Research Article

A Decision on the Store-within-a-Store Strategy Based on the Uncertainty Model

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The store-within-a-store (SWS) arrangement is one of the most important channel structures. Taking the perspective of manufacturers, this paper extends the literature by examining the role of manufacturers’ prediction accuracy, moderated by demand uncertainty and inventory-related parameters, in determining the adoption of the SWS strategy. This study constructs a theoretical model to investigate manufacturers’ decision based on the uncertainty model. The result shows that, first, as a manufacturer’s demand forecast accuracy increases, it would be more likely to choose the SWS mode, and demand uncertainty and inventory-related parameters further strengthen this effect. Second, if the manufacturer and retailer can reach an agreement on a proper percentage of the revenues that the manufacturer pays to the retailer, the SWS mode would be a better choice for both of them. This research provides new insights for the adoption of the SWS strategy.

1. Introduction

The store-within-a-store (SWS) strategy is a cooperative business mode in which a manufacturer has a store or booth in a retail store [1]. For the arrangement, the manufacturer has to pay the retailer a lease for the space of in-store real estate and/or the retailer charges a certain percentage of the manufacturer’s sales. The manufacturer is responsible for the management of the major activities related to its products such as pricing, stocking, merchandising, and promoting. The salespersons of its products in the store are employed by the manufacturer rather than the retailer.

The SWS mode is one of the important strategies used by firms in practice. In America, manufacturers such as Ralph Lauren, Chanel, MAC, Macmillan, and Random House and retailers such as Macy’s, Bloomingdale’s, Rakuen.com Shopping, and Neiman Marcus operate their businesses using the strategy [1–3]. In Asia and Europe, this arrangement is even more prevailing [4]. In China, for example, retailers such as Hisense Plaza, Kai Yuan Department Store, Van’ Dept, and some supermarkets use this strategy [5, 6].

However, little academic attention has been paid to the issues related to the SWS strategy. As exceptions, Jerath and Zhang [1] explored the topic from the perspective of retailers, showing how factors such as substitutability between competing products, effectiveness and costs of in-store services, the store traffic effect, and the intensity of competition at the retail level influence retailers’ choice of the strategy. Abhishek, Jerath, and Zhang [2] extended the study to the context of online commercial business and found that online retailers should make their choice based on their impact on demand in the traditional channel. In China, Zhuang’s [5] case study identified some advantages of the SWS strategy from the perspective of manufacturers. He believed that the SWS strategy can simplify the cooperation between retailers and manufacturers, enhance the connection between manufacturers and consumers, increase manufacturers’ control of marketing channels, and improve their supervision over salespeople in stores with the assistance of retailers. These benefits, in turn, would help manufacturers to more precisely forecast market demand and hereafter to better deal with
the demand uncertainty. Unfortunately, limited by the case method, he did not test how manufacturers' demand forecast affect their selection of the SWS strategy.

Taking the perspective of manufacturers, we extend the literature by examining the role of manufacturer's prediction accuracy, moderated by demand uncertainty and inventory-related parameters (i.e., the disposal cost of inventory and the cost of additional orders), in determining the adoption of the SWS strategy. To achieve this, we consider a manufacturer-retailer channel and assume an uncertainty demand following previous studies (e.g., [7–10]). We use a profit maximization model to determine the optimal price, stock, and profit and examine the impact of manufacturer's prediction accuracy with varying demand uncertainty and inventory-related parameters on the manufacturer's mode choice. We find that, with the increase of its demand forecast accuracy, a manufacturer would be more likely to choose the SWS mode, and demand uncertainty and inventory-related parameters would strengthen this effect. We also find that if the manufacturer and retailer can reach an agreement on a proper percentage of the revenues that the manufacturer pays to the retailer, the SWS mode would be a better choice for both the manufacturer and retailer.

2. Literature Review

Researchers have paid some attention to the composition of a traditional channel with direct channels (online and offline), especially the issue of pricing strategy in the circumstance. For example, in the context of a two-manufacturer and one-retailer channel structure, Choi [11] compares the pricing strategies of the channel members under different power balance scenarios. He finds that while product differentiation helps manufacturers, it hurts retailers and, conversely, while store differentiation helps retailers, it hurts manufacturers. In the situation that the manufacturer opens a direct channel, Chiang, Chhajed, and Hess [12] explore the impact of customer acceptance of the direct channel on the profits of the players in the offline channel, showing that both the manufacturer and retailer increase their profits with some special kinds of productions such as books. Cai [13] investigates the influence of channel structure and channel coordination on profits of the manufacturer, the retailer, and the entire channel in the context of two single-channel and two dual-channel supply chains. They find that the choices of the supplier and the retailer on channel structures are different when the supplier and the retailer coordinate versus when they do not depending upon parameters such as channel demand, channel operational costs, and channel substitutability. Khouja, Park, and Cai [14] analyze channel selection and price setting of a manufacturer that has several distribution options such as a direct channel, a manufacturer-owned retail channel, and/or an independent retail channel. They suggest that the relative segment size and consumers' channel preference influence the manufacturer choices of channel structure. Wei, Shao, and Zhao [15] study the effect of dual-channel format on supply chain's competition ability and the effect of different bargaining powers on the optimal pricing decisions when one supply chain introduces an online retailing channel. However, few studies explore the problems related to the SWS mode. As exceptional examples, Jerath and Zhang [1] investigate the economic incentives of a retailer when deciding on the SWS mode. Then Abhishek, Jerath, and Zhang [2] consider online retailers' choice. Hagiu and Wright [3] find that whether SWS mode is preferred depends on whether independent suppliers or the intermediary has more important information. Nevertheless, as mentioned previously, all of them take the perspective of retailers. In addition, Zhuang [5] identifies some advantages of the SWS strategy from the perspective of manufacturers and suggests that these advantages would help the manufacturers to more precisely forecast market demand and reduce the risk of demand uncertainty. Limited by the case study, he does not test the impact of demand forecast and uncertainty on the manufacturers' choice of the SWS mode.

Another stream of literature related to our study is how the information influences the profits of manufacturers and retailers. For example, Bourland, Powell, and Pyke [16] study a two-level channel composed of a supply and a final assembly plant. Their results show that inventory-related benefits of the plant are particularly sensitive to demand uncertainty and the supplier's service. Chen et al. [17] establish a model including two factors: demand forecasting and order lead time. They prove that the bullwhip effect can be reduced with centralized demand information. Raju and Roy [8] analyze the impact of firm size, product substitutability, and intensity mode of competition on the value of forecast information and find that information is more valuable when product substitutability is higher or the firm is larger. Yao, Yue, and Wang [18] analyze how the manufacturer designs its return policy with a direct channel added to its traditional retail channel. They find that, without forecast information sharing about the demand ratio, the more optimistic the manufacturer is about the demand via the direct channel, the more restricted the returns policy is. Yan and Ghose [10] develop a game-theoretic model to examine the value of forecast information. They show that the profits of both online and traditional retailers increase with an increase of the retailers' forecast accuracy and that forecast accuracy has a greater effect on the performance of traditional retailers. Jiang et al. [19] consider a channel where the manufacturer possesses better demand forecast information. They find that risk aversion plays a critical role in the firms' sharing decisions and impact of forecast accuracy. Zhang and Xiong [20] study the problem of sharing demand forecast information in a closed-loop supply chain with the manufacturer collecting and remanufacturing. Drawing insights from the above literature, we extend the research from the perspective of manufacturers based on the uncertainty model [8, 18, 21]. We study the channel structure in which a manufacturer has two choices: the traditional retailer and the retailer offering the SWS mode. We model the impact of the manufacturer's demand forecast accuracy and stock level on its profit in an environment where the demand is uncertain. Under the SWS mode, the manufacturer directly contacts consumers, so it can forecast the market demand more precisely by obtaining more reliable information on the market from the consumers [5, 22]. This would in
turn increase the manufacturer’s profit by improving the manufacturer’s management on pricing and inventories and reduce risk of the demand uncertainty. We show how demand uncertainty, inventory-related parameters, and prediction accuracy, the factors frequently considered in the uncertainty model [8, 18, 21], affect profits of the manufacturer which finally determine its choice of the SWS mode.

3. Model Framework

We consider a simple channel that consists of one manufacturer and one retailer. There are two options: the traditional mode with the retailer opting for the retailer resells arrangement and the SWS mode with the retailer leasing its retail space to the manufacturer and the manufacturer having all merchandising and pricing autonomy. We assume that the manufacturer and the retailer make their decisions to maximize their profits, respectively. To derive the optimal decisions, following Yue and Liu [9] and Li and Lei, Zhang, and Zhou [23] we use the concept of the Bayesian Nash equilibrium with the assumption that the manufacturer is the Stackelberg leader and the retailer is the follower.

The demand for the manufacturer’s product \(D\) is simply given as

\[
D = a - bP_r, \tag{1}
\]

where \(a\) is the potential demand for the product if the product is free of charge, \(b\) is the slope of \(D\), and \(P_r\) is the retail price. Because the demand varies subject to economic conditions, market changes, and varieties of consumers, we assume that \(a\) is a random variable or \(a = a_0 + \epsilon\), where \(\epsilon\) is normally distributed with mean zero and variance \(\sigma_0^2\). (Although the normality assumption about \(\epsilon\) has limitations, with respect to negative values of demand, it has been used widely in the literature because it simplifies the analysis [8–10, 21, 24, 25]. In fact, we can mitigate this negative effect by allowing a large \(a_0\) value relative to \(\sigma_0\).) Thus \(\sigma_0\) represents the demand uncertainty.

3.1. Analysis of the Traditional Mode. In this scenario, the manufacturer and the retailer make their respective demand forecast first. Then the manufacturer sets its wholesale price \(w\). After that, the retailer sets the retail price and orders the production quantity \(Q\). Based on the retailer’s order, the production of \(Q\) occurs. Since the retailer schedules the production level before the demand is known, it is charged for the burden of inventory disposal or shortage cost.

Let each member obtain a forecast about the unknown market demand based on its information-gathering techniques. Then each has its own forecast about the potential demand \(a\). The manufacturer’s prediction is \(f_t\), while the retailer’s is \(f_r\). We assume that

\[
f_t = a + \epsilon_t, \tag{2}
\]

\[
f_r = a + \epsilon_r, \tag{3}
\]

where \(\epsilon_t\) and \(\epsilon_r\) are normally distributed with mean zero and variances \(\sigma_t^2\) and \(\sigma_r^2\), respectively. A higher variance implies a less precise forecast. To facilitate analysis, following Li [25], we assume that \(\epsilon_t\) and \(\epsilon_r\) are independent of each other or \(\text{cov}(\epsilon_t, \epsilon_r) = \text{cov}(\epsilon_t, \epsilon_r) = 0\). Our analysis will refer to the conditional expectations and variances as shown in Appendix A.

In the traditional mode, the manufacturer and the retailer both maximize their own anticipated profits, \(\pi_{mt}\) and \(\pi_{rt}\), respectively, as shown below:

\[
\pi_{mt} = (w - c)(a - bP_r) \int f_t \, da \tag{4}
\]

\[
\pi_{rt} = \int_0^\infty (P_r - w)(a - bP_r) f(a) \, da 
- \int_0^Q h(Q - a + bP_r) f(a) \, da 
- \int_0^\infty \left( \int_0^Q s(a - bP_r - Q) f(a) \, da \right) f_r(f_t, f_r) \tag{5}
\]

where \(c\) is unit cost of the production, \(w\) is the wholesale price set by the manufacturer, and \(P_r\) is the retail price set by the retailer; \(f(a)\) is the probability density function of \(a\); \(h\) is a disposal cost per unit of inventory when the demand is less than \(Q\). If the demand exceeds \(Q\), following prior studies [9, 21, 26], we assume that the retailer or manufacturer can obtain additional units at the cost of \(s\) per unit. There is usually \(h < c < s\). The retailer is assumed to make its price decision based on \(f_t\) and \(f_r\) because it can infer \(f_t\) from \(w\) [9].

Table 1 shows the Bayesian Stackelberg expected equilibrium prices \(w^* \) and \(P_r^*\), production quantity \(Q^*\), and the expected profits \(\pi_{mt}^* \) and \(\pi_{rt}^*\) for both the manufacturer and retailer in the traditional channel.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(w^*)</td>
<td>(a_{mt} + bc)</td>
</tr>
<tr>
<td>(P_r^*)</td>
<td>(2a_r + a_{rt} + bc)</td>
</tr>
<tr>
<td>(Q^*)</td>
<td>(\frac{\sigma_{TR} \Phi^{-1}(\frac{s}{s+h})}{4b} + \frac{a_r + bc}{4} )</td>
</tr>
<tr>
<td>(\pi_{mt}^*)</td>
<td>(\frac{(2a_t - a_{mt} - bc)^2}{16b} - \frac{\sigma_{TR} (s + h)}{\sigma_r} L(r) )</td>
</tr>
<tr>
<td>(\pi_{rt}^*)</td>
<td>(\frac{(a_{rt} - bc)(2a_t - a_{mt} - bc)}{8b} )</td>
</tr>
</tbody>
</table>

Table 1: Price, production quantity, and profits in the traditional mode.

Note: \(a_t = Ia_0 + Jf_t + Kf_t; a_{mt} = Ia_0 + Jf_t + K((1 - t)a_0 + t_f); a_r = Ia_0 + Jf_r + Kf_r; f_t = \sigma_t^2/\sigma_t^2 + \sigma_0^2(\sigma_t^2 + \sigma_0^2); f_r = \sigma_r^2/\sigma_r^2 + \sigma_0^2(\sigma_r^2 + \sigma_0^2); K = \sigma_0^2/\sigma_t^2 + \sigma_0^2/\sigma_r^2; I_M = Ia_0 + Jf_t + K((1 - t) a_0 + t f_t); I = \sigma_0^2/\sigma_t^2 + \sigma_0^2/\sigma_r^2; \Phi = \int_0^\infty (x - z) d\Phi(x); \Phi\) is the distribution function of the standard normal probability distribution; \(\Phi\) means the variable is an equilibrium solution.
The expected profits of the manufacturer and retailer are shown as below:

\[
E(\pi^*_m) = \frac{2E(a_t a_{IM}) - E(a^2_{IM}) - 2bca_0 + b^2c^2}{8b} \tag{6}
\]

\[
E(\pi^*_r) = \frac{4E(a^2_t) + E(a^2_{IM}) - 4a^2_t - 2bca_0 + b^2c^2}{16b} - h\sigma_{T_1}r + \sigma_{T_1}(s + h) L(r). \tag{7}
\]

3.2. Analysis of the SWS Mode. In this scenario, the manufacturer first makes its demand forecast and then sets the retail price and production quantity (Q). Based on the manufacturer’s setting, the production of Q occurs. The retailer need not order from the manufacturer and sell to consumers. The manufacturer itself has to retail its products in the store. Therefore, the manufacturer has to schedule the production level before the demand is known and is charged for the burden of inventory disposal or shortage cost, while the retailer gets a percentage (s) of the manufacturer’s revenues for leasing space to the manufacturer. (The manufacturer may pay the retailer a lease for the space of in-store real estate. However, this will not change our analysis and conclusions.)

In this mode, the manufacturer’s forecast of the potential demand (a) is \(f_s\). We assume that

\[
f_s = a + \varepsilon, \tag{8}
\]

where \(\varepsilon\) is normally distributed with mean zero and variance \(\sigma^2\). In the SWS mode, since the manufacturer can keep touch with the consumers more closely and make its demand forecasting more accurately, it is reasonable to assume that \(\sigma^2_s \leq \sigma^2\). The manufacturer maximizes its anticipated profit \(\pi^*_m\) in the way shown below:

\[
\pi^*_m = \int_0^{\infty} \left(\theta P_r - c\right)(a - bP_r) f(a) da - \int_0^{Q+bP_r} h(Q - a - bP_r) f(a) da - \int_{Q+bP_r}^{\infty} s(a - bP_r - Q) f(a) da \bigg| f_s. \tag{9}
\]

The profit of the retailer \(\pi^*_r\) hereafter can be decided by

\[
\pi^*_r = E \left[ (1 - \theta) P_{r1} (a - bP_{r1}) \right] f_s. \tag{10}
\]

Table 2 shows the Bayesian Stackelberg expected equilibrium price \(P^*_r\), production quantity \(Q^*_r\), and the expected profits \(\pi^*_r\) and \(\pi^*_m\) for both the manufacturer and retailer in the SWS mode.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(P^*_r)</td>
<td>(\frac{2b}{a_s + bc})</td>
</tr>
<tr>
<td>(Q^*_r)</td>
<td>(\frac{s}{s + h} + \frac{a_s + bc}{(1 - \theta)(a^2_s - b^2c^2)})</td>
</tr>
<tr>
<td>(\pi^*_r)</td>
<td>(\theta a_s + 8bc - 2bc(a_s - bc))</td>
</tr>
<tr>
<td>(\pi^*_m)</td>
<td>(-h\sigma_{SI}r + \sigma_{SI}(s + h)L(r))</td>
</tr>
</tbody>
</table>

Note: \(\sigma_{SI} = \sigma^2_s / \sigma^2_s + \sigma^2_s\), \(a_s = E(a | f_s) = (1 - t) a_0 + t f_s\).

The expected profits of the manufacturer and retailer are shown as below:

\[
E(\pi^*_m) = \left[ \theta E(a^2_t) - 2bca_0 + (2 - \theta) b^2c^2 - h\sigma_{SI}r + \sigma_{SI}(s + h) L(r) \right] \tag{11}
\]

\[
E(\pi^*_r) = (1 - \theta) \frac{E(a^2_t) - b^2c^2}{4b}. \tag{12}
\]

4. Simulation and Discussion

As mentioned previously, the SWS mode could improve the manufacturer’s demand forecast accuracy by reducing \(\sigma_s\), so \(\sigma_s\) is the main factor that we vary in simulation. Next, we illustrate how the model parameter \(\sigma_s\) affects the manufacturer’s and retailer’s profit from one mode over the other under different conditions with varying \(\sigma_s\), s, and h. To simplify our analysis, we assume that (because we consider a situation with one manufacturer and one retailer, double marginalization affects the channel profit only under the traditional mode; in fact, double marginalization is affected by product substitution which is not considered in our research; to eliminate the impact of double marginalization, we subtract the percentage of \((a_0 - bc)^2 / 16b\) in equations (13) and (14))

\[
V_m = E \left[ \pi^*_m - \pi^*_m - \theta \frac{(a_0 - bc)^2}{16b} \right] \tag{13}
\]

\[
V_r = E \left[ \pi^*_r - \pi^*_r - (1 - \theta) \frac{(a_0 - bc)^2}{16b} \right] \tag{14}
\]

\[
V_c = V_m + V_r \tag{15}
\]

where \(V_m, V_r\), or \(V_c\) indicates the profit difference of the manufacturer, the retailer, or the whole channel, respectively, under the SWS mode versus the traditional mode. Our focus is on \(V_m\), because the manufacturer chooses its channel mode based on the value of \(V_m\). If \(V_m\) is above zero, the manufacturer should choose the SWS mode. Otherwise the traditional mode should be a better choice. In addition, an increase of \(V_m\) means that the increased profit that the manufacturer can gain with the SWS mode over the traditional mode.
4.1. Effect of Manufacturer Forecast Accuracy under Different Demand Uncertainty. The manufacturer forecast accuracy is indicated negatively by $\sigma_s$, the manufacturer forecast error. Figures 1–3 show the effect of $\sigma_s$ on $V_m$, $V_r$, or $V_c$, respectively, with different demand uncertainty ($\sigma_0$).

Figure 1 illustrates that $V_m$ (the profit difference of the manufacturer under the SWS mode versus the traditional mode) decreases as $\sigma_s$ increases, and this effect is strengthened when $\sigma_0$ is higher. We offer the following explanations for the results. As mentioned above, the manufacturer bears the risk of inventory disposal or shortage cost under the SWS mode, and so does the retailer under the traditional mode. Therefore, the manufacturer should get a higher percentage of the profit under the SWS mode for taking the risk but a lower percentage of the profit under the traditional mode for not taking the risk.

Under the traditional mode, because the retailer deals with the risk, the manufacturer forecast error ($\sigma_s$) has little impact on the channel profit and hereafter the manufacturer's profit. In contrary, under the SWS mode, since the manufacturer is responsible for the burden of inventory disposal and shortage, the bigger the error of the manufacturer's forecast on the market demand, the larger the loss that the manufacturer has to bear and the less the profit that the manufacturer can gain especially when it pays a fixed rent to the retailer. This leads $V_m$ to decrease with the increase of $\sigma_s$, regardless the level of $\sigma_0$. However, as $\sigma_s$ increases, the market risk is getting higher. This will enlarge the manufacturer’s loss caused by $\sigma_s$ and hereafter enhance the negative effect of $\sigma_s$ on $V_m$.

To sum up, if the manufacturer chooses the traditional mode versus the SWS mode based on its profitability, it will prefer the SWS mode when its forecast accuracy is high (i.e., $\sigma_s$ is low) and the traditional mode when its forecast accuracy is low (i.e., $\sigma_s$ is high). This tendency will be stronger as the demand uncertainty is getting higher.

Figure 2 shows that $V_r$ (the profit difference of the retailer under the SWS mode versus the traditional mode) is higher when $\sigma_0$ is greater and negative when $\sigma_0$ is small (e.g., $\sigma_0 \leq 5$), and $V_r$ decreases slightly as $\sigma_s$ increases. For these results, we have the following explanations. When $\sigma_0$ is small, the risk is
Mathematical Problems in Engineering

The retailer should thus get a higher percentage of the profit for taking the risk if it chooses the traditional mode but a lower percentage of the profit for not taking the risk if it chooses the SWS mode. This leads \( V_r \) to be negative. In contrary, when \( \sigma_0 \) is large and the risk is high, the retailer has to take a higher risk in order to get a higher percentage of the profit under the traditional mode. The losses caused by the risk surpass the additional profit for taking the risk. This makes \( V_r \) positive and increase with \( \sigma_0 \).

Furthermore, under the SWS mode, the manufacturer bears the market risk and gets a higher percentage of the profit. Therefore, when \( \sigma_s \) varies, the manufacturer will receive most of the consequences whether they are losses or benefits. The retailer’s profit would be affected slightly.

In brief, if the retailer chooses the traditional mode versus the SWS mode based on its profitability, it will prefer the traditional mode when the demand uncertainty is small and the SWS mode when the demand uncertainty is high, and its preference for the SWS mode will be intensified as the demand uncertainty is increasing. The manufacturer’s demand forecast accuracy (i.e., negatively indicated by \( \sigma_s \)) only has a limited impact on the retailer’s choice.

Figure 3 shows that \( V_c \) (the profit difference of the whole channel under the SWS mode versus the traditional mode) decreases as \( \sigma_s \) increases, and this effect is strengthened when \( \sigma_0 \) is higher. Since \( V_c = V_m + V_r \) and the value of \( V_c \) is bigger than zero when \( \sigma_s \) is small, the results suggest that when the manufacturer is good at predicting the market demand, both the manufacturer and retailer would benefit from the SWS mode if they can reach an agreement on an appropriate distribution of the value \( V_c \) between them; and the higher the market uncertainty, the greater the joint benefit.

We summarize the results of our above analysis in three propositions: if choosing the traditional mode versus the SWS mode based on profitability, we have the following.

**Proposition 1 (P1).** The manufacturer will prefer the SWS mode when its forecast accuracy is high and the traditional mode when its forecast accuracy is low, and the demand uncertainty positively moderates the effect of the manufacturer’s forecast accuracy on its preference for the SWS mode.

**Proposition 2 (P2).** The retailer will prefer the traditional mode when the demand uncertainty is small and the SWS mode when the demand uncertainty is high.

**Proposition 3 (P3).** Both the manufacturer and retailer may generate more profit under the SWS mode if they can reach an agreement on an appropriate distribution of the value \( V_c \) between them, especially when the demand uncertainty is high.

### 4.2 Moderating Effect of Inventory-Related Parameters

P1 states the moderating effect of demand uncertainty. The two inventory-related parameters, inventory disposal cost \( (h) \) and ordering cost \( (s) \), may also moderate the effect of the manufacturer’s forecast accuracy. To analyze the moderating effect of \( h \) or \( s \), we alternatively assume that \( \sigma_0 = 24 \) and \( s = 20 \) with varying \( h \) or \( \sigma_0 = 24 \) and \( h = 5 \) with varying \( s \). The results are illustrated in Figures 4–6.

As indicated in Figures 4(a) and 4(b), both \( h \) and \( s \) positively moderate the negative effect of \( \sigma_s \) on \( V_m \) in
such a way that when \( h \) or \( s \) is getting higher, the profit difference of the manufacturer under the SWS mode versus the traditional mode will be decreased faster (\( V_m \)) with the increase of the manufacturer’s forecast error (\( \sigma_s \)). The reason is simple. When \( h \) or \( s \) is higher, the inventory disposal or ordering additional units is costlier. Therefore, the same error of the manufacturer’s demand forecast will cause the manufacturer to bear a larger loss if it has to dispose of or reorder some inventories under the SWS mode than under the traditional mode. This reduces \( V_m \), the profit difference of
the manufacturer under the SWS mode versus the traditional mode.

Figures 5(a) and 5(b) indicate that when \( \sigma_0 \) is held consistent, \( V_r \) is higher when \( h \) or \( s \) is greater and negative when \( h \) or \( s \) is smaller (e.g., \( h = 2 \) or \( s = 10 \)), and it decreases slightly as \( \sigma_r \) increases. The explanation for the results lies in the cost of inventory disposal or ordering. When \( h \) or \( s \) is small, the retailer would get a higher percentage of the profit by taking the low cost of inventory under the traditional mode while getting a lower percentage of the profit for not bearing the cost under the SWS mode. Therefore, the retailer’s profit would be higher under the traditional mode, making \( V_r \) negative. In contrary, when \( h \) is high, although the retailer can still get a satisfactory percentage of the profit by using the traditional mode, its profit would decrease due to the increased inventory cost that it has to bear. Nevertheless, its profit would not be affected if the SWS mode is used because the manufacturer has to undertake the inventory cost. Taking together, this makes \( V_r \) positive and increase with \( h \).

Moreover, under the SWS mode, when \( \sigma_r \) varies, the manufacturer will receive most of the benefits or losses. Yet, the retailer’s profit can hardly be influenced, so \( V_r \) decreases slightly as \( \sigma_r \) increases.

Figures 6(a) and 6(b) show the moderating effect of \( h \) and \( s \). Specifically, when \( h \) or \( s \) is high, the profit difference of the channel under the SWS mode versus the traditional mode will decrease more rapidly (\( V_r \)) as the manufacturer’s forecast error (\( \sigma_r \)) increases. Since \( V_r = V_m + V_r \), and the value of \( V_r \) is more than zero when \( \sigma_r \) is small, the results suggest that both the manufacturer and the retailer will benefit from the SWS mode if they can reach an agreement on an appropriate distribution of the value \( V_r \) when the manufacturer has a higher capacity for predicting the market demand; the higher the inventory cost (\( h \) or \( s \)), the greater the joint benefit.

We summarize the results of our above analysis in Propositions 4–6: if choosing the traditional mode versus the SWS mode based on profitability, we have the following.

**Proposition 4 (P4).** When the cost of inventory disposal and/or the ordering cost per additional unit are higher, with high forecast accuracy, the manufacturer will prefer the SWS mode more.

**Proposition 5 (P5).** The retailer will prefer the traditional mode when the cost of inventory disposal or the ordering cost per additional unit is small and the SWS mode when the cost of inventory disposal or the ordering cost per additional unit is large.

**Proposition 6 (P6).** Both the manufacturer and retailer may generate more profit under the SWS mode if they can reach an agreement on an appropriate distribution of the joint benefit between them.

5. Conclusion

The SWS mode is prevailing all around the world. In different countries, retailers reserve SWS for different product categories. In this research, we investigate the impact of manufacturers’ forecast accuracy, moderated by demand uncertainty and two inventory-related parameters, on the profits of manufacturers under different uncertainty modes. Based on the profit varieties, we determine how these variables influence the manufacturers’ decision of the SWS mode. Our results of analysis provide some insights for the SWS strategy.

P1 or P4 highlights the importance of the manufacturer improving its forecast accuracy under the SWS mode, especially when the demand uncertainty or the inventory-related parameters of its product are high. Specifically, our findings echo the common phenomenon that manufacturers are initially forced to accept the SWS mode [5, 6]. As P2 or P5 suggests, a retailer uses the SWS mode to avoid the possible losses of its inventory management caused by the risk of the demand uncertainty under the condition of the relatively high values of \( h \) (the disposal cost per unit of inventory), \( s \) (the ordering cost per additional unit), and \( \sigma_0 \) (the demand uncertainty). Only after the retailer makes the choice can its manufacturer decide whether or not to adopt the SWS mode. However, P1 and P4 imply that, under the SWS mode, a manufacturer can take the advantage of its closer connection with consumers to improve its demand forecast accuracy and gain even bigger profits. Moreover, if a manufacturer can largely improve its demand forecast capability, it will have better choice to adopt the SWS mode when operating under high levels of demand uncertainty, high disposal cost per unit of inventory, or high ordering cost per additional unit.

P3 and P6 suggest that both the manufacturer and retailer may be better off by adopting the SWS mode if they can reach an agreement on appropriate distribution of the joint profit (\( V_r \)) between them.

In addition, P2 states that the retailer prefers the traditional mode when demand uncertainty is small and the SWS mode when demand uncertainty is high. This offers an explanation for O’Connell and Dodes’ [4] and Jerath and Zhang’s [1] observation. They find that the SWS mode is used in more product categories in Asian countries than in the United States. According to P2, with similar cost of inventory disposal and additional orders at place, because demand uncertainty in emerging economies such as Asian countries is relatively higher than that in the United State [27, 28], retailers are more likely to utilize their powerful positions to adopt the SWS mode, so as to avoid potential losses of inventory management caused by high demand uncertainty. Yet, manufacturers have no choices but to adopt the SWS mode.

Moreover, P5 posits that the retailer prefers the SWS mode when the cost of inventory disposal or the ordering cost per additional unit is large. This result echoes another interesting phenomenon. Although such products as delicatessens, fruits, and vegetables are thought inappropriate for the SWS mode [1], they are prevalently sold with such mode in supermarkets. According to P5, these products have a high cost of inventory storage due to their short period of freshness. The same logic is also applicable to some non-high-end brands of apparels sold with the SWS mode in department stores [1]. In addition to the uncertain market,
these apparels are seasonal and it is costly to obtain additional units.

Despite these contributions, the framework has several limitations. First, in this study, we assume that the retailer under the SWS mode charges a certain percentage of the revenues the manufacturer makes. The retailer may have other options, such as to charge a periodic rent or a percentage of the revenues the manufacturer makes plus a periodic rent. Second, in Zhuang’s [5] case study, he suggested that the SWS mode could reduce the retailer’s operation cost and improve the manufacturers’ supervision over their salespersons in the store with the assistance of the retailer. We do not consider these factors in our model. Third, limited by our method, we could not empirically test our model. Future studies may collect suitable data to test the model.

Appendix

A.

\[
E(a | f_j) = (1 - t_f) \cdot a_0 + t_f \cdot f_j \quad (A.1)
\]

\[
E(a | f_j) = (1 - t_f) \cdot a_0 + t_f \cdot f_j \quad (A.2)
\]

\[
E(f_j | f_j) = (1 - t_f) \cdot a_0 + t_f \cdot f_j \quad (A.3)
\]

\[
E(a | f_j, f_j) = I \cdot a_0 + f_j \cdot f_j + K \cdot f_j, \quad (A.4)
\]

where

\[
t_f = \frac{\sigma_0^2}{(a_0^2 + \sigma_f^2)} \quad (A.5)
\]

\[
t_r = \frac{\sigma_0^2}{(a_0^2 + \sigma_r^2)} \quad (A.6)
\]

B.

\[
E(a_t) = E(a_{t,M}) = a_0 \quad (B.1)
\]

\[
E(a_t^2) = a_0 + \frac{\sigma_0^4 \cdot \sigma_r^4 \cdot (a_0^2 + \sigma_r^2) + \sigma_0^4 \cdot \sigma_r^4 \cdot (a_0^2 + \sigma_r^2)}{[a_0^2 + \sigma_r^2 + \sigma_0^2 \cdot (a_0^2 + \sigma_r^2)]^2} \quad (B.2)
\]

\[
E(a_{t,M}^2) = a_0 + \frac{\sigma_0^4 \cdot \sigma_r^4 \cdot (a_0^2 + \sigma_r^2)^2 + \sigma_0^8 \cdot \sigma_r^4}{(a_0^2 + \sigma_r^2) \cdot [a_0^2 + \sigma_r^2 + \sigma_0^2 \cdot (a_0^2 + \sigma_r^2)]^2} \quad (B.3)
\]

\[
E(a_t) = a_0 \quad \text{ (B.4)}
\]

\[
E(a_t^2) = a_0^2 + \frac{\sigma_0^4}{\sigma_0^2 + \sigma_r^2} \quad \text{ (B.4)}
\]

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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