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Channel Selection and Contracting in the Presence of a Retail Platform

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This paper studies how a manufacturer should engage with a platform retailer and a traditional reseller. Our work is motivated by the emergence of increasingly powerful retail platforms in China's consumer electronics and appliances markets. The manufacturer pays a slotting fee and a portion of its sales revenue to the platform retailer in exchange for the opportunity to manage its own space within the retailer's store. The manufacturer can also sell its product to a traditional reseller thereby earning its wholesale price. We first formulate a Stackelberg game where the platform retailer leads by setting the revenue-sharing rate while the manufacturer follows by choosing to sell through one or both channels. We derive the equilibrium channel and characterize each party's associated sales quantities, prices, and profits. After confirming, it is always beneficial for the platform retailer to determine the slotting fee and revenue-sharing rate simultaneously, we then formulate two bargaining models between the manufacturer and the platform retailer. In the first model, they can negotiate just the revenue-sharing rate and in the second they negotiate both the revenue-sharing rate and the slotting fee. In the second model, a win-win result for the manufacturer and platform retailer is possible. We find that the slotting fee is neither always beneficial to the platform retailer nor always harmful to the manufacturer; it depends on the demand substitution effect between the two retail channels.

Key words: channel selection; retail platform; revenue sharing; slotting fee
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1. Introduction

The past two decades have witnessed great changes in how consumer electronics and appliances are sold in China. Traditionally, consumer appliances were distributed through many small regional retailers and department stores. Starting in the late 1990s, two self-owned chain stores, Gome and Suning, emerged as the dominant appliance retailers across the whole country (Sun 2007). In contrast to the traditional reseller model, Gome and Suning each adopted a platform retailer business model (Zhang 2009) where they rent space within the store to a number of manufacturers. Each manufacturer uses its own salesforce to manage the selling process of its products, while paying the platform retailer a slotting fee to cover real estate, advertisement and overhead costs (Abrami et al. 2008). In addition, the manufacturer shares a potion of its sales revenue with the platform retailer. In a nationwide survey of Gome (Linkshop 2007), it was reported that the slotting fee varied from city to city but was identical for all manufacturers in a given store. In contrast, even within a store the revenue-sharing rate often differed by manufacturer.

How manufacturers should go to market in such a dynamic and evolving retail environment is still an open question. Manufacturers often enter the market using Gome and Suning but then expand to the regional distributors to broaden their footprint (Fong and Makino 2006). However, channel conflicts can occur. For example, in 2008, Gome charged a revenue-sharing rate of 17% to Sanyo and 12% to Sony, causing Sanyo to withdraw from Gome. The reason for Sanyo's higher rate was its lower sales volumes (Sina News 2008). Channel conflict between China's strongest domestic air conditioner brand, Gree, and Gome caused Gree to leave Gome and build its own distribution network via partnerships with third-party distributors and retailers (Chow et al. 2011). Despite the potential for conflict, most manufacturers embrace platform retailers, especially in cities where the platform retailers command significant market share. For example, Haier, the largest electronic appliances manufacturer in China has built a nationwide distribution system but still remains a major supplier to Suning and Gome.

Motivated by the consumer appliances market in China, we study a supply chain comprised of a manufacturer, a platform retailer, and a traditional reseller. The platform retailer acts as a Stackelberg leader followed by the manufacturer and the traditional reseller in sequence. The key questions here are as follows (i) should the manufacturer choose the dual channel or a sole channel of either the platform retailer or the traditional reseller? (ii) how should the platform retailer set the revenue-sharing rate? (iii) how does the slotting fee impact the performance of the channel parties? We first assume the slotting fee is exogenous, and then consider a slotting fee endogenously decided by the platform retailer. We also extend the model setting to the situation where the manufacturer and the platform retailer both possess bargaining power and negotiate over just the revenue-sharing rate, or both the revenue-sharing rate and slotting fee. In the Stackelberg model, we find there are threshold conditions for the problem parameters that dictate the equilibrium channel. For the model extensions, we find that an exogenous slotting fee cannot coordinate the channel between the manufacturer and the platform retailer but an endogenous one can. It is further found that in specific situations when the slotting fee is exogenous, the manufacturer prefers a larger slotting fee to a smaller one.

The remainder of this study is organized as follows. We summarize the relevant literature in section 2. Section 3 models the manufacturer's three channel options in the presence of the platform retailer and traditional reseller. In section 4, we analyze the manufacturer's preference among the channel options and the platform retailer's corresponding decisions, characterizing the equilibrium outcome of the channel structure. In section 5, we first extend the basic model to let the platform retailer determine the slotting fee simultaneously with the revenue-sharing rate. We then let the manufacturer hold some bargaining power against the platform retailer in the channel and investigate the impact of the slotting fee on the channel parties. We conclude the paper and discuss the ramifications of several modeling assumptions in section 6.

2. Literature Review

Our work builds upon contributions in distribution channel design, the impact of a dominant retailer, and platform retailing. We hereby review those papers that are most relevant to our work.

Over the past three decades, distribution channel design has attracted the interest of academics and practitioners. McGuire and Staelin (1983) conducted a Nash equilibrium analysis on a system with two manufacturers producing substitutable products and selling through either a franchised store or factory store. Their study provides an explanation for why a supplier would want to use an intermediate retailer in the context of two supply chains. Jeuland and Shugan (1983) and Ingene and Parry (1995) proposed coordination mechanisms in distribution channels. The earlier achievement in this area was summarized in the monograph by Ingene and Parry (2004). Marx and Shaffer (2007) addressed the issue of exclusive dealing in retailing in which charging upfront payments might result in less powerful retailers being excluded from the market. Due to the e-business boom of the past decade, researchers have begun investigating multichannel systems with one direct-sale channel and one standard reseller channel (Cai 2010, Chiang et al. 2003, Luo and Sun 2016, Tsay and Agrawal 2004). Our work is differentiated from the aforementioned studies by its focus on the asymmetric relation of a platform retailer and a traditional reseller.

There is a rich research stream on the dominant retailer, arising from retail giants such as Wal-Mart in the United States and Carrefour in Europe. An interesting question regarding the dominant retailer is whether the manufacturer benefits from the strong channel dominance of the retailer. This was analyzed empirically by Messinger and Narasimhan (1995), who argued that although a retailer's dominance may benefit the manufacturer as the market size is enlarged, the manufacturer's margin could be reduced. Raju and Zhang (2005) and Geylani et al. (2007) proposed mechanisms that allow the manufacturer to combat a dominant retailer in the presence of a weak retailer. A dominant retailer can be either a price leader or a channel leader. In the case of a price leader, the dominant retailer can set the retail price of the product while the weak retailers act as price-takers (Raju and Zhang 2005). In the case of a channel leader, the dominant retailer can dictate the wholesale price (Geylani et al. 2007) through negotiations with the manufacturer. We study the case in which the dominant retailer is a channel leader and determines the revenue-sharing rate and the slotting fee.

The effect of slotting fees has also received much attention. Bloom et al. (2000) summarized two viewpoints on slotting fees. The first is that a slotting fee signals the quality of a new product (Chu 1992, Lariviere and Padmanabhan 1997, Sullivan 1997), whereas the second regards the slotting fee as a source of dominance for retailers with scarce shelf space (Marx and Shaffer 2010, Shaffer 1991). A more recent perspective proposes that the slotting fee arises from the operational cost difference or the vertical margin difference (Dhar 2013, Klein and Wright 2007, Kuksov and Pazgal 2007). In China's electronic appliance retail market, the slotting fee has long been criticized for creating unfair competition (Wang et al. 2012). We study the scenario where the platform retailer charges the manufacturer a slotting fee and show that such a fee is neither always beneficial to the retail platform nor always detrimental to the manufacturer.

Our initial models assume the platform retailer owns the full bargaining power against the manufacturer. However, it is worth investigating the situation where the manufacturer has some bargaining power against the platform retailer, for which we will adopt the setting of generalized Nash bargaining. Bilateral bargaining was first developed by Nash (1950) and has been applied to various channel structures. Iyer and Villas-Boas (2003) discussed channel bargaining with unspecified contract terms, and present a channel coordination mechanism via bargaining. Dukes et al. (2006) showed that manufacturers can benefit from cost asymmetry between two retailers, one of whom is low-cost and has a better bargaining position than its rival. Draganska et al. (2010) further proposed a generalized bargaining setting present in a coffee market. We find that if the platform retailer and the manufacturer bargain over the revenue-sharing rate and slotting fee jointly, there is possibly a win–win situation versus the Stackelberg setting where the platform retailer determines only the revenue-sharing rate.

We position this research in the emerging field of platform retailing, both online and offline. For the internet industry, Wang et al. (2004) studied the revenue-sharing contract between Amazon and its sellers. Jiang et al. (2011) built models to explain online platform retailing, specifically for Amazon's hybrid model as a reseller, as well as a platform. Hao et al. (2017) studied Apple's agency model for app sales in advertising contracts. Tan and Carrillo (2017) studied the agency model for E-book sales. Abhishek et al. (2016) built competitive models to explain why some online retailers act as resellers while others act as platforms in online retailing. Tian et al. (2018) also built similar models to explain why the e-commerce model could be in the form of marketplace, reseller, or hybrid. For brick-and-mortar businesses, Jerath and Zhang (2010) analyzed the occurrence of store-within-a-store retailing in the cosmetics and apparel markets in the United States and in China. Li et al. (2016) studied the change in price and sales in a Chinese department store when the business model switched from a traditional reselling model to a direct-sale model by the manufacturers. Hagiu and Wright (2015) analyzed cases where traditional and online retail businesses switched between reseller and platform business models, and concluded that this switch is determined by the control over a non-contractible decision variable such as a marketing activity. Our study presents a three-party supply chain where the platform retailer has the power to charge a slotting fee and revenue-sharing rate while the manufacturer chooses to sell through the platform retailer, traditional reseller, or both outlets.

3. Model Notation and Assumptions

We consider a setting where the platform retailer is powerful enough to dictate its contractual terms to the manufacturer; that is, the platform retailer is the channel leader. In contrast, the manufacturer dictates a wholesale price to the traditional reseller.

The platform retailer charges the manufacturer a slotting fee, F, and a revenue sharing rate r. We first assume the slotting fee is exogenous, and consider the endogenous case in section 5.1. As channel leader, the platform retailer sets the revenue-sharing rate unilaterally. Under the revenue-sharing contract, the manufacturer keeps a fraction r of the revenue and pays a fraction of $(1 - r)$ of the revenue to the platform retailer. If the manufacturer decides to join the retail platform after learning F and r, the manufacturer then determines its retail price p_1.

If the manufacturer decides to sell to the traditional reseller, the manufacturer decides the wholesale price w. The traditional reseller decides its sales price p_2 after learning the wholesale price w.

Following Ingene and Parry (1995), we define the platform retailer's demand function by $D_1()$ and the traditional reseller's demand by $D_2()$, where:

$$D_1(p_1, p_2) = a - p_1 + \theta p_2, \tag{1}$$

$$D_2(p_1, p_2) = 1 - p_2 + \theta p_1. \tag{2}$$

A general setting of demand functions for two retailers competing in the same market was characterized and shown equivalent to (1) and (2) in McGuire and Staelin (1983). In the above equations, a and 1 are the potential market sizes, p_1 and p_2 are the retail prices, and θ represents the substitution effect between the two channels whereby an increase in one channel's price lowers its own demand while increasing its competitor's demand. In China's electrical appliance market in 2007, the market share of the platform retailer channel exceeded 60% in the top 30 metropolitan areas (Sun 2007). Motivated by this specific case, we further assume $a > 1$ throughout the study. As is common in the literature, we further normalize the production cost of the manufacturer to zero. These assumptions aim to simplify the mathematical derivations of the models while preserving the fundamental qualitative results in the problem.

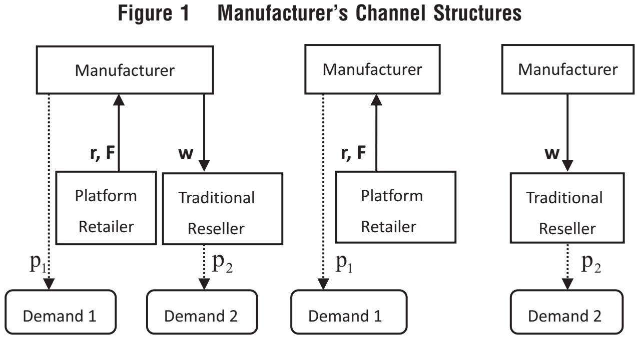
We can now formulate a three-stage game to analyze the decision-making processes of the manufacturer, platform retailer, and traditional reseller:

Stage 1: The platform retailer sets the revenue-sharing rate r and slotting fee F if it is endogenously determined.
Stage 2: The manufacturer determines whether to distribute through one or both channels. In cases where the manufacturer chooses to join the retail platform p_1 is determined and in cases where the traditional reseller is chosen w is determined.
Stage 3: The traditional reseller decides the retail price p_2 if the manufacturer employed the traditional reseller's channel.

The sequence of events implies that the platform retailer is the most powerful player while the traditional reseller is the least powerful. The Stackelberg model implies that the player with more power makes a take-it-or-leave-it contract to the player with less power. In other words, the manufacturer is a Stackelberg follower for the platform retailer but a Stackelberg leader for the traditional reseller. Appendix C considers a setting where the two channels competitively set prices at the same time.

The three potential channel structures are illustrated in Figure 1:
C1: the manufacturer distributes through both retail channels;
C2: the manufacturer only distributes through the platform retailer;
C3: the manufacturer only distributes through the traditional reseller.

Figure 1 Manufacturer's Channel Structures



Demand 1 corresponds to the platform retailer's demand while Demand 2 corresponds to the traditional reseller demand. In C1 Demand 1 is found from Equation (1) while Demand 2 is found from Equation (2); the demands in C2 and C3 are derived later.

We can solve the three-stage game in increasing order of channel dominance. That is, solve the traditional reseller's problem first, followed by the manufacturer's problem, and then the platform retailer's problem. Furthermore, as the traditional reseller's decision on p_2 does not apply to all three channel structures we will merge the sub-games into two sub-problems: the platform retailer's decision and the manufacturer's decision, where the latter has taken into account the traditional reseller's response.

4. Analysis of Channel Equilibrium

This section derives each player's profit function for each channel structure, and then proceeds to sequentially analyze the manufacturer and platform retailer decisions on channel structure. Comparing the results of the three possible channel structures, the one that maximizes the platform retailer's profit is the equilibrium channel structure.

4.1. Profit Functions in Each Channel

4.1.1. Dual Channel Employing Platform Retailer and Traditional Reseller: C1. In channel structure C1, the sales prices are set sequentially. Given revenue-sharing rate r, the manufacturer determines the sales price at the platform retailer, p_1, and the wholesale price, w, at the traditional reseller. The traditional reseller then determines the price, p_2. In Appendix C, we analyze an alternative time sequence in which the manufacturer first announces the wholesale price for the traditional reseller, followed by the manufacturer and traditional reseller acting as competitors and determining the corresponding retail prices, p_1 and p_2, simultaneously. However, in such a time sequence, the manufacturer does not make more profit than the current sequence, and thus it is not further analyzed.

With the proposed time sequence, the problem is solved backwards in two steps. The traditional reseller's decision can be written as follows:

$$PC1 \quad \mathrm{Max}_{p_2>0}\ \pi_2^{C1}(p_2|p_1,w) = (p_2-w)D_2(p_1,p_2) = (p_2-w)(1-p_2+\theta p_1)$$
$$\text{s.t. } p_2 \geq w$$
$$1-p_2+\theta p_1 \geq 0.$$

The two constraints of *PC1* ensure that the traditional reseller's profit and sales are non-negative. Under these conditions, the sales price and sales quantity at the traditional reseller are

$$p_2^*(p_1, w) = \frac{1 + w + \theta p_1}{2}$$
$$D_2^*(p_1, w) = \frac{1 - w + \theta p_1}{2}.$$

The manufacturer's profit given the traditional reseller's best response can be expressed as

$$\pi_M^{C1}(p_1, w) = wD_2^*(p_1, w) + rp_1 D_1^*(p_1, p_2^*(p_1, w)) - F. \tag{3}$$

By optimizing p_1 and w in Equation (3) and in turn p_2 in *PC1*, we solve Stages 2 and 3 of the three-stage game in dual channel structure C1. As a result, the prices at the two channels are

$$p_1^{*C1}(r) = -\frac{4ar + (1+3r)\theta}{\theta^2 + r^2\theta^2 + r(-8 + 6\theta^2)} \tag{4}$$

$$p_2^{*C1}(r) = -\frac{ar(3+r)\theta + 2r(3-\theta^2)}{\theta^2 + r^2\theta^2 + r(-8 + 6\theta^2)}. \tag{5}$$

Meanwhile, the sales at the two channels are

$$D_1^{*C1}(r) = \frac{a(\theta^2 + r(-4 + 3\theta^2)) + \theta(1 - 3r + 2r\theta^2)}{\theta^2 + r^2\theta^2 + r(-8 + 6\theta^2)} \tag{6}$$

$$D_2^{*C1}(r) = \frac{r(a(-1+r)\theta + (-2 + (1+r)\theta^2))}{\theta^2 + r^2\theta^2 + r(-8 + 6\theta^2)}, \tag{7}$$

and the wholesale price at the traditional reseller is

$$w^{*C1}(r) = -\frac{r(2a(1+r)\theta + 4 + (-1+r)\theta^2)}{\theta^2 + r^2\theta^2 + r(-8 + 6\theta^2)}. \tag{8}$$

The profits for the manufacturer, platform retailer, and the sum of these two in dual channel C1 are derived in Appendix A as $\pi_M^{*C1}(r)$, $\pi_1^{*C1}(r)$, and $\pi_T^{*C1}(r)$, respectively. The retailer solves the Stage 1 problem by choosing the r that maximizes $\pi_1^{*C1}(r)$. The conditions to justify the participation of all three members are $p_1^{*C1}(r) \geq 0$, $D_1^{*C1}(r) \geq 0$, $D_2^{*C1}(r) \geq 0$, and $p_2^{*C1}(r) \geq w^{*C1}(r) \geq 0$, which ensure that the sales in both channels are non-negative and that each unit sold earns a non-negative return. These non-negativity conditions automatically guarantee the feasibility of *PC*1 as stated in the following lemma.

LEMMA 1. *If* $r \geq r_1$ *where* $r_1 = \frac{a\theta^2 + \theta}{(4 - 3\theta^2)a + (3 - 2\theta^2)\theta}$ *, the manufacturer will choose the dual channel C*1.

Lemma 1 shows that the manufacturer's share of revenue, r, cannot be set too low. If it is too low, that is, below r_1, the manufacturer will only employ the traditional reseller and not participate in the revenue-sharing contract with the platform retailer.

LEMMA 2. *For dual channel C1, it holds that* (*i*) *the manufacturer's profit increases in r;* (*ii*) *the total profit of the manufacturer and the platform retailer is increasing in r;* (*iii*) *the platform retailer's profit is concave in r;* (*iv*) *the sales price at the platform retailer always decreases in r, and the traditional reseller's sales price and wholesale price both increase in r when it is close to one.*

Higher values of r incentivize the manufacturer to shift the traditional reseller's demand to the platform channel, because the manufacturer only earns the wholesale price from the traditional reseller's channel. As such, the sales price at the platform retailer is a decreasing function of r while at high values of r the wholesale price and traditional reseller's sales price are increasing. In the extreme case where $r = 1$ the platform retailer is only earning the slotting fee and the manufacturer keeps all the sales revenue from the platform channel. The manufacturer's profit and the joint profit of the manufacturer and the platform retailer both increase in r but, as the platform retailer dictates the revenue-sharing rate, the concavity of the platform retailer's profit function makes it unlikely to be the extreme value of one.

4.1.2. Sole Channel of the Platform Retailer: C2. In channel structure C2, the manufacturer contracts with the platform retailer as its only distribution channel. The platform retailer sets revenue-sharing rate r while the slotting fee F is exogenous. Since the traditional reseller is not employed by the manufacturer, we first derive the demand funtion for the platform retailer. Following Abhishek et al. (2016), see the footnote on page 2265, this is achieved by setting $D_2(p_1, p_2) = 0$ which gives $p_2 = 1 + \theta p_1$. Substituting this result in Equation (1) yields the demand function $D_1(p_1) = a + \theta - (1 - \theta^2)p_1$. Note that the platform retailer's baseline demand increases while consumers' price sensitivity decreases.

With this updated demand function, we derive the sales quantity and price as $q_1^{*C2} = \frac{a+\theta}{2}$ and $p_1^{*C2} = \frac{a+\theta}{2(1-\theta^2)}$, which both increase with a or θ increasing. The profits of the platform retailer and manufacturer are:

$$\pi_1^{*C2}(r) = \frac{(1-r)(a+\theta)^2}{4(1-\theta^2)} + F \tag{9}$$

$$\pi_M^{*C2}(r) = \frac{r(a+\theta)^2}{4(1-\theta^2)} - F. \qquad (10)$$

4.1.3. Sole Channel of the Traditional Reseller: C3. In channel structure C3, the manufacturer only distributes through the traditional reseller via a wholesale contract. The demand function for the traditional reseller is $D_2(p_2) = 1 + \theta a - (1-\theta^2)p_2$ and its profit is expressed as $\pi_2^{C3}(p_2) = (p_2 - w) D_2(p_2) = (p_2 - w)(1 + \theta a - (1-\theta^2)p_2)$, resulting in the price of $p_2 = \frac{w}{2} + \frac{1+a\theta}{2(1-\theta^2)}$. The sales quantity and price are $q_2^{*C3} = \frac{1+a\theta}{4}$ and $p_2^{*C3} = \frac{3(1+a\theta)}{4(1-\theta^2)}$, which both increase with a or θ increasing. The profits of the traditional reseller and manufacturer are then expressed as:

$$\pi_2^{*C3} = \frac{(1+a\theta)^2}{16(1-\theta^2)} \qquad (11)$$

$$\pi_M^{*C3} = \frac{(1+a\theta)^2}{8(1-\theta^2)}. \qquad (12)$$

4.2. Manufacturer's Channel Selection

Having characterized the profits associated with each channel structure, we can now investigate the manufacturer's choice of channel structure given the platform retailer's decision on the revenue sharing rate r. The feasible region for dual channel C1 is $r_1 \leq r \leq 1$ and for only the platform retailer C2 is $0 \leq r \leq 1$. Because of the overlapping feasible regions, we compare C1 with C2 and yield the following:

LEMMA 3. *Given r and F,*

(1) *If $r_1 \leq r \leq 1$, there is a r-dependent threshold for F, above which the manufacturer chooses the sole channel of the traditional reseller C3, and otherwise the manufacturer chooses dual channel C1.*
(2) *If $0 \leq r < r_1$, then the manufacturer will not choose dual channel. In this case, if $r_1 \leq \frac{(1+a\theta)^2}{2(a+\theta)^2}$, then the manufacturer chooses the traditional reseller C3; otherwise, there is a r-dependent threshold for F dictating the choice between the two sole channels of C2 and C3.*

Lemma 3 narrows down the solution of dual channel to the region of $r_1 \leq r \leq 1$ and of platform-retailer only to the region of $0 \leq r < r_1$. Through this feasible space reduction, we can analyze C1 and C2 in two independent regions of r respectively. The next subsection will analyze the platform retailer's decision given the manufacturer's optimal response to the terms of the contract.

4.3. Contracting and Channel Equilibrium

The platform retailer decides the revenue-sharing rate to maximize its profit while taking as a constraint the reservation profits of itself and the manufacturer. The reservation profits refer to what the manufacturer and platform retailer can each earn if they fail to form a channel together. If the manufacturer does not choose to distribute through the platform retailer then the manufacturer can only distribute through the traditional reseller, thereby earning a profit of π_M^{*C3}. We assume the platform retailer's reservation profit to accept a manufacturer is the slotting fee, F. Since the platform retailer will make at least F from any accepted manufacturer, we can ignore the reservation profit condition for the platform retailer hereafter.

To determine the platform retailer's optimal revenue-sharing rate, r, and the equilibrium channel structure, we first define two threshold values for the slotting fee:

$$F_1 = \frac{a^2(2-\theta^2) + 2a\theta + \theta^2}{8(1-\theta^2)} \qquad (13)$$

$$F_2 = \frac{a^3\theta^2(-2+3\theta^2) + \theta(-3+4\theta^2) + a^2\theta(-6+7\theta^2+2\theta^4) + a(-4+\theta^2+6\theta^4)}{8(1-\theta^2)(4a+3\theta-3a\theta^2-2\theta^3)}. \qquad (14)$$

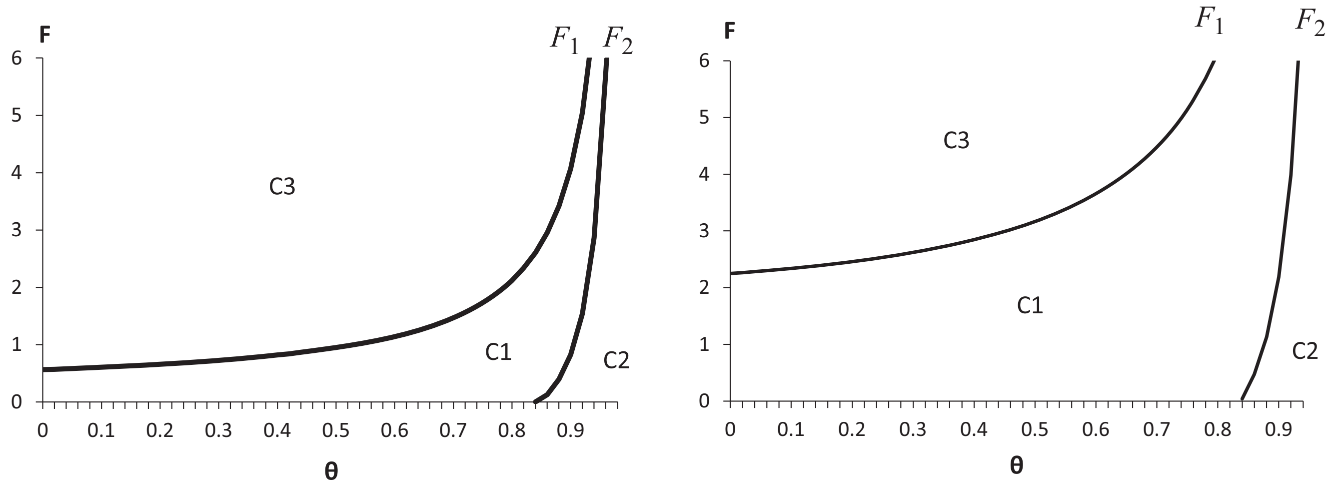
F_1 and F_2 are both functions of a and θ. It is shown in Appendix F that: (i) $F_1 > F_2$ for any θ; (ii) F_1 is increasing and positive in $\theta \in [0, 1)$; F_2 is also increasing in θ, but it is positive when $\theta \in [\theta_0, 1)$ and negative in $\theta \in [0, \theta_0)$ where $\theta_0 \in (\sqrt{2/3}, \sqrt{3/4})$ is the unique θ that makes $F_2 = 0$; (iii) F_1 increases in a for any θ; F_2 increases in a for $\theta > \sqrt{3/4}$ but it is not simply monotonic in a for $\theta \in (\theta_0, \sqrt{3/4})$ which is a very small region.

The channel equilibrium is characterized in the following proposition.

PROPOSITION 1. *When $F > F_1$ the manufacturer only chooses the traditional reseller C3. When $F \leq F_1$, (i) if $\theta < \theta_0$, or if $\theta \geq \theta_0$ and $F > F_2$, then the manufacturer chooses dual channel C1; (ii) if $\theta \geq \theta_0$ and $F \leq F_2$, then the manufacturer chooses only the platform retailer C2.*

Proposition 1 provides the general conditions for the equilibrium channel structure. There are four cases in total. If the slotting fee is excessively high, that is, $F > F_1$, then the added market potential of the platform retailer does not exceed the manufacturer's cost to participate in the retail platform. As such, the

Figure 2 Equilibrium Channel Selection in F and θ



(a) $a = 1.5$ **(b)** $a = 3.0$

manufacturer only chooses the traditional reseller channel. If the slotting fee is not excessive, that is, $F \leq F_1$, then characterizing the optimal channel structure is more nuanced. If there is little demand substitution, that is, $\theta < \theta_0$, then both channels are required for the manufacturer to maximize its profits. In the presence of high demand substitution, that is $\theta \geq \theta_0$, the slotting fee again matters. If the slotting fee is less than F_1 but still sufficiently high, that is $F > F_2$, the manufacturer will have to set the price in the retail platform high enough that maintaining the traditional reseller channel is optimal. If however the slotting fee is low enough, that is, $F \leq F_2$, the manufacturer exploits the demand substitution effect and only sells through the retail platform, thereby foregoing the traditional reseller.

To illustrate Proposition 1, we partition the $F - \theta$ space by equilibrium channel for a = 1.5 in Figure 2a and for a = 3.0 in Figure 2b. Since the original demand model of Equations (1) and (2) is not well defined at $\theta = 1$, we restrict θ to a range between 0 and 0.95 in our numerical analyses. Comparing Figure 2a to Figure 2b demonstrates that the platform retailer can charge a higher slotting fee when the potential market is larger. We partition the $F - a$ space by the equilibrium channel for θ = 0.8 in Figure 3a and θ = 0.9 in Figure 3b. It is known from Proposition 1 that the manufacturer employs only the platform retailer (C2) when θ is high and F is low. Even for θ = 0.8 Figure 3a shows only C1 and C3 are equilibrium outcomes. The feasible regions for C2 in Figures 2a, 2b, and 3b indicate that an equilibrium channel comprising only the platform retailer (i.e., C2) requires relatively extreme model inputs.

4.4. Properties of the Market Outcomes

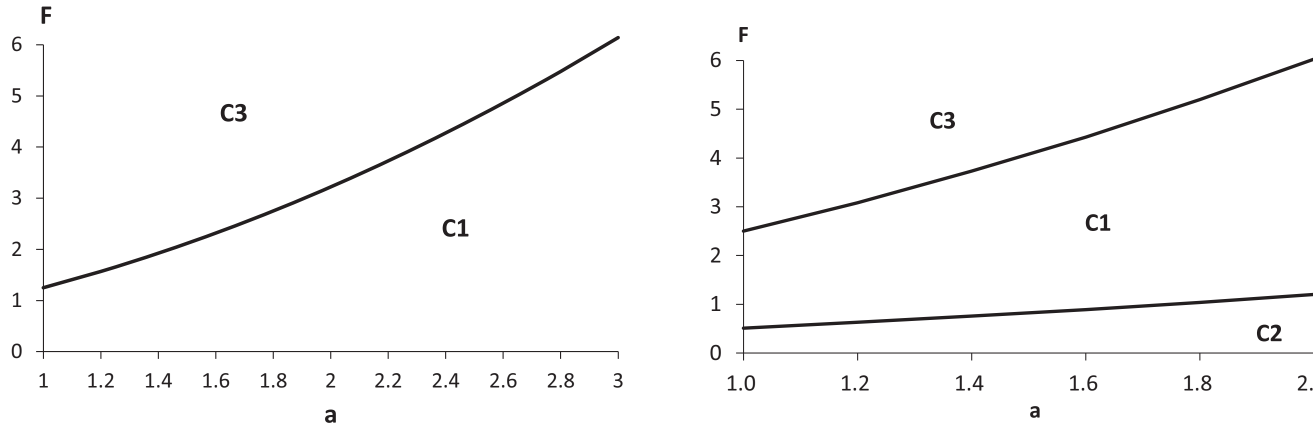
The equilibrium channel depends on the relation of F, a, and θ. a and θ are intrinsically given by the market conditions and F is determined by the platform retailer. Proposition 1 establishes the threshold values of F, as functions of a and θ, that dictate the equilibrium channel structure. Figures 2 and 3 illustrate how the equilibrium channel partitions the space between F and either a or θ. These results also facilitate identifying threshold values of a or θ that dictate the equilibrium channel when one of them and F are both fixed, which can be determined from the expressions of F_1 and F_2.

Even though the manufacturer is a Stackelberg follower, Proposition 1 shows that the manufacturer's channel selection decision is independent of the platform retailer's decision on the revenue-sharing rate. In anticipating the manufacturer's channel selection decision, the platform retailer needs to find the revenue-sharing rate that maximizes its profit while preserving the manufacturer's reservation profit. If F is too high for a specific pair of a and θ, the manufacturer will choose only the traditional reseller channel. If the manufacturer employs the platform retailer, the revenue-sharing rate has the following properties:

PROPOSITION 2. (*i*) *If dual channel C1 is selected, then the optimal revenue-sharing rate* r^* *satisfies* $\frac{\partial r^*}{\partial F} \geq 0$. *However,* r^* *might be non-monotonic in* a *and* θ. (*ii*) *If sole channel of the platform retailer C2 is selected, the optimal revenue-sharing rate is* r_2, *satisfying* $\frac{\partial r_2}{\partial a} < 0, \frac{\partial r_2}{\partial F} > 0$, *and,* $\frac{\partial r_2}{\partial \theta} \geq 0$ *if* $F \leq (a^2 - 1)/8$ *and* $\frac{\partial r_2}{\partial \theta} < 0$ *otherwise.*

Under dual channel C1, finding the optimal r is not straightforward. The constraint for the

Figure 3 Equilibrium Channel Selection in *F* and *a*



(a) $\theta = 0.8$ **(b)** $\theta = 0.9$

manufacturer's reservation profit may or may not be binding, resulting in an optimal r that may be at a boundary of this constraint or at a value maximizing the platform retailer's profit, which is detailed in Appendix G. In Figure 4a,b, we depict the optimal revenue-sharing rate for two different values of F, namely, $F = 0.5$ and 1.5. It is seen the optimal r is nonmonotonic in θ if C1 is the channel choice.

We are also interested in the market output as a result of the channel equilibrium. We therefore try to explore the relationships of the sales prices and quantities for the two retailers in the three possible channels. It is clear that under the sole channel structures (C2, C3) all these variables are explicitly derived. However, in the dual channel these variables are ultimately functions of r which has to be solved numerically. We are able to show analytically:

PROPOSITION 3.

(1) $p_1^{*C1}(r^*) > p_1^{*C2}$; $D_1^{*C1}(r^*) < q_1^{*C2}$;

(2) $p_2^{*C1}(r^*) < p_2^{*C3}$;

(3) $q_1^{*C2} > q_2^{*C3}$; $p_1^{*C2} \le p_2^{*C3}$ *if* $\frac{1+a\theta}{a+\theta} \ge \frac{2}{3}$ *and* $p_1^{*C2} > p_2^{*C3}$ *otherwise.*

From part (i) of Proposition 3, the manufacturer sells less at the platform retailer in dual channel C1 than platform-only channel C2 because the presence of the traditional reseller incentivizes the manufacturer to sell lower volume at higher prices in the platform channel. In C2, the manufacturer lowers the sales price in order to attract consumers from the traditional reseller's channel to the platform. Part (ii) reflects the traditional reseller's role as the least powerful party in this three-company network. As the last company to make its pricing decision in the three-party system in C1, its price is lower than in the channel where it is the only seller. In part (iii), we also compare the output of the two sole channels. We observe that the sales quantity is greater in C2 than in C3 due to the larger consumer base in the retail platform; however, the relation of the sales prices at these two outlets is a more complex function of the platform retailer's potential market size and the demand substitution effect.

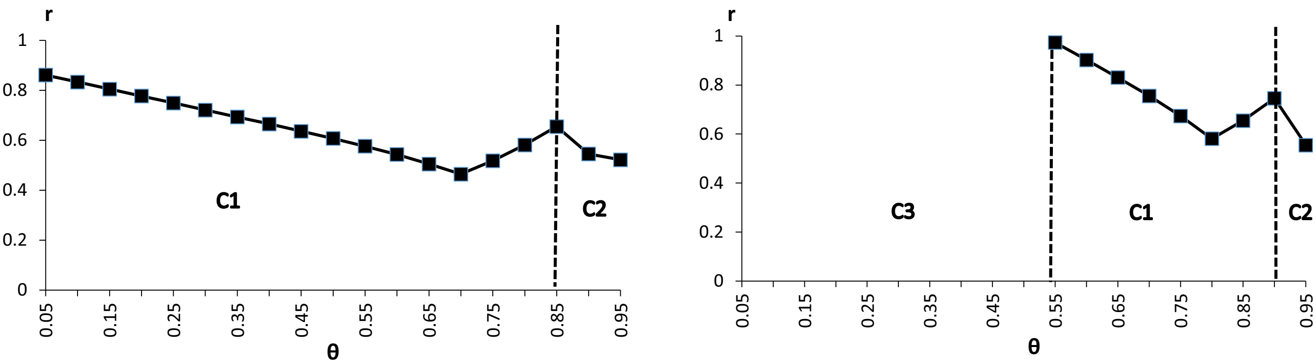
5. Model Extensions and Role of Slotting Fee

Our three-party supply chain admittedly abstracts the motivating case, focusing on the relationship between a platform retailer and a manufacturer that can also sell to a traditional reseller. In practice, the retail platform houses dozens to hundreds of manufacturers and the platform retailer charges an identical slotting fee to all manufacturers under similar conditions (Linkshop 2007). Setting a uniform slotting fee reduces the burden of the platform retailer to individually negotiate this fee with each manufacturer. However, a fixed slotting fee also reduces the platform retailer's options, so we will study the situation with an endogenous slotting fee.

In addition, while most manufacturers have weak bargaining positions relative to the retail platform, there are some noteworthy exceptions. As documented in Abrami et al. (2008), Haier sold about 20% of its products through Gome, and 10% of the sales at Gome were Haier-branded. As they needed each other, Gome and Haier were relatively equal in negotiating contract terms. Therefore, it can be instructive to extend the Stackelberg setting from our earlier sections to a Nash-bargaining setting.

Finally, we further investigate the slotting fee's impact on the performance of the retail platform and the manufacturer through some numerical studies.

Figure 4 Revenue-Sharing Rate vs. θ, a = 1.5 [Color figure can be viewed at wileyonlinelibrary.com]



(a) $F = 0.5$ **(b)** $F = 1.5$

5.1. Model Extensions

5.1.1. Endogenizing the Slotting Fee *F*. When the slotting fee is endogenous, the platform retailer decides the optimal revenue-sharing rate and slotting fee to maximize its profit subject to the constraint imposed by the manufacturer's reservation profit. We can show the following result.

PROPOSITION 4. *If the platform retailer jointly decides the slotting fee and revenue-sharing rate then the manufacturer will choose the dual channel C1 and earn the reservation profit of the traditional reseller-only channel C3. The platform retailer sets r = 1 and the slotting fee F as its maximum channel profit net the manufacturer's reservation profit.*

From Lemma 2, the joint profit of the platform retailer and manufacturer increases in r, and so it is maximized at $r = 1$. Proposition 4 states that the platform retailer first maximizes the channel profit by setting $r = 1$ and then extracts this profit by leaving the manufacturer with its reservation profit. It also implies that the platform retailer can make more profit with an endogenous slotting fee than with an exogenous slotting fee, whereas the manufacturer does no better in the case of an endogenous slotting fee than in the case of an exogenous slotting fee.

5.1.2. Bargaining over *r*. Our earlier analyses assume the platform retailer is a Stackelberg leader where the platform retailer and the manufacturer both impose a reservation profit level. A more general setting is to assume that the revenue-sharing rate r is negotiated through a generalized Nash-bargaining (GNB) mechanism (Draganska et al. 2010), where the manufacturer holds bargaining power α and the platform retailer holds $1 - \alpha$. In the dual channel C1, we solve the following GNB problem:

$$\text{Max}_r(\pi_M^{*C1}(r) - \pi_M^{*C3})^{\alpha}(\pi_1^{*C1}(r) - F)^{1-\alpha}$$

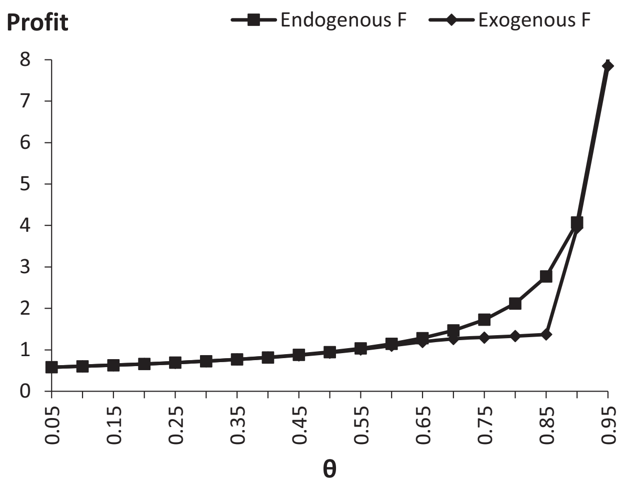
where the reservation profits of the manufacturer and platform retailer, π_M^{*C3} and F, are called their bargaining positions in a GNB setting.

Having introduced the notions of $\pi_M^{*C1}(r) = \Pi_M^{*C1}(r) - F$, $\pi_1^{*C1}(r) = \Pi_1^{*C1}(r) + F$ in the proof of Lemma 3 in Appendix E, it is clear that $r = 1$ is not the optimal solution for the above generalized Nash-bargaining problem as $\Pi_1^{*C1}(r = 1) = 0$. In other words, the optimal solution to the above problem will not maximize the joint profit of the manufacturer and the platform retailer. This bargaining setting can explore the effect of the relative bargaining power between the platform retailer and the manufacturer, for which the Stackelberg setting is a special case ($\alpha = 0$). To do this, we have to resort to numerical studies to further analyze bargaining over r, which is straightforward but not included in this study.

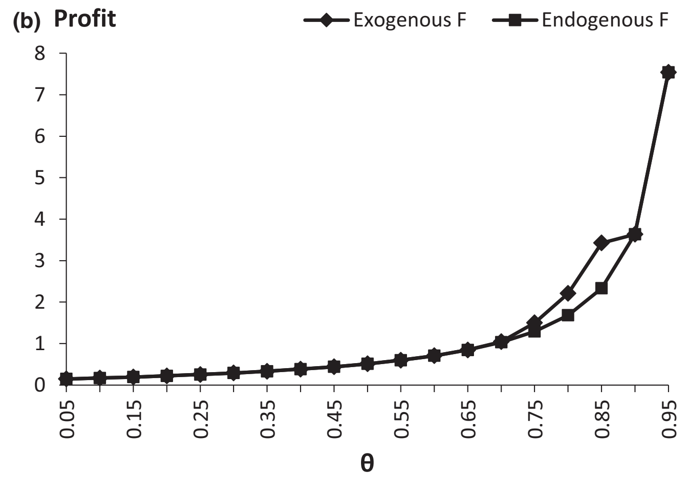
Likewise, we can set up a bargaining setting for r if the manufacturer only chooses the platform retailer's channel C2. The solution is easy to obtain but, as in the case for the dual channel, the channel profits are not maximized.

5.1.3. Bargaining over *r* and *F*. If the slotting fee is exogenous, then the manufacturer and the platform retailer cannot fully extract their channel profit in the Stackelberg setting or the Nash-bargaining setting unless the slotting fee is set as in the endogenous case. The channel with an endogenous slotting fee in the Stackelberg setting can maximize the joint profit of the manufacturer and platform retailer as stated in Proposition 4, but it is a worse outcome for the manufacturer. An intriguing question asks if a contracting mechanism exists to increase the profits of both the manufacturer and the platform retailer relative to their profits in Section 4's Stackelberg setting. We find it is possible in the generalized Nash-bargaining

Figure 5 Profit vs. θ, F = 0.5, a = 1.5



(a) Platform retailer



(b) Manufacturer

(GNB) setting when both slotting fee and revenue-sharing rate are negotiable. The resulting model extends the setting in section 5.1.1 to the GNB setting. Namely, we solve:

$$\mathrm{Max}_{r,F}(\Pi_M^{*C1}(r) - F - \pi_M^{*C3})^{\alpha}(\Pi_1^{*C1}(r) + F)^{1-\alpha}$$

The reservation profits for the manufacturer and the retail platform are π_M^{*C3} and zero respectively. To distinguish from the earlier notations, we use $\bar{r}^*$ and $\bar{F}^*$ to denote the optimal solutions to the above GNB problem, and state the following.

PROPOSITION 5. (*i*) *The optimal solution to the above GNB problem under dual channel C1 are:* $\bar{r}^* = \pm 1, \bar{F}^* = (1-\alpha)F_1$. (*ii*) *Consider the optimal revenue-sharing rate to the Stackelberg setting in C1 as* r^*. *It is found that when* $\alpha_1 \le \alpha \le \alpha_2$ *where* $\alpha_1 = \frac{\Pi_M^{*C1}(r^*) - F - \pi_M^{*C3}}{F_1}$ *and* $\alpha_2 = 1 - \frac{\Pi_1^{*C1}(r^*) + F}{F_1}$, *both the manufacturer and the platform retailer can earn higher profits when bargaining over* (*r*, *F*) *versus the Stackelberg setting where only r is decided by the platform retailer.*

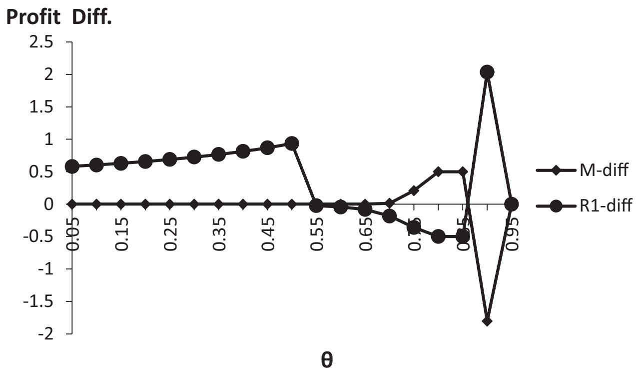
The underlying reason for the result in Proposition 5 is that, under the GNB mechanism, the channel profit can be fully extracted and then shared between the platform retailer and the manufacturer. In contrast, in the Stackleberg setting with an exogenous slotting fee, the channel profit usually could not be fully extracted. Propositions 4 and 5 are consistent in that a manufacturer with little (or zero) bargaining power against the platform retailer would rather not pay an individually negotiated slotting fee. In contrast, a manufacturer with strong bargaining power may benefit from individually negotiating its contract terms with the platform retailer.

5.2. The Effect of an Exogenous Slotting Fee

We conduct a numerical analysis to illustrate the impact exogenous and endogenous slotting fees have on the individual and joint profit functions of the manufacturer and platform retailer. With a = 1.5, Figure 5a,b present the profits for the platform retailer and manufacturer when the slotting fee is exogenous and endogenous. With F = 0.5, the exogenous slotting fee is low so the equilibrium channel is always either dual channel C1 or sole channel of platform retailer only C2, dependent on θ. When θ is either small or large, the exogenous slotting fee and the endogenous slotting fee generate the same profits for both the manufacturer and the platform retailer. However, the results change when θ is in the intermediate range of $\theta \in (0.65, 0.9)$; in this region, the manufacturer earns more under an exogenous slotting fee whereas the platform retailer earns more under an endogenous slotting fee. As expected, the joint profit of the manufacturer and platform retailer with an endogenous slotting fee is always no less than the joint profit for an exogenous slotting fee for any $\theta \in [0, 1)$.

Figure 6 compares the profit differences for the manufacturer and platform retailer in the cases of a low and a high exogenous slotting fee as a function of θ. We let M-diff denote the manufacturer's profit for the equilibrium channel with low slotting fee minus its profit for the equilibrium channel with high slotting fee. The equivalent calculation for the platform retailer is denoted R1-diff. Figure 6 presents two scenarios for the slotting fee that verify Proposition 1. When the slotting fee is low, that is, F = 0.5, the manufacturer chooses dual channel (C1) unless θ is high

Figure 6 Profit Differences Between the Cases of $F = 0.5$ and $F = 1.5$



enough (> 0.9) to cause the manufacturer to only choose the sole channel of the platform retailer (C2). When the slotting fee is high, that is, $F = 1.5$, the manufacturer chooses: (i) the traditional reseller only (C3) for a low θ (<0.5), (ii) dual channel (C1) for an intermediate θ ($\in$ (0.55, 0.9)); (iii) sole channel with the platform retailer only (C2) for an exceedingly high θ ($\sim$ 0.95).

When θ is low (<0.5), the platform retailer benefits from a low slotting fee while the slotting fee makes no difference to the manufacturer. The reason is that by requesting a low slotting fee the platform retailer is still able to share revenue from the manufacturer while the manufacturer only earns its reservation profit. If the slotting fee is high ($F = 1.5$) the channel between the manufacturer and the platform retailer breaks down, leaving the manufacturer with the reservation profit and the platform retailer with zero profit. When θ becomes larger ($\in$ (0.55, 0.85)), a high slotting fee maintains the dual channel (C1) from Proposition 1. However, a high slotting fee ($F = 1.5$) is more likely to make the manufacturer's reservation profit binding versus the low slotting fee ($F = 0.5$). Therefore, a high slotting fee benefits the platform retailer while hurting the manufacturer. When θ is exceedingly high ($\sim$ 0.95), the manufacturer chooses sole channel of the platform retailer for both of the slotting fees; in this case, the manufacturer and platform retailer both make the same profits for $F = 0.5$ or $F = 1.5$ as proved in Lemma 6 in Appendix. An interesting case in Figure 6 is that when $\theta = 0.9$, the manufacturer is more profitable when $F = 1.5$ than when $F = 0.5$ while the platform retailer experiences the opposite result. The reason for such a case is that when $F = 0.5$ the channel choice is C2 and it is C1 when $F = 1.5$; however, the manufacturer makes only the reservation profit in C2 with $F = 0.5$ but more in C1 with $F = 1.5$. The platform retailer, even if losing the sales from the traditional reseller, still makes more in C2 with $F = 0.5$ than in C1 with $F = 1.5$ by attracting customers from the traditional reseller to the retail platform.

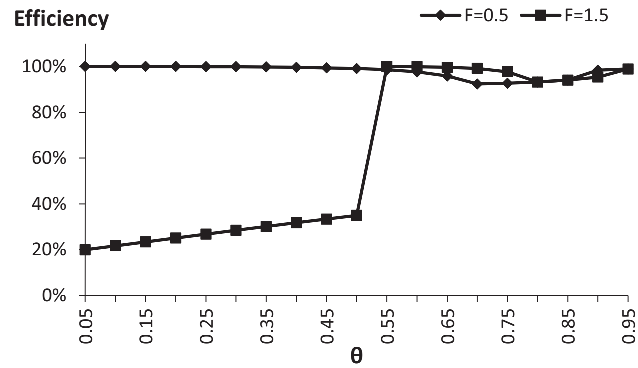
To further explore the effect of slotting fee, we define channel efficiency as the ratio between the joint profit of the platform retailer and the manufacturer with an exogenous F and the joint profit in the channel with an endogenous slotting fee. Figure 7 presents the channel efficiency for $F = 0.5$ and $F = 1.5$ as a function of θ. From this figure, it is seen that for any θ, the appropriate revenue sharing rate can compensate for a low slotting fee to produce high channel efficiency. In contrast, a high slotting fee may break up the channel between the manufacturer and the platform retailer for small θ, but it does benefit the channel, relative to the lower slotting fee, for sufficiently large θ.

Slotting fees are controversial in the retail industry. They are often claimed to be unfair to manufacturers. In this study, we find that the slotting fee is neither always beneficial to the retail platform nor always detrimental to the manufacturer. Different values of demand substitution make the slotting fee help and harm both the platform retailer and manufacturer; in fact, Figure 6 has shown four different scenarios in this regard.

6. Conclusion and Discussion

In a supply chain consisting of a platform retailer, a traditional reseller, and a manufacturer, we have studied the manufacturer's channel selection between a platform retailer and a traditional reseller as a function of the platform retailer's decision on its revenue-sharing rate and slotting fee. To understand the equilibrium channel between the platform retailer and the manufacturer, we formulate a three-stage Stackelberg game with the platform retailer being the leader and analyze three possible channel options. We derive the equilibrium channel structure and the threshold conditions for the channel to exist, as well as each party's associated sales, prices, and profits. If

Figure 7 Channel Efficiencies in the Cases of $F = 0.5$ and $F = 1.5$



the slotting fee is endogenously decided by the platform retailer, the manufacturer will choose both retailers but the manufacturer only earns its reservation profit. It is seen that the platform retailer and manufacturer have opposing preferences for exogenous versus endogenous slotting fees. We also extend the model to consider the cases that the manufacturer and platform retailer can bargain over the revenue-sharing rate and slotting fee. In this generalized Nash bargaining setting, we find that a win-win solution for the platform and the manufacturer is possible. Moreover, the manufacturer can prefer a high slotting fee to a lower one under some specific values of demand substitution.

The following model enhancements would relax assumptions in our model and are good candidates for future research.

(1) Format of the traditional reseller

The traditional reseller is assumed to be independent from the manufacturer. There are cases in which the manufacturer may integrate with the traditional reseller at a high fixed cost. Since the focus of this study is on the relation between the manufacturer and the platform retailer, we only study the situation in which the traditional reseller is independent.

(2) Format of the platform retailer

Zhang (2009) questions who wins between the reselling model of Best Buy and the platform retailing model of Gome and Suning. Although we do not attempt to explain the retreat of Best Buy from the Chinese market, our study supports the channel structure seen in Gome and Suning. Nevertheless, it is worthwhile to study a model where the platform retailer can act as a reseller and the manufacturer can respond with more channel selection options.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix A: Profit Functions in Channel C1.
Appendix B: Proof of Lemma 1.
Appendix C: An Alternative Time Sequence of Channel C1.
Appendix D: Proof of Lemma 2.
Appendix E: Proof of Lemma 3.
Appendix F: Properties of F_1 and F_2.
Appendix G: Proof of Proposition 1.
Appendix H: Proof of Proposition 2.
Appendix I: Proof of Proposition 3.
Appendix J: Proof of Proposition 4.
Appendix K: Proof of Proposition 5.