Sourcing Strategies for Online Retail Marketplaces

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Online marketplaces are increasingly affecting not only buyers and sellers who participate in the marketplaces but also upstream manufacturers. One example is “Poolco” (name disguised) a large US manufacturer of pool equipment that is experiencing changes in its business due to the Amazon marketplace. Demand for Poolco products is highly seasonal and uncertain. Traditionally, Poolco sold its products through a network of geographically separated dealers. Each dealer focused on serving demand and providing customer service and installation within its region. The wholesale price schedule was known to dealers and the sales price for consumers was constant. Dealers placed orders in January in anticipation of sales in May. This gave Poolco sufficient lead time to schedule production and fulfill the orders.

Over the past few years, in addition to the brick and mortar channel, dealers have started selling via the Amazon marketplace in competition with each other. The wholesale price schedule is still fixed, but the selling price on Amazon marketplace is stochastic and determined by competition in a dynamic market. As a result, the dealers are ordering later in the season at unpredictable times. Thus, the upstream demand for Poolco has become more volatile and its seasonality pattern has shifted. Our paper seeks to understand this phenomenon by: (i) analyzing the optimal sourcing strategy for a dealer that sells in an online marketplace with random demand and price, and (ii) examining the implications of this sourcing strategy for Poolco’s business.

This problem is common to many seasonal goods. The Amazon marketplace is a significant source of disruption for Poolco and other companies in its industry.\(^1\) Within five years, it has grown from zero to the largest sales channel. Traditional retailers find it lucrative to expand their market by selling nationally, but their competition in the marketplace results in the uncertain selling prices, high price volatility, and depressed retail margins. Figure 1 illustrates these features of the marketplace for a few products. The left panel shows the price trajectory for a pool pump, a

\(^1\) By various estimates, Amazon marketplace now accounts for 50% of total unit sales and 70% of revenue on Amazon.com (Amazon n.d., Stevens 2017).
product similar to one sold by Poolco, in the Amazon marketplace. In the most recent year of data from September 2016 to August 2017, the daily price volatility is approximately 7.5%. In August 2017, there were 31 resellers in the marketplace. The right panel reports four additional seasonal recreational products from other industries that have similar marketplace participation and price volatility.

We present a model of the sourcing decision of the retailer that captures the key features of online marketplaces for seasonal products. The model is set in continuous time where the selling season occurs instantaneously at time $T$, and the firm has an option to make a single inventory purchase at any time in the interval $[0, T)$. The selling price and the demand for the product are stochastic. The marketplace has a sufficiently large number of sellers so that the firm is a price taker in the marketplace. The information about price and demand improves over time, enabling the firm to gain by optimizing its inventory ordering. Finally, the cost of procurement changes over time according to a known price schedule, accounting for shorter lead times and the cost of expediting. The retailer makes the inventory decision that maximizes its expected profit.

We consider two types of sourcing strategies, the optimal pre-committed ordering time strategy and the optimal time-flexible strategy. In the first strategy, the retailer pre-commits to the time at which the purchase order will be placed but determines the order quantity at that time instant using the most up to date information on demand and prices. This policy is useful because it is optimal under constant selling prices. Thus, we utilize it as a benchmark to evaluate the value of time flexibility. In the second strategy, the retailer dynamically determines at each time instant whether to place the order now or to wait. Thus, in this policy, both the time to place the order and the order quantity can be stochastic. Our main result is to show that the optimal timing of inventory sourcing is indeed flexible and stochastic. It is independent of demand and follows a double-threshold policy in the price variable. That is, at any time, it is optimal for the firm to wait if the current price is below a lower threshold or above an upper threshold. In the former case,
the waiting is valuable because of the option of not buying inventory at all. In the latter case, the waiting is valuable because of learning about selling price and demand. In the intermediate range, the firm does not benefit from waiting and buys the optimal quantity of inventory given current information about price and demand. Thus, the lower and upper thresholds correspond to the two sources of value of timing flexibility: (i) avoiding unprofitable market conditions, and (ii) learning about future price and demand to minimize the supply-demand mismatch.

Given that the optimal ordering policy for a retailer is time-flexible, we study the value of timing flexibility and identify environments where order timing flexibility is most beneficial. In our numerical analysis, calibrated on the Poolco data, dealers’ profit increases by approximately 3.5% because of strategic timing of the orders, compared to ordering late in the season. Poolco also benefits from supporting order timing flexibility: the dealers order quantities, hence, Poolco’s revenues are approximately 35% larger in the time-flexible policy compared to the pre-committed policy. Order timing flexibility carries an additional benefit to Poolco: orders could be placed earlier in the season, compared to the optimal pre-committed timing. Interestingly, if dealers were to (suboptimally) order early in the season, their order quantities would be larger for small price volatilities, but they would drop to zero once price volatility is high enough, i.e., dealers would exit the business entirely.

Our results offer manufacturers some insight into the future. If the current trend of growth and increasing competition in online marketplaces is to continue, the manufacturers should be prepared for more uncertainty in order sizes and timings, i.e., support order timing flexibility in their processes. Moreover, as margins in online marketplaces are expected to decline further (see, e.g., Abraham and Koelemeijer 2015), the pre-committed policies where orders are placed early in the season may be forced out of the market because the supply-demand mismatch cost would be prohibitively high under such policies for transactions to occur. Timing flexibility, therefore, presents an opportunity for manufacturers to adapt and sustain their businesses as even more transactions shift to online marketplaces.

References
