Advance-Selling as a Competitive Marketing Tool

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Abstract

Advance selling before the time of consumption, and other creative pricing strategies, are now possible, for even very small service providers, given new technologies (specifically, web-based transactions, biometrics and smart card technology). Moreover, recent research has revealed that advance selling can substantially improve profits without traditional price-discrimination. However, that research was limited to monopoly settings.

This paper explores the impact of competition on advance selling and produces four major findings. First, advance selling can be advantageous for sellers with competitors. Second, the existence of competitors can limit the situations (i.e., more restrictive parametric conditions) when advance selling is more advantageous. Third, given these restrictive conditions are met; advance selling can be more advantageous to the seller with competitors than a monopolist because advance selling diminishes price competition. Fourth, advance selling can create a win-win-win situation where the profits of two competitors increase while consumer surplus increases because advance selling allows greater market participation.

Hence, advance selling can be a very effective marketing tool in a competitive setting (albeit given more restrictive conditions). It is a tool that can diminish competition while increasing buyer surplus.

(Keywords: Competition, Pricing, Advance selling, Advance Pricing, Advance Ticketing, Services Marketing).
1. Introduction

1.1 The Ability to Advance Sell

Advance selling occurs when sellers sell their services in a period advance of the consumption period (also called the spot period). For example, an airline might sell a ticket for a future flight (i.e., for use in the spot period) at some period before the flight (i.e., the advance period). A carwash might sell a ticket (i.e., in the advance period) for a future wash on a specified date (i.e., the spot period).

Although advance selling may have always been potentially profitable, until recently, past impediments such as transaction costs and arbitrage have limited its usefulness. Transaction costs occur when buyers or sellers incur additional costs to transact in the advance period. For example, buyers may need to physically travel to sellers to make advance purchases. In the past, the travel industry (Gebhart 1993, Lollar 1992, Mclean 1997, O’Brien 1991) was one of the few industries that had a low-transaction cost channel (i.e., travel agents).

Another impediment was arbitrage. Arbitrage occurs when speculators advance purchase at discounted advance prices only to resell later. Arbitrage hinders the seller’s ability to raise prices in the consumption period (i.e., spot prices). Moreover, some buyers may forgo advance purchases and buy later from speculators. Again, the travel industry, which required government identification from users, overcame this impediment.

Fortunately, recent breakthroughs in technology are rapidly and dramatically overcoming these past impediments to advance selling (for both business and consumer services). New technologies are making advance selling economically feasible in numerous industries, more than any prior time in history. Remarkable advances in information technology (Varki and Rust 1998) are lowering buyer and seller transaction costs, as well as almost completely eliminating the overwhelming problem of arbitrage. For example, web-based transactions, SSL encryption, smart cards (i.e., credit card sized tickets with computer chips) and broadband communications, allow complex and secure advance sales transactions from remote locations via web technology (Moad 1996, Gathright 2001). From remote locations, buyers can access on-line reservations to buy tickets and personal vouchers (e.g., http://www.advancetickets.com). Improving technology may make advance selling possible in many new categories including dry cleaning, dining, videos (Eliashberg and Raju 1999), film exhibition and products with network externalities (Padmanabhan, Rajiv, and Srinivasan 1997, Xie and Sirbu 1995).

Technology is also helping to overcome the second impediment – arbitrage. Sellers use personalized bar-coded tickets, tickets with personalized magnetic strips, biometric palm readers and smart cards, and numerous related technologies to develop the capability of advance selling with minimal arbitrage. National Ticket Company, for example, prints personalized bar-coded redemption tickets (www.nationalticket.com). Amusement parks are beginning to place
usage information on magnetic ticket strips that are updated electronically at the gate. Disney is using biometric palm readers and fingerprint scanners to identify season-pass holders (Rogers 2002).

Personalizing tickets, by placing buyer-specific information within the ticket, makes it relatively difficult to re-sell unused tickets. This information allows sellers to identify the buyer and prevents buyers from checking the validity of a ticket purchased from speculators. For example, buyers cannot observe the information on magnetic ticket strips and, therefore, cannot assess whether a ticket is valid.

Hence, new technologies are overcoming past impediments to advance selling, making it possible to advance selling in numerous industries.

1.2 Uses for Advance Selling

The prior literature provides two compelling uses for advance selling. First, advance selling can be a tool to implement price-discrimination. This usage for advance selling is cogent in the travel industry where price-sensitive leisure travelers are able to advance purchase at discounted prices. Meanwhile, price-insensitive business travelers, who are unable to commit to travel in the advance period (e.g., last minute meetings, meetings of unknown length making returns unpredictable), pay much higher spot prices for travel services. The technique called “yield-management” was created to implement this form of price-discrimination by reserving advance capacity for latter sales at high prices. Considerable research exists concerning the effectiveness of advance selling to implement price discrimination (i.e., Gale and Holmes 1992, 1993; Dana 1998). Of course, models requiring spot arrivals of relatively price-insensitive buyer tend to fit best in only travel-related service markets.

Second, advance selling can be a tool to produce greater sales in the advance period than in the spot period (Shugan and Xie 2000, Xie and Shugan 2001, Shugan and Xie 2004). This opportunity occurs in the frequent situation when buyers are uncertain about their future consumption states. That uncertainty may result from uncertainty about future moods, opportunities, conflicts, demands on buyer time or just uncertainty surrounding the consumption occasion (Hauser and Wernerfelt 1990). To understand, be aware that buyers are often uncertain in the advance period about their valuations in the future spot period. A consumer’s utility for a service might depend on the consumption state (e.g., hungry, bored, excited, fatigued, somber, cheerful, gregarious), unforeseen opportunities (e.g., alternative uses for time, personal developments), unforeseen conflicts (e.g., crises, illnesses) and so on.

Hence, consumers are often uncertain about their future states when they advance purchase a future service. For example, consider a buyer of a Chinese dinner buffet on Saturday. Suppose that in a favorable state (i.e., no other opportunities, a sociable mood, a hardy appetite, a craving for Chinese food), a buyer would pay, say, $15 for this festive dinner buffet. However, in an unfavorable state (i.e., friends going to another restaurant or less of an appetite), the buyer might be willing to pay only $5 for the same buffet.
However, on Monday (5 days before the Buffet), the buyer does not know the consumption state and will only pay the expected value. For example, if the states are equally likely, an advance price of $(0.5 \times \$15) + (0.5 \times \$5) = \$10$ produces an advance sale. However, in the spot period, a spot price of $\$10$ generates a sale with only probability 50%. Hence, at $\$10$, the seller enjoys (on average) greater sales volume in the advance period than the spot period. Past research (Shugan and Xie 2000; and Xie and Shugan 2001) shows when this increased volume also produces greater profits.

This paper introduces a third use for advance selling. We demonstrate that advance selling can be a tool to diminish competitors' propensity to cut prices under some demand specifications. We show that price decreases provide smaller gains in volume (i.e., unit sales) in advance period than spot period. We also show that price cuts often cause a greater proportional decrease in profit margins in advance period than spot period. It follows that seller-incentives to engage in price-cutting can be much less when sellers sell their services in the advance period than the spot period. Consequently, advance selling can be a more important marketing tool in markets with competition than in markets without competition.

Although advantage of advance selling can be greater for a competitive seller than a monopolist, competition also reduces the number of settings when advance selling is advantageous (i.e., imposes stronger restrictions). For example, we show that for advance selling to be advantageous, sellers with competitors often need lower costs than sellers without competitors.

Finally, we reveal that when one seller has market power, a situation occurs where the profit of both sellers improves while consumer surplus increases (i.e., a win-win-win situation). This situation occurs when, first, advance selling is profitable and, second, when the market power of the sellers is sufficiently small so that they are unable to extract the entire consumer surplus. In that case, both sellers enjoy greater profits from advance selling and consumers gain surplus as well.

To insure the robustness of our findings, we explore markets satisfying two very different sets of market conditions. The first market consists of two equal competitors. The second market consists of unequal competitors where one competitor has some market power.

This paper is organized as follows. First, we review the literature in advance selling. Second we provide a numeric example showing how buyer uncertainty makes advance selling profitable. Third, we analyze the case with identical competitors using a market-share demand structure (Bell, Keeney and Little 1975). We compare the advantage of advance selling (to spot selling) in a monopolistic market to the advantage of advance selling in a competitive market with equal competitors. Fourth, we analyze a competitive situation when one seller has market power. We again compare the advantage of advance selling (to spot selling) in a monopolistic market to the advantage of advance selling in a competitive market with unequal competitors. Finally, we provide a summary and explicitly state our conclusions.
2. Existing Literature

Advance selling is already an important area of study. As we previously noted, early research on advance selling focused on the price discrimination in travel services such as airlines. For price-discrimination to work, it was necessary to have leisure and business travelers with specific arrival times (i.e., late business arrivals) and specific price sensitivities (i.e., greater for leisure travelers). Advance selling was usually implemented with yield management systems that reserve airline seats for spot sales. Desiraju and Shugan (1999), however, show that the conditions required for yield management to improve profits are satisfied in only a few industries.

One early paper (Gale and Holmes 1992) considers two flights operated by a monopolist, one of which will be a peak flight. The paper assumes transaction costs are too great to efficiently spot price both flights via a day-of-departure auction to obtain a first-best allocation. Advance selling induces customers with weak preferences across flights (i.e., low time costs) to purchase in the advance period accepting a lower probability of taking their preferred flights. Customers with strong preferences buy on the date-of-departure, pay a higher price but usually get their preferred flight. Advance prices are set to equalize demand across the two flights and, thereby, increase the ability of spot buyers to get their preferred flight. The paper concludes that a monopolist who maximizes profits also maximizes social welfare. However, the paper does exploit unique features of the airline industry.

Another paper (Gale and Holmes 1993) considers the same situation when the airline knows which is the peak flight but buyers do not. They show that advance selling by the monopolist airline can divert buyers from peak to off-peak flights, which increases profits. “The main empirical prediction of this paper is that airlines will limit the availability of discount seats on peak flights.” (Gale and Holmes 1993)

Dana (1998) further generalizes these results. He considers two customer types called business and pleasure travelers. Business travelers are willing to pay more (i.e., higher valuation) but have a much greater uncertainty and lower purchase probability. Consequently, there is a negative correlation between valuation and demand uncertainty. As predicted by traditional models of second-degree price discrimination (e.g., Gerstner and Holthausen 1986), pleasure travelers accept advance purchase discounts while business travelers wait and pay higher spot prices. For the peak flight, Dana (1998) considers both proportional and parallel rationing of seats. He shows advance discounts are optimal when sellers are price-takers and pleasure travelers prefer advance purchases. This preference occurs when leisure buyers expect an insufficient number of seats on peak flights (industry-wide) and rationing of seats favors business travelers. Then, pleasure travelers will prefer to advance purchase to avoid discriminatory rationing. In addition, when pleasure travelers are almost certain they will buy, they buy in advance to avoid any rationing.

A related literature considers buy-backs (Biyalogorsky and Gerstner 2004), non-binding reservations (Png 1989) and overbooking (Arenberg 1991; Biyalogorsky, Carmon, Fruchter, and Gerstner 1999, 2000). Biyalogorsky and Gerstner (2004), for example, show that any seller who has a limited number of units for sale (for example, airplane seats or hotel rooms) can profit by buying back previously sold units. The seller should buy back units at higher prices
than the units were originally sold at (incurring a temporary loss), in order to resell those units to buyers at still higher prices. The use of overselling with opportunistic cancellations can increase expected profits and improve allocation efficiency in many business sectors including airlines, hotels, trucking and media advertising.

Although we might expect current yield management systems to implement these clever ideas for improving sales, Desiraju and Shugan (1999) show they do not. Desiraju and Shugan (1999) show that, despite their image of increasing sales, yield management systems are systems that reserve capacity by limiting advance purchases. These limits reserve sufficient capacity for price-insensitive buyers who purchase late. They argue that saving capacity for late buyers is only profitable under restrictive conditions (i.e., negatively correlated valuations and purchase probabilities) that are present in what they call Class A services. Hence, yield management systems may be ineffective in most industries. They also present several other findings. For example, they find that the practice of overbooking increases seats for price-sensitive customers, despite the fact that over-sold tickets are actually sold to price-insensitive customers. Other related articles include Pasternack (1985) and Gerstner and Hess (1987).

Recent research (Shugan and Xie 2000; Xie and Shugan 2001) provides another good reason to advance sell different from traditional price discrimination but not inconsistent with price discrimination. That research shows that advance selling can be profitable for a monopolist under conditions that are far more general than previously thought. These conditions do not require either buyer heterogeneity in price sensitivities or capacity constraints. That research shows that advance selling is more profitable than spot selling (i.e., tickets sold at the gate) because it can increase sales when buyers are uncertain about their future valuations. Shugan and Xie (2000) prove that advance selling can produce greater profits than spot selling. Xie and Shugan (2001) provide the conditions that are necessary for that conclusion as well as guidelines for using advance selling given capacity constraints, refunds, buyer risk-aversion and exogenous credibility. These articles show that buyer uncertainty about future consumption states drives the advantage of advance selling.

In general, the past literature focuses on using advance selling as a tool for price discrimination or a tool for increasing demand; we now explore another use for this tool.

3. Buyer Uncertainty and Advance Selling

Buyers are often uncertain about their future valuations for a service. This situation occurs when buyer utility depends on the consumption occasion (Hauser and Wernerfelt 1990). Some states might provide very high utility while other states might provide almost no utility.

A consumer, for example, might have a high utility for a spare tire in the state of a “flat tire” but virtually no utility in normal situations. More often, the consumer utility varies across states in a less dramatic pattern. A consumer, for example, has a higher utility for an aspirin in the state of a severe headache than a less severe headache. Note that consumption states might depend on many factors more complicated than a simple flat or simple headache. For
example, consider vacationers who plan to visit a city (e.g., Anaheim) and are considering attending a theme park in the city. When booking the trip, these vacationers may be uncertain about the value theme park tickets will have to them. The future valuation of a ticket depends on many unknown future circumstances such as the discovery upon arrival in the city, of unexpected opportunities (e.g., meeting a friend, a particularly desirable beach) that make the park more or less desirable. The state also depends on the traveler’s mood. Depending on these events and information that becomes available in the future, a traveler has different valuations for the park. Hence, the future value of visiting the park may be high or low depending on circumstances. When buyers have uncertainty about their future consumption states, they might still advance buy when the advance price is sufficiently low to compensate for the possible loss due to uncertainty or because they want to secure capacity when there is limited available capacity.

It is important to note that, similar to previous research (Shugan and Xie 2000), we do not focus on uncertainty caused by external factors such as the weather. Such external factors can change demand because all consumers will be influenced in the same way by the external factors (e.g., everyone has a lower willingness to pay for an outdoor concert when it is a bad day). However, sellers can observe external factors and adjust prices accordingly. Instead, we model consumer uncertainty caused by personal factors, such as health, mood, finance, work schedule, and family situations which sellers are unable to observe. The impact of such internal factors on buyer consumption utility will be modeled via the density function of possible consumer valuations. The density function will reflect the different consumption states of different consumers as determined by their personal situation.

As a simple example, consider two consumption states, a favorable and an unfavorable state. Let \( q \) and \( 1 - q \) denote the probability of being in the favorable and unfavorable state, respectively. Let \( H \) and \( L \) denote the valuation in the favorable and unfavorable states, respectively.

Shugan and Xie (2000) reveal that, for a monopolist, advance selling at price \( qH + (1 - q)L \) provides more profits than only spot selling at any spot price. For example, consider 100 vacationers who plan to attend an amusement park in several weeks. If all goes well, they will pay a high price, say $50, at the gate, which we refer to as the high valuation. Otherwise, they will pay only a lower price, say $15, which we refer to as the low valuation. Suppose, for this example, the valuations are equally likely and marginal costs are zero. When the park only spot sells, the park can sell spot tickets at $15 to all buyers, or at $50 to half the buyers. The $15 and $50 spot prices yield profits of $15 \times 100 = $1500$ and $50 \times \frac{1}{2} \times 100 = $2500$, respectively. So the optimal spot price is $50. With advance selling, weeks before their vacation, buyers have an expected valuation of \( \left( 50 \times \frac{1}{2} \right) + \left( 15 \times \frac{1}{2} \right) = $32.50 \). Advance selling at $32.50 produces profits of $32.50 \times 100 = $3250$ which is greater than the spot profits at any spot price. The park improves profits by \( \frac{3250 - 2500}{2500} = 30\% \) and without price discrimination (i.e., all buyers pay the
Moreover, note that first-degree price discrimination in the spot period involves selling to half the buyers at $15, i.e., the buyers with low valuations, and other half the buyers at $50. The profits from first-degree price discrimination in the spot period equal the profits from advance selling to all vacationers.

In this paper, we extend research of advance selling to markets with competition. To explore the robustness of our key findings, we develop two models that are based on very different market structures.

4. The Market with Identical Competitors

We consider competition with two game structures. This section considers the traditional competition between equal competitors. The next section considers competition between unequal competitors where one has market power.

4.1 Monopoly Market (K=1)

We begin by studying the case with no competition (i.e., only one seller j). Consider two periods, \( t = 1, 2 \), where \( t = 1 \) denote advance period and \( t = 2 \) denote spot period, respectively. Consumption occurs in the spot period. Buyers will purchase when their valuations are sufficiently high (i.e., compared to the price). Let \( f(\nu) \) denote the density function of possible buyer valuations, \( \nu \), in the spot period. Note that, the density function, \( f(\nu) \), implies that buyers have the same distribution of valuation but can have an infinite number of possible evaluations (i.e., different consumption states). Different consumers may have different realized levels of consumption utility depending on their consumption states in the spot period, i.e., buyer consumption utility is state-dependent. To obtain easily interpretable closed-form solutions, this section considers the common case when \( f(\nu) \) is exponential\(^1\), i.e., \( f(\nu) = \lambda e^{-\lambda \nu} \).

Let \( \beta_j \) denote consumers purchase probability from the seller in period \( t \). Of course, the probability \( \beta_j \) is a function of price, \( P_j \). Let \( c \) denote the seller’s cost. Equation (1) provides the profit for the monopolist seller \( j = m \) with a market size of \( N \) when it sells in time \( t \).

\[
\pi_{tm} = N \left( P_{tm} - c \right) \beta_{tm}
\]  

(1)

**Spot Selling.** Given the density function of valuations, \( f(\nu) = \lambda e^{-\lambda \nu} \), and a spot price, \( P_{2m} \), the probability of buying is \( \beta_{2m} = \int_{P_{2m}}^{\infty} \lambda e^{-\lambda \nu} d\nu = e^{-\lambda P_{2m}} \). Given, \( \pi_{2m} = N \left( p_{2m} - c \right) \beta_{2m} \), the first order condition, \( \frac{d\pi_{2m}}{dp_{2m}} = 0 \)

\(^1\) Reservation prices and wages are often captured by the exponential distribution. For example, see Perloff and Salop 1985; Hendricks, Porter and Wilson 1994; Trajtenberg (1989); Chikte, Sudhakar and Deshmukh 1987; Anderson, Palma and Hong 1992; Evans 1985; Xie and Sirbu 1995; Bolton 1989.
implies \( p_{2m} = c + \frac{1}{\lambda} \) so that \( \pi_{2m} = \frac{N}{\lambda} e^{-(1+c\lambda)} \).

**Advance Selling.** In advance period, consumers are willing to pay the expected valuation,

\[
E[v] = \int v f(v) dv = \frac{1}{\lambda}.
\]

The purchase probability for the advance period is \( \beta_{1m} = \begin{cases} 1 & \text{if } P_{1m} \leq \frac{1}{\lambda} \\ 0 & \text{otherwise} \end{cases} \) Equation (2) provides the corresponding advance selling profit.

\[
\pi_{1m} = \begin{cases} N(P_{1m} - c) \beta_{1m} & \text{if } P_{1m} \leq \frac{1}{\lambda} \\ 0 & \text{otherwise} \end{cases}
\]

Note that, when \( c\lambda \geq 1 \), advance selling is not profitable (i.e., \( \pi_{1m} \leq 0 \)). Hence, we now only consider the case when \( c\lambda < 1 \). Then, the optimal advance price for the monopolist is \( P_{1m} = \frac{1}{\lambda} \) and the optimal advance profits become \( \pi_{1m} = N(P_{1m} - c) \beta_{1m} = \frac{N}{\lambda} (1 - c\lambda) \). Table 1 summarizes the monopolist profits for advance and spot selling.

**Table 1: Monopoly Profits for Spot and Advance Selling \((c\lambda < 1)\)**

<table>
<thead>
<tr>
<th></th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot</td>
<td>( \pi_{2m} = \frac{N}{\lambda} e^{-1-c\lambda} )</td>
</tr>
<tr>
<td>Advance</td>
<td>( \pi_{1m} = \frac{N}{\lambda} (1 - c\lambda) )</td>
</tr>
</tbody>
</table>

Solving \( \pi_{1m} = \pi_{2m} \) for \( c \) yields the cost \( c_m \). At cost \( c_m \), advance and spot profits equate. When \( c > c_m \), profits from spot selling are greater. When \( c < c_m \), profits from advance selling are greater. Lemma 1 reveals that \( c_m = 0.841404 / \lambda \). See the Appendix for Proofs of the Lemmata and the Theorems.

**Lemma 1 (Profit Advantage of Advance Selling in a Monopoly Market)**

For any mean evaluation \( 1/\lambda \), advance selling is more profitable than spot selling in a monopoly market given sufficiently low seller’s cost \( c \). Mathematically, \( \pi_{1m} > \pi_{2m} \) when \( c < c_m \) where \( c_m = 0.841404 / \lambda \).
Advance selling (at the expected valuation) increases sales when it allows advance sales to buyers who would be in unfavorable states later and would not purchase under a spot selling strategy. Advance selling to those buyers, however, is only profitable when costs are sufficiently small (i.e., $c \leq c_m$). The restriction on costs is weaker for smaller values of $\lambda$ because $c_m$ increases as $\lambda$ decreases (see Lemma 1).

When costs are too high, the optimal advance price might be less than cost. When high valuations are unlikely, again, the optimal advance price might be less than cost. Hence, advance selling increases profits over spot selling for any distribution of consumer valuations provided that expected valuations are above cost. Please see Shugan and Xie (2004).

To illustrate Lemma 1, we provide a numerical example. As shown in Table 1, at the optimal spot price, the monopolist’s spot and advance demand is $Ne^{-\lambda c - \lambda^{-1}}$ and $N$, respectively. Increased sales (i.e., $Ne^{-\lambda c - \lambda^{-1}} - Ne^{-\lambda c}$) come from buyers who will not buy at high spot prices. For example, let $N = 50$, $1/\lambda = 9$ and $c = $1, the optimal advance price of $9$ yields a demand of 50 and profits of $50($9$ - $1$) = $400$ while the optimal spot price of $2$ yields a demand of 16.5 units and a spot profit of $2(Ne^{-\lambda c} - Ne^{-\lambda c - \lambda^{-1}}) = ($10$ - $1$)50e^{-1/9} - $148$. Hence, advance selling with a $1$ price discount increases demand from 16.5 units to 50 units. It also increases profits from $148$ to $400$, an increase of 170%.

Lemma 1 illustrates that the profit advantage of advance selling does not require specific industry characteristics such as capacity constraints nor does it require a negative correlation between buyer’s price sensitivity and their arrival time. The fundamental reason for the profit advantage of advance selling is consumer uncertainty about consumption states. Lemma 1 is consistent with the finding by Xie and Shugan (2001), although the latter is based on a discrete two-point Bernoulli distribution of buyer valuation while the former is based on a continuous exponential distribution. Together, these findings suggest that the profit advantage of advance selling is general and is not subject to the assumption of a specific distribution of buyer valuations.

In the following, we apply the same distribution of consumer valuation used in the monopoly case to a market with two equal competitors. We examine the possible impact of competition on advance selling.

4.2 Duopoly Market

This section considers a competitive duopoly market with two sellers, $i$ and $j$. Sellers divide the market so that choice probabilities are proportional to relative attractiveness (i.e., a market-share model, see Bell, Keeney and Little 1975). Similar to the last section, buyers have the same distribution of valuations in the spot period but the distribution can reflect an infinite number of possible evaluations.
To be precise, let $P_j$ and $\alpha_j$ denote seller $j$’s price and the probability that a consumer prefers seller $j$ in period $t$, respectively. When sellers adopt the same selling strategy (i.e., they both advance sell or both spot sell), competitive attractiveness is inversely proportional to own price, and sellers will divide the market according to their prices. For example, when both sellers advance sell, the preference share for seller $j$ is $\alpha_{ij} = \left(\frac{1}{P_{1j}}\right)\left[\left(\frac{1}{P_{1j}}\right)+\left(\frac{1}{P_{1i}}\right)\right]$.

When one seller spot sells and the other seller advance sells, then buyers in period 1 must decide whether to advance buy or wait until the spot period. We introduce the parameter $\eta \geq 0$ to reflect the buyer’s preference for time. A large $\eta$ implies a strong preference for waiting and a small $\eta$ implies a weak preference for waiting. For example, when only seller $j$ advance sells, $\alpha_{ij} = \left(\frac{1}{P_{1j}}\right)\left[\left(\frac{1}{P_{1j}}\right)+\left(\frac{\eta}{P_{2i}}\right)\right]$. Here, some consumers wait, i.e., $\left(1-\alpha_{ij}\right)$. However, as we will see, in each period, only buyers with sufficiently high valuations will actually buy.

Note that market-share models assume full market coverage regardless of price levels so that all buyers must buy. Hence, no matter how high prices go, all consumers still buy (i.e., full market coverage). However, consistent with the last section, we allow for the possibility that the price of the buyer’s most preferred seller might be too high to induce a purchase so that some buyers fail to buy (i.e., producing less than full market coverage). Hence, we allow a probability $\beta_j \leq 1$ that a consumer who prefers seller $j$ finds the price acceptable. Of course, the probability $\beta_j$ is a function of $P_j$.

There are four possible competitive cases: (1) both sellers advance sell, (2) only seller $j$ advance sells, (3) only seller $i$ advance sells, and (4) both sellers spot sell. For each case, Table 2 provides the corresponding preference share ($\alpha_j$) and the fraction of $\alpha_j$ who buy ($\beta_j$). Symmetric definitions hold for $\alpha_i$ and $\beta_i$.

### Table 2: $\alpha_j$ and $\beta_j$ for Different Selling Strategies

<table>
<thead>
<tr>
<th>Seller $i$ Advance Sells</th>
<th>Seller $j$ Advance Sells</th>
<th>Seller $j$ Spot Sells</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_{ij} = \frac{1}{P_{1j}}$</td>
<td>$\alpha_{ij} = \frac{1}{P_{1j}}$</td>
<td>$\alpha_{ij} = \frac{\eta}{P_{2j}}$</td>
</tr>
<tr>
<td>$\beta_{ij} = 1$ if $P_{ij} \leq 1/\lambda$</td>
<td>$\beta_{ij} = 1$ if $P_{ij} \leq 1/\lambda$</td>
<td>$\beta_{ij} = 1$ if $P_{ij} \leq 1/\lambda$</td>
</tr>
<tr>
<td>$\beta_{ij} = 0$ if $P_{ij} &gt; 1/\lambda$</td>
<td>$\beta_{ij} = 0$ if $P_{ij} &gt; 1/\lambda$</td>
<td>$\beta_{ij} = 0$ if $P_{ij} &gt; 1/\lambda$</td>
</tr>
<tr>
<td>$\beta_{ij} = e^{-\lambda P_{ij}}$</td>
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<td>$\beta_{ij} = e^{-\lambda P_{ij}}$</td>
</tr>
</tbody>
</table>
For each of the four possible competitive cases: (1) both sellers advance sell, (2) only seller $j$ advance sells, (3) only seller $i$ advance sells, and (4) both sellers spot sell, let $\pi_{ij}^{11}$, $\pi_{ij}^{12}$, $\pi_{ij}^{21}$ and $\pi_{ij}^{22}$ denote the corresponding profit for seller $j$. Lemma 2 follows.

**Lemma 2 (Optimal Profits)**

Table 3 provides the optimal profits for seller $j$.

**Table 3: Seller $j$ Profits for Different Selling Strategies**

<table>
<thead>
<tr>
<th>Seller $i$ Advance Sells</th>
<th>Seller $j$ Advance Sells</th>
<th>Seller $j$ Spot Sells</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\pi_{ij}^{11} = \frac{(1-c\lambda)N}{2\lambda}$</td>
<td>$\pi_{ij}^{21} = \frac{B-c\lambda-\eta}{\lambda(B+c\lambda+\eta)}N\eta e^{-\frac{1}{2}(B+c\lambda-\eta)}$</td>
<td>$\pi_{ij}^{22} = \frac{N}{8\lambda}(1-2c\lambda+M)e^{-\frac{1}{4}(1+2c\lambda+M)}$</td>
</tr>
<tr>
<td>$\pi_{ij}^{12} = \frac{(1-c\lambda)(B+c\lambda-\eta)}{\lambda(B+c\lambda+\eta)}N$</td>
<td>Where: $M = \sqrt{1+12c\lambda+4c^2\lambda^2}$, $B = \sqrt{(\eta+c\lambda)(\eta+c\lambda+4)}$</td>
<td></td>
</tr>
</tbody>
</table>

Note that seller $i$ faces a symmetric table (i.e., substitute $i$ for $j$ and $j$ for $i$).

An advance selling equilibrium exists when neither seller has an incentive to deviate from that equilibrium. That occurs when $\pi_{ij}^{11} > \pi_{ij}^{21}$. The additional condition $\pi_{ij}^{11} > \pi_{ij}^{22}$ is required for advance selling to be the most profitable equilibrium. Lemma 3 proves that all necessary conditions are met (i.e., neither seller has an incentive to deviate from advance selling and each seller earns greater profits by advance than spot selling) when costs are sufficiently small.

**Lemma 3 (Stability of an Advance Selling Equilibrium)**

For a sufficiently small cost $c < c_c$

- When both sellers advance sell, neither seller has the incentive to unilaterally spot sell.
- Each seller obtains greater profits when both sellers advance sell than when both spot sellers.

Where $c_c = \frac{1}{\lambda} \min\{f(\eta), 0.847565\}$, and $f(\eta)$ satisfies the condition that:
\[
\frac{1 - f(\eta)}{2\eta e^{-\frac{1}{2}(B' + f(\eta) - \eta)}} = \frac{B' - f(\eta) - \eta}{(B' + f(\eta) + \eta)}, \text{ i.e., sells (i.e., } \pi^1_j > \pi^{21}_j), \text{ where:}
\]

\[
B' = \sqrt{(\eta + f(\eta))(\eta + f(\eta) + 4)}
\]

Lemma 3 proves that advance selling is advantageous (i.e., more profitable than spot selling) for both sellers, when costs are below \( c = (1/\lambda) \min \{f(\eta), 0.847565\} \). There are two constraints. The first constraint, i.e., \( c < f(\eta)/\lambda \), insures the stability of the advance-selling equilibrium so neither seller unilaterally spot sells (i.e., \( \pi^{11}_j > \pi^{21}_j \)). The second constraint, i.e., \( c < 0.847565/\lambda \), insures improved profitability for advance selling (i.e., that \( \pi^{11}_j > \pi^{22}_j \)).

The function \( f(\eta) \) is defined so that, for any given \( \lambda \), the cost \( c = \frac{f(\eta)}{\lambda} \) satisfies \( \pi^{11}_j = \pi^{21}_j \). Although we are unable to provide a closed-form expression for \( f(\eta) \), as shown in the appendix: (1) the function \( f(\eta) \) is only a function of \( \eta \), (2) there exists only one \( f(\eta) \) for every \( \eta \), and (3) the function \( f(\eta) \) is strictly decreasing in \( \eta \). Finally, we can provide the numerical table that defines \( f(\eta) \). See Table 4 for examples of \( f(\eta) \) for different \( \eta \).

<table>
<thead>
<tr>
<th>( \eta )</th>
<th>( f(\eta) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.889665</td>
</tr>
<tr>
<td>1.717567*</td>
<td>.841404</td>
</tr>
<tr>
<td>2</td>
<td>.826460</td>
</tr>
<tr>
<td>5</td>
<td>.735562</td>
</tr>
<tr>
<td>10</td>
<td>.679617</td>
</tr>
<tr>
<td>50</td>
<td>.614330</td>
</tr>
<tr>
<td>100</td>
<td>.604248</td>
</tr>
</tbody>
</table>

*Note: when \( \eta = 1.717567 \) then \( f(\eta) = \lambda c_m \) where lemma 1 defines \( c_m \).

Because \( f(\eta) \) is a strictly decreasing function of \( \eta \), when \( \eta \) increases (i.e., buyers have a stronger preference for waiting), the region where advance selling is advantageous becomes smaller (i.e., \( c < f(\eta)/\lambda \)). The reverse is true when time preference favors buying sooner. When \( \eta \) is small (smaller than 1.610704484 to be precise),
then \( f(\eta) \) becomes larger than 0.8475653685 and the condition in Lemma 3 for the advantage of advance selling reduces to \( c < 0.8475653685/\lambda \).

4.3 Impact of Competition

This section examines the impact of competition on advance selling from two perspectives. First, we compare the range where advance selling is advantageous for a monopolist with that range for a duopolist. Second, given that advance selling is profitable for both the monopolist and the duopolist, we compare the profit improvement from advance selling for a monopolist with the improvement for a duopolist.

From Lemma 1, we know the seller who faces no competitor gains from advance selling when \( c < c_m \). From Lemma 3, we know that the seller, who faces a competitor, gains from advance selling when \( c < c_c \), where \( c_c \) depends on \( \eta \). Hence, when \( c_m > c_c \) the seller with a competitor faces a more restrictive cost range where advance selling is advantageous than the cost range without a competitor. The reverse is true when \( c_c > c_m \). Theorem 1 follows.

**Theorem 1 (Impact of Competition on Range of Costs where Advance Selling is Advantageous):**

When consumers strongly prefer waiting (i.e., a large \( \eta \)), then advance selling is advantageous in fewer situations (i.e., stronger parameter restrictions) with competition than without competition. When consumers weakly prefer waiting, then advance selling is advantageous in more situations with competition than without competition. Mathematically, if \( \eta > \eta_f \) then \( c_m > c_c \) and otherwise \( c_m \leq c_c \) where \( \eta_f = 1.717567 \).

Theorem 1 tells us the impact of competition on the range of costs when advance selling is advantageous. Table 5 summarizes.

### Table 5: Cost Range where Advance Selling is Advantageous

<table>
<thead>
<tr>
<th>Value of ( \eta )</th>
<th>Maximum Cost for Monopolist</th>
<th>Maximum Cost for Competitive Seller</th>
<th>Less Restrictive Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 &lt; ( \eta ) ≤ 1.610704</td>
<td>.841404/\lambda</td>
<td>( c &lt; .847565/\lambda )</td>
<td>Competitor</td>
</tr>
<tr>
<td>1.610704 &lt; ( \eta ) &lt; 1.717500</td>
<td>.841404/\lambda</td>
<td>( c &lt; f(\eta)/\lambda, f(\eta) &gt; .841404 )</td>
<td>Competitor</td>
</tr>
<tr>
<td>( \eta = 1.717500 )</td>
<td>.841404/\lambda</td>
<td>( c &lt; f(\eta)/\lambda, f(\eta) = .841404 )</td>
<td>Same</td>
</tr>
<tr>
<td>( \eta &gt; 1.717500 )</td>
<td>.841404/\lambda</td>
<td>( c &lt; f(\eta)/\lambda, f(\eta) &lt; .841404 )</td>
<td>Monopolist</td>
</tr>
</tbody>
</table>
As Table 5 indicates, the cost-range where advance selling is advantageous depends on whether a seller faces competition. Without competition, advance selling is advantageous given a maximum cost of \( \frac{.841404}{\lambda} \).

With competition, the maximum cost depends on consumer preferences for waiting, i.e., \( \eta \). With competition and consumers with weak preferences for waiting, i.e., \( 0 < \eta \leq 1.610704 \), the maximum cost is \( \frac{.847565}{\lambda} \). With competition and consumers with strong preferences for waiting, i.e., \( \eta > 1.610704 \), then the maximum cost is \( f(\eta)/\lambda \). This condition, i.e., \( c < f(\eta)/\lambda \), insures that no seller has the unilateral incentive to spot sell (recall lemma 3).

Note that when \( \eta < 1.717500 \), the competitive seller has a less restrictive cost condition than the monopolist given the maximum cost for the competitive seller is greater than \( \frac{.841404}{\lambda} \). When \( \eta = 1.717500 \) both the competitive seller and the monopolist face the same cost condition, i.e., \( c < \frac{.841404}{\lambda} \). Finally, when \( \eta > 1.717500 \), then the competitive seller has a more restrictive cost condition than the monopolist given that the maximum cost for the competitive seller is less than \( \frac{.841404}{\lambda} \).

Hence, one implication of Theorem 1 is that competition might limit the applicability of advance selling. The reason is that, although advance selling might bestow higher profits to a seller without competitors, those profits might disappear when a competitor unilaterally spot sells (which is likely when buyers have strong preference for waiting).

We now focus on the impact of competition on the profitability of advance selling when the cost is sufficiently low so that advance selling is advantageous with or without competition (i.e., \( c < c_c \) and \( c < c_m \)). To do that, we define the relative impact of competition on the advantage of advance-selling \( \Theta \) as follows.

\[
\Theta = \frac{\pi_{1j}^1 / \pi_{1j}^2}{\pi_m^1 / \pi_m^2} = \frac{\text{Competitor j's Profit Advantage from Advance Selling}}{\text{Monopolist's Profit Advantage from Advance Selling}}
\]

When \( \Theta > 1 \), competition strengthens the advantage from advance selling, and when \( \Theta > 1 \), competition weakens the advantage from advance selling. Theorem 2 reveals when \( \Theta > 1 \). Note that for the easy of comparison with the monopoly case, we consider the profit advantage in a competitive market when both sellers adopt the same strategy (i.e., \( \pi_{1j}^1 / \pi_{1j}^2 \)).

**Theorem 2 (Impact of Competition on Profit Advantage of Advance Selling)**

*When advance selling is more profitable than spot selling with and without competition (i.e., conditions in Lemmas 1 and 3 hold), competition enhances the advantage of advance selling, i.e., \( \Theta > 1 \).*
Competition weakens or eliminates the effectiveness of many marketing strategies (e.g., bundling, price discrimination). Theorem 2, in contrast, reveals that competition can enhance the advantage of advance selling strategy. The reason goes to the heart of the advantage of advance selling.

With competition, advance selling has two advantages over spot selling. First, like the monopoly case, advance selling increases demand (compared to spot selling). Greater demand creates greater market coverage and greater sales. The first advantage leads to a second advantage in the competitive case. With competition, advance selling creates less downward pressure on prices in the advance period than the spot period.

There are two reasons for this. First, there is less of an incentive to cut price in the advance period than the spot period because price decreases in the advance period provide smaller gains in volume (i.e., unit sales). For example, when $\beta_{2j} = 10\%$, the advance price cuts have no impact on market coverage (i.e., it is already 100%) while lower spot prices can attract some of the uncovered market (i.e., 90% of the market). Second, when the advance price is discounted there is less of an incentive to cut price in the advance period because advance price cuts cause a greater proportional decrease in profit margins. For example, when the cost is $c$, lowering price by $1$ (i.e., from $p_{1j}$ to $p_{1j} - 1$) in the advance period cuts profit margins by a greater percent $\left(i.e., \frac{p_{1j} - c - 1}{p_{1j} - c}\right)$ than lowering price from $p_{2j}$ to $p_{2j} - 1$ in the spot period $\left(i.e., \frac{p_{2j} - c - 1}{p_{2j} - c}\right)$ when $p_{1j} < p_{2j}$.

Hence, the gains to competing on price in the advance period are less than the spot period because there are fewer non-buyers to attract with price decreases. Meanwhile, the cost associated with competing on price in the advance period is higher than the spot period because the number of current customers is larger (who would get a price decrease) and profit margins are smaller (so price decreases have greater impact on profits). We conclude that competition has a greater impact on profits from spot selling than profits from advance selling.

In summary, in this section we provide two new findings. First, when consumers have a strong preference for waiting to buy, sellers facing competition find fewer situations when advance selling is advantageous. The reason is that sellers with competitors must worry about competitors unilaterally spot selling. Second, when advance selling is advantageous for the seller that faces competition, that advantage is greater than the advantage of advance selling for the seller who faces no competition. Hence, competition might decrease the situations when advance selling is advantageous but increase the advantage of advance selling when advance selling is advantageous. For example, with competition, costs might need to be lower for advance selling to be advantageous, but when costs are sufficiently low, the same cost produces a larger advantage for the seller with competitors than the seller without competitors.
5. The Market with Unequal Competitors

5.1 Overview of the Model with Unequal Competitors

The last section derived two new findings given competition between equal sellers and homogenous buyers. This section considers competition between unequal competitors (i.e., one competitor has market power) as well as heterogeneous buyers (i.e., buyers having different preferences for competitive products).

This model will be more complex than the last section and we will require one additional assumption for tractability. Rather than allowing infinite possible consumption states, we assume two possible states (i.e., high and low). This section examines whether our two findings persist under these more complex market conditions.

To formally model advance selling in a competitive market with unequal competitors, we consider two time-periods, two sellers, two buyer types, and two buyer consumption states. The two periods (1 and 2) are the advance and spot periods, respectively. Buyers arrive in the first period and consumption occurs in second period\(^2\). To model seller heterogeneity, we allow one seller to have market power and let that seller to be a Stackelberg leader (See Putsis and Dhar 1998; Kauffman and Wood 2000; Shankar 1997 for the advantages and disadvantages of Stackelberg models of competition).

In addition to seller heterogeneity, we also allow buyer heterogeneity by considering two types of buyers: loyals and switchers. For example, suppose a city (e.g., Orlando) had two theme parks (e.g., Disney World and Universal Studios) that fight for these buyers. Some vacationers may only want to visit one theme park. We refer to these vacationers as loyals. Other travelers consider both parks and make decisions based on the relative prices. We refer to these vacationers as switchers. We, however, allow switchers to have a preference so that they will pay a premium price for one park (e.g., Disney World), which gives that park some market power. Finally, following Xie and Shugan (2001), in this section we assume a discrete two-point Bernoulli distribution for buyer valuations.

5.2 Buyer and Seller Heterogeneity

As noted earlier, the two buyer types are loyals and switchers. Loyals buy from one seller or not at all depending on that seller’s price. Switchers consider buying from either seller or not buying. However, switchers will pay

\(^2\)In this section, advance prices encourage all buyers to advance buy. Please see Shugan and Xie (2001) for the case when some of the buyers buy in advance and others do not. Also, this section considers selects adopting the same strategy (i.e., both advance sell or both spot sell). See Shugan and Xie (2001) for the case when one seller advance sells and the other spot sells.
a premium to buy from the leader. We define that premium as a measure of the leader’s market power. Note that the premium can approach zero.

We now define some additional notation. Let $c$ denote the marginal cost of each seller. Let $p_{\text{L}}$ and $p_{\text{F}}$ denote the prices of the leader and follower, respectively, in period $t$. Let $Y > 0$ denote the number of loyals and $S > 0$ denote the number of switchers. Let $d > 0$ denote the premium that switchers will pay to buy from the leader. Precisely, switchers buy from the leader when $p_{\text{L}} - p_{\text{F}} \leq d$. Note that when $d$ becomes very large, switchers act like loyals and both sellers price as monopolists.

The premium $d > 0$ allows the existence of a competitive equilibrium. However, if $d$ becomes large, the leader has sufficient power to ignore the follower and price as a monopolist in both periods. We refer to the case when the leader has market power but is unable to act as a monopolist as the limited-power case. Later, we derive conditions on $d$ for this case.

Although past research has hitherto not considered buyer-uncertainty about valuations in a competitive setting, this two-seller model of competition is found in other research (Narasimhan 1988; Chen, Narasimhan and John Zhang 2001). Many past articles (e.g., de Palma, et. al. 1985) also assume the same loyal-switcher demand structure with differentiation $d$. For example, our spot demand model parallels Narasimhan (1988) with one exception. Narasimhan assumes Bertrand-Nash competitors. That assumption bars the existence of any pure strategy equilibria. By allowing Stackelberg-Nash competitors, we enable the existence of a pure-strategy equilibrium. Of course, our primary focus involves comparing advance and spot selling rather than these issues.

5.3 The Spot Period

At the time of consumption (i.e., period 2), buyers can be in one of two states: a favorable consumption state with a high valuation or an unfavorable consumption state with a low valuation. In the spot period, buyer evaluation might be either high or low. Let $H$ be the high valuation for loyals (i.e., they will pay at most $H$ to consume their preferred service). Let $L$ be the low valuation for loyals, where $H > L > c$. Similar to leader loyals, switchers will pay at most $H$ in favorable consumption states and $L$ in unfavorable states, respectively, for the leader’s service. However,

---

3 We require a premium greater than zero as a technical condition to insure an equilibrium exists. Otherwise, there is a discontinuity in the demand function when consumers are indifferent between the two sellers.

4 Chintagunta and Jain (1995) develop statistical procedures for testing these types of game theoretic specifications.
to reflect switcher preferences for the leader’s service, switchers will pay at most \( H - d \) in favorable consumption states and \( L - d \) in unfavorable states, respectively, for the follower’s service.

Following customary conventions, we assume consumers buy only when they get a non-negative surplus. Moreover, given several alternatives, they choose the alternative with the largest surplus. When the surplus is equal, buyers choose the alternative favoring the seller. This convention is justified because sellers can resolve buyer indifference with an infinitesimal price reduction.

When sellers only spot-sell, loyals \( (Y) \) choose the action (i.e., spot buy or not) that yields the maximum expected surplus (i.e., \( \max \{ H - p_{2j}, 0 \} \) in favorable states and \( \max \{ L - p_{2j}, 0 \} \) in unfavorable states). Switchers will choose the action (i.e., spot buy from the leader, from the follower, or not spot buy) that yields the maximum surplus (i.e., \( \max \{ H - p_{2L}, H - p_{2F} - d, 0 \} \) in favorable states and \( \max \{ L - p_{2L}, L - p_{2F} - d, 0 \} \) in unfavorable states.

5.4 The Advance Period

In the advance period, buyers are uncertain about their future spot valuations. Let \( q \) denote the probability a buyer has a future high valuation \( H \) in period 2. Hence, the probability of a low valuation \( L \) is \( 1 - q \).

When sellers advance sell, loyals must decide based on expected surpluses. They either advance buy from seller \( j \) or not, depending on their maximum expected surplus, i.e., \( \max \{ ERP - p_{1j}, 0 \} \) where

\[
ERP = qH + (1 - q)L.
\]

Switchers advance buy from the leader, the follower or not at all depending on their maximum expected surplus, i.e., \( \max \{ ERP - p_{1L}, ERP - d - p_{1F}, 0 \} \).

As noted earlier, this section presents the limited-power case where the market power of the leader is limited. The leader must be unable to advance price as a monopolist, i.e., at \( p_{1L} = ERP \). To prevent that, the follower must be able to undercut the leader and profitably capture the switchers by pricing at \( p_{2L} = ERP - d \). Hence, follower profits at \( p_{2L} = ERP - d \) must exceed follower profit at \( ERP - d \). Hence, \( (ERP - c - d)(Y + S) > (ERP - c)Y \).

Given that \( d > 0 \), we obtain the condition that \( 0 < d < (ERP - c)(1 - R) \) where \( R = Y/(Y + S) \).

Note that, the term \( 1 - R \) in this condition measures the relative number of the switchers while \( (ERP - c) \) measures the potential profits from switchers. When either \((ERP - c)\) or \((1 - R)\) decrease, the leader needs less market power to dominate the market because when \((1 - R)\) decreases, the follower gains less by decreasing the price charged to loyals to attract a relatively decreasing number of switchers. When \((ERP - c)\) decreases, the follower has less incentive to fight for switchers given less profit per buyer.
The subsequent analysis only considers limited-power situations where \( 0 < d < (ERP - c)(1 - R) \) because prior research has already analyzed the monopoly case (see Shugan and Xie 2000, Xie and Shugan 2001).

### 5.5 Credibility

Prior research discusses credibility in the monopoly case in some detail (Xie and Shugan 2001). Credibility insures that buyers believe the seller’s claims in the advance period. We now briefly review that concept and then extend it to the competitive case.

Sellers who advance sell must sometimes credibly commit to discounted advance prices (please see Xie and Shugan 2001 for details). In a limited-power case, credibility implies that a seller must not try to sell to some customers in the advance period at \( p_{1j} \) and then sell at a lower spot price \( p_{2j} < p_{1j} \).

There are two ways to establish credibility. First, credibility can be exogenous. Here, rational buyers believe seller claims about future prices because of exogenous factors such as legal constraints or loss of reputational capital.

Second, credibility can be endogenous. Here, rational buyers believe seller claims because deception fails to improve short-term profits (endogenous to the model). Hence, sellers must earn greater profits when \( p_{2j} > p_{1j} \) rather than \( p_{2j} < p_{1j} \). We later show that the claim of a discounted advance price is credible when

\[
q(H-c)Y > (L-c)(Y+S) \quad \text{or} \quad R > \frac{L-c}{q(H-c)},
\]

under which the optimal spot price is higher than the optimal advance price for both sellers.

### 5.6 Price Equilibria

Next, we define \( \hat{p}_{2j} \) as the spot stand-down price for seller \( j \). This price represents the lowest price a seller will adopt when attempting to fight for the switchers with high valuations in the spot period. Sellers will not move to prices that produce less profit than they could earn by selling only to their loyals with high valuations. By spot selling at \( \hat{p}_{2j} \) to both loyals and switchers earns, the seller earns the same profit as selling only to loyals at their maximum valuation, i.e., \( p_{2j} = H \). For example, the follower can earn at least \( (H-c)qY \) with a spot price \( p_{2F} = H \).

Hence, the stand-down price is the minimum price producing the same profit and satisfies the condition

\[
(H-c)qY = (\hat{p}_{2F}-c)q(Y+S).
\]

Similarly, we define \( \hat{p}_{1j} \) as the advance stand-down price for seller \( j \). This price represents the lowest price a seller will adopt when attempting to fight for the switchers in period 1. Sellers will not move to prices that produce less profit than they could earn by selling only to their loyals. By adopting \( \hat{p}_{1j} \), seller \( j \) earns the same profit as pricing at the maximum price that loyals will pay in period 1. For example, the follower’s stand-
down price \( \hat{p}_{1F} \) satisfies the condition \((qH + (1 - q)L - c)Y = (\hat{p}_{1F} - c)(Y + S)\). Given these definitions, Lemma 4 provides the optimal price for seller \( j \) in period \( i \) denoted \( p^*_j \), and the conditions for equilibria for both advance and spot selling.

**Lemma 4 (Price Equilibria)**

In the case of limited-power (i.e., \( 0 < d < (ERP - c)(1 - R) \)), when sellers have credibility (i.e., \( q(H - c)R > (L - c) \)) and a monopolist finds advance selling profitable (i.e., \( L > c \)), both advance and spot selling equilibria exist. The follower sells to only loyals with high valuations by pricing at the maximum price that they will pay. The leader sells to both loyals and switchers with high valuations by pricing at the maximum price that both induces buyers to purchase and preempts the follower from under-cutting. Table 6 reveals the corresponding optimal prices.

**Table 6: Equilibrium Prices and Profits: Unequal Competitors**

<table>
<thead>
<tr>
<th></th>
<th>Leader</th>
<th>Follower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot Sell</td>
<td>( \hat{p}<em>{2L} = \hat{p}</em>{2F} + d )</td>
<td>( p^*_2 = H )</td>
</tr>
<tr>
<td>Advance Sell</td>
<td>( \hat{p}<em>{1L} = \hat{p}</em>{1F} + d )</td>
<td>( p^*_1 = ERP )</td>
</tr>
</tbody>
</table>

Where:

\[
\hat{p}_{1F} = c + (ERP - c)R, \quad \hat{p}_{2F} = c + (H - c)R, \\
ERP = qH + (1 - q)L
\]

Note that, there is a wide range in parameters that satisfies the conditions of Lemma 4. For example, if the number of loyals and switchers are equal, states are equally likely, costs are $1, low evaluations are $3, high evaluations $4, then Lemma 4 is satisfied \$1.25 > d > $0. Hence, the leader must have some power but be unable to price more than $1.25 over the follower’s price and still capture the switchers.

However, the range still creates a restriction not present for the seller not facing competition. Consequently, the seller not facing competition will find advance selling advantageous in a wider set of circumstances.

Table 6 reveals that although the follower acts like a monopolist spot pricing at \( p^*_2 = H \) and advance pricing at \( p^*_1 = ERP \), the presence of the follower in the market causes the leader to lower prices to \( p^*_2 = \hat{p}_{2F} + d \) and \( p^*_1 = \hat{p}_{1F} + d \) respectively.
5.7 Comparison of Advance Selling with Spot Selling

Lemma 4 provides seller prices for both the advance selling equilibrium and the spot selling equilibrium. We now use those prices to compare profits and buyers’ surplus for both equilibria. Theorem 3 follows.

**Theorem 3 (Comparison of Equilibria)**

*In the equilibrium described by Lemma 4, both sellers earn greater profits in the advance selling equilibrium than in the spot selling equilibrium when advance selling improves profits in a monopolist market.*

**Theorem 4 (Win-win-win)**

*In the equilibrium described by Lemma 4, advance selling creates a win-win-win situation with improvements in the buyer surplus and the profits of both sellers when the leader has sufficiently small market power, i.e., \( 0 < d < (L - c)(1 - R) \).*

Theorems 3 proves that when advance selling is more profitable for the monopolist than spot selling (\( L > c \)), both sellers always enjoy a windfall from advance selling in a competitive market under limited-power condition, (i.e., \( 0 < d < (ERP - c)(1 - R) \)). Theorem 4 proves that consumers can gain as well creating a win-win-win situation when the leader’s market power is sufficiently small (i.e., \( d < (L - c)(1 - R) < (ERP - c)(1 - R) \))\(^5\). We discuss the implications of Theorems 3 and 4 in the next section.

5.8 Impact of Advance Selling on Price Cutting

Theorems 3 and 4 reveal three important implications. First, we conclude that competitive sellers with the capability to advance sell should do so. Each seller earns greater profits by advance selling at discounted prices. Advance selling improves profits whenever some buyers would not spot purchase at a high spot price. Competition can magnify this advantage of advance selling.

The second important implication is that the propensity to cut price in the advance period is less than the propensity to cut price in the spot period. To understand, remember that the follower will not want to sell to the switchers

\(^5\) Note that credibility requires \( R > \frac{L - c}{q(H - c)} \) while a win-win-win requires \( 1 - \frac{d}{L - c} > R \), hence the win-win-win only occurs in the range \( 1 - \frac{d}{L - c} > R > \frac{L - c}{q(H - c)} \). As shown in Appendix, some values satisfy this condition. Hence, a win-win-win situation is always possible for some \( Y \) or \( S \).
if the resulting profit is less than the profit from selling only to loyals. When sellers engage in spot selling, the maximum price that follower loyals will pay is \( p_{2f}^* = H \), the lowest price the follower will accept to attract the switchers is \( \hat{p}_{2f} = c + (H - c) R \). Hence, the follower is willing to pursue the switchers with a price reduction of at most \( p_{2f}^* - \hat{p}_{2f} \). When sellers advance sell, the maximum price that follower loyals will pay is \( p_{1f}^* = ERP \), the lowest price the follower will accept to attract the switchers is \( \hat{p}_{1f} = c + (ERP - c) R \). Hence, the follower is willing to reduce price by at most \( p_{1f}^* - \hat{p}_{1f} \). The more the follower is willing to reduce prices, the greater the incentive for price-cutting. It is easy to show that \( p_{2f}^* - \hat{p}_{2f} > p_{1f}^* - \hat{p}_{1f} \), suggesting that when fighting for the switchers, the follower will not accept as large a price reduction in the advance period as in the spot period. This is because the switcher valuations are lower in the advance period making switchers less desirable. Sellers will not fight as vigorously for the switchers in the advance period. Hence, in the cases studied, the propensity to cut prices is greater in the spot period than the advance period.

The third important implication is that with competition, advance selling can improve buyer surplus as well as the profits of both sellers. This win-win-win situation occurs when both sellers advance sell and the leader has insufficient market power to extract the entire buyer surplus. The fact that buyers can benefit from advance selling is somewhat surprising given the finding that the propensity to cut price is less in the advance period than the spot period. The reason is that a decrease in the advance price benefits all of the customers because all customers advance buy at \( p_{1f}^* \). However, a decrease in the spot price only increases the surplus of the \( q \) customers who spot buy at \( p_{2f}^* \).

To be precise, without advance selling, the leader spot sells at \( p_{2l}^* \) and the spot buyers have a surplus of \( q \left( H - p_{2l}^* \right) (Y + S) \) because only a fraction \( q \) of the leader’s consumers buy. With advance selling, the leader advance sells at \( p_{1l}^* \) and the advance buyers have a surplus of \( \left( ERP - p_{1l}^* \right) (Y + S) \). The difference in surplus of leader’s customers between advance and spot selling is \( \left( ERP - p_{1l}^* \right) - q \left( H - p_{2l}^* \right) \) (Y + S). This surplus equals \( (1-q) \left[ (L-c)(1-R)-d \right](Y+S) \). (See the appendix.) As noted earlier, at equilibrium, only leader’s customers have a positive surplus because follower’s customers pay their reservation price (see Lemma 4). Consequently, the difference in total aggregate buyer surplus between advance and spot selling is \( (1-q) \left[ (L-c)(1-R)-d \right](Y+S) \). Hence, as leader’s market power decreases (i.e., \( d \)), the aggregate advance-buyer surplus relative to the spot-buyer surplus increases. In sum, advance selling increases aggregate buyer surplus not merely because of a lower advance price but because more buyers participate in the advance market than would participate in the spot market.
5.9 Relative Advantage of Advance Selling with and without Competition

We now examine whether competition can make advance selling more advantageous in a market with unequal competitors, as it did in a market with equal competitors.

Similar to the case with equal competitors, we now examine the impact of competition on the profit advantage of advance selling in a market with unequal competitors by calculating the advantage ratio,

$$\Theta_j = \frac{\text{Competitor } j\text{'s Profit Advantage from Advance Selling}}{\text{Monopolist's Profit Advantage from Advance Selling}}$$ \quad j = L, F

Hence, $\Theta_j$ measures the profit advantage of advance selling in a competitive market for seller j relative to a monopolist market. Theorem 5 provides follows.

**Theorem 5 (Impact of Competition)**

In the competitive equilibrium described by lemma 4, competition makes advance selling a more attractive marketing tool for the leader but has no impact on the profit advantage of advance selling for the follower. Mathematically, $\Theta_L = 1$ and $\Theta_F > 1$.

Theorem 5 has two important implications. First, the profit advantage of advance selling not only can survive competition when competitors are unequal, but also can be enhanced via competition. Advance selling has two potential advantages compared with spot selling: (1) it increases sales and (2) it reduces the incentive of the competitors to fight for the switchers. The first advantage applies to both a monopoly and a competitive market but the second advantage only applies to a competitive market. This explains why advance selling can be more effective in a market with competition than without it.

Second, the impact of competition on advance selling depends on seller’s market position. Theorem 5 reveals that competition strengthens the profit advantage of advance selling if the seller has market power, but has no effect on advance selling if the seller has no market power. This is because the seller with market power aggressively fights for switchers but the seller without market power focuses on its loyal customers only. Hence, the reduced intensity of competition via advance selling benefits only the seller with a greater interest in competing for switchers. This suggests that the seller with market power should be more interested in developing the capability of advance selling than the seller without such power.

In summary, advance selling can be a powerful marketing tool to increase buyer participation, diminish price-cutting, and generate a higher profit and buyer surplus.
6. Summary and Conclusions

Technological advances in the service sector allow small service providers to develop the capability of administering sophisticated marketing strategies previously enjoyed by only large airlines and hotel chains. These technologies include pre-payment e-commerce web sites, smart cards, broadband communications, electronic ticketing, electronic palm readers and other biometric identification tools.

We have four major findings:

• A seller facing competition can find advance selling more profitable than spot selling when costs are sufficiently low.

• Although advance selling can increase seller profits for a seller facing competitors, the cost conditions required for the advantage of advance selling are restrictive than in a monopolistic market when buyers have a strong preference for waiting to buy. In the competitive market, the cost conditions are a function of consumer-time preference for purchasing. A seller with no competition can overcome preferences for waiting by only advance selling. However, a seller, who advance sells with competition, might lose sales to a competitor who unilaterally spot sells, so a lower cost is often required for advance selling to be advantageous. Consequently, advance selling is only advantageous when cost conditions are such that the competitor has no incentive to unilaterally advance sell. Moreover, there is a parameter region where advance selling is only advantageous in the competitive case. That parameter region corresponds to the case when consumers only have a weak preference for waiting.

• Suppose the cost is sufficiently low so a seller finds that advance selling is more profitable than spot selling with or without competition. Then, given the same cost in both markets, the seller benefits more from advance selling in the market with competition than the market without competition. This benefit comes from the fact that advance selling can diminish competition by mitigating the propensity for competitors to cut price. We find two reasons for this result. First, there is less of an incentive to cut price in the advance period than in the spot period because spot price decreases provide larger gains in volume (i.e., unit sales). Second, in the case of discounted advance prices, there is less incentive to cut price in the advance period than in the spot period because advance price cuts cause a greater proportional decrease in unit profit margins.

• In the case of unequal competitors (i.e., one has market power), the diminished competition is not necessarily at the expense of buyers, whose surplus can improve. In that case, the profit improvement often comes from selling to additional buyers. These are buyers who would be unwilling to pay the future spot price. Hence, everyone can potentially gain creating a “win-win-win” situation. Advance selling increases both sellers’ profit because both are able to sell to more buyers in advance period than in spot period and because the gains from selling to the additional buyers are more than compensates for the discounted advance price. Moreover, advance selling increases aggregate consumer surplus when market power is sufficiently small. This is because
more customers enjoy the reduced price as the result of the low market power in advance period than in spot period given that many of these buyers would find spot prices higher than their valuations.

Hence, advance selling can be a powerful marketing tool. As usual, we leave many interesting and important topics for (hopefully, not too distant) future research. For example, future research might explore the role of refunds in advance selling and how refunds impact competition. Future research might explore the role of repeat purchases in advance selling. Future research might also explore the timing of the sale, the duration between the advance sale and the consumption period, the impact of the length of the consumption period and the types of services most amenable to advance selling. Related to consumer behavior, future research might explore the how consumers react to consumption state uncertainty, whether the seller can manipulate that uncertainty, how the consumer determines expectations, what prices consumers will actually pay in the advance period and whether the purchase itself impacts the future consumption state. Finally, prior research (Wernerfelt Birger and Aneel Karnani 1987) suggests that sellers might also be uncertain about future states. It would be interesting to consider how to modify advance-selling strategies in the situation when both buyer and sellers are uncertain about future states.
References


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