THE 'NAME YOUR OWN PRICE' CHANNEL IN THE TRAVEL INDUSTRY: AN ANALYTICAL EXPLORATION

(Final version dated February 16, 2009)

Tuo Wang*, Esther Gal-Or**, and Rabikar Chatterjee***

* Assistant Professor of Marketing, 532 Business Administration Building, P.O Box 5190, Kent State University, Kent, OH 44242-0001, Email: twang3@kent.edu; phone: 330-672-1258; fax: 330-672-5006.

** Glenn Stinson Chair in Competitiveness and Professor of Business Administration and of Economics, 222 Mervis Hall, Katz Graduate School of Business, University of Pittsburgh, Pittsburgh, PA 15260, E-mail: esther@katz.pitt.edu; phone: 412-648-1722, fax: 412-648-1693.

***Professor of Business Administration and Katz Faculty Fellow in Marketing, 340 Mervis Hall, Katz Graduate School of Business, University of Pittsburgh, Pittsburgh, PA 15260, E-mail: rabikar@katz.pitt.edu; phone: 412-648-1623, fax: 412-648-1693. [Corresponding author]

ABSTRACT

'Name-Your-Own-Price' (NYOP) retailers, such as *Priceline*, offer an alternative distribution channel for service providers in the travel industry such as airlines, hotels, and car rental companies. Our research employs an analytical model to identify and understand key tradeoffs driving the decision by a service provider to employ an NYOP channel, assuming that such a channel is available. This decision requires the existence of forces that counteract the adverse consequences of cannibalization of sales through traditional posted-price channels. Our analysis provides some insight into these forces. Contracting with the NYOP retailer facilitates market segmentation and price discrimination, and allows for disposal of excess capacity after meeting business travel demand. However, the cost of this flexibility is that the service provider can no longer credibly pre-commit to maintaining high prices when there is unsold capacity. Also, when contracting with an independent retailer, the service provide is unable to extract the entire revenue generated from NYOP consumers. A key insight from our model is that the rationale for contracting with an NYOP retailer is driven by the uncertainty in business travel demand, not the expectation of excess capacity. Indeed, all else equal, the larger the capacity, the less likely it is that contracting with an NYOP retailer is the right decision on the part of the service provider.

Key words: Pricing; Name-your-own price channel; Bidding; Bayesian Nash equilibrium; E-commerce.

1. Introduction

1.1. Motivation and Research Questions

In recent years, 'Name-Your-Own-Price' (NYOP) retailers, exemplified by *Priceline*, have emerged as an online alternative to other traditional channels through which service providers such as airlines, hotels, and car rental companies offer their products to customers. Under its patented system, *Priceline* collects individual customer offers (price bids guaranteed by a credit card) and communicates the information directly to participating sellers or to their private databases. It operates on a commission plus the difference between the consumer bid and the price it pays the service provider (Kannan and Kopalle 2001). Unlike most other auction models, the rules restrict consumers to a single bid for the service.

Our research employs a stylized model to identify and understand key tradeoffs driving the decision by a service provider in the travel industry to employ an NYOP channel, assuming that such a channel is available. The decision to distribute through the NYOP channel requires the existence of forces that counteract the adverse consequences of cannibalization of sales through traditional posted-price channels. Our analysis provides some insight into these forces, and examines the following issues:

- The conditions under which it is profitable for the service provider to contract with the NYOP retailer;
- The prices the service provider should set for the posted-price channel and as the "wholesale price" for the NYOP channel; and
- The impact of vertically integrating the activities of the NYOP retailer on the posted price decision.

The first two issues address the questions of when a service provider should contract with an NYOP retailer and what prices to set when it is profitable to do so, while the third considers the implications of the service provider owning the NYOP channel.

1.2. Overview of Modeling Approach and Key Results

While in practice an NYOP channel can be implemented in various forms, we employ a stylized, two-stage, game theoretic model with some plausible characteristics of such a channel to capture the behavior of a monopoly service provider and a population of rational consumers of two 'types,' whom we label as

leisure and business travelers. Leisure travelers have the flexibility to plan their travel well in advance of the service date (in the first stage of the game), and are heterogeneous in their willingness to pay for the service. Business travelers finalize their travel plans closer to the date of departure (in the second stage), and have a willingness to pay that exceeds the average reservation price of leisure travelers. The number of business travelers is uncertain until business demand is actually realized in the second stage. Leisure travelers can either buy advance-purchase tickets in the first stage or they can wait for the second stage to place bids with the NYOP retailer (if contracted by the service provider in the first stage, for service in the second stage). Our key results, based on the Bayesian Nash equilibrium solution for this game, are:

- Engaging an NYOP retailer is profitable for the service provider only when the available capacity is not too large relative to the expected number of business travelers and their willingness to pay. The relative profitability of adding the NYOP retailer to the service provider's own posted-price channel increases in the expected number of business travelers and their willingness to pay.
- When the service provider contracts with an NYOP retailer, the uncertainty of obtaining the service if leisure travelers postpone purchase to the second stage deflates consumer surplus and is sufficient to separate the low and high valuation consumers.
- The service provider is better off setting the wholesale price in the NYOP channel before he is absolutely certain of the extent of business travel demand, because less precise information helps to avoid significant cuts in the wholesale price.

Contracting with the NYOP channel facilitates market segmentation and price discrimination, and allows for disposal of excess capacity after meeting business travel demand. However, this flexibility implies that the service provider can no longer credibly pre-commit to maintaining high prices when there is unsold capacity. Further, if the NYOP retailer is an independent entity, a portion of the revenue generated from NYOP consumers (bid price − wholesale price) is retained by the retailer.

A key insight from our analysis is that it is the *uncertainty in business travel demand* that provides the economic rationale for contracting with an NYOP retailer, not the expectation of excess capacity. Indeed, all else equal, the larger the capacity, the less likely it is that contracting with an NYOP retailer is the

right decision on the part of the service provider. As discussed in our conclusion, this insight offers a plausible explanation for some observed outcomes with regard to *Priceline*.

1.3. Related Literature

Fay (2004), Hann and Terwiesch (2003), and Terwiesch, Savin, and Hann (2005) focus on the NYOP retailer's decision with regard to setting a minimum acceptable price and/or bidding rules. Fay (2008) uses a Hotelling model with two service providers to investigate the rationale for the existence of opaque products, although the model assumes that the retailer of the opaque product sells at a posted price, rather than employing a bidding mechanism characteristic of the NYOP pricing model. Amaldoss and Jain (2008) examine whether asking consumers to place a joint bid for multiple items (rather than the current practice of bidding on one item at a time) can increase NYOP retailer's profits.

From the consumers' perspective, Spann and Tellis (2006) test consumers' rationality with reference to their bidding behavior, using data of bid sequences for airline tickets at a European NYOP retailer (allowing multiple bids, unlike *Priceline*). In a different vein, Ding et al. (2005) incorporate the effect of emotion in modeling bidders' behavior in *Priceline*-like channels, considering the excitement or frustration of having the bid accepted or rejected.

From the service provider's perspective, the emergence of the NYOP retailer provides the opportunity of adding a new channel to the existing posted-price channel. Adding a channel can be risky for the service provider, with potential for cannibalization (Balasubramanian 1998; Chiang, Chhajed and Hess 2003). The cannibalization issue in the context of adding an online channel has received recent research attention (Brynjolfsson and Smith 2000; Geyskens et al. 2002; Lal and Sarvary 1999; Zettelmeyer 2000). Since the products offered on the posted-price and NYOP channels are essentially differentiated in terms of their expected value (due to the uncertainty of obtaining the service), our work is more closely related to the theoretical literature on product line decisions (Balachander and Srinivasan 1994; Desai 2001; Moorthy 1984; Mussa and Rosen 1978; Villas-Boas 1998). However, our setting differs from the traditional quality-differentiated product line framework in that in our case the inferior product is offered

under a "name your own price" (bidding) mechanism, with a sequential (two-stage) process. Distinct – and, as it turns out, critical – to our model is the role played by the uncertainty in demand of the business travel segment in the first stage.

Turning to extant research on yield management, the operation research literature (Belobaba 1989; Belobaba and Wilson 1997) typically treats prices as exogenous. In the economics literature, Dana (1999) and Gale and Holmes (1993) consider the timing of sales in the airline industry. However, all sales are via the service provider's direct channel, and the option of using a reseller is not considered. More recently, a stream of literature has emerged in marketing that focuses on profit maximization for capacity-constrained services. Desiraju and Shugan (1999) use an analytical (two-period, two-segment) model to investigate pricing strategies based on yield management systems (YMS), including early discounting, limiting early sales, and overbooking. Such strategies can apply to services for which price-insensitive customers buy later than price-sensitive ones, as in the travel industry that is the focus of our research. In contrast to our results, their results show that in the traditional yield management setting, the larger the capacity, the more attractive a YMS approach (with early discounting and possible limits to early discounted sales) is relative to a single-price strategy. Furthermore, the relative attractiveness of YMS depends on the size of the price sensitive (leisure customer) segment.

Other profit enhancing mechanisms may be employed, such as overbooking in the presence of "no shows." Biyalogorsky et al. (1999) show that by deliberately overselling capacity, service providers can improve profit by accommodating late-arriving high valuation customers with opportunistic cancellations on low-paying customers. Xie and Gerstner (2007) demonstrate that service providers can improve capacity utilization and increase profit by offering refunds for service cancellation even with late-arriving low valuation consumers. Other related work includes Biyalogorsky and Gerstner (2004) on contingent pricing and Biyalogorsky et al. (1999) on service upgrades. In contrast to the above research, we focus on the possible role for a separate NYOP channel in a yield management system.

Next, we develop the model in §2. Our analysis and results at equilibrium are presented in §3. In §4, we investigate the implications of the service provider vertically integrating the activities of the NYOP

retailer. We conclude in §5 with a discussion of the managerial implications of our findings and directions for future research.

2. The Model

A monopolist service provider can offer his service via two different channels: his direct marketing channel and a Name Your Own Price (NYOP) channel. In his direct marketing channel the provider posts a "take it or leave it" price to consumers. The NYOP channel is operated by an independent retailer. This retailer observes bids submitted by consumers and accepts any bid that exceeds the wholesale price it has to pay to the service provider.[1]

The provider faces two different groups of customers. The first group becomes aware of its need for the service early, well in advance of the service date, and the second group becomes aware of its need very close to the service date. In the context of the airline industry, those two groups correspond to leisure and business travelers. While leisure travelers typically have the flexibility to plan their trips well before the actual travel date, business travelers (including consumers traveling because of a personal emergency) usually finalize their itineraries very close to, and often on, the day of departure.[2] We will use the airline industry example in motivating the assumptions of our model throughout the paper.

Table 1 Definitions of Variables and Parameters in the Model

Variables and Parameters	Definition
$K \in [0,1]$	Capacity of provider
$v \in [0,1]$	Reservation price of leisure travelers
r	Reservation price of business travelers
$y \in [0, \bar{y}]$	Business travel demand
P_H	Posted price in Stage 1
$P_L(y)$	Wholesale price set for NYOP retailer
$B(v)$	Bid submitted by leisure traveler of type v

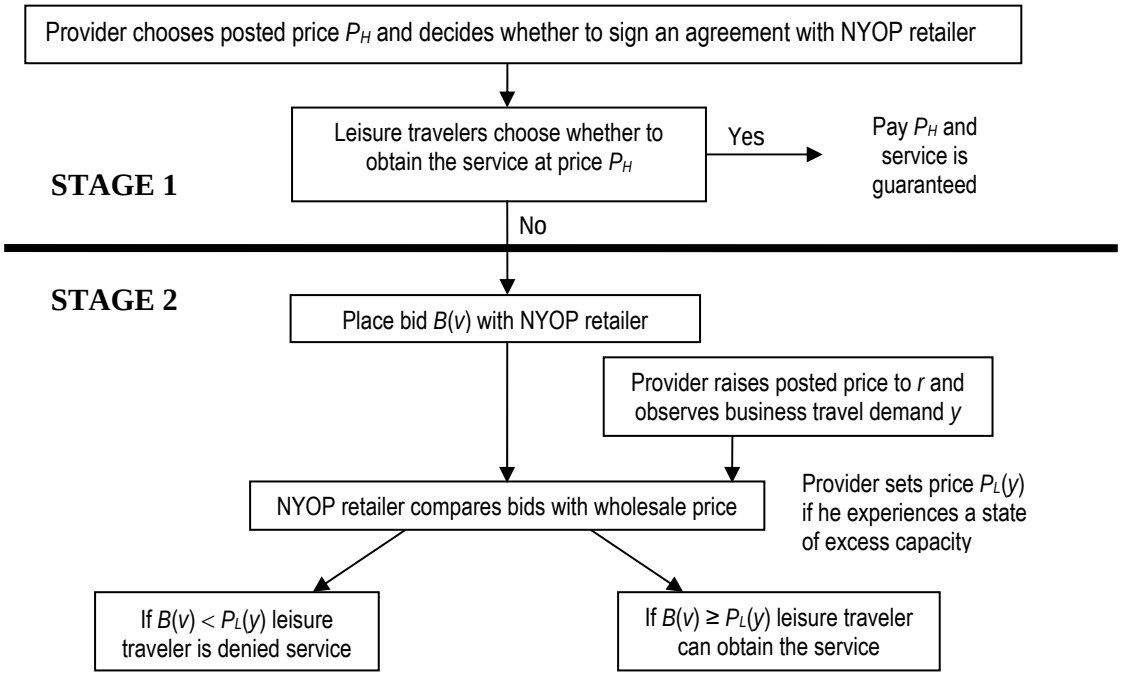
The key assumptions underlying our model are stated below. We seek to capture the essential

[1] Accepting a bid lower than the wholesale price would imply that the retailer incurs losses. On the other hand, any bid in excess of the wholesale price generates a positive surplus for the retailer.
[2] This is equivalent to business travelers having a very high cost of early commitment (Desiraju and Shugan 1999).

characteristics of the travel market, while simplifying the real world for the sake of analytical tractability. Table 1 summarizes our notation, while Figure 1 illustrates the timeline and basic set-up of our model.

- We consider two stages prior to service delivery, to capture the idea that leisure and business travelers learn of their needs at different times – in Stages 1and 2, respectively.

Figure 1. Timeline of the Model



- Leisure travelers differ in their willingness to pay for the service, $v \in [0,1]$, assumed to be uniformly distributed over the unit interval.[3] In contrast, all business travelers share a common reservation price[4] $r > 1/2$, implying a higher reservation price for business travelers than the *average* reservation price of leisure travelers.
- The number of business travelers who demand service in Stage 2, y, is unknown to the service provider in Stage 1 and therefore treated as stochastic, with a uniform distribution over the interval $[0, \bar{y}]$, until its realization in Stage 2.
- While the direct marketing channel of the provider is active in both stages of the game, the NYOP channel becomes available only in the Stage 2, once the provider is informed of the number of

[3] This simple specification of the distribution function can be relaxed without affecting our qualitative results.

[4] We can easily relax this assumption by assuming a distribution of reservation prices for the business travelers as well, assuming that the average reservation price of business travelers is higher than that of leisure travelers.

business travelers demanding service. In the first stage the provider chooses his posted price P_H as well as whether to sign an agreement with the NYOP retailer in the second stage.[5]

- In Stage 2, the service provider assigns higher priority to travelers choosing to buy at the posted price via the direct channel (as will be shown, this price will be higher than the wholesale price realized from the NYOP retailer, making direct sales more profitable for the provider than NYOP sales). Thus, the provider makes available any remaining unallocated capacity to the NYOP retailer only after ascertaining demand via the direct channel and allocating available capacity accordingly. In this case, he chooses the wholesale price $P_L(y)$ charged from the NYOP retailer after observing the state of the business segment demand y. The lower priority accorded to the NYOP channel implies that consumers choosing to bid on this channel run the risk of finding that all seats are sold out.
- We assume that business travelers incur an exorbitantly high cost when they need to travel but are unable to do so. As a result, they never choose to participate in the NYOP bidding process because they find the uncertainty inherent in the outcome unacceptable.[6] This implies that business travelers only buy tickets in the direct channel. In contrast, as long as the posted price in Stage 2 exceeds that in Stage 1, any leisure traveler buying at the posted will only do so in Stage 1. In our analysis, we check to ensure that the posted price indeed increases from Stage 1 to Stage 2. In this situation, only business travelers are active in the direct channel in Stage 2, and therefore the service provider raises the posted price in this stage to r, the business travelers' reservation price.[7]
- Leisure travelers can either purchase the service in Stage 1 for the posted price P_H or they can wait for the second stage to place a bid $B(v)$ with the NYOP retailer. Given lower priority for the NYOP channel, a leisure traveler can possibly obtain the service from the NYOP retailer only if there is excess capacity resulting from low realized demand from the business sector. Even in this case, she

---

[5] In an earlier version of this paper we allowed the provider to choose the extent of opacity in the NYOP channel, by limiting the information provided to customers (on, for example, the exact time of departure of a flight or the identity of the carrier). We find that at the equilibrium the provider never finds it optimal to intentionally introduce opacity since it reduces consumers' average willingness to pay. Given this result, we have now dropped any strategic consideration of opacity by the service provider.

[6] This outcome can be obtained endogenously from the model by assuming a sufficiently high cost of uncertainty for the business traveler. However, we have chosen not to explicitly incorporate this in the model to avoid unnecessary complexity. As a practical matter, there is evidence that the vast majority of business travelers do not use the NYOP channel. According to a *USA Today* July 7, 2003 report, *Hotwire* estimates that 8% of its hotel bookings are made by business travelers. While no comparable estimate is available for *Priceline*, its more restrictive bidding model for airline seats will likely attract even fewer business travelers. *Priceline* states that they "do not in any way cater to business travelers." Corporate travel managers are not keen on using deep-discount sites either. The few business travelers are essentially budget-conscious small business managers or owners not on corporate accounts.

[7] Specifically, in our analysis, we check to verify that $r > P_H$, implying that the posted price increase in Period 2 (and guaranteeing that only business travelers are active in the direct channel in Stage 2). This pattern of rising posted prices is consistent with casual observation of the airline industry, where prices sometimes more than double close to the date of departure in comparison to booking three weeks in advance.

will actually obtain the service only if her bid exceeds the wholesale price set by the provider, i.e., only if $B(v) > P_L(y)$. Since a leisure traveler cannot normally observe the realization of *y*, she runs the risk of her bid failing even if there is excess capacity.

- The service provider's available capacity, *K*, is bounded so that $(1-r) < K < 1$. The lower bound guarantees that the provider has an incentive to reserve capacity for business travelers in Stage 2, which requires that the price he can charge when selling his entire capacity in Stage 1 should be lower than the business travelers' reservation price *r*.

Our assumptions about the nature of demand in the leisure and business segments of the market reflect the reality (albeit stylized) of the travel industry. Business travelers are willing to pay prices that tend to be much higher than those paid by leisure travelers. However, airlines are uncertain about the number of business travelers that might be interested in flying on a certain date, and thus experience difficulty in determining the number of seats to hold for these lucrative last-minute business travelers.

3. Analysis

3.1. Leisure Travelers' Optimal Bidding Strategy

Leisure travelers considering the NYOP channel in Stage 2 are aware that the service provider can set his wholesale price P_L contingent upon the state of the business travel demand *y* and, further, if this demand is above some threshold $\hat{y}$, the provider will sell his entire capacity in the direct channel, leaving no capacity for the NYOP market.[8] A consumer chooses her bid *B* to maximize her expected payoff:

$$\underset{B}{Max}\, CS(B) = (v - B)\Pr(B \geq P_L(y)), \tag{1}$$

or, if P_L is always increasing in *y* (as will be proved later):

$$\underset{B}{Max}\, CS(B) = (v - B)P_L^{-1}(B)/\bar{y}\,. \tag{2}$$

Since *y* is uniformly distributed on the interval $[0, \bar{y}]$, the probability that the bid exceeds the wholesale price $P_L(y)$ is $P_L^{-1}(B)/\bar{y}$, where $P_L^{-1}(\cdot)$ is the inverse function of P_L. A leisure traveler who postpones her purchase to the second stage can obtain a ticket only if her bid is successful and some capacity is

[8] Note that the total demand over the two periods in the posted price channel can exceed capacity if $\hat{y} < y \leq \bar{y}$; if $\hat{y} = \bar{y}$, there is always some residual capacity to sell in the NYOP market.

allocated to the NYOP retailer. If her bid fails, the leisure traveler cannot turn to the posted price channel to obtain a ticket, since capacity has already been fully allocated at this point to leisure travelers who either purchase tickets in advance or else submit successful bids with the NYOP retailer, or to business travelers.[9] Optimizing (2) with respect to B yields the following first and second order conditions:

$$CS'(B) = -P_L^{-1}(B) + \frac{(v-B)}{P_L'(P_L^{-1}(B))} = 0, \text{ and} \tag{3}$$

$$CS''(B) = -\frac{1}{P_L'(P_L^{-1}(B))} - \frac{P_L^{-1}(B)P_L''(P_L^{-1}(B))}{2[P_L'(P_L^{-1}(B))]^2} < 0. \tag{4}$$

Note that a consumer active in the NYOP channel will never find it optimal to submit a bid higher than the highest possible wholesale price that can arise in this market, $P_L(\hat{y})$. Submitting the bid $P_L(\hat{y})$ assures the consumer of a seat as long there is capacity to allocate to the NYOP retailer (i.e., $y < \hat{y}$). As a result, if $B(v)$ is the solution of the first order condition (3), the consumer actually submits a bid:

$$\text{Bid}(v) = \min\{B(v), P_L(\hat{y})\}. \tag{5}$$

Since condition (3) implies that the solution $B(v)$ is an increasing function of the consumer's valuation v, there may be consumers with low valuations whose bids fall short of the minimum acceptable price $P_L(y)$. Let $\underline{v}(y)$ designate the threshold consumer who submits a bid just equal to $P_L(y)$. Since $B(\underline{v}(y)) = P_L(y)$, it follows that $P_L^{-1}(B(\underline{v}(y))) = y$, and hence $\underline{v}(y)$ satisfies, from (3):

$$\underline{v}(y) = P_L(y) + yP_L'(y). \tag{6}$$

The expected payoff of a consumer active in the NYOP channel is obtained by substituting the optimal solution $B(v)$ back into (2), to yield:

$$CS^{NYOP}(v) = \begin{cases} CS(B(v)) & \text{if } B(v) \le P_L(\hat{y}) \\ (v - P_L(\hat{y}))(\hat{y}/\bar{y}) & \text{if } B(v) > P_L(\hat{y}). \end{cases} \tag{7}$$

In deciding on whether to buy at the posted price in advance (in Stage 1) or to wait till Stage 2 to submit a bid to the NYOP retailer, each leisure traveler compares the above expected payoff to the one

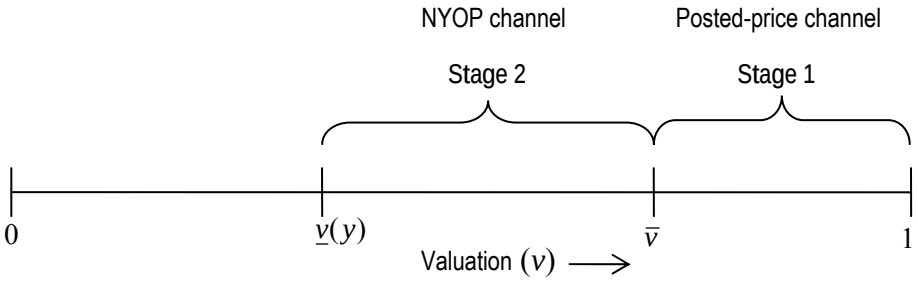
[9] In an extended model consisting of more than two periods, the provider would adjust his posted price and the allocation of his capacity more gradually over time. Leisure travelers submitting failed bids would then be able to return to the posted price market.

she can expect by purchasing at the posted price P_H, $CS^{posted}(v) = v - P_H$. In order to identify the group of consumers who find it optimal to submit bids to the NYOP retailer, we define the function $R(v)$ as the *incremental* benefit derived by a leisure traveler of type v from purchasing the product at the posted price in Stage 1 relative to the NYOP channel:

$$R(v) = CS^{posted}(v) - CS^{NYOP}(v). \tag{8}$$

We conjecture that at equilibrium the segment of leisure travelers purchasing in Stage 1 is from the upper end of the distribution of reservation prices v. (This conjecture will be confirmed later.) Specifically, there exists a threshold value $\bar{v}$ such that $R(v) \geq 0$ if $v \geq \bar{v}$ and < 0 if $v < \bar{v}$.

Figure 2. Market Segmentation of Leisure Travelers



This conjecture implies that the leisure travel market can be divided into three segments as shown in Figure 2. Consumers with valuations below $\underline{v}(y)$ withdraw from the market. Those in the interval $[\underline{v}(y), \bar{v}]$ place bids with the NYOP retailer in Stage 2, and those in the interval [$\bar{v}$, 1] buy at the posted price in Stage 1. Since the threshold consumer $\bar{v}$ is indifferent between buying in Stage 1 or bidding in Stage 2,

$$\bar{v} - P^H = CS^{NYOP}(\bar{v}). \tag{9}$$

The threshold consumer $\underline{v}(y)$ submits a bid $B(\underline{v}(y))$ that is just equal to the wholesale price $P_L(y)$.[10] While $\bar{v}$ is independent of y, $\underline{v}(y)$ depends upon the realization of business travel demand y (see (6)).

[10] Since leisure travelers cannot observe the realization of business travel demand y before placing their bids, they cannot match the wholesale price. Specifically, $B(v) > P_L(y)$, except for the threshold leisure traveler $\underline{v}(y)$, whose bid exactly equals $P_L(y)$.

We will show that $\underline{v}(y)$ is increasing in y, implying that when business travel demand is high, only higher valuation leisure travelers are able to submit successful bids with the NYOP retailer.

3.2. Setting Wholesale Prices in the Second Stage

Since the salvage value of unsold capacity is zero, the only *credible* mode of behavior on the part of the service provider in Stage 2 is to set the wholesale price $P_L(y)$ to guarantee full utilization of his capacity (as long as $P_L > 0$).[11] This inability to pre-commit to prices that will leave some capacity unutilized may hurt the service provider, especially if his capacity is relatively large, because he has to accept low prices from the NYOP retailer in order to clear capacity.[12] Low wholesale prices anticipated in the NYOP channel exert downward pressure, in turn, on the posted price P_H in Stage 1, since rational consumers anticipate that they can obtain the service for low bids in the NYOP channel. This is reminiscent of the problem facing a durable goods monopolist who is unable to pre-commit to not reducing its price in the future (Coase 1972; Bulow 1982). The service provider loses some control over his pricing when he contracts with the NYOP retailer, since consumers understand that he will attempt to clear any remaining capacity in the second (and last) stage of the game.

Notice that the combined demand in the direct marketing channel of the provider over the two periods amounts to $(1-\bar{v})+y$. Hence, the service provider chooses $P_L(y)$ to clear the market so that:

$$\bar{v}-\underline{v}(y)=K-(1-\bar{v})-y. \tag{10}$$

We use (10) to derive $P_L(y)$ as a function of capacity and business travel demand in Lemma 1.

LEMMA 1: *The wholesale price to be paid by the NYOP retailer in Stage 2 is a linear and increasing schedule of the realization of the business class demand, as follows:*

$$P_L(y)=(1-K)+y/2. \tag{11}$$

For proofs of this and subsequent Lemmas and Propositions, see Appendix 1.

---

[11] A commitment to any other price is not credible because the service provider will always have an incentive to sell any remaining (unsold) capacity in the second stage.

[12] We will later point out the implications of the service provider having commitment power to leave some capacity unutilized in Stage 2.

The service provider raises the wholesale price in the NYOP channel on observing stronger business travel demand, since he is less concerned about idle capacity. A higher capacity *K* lowers the wholesale price, all else equal. The upper bound of $P_L(y)$ depends on the capacity. In case $K < (1-\bar{v}) + \bar{y}$, the provider does not allocate any capacity to the NYOP channel when $y > K - (1-\bar{v})$ since $\hat{y} = K - (1-\bar{v}) < y \le \bar{y}$. In contrast, if $K > (1-\bar{v}) + \bar{y}$, $\hat{y} = \bar{y}$ and the NYOP channel is active for every possible realization of *y*. The wholesale price schedule derived in Lemma 1 allows us to characterize the bid submitted by leisure travelers active in the NYOP channel and their expected payoff, as follows:

LEMMA 2: T*he bid submitted by a leisure traveler of type v and her expected payoff, conditional on the ranges of capacity K and valuation v are as follows:*

Capacity *K*	Valuation *v*	Bid (v)	Expected payoff $CS^{NYOP}(v)$
i. $K < (1-\bar{v}) + \bar{y}$	$0 \le v \le \bar{v}$	$(v+1-K)/2$	$(v-(1-K))^2/2\bar{y}$
	$\bar{v} < v \le 1$	$(\bar{v}+1-K)/2$	$[v-(\bar{v}+1-K)/2][(\bar{v}-(1-K))/\bar{y}]$
ii. $K > (1-\bar{v}) + \bar{y}$	$0 \le v \le 1-K+\bar{y}$	$(v+1-K)/2$	$(v-(1-K))^2/2\bar{y}$
	$1-K+\bar{y} < v \le 1$	$(1-K)+\bar{y}/2$	$(v-(1-K))-\bar{y}/2$

According to Lemma 2, the threshold leisure traveler who is just indifferent between purchasing the product in the posted price and in the NYOP channel $(v = \bar{v})$ submits a bid equal to the highest possible wholesale price that can be selected by the provider. Such a choice guarantees this traveler that her bid will be accepted as long as the NYOP channel is active, i.e., $y < K - (1-\bar{v})$. Part (i) of the Lemma asserts that if excess demand can arise (i.e. when $\hat{y} < \bar{y}$), the consumer with valuation $\bar{v}$ is the only one submitting this high bid and all other consumers who are active in the NYOP channel submit lower bids. Part (ii) asserts that when excess capacity is definitely available for sale by the NYOP retailer (i.e., $\hat{y} = \bar{y}$) there is a range of consumers with valuations at the upper end of the distribution who submit the bid $P_L(\bar{y})$ – the highest possible wholesale price – in the NYOP channel.

Given the expected payoff expression for leisure travelers in Lemma 2, it follows that $R(v)$ defined in (8) is strictly increasing in v if $K < (1-\bar{v}) + \bar{y}$, i.e., if excess demand can arise in the direct channel. From Part (ii) if the lemma, when $K > (1-\bar{v}) + \bar{y}$, $R(v)$ is independent of v for $v \in [1-K+\bar{y}, 1]$. This interval includes $\bar{v}$, implying that $R'(v)\big|_{v=\bar{v}} = 0$. Hence, the segmentation of leisure travelers in Figure 2 cannot be valid if $K > (1-\bar{v}) + \bar{y}$. In this case, *all* leisure travelers make their purchase either at the posted price in Stage 1 or from the NYOP retailer in Stage 2. On the other hand, when $K < (1-\bar{v}) + \bar{y}$, $R'(v) > 0$ everywhere, and segmentation is feasible. The threshold leisure traveler $\bar{v}$ satisfies the condition $R(\bar{v}) = 0$, which determines the following relationship between the posted price P_H and $\bar{v}$:

$$P_H = \bar{v} - [\bar{v} - (1-K)]^2 / 2\bar{y} \qquad \text{if } K \le (1-\bar{v}) + \bar{y}. \tag{12}$$

We formulate the service provider's maximization problem in terms of $\bar{v}$ rather than P_H, since this is analytically simpler; the optimal P_H then follows from (12). Note that in the absence of the secondary NYOP market, the posted price in the first stage would be set to satisfy $P_H = \bar{v}$, so that the entire surplus of a leisure traveler of type $\bar{v}$ is extracted. The existence of the secondary channel allows the service provider to segment the market; as a result, $P_H < \bar{v}$. From (12), we can also derive a sufficient condition to guarantee that $P_H < r$ at the equilibrium: the capacity $K > (1-r) + \bar{y}/2$. This condition guarantees our initial assumption that only business travelers are active in the direct channel in Stage 2. Since this lower bound on K is a sufficient rather than necessary condition, the pattern of increasing posted prices can be supported even for lower values of K.

3.3. The Bayesian Nash Equilibrium of the Entire Game

We first consider the case that both leisure and business travelers exist, but the provider has no contract with the NYOP retailer to sell idle capacity in Stage 2, so that the provider's objective becomes:

$$E\pi = \begin{cases} \bar{v}(1-\bar{v}) + \dfrac{r}{\bar{y}}\displaystyle\int_0^{\bar{y}} y\partial y & \bar{y} \le K - (1-\bar{v}) \\ \bar{v}(1-\bar{v}) + \dfrac{r}{\bar{y}}\left[\displaystyle\int_0^{K-(1-\bar{v})} y\partial y + \int_{K-(1-\bar{v})}^{\bar{y}} (K-(1-\bar{v}))\partial y\right] & \bar{y} > K - (1-\bar{v}) \,. \end{cases} \tag{13}$$

The service provider chooses $\bar{v}$ to maximize his objective in (13). In the absence of sales in the NYOP channel, $P_H = \bar{v}$ and the size of the active leisure market is $(1-\bar{v})$, thus generating revenues of $\bar{v}(1-\bar{v})$ from leisure travelers. The two expected payoff expressions derived in (13) correspond to the two possibilities: first, when the capacity is so large that even the maximum possible business travel demand can be met (i.e., $K \ge 1-\bar{v}+\bar{y}$) and second, when the capacity is limited (i.e. $K < 1-\bar{v}+\bar{y}$), so that the provider is unable to satisfy the entire business travel demand when $K-(1-\bar{v}) < y \le \bar{y}$.

In Proposition 1 we describe the solution to the service provider's maximization problem when he offers his service only through his direct marketing channel. We use the subscript *S* to designate the solution with a single (posted price) channel ($\bar{v}_S$, P_{HS}, and $E\pi_S$).

PROPOSITION 1: *When the provider can sell his service only via his direct marketing channel:*

(i) *If* $K \ge \dfrac{1}{2} + \bar{y}$, $P_{HS} = \bar{v}_S = \dfrac{1}{2}$, *and* $E\pi_S = \dfrac{1}{4} + \dfrac{r\bar{y}}{2}$. (14)

(ii) *If* $Max\left\{0, \dfrac{r-1}{r}\bar{y}\right\} \le K < \dfrac{1}{2} + \bar{y}$, $P_{HS} = \bar{v}_S = \dfrac{\bar{y}(1+r) + r(1-K)}{r+2\bar{y}}$, *and*

$$E\pi_S = \bar{v}_S(1-\bar{v}_S) + r\left[K-(1-\bar{v}_S)\right]\left[1 - \frac{K-(1-\bar{v}_S)}{2\bar{y}}\right]. \tag{15}$$

(iii) *If* $r > 1$ *and* $K < \dfrac{r-1}{r}\bar{y}$, $\bar{v}_S = 1$ *and* $E\pi_S = rK\left[1 - \dfrac{K}{2\bar{y}}\right]$. (16)

Proposition 1 shows that the characterization of the equilibrium depends upon the business segment's willingness to pay and its size relative to the level of capacity. According to part (i), when the capacity exceeds the sum of half of the leisure market and the maximum possible size of the business market, the service provider chooses to serve half of the leisure market in Stage 1 by charging leisure travelers $P_{HS} = 1/2$. In Stage 2, there is sufficient capacity to serve any level of business travel demand that may

arise. The expected business demand is $\bar{y}/2$, generating expected revenues of $r\bar{y}/2$. If the service provider's capacity is insufficient to provide this coverage, then part (ii) of the proposition shows that $1/2 < \bar{v}_S \le 1$. The service provider chooses to serve less than half of the leisure market in Stage 1 in order to preserve capacity for the more lucrative business travelers. In this case, the capacity available in Stage 2 may or may not be sufficient to meet actual business demand *y*, depending on the realization of *y* relative to the capacity available in Stage 2, $K-(1-\bar{v}_S)$. Part (iii) shows that the service provider may choose to abandon the leisure market altogether (i.e., $\bar{v}_S = 1$), when the business travel market is very attractive in terms of both willingness to pay *r* and potential size $\bar{y}$ and capacity is limited (i.e. $K < \bar{y}(r-1)/r$). In this case, it is necessary that *r* > 1, implying that business travelers are willing to pay more than even the highest valuation leisure traveler. The service provider can reserve his entire capacity for business travelers by posting a price $1 \le P_{HS} < r$ in Stage 1.

Having established the solution without the NYOP channel, we now derive the service provider's expected payoff if he has an agreement with the NYOP retailer to sell any remaining capacity in Stage 2, using the expressions derived for $P_L(y)$ in (11) and P_H in (12):

(a) If $K \ge \bar{y} + (1-\bar{v})$:

$$E\pi = \begin{cases} r\bar{y}/2 + \bar{v}(1-\bar{v}) & \text{when leisure travelers are active only in Stage 1} \\ r\bar{y}/2 + (1/\bar{y})\int_0^{\bar{y}} (K-y)(1-K+(y/2))\partial y & \text{when leisure travelers are active only in Stage 2.} \end{cases} \quad (17a)$$

(b) If $K < \bar{y} + (1-\bar{v})$:

$$E\pi = (1-\bar{v})\left[\bar{v} - \frac{(\bar{v}-(1-K))^2}{2\bar{y}}\right] + r(K-(1-\bar{v}))\left[1 - \frac{K-(1-\bar{v})}{2\bar{y}}\right] + \frac{1}{\bar{y}}\int_0^{K-(1-\bar{v})} \left(1-K+\frac{y}{2}\right)(K-(1-\bar{v})-y)\partial y \quad (17b)$$

Since segmentation is not feasible when $K \ge \bar{y} + (1-\bar{v})$, leisure travelers are either all active in Stage 1 or else they all wait till Stage 2 to bid on the NYOP channel, in which case the retailer has capacity

$(K - y)$ to sell to leisure travelers (i.e., the capacity left after serving the business market). When $K < \bar{y} + (1 - \bar{v})$, the service provider segments the leisure market. The first term of the expected profit expression (17b) corresponds to profits from leisure travelers paying the posted price in Stage 1, the second term is the expected profit from business travelers, and the third terms is the profit from sales through the NYOP retailer. The service provider chooses $\bar{v}$ to maximize his expected profits in (17). In Proposition 2, we characterize the solution to this maximization.

PROPOSITION 2: *When the service provider can sell his service both via direct and NYOP channels:*

(i) *If* $K \geq \bar{y} + 1/2$*, he will definitely choose not to sell through the NYOP retailer. In this case*

$P_H = \bar{v} = 1/2$ *and* $E\pi = (r\bar{y}/2) + (1/4)$.

(ii) *If* $K < \bar{y} + 1/2$ *and the provider chooses to sell through the NYOP retailer, then:*

a. If $r \leq 1$, *or if* $r > 1$ *and* $K \geq 2(r-1)\left(\sqrt{r\bar{y}/(r-1)} - 1\right)$,

$$\bar{v} = \frac{1+r}{2} + \frac{8\bar{y} - 6K + 3(1-r)}{14} - \sqrt{\frac{(K-(1-r)/2)^2}{7} + \left(\frac{8\bar{y} - 6K + 3(1-r)}{14}\right)^2} < \frac{1+r}{2}. \tag{18}$$

The service provider's expected profit is

$$E\pi = \bar{v}(1-\bar{v}) + r\left[K - (1-\bar{v})\right]\left[1 - \frac{K-(1-\bar{v})}{2\bar{y}}\right] + \frac{\left[K-(1-\bar{v})\right]^2}{12\bar{y}}\left[5(1-K) + 7\bar{v} - 6\right]. \tag{19}$$

b. If $r > 1$ *and* $K < 2(r-1)\left(\sqrt{r\bar{y}/(r-1)} - 1\right)$, $\bar{v} = 1$, *and the expected profit is*

$$E\pi = rK\left[1 - \frac{K}{2\bar{y}}\right] + \frac{K^2}{12\bar{y}}(6 - 5K). \tag{20}$$

As an illustrative example, consider the case of business market potential $\bar{y}$ = 0.3 and capacity K = 0.8. Thus, $K \geq \bar{y} + 1/2$, corresponding to part (i) of Proposition 2. For the business travelers' reservation price r = 0.8, the expected profit when selling through an NYOP retailer is 0.33, while the expected profit via a single channel is higher at 0.37, in line with the result in part (i). On the other hand, for the same $\bar{y}$ but a lower capacity K = 0.6 and r = 0.8, we have $K < \bar{y} + 1/2$ and r < 1, corresponding to part (ii)a. In

this case, the expected profit when selling through an NYOP retailer (= 0.353) is higher than the expected single channel profit (= 0.347), as per the proposition.

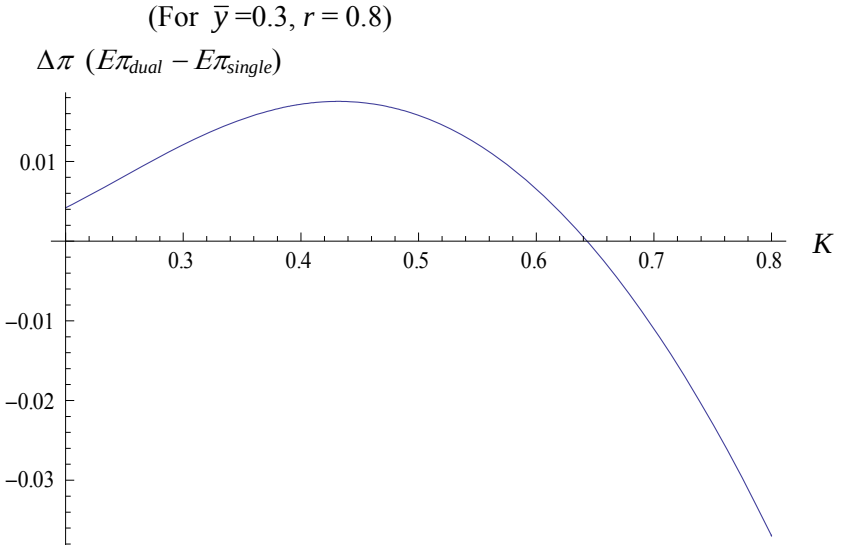
A comparison for the expected profit expressions obtained in Propositions 1 and 2 yields the main result of our paper, reported in Proposition 3.

PROPOSITION 3: *Operating a dual channel (direct and NYOP) is Stage 2 is profitable if the capacity* $K \le K^*$, *where* $K^* \in \left(\frac{1}{2} + \frac{7r\bar{y}}{12r + 10\bar{y}}, \quad \frac{1}{2} + \bar{y} \right)$. *Otherwise, if* $K > K^*$, *the service provider is better off offering his service exclusively via his own direct channel.*

Proposition 3 states that the profitability of operating a dual channel depends on the capacity relative to the number of business travelers and/or their reservation price. Since the lower bound of the interval containing K^* is increasing in both r and $\bar{y}$, selling via the NYOP retailer is the more profitable option as the business segment becomes more lucrative, even when capacity is relatively large.

As a numerical illustration, consider the case of $\bar{y} = 0.3$, and $r = 0.8$, in which case $K^* \in (0.63, 0.80)$. The relative profitability of the dual channel (i.e., dual channel profits – single channel profits) is plotted as a function of capacity K in Figure 3. Observe that the single channel option becomes more profitable only when the capacity K exceeds 0.64 (which is in the range (0.63, 0.80)); thus the service provider is better off offering his service exclusively via his own direct channel if $K > 0.64$.

Figure 3. Profits in Dual Channel Relative to Single Channel ($\Delta\pi$) as a Function of Capacity (K)



The following numerical examples illustrate the positive impact of $\bar{y}$ and r on the critical capacity K, (beyond which the single channel option is more profitable). First, with r fixed at 0.8, and for $\bar{y} = 0.3$, 0.6, and 0.9, the corresponding K^* values are 0.64, 0.74, and 0.81, respectively. Next, with $\bar{y}$ fixed at 0.6, and for $r = 0.7$, 0.8, and 0.9, the corresponding K^* values are 0.73, 0.74, and 0.75, respectively. Thus, higher values of $\bar{y}$ and r make the dual channel option more profitable over a longer range of capacity.[13]

Recall that when the service provider signs an agreement with the NYOP retailer he always sells any idle capacity remaining in the second stage since, given the option to receive a positive price for his idle capacity, he cannot credibly commit to leave some capacity unutilized. When capacity is large relative to the maximum number of business travelers, the service provider is very likely to experience excess capacity in the second stage. An agreement with the NYOP retailer exerts downward pressure on the posted prices that the service provider can obtain from leisure travelers in the first stage, since those travelers can anticipate being able to obtain the service with low bids in the second stage given large capacity and relatively few business travelers.

By signing an agreement with the NYOP retailer the service provider loses some control over the prices he can charge from leisure travelers. This loss of control is especially severe when his capacity is large in comparison to the size of the business segment. Moreover, establishing a secondary channel introduces another disadvantage to the provider, of having to share revenues with the retailer. Since only the retailer can observe the bid submitted by the traveler, he can retain the difference between the bid and the wholesale price he has to transfer to the provider. Given this dual threat, the service provider may choose to sign an agreement with the retailer only if the maximum number of business travelers and their reservation price are sufficiently high relative to the capacity.

The uncertainty confronting leisure travelers about their ability to obtain the service, if they postpone the purchase to the second stage, is sufficient to induce separation between high and low valuation leisure

[13] In the first case (r fixed at 0.8), the first stage posted price P_H (for $K = 0.6$) is also increasing in $\bar{y}$, as expected: for $\bar{y} = 0.3$, 0.6, and 0.9, $P_H = 0.55$. 0.66, and 0.73, respectively. Similarly, in the second case ($\bar{y}$ fixed at 0.6), for r = 0.7, 0.8, and 0.9, $P_H = 0.65$, 0.66, and 0.67, respectively. Note that in all cases, $P_H < r$, as asserted in our model (thus ensuring that the posted price increases from Stage 1 to Stage 2).

travelers. Segmentation becomes optimal because business traveler demand in the second stage is uncertain. Thus, contracting with the NYOP retailer serves as a vehicle to absorb idle capacity when it arises – but this makes sense only if the capacity is not too large relative to the expected size and willingness to pay of business travelers.

After 9/11, airlines drastically reduced their sales through *Priceline*, suggesting that it is not excess capacity but rather uncertain business travel demand that is driving NYOP business. As evidence of this, note that while the online travel market increased by 45% from 2001 to 2002, Priceline's revenue declined by 30%. Looking at Priceline's bid acceptance rates, in Q3 of 2001, 1.4 million bids were received and 1.2 million tickets were sold (an 82% success rate). In contrast, in Q3 of 2002, 1.2 million bids were receive and only 645,000 tickets were sold (a 54% success rate).[14] This decline in bid acceptance rate reflects low availability of discount tickets from airlines. In addition, observe that the discount airlines, that do not focus on the business travel segment, do not contract with *Priceline*. These empirical observations are consistent with the implications of Proposition 3.

4. Model Extensions

In this section, we consider three extensions of our model and discuss their implications. In the interests of length, the formal results and their derivations are presented in Appendix 2.

4.1. Information about Business Travel Demand

Given that signing an agreement with the NYOP retailer may erode the commitment power of the service provider to keep prices high in Stage 1, it is interesting to investigate whether the provider can increase his profits by choosing the wholesale price charged from the NYOP retailer *before* the uncertainty concerning business demand is fully resolved. This may be relevant, for instance, when the service provider has to contract early with the NYOP retailer. When choosing the wholesale price early, the provider may have access to some, but less than perfect, information about the extent of business class

[14] Data from ecommerce-guide.com: http://www.ecommerce-guide.com/news/trends/article.php/1549351; Marcussen, http://www.crt.dk/uk/staff/chm/trends/USA_2003.pdf.

demand *y*. In Appendix 2 we explore this question by assuming that at the time the service provider chooses his wholesale price he observes a signal $\tilde{y} \in [0, \bar{y}]$, which with probability *h* is perfectly precise and equal to *y*, and with probability $(1-h)$ is completely uninformative, and has a distribution equal to the prior distribution of *y* (i.e., Uniform$[0, \bar{y}]$). Hence, the parameter *h* measures the precision of the signal, with higher precision achieved when postponing the choice of wholesale price closer to the realization of the random variable *y* (our analysis so far considers the case *h* = 1). We demonstrate that when the parameter *h* can be endogenously determined, its optimal value is less than one. *Thus, the service provider should set the wholesale price before he is absolutely certain about the state of business class demand*. In essence, less precise information offers an indirect mechanism to avoid significant price cuts in the NYOP market in response to a signal that is known to be less reliable. Such a mechanism is especially important when *K* is large relative to *r* and $\bar{y}$.

4.2. The Service Provider Can Choose Capacity Level

We have so far assumed that the service provider has no commitment power to restrict (or increase) capacity allocated for Stage 2 sales. We can relax this to allow the service provider to choose his capacity *K* – that is, the provider optimally chooses both *K* and posted price P_H to implement self selection by the leisure traveler. In Appendix 2, we characterize the single and dual channel equilibria when *K* can be chosen endogenously, with the unit cost of capacity denoted by *c*. If the provider can choose *K* optimally, he sets a Stage 1 posted price $P_H = (1+c)/2$ whether or not the NYOP channel is engaged, and also equal to that chosen by a monopolist serving only leisure travelers. Of course, the profits vary between single and dual channels even if P_H is the same in both cases, with a single channel recommended when the cost of capacity is "sufficiently" small and dual channel when this cost is large, akin to Proposition 3.

4.3. Vertical Integration of the NYOP Channel

When the service provider can establish his own NYOP channel, he can observe and extract the entire bid submitted by each leisure traveler active in this channel, instead of only obtaining the wholesale price. However, as in the case of vertical separation considered in the baseline model, the threshold price

that determines which bids are accepted is still given by the schedule of the wholesale price $P_L(y)$. This schedule guarantees that the entire capacity is cleared even with vertical integration.

Our analysis (in Appendix 2) shows that even when the NYOP channel is owned and operated by the service provider himself, he will choose to establish this secondary channel only if his capacity is sufficiently small in comparison to the potential size and willingness to pay of the business class segment. The very fact that the provider has a secondary channel may threaten his ability to keep prices high in the first stage, if his capacity is relatively large relative to r and $\bar{y}$, as in the case of the independent NYOP retailer. However, since the service provider can extract and retain the entire bids of the NYOP customers, his profitability is greater than in the independent NYOP channel case. Further, establishing the second NYOP channel becomes optimal at a higher capacity when this channel is integrated rather than independent. Finally, a vertically integrated provider is more willing to defer sales to the second stage. In our conclusion below, we discuss why we do not observe such vertical integration in practice.

5. Conclusion

5.1. Managerial Implications

Service providers now have a wider choice of channels to distribute their products with the help of the Internet, among other technological innovations. One of the most salient innovations is the NYOP retailer. Managerially, the service provider must recognize the benefits and costs when deciding whether to contract with the (available) NYOP channel. Such contracting facilitates market segmentation and price discrimination, and allows for disposal of excess capacity after meeting business travel demand. However, the cost of this flexibility is that the service provider can no longer credibly pre-commit to maintaining high prices when there is unsold capacity. Also, when contracting with an independent retailer, the service provide is unable to extract the entire revenue generated from NYOP consumers.

The rationale for contracting with an NYOP retailer is driven by the uncertainty in business travel demand, not the expectation of excess capacity. Indeed, all else equal, the larger the capacity, the less likely it is that contracting with an NYOP retailer is the right decision on the part of the service provider.

There is some anecdotal evidence relating to certain business outcomes for *Priceline* that is consistent with this rationale. Following 9/11 and the downturn in both leisure and business travel, *Priceline* struggled because the airlines preferred to use their own channels (and lowering posted prices). Thus, the increase in spare capacity did not turn airlines to use *Priceline* more extensively. Furthermore, while *Priceline* has tried its NYOP model in a variety of businesses with perishable products or services, it has been successful only in the travel industry. Interestingly, this is the one industry (classified as a Class A service by Desiraju and Shugan 1999) in which there is a lucrative market segment (with high willingness to pay) that enters late in the game and whose size is uncertain. Our results suggest that this characteristic may explain why *Priceline's* success has been limited to the travel industry. The main insights on when and how a service provider should contract with an NYOP channel are as follows:

- Contracting with an NYOP retailer is profitable for the service provider only when the available capacity is not too large relative to the expected number of business travelers and their willingness to pay. The relative profitability of the two-channel option (i.e., adding the NYOP retailer to the service provider's own posted-price channel) increases in the expected number of business travelers and their willingness to pay.
- In our model, when the service provider contracts with an NYOP retailer, the uncertainty of obtaining the service if leisure travelers postpone purchase to the second stage is sufficient to separate the low and high valuation consumers. The uncertainty serves to deflate consumer surplus, and it is therefore not necessary to impose further deflation via opacity. If multiple competing service providers were considered, it would be efficient for the NYOP retailer to consolidate all available seats across airlines for a particular service (defined by route and date). This would imply concealing specific information on the airline, flight times, etc. from the bidder at the time of bidding. Indeed, at the time of receiving a bid, the NYOP retailer himself would likely be unaware of the airline and the specific flight that would be assigned to the traveler if her bid were successful.[15]
- The service provider is better off setting the wholesale price in the NYOP channel before he is absolutely certain of the extent of business travel demand, because less precise information helps to

[15] After receiving a bid, the NYOP retailer would shop across all contracting airlines flying the route to find the flight with the lowest wholesale price and maximize his margin by assigning the bidder to that flight (assuming that the bid exceeds this wholesale price). Thus, at the time of *receiving* a bid, the opacity would simply be a consequence of the NYOP retailer being unaware of the flight details. In practice, even though the NYOP retailer may become aware of these flight details at the time of *accepting* the bid, he does not disclose this information to the traveler until after the payment for the service is complete.

avoid significant cuts in the wholesale price. A practical implication of this result is that the wholesale price does not have to be set at the last possible moment, when the business travel demand is known with complete certainty.

- If the service provider can choose his capacity optimally, a single channel is recommended when the cost of capacity is small and dual channel (contracting with an NYOP retailer) when this cost is large.
- Vertical integration of the NYOP channel by the service provider results in higher profits and also defers more of the leisure segment to the NYOP market in the second stage. In practice, possible reasons why service providers have not embraced this option include the following. First, there is concern about the possible loss of customer goodwill when operating two parallel channels offering the service at different prices. Second, a single NYOP retailer serving the multiple competing service providers (consolidating supply across them) is likely to be more efficient than multiple service-provider owned NYOP outlets

Our paper also allows an evaluation of the NYOP channel from both the consumers' and the service provider's perspectives. Previous studies attribute the existence of NYOP channel to consumers' haggling cost of repeat bidding (Terwiesch, Hann and Savin 2005). Our analysis adds new insights to the NYOP process as it examines optimal strategies for both the service provider and the consumers. While parallel channels selling discounted products need not necessarily follow the NYOP model (e.g., *Hotwire*), the NYOP's appeal is its greater pricing flexibility relative to posted price options.

5.2. Limitations and Directions for Future Research

This paper represents a first step in studying the NYOP channel employing a game-theoretic framework to derive a Bayesian Nash equilibrium. In this initial endeavor, we have limited ourselves to focusing on the buyer-seller interaction assuming a monopolistic service provider. It would be interesting to determine whether the primary results of the paper extend to the case of competition among service providers. In such an extension of our model, the uncertainty confronting the consumer would comprise of both the prospect of not finding seats available and the lack of information about the flight (opacity). A further extension can accommodate competition between different types of channel members – for example, considering one non-opaque channel (Expedia.com) and two opaque channels (*Priceline* and. *Hotwire*) with different pricing mechanisms (NYOP vs. posted-price).

Other simplifying assumptions, made to ensure model tractability, may also be relaxed. In particular, the two-period model may be extended to multiple periods, which might provide a basis for capturing the actual dynamics of the market more realistically. More general distributional assumptions about valuations (for both leisure and business markets) is another logical extension. Nevertheless, we believe that the results derived in this paper are relevant in their insight, and may be seen as a useful first step.

References

Amaldoss, W. and S. Jain. 2008. Joint bidding in a name-your-own-price channel: a strategic analysis. *Management Sci.* 54(10) 1685-1699.

Balachander, S. and K. Srinivasan. 1994. Selection of product line qualities and prices to signal competitive advantage. *Management Sci.* 40(7) 824-841.

Balasubramanian, S. 1998. Mail versus mall: a strategic analysis of competition between direct marketers and conventional retailers. *Marketing Sci.* 17(3) 181-95.

Belobaba, P. 1989. Application of a probabilistic decision model to airline seat inventory control. *Oper. Res.* 37(2) 183-198.

Belobaba, P., J. Wilson. 1997. Impacts of yield management in competitive airline markets. *J. Air Transport Management* 3(1) 3-9.

Biyalogorsky, E., Z. Carmon, G. Fruchter, E. Gerstner. 1999. Overselling with opportunistic cancellations. *Marketing Sci*. 18(4) 605-610.

Biyalogorsky, E., E. Gerstner. 2004. Contingent pricing to reduce price risks. *Marketing Sci*. 23(1) 146-155.

Biyalogorsky, E., E. Gerstner et, D. Weiss, J. Xie. 1999. Economics of service upgrades. *J. Service Res.* 7(3) 234-244.

Brynjolfsson, E., M. D. Smith. 2000. Frictionless commerce? A comparison of internet and conventional retailers. *Management Sci.* 46(4) 563-85.

Bulow, J. I. 1982. Durable goods monopolists. *J. Political Econom.* 90(2) 314-332.

Chiang, W., D. Chhajed, J. D. Hess. 2003. Direct marketing, indirect profits: a strategic analysis of dual-channel supply chain design", *Management Science*, 49(1) 1-20.

Coase, R. H. 1972. Durability and monopoly. *J. Law Econom.* 15(1) 143-149.

Dana, J. 1999. Using yield management to shift demand when the peak time is unknown. *RAND J. Econom.* 30(3) 456-474.

Desai, P. 2001. Quality segmentation in spatial markets: when does cannibalization affect product line design? *Marketing Sci.* 20(3) 265-283.

Desiraju, R., S.M. Shugan. 1999. Strategic Service pricing and yield management. *J. Marketing* 63(January), 44-56.

Ding, M., J. Eliashberg, J. Huber, R. Saini. 2005. Emotional bidders – an analytical and experimental examination of consumers' behavior in a Priceline-like reverse auction. *Management Sci.* 51(3) 352-364.

Fay, S. 2004. Partial repeat bidding in the name-your-own-price channel. *Marketing Sci.* 23(3), 407-18.

Fay, S. 2008. Selling an opaque product through an intermediary: the case of disguising one's product," *J. Retailing* 84(1) 59-75.

Gale, I., T. Holmes. 1993. Advance-purchase discounts and monopoly allocation of capacity. *Amer. Econom. Rev.* 83(1) 135-146.

Geyskens, I., K. Gielens, M. G. Dekimpe. 2002. The market valuation of internet channel additions. *J. Marketing* 66(April) 102-19.

Hann, I-H., C. Terwiesch. 2003. Measuring the frictional costs of online transactions: the case of a name-your-own-price channel. *Management Sci.* 49(11) 1563-79.

Kannan, P. K., P. K. Kopalle. 2001. Dynamic pricing on the internet: importance and implications for consumer behavior. *Internat. J. Electronic Commerce* 5(3) 63-83.

Lal, R., M. Sarvary. 1999. When and how is the internet likely to decrease price competition? *Marketing Sci.* 18(4) 485-503.

Moorthy, K. S. 1984. Market segmentation, self-selection, and product line design. *Marketing Sci.* 3(4) 288-307.

Mussa, M., S. Rosen. 1978. Monopoly and product quality. *J. Econom. Theory* 18(2) 301-317.

Spann, M., G. J. Tellis. 2006. Does the internet promote better consumer decisions? The case of name-your-own-price auctions. *J. Marketing* 70(1) 65-78.

Terwiesch, C., I-H. Hann, S. Savin. 2005. Online haggling at a name-your-own-price retailer: theory and application. *Management Sci.* 51(3) 339-351.

Villas-Boas, J. M. 1998. Product line design for a distribution channel. *Marketing Sci.* 17(2) 156-169.

Xie, J., E. Gerstner. 2007. Service escape: profiting from customer cancellations. *Marketing Sci*. 26(1) 18-30.

Zettelmeyer, F. 2000. Expanding to the internet: pricing and communication strategies when retailers compete on multiple channels. *J. Marketing Res.* 37(3) 292-308.