

Advance Selling for Services

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Advance selling occurs when buyers make purchase commitments before the time of service delivery. In return for an advance purchase commitment—consummated with tickets, tokens, vouchers, passes, or certificates—the buyer receives some benefit. The most common benefits are a price discount and a guarantee of future capacity. Each benefit has different profit and demand implications.

Although some sellers have practiced advanced selling, the generality of its profit advantage is just now being realized.¹ Further, recent development in technologies such as electronic tickets, smart cards, biometrics, and online pre-payments now make it appropriate for nearly all services. Advance selling can improve profits for reasons very different from the traditional price discrimination explanations associated with yield management (i.e., charging the price-sensitive segments less). Essentially, advance selling can improve profits when buyers are uncertain about their future valuations of a service.

For example, consider a Chinese restaurant offering a dinner buffet on Saturdays. The value of the buffet to a given customer on a given Saturday evening may depend on factors only known to that customer on that evening. These factors include whether the customer craves Chinese food and the degree of the customer's hunger. Clearly, the greater the craving for Chinese food (relative to other available cuisines) and the greater the hunger, the more the customer will pay for the buffet dinner. However, when Saturday evening arrives, the customer knows these factors and has some valuation (willingness-to-pay) for the Chinese buffet. Before Saturday evening (e.g., on Monday or Tuesday), however, there is some uncertainty in the consumer's mind about future valuations.

A service provider can improve profits by selling the service in advance when the customer has uncertainty. Suppose, at any given Saturday night, there are 100 uncertain customers who are equally likely to be in the consumption state for such a dinner buffet (craving for Chinese food and hungry) and the unfavorable consumption state (preferring a light meal involving another cuisine). Suppose these consumers are willing to pay \$10 when in the favorable state but only \$4 in the unfavorable state. Also suppose that the average variable cost of serving a customer is \$2. Without advance selling, the restaurant can charge a high price of \$10 and sell the buffet to 50 customers who happen to have a high valuation (i.e., \$10) on Saturday evening, earning a profit of $(\$10 - \$2) \times 50 = \$400$. Alternatively, the restaurant can charge a low price of \$4 and sell the buffet to all 100 potential customers, earning a profit of $(\$4 - \$2) \times 100 = \$200$. Now consider advance selling "Discounted Saturday Chinese Dinner Buffet tickets" at a price of \$7 on Mondays that are only good for the following Saturday night. Because favorable and unfavorable states are equally likely, on Monday, uncertain customers will pay $\$10 \times 1/2 + \$4 \times 1/2 = \$5 + \$2 = \$7$ for the Saturday buffet. Hence, by charging \$7, the restaurant will be able to advance sell to all 100 potential customers and make an advance profit of $(\$7 - \$2) \times 100 = \$500$. No spot price can achieve these profits.

We might wonder what is the source of the improved profits for the restaurant. There are two possible sources. First, if the restaurant charges a high spot price of \$10, then, by advance selling, the restaurant adds 50 more customers on Saturday evening, which improves profit by $(\$500 - \$400) \div \$400 = 25\%$. Second, if the restaurant charges a low spot price of \$4, then advance selling increases the profit margin by $(\$5 - \$2) = \$3$, which improves profit by $(\$500 - \$200) \div \$200 = 150\%$. Clearly, spot selling alone can never achieve as high a profit as advance selling unless the seller is able to perfectly identify which customers will pay \$4 and which will pay \$10, and then charge them these respective prices. When the seller can execute this procedure, the seller makes $50 \times (\$4 - \$2) + 50 \times (\$10 - \$2) = \$100 + \$400 = \$500$ which is the same as advance selling at \$7. Of course, such perfect price discrimination is seldom practicable, while advance selling is often practicable.

Note that, in this example, 100 customers purchase at an advance price of \$7. If the seller were to spot sell at this same price (i.e., \$7), only 50 customers

would buy. Hence, advance selling improves profits by selling to more customers at the same price. Also note that, in this example, buyers have similar price sensitivities and arrival times. Moreover, the seller does not have capacity constraints. Hence, advance selling improves the restaurant's profit neither because it allows a greater degree of price discrimina-

tion (because all buyers pay the same price) nor because it leads to a better capacity allocation as in yield or revenue management system (because the

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seller sells and serves all potential buyers in the same respective periods). The profit advantage of advance selling does not require industry-specific factors such as late arrivals by price-insensitive buyers or capacity constraints (common in the airline industry). In fact, advance selling is generally more profitable than spot selling as long as consumers are uncertain about their future consumption states. Since such consumer uncertainty occurs in almost all service markets, advance selling can be a powerful marketing tool for far more sellers than previously believed.²

New Technology and Advance Selling

Although some sellers have practiced advanced selling, older technologies have limited its usefulness. Many recent technological advances such as Internet web sites, electronic tickets, and smart cards are overcoming these limitations and making advance selling possible and desirable for many, if not all, service providers.

New Technology

Internet Web Sites

The wide spread access to Internet web sites allows at least two distinct advantages associated with advance selling. The first advantage is the ability to make transactions at a location close to the buyer. Without web-site access, advance selling requires either the buyer to physically visit the seller (e.g., a restaurant) or for the seller to work with a complex distribution channel. The second-advantage is the ability to present, to the buyer, an assortment of potentially complex options involving detailed pricing schedules. The channel is complex because the capacity limitations require constant communication between channel members to either prevent over-selling of capacity or adjust prices as remaining capacity changes.

Electronic Tickets

Electronic tickets come in two forms. The first form employs a physical ticket. The physical ticket may be primitive compared to the smart card. The ticket contains a magnetic strip or other simple means of storing information. When a purchase occurs, the ticket contains all the relevant information. That information might include the expiration date (if any), the times when the ticket is valid, the value of the ticket, the nature of the pre-paid services, all restrictions on the quantity of pre-paid services, and the quantity of services already consumed. The ticket might also record identifying characteristics of the user including the user name, address, simple descriptive details, and, possibly, a crude picture of the user. As services are consumed, an electronic recorder updates the information on the ticket.

The second form of an electronic ticket is the paperless and centralized system. Most modern airlines employ this system. After customers purchase

services, the service provider records their purchase in a centralized database. When customers use or seek to use services, the service provider accesses the centralized database to check the customer's status and update the database. The centralized computer system can be real-time or delayed. When capacity constraints are binding, ticket sales require some real-time updating. However, updating on usage need only occur at the end-of-the day.

Both the physical and the paperless electronic ticketing systems have advantages and disadvantages. However, physical ticketing systems are usually easier to implement because they do not require the constant real-time communication between every station receiving customers and the central database. With all information on the ticket, record keeping is relatively simple and requires much less sophisticated equipment. By requiring customer identification at the time of use, service providers can avoid the re-sell of tickets. Hence, electronic tickets are simpler to implement than centralized systems because they require less of a communication burden and less centralized computer power.

Smart Cards

Smart cards represent the ultimate electronic ticket. Not only do smart cards provide ample capacity for storing information (e.g., a digital picture of the user, biometric information), smart cards also provide computational capabilities as well. This computational capability allows more advanced applications including high level encryption, sophisticated security protocols to identify users, interaction with other computerized systems, and personalized services.

Why Technology Is Important

These technological advances are having a profound impact on advance selling, providing four major benefits. First, these technologies prevent the resale of advance tickets, an activity known as arbitrage. Second, these technologies lower the actual transaction costs associated with advance sales for both service providers and buyers. Third, these technologies allow far more complex price schedules involving either bundles of services or purchases with complex restrictions on customer usage. Fourth, they provide more information about buyers and demand over time.

Less Arbitrage

To effectively use advance selling, it is important to prevent the reselling of advance tickets. This practice, called arbitrage, usually makes advance selling less profitable or perhaps makes it completely unprofitable. The reason is that very profitable buyers, who would have been willing to pay a high spot price, now purchase from the arbitrageur at a lower price. Profits go to the arbitrageur of the ticket rather than the service provider.

Consider the following example. An individual or organization advance purchases tickets from Disney for admission to Disney's theme park at a discount. Rather than using the ticket for future admission, the original purchaser

then resells the tickets to another buyer who would have purchased a ticket at the gate. The buyer buys from the arbitrageur at a price lower than the spot price but often higher than the advance price. Disney loses the additional profit from the high spot price and the buyer pays more than the discounted advance price. Only the arbitrageur gains from the transaction.

There are two ways that new technology (such as electronic tickets) benefits advance selling by discouraging or preventing the resale of tickets (i.e., the arbitrage of tickets). The first is to hide the true value of a ticket. Before the use of electronically coded electronic strips, the value of a ticket was clearly printed on the face of the ticket. A buyer could readily observe the value and validity of a ticket purchased from a third party. For example, expiration dates, restrictions, and remaining value were all visible.

Electronic tickets encode information either on a magnetic strip or within a computer chip. This encoding makes it difficult for the arbitrageur to re-sell the ticket. With the value concealed, both the arbitrageur and the buyer are unable to authenticate the value of the ticket (if any). Arbitrageurs are unable to easily convince buyers that the ticket provides the claimed services and has not expired.

A second way that electronic tickets frustrate arbitrageurs is by recording buyer identities on the tickets. These tickets allow identity checks. When the buyer redeems the ticket, information encoded on the ticket reveals at least the buyer's name. The ticket can also reveal descriptive information about the buyer. In some cases, the buyer's picture can be encoded on the ticket. These items can all be digitally written to on the electronic ticket using anything from a bar code to encrypted data within the ticket's processing chip. This technology has become so advanced that smart cards currently are used for rapid and accurate identification of individuals at locations requiring the highest level of security. Smart cards allow facial identification, fingerprint matching, and retina scans as well. Of course, for most applications, merely personalizing the tickets allows buyer identification and is sufficient to deter considerable arbitrage.

Lower the Actual Transaction Costs

There are two ways that new technology benefits advance selling by lower transactions costs. First, they avoid the use of a central database and the necessary infrastructure for communicating with that database. Second, they allow sellers to transact with distant buyers without the need for physical presence.

Traditional methods of advance selling often required a central database for implementation and a complete distribution network to issue tickets. It was necessary to access a central database to advance sell a service and, later, to determine a customer's prior credits. Physical distribution of tickets requires special distribution channels (e.g., travel agents or Ticketron). Airlines, for example, maintain central computer systems that maintain accounts and record transactions. Each transaction requires access to the central database.

Using a central database is more costly and complex to implement than an electronic ticketing system. Every station at every location must have continuous access to the central database for the system to function.

Fortunately, new technologies are rapidly overcoming that impediment. As tickets become smarter through advances in technology, it is possible to securely record transaction records within the ticket. An electronic reader at any remote or decentralized location can obtain a customer's transaction records from the ticket itself. For example, a ticket for an under-hood automotive service could contain credits for three oil changes, one tune-up, and two brake inspections. As a customer consumes the services, a local device debits the ticket so that the ticket is kept current. When the customer advance buys additional services, a credit is added to the ticket. The ticket does the accounting and no communication with a central database is required. However, it is possible to keep duplicate records at a central location by downloading ticket transactions on a daily or weekly basis.

Of course, maintaining information within a central database does have some advantages. Central databases are less vulnerable to problems such as ticket fraud and lost tickets. However, further improvements in technologies will soon give electronic tickets the same advantages.

The second way new technologies are lowering transactions costs is that they allow sellers to transact with distant buyers without the need for physical presence. In the past, special distribution channels were necessary to allow advance sales. For example, travel agents sold travel services in advance for service providers who lacked physical contact with customers. Ticket agents did the same. However, many services (e.g., restaurants and printing services) lack established distribution channels for advance selling. New technologies allow these service providers to transact on the Internet. The Internet provides both the function of allowing remote transactions and communicating with customers. Before widespread consumer access to the Internet, communicating the availability and variety (i.e., menu) of possible advance purchase opportunities was prohibitively expensive for many service providers.

Far More Complex Service Packages

New technologies allow far more complex transactions at locations remote from the seller. These transactions can involve service packages with non-linear pricing, bundling, and variable consumption periods. For example, a hotel package can sell a three-night stay at a lower price than a two-night stay, or it can bundle a 3-night stay with a dinner, a breakfast, and, perhaps, tickets to local events. Highly complex packages are possible for many services from car washes to landscaping services.

Moreover, prices as well as all package components can continuously change over time as the service provider learns demand and available capacity changes (e.g., due to cancellations). The service provider can now instantaneously adjust to changing conditions. In fact, it might be possible to make contingent sales, which are similar to the early sales to stand-by flyers at airlines.³

Contingent sales allow buyers to buy excess capacity only during times of low demand. The buyer buys the right to use the service contingent on capacity being available. The service provider, for example, could inform the buyer over the web whether the capacity will be available. When it is, the buyer has the ability to use previously purchased credits (purchased at a discount) for the available capacity. The ultimate effect is better capacity utilization without the underselling of capacity during times of unexpected peak demand.

More Information about Buyers and Demand Over Time

New technologies are allowing the continuous monitoring of demand and quick adaptation to changing demand conditions. New computer systems, interactive electronic monitoring, and electronic payments now allow both rapid changes in marketing decisions as well as experimentation. Using new technologies, the seller can monitor advance sales over time to learn about buyer behavior or changing demand conditions well before the time of consumption. New technologies quickly alert sellers when the price is too low and demand exceeds expectations. Sellers can react by raising prices or limiting amount the amount of capacity sold at the low advance price. New technologies can also alert sellers when the price is too high and demand falls short of expectations. Sellers can quickly react by lowering prices or stimulating demand by offering more service. Without advance selling, the seller has only one period to make these decisions. With these new technologies, sellers can run advance-selling experiments and, by limiting quantities sold, learn more about buyer reactions and current demand conditions.

Not Yield Management

Advance selling is often associated with the topic of yield management. However, yield management (often called revenue management) is sometimes misunderstood. Modern yield management systems (YMSs) only work under very restricted situations.⁴ They require binding capacity constraints. They require a very low marginal cost of serving additional customers. Most importantly, they require an inverse relationship between consumer price sensitivity and customer arrival time. To be specific, YMSs require that less price sensitive customers are unwilling to purchase in the advance period so that advance purchases are made to only low-valuation customers as predicted by traditional models of second-degree price discrimination.⁵

This requirement is reasonable for many services in the travel industry (but not all). Business travelers with expense accounts are usually less sensitive to price than leisure travelers are. They are often willing to pay more than leisure travelers are. Moreover, business travelers, because of last minute scheduling, are often unwilling to advance purchase.

Parenthetically, it is interesting to note that yield management can sometimes help business travelers because, when demand is stochastic, leisure travelers will shift to under-utilized capacity making more capacity available during

peak periods to business travelers.⁶ Hence, because leisure travelers are flexible, they help smooth demand when peak demand is unpredictable.

In any case, YMSs are a form of price discrimination. It is a means of charging business travelers more by reserving capacity for them to purchase at higher prices near the time of consumption. The seller charges a low price in the advance period. The low price encourages sales by leisure travelers. However, service providers must prevent sales at this low price from completely consuming capacity. Therefore, service providers restrict early sales to save capacity for late arrivals that are willing to pay more. A YMS is a sophisticated computer program for saving capacity. As capacity fills from early sales, the YMS raises the price to save sufficient capacity for sales at high prices.

Note that a YMS would be unnecessary if any of these requirements fail to be met. For example, were there sufficient capacity, a YMS would be unneeded. Service providers would merely sell in the advance period to everyone who wishes to purchase. In the spot period, service providers would simply raise the price.

If late arrivals were more price-sensitive than early arrivals (which is true in many industries), a YMS would again be unneeded. It would not be possible to charge early arrivals a higher price because they would all wait to purchase at the lower spot price. Late arrivals by business travelers are necessary to make the system work.

Hence, YMSs can be very effective, albeit under restrictive conditions. Moreover, YMSs produce the common practice of price discrimination. YMSs sell to some buyers at a higher price than to other buyers. For that reason, many buyers consider price discrimination unfair. It generally creates an unfavorable image for the service provider who is thought to be price gouging. It is often better to provide some additional benefit when charging a higher price. Unlike a YMS, the profit advantage of advance selling requires neither industry-specific characteristics nor price discrimination.

Enormous Profit Potential without Price Discrimination

Advance selling is a general marketing tool that can help most service providers to improve profits, even by as much as 100%. Advance selling can be profitable for a service provider when consumers have uncertainty about their future valuation of the service. The value of a service (such as a vacation package, a Broadway show, or an amusement park pass) to a given buyer is not fixed but may vary from time to time, even if the quality of the service is constant. The reason is that consumers can have multiple consumption states, and the level of enjoyment for a service depends on the state of the consumer. A buyer's consumption state in the consumption period is often determined by personal factors such as health, mood, finance, work schedule, and family situations. Consumers might enjoy watching feature films at movie theaters when they lack distractions and are not preoccupied, rather than when pressing matters demand attention. Consumers might enjoy amusement parks more when they are alert

or can attend with friends, rather than when they are fatigued or when friends are unavailable. Consumers might enjoy cruises more when they have good health and are relaxed than when they are ill or have to prepare a business presentation scheduled one day after the vacation.

At the time that consumers advance purchase services (e.g., buying tickets, vouchers, or passes), they may be uncertain about their future enjoyment or their valuation associated with the consumption of the service. For example, consider a three-day ski resort package (including lodging, lift tickets, and equipment rental) valid in the first week of February. A consumer may be willing to pay a maximum \$250 for such a package given a favorable consumption state or a maximum of \$150 for the package given an unfavorable state (e.g., if a close friend happens to be in town or if the consumer is having minor back pain). However, if the consumer were advance purchasing the winter package in the fall (say October), the consumer would be uncertain whether the package would eventually be worth \$250 or only \$150.

This uncertainty creates symmetry between the buyer and seller in the advance period. In October, neither the buyer nor the seller knows what the consumer's valuation of the service will be several months later. In February, however, the seller is at a disadvantage because only the buyer knows whether the package is worth \$250 or \$150. Hence, the seller is at a disadvantage negotiating with the buyer with spot selling. In theory, sellers should do better by negotiating with buyers at the time when the seller does not have a disadvantage in information. In this example, that could be weeks or months before the first week of February.

In the spot period (i.e., the first week of February), the consumer is willing to pay either \$250 or \$150 for the package. Suppose that there are 100 of these consumers. Suppose that about half the consumers will be in a favorable state (i.e., willing to pay only \$250) and the other half will be in an unfavorable state (i.e., willing to pay \$150). In other words, there is a fifty-fifty probability of a favorable state in the spot period. Suppose that it costs the seller \$80 to serve each customer.

As the seller, we could charge one of two spot prices. In the spot period, we could charge \$150 for the ski resort package and all 100 consumers would buy. Our profit would be $100 \times (\$150 - \$80) = \$7,000$. We could also charge a price of \$250. However, then only consumers in favorable states would buy and we would sell to only 50 buyers. Our profit would be $50 \times (\$250 - \$80) = \$8,500$. Hence, it would be better to sell at \$250 to only customers in favorable states.

Now suppose that we sold tickets in the advance period (i.e., October). In that case, customers would only buy when a sufficient discount is offered. Otherwise, buyers would wait and decide whether to pay \$250 in February. To determine how much of a discount we must offer, we determine how much consumers are willing to pay in the advance period. They expect a fifty-fifty chance of \$250 or \$150, hence they should be willing to pay about the average, i.e., $(\$250 + \$150) \div 2 = \$200$. When we charge \$200 in the advance period,

then all of the consumers are willing to buy. Our profit from advance sales is $100 \times (\$200 - \$80) = \$12,000$. We earn more profits by advance selling at \$200 than spot selling at either \$250 or \$150. To be precise, we earn $(\$12,000 - \$8,500) \div \$8,500 = 41\%$ more profit by advance selling.⁷ (Although we presented the example for only one specific set of numbers in this discussion, the conclusion is quite general and only requires that buyer valuations are above seller costs in the spot period. Please see the Appendix for details.)

Advance selling increases profits when it allows advance sales to buyers who would be in unfavorable states later and would not purchase under a spot-only selling strategy. Selling to those buyers, however, is unprofitable when they value the product/service less than its cost. When costs are too high, advancing selling might provide no greater profits than spot selling. Advance selling increases profits over spot selling for any distribution of consumer valuations provided that valuations are above cost. With a combination strategy (both advance and spot selling), we also require that buyers believe that the spot price will be sufficiently higher than the advance price.⁸

Regarding the exact price at which a service provider should advance sell, determining that price should be done in the same way that the service provider determines the best spot price. One method would be experimentation. The best procedure is to start with an advance price slightly below the spot price and gradually reduce it. As long as the advance price is above cost, the cost of the experiment is limited.

An Example with Price Discrimination

In markets with heterogeneous buyers, sellers can take advantage of this heterogeneity by adopting a combination strategy: advance selling at a discounted price and spot selling at a high price. Consider, for example, a car rental company located at an airport. The rental company offers two possible re-fueling options. The first option is for the car renter to advance purchase a full tank of fuel. The second option is to return the gas tank full and pay a high spot price for any missing fuel. This type of option is currently prevalent for some car rental companies. When deciding whether to advance purchase the fuel, the car-renter is uncertain about the consumption state when the car is returned. The renter can envision two possible outcomes. First, the car-renter may find a convenient gas station en route to the airport and find the refueling effortless. Here, the utility of an advance purchase full tank of gas is low. Second, the car-renter may arrive late at the airport, be unable to find a convenient gas station (i.e., risk missing a flight in an effort to find a gas station) or pay a high spot price for gasoline from the rental company. In this outcome, the utility of an advance purchased full tank of gas is high.

Suppose there are two buyer segments. First, the informed segment is relatively disposed toward buying spot and will look for a gas station. This informed segment may be renters who travel often. They have flexible schedules, have sufficient time en route, and are comfortable reading a map. In short,

these informed renters are more likely to find a gas station with ease. For this example, assume that this segment has a 90% chance of finding a gas station. Second, the uninformed segment is relatively disposed toward a state of avoiding a last minute gas purchase. They are less informed renters who have a lower chance of finding a gas station before their plane departs. The uninformed segment consist of renters who are unfamiliar with the city, are on a very tight schedule, often get lost, and have trouble managing their time. Assume this segment has a 60% chance of finding a gas station. In this example, assume the spot fuel price charged by the car rental company is set to a legal maximum of \$50 per tank. The price for gasoline at city gas stations is \$10 per tank. Suppose each segment uses one tank of gasoline.

The expected cost of gas is different for the two segments. Members of the informed-segment expect to pay $(.9)(\$10) + (.1)(\$50) = \$14$. Members of the uninformed segment expect to pay $(.6)(\$10) + (.4)(\$50) = \$26$. For simplicity, assume each segment has 100 members and the marginal cost is zero. When the seller charges all buyers the same price, there are three possible single-price strategies. First, spot sell at \$50 and (given that 10% and 40% of the informed and uninformed segments buy, respectively) the seller earns $100 \times (0.1 + 0.4) \times \$50 = \$2,500$. Second, advance sell at \$14 and (given that both segments buy) the seller earns $200 \times \$14 = \$2,800$. Third, advance sell at \$26 and (given only the uninformed segment buys) the seller earns $100 \times \$26 = \$2,600$. We see advance selling at \$14 is most profitable. Advance selling is more profitable than spot selling because it increases buyer participation.

With heterogeneous buyers, advance selling can further improve profits by price discriminating between the two segments with a combination strategy: advance selling at a discounted price and spot selling at a high price. For example, suppose the seller advance sells at \$25 and spot sells at \$50. In this case, members of the informed segment will choose to wait because their expected cost is only \$14 if they wait, but members of the uninformed segment will choose to advance buy because they face an expected cost of \$26. Hence, a combination of an advance price of \$25 and a spot price of \$50 earns $100(\$25) + 100(.1)(\$50) = \$3,000$. Note that the car rental company earns greater profits with a combination of an advance price of \$25 and a spot price of \$50 than having either a spot or advance price alone. This is true despite the fact that the car rental company earns no profits when either segment buys their gasoline from an alternative source and the fact that the \$25 is not the optimal advance price.

Capacity Constraints

Capacity constraints can create some additional complexity. The primary advantage of advance selling in the preceding example was to sell to more buyers than would be possible when not advance selling. However, selling to more buyers may be infeasible when we reach the limits of our capacity. On the other hand, capacity constraints may make advance tickets more attractive to buyers because advance purchase implies guaranteed service. Consequently, sellers can

benefit from advance selling when facing capacity constraints. Specifically, two new advance-selling strategies can be profitable under capacity constraints: advance selling with limited sales; and advance selling at a premium price.

Advance Selling with Limited Advance Sales

While capacity constraints often reduce the seller's advantage of increased customer participation made possible by advance selling, the seller can still benefit from advance selling by adopting a different strategy—advance selling with limited advance sales. When sellers face capacity constraints, this strategy is often more profitable than spot selling as well as the advance selling without a limit on advance sales.

To demonstrate the impact of capacity constraints, consider the pricing decision of a skating rink. Suppose that potential skaters have an equal chance of being in a favorable and an unfavorable state. They will pay \$12 for a ticket (with skate rental) when in a favorable state but only \$7 in the unfavorable state. Suppose, as the seller, we have the capacity to safely serve 60 skaters at any given time and the average cost per customer is about \$2. There are normally 50 potential customers during weekdays and 100 potential customers during weekends. Clearly, we have sufficient capacity for weekdays but insufficient capacity for weekends.

Given no capacity constraints during weekdays, we should advance sell our weekday skating tickets at $(\$12 + \$7) \times 1/2 = \$9.50$ rather than spot sell at \$12 or \$7. The reason is that an advance price of \$9.50 earns us a profit of $50 \times (\$9.50 - \$2) = \$375$, while spot selling at a high price of \$12 earns a profit of $25 \times (\$12 - \$2) = \$250$ and spot selling at a low price of \$7 earns a profit of $50 \times (\$7 - \$2) = \$250$.

Let's consider our pricing strategy for weekends when we have 100 potential customers but can only serve 60. If we only sell in the spot period at \$12, we could sell to the 50 customers in favorable states and earn a profit of $50 \times (\$12 - \$2) = \$500$. If we only sell in the spot period at \$7, one hundred customers would buy, but we have capacity for only 60. Hence, our profits would be $60 \times (\$7 - \$2) = \$300$. If we were to advance sell at \$9.50, one hundred customers would buy, but we have only 60 tickets. Our profits would be $60 \times (\$9.50 - \$2) = \$450$. Clearly, our best profits are earned by not advance selling but spot selling at \$12. This reasoning suggests that capacity constraints can reduce the seller's need for advance sell, thus make advance selling less attractive.

However, let's consider a different advance selling strategy: selling only limited capacity in advance period and selling the rest of the capacity in spot period. Suppose we advance sell at a discounted price of \$9.50 but limit advance sales to only 20 customers. In that case, we would advance sell 20 tickets at \$9.50, earning $20 \times (\$9.50 - \$2) = \$150$. That would leave 80 customers in the spot period. Of those 80, half of them or 40 customers would be willing to pay \$12, and our remaining capacity ($60 - 20 = 40$) can serve 40 customers. Hence, we can sell to those 40 customers at \$12 and earn additional spot profits of

$40 \times (\$12 - \$2) = \$400$. Our total profits are $\$150 + \$400 = \$550$. That strategy earns more profits than the spot selling alone $50 \times (\$12 - \$2) = \$500$ or advance selling alone $60 \times (\$9.50 - \$2) = \$450$.

When capacity constraints are limited but still exceed demand at high prices in the spot period, limiting advance sales can be best. In this case, limiting advance sales can improve profits because limits save sufficient capacity for very profitable sales in the spot period.

Advance Selling at a Premium Price

Advance selling at a premium price occurs when the best advance price is higher than the best spot price. Again, consider the example of the skating rink, but with one additional complication. Suppose in addition to the 100 people who arrive in advance period, there are an additional 200 people arrive during the spot period. In addition, suppose that the 200 arrivals in the spot period are willing to pay at most \$8 for our service. Of course, these late arrivals are unable to purchase advance tickets.

First, consider the case without capacity constraints. In this new example, we can spot sell at \$12, \$8, and \$7. A spot price of \$12 sells only to those in favorable states and earns profits of $1/2 \times 100 \times (\$12 - \$2) = \$500$. A spot price of \$8 sells to those in favorable states as well as late arrivals. It earns profits of $(50 + 200) \times (\$8 - \$2) = \$1,500$. Finally, a spot price of \$7 sells to everyone and earns profits of $(100 + 200) \times (\$7 - \$2) = \$1,500$. Hence, without capacity constraints, our spot prices of either \$7 or \$8 maximize our profits.

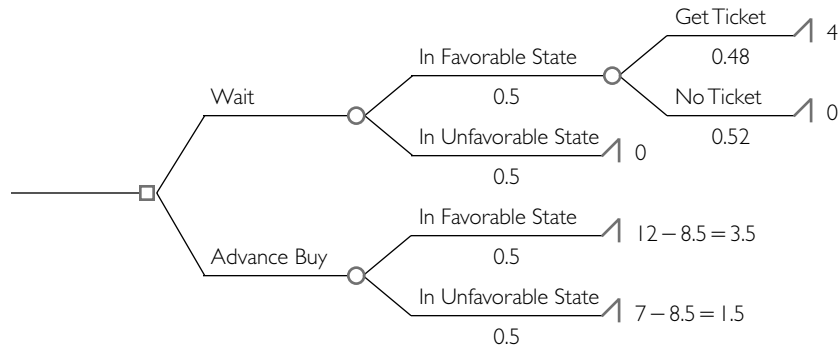
Note that advance selling at \$9.50 as in the previous example is infeasible because early arrivals will wait to pay the lower spot price rather than advance buying at \$9.50. Hence, so far, advance selling fails to improve profits. However, now consider the impact of capacity constraints.

Suppose we have a capacity constraint of 120. We will find that this capacity constraint makes it possible to advance sell at a higher price. With a capacity constraint of 120, again we can spot sell at \$12, \$8, and \$7. A spot price of \$12 sells only to those in favorable states and earns profits of $1/2 \times 100 \times (\$12 - \$2) = \$500$. A spot price of \$8 sells all of our available capacity. It earns profits of $120 \times (\$8 - \$2) = \$720$. Finally, a spot price of \$7 sells all of our available capacity. It earns profits of $120 \times (\$7 - \$2) = \$600$. Hence, with capacity constraints, our best spot price is \$8.

Now consider advance selling at \$8.50. We must ask whether customers will advance buy at \$8.50 when the spot price is only \$8. Let's consider the tradeoff faced by customers. As shown in Figure 1, customers have two choices: buy the ticket in advance or delay their purchase decision.

If they advance buy (see the lower part of the tree in Figure 1), there are two possibilities that can occur in the spot period. Each possibility occurs with equal likelihood. First, they may be in an unfavorable state in the spot period and only willing to pay \$7. They advance bought at \$8.50, so they overpaid and suffer what economists call a negative surplus of $(\$7 - \$8.50) = -\$1.50$. There is

FIGURE 1. Buyer Decision When Facing Capacity Constraints



$$\text{Surplus (Wait)} = (0.48)(0.5)(12 - 8) = 0.96$$

$$\text{Surplus (Advance Buy)} = (0.5)(12 - 8.5) + (0.5)(7 - 8.5) = 1$$

→ **Buyer's Decision: Advance Buy even though the advance price is higher than the spot price.**

also a second possibility. They may be in a favorable state in the spot period. In that case, they enjoy a gain. They are willing to pay \$12 but only pay \$8.50 in advance period, hence the gain (also known as a surplus) from advance buying is $(\$12 - \$8.50) = \$3.50$. Given a fifty-fifty probability of being in a favorable and an unfavorable state, their expected surplus from advance purchase is $(\$3.50 - \$1.50) \div 2 = \$1$.

Now consider their expected surplus from delaying their purchase decision (see the upper part of the tree in Figure 1). If they will be in an unfavorable state, they will not spot buy at \$8 because they are only willing to pay \$7. In that case, they receive a zero surplus. If they are in a favorable state, in contrast, they will try to buy at the spot price of \$8. However, they may or may not get capacity. If they can successfully get the tickets, they will enjoy a surplus gain of $(\$12 - \$8) = \$4$, but if they fail to get the tickets, they will get a zero surplus. Note that, we have capacity for only 120 customers while there will be 50 (first period arrivals who are in a favorable state) + 200 (second period arrivals) = 250 customers in the spot period. Hence, there is only a $120 \div 250 = .48$ chance of obtaining capacity in the spot period. It is easy to see from Figure 1 that, if customers wait, they will get an expected surplus of $.48 \times .5 \times 4 = \0.96 , which is lower than the surplus they receive if they advance purchase, i.e., \$1. Hence, consumers who arrive in the advance period should be willing to advance purchase at \$8.50 to guarantee capacity and a higher expected surplus. Although the \$8 spot price is lower, they prefer to advance buy at \$8.50 over waiting because the \$.40 premium insures capacity in the situation when both capacity is unavailable and they are in a favorable state (i.e., willing to pay \$12).

Hence, premium advance selling can be optimal. Finally, note that the optimality of premium advance selling can depend on the amount of available capacity, the distribution of consumer valuations, the marginal cost of the service, and consumer expectations.

Summary and Conclusions

Advance selling is a more powerful marketing tool than previously believed. The profit improvement from advance selling can be tremendous and this profit improvement does not require industry-specific factors such as early arrivals by price sensitive customers. The key condition for the profitability of advance selling is buyers' uncertainty about their future consumption—a common buyer characteristic existing in almost all service markets. Rapid advances in technology (e.g., computerized transaction systems and Internet interfaces) are now making advance selling more profitable than ever by lowering transaction costs and discouraging arbitrage.

Compared with spot selling, service providers have an advantage when selling before the period of consumption. The reason is that the relative uncertainty of the seller about the buyer's consumption state increases as the time of consumption approaches. Well before consumption, both buyers and sellers have nearly the same degree of uncertainty. As the consumption period approaches, buyers gain more information than sellers do about their own buyer consumption state. Service providers have a relative advantage by selling in the advance period because, unlike the spot period, neither the buyer nor the seller knows their consumption states.

To summarize the conclusions:

- The profit advantage of advance selling can be enormous. It is possible for the service providers to double their profits by adopting advance-selling strategies.
- Advance selling can increase sales by selling to more customers in the advance period than would purchase at the same price in the spot period.
- Advance selling can be more profitable than spot selling alone when buyers have multiple possible consumption states; and they are willing to pay more than the incremental cost of serving them in a sufficient number of those states.
- The added profitability of advance selling will vanish if the marginal cost is too high. The reason is that advance selling increases sales by selling to buyers in the advance period who would have later found themselves in unfavorable states and, consequently, would not have purchased at the same price in the spot period. Advance selling increases buyer participation by charging a discounted price that generates additional sales albeit at a lower profit contribution. When the cost is too high, service providers gain no profit advantage from the additional sales generated at a discounted advance price.

- The service providers can implement different types of advance selling strategies. For example, the service providers can either offer only advance tickets or a combination of advance tickets and spot tickets. They can advance sell at a discounted or a premium price. They can limit the sales of advance selling or sell to all buyers who are willing to advance buy. The optimal advance selling strategy is determined by market/service conditions.
- When facing homogenous buyers, service providers can sometimes maximize profits by only advance selling (i.e., no spot selling). An advantage of an advance-selling-only strategy is that service providers could offer advance tickets at a higher price than the price at which spot tickets would have been sold and buyers would not wait to buy. Capacity constraints or reputation can make this a credible strategy.
- When facing heterogeneous buyers who differ either in their arrival time or their uncertainty about future consumption states, service providers can use advance selling to segment the market. Advance selling increases opportunities for service providers to price discriminate between buyers by offering a higher spot price than the discounted advance price.
- To implement such a combination strategy (advance selling at a discounted price and spot selling at a higher price), the announced high spot prices need to be credible (i.e., buyers must believe the spot price will be higher than the advance price). Otherwise, buyers will wait rather than commit to advance purchase. Different factors can ensure the credibility of the announced high spot prices. For example, when service providers have capacity constraints or when a reputation for honesty is essential to business survival (e.g., most profits are from repeat business), the announced high spot prices will be credible. Also, when service providers simultaneously offer discounted advance tickets (for future days) and higher priced spot tickets (for today), buyers can observe both prices of advance and spot tickets. Finally, a sufficiently high marginal cost can create sellers' credibility because buyers believe that such a high cost will lead to high spot prices.
- When service providers have sufficient capacity to serve customers with high valuation (those in more favorable states) but insufficient capacity to serve all buyers, it is best to limit advance sales to reserve capacity for spot sales to buyers with high valuations. By advance selling to a limited number of buyers at a discounted price and spot selling to buyers in favorable consumption states at a higher price, service providers can best utilize their capacity and achieve the highest profits.
- When service providers have capacity constraints, it is sometimes best for service providers to charge advance prices that are greater than the subsequent spot price. Buyers will be willing to advance purchase at a premium to spot prices when they expect binding capacity constraints may prevent them from spot purchasing. Moreover, by advance selling some

capacity in the advance period, the seller can convince buyers that spot capacity will be limited.

APPENDIX

To show the generality of our conclusions, we present a general model of advance selling and derive conditions under which advance-selling profits π_A are greater than spot-selling profits π_S . This model identifies conditions when advance selling is more profitable given any number and distribution of consumption states.

Let c denote the constant marginal cost for providing the service. Let N denote the number of consumers. In the advance period, consumers don't know their valuations in the spot period, but they know their expected valuation is X and their minimum valuation is $L < X$. We assume that $L > c$ which is not a restrictive assumption because we could offer guaranteed refunds of c with no loss in profit. Finally, let q be the probability that spot valuations are no less than spot price p_S where, of course, q is a function of p_S . We show advance selling is more profitable than spot selling for *any* p_S . There are two cases $p_S < X$ and $p_S \geq X$.

- *Case 1. $p_S < X$* —Here, advance profits $(X - c)N$ are greater than spot profits $(p_S - c)qN$ because $q \leq 1$ and $p_S < X$.
- *Case 2. $p_S \geq X$* —Here, a fraction q of consumers will pay at least p_S in the spot period (i.e., their mean valuation is at least p_S) and the remaining $1 - q$ will pay at least L . Hence, the expected valuation X for all consumers must be at least $qp_S + (1 - q)L$. Consequently, advance profits $\pi_A = (X - c)N$ must be at least $([qp_S + (1 - q)L] - c)N$.

Rearranging yields $\pi_A \geq (1 - q)(L - c)N + (p_S - c)qN$. However, spot profits are $\pi_S = (p_S - c)qN$. Substituting yields $\pi_A \geq (1 - q)(L - c)N + \pi_S$.

So, advance selling at X is more profitable than spot selling at any spot price, p_S , provided that $q < 1$ and $L - c > 0$. The condition $q < 1$ insures that there is some consumer uncertainty (i.e., sometimes buyers will pay more than L). The condition $L > c$ insures that costs are sufficiently low so that serving lower valuation customers produces some profits. Note that this latter condition is *not* required when X is strictly greater than $qp_S + (1 - q)L$ at the p_S . Hence, advance selling is more profitable than spot selling under fairly general conditions.

Notes

1. Recent articles on this topic include: Steven Shugan and Jinhong Xie, "Advance Pricing of Services and Other Implications of Separating Purchase and Consumption," *Journal of Service Research*, 2 (February 2000): 227-239; Jinhong Xie and Steven M. Shugan, "Electronic Tickets, Smart Cards, and Online Prepayments: When and How to Advance Sell," *Marketing Science*, 20/3 (Summer 2001): 219-243; Steven Shugan and Jinhong Xie, "Advance-Selling Strategies with Competition," *Review of Marketing Science* working paper series, WP No. 2001213, February 2001, <http://roms.utdallas.edu/working_series.asp>.
2. Ibid.
3. For example, see Eyal Biyalogorsky and Eitan Gerstner, "Contingent Pricing to Reduce Price Risks," *Marketing Science* (forthcoming).

4. Ramarao Desiraju and Steven Shugan, "Strategic Service Pricing and Yield Management," *Journal of Marketing*, 63/1 (Winter 1999): 44; Jeffrey I. McGill and Garrett J. Van Ryzin, "Revenue Management: Research Overview and Prospects," *Transportation Science*, 23/2 (May 1999): 233-256.
5. James D. Dana, Jr., "Advance-Purchase Discounts and Price Discrimination in Competitive Markets," *The Journal of Political Economy*, 106/2 (April 1998): 395-422.
6. James D. Dana, Jr., "Using Yield Management to Shift Demand When the Peak Time Is Unknown," *The Rand Journal of Economics*, 30/3 (Autumn 1999): 456-474.
7. Note that we can view this example as a problem in hidden knowledge contracting framework. For example, see Jean-Jacques Laffont and David Martimort, *The Theory Of Incentives: The Principal-Agent Model* (Princeton, NJ: Princeton University Press, 2000). However, unlike extant models: our model is self-enforcing (in period 2, the buyer wants to consume and it is always profitable for the seller to produce); the buyer is unable to extract a rent from hidden knowledge; and risk-aversion has a different impact on our agents. For a discussion on risk-aversion, see Xie and Shugan, *op. cit.*
8. For more discussion of this issue, see Shugan and Xie (2000), *op. cit.*, as well as Xie and Shugan, *op. cit.*

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