 2c - 3d}{3A}.$$

Case 1. $0 < \theta < \theta^*$

If $0 < \theta < \theta^*$, the optimal number of rooms sold is less than the capacity, then both the hotel and OTA will make the same decisions with (1) and (2). The profits of the hotel and OTA can be easily obtained.

$$\pi_t^* = w^*(\theta A - p^* + d - 1/w^*) - \ln(w^* d)$$

(5)

$$\pi_h^* = (A + \theta A - 2p^* + d - 1/w^*)(p^* - c) - w^*(\theta A - p^* + d - 1/w^*)$$

(6)

Case 2. $\theta \geq \theta^*$

If $\theta \geq \theta^*$, all the rooms are occupied. The hotel should make decisions with considering the room capacity. We assume that the hotel first decide the commission fee. By solving $\max\limits_{p} \ (q+m)(p-c) - wm$, we get that the relational expression between room price and commission is $p = \frac{1}{4}(w - \frac{1}{w}) + \frac{(1+\theta)A + d + 2c}{4}$. In addition, under this situation, all the room will be sold, then we get that $m + q = C$, i.e. $(1+\theta)A + d - 2c - 1/w - w = 2C$. Then the optimal commission fee is

$$w'^* = \frac{1}{2}(A + \theta A + d + \sqrt{(A + \theta A + d - 2C - 2c)^2 - 4} - 2C - 2c)$$

(7)

Based on (7) and the relational expression between room price and commission, the optimal room price is

$$p'^* = \frac{1}{8}[3(1+\theta)A + 4c + 3d - 2C$$
$$+ \sqrt{(A + \theta A + d - 2C)^2 - 4} - \frac{4}{A + \theta A + d + \sqrt{(A + \theta A + d - 2C)^2 - 4}}]$$

(8)

The profits of the hotel and OTA can be easily obtained.

$$\pi_t'^* = w'^*(\theta A - p'^* + d - 1/w'^*) - \ln(w'^* d)$$

(9)

$$\pi_h^{\prime *} = (A + \theta A - 2p^{\prime *} + d - 1/w^{\prime *})(p^{\prime *} - c) - w^{\prime *}(\theta A - p^{\prime *} + d - 1/w^{\prime *}) \quad (10)$$

As discussed above, we get the following proposition.

Proposition 2. The cooperative relationship between hotel and OTA mainly depends on the market impact of OTA.

(1) If $\theta \le \dfrac{2c - 3d + A}{3A}$, the commission fee is negative, then OTA will not cooperate with the hotel.

(2) If $\dfrac{2c - 3d + A}{3A} < \theta < \theta^*$, the optimal number of rooms sold is less than the capacity, and the commission is $w^* \approx \dfrac{1}{4}(3\theta A - A + 3d - 2c)$, the room price is

$$p^* = \frac{1}{16}[(3 + 7\theta)A + 6c + 7d - \frac{16}{(3\theta - 1)A - 2c + 3d})].$$

(3) If $\theta \ge \theta^*$, all the rooms are occupied, and the commission is

$$w^{\prime *} = \frac{1}{2}(A + \theta A + d + \sqrt{(A + \theta A + d - 2C - 2c)^2 - 4} - 2C - 2c), \quad \text{the room price is}$$

$$p^{\prime *} = \frac{1}{8}[3(1 + \theta)A + 4c + 3d - 2C$$

$$+ \sqrt{(A + \theta A + d - 2C)^2 - 4} - \frac{4}{A + \theta A + d + \sqrt{(A + \theta A + d - 2C)^2 - 4}}].$$

3.3. OTA selection

The success of the cooperation between hotel and OTA lies on whether the cooperation is beneficial to both parties. That is to say, through cooperation, OTA can obtain commission revenues, and make hotel's profit improved.

If the hotel does not cooperate with any OTA, the hotel determines the room price to obtain the maximal profit by solving $\max_p \; q(p - c)$. Then we get the optimal price $p^* = \dfrac{A + c}{2}$, and the maximal profit of the hotel is $\pi_{nh}^* = \dfrac{(A - c)^2}{4}$.

Therefore, we get the conditions of cooperation, that is $\{\pi_t^*, \pi_t^{\prime *}\} \ge 0$ and $\{\pi_h^*, \pi_h^{\prime *}\} \ge \pi_{nh}^*$. According to the profit functions, we see that, for a given hotel (A, C, c are specified), the conditions of cooperation are related to the market share and market impact of OTA. In other words, the hotel should select the partner OTA with considering the attributes of OTA. For the computational complexity, we use the numerical simulation method to show the impact of OTA's attributes on the formation of cooperation, and the results are given in the next section.

4. Numerical Study

In order to show the profitability of cooperation between hotel and OTA clearly, we present a numerical example to elaborate the findings. Without loss of generality, we assume that the hotel has $C = 350$ rooms and the variable cost of each room per day is $c = 20$, the fixed cost per day is ignored. In addition, we assume the demand function faced by hotel's official website is

$q = 500 - p$. Therefore, if the hotel does not cooperate with OTA, the optimal room price is 260, the number of rooms sold is 240, the occupancy rate is 68.57%, and the maximal profit is 57600. The success of cooperation depends on whether the profit obtained with cooperation is larger than 57600.

4.1. Numerical results and sensitivity analysis

4.1.1. Effects of the Market Share of OTA

At first, we analyze the impact of market share of OTA, i.e. θ. We assume the demand function of OTA is $m = 500\theta - p + 50(1 - e^{-u})$. According to formula (1), we get that, if $\theta \leq 0.26$, the OTA will cooperate with the hotel for the commission is negative. In addition, we get the critical point of θ to make all the rooms being occupied, that is $\theta^* = 0.74$. According to proposition 2, the numerical results are shown in Table 1, and the profits of the hotel and OTA are given in Figure 2.

Table 1: The numerical results

| θ	w	u	p	π_t	π_h
0.27	3.75	5.233779	182.1208	4.563096	51948.58
0.33	26.25	7.179689	195.303	508.8672	56344.52
0.39	48.75	7.798728	208.4324	1773.873	60045.77
0.45	71.25	8.178218	221.559	3798.494	63084.3
0.51	93.75	8.452655	234.6848	6582.594	65461.41
0.57	116.25	8.667766	247.8103	10126.13	67177.36
0.63	138.75	8.844697	260.9357	14429.08	68232.27
0.69	161.25	8.994979	274.0609	19491.43	68626.18
0.75	184.9946	9.13235	287.4973	25427.12	68187.8
0.81	214.9953	9.282639	302.4977	32777.01	66087.9
0.87	244.9959	9.413265	317.498	41026.9	63087.97
0.93	274.9964	9.528781	332.4982	50176.81	59188.03
0.99	304.9967	9.632324	347.4984	60226.72	54388.07
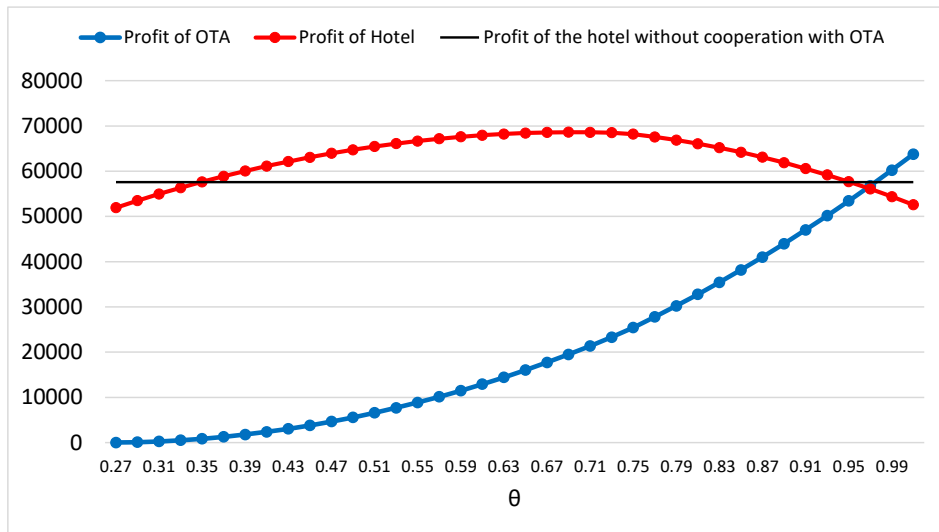
Figure 2: Effect of market share of OTA on the profits

From Table 1 and Figure 2, we see clearly that the profit of OTA increases with the market share, and the profit of the hotel is a downward parabola. Specifically, if the market share θ is 0.69, the hotel can obtain the maximal profit, if θ is smaller than 0.69, the profit of hotel increases with the market share, while if θ is larger than 0.69, the profit of hotel decreases with it. Furthermore, if θ is smaller than 0.34 or larger than 0.96, the hotel's profit will be lower than it obtained without cooperation. In addition, if θ is larger than 1.38, the hotel's profit will be negative.
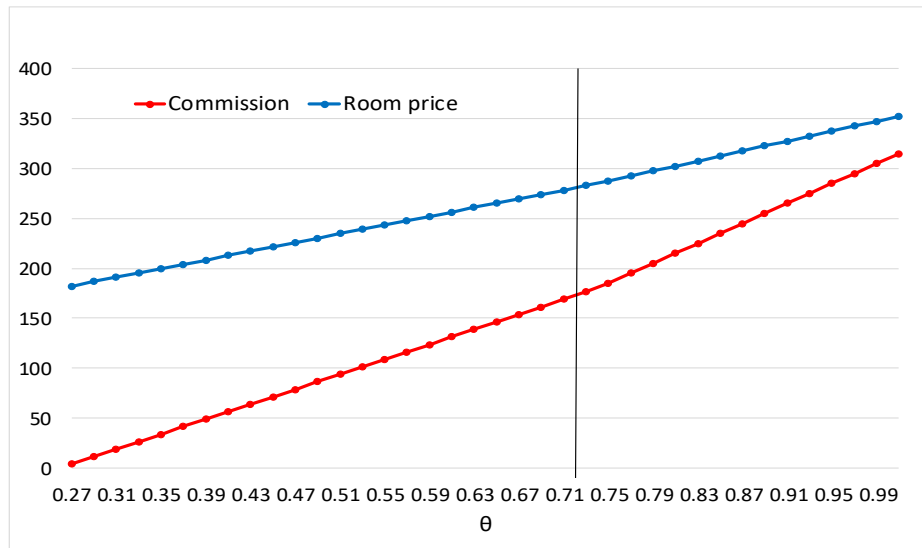

Figure 3: Effect of market share of OTA on commission and room price

Figure 3 shows the changes of commission and room price with market share of OTA. We find that, as the escalate of the OTA's market, the hotel will improve the price and commission. In addition, if θ is larger than 0.74, i.e. all the rooms are occupied, the commission is added fast accelerate. If θ is larger than 1.16, the commission will larger than the room price.
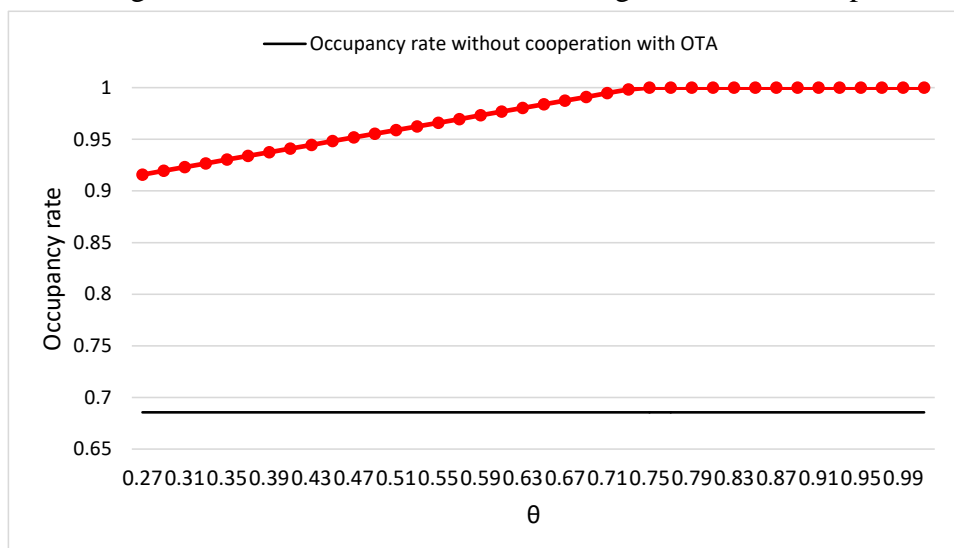

Figure 4: Effect of market share of OTA on the occupancy rate

Intuitively, cooperation will improve the occupancy rate for the greater customer source, as Figure 4 shows, the occupancy rate with cooperation is larger than it without cooperation, and all rooms are occupied if θ is larger than 0.74.

Comparing the results of Figure 2 and Figure 4, we find that the improvement of occupancy rate

does not necessarily bring an increase in profits.

4.1.2. Effects of the Market Impact of OTA

In our study, we use the maximal additional sales to describe the market impact, which indicates the effectiveness of OTA's efforts. If the maximal additional sale is big, it means that the OTA has high reliability, and OTA can attract more consumers easily. Conversely, if the market impact if low, the OTA need to pay more cost to attract the same number of consumers. In this subsection, we study the effect of market impact on cooperation. The demand function of official website is the same with it in the previous section, while the demand function of OTA is changed to $m = 250 - p + d(1 - e^{-u})$, here we set the market share of OTA is 0.5.
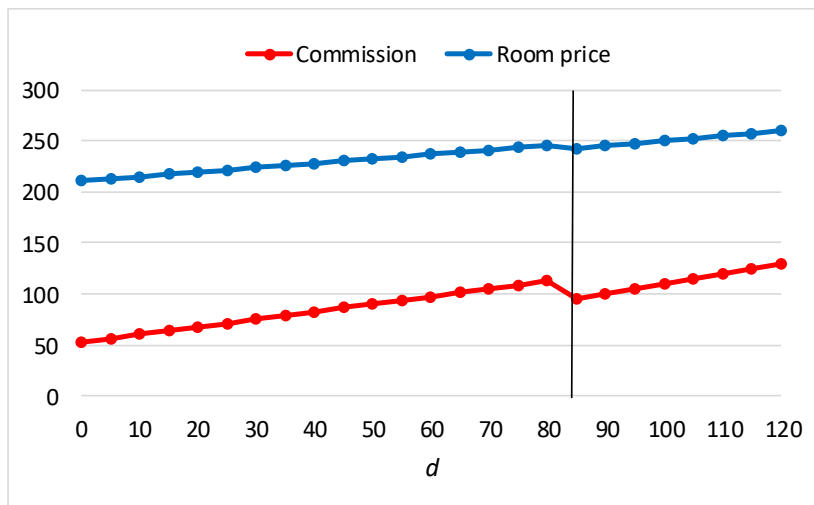
Figure 5: Effect of market impact of OTA on commission and room price

Figure 5 shows that, both the commission and room price have position correlation with market impact of OTA, except one point at which both them decrease.
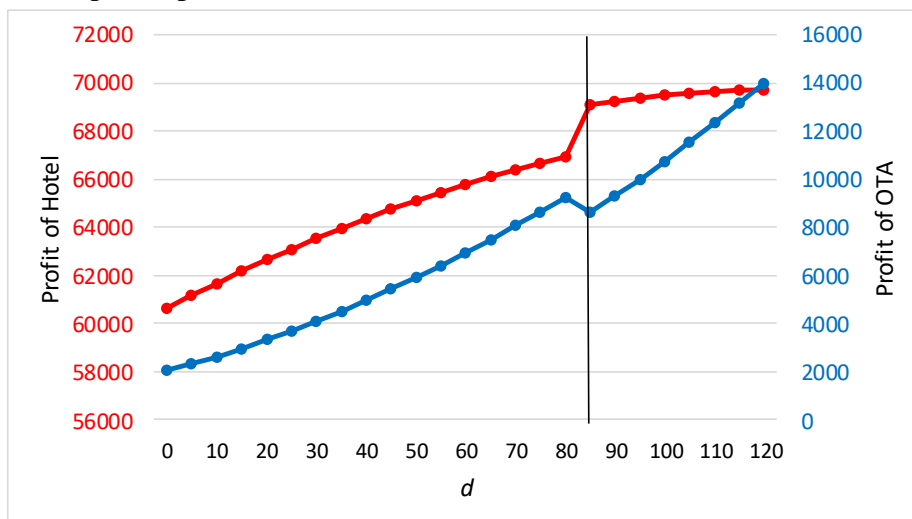
Figure 6: Effect of market impact of OTA on the profits

As the market impact grows, both the profits of the hotel and OTA increase, as Figure 6 shows. However, if d is 85, the hotel's profit decreases. While the OTA's profit suddenly increases at the same point $d=85$, and if d is larger than 85, the growth of the OTA's profit is slowing.

4.2. Discussion of results

In practice, more and more hotels entrust amount of rooms to OTA to sell. However, through our analysis, we find that cooperation is conditionally profitable for hotels. If the hotels cooperate with OTAs that have very small market share and excessive market share, the profits will lower than the profits obtained without cooperation. Specifically, we can discuss the profitability of cooperation from four aspects, i.e. occupancy rate, competing for customers, bargaining power, and OTA selection.

Occupancy rate. Cooperation improves the occupancy rate of the hotel. Especially, if the hotel cooperates with OTAs that have very big market share, the occupancy rate of the hotel is 1, i.e. all the rooms will be occupied, while the profit of the hotel decreases with the increase in market share of OTA. If the hotel does not cooperate with OTA, it can sell out the remaining rooms by using some methods related to pricing, such as lastminute.

Competing for customers. Cooperation expands the source of consumers for the hotel. Then the hotel can raise room price for more profits. However, with the increasing of the OTA's market share, the hotel will pay higher commissions to OTA. If the market share of OTA is large enough, the hotel is in a disadvantage position, even obtain negative profit.

Bargaining power. Although cooperation may make the profit of hotel lower, the total profit always increases. If the hotel has strong bargaining power, it can share more benefit.

OTA selection. In tourism industry, there are many OTAs which have different market shares and market impacts. Hotels should select the most appropriate OTA to cooperate on the basis of the market environment (potential customers, market type, and location) and their own attributes (cost, capacity, etc.).

5. Conclusions and Further Research

This paper studies the cooperation contract between tourism hotels and OTAs from the perspective of partner selection. The OTA receives commission fees from the hotels for selling room reservations online, and determines the level of sales effort (such as ranking position of hotels' information on its webpage, customer evaluations, picture and video show, etc.) to maximize its profit with a finite effort capacity. We give the decentralized decisions of hotel and OTA, and mainly discuss the effects of OTA's market share and market impact on the cooperative relationship between them.

Intuitively, OTA will make greater effort with the increasing of commission fee. However, through the analysis, we see that there is a positive correlation between effort level and the maximal additional sales. This suggests that, in practice, the hotel can appropriate to reduce the commission fee, if the OTA has a strong market impact. While if the OTA's market impact is weak, the hotel need to charge a relatively high commission fee for each room sold through OTA.

Meanwhile, from the numerical studies, we find that cooperation is conditionally profitable for hotels. If the hotels cooperate with OTAs that have very small market share and excessive market share, the profits will lower than the profits obtained without cooperation. Hotels should select the most appropriate OTA to cooperate on the basis of the market environment (potential customers, market type, and location) and their own attributes (cost, capacity, etc.).

Finally, the model of this paper is limited by some necessary restrictions in scope, and can be extended to a number of interesting further studies. Firstly, this model can be extended to the scenario that the information of the players is unobservable to each other. And then an asymmetric information game will be presented. Secondly, a dynamic pricing policy depends on the reservation date and room inventory for a hotel would yield some interesting insights for the service operators, although this may be a great challenge. Finally, cancellations and no-shows are very common in the

hospitality industry, and accordingly, an overbooking strategy can be adopted to fix this problem, and this would certainly be worth working on.

Acknowledgments

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