Advance Selling in Marketing Channels

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Abstract

Manufacturers and retailers often advance sell seasonal products or services (e.g., holiday decorations, summer or winter entertainment). The authors examine advance selling in marketing channels to offer several insights: First, it is well-established that a decentralized channel suffers from the issue of double marginalization, i.e, the manufacturer and retailer both add positive margins when setting their prices, which results in inefficiently high retail prices. The authors find that, under a dynamic wholesale-price contract, advance selling can alleviate this double-marginalization problem and benefit the manufacturer, the retailer, and consumers. Second, the benefit of advance selling diminishes with the product's holding cost, the retailer's stockpiling ability, and the manufacturer's commitment to spot wholesale price. Third, with wholesale-price commitment, advance selling benefits the manufacturer and consumers but hurts the retailer; the manufacturer is better off making a price commitment only when its product's holding cost is sufficiently low and worse off otherwise. Last, the retailer's stockpiling ability decreases its own profit under a dynamic contract but increases it under a commitment contract.

Keywords: advance selling, channel coordination, seasonal products, game theory

Seasonal products or services such as holiday decorations, clothing, summer or winter entertainment and recreation services, and sporting gear are heavily consumed during particular times of the year (IMF 2004). In 2018, sales in the seasonal fashion segment alone were $268 billion in the United States, representing more than 5.1% of total retail sales in the country (Sodero et al. 2021; US Census 2018). For a typical country, seasonal purchases often account for one-fifth to one-third of all consumer purchases (IMF 2004).

Many retailers begin marketing and selling seasonal products or services well in advance of their consumption season (Milano 2020). For example, supermarkets put out holiday accessories for Valentine's Day, Easter, and Thanksgiving many weeks before these holidays arrive, while other retail shops begin marketing Halloween costumes in July and Christmas decorations in October (Kenney 2018; Tice 2014). Retailers begin selling swimsuits, sunscreens, baseball gear, golf equipment, bikes, coolers, sandals, and beach goods in the spring (McGray 2018) and snow gear, snowmobiles, sleds, shovels, and sandbags in the fall. The video game companies Samsung, Nintendo, and Huawei offer preorders through the retailers Amazon and Target (Zhao, Pang, and Stecke 2016). Travel agencies sell summer or winter vacation recreation services six to eight weeks in advance (Kelleher 2021). As Michael Guggino, the President of Pro-Tech Sno Pusher Company, notes: "Even though the average person doesn't think about buying a snow plow until the weather changes, we actively market in summer and fall to those that are thinking ahead"(Olenski 2015). These business practices raise the question of why firms sell seasonal products or services so early.

Explanations for advance selling include that early consumer arrivals have lower valuations, the seller has limited capacity, and advance selling removes the seller's information disadvantage about consumers' valuations (Shugan and Xie 2000; Xie and Shugan 2001, 2009). In this paper, we offer another explanation for why advance selling can be a profitable marketing approach. Specifically, we show that advance selling enables a manufacturer to alleviate the channel's double-marginalization problem to improve channel

coordination.

While a wealth of research has focused on nonchannel settings, manufacturers frequently advance sell seasonal products to consumers through retailers and therefore face unique challenges to coordinate channels effectively over time. In particular, when a manufacturer advance sells with a low wholesale price, its retailer may stockpile the product and spot sell it during the consumption season. In practice, a manufacturer can restrict the retailer's stockpiling by using vendor-managed inventory (VMI) systems, which allow the supplier to "decid[e] on the appropriate inventory levels of each of the products. . . to eliminate retailer oversight on specific orders" (Simchi-Levi et al. 2009, pp. 245-255). Such contractual agreements seem favorable only for manufacturers. Yet retail giants, such as Walmart, Kmart, Dillard Department Stores, and JCPenney, have formed partnerships to adopt VMI systems with manufacturers (Waller, Johnson, and Davis 1999; Dong and Xu 2002). This reality suggests that there are optimal conditions when a retailer is willing to curtail its stockpiling ability.

Alternatively, a manufacturer can restrict its retailer's stockpiling by employing scan-back contracts. With scanner data, a manufacturer can monitor the retailer's sales transactions to charge a wholesale price according to when the retailer sells the product (i.e., during the season) instead of when the retailer buys the product from the manufacturer (i.e., before the season) (Bell and Drèze 2001). In other words, even if a retailer advance buys a seasonal product when the wholesale price is still low and stockpiles to spot sell it later when the wholesale price is high, the manufacturer can charge the retailer the high spot wholesale price. As a result, scan-backs effectively disincentivize retailer stockpiling. For example, a national-brand beverage manufacturer performed a yearlong field study and found that retailers loaded up on products when offered a trade promotion but did not do so when offered a scan-back (Bell and Drèze 2002), supporting the effectiveness of scan-back to control retailer stockpiling. In their unique data set from 36 U.S. supermarket companies, accounting for approximately $200 billion of annual revenues (approximately

40% of total U.S. supermarket sales), Gómez, Rao, and McLaughlin (2007) find that the allocation of promotional funds to scan-backs constitutes the largest portion of promotional funding in the data (31.0%), showing the popularity of scan-backs.

In addition, retailers' and consumers' willingness to stockpile products when advance buying varies with the product's holding cost. The cost of stockpiling a 32 oz. ketchup is estimated to be approximately $.01 per week (Erdem et al. 2003), and the holding cost for laundry detergents can be as high as 12.7% of the retail price (Seiler 2013; Hendel and Nevo 2006). Storing a winter jacket takes less space than storing a Christmas tree; storing perishable products (e.g., whole Thanksgiving turkeys) is also more costly than storing non-perishable products (e.g., swimsuits). Assessment of the profitability of advance selling needs to account not only for digital products or services with a negligible holding cost but also for physical products with a considerable holding cost.

Moreover, manufacturers are commonly contracted with retailers through two wholesale-pricing contracts: (1) dynamic contracts through which the manufacturer sets each period's wholesale price during that period and (2) commitment contracts through which the manufacturer commits to its spot wholesale price when it advance sells. Comparing equilibrium outcomes between these two channel contracts can help us understand how advance selling and channel profits change with channel contracts. Moreover, we can identify the conditions under which a manufacturer should commit to spot prices when advance selling products.

Motivated by these business observations, we investigate how the manufacturer of a seasonal product should coordinate its channel with advance selling, stockpiling restriction, and pricing decisions. We consider a game-theoretic framework in which a manufacturer sells a seasonal product to consumers through an independent retailer over two periods. The first period represents the advance-selling period before a season, and the second period represents the spot-selling period during a season. Consumption of the seasonal product occurs only in the second period. However, the manufacturer and re-

tailer can both advance sell the product in the first period, meaning that both the retailer and its consumers can advance buy in the first period and stockpile the product for spot selling and consumption, respectively, in the second period.

Using this modeling framework, we investigate the role of advance selling in a marketing channel. Specifically, we address the following set of research questions: First, when should a manufacturer and retailer advance sell a seasonal product? Second, how does advance selling affect channel members' profits and consumer surplus? Third, how does the retailer's stockpiling ability affect the manufacturer and the retailer? When should the manufacturer restrict its retailer's ability to stockpile products? When should the retailer commit not to advance sell or instead to circumvent the manufacturer's restriction if possible? Fourth, when should the manufacturer commit to its spot wholesale price when it advance sells, and how does this price commitment affect the equilibrium outcome?

Our analysis reveals several noteworthy findings. First, we find that advance selling can enable a manufacturer to coordinate its channel more efficiently. Under a dynamic contract, advance selling results in a win-win-win outcome, benefiting the manufacturer, the retailer, and consumers by alleviating the channel's double-marginalization problem. This benefit comes from offering downstream channel members (retailer or consumers) the option to buy either in the advance period or in the spot period, which induces the upstream supplier (manufacturer or retailer) to compete with itself intertemporarily. As a result, advance selling constrains the upstream supplier's pricing power and reduces weighted average retail prices, thereby alleviating the double-marginalization problem. Under a commitment contract, the manufacturer can induce the retailer to advance buy by committing to a higher spot wholesale price to extract more retailer surplus while depressing retail prices to alleviate the double-marginalization problem. In this case, advance selling benefits the manufacturer and consumers at the expenses of the retailer.

Second, we show that the benefit of advance selling for the manufacturer diminishes with three factors: the product's holding cost (e.g., storage, spoilage), the retailer's abil-

ity to stockpile the product, and the manufacturer's commitment to spot wholesale price in the advance period. Given that advance buying and thus carrying the product for consumption in the spot period can be costly, the holding cost reduces the net value of advance selling. Therefore, manufacturers and retailers selling services or digital products with negligible holding costs should have stronger incentives to advance sell than those selling physical goods with considerably high holding costs. In addition, as long as the retailer can stockpile products, it prefers to advance buy from the manufacturer, stockpile, and only spot sell to consumers. The retailer's stockpiling ability constrains the manufacturer's pricing power, thereby attenuating the benefit of advance selling for the manufacturer. When the manufacturer can commit to its spot-period wholesale price in advance, it induces advance selling by committing to a high spot wholesale price instead of reducing the advance wholesale price. Therefore, the benefit of advance selling for reducing prices to alleviate the double-marginalization problem diminishes.

Taking all factors together, under a dynamic contract, the manufacturer should advance sell a product if its holding cost is low; however, it becomes less willing to do so when the retailer can stockpile the product. Under a commitment contract, the manufacturer should only advance sell a product when the retailer cannot stockpile and the product's holding cost is low; if the retailer can stockpile, the manufacturer should only spot sell (see Table 1).

Third, given that advance selling is less effective in reducing the double-marginalization problem under a commitment contract than a dynamic contract, the manufacturer can make a higher profit without price commitment (i.e., when the holding cost is high). This finding suggests that a manufacturer may voluntarily forfeit its ability to make credible commitments to future prices.

Finally, the retailer's ability to stockpile the product is detrimental to the manufacturer and sometimes to the retailer itself as well as consumers. This is because the manufacturer offers the retailer a low advance price when the retailer cannot stockpile but a high

Table 1: Equilibrium Selling Strategies

$h < .25$	Dynamic Contract	Commitment Contract
Retailer cannot stockpile	Both AS	Both AS
Retailer can stockpile	Manufacturer AS, retailer SS	Both SS
$h \in [.25, .375]$	Dynamic Contract	Commitment Contract
Retailer cannot stockpile	Both AS	Both SS
Retailer can stockpile	Both SS	Both SS
$h > .375$	Dynamic Contract	Commitment Contract
Retailer cannot stockpile	Both SS	Both SS
Retailer can stockpile	Both SS	Both SS

Notes: SS = spot selling; AS = advance selling; h is holding cost

advance price when the retailer can stockpile. As a result, agreements that restrict the retailer's stockpiling abilities can be mutually beneficial for the manufacturer, retailer, and consumers. The retailer also has incentives to commit not to stockpile up front. That said, under a commitment contract, a retailer's stockpiling ability dissuades the manufacturer from squeezing retailer surplus through advance selling; in this case, the retailer is better off circumventing the manufacturer's restriction.

LITERATURE REVIEW

Our research is closely related to the stream of literature on advance selling (for a comprehensive review, see Xie and Shugan 2009). Dana (1998) suggests that advance selling enables firms to practice second-degree price discrimination by selling to low-valuation consumers in the advance market while selling to high-valuation consumers in the spot market. Biyalogorsky and Gerstner (2004) propose that in markets in which low-valuation consumers arrive early and high-valuation consumers arrive late, advance selling assists a firm in managing its capacity more efficiently, thereby increasing profits. Xie and Gerstner (2007) reveal that advance selling can also allow a firm to sell a product multiple times to profit from consumers' cancellations and repurchases. Shugan and Xie (2000) show that advance selling separates purchase from consumption to generate con-

sumers' uncertainty about their future valuation, thus leveling their knowledge with the seller's information disadvantage. Xie and Shugan (2001) extend the theory by investigating how seller credibility, buyer risk aversion, capacity constraints, and refunds affect the profitability of advance selling. Shugan and Xie (2005) further examine the profitability of advance selling in a competitive market. Our study complements this literature by providing an alternative explanation for advance selling; that is, advance selling can be helpful in a distribution channel by alleviating double marginalization.

Prasad, Stecke, and Zhao (2011) consider a retailer's newsvendor problem (i.e., price and inventory decisions) when deciding whether to advance sell in a two-period model. They show that the profitability of advance selling varies with market (e.g., potential, uncertainty) and consumer (e.g., valuation, risk aversion, heterogeneity) characteristics. Zhao and Stecke (2010) incorporate consumers' loss aversion into a retailer's advance-selling decision to examine how the retailer chooses among no advance selling, advance selling with moderate discounts, and advance selling with deep discounts. Our research differs from this stream of literature by considering advance selling in a channel framework. Zhao, Pang, and Stecke (2016) also investigate advance selling in a distribution channel and show that a retailer's option on whether or not to advance sell after observing the wholesale price can benefit both the manufacturer and the retailer. In contrast with Zhao, Pang, and Stecke (2016), we consider situations when the manufacturer restricts the retailer's stockpiling ability so that the retailer must advance sell when the manufacturer does. Moreover, whereas Zhao, Pang, and Stecke (2016) examine the retailer's advance selling, we consider both the manufacturer's and the retailer's advance selling decisions.

Another related stream of literature examines intertemporal price discrimination of seasonal products. Lazear (1986) examines how a firm should set intertemporal prices when selling a new product in two periods, with the first-period sale revealing information about consumers' valuation. Prices fall over time and the firm's profit is higher when selling over two periods than when selling in one period because of the informa-

tional benefit of first-period selling (see Web Appendix A for a detailed comparison). Lazear (1986) shows that intertemporal price discrimination improves profit by extracting surplus from heterogeneous consumers. By contrast, we show that advance selling improves profit by alleviating the double marginalization problem in the channel. Our model results and mechanisms do not rely on consumer heterogeneity or price discrimination which are central drivers of the effects in Lazear (1986). Bitran and Mondschein (1997) show that when retail stores sell perishable products, prices decline over time as stores successively discount the product over the planning horizon and that the optimal pricing strategy is a function of the inventory and time left in the season. Tang et al. (2004) examine the profitability of pre-season or advance booking discount. They show that this program can allow retailers to update demand forecasts by utilizing information generated from the precommitted orders. McCardle, Rajaram, and Tang (2004) further study this pre-season discount in competitive retail markets. The benefit of advance selling that we identify comes from imposing intertemporal price competition between the upstream supplier and its future self instead of extracting surplus from heterogeneous consumers, as with intertemporal price discrimination. Moreover, in our model, prices increase over time, instead of the decreasing price trend with intertemporal price discrimination (see Table 2).

Table 2: Comparison Between Intertemporal Price Discrimination and Our Model

	Intertemporal price discrimination	Our model
Consumer valuation	Heterogeneous	Homogeneous
Prices over time	Decreasing	Increasing
Mechanism	Extract surplus from heterogeneous consumers	Alleviate double marginalization

Our work is also related to the literature on forward buying or stockpiling of storable goods. Some researchers have examined how consumers' stockpiling behaviors affect firms' pricing strategies and profits. For example, Guo and Villas-Boas (2007) show that consumer stockpiling in a differentiated market can intensify future price competitions.

Other researchers have focused on retailers' stockpiling behavior. For example, Lal, Little, and Villas-Boas (1996) find that in a market comprising both "loyal consumers" and "switchers," competing manufacturers randomly offer dynamic linear prices to a common retailer to compete for switchers. The retailer takes advantage of the dynamic linear prices to build up its inventory. Iyer, Narasimhan, and Niraj (2007) examine retailer inventory when market demand is uncertain and discuss the trade-offs between demand information and inventory in a distribution channel. Anand, Anupindi, and Bassok (2008) and Li, Li, and Chen (2022) consider a distribution channel in which a retailer may carry "strategic inventory" in the first period to convince the manufacturer to lower its wholesale price in the second period. Our research differs from this stream of research by considering both the manufacturer's and retailer's advance-selling decisions when both the retailer and consumers can stockpile products.

THE MODEL

Model Setup

Consider a manufacturer that sells a seasonal product or service (e.g., winter apparel, summer entertainment) to consumers through an independent retailer. The marginal cost to produce the product is constant, and we standardize it to zero. To capture the seasonal nature of the product, we consider a two-period model, in which the first period ($t = 1$) represents the advance-selling period before the consumption season and the second period ($t = 2$) represents the spot period during the consumption season. The manufacturer charges a unit wholesale price w_t, while the retailer charges a unit retail price p_t for selling the product in period t. If the manufacturer does not sell in period t, then $w_t = \emptyset$; if the retailer does not sell during period t, then $p_t = \emptyset$.

Consumers are homogeneous, and their utility of consuming Q units of products is $U = Q - \frac{Q^2}{2}$, which gives rise to the standard linear demand function $D(p) = 1 - p$. Although consumers may purchase in each period, consumption of the seasonal product

occurs only in the second period. If the manufacturer and retailer both advance sell, consumers can purchase in the first period and stockpile for consumption in the second period. Alternatively, consumers can wait and spot buy in the second period.

Similarly, if the manufacturer advance sells, the retailer can advance buy the product to either advance sell in the first period or stockpile to spot sell later during the second period. The retailer and consumers incur a holding cost $h \geq 0$ for stockpiling each unit of product, which accounts for storage and potential spoiling.[1] Our model applies to both physical products with a positive holding cost (i.e., $h > 0$) and digital products or services with a negligible holding cost (i.e., $h = 0$).

Benchmark: Spot Selling Only

Consider a benchmark model in which the manufacturer and retailer only spot sell a seasonal product in the second period, which reflects a standard static model for a decentralized channel. The aggregate consumer demand is $D_2 = 1 - p_2$. The retailer's profit function is $\pi = (p_2 - w_2)D_2$, while the manufacturer's profit function is $\Pi = w_2 D_2$. We find that $w_2 = \frac{1}{2}$, $p_2 = \frac{3}{4}$, $\Pi = \frac{1}{8}$, and $\pi = \frac{1}{16}$.

Channel literature has established that a decentralized channel suffers from the double-marginalization problem: The manufacturer and retailer set their wholesale and retail prices, respectively, to maximize their own profit instead of the total channel profit; as a result, compared with what would be observed in a centralized channel, the retail price that consumers face is too high, which discourages consumption and demand, reducing channel members' profits and consumer surplus. To alleviate the double-marginalization problem, the manufacturer and retailer must be incentivized to reduce their prices in each period. We show in the next section that advance selling can have such an effect, alleviating the double-marginalization problem and benefiting channel members and consumers.

ADVANCE SELLING UNDER A DYNAMIC CONTRACT

[1]The structural industrial organization literature estimates holding costs for certain products. For instance, Seiler (2013) estimates that the holding costs can be as high as £.318 for consumers to carry laundry detergent over a four-week period and 12.7% of the retail price for high-cost consumers.

In this section, we consider channel environments in which the manufacturer uses a dynamic wholesale-price contract; that is, the manufacturer sets w_1, the advance-selling wholesale price in the first period, and w_2, the spot-selling wholesale price in the second period.

We consider two scenarios. In the first scenario, the retailer cannot stockpile products, either because the manufacturer prohibits the retailer from stockpiling by using scan-backs, VMI, or other contractual tactics or because the retailer commits not to stockpile by opting not to use any warehouses that provide storage space. In this case, the retailer must advance sell all products that it advance buys in the first period. In the second scenario, the retailer can stockpile products, either because the manufacturer allows the retailer to stockpile or because the retailer can circumvent the manufacturer's restriction.

The game unfolds as follows: The first period comprises three stages. The manufacturer sets the first-period wholesale price w_1 if it advance sells the product to the retailer; then, the retailer chooses the first-period retail price p_1 if it advance sells to consumers; and, finally, consumers decide on Q_1, the quantity to advance buy in the first period, and carry the product forward to the second period. If the retailer can stockpile products, it also decides on S, or how much to stockpile for spot selling in the second period. The second period also consists of three stages. The manufacturer chooses the second-period wholesale price w_2; then, the retailer chooses the second-period retail price p_2 and procures from the manufacturer, fulfilling consumer demand with both new procurements and its stockpiled inventory from the first period, if, again, stockpiling is allowed; and, finally, after observing the retail price, consumers purchase Q_2 units and consume $Q_1 + Q_2$ units.

Retailer Cannot Stockpile

Consider the case in which the retailer cannot stockpile products. We analyze the second period first. Suppose that consumers stockpile Q_1 units of the product, where the second-period residual demand is $D_2 = 1 - p_2 - Q_1$. The retailer chooses p_2 to maximize

its second-period profit $\pi_2 = (p_2 - w_2)D_2$, which yields $p_2 = \frac{1-Q_1+w_2}{2}$. The manufacturer chooses w_2 to maximize its second-period profit $\Pi_2 = w_2 D_2$, which yields $w_2 = \frac{1-Q_1}{2}$. In the first period, given retail price p_1, consumers decide how many units to purchase. We have the following result (all proofs are provided in Web Appendix B):

Lemma 1 *In equilibrium, retail prices and first-period purchase satisfy:*

$$\begin{cases} p_1 + h \geq p_2 & \text{if } Q_1 = 0, \\ p_1 + h = p_2 & \text{if } Q_1 > 0. \end{cases}$$

Lemma 1 shows that, in equilibrium, whenever consumers advance buy a product (i.e., $Q_1 > 0$), they are indifferent between advance buying and spot buying. The intuition is that if the total cost of advance buying exceeds the price of spot buying (i.e., $p_1 + h > p_2$), consumers will not advance buy; however, if consumers can obtain a strictly positive arbitrage gain from advance buying (i.e., $p_1 + h < p_2$), they will advance buy more and the second-period price decreases accordingly (i.e., $\frac{\partial p_2}{\partial Q_1} < 0$). Eventually, the option to advance buy eliminates any positive arbitrage gains, leaving consumers indifferent. Using Lemma 1, we derive consumers' first-period purchase decision as follows:

$$Q_1 = \begin{cases} 1 - \frac{4}{3}p_1 - \frac{4}{3}h & \text{if } p_1 \leq \frac{3}{4} - h, \\ 0 & \text{otherwise,} \end{cases} \tag{1}$$

which suggests that consumers advance buy if the first-period retail price is sufficiently low. Because the retailer cannot stockpile products in the first period, it advance sells Q_1 units to consumers and chooses p_1 to maximize its total profit over the two periods: $\pi = (p_1 - w_1)Q_1 + \pi_2$. Solving the retailer's profit maximization problem, we obtain

$$p_1 = \begin{cases} \frac{9-10h+12w_1}{22} & \text{if } w_1 \leq \frac{5}{8} - h, \\ \emptyset & \text{otherwise,} \end{cases} \tag{2}$$

which suggests that the retailer sets p_1 to advance buy and advance sell only when the first-period wholesale price w_1 is sufficiently low. Anticipating the retailer's pricing decision, the manufacturer chooses w_1 to maximize its total profit over the two periods: $\Pi = w_1 Q_1 + \Pi_2$. Solving the manufacturer's problem, we have

$$w_1 = \begin{cases} \frac{67-72h}{160} & \text{if } h \leq \frac{3}{8}, \\ \emptyset & \text{otherwise.} \end{cases} \tag{3}$$

We summarize the detailed equilibrium outcomes in Table 3 and present our main findings in the following propositions.

Table 3: Comparison of Equilibria under Dynamic Contracts

	No AS	AS without Retailer Stockpiling ($h \leq \frac{3}{8}$)	AS with Retailer Stockpiling ($h \leq \frac{1}{4}$)
w_1	$\emptyset$	$\frac{67-72h}{160}$	$\frac{9-4h}{16}$
p_1	$\emptyset$	$\frac{51-56h}{80}$	$\emptyset$
S	0	0	$\frac{1-4h}{8}$
Q_1	0	$\frac{3-8h}{20}$	0
w_2	$\frac{1}{2}$	$\frac{17+8h}{40}$	$\frac{3+4h}{8}$
p_2	$\frac{3}{4}$	$\frac{3(17+8h)}{80}$	$\frac{11+4h}{16}$
Q_2	$\frac{1}{4}$	$\frac{17+8h}{80}$	$\frac{5-4h}{16}$
Π	$\frac{1}{8}$	$\frac{49-48h+64h^2}{320}$	$\frac{9-8h+16h^2}{64}$
π	$\frac{1}{16}$	$\frac{499-528h+704h^2}{6400}$	$\frac{19-24h+48h^2}{256}$
CS	$\frac{1}{32}$	$\frac{(29-24h)^2}{12800}$	$\frac{(5-4h)^2}{512}$

Notes: AS = advance selling.

Proposition 1 *Under a dynamic wholesale-price contract, when the retailer cannot stockpile:*

a. If the holding cost is not prohibitive (i.e., $h \leq \frac{3}{8}$), the manufacturer and retailer both advance sell. Otherwise, the manufacturer and retailer only spot sell.

b. The manufacturer, the retailer, and consumers are all better off with advance selling.

Proposition 1 shows that when the retailer cannot stockpile products, as long as the holding cost is not too prohibitive, the manufacturer and retailer both have incentives to advance sell, which benefits them and consumers alike. The benefit of advance selling comes from alleviating the channel's double-marginalization problem. When the retailer cannot stockpile products, advance selling offers consumers the option to buy in the advance period. As a result, consumers can source from the first or second period, which induces the retailer to compete with itself intertemporarily. As a result, advance selling constrains the retailer's pricing power and reduces weighted average retail prices, thereby expanding demand and alleviating the double-marginalization problem. The demand expansion increases profits for both the manufacturer and the retailer. The price reduction and demand expansion offset the holding cost that consumers incur when stockpiling products, thereby increasing consumer surplus.

We can further unpack the mechanism by examining how advance selling incentivizes channel members to reduce retail prices in both periods. When consumers advance buy and stockpile products, their carried-over inventory decreases the second-period residual demand, forcing the manufacturer and retailer to reduce their second-period prices (i.e., $\frac{\partial p_2}{\partial Q_1} < 0, \frac{\partial w_2}{\partial Q_1} < 0$) and thereby alleviating the double-marginalization problem in the second period.

Consumers are only willing to advance buy and stockpile products when the first-period price p_1 is sufficiently low (see Equation 1). To secure a lower second-period wholesale price, the retailer reduces its first-period retail price from the static price (i.e., $p_1 < \frac{1+w_1}{2}$) to induce consumer stockpiling. Anticipating the benefit of advance selling, the manufacturer charges a lower wholesale price in the first period than the static price (i.e., $w_1 < \frac{1}{2}$) to subsidize the retailer for advance selling. As a result, first-period wholesale and retail prices decline with advance selling, which alleviates the double-marginalization problem in the first period.

In this case, advance selling benefits channel members and consumers by reducing retail prices and alleviating the double-marginalization problem in both periods. We have interviewed managers at five major retail chain stores and directors at two retailing centers at major institutions. Retail managers indicated that manufacturers tend to offer favorable prices when advance selling seasonal products, which is in line with this mechanism. This result arises only when the holding cost is not prohibitive (i.e., $h \leq \frac{3}{8}$). Otherwise, channel members must reduce first-period prices substantially to induce consumers to advance buy and stockpile the product, which is less profitable than spot selling alone.

Retailer Can Stockpile

Now consider the case when the manufacturer sells the product in both periods and the retailer can stockpile.[2] We begin with the second period, the equilibrium of which relies on whether or not the retailer advance sells the product in the first period to consumers.

The retailer only spot sells. If the retailer only spot sells, consumers do not have any inventory of the product at the beginning of the second period. Assume that the retailer carries S units of inventory. The retailer sells $1 - p_2$ units of the product to fulfill consumers' demand but only needs to purchase $1 - p_2 - S$ units of the product from the manufacturer. Thus, the retailer's second-period profit is $\pi_2 = (1 - p_2)p_2 - (1 - p_2 - S)w_2$. Accordingly, its second-period pricing decision is $p_2 = \frac{1+w_2}{2}$. Meanwhile, the manufacturer chooses wholesale price w_2 to maximize its second-period profit $\Pi_2 = (1 - p_2 - S)w_2$. We obtain $w_2 = \frac{1-2S}{2}$ and $p_2 = \frac{3-2S}{4}$.

The retailer advance sells. If the retailer advance sells the product, assume that it carries S units forward to the second period while consumers carry Q_1 units. Then, the second-period residual consumer demand is $1 - p_2 - Q_1$. With S units in inventory, the retailer must purchase $1 - p_2 - Q_1 - S$ units from the manufacturer and thus chooses

[2]Theoretically, the manufacturer can choose to only advance sell the product without spot selling. However, such a strategy is dominated: In the second period, the manufacturer strictly prefers to sell the product.

p_2 to maximize its second-period profit $\pi_2 = (1 - p_2 - Q_1)p_2 - (1 - p_2 - Q_1 - S)w_2$. Solving the retailer's pricing problem, we have $p_2 = \frac{1-Q_1+w_2}{2}$. Meanwhile, the manufacturer chooses w_2 to maximize its second-period profit $\Pi_2 = (1 - p_2 - Q_1 - S)w_2$, and we obtain $w_2 = \frac{1-Q_1-2S}{2}$. After setting p_1, the retailer chooses its inventory level S to maximize its residual profit $\pi' = -(w_1 + h) \cdot S + \pi_2$. Using Lemma 1 and the second-period equilibrium outcome, we solve the retailer's and consumers' stockpiling decisions:

$$(S, Q_1) = \begin{cases} \left(p_1 - w_1, \frac{3-4h-6p_1+2w_1}{3}\right) & \text{if } p_1 \leq \frac{3-4h+2w_1}{6}, \\ \left(\frac{3-4h-4w_1}{6}, 0\right) & \text{if } p_1 > \frac{3-4h+2w_1}{6}, w_1 \leq \frac{3}{4} - h, \\ (0, 0) & \text{otherwise.} \end{cases} \tag{4}$$

Equation (4) suggests that, if the first-period retail price is low (i.e., $p_1 \leq \frac{3-4h+2w_1}{6}$), both the retailer and consumers advance buy and stockpile the product. If the first-period retail price is high (i.e., $p_1 > \frac{3-4h+2w_1}{6}$) but the first-period wholesale price is not too high (i.e., $w_1 \leq \frac{3}{4} - h$), only the retailer advance buys and stockpiles the product. If the first-period wholesale price is too high (i.e., $w_1 > \frac{3}{4} - h$), the retailer also forfeits advance buying.

If the first-period wholesale price is not too high, the retailer can choose a low retail price (i.e., $p_1 < \frac{3-4h+2w_1}{6}$ such that $Q_1 > 0$) to maximize its profit with advance selling:

$$\pi = Q_1 \cdot p_1 - (Q_1 + S)w_1 - S \cdot h + \pi_2, \tag{5}$$

where Q_1 and S are given by (4). Alternatively, the retailer can choose a high retail price (i.e., $p_1 > \frac{3-4h+2w_1}{6}$ such that $Q_1 = 0$) to maximize its profit with only spot selling:

$$\pi = -(w_1 + h)S + \pi_2. \tag{6}$$

Solving the retailer's problem, we obtain $p_1 = \emptyset$; that is, the retailer does not advance sell (or equivalently, it sets a prohibitively high retail price so that consumers do not

advance buy). Anticipating the retailer's pricing decisions, the manufacturer chooses w_1 to maximize its total profit over two periods $\Pi = w_1 S + \Pi_2$. We have

$$w_1 = \begin{cases} \frac{9-4h}{16} & \text{if } h \leq \frac{1}{4}, \\ \emptyset & \text{otherwise.} \end{cases} \tag{7}$$

Table 3 summarizes the detailed equilibrium outcomes.

Proposition 2 *Under a dynamic wholesale-price contract, when the retailer can stockpile:*

a. If the holding cost is low (i.e., $h \leq \frac{1}{4}$), the manufacturer advance sells, but the retailer stockpiles and only spot sells. Otherwise, the manufacturer and retailer both only spot sell.

b. The manufacturer, the retailer, and consumers are all better off with advance selling.

Proposition 2 reveals two theoretical insights. Part (a) suggests that in a decentralized channel, a manufacturer and its retailer can make different decisions as to whether or not to advance sell. While the manufacturer may advance sell to the retailer, the retailer stockpiles the product and only spot sells. Part (b) of Proposition 2 suggests that, as when the retailer cannot stockpile in Proposition 1, when the retailer can stockpile, advance selling also benefits the manufacturer, the retailer, and consumers, resulting in a win-win-win outcome. We elaborate on the underlying mechanisms as follows.

When the retailer can stockpile products, the benefit of advance selling comes from offering the retailer the option to buy in the advance period in addition to the spot period, which induces the manufacturer to compete with itself intertemporarily. As a result, the option value of advance selling constrains the manufacturer's pricing power, reducing its weighted average wholesale price. Consequently, the retailer charges a lower retail price when spot selling all its products, thereby expanding demand and alleviating the channel's double-marginalization problem to benefit the manufacturer, retailer, and consumers. We can illustrate this *pricing-reducing effect* of advance selling numerically. Let

$h = 0$ (see Table 3): When the manufacturer only spot sells, wholesale and retail prices are $w_2 = .5$ and $p_2 = .75$, respectively. With advance selling, the weighted average wholesale price is $\bar{w} = \frac{w_1 S + w_2 Q_2}{S + Q_2} = .45 < .5$, and the weighted average retail price is $\bar{p} = p_2 = .6875 < .75$. Both average prices are lower than what they would be with only spot selling. Thus, advance selling leaves channel members better off, provided that the product's holding cost is low (i.e., $h \leq \frac{1}{4}$). Otherwise, the holding cost offsets the benefit of advance selling, and channel members only spot sell the product.

We can dive deeper into the retailer's and manufacturer's selling incentives. Although the retailer may only spot sell, it still prefers to advance buy and stockpile products (i.e., $S > 0$) from the manufacturer instead of waiting to buy all products in the second period (i.e., $S = 0$). This is because the retailer's inventory lowers its demand in the second period, forcing the manufacturer to reduce the second-period wholesale price (i.e., $\frac{\partial w_2}{\partial S} < 0$). The retailer then passes half the wholesale price reduction on to consumers (i.e., $\frac{\partial p_2}{\partial w_2} = \frac{1}{2}$) to boost demand and retains the remainder to enjoy a higher profit margin. In this way, the retailer's advance buying increases its second-period profit.

When advance buying from the manufacturer, the retailer prefers to stockpile the product for spot selling instead of advance selling at all to consumers. This is because, if the retailer advance sells, consumers advance buy and stockpile the product for future consumption. Although consumers' storage also decreases the retailer's second-period demand from the manufacturer (which can also reduce the second-period wholesale price), the retailer can secure an even lower second-period wholesale price when *it* stockpiles rather than when *its consumers* stockpile. This is because, when consumers stockpile, their storage reduces demand for the retailer's product in the second period, forcing the retailer to reduce its second-period retail price, which alleviates the decrease in residual demand that drives the manufacturer to reduce its second-period wholesale price. However, when the retailer stockpiles, its inventory directly reduces its demand for the manufacturer's product without affecting consumers' demand for the retailer's prod-

uct in the second period. Moreover, the manufacturer must reduce its wholesale price to a greater degree to respond to the retailer's storage than to consumers' storage: Mathematically, the second-period wholesale price decreases with the retailer's storage by $\frac{\partial w_2}{\partial S} = -1$ and decreases with consumers' storage by $\frac{\partial w_2}{\partial Q_1} = -\frac{1}{2}$. Therefore, the retailer can receive a more favorable spot wholesale price when it carries inventory over to the second period instead of advance selling to let consumers carry inventory (i.e., $\frac{\partial w_2}{\partial S} < \frac{\partial w_2}{\partial Q_1}$).

However, anticipating the retailer's incentive to stockpile products in the first period for its second-period benefit, the manufacturer raises its wholesale price in the first period. As a result, the equilibrium wholesale price is higher in the first period but still lower in the second period than the static wholesale price. Essentially, with advance selling, the manufacturer implements a *quantity-discount* contract. Suppose that $h = 0$. The retailer purchases the first S units at a higher wholesale price $w_1 = .5625 > .5$ and the remaining Q_2 units at a lower wholesale price $w_2 = .375 < .5$ (see Table 3). Then, the manufacturer can simultaneously enjoy a high margin through w_1 for the first S units that it sells and a high consumer demand, as the second-period retail price ($p_2 = \frac{1+w_2}{2}$) and demand are determined only by w_2. As such, the manufacturer's total profits over the two periods increase with advance selling.

It is worth mentioning that while Proposition 2 focuses on the case in which both the retailer and consumers incur a positive storage cost h, the results are not qualitatively changed when consumers can costlessly stockpile products. Consider a case in which consumers' holding costs are negligible but the retailer incurs holding costs ($h > 0$) when retailer stockpiling is permitted. We find that, as long as h is not too high, in equilibrium the manufacturer advance sells to the retailer, and the retailer stockpiles products and does not advance sell to consumers, and advance selling leads to a "win-win-win" outcome.

Propositions 1 and 2 show that regardless of whether or not the retailer can stockpile products, both the retailer's and consumers' advance buying alleviates issues of double

marginalization and leaves channel members better off. If so, how does the retailer's stockpiling ability affect the manufacturer and the retailer itself? When should the manufacturer restrict the retailer's stockpiling ability? In practice, when agreeing to adopt scan-backs, VMI systems, or contractual terms that restrict its stockpiling, the retailer credibly commits not to stockpile. In addition, a retailer could opt not to use any warehouses that provide storage space and/or keep its retail stores compact and fully utilized (without space in backrooms or elsewhere). If the retailer commits not to stockpile, it agrees to advance sell products that it advance buys from the manufacturer. Thus, the manufacturer and not the retailer decides whether the retailer must advance sell. If so, why and when should the retailer commit not to stockpile or instead to circumvent the manufacturer's restriction? We address these questions in Proposition 3.

Proposition 3 *Under a dynamic wholesale-price contract, the retailer's stockpiling ability decreases retailer profit, manufacturer profit, and consumer surplus.*

The option to stockpile empowers the retailer over the manufacturer. With this option, the retailer can stockpile products that it advance buys and wait to sell in the spot period (see Proposition 2), which induces the manufacturer to compete with itself intertemporarily. As a result, the manufacturer faces greater challenges in coordinating its channel. Consequently, by restricting the retailer's ability to stockpile products, the manufacturer gains stronger channel power by forcing the retailer to advance sell products that it advance buys. Therefore, the manufacturer is weakly better off restricting the retailer's stockpiling ability.

However, the retailer's stockpiling ability is detrimental not only to the manufacturer but also to the retailer itself and consumers. The reason is that when the retailer has no stockpiling ability, the manufacturer lowers the first-period wholesale price to help the retailer offer a low retail price to induce consumers' advance buying. However, if the retailer can stockpile, for a given wholesale price, the retailer prefers not to advance sell to

consumers and stockpiles the product itself. Anticipating the retailer's stockpiling incentive, the manufacturer is only willing to offer the low first-period wholesale price when it has an assurance that the retailer cannot take advantage of the low price to advance buy or to stockpile products for spot selling. By giving up its stockpiling ability, the retailer credibly commits to working collaboratively with the manufacturer to advance sell products to consumers at a lower price. The reduction in the first-period wholesale price increases the retailer's total profits; furthermore, as the first-period wholesale price declines, the retailer offers a low first-period retail price to induce more consumers to advance buy, thus alleviating the double-marginalization problem and benefiting the manufacturer as well. The price reduction also increases demand, thereby improving consumer surplus. Thus, the retailer is better off committing not to stockpile. Consequently, even if the retailer has tactics to circumvent a manufacturer's attempt to prevent stockpiling, it will not be in the retailer's best interest to do so.

Proposition 3 also offers an explanation to the observation that manufacturers in practice frequently adopt contractual tactics to prevent retailer stockpiling (e.g., through adopting a VMI system or imposing restrictions on contract terms). It also explains why retailers are willing to accept these seemingly harmful arrangements and forfeit their ability to carry inventory.

ADVANCE SELLING UNDER A COMMITMENT CONTRACT

In practice, manufacturers may offer the retailer a commitment wholesale price contract by setting both the advance-period and spot-period wholesale prices in advance. Practitioners suggest that it is common for manufacturers to set future prices up front. Such a commitment is more feasible when the manufacturer can better predict future supply, cost, and market conditions. In this section, we examine channel members' advance-selling incentives under a commitment contract. The sequence of decisions remains the same as under a dynamic wholesale-price contract except that, now, the manufacturer

sets both w_1 and w_2 in the first period. As in the previous section, we separately analyze scenarios in which the retailer can or cannot stockpile.

Retailer Cannot Stockpile

We first analyze the second period. Suppose that consumers advance buy and stockpile Q_1 units in the first period and the retailer offers a second-period price p_2; if so, the second-period residual demand will be $D_2 = 1 - p_2 - Q_1$. Given the second-period wholesale price w_2, the retailer chooses p_2 to maximize its second-period profit $\pi_2 = (p_2 - w_2)D_2$. Solving the retailer's problem, we obtain the second-period retail price $p_2 = \frac{1+w_2-Q_1}{2}$. If consumers advance buy any products (i.e., $Q_1 > 0$), the no-arbitrage condition in Lemma 1 dictates that $p_1 = p_2 - h = \frac{1+w_2-Q_1}{2} - h$, which implies that

$$Q_1 = \begin{cases} 1 - 2h - 2p_1 + w_2 & \text{if } p_1 \leq \frac{1+w_2}{2} - h, \\ 0 & \text{otherwise.} \end{cases} \tag{8}$$

In the first period, the retailer chooses p_1 to maximize its total profit over the two periods $\pi = (p_1 - w_1)Q_1 + \pi_2$. Solving the retailer's problem, we obtain

$$p_1 = \begin{cases} \frac{1+2w_1-w_2}{2} & \text{if } h \leq w_2 - w_1, \\ \emptyset & \text{otherwise.} \end{cases} \tag{9}$$

Finally, the manufacturer chooses w_1 and w_2 to maximize its total profit across the two periods (i.e., $\Pi = w_1Q_1 + w_2D_2$). Solving the manufacturer's pricing decisions, we have

$$(w_1, w_2) = \begin{cases} \left(\frac{1}{2} - h, \frac{2(1-h)}{3}\right) & \text{if } h \leq \frac{1}{4}, \\ \left(\emptyset, \frac{1}{2}\right) & \text{otherwise.} \end{cases} \tag{10}$$

We summarize the equilibrium outcomes in Table 4 and present the results as follows.

Proposition 4 *Under a commitment wholesale-price contract, when the retailer cannot stockpile:*

a. If the holding cost is low (i.e., $h \leq \frac{1}{4}$), the manufacturer and retailer advance sell to con-

Table 4: Comparison of Equilibria Under Commitment Contracts

	No AS	AS without Retailer Stockpiling ($h \leq \frac{1}{4}$)	AS with Retailer Stockpiling
w_1	$\emptyset$	$\frac{1-2h}{2}$	$\emptyset$
p_1	$\emptyset$	$\frac{2(1-h)}{3}$	$\emptyset$
S	0	0	0
Q_1	0	$\frac{1-4h}{3}$	0
w_2	$\frac{1}{2}$	$\frac{2(1-h)}{3}$	$\frac{1}{2}$
p_2	$\frac{3}{4}$	$\frac{2+h}{3}$	$\frac{3}{4}$
Q_2	$\frac{1}{4}$	h	$\frac{1}{4}$
Π	$\frac{1}{8}$	$\frac{1-2h+4h^2}{6}$	$\frac{1}{8}$
π	$\frac{1}{16}$	$\frac{1-2h+10h^2}{18}$	$\frac{1}{16}$
CS	$\frac{1}{32}$	$\frac{(1-h)^2}{18}$	$\frac{1}{32}$

Notes: AS = advance selling.

sumers. Otherwise, the manufacturer and retailer only spot sell.

b. *The manufacturer and consumers are better off but the retailer is worse off with advance selling.*

Propositions 1 and 4 suggest that when the retailer cannot stockpile, the manufacturer's advance selling decision remains qualitatively consistent under either commitment or dynamic contracts because, so long as the holding cost is low, the manufacturer profits from advance selling in both cases. Quantitatively, advance selling benefits the manufacturer in a narrower range of situations under a commitment contract (e.g., $h \leq \frac{1}{4}$) than a dynamic contract (e.g., $h \leq \frac{3}{8}$). This is because advance selling offers consumers the option to buy in the first period or the second period, which imposes an intertemporal price competition between the first-period and second-period retailer and an intertemporal price competition between the first-period and second-period manufacturer. However, if the manufacturer can commit to its future price, advance buying does not

affect its pricing power, which attenuates the *price-reducing effect* of advance selling. As a result, advance selling does not reduce retail prices or the double-marginalization problem as much as under the dynamic contract. Therefore, the benefit of advance selling diminishes, and the manufacturer advance sells in a narrower range of situations.

In addition, the manufacturer's advance selling benefits the retailer under a dynamic contract but hurts it under a commitment contract. This is because the manufacturer's ability to commit to the spot wholesale price enables it to induce the retailer's and consumers' advance buying by committing to a high spot wholesale price instead of offering a favorable advance wholesale price. Moreover, the manufacturer does not need to reduce its spot wholesale price to respond to consumers' storage that decreases spot-period demand. The retailer's advance buying or selling cannot help it obtain a favorable wholesale price in the second period. On the flip side, the high wholesale prices in both periods decrease the retailer's profit.

More specifically, the manufacturer commits to a high second-period wholesale price $w_2 > w_1$; meanwhile, the retailer prefers to advance sell to consumers so that it can take advantage of the lower cost w_1 instead of paying the high w_2. However, as consumers advance buy and stockpile the product, the second-period residual demand decreases, forcing the retailer to lower its second-period retail price (i.e., $\frac{\partial p_2}{\partial Q_1} < 0$). Despite the high second-period wholesale price w_2, the retailer must now charge a low second-period retail price p_2. This means that, by making a price commitment, the manufacturer forces the retailer to charge low retail prices while keeping wholesale prices high, thereby exploiting the retailer. The reduction in retail prices benefits consumers. Thus, this strategy improves the manufacturer's profit and consumer surplus at the retailer's expense.

Retailer Can Stockpile

Now, suppose that the retailer can stockpile the product. In this case, the retailer stockpiles S units and consumers advance buy Q_1 units in the first period. We can derive

the second-period retail price as follows.

$$p_2 = \begin{cases} \frac{1-Q_1+w_2}{2} & \text{if } S \leq \frac{1-Q_1-w_2}{2}, \\ 1-Q_1-S & \text{if } \frac{1-Q_1-w_2}{2} \leq S \leq \frac{1-Q_1}{2}, \\ \frac{1-Q_1}{2} & \text{otherwise.} \end{cases}$$

Using the no-arbitrage condition and maximizing the retailer's profit, we solve for the retailer's and consumers' advance buying and stockpiling quantities:

$$(Q_1, S) = \begin{cases} (1-h-2p_1+w_1, p_1-w_1) & \text{if } p_1 \leq \frac{1+w_1-h}{2},\ w_1+h < w_2, \\ (0, \frac{1-h-w_1}{2}) & \text{if } p_1 \geq \frac{1+w_1-h}{2},\ w_1+h < w_2, \\ (1-2h-2p_1+w_2, 0) & \text{if } p_1 \leq \frac{1+w_2}{2}-h,\ w_1+h \geq w_2, \\ (0,0) & \text{if } p_1 \geq \frac{1+w_2}{2}-h,\ w_1+h \geq w_2. \end{cases}$$

We then solve for the retailer's first-period retail price and find that the retailer does not advance sell to consumers. Finally, we solve for the manufacturer's first-period pricing decisions and obtain the following proposition.

Proposition 5 *Under a commitment wholesale-price contract, when the retailer can stockpile, the manufacturer and retailer only spot sell the product.*

Comparing Proposition 2 with Proposition 5, we show that when the retailer can stockpile, the manufacturer's advance-selling decision varies with the type of wholesale price contract it uses. Under a dynamic contract, the manufacturer prefers to advance sell to the retailer. However, under a commitment contract, the manufacturer prefers to only spot sell, even though, in both cases, the retailer only spot sells to consumers.

The intuition is as follows: Suppose that wholesale prices satisfy $w_1 + h > w_2$. Then, the retailer has no incentive to advance buy from the manufacturer and strictly prefers to wait for the lower spot-period wholesale price. Conversely, if $w_1 + h < w_2$, the retailer has no incentive to buy from the manufacturer in the second period, which is strictly domi-

nated by the retailer's advance buying and stockpiling the product in the first period. In either case, the manufacturer only sells to the retailer in one period and cannot make a greater profit than when strictly spot selling to the retailer. Comparing equilibrium profits with and without retailer stockpiling, we obtain the following:

Proposition 6 *Under a commitment wholesale-price contract, the retailer's stockpiling ability increases its profit but decreases the manufacturer's profit and consumer surplus.*

Proposition 3 suggests that, under a dynamic contract, the retailer's stockpiling ability is detrimental to channel members and consumers. Therefore, restricting the retailer's stockpiling ability results in a win-win-win outcome. By contrast, Proposition 6 suggests that, under a commitment contract, the retailer is worse off when the manufacturer restricts its stockpiling ability.

The reason is as follows: Proposition 4 shows that if the retailer cannot stockpile, it will advance sell, which benefits the manufacturer and consumers at the expenses of the retailer. Meanwhile, Proposition 5 shows that if the retailer can stockpile, it will not advance sell. Comparison of the two outcomes suggests that the retailer's stockpiling ability increases its profit but decreases the manufacturer's profit and consumer surplus. Anticipating these outcomes, the manufacturer should restrict the retailer's stockpiling, while the retailer should try to circumvent such restriction.

Proposition 7 *Comparing a dynamic and a commitment wholesale-price contract, we have:*

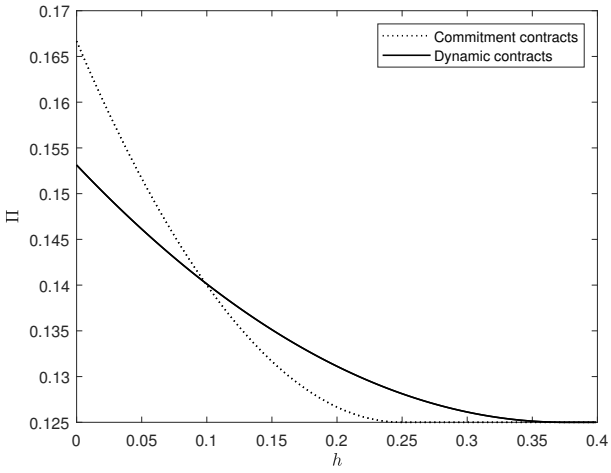
a. The manufacturer's profit is higher under a commitment contract when $h < h_0 = \frac{11-\sqrt{30}}{56} \approx .099$ *and lower otherwise.*

b. The retailer's profit is always lower under a commitment contract.

Research has shown how a firm's ability to make credible commitments to its future actions can benefit it in various contexts. For example, when a firm sells a durable product to consumers with heterogeneous valuations, the firm is better off committing to only

selling its product in a single period rather than in two periods (Coase 1972). When a firm uses consumers' first-period purchase decisions to price discriminate consumers in the second period, the firm is better off committing to forgoing price discrimination (Fudenberg and Tirole 2000; Fudenberg and Villas-Boas 2006). Along this line of reasoning, we would expect the manufacturer's profit to be higher when it can commit to its future wholesale price. However, Proposition 7 shows that this intuition is true only when the holding cost is sufficiently low. When the holding cost is high, the manufacturer is better off offering a dynamic wholesale-price contract (see Figure 1). To show this, we compare the equilibrium outcomes under a commitment and a dynamic contract when h is low in Table 5 and when h is high in Table 6.

Figure 1: The Manufacturer's Profit under Commitment and Dynamic Contracts



Our results in Propositions 3 and 6 show that, under either a dynamic or a commitment contract, the manufacturer will be weakly better off by restricting the retailer's stockpiling capabilities. Given this, we focus on the channel members' equilibrium profits with the retailer's ability to stockpile restricted. When the holding cost is high (i.e., $h > \frac{3}{8}$), the manufacturer only spot sells products, and its commitment to a future price becomes irrelevant. When the holding cost is medium (i.e., $h \in (\frac{1}{4}, \frac{3}{8})$), the manufacturer only advance sells under a dynamic contract. Thus, in this case, the manufacturer can

only benefit from advance selling under a dynamic contract; that is, its profit is higher under a dynamic contract than under a commitment contract.

Finally, when the holding cost is lower than $\frac{1}{4}$, the manufacturer benefits from advance selling under both dynamic and commitment contracts, but its profit is higher under a dynamic contract when the holding cost is higher than $h_0 \approx .099$. The intuition is as follows: The manufacturer's commitment power exerts two countervailing effects on its profit: On the one hand, as we discussed in Proposition 4, the manufacturer's commitment power enables it to induce retailer stockpiling by committing to a higher spot wholesale price, thereby exploiting retailer surplus. As a result, the manufacturer extracts a larger share of the channel surplus. This effect increases the manufacturer's profit. Tables 5 and 6 show that the manufacturer's share of channel surplus measured by social welfare is higher under the commitment contract (60% when $h = 0$ and 58.1% when $h = .2$) than the dynamic contract (51.6% when $h = 0$ and 54% when $h = .2$).

On the other hand, the benefit of advance selling to alleviate the double-marginalization problem and improve channel profit decreases with the manufacturer's commitment power. This is because advance selling gives the retailer or consumers the option to buy in the first period or the second period, which leads to an intertemporal price competition between the first-period and second-period manufacturer. However, if the manufacturer can commit to its future price, advance buying does not affect its pricing power. Therefore, the benefit of advance selling to alleviate the double-marginalization problem by reducing wholesale and retailer prices diminishes. Tables 5 and 6 show that the channel's total surplus is lower under a commitment contract (e.g., .280 when $h = 0$ and .238 when $h = .2$) than a dynamic contract (e.g., .297 when $h = 0$ and .243 when $h = .2$).

As a result, the commitment contract reduces channel surplus (i.e., the size of the pie) but increases the manufacturer's share of the channel surplus (i.e., the slice of the pie). When the holding cost is sufficiently low, the positive effect dominates, and the manufacturer's profit is higher under a commitment contract (e.g., .167 when $h = 0$) than

Table 5: Equilibrium Outcomes Over Two Periods ($h = 0$)

	Nonstorable	Commitment	Dynamic
Weighted average wholesale price ($\bar{w}$)	.5	.5	.422
Weighted average retail price ($\bar{p}$)	.75	.667	.638
Manufacturer's profit (Π)	.125 (57.1%)	.167(60%)	.153(51.6%)
Retailer's profit (π)	.068 (28.6%)	.057(20%)	.078(26.3%)
Consumer surplus	.031(14.3%)	.057(20%)	.066 (22.1%)
Social welfare	.219 (100%)	.280 (100%)	.297 (100%)

Table 6: Equilibrium Outcomes Over Two Periods ($h = .2$)

	Nonstorable	Commitment	Dynamic
Weighted average wholesale price ($\bar{w}$)	.5	.475	.433
Weighted average retail price ($\bar{p}$)	.75	.683	.651
Manufacturer's profit (Π)	.125 (57.1%)	.127(58.1%)	.131(54%)
Retailer's profit (π)	.068 (28.6%)	.056(25.5%)	.066(27.1%)
Consumer surplus	.031 (14.3%)	.036(16.3%)	.046(18.8%)
Social welfare	.219 (100%)	.238 (100%)	.243 (100%)

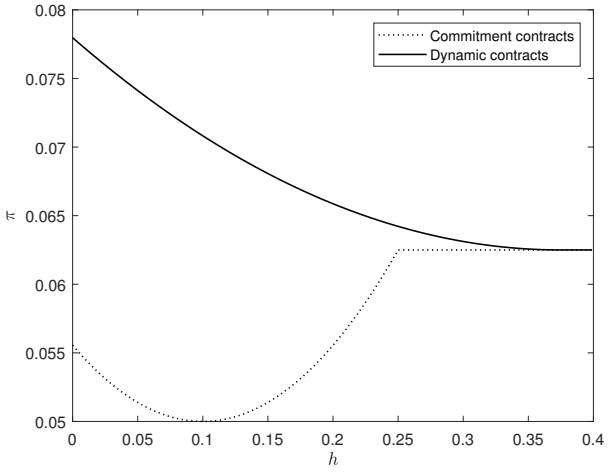
a dynamic contract (e.g., .153 when $h = 0$). Otherwise, the negative effect of commitment dominates, and the manufacturer's profit is higher under a dynamic contract (e.g., .131 when $h = .2$) than a commitment contract (e.g., .127 when $h = .2$).

In addition, as we discussed in Proposition 4, by committing to a high second-period price, the manufacturer forces the retailer to advance sell with low retail prices without needing to decrease its own margin. By contrast, under a dynamic pricing contract, the manufacturer can only induce the retailer to advance sell with low retail prices by decreasing its first-period wholesale price and profit margin. As a result, with commitment power, the manufacturer can enjoy both a high demand and a high margin. The manufacturer's profit improvement, however, is at the retailer's expense: The retailer is worse off under a commitment contract (see Figure 2).

COMPETITION

In the main model, we consider a bilateral monopoly setting with one manufacturer and one retailer and demonstrate the benefits of advance selling in a channel setting. Competitive forces reduce prices, which can change manufacturers' and retailers' ad-

Figure 2: The Retailer's Profit under Commitment and Dynamic contracts



vance selling incentives. To examine the effect of competition on firms' advance selling decision, we consider four cases (see Table 7), depending on whether the firms are selling through a distribution channel and whether there is market competition. The detailed analysis is provided in Web Appendix C.

Table 7: When Would Firms Advance Sell?

	Monopoly	Competition
Direct selling	No AS	AS (AS is prisoner's dilemma)
Selling through channel	AS (AS is win-win)	AS (AS is win-win)

Notes: AS = advance selling.

First, when a monopolistic firm sells directly to consumers, the firm does not advance sell. This is because advance selling only shifts the spot-period demand to the advance period without creating new demand. Moreover, advance selling induces the firm to compete with itself intertemporarily, which constrains its pricing power. Therefore, the firm does not have any incentives to advance sell. Second, when competing firms sell to consumers directly, the firms engage in advance selling as long as the holding cost h is

not too high. The intuition is that by advance selling, a firm can capture the future market share of the rival firm, forcing the rival firm to sell less in the spot period. Therefore, advance selling helps a firm gain a competitive advantage over its rival. Nonetheless, as both firms engage in advance selling, the competition becomes fiercer, resulting in lower profits, which leads to a prisoner's dilemma.

Third, our main model considers the case of a monopolistic channel advance selling to consumers. The rationale is that in a distribution channel, advance selling alleviates the issue of double marginalization, which improves channel efficiency and firm profits. As a result, both the manufacturers and retailers can be better off with advance selling. Finally, consider the case of competing channels, in which each manufacturer sells through its own retailer. In this case, both channels engage in advance selling. Here, advance selling has two effects: (1) As our monopolistic model shows, the firms can alleviate the issue of double marginalization through advance selling, and (2) as when competing firms sell directly to consumers, by selling to consumers in the advance period, firms of one channel can capture the future market share of the rival firms. As both channels advance sell, the competition between the channels becomes fiercer. While the former effect benefits the firms, the latter effect hurts the firms. Overall, the former effect dominates the latter, and all firms are better off with advance selling. Therefore, the channel coordination benefit of advance selling that we demonstrate in the monopolistic model continues to hold in a competitive setting.

MULTIPLE-PERIOD SPOT SELLING

In the main model, we illustrated the benefits of advance selling before a single-period spot selling. In practice, a retailer often sells a seasonal product over multiple periods rather than one. Multiple-period spot selling can lead to intertemporal price discrimination and a lower second-period retail price, which can promote greater channel coordination in comparison with that with single-period spot selling. It is unclear whether the

outcome of channel coordination arises from intertemporal price discrimination over two spot-selling periods or advance selling. To disentangle these two underlying forces and expose the unique benefit of advance selling, we generalize the single-period spot selling model to a multiple-period spot selling model with and without advance selling. We present the detailed analysis in Web Appendix D and summarize the main findings here.

Our analysis reveals that two-period spot selling indeed promotes greater channel coordination than single-period spot selling. The manufacturer's and retailer's profits are higher when they spot sell the product over two periods rather than one period. To assess the incremental benefits of advance selling, we consider a three-period model that adds an advance selling period before the two periods in spot selling. We summarize the equilibrium channel prices and profit allocations in Table 8. Without advance selling, the manufacturer's profit in the two-period spot selling model is .270, and it increases to .306 with advance selling in the three-period model, which shows the additional benefit of advance selling on top of the two-period intertemporal price discrimination.

Table 8: Equilibrium Outcomes Over Two and Three Periods ($h = 0$)

	Two-Period Model (Two spot periods)	Three-Period Model (One advance period and two spot periods)
Weighted average wholesale price ($\bar{w}$)	.662	.633
Weighted average retail price ($\bar{p}$)	.999	.960
Manufacturer's profit (Π)	.270 (52.6%)	.306(48.6%)
Retailer's profit (π)	.138 (26.8%)	.158(25.1%)
Consumer surplus	.106 (20.6%)	.166(26.3%)
Social welfare	.514 (100%)	.630 (100%)

Moreover, advance selling improves channel coordination by reducing retail prices to expand demand and alleviate the double-marginalization problem. This mechanism is reflected in Table 8 as follows: The weighted average retail price is .999 without advance selling, and it drops to .960 with advance selling. Consequently, advance selling expands channel surplus or social welfare from .514 to .630, which benefits channel members and consumers. This result shows the robustness of our main results regarding the benefit of

advance selling; moreover, it reveals the incremental benefit of advance selling on top of the intertemporal price discrimination with multiple-period spot selling.

ADVANCE SELLING WITH UNCERTAIN CONSUMER VALUATIONS

Shugan and Xie establish the benefit of advance selling when consumers have uncertain valuations about a product before the spot period (Shugan and Xie 2000; Xie and Shugan 2001, 2009). In our main model, we show the benefits of advance selling in the absence of valuation uncertainty. In this section, we allow for valuation uncertainty, similar to Shugan and Xie, and extend it to our channel setting.

We assume that all consumers have unit demand for the product, where α consumers have a high valuation H and $1 - \alpha$ consumers have a low valuation $L < H$. In the first period, consumers do not know their valuation, which is realized in the second period. We assume that the firms cannot commit to future prices, the manufacturer's cost is normalized to 0, and consumers do not incur any holding cost. We first analyze a benchmark model in which the manufacturer sells directly to consumers, which replicates the main result and insight in Shugan and Xie's studies. Then, we augment the model with a channel structure in which the manufacturer sells to consumers through an independent retailer. We find that compared with direct selling, advance selling benefits the manufacturer in a broader range of situations when the manufacturer sells through a retailer (for details, see Web Appendix E). This is because resolving information asymmetry is more beneficial for the manufacturer in a channel than a nonchannel setting. Therefore, our result continues to hold with demand uncertainty as in Shugan and Xie's framework.

CONCLUSION

Both manufacturers and retailers often advance sell seasonal products and services to consumers before the consumption season. In the absence of capacity constraints, consumer heterogeneity, demand uncertainty, or other factors that make advance selling profitable, a manufacturer can advance sell to coordinate its channel and improve

profits. Under a dynamic contract, advance selling alleviates the double-marginalization problem, benefiting the manufacturer, the retailer, and consumers. Under a commitment contract, advance selling enables the manufacturer to improve profits by extracting more channel surplus at the retailer's expenses, which also works to the consumers' benefit. Moreover, the incentive to advance sell can vary depending on the channel member (i.e., manufacturer or retailer), type of channel contract (i.e., dynamic or commitment wholesale-price contracts), the retailer's ability to stockpile the product, and the holding cost of the product. Our theoretical results offer several actionable implications for managers.

When should a retailer advance sell seasonal products? Our results suggest that retailers such as Walmart and Target should not advance sell seasonal products (e.g. summer or winter apparels or equipment) when they can stockpile products for spot selling. Retailers should advance sell products that have low holding costs (e.g. nonperishable products) when they cannot stockpile products, either because they lack storage space or have contractual agreements such as VMIs or scan-backs with the manufacturer.

When should a manufacturer advance sell in anticipation of its retailer's interest in advance selling? When a retailer (e.g. Target) cannot stockpile products, manufacturers of seasonal products (e.g., Zooby Industrial, supplier of holiday decorations) should advance sell as long as the product's holding cost is low (e.g., nonperishable decorations that are easier to be stockpiled). If the retailer can stockpile products, the manufacturer should only advance sell when the channel contract is a dynamic contract and the holding cost is even lower.

How should a manufacturer decide whether to restrict or allow its retailer to stockpile seasonal products? The manufacturer should restrict retailer stockpiling when the product's holding cost is low. For example, Zooby Industrial should offer scan-back contracts to Target for selling nonperishable holiday items, so that Target has no incentives to stockpile these items. When the holding cost is high, the manufacturer only spot sells, and the restriction

decision becomes irrelevant.

How should a retailer decide whether to forfeit its stockpiling ability? The retailer should forfeit its stockpiling ability when the channel contract is a dynamic contract but retain its stockpiling ability when the channel contract is a commitment contract. For example, Target should accept scan-back contracts for seasonal products when the manufacturer changes wholesale prices periodically but decline scan-back contracts when the manufacturer commits to future wholesale prices.

When should the manufacturer commit to its spot wholesale price when it advance sells a product, and how does this price commitment affect the retailer? The manufacturer should commit to its spot price when it advance sells if and only if the product's holding cost is sufficiently low. However, the retailer prefers a dynamic contract to a commitment contract. Therefore, channel members may be misaligned in their interest for channel contracts when a product's holding cost is low.

Our research can be extended in several directions. In this paper, we provide one theoretical explanation as to how channel members can be incentivized to advance sell seasonal products in a bilateral monopolist framework. Future works might examine advance selling incentives in other channel structures. In addition, future research could explore the profitability of advance selling when a manufacturer makes multichannel decisions such as encroachment into the retail market with its direct channel. In addition, to determine how channel relationships drive advance selling incentives, we assume away demand uncertainty, information asymmetry, capacity constraints, and other market factors that can affect channel decisions. Future studies could incorporate these factors to provide more theoretical insights and managerial guidance to firms.

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