Reservations, Refunds, and Price Competition

Staffan Ringbom

Swedish School of Economics

Oz Shy

University of Haifa

Paper can be downloaded from:

`www.ozshy.com`

Goals

1. Analyze service providers' incentives to utilize refunds in their advance reservation systems

2. Our Novelty: Investigate these incentives under price competition (imperfectly-competitive industry)

3. Investigate how booking strategies affect price competition (and vice versa)

Observations

- Some industries sell only refundable tickets: Car rentals,
- Some industries sell only nonrefundable tickets: Movies, theaters, live performances
- A few sell both types of tickets: Airline tickets (full-fare versus discounted tickets)
- Thus, refundability option seems to be an industry characteristic
- and rarely vary among firms in the same industry!

Literature

- Most papers analyze a single seller
- The few oligopoly papers assume fixed prices (compete on capacity only)
- Gale & Holmes (92;93): Compare seller's advance booking with social optimum
- Gale (93): Consumers learn their preference only after then they are offered an advanced-purchase option
- Miravete (96), Courty & Li (00): Analyze the screening aspect of advance booking
- Dana (98): Studies market segmentation by price-taking firms

Literature (Con'd)

- Mackasai (2003) Duopoly: Consumers with ex-ante unknown location
- Ringbom & Shy (2003): Analyze how capacity constraints affect a monopoly's choice of the booking strategy

Questions We Ask and Investigate

- Our approach: Introduce price competition into an advance booking model
- Firms compete in prices in addition to setting refundability option
- How booking strategies affect equilibrium prices?
- How varying the degree of competition affects firms' choice of booking strategies?
- Booking strategies and social welfare
- Dual booking strategy: Competing firms offer both refundable and nonrefundable tickets

Our Contribution

- Introduce price competition into an advance booking model

- Introduce 2 types of costs:

  Capacity costs: Borne by sellers for each reservation made

  Operation Costs: Borne by sellers only if customers actually show up

- Facilitate empirical simulations: Compute equilibrium prices and booking strategies as functions of expected number of customers

- Identifies different degrees of market segmentation

Our Findings

1. Industry profit is higher when all firms utilize nonrefundable booking (compared with all utilize nonrefundable booking)

   Remark: In contrast to the monopoly model (more surplus is extracted when refunds are allowed)

2. Firm selling refundable tickets (compared with firm selling nonrefundable tickets)

   (a) charges a higher price
   (b) makes more reservations
   (c) less customers show up
   (d) earns a higher or lower profits (depends on the type of costs)

Our Findings (Con'd)

3. There does not exist an equilibrium where firms utilize different booking strategies

   Remark: Thus, explaining the stylized fact that booking policies vary more across industries (than across firms in the same industries)

4. Dual booking strategies: Both sell only refundable tickets is not an equilibrium

The Model

Consumers are indexed by:
$(\sigma, x) \in [0,1] \times [0,1]$

$$U(\sigma, x) \stackrel{\text{def}}{=} \begin{cases} \sigma(\beta - p_A) - \tau x \\ \sigma\beta - p_A - \tau x \\ \sigma(\beta - p_B) - \tau(1-x) \\ \sigma\beta - p_B - \tau(1-x) \end{cases}$$

if $\begin{cases} \text{Book with } A \text{ \& ticket is refundable} \\ \text{Book with } A \text{ \& ticket is nonrefundable} \\ \text{Book with } B \text{ \& ticket is refundable} \\ \text{Book with } B \text{ \& ticket is nonrefundable,} \end{cases}$

Both Sell Refundable Tickets

$$\hat{x}^R(\sigma) = \frac{1}{2} + \frac{\sigma(p_B - p_A)}{2\tau}$$

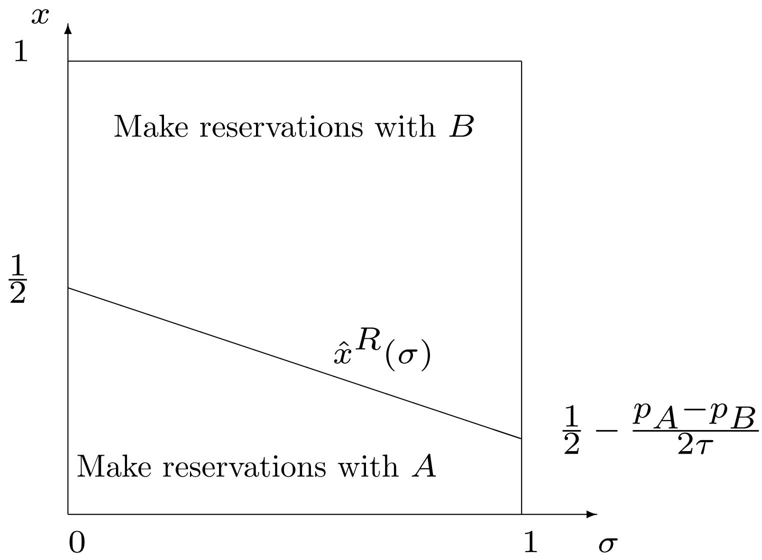


Figure 1: Reservations allocation between service providers A and B. *Note:* Figure drawn assuming out-of-equilibrium prices $p_A > p_B$.

Both Refundable Tickets (Con'd)

Number of reservations made:

$$q_A = \int_0^1 \hat{x}^R(\sigma)\, d\sigma$$

$$q_B = \int_0^1 \left[1 - \hat{x}^R(\sigma)\right]\, d\sigma$$

Expected number of show-ups:

$$s_A = \int_0^1 \sigma \hat{x}^R(\sigma)\, d\sigma$$

$$s_B = \int_0^1 \sigma \left[1 - \hat{x}^R(\sigma)\right]\, d\sigma$$

Both Refundable Tickets (Con'd)

Service provider i ($i = A, B$) solve:

$$\max_{p_i} \pi_i(p_A, p_B) = (p_i - c)s_i - kq_i$$

yielding

$$p_A^R = p_B^R = c + \frac{3(k+\tau)}{2}$$

$$\pi_A^R = \pi_B^R = \frac{3\tau - k}{8}$$

$$q_A^R = q_B^R = \frac{1}{2} \quad \text{and} \quad s_A^R = s_B^R = \frac{1}{4}$$

Both Sell Nonrefundable Tickets

Service provider i ($i = A, B$)

$$\max_{p_i} \pi_i(p_A, p_B) = (p_A - k)q_i - cs_i$$

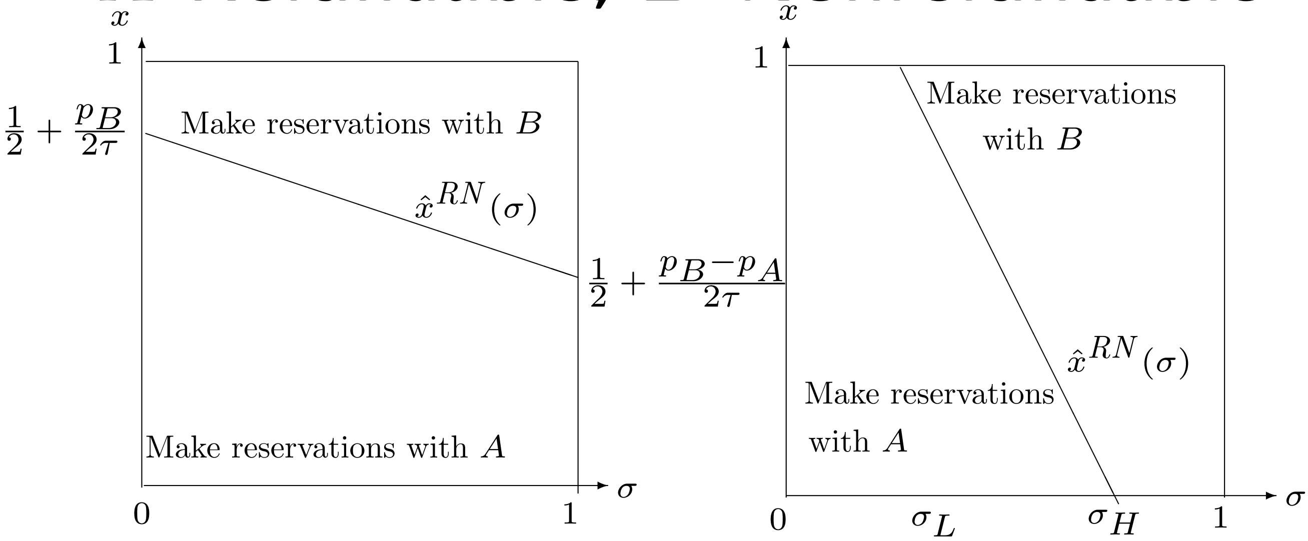
yielding

$$p_A^N = p_B^N = \frac{c + 2(k + \tau)}{2}$$

$$\pi_A^N = \pi_B^N = \frac{\tau}{2}$$

$$q_A^N = q_B^N = \frac{1}{2} \quad \text{and} \quad s_A^N = s_B^N = \frac{1}{4}$$

A Refundable, B Nonrefundable



- **weak market segmentation** if for each consumer type σ, some consumers purchase refundable tickets (from A), and some purchase nonrefundable tickets (from B);

- **strong market segmentation** if there are some consumer types σ who all purchase refundable ticket (from A), and some other types who purchase only nonrefundable tickets (from B).

Asymmetric Bookings (Con'd)

Each service provider chooses her price to solve

$$\max_{p_A} \pi_A(p_A, p_B) = (p_A - c)s_A - kq_A$$

$$\max_{p_B} \pi_B(p_A, p_B) = (p_B - k)q_B - cs_B$$

Looking for a Subgame-Perfect Equilibrium for the following two-stage game:

Stage I: Each service provider decides whether to sell refundable or nonrefundable tickets

Stage II: Price competition

Asymmetric Bookings (Con'd): Results

- $p_A^R > p_B^N$ (refundable tickets are more expensive)
- $q_A^R > q_B^N$ (more refundable reservations are made compared with nonrefundable reservations), but...
- $s_A^R < s_B^N$ (Refundable reservations show up less in absolute terms, and far less proportionally)
- No capacity cost $(k = 0) \Longrightarrow \pi_A^R > \pi_B^N$
- No operation cost $(c = 0) \Longrightarrow \pi_A^R < \pi_B^N$

Equilibrium Booking Strategies: Weak Segmentation (high τ)

Service Provider B:

	R		N	
R	$\frac{3\tau}{8}$	$\frac{3\tau}{8}$	$\bullet$	$\bullet$
N	$\frac{726\tau^2-183c\tau-70c^2}{2028\tau}$	$\frac{2(81\tau^2-18c\tau+c^2)}{507\tau}$	$\frac{\tau}{2}$	$\frac{\tau}{2}$

Table 1: Profit levels under all refund policy outcomes ($k = 0$)

Service Provider B:

	R		N	
R	$\frac{3\tau-k}{8}$	$\frac{3\tau-k}{8}$	$\bullet$	$\bullet$
N	$\frac{(11\tau-2k)^2}{338\tau}$	$\frac{108\tau^2-96k\tau-35k^2}{338\tau}$	$\frac{\tau}{2}$	$\frac{\tau}{2}$

Table 2: Profit levels under all refund policy outcomes ($c = 0$)

Equilibrium Booking Strategies: Weak Segmentation: Results

- There exist exactly 2 equilibria: $\langle R, R\rangle$ and $\langle N, N\rangle$

- $\langle N, N\rangle$ yields higher profits than $\langle R, R\rangle$ *Remark*: Differs from the monopoly results

- *Policy Implication*: Industries with observed refunds are not colluding

Equilibrium Booking Strategies: Low Segmentation (Low τ)

Service Provider B:

	R		N	
R	$\frac{3\tau}{8}$	$\frac{3\tau}{8}$	$\frac{16c^2+3\tau^2}{72c}$	$\frac{4c^2+\tau^2}{24c}$
N	$\frac{4c^2+\tau^2}{24c}$	$\frac{16c^2+3\tau^2}{72c}$	$\frac{\tau}{2}$	$\frac{\tau}{2}$

Table 3: Profit levels under all refund policy outcomes ($k = 0$)

Service Provider B:

	R		N	
R	$\frac{3\tau-k}{8}$	$\frac{3\tau-k}{8}$	$\bullet$	$\bullet$
N	$\frac{\sqrt{3}\left(3k^2-\tau^2\right)}{3\left(2\sqrt{3k^2-\tau^2}+\sqrt{3}k\right)}$	0	$\frac{\tau}{2}$	$\frac{\tau}{2}$

Table 4: Profit levels under all refund policy outcomes ($c = 0$)

Equilibrium Booking Strategies: Strong Segmentation: Results

- No capacity cost $(k = 0) \Longrightarrow$ 2 equilibria: $\langle R, N \rangle$ and $\langle N, R \rangle$
  Implication: Industries where firms differ in their booking strategies must be under intense price competition

- No capacity cost $(c = 0) \Longrightarrow$ 1 or 2 equilibria: $\langle N, N \rangle$ and $\langle R, R \rangle$ under some parameter values

- $\langle N, N \rangle$ yields higher profits than $\langle R, R \rangle$

Dual Booking Strategies

Let $\hat{\sigma}_A$ and $\hat{\sigma}_B$ consumer types indifferent between buying refundable and nonrefundable tickets from firms A and B

$$\hat{\sigma}_A = \frac{p_A^N}{p_A^R} \quad \text{and} \quad \hat{\sigma}_B = \frac{p_B^N}{p_B^R}.$$

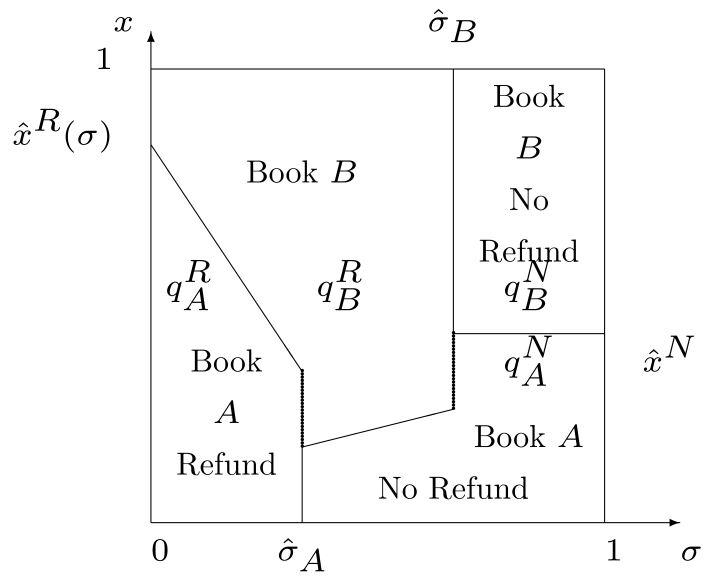


Figure 2: Customers' choices of booking options under dual booking strategy.

Dual Booking Strategies (Con'd)

Each service provider i solves:

$$\max_{p_i^R, p_i^N} \pi_i = p_i^R s_i^R + p_i^N q_i^N - c(s_i^R + s_i^N) - k\left(q_i^R + q_i^N\right)$$

- There does not exists an interior symmetric equilibrium, i.e., where $0 < \hat{\sigma}_A = \hat{\sigma}_B < 1$ and $p_A^R = p_B^R$ and $p_A^N = p_B^N$

- $\hat{\sigma}_A = \hat{\sigma}_B = 1$ (both selling only refundable tickets) is NOT an equilibrium

- $\hat{\sigma}_A = \hat{\sigma}_B = 0$ (both selling only nonrefundable tickets) with

$$p_A^R = p_B^R = p_A^N = p_B^N = c + \frac{3(k+\tau)}{2}$$

is an equilibrium

Possible Extensions

- Introducing overbooking:

  $$\pi_i(p_A, p_B) = (p_i - c)s_i - kr_i - \psi \max\{0, s_i - r_i\}$$

  where r_i is prepared capacity

- Introducing scrap value:

  $$\pi_i(p_A, p_B) = (p_i - c)s_i - kr_i + \rho \max\{0, s_i - r_i\}$$

  where ρ is scrap value of unused unit