Discussion Paper No. 1020

SUPPLIER ENCHROACHMENT AND CONSUMER WELFARE: UPSTREAM FIRM'S OPPORTUNISM AND MULTICHANNEL DISTRIBUTION

Cong Pan

February 2018

The Institute of Social and Economic Research
Osaka University
6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

Supplier Encroachment and Consumer Welfare: Upstream Firm's Opportunism and Multichannel Distribution*

Cong Pan†
Faculty of Economics, Nagoya University of Commerce & Business

February 14, 2018

Abstract

I revisit supplier encroachment under the framework of a two-part tariff contract. When a monopoly manufacturer supplies competing retailers and each retailer's contracting process is unobservable to the rival, the retailer's lack of knowledge vis-à-vis its rival's contract may undermine the manufacturer's commitment power, which prevents the manufacturer from achieving optimal profit. I demonstrate that when the manufacturer directly supplies the resale market, it can use the direct channel as a commitment tool and thus restore its market power. Even though the manufacturer's encroachment creates more competitors in the resale market, the resultant higher wholesale prices aggravate double marginalization, which may reduce consumer welfare. This result holds even when the manufacturer is very efficient in direct selling.

Keywords: channels of distribution; encroachment; two-part tariff contract; supplier opportunism; consumer welfare

JEL Classification Numbers: L14, L22, M11

*I would like to express my sincere thanks to Noriaki Matsushima for his constructive suggestions on this paper. Besides, I really thank Hiroshi Kitamura, Toshihiro Matsumura, Tomomichi Mizuno and Shohei Yoshida, the conference participants at Asia-pacific Industrial Organisation Conference 2017, the 44th Annual Conference of EARIE 2017 and 2017 Spring Meeting of Japanese Economic Association, the seminar participants at Centre d'économie de la Sorbonne-Cachan, ENS Université paris Saclay and Osaka University for their kind encouragement and suggestions. The author acknowledges the financial support from the Japan Society for the promotion of Science (Pan, 15J05223) and Nagoya University of Commerce & Business. Needless to say, all errors are mine.

†Address: Nagoya University of Commerce & Business, 4-4 Sagamine Komenoki-cho Nisshin-shi, Aichi, 470-0193, Japan. Tel: (81)-561-73-2111. E-mail: cong_pan@nucba.ac.jp.

1 Introduction

Direct distribution by upstream suppliers is very commonplace in vertically related industries.[1] Over decades, incumbent retailers (or franchisees) in traditional indirect channels have been complaining about the competitive pressure caused by upstream manufacturers' (or franchisers') downward entry, known as "supplier encroachment," and making lobbying efforts in convincing governments that their territory should be legally protected (Kalnins, 2004). On the other hand, the conventional wisdom that any policy against manufacturers' downward entry is anti-competitive and harmful to consumers' benefits (Dutta et al., 1999; Blair and Lafontaine, 2005) has put governments in an unusual position when deciding how encroachment should be regulated.

Surprisingly, despite of the extensive attention from pioneering theoretical studies on manufacturers' encroaching activities (e.g., Arya et al., 2007), the welfare magnitude of this important and controversial economic phenomenon has not been rigorously discussed. The focus on supply chain profit makes a linear contract more suitable for modeling supplier encroachment than a two-part tariff contract. One technical reason is that under a two-part tariff contract (contract terms comprise a wholesale price and a fixed fee) the manufacturer can always achieve full downstream surplus through the fixed fee and would thus have no incentive to encroach.[2] Actually, under a linear contract, the welfare effect of encroachment becomes quite straightforward as well known by the conventional wisdom. Specifically, the encroachment promotes competition and alleviates double marginalization, and thus must

[1] In the background of franchising contracts, over several decades, franchisors in traditional industries (e.g., auto services, business aids, hotels and motels, and laundries and dry cleaners) have operated some stores directly, while franchising others to third parties (Lafontaine, 1992). Also in manufacturing, the proliferation of e-commerce enables upstream manufacturers (e.g., Nike, Adidas, Apple, and Samsung) to open online channels to drop-ship directly to consumers (Randall et al., 2006), while maintaining traditional brick-and-mortar wholesale channels.

[2] Notice that for analytical simplicity, the main trend of theoretical studies on this topic has focused on the case wherein the upstream manufacturer has full bargaining power. The arguments in this paper are also restricted to this case. If instead, the upstream manufacture does not have full bargaining power, analyses under a two-part tariff contract would also be feasible. See concluding remarks for the author's future work about supplier encroachment and Nash bargaining under a two-part tariff contract.

increase consumer welfare.

However, the empirical literature shows a contrasting reality to the existing theoretical models that in industries wherein supplier encroachment occurs, the two-part tariff contract is far more customary than the linear contract (Lafontaine, 1992; Kalnins, 2004).[3] More surprisingly, recent empirical study on food market shows a quite counterintuitive result: local farmers' direct selling leads to lower total sale, implying that encroachment may have a negative effect on consumer welfare (Park, 2015). The above contrasting results demonstrated respectively by empirical and theoretical studies confirm the importance of reexamining the existing theoretical models and studying how encroachment affects consumer welfare.

Motivated by the above, I develop a two-part tariff framework to study the welfare effect on consumers caused by encroachment, using a model wherein a monopoly manufacturer sells through competing retailers. I show that under quantity competition and when each retailer's contracting process is unobservable to the rival throughout the game (interim unobservability), the manufacturer's encroachment always reduces consumer welfare, even when the manufacturer is very efficient in direct selling. This result holds even when the contracting process is unobservable but the contracting results can be observed before quantity competition (interim observability). The same result also holds under price competition with interim unobservability.

The above result is somewhat counterintuitive in that increasing the number of resale competitors (with the manufacturer's downward entry) may trigger an anticompetitive effect. The intuition is as follows. Under secret contracting, when there is no encroachment, each retailer only accepts a wholesale price as low as the manufacturer's production cost. Otherwise, the retailer would be hurt by the manufacturer who always secretly offers a lower wholesale price to the other retailer. Because of a lack of commitment, the manufacturer

[3]Lafontaine (1992) uses data from 548 franchisors to suggest that manufacturers' multichannel marketing exists in most industries (e.g., auto services, business aids, education services, and hotels and motels) and that over 90% (504 out of 548) of observations employed two-part tariff contracts. In Kalnins (2004), the adoption rate of the two-part tariff contract is 88% (7 out of 8).

has to supply the retailers at equal-to-margin wholesale prices, and thus fails to achieve an optimal profit. On the other hand, when the manufacturer has committed to encroach, its incentive to raise wholesale prices so as to shift more share to its direct channel is well understood by each retailer. In other words, the manufacturer can use the encroachment as a commitment tool to charge above-margin wholesale prices, which solves its commitment problem. The higher wholesale prices amplify double marginalization, thus curtailing consumers welfare.

My main logic that the invalidation of a two-part tariff contract may trigger a manufacturer's encroaching incentive is consistent with some empirical studies. For example, Kaufmann and Lafontaine (1994) use the case of McDonald's to show that a monopolist with a two-part tariff contract may enhance its profit by opening direct outlets. Michael and Moore (1994) support this conclusion and provide more generalized results among a wider set of franchise systems. Moreover, my findings concerning consumer welfare have significant policy implications vis-à-vis the debate over anti-encroachment legislation. Since the early 1990s, managers and legislators have sought to protect incumbent retailers' territories against manufacturers' (franchisors') direct sales (e.g., Hadfield, 1990; Blair and Lafontaine 2005; Espinoza, 2008). However, their efforts have been considered anticompetitive and thus harmful to consumers' benefits (Dutta et al., 1999; Blair and Lafontaine, 2005). Some who protest anti-encroachment legislation argue that encroachment may even benefit incumbent retailers, inducing pareto improvements (Kaufmann and Rangan, 1990; Kalnins, 2004). My study, on the contrary, demonstrates that supplier encroachment may be anticompetitive under some market circumstances and provides support for anti-encroachment legislation.

As noted, studies concerning supplier encroachment generally employ linear contract frameworks. For example, Chiang et al. (2003) discuss a price-setting game and show that a manufacturer uses the direct channel to threaten retailers into reducing their prices, although no direct sales actually occur. Arya et al. (2007) consider a quantity-setting game and show

that supplier encroachment triggers the manufacturer's incentive to reduce the wholesale price and may thus benefit the incumbent retailer. Tsay and Agrawal (2004) consider the case wherein both manufacturer and retailer invest in sales promotions. Cattani et al. (2006) discuss whether a manufacturer would promise an incumbent retailer to maintain a consistent wholesale or retail price after it encroaches. In sum, under a linear contract framework, these studies reveal that supplier encroachment works as an approach to alleviate double marginalization.My study differs from previous literature at the outset by focusing on how supplier encroachment performs under a two-part tariff contract. From this outset, my analysis offers a different standpoint–encroachment provides the manufacturer with a strategic tool to solve its commitment problem, which aggravates double marginalization.

To the best of my knowledge, Li et al. (2015) is the only study that analyzes supplier encroachment within a framework of nonlinear contracts. It discusses a bilateral monopoly with asymmetric market information in which the retailer knows the true market size whereas the manufacturer knows only the distribution. The manufacturer offers a nonlinear contract comprising a unit wholesale price and a corresponding quantity. The manufacturer faces a trade-off between using a direct channel to reduce information rent and causing distortions in retailer' order quantity. Essentially, in that study, the nonlinear contract always perfectly resolves double marginalization regardless of encroachment. Consumers always benefit from the encroachment because the downstream competition becomes more intense.[4] Since my study does not incorporate asymmetric market information, reducing information rent is not a concern. Then, I can focus on investigating how encroaching upon the resale market helps the manufacturer restore market power and how this affects consumer welfare. Therefore, despite of new results obtained in this research, I add several new insights to the literature.

My study is also related to the literature discussing upstream monopolist's commitment problem. A large theoretical literature shows that when a monopoly manufacturer supplies

[4]Their earlier study (Li et al., 2014) discusses supplier encroachment under asymmetric market information using a framework of linear contract.

competing retailers and secretly offers each a two-part tariff contract, each retailer's lack of knowledge of its rival's contracting results may undermine the manufacturer's commitment power. Specifically, the lack of commitment triggers each retailer to distrust the manufacturer's offer, which prevents the manufacturer from achieving optimal profit via the fixed fee (e.g., Hart and Tirole, 1990; O'Brien and Shaffer, 1992; McAfee and Schwartz, 1994). Solutions that help the manufacturer solve the commitment problem include imposing minimum resale price maintenance (O'Brien and Shaffer, 1992), allowing for nondiscrimination clauses for retailers (Marx and Shaffer, 2004),[5] utilizing upstream capacity constraint (Avenel, 2012), and carrying out vertical integration (Reisinger and Tarantino, 2015).[6] In this study, I demonstrate that an encroachment can also help a manufacturer solve this problem by creating a commitment tool (i.e., a direct channel).

The remainder of the paper is organized as follows. Section 2 introduces quantity competition with retailers' interim unobservability. Section 3 uses a general demand to demonstrate changes in wholesale prices, the manufacturer's profit and consumer welfare after the encroachment. Section 4 uses some examples to derive the manufacturer's encroaching decision in equilibrium and how consumer welfare is affected. Section 5 carries out an extension to analyze differentiated products. Section 6 discusses quantity competition with retailers' interim observability, and price competition with both interim unobservability and observability. Section 7 concludes the paper and discusses the case of the linear wholesale price contract.

[5]Marx and Shaffer (2004) challenge one of McAfee and Schwartz (1994)'s results that nondiscrimination clauses is not able to solve the monopoly supplier's opportunism and thus fails to solve the commitment problem. Marx and Shaffer (2004) show that the commitment can be solved when retailers are allowed to invoke their nondiscrimination clauses.

[6]Also as demonstrated by law literature, more solutions to the manufacturer's commitment problem could include operating through a sole outlet (Hadfield, 1990) and creating exclusive territories for each downstream retailer (Gilo, 1999).

2 Basic Model

Consider a vertically related industry in which manufacturer M uses an indirect channel to supply wholesale products to two retailers, R_1 and R_2, that compete in quantity in the resale market. The manufacturer can also develop a direct channel through which it encroaches upon the resale market and competes with incumbent retailers. The retailer's resale cost is normalized to zero, and the manufacturer's marginal direct selling cost when it encroaches is $c > 0$.[7] For simplicity, I assume the manufacturer's production cost is zero.

Let us first consider a homogeneous product oligopoly. Denote each retailer's quantity by q_i, q_j, $i, j = 1$ or 2, and the manufacturer's by q_M (if it encroaches). I assume that the demand for retailers' products is symmetric and that the inverse demand functions for resale products, $p = P(\cdot)$, is continuous, nonnegative, strictly decreasing, and twice differentiable. To guarantee that profit functions are strictly quasi-concave and that resale competition involves strategic substitutability, I assume $P'(\cdot) + P''(\cdot)q_M < 0$ (if encroachment happens) and $P'(\cdot) + P''(\cdot)q_i < 0$ (Vives, 1999).

In the contracting stage, the manufacturer offers each retailer a take-it-or-leave-it two-part tariff contract $T_i \equiv (w_i, F_i)$, where w_i is the wholesale price per wholesale product and F_i is a fixed fee. I assume the contract is offered secretly in the sense that each retailer cannot observe its rival's contract. The manufacturer and each retailer's profit, π_M and π_i, are realized as follows:

$$\pi_i = [P(q_M + q_i + q_j) - w_i]q_i - F_i, \tag{1}$$

[7] For example, suppose the incumbent retailers are brick-and-mortar ones and the manufacturer's direct channel is employed through an online store. Then, the brick-and-mortar retailers are more familiar with consumers' preferences from direct contact than the online store (Arya et al., 2007). Moreover, the manufacturer pays higher transportation costs to ship directly to consumers, whereas the brick-and-mortar retailers do not need to do this (Li et al., 2015). When the manufacturer utilizes an online store to sell directly, it must risk returns and redress because consumers cannot physically inspect products before ordering (Pan, 2016). This assumption is also standard in the literature in that the manufacturer acts as an entrant and is thus less efficient than the incumbent retailers.

$$
\begin{aligned}
\pi_M &= (w_i q_i + F_i) + (w_j q_j + F_j) + [P(q_M + q_i + q_j) - c]q_M, \qquad (2)\\
s.t.\quad & F_i \leq [P(q_M + q_i + q_j) - w_i]q_i,\\
& F_j \leq [P(q_M + q_i + q_j) - w_j]q_j.
\end{aligned}
$$

Note that q_M and the third term in Eq. (2) does not exist when the manufacturer chooses not to encroach.

The game proceeds as follows: In period 1, M decides whether to encroach and commit to this decision in the following games. In period 2, M secretly offers a two-part tariff contract T_i to each retailer R_i. Retailers simultaneously and independently decide whether to accept or reject the contract. If one accepts, it immediately pays the fixed fee. In period 3, Retailers order the quantity of wholesale products (q_i) and pay the wholesale price per product. If the manufacturer encroaches, it chooses its quantity (q_M) and simultaneously competes with the retailers.

The timing line that the manufacturer decides whether to encroach before the contracting process reflects the idea that starting a direct channel is relatively irreversible and thus must be taken prudently. To start direct sale as an market entrant, the manufacturer has to deal with resale issues such as inventory and siting locations, which are always regarded as long-term decisions. Moreover, the above timing reflects the assumption that a manufacturer's commitment of encroachment is credible for the incumbent retailers. This assumption follows from the fact that the manufacturer's direct sale must be in compliance with the incumbent retailer's favor, which is requested by anti-encroachment legislation. Conducting direct sale without informing the incumbent retailer will possibly cause legal dispute afterwards.[8]

The above timing also follows the setting with "interim unobservability" in McAfee and Schwartz (1994) in the sense that each retailer can only observe its own contracting results before competing on the resale market (except for the encroachment decision by the man-

[8] For example, some manufacturers (or franchisors in the franchising literature) are requested to open direct stores certain distance out of its incumbent retailers (franchisees)'s locations. A manufacturer will be accused if its direct sale is justified to have caused share losing of the incumbent retailers (Blair and Lafontaine, 2002; Espinoza, 2008).

ufacturer). In Section 6, I will discuss the other case with "interim observability" wherein each retailer observes its rival's contracting results before the competition starts.

For simplicity, I also make the following tie-breaking assumptions: 1) if each retailer is indifferent between accepting and rejecting the contract offered by the manufacturer in period 2, the retailer accepts it. 2) If the manufacturer is indifferent between encroaching and not, it encroaches. 3) If the manufacturer is indifferent between supplying both retailers and foreclosing both of them, it supplies both of them. The equilibrium is solved by backward induction. Throughout the analysis, equilibria are derived by first-order conditions, and the solutions satisfy the weak perfect Bayesian equilibrium.

3 Equilibrium Analysis

The manufacturer's decision in period 1 gives rise to two subgames: the manufacturer encroaches or not. I first derive equilibrium outcomes in each subgame, following the process in the literature on multilateral contracting under the passive belief assumption. The passive belief assumption requires that each retailer's conjecture about the contract offered to its retail competitor is unaffected by the out-of-equilibrium contract it receives from the manufacturer. Hence, in equilibrium, each retailer, say R_i, always expects that its rival R_j is offered an equilibrium wholesale price, w_j^*. This implies that each retailer's quantity is decided by only its own wholesale price, which is denoted by $q_i(w_i)$. I will go back to this point hereafter.

3.1 No-encroachment

First, let us consider the no-encroachment subgame. Under the assumption of passive belief, each retailer, say R_i, always expects that R_j receives an equilibrium wholesale price and that R_j also expects this in the same way. This implies that R_i always expects that R_j will choose

an equilibrium quantity, q_j^*. The manufacturer solves the following maximizing problem:

$$\begin{aligned} \max_{w_i,w_j,F_i,F_j} \quad & q_i(w_i)w_i + F_i + q_j(w_j)w_j + F_j \\ s.t. \quad & F_i \leq \left\{P[q_i(w_i), q_j^*] - w_i\right\} q_i(w_i) \\ & F_j \leq \left\{P[q_i^*, q_j(w_j)] - w_j\right\} q_j(w_j). \end{aligned} \tag{3}$$

Plugging F_i and F_j, the wholesale price w_i offered by the manufacturer to R_i only maximizes their joint profit. The manufacturer acts as if it and the contracting partner are integrated and face a given residual downstream demand. The first-order effect on the retailer's profit from changing R_i's quantity q_i in response to w_i is zero by the envelope theorem. The direct effect of changing w_i is an internal transfer and is thus canceled. Therefore, the optimal w_i must satisfy

$$w_i \frac{\partial q_i}{\partial w_i} = 0. \tag{4}$$

Because $\partial q_i/\partial w_i < 0$, the wholesale price in equilibrium equals the manufacturer's marginal production cost (i.e., $w_i = 0$). Such an equal-to-margin wholesale pricing outcome is standard in the literature (Hart and Tirole, 1990; O'Brien and Shaffer, 1992; McAfee and Schwartz, 1994; Rey and Vergé, 2004; Reisinger and Tarantino, 2015). As an upstream monopolist, the manufacturer should have optimally set positive wholesale prices such that the resultant total quantity equals the monopoly level. However, because the contracting process is unobservable, each retailer only accepts a zero wholesale price. If one retailer accepts a positive wholesale price and pays the corresponding fixed fee, it will be hurt by the manufacturer's undercutting. More precisely, if one retailer accepts a positive wholesale price, the manufacturer would always secretly offers a lower wholesale price to the other retailer. Because of a lack of commitment, a two-part tariff contract does not ensure a monopoly profit for the monopoly manufacturer. The manufacturer can only commit to zero wholesale prices and the resultant competition gives rise to the total quantity of Cournot level. Notice that the manufacturer is better off when it forecloses either retailer and offers the remaining retailer $w_i = 0$ and F_i equals to the monopoly retailer's resale profit. However, the retailer

must reject this offer because the manufacturer's commitment of foreclosure can never be guaranteed.[9] Such a commitment problem causes retailers to oversupply and prevents the manufacturer from achieving the downstream monopoly profit.

3.2 Encroachment

Next, I examine the subgame wherein the manufacturer encroaches. The optimal wholesale price w_i is determined as follows.

$$\begin{aligned}
\max_{w_i,w_j,F_i,F_j} \quad & q_i(w_i)w_i + F_i + q_j(w_j) + F_i \\
+ \quad & \left\{P\left(q_i(w_i), q_j(w_j), q_M[q_i(w_i), q_j(w_j)]\right) - c\right\} q_M[q_i(w_i), q_j(w_j)], \\
s.t. \quad & F_i \leq \left\{P\left(q_i(w_i), q_j^*, q_M(w_i, q_j^*)\right) - w_i\right\} q_i(w_i), \\
& F_j \leq \left\{P[q_i^*, q_j(w_j), q_M(q_i^*, w_j)] - w_j\right\} q_j(w_j). \qquad (5)
\end{aligned}$$

The first row in Eq. (5) denote the profit from the indirect channels, and the second row denotes that from the direct channel. Because each retailer only knows its own wholesale price, even though the quantity competition happens in period 3, q_i has already been decided by R_i in period 2, based on w_i and its expectation about q_j and q_M.[10] Thus, the manufacturer acts as a Stackelberg follower who decides q_M based on $q_i(w_i)$ and $q_j(w_j)$, or formally $q_M[q_i(w_i), q_j(w_j)]$ in the second row of Eq. (5). Note that as denoted in the third row of Eq. (5), when R_i decides whether to accept the highest fixed fee, its expectation about q_M in period 3 is also formed from its expectation about q_j^*. Now, the manufacturer still faces the commitment problem that it can only maximize the joint profit with R_i when choosing w_i. The optimal wholesale price is decided in the following lemma:

[9] Given that R_1 chooses the monopoly resale quantity q^M in period 3, the manufacturer always maintains R_2 a positive resale quantity, $q_2 = \arg\max_q [P(q^M + q)]q > 0$, implying the manufacturer does not actually foreclose R_2.

[10] Even though c is public information, R_i cannot make a precise expectation about q_M unless it knows w_j.

Lemma 1 *In the subgame with encroachment, w_i satisfies the follow:*

$$w_i \frac{\partial q_i}{\partial w_i} + q_i \frac{\partial P}{\partial q_M} \frac{\partial q_M}{\partial w_i} + q_M \frac{\partial P}{\partial q_i} \frac{\partial q_i}{\partial w_i} = 0. \tag{6}$$

proof. The maximization problem in Eq. (5) can be derived as

$$\begin{aligned} w_i \frac{\partial q_i}{\partial w_i} + q_i \quad &+ \quad (P' q_i + P - w_i) \frac{\partial q_i}{\partial w_i} + q_i \frac{\partial P}{\partial q_M} \frac{\partial q_M}{\partial w_i} - q_i \\ &+ \quad (P' q_M + P - c) \frac{\partial q_M}{\partial w_i} + q_M \frac{\partial P}{\partial q_i} \frac{\partial q_i}{\partial w_i}. \end{aligned} \tag{7}$$

Using envelope theorem, I obtain Lemma 1. ■

From Lemma 1, the sign of w_i is decided by the relative share of the wholesale channel and its direct channel, namely q_i and q_M. Comparing with the subgame without encroachment, because now the manufacturer has committed that it will encroach in period 1, the retailer has to take into account the strategic interaction from the direct channel. Specifically, how w_i affects q_M is known by R_i. This implies that when encroachment happens, the manufacturer faces the following trade-off: to levy a positive wholesale price in order to shift more share to its direct channel, or to subsidize the retailer to promote the retailers' sales. This trade-off makes the current research different with those existing ones in the sense that the manufacturer may use the direct channel to solve its commitment problem.

In order to formulate a rigorous analysis on the sign of equilibrium w_i, I derive the manufacturer's maximization problem in an alternative way. Because w_i decided in period 2 will ultimately determine q_i decided in period 3, the contract can be regarded as a quantity based two-part tariff, namely $T_i = (q_i, F_i)$. Each retailer, say R_i, only knows its own quantity q_i and forms an expectation about the rival's quantity q_j^*. In period 3, the manufacturer chooses q_M to maximize its own profit, ignoring its impact on the profit from the retailer's channel,

because it has already levied F_i in period 2:

$$\max_{q_M}[P(q_i + q_j + q_M) - c]q_M. \tag{8}$$

The corresponding FOC will result in a best response, $q_M(q_i+q_j)$. In period 2, the contracting between M and R_i requires solving

$$\begin{aligned} &\max_{q_i} F_i + w_i q_i + F_j + w_j q_j + \left\{P[q_i + q_j + q_M(q_i + q_j)] - c\right\} q_M(q_i + q_j), \\ s.t. \quad &F_i \leq \left\{P[q_i + q_j^* + q_M(q_i + q_j^*)] - w_i\right\} q_i; \\ &F_j \leq \left\{P[q_i^* + q_j + q_M(q_i^* + q_j)] - w_j\right\} q_j. \end{aligned} \tag{9}$$

Plugging F_i and F_j, the manufacturer chooses q_i to maximize the joint profit with R_i. Therefore, the problem in period 2 can be rewritten as

$$\max_{q_i} P[q_M(q_i + q_j^*) + q_i + q_j^*]q_i + \left\{P[q_M(q_i + q_j) + q_i + q_j] - c\right\} q_M(q_i + q_j). \tag{10}$$

In this subgame, the manufacturer acts as if it plays a Stackelberg game with itself, but with a different objective function in each period–in period 2, it takes into account the impact on the indirect channel, but in period 3, it ignores such an impact. Following this idea, it is straightforward to derive the each retailer's equilibrium share in this subgame:

Lemma 2 *In the subgame with encroachment, each retailer's quantity is given by*

$$q_i = \frac{-c \times (P'' q_M + 2P')}{(P')^2} > 0. \tag{11}$$

proof. The FOC in period 3 is given by

$$P' q_M + P - c = 0. \tag{12}$$

Totally differentiating Eq. (12) gives rise to

$$\frac{dq_M}{dq_i} = -\frac{P''q_M + P'}{P''q_M + 2P'}. \tag{13}$$

Using Eq. (12), the maximization problem in Eq. (10) can be derived as

$$\begin{aligned} & [P'q_M + P - c]\frac{dq_M}{dq_i} + P'q_i\frac{dq_M}{dq_i} + P'q_M + P'q_i + p = 0 \\ \Rightarrow \quad & P'q_i\frac{dq_M}{dq_i} + c + P'q_i = 0 \\ \Rightarrow \quad & q_i = \frac{-c}{P' \times (1 + dq_M/dq_i)}. \end{aligned} \tag{14}$$

Substituting Eq. (13) gives rise to the expression in Lemma 2. Because of strategic substitutability, q_i is positive. ■

Lemma 2 implies that as long as retailers have a cost advantage in resale activities, it is always optimal for the manufacturer to assign a positive share to each retailer. The value of each retailer's share is determined by how efficient its resale is. At extreme, when the manufacturer is as efficient as the retailers ($c = 0$), the manufacturer assigns each retailer zero quantity so that its optimal direct sale becomes a monopoly level which is decided by Eq. (12). Therefore, due to the continuity, when c is sufficiently small, the second term in Eq. (6) is trivial, implying that the manufacturer levies a positive w_i. This finding is summarized in the next proposition:

Proposition 1 *$\exists \bar{c} > 0$ such that $\forall c < \bar{c}$, the manufacturer offers each retailer an above-margin wholesale price when it encroaches.*

The intuition is as follows. When the the manufacturer is almost as efficient as the retailers, it depends quite less on them. But, as the manufacturer still cannot make its commitment of foreclosing either retailer credible, it still faces the commitment problem. Since the manufacturer's low resale cost is observed by each retailer, its incentive to charge a positive w_i to shift share to the direct channel is also well understood. Each retailer knows that even if it

accepts the positive wholesale price, it would not be undercut by the manufacturer as in the case without encroachment. This is because secretly undercutting either retailer harms the manufacturer's benefit from the direct channel. Thus, the encroachment acts as a commitment tool that makes the manufacturer's offer of positive wholesale prices credible. In other words, the encroachment authorizes the manufacturer a strategic option to control the total quantity sold in the resale market, which may partially solve its commitment problem.

3.3 No-encroachment vs. Encroachment

Now, I compare the manufacturer's profits and consumer welfare in the above two subgames. Let all notations with superscripts N and E denote equilibrium outcomes in the no-encroachment and encroachment cases, respectively. Let CW denote consumer welfare. Following the similar logic in deriving Proposition 1, I derive how the encroachment affects consumer welfare, which is summarized in the next proposition:

Proposition 2 $\exists \bar{c} > 0$ *such that* $\forall c < \bar{c}$*, the encroachment helps the manufacturer increase profit, which reduces consumer welfare.*

proof. Let us consider the extreme case wherein the manufacturer's marginal resale cost becomes zero.

When the manufacturer does not encroach, q_1^N and q_2^N are solutions to the optimization system

$$q_1^N = \arg\max_q P(q + q_2)q, \; q_2^N = \arg\max_q P(q_1 + q)q. \tag{15}$$

The manufacturer's Profit and consumer welfare are given by

$$\Pi_M^N = \Pi^{duopoly} \equiv P(q_1^N + q_2^N) \times (q_1^N + q_2^N), \tag{16}$$

$$CW^N = CW^{duopoly} \equiv \int_0^{q_1^N + q_2^N} P(z)dz - \Pi^{duopoly}. \tag{17}$$

When the manufacturer encroaches, the equilibrium quantities are

$$q_i^E = 0,\ q_M^E = \arg\max_q P(q)q. \tag{18}$$

The manufacturer's profit and consumer welfare are given by

$$\pi_M^E = \pi^{monopoly} \equiv P(q_M^E) \times q_M^E, \tag{19}$$

$$CW^E = CW^{monopoly} \equiv \int_0^{q_M^E} P(z)dz - \pi^{monopoly}. \tag{20}$$

Because $q_1^N + q_2^N > q_M^E$ and $\pi^{duopoly} < \pi^{monopoly}$,

$$\pi_M^N|_{c=0} < \pi_M^E|_{c=0},\ CW^N|_{c=0} > CW^E|_{c=0}. \tag{21}$$

Using continuity, I finish proving Proposition 2. ■

The above proposition is seriously counterintuitive because consumers may be worse off with an additional supplier (the manufacturer) joining the resale competition, even though such an additional supplier is very efficient. The manufacturer's encroachment turns resale competition from a duopoly to a triopoly, generating a pro-competitive effect. Meanwhile, the above-margin wholesale prices incurred by the encroachment cause efficiency losses in the indirect channels, generating an anti-competitive effect. How consumers are affected is determined by the above trade-offs. Specifically, when c is small enough, the manufacturer is capable to use the direct sale to commit to the wholesale prices which are high enough to restrain the retailers' oversupply. In this way, the manufacturer solves its commitment problem and achieves a profit that is close to the monopoly level. On the other hand, consumers are harmed by the encroachment because the manufacturer restrains the total supply in the resale market. This implies that even if c is very small, the anti-competitive effect caused by the encroachment can outweigh the pro-competitive effect.

Notice that Proposition 2 holds with more downstream retailers. This is because the growing number of retailers will aggravate oversupply, which makes the manufacturer's

commitment problem more severe. Then, the manufacturer must have a stronger willingness to develop a direct channel to restrict the total quantity in the resale market. Only by restricting the total quantity can the manufacturer enhance profit, implying that a profit-enhancing encroachment and a consumer welfare-improving encroachment must be paradoxical.

Even though comparing the two subgames is indicative of a downward entry that harms consumers, to derive the manufacturer's equilibrium decision in period 1, I still need to confirm the deviation cases wherein the manufacturer forecloses one or both retailers in the no-encroachment subgame. Note first that the case wherein the manufacturer encroaches while supplying only one retailer can not occur in equilibrium. This imperative is established in the literature on supplier encroachment. When only one retailer constitutes the resale market, the manufacturer's opportunism is no longer a concern. Because the manufacturer can fully extract the monopoly retailer's surplus with a two-part tariff contract, it never encroaches upon the territory of the retailer who is more efficient in resale activities. This would give rise to the case wherein the manufacturer supplies only one retailer without encroaching, which actually never occurs under the assumption of unobservable contracting. In other words, as long as $\pi_M^E > \pi_M^N$ is satisfied, the manufacturer never deviates by foreclosing one retailer. Therefore, I only need to exclude the deviation case wherein the manufacturer forecloses both retailers. This will be confirmed in the following sections.

4 Examples

4.1 Example 1: Linear Demand

In this subsection, I use a linear demand system to confirm the results in Proposition 1 and 2 and derive another result regarding consumer welfare. Let $p = a - b(q_1 + q_2)$ when there is no encroachment and $p = a - b(q_1 - q_2 - q_M)$ when encroachment happens.

No-encroachment: In equilibrium, each retailer is offered zero wholesale price, and the manufacturer obtains a profit comprising retailers' Cournot profits. Equilibrium outcomes

are as follows:

$$\begin{aligned} w_1^N = w_2^N &= 0; \\ q_1^N = q_2^N &= \frac{a}{3b}; \\ \pi_M^N &= 2 \times [a - b(q_1^N + q_2^N)] = \frac{2a^2}{9b}; \quad (22) \\ CW^N &= \int_0^{q_1^N + q_2^N} P(z)dz - \pi_M^N = \frac{2a^2}{9b}; \quad (23) \end{aligned}$$

Encroachment: Notice again that because the manufacturer has levied the fixed fee in period 2, it ignores the retailers' profits In period 3. Based on the the assumption of passive belief, R_i believes that R_j would choose an equilibrium quantity q_j^* which is given by[11]

$$q_j(w_i^*, w_j^*) = \frac{a + c - 3w_j^* + w_i^*}{4b}. \quad (24)$$

passive belief requires that $w_i^* = w_j^* \equiv w^*$, from which

$$q_j^* = \frac{a + c - 2w^*}{4b}. \quad (25)$$

Besides, R_i also believes that the manufacturer would choose q_M in response to q_j^*. Then, q_i and R_i's expectation about q_M are decided by simultaneously solving $\max_{q_i}[a - b(q_i + q_j^* + q_M) - w_i]q_i$ and $\max_{q_M}[a - b(q_i + q_j^* + q_M) - c]q_M$, which are given as follow:

$$q_i(w_i) = \frac{3a + 3c - 8w_i + 2w^*}{12b}; \; q_M(w_i, q_j^*) = \frac{3a - 9c + 4w_i + 2w^*}{12b}. \quad (26)$$

This implies that when each retailer is offered a wholesale price in period 2, it can decide which quantity to sell in period 3. Knowing this, the manufacturer decide its quantity by maximizing the profit from direct selling, $\max_{q_M}[P(q_i + q_j + q_M) - c]q_M$, from which the

[11] $q_j(w_i, w_j)$ is the solution to the maximization problems $\max_{q_i}[a - b(q_i + q_j + q_M) - w_i]q_i$ and $\max_{q_M}[a - b(q_i + q_j + q_M) - c]q_M$, where $i = 1, 2$.

manufacturer's optimal direct share can be derived as follows:

$$q_M[q_1(w_1), q_2(w_2)] = \frac{a - c - q_1(w_1) - q_2(w_2)}{2} = \frac{3a - 9c + 4w_1 + 4w_2 - 2w^*}{12b}. \tag{27}$$

Substituting Eq. (25), (26) and (27) to Eq. (5) the equilibrium outcomes can be derived as follow:

$$\begin{aligned} w_1^E = w_2^E &= \frac{a - 7c}{2}; \\ q_1^E = q_2^E &= \frac{2c}{b},\ q_M^E = \frac{a - 5c}{2b}; \\ \pi_M^E &= \frac{(a - c)^2}{4b}; \qquad (28) \\ CW^E &= \int_0^{q_1^E + q_2^E + q_M^E} p(z)dz - \pi_M^E - cq_M^E = \frac{(a + 3c)^2}{8b}. \qquad (29) \end{aligned}$$

Deviation: When the manufacturer forecloses both retailers and supplies the resale market directly, it obtains monopoly output q'_M and profit π'_M, with marginal resale cost c:

$$\begin{aligned} q'_M &= \frac{a - c}{2b}; \\ \pi'_M &= \frac{(a - c)^2}{4b}; \qquad (30) \\ CW' &= \int_0^{q'_M} [p(z) - c]dz - \pi'_M = \frac{(a - c)^2}{8b}. \qquad (31) \end{aligned}$$

Comparing the outcomes under the "no-encroachment" and "encroachment," I can confirm the arguments that the encroachment helps the manufacturer enhance profit and always reduces consumer welfare. Taking into account the deviation case, $\pi_M^E = \pi'_M$ implies that foreclosing both retailers cannot bring a better profit than encroachment for the manufacturer. By the tie-breaking assumption 3), a consumer welfare-reducing downward entry can actually happen in equilibrium, which is summarized as follows:

Corollary 1 *In a linear demand system,*

i) the manufacturer encroaches in equilibrium if and only if

$$0 < \frac{c}{a} < \frac{3 - 2\sqrt{2}}{3}; \tag{32}$$

ii) the encroachment always reduces consumer welfare.

Moreover, $CW^E > CW'$ implies that even though the manufacturer achieves the same profit when employing multichannel distribution as when running the direct channel only, the multichannel distribution results in a larger total quantity than that in the case when both retailers are foreclosed, implying a better consumer welfare.

It is noteworthy that CW^E increases in c. This finding is also counterintuitive because in the linear demand system, one firm's lower marginal cost always gives rise to a smaller total quantity and a higher market price, which is summarized in the following proposition:

Proposition 3 *In a linear demand system, when encroachment happens, the manufacturer's cost reduction always harms consumer welfare.*

Now I discuss the intuition. In a quantity competition with homogeneous products, according to the theorem of Bergstrom and Varian (1985), price, total quantity and consumer welfare depend only on the total marginal costs of all firms, namely $w_1^E + w_2^E + c$. When running multichannel distribution, the manufacturer's main task becomes managing its direct and indirect channels such that it achieves an optimal aggregate profit. A lower c motivates the manufacturer to become more active in the direct channel and to rely less on the retailers who cause a commitment problem for the manufacturer. Therefore, the manufacturer's incentive to charge a higher wholesale price becomes credible for each retailer who then accepts such a wholesale price. Because there are two indirect channels in this market, the efficiency loss due to higher wholesale prices is doubled nad outweighs the gain due to a lower c. Consequently, under multichannel distribution, a lower c enables the manufacturer to better solve its commitment problem, meanwhile causing loss for consumers.

$c \times 10^3$	10	8.5	7	5.5	4	2.5
$\pi_M^E \times 10^3$	379.1503	380.0089	380.8691	381.7307	382.5937	383.4579
$\pi_M^N \times 10^3$	353.5534	353.5534	353.5534	353.5534	353.5534	353.5534
$\pi_M' \times 10^3$	379.1411	380.0031	380.8658	381.7291	382.5931	383.4577
$CW^E \times 10^3$	137.7128	136.3260	134.9308	133.5269	132.1140	130.6918
$CW^N \times 10^3$	235.7023	235.7023	235.7023	235.7023	235.7023	235.7023

Table 1: $\beta = 2$

4.2 Example 2: Non-linear Demand

In this subsection, I use a nonlinear demand system to confirm my results. Let $p = a - (q_1 + q_2)^\beta$ when there is no encroachment and $p = a - (q_1 + q_2 + q_M)^\beta$ when encroachment happens. Due to mathematical complexity involved, I cannot explicitly derive the close-form solutions. Therefore, I specify a to 1, and provide numerical results as denoted Tables 1. The following information can be obtained: 1) even though with a non-linear demand system, an encroachment in equilibrium may still reduce consumer welfare. 2) the manufacturer's cost reduction harms the consumers.

5 Extension: Differentiated Products

In this section, I consider a case wherein the manufacturer and retailers sell heterogeneous products and products sold by different retailers are perfect substitutes.[12] Let π_M denote the manufacturer's profit including the fixed fee. A representative consumer's utility is quadratic with the form

$$u(q_1, q_2, q_M) = a(q_1 + q_2 + q_M) - \frac{1}{2}[(q_1 + q_2)^2 + 2\gamma(q_1 + q_2)q_M + q_M^2] + I, \tag{33}$$

where $\gamma \in (0, 1]$ denotes the substitutability between the two varieties and I denotes consumer income. Notice that all results here are consistent with the case of homogeneous

[12] In Section 6, I will consider the case wherein products sold by different retailers are differentiated.

products when $\gamma = 1$. The inverse demand functions for products R and M are denoted by

$$p_R = a - (q_1 + q_2) - \gamma q_M,\ p_M = a - q_M - \gamma(q_1 + q_2). \tag{34}$$

Consumer welfare when the encroachment happens can be denoted as

$$CW = u(q_1, q_2, q_M) - cq_M - \pi_M. \tag{35}$$

I omit the detailed calculations because they are quite similar with those in our basic model. Details can be provided upon request. The equilibrium outcomes in each subgame and in the deviation case are given as follow:

No-encroachment:

$$w_i^N = 0;\ q_i^N = \frac{a}{3};\ \pi_M^N = \frac{2a^2}{9};\ CW^N = \int_0^{q_1^N + q_2^N} p_R(z)dz - \pi_M^N = \frac{2a^2}{9}. \tag{36}$$

Encroachment:

$$\begin{aligned}
w_i^E &= \frac{\gamma[(6 - 6\gamma + \gamma^2)a - (6 + \gamma^2)c]}{2(6 - 5\gamma^2)};\\
q_i^E &= \frac{2[(1 - \gamma)a + \gamma c]}{6 - 5\gamma^2},\ q_M^E = \frac{(6 - 4\gamma - \gamma^2)a + (6 - \gamma^2)c}{6 - 5\gamma^2};\\
\pi_M^E &= \frac{(68 - 64\gamma - 60\gamma^2 + 64\gamma^3 - 7\gamma^4)a^2 - 2(36 - 32\gamma - 28\gamma^2 + 32\gamma^3 - 7\gamma^4)ac}{4(6 - 5\gamma^2)^2}\\
&\quad + \frac{(36 - 28\gamma^2 - 7\gamma^4)c^2}{4(6 - 5\gamma^2)^2};
\end{aligned} \tag{37}$$

$$\begin{aligned}
CW^E &= \frac{(100 - 80\gamma - 92\gamma^2 + 56\gamma^3 + 17\gamma^4)a^2 - 2(36 - 40\gamma - 44\gamma^2 + 28\gamma^3 + 17\gamma^4)ac}{8(6 - 5\gamma^2)^2}\\
&\quad + \frac{(36 - 44\gamma^2 + 17\gamma^4)c^2}{8(6 - 5\gamma^2)^2}.
\end{aligned} \tag{38}$$

Deviation:

$$
\begin{aligned}
q'_M &= \frac{a-c}{2}; \\
\pi'_M &= \frac{(a-c)^2}{4}; \qquad (39) \\
CW' &= \frac{(a-c)^2}{8}. \qquad (40)
\end{aligned}
$$

Comparing π_M^E, π_M^N and π'_M, I can confirm that when $\pi_M^E > \pi_M^N$ is satisfied, $\pi_M^E > \pi'_M$ must also be satisfied. The next proposition summarizes the conditions under which our arguments in the case of homogeneous products hold.

Proposition 4 *When products in the direct and indirect channels are differentiated,*

i) the manufacturer encroaches in equilibrium if and only if $0 < c/a < f_1(\gamma)$, *where* $f_1(\gamma)$ *is the threshold value satisfying* $\pi_M^E = \pi_M^N$;

ii) the encroachment reduces consumer welfare if and only if $f_2(\gamma) < c/a < f_3(\gamma)$, *where* $f_2(\gamma)$ *and* $f_3(\gamma)$ *are threshold values satisfying* $CW_M^E = CW_M^N$;

iii) the manufacturer's cost reduction harms consumer welfare if and only if $c/a > f_4(\gamma)$, *where* $f_4(\gamma)$ *is the threshold value satisfying* $\partial CW_M^E/\partial c = 0$.

$$
\begin{aligned}
f_1(\gamma) &\equiv \frac{36-32\gamma-28\gamma^2+32\gamma^3-7\gamma^4}{36-28\gamma^2-7\gamma^4} - \frac{2\gamma(6-5\gamma^2)\sqrt{16-14\gamma^2}}{3(36-28\gamma^2-7\gamma^4)}, \\
f_2(\gamma) &\equiv \frac{36-40\gamma-44\gamma^2+28\gamma^3+17\gamma^4}{36-44\gamma^2+17\gamma^4} - \frac{4\gamma(6-5\gamma^2)\sqrt{8-17\gamma^2}}{3(36-44\gamma^2+17\gamma^4)}, \\
f_3(\gamma) &\equiv \frac{36-40\gamma-44\gamma^2+28\gamma^3+17\gamma^4}{36-44\gamma^2+17\gamma^4} + \frac{4\gamma(6-5\gamma^2)\sqrt{8-17\gamma^2}}{3(36-44\gamma^2+17\gamma^4)}, \\
f_4(\gamma) &\equiv \frac{36-40\gamma-44\gamma^2+28\gamma^3+17\gamma^4}{36-44\gamma^2+17\gamma^4}. \qquad (41)
\end{aligned}
$$

Figure 1 depicts the ranges in Proposition 4. In the range wherein the encroachment happens ($c/a < f_1(\gamma)$), the encroachment reduces consumer welfare when γ is relatively

large, which is denoted by the shaded area. When products sold in the direct and indirect

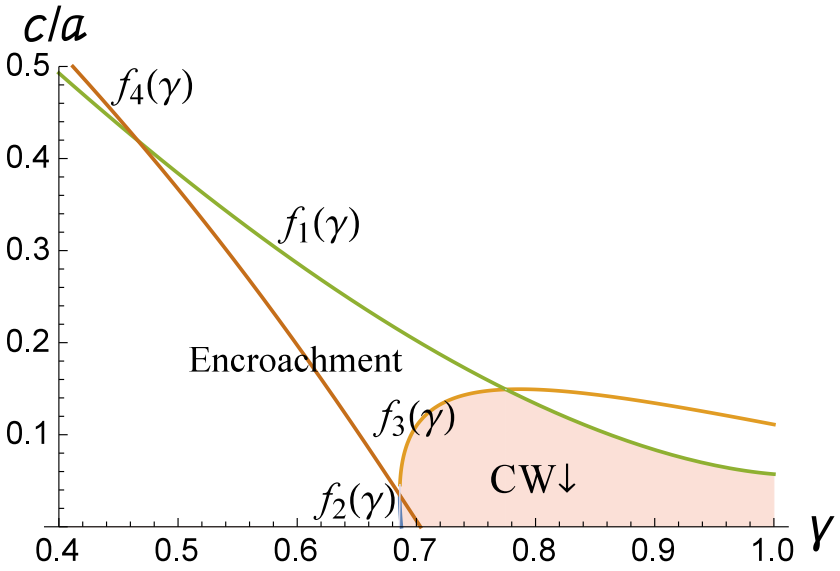

Figure 1: The Change in CW

channels are closely substitutable, the manufacturer's commitment problem is solved to the best, which enables the manufacturer to greatly restrict the total quantity. The resultant high price implies that the procompetitive effect due to the downward entry is outweighed by the anticompetitive effect due to the efficiency loss.

6 Discussion

In this section, following McAfee and Schwartz (1994), I discuss quantity competition with "interim observability" and price competition with both "interim observability" and "interim unobservability."[13] Now, the quantity eventually sold by each retailer, whether in quantity or price competition, depends on the contracting results of its rival retailer, which triggers the manufacturer's incentive for multilateral deviation on both retailers. As noted in Rey and Vergé (2004), such a deviation occurs when products sold by retailers are homogeneous (as

[13]In the game with "interim observability," each retailer observes its rival's contracting results before the competition starts. In the game with "interim unobservability," each retailer never observes the rival's contracting results.

in my basic setting), resulting in the non-existence of equilibrium. I then consider the case wherein retailers compete in differentiated products. To construct a symmetric marketing position for both retailers and to better track the main mechanism, I assume the products sold by the manufacturer are substitutable with those by each retailer to the same extent. Such substitutability is denoted by γ. The inverse demand functions are

$$p_i = a - q_i - \gamma(q_j + q_M),\ p_M = a - q_M - \gamma(q_i + q_j),\ i, j = 1, 2. \tag{42}$$

6.1 Quantity Competition with Interim Observability

I first consider the case of no-encroachment. The results are consistent with Rey and Vergé (2004) except that the manufacturer's production cost is assumed to be zero. In the last stage, each retailer decides its quantity, observing the contracting results of the rival. By symmetry, the equilibrium quantities and profits are given by

$$q_i(w_i, w_j) = \frac{2 - \gamma - 2w_i + \gamma w_j}{4 - \gamma^2}; \tag{43}$$

$$\pi_i(w_i, w_j) = \left(\frac{2 - \gamma - 2w_i + \gamma w_j}{4 - \gamma^2}\right)^2. \tag{44}$$

The manufacturer chooses w_i and w_j to solve

$$\max_{w_i, w_j} w_i q_i(w_i, w_j) + \pi_i(w_i, w_j^*) + w_j q_j(w_i, w_j) + \pi_j(w_i^*, w_j), \tag{45}$$

from which I have

$$w_i^N = w_j^N = \frac{-a\gamma^2}{2(2 - \gamma^2)}. \tag{46}$$

Because $w_i^N < 0$, the interim observability aggravates the manufacturer's commitment problem: it has to commit to a subsidy to each retailer, otherwise its offer would be rejected. To

guarantee that the manufacturer does not unilaterally deviate, I need that

$$\frac{\partial \pi_M^2(w_i, w_j)}{\partial q_i^2} + \frac{\partial \pi_M^2(w_i, w_j)}{\partial q_i \partial q_j} \leq 0 \Rightarrow \gamma \leq 0.806. \tag{47}$$

The equilibrium outcomes are

$$\begin{aligned} q_i^N = q_j^N &= \frac{(2-\gamma)a}{2(2-\gamma^2)}; \\ \pi_M^N &= \frac{(1-\gamma)(4-\gamma^2)a^2}{2(2-\gamma^2)^2}; \qquad (48) \\ CW^N &= \frac{(1+\gamma)(2-\gamma)^2 a^2}{4(2-\gamma^2)^2}. \qquad (49) \end{aligned}$$

Next, I consider the case where the manufacture encroaches. The equilibrium quantities and profits are given by

$$\begin{aligned} q_i(w_i, w_j) &= \frac{(2-\gamma)a + \gamma c - (2+\gamma)w_i + \gamma w_j}{2(2-\gamma)(1+\gamma)}; \qquad (50) \\ q_M(w_i, w_j) &= \frac{(2-\gamma)a - (2+\gamma)c + \gamma w_i + \gamma w_j}{2(2-\gamma)(1+\gamma)}; \qquad (51) \\ \pi_i(w_i, w_j) &= \left[\frac{(2-\gamma)a + \gamma c - (2+\gamma)w_i + \gamma w_j}{2(2-\gamma)(1+\gamma)}\right]^2. \qquad (52) \end{aligned}$$

The manufacturer chooses w_i and w_j to solve

$$\begin{aligned} \max_{w_i, w_j} \pi_M(w_i, w_j) &= w_i q_i(w_i, w_j) + \pi_i(w_i, w_j^*) + w_j q_j(w_i, w_j) + \pi_j(w_i^*, w_j) \\ &+ [P_M(w_i, w_j) - c] q_M(w_i, w_j), \qquad (53) \end{aligned}$$

from which I have

$$w_i^E = w_j^E = \frac{\gamma[(2-3\gamma+\gamma^2)a - (2+\gamma+\gamma^2)c]}{2(1-\gamma)(2+3\gamma)}. \tag{54}$$

Notice that for ranges wherein all equilibrium quantities are interior solutions, the equi-

librium wholesale price under the encroachment case is always higher than that in the no-encroachment case. This is because the manufacturer now obtains additional profit from the direct channel and thus relies less on the incumbent retailers. To guarantee that the manufacturer does not unilaterally deviate, I need that

$$\frac{\partial \pi_M^2(w_i, w_j)}{\partial w_i^2} + \frac{\partial \pi_M^2(w_i, w_j)}{\partial w_i \partial w_j} \leq 0 \Rightarrow \gamma \leq 0.756. \tag{55}$$

The equilibrium outcomes are

$$\begin{aligned}
q_i^E = q_j^E &= \frac{(1-\gamma)a + \gamma c}{(1-\gamma)(2+3\gamma)}; \\
q_M^E &= \frac{(2-\gamma-\gamma^2)a - (2+\gamma-\gamma^2)c}{2(1-\gamma)(2+3\gamma)}; \\
\pi_M^E &= \frac{3(1-\gamma)^2(4+4\gamma-\gamma^2)a^2 - 2(1-\gamma)(4-3\gamma^2+3\gamma^3)ac}{4(1-\gamma)^2(2+3\gamma)^2} \\
&+ \frac{(1+\gamma)(4-3\gamma^2-3\gamma^3)c^2}{4(1-\gamma)^2(2+3\gamma)^2}; \qquad (56) \\
CW^E &= \frac{(1-\gamma)^2(4+32\gamma+13\gamma^2)a^2 - 2\gamma(10-21\gamma-2\gamma^2+13\gamma^3)ac}{8(2+\gamma-3\gamma^2)^2} \\
&+ \frac{(1+\gamma)(4+8\gamma-23\gamma^2+13\gamma^3)c^2}{8(2+\gamma-3\gamma^2)^2}. \qquad (57)
\end{aligned}$$

To rule out the manufacturer foreclosing both retailers, I need $\pi_M^E > \pi_M'$ or $q_M' \leq 0$.[14] Moreover, I need all equilibrium outcomes to be interior solutions.

The next proposition summarizes how the manufacturer's encroachment affects consumer welfare in quantity competition with interim observability.

Proposition 5 *In a quantity competition with interim observability,*

i) the manufacturer encroaches in equilibrium if and only if $0 < c/a < f_5(\gamma)$*, where* $f_5(\gamma)$ *is the threshold value satisfying* $\pi_M^E = \pi_M^N$*;*

ii) the encroachment reduces consumer welfare if and only if $f_6(\gamma) < c/a < f_5(\gamma)$*, where* $f_6(\gamma)$ *are threshold values satisfying* $CW_M^E = CW_M^N$*.*

[14]The equilibrium outcomes when the manufacturer forecloses both retailers and monopolizes the resale market itself are equivalent to Eq. (31) in Section 4.

$$
\begin{aligned}
f_5(\gamma) &\equiv \frac{(1-\gamma)(4-3\gamma^2+3\gamma^3)}{(1+\gamma)(4-3\gamma^2-3\gamma^3)} - \frac{\gamma(2+\gamma-3\gamma^2)\sqrt{2(8-12\gamma-9\gamma^2+15\gamma^3+3\gamma^4-3\gamma^5)}}{(1+\gamma)(2-\gamma^2)(4-3\gamma^2-3\gamma^3)}, \\
f_6(\gamma) &\equiv \frac{4+8\gamma-13\gamma^2-22\gamma^3+20\gamma^4+16\gamma^5-13\gamma^6}{4+12\gamma+\gamma^2-16\gamma^3+6\gamma^5-3\gamma^6} \\
&- \frac{\gamma(2+\gamma-5\gamma^2+2\gamma^4)\sqrt{2(8+16\gamma-29\gamma^2-55\gamma^3+25\gamma^4+31\gamma^5-14\gamma^6)}}{(2-\gamma^2)(4+12\gamma+\gamma^2-16\gamma^3+6\gamma^5-3\gamma^6)}.
\end{aligned}
$$

The encroachment drives the wholesale price up to a positive value, which enables the manufacturer to restrict the retailers' total outputs and thus to partially solve its commitment problem.

Notice that the assumption that the fixed fee must be paid before the competition starts plays an important role in the setting of interim observability. As shown by Fontenay and Gans (2005), with interim observability, the manufacturer's opportunism is no longer a concern if the manufacturer is allowed to offer a fixed fee contingent on the retailer's quantity.

6.2 Price Competition

6.2.1 Price Competition with Interim Unobservability

I first consider the game with interim unobservability. In the last stage, each retailer decides its price by solving a Bayesian game. The no-encroachment case is identical to that in O'Brien and Shaffer (1992) and Rey and Vergé (2004). If there exists an equilibrium in price competition with interim unobservability, I need γ to be smaller than $1/2$. The manufacturer's maximization problem is as follows:

$$
\begin{aligned}
\max_{w_i,w_j} \quad & w_i q_i[p_i(w_i), p_j(w_j)] + [p_i(w_i) - w_i] q_i[p_i(w_i), p_j^*] \\
+ \quad & w_j q_j \left\{ p_i(w_i), p_j(w_j) \right\}] + [p_j(w_j) - w_j] q_j[p_i^*, p_j(w_j)]. \qquad (58)
\end{aligned}
$$

The equilibrium outcomes are summarized as follow:

$$\begin{aligned} w_i^N = w_j^N &= 0; \\ p_i^N = p_j^N &= \frac{(1-\gamma)a}{2-\gamma}; \\ \pi_M^N &= \frac{2(1-\gamma)a^2}{(2-\gamma)^2(1+\gamma)}; \qquad (59) \\ CW^N &= \frac{a^2}{(2-\gamma)^2(1+\gamma)}. \qquad (60) \end{aligned}$$

In the encroachment case, the manufacturer's maximization problem is as follows:

$$\begin{aligned} \max_{w_i,w_j} \quad & w_i q_i \left\{p_i(w_i), p_j(w_j), p_M[p_i(w_i), p_j(w_j)]\right\} + [p_i(w_i) - w_i] q_i[p_i(w_i), p_j^*, p_M(w_i, p_j^*)] \\ + \quad & w_j q_j \left\{p_i(w_i), p_j(w_j), p_M[p_i(w_i), p(w_j)]\right\} + [p_j(w_j) - w_j] q_j[p_i^*, p_j(w_j), p_M(p_i^*, w_j)] \\ + \quad & \left\{p_M[p_i(w_i), p_j(w_j)] - c\right\} q_M \left\{p_i(w_i), p_j(w_j), p_M[p_i(w_i), p_j(w_j)]\right\}. \qquad (61) \end{aligned}$$

The equilibrium outcomes in the encroachment case are summarized as follows:

$$\begin{aligned} w_i^E = w_j^E &= \frac{\gamma[(1-\gamma)(2+3\gamma)^2 a - (4+10\gamma+3\gamma^2-3\gamma^3)c]}{2(4+10\gamma+\gamma^2-9\gamma^3-3\gamma^4)}; \\ \pi_M^E &= \frac{(1+\gamma)(1-\gamma)^2(48+240\gamma+348\gamma^2-28\gamma^3-391\gamma^4-176\gamma^5+36\gamma^6)a^2}{4(1-\gamma)(1+2\gamma)(4+10\gamma+\gamma^2-9\gamma^3-3\gamma^4)^2} \\ &- \frac{2(1-\gamma^2)(16+64\gamma+44\gamma^2-88\gamma^3-75\gamma^4+55\gamma^5+12\gamma^6-36\gamma^7)ac}{4(1-\gamma)(1+2\gamma)(4+10\gamma+\gamma^2-9\gamma^3-3\gamma^4)^2} \\ &+ \frac{(1+\gamma)\begin{pmatrix} 16+80\gamma+108\gamma^2-52\gamma^3-211\gamma^4 \\ -110\gamma^5+45\gamma^6+72\gamma^7+36\gamma^8 \end{pmatrix} c^2}{4(1-\gamma)(1+2\gamma)(4+10\gamma+\gamma^2-9\gamma^3-3\gamma^4)^2}; \qquad (62) \\ CW^E &= \frac{(1+\gamma)^2(1-\gamma)(48+208\gamma+188\gamma^2-268\gamma^3-399\gamma^4+70\gamma^5+180\gamma^6)a^2}{8(1-\gamma)(1+2\gamma)(4+10\gamma+\gamma^2-9\gamma^3-3\gamma^4)^2} \\ &- \frac{2(1+\gamma)^2(1-\gamma)(16+64\gamma+36\gamma^2-128\gamma^3-131\gamma^4+66\gamma^5+84\gamma^6)ac}{8(1-\gamma)(1+2\gamma)(4+10\gamma+\gamma^2-9\gamma^3-3\gamma^4)^2} \\ &+ \frac{(1+\gamma)^2(16+64\gamma+44\gamma^2-80\gamma^3-51\gamma^4+69\gamma^5+6\gamma^6-36\gamma^7)c^2}{8(1-\gamma)(1+2\gamma)(4+10\gamma+\gamma^2-9\gamma^3-3\gamma^4)^2}. \qquad (63) \end{aligned}$$

Given $\gamma < 1/2$, the manufacturer never forecloses both retailers, and the manufacturer's multilateral deviation never happens in this case.

The next proposition summarizes how the manufacturer's encroachment affects consumer welfare in price competition with interim unobservability.

Proposition 6 *Under the two-part tariff contract, in price competition with interim unobservability,*

i) the manufacturer encroaches in equilibrium if $\gamma < 1/2$ and $c/a < f_7(\gamma)$, where $f_7(\gamma)$ is the threshold value satisfying $\pi_M^E = \pi_M^N$;

ii) the encroachment always reduces consumer welfare.

$$
\begin{aligned}
f_7(\gamma) \equiv\ & \frac{16+48\gamma-20\gamma^2-132\gamma^3+13\gamma^4+130\gamma^5-43\gamma^6-48\gamma^7+36\gamma^8}{16+80\gamma+108\gamma^2-52\gamma^3-211\gamma^4-110\gamma^5+45\gamma^6+72\gamma^7+36\gamma^8} \\
& - \frac{2\gamma(1-\gamma)(4+10\gamma+\gamma^2-9\gamma^3-3\gamma^4)}{(2-\gamma)(1+\gamma)\left(\begin{array}{l}16+80\gamma+108\gamma^2-52\gamma^3-211\gamma^4 \\ \quad +-110\gamma^5+45\gamma^6+72\gamma^7+36\gamma^8\end{array}\right)} \\
& \times \frac{\sqrt{2(1+2\gamma)(8+28\gamma+5\gamma^2-76\gamma^3-63\gamma^4+50\gamma^5+56\gamma^6)}}{(2-\gamma)(1+\gamma)\left(\begin{array}{l}16+80\gamma+108\gamma^2-52\gamma^3-211\gamma^4 \\ \quad +-110\gamma^5+45\gamma^6+72\gamma^7+36\gamma^8\end{array}\right)}, \qquad (64)
\end{aligned}
$$

6.2.2 Price Competition with Interim Observability

I now consider the game with interim observability. When the manufacturer does not encroach, in the last stage, each retailer's equilibrium resale prices and profits are given by

$$
\begin{aligned}
p_i(w_i, w_j) &= \frac{(2-\gamma-\gamma^2)a+2w_i+\gamma w_j}{4-\gamma^2}; \qquad (65) \\
\pi_i(w_i, w_j) &= \frac{[(2-\gamma-\gamma^2)a-(2-\gamma^2)w_i+\gamma w_j]^2}{(4-\gamma^2)^2(1-\gamma^2)}. \qquad (66)
\end{aligned}
$$

The manufacturer chooses w_i and w_j to solve

$$\begin{aligned}\max_{w_i,w_j} \pi_M(w_i,w_j) &= w_i q_i\left[p_i(w_i,w_j),p_j(w_i,w_j)\right]+\pi_i(w_i,w_j^*)\\ &+ w_j q_j\left[p_i(w_i,w_j),p_j(w_i,w_j)\right]+\pi_j(w_i^*,w_j),\end{aligned} \tag{67}$$

from which I have

$$w_i^N = w_j^N = \frac{a\gamma^2}{4}. \tag{68}$$

In price competition with interim observability, even if the manufacturer does not encroach, it can charge each retailer a positive wholesale price, implying that the commitment problem is not as serious as the cases I discussed above. To guarantee that the manufacturer does not unilaterally deviate, I need that

$$\frac{\partial\pi_M^2(w_i,w_j)}{\partial w_i^2}+\frac{\partial\pi_M^2(w_i,w_j)}{\partial w_i\partial w_j}\leq 0 \Rightarrow \gamma\leq 0.806. \tag{69}$$

The equilibrium outcomes are

$$\begin{aligned}p_i^N = p_j^N &= \frac{(2-\gamma)a}{4};\\ \pi_M^N &= \frac{(4-\gamma^2)a^2}{8(1+\gamma)}; \qquad (70)\\ CW^N &= \frac{(2+\gamma)^2a^2}{16(1+\gamma)}. \qquad (71)\end{aligned}$$

Next, I consider the case when the manufacture encroaches. The equilibrium quantities

and profits are given by

$$p_i(w_i, w_j) = \frac{(2+\gamma-3\gamma^2)a + (\gamma+\gamma^2)c + (2+3\gamma+\gamma^2)w_i + (\gamma+\gamma^2)w_j}{2(2+3\gamma)}; \quad (72)$$

$$p_M(w_i, w_j) = \frac{(2+\gamma-3\gamma^2)a + (2+3\gamma+\gamma^2)c + (\gamma+\gamma^2)w_i + (\gamma+\gamma^2)w_j}{2(2-\gamma)(1+\gamma)} \quad (73)$$

$$\pi_i(w_i, w_j) = \frac{(1+\gamma)\left(\begin{array}{c}(2+\gamma-3\gamma^2)a + (\gamma+\gamma^2)c \\ + -(2+3\gamma-\gamma^2)w_i + (\gamma+\gamma^2)w_j\end{array}\right)^2}{4(1-\gamma)(1+2\gamma)(2+3\gamma)^2}. \quad (74)$$

The manufacturer chooses w_i and w_j to solve

$$\begin{aligned}\max_{w_i,w_j} \pi_M(w_i, w_j) &= w_i q_i[p_i(w_i, w_j), p_j(w_i, w_j), p_M(w_i, w_j)] + \pi_i(w_i, w_j^*) \\ &+ w_j q_j[p_i(w_i, w_j), p_j(w_i, w_j), p_M(w_i, w_j)] + \pi_j(w_i^*, w_j) \\ &+ [p_M(w_i, w_j) - c]q_M[p_i(w_i, w_j), p_j(w_i, w_j), p_M(w_i, w_j)], \end{aligned} \quad (75)$$

from which I have

$$w_i^E = w_j^E = \frac{\gamma(1+2\gamma)[(2+\gamma-3\gamma^2)a - (2+\gamma-\gamma^2)c]}{2(1+\gamma)(2+3\gamma-2\gamma^2-2\gamma^3)}. \quad (76)$$

To guarantee that the manufacturer does not unilaterally deviate, I need that

$$\frac{\partial \pi_M^2(w_i, w_j)}{\partial w_i^2} + \frac{\partial \pi_M^2(w_i, w_j)}{\partial w_i \partial w_j} \leq 0 \Rightarrow \gamma \leq 0.884. \quad (77)$$

The equilibrium outcomes are

$$\begin{aligned}\pi_M^E &= \frac{(1-\gamma)(12+48\gamma+45\gamma^2-29\gamma^3-49\gamma^4-9\gamma^5)a^2-2(1-\gamma^2)(2+3\gamma-\gamma^2)ac}{4(1+2\gamma)(2+3\gamma-2\gamma^2-2\gamma^3)^2} \\ &+ \frac{(1+\gamma)(4+16\gamma+17\gamma^2-3\gamma^3-13\gamma^4-7\gamma^5)c^2}{4(1+2\gamma)(2+3\gamma-2\gamma^2-2\gamma^3)^2}; \qquad (78) \\ CW^E &= \frac{(1+\gamma)(4+4\gamma-5\gamma^2)(3+7\gamma-\gamma^2-7\gamma^3)a^2}{8(1-\gamma)(1+2\gamma)(2+3\gamma-2\gamma^2-2\gamma^3)^2} \\ &- \frac{(1+\gamma)(4+12\gamma-\gamma^2-23\gamma^3-3\gamma^4+13\gamma^5)ac}{8(1-\gamma)(1+2\gamma)(2+3\gamma-2\gamma^2-2\gamma^3)^2} \\ &+ \frac{(1+\gamma)(4+12\gamma+\gamma^2-16\gamma^3+6\gamma^5-3\gamma^6)c^2}{8(1-\gamma)(1+2\gamma)(2+3\gamma-2\gamma^2-2\gamma^3)^2}. \qquad (79)\end{aligned}$$

To rule out the manufacturer foreclosing both retailers, I need $\pi_M^E > \pi'_M$ or $q'_M \leq 0$. Moreover, I need all equilibrium outcomes to be interior solutions.

The next proposition summarizes how the manufacturer's encroachment affects consumer welfare in quantity competition with interim observability.

Proposition 7 *In a price competition with interim observability,*

i) the manufacturer encroaches in equilibrium if and only if $\gamma \leq 0.594$ *and* $0 < c/a < f_8(\gamma)$*, where* $f_8(\gamma)$ *is the threshold value satisfying* $\pi_M^E = \pi_M^N$*;*

ii) the encroachment always enhances consumer welfare in equilibrium.

$$\begin{aligned}f_8(\gamma) &\equiv \frac{2(1+\gamma)(2+3\gamma-\gamma^2)^2}{2(1+\gamma)(4+16\gamma+17\gamma^2-3\gamma^3-13\gamma^4-7\gamma^5)} \\ &- \frac{\gamma(2+3\gamma-2\gamma^2-2\gamma^3)\sqrt{2(1+2\gamma)(8+20\gamma+3\gamma^2-9\gamma^3+13\gamma^4+7\gamma^5)}}{2(1+\gamma)(4+16\gamma+17\gamma^2-3\gamma^3-13\gamma^4-7\gamma^5)}. \qquad (80)\end{aligned}$$

7 Concluding Remarks

In this study, I discuss supplier encroachment within a framework of two-part tariff contracts. I consider a multilateral contracting case wherein a monopoly manufacturer supplies competing retailers. Given the assumption of unobservable contracting, the monopoly manufacturer

loses market power even when offering two-part tariff contract because its opportunism triggers each retailer to form a belief about the rival's contracts that is independent from what itself is offered; this prevents the manufacturer from optimizing wholesale profit through a fixed fee. In a quantity-setting game with interim unobservability, I demonstrate that the manufacturer restores its market power by encroaching upon the resale market and that the encroachment may result in higher wholesale prices; this aggravates double marginalization and always harms consumer welfare. When the quantity-setting game is with interim observability, the encroachment may still reduce consumer welfare. On the other hand, I show that in a price competition with interim unobservability, the encroachment always reduces consumer welfare; in a price competition with interim observability, the encroachment always enhances consumer welfare.

This paper mainly studies the effect of encroachment on consumer welfare instead of social welfare. This is because I want to focus on the price change caused by the manufacturer's downward entry. If we take producer surplus into account as well, whether the encroachment increases or reduces social welfare is decided by the trade-off between the manufacturer's gain and consumers' loss. Actually, the encroachment may also reduce social welfare in equilibrium, whether under a quantity or price competition. Details are provided upon request.

Following most existing literature, the manufacturer's opportunism is captured by the two-part tariff contract. Recently, this issue under a linear wholesale price contract has been discussed by several researchers (e.g., Aghadadashli et al., 2016; Gaudin, 2016). As noticed by Gaudin (2016), when a monopoly manufacturer supplies competing retailers with a linear wholesale price contract, the equilibrium wholesale price under secret contracts is lower than that under public contracts. Following the main mechanism in the current study, the encroachment triggers the manufacturer's incentive to raise the wholesale price, which aggravates the double marginalization. However, because the double marginalization before encroachment is not as severe as the case with two-part tariff contract (in the case with linear wholesale price contract, the equilibrium wholesale price is always above the manufacturer's

production cost, whether with or without the encroachment), whether the encroachment enhances consumer welfare or not is also worth discussing.

As already noted in the introduction, theoretical analysis on supplier encroachment with the base of two-part tariff contract is an important issue worth further elaboration. This paper presents one standpoint wherein the manufacturer fails to obtain the optimal supply chain profit via the two-part tariff contract because of the opportunism behavior. Another possible attempt is to consider a bargaining problem wherein the manufacturer can only obtain a part of the supply chain profit based on its bargaining power. To summarize, under a two-part tariff contract, the analysis of supplier encroachment is quite difficult with the case of a linear contract which is discussed by most existing literature, and is an interesting topic for future research.

References

[1] Aghadadashlia, H.; Dertwinkel-Kalt, M. and Wey, C., 2016, 'The Nash Bargaining Solution in Vertical Relations with Linear Input Prices,' *Economics Letters*, **145**, pp. 291-294.

[2] Arya, A.; Mittendorf, B. and Sappington, D. E. M., 2007, 'The Bright Side of Supplier Encroachment,' *Marketing Science*, **26**(5), pp. 651-659.

[3] Avenel, E., 2012, 'Upstream Capacity Constraint and the Preservation of Monopoly Power in Private Bilateral Contrasting,' *Journal of Industrial Economics*, **60**(4), pp. 578-598.

[4] Bergstrom, C. T. and Varian, H. R., 1985, 'When Are Nash Equilibria Independent of the Distribution of Agents' Characteristics,' *Review of Economic Studies* **52**, 715-718.

[5] Blair, R. D. and Lafontaine, F., 2005, *The Economics of Franchising*, Cambridge, UK: Cambridge University Press.

[6] Cattani, K.; Gilland, W.; Heese, S. and Swaminathan, J., 2006, 'Boiling Frogs: Pricing Strategies for a Manufacturer Adding an Internet Channel,' *Production and Operations Management*, **15**(1), pp. 40-56.

[7] Chiang, W. K.; Chhajed, D. and Hess, J. D., 2003, 'Direct Marketing, Indirect Profits: a Strategic Analysis of Dual-Channel Supply-Chain Design,' *Management Science*. **49**(1), pp, 1-20.

[8] Dutta, S.; Heide, J. and Bergen, M., 1999, 'Vertical Territory Restrictions and Public Policy: Theories and Industry Evidence,' *Journal of Marketing*, **63**, pp. 121-134.

[9] Espinoza, G., 2008, 'Franchisors' Encroachment in the Eyes of the Beholder: How to Protect a Franchisee?' Available at SSRN: http://ssrn.com/abstract=1137945 or http://dx.doi.org/10.2139/ssrn.1137945.

[10] Fontenay C. C. and Gans J. S., 2005, 'Optional Fixed Fees in Multilateral Vertical Relations,' *Economic Letters*. **88**(2005), pp, 184-189.

[11] Gaudin, G., 2016, 'Vertical Relations, Opportunism, and Welfare,' Available at SSRN: https://ssrn.com/abstract=2819489.

[12] Gilo, D., 1999, 'Does a Supplier Have the Market Power We Thought it Had? The Use of Vertical Integration and Vertical Restraints to Restore the Supplier's Market Power,' Harvard Law School John M. Olin Center for Law, Economics and Business Discussion Paper Series, paper 262.

[13] Hart, O. and Tirole, J., 1990, 'Vertical Integration and Market Foreclosure,' *Brookings Papers on Economic Activity: Microeconomics*, **1990**, pp. 205-286.

[14] Hadfield, G. K., 1990, 'Problematic Relations: Franchising and the Law of Incomplete Contracts,' *Stanford Law Review*. **42**(4), pp. 927-992.

[15] Kalnins, A., 2004, 'An Empirical Analysis of Territorial Encroachment within Franchised and Company-owned Branded Chains,' *Management Science*, **23**(4), pp. 1-20.

[16] Kaufmann, P. J. and Lafontaine, F., 1994, 'Costs of Control: The Source of Economic Rents for McDonald's Franchisees,' *The Journal of Law and Economics*, **37**(2), pp. 417-453.

[17] Kaufmann, P. J. and Rangan, V. K., 1990, 'A Model for Managing System Conflict During Franchise Expansion,' *Journal of Retailing*, **66**(2), pp. 155-173.

[18] Lafontaine, F., 1992, 'Agency Theory and Franchising: Some Empirical Results,' *RAND Journal of Economics*, **23**(2), pp. 263-283.

[19] Li, Z.; Gilbert, S. M. and Lai, G., 2014, 'Supplier Encroachment under Asymmetric Information,' *Management Science*, **60**(2), pp. 449-462.

[20] Li, Z.; Gilbert, S. M. and Lai, G., 2015, 'Supplier Encroachment as an Enhancement or a Hindrance to Nonlinear Pricing,' *Production and Operations Management*, **24**(1), pp. 89-109.

[21] Marx, L. M. and Shaffer, G., 2004, 'Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity, and Uniformity: Comment,' *American Economic Review*, **94**(3), pp. 796-801.

[22] McAfee, R. P. and Schwartz, M., 1994, 'Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity and Uniformity,' *American Economic Review*, **84**(1), pp. 210-230.

[23] Michael, S. C. and Moore, H. J., 1995, 'Returns to Franchising,' *Journal of Corporate Finance*, **2**(1995), pp. 133-155.

[24] O'Brien, D. P. and Shaffer, G., 1992, 'Vertical Control with Bilateral Contracts,' *RAND Journal of Economics*, **23**(3), pp. 299-308.

[25] Pan, C., 2016, 'Retailer's Product Line Choice with Manufacturer's Multichannel Marketing,' ISER Discussion Paper No. 938. Available at SSRN: http://ssrn.com/abstract=2808837.

[26] Park, T., 2015, 'Direct Marketing and the Structure of Farm Sales: An Unconditional Quantile Regression Approach,' *Journal of Agricultural and Resource Economics*, **40**(2), pp. 266-284.

[27] Randall, T.; Netessine, S. and Rudi, N., 2006, 'An Empirical Examination of the Decision to Invest in Fulfillment Capabilities: A Study of Internet Retailers,' *Management Science*, **52**(4), pp. 567-580.

[28] Reisinger, M. and Tarantino, E., 2015, 'Vertical Integration, Foreclosure, and Productive Efficiency,' *RAND Journal of Economics*, **46**(3), pp. 461-479.

[29] Rey, P. and Vergé, T., 2004, 'Bilateral Control with Vertical Contracts,' *RAND Journal of Economics*, **35**(4), pp. 728-746.

[30] Tannenbaum, J., 1995, 'Franchisees Resist Poaching via Software, Kiosks, Internet,' *Wall Street Journal*, October 30.

[31] Tsay, A. A. and Agrawal, N., 2004, 'Channel Conflict and Coordination in the E-Commerce Age,' *Production and Operations Management*, **13**(1), pp. 93-110.

[32] Villas-Boas, J. M., 1998, 'Product Line Design for a Distribution Channel,' *Marketing Science*, **17**(2), pp. 156-169.

[33] Vives, X. 1999. *Oligopoly Pricing: Old Ideas and New Tools*, Cambridge, Mass. MIT Press.