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A manufacturer's incentive to open its direct channel and its impact on welfare*

Noriaki Matsushima†, Tomomichi Mizuno‡, Cong Pan§

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Abstract

We consider a bilateral monopoly wherein a manufacturer can open its direct channel that is less efficient than the existing retailer. We show the following results. The manufacturer opens its direct channel if its bargaining power over the existing retailer is weak. In a quantity competition, opening the direct channel is detrimental to social welfare if the direct channel's inefficiency level is low, but beneficial to social welfare if the inefficiency level is high. In a price competition with horizontally differentiated channels, opening the direct channel is detrimental to social welfare if the direct channel's inefficiency level is high.

Keywords: distribution channels, supplier encroachment, two-part tariff contract, welfare

JEL Classification Numbers: L14, L22, M11, D43

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1 Introduction

Manufacturers often open their own direct channels to expand accessibility to consumers even when they indirectly sell products through traditional retail channels. Owing to the tougher downstream competition in those markets, such introductions of direct channels, known as "encroachment," intuitively seem welfare-improving, although existing retailers that trade with those manufacturers fall into difficulties to maintain profits as large as before. Such a positive effect of encroachment on welfare seems more likely to hold if a manufacturer's direct channel is an efficient one. This fact has put policymakers in a dilemma of whether encroachment should be given policy support from the perspective of social welfare or legally restrained to protect existing retailers' benefits (Kalnins, 2004).[1]

Because of the common expectation of a positive impact of encroachment on welfare (Dutta et al., 1999; Blair and Lafontaine, 2005), the welfare magnitude of this important issue has not been theoretically considered in the economics literature, except for the recent study by Pan (2018), who considers an *ex ante* downstream duopoly wherein two retailers are offered take-it-or-leave-it contracts secretly from a monopoly manufacturer.[2] The main focus of Pan (2018) is to show that encroachment may result in higher price and lower consumer surplus although the negative impact of encroachment on social welfare is also discussed in his concluding remarks.[3] A manufacturer using encroachment to solve its com-

[1] Some theoretical studies even show that such an introduction of a direct channel does not always harm existing retailers (see Arya et al., 2007; Matsushima and Mizuno, 2018). These studies provide theoretical support for the positive effect of encroachment on existing retailers.

[2] This market structure is extensively discussed in the literature on supplier opportunism. The main finding is that under such a structure, the upstream monopolist faces a commitment problem in that it fails to achieve a monopoly outcome (e.g., Hart and Tirole, 1990; McAfee and Schwartz, 1994; Reisinger and Tarantino, 2015).

[3] Since the pioneering work by Chiang, Chhajed, and Hess (2003) discussing direct marketing by a manufacturer (manufacturer's encroachment), the topic has been discussed by many other researchers (e.g., Cattani *et al.*, 2006; Kumar and Ruan, 2006; Yoo and Lee, 2011; Mizuno, 2012; Hsiao and Chen, 2013, 2014; Matsui, 2016). However, a detrimental effect of manufacturer encroachment has not been pointed out until the recent work by Pan (2018).

mitment problem plays a key role in Pan (2018), meaning that the counterintuitive result is driven by two important elements: (i) the *ex ante* downstream duopoly of existing retail channels and (ii) contract secrecy. Specifically, in Pan (2018), encroachment may reduce social welfare because it changes the market outcomes from an *ex ante* duopoly to an *ex post* quasi-monopoly.[4] Moreover, he does not discuss the impact of encroachment on existing retailers because their *ex ante* and *ex post* profits are always zero owing to take-it-or-leave-it offers.

In this study, we consider a manufacturer–retailer (bilateral monopoly) relation so that the manufacturer's commitment problem is no longer a concern. A bargaining problem is also considered so that the pros and cons of encroachment can be tracked from the perspectives of all the players. Further, the *ex ante* market status is a bilateral monopoly in our study, implying that our result is motivated by a different and new mechanism than in Pan (2018).

We consider a bilateral monopoly where a manufacturer can open its direct channel which is less efficient than the existing retailer. A two-part tariff contract is considered. We need to compare two cases: (i) the manufacturer does not open its direct channel and (ii) it opens its direct channel, inducing a downstream duopoly. In the second case, we consider both quantity and price competition.

In the first case, the manufacturer and retailer decide their contract terms through Nash bargaining, inducing them to set the unit price at the manufacturer's marginal production cost in equilibrium. In the second case, the bargaining partners maximize their joint profit including the profit of the manufacturer's direct channel, which distorts the unit price in equilibrium. This is because the trading pair needs to balance the volume of supply in both the direct and indirect channels by controlling the unit price.

Under a quantity competition, we first show that the manufacturer opens its direct chan-

[4] We call the *ex post* status a quasi-monopoly because it is exactly a monopoly only when selling directly is as efficient as selling via existing retailers.

nel if its bargaining power over the existing retailer is weak. We further show that opening the manufacturer's direct channel is detrimental to social welfare if the direct channel's inefficiency level is low, but beneficial to social welfare if the inefficiency level is high.

The welfare property is a novelty of our study. The intuition is as follows. When the manufacturer decides the quantity in the direct channel, it neglects the impact on the indirect channel's quantity, inducing a standard asymmetric Cournot duopoly outcome. Hence, the unit price becomes the only strategic tool for the trading pair to balance shares in different channels. If the direct channel's inefficiency level is low, to maximize the joint profit, the trading pair needs to significantly restrict the indirect channel's quantity through a high unit price, leading to a large supply volume in the direct channel which is still less efficient than the indirect channel. The restriction on the indirect channel's supply becomes stronger as the inefficiency level of the direct channel grows lower. On the other hand, if the direct channel's inefficiency level is high such that the market share of the direct channel is small enough, the manufacturer would give a subsidy to the indirect channel, leading to a large total quantity.

Under a price competition wherein the direct and indirect channels are horizontally differentiated, we first show a similar condition that the manufacturer opens its direct channel. We then show that opening the manufacturer's direct channel is detrimental to social welfare if the direct channel's inefficiency level is high, contrasting with the welfare property in the quantity competition.

Contrary to the quantity competition, under a price competition, the manufacturer's price directly affects the indirect channel's share, which improves the effectiveness of balancing shares in different channels through the unit price. The manufacturer thus does not need to subsidize the indirect channel even if its direct channel's inefficiency level is high, which is in sharp contrast with the result in the quantity competition. Therefore, the encroachment always results in a higher unit price, which diminishes social welfare.

The above outcomes have some important policy implications. The realized market share

of an encroaching manufacture may not be adequate as an indicator to evaluate the welfare effect of the encroachment. Specifically, a small *ex post* market share of the direct channel may indicates a welfare-enhancing encroachment and a negative unit price in a quantity competition, but a welfare-reducing encroachment and a positive unit price in a price competition. That is, the relations between the welfare effect of encroachment and the direct channel's market share are completely reverse under the two competition modes. Despite this, we could say that the manufacturer's encroachment tends to be harmful only if the input price in the indirect channel is strictly positive. This implies that it would be better for competition authorities to pay more attention to the claim by an existing retailer that trades with an encroaching manufacturer if the claim is based on an increase in its unit price. This is another novelty of our study.

Besides Pan (2018), another closely related study is Reisinger and Tarantino (2015). A monopoly manufacturer that secretly supplies two competing retailers with asymmetric marginal costs in a take-it-or-leave-it manner (downstream duopoly) faces a commitment problem. The authors study the manufacturer's incentive for vertical integration in solving this problem. The main finding is that when the manufacturer chooses to integrate with the inefficient retailer, it will subsidize the other efficient retailer to optimally reallocate the channel distribution.[5] This finding implies that vertical integration is welfare-improving (welfare-reducing) if and only if the degree of subsidization is high (low). This setting is similar to ours in that encroachment can also be comprehended as downward integration with an inactive retailer. However, in Reisinger and Tarantino (2015), integration with the inefficient retailer rather than the efficient one is always suboptimal for the manufacturer, implying that the welfare-reducing impact of vertical integration can only happen off the equilibrium path.[6] Conversely, our study offers a new insight that the welfare-reducing downward entry

[5] The Nash bargaining setting is also considered in the web appendix of Reisinger and Tarantino (2015).

[6] As an extension of their model, by incorporating marginal cost uncertainty, they show that both downstream retailers can be chosen by the manufacturer as a partner for vertical integration.

may actually happen in equilibrium.

The remainder of the paper is as follows. Section 2 provides the model setting. Section 3 shows the analytical outcomes of the model in a quantity competition. Section 4 presents the welfare property of the outcomes in Section 3. Section 5 discusses a price competition. Section 6 concludes.

2 Model

Let us first consider a monopoly supply chain that comprises one upstream manufacturer U and one downstream retailer D. U supplies final products to D that then resells them to consumers. U can also choose whether to directly supply to consumers through a direct channel, which is known as "supplier encroachment." We assume that D incurs no cost in the reselling process. On the contrary, when U encroaches, it incurs a positive marginal cost for retailing c.[7] For simplicity, U's production cost is normalized to zero.

The trading term between U and D is determined through a negotiation over a two-part tariff contract comprising a unit price w and a fixed fee f. The negotiation outcome is decided by the Nash bargaining solution.[8] The bargaining power of U over D is $\beta \in (0, 1)$. We assume that U's direct channel and D supply homogeneous final products in the retail market.[9] Denote D's quantity by q_D and U's by q_U (if it encroaches). We assume that the

[7] The assumption that retailers are more efficient than manufacturers is common in the literature. Such an efficiency gap occurs for various reasons. For example, in competition between bricks-and-mortar retailers and manufacturers' online stores, the latter are less familiar with consumers' preferences than the former, which benefit from direct contact (Arya et al., 2007). Moreover, the latter incur higher transportation costs by shipping directly to consumers, whereas the former benefit from bulk shipping (Li et al., 2015). Further, the latter must risk returns and redress because consumers cannot physically inspect products before ordering (Pan, 2016).

[8] Employing the Nash bargaining solution is common in the literature (e.g., Horn and Wolinsky, 1988; Inderst and Wey, 2003; Iozzi and Valletti, 2014; Gaudin, 2017). Section 1 in Gaudin (2017) clearly explains the literature.

[9] If they compete in heterogeneous products, U would have a stronger incentive to encroach because it would enjoy an market expansion effect by doing so.

inverse demand function $P(Q)$ for final products is nonnegative, strictly decreasing, and twice differentiable, where P is the price and Q is the total quantity sold in the retail market. To guarantee that profit functions are strictly quasi-concave and that resale competition involves strategic substitutability, we assume $P'(Q) + QP''(Q) < 0$ (Vives, 1999).

The game proceeds as follows. In stage 1, U chooses whether to encroach. In stage 2, U and D negotiate over the two-part tariff contract. In stage 3, if U encroached in stage 1, D and U simultaneously set their own quantities; otherwise, only D sets its own quantity.

The timeline in which U's encroaching decision comes before the contracting process follows the idea that starting a direct channel is relatively irreversible and thus must be taken prudently. For example, to conduct direct sales, whether through an online store or a physical direct store, U has to deal with resale issues such as inventory and siting locations, which are always regarded as long-term decisions.

3 Analysis

The game is solved by backward induction. Based on U's decision in stage 1, there are two types of subgames: U encroaches or not. We use the superscripts e and n to denote each subgame. Note that the Nash bargaining process naturally guarantees that the negotiation between U and D succeeds in equilibrium and that U does not foreclose D because D is more efficient than U's direct channel.

3.1 U does not encroach

First, we discuss the subgame wherein U does not encroach. In stage 3, given the unit price assigned in stage 2, D sets quantity q to maximize its profit:

$$q(w) \equiv \arg\max_{q} \left(P(q) - w\right) q.$$

To simplify the notation, we define the industry profit as $\Pi^M(w) \equiv P(q(w))q(w)$, where the superscript M represents the integrated monopoly.[10] Anticipating the outcome in stage 3, U and D know that if the negotiation succeeds, they can obtain

$$\pi_U^n = wq(w) + f, \;\; \pi_D^n = (P(q(w)) - w)\, q(w) - f.$$

On the contrary, if the negotiation breaks down, both of them obtain zero profits. The negotiation in stage 2 specifies the contract as follows:

$$\max_{w,f} \{\pi_U^n\}^{\beta} \{\pi_D^n\}^{1-\beta}.$$

The first-order condition can be denoted as follows:

$$\begin{aligned} &\frac{\partial q}{\partial w} w = 0; \\ &f = \beta \Pi^M(w) - wq(w), \end{aligned} \tag{1}$$

leading to

$$w^n = 0; \;\; f^n = \beta \Pi^M(0).$$

The corresponding profits of U and D are

$$\pi_U^n = \beta \Pi^M(0); \;\; \pi_D^n = (1-\beta)\Pi^M(0).$$

[10] In this case, U and D act as if they are integrated as one agent. They jointly solve their maximization problem and then divide the aggregate profit based on their bargaining powers. The payments via the unit price become internal transfers and thus do not affect the industry profit.

This result is standard. With a two-part tariff contract, U always sets the unit price to its production cost (zero) and abstracts D's surplus through the fixed fee based on its bargaining power.

3.2 U encroaches

Next, let us consider the subgame wherein U encroaches. In this case, it sells through both D and its direct channel. The following maximization problems in stage 3 are

$$\max_{q_D} \ (P(q_D, q_U) - w)\, q_D - f, \ \ \max_{q_U} \ (P(q_D, q_U) - c)\, q_U + q_D w + f,$$

leading to the subgame quantities: $q_D(w, c)$ and $q_U(w, c)$. We define the industry profit as follows (we use the superscript I to represent it):

$$\Pi^I(w, c) \equiv P(q_D(w, c), q_U(w, c))q_D(w, c) + [P(q_D(w, c), q_U(w, c)) - c]q_U(w, c).$$

If the negotiation succeeds, they can obtain

$$\pi_U^e(w, c, f) = [P(q_D(w, c), q_U(w, c)) - c]q_U(w, c) + wq_D(w, c) + f,$$
$$\pi_D^e(w, c, f) = [P(q_D(w, c), q_U(w, c)) - w]q_D(w, c) - f.$$

On the contrary, if the negotiation breaks down, U has a disagreement payoff in which it directly sells and monopolizes the retail market with marginal cost c, although D gains zero profit. The profits of U and D in the negotiation breakdown are given as

$$\tilde{\pi}_U^e = \Pi^M(c), \ \ \tilde{\pi}_D^e = 0.$$

The bargaining problem in stage 2 is given as

$$\max_{w,f} \ \{\pi_U^e(w,c,f) - \tilde{\pi}_U^e\}^{\beta} \{\pi_D^e(w,c,f) - \tilde{\pi}_D^e\}^{1-\beta},$$

leading to

$$\begin{aligned} w^e &\equiv \arg\max_{w} \ \Pi^I(w,c) - \Pi^M(c), \\ f^e &= (1-\beta)\left[\Pi^M(c) - (P(q_D(w^e,c) + q_U(w^e,c)) - c)q_U(w^e,c)\right] \\ &\qquad +\beta[P(q_D(w^e,c) + q_U(w^e,c))q_D(w^e,c)] - w^e q_D(w^e,c). \end{aligned}$$

Owing to the bargaining procedure, they set w as if they maximize their joint profit through the control of w and split the maximized joint profit through fixed fee f. By using the envelop theorem, we derive the first-order condition of w:

$$\frac{\partial q_D}{\partial w} w + \underbrace{P'(\cdot)\frac{\partial q_D}{\partial w} q_U}_{\textit{positive effect on } w} + \underbrace{P'(\cdot)\frac{\partial q_U}{\partial w} q_D}_{\textit{negative effect on } w} = 0. \tag{2}$$

In addition to the first term of Eq. (1) in the case without encroachment, the second and third terms are included. Those terms reflect the control of the downstream quantities through w. Specifically, the second term of Eq. (2) denotes a positive effect on w from the direct channel, while the third term denotes a negative one from the indirect channel. Intuitively, as marginal cost c increases, the relative efficiency of D improves, inducing the bargaining pair to increase q_D through a decrease in w.

We remark on the equilibrium property in the second- and third-stage outcomes. D's quantity q_D is ultimately controlled by unit price w, which implies that the two-part tariff contract can be regarded as a quantity-based one, (q_D, f). We can convert the procedure in the second and third stages as follows: the bargaining in stage 2 is that U chooses q_D to

maximize the joint profit of the bargaining pair, anticipating $q_U(q_D)$, which will be chosen by U's direct channel in stage 3. In stage 3, because U has already levied the fees on D in stage 2, it ignores the impact on D's profit. In other words, U solves the following:

$$\max_{q_U} [P(q_D, q_U) - c]q_U,$$

from which we have U's best-response function $q_U(q_D, c)$. In stage 2, U solves the following:

$$\max_{q_D} [P(q_D, q_U(q_D, c)) - c]q_U(q_D, c) + P(q_D, q_U(q_D, c))q_D - \Pi^M(c). \tag{3}$$

Lemma 1 *The optimal q_D is given by*

$$q_D^e = -c \times \frac{(P''q_U + 2P')}{(P')^2} (> 0). \tag{4}$$

Proof. The first-order condition of U's direct channel in stage 3 is given by

$$P'q_U + P - c = 0. \tag{5}$$

Totally differentiating Eq. (5) gives rise to

$$\frac{dq_U}{dq_D} = -\frac{P''q_U + P'}{P''q_U + 2P'}. \tag{6}$$

By using Eq. (6), the maximization problem in Eq. (3) can be derived as

$$\begin{aligned} & [P'q_U + P - c]\frac{dq_U}{dq_D} + P'q_D\frac{dq_U}{dq_D} + P'q_U + P'q_D + P = 0 \\ \Rightarrow \quad & P'q_D\frac{dq_U}{dq_D} + c + P'q_D = 0 \\ \Rightarrow \quad & q_D = \frac{-c}{P' \times (1 + dq_U/dq_D)}. \end{aligned}$$

Substituting Eq. (6) into the last equation gives rise to the expression in Lemma 1. Because of strategic substitutability, q_D is positive. □

Lemma 1 implies that as long as D has a cost advantage, it is always assigned a positive share proportional to c by U. Because of continuity, it is straightforward that when c is almost zero, q_D^e will be close to zero. Owing to strategic substitutability, q_U^e will be close to the monopoly quantity under which its marginal cost is zero. Then, the positive effect in Eq. (2) becomes a dominant one so that $w^e > 0$. On the contrary, when c is relatively large so that q_U^e is almost zero, the negative effect becomes a dominant one so that $w^e < 0$. This fact is summarized by the following lemma:

Lemma 2 *For a small c,* $w^e > 0$. *For a relatively large c,* $w^e < 0$.

D is possibly offered either a tax or a subsidy in a bilateral monopoly with a two-part tariff contract. Given that U has committed to encroachment, when its direct channel is efficient, it would rather restrain D's sales and shift some share back to U's direct channel. On the other hand, when the efficiency advantage in the indirect channel is large enough, U tends to restrain its own sale and promote the indirect channel.

In Reisinger and Tarantino (2015), when a manufacturer supplies duopoly retailers with asymmetric marginal costs and the manufacturer integrates with the less efficient retailer, the more efficient one will be offered a subsidy. Although this result is similar to Lemma 2, their finding is essentially different to ours because we consider the case wherein the manufacturer creates a new retailer (i.e., encroachment) instead of integrating with an incumbent one. In other words, the baseline situation in Reisinger and Tarantino (2015) is an asymmetric downstream duopoly with a monopoly manufacturer, whereas that in our study is a bilateral monopoly with the possibility of supplier encroachment. Moreover, in our study, the manufacturer's decision on whether to encroach is explicitly considered and the subsidy can exist in the subgame perfect equilibrium. This part is discussed after we derive Proposition

1.

3.3 U's incentive to encroach

Given a certain w^e that satisfies Eq. (2), the corresponding profits in this subgame can be denoted as

$$\pi_U^e = \beta\Pi^I(w^e, c) + (1-\beta)\Pi^M(c); \;\; \pi_D^e = (1-\beta)[\Pi^I(w^e, c) - \Pi^M(c)].$$

To restrict our attention to the parameter range wherein encroachment happens in equilibrium, we need to confirm U's incentive to encroach within the parameter range wherein its direct channel is active. Let $\hat{c}$ such that $q_U^e > 0$ for any $c < \hat{c}$. By comparing π_U^n with π_U^e, we derive the following equation:

$$\pi_U^e - \pi_U^n = \beta[\Pi^I(w^e, c) - \Pi^M(0)] + (1-\beta)\Pi^M(c). \tag{7}$$

Compared with the monopoly case with zero marginal cost, the industry profit of the duopoly case with one agent having a positive marginal cost (i.e., $c > 0$) is strictly lower, no matter how U chooses w^e. In other words, an efficiency loss at the industry level is inevitable. Hence, the first term of Eq. (7) is always negative. On the contrary, when $c < \hat{c}$, the second term must be positive.[11] Therefore, whether U encroaches is decided by U's bargaining power, which is summarized in Proposition 1.

Proposition 1 *Given that $c < \hat{c}$, U encroaches when its bargaining power is relatively small. Formally,*

$$\beta < \frac{\Pi^M(c)}{\Pi^M(c) + \Pi^M(0) - \Pi^I(w^e, c)}.$$

[11] $\Pi^M(c)$ is positive if the monopoly price is higher than c. The condition $c < \hat{c}$ guarantees that q_U^e is positive in duopoly competition and thus that the duopoly price is higher than c. Because the monopoly price is always higher than the duopoly price, $\Pi^M(c)$ must be positive if $c < \hat{c}$ is satisfied.

When U's bargaining power is weak, the transfer from D in the bilateral monopoly is small. Encroachment enhances U's bargaining position through an increase in its disagreement payoff, whereas it diminishes the total industry profit.

The threshold value of β in Proposition 1 is always located in the interval $(0, 1)$. Then, by comparing it with the case of no encroachment, U's encroachment may either raise or reduce the unit price contingent on the value of c, which contrasts with most of the literature on supplier encroachment.[12]

4 Welfare

We check the impact of U's encroachment on the social welfare and consumer surplus. First, we consider it under the general demand function. Second, by employing a linear demand function, we explicitly solve the problem in the previous section. Notice that all welfare analyses will be carried out with β satisfying the inequality in Proposition 1. As will be shown below, all of our results are independent of β, so they can exist as equilibrium outcomes.

The social welfare and consumer surplus are denoted by

$$\begin{aligned} W^e &= \int_0^{q_U(q_D(c),c)+q_D(c)} P(x)dx - c \times q_U(q_D(c), c); \\ CS^e &= W^e - \pi_U^e - \pi_D^e. \end{aligned}$$

The next proposition summarizes how the encroachment affects welfare and consumer surplus when c is small.

[12] In all studies modeling a linear contract, the unit price must reduce after encroachment (e.g., Arya et al., 2007); by contrast, in all research that models a two-part tariff contract, the unit price must increase after encroachment (e.g., Matsushima and Mizuno, 2018; Pan, 2018).

Proposition 2 *For a small c, U's encroachment is detrimental to social welfare, but beneficial to consumer surplus.*

Proof. When $c = 0$, $W^e = W^n$ and $CS^e = CS^n$. By continuity, it suffices to prove $dW^e/dc < 0$ and $dCS^e/dc > 0$ at $c = 0$. By differentiating W^e and CS^e with respect to c, we have

$$\begin{aligned}\frac{dW^e}{dc} &= P \times \frac{d(q_U(q_D(c), c) + q_D(c))}{dc} - q_U(q_D(c), c) - c \times (q_U(q_D(c), c))', \\ \frac{dCS^e}{dc} &= \frac{dW^e}{dc} - \frac{d\pi_U^e}{dc} - \frac{d\pi_D}{dc} = -P' \times (q_U(q_D(c), c) + q_D(c)) \times \frac{d(q_U(q_D(c), c) + q_D(c))}{dc}.\end{aligned} \tag{8}$$

At $c = 0$,

$$\begin{aligned}\left.\frac{d(q_U(q_D(c), c) + q_D(c))}{dc}\right|_{c=0} &= (dq_U/dq_D + 1) \left.\frac{dq_D(c)}{dc}\right|_{c=0} + \left.\frac{\partial q_U}{\partial c}\right|_{c=0} \\ &= -\frac{P'}{P''q^M + 2P'} \times \frac{(P''q^M + 2P')}{(P')^2} + \frac{1}{P''q^M + 2P'} \\ &= -\frac{P''q^M + P'}{P'(P''q^M + 2P')} > 0,\end{aligned} \tag{9}$$

where q^M is the monopoly quantity in which the marginal cost is zero.[13] Using Eqs. (8), (9) and Eq. (5) at $c = 0$, we obtain

$$\begin{aligned}\left.\frac{dW^e}{dc}\right|_{c=0} &= -P\frac{P''q^M + P'}{P'(P''q^M + 2P')} - q^M = \frac{P}{P''q^M + 2P'} < 0, \\ \left.\frac{dCS^e}{dc}\right|_{c=0} &= q^M \frac{P''q^M + P'}{P''q^M + 2P'} > 0.\end{aligned} \tag{10}$$

□

The intuition of Proposition 2 can be understood as follow. Firstly, a small c will result in a higher q_U in the direct channel, which is a first-order effect. Moreover, according to Eqs. (2) and (4), a small c will motivate U to charge a high w, which implies that there is

[13] By substituting Eq. (6) into the first line of Eq. (9), we obtain the first fraction in the second line of Eq. (9). By simply differentiating q_D in Eq. (4) with respect to c, we obtain the second fraction in the second line of Eq. (9). Finally, from the partial derivative of q_U in Eq. (5) with respect to c, we obtain $\partial q_U/\partial c$ at $c = 0$.

a second-order effect to further raise q_U. Hence, when c is small, the market share of U's direct channel is large, implying that the relatively inefficient channel handles most retailing. This inefficient allocation of supply worsens the social welfare.

Next, we discuss the case wherein c is so large that U is almost inactive in retailing, or namely c is close to $\hat{c}$ such that $q_U(\hat{c}) = 0$. How social welfare and consumer surplus are affected by the encroachment is summarized by the next proposition:

Proposition 3 *For a relatively large c, U's encroachment is beneficial to both social welfare and consumer surplus.*

Proof. By continuity, it suffices to prove $W^e > W^n$ and $CS^e > CS^n$ at $c = \hat{c}$. Furthermore, at $c = \hat{c}$, because $q_U = 0$, D becomes a monopolist whose quantity q_D^e is positively related to both W^e and CS^e. Because q_D^e solves $P'q_D + P - w = 0$, we only need to prove that $w^e < w^n = 0$.

By substituting $q_U = 0$ into Eq. (2), we have

$$w^e = -\frac{P'q_D(\partial q_U/\partial w)}{\partial q_D/\partial w} < 0. \tag{11}$$

□

Proposition 3 follows from the a mechanism opposite to that in Proposition 2. Specifically, a relatively large c not only results in a small q_U, but also motivates U to subsidize D to further promote the share in the indirect channel. Hence, even though the direct channel becomes an inefficient one in this case, the relatively efficient channel, namely the indirect one, handles most retailing, which means an efficient allocation.

Notice that the encroachment always increases consumer surplus when c is either small or large, which differs from Pan (2018) who demonstrates that the encroachment reduces consumer surplus when c is small.[14] Moreover, the encroachment inducing D being either

[14] Pan and Yoshida (2018) consider an international oligopoly wherein domestic manufacturers compete with

levied a tax when c is small or subsidized when c is large implies that D may either benefit or be hurt from U's direct selling.[15] This finding implies that an increase in w can be a signal that encroachment is welfare-reducing and that the competition authority should consider a claim by an existing retailer that trades with an encroaching manufacturer if the claim is based on an increase in its unit price.

5 Price competition

We discuss price competition. When U does not encroach, it offers D a unit price $w^n = 0$. D sets $p_D^n = p^M$, where p^M is the monopoly price in which the marginal cost is zero When U encroaches, the demand functions are given by $Q_U(p_U, p_D)$ and $Q_D(p_U, p_D)$. The profits of U and D are

$$\pi_U^e = (p_U - c)Q_U(p_U, p_D) + wQ_D(p_U, p_D) + f, \tag{12}$$

$$\pi_D^e = (p_D - w)Q_D(p_U, p_D) - f. \tag{13}$$

We impose the following assumptions: $\partial Q_i/\partial p_i < 0$ (law of demand); $\partial Q_i/\partial p_j > 0$ (product substitution); $|\partial Q_U/\partial p_U| > |\partial Q_U/\partial p_D|$ (the direct effect is stronger than the cross effect), $\partial^2\pi_i^e/\partial p_i^2 < 0$ (the standard second-order condition); $\partial^2\pi_i^e/\partial p_i\partial p_j > 0$ (strategic complementarity), $\partial^2\pi_U^e/\partial p_U^2 + \partial^2\pi_U^e/(\partial p_D\partial p_U) < 0$ and $\partial^2\pi_D^e/\partial p_D^2 + \partial^2\pi_D^e/(\partial p_D\partial p_U) < 0$ (stability for equilibrium).

We first check how w^e affects the retail prices. In the final stage, the first-order conditions

foreign manufacturers who carry out FDI and sell foreign-made products directly through e-commerce sites. In that study, foreign manufacturers' cost disadvantage in direct selling is captured by a specific tariff. Although similar in market structure, Pan and Yoshida (2018) focus on the case wherein direct selling happens, which is one subgame in our study.

[15]This also differs from Pan (2018) who considers a take-it-or-leave-it contract offered by a monopoly manufacturer so that the incumbent retailers always have zero profits.

are given as

$$\frac{\partial \pi_U^e}{\partial p_U} = Q_U(p_U, p_D) + (p_U - c)\frac{\partial Q_U(p_U, p_D)}{\partial p_U} + w\frac{\partial Q_D(p_U, p_D)}{\partial p_U} = 0, \tag{14}$$

$$\frac{\partial \pi_D^e}{\partial p_D} = Q_D(p_U, p_D) + (p_D - w)\frac{\partial Q_D(p_U, p_D)}{\partial p_D} = 0. \tag{15}$$

The total differentials of the first-order conditions are given as

$$\frac{\partial^2 \pi_U^e}{\partial p_D \partial p_U} dp_D + \frac{\partial^2 \pi_U^e}{\partial p_U^2} dp_U + \frac{\partial Q_D(p_U, p_D)}{\partial p_U} dw = 0, \tag{16}$$

$$\frac{\partial^2 \pi_D^e}{\partial p_D^2} dp_D + \frac{\partial^2 \pi_D^e}{\partial p_D \partial p_U} dp_U - \frac{\partial Q_D(p_U, p_D)}{\partial p_D} dw = 0. \tag{17}$$

Solving them with respect to dp_D and dp_U, we have

$$\frac{dp_D}{dw} = -\left(\frac{\partial Q_D(p_U, p_D)}{\partial p_D} \cdot \frac{\partial^2 \pi_U^e}{\partial p_U^2} + \frac{\partial Q_D(p_U, p_D)}{\partial p_U} \cdot \frac{\partial^2 \pi_D^e}{\partial p_D \partial p_U}\right)/\Delta, \tag{18}$$

$$\frac{dp_U}{dw} = \left(\frac{\partial Q_D(p_U, p_D)}{\partial p_D} \cdot \frac{\partial^2 \pi_U^e}{\partial p_D \partial p_U} + \frac{\partial Q_D(p_U, p_D)}{\partial p_U} \cdot \frac{\partial^2 \pi_D^e}{\partial p_D^2}\right)/\Delta, \tag{19}$$

$$\text{where } \Delta \equiv \frac{\partial^2 \pi_D^e}{\partial p_D \partial p_U} \cdot \frac{\partial^2 \pi_U^e}{\partial p_D \partial p_U} - \frac{\partial^2 \pi_D^e}{\partial p_D^2} \cdot \frac{\partial^2 \pi_U^e}{\partial p_U^2} < 0, \tag{20}$$

where the last inequality is the Routh-Hurwitz stability condition (Hinloopen, 2015). The second terms in Eqs. (18) and (19) correspond to U's strategic incentives to earn profits from the indirect channel through w. Under the assumptions, both dp_D/dw and dp_U/dw are positive. Intuitively, raising w will increase both p_D and p_U owing to U's incentive to increase its indirect profit and the strategic complementarity between p_D and p_U.

Next, we see how the optimal unit price is decided in stage 2. The optimal w maximizes U and D's joint profit, namely $\pi_U^e + \pi_D^e$. By using envelop theorem, we derive the first-order

condition of w:

$$\frac{\partial Q_D}{\partial p_D}\frac{dp_D}{dw}w + \underbrace{(p_U - c)\frac{\partial Q_U}{\partial p_D}\frac{dp_D}{dw}}_{\textit{positive effect on } w} + \underbrace{p_D\frac{\partial Q_D}{\partial p_U}\frac{dp_U}{dw}}_{\textit{positive effect on } w} = 0. \tag{21}$$

Because both p_D and p_U increase in w, the encroachment generates positive effects on w in both direct and indirect channels. This implies that when encroachment happens, U always charges D a tax, which is summarized by the following lemma:

Lemma 3 *In a price competition, when encroachment happens, $w^e > 0$.*

The above fact substantially differs from the quantity competition case wherein D is subsidized for a relatively large c.

Now we check the welfare property in the price competition. In order to validate our analyses in equilibrium, we assume U's bargaining power satisfies the inequality in Proposition 1 with w^e being defined by Eq. (21). The different property of w^e here consequently gives rise to a different welfare property, comparing with that in the quantity competition. We summarize this finding by the following proposition:

Proposition 4 *In a price competition, for a relatively large c, U's encroachment is detrimental to social welfare.*

Proof. We first prove that $dQ_U/dc < 0$. By totally differentiating Eqs. (14) and (15), we have

$$\frac{dp_U}{dc} = \frac{\partial Q_U/\partial p_U}{\partial^2\pi_U^e/\partial p_U^2} > 0, \tag{22}$$

$$\begin{aligned}\frac{dp_D}{dc} &= \frac{dp_D}{dp_U}\frac{dp_U}{dc} \\ &= -\frac{\partial^2\pi_D^e/(\partial p_U\partial p_D)}{\partial^2\pi_D^e/\partial p_D^2}\times\frac{dp_U}{dc}.\end{aligned} \tag{23}$$

From the stability of equilibrium,

$$0 < \frac{dp_D}{dc} < \frac{dp_U}{dc}. \tag{24}$$

Because $|\partial Q_U/\partial p_U| > |\partial Q_U/\partial p_D|$, we have

$$\frac{dQ_U}{dc} = \frac{\partial Q_U}{\partial p_U}\frac{dp_U}{dc} + \frac{\partial Q_U}{\partial p_D}\frac{dp_D}{dc} < 0. \tag{25}$$

In addition, there exist a $\tilde{c}$ such that for $c \geq \tilde{c}$, $Q_U = 0$.

Now, let $Q^M(p)$ be the demand function for a monopolist. Let $q^M(w) = Q^M(p(w))$ be the the monopoly quantity with the marginal cost w. By continuity, it suffices to prove $W^e < W^n$ at $c = \tilde{c}$. Furthermore, at $c = \tilde{c}$, D becomes a monopolist whose quantity Q_D^e is positively related to W^e. Then, it suffices to prove that $Q_D^e < Q_D^n = Q^M(p(w^n)) = q^M(w^n)$.

Given w^e decided in stage 2 and $\tilde{p}_U$ decided by U in stage 3, D's quantity will be

$$Q_D^e = \begin{cases} Q^M(p^D) & \text{if } p_D < \tilde{p}_D, \\ Q_D(\tilde{p}_U, p_D) & \text{if } p_D \geq \tilde{p}_D, \end{cases} \tag{26}$$

where $p_D = \tilde{p}_D$ is the threshold value with which $Q_U(\tilde{p}_U, p_D) = 0$. Hence, $Q_D^e = Q_D(\tilde{p}_U, \tilde{p}_D) \leq q^M(w^e) < q^M(w^n)$.

□

The intuition is as follow. In the price competition, U's strategic variable p_U has a direct impact on D's quantity, while its strategic variable in the quantity competition, q_U, does not. Here, U can control the share in its direct and indirect share through p_U, without bearing a revenue loss in the indirect channel caused by lowering w^e. Therefore, even though U is almost inactive in direct selling as c approaches $\tilde{c}$, the indirect channel handles retailing in an inefficient way, which causes a welfare loss.

6 Conclusion

We consider a bilateral monopoly model in which an upstream manufacturer that trades with a downstream retailer can open its direct channel (so-called supplier encroachment). We show that encroachment by the manufacturer may harm social welfare, although it changes the downstream market from a monopoly to a duopoly. This finding complements the recent study by Pan (2018), who also shows that supplier encroachment may harm social welfare in an *ex ante* downstream duopoly. Under a linear demand specification, we show that welfare-decreasing encroachment occurs almost along with an increase in the unit price for the downstream retailer, which implies that the competition authority should consider a claim by an existing retailer that trades with an encroaching manufacturer if the claim is based on an increase in its unit price.

Matsushima and Mizuno (2018) extend the linear demand setting by incorporating the cost-reducing efforts of an existing retailer. The main concern of Matsushima and Mizuno (2018), however, is how the threat of supplier encroachment influences the retailer's effort level and economic welfare. Our study and Matsushima and Mizuno (2018) thus complement each other.

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