Advanced sales and competition in a service industry

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Abstract: This paper analyses the relationship between a firm’s interest in advanced sales and the competition intensity in the market when consumers adopt a strategic behaviour in purchasing. We demonstrate how firms in a more competitive market have more incentives to offer advanced sales. When a firm increases their advanced sales, the profits of last-minute sales go down; therefore, a firm will aim to sell in advance until the expected profit on the margin for advanced sales equals the marginal profit lost for last-minute sales. When competition goes up, the marginal profit lost at last-minute market for increase advanced sales goes down, so it is in the firms’ best interest to increase advanced sales and to decrease last-minute sales. Therefore, competition encourages advanced sales.

Keywords: services marketing; game theory; advance sales; competition.

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Biographical notes: Miquel Carreras-Simó received his Bachelor in Economics from Universitat Autonoma de Barcelona (UAB). He received his Master in Economics and Business and his PhD in Economics and Business from Universitat Pompeu Fabra (UPF). Currently, he is a Full Professor at the Faculty of Economics and Business Sciences from Universitat de Girona (UdG). His research interests include marketing economics, sport economics and industrial organisation.

1 Introduction

Advanced sales are a marketing strategy normally employed by service firms. For instance, in businesses such as car rental, airlines, theatres or hotels, it is commonplace that firms make sales commitments before the time of service delivery. The extension of this marketing practice has been favoured by technological advances such as the internet (Shugan and Xie, 2004). The development of management paradigms such as Revenue Management (Harris and Peacock, 1995; Chiang et al., 2007) has also helped to spread its use. Essentially, these paradigms promote the use of advanced sales in order to confront two particular issues in the marketing of services. On the one hand, service firms provide a perishable product which is not storable (Parasuraman and Varandarajan, 1988) and, on the other hand, they dispose of a limited capacity to meet their demand. Thus, service
firms can use advanced sales as a marketing tool in order to guarantee that their service is marketed and that they obtain the highest possible revenues (Desiraju and Shugan, 1999).

In order to explain how the use of advanced sales can improve the profitability of a service firm in a monopolistic situation, two well-established theoretical and complementary arguments have been used in marketing and economics literature. One of these arguments relies on advanced sales as a marketing mechanism to implement price discrimination (Png, 1991; Dana, 1998; Desiraju and Shugan, 1999; Nocke et al., 2011). Let us consider a context in which a service provider faces different market segments arriving at different times to purchase the service. Let us also assume that the less price-sensitive segment prefers to purchase the service at the last minute. Thus, if the capacity of a service firm is greater than the demand of the less price-sensitive segment, then the service provider can improve its profitability, provided it is able to sell in advance this capacity that is unused by a less price-sensitive segment, to higher price-sensitive segments. Another complementary argument shows how advanced selling can improve a firm’s profit when future demand is uncertain and the service capacity is previously established – Dana (1999) and Shugan and Xie (2000, 2001, 2005). When demand is uncertain, a service provider can increase its expected sales and its profits too, provided it sells its services in advance at an appropriate price, given consumer expectation, in contrast to selling only at the last minute. Moreover, Möller and Watanabe (2009) show how, in a monopolistic market for which consumers face individual demand uncertainty but rationing risk is low (the risk of not getting a product at the last minute), a monopolistic firm will use advance purchase strategies in order to increase its profits. In the opposite case, the best strategy for a monopolistic firm will be clearance sales – see Jensen and Drozdenko (2008) in order to obtain some empirical evidence on this subject.

When considering advanced sales in a competitive situation, a relevant question arises: how can competition modify a firms’ interest in advanced sales? Some previous works have discussed this relationship. Shugan and Xie (2005) consider a duopolistic framework where firms choose if their services are sold either in advance or at the last minute, each firm deciding a single marketing policy (advance sales or last-minute sales). In this context, they show that market advance selling is a more profitable strategy than last-minute sales, which are bound to more restrictive conditions than those in a monopolistic scenario. Moreover, when these restrictive conditions apply, then duopoly competition increases firms’ interest in advanced sales. However, this framework does not capture the real trade-off for a firm between advanced and last-minute sales, because firms adopt a single marketing policy. Ng and Lee (2008) analyse this trade-off in a duopolistic context. They consider two markets, one being the advanced market and another being the last-minute market, and assume that advanced demand depends on last-minute supply but last-minute demand does not depend on advanced sales. Thus, increasing supply in the last minute has a negative impact on advanced sales, but increased advanced sales have no negative effect on last-minute sales. In this context, they show that competition can reduce the firms’ interest in advanced sales. Compared with a monopolistic scenario, the total of advance sales supplied in a duopoly scenario is lower. These previous works consider a framework in which consumers do not decide strategically when buying the service. Levin et al. (2010) show that, when a firm ignores strategic consumer behaviour in purchasing, its total revenues turn out to be much lower than when it does not. Liu and Ryzin (2008) also consider how competitive firms can use strategic capacity rationing to induce early purchases in a context where commitments are met and consumers behave strategically. Thus, a firm can ration the services it supplies at
the last minute in order to make the purchase riskier, thus increasing profits. They show that increased competition eliminates the firms’ ability to support segmentation between advanced and last-minute sales. Therefore, competition reduces a firms’ interest in advanced sales.

Advanced-sales strategies are related to dynamic pricing. Dynamic management of pricing means that a service firm is reviewing the price of an unsold service, as it is at roughly the time of delivery and consumption, and the firm gets updated information on market conditions – see den Boer (2015) for a survey on dynamic pricing and learning literature. In this context, the challenge for a firm lays in being able to set the optimal price at each moment before the time of service delivery, given available information. At all times, when a firm sets a lower (higher) price for the service not sold, it increases (decreases) the likelihood of selling the service at this stage, but the company is giving up (expediting) the expected income it could get if it sold the service later. Therefore, the dynamic-pricing policy that is optimal at each moment should comply with this trade-off at all times. Moreover, this dynamic policy must be updated as the company gains further insight on current and future market conditions. Several studies have incorporated competition in a context of dynamic pricing, its purpose being to characterise the competitive equilibria that arise in this strategic framework, as well as to propose computational approaches in order to implement optimal pricing policies in such contexts. These studies generally assume a restricted competition context (duopoly) and no strategic consumer behaviour. We will discuss the model insights in light of dynamic pricing within a competitive context in this work’s conclusion.

Some empirical evidence shows that, when competition proves stronger, firms can be interested in strengthening their advance-sale strategy. For instance, the North American hotel industry suggests that, compared with their competitors, hotels engaged in direct competition obtain higher profits whenever they maintain comparatively higher prices and avoid going into competition by offering last-minute discounts in order to fill rooms (Enz et al., 2004). A way to achieve this is by developing an adequate advanced sales management, which would reduce a hotel’s interest in supplying last-minute discounts and, in this way, reduce price competition. Therefore, revenue management policies must consider the competitive conditions of the relevant market. North American hotels certainly seem to be altering their revenue management policies under certain competitive conditions (Enz et al., 2005). Moreover, empirical evidence seems to suggest that a stronger positive correlation exists between occupancy and profitability in hotels where the revenue management is adequate, and these marketing policies are designed as a function of their competitive context. We can verify similar empirical evidence in the Spanish hotel sector, where some hotel companies are interested in designing advanced-sales policies as a mechanism for smoothing out the growing intensity of the competition. Thus, whilst the number of rooms in higher quality hotels (four and five-star hotels) in Spain increased by 52.5% in the period between 2000 and 2004, the number of rooms reserved two months in advance increased by 61.7%. Consequently, the ratio between rooms booked two months in advance, with regard to occupied rooms, grew up from 30% in 2000 to 36% in 2004. However, this ratio decreased in the lower quality hotel sector, where competition also decreased, dropping as it did from 32.8% in the year 2000 to 28.7% in the year 2004.

This strategic approach based in strengthening advanced sales could also be a marketing strategy tool that is adopted by some European low-cost airlines (Koenigsberg et al., 2004). Some of these firms focus their marketing efforts on advanced sales, so that
prices are low at the outset and, inversely, increase over time with available unused seats. This strategy could lead to a clear objective, reducing available capacity over time in order to reduce competition intensity in the last-minute segment and, in this way, obtain a higher profit. In recent years, however, one could argue the increasing competition in airlines markets may justify a firms’ interest in reinforcing advanced sales strategy.

Our wok presents a competitive scenario where consumers must choose between purchasing the service in advance or at the last minute in a strategic way. Thus, last-minute demand depends on advanced sales, and higher advanced sales will decrease last-minute demand. Each consumer is uncertain as to their subjective value of the service at the last minute, so they can choose to either buy the service in advance or at the last minute, once they know their specific personal criteria. Firms must decide how many of their services they sell in advance and how many they sell at the last minute, thus establishing the point where there is a trade-off between these commercial strategies. Our work presents a model in which competing firms simultaneously choose their service allocations for advanced sales, and then, at the last minute, they will simultaneously choose their service allocations for last-minute sales. The competition model is a Cournot (1838) style one, whereby competing firms choose how many services to sell in advance and then the price of advanced sales rises, cleaning the market, the same scenario develops with last-minute sales. In this context, we argue that firms can find a trade-off equilibrium between advance sales and postponed sales at the last minute. Therefore, firms supply some services in advance and some services at the last minute. We show how, whenever competition arises, this trade-off is altered, so firms show more of an interest in increasing their advanced sales and decreasing their last-minute sales. Moreover, competition goes up the aggregated supply in the market, but last-minute sales will decrease and advanced sales will increase.

2 Model

Let us consider that each consumer is interested in a unit of the service supplied at moment \( t \), and total consumers’ population is \( N \). Consumers can buy the service supplied at moment \( t \), at the last minute, or in advance (at moment \( a \)). Each consumer is uncertain as to his personal circumstances at moment \( a \), and these circumstances will influence the value of the service consumed at moment \( t \). We consider two types of contingencies that will influence this value, both of which are uncorrelated. On the one hand, there is the possibility that the consumer will be not able to gain access to the service (illness or other contingencies at moment \( t \) can prevent said access). On the other hand, we have the real value of the service given by the consumer at moment \( t \) which is still unknown at moment \( a \) (for instance, changing consumer preferences or changing priorities in terms leisure time). We assume that these contingencies will be known at moment \( t \). Moreover, consumers are unaware of these contingencies in advance but they have some expectations about them. Thus, each consumer has a probability of \( \beta \in (0, 1) \) that they will be able to access the service. We assume that \( \beta \) is uniformly distributed between the consumer population. Furthermore, \( V \in (0, V_H) \) will be the real service value for a consumer at moment \( t \). We assume that this real value is uniformly distributed among the consumer population. Therefore, the expected value of the real service value at moment \( a \) is \( V_H/2 \). We assume that the realisations of these random variables are independent across consumers. We also assume that the lowest value in moment \( a \) for the probability of
access to the service at moment $t$ is zero. This assumption simplifies the parameters in the analysis; similar conclusions are obtained when said parameter is greater than zero but lower than one. In the same sense, we consider that lowest service value at moment $t$ is zero, in order to simplify parameter analysis, but we will obtain similar conclusions in a more restrictive ranking for the service value at the moment of consumption. Assumption on $\beta$ distribution causes advanced demand to become a continuous function. In the same sense, assumption on $V$ distribution means that last-minute demand will also be a continuous function.

Consumers are risk-neutral and, given that they make decisions in a rational way, they will buy the service if its expected value is greater than its price at the time of purchase. Moreover, they will buy the service in advance, provided this works out cheaper than at the last minute, given expected service value. In other cases, consumers will wait until the last minute to buy. This model does not consider the possibility of cancellations, overbooking or any kind of arbitrage strategy from firms or consumers. Additionally, we assume that consumers have a constant utility function over time, whereby it is acceptable if the time horizon is not too long (Liu and Rizing, 2008). Risk aversion and time discounting have an impact on consumers’ interest in advancing purchases, but they are not an essential element in analysing how this interest is modified by the intensity of the competition.

There are also $m$ firms, which supply identical services at moment $t$. These firms will produce the services at the time they are to be consumed, but firms can commercialise their services either in advance or at the last minute. Service sectors are characterised by a cost structure where fixed cost is the most relevant cost in service provision. Thus, in order to simplify the analysis, we consider that variable cost to be zero and firms to only incur in a fixed cost for service provision (Desiraju and Shugan, 1992). We thereby assume that firms compete in a Cournot model. Thus, each firm decides on the quantity of services sold both in advance and at the last minute. Market prices for these services will rise, due to a void in the market. Moreover, there exist two market pricings in the model, one for advanced sales and another for last-minute sales. The formation of advanced sales prices depends on two forces, expectation of the last minute prices and the volume of advanced sales supplied by firms. On the other hand, the formation of last minute prices also depends on advanced sales and the volume of services supplied by firms at the last minute. Thus, there is a relationship between pricing and sales in advance, and pricing and sales at the last minute. Whenever firms decide to sell at the last minute, they are aware of sales made in advance. Thus, increasing advanced sales means that last-minute demand goes down (by advanced sales eating into last-minute demand). This context is a sequential framework, whereby firms choose on advanced sales during a first period and then, during a second period, must choose last-minute sales, given advanced sales made during the first period. This situation is then analysed using background induction. First, we will analyse equilibrium at the last-minute period as a function of a firms’ decisions at the advanced period. Then, we can consider the advanced market sales and we will obtain the model equilibrium.

Advance-sales strategies have often been associated with the type of situation in which firms have committed their service capabilities, and these capacities cannot be modified on the short term. The model, however, considers a situation where firms have not committed their services capabilities before the advance sales moment. Thus, firms have no restrictions on how many services can be sold in advance or at the last minute. Even if firms have capacity restrictions at the time of deciding their advance sales
strategies, then they would face to a trade-off between advance or last-minute sale. Therefore, the conclusions drawn from this model can be extrapolated to the scenario in which firms have established their service capacities, thus they must decide on the amount of services sold in advance and at the last minute.

2.1 Demand analysis

2.1.1 Advanced demand

During the advanced period, each consumer is unaware as to whether their personal circumstances will allow them access to the service, as well as how they will value the service once they eventually do. However, each consumer receives a signal on the personal chance to access the service at moment \( t \), this being \( \beta \). Moreover, the expected service value at moment \( t \) is \( \frac{VH}{2} \). Therefore, if \( p_a \) is the service price in advance, then a consumer will demand the service in advance if:

\[
\beta \frac{VH}{2} \geq p_a .
\]

This is a sufficient condition if we assume that \( p_a \leq p_r \), then the service price in the advanced period is not greater than the service price in the last-minute period. For the moment, we will assume this condition, and we will show that it holds true in the model equilibrium.

Thus, the advanced demand as a function of \( p_a \) is

\[
D_a (p_a) = N \left[ 1 - \frac{2p_a}{VH} \right],
\]

where \( \left[ 1 - \frac{2p_a}{VH} \right] \) is one less the distribution function of \( \beta \) by \( \beta = \frac{2p_a}{VH} \).

2.1.2 Last-minute demand

Last-minute demand comes from consumers who have not purchased the service in advance. Moreover, these consumers have observed their personal contingencies on access to service and personal service value at moment \( t \). Therefore, this demand will be defined by the proportion of consumers who did not purchase in advance, who have personal access to the service at moment \( t \) and whose service value at moment \( t \) is higher than \( p_r \), the service price at the last moment.

The expected value of \( \beta \) for consumers who have not purchased the service in advance is

\[
E \left[ \beta / \beta < \frac{2p_a}{VH} \right] = \frac{p_r}{VH} .
\]

Consumers who have not purchased the service in advance, \( N(2p_a/VH) \), and who can access the service at consumption moment, \( (p_a/VH) \), will purchase the service at the last minute if: \( V \geq p_r \). Thus, the proportion of consumers who have not purchased the service and whose service value is greater than the last-minute price is: \( \left[ 1 - \frac{p_r}{VH} \right] \), where this is one minus the distribution function of \( V \) by \( V = \frac{p_r}{VH} \).
Therefore, considering all conditions, expected demand at the last minute will be

\[ D(p, p_e) = N \left( 1 - \frac{p_e}{V_t} \right) \left( \frac{p}{V_t} \right)^2. \]  

(4)

### 2.2 Competition analysis

#### 2.2.1 Advanced sales competition

If firms supply services in the advanced period \( a \), let us assume that the total of services supplied in period \( a \) is \( Q^a \). Then, the price is set by supply and consistent market demand. Consequently, the advanced service price holds:

\[ Q^a = N \left( 1 - \frac{2p_a}{V_t} \right) \quad \text{and} \quad p_a(Q^a) = \frac{V_t}{2} \left[ 1 - \frac{Q^a}{N} \right]. \]  

(5)

#### 2.2.2 Last-minute competition

As per during the advanced period, the price at the last minute is set by both supply and consistent market demand. Let us assume that the total of services supplied at the last minute is \( Q^t \). Then, the last-minute price holds:

\[ Q^t = 2N \left( 1 - \frac{p}{V_t} \right) \left( \frac{p_e}{V_t} \right)^2. \]  

(6)

Using the expression \( p_a(Q^a) \) in equation (5), the last period price of the service is

\[ p_a(Q^a, Q^t) = V_t \left[ 1 - \frac{2Q^t}{N \left( 1 - \frac{Q^a}{N} \right)^2} \right]. \]  

(7)

### 2.3 Equilibrium analysis

#### 2.3.1 Last-minute period

Consider a firm \( i \), that must decide how many services they will sell at the last minute, let \( q_i' \) be this number and \( q_{\text{a},i} \) be the total of last-minute services sold by its competitors. Thus, the profit function of firm \( i \) at the last minute market is

\[ \Pi_i(q_i', q_{\text{a},i}) = V_t \left[ 1 - \frac{2(q_i' + q_{\text{a},i})}{N \left( 1 - \frac{Q^t}{N} \right)^2} q_i' \right]. \]  

(8)

By maximising this profit function, we obtain the following first-order condition:
This first-order condition balances the marginal revenue that a firm obtains by the last service sold at period $t$. So, when a firm increases sales marginally at the last minute, profit and revenue are impacted in two ways: first, the firm profit goes up due to additional services being sold; the value of this marginal effect is the service price at the last minute. However, there is a second indirect effect that reduces profit when last-minute sales marginally increase. A marginal increase in sales during period $t$ means that the last-minute price for the service goes down, thus having a negative marginal effect on the firm’s profit. The value of this negative effect is $q'_{t} \left( \frac{\partial p_{t}}{\partial Q'} \right)$. The first condition establishes that the aggregation of two effects must be equal to zero, provided each firm maximises its profits.

We assume that firms are symmetrical and $m$ is the firms’ number operating in the market. Therefore, symmetrical equilibrium holds that $q'_{i} = (m-1)q'_{i}$ and let be $q_{i} = q_{i}$ for all $i$ in $m$.

Solving the first-order condition, we find that the last-minute sale equilibrium for each firm is

$$q'_{i} = \frac{N}{2(m+1)} \left[ 1 - \frac{Q_{i}}{N} \right]^{-2}. \quad (10)$$

And the total of last-minute supplies is

$$Q' = \frac{mN}{2(m+1)} \left[ 1 - \frac{Q_{i}}{N} \right]^{-2}. \quad (11)$$

Moreover, the equilibrium price for last-minute sales market is

$$p_{t} = V_{ii} \left( 1 - \frac{m}{m+1} \right). \quad (12)$$

Therefore, the profit of each firm from the last-minute sale equilibrium is

$$\Pi' \left( Q' \right) = \frac{NV_{ii}}{2(m+1)} \left[ 1 - \frac{m}{m+1} \right] \left[ 1 - \frac{Q_{i}}{N} \right]^{-2}. \quad (13)$$

### 2.3.2 Advanced sales period

Again, let consider a firm $i$ that is choosing how many services it sells in advance, which we will call $q'_{i}$. The total number of services supplied in advance by competitors is $q''_{i}$. Thus, the profit function of firm $i$, taking into account the profit from advanced sales and the profit from last moment sales, is

$$\Pi_{i}^{\text{Total}} \left( q'_{i}, q''_{i} \right) = \Pi' \left( q'_{i} + q''_{i} \right) + \frac{V_{ii}}{2} \left[ 1 - \frac{q'_{i} + q''_{i}}{N} \right] q''_{i}. \quad (14)$$
When maximising this profit function, it is worth remembering that \( Q^* = q^* + q^*_{-i} \). 

Thereby, we obtain the following first-order condition

\[
\begin{align*}
-\left(1 - \frac{m}{m+1}\right) \left( \frac{1}{m+1} \right) \left[1 - \frac{q^* + q^*_{-i}}{N} \right] + \frac{1}{2} \left[1 - \frac{2q^* + q^*_{-i}}{N}\right] &= 0 \tag{15}
\end{align*}
\]

This first-order condition presents the total marginal effects that a firm derives when it marginally increases its advanced sales. On the one hand, it affects the firm profit at the advanced market. The argument is similar to the previous one, when we analysed the first-order condition by firm profit at the last-minute period. Thus, a firm must consider marginal increased profit by making more advanced sales and the marginal decreased profit by declining the advanced sales price. The value of this effect is described by the second term in the first-order condition. On the other hand, from expression \( \Pi_i(Q^*) \) in equation (13), advanced sales have a negative effect on the firm profit at last-minute market. This is because last-minute demand is reduced when advanced sales increase. The value of this effect is set by the first term in the first-order condition. Thus, when a firm decides its advanced sale strategy, there is a trade-off between firm profits at the advanced and last-minute markets.

In equilibrium, advanced sales from firm \( i \) is

\[
q^*_i = \left(\frac{(m+1)^2 - 2}{2m(m+2)}\right) \left[N - q^*_{-i}\right]. \tag{16}
\]

As per with the last-minute equilibrium, we assume that firms are symmetrical. Thus, symmetrical equilibrium in the advanced period holds that \( q^*_i = (m-1)q^*_{-i} \) and let be \( q^*_i = q^* \) for all \( i \) in \( m \). Using the previous expression (16), we obtain that the advanced sales in equilibrium for each firm is

\[
q^* = NH(m), \text{ where} 
\]

\[
H(m) = \frac{\left[(m+1)^2 - 2\right]}{2m(m+2) + (m-1)\left[(m+1)^2 - 2\right]} \tag{17}
\]

The total advanced sales in equilibrium is \( Q^* = NmH(m) \).

Moreover, the equilibrium price for advanced sales market is

\[
p_a = \frac{V}{2 \left[1 - mH(m)\right]} \tag{18}.
\]

In order to prove that the characterised equilibrium meets all required criteria, we must show that \( p_i \geq p_a \). It is worth remembering our assumption that consumers considering the purchase of the service in advance will rule out the possibility of buying at the last minute. This also assumes that, if given expected service value, the price at the advanced moment is not greater than at last moment. Thus, using prices expressions obtained in equations (12) and (18), it is verified if:

\[
\frac{V}{2 \left[1 - mH(m)\right]} \leq V \left[1 - \frac{m}{m+1}\right]. \tag{19}
\]
This relationship holds true when
\[ G(m) = \frac{2m}{m+1} - mH(m) \leq 1. \] (20)
You can check that \( G(m) \) is an increasing and concave function on \( m \) when \( m \geq 1 \). The limit of \( G(m) \) when \( m \) goes to infinity is 1. Therefore, \( G(m) \leq 1 \) for any \( m \geq 1 \).

Finally, we can derive the firms’ total profit at the equilibrium. The profit of each firm in the equilibrium is
\[
\Pi_{i}^{\text{Total}}(m) = \frac{N V_{ii}}{2(m+1)} \left[ (1-mH(m)) \left( 1 - \frac{m}{m+1} \right) (1-mH(m) + (m+1)H(m) \right].
\] (21)
We summarise the complete analysis on equilibrium in the next proposition.

**Equilibrium proposition:**
- In equilibrium, each symmetrical firm supplies respectively the following services in advance and at last moment:
  \[ \hat{q}^a = NH(m) \text{ and } \hat{q}^l = \frac{N}{2(m+1)} \left[ 1 - H(m) \right]^2, \]
as previously defined in expression (17).
- In equilibrium, the total advanced services and last-minute services supplied in the market for symmetrical firms are, respectively,
  \[ \hat{Q}^a = mNH(m) \text{ and } \hat{Q}^l = \frac{Nm}{2(m+1)} \left[ 1 - mH(m) \right]^2. \]
- In equilibrium, the advanced sales price and the last-minute sales are, respectively,
  \[ \hat{p}_a = \frac{V_{ii}}{2} \left[ 1 - mH(m) \right] \text{ and } \hat{p}_l = V_{ii} \left[ 1 - \frac{m}{m+1} \right]. \]
  Where it holds that \( \hat{p}_a \leq \hat{p}_l \).

**Proof:** This proposition can be demonstrated following the previous analytical development.

### 3 Model equilibrium and competition intensity

From our equilibrium proposition, we can characterise the equilibrium scenario as a function of the intensity of market competition. Thus, whenever there are more firms competing on the market (in other words, competition intensity is greater), so the market equilibrium changes. The following corollaries describe these relations.
Corollary 1: When the firms’ number increases, then the total of advanced sales goes up and the total of last-minute sales goes down. Moreover, when the firm’s number increases, then the total of services supplied on the market (advanced and last-minute services) increases.

Proof. From expressions of advanced sales and last-minute sales in equilibrium, we obtain the first and second derivatives on $m$. $\hat{Q^a}$ is an increasing and concave function on $m$ and its limit when $m$ goes to infinity is $N$. $\hat{Q^l}$ is a decreasing and concave function on $m$ and its limit when $m$ goes to infinity is zero. Moreover, total supplied services become an increasing and concave function on $m$, and its limit when $m$ goes to infinity is $N$. These functions are in Figure 1.

Figure 1 Relationship between market sales equilibrium (divided by $N$) and number of firms

From Corollary 1, a monopolistic market is defined as the situation where a firm has fewer incentives for using advanced-sales strategy. In this context, increasing advanced sales has a more negative impact on last-minute profits, and monopolistic firms restrain their advanced sales supply. When the number of competitors increases, increasing advanced sales has a lesser negative impact on last-minute profit for a firm, and each firm increases the advanced-sales proportion on its total sales.

Corollary 2: When the number of firms increases, the advanced sales price ($\hat{p}_a$) and the last moment sales price ($\hat{p}_l$) both go down.

Proof: From expressions of advanced sales price and last-minute sales price in equilibrium, we obtain the first and second derivatives on $m$. Both prices are increasing, and concave functions on $m$ and their limits when $m$ goes to infinity give a result of zero in both cases. We represent these functions in Figure 2.

From Corollary 2, intensity competition reduces prices in both periods, and these prices tend towards the competitive market (marginal cost of the service being zero) when $m$ becomes greater. This fact is consistent with empirical observations; see, for instance, Abrate et al. (2012).
Corollary 3: When the number of firms increases, the advanced sales and the last-minute sales of each firm go down. Moreover, last-minute sales decrease faster than the advanced sales when the number of competitors increases.

Proof. We obtain these conclusions using the first and second derivatives of $\tilde{q}^a$ and $\tilde{q}^l$ on $m$. These functions are in Figure 3.

Completing this section, Table 1 presents some numerical equilibrium results in order to illustrate the model conclusions obtained.
Table 1  Numerical equilibrium results

<table>
<thead>
<tr>
<th>Variables</th>
<th>m = 1</th>
<th>m = 2</th>
<th>m = 5</th>
<th>m = 10</th>
<th>m = 20</th>
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<td>q^m</td>
<td>N/3</td>
<td>0.3 N</td>
<td>0.17 N</td>
<td>9.1 × 10^{-3} N</td>
<td>4.8 × 10^{-3} N</td>
</tr>
<tr>
<td>q^l</td>
<td>N/9</td>
<td>0.03 N</td>
<td>2.5 × 10^{-4} N</td>
<td>4 × 10^{-4} N</td>
<td>0.5 × 10^{-4} N</td>
</tr>
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<td>Q^m</td>
<td>N/3</td>
<td>0.61 N</td>
<td>0.83 N</td>
<td>0.9 N</td>
<td>0.95 N</td>
</tr>
<tr>
<td>Q^l</td>
<td>N/9</td>
<td>0.06 N</td>
<td>13 × 10^{-3} N</td>
<td>4 × 10^{-3} N</td>
<td>1 × 10^{-3} N</td>
</tr>
<tr>
<td>[Q^m(Q^m + Q^l)]%</td>
<td>75%</td>
<td>92.3%</td>
<td>98.4%</td>
<td>99.6%</td>
<td>99.9%</td>
</tr>
<tr>
<td>p_a</td>
<td>V_H/3</td>
<td>0.2 V_H</td>
<td>8.7 × 10^{-3} V_H</td>
<td>4.6 × 10^{-3} V_H</td>
<td>2.4 × 10^{-3} V_H</td>
</tr>
<tr>
<td>p_l</td>
<td>V_H/2</td>
<td>V_H/3</td>
<td>0.17 V_H</td>
<td>0.09 V_H</td>
<td>4.17 × 10^{-3} V_H</td>
</tr>
</tbody>
</table>

4 Conclusions

We have presented a model whereby consumers display strategic behaviour when deciding on the time they purchase a service, and advanced sales affect last-minute demand. In this setting, firms have a trade-off when they define their advanced sales policy. Increasing advanced sales reduces the last-minute market. In this context, this paper poses a simple and relevant question: when competition intensity is higher in the market, firms have more incentives to intensify their advanced-sales strategy. This is because, in a more competitive context, the trade-off between advancing and delaying a sale is reduced. Thus, increasing competition reduces the cost of advanced sales in terms of the last-minute profit lost. Therefore, more competition derives in an increasingly aggressive advanced-sales policy from firms.

Our model uses explicit functions in order to simplify algebraic model analysis. However, we believe that similar conclusions would be obtained in a more general framework. More specifically, we use uniformly continuous distributions in order to represent personal random shocks affecting consumers’ valuation on service and, therefore, influencing demand. Uniform continuous distribution holds some nice mathematical properties. In future works, we will be interested in a more technical analysis, and characterise what distribution properties are required to support equilibrium in an advanced-sales market.

Advance-sales strategies have often been associated with the type of situation in which firms have committed their service capabilities, and these capacities cannot be modified on the short term. The model considers a situation where firms have not committed their service capabilities before the advanced sales moment. Thus, firms have no restrictions on how many services can be sold in advance or at the last minute. Even when firms have capacity restrictions before deciding on their advance-sales strategies, they face a trade-off between advance and last-minute sales. Therefore, a firm must consider the marginal income effect from selling a service in advance, in contrast to delaying the sale to the last minute. This paper has showed how, whenever competition goes up, the marginal profit lost at last-minute market for increase advanced sales goes down, so firms have a greater interest in increasing advanced sales and decreasing last-minute sales when competition is higher. This relationship will also be fulfilled in a context where firms’ service capacity is constrained.
In terms of dynamic pricing, model conclusions show that competition modifies the inter-temporal trade-off between anticipating and delaying a sale. As competition grows, the opportunity cost of gaining a sale now is reduced in terms of expected revenues that would be obtained if the sale was postponed for later. Consequently, firms are more interested in advancing their time-path sales when competition is higher. As established by Gallego and Hu (2014), increasing competition reduces the effect of capacity externalities (in our model, this effect comes from underserved consumers, who will shape the service demand in the near future). Therefore, whenever it is relevant to consider strategic consumers’ behaviour in the purchasing process, then it will become even more necessary to introduce competition intensity as a model variable, in order to derive computational heuristics leading to a better fit of the optimal dynamic pricing path.

Firms can realise marketing efforts in order to modify demand, and these efforts can be applied at various times prior to the delivery of the service, so as to increase the probability that the service capacity will be exhausted at the time of service delivery. For example, service firms can modulate the online management of customer relationship or loyalty programs on a temporary basis. The model insights show that, whenever competition increases, firms have a larger interest in focusing their marketing efforts on the initial periods, because it is more profitable to advance a sale than to delay it. Obviously, this increased interest should be controlled by the effect on demand (elasticity) of marketing efforts. Therefore, in service markets where consumer demand is sensitive to alternative marketing efforts in the pricing policy, firms will be interested in increasing the use of these alternative marketing tools at the initial times of sale, when competition is greater and consumer demand is sensitive to them.

Another point worth bearing in mind is that this model assumes that common business practices used in advanced sales trades are not possible. For instance, booked fees, free cancellations or cancellation compensation are common practices. We plan to incorporate these aspects to the analysis in future works.

Finally, our analysis considers that firms are symmetrical. In some markets, this can be a correct assumption. However, there are markets where firms are very heterogeneous, and only one or a small handful of firms have a dominating position. Are our conclusions maintained in these market structures? Again, we are interested in analysing this aspect in a future piece of work. Stakelberg’s framework, where some firms are leaders and others are followers, could be a fitting reference.

References


Notes

1It is easy to extend the analysis for a framework with m-symmetrical competitors; indeed, the equilibrium game shows that the ratio between total advanced sales and total sales (advanced and last-minute) is: \((m + 2)^{-1}\), and the ratio of advanced sales on total sales goes down whenever competition increases. Moreover, the total supply increases whenever competition goes up. The author can supply proof of these arguments if the reader is interested.
For instance, Hotel Corporation Group Magic Costa Blanca implemented a booking and pricing system called ‘Magic Low Cost’ in 2006, with the explicit purpose of promoting advanced sales and discouraging last-minute sales (http://www.hosteltur.com/32522_magic-costa-blanca-relanza-su-campana-reservas-anticipadas.html, 18 January, 2006). The price could be 20% lower depending on booking time.

These calculations are based on data from the Instituto Nacional de Estadística (Spain) and correspond to the ‘Encuesta de ocupación hotelera: 2000–2004’. Unfortunately, these data are not available after 2004, as the questionnaire changed and the new template does not recollect this information.