

Facilitate Fit Revelation in a Distribution Channel

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Abstract

Firms facilitate consumer learning of their true product fit if doing so increases firms' profits. Our study investigates the optimal facilitation strategies of a supplier and a retailer in a distribution channel under agency pricing. Considering both the supplier and the retailer have the option to facilitate, our model shows that both parties will choose to facilitate when the product is highly niche or relatively niche with sufficiently informative product information prior to facilitation. When the retailer's marginal cost of the product is lower than the supplier's, the supplier will be willing to facilitate relatively popular product whereas the retailer will not. Interestingly, increasing the supplier's marginal cost will not dampen but widen the range of product types which both parties will choose to facilitate. Increasing retailer's revenue share and closing fee in agency pricing has a similar effect. Our results indicate that the conditions to achieve coordination on facilitation decision may be at odds with the conditions to achieve coordination on distribution channel efficiency. Achieving coordination on facilitation decision may be at the expense of consumer surplus and social welfare. When two parties' interests on facilitation are uncoordinated, the interest of consumer surplus and social welfare are mostly coincided with that of the retailer rather than supplier.

Keywords: fit revelation, information disclosure, agency pricing, distribution channel, coordination

1. Introduction

In November 2015, the world's giant online retailer Amazon.com opened its first physical store, named Amazon Books, at University Village in Seattle (Flood 2015). After achieving a tremendous success as an online retail platform, Amazon.com starts to show its interests in connecting products with their potential consumers in an offline setting. This particular bookstore stocks around 5000 titles and sells them at the same prices on Amazon.com (Salkowitz 2015). One salient feature that distinguishes this newly opened bookstore from all other brick-and-mortar bookstores is that all titles in the shop will *face out* (Greene 2015). Commentators have mentioned that the purpose of facing every title out, rather than stacking on the shelf, is that the company wants to “showcase authors and their work” (Greene 2015). Despite that consumers nowadays are very used to and probably already sophisticated in searching for products online, finding related product information online and eventually making purchase online, having an chance to really experience a product offline, for example, feeling the physical sensation of looking and touching the product, will help consumers to figure out how the product exactly fits their individual taste and thus how much they are really willing to pay (McGreal 2015). This idea of facilitating fit revelation for consumers is particularly important to experience goods like shoes and cloth which consumers can hardly estimate their true fit without experiencing the product, regardless of how much product related information such as product description, consumer/expert review they have read online.

One question arises when firms want to facilitate consumer learning of their true product fit: on what type of product a firm should, or should not, facilitate? In the case of Amazon Book store, newspaper reports have mentioned that Amazon.com right now decides whether to include a title in its physical bookstore based on online review, book category, pre-orders, etc. Then a

follow-up question emerges: what dimension of online review shall be used to make the selection, and is there any specific category of products that will incur higher profitability than the others to the online retail platform once being facilitated?

What complicated this issue further is, as anecdotal evidence has shown, that it is not only the online retail platform's concern and decision regarding whether to facilitate fit revelation of a product. Nowadays many products listed on an online retail platform like Amazon.com are actually sold by third-party sellers. Those third-party sellers often have contracts with the online retail platform regarding how product's retail price is determined, how payments are transferred and how sales revenue is distributed between them. As facilitating fit revelation will affect consumers' willingness to pay and subsequently cause price and demand change, it will affect each player's profitability in supply chain. In the meantime, on China's largest online retail platforms like Taobao.com and Tmall.com, many third-party sellers open their offline experience centers to facilitate consumers learning about their product fit while consumers still purchase product from their online stores. In those cases, it is the third-party sellers, rather than the online retail platform, who decides whether to facilitate. How does matter who make facilitation decision? Do third-party sellers make the same facilitation decision as online retail platform under a given market condition?

Our study aims to shed lights on the aforementioned questions under a particular channel setting – agency pricing. Agency pricing contract, originated in e-book industry, involves a retailer that delegates the retail price decision to the supplier (Trachtenberg 2011). In exchange for gaining control of the retail price, the supplier passes a certain percentage of total revenue to the retailer and for certain product categories, also pays a closing fee for each unit sold. Amazon.com has adopted agency pricing as the major pricing model with third-party sellers on

its platform.¹ This pricing model has become widely popular in many other contexts such as mobile commerce (Hao et. al 2016). Specially, we ask the following research questions: What is the supplier's and the retailer's optimal facilitation strategy under agency pricing? How should the retailer optimally decide whether to facilitate fit revelation of a product based on its level of nicheness and level of online review's informativeness? Is the retailer's incentive to facilitate always coordinated with the supplier's? What roles do agency pricing contract parameters like revenue sharing percentage and closing fee play in coordinating their incentive on facilitation? When their incentives to facilitate are uncoordinated, would consumer surplus and social welfare be better off if the retailer, or the supplier, dictates facilitation decision?

In our paper, we built a game-theoretical model to address above questions. We have developed several key insights: in general, both the supplier and the retailer will choose to facilitate fit revelation of (i) a highly niche product, or (ii) a relatively niche product with sufficiently informative product information (e.g., online review) prior to facilitation. Both the supplier's and the retailer's choices of facilitation are sensitive to product information prior to facilitation only when the product is moderately niche. When the product is extremely niche or extremely popular, the complement role of *ex-ante* product information (Chen and Xie (2008)) no longer exists. When the retailer's marginal cost of the product is lower than the supplier's, the supplier will be willing to facilitate a wider range of product type in terms of their level of nicheness than the retailer. Particularly, the supplier will choose to facilitate relatively popular ones which the retailer will not. Despite that the reason for this uncoordinated incentive to facilitate is the marginal cost discrepancy, an increase in supplier's marginal cost would counter-intuitively widen the range of product type which both parties will choose to facilitate. Increasing retailer's revenue share and charging a higher closing fee has a similar effect. This

¹ See "Selling on Amazon Fee Schedule" <https://www.amazon.com/gp/help/customer/display.html?nodeId=1161240>

essentially means that the conditions to achieve coordination on facilitation decision may be at odds with the conditions to achieve coordination on channel efficiency. Coordinating both parties to facilitate may be at the expense of consumer surplus and social welfare. The reason for this intriguing result is as follows. The main issue of incoordination on channel efficiency and loss of consumer surplus and social welfare is that retail price is too high due to factors such as vertical externality. However, the main issue of incoordination on facilitation decision is that retail price is too low prior to facilitation. The too low retail price will cause demand to decrease after facilitation, which overall might not hurt the supplier but hurt the retailer. In the end we point out in case of incoordination, the interest of consumer surplus and social welfare is mostly coincided with the retailer rather than the supplier with respect to facilitation decision. This is because given the supplier's control over the retail price in agency pricing, facilitating fit revelation in their uncoordinated case adds to the supplier's monopoly power over the market.

The rest of this paper is organized as follows. In the next section, we conduct a literature review. Then we set up our model and analyze both the supplier's and the retailer's choice of facilitating fit revelation. We then compare their conditions for facilitation and explain their similarities and differences. Several key insights are discussed in model results section. Finally, we conclude the paper with a summary of our findings.

2. Literature Review

During the past decades, a vast amount of work has been dedicated to the topic of product information revelation from the fields of economics, marketing and information system. The central issue that the extant literature has been examining is under what condition a seller should reveal her product information. Early on, product information mainly refers to a single attribute –

product quality. The general unraveling theory established by Grossman (1981) and Milgrom (1981) demonstrates that all sellers would choose to reveal their product quality because the highest quality type in any pooling equilibrium wants to differentiate itself from all others in the pool. The subsequent studies extend this line of work by examining sellers' optimal strategies on quality revelation under different market settings. For example, Guo (2009) analyzes revelation decision in a channel setting with bilateral monopolies. Kuksov and Lin (2010) investigate two competing firms' optimal revelation strategies when consumers are uncertain about the quality of both firms' products as well as their preference for quality. In addition to product quality, the recent literature has explored the role of other important dimensions of product information, most notably product fit. In addition to revealing quality information, a firm can choose whether to reveal fit information, or how much fit information that the firm wants to facilitate. Kwark et. al (2014) study a setting where consumers face the uncertainty about not only product quality but also their product fit (or product match). This work demonstrates how the provisioning of quality information and fit information respectively affects the retailer and two competing manufacturers in a wholesale distribution channel. Gu and Xie (2013) examine two competing firms' decisions on fit revelation, showing that whether each firm wants to facilitate fit revelation critically depends on the quality of the products they offer. Sun (2015) studies fit revelation facilitation in a distribution channel under wholesale pricing. She compares two scenarios where both are under wholesale pricing, while in one the supplier sells through a monopolistic retailer and in the other the supplier sells through competitive retailers. Hong and Pavlou (2014) conceptualize the product fit uncertainty as an information problem and theorize its effect on consumer satisfaction and product returns. Sun (2011) analyzes a case where the product has multiple attributes and

shows that the results from unraveling theory may not hold after accounting for fit information revelation.

In addition to discovering quality of a product and their product fit from seller-created information, consumers can also rely on online review to resolve uncertainty. The literature on online review has been proliferating rapidly during the past ten years. Most of them are empirical work in the context of movie and book industry, focusing on the effects of online WOM on predicting or influencing sales revenue (Dellarocas 2004, Chevalier and Mayzlin 2006, Liu 2006, Duan et al. 2008). Dellarocas (2004) demonstrates that online rating is a useful proxy for WOM in movie industry and serves as one of the predictors for a movie's total revenue. Dellarocas and Narayan (2006) identify three metrics of online word-of-mouth: valence, variance and volume, in which valence is usually denoted by the average numeric average rating, variance is usually measured by its statistical variance or entropy (Godes and Mayzlin 2004), and volume is counted as the number of ratings. Liu (2006) shows that online WOM has significant explanatory power for box office revenue while volume is a stronger predictor than valence. Duan et al. (2008) reveal that movies' online WOM valence significantly affects volume which in turn determines box office performance. For book markets, Chen et al. (2004) find that the consumer rating is only a predictor for book sales. However, Chevalier and Mayzlin (2006) show that the improvement of online WOM valence will increase book sales based on the data from Amazon.com and BarnesandNoble.com. Forman et al (2008) demonstrate that raters offer more positive rating to the reviews with identity information and the disclosure of identity information increases the sales. Hong et. al (2014) proposes a data-driven method that measures product type based on dynamics of variances of online product review. Researchers have also investigated the connection between consumer ratings and sales in the context of other markets such as beer,

DVD and video games (Clemson 2006, Hu et al. 2008, Zhu et al. 2010). Zhou and Duan (2010) find that, from CNET download.com, the increase in product variety strengthens the impact of positive consumer reviews but weakens that of negative ones. They also show that positive expert reviews lead to more software downloads.

Given the significance of online review, prior studies have examined how firms should optimally react to online review in terms of their pricing decisions and decisions on information revelation. Chen and Xie (2005) show that a firm should choose advertising instead of price to adapt consumer review when sufficient consumers value the product's horizontal features. Chen and Xie (2008) reveal when and how sellers should adjust their marketing communication strategy by changing product attribute information they offer to adapt consumer reviews. Dellarocas (2006) demonstrates how firms' shilling behavior, i.e. post anonymous messages that exalt their products on the purpose of changing consumers' perception, will influence firms' profits and consumers' surplus. Kuksov and Xie (2010) study the optimal pricing and whether the firm should give an unexpected frill to early customers to boost their product experience. Li and Hitt (2010) show, analytically and empirically, that unidimensional ratings are more correlated with the net value, rather than quality, of a product. Firms need to account for price effects and can better serve the consumers by setting up review systems which explicitly separate the perceived value and quality.

Our study is also closely related to the burgeoning literature of agency pricing. Hao and Fan (2014) study the agency pricing model in the electronic book market and show that the complementary consumption of e-reader and e-book may lead to a lower publisher's profit in agency pricing compared to that in the wholesale model. Abhishek et al. (2015) examine a dual channel structure where e-tailers can choose whether to use agency pricing or use wholesale

model to manage the upstream supplier. They show that the e-tailer will choose agency pricing if electronic channel cannibalizes the demand in the traditional channel while she will choose wholesale model when the electronic channel stimulates the demand in the traditional channel. Johnson (2013) investigates the agency pricing model when a retailer has capability to lock in consumers.

Our paper contributes to the literature on both agency pricing model and product information revelation. We extend the body of literature on how fit information provisioning affects equilibrium market outcomes in a distribution channel by investigating a new case where the channel is regulated by agency pricing. Specially, we examine how the retailer's incentive to facilitate fit revelation differs from the supplier's and how that difference is related to the agency pricing channel structure. Hence, our study sheds light on how the agency pricing model affects the supplier's and the retailer's incentive to provide important product information. To the best of our knowledge our study is the first to examine the issue of product information revelation in a distribution channel under agency pricing model.

3. The Model

Consider a supplier that sells one product to a mass of consumers through a monopolistic retailer. Consumers are horizontally heterogeneous in terms of their tastes towards the product – they find the product fits their tastes at different degrees. Denote a consumer's degree of misfit by λ . We assume that λ is uniformly distributed in $[0,1]$ where $\lambda=0$ represents zero degree of misfit (i.e., “a perfect fit”) while $\lambda=1$ represents full degree of misfit (i.e., “a complete misfit”). Suppose a consumer's utility reduction due to product misfit, i.e. the misfit cost, is $t \cdot \lambda$. The parameter t represents the misfit cost rate and is associated with the degree of nicheness of the product. A

high misfit cost rate t indicates the product is a niche product which will give the consumers who do not find fit a significant utility reduction, while a low t indicates the product is a popular one for which such utility reduction is mild. Denote the product quality by v which represents the value of the features which all consumers have the same preference order on. For example, consumers who shop for shoes all prefer longer durability with all other factors held the same. As our study focuses on fit revelation, we assume that product quality v is homogenous across consumers and both v and t are common knowledge. Based on the Hotelling model, a consumer, if she knows her degree of misfit λ , derives her product utility u where:

$$u = v - t \cdot \lambda .$$

Without loss of generality, we normalize $v=1$ and assume $t < 1$. Each consumer has a unit demand and the market size is normalized to 1.

Before the facilitation of fit revelation, a consumer knows her own taste but is uncertain about her degree of misfit of the product λ prior to purchase. In order to decide whether to purchase the product or not, she estimates her degree of misfit λ based on product information available on the market, such as online product review. In this paper, the term “*ex-ante*” refers to “before the facilitation of fit revelation” whereas “*ex-post*” refers to “after the facilitation of fit revelation”. According to Kwark et al (2014), suppose a consumer receives a private signal θ from those sources of *ex-ante* product information which, with probability b , equals to the consumer’s true degree of misfit λ , i.e., $\Pr(\theta = x | \lambda = x) = b$, and with probability $(1-b)$ is completely uninformative, i.e., $\Pr(\theta \neq x | \lambda = x) = 1-b$. If $b=1$, a consumer with λ equal to x will always receive a signal which also indicates x , i.e., the *ex-ante* product information is perfectly informative in terms of revealing a consumer’s fit. If $b=0$, a consumer with λ equal to x will never receive a signal which indicates x , i.e., the *ex-ante* product information is completely

uninformative. If $0 < b < 1$, the *ex-ante* product information is able to partially reveal a consumer's true degree of misfit but cannot achieve a perfect fit revelation. The parameter b essentially characterizes the degree of informativeness of product information with respect to revealing the product fit prior to the facilitation of fit revelation. Based on Bayesian updating, the expected conditional degree of misfit $E(\lambda|\theta)$ is $E(\lambda|\theta=x) = b \cdot x + (1-b)/2$. Hence a customer derives her expected product utility:

$$E(u|\theta) = v - t \cdot (b \cdot x + (1-b)/2).$$

Note that $x \in [0,1]$ since λ is uniformly distributed in $[0,1]$. Suppose the product's retail price is p . A consumer will make the purchase when her expected net utility is greater or equal to zero, i.e., $E(u|\theta) - p \geq 0$. Therefore, the product demand before the facilitation of fit revelation D_{NF} is

$$D_{NF} = \begin{cases} 0 & p > 1 - \frac{(1-b)t}{2} \\ \frac{1}{2} + \frac{2-t-2p}{2bt} & 1 - \frac{(1+b)t}{2} < p \leq 1 - \frac{(1-b)t}{2} \\ 1 & 0 \leq p \leq 1 - \frac{(1+b)t}{2} \end{cases}.$$

Suppose after the facilitation of fit revelation, consumers can use the *ex-post* product information to perfectly recover their true degree of misfit respectively. Hence according to the utility function under no fit uncertainty $u = v - t \cdot \lambda$, we derive the product demand *ex-post* D_F

$$D_F = \begin{cases} 0 & p > 1 \\ \frac{1}{2} + \frac{2-t-2p}{2t} & 1-t < p \leq 1 \\ 1 & 0 \leq p \leq 1-t \end{cases}.$$

Next, we model the supply side. Figure 1 illustrates a typical structure of agency pricing. The supplier decides the retail price p . Meanwhile, the supplier passes s share of her revenue

($0 < s < 1$) to the retailer. Some agency pricing contracts like the one adopted by Amazon.com requires a third-party seller (a supplier) to send to the retailer a non-negative closing fee g per unit item sold if she sells certain category of product like media. Usually, retailer's revenue share s and closing fee g are fixed across different products within the similar categories. Denote the supplier's marginal cost of the product by c . Therefore, the supplier's profit function π_i^S is

$$\pi_i^S = (p(1-s) - g - c) \cdot D_i$$

We assume that the retailer's marginal cost of the product is lower than the supplier's. Without loss of generality, we normalize it to zero. Hence the retailer's profit function π_i^R is

$$\pi_i^R = (ps + g) \cdot D_i$$

where $i = NF$ corresponds to "in case of no facilitation" and $i = F$ corresponds to "in case of facilitation".

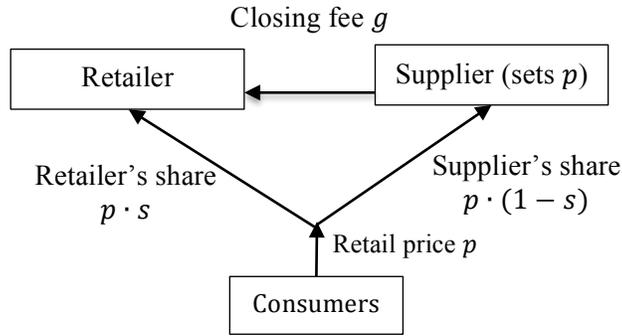


Figure 1: A typical structure of agency pricing model

Both the retailer and the supplier can facilitate the fit revelation of the product. If either of them facilitates, consumers can discover their true degrees of product fit, otherwise they can only estimate their degree of misfit to be $E(\lambda|\theta)$ based on signal θ . Therefore, the product demand is $D = D_{NF}$ *ex-ante* and is $D = D_F$ *ex-post*. The supplier will respond to the facilitation decision

through adjusting the product retailer price. Hence, the objective of the supplier is $\max_p \pi_F^S = (p(1-s) - g - c) \cdot D_F$ in case of facilitation and $\max_p \pi_{NF}^S = (p(1-s) - g - c) \cdot D_{NF}$ in case of no facilitation. Denote the supplier's optimal price in case of facilitation as p_F^* and that in case of no facilitation as p_{NF}^* . Denote the retailer's profit with the supplier's choice of p_F^* by $\pi_F^R(p_F^*)$ and that with the supplier's choice of p_{NF}^* by $\pi_{NF}^R(p_{NF}^*)$. Define:

$$I_R = \pi_F^R(p_F^*) - \pi_{NF}^R(p_{NF}^*).$$

I_R represents the difference between the retailer's profit in case of facilitation and that in case of no facilitation. The retailer will choose to facilitate if $I_R \geq 0$. Similarly, denote the difference of the supplier's profit between facilitation and non-facilitation by I_S where $I_S = \pi_F^S(p_F^*) - \pi_{NF}^S(p_{NF}^*)$. The supplier will choose to facilitate if $I_S \geq 0$. The retailer's incentive on facilitation decision is said to be *coordinated* with supplier's incentive on facilitation decision under market condition Ω if and only if both $I_R > 0$ and $I_S > 0$ under Ω , or both $I_R < 0$ and $I_S < 0$ under Ω .

We consider the market has a two periods. At the beginning of the first period, the supplier releases the product on the retailer's platform and a unit mass of consumers enters the market. Some early-adopting consumers purchase the product and leave their product review which becomes part of the *ex-ante* product information. Then the supplier sets the retail price based on the degree of informativeness of the *ex-ante* product information (i.e., b). The first period ends. At the beginning of the second period, the retailer and the supplier decide whether to facilitate the fit revelation based on the degree of informativeness of the *ex-ante* product information b and other parameters like misfit cost rate t and the retailer's revenue share s . If either of them chooses to facilitate, the supplier adjusts the retail price. If neither firm chooses to facilitate, the

supplier will remain the same retail price. Then another mass of unit consumer enters the market and makes purchases. The second period ends. Our study considers that the first period to be an introductory period which is relatively short and thus focuses on the market outcome in the second period. Meanwhile, in order to focus our attention on non-trivial cases, we assume that $c < 1 - s - g$. This means the supplier's marginal cost c is not excessively high such that the supplier can make non-negative profit with the revenue share she has. We also assume that $c > (1-s)/2 - g$ which implies that suppliers of the most niche product (i.e., $t=1$) cannot earn positive profit if no *ex-ante* product information is provided to consumers (i.e., $b=0$) and no fit revelation is facilitated. All important notation are summarized in Table 1.

Table 1. Model Parameters and Variables

Parameters

| | |
|-----|--|
| b | Degree of informativeness of product information prior to facilitation |
| t | Misfit cost rate |
| g | Closing fee |
| s | Retailer's revenue sharing percentage |
| c | Supplier's marginal cost of the product |

Variables (Note that $i = F$ means facilitation and $i = NF$ means no facilitation)

| | |
|-----------|--|
| p | Product's retail price |
| λ | Consumers' true degree of misfit |
| D_i | Demand of the product under scenario i |
| π_i^S | Supplier's profit under scenario i |
| π_i^R | Retailer's profit under scenario i |

4. Model Results

We first present the supplier's optimal choice of retail price in case of facilitations and no facilitation. In order to simplify the presentation and highlight the insights, Lemma 1 only show the results based on the internal solutions of the supplier's optimization problem².

Lemma 1 (Optimal retail prices and demand in case of facilitation and no facilitation)³ *The supplier's optimal choice of retail price p_i^* , the corresponding demand $D_i(p_i^*)$ in case of facilitation ($i = F$) and that in case of no facilitation ($i = NF$) are*

- (Facilitation) $p_F^* = \frac{1}{2} + \frac{c+g}{2(1-s)}$ and $D_F(p_F^*) = \frac{1-s-c-g}{2t(1-s)}$
- (No facilitation) $p_{NF}^* = \frac{1}{2} + \frac{c+g}{2(1-s)} - \frac{t(1-b)}{4}$ and $D_{NF}(p_{NF}^*) = \frac{1}{4} + \frac{2-t}{4bt} - \frac{c+g}{2bt(1-s)}$.

After the facilitation, the optimal retail price will increase, i.e., $p_F^ > p_{NF}^*$. The demand will also*

increase if the ex-ante retail price is higher than a threshold p_E , i.e., $D_F(p_F^) > D_{NF}(p_{NF}^*)$ if*

$p_{NF}^ > p_E$. It will remain the same if $p_{NF}^* = p_E$ or decrease if $p_{NF}^* < p_E$. The price threshold is*

$$p_E = (1 + (1-t)(1-b)) / 2 + b(c+g) / 2(1-s).$$

When lack of informative *ex-ante* product information (i.e., b is low), consumers' estimated fits $E(\lambda|\theta)$ are distributed mostly around the average fit $1/2$. The consumers whom the product indeed fits very well (hereafter called as "fit consumers") will only perceive the product as an average fit such that they underestimate their value of product, while the consumers whom the product indeed fits very poorly (hereafter called as "misfit consumers") will also perceive it as an

² However, all the subsequent propositions take into account both the internal solutions and the boundary solutions.

³ Detailed proof of all lemmas, propositions and corollaries will be provided upon request.

average fit such that they overestimate their value of the product. Once the fit revelation is facilitated (i.e., $b=1$), the fit consumers become able to discover the product to be a good fit and the misfit ones become able to discover the product to be a bad fit – consumers’ estimated fits become more heterogeneous. As the average fit consumers whose λ are around $1/2$ hold their valuation unchanged before and after the facilitation, the facilitation essentially rotates the demand curve clock-wise as shown in Figure 2 (from $b=0.4$ to $b=1$). The market demand becomes more inelastic and consequently the supplier shall optimally set a higher retail price after the facilitation (i.e., $p_F^* > p_{NF}^*$).

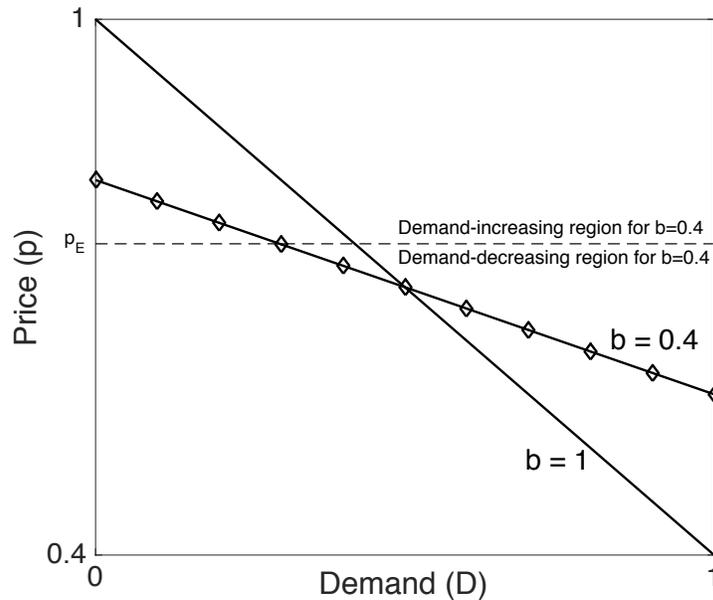


Figure 2: Rotation effect of facilitating fit revelation on demand

Note: Figure 2 is generated based on $t = 0.6$

Lemma 1 also demonstrates that the impact of the facilitation on the product demand depends on the level of *ex-ante* retail price p_{NF}^* . If *ex-ante* retail price p_{NF}^* is relatively high, more consumers will be willing to buy the product after the facilitation, i.e., $D_F(p_F^*) > D_{NF}(p_{NF}^*)$.

This is because due to the facilitation, many fit consumers who were *ex-ante* ruled out by the relatively high p_{NF}^* now recover their high willingness to pay for the product. The number of consumers whose willingness to pay greater than p_{NF}^* grows significantly. Therefore, despite the supplier increases the retail price from p_{NF}^* to p_F^* , the product demand eventually increases from $D_{NF}(p_{NF}^*)$ to $D_F(p_F^*)$. On the contrary, if *ex-ante* retail price p_{NF}^* is relatively low, fewer consumers will be willing to buy the product after the facilitation, i.e., $D_F(p_F^*) < D_{NF}(p_{NF}^*)$. This is because many misfit consumers who were *ex-ante* captured by the relatively low p_{NF}^* now recover their even lower willingness to pay for the product due to the facilitation. The number of consumers who are willing to pay p_{NF}^* decreases. In addition, the supplier raises the price to account for the more inelastic. Hence the demand eventually decreases from $D_{NF}(p_{NF}^*)$ to $D_F(p_F^*)$.

Threshold p_E is the price point where the product demand does not change before and after the facilitation. It defines two regions, the demand-increasing region for any $p_{NF}^* > p_E$ and the demand-decreasing region for any $p_{NF}^* < p_E$. The supplier will definitely choose to facilitate if the *ex-ante* retail price is in the demand-increasing region because both the price and the product demand will increase after the facilitation. However, the supplier's decision becomes more complex when it is in the demand-decreasing region. To obtain the complete set of conditions under which the supplier will choose to facilitate, we derive the following proposition.

Proposition 1 (Conditions for the supplier to facilitate) *The supplier will choose to facilitate if and only if (i) the product is highly niche (i.e., $t_3^S < t < 1$), or (ii) the product is relatively niche and the ex-ante product information is sufficiently informative (i.e., $t_2^S < t < t_3^S$ and $b_2^S < b < 1$ or*

$$t_1^S < t < t_2^S \text{ and } b_1^S < b < 1). \text{ The above thresholds are: } t_3^S = \frac{(2 + \sqrt{2})(1-s-c-g)}{2(1-s)}, t_2^S = \frac{3(1-s-c-g)}{2(1-s)},$$

$$t_1^S = \frac{1-s-c-g}{1-s}, b_1^S = \frac{(2(c+g)-(2-t)(1-s))^2}{t^2(1-s)^2}, b_2^S = 1 - \frac{((c+g)-(1-2t)(1-s))^2}{2t^2(1-s)^2}.$$

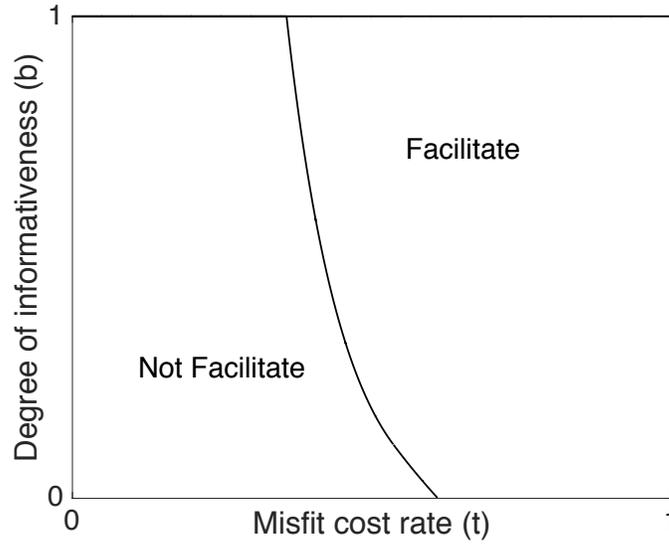


Figure 3: Market conditions for the supplier to facilitate

Note: Figure 3 is generated based on $s = 0.3$ $c = 0.4$ and $g = 0.05$.

Figure 3 illustrates the market conditions under which the supplier will choose to facilitate in terms of the level of product niche (indicated by misfit cost rate t) and the degree of informativeness of the ex-ante product information (indicated by b). Intuitively, the reason why the supplier has incentive to facilitate the fit revelation for a highly niche product (i.e., $t_3^S < t < 1$) is because the facilitation recovers the high-valuation demand that has been suppressed by

uninformative fit information *ex-ante*. Thus the supplier can restore to their margin strategy – extract a high margin from fit consumers by changing a high price (Chen & Xie 2008). In addition, we can also explain this result based on our findings in Lemma 1. Despite the consumers may not correctly estimate their misfit hence may underestimate the nicheness of the product, a highly niche product will be priced higher than a relative popular product keeping all the other market parameter constant. The low price elasticity of the highly niche product will lead to a high *ex-ante* retail price, driving the market into the demand-increasing region where the demand will be boosted after the facilitation (the case $t = 0.8$ in Figure 4). Hence, the supplier is better off choosing to facilitate when the product is highly niche. On the other end, a popular product with high price elasticity will lead to a low *ex-ante* retail price, driving the market into the demand-decreasing region. Hence, the demand will drop after the facilitation (the case $t = 0.4$ in Figure 4). When the demand reduction outweighs the price increase due to sufficiently high t , the supplier will be worse off if she facilitates.

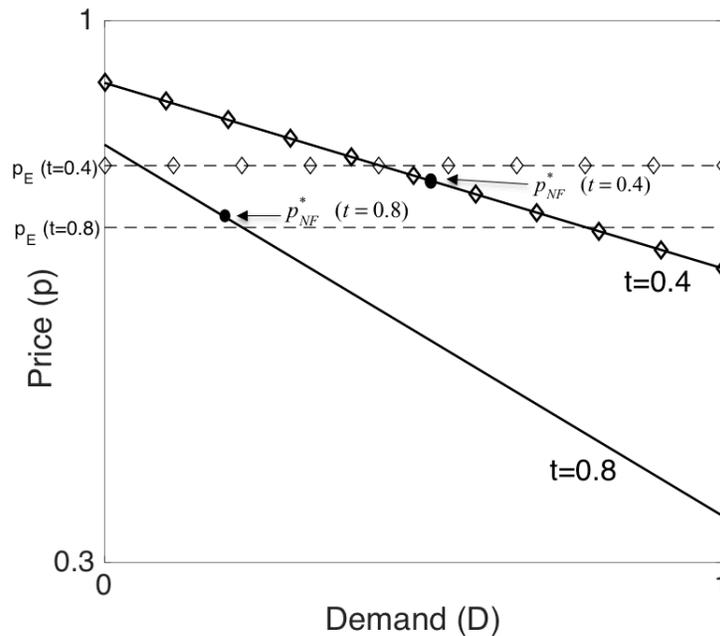


Figure 4: Demand curves under different misfit cost rate t

Note: Figure 4 is generated based on $b = 0.4$

Proposition 1 also shows that the supplier's choice of facilitation is sensitive to *ex-ante* product information only when the product is moderately niche. In those situations, the *ex-ante* product information is a complement to the supplier's incentive to facilitate – the supplier will choose to facilitate when the *ex-ante* product information is informative. Chen and Xie (2008) has documented the similar results in a monopolistic setting with discrete distribution of consumers tastes. Our model extended their results by showing when the product is extremely niche or popular, such complement role of *ex-ante* product information (e.g., online consumer review) no longer exists.

Proposition 2 (Conditions for the retailer to facilitate) *The retailer will choose to facilitate the fit revelation if and only if (i) the product is highly niche (i.e., $t_2^R < t < 1$), or (ii) the product is relatively niche and the *ex-ante* product information is sufficiently informative (i.e., $t_1^R < t < t_2^R$*

and $b_1^R < b < 1$). The thresholds are: $b_1^R = \frac{(2(c+g)s+(1-s)(s(2-t)+4g))((2-t)(1-s)-2(c+g)c)}{st^2(1-s)^2}$,

$$t_2^R = \frac{2(1-s-c-g)}{1-s} \text{ and } t_1^R = \frac{((c+g)s+(1-s)(s+2g))(1-s-c-g)}{(1-s)^2(g+s)}.$$

Figure 5 illustrates the market conditions under which the retailer will choose to facilitate. At the first glance, the retailer's optimal facilitation strategy is at large similar to the supplier's – facilitating the highly niche ones and the relatively niche ones with informative *ex-ante* product information. In agency pricing, the retailer takes a fixed percentage of the channel total revenue after delegating the retail price decision to the supplier. This revenue sharing mechanism makes the retailer's profit margin moves in the same direction as the supplier's does. Hence if the retail

price increases after the facilitation and the demand also increases (i.e., the *ex-ante* retail price is seated in the demand increasing region), the retailer also becomes better off.

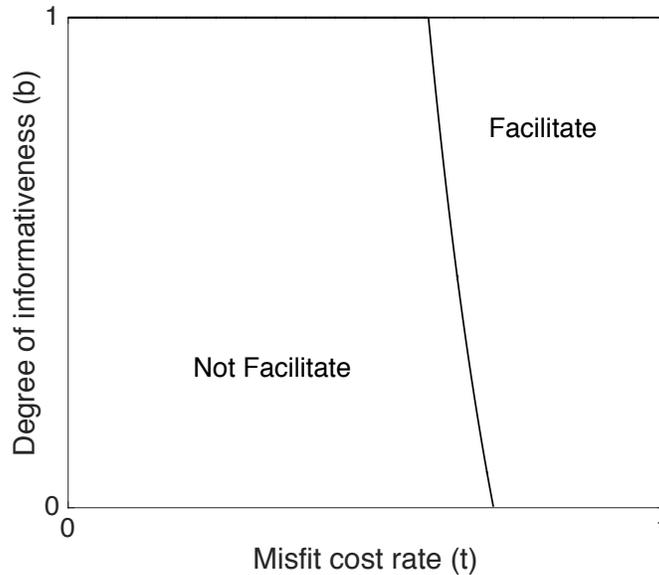


Figure 5: Market conditions for the retailer to facilitate

Note: Figure 5 is generated based on $s = 0.3$ $c = 0.4$ and $g = 0.05$.

Nonetheless, if we carefully compare the facilitation conditions in Proposition 1 and those in Proposition 2, we will discover an important finding: The supplier’s and the retailer’s incentive to facilitate are not always coordinated with each other. The conditions for the retailer to facilitate are a subset of those for the supplier. In order to explain this finding in detail, we derive the following proposition.

Proposition 3 (Coordination and incoordination on facilitation decision) *The retailer’s choice to facilitate is coordinated with the supplier’s when and only when either of the following two sets of conditions holds:*

(i) (Coordinated to facilitate) the product is highly niche, or the product is relatively niche and the ex-ante product information is sufficiently informative (i.e., $t_2^R < t < 1$ and $t_1^R < t < t_2^R$ and $b_1^R < b < 1$), or

(ii) (Coordinated to not facilitate) the product is highly popular, or the product is relatively popular and the ex-ante product information is not sufficiently informative (i.e., $0 < t < t_1^S$, or $t_1^S < t < t_2^S$ and $0 < b < b_1^S$, or $t_2^S < t < t_3^S$ and $0 < b < b_2^S$).

Note that the region characterized by conditions (i) is not overlapped with that of conditions (ii).

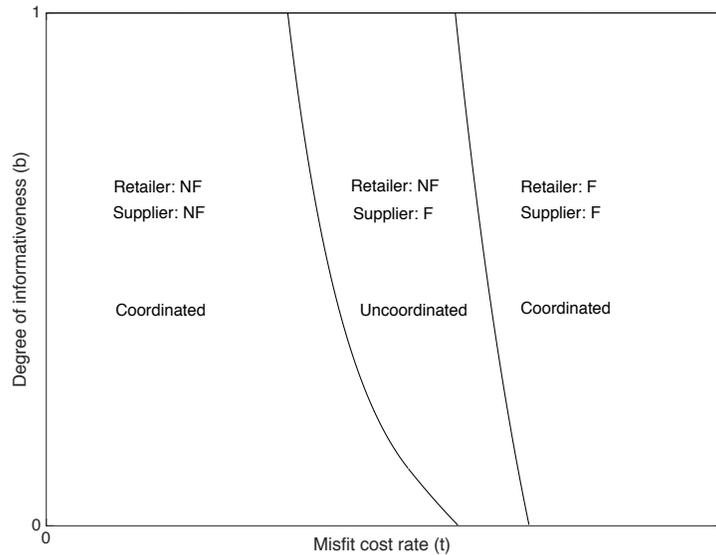


Figure 6: Coordination on facilitation decision between the supplier and the retailer

Note: Figure 6 is generated based on $s = 0.3$ $c = 0.4$ and $g = 0.05$.

Proposition 3 shows the coordination is achieved either for a highly niche product which they both agree to facilitate, or for a highly popular product which both parties agree not to facilitate. The incoordination happens when the product is moderately popular/niche: the supplier has incentive to facilitate while the retailer does not.

The reason that contributes to the incoordination is the difference between the supplier's marginal cost of the product and the retailer's. In order to simplify the matter, suppose the closing fee is zero (i.e., $g=0$). Based on our discussion in Lemma 1, suppose immediately after the facilitation, the *ex-ante* demand $D_{NF}(p_{NF}^*)$ changes to an intermediate state $D_F(p_{NF}^*)$. As the supplier starts to raise the price from p_{NF}^* to p_F^* , the demand starts to drop from the intermediate state $D_F(p_{NF}^*)$ to $D_F(p_F^*)$. During this process, a given amount of price increase in percentage will lead to the same amount of demand reduction in percentage to the supplier and the retailer. However, because of the supplier's higher marginal cost of the product, it will incur a higher amount of increase in percentage in the supplier's profit margin (i.e., $p(1-s)-c$) than that would incur to the retailer's (i.e., ps). Consequently the supplier is willing to trade a higher amount of demand reduction in percentage for a given amount of price increase in percentage than the retailer. Eventually, since the supplier who decides the retail price will only take into account her own marginal cost, it creates a negative externality on the retailer's profit. Therefore, the retailer is already worse off when the supplier just breaks even.

It is interesting to see that when the *ex-ante* product information becomes more informative (i.e., b increases), the uncoordinated region gets expanded in terms of its range on misfit cost rate t – a wider range of product will be subject to the retailer and the supplier's conflicting incentive on fit revelation facilitation. According to Lemma 1, a higher b implies a less significant rotation on the demand curve. Consequently, the difference between the supplier's optimal price before and after the facilitation (i.e., $p_F^* - p_{NF}^*$) becomes smaller. However, this smaller difference exacerbates the role of marginal cost c in creating an uncoordinated change between the retailer and the supplier's profit margin. An extreme opposite case to show this point

is when price change $p_F^* - p_{NF}^*$ is exceedingly large due to a significant rotation of the demand curve, it will dominate the influence of the marginal cost on the supplier's profit margin $p(1-s) - c$. Hence the supplier's change in her profit margin in percentage will be similar to the retailer's. Therefore, better coordination on facilitation decision is achieved.

Corollary 1 (Effects of marginal cost c) *When the supplier's marginal cost increases, it expands the coordinated region in which both the supplier and the retailer choose to facilitate.*

Although the difference between the supplier's and the retailer's marginal cost contributes to the incoordination, Corollary 1 shows that increasing the supplier's marginal cost, which enlarges such difference, actually leads to a larger coordinated region where both want to facilitate (shown in Figure 7). Recall that the essence of making both parties have incentive to facilitate is the demand must increase after the facilitation. One way to guarantee that is to have a high *ex-ante* retail price in the demand-increasing region before the facilitation. A high supplier's marginal cost will drive the supplier to set a high *ex-ante* retail price, which leads to better coordination on facilitation decision.

We next investigate how the factors on the retailer's side – retailer's revenue share s and closing fee g – will affect the landscape of the coordination on facilitation decision.

Proposition 4 (Effects of revenue share s and closing fee g) *When the retailer takes higher revenue share s or charges higher closing fee g , it shrinks the incoordination region while expands the coordinated region in which both parties choose to facilitate.*

The rationale behind the results of Proposition 4 is similar to that in Corollary 1. Thanks to the agency pricing model, when the retailer takes more revenue share or charges a higher closing fee *ex-ante*, the supplier will respond with a higher *ex-ante* retail price. The high *ex-ante* retail price sets the market in the demand-increasing region where the demand and the price will both increase after the facilitation.

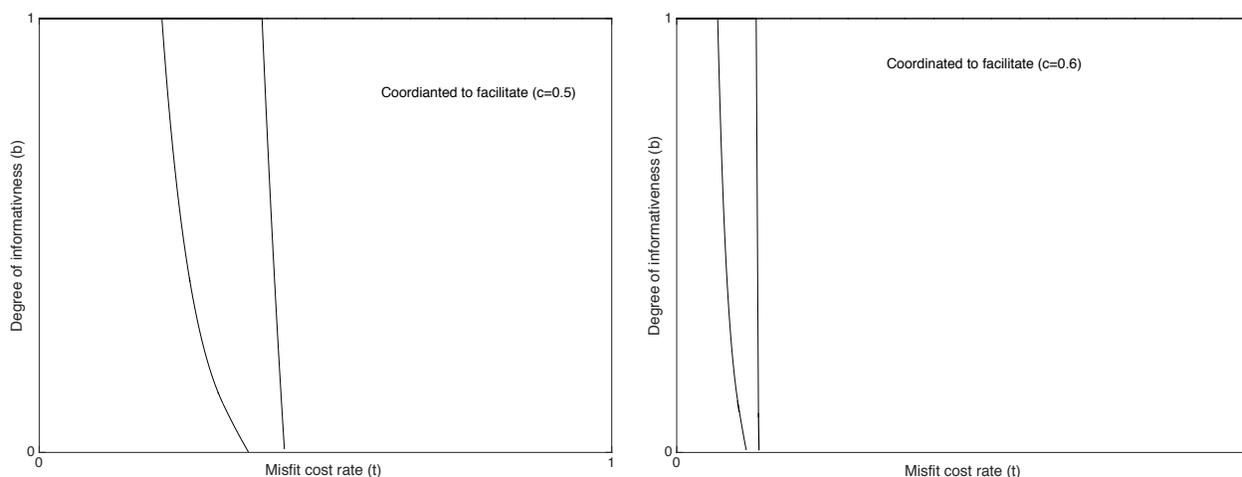


Figure 7: Coordination on facilitation decision under different supplier's marginal cost c

Note: Figure 7 is generated based on $s = 0.3$ and $g = 0.05$.

Proposition 4 reveals an important finding of our paper. Past literature have shown that when a retailer takes more shares, it hurts supply chain efficiency as well as consumer surplus and social welfare. However, we find that a high retailer's revenue share may increase the opportunity to coordinate the supplier's and the retailer's incentive on facilitation decision. It essentially means that the conditions to achieve coordination on facilitation decision may be at odd with the conditions to achieve coordination on channel efficiency. Coordinating both parties to facilitate may be at the expense of consumer surplus and social welfare. This is because the main issue of incoordination on channel efficiency is retail price is too high due to factors like

vertical externality. However, the main issue of incoordination on facilitation decision is retail price is too low *ex-ante*, which causes demand to decrease after facilitation.

Corollary 2 (Social welfare and consumer surplus) *When the ex-ante product information is generally informative (i.e., $1/9 < b < 1$), the consumer surplus and the social welfare are better off if the retailer dictates the facilitation decision when there is a conflict with the supplier.*

Corollary 2 shows that in case of incoordination, the interest of the consumers as a whole and the society as a whole side with the retailer with respect to the facilitation decision. Recall the reason for incoordination is the retailer finds the demand reduction caused by the facilitation cannot be compensated by the retail price increase yet the supplier finds it can because of their uncoordinated increase in profit margin. Hence if the facilitation is chosen in those uncoordinated region, consumers will need to pay a higher price and the market end up with a lower demand. Therefore, it hurts consumer surplus. Essentially, facilitation in the uncoordinated region partially adds to the supplier's monopoly power through making the demand more inelastic but not directly compensating the demand that could happen from the more heterogeneous consumers' valuation distribution.

5. Concluding remarks

Our study examines the issue of facilitating fit revelation in a distribution channel under agency pricing. We consider a horizontally continuous consumer taste distribution and assume that consumers do not know their true product fit prior to purchase. Product information such as product description and online consumer review can be informative but not perfect in terms of

revealing consumers' true degree of product fit. Remaining uncertainty can be resolved by seller's efforts in facilitating fit revelation of a product and either the supplier or the retailer can facilitate. Our results show that in general both the retailer and the supplier want to facilitate fit revelation for a niche product. However, the exact conditions for either of them to agree to facilitate are different. When the retailer has marginal cost advantage over the supplier, the supplier will facilitate fit revelation over a wider range of product type than the retailer. Despite one major reason why they are not coordinated on facilitation decision is the discrepancy in their marginal cost, increasing the supplier's marginal cost improves the likelihood of coordination. Meanwhile, increasing retailer's revenue share and closing fee in agency pricing contract will also improve coordination. This result implies that the conditions to achieve coordination on facilitation decision may be at odd with the conditions to achieve coordination on channel efficiency. When incoordination happens, the interest of consumer surplus and social welfare is mostly coincided with retailer rather than supplier with respect to facilitation decision.

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