Naked Exclusion under Exclusive-offer Competition*

Hiroshi Kitamura† Noriaki Matsushima‡ Misato Sato§

July 10, 2017

Abstract

This study constructs a model of anticompetitive exclusive-offer competition between two existing suppliers. Although previous studies assume that one of the suppliers is a potential entrant, which cannot make an exclusive offer, we assume that all suppliers are existing firms. When suppliers compete imperfectly, the exclusive-offer competition reduces the supplier's profit for the case where it fails to exclude the rival supplier, which induces each supplier to make a better exclusive offer. We point out that this leads to an exclusion of the existing supplier even when there is no exclusion of the potential entrant.

JEL classifications code: L12, L41, L42.
Keywords: Antitrust policy; Exclusive dealing; Exclusive-offer competition; Imperfect competition.

*We thank Masaki Aoyagi, Atsushi Kajii, Toshihiro Matsumura, Stuart McDonald, conference participants at 15th Annual International Industrial Organization Conference (Renaissance Boston Waterfront Hotel), and seminar participants at Kyoto Sangyo University, Osaka University, and Tohoku University. We gratefully acknowledge financial support from JSPS KAKENHI Grant Numbers JP15H03349, JP15H05728, JP15K17060, JP17H00984, JP17J03400, and JP17K13729, and the program of the Joint Usage/Research Center for 'Behavioral Economics' at ISER, Osaka University. The usual disclaimer applies.

†Faculty of Economics, Kyoto Sangyo University, Motoyama, Kamigamo, Kita-Ku, Kyoto, Kyoto 603-8555, Japan. Email: hiroshikitamura@cc.kyoto-su.ac.jp

‡Institute of Social and Economic Research, Osaka University, 6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan. Email: nmatsush@iser.osaka-u.ac.jp

§Postdoctoral Research Fellow of the Japan Society for the Promotion of Science (JSPS), Faculty of Economics, Kyoto Sangyo University, Motoyama, Kamigamo, Kita-Ku, Kyoto, Kyoto 603-8555, Japan. Email: smisato@gwmail.gwu.edu

1 Introduction

Exclusive contracts have been a controversial issue in the field of competition policy because such contracts are seemingly anticompetitive due to exclusion of rival firms. However, by taking into account all members' participation constraints for such exclusive dealing in the contract party under one-supplier-one-buyer framework, Posner (1976) and Bork (1978) show that such contracts do not exist and conclude that rational economic agents do not engage in anticompetitive exclusive dealing.[1] In rebuttal to the Chicago School argument, post-Chicago economists indicate specific circumstances under which anticompetitive exclusive dealing occurs (Aghion and Bolton, 1987; Rasmusen, Ramseyer, and Wiley, 1991; Segal and Whinston, 2000; Simpson and Wickelgren, 2007; Abito and Wright, 2008).

The common feature of these studies by the post-Chicago economists is that the entrant is a potential entrant, which cannot make an exclusive offer. However, in real business situations, exclusive contracts can be signed to deter existing firms. For example, in the Intel antitrust case, AMD and Transmeta, already in the market, are excluded.[2] Furthermore, in the case of Virgin Atlantic Airways v. British Airways, Virgin Atlantic Airways charges that it is excluded.[3] In these cases, excluded firms might also be able to make exclusive offers. More importantly, in 'Cola Wars' between Pepsi-Cola and Coca-Cola, both firms actually make exclusive offers.[4] Thus, this study aims to ascertain how the exclusive-offer competition affects anticompetitive exclusive dealing.

In this study, we construct a model of anticompetitive exclusive contracts to deter an existing firm. Following Wright (2008), upstream firms produce horizontally differentiated prod-

[1] For analysis of the impact of this argument on antitrust policies, see Motta (2004) and Whinston (2006).

[2] Intel was accused of awarding rebates and various other payments to major original equipment manufacturers (e.g., Dell and HP). See Gans (2013) for an excellent case study on the Intel case.

[3] Virgin Atlantic Airways charges that British Airways grants rebates to travel agents or corporate customers only if they purchase all or a certain percentage of their travel requirements from British Airways. See "Virgin Atlantic Airways v. British Airways, 872 F. Supp. 52 (S.D.N.Y. 1994)" *JUSTIA US LAW,* December 30,1994. (http://law.justia.com/cases/federal/district-courts/FSupp/872/52/1442497/).

[4] See, for example, "'Cola Wars' Foaming On College Campuses" *Chicago Tribune,* November 6, 1994. (http://articles.chicagotribune.com/1994-11-06/news/9411060065_1_pepsi-cola-coke-cola-wars).

ucts; the upstream duopoly leads to the higher industry profits than the upstream monopoly does. Although Wright (2008) assumes multiple downstream firms, playing an essential role for exclusion, we assume a single downstream firm to clarify the essential role of exclusive-offer competition. We compare the case where one of the upstream firms is a potential entrant (benchmark analysis) with the case where both upstream firms are existing firms (main analysis).

In a setting of general demand function and negotiations between the downstream firm and each upstream firm through Nash bargaining under two-part tariff, we first show that exclusion never occurs in the benchmark analysis, and then upstream duopoly occurs; that is, the Chicago School argument can be applied. When the exclusive offer is rejected, upstream competition induces the downstream firm to earn higher profits as long as upstream entry increases the industry profits. The upstream incumbent cannot compensate the downstream firm for such profits; thus, there exists no exclusive contract to satisfy all participation constraints in the contracting party.

We then show that in the main analysis, exclusion can be an equilibrium outcome if the downstream firm has weak bargaining power. Under exclusive-offer competition, an upstream supplier's profit depends on not only its exclusive offer but also its rival's offer. When the rival upstream firm makes an exclusive offer which is acceptable for the downstream firm, the upstream firm cannot earn positive profits for the case where it fails to induce the downstream firm to accept its exclusive offer, which implies that each upstream firm's profit gain under exclusive dealing becomes higher. Hence, compared with the benchmark analysis, the exclusive-offer competition induces each upstream firm to make a higher exclusive offer. As the downstream firm has weak bargaining power, the downstream firm earns lower profits and its profit loss under exclusive dealing becomes smaller; namely, the amount of compensation for exclusive dealing becomes smaller. Therefore, exclusion can be an equilibrium outcome.

We also check the robustness of the above exclusion outcome by extending the model. First, our exclusion logic can be applied in the case of linear wholesale pricing. The exclusion equilibrium exists when upstream firms are sufficiently differentiated. Second, in appendix, we show that the exclusion equilibrium exists for the case where downstream firms competing in quantity make exclusive supply offers to a single upstream firm. Note that in both cases, exclusion cannot be an equilibrium outcome in the absence of exclusive-offer competition. Therefore, the exclusion outcome identified in this study can be widely applied to diverse real-world vertical relationships.

This study is related to the literature on anticompetitive exclusive contracts to deter socially efficient entry. First, by extending the Chicago School arguments single-buyer model to a multiple-buyer model, these studies introduce scale economies, wherein the entrant needs a certain number of buyers to cover fixed costs (Rasmusen, Ramseyer, and Wiley, 1991; Segal and Whinston, 2000) and competition between the buyers (Simpson and Wickelgren, 2007; Abito and Wright, 2008).[5] These studies share a common feature: reaching the exclusion result requires multiple downstream buyers.[6] In contrast, this study shows that anticompetitive exclusive contracts can be signed even under a single-buyer model.

In the framework of a single downstream firm, this study is related to the literature on anticompetitive exclusive contracts focusing on the nature of upstream competition.[7] The studies in this literature point out that the intensity of upstream competition plays a crucial role in the Chicago school critique. These studies show that the exclusion result is obtained in the cases where the incumbent sets liquidated damages for the case of entry (Aghion and Bolton, 1987), where the entrant is capacity constrained (Yong, 1996), where suppliers compete à

[5] In the literature on exclusion with downstream competition, Fumagalli and Motta (2006) show that the existence of participation fees to remain active in the downstream market plays a crucial role in exclusion if buyers are undifferentiated Bertrand competitors. See also Wright's (2009) study, which corrects the result of Fumagalli and Motta (2006) in the case of two-part tariffs.

[6] For extended models of exclusion with downstream competition, see Wright (2008), Argenton (2010), and Kitamura (2010). Whereas these studies all show that the resulting exclusive contracts are anticompetitive, Gratz and Reisinger (2013) show potentially pro-competitive effects if downstream firms compete imperfectly and contract breaches are possible. See also DeGraba (2013), who consider a situation in which a small rival that is more efficient at serving a portion of the market can make exclusive offers.

[7] For another mechanism of anticompetitive exclusive dealing, see Fumagalli, Motta, and Rønde (2012) focus on the incumbent supplier's relationship-specific investments. See also Kitamura, Matsushima, and Sato (2016) who focus on the existence of complementary input supplier with market power.

la Cournot (Farrell, 2005), and where suppliers can merge (Fumagalli, Motta, and Persson, 2009).[8] Our study is a complement with these studies in the sense that we show an alternative route in which the less intensity of upstream competition leads to anticompetitive exclusive dealing in the presence of the exclusive-offer competition.

Few studies address exclusive dealing to exclude existing firms.[9] By extending the model of Wright (2008), Shen (2014) explores the exclusive-offer competition. In his study, exclusion arises because of downstream competition. In contrast, this study explores anticompetitive exclusive dealing in the absence of downstream competition and shows that the exclusive-offer competition increases the possibility of anticompetitive exclusive dealing.

In terms of exclusive-offer competition, this study is also close to the benchmark model of Berheim and Whinston (1998, Sections II and III).[10] In their study, the exclusive offer involves wholesale price contracts, which is suitable to explore short-term exclusive contracts.[11] In such offers, upstream firms can commit not to sell their products to the downstream firm if the downstream firm rejects the exclusive offer. In contrast, following the standard naked exclusion literature, we assume that when the exclusive offer is made, each upstream firm cannot commit to wholesale prices when its exclusive offer is rejected, which is suitable for long-term exclusive contracts.[12] In reality, for example, in the 'Cola Wars', Pepsi-Cola outbids Coca-Cola for a $14 million to be 12-year monopoly at Pennsylvania State University, which implies that it is a long-term exclusive contract. In this setting, when the downstream

[8] See also Kitamura, Matsushima, and Sato (2017a) who show that anticompetitive exclusive dealing can occur if the downstream buyer bargains with suppliers sequentially.

[9] See Choi and Stefanadis (fothcoming) who explore the exclusive offer competition between suppliers before they enter the market. By extending the model of exclusion with scale economies, they point out that exclusion becomes a unique coalition-proof subgame-perfect equilibrium outcome when a derivative innovator can enter the market only if the incumbent innovator enters the market.

[10] See also Calzolari and Denicolò (2013, 2015) who explore upstream firms make exclusive offer in the presence of adverse selection, while we assume the complete information.

[11] See the discussion on p.166 in Whinston (2006).

[12] In addition to the commitment problem, we also consider cases in which each upstream firm does not always have full bargaining power over the downstream firm when they determine their wholesale prices.

firm rejects the exclusive offer, it can deal with both upstream firms and earn considerably higher profits, under which anticompetitive exclusive dealing is difficult. Therefore, this study is suitable for exclusive dealing in the industry where the commitment on wholesale prices are difficult. It also clarifies the role of exclusive-offer competition in the literature of naked exclusion.

The remainder of this paper is organized as follows. Section 2 constructs a model. Section 3 analyzes the existence of exclusion outcomes under two-part tariffs. Section 4 provides the analysis under linear wholesale pricing. Section 5 offers concluding remarks. Appendix A provides proofs of results. Appendix B provides parametric results when manufacturers operate at same marginal costs under linear demand. Appendix C introduces parametric results when manufacturers operate at different marginal costs under linear demand. Appendix D explores the case of exclusive supply agreements.

2 Model

This section develops the basic environment of the model. The upstream market consists of two manufacturers U_1 and U_2. Following Wright (2008), each manufacturer operates at the same marginal cost $c \geq 0$ and each manufacturer produces a final product, which is differentiated. We explore the case of asymmetric cost function in Section 3.4. Given the pair of manufacturers' product prices (p_1, p_2), the demand for U_1's product is denoted by $Q(p_1, p_2)$. By assuming the symmetric demand, the demand for U_2's product is denoted by $Q(p_2, p_1)$. When the prices between manufacturers' products are sufficiently close, both obtain positive demand. However, when the prices differ sufficiently, the higher priced manufacturer loses demand while the lower priced manufacturer obtains all demand.

The degree of product substitution between manufacturers' products is represented by $\gamma \in (0, 1)$. Manufacturers' products become homogeneous as the value of γ increases. For $\gamma = 0$, manufacturers produce independent goods. Alternatively, for $\gamma = 1$, manufacturers produce perfectly substitute goods. In addition, when U_j is excluded, the demand for U_i's product does not depend on γ, where $i, j \in \{1, 2\}$ and $i \neq j$. We denote the demand for U_i's product in the monopoly case by $Q(p_i) \equiv Q(p_i, \infty)$.

For the sake of the analysis under generalized Nash bargaining, we introduce an assumption on the demand system. We assume that industry profits under exclusive dealing $(p_i - c)Q(p_i)$, and those under non-exclusion cases $(p_i - c)Q(p_i, p_j) + (p_j - c)Q(p_j, p_i)$ are globally and strictly concave and satisfy the second-order conditions. We define p_m and p_d as follows.

$$p_m \equiv \arg\max_{p_i}(p_i - c)Q(p_i),$$
$$(p_d, p_d) \equiv \arg\max_{p_i, p_j}(p_i - c)Q(p_i, p_j) + (p_j - c)Q(p_j, p_i)$$

We define Π_m and Π_d be the net profit of each vertical chain under monopoly and under duopoly;

$$\Pi_m \equiv (p_m - c)Q(p_m), \;\; \Pi_d \equiv (p_d - c)Q(p_d, p_d).$$

We assume the following relationship:

Assumption 1. *For all* $0 < \gamma < 1$*,*

$$2\Pi_d > \Pi_m > \Pi_d, \tag{1}$$

where $\partial\Pi_m/\partial\gamma = 0$*,* $\partial\Pi_d/\partial\gamma < 0$*,* $\Pi_d \to \Pi_m$ *as* $\gamma \to 0$*, and* $2\Pi_d \to \Pi_m$ *as* $\gamma \to 1$.

The first inequality of condition (1) is the key property in this study, which implies that an increase in the number of product varieties generates an additional industry value except $\gamma = 1$. In addition, the second inequality implies that the increase in the number of product varieties reduces the net profit per vertical chain except $\gamma = 0$. Note that the properties introduced above hold under the standard linear demand with a representative consumer, which is introduced when we explore the case of linear wholesale pricing in Section 4.

The downstream market is composed of a downstream retailer D, which sells the manufacturers' products. This modeling strategy clarifies the role of exclusive-offer competition because we can easily compare the result of this study with that of the Chicago School argument; exclusion never occurs in the benchmark analysis. To simplify the analysis, we assume that D incurs no operating cost aside from paying for the product of U_i. Therefore, given wholesale price w_i, resale cost of D when it sells q_i amount of U_i's final product to final consumers is given by $C_D(q_1, q_2) = \sum_i w_i q_i$.

The model contains three stages. In Stage 1, U_1 and U_2 make an exclusive offer to D with fixed compensation $x_i \geq 0$. Following the standard literature on naked exclusion, we assume that each exclusive offer does not contain the term of wholesale prices.[13] D can reject both offers or it can accept one of the offers. Let $\omega \in \{R, E1, E2\}$ be D's decision in Stage 1. D immediately receives x_i if it accepts U_i's exclusive offer. If D is indifferent between two exclusive offers and the acceptance leads to higher profits, it accepts one of the offers with probability $1/2$. In Stage 2, active manufacturers offer a two-part tariff contract. We extend the model to the case of linear wholesale pricing in Section 4. In Stage 3, D orders the final product and sells it to consumers at p_i^{ω}. U_i's profit is denoted by π_{Ui}^{ω}. Likewise, D's profit is denoted by π_D^{ω}.

3 Two-part tariffs

This section analyzes the existence of anticompetitive exclusive contracts under two-part tariffs, which consist of a linear wholesale price and an upfront fixed fee; the two-part tariff offered by U_i when D's decision is $\omega \in \{R, E1, E2\}$ is denoted by $(w_i^{\omega}, F_i^{\omega})$, where $i \in \{1, 2\}$. We assume that the industry profit allocation after Stage 1 is given by Nash bargaining solution and that the net joint surplus is divided between D and each manufacturer in the proportion β to $1 - \beta$, where $\beta \in (0, 1)$ represents D's bargaining power.

The rest of this section is organized as follows. In Section 3.1, we first derive the equilibrium outcomes after the game in Stage 1 by using backward induction. In Section 3.2, we then examine the game in Stage 1 by introducing the benchmark analysis in which one of the

[13] Rasmusen, Ramseyer, and Wiley (1991) and Segal and Whinston (2000) point out that price commitments are unlikely if the product's nature is not precisely described in advance. In the naked exclusion literature, it is known that if the incumbent can commit to wholesale prices, then anticompetitive exclusive dealings are enhanced. See Yong (1999) and Appendix B of Fumagalli and Motta (2006).

manufacturers is a potential entrant as in the Chicago School model. We finally explore the case where both manufacturers make exclusive offers in Section 3.3.

3.1 Equilibrium outcomes after Stage 1

We first consider the case in which U_i's exclusive offer is accepted in Stage 1. Note that for notational simplicity, we do not discuss explicitly how the wholesale price is determined in each instance of bargaining because we can easily show that marginal cost pricing is achieved in all cases by using the envelope theorem. In Stage 2, D negotiates with U_i and makes a the two-part tariff contract, (c, F_i^{Ei}). The bargaining problem between D and U_i is described by the payoff pairs $(\Pi_m - F_i^{Ei}, F_i^{Ei})$ and the disagreement point $(0, 0)$. The solution is given by:

$$F_i^{Ei} = \arg\max_{F_i} \ \beta \log[\Pi_m - F_i] + (1-\beta) \log F_i.$$

The maximization problem leads to

$$F_i^{Ei} = (1-\beta)\Pi_m.$$

The firms' equilibrium profits, excluding the fixed compensation x_i, are

$$\pi_{Ui}^{Ei} = (1-\beta)\Pi_m, \ \ \pi_{Uj}^{Ei} = 0, \ \ \pi_D^{Ei} = \beta\Pi_m. \tag{2}$$

Depending on the bargaining power β, U_i and D split the monopoly profit, Π_m.

We next consider the case in which D rejects both exclusive offers in Stage 1. In this case, D sells both manufacturers' products. We assume that the bargaining in Stage 2 takes a form of simultaneous bilateral negotiation; that is, when negotiating with two manufacturers, D simultaneously and separately negotiates with each of the manufacturers, U_1 and U_2. D and U_i make a two-part tariff contract, (c, F_i^R). The outcome of each negotiation is given by Nash bargaining solution, based on the belief that the outcome of bargaining with the other party is determined in the same way. The bargaining problem between D and U_i is described by the payoff pairs $(2\Pi_d - F_i^R - F_j^R, F_i^R)$ and the disagreement point $(z_j, 0)$, where $z_j \equiv \Pi_m - F_j^R$

is D's profit when it sells only U_j's product at two-part tariff contract (c, F_j^R). The solution is given by:

$$F_i^R = \arg\max_{F_i} \beta \log[2\Pi_d - F_i - F_j - z_j] + (1-\beta)\log F_i.$$

The maximization problem leads to

$$F_i^R = (1-\beta)(2\Pi_d - \Pi_m),$$

for each $i \in \{1, 2\}$. The resulting profits of firms are given as

$$\pi_{Ui}^R = (1-\beta)(2\Pi_d - \Pi_m), \;\; \pi_D^R = 2((1-\beta)(\Pi_m - \Pi_d) + \beta\Pi_d). \tag{3}$$

U_i obtains its additional contribution weighted by its bargaining power $(1-\beta)$, and D earns the remaining duopoly profit subtracted by the payments for U_1 and U_2 (that is, $2\Pi_d - \pi_{U1}^R - \pi_{U2}^R$).

3.2 Benchmark analysis

Assume that U_j is a potential entrant and only U_i can make an exclusive offer as in the Chicago School model. In this subsection, we modify the timing of Stage 1 as follows. In Stage 1.1, U_i makes an exclusive offer x_i and D decides whether to accept the offer. After observing D's decision, U_j decides whether to enter the upstream market in Stage 1.2. The fixed cost of entry is sufficiently small that U_j earns positive profits.

To start analysis, we derive the essential conditions for an exclusive contract when only one manufacturer makes exclusive offers. For an exclusion equilibrium to exist, the equilibrium transfer x_i^* must satisfy the following two conditions.

First, the exclusive contract must satisfy individual rationality for D; that is, the amount of compensation x_i^* induces D to accept the exclusive offer:

$$\pi_D^{Ei} + x_i^* \geq \pi_D^R \;\; or \;\; x_i^* \geq \Delta\pi_D \equiv \pi_D^R - \pi_D^{Ei}, \tag{4}$$

where $\Delta\pi_D$ is the absolute value of D's profit loss under exclusive dealing.

Second, it must satisfy individual rationality for U_i; that is, U_i earns higher profits under exclusive dealing:

$$\pi_{Ui}^{Ei} - x_i^* \geq \pi_{Ui}^R \;\; or \;\; x_i^* \leq \Delta\pi_U \equiv \pi_{Ui}^{Ei} - \pi_{Ui}^R, \tag{5}$$

where $\Delta\pi_U$ is U_i's profit increase under exclusive dealing. Note that $\Delta\pi_U = \pi_{U1}^{E1} - \pi_{U1}^{R} = \pi_{U2}^{E2} - \pi_{U2}^{R}$.

From the above conditions, it is evident that an exclusion equilibrium exists if and only if inequalities (4) and (5) simultaneously hold. This is equivalent to the following condition:

$$\Delta\pi_U \geq \Delta\pi_D \ \ or \ \ \pi_{Ui}^{Ei} + \pi_D^{Ei} \geq \pi_{Ui}^{R} + \pi_D^{R}. \tag{6}$$

Condition (6) implies that anticompetitive exclusive contracts attain if exclusive contracts increase the joint profits of U_i and D or equivalently if U_i's profit increase is higher than D's profit loss under exclusive dealing.

By using the subgame outcomes derived in the previous subsection, we now consider the game in Stage 1. Substituting equations (2) and (3), we have

$$\Delta\pi_U - \Delta\pi_D = -\beta(2\Pi_d - \Pi_m) < 0,$$

under condition (1) holds, which implies that exclusion never occurs:

Proposition 1. *Suppose both manufacturers adopt two-part tariffs. If U_j is a potential entrant and only U_i can makes an exclusive offer, U_i cannot exclude U_j through exclusive contracts.*

Proposition 1 confirms the robustness of the Chicago School argument when we extend their model to the case where manufacturers produce differentiated products and they adopt two-part tariffs. Under the non-linear pricing scheme, following the bargaining procedure, the firms split the total industry profit. Except the cases of $\beta = 0$ and $\gamma = 1$, entry by U_j generates some additional profits for D, those of which are sufficient to eliminate the incentives of D and U_i to reach exclusion.[14] Therefore, exclusion does not occur when only one manufacturer can make the exclusive offer.

[14] When $\beta = 0$, U_j obtains all its additional contribution, implying that entry leaves nothing to D. When $\gamma = 1$, U_j does not add any contribution to the industry due to perfect substitute of products.

3.3 When exclusive-offer competition exists

In contrast to the previous subsection, we now assume that both manufacturers are existing firms and they can make exclusive offers. Compared to the case where exclusive-offer competition does not exist, the difference arises in the upper bound of U_i's exclusive offer $x_i^{\max}$, which depends on U_j's offer, where

$$x_i^{\max} \equiv \begin{cases} \pi_{Ui}^{Ei} & \text{if } x_j \geq \Delta\pi_D, \\ \Delta\pi_U & \text{if } x_j < \Delta\pi_D. \end{cases} \tag{7}$$

Note that $\pi_{Ui}^{Ei} > \Delta\pi_U$ and that $x_i^{\max} = \Delta\pi_U$ in the benchmark case. The feature of $x_i^{\max}$ is explained by D's decision whether to accept the exclusive offer by U_j. Figure 1 summarizes D's decision against both manufacturers' offers in Stage 1. When both exclusive offers are lower than $\Delta\pi_D$, D rejects both exclusive offers. By contrast, when at least one of the exclusive offers is higher than or equal to $\Delta\pi_D$, D accepts the better offer; more concretely, at least one of x_i and x_j satisfies condition (4) in the shadowed area of Figure 1. These D's behaviors affect manufacturers' exclusive offer as follows. When U_j offers $x_j < \Delta\pi_D$, U_i can be active and earn $\pi_{Ui}^{R}(> 0)$ even when it fails to exclude U_j. By comparing this profit with its net profit under exclusion $\pi_{Ui}^{Ei} - x_i$, U_i does not offer $x_i (> \Delta\pi_U)$ as in the benchmark case. On the contrary, when U_j's exclusive offer satisfies $x_j \geq \Delta\pi_D$, U_i is out of market and earns $\pi_{Ui}^{Ej} = 0$ if it fails to exclude U_j. In this case, exclusion of U_j is profitable for U_i if $\pi_{U_i}^{Ei} - x_i \geq 0$. Therefore, U_i makes a higher exclusive offer if $x_j \geq \Delta\pi_D$.

[Figure 1 about here]

Figures 2 and 3 summarize the set of each manufacturer's feasible offer (x_1, x_2) which satisfies $x_i \in [0, x^{\max}]$ for each $i \in \{1, 2\}$. Each manufacturer's offer is feasible at the shadowed area of Figures 2 and 3, which can be a candidate for the set of exclusion offers in the exclusion equilibrium (x_1^{**}, x_2^{**}); in other words, other area cannot be the exclusion equilibrium.

Depending on the magnitude relationship between π_{Ui}^{Ei} and $\Delta\pi_D$, we have two cases. First, if $\pi_{Ui}^{Ei} < \Delta\pi_D$, summarized in Figure 2, each manufacturer's exclusive offer is feasible at only one region because D's rejection profit is considerably high and each manufacturer cannot compensate D profitably when its rival's makes the higher offer. Second, if $\pi_{Ui}^{Ei} \geq \Delta\pi_D$, summarized in Figure 3, each manufacturer's exclusive offer is feasible at two regions. Because D's rejection profit is not too high in this case, U_i can profitably offer $x_i(\geq \Delta\pi_D)$ when U_j makes the high offer $x_j \geq (\Delta\pi_D)$.

[Figures 2 and 3 about here]

To explore the existence of an exclusion equilibrium, we now combine the results in Figures 1, 2, and 3. Figures 4 and 5 combine these figures and D's decision at the shadowed areas in Figures 2 and 3. Figures 4 implies that exclusion never occurs if $\pi_{Ui}^{Ei} < \Delta\pi_D$. In this case, there exist only non-exclusion equilibria in which each manufacturer offers $x_i \in [0, \Delta\pi_D)$ and D rejects both offers. By contrast, Figure 5 shows that an exclusion equilibrium exists if $\pi_{Ui}^{Ei} \geq \Delta\pi_D$. The candidate for the equilibrium offer is the area in which $(x_1, x_2) \in [\Delta\pi_D, \pi_{U_i}^{Ei}]^2$ holds. Obviously, $x_i > x_j \geq \Delta\pi_D$ and $x_i = x_j < \pi_{U_i}^{Ei}$ cannot be an equilibrium because at least one of the manufacturers has an incentive to deviate. There exists the exclusion equilibrium in which each manufacturer offers $x_i^{**} = \pi_{Ui}^{Ei}$ and D accepts one of the offers. Note that even when $\pi_{Ui}^{Ei} \geq \Delta\pi_D$, there also exists the non-exclusion equilibria in which each manufacturer offers $x_i \in [0, \Delta\pi_D)$ and D rejects both offers.

[Figures 4 and 5 about here]

We finally consider the existence of an exclusion equilibrium. From the above discussion, we need to check whether $\pi_{Ui}^{Ei} \geq \Delta\pi_D$ holds. By substituting equations (2) and (3), we obtain

$$\pi_{Ui}^{Ei} - \Delta\pi_D = (1 - 2\beta)(2\Pi_d - \Pi_m) \geq 0,$$

if and only if $\beta \in (0, 1/2]$; which implies that an exclusion equilibrium exists for weak bargaining power of D:

Proposition 2. *Suppose that both manufacturers make exclusive offers in Stage 1 and adopt two-part tariffs in Stage 2. If D has strong bargaining power ($\beta > 1/2$), exclusion cannot be an equilibrium outcome. By contrast, if D has weak bargaining power ($\beta \leq 1/2$), there exist both an exclusion equilibrium and non-exclusion equilibria.*

Proposition 2 shows that under the exclusive-offer competition, an exclusion equilibrium exists depending on the bargaining power of D over manufacturers. For weak bargaining power of D, D earns a smaller profit when it rejects both exclusive offers in Stage 1. Therefore, each manufacturer can compensate D profitably. Moreover, the existence of exclusion equilibrium does not depend on the degree of product substitution γ under non-linear wholesale pricing. Note that the result here highly depends on the assumption that manufacturers' costs are symmetric. In the following subsection, we explore the case of an asymmetric cost structure and we show that the exclusion equilibrium is more likely to be observed for lower γ.

Note that Proposition 2 shows that exclusion is not a unique equilibrium outcome. By comparing the two types of equilibria, the manufacturers strictly prefer the non-exclusion equilibria to the exclusion equilibrium. Therefore, they do not have an incentive to yield the exclusion outcome. By contrast, D has such an incentive. Because condition (4) holds with strict inequality under the exclusion equilibrium, D prefers the exclusion equilibrium to the non-exclusion equilibrium. Hence, D may try to do something to yield the exclusion outcome.

3.4 Cost asymmetry

This subsection briefly discusses the effect of cost asymmetry on the existence of exclusion equilibrium. Thus far, we assumed that each manufacturer operates at the same marginal cost $c \geq 0$. We now extend the model to the case in which manufacturers operate at different marginal costs. Without loss of generality, we assume that the marginal cost of U_1 is lower than that of U_2; namely, $0 \leq c_1 < c_2$. We define p_{mi} and p_{di} as follows.

$$p_{mi} \equiv \arg\max_{p_i} (p_i - c_i) Q(p_i),$$

$$(p_{di}, p_{dj}) \equiv \arg\max_{p_i, p_j} (p_i - c_i) Q(p_i, p_j) + (p_j - c_j) Q(p_j, p_i.)$$

We define Π_{mi} and Π_{di} be the net profit of U_i's vertical chain under monopoly and under duopoly;

$$\Pi_{mi} \equiv (p_{mi} - c_i)Q(p_{mi}), \;\; \Pi_{di} \equiv (p_{di} - c_i)Q(p_{di}, p_{dj}).$$

For the sake of notational convenience, we define $\Delta\Pi_i \equiv \Pi_{di} + \Pi_{dj} - \Pi_{mj}$, which can be interpreted as the level of the industry profit increase when U_i's product is also launched in the market monopolized by U_j. As in Assumption 1, we assume the following relationships:

Assumption 2. Π_{mi} *and* Π_{di} *have the following properties;*

1. U_1 *earns higher profits than* U_2*;*

$$\Pi_{m1} > \Pi_{m2}, \;\; \Pi_{d1} > \Pi_{d2}. \tag{8}$$

2. *For each* $i \in \{1, 2\}$ *and* $\gamma \in (0, 1)$*,*

$$\Pi_{d1} + \Pi_{d2} > \Pi_{mi} > \Pi_{di}, \tag{9}$$

where $\partial\Pi_{mi}/\partial\gamma = 0$*,* $\partial\Pi_{di}/\partial\gamma < 0$*,* $\Pi_{di} \to \Pi_{mi}$ *as* $\gamma \to 0$*, and* $\Pi_{d2} \to 0$ *and* $\Pi_{d1} \to \Pi_{m1}$ *for sufficiently high* γ*.*

3. $\Delta\Pi_1$ *is decreasing in* c_1 *but* $\Delta\Pi_2$ *is increasing in* c_1*;*

$$\frac{\partial\Delta\Pi_1}{\partial c_1} < 0, \;\; \frac{\partial\Delta\Pi_2}{\partial c_1} > 0. \tag{10}$$

Note that conditions (8) and (9) imply that we have $\Delta\Pi_1 > \Delta\Pi_2 > 0$, where the upstream market becomes duopoly in the absence of exclusive dealing.

As in Section 3.1, the wholesale price between the negotiation between D and U_i is c_i. By using above definitions, the firms' equilibrium profits under exclusive dealing, excluding the fixed compensation x_i, are

$$\pi_{Ui}^{Ei} = (1-\beta)\Pi_{mi}, \;\; \pi_{Uj}^{Ei} = 0, \;\; \pi_{D}^{Ei} = \beta\Pi_{mi}. \tag{11}$$

By contrast, the firms' equilibrium profits under non-exclusive dealing are

$$\pi_{Ui}^{R} = (1-\beta)\Delta\Pi_i, \;\; \pi_{D}^{R} = (1-\beta)(\Pi_{mi} - \Pi_{di} + \Pi_{mj} - \Pi_{dj}) + \beta(\Pi_{di} + \Pi_{dj}). \tag{12}$$

From condition (10), we have $\partial\pi_{U1}^{R}/\partial c_1 < 0$ but $\partial\pi_{U2}^{R}/\partial c_1 > 0$, which is observed in the linear demand model.[15]

We now consider the existence of exclusion equilibrium. We first explore the case in which only U_i can make an exclusive offer. Substituting equations (11) and (12), we have

$$\pi_{Ui}^{Ei} + \pi_{D}^{Ei} - (\pi_{Ui}^{R} + \pi_{D}^{R}) = -\beta\Delta\Pi_j < 0,$$

under condition (9), which implies that exclusion never occurs:

Proposition 3. *Suppose both manufacturers adopt two-part tariffs. If U_j is a potential entrant and only U_i can makes an exclusive offer, U_i cannot exclude U_j through exclusive contracts even under asymmetric costs.*

Proposition 3 implies that U_1 cannot deter entry of U_2 as long as entry increases the industry profit. Therefore, the result confirms the robustness of Chicago School argument in the case where the incumbent manufacturer cannot deter entry of a potential entrant manufacturer, which is even less efficient.

We next consider the case in which both manufacturers make exclusive offers. Note that the exclusion equilibrium exists if and only if $\pi_{Ui}^{Ei} + \pi_{D}^{Ei} \geq \pi_{D}^{R}$ holds for each $i \in \{1, 2\}$. Substituting equations (11) and (12), we have $\pi_{Ui}^{Ei} + \pi_{D}^{Ei} - \pi_{D}^{R} \geq 0$ if and only if

$$\beta \leq \beta_i \equiv \frac{\Delta\Pi_i}{\Delta\Pi_i + \Delta\Pi_j}. \tag{13}$$

for each $i \in \{1, 2\}$. From conditions (8), (9), and (13), β_i have the following relationships;

$$0 < \beta_2 < \frac{1}{2} < \beta_1 < 1, \tag{14}$$

where $\beta_1 \to 1$ and $\beta_2 \to 0$ as $\Delta\Pi_2 \to 0$. Condition (14) shows that $\beta_1 > \beta_2$ always holds; thus, the exclusion equilibrium exists if and only if $\beta \leq \beta_2$. Because $\beta_2 < 1/2$ always

[15] See Appendix C, which introduces the results under the linear demand model.

holds, cost asymmetry reduces the possibility of exclusion equilibrium. More precisely, by differentiating β_i with respect to c_1, we have

$$\frac{\partial \beta_i}{\partial c_1} = \frac{1}{(\Delta\Pi_i + \Delta\Pi_j)^2}\left(\frac{\partial \Delta\Pi_i}{\partial c_1}\Delta\Pi_j - \frac{\partial \Delta\Pi_j}{\partial c_1}\Delta\Pi_i\right).$$

Under condition (10), we have $\partial\beta_1/\partial c_1 < 0$ and $\partial\beta_2/\partial c_1 > 0$. Therefore, as U_1 becomes more efficient, β_2 decreases; namely, the exclusion equilibrium is less likely to exist. The following proposition summarizes the results provided above.

Proposition 4. *Suppose that both manufacturers make exclusive offers in Stage 1 and adopt two-part tariffs in Stage 2. As the degree of cost asymmetry increases, exclusion is less likely to be an equilibrium outcome.*

The result in Proposition 4 implies that the exclusion mechanism in this study is more likely to work well when each manufacturer has the similar cost structure. When U_1's efficiency increases, the industry profit under duopoly $\Pi_{d1}+\Pi_{d2}$ increases, which allows D to earn higher profit under upstream duopoly because $\partial\pi_D^R/\partial c_1 = -(1-\beta)\partial\Delta\Pi_2/\partial c_1 + \beta(\partial\Pi_{d1}/\partial c_1 + \partial\Pi_{d2}/\partial c_2) < 0$. By contrast, the increase in U_1's efficiency does not affect U_2's monopoly profit under exclusive dealing; namely, U_2 has difficulty in compensating D. Therefore, the possibility of exclusion becomes lower under cost asymmetry.

Finally, we explore the relationship between the existence of exclusion equilibrium and the degree of product substitution γ. By differentiating β_i with respect to γ, we have

$$\frac{\partial \beta_i}{\partial \gamma} = \frac{\Pi_{mj} - \Pi_{mi}}{(\Delta\Pi_i + \Delta\Pi_j)^2}\left(\frac{\partial \Pi_{di}}{\partial \gamma} + \frac{\partial \Pi_{dj}}{\partial \gamma}\right) > 0 \text{ if and only if } \Pi_{mi} > \Pi_{mj}.$$

From condition (8), we have $\partial\beta_1/\partial\gamma > 0$ and $\partial\beta_2/\partial\gamma < 0$, which leads to the following proposition:

Proposition 5. *Suppose that both manufacturers make exclusive offers in Stage 1 and adopt two-part tariffs in Stage 2. Under cost asymmetry, the exclusion equilibrium is more likely to be observed for the cases in which manufacturers produce highly differentiated products.*

The result in Proposition 5 implies that under cost asymmetry, the existence of exclusion equilibrium is determined by the degree of product substitution γ; that is, the result in Proposition 2 highly depends on the symmetric cost structure. The result here is explained by the property of bargaining when D rejects both exclusive offers. By differentiating π_D^R with respect to γ, we have $\partial\pi_D^R/\partial\gamma = (2\beta - 1)(\partial\Pi_{d1}/\partial\gamma + \partial\Pi_{d2}/\partial\gamma) > 0$ for $\beta < 1/2$, which implies that for weak bargaining power of D, its profits under upstream duopoly increases with γ. Because U_2 earns low monopoly profits under exclusive dealing, it has difficulty in compensating D; thus, the exclusion equilibrium is less likely to be observed as the products are less differentiated.

4 Linear wholesale pricing

This section explores the existence of anticompetitive exclusive dealing under linear wholesale pricing by assuming the standard linear demand with a representative consumer, in which the demand for U_i's product is provided by

$$Q(p_i, p_j) = \begin{cases} \dfrac{a - p_i}{b} & \text{if } \ 0 < p_i \leq \dfrac{-a(1-\gamma) + p_j}{\gamma}, \\ \dfrac{a(1-\gamma) - p_i + \gamma p_j}{b(1-\gamma^2)} & \text{if } \ \dfrac{-a(1-\gamma) + p_j}{\gamma} < p_i < a(1-\gamma) + \gamma p_j, \\ 0 & \text{if } \ p_i \geq a(1-\gamma) + \gamma p_j, \end{cases} \tag{15}$$

where $i, j \in \{1, 2\}$ and $i \neq j$. Like the previous section, we assume that the industry profit allocation after Stage 1 is given by Nash bargaining solution.

We first explore the case in which U_i's exclusive offer is accepted in Stage 1. Under exclusive dealing, the final consumer's demand for U_i's product becomes $Q(p_i) = (a - p_i)/b$. We solve the game by using backward induction. In Stage 3, given w_i determined in Stage 2, D optimally chooses the price of U_i's product; namely, $p^*(w_i) \equiv \arg\max_{p_i}(p_i - w_i)Q(p_i) = (a + w_i)/2$. The optimal production level of U_i's product supplied by D given w_i becomes $Q^*(w_i) \equiv Q(p^*(w_i)) = (a - w_i)/2b$. In Stage 2, U_i and D negotiate and make a contract for the linear wholesale price w_i^{Ei}. By defining D's profit given w_i as $\Pi^*(w_i) \equiv (p^*(w_i) - w_i)Q^*(w_i)$, the bargaining problem between D and U_i is described by the payoff pairs $(\Pi^*(w_i), (w_i - c)Q^*(w_i))$ and the disagreement point $(0, 0)$. The solution is given by:

$$w_i^{Ei} = \arg\max_{w_i} \ \beta \log \Pi^*(w_i) + (1-\beta) \log[(w_i - c)Q^*(w_i)].$$

The maximization problem leads to

$$w_i^{Ei} = \frac{a + c - \beta(a-c)}{2}.$$

The firms' equilibrium profits, excluding the fixed compensation x_i, are

$$\pi_{Ui}^{Ei} = \frac{(1-\beta^2)(a-c)^2}{8b}, \ \ \pi_{Uj}^{Ei} = 0, \ \ \pi_D^{Ei} = \frac{(1+\beta)^2(a-c)^2}{16b}. \tag{16}$$

We next explore the case in which D rejects both exclusive offers in Stage 1. In Stage 3, given wholesale prices w_i and w_j determined in Stage 2, D optimally chooses the prices of each manufacturer's product $(p^*(w_i, w_j), p^*(w_j, w_i))$, where

$$(p^*(w_i, w_j), p^*(w_j, w_i)) \equiv \arg\max_{p_i, p_j} (p_i - w_i)Q(p_i, p_j) + (p_j - w_j)Q(p_j, p_i),$$

where $i, j \in \{1, 2\}$ and $i \neq j$. The production level of each final product supplied by D given w_i and w_j is given by

$$Q^*(w_i, w_j) \equiv Q(p^*(w_i, w_j), p^*(w_j, w_i)) = \frac{a - w_i - \gamma(a - w_j)}{2(1-\gamma^2)b},$$

In Stage 2, U_1, U_2, and D makes contract(s) for the linear wholesale prices, w_1^R and w_2^R. By defining D's profit from selling U_i's product given (w_i, w_j) as $\Pi^*(w_i, w_j) \equiv (p^*(w_i, w_j) - w_i)Q^*(w_i, w_j)$, the bargaining problem between D and U_i is described by the payoff pairs $(\Pi^*(w_i^R, w_j^R) + \Pi^*(w_j^R, w_i^R), (w_i^R - c)Q^*(w_i^R, w_j^R))$ and the disagreement point $(\Pi^*(w_j^R), 0)$, where $\Pi^*(w_j^R)$ is D's profit when it sells only U_j's product given the linear wholesale price w_j^R. The solution is given by:

$$w_i^R = \arg\max_{w_i} \beta \log[\Pi^*(w_i, w_j) + \Pi^*(w_j, w_i) - \Pi^*(w_j)] + (1-\beta) \log[(w_i - c)Q^*(w_i, w_j)].$$

The maximization problem leads to

$$w_i^R = \frac{a(1-\gamma) + c - \beta(a(1-\gamma) - c)}{2 - \gamma(1-\beta)},$$

for each $i \in \{1, 2\}$. The resulting profits of firms are given as

$$\pi_{Ui}^R = \frac{(1-\beta^2)(1-\gamma)(a-c)^2}{2b(1+\gamma)(2-\gamma(1-\beta))^2}, \quad \pi_D^R = \frac{(1+\beta)^2(a-c)^2}{2b(1+\gamma)(2-\gamma(1-\beta))^2}. \tag{17}$$

We now explore the existence of exclusion. Like the case of two-part tariffs, when only U_i can make an exclusive offer, exclusion never occurs:

Proposition 6. *Suppose both manufacturers offer linear wholesale prices. If U_j is a potential entrant and only U_i can makes an exclusive offer, U_i cannot exclude U_j through exclusive contracts for any pair of bargaining power allocation and the degree of product substitution.*

Proof. See Appendix A.1. □

Proposition 6 implies that in the absence of exclusive-offer competition, anticompetitive exclusive dealing cannot occur, which can be explained by the logic underlying the Chicago School argument. When D accepts the exclusive offer from U_i in Stage 1.1, U_i can enjoy monopoly profits. However, U_i cannot maximize the joint profit between U_i and D under linear wholesale pricing due to the double marginalization problem. On the contrary, when D rejects U_i's exclusive offer in Stage 1.1, U_j enters the upstream market in Stage 1.2. Because of upstream competition, U_i 's wholesale price decreases and D can earn considerably higher rejection profits; namely, profit loss under exclusive dealing $\Delta\pi_D$ is significantly large. In addition, a higher degree of product substitution allows U_i to earn a higher profit even in the case of entry, which reduces U_i's profit increase through exclusion, $\Delta\pi_U$. Therefore, like the Chicago School argument, U_i cannot profitably compensate D; anticompetitive exclusive dealing cannot occur.

By contrast, when both manufacturers can make exclusive offers, an exclusion equilibrium exists under some conditions:

Proposition 7. *Suppose that both manufacturers make exclusive offers in Stage 1 and linear wholesale prices are determined through Nash bargaining in Stage 2. When the products are less differentiated ($\gamma > \tilde{\gamma} \simeq 0.77393$), exclusion cannot be an equilibrium outcome. By contrast, when those are sufficiently differentiated ($\gamma \leq \tilde{\gamma}$), there exist both an exclusion equilibrium and non-exclusion equilibria for sufficiently weak bargaining power of D ($\beta \leq \hat{\beta}(\gamma)$), where*

$$\hat{\beta}(\gamma) \equiv \frac{4\phi^2 + 2\gamma(1+\gamma)(5\gamma-4)\phi + 4\gamma^2(1+\gamma)(\gamma^3+3\gamma^2+3\gamma-5)}{6\gamma^2(1+\gamma)\phi},$$

and

$$\begin{aligned}\phi \equiv \Big[&\gamma^3(1+\gamma)^2(\gamma^4+4\gamma^3+6\gamma^2-32\gamma+19) \\ &+3\sqrt{6\gamma^6(1+\gamma)^2(1-\gamma^2)(\gamma^5+5\gamma^4+10\gamma^3+5\gamma^3-12\gamma^2-11\gamma+9)}\Big]^{\frac{1}{3}}.\end{aligned}$$

Proof. See Appendix A.2. □

Note that $\hat{\beta}(\gamma)$ has a single peaked property with $\hat{\beta}(\gamma) \to 1/3$ as $\gamma \to 0$, $\hat{\beta}(\gamma) \to 0$ as $\gamma \to \tilde{\gamma}$, and the maximized value $\hat{\beta}(\gamma^*) \simeq 0.413049$ at $\gamma^* \simeq 0.469146$.

[Figure 6 about here]

Figure 6 summarizes Proposition 7. The notable result in Proposition 7 is that linear wholesale pricing leads to the low possibility of the anticompetitive exclusion equilibrium when the exclusive-offer competition occurs; exclusion never occurs for less differentiated manufacturers' products. Note that the major difference between two types of pricing is the existence of a double marginalization problem, which becomes serious for weak bargaining power of D. The double marginalization problem occurs not only under exclusive dealing but also under the case where D deals with both manufacturers. More importantly, when D deals with both manufacturers, the seriousness of double marginalization problem depends on the degree of production substitution γ. When the manufacturers produce almost homogeneous products, the double marginalization problem is not too serious, which allows D

to earn large rejection profits π_D^R. Hence, the exclusion equilibrium does not exist when the products are less differentiated. By contrast, as those are differentiated, the double marginalization problem becomes serious; namely, the rent extraction by each manufacture becomes significant. This prevents D from earning large rejection profits while the industry profit increases. Therefore, the manufacturers can compensate D profitably if those are sufficiently differentiated.

Figure 6 also shows that $\hat{\beta}(\gamma)$ has the single peaked property, which implies that the possibility of the exclusion equilibrium is non-monotonic in the degree of product substitution γ. Because only D's rejection profit π_D^R depends on γ in $\pi_{Ui}^{Ei} - \Delta\pi_D$, this phenomenon can be explained by the following two effects on π_D^R. First, as the products are differentiated, the double marginalization problem when D deals with both manufacturers becomes serious, which is pointed out above. This becomes more serious as β is smaller, which enables the manufacturers to set higher w_i. Second, as those are differentiated, the industry profit increases. This would allow D to earn higher rejection profits if the wholesale prices were exogenously fixed. This positive effect is weaker as β is smaller because D's profit share is small. The magnitude of these two effects is determined by the degree of product substitution and that of D's bargaining power. By differentiating π_D^R with respect to γ, we obtain the following relationship;

$$\frac{\partial \pi_D^R}{\partial \gamma} = \frac{(1+\beta)^2(3\gamma - \beta(2+3\gamma))}{b(1+\gamma)^2(2-\gamma(1-\beta))^3} < 0, \text{ if and only if } \beta > \overline{\beta}(\gamma) \equiv \frac{3\gamma}{2+3\gamma} \text{ or } \gamma < \frac{2\beta}{3(1-\beta)}.$$

The properties of $\overline{\beta}(\gamma)$ are summarized in Figure 6. This relationship implies that when $\beta \leq 1/2$, as manufacturers become differentiated when they produce almost homogeneous products, D's rejection profit decreases for all because the double marginalization problem when D deals with both manufacturers is more serious. By contrast, as manufacturers become differentiated when they produce sufficiently differentiated products, D's rejection profit is more likely to increase for sufficiently strong D's bargaining power because the increase in the industry profit is the dominant effect.

5 Conclusion

This study has explored the existence of anticompetitive exclusive dealing when all upstream firms can make exclusive offers. Most of previous studies consider anticompetitive exclusive dealing to deter a potential entrant, which cannot make an exclusive offer. However, in real-world situation, existing firms are often excluded. Therefore, we need to consider how the existence of exclusive-offer competition affects the possibility of exclusion to apply the model to these cases.

We show that a seemingly small difference in the setting turns out to be crucial. In contrast to the case where one of the upstream firms is a potential entrant, the existence of exclusive-offer competition eliminates the upstream firms' outside option to earn positive profits when it fails to exclude the rival upstream firm. We point out that this induces upstream firms to make higher exclusive offers and show that when the downstream firm has weak bargaining power, anticompetitive exclusive dealing can be an equilibrium outcome in the two-part tariff setting of general demand function and Nash bargaining. Moreover, this result hold in various setting; the exclusion outcome identified in this study can be widely applied to diverse real-world vertical relationships.

The finding here provides new implication for antitrust agencies; anticompetitive exclusive dealing is more likely to be observed when upstream firms are existing firms. In addition, because the downstream firm has an strong incentive to engage in anticompetitive exclusive dealing, the downstream firm is more likely to lead the negotiation of anticompetitive exclusive dealing when upstream firms are existing firms.

Several outstanding issues require future research. First, there is a concern about upstream firms' behavior needed to achieve market environment where exclusive dealing is impossible. Although we assume that the level of product substitution or bargaining power are exogenously given parameters, upstream firms could control these parameters. Second, there is a concern about this study's relationship with other studies on anticompetitive exclusive dealing. We predict that if we add the exclusive-offer competition into the previous studies, exclusion becomes less costly. We hope that this study will assist future researchers in addressing these issues.

A Proofs of Results

A.1 Proof of Proposition 6

We show that condition (6) never holds; that is, by substituting equations (16) and (17), we have

$$\Delta\pi_U - \Delta\pi_D = -\frac{(a-c)^2(1+\beta)(8-(1+\gamma)(2-\gamma(1-\beta))(3-\beta))}{16b(1+\gamma)(2-\gamma(1-\beta))} < 0, \tag{18}$$

for all $(\beta,\gamma) \in (0,1)^2$. Let $\eta(\beta,\gamma) \equiv -8 + (1+\gamma)(2-\gamma(1-\beta))(3-\beta)$. Note that $\eta(\beta,\gamma) < 0$ if and only if condition (18) holds. By differentiating $\eta(\beta,\gamma)$ with respect to β and γ, we have

$$\eta_\beta(\beta,\gamma) \gtreqless 0 \Leftrightarrow \beta \lesseqgtr K(\gamma) \equiv \frac{-1+2\gamma}{\gamma},$$

$$\eta_\gamma(\beta,\gamma) \gtreqless 0 \Leftrightarrow \beta \gtreqless L(\gamma) \equiv \frac{-1+2\gamma}{1+2\gamma}.$$

Note that for $\gamma \in (1/2, 1]$, $K'(\gamma) > L'(\gamma) > 0$ and $K(\gamma) > L(\gamma) > 0$ and that $K(1/2) = L(1/2) = 0$ and $K(1) = 1$ and $L(1) = 1/3$. Figure 7 summarizes the properties of $\eta_\beta(\beta,\gamma)$ and $\eta_\gamma(\beta,\gamma)$. There are six regions in $(\beta,\gamma) \in [0,1]^2$ such that (i) $\eta_\beta(\beta,\gamma) = \eta_\gamma(\beta,\gamma) = 0$, (ii) $\eta_\beta(\beta,\gamma) < 0, \eta_\gamma(\beta,\gamma) > 0$, (iii) $\eta_\beta(\beta,\gamma) = 0, \eta_\gamma(\beta,\gamma) > 0$, (iv) $\eta_\beta(\beta,\gamma) > 0, \eta_\gamma(\beta,\gamma) > 0$, (v) $\eta_\beta(\beta,\gamma) > 0, \eta_\gamma(\beta,\gamma) = 0$, and (vi) $\eta_\beta(\beta,\gamma) > 0, \eta_\gamma(\beta,\gamma) < 0$. Arrows in Figure 7 indicate the direction of an increase in $\eta(\beta,\gamma)$ for each region. From Figure 7, for $(\beta,\gamma) = (0, 1/2)$, $\eta(\beta,\gamma)$ takes the locally maximized value in region (i), where we have $\eta(\beta,\gamma) = -5/4 < 0$. More importantly, Figure 7 shows that $\eta(\beta,\gamma)$ is globally maximized in the domain $(\beta,\gamma) \in [0,1]^2$ when $(\beta,\gamma) = (1,1)$ where we have $\eta(1,1) = 0$. Therefore, $\eta(\beta,\gamma) < 0$ for all $(\beta,\gamma) \in (0,1)^2$.

Q.E.D.

A.2 Proof of Proposition 7

We check whether $\pi_{U_i}^{Ei} \geq \Delta\pi_D$ holds. By substituting equations (16) and (17), we obtain $\pi_{Ui}^{Ei} - \Delta\pi_D \geq 0$ if and only if $\gamma \leq \tilde{\gamma}$ and $\beta \leq \hat{\beta}(\gamma) < 1/2$.

Q.E.D.

B Results under linear demand and symmetric cost

This appendix introduces the analysis of the model in Section 3.1–3 under linear demand function (15). Under linear demand function, we have

$$\Pi_m = \frac{(a-c)^2}{4b}, \;\; \Pi_d = \frac{(a-c)^2}{(1+\gamma)b}. \tag{19}$$

Then the firms' equilibrium profits under exclusive dealing, excluding the fixed compensation x_i, are

$$\pi_{Ui}^{Ei} = \frac{(1-\beta)(a-c)^2}{4b}, \;\; \pi_{Uj}^{Ei} = 0, \;\; \pi_D^{Ei} = \frac{\beta(a-c)^2}{4b}. \tag{20}$$

The profits of firms under no exclusive dealing are given as

$$\pi_{Ui}^{R} = \frac{(1-\beta)(1-\gamma)(a-c)^2}{4b(1+\gamma)}, \;\; \pi_D^{R} = \frac{(\beta(1-\gamma)+\gamma)(a-c)^2}{2b(1+\gamma)}. \tag{21}$$

We now explore the existence of exclusion. For the case in which only U_i can make an exclusive offer, we check whether condition (6) holds. By substituting equations (20) and (21), we have

$$\Delta\pi_U - \Delta\pi_D = -\frac{\beta(1-\gamma)(a-c)^2}{4b(1+\gamma)} < 0, \tag{22}$$

for all $\gamma \in [0,1)$ and $\beta \in (0,1)$; like linear wholesale pricing, exclusion never occurs. This result is consistent with Proposition 1.

By contrast, for the existence of exclusion when both manufacturers can make exclusive offers, we check whether $\pi_{U_i}^{Ei} \geq \Delta\pi_D$ holds. By substituting equations (20) and (21), we have

$$\pi_{Ui}^{Ei} - \Delta\pi_D = \frac{(1-2\beta)(1-\gamma)(a-c)^2}{4b(1+\gamma)} \geq 0, \tag{23}$$

for $\beta \in (0, 1/2]$. Therefore, an exclusion equilibrium exists if $\beta \leq 1/2$, which is consistent with Proposition 2.

C Results under linear demand and asymmetric cost

This appendix introduces the analysis of the model in Section 3.4 under linear demand function (15). We measure U_1's cost advantage by θ, where $c_2 = \theta p_{m1} + (1-\theta)c_1$ and $p_{m1} = (a+c_1)/2$. $\theta = 0$ implies that U_1 has no cost advantage. As θ increases, U_1 becomes efficient. We assume the following relationship;

$$0 < \theta < \min\{2(1-\gamma), 1\}. \tag{24}$$

If condition (24) holds, the upstream market becomes duopoly if the exclusive offer is rejected. When D accepts U_1's exclusive offer, the firms' equilibrium profits, excluding the fixed compensation x_1, are

$$\pi_{U1}^{E1} = \frac{(1-\beta)(a-c_2)^2}{(2-\theta)^2 b}, \;\; \pi_{U2}^{E1} = 0, \;\; \pi_D^{E1} = \frac{\beta(a-c_2)^2}{(2-\theta)^2 b}. \tag{25}$$

Likewise, when D accepts U_2's exclusive offer, the firms' equilibrium profits, excluding the fixed compensation x_2, are

$$\pi_{U2}^{E2} = \frac{(1-\beta)(a-c_2)^2}{4b}, \;\; \pi_{U1}^{E2} = 0, \;\; \pi_D^{E2} = \frac{\beta(a-c_2)^2}{4b}. \tag{26}$$

By contrast, when D rejects both exclusive offers, the firms' equilibrium profits are

$$\begin{aligned} \pi_D^R &= \frac{(\theta^2 + 4(1-\gamma)(2-\theta) - (1-\beta)((2(1-\gamma)+\theta\gamma)^2 + (2(1-\gamma)-\theta)^2))(a-c_2)^2}{4b(1-\gamma^2)(2-\theta)^2}, \\ \pi_{U1}^R &= \frac{(1-\beta)(2(1-\gamma)+\theta\gamma)^2(a-c_2)^2}{4b(1-\gamma^2)(2-\theta)^2}, \;\; \pi_{U2}^R = \frac{(1-\beta)(2(1-\gamma)+\theta)^2(a-c_2)^2}{4b(1-\gamma^2)(2-\theta)^2}. \end{aligned} \tag{27}$$

We now consider the existence of an exclusion equilibrium when both manufacturers make exclusive offers. By substituting (25), (26) and (27), $\pi_{Ui}^{Ei} + \pi_D^{Ei} - \pi_D^R \geq 0$ if and only if $\beta \leq \beta_i(\gamma, \theta)$, where

$$\beta_1(\gamma,\theta) \equiv \frac{(2(1-\gamma)+\theta\gamma)^2}{4(1-\gamma)^2(2-\theta)+\theta^2(1+\gamma^2)}, \;\; \beta_2(\gamma,\theta) \equiv \frac{(2(1-\gamma)-\theta)^2}{4(1-\gamma)^2(2-\theta)+\theta^2(1+\gamma^2)}.$$

The following lemma summarizes the properties of $\beta_i(\gamma, \theta)$;

Proposition C.1. *$\beta_i(\gamma, \theta)$ has the following properties;*

1. $0 < \beta_2 < 1/2 < \beta_1 < 1$.

2. $\partial\beta_1/\partial\gamma > 0$ *and* $\partial\beta_2/\partial\gamma < 0$.

3. $\partial\beta_1/\partial\theta > 0$ *and* $\partial\beta_2/\partial\theta < 0$.

4. *As* $\gamma \to (2-\theta)/2$*,* $\beta_1 \to 1$ *and* $\beta_2 \to 0$.

5. *As* $\theta \to 0$*,* $\beta_1 \to 1/2$ *and* $\beta_2 \to 1/2$.

Proof. We first examine the first property. Note that $\beta_2 > 0$ is obvious. Then, we have

$$\beta_1 - \frac{1}{2} = \frac{1}{2} - \beta_2 = \frac{(\theta(4-\theta)(1-\gamma))^2}{2(4(1-\gamma)^2(2-\theta) + \theta^2(1+\gamma^2))} > 0,$$

$$1 - \beta_1 = \frac{(2(1-\gamma)-\theta)^2}{4(1-\gamma)^2(2-\theta) + \theta^2(1+\gamma^2)} > 0.$$

Therefore, the first property holds. The second and third properties can be derived by the following results; under condition (24)

$$\frac{\partial\beta_1}{\partial\gamma} = \frac{2\theta(4-\theta)(2(1-\gamma)+\theta\gamma)(2(1-\gamma)-\theta)}{4(1-\gamma)^2(2-\theta) + \theta^2(1+\gamma^2)} > 0,$$

$$\frac{\partial\beta_2}{\partial\gamma} = -\frac{2\theta(4-\theta)(2(1-\gamma)+\theta\gamma)(2(1-\gamma)-\theta)}{4(1-\gamma)^2(2-\theta) + \theta^2(1+\gamma^2)} < 0,$$

$$\frac{\partial\beta_1}{\partial\theta} = \frac{4(1-\gamma^2)(2(1-\gamma)+\theta\gamma)(2(1-\gamma)-\theta)}{4(1-\gamma)^2(2-\theta) + \theta^2(1+\gamma^2)} > 0,$$

$$\frac{\partial\beta_2}{\partial\gamma} = -\frac{4(1-\gamma^2)(2(1-\gamma)+\theta\gamma)(2(1-\gamma)-\theta)}{4(1-\gamma)^2(2-\theta) + \theta^2(1+\gamma^2)} < 0.$$

The fourth and fifth properties are obtained by substituting $\gamma = (2-\theta)/2$ and $\theta = 0$ into $\beta_i(\gamma, \theta)$, which is continuous in θ and γ.

□

D Exclusive supply contracts when downstream firms compete in quantity

This appendix introduces another case where exclusive-offer competition plays an essential role in exclusive dealing. The upstream market is composed of an upstream monopolist U, whose marginal cost is $c \geq 0$. The downstream market is composed of two downstream firms which produce homogeneous products. Each downstream firm produces one unit of final product by using one unit of input produced by U. For simplicity, we assume that the cost of transformation is zero for each D_i; given the input price w, per unit production cost of D_i is given by $c_{Di} = w_i$, where $i \in \{1, 2\}$. D_1 and D_2 compete in quantity. Let Q_i be the production level of D_i. We assume that the inverse demand for the final product $P(Q)$ is given by a simple linear function:

$$P(Q) = a - bQ,$$

where $Q \equiv Q_1 + Q_2$ is the output of the final product, $a > c$, and $b > 0$.

The model in this appendix contains three stages. In Stage 1, D_1 and D_2 make exclusive supply offers to U with fixed compensation $y_i \geq 0$, where $i \in \{1, 2\}$. U can reject both offers or it can accept one of the offers. As defined in Section 2, let $\omega \in \{R, E1, E2\}$ be U's decision in Stage 1. If U is indifferent between two exclusive offers and the acceptance is more profitable, it accepts one of the offers with probability $1/2$. In Stage 2, U offers a linear wholesale price w to active downstream firms. The equilibrium wholesale price offered by U is denoted by w^{ω}. In Stage 3, active downstream firms order input and determine the production level of the final product Q_i. D_i's profit is denoted by π^{ω}_{Di}. Likewise, U's profit is denoted by π^{ω}_{U}.

D.1 Equilibrium outcomes after Stage 1

We first explore the case in which D_i's exclusive supply offer is accepted by U in Stage 1. In Stage 3, given w, D_i optimally chooses the production level $Q^{Ei}_i(w) \equiv \arg\max_{Q_i}(P(Q_i) - w)Q_i = (a - w)/2b$. Then the input demand for U becomes $Q^{Ei}(w) = Q^{Ei}_i(w) = (a - w)/2b$. In Stage 2, by anticipating these results, U optimally choose input price $w^{Ei} \equiv \arg\max_w(w -$

$c)Q(w) = (a + c)/2$. The equilibrium production levels become $Q^{Ei} = Q_i^{Ei} = (a - c)/4b$ and $Q_j^{Ei} = 0$, where $i, j \in \{1, 2\}$ and $i \neq j$. The firms' equilibrium profits, excluding the fixed compensation y_i, are

$$\pi_{Di}^{Ei} = \frac{(a-c)^2}{16b}, \;\; \pi_{Dj}^{Ei} = 0, \; \pi_D^{Ei} = \frac{(a-c)^2}{8}. \tag{28}$$

We next explore the case in which U rejects exclusive supply offers in Stage 1. In Stage 3, given w, D_i compete in quantity. The standard Cournot competition leads to $Q_i^R(w) = (a - w)/3b$. Then the input demand for U becomes $Q^R(w) = 2(a - c)/3b$. In Stage 2, by anticipating these results, U optimally chooses input price $w^R \equiv \arg\max_w (w - c)Q^R(w) = (a + c)/2$. The equilibrium production levels become $Q_1^R = Q_2^R = (a - c)/6b$. The firms' equilibrium profits are

$$\pi_{Di}^R = \frac{(a-c)^2}{36b}, \;\; \pi_U^R = \frac{(a-c)^2}{6b}. \tag{29}$$

D.2 Benchmark analysis

Like Section 3.2, we assume that D_2 is a potential entrant and only D_i can make an exclusive offer in Stage 1. For an exclusion equilibrium to exist, the equilibrium transfer y_i^* must satisfy the following two conditions.

First, the exclusive contract must satisfy individual rationality for U:

$$y_i^* \geq \Delta\pi_U^c, \tag{30}$$

where $\Delta\pi_U^c \equiv \pi_U^R - \pi_U^{Ei}$.

Second, it must satisfy individual rationality for D_i:

$$y_i^* \leq \Delta\pi_D^c, \tag{31}$$

where $\Delta\pi_D^c \equiv \pi_{Di}^{Ei} - \pi_{Di}^R$.

From the above conditions, it is evident that an exclusion equilibrium exists if and only if inequalities (30) and (31) simultaneously hold. This is equivalent to the following condition:

$$\Delta\pi_D^c \geq \Delta\pi_U^c. \tag{32}$$

We now consider the game in Stage 1. By substituting equations (28) and (29), we obtain

$$\Delta\pi_D^c - \Delta\pi_U^c = \frac{(a-c)^2}{144b} < 0, \tag{33}$$

which implies that condition (32) never holds. Therefore, exclusion outcomes cannot be observed.

Proposition D.1. *Suppose that downstream firms D_1 and D_2 compete in quantity by purchasing input from upstream monopolist U. If D_2 is a potential entrant and only D_1 can make an exclusive offer, D_1 cannot exclude D_2 via exclusive contracts.*

The result here coincides with that of Appendix B in Kitamura, Matsushima, and Sato (2017b).[16]

D.3 When exclusive-offer competition exists

Assume that both downstream firms make exclusive offers. Like Section 3.3, the upper bound of D_i's exclusive offer $y_i^{\max}$ depends on D_j's offer, where

$$y_i^{\max} \equiv \begin{cases} \pi_{Di}^{Ei} & \text{if } y_j \geq \Delta\pi_U^c \\ \Delta\pi_D & \text{if } y_j < \Delta\pi_U^c \end{cases}$$

and where $\pi_{Di}^{Ei} > \Delta\pi_D$.

For $y_j < \Delta\pi_U^c$, we have $y^{\max} = \Delta\pi_D^c$. With this offer, U_i earns $\pi_{D_i}^{Ei} + y^{\max} < \pi_U^R$ because inequality (33) holds; namely, individual rationality constraint for U does not hold. Therefore, like Section 3.3, non-exclusion equilibrium always exists . For the existence of an exclusion equilibrium, we check whether $\pi_{Di}^{Ei} \geq \Delta\pi_U^c$ holds. By substituting equations (28) and (29), we obtain

$$\pi_{Di}^{Ei} - \Delta\pi_U^c = \frac{(a-c)^2}{48b} > 0,$$

which implies that exclusion outcomes can be observed.

[16] More precisely, both models coincide for $k = 1$ in their model.

Proposition D.2. *Suppose that downstream firms D_1 and D_2 compete in quantity by purchasing input from upstream monopolist U. When both downstream firms can make exclusive offers, there exist both an exclusion equilibrium and a non-exclusion equilibrium. In the exclusion equilibrium, both D_1 and D_2 offer $y_i^* = \pi_{D_i}^{Ei} > \Delta\pi_U$ and U earns all industry profits.*

References

Abito, J.M., and Wright, J., 2008. Exclusive Dealing with Imperfect Downstream Competition. *International Journal of Industrial Organization* 26(1), 227–246.

Aghion, P., and Bolton, P., 1987. Contracts as a Barrier to Entry. *American Economic Review* 77(3), 388–401.

Argenton, C., 2010. Exclusive Quality. *Journal of Industrial Economics* 58(3), 690–716.

Bernheim, B.D., and Whinston, M.D., 1998. Exclusive Dealing. *Journal of Political Economy* 106(1), 64–103.

Bork, R.H., 1978. *The Antitrust Paradox: A Policy at War with Itself.* New York: Basic Books.

Calzolari, G., and Denicolò, V., 2013. Competition with Exclusive Contracts and Market-Share Discounts. *American Economic Review* 103(6), 2384–2411.

Calzolari, G., and Denicolò, V., 2015. Exclusive Contracts and Market Dominance. *American Economic Review* 105(11), 3321–3351.

Choi, J.P., and Stefanadis, C., forthcoming. Sequential Innovation, Naked Exclusion, and Upfront Lump-sum Payments. *Economic Theory*.

DeGraba, P., 2013. Naked Exclusion by an Input Supplier: Exclusive Contracting Loyalty Discounts. *International Journal of Industrial Organization* 31(5), 516–526.

Farrell, J., 2005. Deconstructing Chicago on Exclusive Dealing. *Antitrust Bulletin* 50, 465–80.

Fumagalli, C., and Motta, M., 2006. Exclusive Dealing and Entry, When Buyers Compete. *American Economic Review* 96(3), 785–795.

Fumagalli, C., Motta, M., and Persson, L., 2009. On the Anticompetitive Effect of Exclusive Dealing When Entry by Merger Is Possible. *Journal of Industrial Economics* 57(4), 785–811.

Fumagalli, C., Motta, M., and Rønde, T., 2012. Exclusive Dealing: Investment Promotion may Facilitate Inefficient Foreclosure. *Journal of Industrial Economics* 60(4), 599–608.

Gratz, L. and Reisinger, M., 2013. On the Competition Enhancing Effects of Exclusive Dealing Contracts. *International Journal of Industrial Organization* 31(5), 429-437.

Kitamura, H., 2010. Exclusionary Vertical Contracts with Multiple Entrants. *International Journal of Industrial Organization* 28(3), 213–219.

Kitamura, H., Matsushima, N., and Sato, M., 2016. Exclusive Contracts with Complementary Input. mimeo.

http://ssrn.com/abstract=2547416

Kitamura, H., Matsushima, N., and Sato, M., 2017a. Exclusive Contracts and Bargaining Power. *Economics Letters* 151, 1–3.

Kitamura, H., Matsushima, N., and Sato, M., 2017b. How Does Downstream Firms' Efficiency Affect Exclusive Supply Agreements? mimeo.

http://ssrn.com/abstract=2306922

Motta, M., 2004. *Competition Policy. Theory and Practice.* Cambridge: Cambridge University Press.

Posner, R.A., 1976. *Antitrust Law: An Economic Perspective.* Chicago: University of Chicago Press.

Rasmusen, E.B., Ramseyer, J.M., and Wiley Jr., J.S., 1991. Naked Exclusion. *American Economic Review* 81(5), 1137–1145.

Segal, I.R., and Whinston, M.D., 2000. Naked Exclusion: Comment. *American Economic Review* 90(1), 296–309.

Shen, B., 2014. Naked exclusion by a manufacturer without a first-mover advantage, mimeo.

Simpson, J., and Wickelgren, A.L., 2007. Naked Exclusion, Efficient Breach, and Downstream Competition. *American Economic Review* 97(4), 1305–1320.

Whinston, M.D., 2006. *Lectures on Antitrust Economics*. Cambridge: MIT Press.

Wright, J., 2008. Naked Exclusion and the Anticompetitive Accommodation of Entry. *Economics Letters* 98(1), 107–112.

Wright, J., 2009. Exclusive Dealing and Entry, when Buyers Compete: Comment. *American Economic Review* 99(3), 1070–1081.

Yong, J.S., 1996. Excluding Capacity-Constrained Entrants Through Exclusive Dealing: Theory and an Application to Ocean Shipping. *Journal of Industrial Economics* 44(2), 115–29.

Yong, J.S., 1999. Exclusionary Vertical Contracts and Product Market Competition. *Journal of Business* 72(3), 385-406.

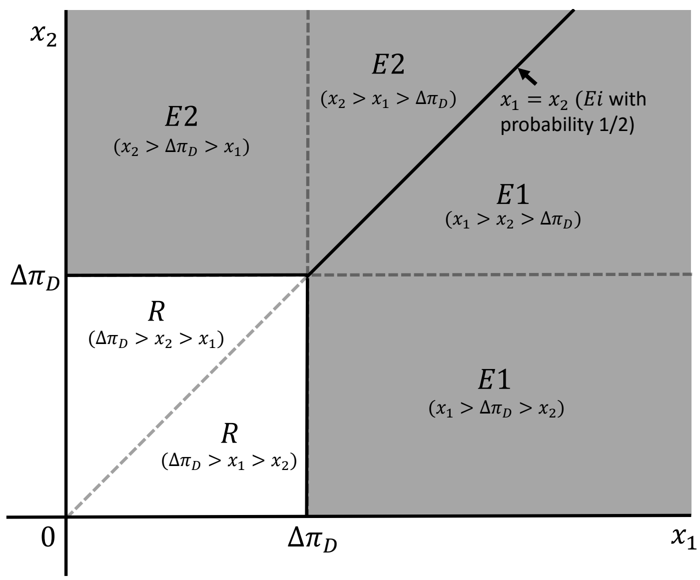

Figure 1: Individual Rationality for *D*

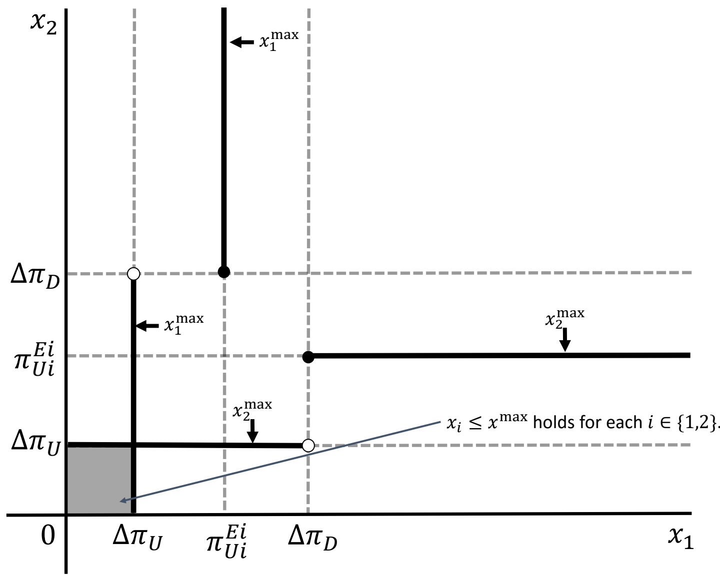

Figure 2: Area of Feasible Offers for U_i ($\pi_{Ui}^{Ei} < \Delta\pi_D$)

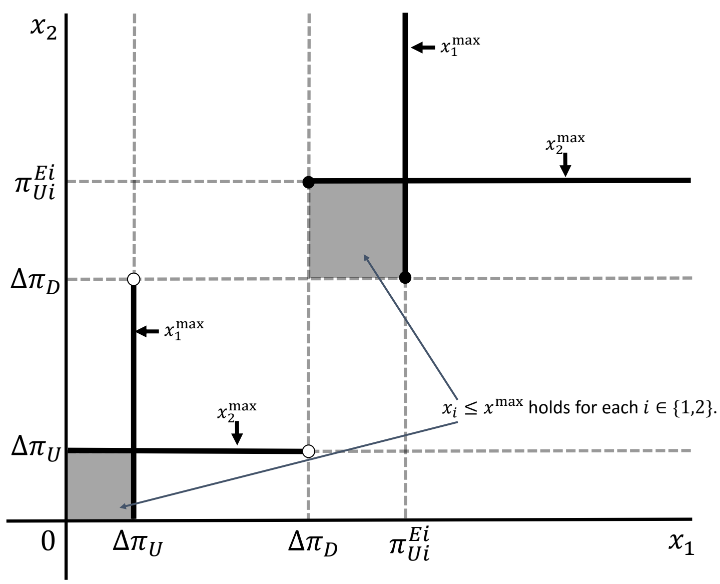

Figure 3: Area of Feasible Offers for U_i ($\pi_{Ui}^{Ei} \geq \Delta\pi_D$)

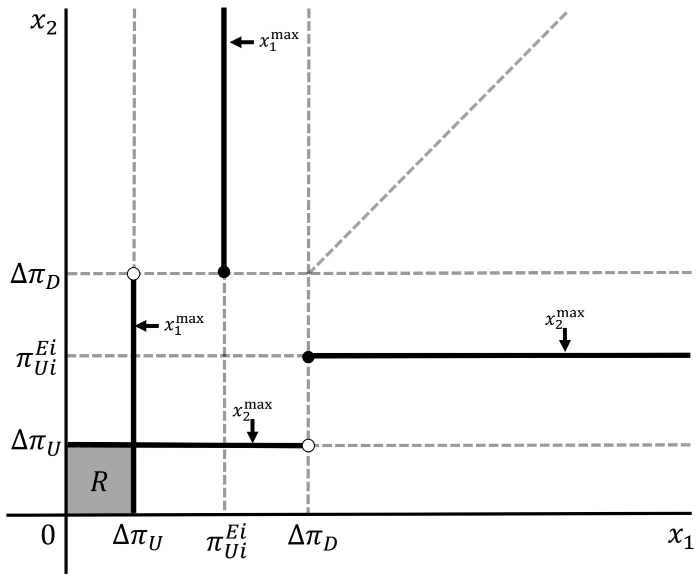

Figure 4: Existence of An Exclusion Equilibrium for $\pi_{Ui}^{Ei} < \Delta\pi_D$

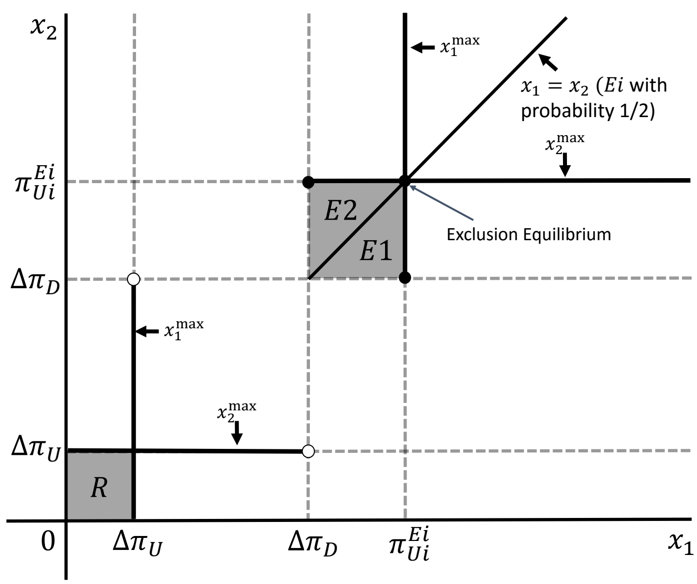

Figure 5: Existence of An Exclusion Equilibrium for $\pi_{Ui}^{Ei} \geq \Delta\pi_D$

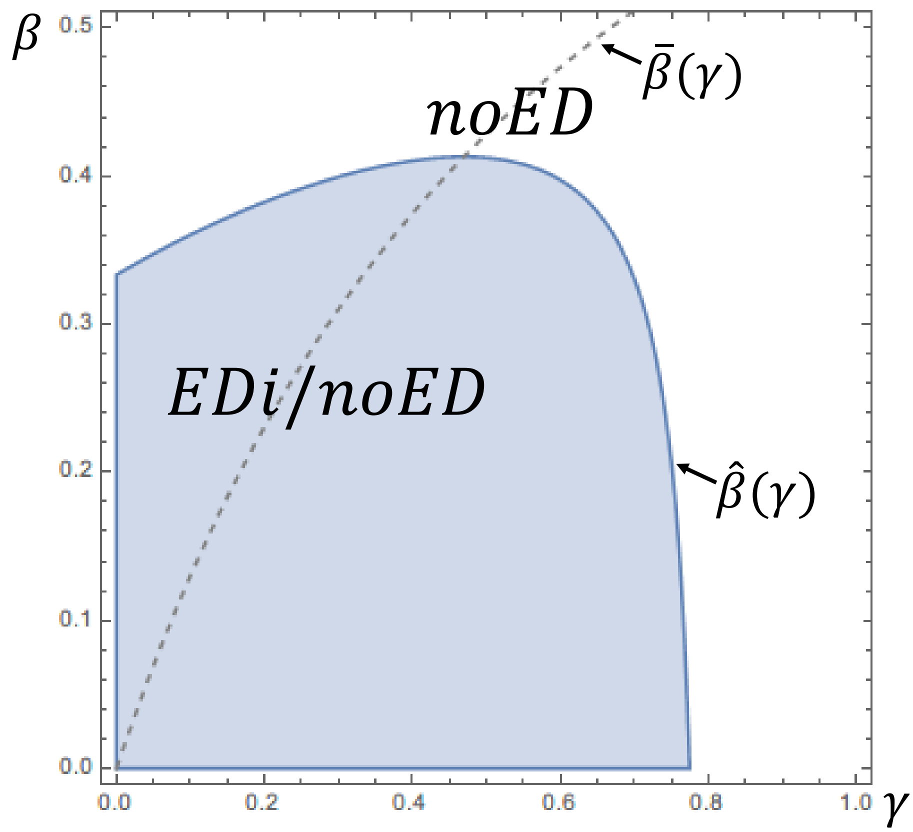

Figure 6: Existence of An Exclusion Equilibrium under Linear wholesale pricing

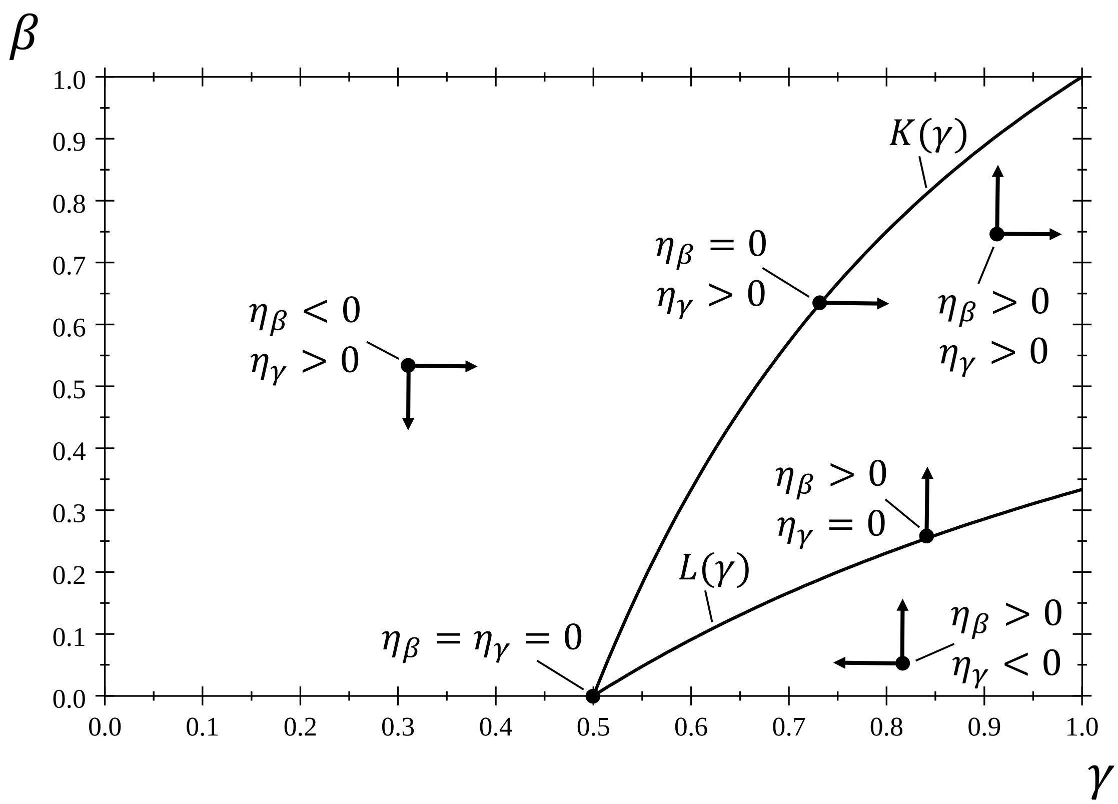

Figure 7: Properties of $\eta_\beta(\beta, \gamma)$ and $\eta_\gamma(\beta, \gamma)$