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Ruhai Wu
University of Texas at Austin

Ling Xue
University of Texas at Austin

Andrew Whinston
University of Texas at Austin

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ECONOMIC ANALYSIS OF THE SUPPLIER–RESELLER SYMBIOTIC COMPETITION IN AN ONLINE DISTRIBUTION BUSINESS

Ruhai Wu, Ling Xue, and Andrew B. Whinston
Center for Research in Electronic Commerce
Department of Information, Risk, and Operations Management
University of Texas at Austin
Austin, TX U.S.A.
ruhaiwu@eco.utexas.edu lingxue@mail.utexas.edu
abw@uts.cc.utexas.edu

Abstract

The Internet brings suppliers unprecedented opportunity of selling directly to consumers, a trend predicted as disintermediation (Malone et al. 1987). However, the coexistence of online reseller channels and direct channels leads to a subtle relationship between suppliers and online resellers, that is, the two parties cooperate as well as compete with each other. In this paper, we build a game-theoretical model to examine the relationship of symbiotic competition between a supplier and a reseller, in which while the supplier relies upon the reseller in distribution, she also competes with the reseller. We further compare possible mechanisms for the supplier to control the symbiotic competition (i.e., the low-price guarantee and the capacity control mechanism). Both mechanisms are shown to reduce the channel conflicts and benefit the supplier. The capacity control mechanism provides the supplier a competitive advantage over the reseller and consequently the maximum profit. The related IT/IS techniques and information systems adoption issue are also discussed.

Keywords: Channel competition, disintermediation, online market, control mechanism

Introduction

Advances in information technology cause fundamental changes in market structures. Early information systems research focused on cost of intermediation and tended to suggest a disintermediation trend, or in other words, the gradual elimination of intermediaries from the value system (Malone et al. 1987). Later research emphasizes the intermediaries’ value-added functions and suggests the promise of reintermediation or cybermediation (Chircu and Kauffmann 1999; Giaglis et al. 2002). In many online marketplaces, both disintermediation and cybermediation are evidenced by empirical observations. Suppliers’ direct channels and independent intermediaries often coexist. The relationship between the suppliers and intermediaries in online distribution becomes unprecedentedly subtle.

Take the lodging industry as an example. Online booking now brings over 25 percent of all hotel room revenue (Starkov and Price 2005). Resellers like Expedia and Travelocity play a significant role, accounting for over 50 percent of online booking and for 17 percent of market share of total travel expected in the year 2006 (Mullaney 2004). Hotels chains rely heavily on those resellers for the new guest markets and new revenue streams the latter bring. Meanwhile, hotel chains also launched direct Web sites for retail booking. The low online search cost inevitably causes competition between the hotels’ direct channels and the reseller channels. Hence, the relationship between hotel chains and resellers is far from being consonant. On one hand, hotels are willing

1A quote from Orbitz’s Vice President of Hotels illustrates that indirect channels help hotels to access new markets: “We help hoteliers find customers they do not reach through their own brand sites….Orbitz helps open up new guest markets and new revenue streams” (Cendant 2005).
to cooperate with resellers for the additional sales brought by the latter; on the other hand, they are anxious about the channel competition since it erodes the overall profit margin. In this paper, we define the relationship as symbiotic competition (i.e., a supplier relies upon a reseller channel in distribution, while also managing a certain degree of competition with the latter).

The symbiotic competition is more remarkable in online distribution than in traditional offline cases. Under offline circumstances, the market segments targeted by a supplier’s direct channel and reseller channels are mostly separated. In online distribution, the market segments overlap. Consumers in the overlapped segment visit both channels and compare the prices. Especially for standardized and purchase-path independent products, such as hotel rooms, airline and event tickets, price is the main weapon used to attract consumers. Other features of the online market further intensify the price competition. Comparison-shopping sites and smart deal-hunting software agents help consumers easily search for discounts. Deals Web sites, such as priceline.com, make consumers associate products with lower prices and encourages their deal-hunting. Hence, the supplier loses considerable profit from the sales in the overlapped segment. She not only shares the profit with the reseller for the sales through the latter, but also bears the profit margin decrease caused by the price competition.

The existing research\(^2\) on the competition between the supplier’s direct channel and the independent retail channel(s) explore the effect of competition in various scenarios. Chiang et al. (2003) assume that the supplier’s direct channel and reseller channels target the same market. The direct channel loses all of its business in the competition but serves as an instrument to influence the resellers’ pricing. Bell et al. (2002) explore the positive spillover effects by the supplier’s direct channel. The direct channel’s revenue is nevertheless reduced by competition from reseller channels. Tsay and Agrawal (2004a) argue that the effect of competition is not necessarily negative. With the competition on both prices and sale efforts, the coexistence of the supplier’s direct channel and the reseller channel may benefit both parties by an efficient division of labor. Nevertheless, few papers examine possible mechanisms for the supplier to control the competition. Since in reality it is in suppliers’ interest to avoid the negative effect of competition, it is of great academic and managerial importance to study the optimal control mechanism and related information systems adoption strategies.

The **low-price guarantee** is widely adopted by major hotel suppliers (such as Marriott, Hilton, and Hyatt) as a mechanism to control the symbiotic competition. In the low-price guarantee agreement, a hotel chain does not precisely specify a reseller channel’s price but forces the reseller to promise not to undercut the direct channel price. Supported by the agreement, the supplier promises consumers lower rates from the hotel’s direct Web site than from any independent travel agent sites. Price-matching strategies and rate monitoring techniques are used by the supplier to guarantee the lowest rates in the direct channel.

A low-price guarantee helps the supplier attract consumers to the direct channel and reduces the share passed to the resellers. Furthermore, as Grover and Ramanial (1999) observe, low-price guarantee does not necessarily lower the market prices, but may raise them up and consequently increase the supplier’s profit margin. However, using the low-price guarantee agreement to control the symbiotic competition is still subject to a number of issues. First, the commitment of the lowest price through the direct channel is largely questioned.\(^1\) For example, when hotels use price-matching strategies, they normally impose rigid rules requiring consumers to provide evidence about the third-party site’s better deals for the same type of room. Therefore, the promise of the lowest direct-channel price may not always be delivered. Second, many implicit price competition instruments (e.g., coupons, rebates, and mileage) are beyond the scope of low-price guarantee. Third, the low-price guarantee often results in a consistent price level across channels, which does not provide the direct channel a competitive advantage over the reseller. Fourth, the low-price guarantee may lead to undesirable price competition among different brands which inevitably erodes profit margin.\(^4\)

Another potential mechanism to control the symbiotic competition is the management of capacity allocation among channels, namely the **capacity control** mechanism. Under the capacity control mechanism, the supplier determines in advance the shares of the total capacity allocated to different channels, in order to restrict the reseller’s competitive ability. In the lodging industry, the capacity control mechanism can be implemented technically through many hotel yield management systems. For example, systems like IDEaS’s E-yield allow hotels to set up distribution policies (e.g., opening and closing rates, providing overbooking.

\(^2\)Tsay and Agrawal (2004b) provides a comprehensive review.

\(^1\)A KPMG survey conducted across 330 hotels in 16 countries found that although 43 percent of hotels offered best Web rate price guarantees, only 27 percent of them delivered their price promise. Also, the same study found that 36 percent of the cheapest hotel room rates found online were from online intermediaries (Hotelmarketing.com 2005).

\(^4\)The report from *The Wall Street Journal* (Rich 2003) quotes, “David Lane of Paramount Hospitality Management, which manages the Comfort Suites San Francisco Airport, says if consumers are being encouraged to shop around so much for cheaper rooms—they might end up finding a better deal at another chain entirely. ‘I think the price guarantee is ridiculous….It’s going to drive business away.’”
restricting reservation acceptance from different channels, imposing length-of-stay restriction, etc.) based on demand forecasts and the hotel’s own strategies. Capacity availability to the reseller channel can be restricted through this system. Switch systems can also be used to filter requests between global distribution systems (GDS) and the hotels’ reservation systems and to implement the capacity allocation across different channels (Choi and Kimes 2002). Moreover, real-time capacity allocation decisions can be made in which hotels decide whether or not to accept reservations upon receiving the requests from specific resellers. The decision on capacity allocation is based on the demand forecasts and consumer distribution. For example, IDeaS’s E-yield system allows hotels to estimate dollar value of business displaced should it accept a particular request and helps hotels to decide whether or not to accept certain requests.

In this paper, we examine the symbiotic competition in a purchase-path independent good market. A game theoretical model is used to study the supplier-reseller symbiotic competition relationship determined by partially overlapped market segments. The reseller has the capability to generate external demands which the supplier herself cannot. The supplier, while cooperating with the reseller for the additional revenue source, balances the channel competition to maximize her profit. We consider the supplier’s use of two different mechanisms, the low-price guarantee mechanism and the capacity control mechanism, in managing this cooperative and competitive relationship. We identify the potential drawbacks of the low-price guarantee mechanism, and show that the capacity control mechanism dominates the low-price guarantee mechanism by providing the direct channel with a competitive advantage in the overlapped market segment.

The rest of the paper is organized as follows. In the next section, we introduce a branch mark model of symbiotic competition between a supplier and a reseller and introduce the principle of rationing rule adopted in analysis. The subsequent section illustrates the outcome of symbiotic competition if no additional control mechanism is applied by the supplier. The two sections that follow study the outcome if the supplier uses the low-price guarantee mechanism and if she uses the capacity control mechanism respectively. The final section concludes the paper and provides more technology-based implementation of the capacity control mechanism.

Model of Symbiotic Competition

In this section, we introduce the model setup to illustrate the symbiotic competition between the supplier and the reseller. The random rationing rule is adopted in cases with capacity constraints.

Model Setup

A monopolistic supplier sells a single product with total capacity $T$. The demand function of the product is $Q = D - cP$. She can sell the product through her direct channel and/or through a reseller. From now on, we adopt the convention of using the pronouns she and he to refer to the supplier and the reseller, respectively. The supplier sets the direct channel price as $P_s$ (the subscript “$s$” denotes the supplier). The reseller sets the reseller channel price as $P_r$ (the subscript “$r$” denotes the reseller) and earns a percentage commission fee $\gamma$ of the sales revenue.

The market for the product is made up of three segments, namely the direct segment, the indirect segment, and the mixed segment. Consumers in the direct (indirect) segment only visit and buy from the supplier’s direct channel (the reseller channel), while consumers in the mixed segment visit both channels and buy from the one with the lower price. The market shares of three segments are $\alpha$, $\beta$, and $1 - \alpha - \beta$, respectively. Thus, provided there is enough capacity, the demands in the direct channel and reseller channel are $q = \alpha D - \alpha cP_s$ and $q = \beta D - \beta cP_r$, respectively. Demand in the mixed segment is

$$q = \begin{cases} 
(1 - \alpha - \beta)(D - cP_r) & \text{if } P_r < P_s \\
(1 - \alpha - \beta)(D - cP_s) & \text{if } P_r > P_s \\
(1 - \alpha - \beta)(D - cP) & \text{if } P_r = P_s = P
\end{cases}$$

In reality, the supplier can use special systems to estimate demand, differentiate and manage customers based on market segments. For example, OPUS 2’s TopLine PROPHET can retrieve historical data from hotels’ reservation and property management systems and provides tools for hotels to discern consumers based on their past behaviors.
When \( P_s = P_r \), it is assumed that consumers from the mixed segment buy from either channel with an equal probability (i.e., 50 percent).

We assume that the supplier’s total capacity satisfies that \( (1 - \beta) \frac{D}{2} \leq T \leq \frac{D}{2} \). That is, the total capacity is not redundant relative to the profit-maximizing quantity of a monopolist serving the whole market, \( \frac{D}{2} \); and it is excessive relative to the profit-maximizing quantity of a monopolist serving both the direct segment and the mixed segment, \( (1 - \beta) \frac{D}{2} \). Also, we assume that the supplier sets the direct channel price first and the reseller chooses the reseller channel price after that.

Rationing

Price competition between the two channels drops channel prices lower than the profit-maximizing level. It leads to capacity constraint, that is, given a channel price, the amount of total potential buyers, who access the channel and are willing to buy, exceeds the capacity provided by the channel. Not all potential buyers can successfully buy the product under the capacity constraint. We assume consumers arrive independently in random order. Thus we adopt the random (proportional) rationing rule in this paper to decide how products are allocated to potential buyers. That is, facing a limited capacity, all potential buyers have the same chance to buy the product. For instance, when \( P_r < P_s \), the potential buyers of the reseller channel are from both the mixed segment and the indirect segment. If the amount of products the reseller channel provides, \( x \), is less than the demand from both segments, \( (1 - \alpha)(D - cP_r) \), then all potential buyers of the reseller channel, no matter they are from the mixed segment or the indirect segment, have a chance of \( \frac{x}{(1 - \alpha)(D - cP_r)} \) to get a product.

It is worth remarking that if the supplier does not discriminate between channels in capacity sharing, then when the total capacity constraint is binding, the random rationing rule applies across two channels (or consumers from all three segments). Specifically, if \( P_r < P_s \), all consumers in the mixed segment would like to buy from the reseller channel. Thus the total number of potential buyers of the reseller channel is \( (1 - \alpha)(D - cP_r) \), while the number of potential buyers of the direct channel is \( \alpha(D - cP_s) \). Then, each potential buyer of either channel has a chance of \( \frac{T}{\alpha(D - cP_r) + (1 - \alpha)(D - cP_s)} \) to get a product. If \( P_r < P_s \), all consumers in the mixed segment would like to buy from the direct channel. The amounts of potential buyers of the reseller channel and the direct channel are \( \beta(D - cP_r) \) and \( (1 - \beta)(D - cP_s) \), respectively. Each potential buyer has a chance of \( \frac{T}{(1 - \beta)(D - cP_r) + \beta(D - cP_s)} \) to get a product.

The outcome of rationing is complicated if both channels have separated capacity constraints since rationing may first happen at one channel and may then happen at the other channel some time later. That makes it difficult to measure the chance for a consumer in the mixed segment to buy from the second channel after he fails to buy from the first one. Nevertheless, this concern is not relevant to the analysis in the paper. The above case never happens in the equilibrium. Otherwise, the first channel can always increase her/his profit by slightly raising her/his price while keeping the same sale quantity as before.

Symbiotic Competition with No Control Mechanism

We first examine the case where the supplier does not use any control mechanism. This case corresponds to many industrial scenarios in which the hotels share the whole capacity with third-party agents and do not have any regulation on the agents’ pricing behaviors. For example, online resellers can send reservation requests directly to hotels’ central reservation systems.

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\( ^4 \)Even if serving in the whole market directly by herself, the monopoly supplier at most sells \( \frac{D}{2} \) products, at which level her profit is maximized. Since the supplier cannot sell to the indirect segment in reality, she should not set her capacity more than \( \frac{D}{2} \) in the long run.

\( ^5 \)The supplier’s direct channel can serve in the direct segment and the mixed segment. If \( T \leq (1 - \beta)\frac{D}{2} \), the supplier would sell solely through the direct channel rather than cooperate with the reseller at all.
(CRS). In this case, hotels do not distinguish requests sent by resellers from requests directly by consumers through the direct channel. Resellers have flexibility in adjusting the reseller channel price.

Since the reseller sets his price after the supplier, he can always marginally undercut the direct channel price in order to beat the supplier in selling to the mixed segment. In this case, he earns commission profit by selling to both the mixed segment and the indirect segment. However, if the direct channel price is sufficiently low, selling to both segments becomes less profitable. The reseller would rather raise his price higher than the direct channel price and sell only to the indirect segment. The increased profit from the indirect segment due to the higher price outweighs the loss of profit from the mixed segment.

**Lemma 1**: If \( P_s > \frac{D}{2c} \), the reseller sets \( P_r = P_s - \epsilon = P_s \).

Lemma 1 is easily proven by contradiction. If \( P_r \geq P_s > \frac{D}{2c} \), the reseller’s profit is only from the indirect segment. He always has the incentive to further lower the reseller channel price.

**Lemma 2**: If \( P_s \leq \frac{D}{2c} \), and if the reseller sets \( P_r > P_s \), he sells only to the indirect segment. His optimal price is \( P_r^* = \frac{1}{\beta c} \left( D - (1 - \beta) c P_s - \sqrt{(1 - \beta) (D - c P_s) (D - (1 - \beta) c P_s)} \right) \)

and his maximized profit is \( \pi_r(P_r^*) = \frac{\gamma T}{\beta c} \left( \frac{D - (1 - \beta) c P_s}{\sqrt{(1 - \beta) (D - c P_s)}} \right)^2 \).

**Lemma 3**: If \( P_s \leq \frac{D}{2c} \), and if the reseller sets \( P_r < P_s \), he sells to both the mixed segment and the indirect segment. His optimal price is \( P_r = P_s - \epsilon \), and his maximized profit is \( \pi_r(P_r^*) = \gamma (1 - \alpha) T P_s \).

Lemma 2 and Lemma 3 characterize the reseller’s optimal pricing strategies if he sells only to the indirect segment and if he sells to both the mixed segment and the indirect segment, respectively. When \( P_s = \frac{D}{2c} \), it can be shown that \( \pi_r(P_r^*) > \pi_r(P_s^*) \), selling to both segments is more profitable. However, as \( P_s \) decreases, there may exist a cutoff level \( P_{s,NCM} \) (the superscript “NCM” denotes the case with no control mechanism) such that if \( P_s \leq P_{s,NCM} \), it satisfies that \( \pi_r(P_r^*) \leq \pi_r(P_{s,NCM})^* \) and the reseller would like to sell only to the indirect segment. The comparison between the results from Lemma 2 and Lemma 3 indicates that \( P_{s,NCM} \) satisfies the following condition

\[
(1 - \alpha) P_{s,NCM} = \frac{1}{\beta c} \left( \sqrt{D - (1 - \beta) c P_{s,NCM}} - \sqrt{(1 - \beta) (D - c P_{s,NCM})} \right)^2
\]  

(1)

Anticipating the reseller’s optimal pricing strategy, the supplier has two potential optimal pricing strategies. If she chooses to sell to the mixed segment by herself, she has to significantly lower the direct channel price to \( P_{s,NCM} \). Her profit from the direct segment and mixed segment drops off as the direct channel price falls. Otherwise, if she chooses a high direct channel price, the reseller will beat her in the mixed segment. She then has to pay commission fee for sales in the mixed segment, although the reseller’s service in this segment is undesirable. Considering the above tradeoff, the supplier’s optimal price is characterized by the following proposition:
Proposition 1: The supplier’s direct channel price is \( D - T \) \((P_{s}^{NCM})\) if \( \pi_{s}\left(D - T\right) \) is greater (less) than \( \pi_{s}\left(P_{s}^{NCM}\right) \). Where

\[
\pi_{s}\left(D - T\right) = [\alpha + (1 - \gamma)(1 - \alpha)] T D - T c - \pi_{s}^{NCM}, \quad \text{and} \quad \pi_{s}\left(P_{s}^{NCM}\right) = \left[\frac{(1 - \beta)(D - cP_{s}^{NCM})}{D - (1 - \beta)cP_{s}^{NCM}} + (1 - \gamma)(1 - \alpha)\right] TP_{s}^{NCM}
\]

As Proposition 1 illustrates, as the indirect segments account for large market share, or \( \beta \) is not too small, \( \pi_{s}\left(D - T\right) > \pi_{s}\left(P_{s}^{NCM}\right) \), the supplier chooses to set a high direct channel price \( D - T \). In this case, the reseller channel price is lower than the direct channel price. Although consumers (in the mixed segment) know both channels, they only buy from the reseller channel. This was a common occurrence before the low-price guarantee conducted by the hotels. Since the online resellers brought considerable extra revenue sources, hotels conceded in the channel price competition.

Symbiotic Competition under the Low-Price Guarantee Mechanism

In the mechanism of low-price guarantee, the supplier only requires the reseller’s price to be at least as high as the direct channel price but does not specify the exact price level for the reseller. Therefore, the low-price guarantee is equivalent to a price floor which still grants the reseller certain pricing flexibility. To realize the low-price guarantee, the supplier can match (in her direct channel) any lower price found in the reseller’s channel. Moreover, many technical systems on rate monitoring can also be used by the supplier to ensure that the lowest price is offered through the direct channel. For example, Electrobug’s channel management toolset allows hotel suppliers to track third-party sites and hotels’ brand sites simultaneously and to compare competing offers in a single view. Rate monitoring and extraction are conducted in a real-time fashion and rule-based e-mail alert systems can be set up. Reports can be exported to other data warehouses for decision use. Such close monitoring enables the supplier to guarantee the pricing advantage of her direct channel.

In this section, we analyze the low-price guarantee’s impact on the strategic interaction between the supplier and the reseller. With the low-price guarantee agreement, the reseller cannot undercut the direct channel price anymore. However, he can equalize his price to the direct channel price and still sell to the mixed segment. Similar to Lemma 1, if \( P_{s} > \frac{D}{2c} \) the reseller will set \( P_{r} = P_{s} \). If \( P_{s} \leq \frac{D}{2c} \) and the reseller intends to sell only to the indirect segment, the reseller will choose a price \( P_{s} > P_{r} \). His pricing strategy resembles that in the case with no control mechanism (Lemma 2). If \( P_{s} \leq \frac{D}{2c} \) but the reseller intends to sell to both the mixed segment and the indirect segment, his pricing strategy is given by the Lemma 4.

Lemma 4: If \( P_{s} \leq \frac{D}{2c} \), and the reseller sells to both the mixed segment and the indirect segment, his optimal price is \( P_{r}' = P_{s} \), and his profit is \( \pi_{s}(P_{r}') = \frac{1 - \alpha + \beta}{2} TP_{r} \).

In comparison to the case without any control mechanism, when the reseller sells to both the mixed segment and the indirect segment, his profit under the low-price guarantee mechanism from selling to these two segments decreases. Denote \( P_{s}^{LPG} \) as the cutoff level (the superscript “LPG” denotes the case under the low-price guarantee mechanism) such that if \( P_{s} \leq P_{s}^{LPG} \), it satisfies that \( \pi_{s}(P_{s}') \leq \pi_{s}(P_{s}) \). Then \( P_{s}^{LPG} \) is determined by the following condition:

\[
\left(1 - \alpha + \beta\right)P_{s}^{LPG} = \frac{1}{\beta c} \left(\sqrt{D - (1 - \beta)cP_{s}^{LPG}} - \sqrt{(1 - \beta)(D - cP_{s}^{LPG})}\right)^{2}
\]
Lemma 5: \( P_s^{LPG} > P_s^{NCM} \).

Intuitively, Lemma 5 can be explained in the following way. In the case with low-price guarantee and that without any control mechanism, the reseller’s profit is the same if he tries to avoid the price competition in mixed segment. However, the low-price guarantee largely reduces his profit when fighting in the mixed segment, and consequently forces him more likely to concede. Therefore, the cutoff direct channel price increases under the low-price guarantee.

Considering the reseller’s pricing strategy in the case with low-price guarantee, the supplier’s optimal pricing strategy and corresponding profit are characterized by Proposition 2.

Proposition 2: The supplier’s direct channel price is \( \frac{D-T}{c} (P_s^{LPG}) \) if \( \pi_s\left(\frac{D-T}{c}\right) \) is greater (less) than \( \pi_s\left(P_s^{LPG}\right) \). Where \( \pi_s\left(\frac{D-T}{c}\right) = \left[1 - \gamma \left(1 - \frac{1 - \alpha + \beta}{2}\right)\right] T(D-T) \) and \( \pi_s\left(P_s^{LPG}\right) = \left[\frac{1 - \beta}{D - (1 - \beta) c P_s^{LPG}} + (1 - \gamma)(1 - \alpha)\right] T P_s^{LPG} \).

Corollary 1: Compared with the case with no control mechanism, the supplier’s profit under the low-price guarantee mechanism increases.

The low-price guarantee agreement limits the reseller’s advantage on pricing and attracts consumers in the mixed segment. Comparing Propositions 1 and 2, it is interesting to find that when \( \beta \) is not small, the low-price guarantee agreement does not change the direct channel price, but purely increase its sales. However, it is also worth remarking that the low-price guarantee mechanism does not eliminate the undesirable channel competition. The suppliers still need to pay commission fees for the sales in the mixed segment. There should be better way for the supplier to control the symbiotic competition.

Symbiotic Competition with Capacity Control Mechanism

Outcome with Capacity Control Mechanism

In this section, we examine the capacity control mechanism. Technically, the capacity control can be realized in a variety of ways. For example, hotel chains can use a switch system to automatically assign quotas of rooms to different resellers who books through the same GDS. Revenue management systems like IDeaS’s E-yield allow suppliers to plan and adjust in real-time the product/service availability and other rule-based distribution policies through reseller channels. Moreover, suppliers can also choose to work only with those cooperative distribution partners.\(^8\)

We model the capacity control mechanism as follows. The supplier first signs a contract with the reseller to allocate part of her capacity \( x < T \) to the reseller, and then decides the direct channel price \( P_s \). After that, the reseller decides her resale price \( P_r \).

Unlike the case with no control mechanism and the case under the low-price guarantee mechanism, given the capacity allocation, the reseller has less incentive to undercut the direct channel price, since he can only sell up to the amount of \( x \). The supplier is also reluctant to lower the direct channel price since she also faces a capacity limit of \( T - x \). The malignant price competition then can be avoided. Lemma 6 characterizes the supplier’s and the reseller’s selling strategy given the capacity allocation.

Lemma 6: Given certain capacity allocation \( T-x \), \( x \), the optimal direct channel price and the reseller channel price are the following:

\[
\text{If } x \leq \beta T < \frac{D}{2}, \quad P_s = \max \left\{ \frac{D}{2c} - \frac{T-x}{(1-\beta)c}, \frac{D}{c} - \frac{x}{\beta c} \right\} \text{ and } P_r = \frac{D}{c} - \frac{x}{\beta c} \geq \frac{D}{2c};
\]

\(^8\)For example, in August 2004, InterContinental Hotels Group (IHG) certified Travelocity and Travelocity Business as third-party distributors of its more than 3,500 hotels worldwide, while it decided to relinquish business relationships with Expedia and Hotels.com, who failed to avoid confusing and potentially unclear marketing practices.
If $\beta T < x \leq (1-\alpha)T$, \( P_s = P_r = \frac{D}{c} - \frac{T}{c} > \frac{D}{2c} \);

If \( (1-\alpha)T < x < (1-\alpha)\frac{D}{2} \), \( P_s = \frac{D}{c} - \frac{T-x}{\alpha c} > \frac{D}{2c} \) and \( P_r = \frac{D}{c} - \frac{x}{(1-\alpha)c} > \frac{D}{2c} \);

If \( x \geq (1-\alpha)\frac{D}{2} \), \( P_s = \frac{D}{c} - \frac{T-x}{\alpha c} > \frac{D}{2c} \) and \( P_r = \frac{D}{c} \).

It is worth noticing that given any capacity allocation, the direct channel price and the reseller channel price are always no less than the monopoly price level \( \frac{D}{2c} \), and rationing never happens. Taking into account the pricing behaviors as in Lemma 6, the supplier chooses the optimal capacity allocated to the reseller in order to maximize her profit. Proposition 3 illustrates the optimal capacity allocation level and the corresponding optimal direct channel price, reseller channel price, and supplier’s maximized profit.

**Proposition 3:**

The optimal capacity allocated to the reseller is 
\[
x^* = \beta T - \frac{\gamma \beta (1-\beta) \left( \frac{D}{2} - T \right)}{1 - \gamma (1-\beta)};
\]

The optimal direct channel price is 
\[
P_s = \frac{D}{c} - \frac{\gamma \beta \left( \frac{D}{2} - T \right)}{c(1 - \gamma (1-\beta))};
\]

The optimal reseller channel price is 
\[
P_r = \frac{D}{c} - \frac{\gamma (1-\beta) \left( \frac{D}{2} - T \right)}{c(1 - \gamma (1-\beta))};
\]

The supplier’s maximized profit is (the superscript “CCM” denotes the case with the capacity control mechanism)
\[
\pi_{s,CCM} = \frac{T(D-T)}{c} - \frac{\gamma \beta \left[ T \left( \frac{D}{2} - T \right) + \frac{D}{2} \left( T - \gamma (1-\beta) \frac{D}{2} \right) \right]}{c(1 - \gamma (1-\beta))};
\]

Proposition 3 yields interesting observations and managerial applications. First, under the optimal capacity allocation, the reseller channel price is higher than the direct channel price (i.e., \( P_r > P_s \)). Even without low-price guarantee agreement, the capacity constraint forces the reseller to voluntarily raise his price and sells only to the indirect segment. The supplier takes all sales in both the mixed segment and the direct segment. The channel conflict in the mixed segment can be avoided by properly choosing the amount of capacity allocated to the reseller. The low-price guarantee mechanism is not necessary if there is a capacity control mechanism.

Second, \( x < \beta T \), the optimal capacity allocated to the reseller is proportionally less than the market share of the indirect segment, while the capacity held by the supplier is proportionally more than the market share of the mixed segment and direct segment. The allocation of the capacity guarantees the supplier’s advantage on the later channel competition. Furthermore, it is worth noticing that the optimal capacity allocation is dependent only on the size of the indirect segment (i.e., \( \beta \)), but not on the size of the direct segment (i.e., \( \alpha \)). It implies that the supplier uses the capacity control mechanism, the critical information she needs
is the demand potential of the loyal consumers from the reseller channel. In contrast, the proportion of remaining consumers that are loyal to her direct channel or are switching between channels is irrelevant.

**Outcome under the Optimal Channel Cooperation**

In order to evaluate the advantage of the capacity control mechanism and compare it with the low-price guarantee mechanism, we first analyze an imaginary case of optimal channel cooperation where channels can distinguish which segments consumers are from and the supplier can decide the reseller channel price. It is obvious that the maximized supplier’s profit in the imaginary case is no less than that in any realistic symbiotic competition outcome. We will show that with the capacity control mechanism, the suppliers can realize the maximized profit in case of the optimal channel cooperation.

**Lemma 7**: In the optimal channel cooperation, the supplier sells to both the mixed segment and direct segment, while the reseller sells only to the indirect segment.

Since the supplier has to pay the commission fee for the reseller’s sale in the mixed segment, she would rather sell by herself. In contrast, recall that in the case under the low-price guarantee mechanism, if the supplier set the direct channel price $P_s = \frac{D - T}{c}$, the reseller also sells to the mixed segment besides the indirect segment. Therefore, the supplier’s profit under the low-price guarantee mechanism is suboptimal.

**Lemma 8**: In the optimal channel cooperation, rationing never happens.

If rationing happens, the supplier can always increase her profit by raising channel prices while keeping the same amount of sales. Recall in the case under the low-price guarantee mechanism, if the supplier set the direct channel price $P_s = P^{p}_s$, rationing happens. Therefore, the supplier’s profit under low-price guarantee mechanism is suboptimal.

Given Lemma 7 and Lemma 8, the supplier’s objective function in the optimal channel cooperation is

$$\max_{P_s, P_r} P_s (1 - \beta)(D - cP_s) + (1 - \gamma)P_r \beta(D - cP_r)$$

subject to

$$(1 - \beta)(D - cP_s) + \beta(D - cP_r) = T$$

It can be shown that $\pi^{OCC}_s = \frac{T(D - T)}{c} - \frac{\gamma\beta}{c} \left[\frac{T}{2} \frac{D}{2} \frac{T}{2} \gamma(1 - \beta) \frac{D}{2}ight]$ where the superscript “OCC” denotes the case of optimal channel cooperation. Comparing $\pi^{OCC}_s$ with $\pi^{CCM}_s$, we get Proposition 4.

**Proposition 4**: The supplier’s maximized profit under the capacity control mechanism is equivalent to that under optimal channel cooperation.

**Corollary 2**: The capacity control mechanism is more profitable for the supplier than the low-price guarantee mechanism.

Proposition 4 implies that by efficiently allocating capacity, the supplier is able to completely resolve the contrast of the symbiotic competition. While sharing the profit from the reseller channel’s loyal consumers, the supplier maximizes the direct channel’s sales and avoids the potential channel conflicts. In contrast, in the case under the low-price guarantee mechanism, channel conflicts exist in any equilibrium outcome. Thus, the capacity control mechanism is superior to the low-price guarantee mechanism, as shown in Corollary 2.

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*Estimation can be made on the number of sole visitors of online third-party sites. For example, sites like Expedia.com and Hotels.com are found to have 20 million sole visitors each month (Liu and Yee 2004).*
Conclusion

The symbiotic competition phenomena reflect the features of both disintermediation and reintermediation. In this paper, we model the coexistence of the direct channel and the reseller channel in online business, and explore the relationship of symbiotic competition between the supplier and the reseller. We further compare the supplier’s possible control mechanisms, low-price guarantee mechanism, and capacity control mechanism. Both mechanisms reduce the channel competition and benefit the supplier. Moreover, the capacity control mechanism helps the supplier beat the reseller in the overlapped market segment and realize a local disintermediation.

The strategic implications drawn from our analysis provide guidance for suppliers to adopt specific technology-based solutions in managing their different online channels. The control mechanisms discussed in this paper are implemented through different types of information systems. Therefore, when choosing the information systems for channel management, the manager needs to be aware of which control mechanisms can be essentially realized by the adopted systems. For example, when rate-monitoring and controlling systems, such as Electrobug, are adopted, low-price guarantee mechanism can be realized. When revenue management systems enabling capacity allocation, such as E-yield, are adopted, the control mechanism that can be realized is essentially the capacity control. The strategic analyses on different mechanisms in this paper helps managers with the underlying strategic impacts of different types of information systems and, therefore, helps them choose more appropriate systems to better manage the channel competition.

The analysis on the capacity control has another important implication on the application of revenue management systems. Revenue management systems help suppliers identify market segments and set up capacity allocation rules so that the right product will be provided to the right consumers at the right price and the right time. Our analysis shows that the potential value of these systems can extend beyond the mere improvement of operational-level performance. In online marketplaces, where the cooperation and competition between suppliers and resellers coexists, revenue management systems that allow capacity control can also be strategic tools for suppliers to regulate resellers’ pricing behaviors and realize healthy symbiotic competition.

References


Appendix

In this appendix, we present the proofs of Lemma 2, Lemma 5, Lemma 6, Proposition 3, and Corollary 1. The proofs of other lemmas, propositions, and corollary are direct and omitted in this version. They are available from the authors upon request.

**Proof of Lemma 2:**

If there is no rationing, the reseller at most lowers the price to

\[ P_r^* = \frac{D - T}{\beta c} - \frac{1 - \beta}{\beta} P_s > \frac{D}{2c}. \]

If rationing happens, the reseller’s objective function is

\[
\max_{P_r} \pi_r = \max_{P_r} \frac{T}{\beta P_r (D - cP_r) + \beta (D - cP_r)} \pi_r \beta (D - cP_r)
\]

\[
\frac{\partial \pi_r}{\partial P_r} |_{P_r^*} < 0 \Rightarrow P_r^* \text{ is not the optimal reseller channel price.}
\]

\[
\frac{\partial \pi_r}{\partial P_r} |_{P_r^*} = 0 \Rightarrow P_r^* = \frac{1}{\beta c} \left( D - (1 - \beta)cP_s - \sqrt{(1 - \beta)(D - cP_s)(D - (1 - \beta)cP_s)} \right)
\]

Therefore,

\[
\pi_r = \frac{\gamma T}{\beta c} \left( D - (1 - \beta)cP_s - \sqrt{(1 - \beta)(D - cP_s)} \right)^2
\]

**Proof of Lemma 5:**

Set \( f_1(P_s) = (1 - \alpha)P_s \), \( f_2(P_s) = \left( \frac{1 - \alpha + \beta}{2} \right) P_s \), and \( f_3(P_s) = \frac{1}{\beta c} \left( D - (1 - \beta)cP_s - \sqrt{(1 - \beta)(D - cP_s)} \right) \).

Then from Eq. (1) and (2), \( P_{s\text{NCM}} \) and \( P_{s\text{LPG}} \) are the solution of \( f_1(P_s) = f_3(P_s) \), and \( f_2(P_s) = f_3(P_s) \) respectively.

Note \( \frac{\partial f_1}{\partial P_s} = (1 - \alpha), \frac{\partial f_2}{\partial P_s} = \left( \frac{1 - \alpha + \beta}{2} \right), \frac{\partial^2 f_1}{\partial P_s^2} > 0, \frac{\partial f_3}{\partial P_s^2} > 0 \text{ and } f_1\left( \frac{D}{2c} \right) > f_2\left( \frac{D}{2c} \right) \text{ and } f_2\left( \frac{D}{2c} \right) > f_3\left( \frac{D}{2c} \right). \)

Thus, \( P_{s\text{NCM}} < \frac{D}{2c} \) and \( P_{s\text{LPG}} < \frac{D}{2c} \) (The domain for \( f_1(P_s) \), \( f_2(P_s) \) and \( f_3(P_s) \) is \( P_s \leq \frac{D}{2c} \)). Since \( 1 - \alpha > \frac{1 - \alpha + \beta}{2} \), then \( P_{s\text{NCM}} < P_{s\text{LPG}} \).

**Proof of Corollary 1:**

It is obvious that the supplier’s profit is higher in the case under the low-price guarantee mechanism if the direct channel price is \( P_s = \frac{D - T}{c} \); if the direct channel is chosen as \( P_{s\text{NCM}} \) and \( P_{s\text{LPG}} \), recall in the proof of Lemma 5, \( \frac{\partial f_1}{\partial P_s} > 0 \) and \( P_{s\text{NCM}} < P_{s\text{LPG}} \). Thus, \( \pi_s\left( P_{s\text{NCM}} \right) < \pi_r\left( P_{s\text{LPG}} \right) \).
Proof of Lemma 6:

The lemma is proved by the backward induction.

Step 1: Given $x$ and $P_s$, we first analyze the reseller’s optimal selling strategy.

If $x < \beta(D - cP_s)$, then $P_s = \frac{D - x}{\beta c}$, the reseller will set $P_r > P_s$, selling only to the indirect segment.

$$
\pi_r = \begin{cases} 
\gamma \left( \frac{D}{c} - \frac{x}{\beta c} \right) & \text{if } \frac{D}{c} - \frac{x}{\beta c} > \frac{D}{2c} \\
\gamma \beta \frac{D^2}{4c} & \text{otherwise}
\end{cases}
$$

where $P_r = \frac{D - x}{\beta c}$, $q_r = x < \beta \frac{D}{2}$

$$
\pi_s = P_s \cdot \min\left\{ T - x, (1 - \alpha)(D - cP_s) \right\} + \frac{1 - \gamma}{\gamma} \pi_r
$$

If $\beta(D - cP_s) \leq x \leq (1 - \alpha)(D - cP_s)$, the reseller may marginally undercut the direct channel price $P_r = P_s - \epsilon$ and sell to both the mixed segment and the indirect segment. If $P_s$ is sufficient low, he may set the reseller channel price as the monopoly price level $P_r = \frac{D}{2c}$ and sell only to the indirect segment.

$$
\pi_r = \begin{cases} 
\gamma \beta \frac{D^2}{4c} & \text{if } xP_s < \frac{\beta D^2}{4c} \text{ and } P_s < \frac{D}{2c} \\
\gamma P_s & \text{otherwise}
\end{cases}
$$

where $P_r = \frac{D}{2c}$, $q_r = \frac{D}{2}$

$$
\pi_s = P_s \cdot \min\left\{ T - x, D - cP_s - x \right\} + \frac{1 - \gamma}{\gamma} \pi_r
$$

If $x > (1 - \alpha)(D - cP_s)$, the reseller will set the price $P_r < P_s$, taking all sales in the mixed segment and the indirect segment.

$$
\pi_r = \begin{cases} 
\gamma \left( \frac{D}{c} - \frac{x}{(1 - \alpha)c} \right) & \text{if } \frac{D}{c} - \frac{x}{(1 - \alpha)c} > \frac{D}{2c} \\
\gamma(1 - \alpha) \frac{D^2}{4c} & \text{otherwise}
\end{cases}
$$

where $P_a = \frac{D}{2c}$, $q_a = (1 - \alpha) \frac{D}{2} \leq x$

$$
\pi_s = P_s \cdot \min\left\{ T - x, \alpha(D - cP_s) \right\} + \frac{1 - \gamma}{\gamma} \pi_r
$$

Step 2: We then analyze that given $x$, what’s the supplier’s best pricing strategy $P_s$.

If $x \leq \beta T < \beta \frac{D}{2}$, the optimal direct channel price is $P_s = \max\left\{ \frac{D}{2c}, \frac{D}{c} - \frac{T - x}{(1 - \beta)c} \right\}$. In this scenario, the reseller channel price is $P_r = \frac{D}{c} - \frac{x}{\beta c} \geq P_s$. The supplier’s profit is $\pi_s = \min\left\{ (1 - \beta) \frac{D^2}{4c}, (T - x) \left( \frac{D}{c} - \frac{T - x}{(1 - \beta)c} \right) \right\} + (1 - \gamma) x \left( \frac{D}{c} - \frac{x}{\beta c} \right)$.
If $\beta T < x \leq (1-\alpha)T$, the optimal direct channel price is $P_s = \frac{D}{c} - \frac{T}{c} > \frac{D}{2c}$. In this scenario, the reseller channel price is $P_r = \frac{D}{c} - \frac{T}{c} = P_s$. The supplier’s profit function is $\pi_s = \frac{D}{c} - \frac{T}{c} - (T-x)\frac{\alpha}{c}$. 

If $(1-\alpha)T < x < (1-\alpha)\frac{D}{2}$, the optimal direct channel price is $P_s = \frac{D}{c} - \frac{T-x}{\alpha c} > \frac{D}{2c}$. In this scenario, the reseller channel price is $P_r = \frac{D}{c} - \frac{T-x}{\alpha c} < P_s$, yet $P_s = \frac{D}{2c}$. The supplier’s profit function is $\pi_s = (T-x)\left(\frac{D}{c} - \frac{T-x}{\alpha c}\right) + (1-\gamma)x\left(\frac{D}{c} - \frac{x}{(1-\alpha)c}\right)$. 

If $x \geq (1-\alpha)\frac{D}{2}$, the optimal direct channel price is $P_s = \frac{D}{c} - \frac{T-x}{\alpha c} < \frac{D}{2c}$. In this scenario, the reseller channel price is $P_r = \frac{D}{2c} < P_s$. The supplier’s profit function is $\pi_s = (T-x)\left(D - \frac{T-x}{\alpha c}\right) + (1-\gamma)(1-\alpha)\frac{D^2}{4c}$. 

**Proof of Proposition 3:** 

If $x \geq (1-\alpha)\frac{D}{2}$, $\frac{\partial \pi_s}{\partial x} = 2(T-x)\frac{\alpha}{\alpha c} - \frac{D}{c} = \frac{2}{\alpha c}\left(T - x - \frac{\alpha D}{2}\right) \leq \frac{2}{\alpha c}\left(T - (1-\alpha)\frac{D}{2} - \frac{\alpha D}{2}\right) = \frac{2}{\alpha c}\left(T - \frac{D}{2}\right) < 0$. 

If $(1-\alpha)T < x < (1-\alpha)\frac{D}{2}$, $\frac{\partial \pi_s}{\partial x} = 2(T-x)\frac{\alpha}{\alpha c} - \frac{D}{c} + (1-\gamma)\left(\frac{D}{c} - \frac{2x}{(1-\alpha)c}\right) = \frac{2}{c}\left(\frac{(1-\alpha)T - x + \alpha x}{\alpha(1-\alpha)} - \gamma \frac{D}{2}\right) < 0$. 

If $\beta T < x \leq (1-\alpha)T$, $\frac{\partial \pi_s}{\partial x} = -\gamma \frac{D-T}{c} < 0$. 

If $x \leq \beta T < \beta\frac{D}{2}$, $\pi_s = \min \left\{ (1-\beta)\frac{D^2}{4c}, (T-x)\left(\frac{D}{c} - \frac{T-x}{(1-\beta)c}\right) \right\} + (1-\gamma)x\left(\frac{D}{c} - \frac{x}{\beta c}\right)$. 

If $x \leq T - (1-\beta)\frac{D}{2}$, $\frac{\partial \pi_s}{\partial x} = \frac{2(1-\gamma)}{c\beta}\left(\beta \frac{D}{2} - x\right) > 0$. 

If $x > T - (1-\beta)\frac{D}{2}$, $\frac{\partial \pi_s}{\partial x} = \frac{2(T-x)}{(1-\beta)c} - \frac{D}{c} + (1-\gamma)\left(\frac{D}{c} - \frac{2x}{\beta c}\right) = \frac{2}{c}\left(\frac{\beta T - \beta x - (1-\beta)(1-\gamma)x - \gamma \frac{D}{2}}{\beta(1-\beta)}\right) = 0 \Rightarrow x = \frac{\beta T - \beta x}{1-\gamma(1-\beta)} > T - (1-\beta)\frac{D}{2}$. 

Therefore, since the profit function is continuous at $[0,T]$, the optimal capacity allocation is $x^* = \beta T - \frac{\gamma \beta (1-\beta)\left(D - \frac{T}{2}\right)}{1-\gamma(1-\beta)}$. 

and $\pi_s^{CM} = \frac{T(D-T)}{c} - \frac{\gamma \beta \left(T\left(D - \frac{T}{2}\right) + \frac{D}{2} \left(T - (1-\beta)\frac{D}{2}\right)\right)}{c(1-\gamma(1-\beta))}$. 
