FIT REVELATION STRATEGY IN A SUPPLY CHAIN WITH TWO TYPES OF CONSUMERS

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Abstract. This paper develops a game theoretical model for a supply chain consisting of one manufacturer and one retailer who chooses one of two strategies: implementing fit revelation or not implementing fit revelation. Firstly, the fit revelation strategy of the retailer in the decentralized supply chain is analyzed. When the market scale is medium, the fit revelation strategy is implementing fit revelation and only good-fit consumer will buy the product; otherwise, it is not implementing fit revelation. The results are counterintuitive because people may believe that it would be better to let consumers know more information about the product when the market scale is low. Implementing fit revelation is not always beneficial for consumers. When the market scale is sufficiently low, good-fit and bad-fit consumers both prefer not implementing fit revelation. Secondly, the paper also considers the case in which the manufacturer decides whether to implement fit revelation. Sometimes, the retailer and the manufacturer prefer themselves to facilitate fit revelation. Thirdly, the effect of decentralization is investigated. Numerical examples show that the interval in which implementing fit revelation is optimal is larger under the centralized setting than that under the decentralized setting. The decentralization decreases the probability to implement fit revelation.

1. Introduction. In nowadays, product variety and complexity are not uncommon. Although price is easy to acquire and quality can be assured by brand, it is very hard for consumers to choose the product with the right attributes matching her taste, especially in e-commerce age. Taking computers, cars, tennis rackets, mattresses, infant food as examples, if the horizontal attributes of the product turn out to be misfit with the consumer’s taste, a mismatching cost is incurred. For each kind of product, there exists two types of consumers. One is good-fit consumer, and the other is bad-fit consumer. However, consumers couldn’t know their types before they try the product. Thus, when buying the product, there is a risk for the consumer. There are many ways for sellers to make consumers more informed about the attributes of the product by implementing fit revelation. Sellers can describe
product attributes in advertisements [24] or allow consumers to see the reviews of other consumers [2]. In China, there is a new phenomenon that sellers can sell product in live network broadcast. It is a more vivid form to reveal attributes of the product. Moreover, some platforms offer virtual fitting room. Another way is to offer free samples and free trials [8]. Store assistance is also a way to help consumers to find the right product fitting with their tastes [19]. Store assistance includes displaying more types of products in store, hiring skilled salesperson, and providing excellent trying experience. For example, Sierra Trading Post Inc., a seller of outdoor and recreational footwear provides a good store assistant service to reduce product return occurred due to wrong sizes and colors. Sierra hires a size and fit specialist for shoes and puts a lot of effort in presenting appropriate colors and shapes [23]. Besides, returns policy can give consumers chances to try the product freely or with certain costs.

It is common that some sellers provide various of ways to inform consumers about the attributes of the product. However, some sellers do not. This paper classifies them into two categories: implementing fit revelation (IR) and not implementing fit revelation (NR). It is interesting to study when the retailer would better to implement fit revelation. Fit revelation has a large impact on demand. When mis-matching occurs, consumer will lose a value. This paper develops a game theoretic model of a one-manufacturer and one-retailer supply chain to investigate the fit revelation strategy when there exists good-fit consumers and bad-fit consumers. Some interesting questions arise. (a) What are the equilibrium decisions of the retailer under different fit revelation strategies facing two types of consumers? (b) What is the optimal fit revelation strategy of the retailer? (c) What is the impact of the fit revelation strategy on each type of consumers? (d) What kind of fit revelation strategy the manufacturer will prefer if it is the manufacturer who decides whether to implement fit revelation? (e) What are the differences in modeling when different members facilitate fit revelation? (f) What is the effect of decentralization of the supply chain on the fit revelation strategy?

To answer these questions, this paper proposes a stylized model that includes one manufacturer and one retailer selling products to two types of consumers. Fit information is critical for a consumer to make purchasing decision.

This study contributes to the extant literature in following ways. (1) The results show whether to implement fit revelation depends on the market scale. When the market scale is medium, it is better to implement fit revelation; otherwise, it is better to choose not implementing fit revelation. The results are counterintuitive because people may believe that it is better to reveal fit information to let consumers know more information about the product when the market scale is low. This paper enriches the unravelling theory from the perspective of fit revelation [11, 4, 10]. (2) The fit revelation strategy is studied in a supply chain. The interaction between the upstream and downstream of a supply chain is explored. The results show that if it is the manufacturer who decides the fit revelation, the manufacturer would choose similar strategy to the retailer. However, the thresholds would be different from that of the retailer. For the retailer and the manufacturer, sometimes they prefer themselves to facilitate fit revelation. (3) The effect of the decentralization is analyzed. The results show that if a firm operated in a centralized setting, it is more likely for them to choose implementing fit revelation. The decentralization will decrease the probability to implement fit revelation. (4) Heterogenous consumers are considered in this paper. The results show that when the market scale is medium,
the retailer or the manufacturer will choose implementing fit revelation. Only the good-fit consumer will buy product, and bad-fit consumer will not buy any product. 

(5) The impact of different fit revelation strategies on each type of consumers are studied. It is not always good for consumers to know fit information which may be counterintuitive because people may think that it is good for consumers to know fit information especially when the market scale is low.

The remainder of this paper is organized as follows. The next section summarizes relevant studies. In section 3, the basic model is described. Section 4 investigates the optimal fit revelation strategy of the retailer in a decentralized supply chain. Section 5 discusses two extensions. Section 6 provides concluding remarks.

2. Literature review. This study focuses on product information revelation, fit revelation strategy, and heterogenous consumer.

2.1. Information revelation. Some research primarily focuses on the revelation of quality information [7, 16]. Some mechanisms are used because high-quality providing firms want to separate from low-quality manufacturers. Advertising expenditures, reputation, brand investments and (introductory) pricing are all tools to reveal quality information [18]. For example, Moorthy and Hawkins [17] find there is a clear, positive relationship between advertising expenditure and perceived quality. Purohit and Srivastava [20] assess the effects of manufacturer reputation, retailer reputation, and warranty on consumer perceptions of product quality. Schmidbauer and Stock [21] find that a high quality firm benefits from using strikethrough pricing when the prior probability of high quality is relatively low while the probability of costs falling is relatively high. Bar-Issac et al. [1] examine a monopolistic firm’s strategic decision to make consumers’ information about quality gathering easier or harder. Some studies on information revelation focus on fit information revelation. For certain products, consumers may have no doubt about the quality. However, they may find that the products do not fit with them well. This is called misfit [26]. Store assistance is one way to mitigate misfit and reveal fit information [19, 22]. Providing free samples is another way to reveal fit information.

2.2. Fit information revelation strategy. There are several papers considering the monopolistic firm’s strategy to inform fit information. For example, Chen and Xie [2] study the interaction between consumer reviews and the firm’s information strategy. They find that when the production cost is low and/or there are enough expert product users, the seller’s best response is to increase the amount of product attribute information conveyed. When the production cost is high and there are enough product users, the seller’s best response is to reduce the amount of product attribute information it offers, even if it is cost-free to provide such information. Sun [24] studies a firm’s incentive to reveal information whose product differs in vertical quality and horizontal attribute. Johnson and Myatt [11] find that a firm’s optimal profit may be generated by either extremely high or extremely low levels of match informativeness. Chu and Zhang [4] investigate the integrated information and pricing strategy for a seller who can take consumers preorders before the release of a product. They find that the optimal information strategy depends on the normalized margin, which is the ratio between the expected profit margin and the standard deviation of consumer valuation.

Some studies consider competing firms’ incentive to reveal fit information. Gu and Xie [8] combine quality and fit together and study two competing firms’ fit
revelation strategy. They find that how much fit information the company will reveal depends on the product quality level. Zhang et al. [26] consider an online selling platform with an intermediary and two competitive sellers. They find that given the information disclosure tools, the competitive sellers always choose to disclose as much information as possible. Whereas, the intermediary’s optimal information strategy is determined by the disclosure cost and product characteristics. Hotz and Xiao [10] study the case when products have more than one attribute and there is heterogeneity in consumer tastes over these attributes in competitive environment. They show that sellers are worse off when more information is disclosed. However, none of above research considers the problem in a vertical supply chain. This paper fills the gap. This study differs from the extant studies and contributes to the literature. This paper show whether to implement fit revelation depends on market scale. When the market scale is medium, implementing fit revelation is optimal. This result is counterintuitive because people may think that it would be better to let people know more information about the product when the market scale is low.

2.3. Heterogenous consumer. In the existing literature, most studies concentrate on one type of consumer. That is, consumers are homogenous [8]. However, there are heterogenous consumers in reality. It is common in the economics literature to consider a discrete two-type case. For example, some papers divide consumers into strategic consumer and myopic consumer. Loginova and Taylor [14] study the price-experimentation problem of the seller to learn about the demand in two periods when the consumer is strategic and not strategic, respectively. The strategic consumers are also divided into two types: high-valuation buyer and low-valuation buyer. Luo and Li [15] assume that there are two kinds of consumers in the market: multi-channel consumers and physical channel consumers. Zhang and Jin [27] assume that there are two situations associating with consumer’s returning cost: low returning cost and high returning cost and analyze the pricing and contract design within a supply chain consisting of a manufacturer and an online retailer under asymmetric and symmetric information of returning cost, respectively. Some papers consider that consumers have different preferences. Deng et al. [5] assume that consumers have two kinds of preferences for quality: high quality and low quality. They study the quality revelation strategy and information acquisition of the manufacturer in dual-channel supply chain. They find that brand manufacturer is more willing to disclose information to high type consumer than low type consumers. Shi and Xiao [22] divide consumers into two types according to the loss of mismatching. They assume that consumers do not know whether the product fit with them. However, consumers know what type they belong to if mismatching happens. They study the returns policy in a vendor-managed-inventory environment. Different from Shi and Xiao [22], this paper assumes that when fit revelation strategy is implemented, consumers can know whether they fit with the product. Consumers are divided into two types: good-fit consumer and bad-fit consumer. The most relevant literature to this paper is Gu and Xie [8]. They consider the fit revelation strategies of two competing retailers. They also assume that for each product half of the consumers will be good-fit consumers, and the other half of the consumers will be bad-fit consumers. Different from theirs, this paper considers the fit revelation strategy in a supply chain environment.

3. The basic model. This paper studies a supply chain consisting of one manufacturer and one retailer, where the manufacturer sells products to consumers through
the retailer. For some products, such as food, drugs, cosmetics, books, and magazines, consumers cannot decide whether the product fit with their taste unless they “experience” with them. Thus, misfit often happens. Moreover, these products usually do not provide returns policy. For example, you may find your baby does not like the taste of an infant formula after you purchase it. You cannot return it to the retailer without quality problems. Thus, a loss happens.

Consumer’s utility with the product largely depends on the fit with the product. The buying decision of consumer is largely influenced by the perceived fit with the product [8]. Thus, in practice, some retailers implement fit-revealing activities to help consumers resolve fit uncertainty before purchase, such as providing free samples or free trials. However, it brings cost to the retailer. For example, the retailer may need to provide free samples, or to hire employees to facilitate free trials. The retailer needs to make a trade-off between the benefit and the cost. The retailer decides whether to implement fit revelation to consumers, i.e. the retailer chooses one of two strategies: implementing fit revelation (IR) and not implementing fit revelation (NR).

There are two types of consumers in the market. One is good-fit consumer with zero loss and the other is bad-fit consumer with a loss after purchasing. Let the proportion of the bad-fit consumer be \( \gamma \) (\( 0 \leq \gamma \leq 1 \)). A consumer does not know her own type unless the consumer experiences the product or she is fully informed about fit information.

Let the unit production cost of the manufacturer be \( c \), the unit wholesale price be \( w \), and the retailer price be \( p \). Following Gu and Xie [8], the retailer incurs a fixed cost \( F > 0 \) to implement fit revelation.

Similar to Chiang et al. [3], this paper assumes that the willingness to pay (WTP) of each type consumer \( v \) is uniformly distributed over the interval \([0, \bar{v}]\) , where \( \bar{v} \) is the highest WTP for consumers. By normalizing the scale of consumers per unit line to one, the market scale is \( \bar{v} \).

Under strategy NR, there is no fit revelation activity and consumers do not know their types before purchasing. They purchase the product based on their expected utilities. The expected utility of the consumer is

\[
U_{NR} = v - p - \gamma b
\]

They buy the product only when \( U_{NR} \geq 0 \), i.e. \( v \geq p + \gamma b \). Thus, the demand of the product can be derived as follows.

\[
q_{NR} = \bar{v} - p - \gamma b
\]

Under strategy IR, the retailer implements fit revelation and consumers know their type before purchasing. The utility of the good-fit consumer is

\[
U_{IR}^G = v - p
\]

Note that a consumer buys a product only when she can obtain a nonnegative utility, i.e., \( U_{IR}^G \geq 0 \), or \( v \geq p \). The retail price should be less than \( \bar{v} \), i.e. \( p \leq \bar{v} \).

The utility of the bad-fit consumer is

\[
U_{IR}^B = v - p - b
\]

The bad-fit consumer buys the product only when \( U_{IR}^B \geq 0 \), or \( v \geq p + b \). The retail price should be less than \( \bar{v} - b \), i.e. \( p \leq \bar{v} - b \).
The retail price should be less than $\bar{v}$; otherwise, no consumer will buy the product, i.e., $p \leq \bar{v}$. However, the retail price may satisfy $\bar{v} - b < p \leq \bar{v}$ such that the bad-fit consumer does not buy any product and only the good-fit consumer purchases the product. As a result, the demand function can be derived as follows.

$$q_{IR} = \gamma \max\{\bar{v} - p - b, 0\} + (1 - \gamma)(\bar{v} - p)$$

$$= \begin{cases} 
\bar{v} - p - \gamma b, & \text{if } p \leq \bar{v} - b \\
(1 - \gamma)(\bar{v} - p), & \text{if } p > \bar{v} - b 
\end{cases}$$

Here the second branch of Equation (5) is the demand function at corner. Under strategy NR, the profit of the retailer is

$$\pi_{NR}^R = (p - w)q_{NR}$$

Under strategy NR, the profit of the manufacturer is

$$\pi_{NR}^M = (w - c)q_{NR}$$

Under strategy IR, the retailer implements fit revelation to reveal fit information. In some situations, the manufacturer provides free samples to the retailer and the retailer helps to send out. For example, Firmus is a well-known infant milk brand in China. Firmus provides free samples to retailers and then retailers use samples to develop new customers. Thus, the cost of fit revelation is undertaken by both parties. However, in other cases, it is the retailer who provides free samples and trails to consumers. For example, many retail stores such as RT-Mart provides free food to consumers to taste. The retailer undertakes all the cost. In order to capture all the cases, a subsidy rate is incorporated into this model. Let the fraction of fit revelation related cost born by the manufacturer be $t$, $0 \leq t \leq 1$.

Under strategy IR, the profit of the retailer is

$$\pi_{IR}^R(p) = (p - w)q_{IR} - (1 - t)F$$

Under strategy IR, the profit of the manufacturer is

$$\pi_{IR}^M(w) = (w - c)q_{IR} - tF$$

The time sequence of this game is as follows: (i) The retailer firstly chooses fit revelation strategy: NR or IR; (ii) The manufacturer decides the unit wholesale price $w$. (iii) The retailer decides the retail price $p$.

In this paper, the fit revelation strategy is considered as a long-term strategy and is determined ahead of pricing decisions. This kind of assumption is not uncommon in the literature [9, 12]. Gu and Xie [8] assume that two competing firms firstly decide fit revelation strategy and then make pricing decisions. In reality, changing price is easy to implement. However, if a firm wants to implement fit revelation, a more complex planning process will be considered. For example, budgeting, staffing, and advertising need to be carefully planned [8]. Thus, comparing to price, fit revelation strategy is usually assumed as a long-term strategy. This model allows the manufacturer to respond to the retailer’s fit revelation strategy through wholesale price adaptation since price is easy to change.

4. **Equilibrium analysis under the decentralized setting.** In Section 4, the decentralized supply chain is studied. Firstly, the equilibrium outcome under strategy NR is derived, and then the equilibrium outcome under strategy IR is obtained. Finally, the fit revelation strategy is explored.
4.1. Equilibrium under strategy NR. Under strategy NR, consumers do not know whether the product fit with them before purchasing. Both type consumers will buy the product as long as the expected utility is positive. The demand function is given in Equation (2). By using backward induction, the equilibrium outcome can be derived as follows.

**Proposition 1.** Under strategy NR, at the equilibrium, the manufacturer’s wholesale price is \( w_{NRs}^* = (\bar{v} + c - b\gamma)/2 \). The retailer’s retail price is \( p_{NRs}^* = (3\bar{v} + c - 3b\gamma)/4 \). The manufacturer’s profit is \( \pi_{M}^{NRs} = (\bar{v} - c - b\gamma)^2/8 \) and the retailer’s profit is \( \pi_{R}^{NRs} = (\bar{v} - c - b\gamma)^2/16 \).

**Proof.** Since \( \frac{\partial^2 \pi_{R}^{NR}}{\partial p^2} = -2 < 0 \), \( \pi_{R}^{NR} \) is a concave function of \( p \). By solving the first-order condition \( \frac{\partial \pi_{R}^{NR}}{\partial p} = \bar{v} - 2p + w - b\gamma = 0 \), we obtain the reaction function \( p(w) = (\bar{v} + w - b\gamma)/2 \). By inserting \( p(w) = (\bar{v} + w - b\gamma)/2 \) into the manufacturer’s profit function \( \pi_{M}^{NR} \), we can derive \( \frac{\partial^2 \pi_{M}^{NR}}{\partial w^2} = -1 < 0 \). That is, \( \pi_{M}^{NR}(w) \) is a concave function of \( w \). By solving \( \frac{\partial \pi_{M}^{NR}}{\partial w} = (\bar{v} + c - b\gamma)/2 = 0 \), we can get the optimal wholesale price \( w_{NRs}^* = (\bar{v} + c - b\gamma)/2 \). Finally, we can get the optimal retail price \( p_{NRs}^* = (3\bar{v} + c - 3b\gamma)/4 \). The manufacturer’s profit and the retailer’s profit are \( \pi_{M}^{NRs} = (\bar{v} - c - b\gamma)^2/8 \) and \( \pi_{R}^{NRs} = (\bar{v} - c - b\gamma)^2/16 \), respectively. \( \square \)

Proposition 1 shows that the manufacturer’s profit is twice of the retailer’s profit. The reason may be that the manufacturer makes pricing decision ahead of the retailer.

4.2. Equilibrium under strategy IR. Under strategy IR, the retailer implements fit revelation. Consumers can know their types before purchasing. In the basic model, the utilities of different type of consumers are presented. There are three situations. When the retailer’s price is higher than \( \bar{v} \), no consumer will buy any product. When the retailer’s price is between the interval \( (\bar{v} - b, \bar{v}] \), bad-fit consumer will not buy any product because of negative utility. When the retail price is lower than \( \bar{v} - b \), good-fit consumer and bad-fit consumer both will buy the product. Through backward induction, the equilibrium is derived and the thresholds that the retailer discriminates consumers are obtained.

**Proposition 2.** Under the decentralized setting, if the retailer chooses strategy IR, the equilibrium decisions are as follows. The wholesale price and the retail price are

\[
\begin{align*}
  w_{IR}^* &= \begin{cases} 
  w_{IR}^{1*}, & \text{if } \hat{v} \geq \hat{v}_1 \\
  w_{IR}^{2*}, & \text{if } \hat{v} < \hat{v}_1 
  \end{cases}, \\
  p_{IR}^* &= \begin{cases} 
  p_{IR}^{1*}, & \text{if } \hat{v} \geq \hat{v}_1 \\
  p_{IR}^{2*}, & \text{if } \hat{v} < \hat{v}_1 
  \end{cases},
\end{align*}
\]

The profit of the manufacturer and the retailer are

\[
\begin{align*}
  \pi_{M}^{IRs} &= \begin{cases} 
  \pi_{M}^{IRs1}, & \text{if } \hat{v} \geq \hat{v}_1 \\
  \pi_{M}^{IRs2}, & \text{if } \hat{v} < \hat{v}_1 
  \end{cases}, \\
  \pi_{R}^{IRs} &= \begin{cases} 
  \pi_{R}^{IRs1}, & \text{if } \hat{v} \geq \hat{v}_1 \\
  \pi_{R}^{IRs2}, & \text{if } \hat{v} < \hat{v}_1 
  \end{cases},
\end{align*}
\]

of the manufacturer and the retailer are \( \pi_{M}^{IRs} = \begin{cases} 
\pi_{M}^{IRs1}, & \text{if } \hat{v} \geq \hat{v}_1 \\
\pi_{M}^{IRs2}, & \text{if } \hat{v} < \hat{v}_1
\end{cases} \), \( \pi_{R}^{IRs} = \begin{cases} 
\pi_{R}^{IRs1}, & \text{if } \hat{v} \geq \hat{v}_1 \\
\pi_{R}^{IRs2}, & \text{if } \hat{v} < \hat{v}_1
\end{cases} \)

\[
\begin{align*}
  w_{IR}^{1*} &= (\bar{v} + c)/2, \quad p_{IR}^{1*} = (3\bar{v} + c - 3b\gamma)/4, \\
  p_{IR}^{2*} &= (3\bar{v} + c - 3b\gamma)/4, \quad \pi_{IR}^{1*} = [(\bar{v} - b\gamma - c)^2 - 8tF]/8, \\
  \pi_{IR}^{2*} &= [(\bar{v} - c)^2(1 - \gamma) - 8tF]/8, \quad \pi_{IR}^{1*} = [(\bar{v} - b\gamma - c)^2 - 16(1 - t)F]/16, \\
  \pi_{IR}^{2*} &= [(\bar{v} - c)^2(1 - \gamma) - 16(1 - t)F]/16.
\end{align*}
\]

**Proof.** (i) We first consider the case of \( p \leq \bar{v} - b \). When \( p \leq \bar{v} - b \), both types of consumers will buy the product. The demand is \( \bar{v} - p - b\gamma \), which is similar to the case without implementing fit revelation. Thus, we can directly get the reaction function of the retailer as \( p_{IR}^R(w) = (\bar{v} + w - b\gamma)/2 \) according to Proposition 1. \( p_{IR}^R(w) \leq \bar{v} - b \) is equivalent to \( w \leq \bar{w}_1 \), where \( \bar{w}_1 = \bar{v} - 2b + b\gamma \). (ii) When \( p > \bar{v} - b \), only good-fit
consumers buy the product. The demand is \((1 - \gamma)(\bar{v} - p)\). From \(\partial^2 \pi_{IR}^R / \partial p^2 = -2(1 - \gamma) < 0\), we know that the retailer’s profit function is a concave function of the retail price. By solving the first-order condition \(\partial \pi_{IR}^R / \partial p = (\bar{v} + w - 2p)(1 - \gamma) = 0\), the retailer’s reaction function can be obtained as \(p_2^{IR}(w) = (\bar{v} + w)/2\).

When \(w > \hat{w}_1\), \(p_2^{IR}(w) = (\bar{v} + w)/2 - (\bar{v} - b) > 0\), that is, \(p_2^{IR}(w) > (\bar{v} - b)\) is satisfied. Note that \(p_1^{IR}(w)\) is the primary reaction function of the retailer and \(p_2^{IR}(w)\) is only the reaction function at corner. Moreover, when \(w \leq \hat{w}_1\), the constraint of \(p_1^{IR}(w)\) is satisfied; when \(w > \hat{w}_1\), the reaction function becomes \(p_2^{IR}(w)\) and its constraint is non-binding. Similar to Xiao et al. [25], the retail price reactions can be concluded as follows. \(p^{IR}(w) = \begin{cases} p_1^{IR}(w), & \text{if } w \leq \hat{w}_1 \\ p_2^{IR}(w), & \text{if } w > \hat{w}_1 \end{cases}\), where \(p_1^{IR}(w) = (\bar{v} + w - b\gamma)/2, p_2^{IR}(w) = (\bar{v} + w)/2, \hat{w}_1 = \bar{v} - 2b + b\gamma\).

Inserting \(p_1^{IR}(w) = (\bar{v} + w - b\gamma)/2\) into the manufacturer’s function, we can get \(\pi_{M1}^{IR}(w) = (\bar{v} - w - b\gamma)(w - c)/2 - tF\). Because \(\partial^2 \pi_{M1}^{IR}(w) / \partial w^2 = -1\), \(\pi_{M1}^{IR}(w)\) is a concave function of \(w\). Then the optimal wholesale price is derived as \(w_1^{IR*} = (\bar{v} + c - b\gamma)/2\). \(w_1^{IR*} \leq \hat{w}_1\) is equivalent to \(\bar{v} \geq \hat{v}_1\), where \(\hat{v}_1 = 4b + c - 3b\gamma\). Then we can get the optimal retail price of the retailer as \(p_1^{IR*} = (3\bar{v} + c - 3b\gamma)/4\).

When \(\bar{v} < \hat{v}_1\), \(w_2^{IR} = (\bar{v} + c)/2 > \hat{w}_1\). That is, the constraint is not binding. Further, the equilibrium unit wholesale price is

\[
\begin{align*}
    \text{if } & \bar{v} \geq \hat{v}_1 \\
    \text{if } & \bar{v} < \hat{v}_1
\end{align*}
\]

At the equilibrium, the threshold that the retailer discriminates consumers is derived as \(\hat{v}_1\). Note that when the market scale is sufficiently high \((\bar{v} \geq \hat{v}_1)\), the wholesale price is relatively lower \((w_1^{IR*} \leq w_2^{IR*})\) and the retail price is lower than \(\bar{v} - b\) \((p_1^{IR*} \leq \bar{v} - b)\). According to the analysis in the basic model, when the retail price is lower than \(\bar{v} - b\), both types of consumers will buy the product. However, when the market scale is sufficiently low \((\bar{v} < \hat{v}_1)\), the manufacturer will offer a higher unit wholesale price \((w_2^{IR*} > w_1^{IR*})\) and the retailer will offer a retail price \(p_2^{IR*} = (\bar{v} + w_2^{IR*})/2 = (3\bar{v} + c)/4\). It can be easily proved that \(p_2^{IR*} > \bar{v} - b\). According to the basic model, when the retail price is higher than \(\bar{v} - b\), bad-fit consumer will not buy any product.

It is concluded that when the market scale is sufficiently high \((\bar{v} \geq \hat{v}_1)\), both types of consumers buy the product. However, when the market scale is sufficiently low \((\bar{v} < \hat{v}_1)\), only good-fit consumer will buy the product and bad-fit consumer will not buy any product. Thus, under strategy IR, \(\hat{v}_1\) is the threshold that the retailer discriminates the consumers.

The management insight from Proposition 2 is that: whether to discriminate consumers depends on the market scale. Under strategy IR, if the market scale is sufficiently large, the manufacturer and the retailer would better give relatively lower prices. However, when the market scale is sufficiently large, they would better enhance their prices. This result is counterintuitive. People may believe that when demand increases, it would be better to enhance prices and when demand decreases, lower prices are better decisions. The reason here may be that consumers are fully informed under strategy IR. When the market scale is sufficiently large, lower retail price can attract both types of consumers. If the market scale is sufficiently low, it would be better to give up bad-fit consumers because they ask for a lower price which will loss profit from good-fit consumers.
4.3. The fit revelation strategy of the retailer. This subsection assumes that it is the retailer who decides the fit revelation strategy. The retailer’s fit revelation strategy is investigated. The retailer chooses strategy IR only when $\pi^{IR}_R > \pi^{NR}_R$.

**Proposition 3.** Under decentralized setting, when the market scale is in the interval $\bar{v}_1 < \bar{v} < \bar{v}_2$, the optimal fit revelation strategy is strategy IR, or else the optimal revelation strategy is strategy NR, where $\bar{v}_1 = b + c - \sqrt{\gamma[\beta^2(1-\gamma)\gamma - 16F(1-t)]/\gamma}$ and $\bar{v}_2 = b + c + \sqrt{\gamma[\beta^2(1-\gamma)\gamma - 16F(1-t)]/\gamma}$.

**Proof.** From Proposition 1, we know $\pi^{NR}_R = (\bar{v} - c - \gamma r)^2/16$. From Proposition 2, when $\bar{v} \geq \hat{v}_1$, $\pi^{IR}_R = [(\bar{v} - c - \gamma r)^2 - 16(1-t)F]/16$, we can see that $\pi^{IR}_R < \pi^{NR}_R$, which means that it is always better for the retailer to choose strategy NR. When $\bar{v} < \hat{v}_1$, $\pi^{IR}_R = [(\bar{v} - c - \gamma r)^2(1-\gamma) - 16(1-t)F]/16$. Let $f(v) = \pi^{NR}_R - \pi^{IR}_R$. There are two roots of $f(\bar{v}) = 0$, one is $\hat{v}_1$, and the other is $\hat{v}_2$, where $\bar{v}_1 < \hat{v}_2$. Because $\partial^2 f(\bar{v})/\partial \bar{v}^2 = \gamma/8 > 0$, $f(\bar{v})$ is a convex function of $\bar{v}$. Thus, when $\bar{v}_1 < \bar{v} < \bar{v}_2$, $f(\bar{v}) = \pi^{NR}_R - \pi^{IR}_R < 0$. It is better for the retailer to choose strategy IR. When $\bar{v} < \bar{v}_1$ or $\bar{v} > \bar{v}_2$, $f(\bar{v}) = \pi^{NR}_R - \pi^{IR}_R > 0$. It is better for the retailer to choose strategy NR. \hfill \Box

From Proposition 3, when the market scale is sufficiently high or sufficiently low ($\bar{v} > \bar{v}_2$ or $\bar{v} < \bar{v}_1$), the retailer’s optimal strategy is strategy NR. It is better for the retailer to choose not implementing fit revelation. However, when the market scale is medium ($\bar{v}_1 < \bar{v} < \bar{v}_2$), it is better for the retailer to choose strategy IR. This result is counterintuitive. People may think that when the market demand is low, it is better to implement fit revelation to let consumers know more about the product. The result shows that when the market demand is sufficiently low, it is better to choose not implementing fit revelation.

From the proof of Proposition 3, when the market scale is higher than $\bar{v}_1$, the retailer will choose strategy NR. When the market scale is lower than $\hat{v}_1$, only in the interval $\hat{v}_1 < \bar{v} < \hat{v}_2$, the retailer will choose strategy IR. From Proposition 2, when the retailer chooses strategy IR and the market scale is lower than $\hat{v}_1$, only good-fit consumer will buy the product, bad-fit consumer will not buy any product. Thus, when $\bar{v}_1 < \bar{v} < \bar{v}_2$, the retailer will choose strategy IR and only good-fit consumer will buy the product.

**Proposition 4.** When the market scale is sufficiently high ($\bar{v} \geq \hat{v}_1$), there is no difference for each kind of consumers under two different fit revelation strategies. However, when the market scale is sufficiently low ($\bar{v} < \hat{v}_1$), good-fit and bad-fit consumers both will prefer strategy NR. When $b$ or $\gamma$ increases, the utility differences of each kind of consumers under two fit revelation strategies increases.

**Proof.** Under strategy NR, the retailer does not reveal fit information. Thus, consumers buy products based on their expected utilities. After they experience the product, the real utility is realized. The utility of good-fit and bad-fit consumer are $U^G_B = v - p^{NR}_R$ and $U^B_B = v - p^{NR}_R - b$, respectively. From Proposition 1, $p^{NR}_R = (3\bar{v} + c - 3\gamma r)/4$. Thus, $U^G_B = v - (3\bar{v} + c - 3\gamma r)/4$, $U^B_B = v - (3\bar{v} + c - 3\gamma r)/4 - b$. Under strategy IR, the retailer reveals fit information. The utility of good-fit and bad-fit consumer are $U^G_R = v - p^{IR}_R$ and $U^B_R = v - p^{IR}_R - b$, respectively. From Proposition 2, $p^{IR}_R = \begin{cases} p^{IR}_1, & \text{if } \bar{v} \geq \hat{v}_1, \\ p^{IR}_2, & \text{if } \bar{v} < \hat{v}_1 \end{cases}$ where $\hat{v}_1 = 4b + c - 3\gamma r$, $p^{IR}_1 = (3\bar{v} + c - 3\gamma r)/4$, $p^{IR}_2 = (3\bar{v} + c)/4$. Thus, the utility of good-fit and bad-fit
consumers are as follows. 

\[ U_{IR}^G = \begin{cases} 
    v - (3\tilde{v} + c - 3b\gamma)/4, & \text{if } \tilde{v} \geq \hat{\tilde{v}}_1, \\
    v - (3\tilde{v} + c)/4, & \text{if } \tilde{v} < \hat{\tilde{v}}_1,
\end{cases} \]

and 

\[ U_{IR}^B = \begin{cases} 
    v - (3\tilde{v} + c - 3b\gamma)/4 - b, & \text{if } \tilde{v} \geq \hat{\tilde{v}}_1, \\
    v - (3\tilde{v} + c)/4 - b, & \text{if } \tilde{v} < \hat{\tilde{v}}_1.
\end{cases} \]

When \( \tilde{v} \geq \hat{\tilde{v}}_1 \), there is no difference for each kind of consumers between two different strategies. However, when \( \tilde{v} < \hat{\tilde{v}}_1 \), the utilities under strategy NR is higher than that under strategy IR. When \( \tilde{v} < \hat{\tilde{v}}_1 \), \( U_{IR}^G - U_{IR}^B = 3b\gamma/4 \) and \( U_{IR}^B - U_{IR}^B = 3b\gamma/4 \).

By comparing the utilities of good-fit consumer and bad-fit consumer under two different fit revelation strategy, the results show that when \( \tilde{v} \geq \hat{\tilde{v}}_1 \), there is no difference for each kind of consumers between two different strategies. However, when \( \tilde{v} < \hat{\tilde{v}}_1 \), both kinds of consumers prefer strategy NR because the utilities under strategy NR is higher than that under strategy IR. When \( \tilde{v} < \hat{\tilde{v}}_1 \), \( U_{NR}^G - U_{IR}^G = 3b\gamma/4 \) and \( U_{NR}^B - U_{IR}^B = 3b\gamma/4 \). When the bad-fit consumer’s loss \( b \) or the proportion of the bad-fit consumer \( \gamma \) increases, the differences of utilities between two strategies increase. That is, consumers will benefit more when there is no fit revelation. The reason is that under strategy NR, the retailer price is lower than that under strategy IR. Implementing fit revelation strategy is not always good for consumers.

5. Extensions. In this section, two extensions are studied based on the basic model to generate more management insights.

5.1. The fit revelation strategy of the manufacturer. In the previous part of this paper, the retailer decides whether to implement fit revelation. In this section, the situation that it is the manufacturer who decides whether to implement fit revelation is explored. The manufacturer chooses strategy IR only when \( \pi_{IR}^M \geq \pi_{NR}^M \).

Proposition 5. When \( \hat{v}_1 < \tilde{v} < \hat{v}_2 \), it is better for the manufacturer to choose strategy IR; otherwise, it is better to choose strategy NR, where \( \hat{v}_1 = b + c - \sqrt{\gamma[b^2(1-\gamma)\gamma - 8Ft]/\gamma} \) and \( \hat{v}_2 = b + c + \sqrt{\gamma[b^2(1-\gamma)\gamma - 8Ft]/\gamma} \).

Proof. From Proposition 1, \( \pi_{NR}^M = (\tilde{v} - c - b\gamma)^2/8 \). From Proposition 2 we know that when \( \tilde{v} \geq \hat{v}_1 \), \( \pi_{IR}^M = \pi_{IR}^M = (\tilde{v} - c - b\gamma)^2 - 8tF]/8 \), we can see that \( \pi_{IR}^M < \pi_{NR}^M \), which means that it is always better for the manufacturer to choose not implementing fit revelation as long as there exists a fit revelation-relation cost. When market scale is sufficiently low (\( \tilde{v} < \hat{v}_1 \)), \( \pi_{IR}^R = \pi_{IR}^R = (\tilde{v} - c)^2(1 - \gamma) - 8tF]/8 \). Let \( g(\tilde{v}) = \pi_{IR}^R - \pi_{IR}^M \). Differentiating \( g(\tilde{v}) \) with \( \tilde{v} \), we can get \( \partial^2 g(\tilde{v})/\partial \tilde{v}^2 = \gamma/4 \).

From Proposition 5, when the market scale of the product is sufficiently high (\( \tilde{v} \geq \hat{v}_2 \)) or sufficiently low (\( \tilde{v} \leq \hat{v}_1 \)), if the manufacturer decides the fit revelation strategy, strategy NR would be optimal. However, when the market scale is medium (\( \hat{v}_1 < \tilde{v} < \hat{v}_2 \)), the manufacturer will choose strategy IR. By comparing Proposition
with Proposition 3, we can see that the manufacturer has similar choice with the retailer. However, the thresholds are different.

Numerical examples are then used to illustrate the differences in modeling when different members implement the fit revelation strategy. The default values of parameters are $t = 0.5; b = 46; c = 30; F = 50; \gamma = 0.7$. $\pi^R_M$ and $\pi^R_R$ are profits of the retailer and the manufacturer when the retailer facilitates fit revelation strategy, respectively. $\pi^M_M$ and $\pi^M_R$ are profits of the retailer and the manufacturer when the manufacturer facilitates fit revelation strategy, respectively. The profits are derived under the equilibrium of the fit revelation strategy.

In Figure 1, the dashed curves and solid lines illustrate the setting where the retailer or the manufacturer facilitate fit revelation, respectively. The thick and thin lines denote the profits of the manufacturer or the retailer, respectively. Figure 2 shows that under some circumstances, the manufacturer prefers herself to facilitate fit revelation than to let the retailer facilitate. Under some circumstances, the retailer prefers himself to facilitate fit revelation than to let the manufacturer facilitate. In order to gain the maximum profit of the supply chain, the retailer and the manufacturer needs to bargain.

5.2. The effect of decentralization on the fit revelation strategy. Up to now, this paper assumes that the manufacturer and the retailer maximize their own profits, independently. Sometimes, the members of a supply chain can be coordinated by mechanisms and act as a central decision maker [6]. To understand the effect of decentralization on the fit revelation strategy, this section considers the centralized system.

The profits of the centralized setting under two strategies are

$$\pi^N_{C} = (p - c)q^N$$

and

$$\pi^I_{C} = (p - c)q^I - F.$$

Proposition 6. Under the centralized setting, when the supply chain implements strategy NR, the optimal decision of the supply chain is

$$p^N_{C} = (\bar{v} + c - b\gamma)/2.$$  

The profit of the whole supply chain is

$$\pi^N_{C} = (\bar{v} - c - b\gamma)^2/2.$$
Proof. Because $\partial^2 \pi^N_{IR}/\partial p^2 = -2 < 0$, $\pi^N_{IR}$ is a concave function of $p$. By solving $\partial^2 \pi^N_{IR}/\partial p = 0$, we can get the optimal retail price of the supply chain $p^N_{IR^*} = (\bar{v} + c - 2p + \bar{v} - b\gamma)/2$. Then we can get the supply chain’s profit $\pi^N_{IR^*} = (\bar{v} - c - b\gamma)^2/4$.

Proposition 6 shows that when the centralized supply chain chooses strategy NR, the retail price increases on market scale and production cost, and decreases with the proportion of bad-fit consumer and the loss of bad-fit consumer. This is intuitive. When the market scale increases, the supply chain enhances the retail price to get more benefit from the market. When the production cost increases, the supply chain enhances the retail price to compensate the increased cost. When the loss of bad-fit consumer increases, consumers may become more careful about their decisions. In order to make them buy the product, the retailer may lower the retail price. When the proportion of bad-fit consumer increases, in order to lower their loss of utility and attract consumers, the price should be lowered. When the production cost increases, the profit of the whole supply chain decreases. The reason is that the increase in retail price cannot fully compensate the increase in production cost.

From Proposition 1, under the decentralized setting, the profit of the total supply chain is $\pi^N_{IR^*} = \pi^N_{IR^*} + \pi^N_{IR} = (\bar{v} - c - b\gamma)^2/8 + (\bar{v} - c - b\gamma)^2/16 = 3(\bar{v} - c - b\gamma)^2/16$ which is lower than the profit under centralized setting. That is, there exists double marginalization effect under strategy NR. If the decentralized supply chain wants to maximize the whole profit, coordination mechanisms are needed [13].

Under the centralized setting, when the supply chooses strategy IR, following proposition can be derived.

**Proposition 7.** Under the centralized setting, when the supply chooses strategy IR, the optimal decision is $p^C_{IR^*} = \begin{cases} p^C_{I1^*}, & \text{if } \bar{v} \geq \hat{v}_C; \\ p^C_{I2^*}, & \text{if } \bar{v} < \hat{v}_C \end{cases}$. The profit of the whole supply chain is $\pi^C_{IR^*} = \begin{cases} \pi^C_{I1^*}, & \text{if } \bar{v} \geq \hat{v}_C; \\ \pi^C_{I2^*}, & \text{if } \bar{v} < \hat{v}_C \end{cases}$, where $p^C_{I1^*} = (\bar{v} + c - b\gamma)/2$, $p^C_{I2^*} = (\bar{v} + c - b\gamma)/2(1 - \gamma)/4 - F$, and $\hat{v}_C = 2b + c - b\gamma$.

Proof. (i) Firstly, consider the case with $p \leq \bar{v} - b$. When $p \leq \bar{v} - b$, both type of consumers will buy the product. The demand is $\bar{v} - p < \gamma b$, which is similar to the case without implementing fit revelation. Thus, we can directly get the optimal price of the supply chain as $p^C_{IR^*} = (\bar{v} + c - b\gamma)/2$ according to Proposition 5. The profit of the supply chain is $\pi^C_{IR^*} = (\bar{v} - c - b\gamma)^2/4 - F$. $p^C_{I1^*} = \bar{v} - b$ is equivalent to $\bar{v} \geq \hat{v}_C$, where $\hat{v}_C = 2b + c - b\gamma$.

(ii) When $p > \bar{v} - b$, only good-fit consumers buy the product. The demand is $(1 - \gamma)(\bar{v} - p)$. From $\partial^2 \bar{\pi}^C_{IR}(p)/\partial p^2 = -2(1 - \gamma) < 0$, we know that the supply chain’s profit function is a concave function of the retail price. By solving the first-order condition $\partial \bar{\pi}^C_{IR}(p)/\partial p = (\bar{v} + c - 2p)(1 - \gamma) = 0$, we can get the optimal retail price $p^C_{I2^*} = (\bar{v} + c)/2$. The profit of the supply chain is $\pi^C_{I2^*} = (\bar{v} - c)^2(1 - \gamma)/4 - F$.

When $\bar{v} < \hat{v}_C$, $p^C_{IR^*} = (\bar{v} + c)/2 - (\bar{v} - b) > 0$, i.e., the second constraint is non-binding. Similar to proof of Proposition 2, the optimal retail price is $p^C_{IR^*} = \begin{cases} p^C_{I1^*}, & \text{if } \bar{v} \geq \hat{v}_C; \\ p^C_{I2^*}, & \text{if } \bar{v} < \hat{v}_C \end{cases}$.

From Proposition 7, when the market scale is sufficiently high ($\bar{v} \geq \hat{v}_C$), the supply chain will offer a lower retail ($p^C_{I1^*} < p^C_{I2^*}$) price such that the supply chain
will serve two types of the consumers. However, when the market scale is sufficiently low ($\hat{v} < \hat{v}_C$), the supply chain will offer a higher retail price ($p^{IR}_C > p^{IR}_1$) such that the supply chain will sell the product only to good-fit consumers and the bad-fit consumers do not buy the product.

Proposition 8 concludes the optimal fit revelation strategy of the centralized supply chain. The centralized system chooses strategy IR only when $\pi^{IR}_C > \pi^{IR}_C$.

**Proposition 8.** Under centralized setting, when the market scale is in the interval $\hat{v}_1C < \hat{v} < \hat{v}_2C$, the optimal fit revelation strategy is strategy IR, or else the optimal revelation strategy is strategy NR, where $\hat{v}_1C = b + c - \sqrt{b^2 - b^2 - 4F/\gamma}$ and $\hat{v}_2C = b + c + \sqrt{b^2 - b^2 - 4F/\gamma}$.

**Proof.** From Proposition 6, under centralized setting, when the supply chain adopts strategy NR, the maximum profit of the supply chain is $\pi^{NR}_C = (\hat{v} - c - b\gamma)^2/4 - F$ that is lower than that under strategy NR because of $F > 0$. It is better for the supply chain to choose strategy NR. Then, the profit of the supply chain is $\pi^{IR}_C = (\hat{v} - c - b\gamma)^2/4 - F$ with $\hat{v}$ twice, we can get $\partial^2 (\pi^{IR}_C - \pi^{IR}_C)/\partial \hat{v}^2 = \gamma/2 > 0$, i.e., $\pi^{IR}_C - \pi^{IR}_C$ is a convex function of $\hat{v}$. Solving $\pi^{IR}_C = \pi^{IR}_C$ with $\hat{v}$, we can get two roots $\hat{v}_1C = b + c - \sqrt{b^2 - b^2 - 4F/\gamma}$ and $\hat{v}_2C = b + c + \sqrt{b^2 - b^2 - 4F/\gamma}$, where $\hat{v}_1C < \hat{v}_2C$. When $\hat{v}_1C < \hat{v} < \hat{v}_2C$, it is better to choose strategy IR. However, when $\hat{v} < \hat{v}_1C$ or $\hat{v} > \hat{v}_2C$, it is better to choose strategy NR.

From Proposition 8, when market demand is sufficiently high ($\hat{v} \geq \hat{v}_2C$) or sufficiently low ($\hat{v} \leq \hat{v}_1C$), it is better for the supply chain to choose strategy NR and serve two types of consumers. If the market scale is medium ($\hat{v}_1C < \hat{v} < \hat{v}_2C$), it is better to choose strategy IR. According to the proof of Proposition 7, the supply chain will only sell products to good-fit consumers.

In order to well understand the effect of decentralization, numerical examples are used to illustrate. The dashed lines indicate the decentralized setting and the other two lines indicate the centralized setting. The thin lines and bold lines indicate the lower bound and upper bound of the interval inside which strategy IR is optimal, respectively. The default values of parameters are $t = 0.2; c = 30; F = 20$.

Figures 2 and 3 show that the interval inside which strategy IR is optimal is larger under the centralized setting than that under the decentralized setting. That is, under the centralized setting, there are more situations that the supply chain will choose strategy IR. The managerial insight here is that: if the supply chain is operated in a centralized mode, it is more likely for the supply chain to implement fit revelation. The decentralization will decrease the probability to implement fit revelation.

6. **Conclusions.** This paper considers a supply chain consisting of one manufacturer and one retailer to investigate how to choose the fit revelation strategy: IR or NR. Firstly, the decentralized supply chain is investigated. The results show that whether to implement fit revelation depends on the market scale. Thus, in practice, the retailer can make fit revelation plans according to the demand scale. When the demand is medium, it is better to facilitate fit revelation. This result is counterintuitive because people may believe that when market scale is low, it would be better to let consumers know more about the product. The reason may be that when the market scale is sufficiently low, it would be better for the company to give up bad-fit
consumer and asks for a higher price from the good-fit consumer. The impact of fit revelation strategy on consumers are investigated. Results show that fit revelation is not always good for consumers. When market scale is sufficiently high, there is no difference for consumers under two different fit revelation strategies. However, when the market scale is sufficiently low, good-fit consumer and bad-fit consumer both prefer not implementing fit revelation. The reason is that the retail price under strategy NR is lower than that under strategy IR. This result may also be counterintuitive because people may think that revealing fit information is better for consumer than not revealing fit information. Secondly, the situation that it is the manufacturer who decides the fit revelation strategy is considered. The optimal decision of the manufacturer is similar to that of the retailer. However, the thresholds

**Figure 2.** The upper bound and lower bound versus the proportion of bad-fit consumer

**Figure 3.** The upper bound and lower bound versus the loss of bad-fit consumer
are different. For the retailer and the manufacturer, under certain circumstances, they prefer themselves to facilitate fit revelation. Thirdly, the effect of the decentralization is investigated. Numerical examples show that the interval inside which implementing fit revelation is optimal is larger under the centralized setting than that under the decentralized setting. That is, the decentralization decreases the probability to implement fit revelation. When the firm is operated in a centralized supply chain, it is more likely to implement fit revelation. There are some directions for future research. Firstly, this paper only considers two kinds of strategies and the fit revelation-related cost is assumed to be fixed. For future research, we can consider the extent of the fit revelation and the fit revelation-related cost can depend on the extent of the fit revelation. Secondly, this paper assumes that the subsidy rate is exogenously given. It is interesting to extend to endogenous setting. Thirdly, this paper assumes that the retailer or the manufacturer determines the fit revelation strategy ahead of pricing decisions. If there are only single transaction between the manufacturer and the retailer, the fit revelation strategy can be made after buying the product. This time sequence of the game can be considered in future research.

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REFERENCES

[1] H. Bar-Issac, G. Caruana and V. Cuñat, Information gathering and marketing, Journal of Economics & Management Strategy, 19 (2010), 375–401.
[2] Y. B. Chen and J. H. Xie, Online consumer review: Word-of-mouth as a new element of marketing communication mix, Management Science, 54 (2008), 477–491.
[3] W. Y. K. Chiang, D. Chhajed and J. D. Hess, Direct marketing, indirect profits: A strategic analysis of dual-channel supply-chain design, Management Science, 49 (2003), 1–20.
[4] L. Y. Chu and H. Zhang, Optimal preorder strategy with endogenous information control, Management Science, 57 (2011), 1055–1077.
[5] L. Deng, J. G. Zheng and R. J. Zhao, Manufacturer’s quality disclosure strategy in a dual-channel supply chain considering the impact of information acquisition, Industrial Engineering and Management, 23 (2018), 1007–5429.
[6] C. Ding, K. H. Wang and S. Y. Lai, Channel coordination mechanism with retailers having fairness preference: An improved quantity discount mechanism, Journal of Industrial and Management Optimization, 9 (2013), 967–982.
[7] S. J. Grossman, The informational role of warranties and private disclosure about product quality, Journal of Law and Economics, 24 (1981), 461–483.
[8] Z. Y. Gu and Y. Xie, Facilitating fit revelation in the competitive market, Management Science, 59 (2013), 1196–1212.
[9] L. Guo and Y. Zhao, Voluntary quality Disclosure and market interaction, Marketing Science, 28 (2009), 488–501.
[10] V. J. Hotz and M. Xiao, Strategic information disclosure: The case of multiattribute products with heterogeneous consumers, Economic Inquiry, 51 (2013), 865–881.
[11] J. Johnson and D. P. Myatt, On the simple economics of advertising, marketing, and product design, The American Economic Review, 96 (2006), 756–784.
[12] D. Kuksov and Y. Lin, Information provision in a vertically differentiated competitive marketplace, Marketing Science, 29 (2010), 1–198.
[13] X. Li, Y. J. Li and X. Q. Cai, Double marginalization and coordination in the supply chain with uncertain supply, European Journal of Operational Research, 226 (2013), 228–236.
[14] O. Loginova and C. R. Taylor, Price experimentation with strategic buyers, Review of Economic Design, 12 (2008), 165–187.
[15] M. L. Luo and G. Li, Cross-channel consumers return in a multi-channel supply chain, Operations Research and Management Science, 28 (2019), 16–22.
[16] P. R. Milgrom, Good news and bad news: Representation theorems and applications, The Bell Journal of Economics, 12 (1981), 380–391.
[17] S. Moorthy and S. A. Hawkins, Advertising repetition and quality perception, Journal of Business Research, 58 (2005), 354–360.
[18] J. Noll, Comparing quality signals as tools of consumer protection: Are warranties always better than advertisements to promote higher product quality?, International Review of Law and Economics, 24 (2004), 227–239.
[19] E. Ofek, Z. Katona and M. Sarvary, Bricks and clicks: The impact of product returns on the strategies of multi channel retailers, Marketing Science, 30 (2011), 1–194.
[20] D. Purohit and J. Srivastava, Effect of manufacturer reputation, retailer reputation, and product warranty on consumer judgments of product quality: A cue diagnosticity framework, Journal of Consumer Psychology, 10 (2001), 123–134.
[21] E. Schmidbauer and A. Stock, Quality signaling via strikethrough prices, International Journal of Research in Marketing, 35 (2018), 524–532.
[22] J. Shi and T. J. Xiao, Service investment and consumer returns policy in a vendor-managed inventory supply chain, Journal of Industrial and Management Optimization, 11 (2015), 439–459.
[23] J. Stock, T. Spek and H. Shear, Managing product returns for competitive advantage, MIT Sloan Management Review, 48 (2006), 57–62.
[24] M. Sun, Disclosing multiple product attributes, Journal of Economics & Management Strategy, 20 (2011), 195–224.
[25] T. J. Xiao, T.-M. Choi and T. C. E. Cheng, Product variety and channel structure strategy for a retailer-Stackelberg supply chain, European Journal of Operational Research, 233 (2014), 114–124.
[26] T. Zhang, G. Li, K. K. Lai and J. W. K. Leung, Information disclosure strategies for the intermediary and competitive sellers, European Journal of Operational Research, 271 (2018), 1156–1173.
[27] X. M. Zhang and L. Jin, Pricing and contract design of supply chain under money-back guarantees offered by the online retailer, Forcasting, 37 (2018), 74–80.

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