Sequential selling, a common phenomenon in airline companies and hotels, has been extensively studied in the revenue management literature (e.g., McGill and van Ryzin 1999, Bitran and Caldentey 2003, Talluri and van Ryzin 2004). The traditional revenue management literature focuses on deriving the seller firm’s optimal pricing strategy based on the stock or capacity. Recently, researchers have started examining selling schemes like bargaining (Wang 1995), auction (Vulcano et al. 2002), end-of-season sale (Feng and Gallego 1995), and clearance price (Smith and Achabal 1998), as alternatives to the take-it-or-leave-it pricing (Gallego and van Ryzin 1994).

The objective of this study is to understand the role of negotiation in competitive revenue management. We consider two firms selling some initial stocks over a fixed selling season, which is divided into small time periods so that at most one customer appears during each period. At the beginning of each period, the firms each decide on a list price of their product. An arriving customer, if any, evaluates the firms’ offers and may choose one or neither to trade. If the customer picks a firm, he may choose to purchase at the list price or to negotiate a deal with the firm. The setting of this model is very similar to that of Martínez-de-Albéniz and Talluri (2011), except that the seller firms in our model allow the customers to negotiate. Such a situation is common in selling cars and other large ticket items (Grennan 2013).

When firms dynamically compete for customers, the reservation value a seller firm has for a possible trade in a given period is her expected future profit due to losing the customer to her competitor now. Specifically, this value equals the difference between the seller’s value function when the opponent has one less item in the next period and that when she has one less item in the next period. As Martínez-de-Albéniz and Talluri (2011) show, under the take-it-or-leave-it pricing scheme, the firm with a lower stock level has a lower reservation value and wins the competition.

When the customers are allowed for bargaining, the sellers’ strategies depend not only on their 

reservation values, but also on their disagreement points for negotiation. Specifically, a seller’s disagreement point is her profit from the item in the event of negotiation breakdown, which is the difference between her profit with the current stock level and that with one less item in the next period. With the possibility of bargaining, there exists a continuum of subgame perfect equilibria for the dynamic competition game. To generate clear insights into the competition dynamics, we focus on analyzing two extremal of the equilibria. The most (least) competitive equilibrium arises when both sellers compete most (least) aggressively in the sense that the seller losing the competition would set the lowest (highest) possible price so that the opponent obtains the least (most) trade surplus.

Interestingly, in our model, the observation from previous studies on revenue management under competition (Martínez-de-Albéniz and Talluri 2011) holds only up to the three-period setting. Specifically, if the selling season is longer than three periods, it is not always the case that the seller with a lower stock wins the competition. This is because with the option of bargaining, the sellers’ disagreement points, in addition to their reservation values, play a critical role in the competition dynamics.

To understand such a phenomenon, it is important to recognize that there are two kinds of competition between sellers in a dynamic environment depending on the length of the selling season relative to the amount of initial stocks. When the selling season is very short, the sellers compete to win a customer. Such a situation is very similar to that in a one-shot static competition game, where the seller with the worse outside option would be willing to make a sale at a lower price and thus winning the customer. When the selling season is relatively long, in contrast, the sellers compete to lose a customer. This is because, given that there are many selling opportunities in the future, a seller would like the opponent to deplete her stock first so that the seller would then enjoy the monopolist power. Consequently, in the early stage of the selling season, each seller attempts to increase her price, inducing the customers to choose the other seller. These observations are obtained under both the most competitive and the least competitive equilibria, indicating the robustness with respect to equilibrium choice.
In summary, our study discovers the unique feature associated with negotiation in the context of dynamic competition. Our analysis underscores the importance of dynamic modeling in understanding firms’ competition strategies in the context of revenue management, as we have shown that firms compete in different ways depending on the length of the selling season.

References


