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NAKED EXCLUSION UNDER EXCLUSIVE-OFFER COMPETITION

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Naked Exclusion under Exclusive-offer Competition*

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Abstract

This study constructs a model of exclusive-offer competition between two existing upstream firms. Under exclusive-offer competition, the upstream firm's profit depends on the rival's exclusive offer. If the rival makes an exclusive offer acceptable for the downstream firm, the upstream firm is excluded unless it succeeds in exclusion. Consequently, the upper bound of exclusive offers becomes higher than when one of the upstream firms is a potential entrant that cannot make any exclusive offer. Thus, the exclusion of the existing upstream firm can be an equilibrium outcome even in the case where the potential entrant is never excluded.

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

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1 Introduction

Firms often sign exclusive contracts with their trading partners to prevent the firms' rivals from having relationships with those partners, limiting the sales opportunities of the rivals. In the "cola wars" between PepsiCo and Coca-Cola, both firms propose exclusive offers to retailers, restaurants, cinemas, and universities. These entities choose one exclusive offer over the other to obtain a large monetary transfer from either supplier.[1] [2] We also observe exclusive-offer competition in shipping markets. In 2000, Nippon Express, a Japanese shipping company, won a competition against Yamato Transport and Sagawa Express over an exclusive shipping contract with Amazon when Amazon opened Amazon.co.jp, Amazon's Japanese branch.[3] Recently, in semiconductor markets, Taiwan Semiconductor Manufacturing Company (TSMC) and Samsung Electronics often compete to become an exclusive supplier of Apple and Nvidia.[4] [5]

We can also see exclusion in antitrust cases. For example, in the Intel antitrust case, Intel's contract terms prevented AMD and Transmeta, already in the market, from trading with the major original equipment manufacturers that had signed with Intel.[6] Also, in the case of Virgin Atlantic Airways vs. British Airways, Virgin Atlantic sued, claiming that it was excluded through British

[1] See, for example, "'Cola Wars' Foaming On College Campuses" *Chicago Tribune,* November 6, 1994 (link). The cola wars at restaurants, cinemas, and universities are discussed in Section 5.1.

[2] We often observe exclusive-offer competition among beer companies. For example, in Japan, Torikizoku, a large grilled-chicken restaurant chain, changed its beer supplier from Kirin to Suntory in 2014. See "Unhappy hour for Kirin as its beer sales tumble in Japan" *REUTERS,* July 11, 2014 (link).

[3] See "Amazon Japan: Localization" *LOGI-BIZ,* May 2001, written in Japanese (link).

[4] See "Samsung Electronics Loses to TSMC over AP Supply for iPhone XS" *BUSINESSKOREA,* October 16, 2018 (link) and "Samsung Loses Nvidia's GPU Foundry Competition to Taiwan's TSMC" *BUSINESSKOREA,* September 20, 2018 (link).

[5] The other example of exclusive-offer competition is found in aviation industry. The Boeing Company and Airbus sometimes award exclusivity to one or two jet engine makers over the others. For example, The Boeing Company selected General Electric as the exclusive engine supplier for Boeing 777X in 1999. Airbus granted an exclusive contract to Rolls-Royce for the A330neo in 2014. See "GE Unit Lands Exclusive Boeing Pact For Developing Commercial Jet Engine" *The Wall Street Journal,* July 8, 1999 (link) and "Airbus selects Rolls-Royce Trent 7000 as exclusive engine for the A330neo" *Rolls-Royce,* July 14, 2014 (link).

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

Airways' exclusive dealings with corporate customers and travel agents.[7] In these cases, the excluded firms potentially could offer exclusive contracts.

In this study, we construct a model of exclusive contracts that deter an existing upstream firm. Although most previous studies assume that upstream firms produce perfectly homogeneous products, we assume that upstream firms produce horizontally differentiated products so that they earn positive profits under upstream duopoly. This modeling strategy is close to that of Wright (2008). Although Wright (2008) shows that multiple downstream firms play an essential role in exclusion, we assume the presence of only a single downstream firm to clarify the role of exclusive-offer competition. Following previous studies, an exclusive offer involves a fixed compensation. After the downstream firm decides whether to accept exclusive offers, the industry profit allocation is determined by negotiations between the downstream firm and each existing upstream firm through generalized Nash bargaining. In this setting, we compare the case where one of the upstream firms is a potential entrant that cannot make exclusive offers (benchmark analysis) with the case where both upstream firms are existing firms (main analysis).

By introducing non-linear wholesale pricing and a general demand function, we first show that exclusion never occurs and that the upstream market always becomes a duopoly in the benchmark analysis; that is, the Chicago School argument applies. When the exclusive offer is rejected, upstream competition induces the downstream firm to earn higher profits. Considering the industry profit allocation under the upstream duopoly, exclusive dealing is not profitable for the upstream incumbent because the acceptable exclusive offer is costly for any bargaining power allocation.

We then show that in the main analysis, exclusion can be an equilibrium outcome. Under exclusive-offer competition, an upstream firm's profit depends on the rival's offer. When the rival upstream firm makes an acceptable exclusive offer, the upstream firm is excluded unless it succeeds in exclusion. That is, exclusive-offer competition prevents the upstream firm from enjoying

[7] Virgin Atlantic Airways charged that British Airways granted 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 (link).

positive profits under the upstream duopoly. As a result, compared to the benchmark analysis, the upstream firm has a strong incentive for exclusive dealing; the willingness to offer increases. Therefore, there exists a possibility that each upstream firm reluctantly makes a higher acceptable exclusive offer. We find that this exclusion mechanism works if the upstream firms have relatively strong bargaining power because the loss of sales opportunities from the rival's acceptable exclusive offer is higher under strong bargaining power.

We conduct a laboratory experiment to confirm the existence of the above exclusion outcome. Using a parameter set in which we theoretically predict the existence of an exclusion outcome, the experimental analysis finds that exclusion outcomes can be observed with a relatively high frequency.[8] The experimental finding confirms the relevance of the exclusion mechanism in the presence of exclusive-offer competition.

This study is related to the literature on anticompetitive exclusive contracts that deter the socially efficient entry of a potential entrant.[9] The Chicago School researchers Posner (1976) and Bork (1978) conclude that rational economic agents do not engage in anticompetitive exclusive dealing by taking into account all members' participation constraints for an exclusive contract under a bilateral monopoly with an upstream entrant.[10] In rebuttal to the Chicago School argument, many papers find certain market environments in which anticompetitive exclusive contracts are attainable.

We explain two types of related papers that extend the Chicago School argument: (i) increasing the number of downstream buyers from one and (ii) changing the nature of upstream competition.

[8] By varying key parameters in this study, Kitamura et al. (2025) conduct an additional experimental analysis demonstrating that exclusion occurs across different parameter settings, thereby reinforcing the credibility of the exclusion mechanism in this study.

[9] Several studies examine pro-competitive exclusive dealings, for example, non-contractible investments (Marvel, 1982; Besanko and Perry, 1993; Segal and Whinston, 2000a; de Meza and Selvaggi, 2007; de Fontenay, Gans, and Groves, 2010), industry R&D and welfare (Chen and Sappington, 2011), and risk sharing (Argenton and Willems, 2012).

[10] For the analysis of the impact of this argument on antitrust policies, see Motta (2004), Whinston (2006), and Fumagalli, Motta, and Calcagno (2018).

In the first type, some papers consider scale economies in which the entrant needs a certain number of buyers to cover its fixed costs (Rasmusen, Ramseyer, and Wiley, 1991; Segal and Whinston, 2000b).[11] They find that signing exclusive contracts reduces the possibility of entry under scale economies. Also, other papers consider competition between buyers (Simpson and Wickelgren, 2007; Abito and Wright, 2008).[12] They point out that upstream entry reduces industry profits in the presence of downstream competition.[13] In contrast to those papers, this study shows that anticompetitive exclusive contracts can be attainable even under a single-buyer model because of a negative externality that the high exclusive offer by an upstream firm reduces the rival upstream firm's profits for the case of failing exclusive dealing.

In the second type, related studies consider many kinds of upstream competition. The studies in this strand point out that the intensity of upstream competition plays a crucial role in the Chicago School critique. The key factors in those studies are liquidated damages for the case of supplier entry (Aghion and Bolton, 1987),[14] upstream capacity constraint (Yong, 1996), upstream competition à la Cournot (Farrell, 2005), upstream merger (Fumagalli, Motta, and Persson, 2009), relationship-specific investments (Fumagalli, Motta, and Rønde, 2012), complementary input supplier (Kitamura, Matsushima, and Sato, 2018b), and the incumbent's fixed cost to stay (Liu and Meng, 2021).[15] Our study complements these works in that we show an alternative route through

[11] For an extended analysis, see Chen and Shaffer (2014, 2019), Miklós-Thal and Shaffer (2016), Choi and Stefanadis (2018), and Chen and Zápal (2024).

[12] 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 (2009), who corrects the result of Fumagalli and Motta (2006) in the case of two-part tariffs.

[13] For extended models of exclusion with downstream competition, see Wright (2008), Argenton (2010), Kitamura (2010), and Gratz and Reisinger (2013).

[14] See also Spier and Whinston (1995) for the extension of Aghion and Bolton (1987).

[15] Recently, Kitamura, Matsushima, and Sato (2017) show that anticompetitive exclusive dealing can occur if the downstream buyer bargains with suppliers sequentially. Kitamura, Matsushima, and Sato (2023a) show that exclusive contracts can be attainable to deter upstream entry in durable goods markets. Assuming an outside option for the efficient entrant, Kitamura, Matsushima, and Sato (2023b) show that excluding an upstream entry emerges if the efficiency of the upstream entrant is high.

which the lower intensity of upstream competition due to product differentiation leads to anticompetitive exclusive dealing in the presence of exclusive-offer competition.

Few studies address exclusive dealing that aims to exclude existing firms.[16] By extending the model of exclusion with downstream competition, DeGraba (2013) and Shen (2014) explore exclusive-offer competition.[17] In their studies, exclusion arises because of downstream competition. By contrast, this study explores anticompetitive exclusive dealing in the absence of downstream competition and shows that exclusive-offer competition leads to anticompetitive exclusive dealing.

In terms of exclusive-offer competition, this study is also related to the benchmark model of Bernheim and Whinston (1998, Sections II and III).[18] In their study, upstream firms can commit not to sell their products to the downstream firm if the downstream firm rejects both exclusive offers, although the upstream firms prefer to trade with the downstream firm after the rejections. Such a commitment plays an essential role in achieving exclusion outcomes. Conversely, this study considers that upstream firms cannot make such a commitment, following the Chicago School argument. We show that exclusion is achievable owing to the exclusive-offer competition even in such a situation; thus, this study clarifies the role of exclusive-offer competition in the literature on naked exclusion. Section 5.2 provides a detailed discussion on the difference between this study and Bernheim and Whinston (1998).

The remainder of this paper is organized as follows. Section 2 constructs the model. Section 3 analyzes the existence of exclusion outcomes under two-part tariffs. Section 4 introduces

[16] Choi and Stefanadis (2018) explore the exclusive-offer competition between upstream firms 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.

[17] Jing and Winter (2014) also remove the first-mover advantage for the incumbent. They derive exclusion outcomes by assuming the complementarity among upstream inputs, which is not focused on in our analysis.

[18] For the studies focusing on the fact that active firms may compete for exclusivity, see also Mathewson and Winter (1987), O'Brien and Shaffer (1997). Recently, Calzolari and Denicolò (2013, 2015) and Calzolari, Denicolò, and Zanchettin (2020) introduce asymmetric information in this literature.

experimental results. Section 5 provides a discussion, and Section 6 offers concluding remarks. Supplementary Appendixes A–D provide several supplementary discussions.

2 Model

This section develops the basic setting of the model. The upstream market consists of two manufacturers, U_1 and U_2. Each manufacturer operates at the same marginal cost $c \geq 0$ and produces a differentiated final product. We explore the case of asymmetric costs in Section 3.4. The downstream market consists 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.[19] To simplify the analysis, we assume that D incurs no operating cost aside from paying for the product of U_i ($i = 1, 2$). Therefore, given wholesale price w_i, the resale cost of D selling q_i units of U_i's final product ($i = 1, 2$) is $C_D(q_1, q_2) = \sum_i w_i q_i$.

The downstream demand has the following properties. Given the retail prices of manufacturers' products (p_1, p_2), demand for U_1's product is $Q(p_1, p_2)$. Assuming symmetric demand, demand for U_2's product is $Q(p_2, p_1)$. When U_j is excluded, U_i is the monopolist, and demand for its product is $Q(p_i) \equiv Q(p_i, \infty)$.

For the sake of the analysis under generalized Nash bargaining, 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:

$$p_m \equiv \underset{p_i}{\operatorname{argmax}} (p_i - c)Q(p_i),$$

$$(p_d, p_d) \equiv \underset{p_i, p_j}{\operatorname{argmax}} (p_i - c)Q(p_i, p_j) + (p_j - c)Q(p_j, p_i).$$

[19] Although a buyer is a final consumer in the Chicago School model, the results in all the propositions in this paper do not change if we assume that the buyer is a downstream monopolist.

We define Π_m and Π_d as the net profit of each vertical chain under upstream monopoly and under upstream 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. *We assume the following relations concerning* Π_m *and* Π_d*:*

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

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 when the two products are perfectly homogeneous. In addition, the second inequality in Condition (1) implies that an increase in the number of product varieties reduces the net profit per vertical chain except when those products are perfectly different. Note that the properties introduced above hold under standard linear demand function (18) in Appendix A, derived from a representative consumer's maximization problem.

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.[20] 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 acceptance leads to higher profits, it accepts one of the offers with probability $1/2$. Moreover, if D is indifferent between accepting the higher of two exclusive offers and rejecting both, it accepts the higher exclusive offer. In Stage 2, active manufacturers offer a two-part tariff contract. We extend the model to the case of linear wholesale pricing in Appendix D. In Stage 3, D orders the

[20] Rasmusen, Ramseyer, and Wiley (1991) and Segal and Whinston (2000a) 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 the possibility of anticompetitive exclusive dealing is enhanced. See Yong (1999) and Appendix B of Fumagalli and Motta (2006).

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 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^ω, F_i^ω), where $i \in \{1, 2\}$. We assume that the industry profit allocation after Stage 1 is given by the 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. Section 3.1 derives the equilibrium outcomes after the game in Stage 1 by using backward induction. Section 3.2 examines the game in Stage 1 by introducing the benchmark analysis in which one of the manufacturers is a potential entrant, as in the Chicago School model. Section 3.3 then explores the case where both manufacturers make exclusive offers. Section 3.4 finally examines the effect of cost asymmetry on the existence of an exclusion equilibrium.

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 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

$$F_i^{Ei} = \underset{F_i}{\operatorname{argmax}}\ \beta \log[\Pi_m - F_i] + (1-\beta) \log F_i.$$

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 the form of simultaneous bilateral negotiation; that is, when negotiating with two manufacturers, D simultaneously and separately negotiates with each of them. D and U_i then make a two-part tariff contract, (c, F_i^R). The outcome of each negotiation is given by the Nash bargaining solution based on the belief that the outcome of the 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 $(2\Pi_d - F_j^R - F_i^R, F_i^R)$ 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 under two-part tariff contract (c, F_j^R).[21] The solution is given by

$$F_i^R = \underset{F_i}{\operatorname{argmax}} \; \beta \log[2\Pi_d - F_j - F_i - z_j] + (1-\beta)\log F_i.$$

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 the 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 industry profit under upstream duopoly after subtracting the payments for U_1 and U_2 (that is, $2\Pi_d - \pi_{U1}^R - \pi_{U2}^R$).

[21] This type of bargaining process is used in Horn and Wolinsky (1988), O'Brien and Shaffer (1992), Caprice (2006), Milliou and Petrakis (2007), Pinopoulos (2022), and Milliou and Petrakis (2024). Recently, Collard-Wexler, Gowrisankaran, and Lee (2019) provide a microfoundation for those kinds of bargaining procedures.

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 so that U_j earns positive profits.

To start the 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 exclusive contracts are attained 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. By substituting Equations (2) and (3), we find that under Condition (1)

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

which implies that exclusion never occurs.[22]

Proposition 1. *Suppose both manufacturers adopt two-part tariffs. If U_j is a potential entrant and only U_i can make 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 its model to the case where manufacturers produce differentiated products and adopt two-part tariffs. Under the non-linear pricing scheme, following the bargaining procedure, the firms split the total industry profit. Except for the cases of $\beta = 0$ and $2\Pi_d = \Pi_m$, 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.[23] Therefore, exclusion does not occur when only one manufacturer can make the exclusive offer.

3.3 When exclusive-offer competition exists

In contrast to the previous subsection, we now assume that both manufacturers are existing firms and can make exclusive offers. Compared with 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 on whether to accept the exclusive offer by U_j. Figure 1 summarizes D's decision

[22] Note that we assume that U_i makes take-it-or-leave-it offers in Stage 1 for simplicity. If Condition (6) holds, the existence of an exclusive equilibrium is not affected even when x_i is determined by the generalized Nash bargaining between U_i and D because any such bargaining outcomes satisfy Condition (6).

[23] 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 because of the perfect substitutability of products.

in response to both manufacturers' offers in Stage 1. When both exclusive offers are lower than $\Delta\pi_D$, D rejects both. 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. Hence, D's behaviors affect both manufacturers' exclusive offers as follows. When U_j offers $x_j < \Delta\pi_D$, U_i can be active and earn $\pi^R_{Ui}(> 0)$ even when it fails to exclude U_j. By comparing this profit with its net profit under exclusion $\pi^{Ei}_{Ui} - x_i$, 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 the market and earns $\pi^{Ej}_{Ui} = 0$ if it fails to exclude U_j. In this case, the exclusion of U_j is profitable for U_i if $\pi^{Ei}_{U_i} - x_i \geq 0$. 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) that satisfies $x_i \in [0, x^{\max}]$ for each $i \in \{1, 2\}$. Each manufacturer's offer is feasible in 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 areas cannot be the exclusion equilibrium.

Depending on the magnitude relationship between π^{Ei}_{Ui} and $\Delta\pi_D$, we have two cases. First, if $\pi^{Ei}_{Ui} < \Delta\pi_D$, summarized in Figure 2, each manufacturer's exclusive offer is feasible in only one region because D's rejection profit is considerably high and each manufacturer cannot compensate D profitably when its rival makes the higher offer. Second, if $\pi^{Ei}_{Ui} \geq \Delta\pi_D$, summarized in Figure 3, each manufacturer's exclusive offer is feasible in 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 in the shadowed areas in Figures 2 and 3. Figure 4 implies that exclusion never occurs if $\pi^{Ei}_{Ui} < \Delta\pi_D$. 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 the 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 ($\beta \leq 1/2$), both exclusion and non-exclusion equilibria exist.*

Proposition 2 shows that under exclusive-offer competition, an exclusion equilibrium exists depending on the bargaining power of D over manufacturers. For the weak bargaining power of D, D earns a lower profit when it rejects both exclusive offers in Stage 1. Therefore, each manufacturer can compensate D profitably. Moreover, the existence of an exclusion equilibrium does not depend on the magnitudes of Π_m and Π_d if those values satisfy Assumption 1 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.

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. Nevertheless, the experimental study in Section 4 shows that exclusion outcomes can be observed with a certain level of frequency. The experimental result confirms the robustness of the exclusion mechanism in this study.

Seemingly, the cola wars capture the exclusion equilibrium because both Coca-Cola and PepsiCo pay a large monetary transfer. The likelihood of exclusion here may depend on the market history. If a president of one upstream firm has a managerial incentive to maximize market share rather than profit, exclusion is more likely to occur. Once exclusion occurs, it is more likely to be observed continuously—even when the managerial incentive changes. In addition, D has a strong incentive to yield the exclusion outcome. 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 an exclusion equilibrium. Thus far, we have 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:

$$p_{mi} \equiv \operatorname*{argmax}_{p_i} \, (p_i - c_i)Q(p_i),$$

$$(p_{di}, p_{dj}) \equiv \operatorname*{argmax}_{p_i, p_j} \, (p_i - c_i)Q(p_i, p_j) + (p_j - c_j)Q(p_j, p_i).$$

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

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

Since our focus is the existence of anticompetitive exclusive dealing, we only consider the case where the upstream market becomes a duopoly in the absence of exclusive dealing, namely $\Pi_{di} > 0$ for each $i \in \{1, 2\}$. 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 increment in the industry profit when U_i's product is also launched in the upstream 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. *Trading with U_1 leads to higher profits than that with U_2;*

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

2. *For each $i \in \{1, 2\}$,*

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

   and when $c_2 - c_1$ is larger than a threshold value, $\Pi_{d2} = 0$ and $\Pi_{d1} = \Pi_{m1}$.

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

$$\Delta\Pi_1 > \Delta\Pi_2 > 0. \tag{11}$$

By using the above definitions, we can derive the equilibrium profits under asymmetric costs. As in Section 3.1, the negotiation between D and U_i leads to marginal cost pricing in all cases. Under generalized Nash bargaining, the firms' equilibrium profits under exclusive dealing, excluding the fixed compensation x_i, are

$$\pi_{Ui}^{Ei} = (1-\beta)\Pi_{mi}, \;\; \pi_{Uj}^{Ei} = 0, \;\; \pi_{D}^{Ei} = \beta\Pi_{mi}. \tag{12}$$

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

$$\pi_{Ui}^R = (1-\beta)\Delta\Pi_i, \;\; \pi_D^R = (1-\beta)(\Pi_{mi} - \Pi_{di} + \Pi_{mj} - \Pi_{dj}) + \beta(\Pi_{di} + \Pi_{dj}). \tag{13}$$

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.[24]

We now consider the existence of an exclusion equilibrium. We first explore the case in which only U_i can make an exclusive offer. By substituting Equations (12) and (13), we find that under Condition (9)

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

which implies that exclusion never occurs.

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

Proposition 3 implies that U_1 cannot deter the entry of U_2 as long as entry increases the industry profit. Therefore, the result confirms the robustness of the Chicago School argument in the case where the incumbent manufacturer cannot deter the 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 $i \in \{1, 2\}$. By substituting Equations (12) and (13), we have $\pi_{Ui}^{Ei} + \pi_D^{Ei} - \pi_D^R \geq 0$ if and only if

$$\beta \leq \beta_i \equiv \frac{\Delta\Pi_i}{\Delta\Pi_i + \Delta\Pi_j} \tag{14}$$

for each $i \in \{1, 2\}$. From Conditions (11) and (14), β_i have the following relationships:

$$0 < \beta_2 < \frac{1}{2} < \beta_1 < 1, \tag{15}$$

[24] See Appendix B, which introduces the results under the linear demand model.

where $\beta_1 \to 1$ and $\beta_2 \to 0$ as $\Delta\Pi_2 \to 0$. Condition (15) 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 holds, cost asymmetry reduces the possibility of the 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; in other words, 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 a 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 profits 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; hence, 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 an exclusion equilibrium and the degree of product substitution (denote it by γ) that influences Π_{d1} and Π_{d2}. As the value of $\gamma \in (0,1)$ increases, Π_{d1} and Π_{d2} decreases ($\partial\Pi_{d1}/\partial\gamma < 0$ and $\partial\Pi_{d2}/\partial\gamma < 0$) because the manufacturers produce less differentiated products. 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 lead 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 the manufacturers produce highly differentiated products.*

The result in Proposition 5 implies that under cost asymmetry, the existence of an exclusion equilibrium is determined by the degree of product substitution γ; in other words, 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

$$\frac{\partial \pi_D^R}{\partial \gamma} = (2\beta - 1)\left(\frac{\partial \Pi_{d1}}{\partial \gamma} + \frac{\partial \Pi_{d2}}{\partial \gamma}\right) > 0 \text{ for } \beta < 1/2,$$

which implies that as the manufacturers produce less differentiated products, D earns high profits under upstream duopoly for the weak bargaining power of D. The degree of product substitution affects D's profit under upstream duopoly in two ways. First, as γ increases, the industry profit $\Pi_{di} + \Pi_{dj}$ directly decreases, which has the negative effect of decreasing π_D^R. Second, because U_i's additional contribution decreases, it earns lower profits $\pi_{Ui}^R = F_i^R$, which indirectly increases D's outside option profit under the bargaining with U_j, $z_j = \Pi_{mi} - F_i^R$. This indirect effect increases π_D^R and becomes dominant for lower β because the strong bargaining power of U_i decreases F_i^R largely. Under this relationship, as the manufacturers produce more differentiated products when the downstream firm has weak bargaining power, U_2 can compensate D more easily; thus, the exclusion equilibrium is more likely to be observed.[25]

4 Experiment

In this section, as in the related experimental studies of exclusive dealing (Landeo and Spier, 2009, 2012; Smith, 2011; Boone, Müller, and Suetens, 2014), we provide evidence for our theory from a

[25] When the downstream firm and each manufacturer have the same bargaining power ($\beta = 1/2$), we have $\partial \pi_D^R / \partial \gamma = 0$; thus, the degree of product substitution does not affect D's profit under upstream duopoly. Since the threshold value of D's bargaining power under symmetric costs is $1/2$, the likelihood of exclusion under symmetric costs does not depend on product substitution.

D's choice	Payoffs		
	Player U_1	Player U_2	Player D
(i) Accept x_1	$1000 - x_1$	0	$200 + x_1$
(ii) Accept x_2	0	$1000 - x_2$	$200 + x_2$
(iii) Reject both	750	750	600

Table 1: The subjects' payoffs in the games

laboratory experiment. In particular, we focus on Proposition 2, according to which there are two pure strategy equilibria (when $\beta < 1/2$). One is the non-exclusion equilibrium, in which the manufacturers coordinate to make lower exclusive offers to the retailer, intending to induce the rejection by the retailer and result in the Pareto dominant outcome. The other is the exclusion equilibrium, in which the manufacturers compete in exclusive offers, resulting in the Pareto-dominated outcome. We focus on whether and to what extent exclusion occurs in the laboratory experiment. Section 4.1 provides the experimental design. Section 4.2 briefly introduces the results.

4.1 Experimental design

The game played by experimental subjects is a simplified version of the model described in Section 3.3. Because we focus on the exclusive-offer competition in Stage 1, we eliminate Stages 2 and 3 in our experiment by assuming rational behavior. We consider the following game in Stage 1. First, two subjects, Players U_1 and U_2, simultaneously choose x_1 and x_2 to another subject, Player D. The choice set of Players U_i ($i \in \{1, 2\}$) is $x_i \in \{0, 1, \ldots, 1000\}$. Second, after observing x_1 and x_2, Player D chooses one of the three alternatives: (i) accept Player U_1's offer, x_1; (ii) accept Player U_2's offer, x_2; and (iii) reject both.

We use the payoffs presented in Table 1. The first and second rows show the payoffs when Player D accepts U_1's and U_2's offer, respectively. The third row corresponds to the case when Player D rejects both offers. The payoffs here correspond to the setting with the model parameters of $\Pi_m = 1200$, $\Pi_d = 1050$, and $\beta = 1/6$.

We say that Player U_i's exclusive offer is (strictly) acceptable for Player D if $x_i \geq 400$ ($x_i > 400$). In the exclusion equilibrium, both Players U_1 and U_2 make the acceptable offers, and Player D accepts the highest one. In the non-exclusion equilibrium, Players U_1 and U_2 make offers less than 400, and Player D rejects both offers.

The experimental design consists of two matching treatments (see Table 2). One is the random matching treatment, and the other is the fixed matching treatment. Each subject is randomly assigned one of the two roles in each treatment, Player U and Player D, and plays the game in 20 rounds without practice. The assigned role remains the same throughout the experiment.[26]

In the random matching treatment, nine subjects (six Players U and three Players D) form a matching group and randomly rematch within it to form groups to play the three-player game at each round. In the fixed matching treatment, three subjects (two Players U and one Player D) randomly form each round group by fixing the pair of U_1 and U_2 throughout 20 rounds; namely, Players U play the game with the same opponents for all 20 rounds.[27] The instruction handouts clearly specify the matching protocol.[28] Subjects were informed that monetary earnings depend on the cumulative earnings made throughout the experiment.[29] We convert 1000 payoff points in the experiment to 170 Japanese Yen (JPY).

The experiment was run from February 2019 to October 2020 in the ISER lab at Osaka University, with 162 students from different fields of study. We conducted four sessions for the random matching treatment by recruiting 108 students and two sessions for the fixed matching treatment

[26] In the experiment, we used neutral labels for the subjects' roles, referring to U_i as role Ai and D as role B.

[27] In each treatment, the labels of Players U, U_1 and U_2 are randomly reassigned at each round so that the labels can change over 20 rounds.

[28] In the random matching treatment, however, we told the participants only the randomness of matching but not the specific size of matching groups. Therefore, the participants may estimate the probability of rematching with the same participant lower than the actual one because we conducted each experimental session with 27 participants, randomly divided into three matching groups.

[29] At the end of each round, participants receive feedback about the action profiles of the direct opponents of the game and their own payoffs but not the outcomes in other groups, even within the same matching group. Bruttel (2003) discusses the effect of information feedback in Bertrand duopoly experiments. According to Bruttel (2003), the information structure we used facilitates competition and generates monotone convergence to the Bertrand equilibrium.

Treatment	Π_m	Π_d	β	Matching protocol	The number of matching groups
Random Matching	1200	1050	1/6	Random	3 groups × 4 sessions
Fixed Matching	1200	1050	1/6	Fixed	9 groups × 2 sessions

Table 2: Treatments

by recruiting 54 students. Every subject participates in only one session. In every session, 27 subjects participated, so we have 12 independent matching groups for the random matching treatment and 18 independent matching groups for the fixed matching treatment. All sessions are computerized using the experimental software z-Tree (Fischbacher, 2007). Participants were recruited through the ORSEE (Greiner, 2015) at Osaka University. Sessions took about 100 minutes, and each participant earned 2794 JPY, on average, including 1000 JPY as a participation fee.

Finally, we hypothesize about the difference between the frequencies of exclusion in the two treatments.[30] We define exclusion rates as the frequency with which Player D accepts either an exclusive offer from U_1 or U_2. Table 3 summarizes the theoretical predictions on average exclusion rates in 20 rounds and exclusive offers and payoffs under two types of equilibria for each round game.[31] In each round game level, equilibrium offers, and payoffs do not differ between the two treatments. The crucial difference appears in whether Players U repeatedly interact with each other, which can lead to the difference in exclusion rates in 20 rounds. The repeated interaction can facilitate cooperation and increase the observation of the non-exclusion outcome because the exclusion equilibrium is a kind of coordination failure between Players U.[32] Thus, we have the

[30] In Kitamura et al. (2025), we also assess how the model parameters affect the frequency of exclusive outcomes. Specifically, we address the effect of bargaining power and that of product differentiation. In the bargaining power treatment, we set the profit share to the retailer at $\beta = 0$ or $\beta = 1/3$, which is lower or higher than the baseline treatment ($\beta = 1/6$). In the product differentiation treatment, we set $\Pi_d = 975$, representing a case of lower product differentiation.

[31] In our prediction, non-exclusion equilibria occur for $\max\{x_1, x_2\} < 400$ due to the assumption that if Player D is indifferent between accepting the higher of two exclusive offers and rejecting both, it accepts the higher offer. Without such an assumption, there exists a non-exclusion equilibrium for $\max\{x_1, x_2\} = 400$.

[32] Such prediction is supported by empirical evidence from the experimental economics literature. Orzen (2008) shows that in price competition scenarios, duopoly prices are significantly higher under fixed matching than under random matching. Similarly, Clark and Sefton (2001) find that repeated interactions in stag-hunt games lead to higher

Table 3: Theoretical prediction on exclusion rates, offers, and payoffs

	20 round outcomes	Each round outcomes					
		Exclusion			Non-exclusion		
Treatment	Exclusion rate	(x_i, x_j)	U_i, U_j	D	(x_i, x_j)	U_i, U_j	D
Random Matching	$\in [0, 1]$	(1000, 1000) (999, 999) (998, 998)	0 1/2 1	1200 1199 1198	$\in [0, 399]^2$	750	600
Fixed Matching	$\in [0, 1]$	(1000, 1000) (999, 999) (998, 998)	0 1/2 1	1200 1199 1198	$\in [0, 399]^2$	750	600

following hypothesis.[33]

Hypothesis 1. *Exclusion rates in the random matching treatment are higher than those in the fixed matching treatment.*

4.2 Results

We first focus on the exclusion rates. The experimental results show that exclusion outcomes can be observed with a certain level of frequency, although Players U_1 and U_2 strictly prefer non-exclusion outcomes to exclusion outcomes, which confirms the robustness of the exclusion mechanism in this study.[34] Figure 6 shows the transition of exclusion rates through 20 rounds for each treatment. In the random matching treatment, the exclusion rate is 78% on average, slightly increasing over 20

levels of coordination and risk-taking for greater rewards. These results imply that repeated interaction facilitates cooperation.

[33] When Players U believe that the rival chooses acceptable offers, the incentive structure is identical to the standard Bertrand competition and comparable with the existing experimental studies, including Dufwenberg and Gneezy (2000). Therefore, under the duopoly offer competition, we do not necessarily expect convergence to the so-called Bertrand equilibrium in which both manufacturers offer the maximum amount of transfers and earn zero profits even in the random matching protocol. Kitamura et al. (2025) show that the exclusive-offer competition does not lead to an extremely high exclusive offer.

[34] Such observation is consistent with the experimental results of Cooper et al. (1990), who show that Pareto-dominant equilibrium is not always selected in coordination games.

rounds. In contrast, the exclusion rate in the fixed matching treatment is quite low. It rapidly drops from 50% to 11% in the first ten rounds, indicating that Players U_1 and U_2 successfully coordinate their offers to achieve the Pareto efficient outcome. The observation in Figure 6 is consistent with Hypothesis 1.[35]

[Figure 6 about here]

Next, we take a closer look at the group dynamics of Players U in the random matching treatment. Figure 7 shows the rate of acceptable offers in each matching group with the rate of strictly acceptable offers as the light gray lines.[36] Matching groups R01, R02, R03, R06, R10, and R11 (6 out of 12 groups) consistently recorded relatively high rates of acceptable offers, and R07, R08, and R12 (3 out of 12 groups) were intermediate values. In Matching group R04, Players U seem to successfully coordinate their actions, while Players U in Matching group R09 seem to fall into the exclusive equilibrium in the last ten rounds. Only Matching group R05 would be a counterexample that seems to switch from a non-cooperative phase to a cooperative phase. Although we do not address the equilibrium selection in this paper, the observations here are basically consistent with the prediction behind Hypothesis 1 (except for Matching group R05).

[Figure 7 about here]

5 Discussion

This section provides two discussions. Section 5.1 introduces some examples of exclusive-offer competition. Section 5.2 discusses the difference between this study and Bernheim and Whinston (1998).

[35] Even in the first round, we observed exclusion in 29 out of 36 groups (80.6%) in the random matching treatment and in 10 out of 18 (55.6%) in the fixed treatment. This difference is not statistically significant based on the two-sample proportion test. However, the proportions of acceptable offers in the first round were 51 out of 72 (70.8%) for the random matching treatment and 13 out of 36 (36.1%) for the fixed matching treatment, and we find that this difference is statistically significant based on the two-sample proportion test (p-value < 0.01).

[36] Because in the random matching treatment, each matching group has six Players U, the proportion of acceptable offers can take values in increments of 1/6.

5.1 Cola wars in the real world

In this subsection, we provide examples of exclusive-offer competition in the soft drinks industry. Cola wars have continued for decades between Coca-Cola and PepsiCo, with each aiming to be the exclusive beverage provider to fast food restaurants.[37] Through exclusive-offer competition, some customers shift from one manufacturer to the other. For example, Arby's Restaurant Group Inc. decided to switch from PepsiCo to Coca-Cola starting from early 2018 after more than a decade-long contract with PepsiCo.[38] Subway had had a partnership with PepsiCo as its primary beverage provider since 1988; however, in 2003, it decided to make a transition to Coca-Cola in its worldwide restaurants.[39] Notably, the Cola wars over Subway are ongoing even nowadays; from 2025, PepsiCo will be the sole beverage supplier to Subway's U.S. stores.[40][41]

Another example of the exclusive-offer competition between these two giant suppliers can be observed on university campuses, as noted in Introduction.[42] The cola wars forming on university campuses are widespread in the United States and contain some of the key features in our analysis. First, exclusive-offer competition involves a large monetary transfer in return for a long-term monopoly position; for example, in 1998, The University of Maryland at College Park signed a 15-year exclusive contract with PepsiCo worth \$57.5 million.[43] Second, universities receive not

[37] Cola wars have also been observed in the relationship between the cola providers and cinemas. See "Coca-Cola Lures Regal Cinemas From Rival Pepsi in Latest Steal" *The Wall Street Journal*, April 9, 2002 (link).

[38] See "Coca-Cola Wins Arby's Away From PepsiCo in Latest Showdown" *Bloomberg*, August 18, 2017 (link).

[39] See "Coke Wins a 10-Year Contract From Subway, Ousting PepsiCo" *The Wall Street Journal*, November 28, 2003 (link).

[40] See "Pepsi takes on rival Coke's biggest client, landing its beverages and snacks in 20,000 Subway sandwich shops" *Fortune*, March 21, 2024 (link).

[41] Also, in Canada, PepsiCo Canada started to serve Subway Canada as its exclusive beverage and snack provider from 2015. See the second paragraph from the bottom in "Coca-Cola Wins Arby's Away From PepsiCo in Latest Showdown."

[42] Regarding universities' switch between Coca-Cola and PepsiCo, see "Coke vs. Pepsi: University Chooses Side In Cola Wars" *Montclair Patch*, July 12, 2016 (link).

[43] See "Thirsting For Cash, Colleges Take Sides In Corporate Cola Wars" *The Washington Post*, December 23, 1997 (link).

only an annual royalty fee but also a commission fee from the retail sale of some products. The commission rates, which could be correlated to β in our analysis, vary across universities. In the case of Ohio State University and Rutgers University, they range from about 20 percent to over 50 percent of the retail sales of drinks and snacks.[44] Finally, universities are usually local monopolists; hence, exclusive-offer competition is more likely to play an essential role in exclusion. Although the objective of universities may not be to maximize their profits, our results remain valid even when universities are consumer surplus maximizers.[45] Therefore, we think that our analysis fits the cola wars on university campuses well.

Although the above examples are not antitrust cases, the cola wars sometimes lead to antitrust cases. For example, in 1998, PepsiCo filed an antitrust lawsuit against Coca-Cola, alleging that Coca-Cola did not allow food-service distributors who already distribute Coke to distribute Pepsi.[46] The notable point here is that Coca-Cola was stronger in the food-service distribution sector of the soft drinks market than in the overall market; the share of Coca-Cola in the food-service distribution sector was 65 percent and that of PepsiCo was 22 percent, while in the overall soft drinks market Coca-Cola had a 43.9 percent share and PepsiCo had a 30.9 percent share. Therefore, if one of the firms has an extremely higher market share in a market segment because of exclusive dealing, it will be more likely to take the cola wars to court.

5.2 Comparison with Bernheim and Whinston (1998)

This subsection discusses the difference between this study and Bernheim and Whinston (1998, Sections II and III) by extending the analysis in Section 3.3. To understand the difference in the

[44] For the case of Ohio State University, see "Refreshing or restricting? Ohio State's $32M deal with Coca-Cola brings up questions of transparency" *The Lantern*, December 19, 2013 (link). In addition, for the case of Rutgers University, see "As of May 2005, Rutgers University no longer has a contract with Coca-Cola" *Rutgers University*, May 2005 (link).

[45] The results are available upon request.

[46] See "Taking The 'Cola Wars' Into Court" *The Washington Post*, May 31, 1998 (link). See also Hamilton and Flecher (2004).

simplest way, we assume that exclusive contracts offered by U_i consist of (x_i, y_i), where x_i is the fixed compensation from U_i to D under exclusive dealing and y_i is the fixed fee from D to U_i when D rejects both exclusive offers and sells both manufacturers' products. Note that if we assume that $y_i = 0$, the model in this subsection coincides with our model in Section 3.3; in other words, the manufacturers' strategy space in Bernheim and Whinston (1998) is wider than our model.

In this setting, we briefly explore the existence of exclusion outcomes. If both manufacturers offer sufficiently high y_i such that $\pi_D^R - y_i < 0$ holds, D deals with none of the manufacturers after rejecting both exclusive offers. Hence, unlike Section 3.3, if D rejects both exclusive offers in Stage 1, it earns nothing; namely, each manufacturer can commit not to sell its product to D if D rejects both exclusive offers. In this case, x_i^* needs to satisfy the following two conditions simultaneously;

$$\pi_D^{Ei} + x_i^* \geq 0 \;\; or \;\; x_i^* \geq -\pi_D^{Ei}. \tag{16}$$

$$\pi_{Ui}^{Ei} - x_i^* \geq 0 \;\; or \;\; x_i^* \leq \pi_{Ui}^{Ei}. \tag{17}$$

From conditions (16) and (17), we have $-\pi_D^{Ei} \leq x_i^* \leq \pi_{U_i}^{Ei}$, which implies that for all $\beta \in (0, 1)$ an exclusion equilibrium exists.

The above result highly depends on the assumption that each manufacturer can commit not to sell its products to D if D rejects both exclusive offers. Such commitment induces U_1, U_2, and D to earn nothing if D rejects both exclusive offers, whereas all of them can earn positive profits (3) if D sells both manufacturers' products. Hence, there exists a possibility of renegotiation in the framework of Bernheim and Whinston (1998). In this regard, their framework may be suitable for exploring short-term exclusive contracts.[47] By contrast, following the standard naked exclusion literature (Rasmusen et al., 1991; Segal and Whinston, 2000b), we assume that each manufacturer cannot commit to no dealing when its exclusive offer is rejected, which is suitable for long-term exclusive contracts. In this setting, when D rejects both exclusive offers, it can deal with both manufacturers and earn considerably higher profits, under which the Chicago School model does

[47] See the discussion by Whinston (2006, p. 166).

not lead to exclusive outcomes. Thus, this study clarifies the role of exclusive-offer competition in the literature on naked exclusion.

6 Concluding Remarks

This study has explored the existence of exclusive dealing when all upstream firms can make exclusive offers. Most previous studies consider exclusive dealing that deters a potential entrant who cannot make an exclusive offer. In contrast to those studies, existing firms are often excluded in the real-world situation. Therefore, we consider exclusive-offer competition between two existing upstream firms that trade with a monopolistic downstream firm.

In contrast to the case where one of the upstream firms is a potential entrant, we show that exclusive dealing can be attainable if the upstream firms have strong bargaining power over the downstream firm. Also, this result holds in various settings. Thus, our exclusion outcome can widely apply to diverse real-world vertical relationships.

The finding here provides new implications for antitrust agencies; exclusive dealing is more likely to be observed when upstream firms are existing firms and exert strong bargaining power over downstream trading firms. Interestingly, such exclusive-offer competition benefits those trading downstream firms whose bargaining power is weak.

Despite these contributions, there remain several outstanding issues requiring future research. First, there is a concern about upstream firms' behavior to achieve a market environment where an exclusion equilibrium does not exist. Although we assume that the level of product substitution or bargaining power is exogenously given, upstream firms could control these parameters. Second, there is a concern about this study's relationship with other studies of anticompetitive exclusive dealing. We predict that if we add exclusive-offer competition into previous studies, exclusion becomes less costly. We hope that this study will assist future researchers in addressing these issues.

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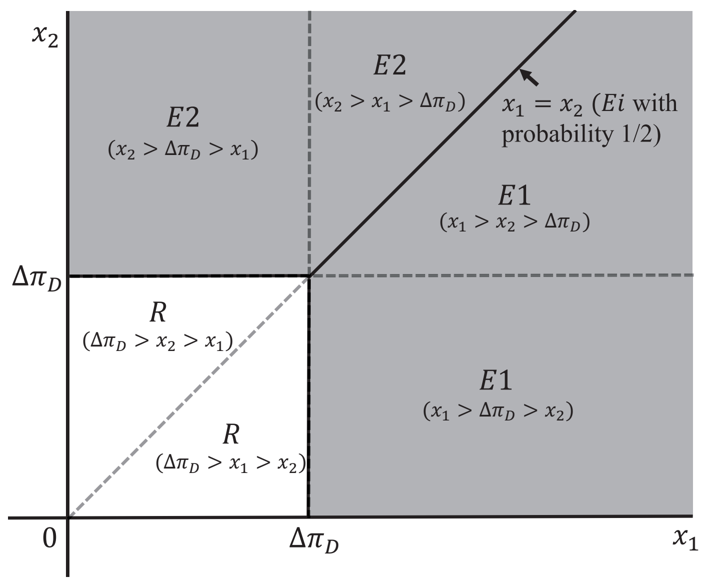


Figure 1: Individual Rationality for *D*

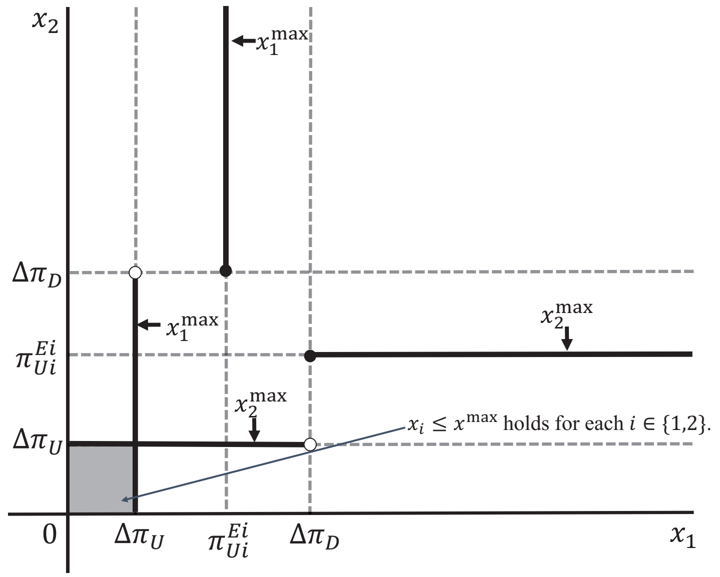


Figure 2: Area of Feasible Offers for U_i ($\pi_{Ui}^{Ei} < \Delta\pi_D$)

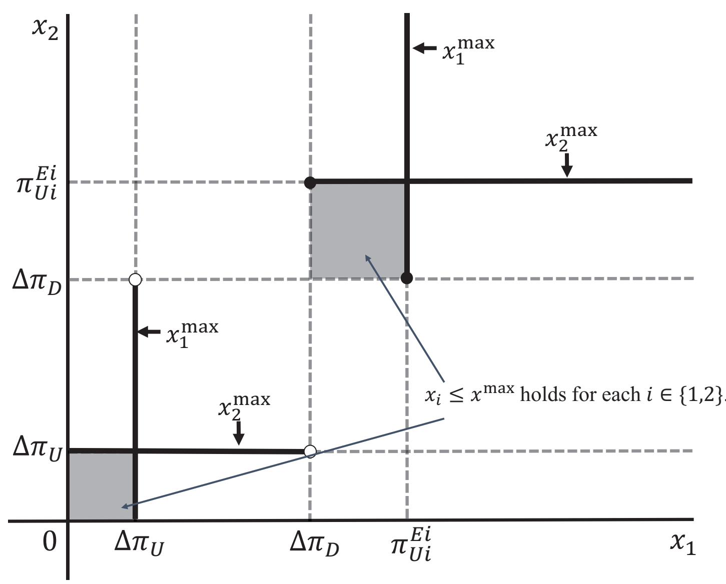


Figure 3: Area of Feasible Offers for U_i ($\pi_{Ui}^{Ei} \geq \Delta\pi_D$)

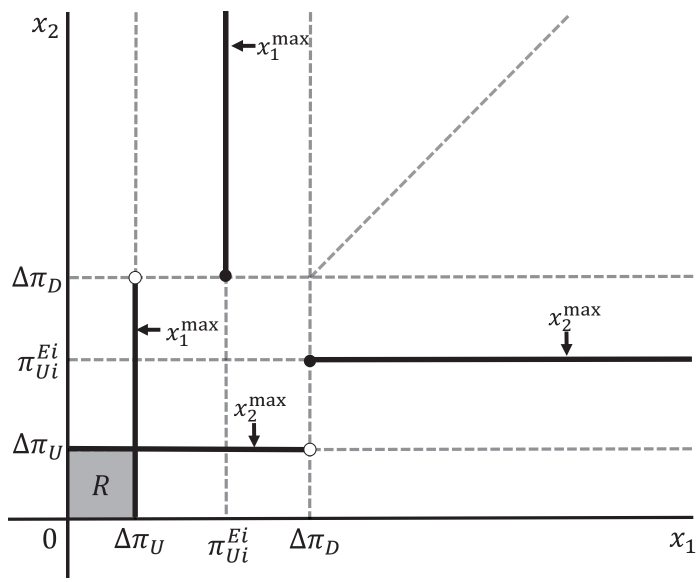


Figure 4: Existence of an Exclusion Equilibrium for $\pi_{Ui}^{Ei} < \Delta\pi_D$

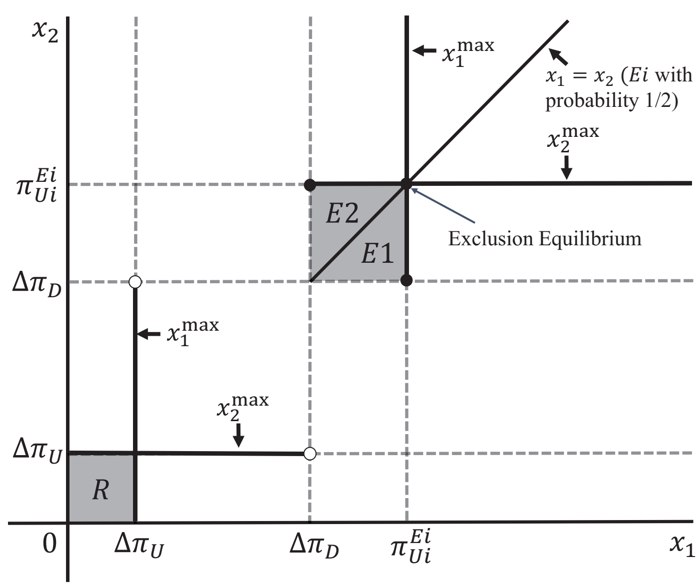


Figure 5: Existence of an Exclusion Equilibrium for $\pi_{Ui}^{Ei} \geq \Delta\pi_D$

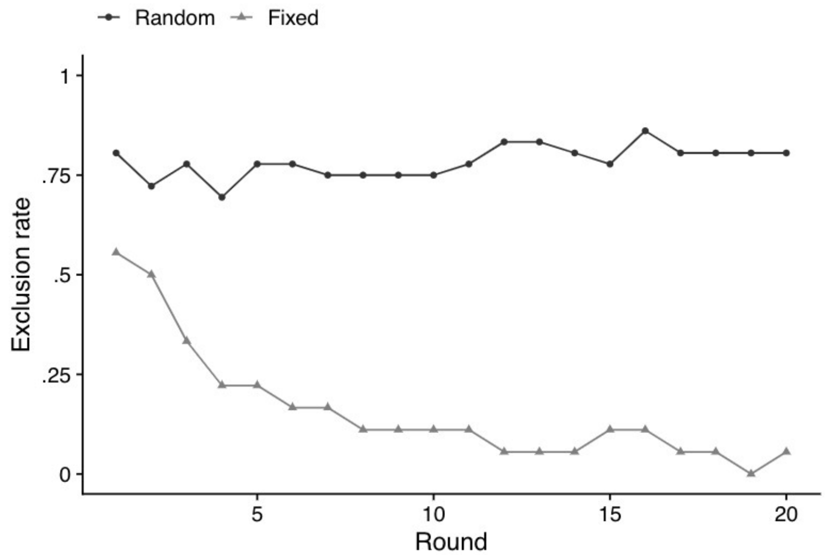
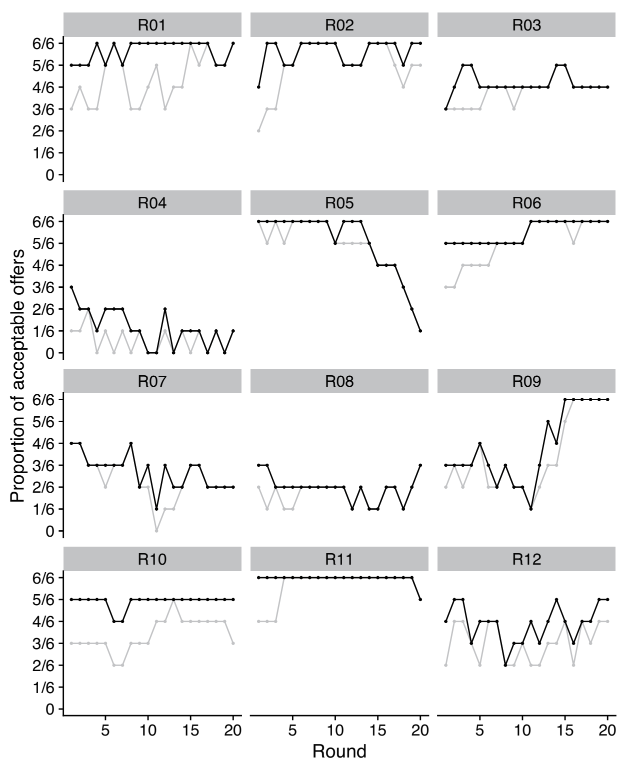


Figure 6: Transition of exclusion rates



Note: Light grays indicate the proportions of strictly acceptable offers

Figure 7: Proportion of acceptable offers in random matching treatment

A Results under linear demand and symmetric costs

This appendix introduces the analysis of the model in Section 3.1–3.3 under the standard linear demand with a representative consumer, in which demand for U_i's product is provided by

$$Q(p_i, p_j) = \begin{cases} \dfrac{a - p_i}{b} & \text{if } \ 0 < p_i \leq \dfrac{-a(1-\gamma) + p_j}{\gamma}, \\ \dfrac{a(1-\gamma) - p_i + \gamma p_j}{b(1-\gamma^2)} & \text{if } \ \dfrac{-a(1-\gamma) + p_j}{\gamma} < p_i < a(1-\gamma) + \gamma p_j, \\ 0 & \text{if } \ p_i \geq a(1-\gamma) + \gamma p_j, \end{cases} \tag{18}$$

where $i, j \in \{1, 2\}$ and $i \neq j$.[48] 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 substitutes.

Under the 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 an exclusion equilibrium. 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

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

[48] The representative consumer's utility function is a simplified version of Dixit (1979, p.26): $u = Q_0 + a(Q_1 + Q_2) - b(Q_1^2 + 2\gamma Q_1 Q_2 + Q_2^2)/2$, where Q_0 is a numéraire.

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

By contrast, for the existence of an exclusion equilibrium 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.

B Results under linear demand and asymmetric costs

This appendix introduces the analysis of the model in Section 3.4 under the linear demand function (18). 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 a 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

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

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

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

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 B.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 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. □

C 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 that produce homogeneous products. Each downstream firm produces one unit of the 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, the 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 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 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 these two exclusive offers and acceptance is more profitable, it accepts one of the offers with probability 1/2. In Stage 2, U offers 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 inputs 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}.

C.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 $Q^{Ei}_i(w) \equiv \mathrm{argmax}_{Q_i}(P(Q_i) - w)Q_i = (a - w)/2b$. Then, input demand for U becomes $Q^{Ei}(w) = Q^{Ei}_i(w) = (a - w)/2b$. In Stage 2, by anticipating these results, U optimally chooses input price $w^{Ei} \equiv \mathrm{argmax}_w(w-c)Q(w) = (a+c)/2$. The equilibrium production levels become $Q^{Ei} = Q^{Ei}_i = (a-c)/4b$ and $Q^{Ei}_j = 0$, where $i, j \in \{1, 2\}$ and $i \neq j$. The firms' equilibrium profits, excluding the fixed compensation y_i, are

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

We next explore the case in which U rejects the exclusive supply offers in Stage 1. In Stage 3, given w, D_i competes in quantity. Standard Cournot competition leads to $Q^R_i(w) = (a - w)/3b$. Then, input demand for U becomes $Q^R(w) = 2(a - c)/3b$. In Stage 2, by anticipating these results, U optimally chooses input price $w^R \equiv \mathrm{argmax}_w(w - c)Q^R(w) = (a + c)/2$. The equilibrium production levels become $Q^R_1 = Q^R_2 = (a - c)/6b$. The firms' equilibrium profits are

$$\pi^R_{Di} = \frac{(a-c)^2}{36b}, \ \ \pi^R_U = \frac{(a-c)^2}{6b}. \tag{29}$$

C.2 Benchmark analysis

As in Section 3.2, we assume that D_j 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:

$$y^*_i \geq \Delta\pi^c_U, \tag{30}$$

where $\Delta\pi^c_U \equiv \pi^R_U - \pi^{Ei}_U$.

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, the exclusion outcomes cannot be observed.

Proposition C.1. *Suppose that downstream firms D_1 and D_2 compete in quantity by purchasing inputs 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 Section 4.4 in Kitamura, Matsushima, and Sato (2024).[49]

C.3 When exclusive-offer competition exists

Assume that both downstream firms make exclusive offers. As in 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 $\pi_{Di}^{Ei} > \Delta\pi_D$.

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

For $y_j < \Delta\pi^c_U$, we have $y^{\max} = \Delta\pi^c_D$. With this offer, U_i earns $\pi^{Ei}_{D_i} + y^{\max} < \pi^R_U$ because inequality (33) holds; hence, the individual rationality constraint for U does not hold. Therefore, as in Section 3.3, the non-exclusion equilibrium always exists. For the existence of an exclusion equilibrium, we check whether $\pi^{Ei}_{Di} \geq \Delta\pi^c_U$ holds. By substituting Equations (28) and (29), we obtain

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

which implies that the exclusion outcomes can be observed.

Proposition C.2. *Suppose that downstream firms D_1 and D_2 compete in quantity by purchasing inputs 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 $y^*_i = \pi^{Ei}_{D_i} > \Delta\pi_U$ and U earns all the industry profits.*

D Linear wholesale pricing

This appendix explores the existence of exclusive dealing under the linear demand function (18). As in Section 3.1–3.3, we assume that the industry profit allocation after Stage 1 is given by the Nash bargaining solution.

First, we show that exclusion never occurs when only U_i can make an exclusive offer.

Proposition D.1. *Suppose that both manufacturers offer linear wholesale prices. If U_j is a potential entrant and only U_i can make 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.*

Proposition D.1 implies that in the absence of exclusive-offer competition, exclusive dealing cannot occur, which can be explained by the logic underlying the Chicago School argument.

Second, we show that an exclusion equilibrium exists under some conditions when both manufacturers can make exclusive offers.

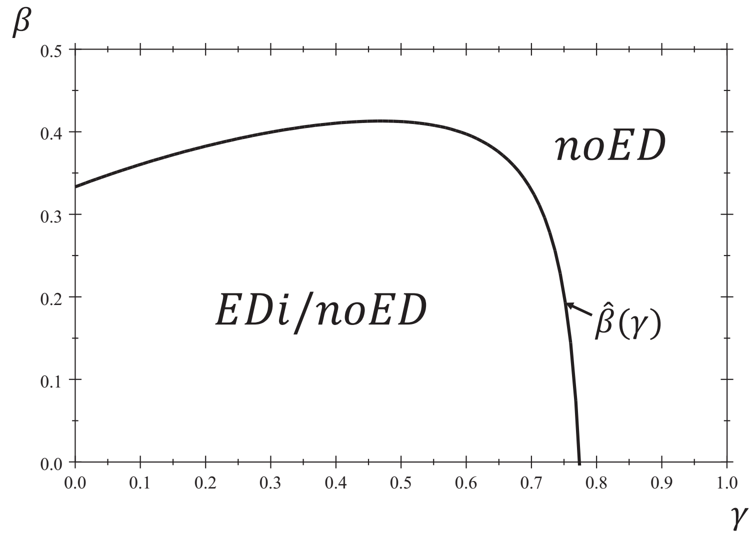


Figure A1: Existence of an Exclusion Equilibrium under Linear Wholesale Pricing

Proposition D.2. *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 a 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

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

Figure A1 summarizes Proposition D.2. The notable result in Proposition D.2 is that linear wholesale pricing leads to the low possibility of the exclusion equilibrium; exclusion never occurs for the intermediate level of *D*'s bargaining power or for less differentiated manufacturers' products.

Double marginalization is a key point in linear wholesale pricing. Although exclusive dealing sustains double marginalization, upstream competition alleviates it. The intensity of upstream competition increases as the degree of product substitution, γ, rises. This implies that when γ is large, D earns larger rejection profits, π_D^R. Therefore, the exclusion equilibrium does not exist when the products are less differentiated.

Proof. To prove the above propositions, we derive firms' equilibrium profits in the subgame after D's decision in Stage 1. 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 $p^*(w_i) \equiv \text{argmax}_{p_i}(p_i - w_i)Q(p_i) = (a + w_i)/2$. 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

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

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

$$\pi_{Ui}^{Ei} = \frac{(1 - \beta^2)(a - c)^2}{8b}, \ \ \pi_{Uj}^{Ei} = 0, \ \ \pi_D^{Ei} = \frac{(1 + \beta)^2(a - c)^2}{16b}. \tag{34}$$

We next explore the case in which D rejects both exclusive offers in Stage 1. In Stage 3, given the 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

$$(p^*(w_i, w_j), p^*(w_j, w_i)) \equiv \underset{p_i, p_j}{\text{argmax}}(p_i - w_i)Q(p_i, p_j) + (p_j - w_j)Q(p_j, p_i),$$

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 make 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

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

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 the firms are given as

$$\pi_{Ui}^R = \frac{(1 - \beta^2)(1 - \gamma)(a - c)^2}{2b(1 + \gamma)(2 - \gamma(1 - \beta))^2}, \;\; \pi_D^R = \frac{(1 + \beta)^2(a - c)^2}{2b(1 + \gamma)(2 - \gamma(1 - \beta))^2}. \tag{35}$$

We prove Proposition D.1 by showing that Condition (6) never holds; in other words, by substituting Equations (34) and (35), we have

$$\Delta\pi_U - \Delta\pi_D = -\frac{(a - c)^2(1 + \beta)(8 - (1 + \gamma)(2 - \gamma(1 - \beta))(3 - \beta))}{16b(1 + \gamma)(2 - \gamma(1 - \beta))} < 0, \tag{36}$$

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 (36) 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 A2 summarizes the properties of $\eta_\beta(\beta, \gamma)$ and $\eta_\gamma(\beta, \gamma)$. There

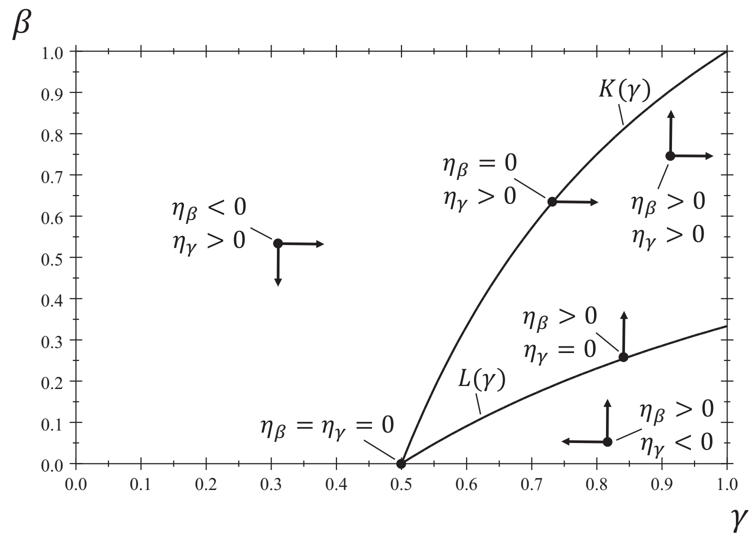


Figure A2: Properties of $\eta_\beta(\beta, \gamma)$ and $\eta_\gamma(\beta, \gamma)$

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) $\eta_\beta(\beta, \gamma) > 0, \eta_\gamma(\beta, \gamma) < 0$. The arrows in Figure A2 indicate the direction of the increase in $\eta(\beta, \gamma)$ for each region. From Figure A2, 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 A2 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 $(\beta, \gamma) \in (0, 1)^2$.

Finally, we prove Proposition D.2 by checking whether $\pi_{U_i}^{Ei} \geq \Delta\pi_D$ holds. By substituting Equations (34) and (35), we obtain $\pi_{Ui}^{Ei} - \Delta\pi_D \geq 0$ if and only if $\gamma \leq \tilde{\gamma}$ and $\beta \leq \hat{\beta}(\gamma) < 1/2$. □

Instructions for "Naked Exclusion under Exclusive-offer Competition"

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Abstract

We provide the instruction for the experimental study in Section 4 of Kitamura et al. (2025). We introduce the random matching treatment in Section 3 and the fixed matching treatment in Section 4.

1 General announcement

- In this experiment, we will ask you to play a decision-making computer game. In this experiment, you can obtain not only a participation fee but also the game's earnings based on the sum of the points you earn throughout the experiment.
- Your identity will remain anonymous to us and the other participants.
- If you have a question, raise your hand.
- Do not communicate with anyone and be quiet during the entire experiment. In addition, do not talk to anyone about this experiment after leaving.
- At the end of the experiment, please return these instructions to the experimenter.

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2 Session Payoff

The experiment consists of 20 rounds. Your earnings are determined by the sum of the points you earn for the 20 rounds. The exchange rate is 1000 points to 170 yen. The game's earnings in yen are given by

$$\text{Your game earnings in yen} = \frac{17 \times \text{Sum of points you earn for 20 rounds}}{100}.$$

Therefore, the total earnings in yen will be equal to the 1000 yen participation fee plus the game's earnings in yen.

3 Specific for *Random Matching Treatment*

3.1 Players

- At the beginning of each round, the computer will randomly form several groups, and you will be assigned to one of these groups.

- In each group, there are three participants who will be assigned to two roles. More precisely, two participants will play the role of A, while one participant will play the role of B. The participant who will play the role of A is called $A1$ or $A2$.

- The role of each participant will be fixed throughout the 20 rounds; that is, at the beginning of the first round, you will be assigned to one of the two roles, and you will keep the same role throughout the 20 rounds.

- By contrast, the group members can be different in each round. The participant who was called $A1$ in the last round may be called $A2$ in the current round. You will not know the identity of the other two players in any round.

3.2 Timing of the game

We explain the timing of each round. Each round consists of two stages.

- In Stage 1, $A1$ and $A2$ offer some points to B, which is denoted by X_1 and X_2, respectively. Each Player A chooses the offer from 0 to 1000 by increments of 1 point. Before deciding, $A1$ cannot observe $A2$'s decision. Likewise, $A2$ cannot observe $A1$'s decision.
- In Stage 2, after observing each Player A's offer, B decides one of following three actions:
  1. Accept $A1$'s offer.
  2. Accept $A2$'s offer.
  3. Reject both offers.

The following table summarizes the choice of each player.

	Timing of move	**Choice of each player**
$A1$	Stage 1	$0 \leq X1 \leq 1000$
$A2$	Stage 1	$0 \leq X2 \leq 1000$
B	Stage 2	Accept $A1$'s offer, Accept $A2$'s offer, Reject both offers

Table 1: Choice of each player

3.3 Round Payoff

We explain the relationship between the decision of each role and round payoffs. Each player's round payoff highly depends on B's decision, which is summarized in the following table:

	If B accepts $A1$'s offer	**If B accepts $A2$'s offer**	**If B rejects both offers**
$A1$	$1000 - X_1$	0	750
$A2$	0	$1000 - X_2$	750
B	$200 + X_1$	$200 + X_2$	600

Table 2: Relationship between B's decision and each player's round payoffs

This means:

- When B rejects both $A1$ and $A2$'s offers,

- $A1$'s round payoff is equal to 750.
- $A2$'s round payoff is equal to 750.
- B's round payoff is equal to 600.

- When B accepts one of the offers made by Players A,
  - The round payoff of Player A whose offer is accepted is equal to 1000 − (his/her offer.)
  - The round payoff of Player A whose offer is rejected is equal to 0.
  - B's round payoff is equal to 200 + (accepted Player A's offer).

4 Specific for *Fixed Matching Treatment*

4.1 Players

- At the beginning of each round, the computer will randomly form several groups and you will be assigned to one of these groups.
- In each group, there are three participants who will be assigned to two roles. More precisely, two participants will play the role of A, while one participant will play the role of B. The participant who will play the role of A is called $A1$ or $A2$.
- The role of each participant will be fixed throughout the 20 rounds; that is, at the beginning of the first round, you will be assigned to one of the two roles, and you will keep the same role throughout the 20 rounds.
- Although the computer will randomly form several groups at the beginning of each round, the pair of $A1$ and $A2$ is fixed throughout the 20 rounds. For example, if you are assigned to the role of A, the other Player A remains unchanged throughout the 20 rounds. However, whether you are called $A1$ or $A2$ is not fixed; that is, at the beginning of each round, you will be randomly assigned to $A1$ or $A2$.

4.2 Timing of the game

We explain the timing of each round. Each round consists of two stages.

- In Stage 1, $A1$ and $A2$ offer some points to B, which is denoted by X_1 and X_2, respectively. Each Player A chooses the offer from 0 to 1000 by increments of 1 point. Before deciding, $A1$ cannot observe $A2$'s decision. Likewise, $A2$ cannot observe $A1$'s decision.
- In Stage 2, after observing each Player A's offer, B decides one of following three actions:

  1. Accept $A1$'s offer.
  2. Accept $A2$'s offer.
  3. Reject both offers.

The following table summarizes the choice of each player.

	Timing of move	**Choice of each player**
$A1$	Stage 1	$0 \leq X1 \leq 1000$
$A2$	Stage 1	$0 \leq X2 \leq 1000$
B	Stage 2	Accept $A1$'s offer, Accept $A2$'s offer, Reject both offers

Table 3: Choice of each player

4.3 Round Payoff

We explain the relationship between the decision of each role and round payoffs. Each player's round payoff highly depends on B's decision, which is summarized in the following table:

	If B accepts $A1$'s offer	**If B accepts $A2$'s offer**	**If B rejects both offers**
$A1$	$1000 - X_1$	0	750
$A2$	0	$1000 - X_2$	750
B	$200 + X_1$	$200 + X_2$	600

Table 4: Relationship between B's decision and each player's round payoffs

This means:

- When B rejects both $A1$ and $A2$'s offers,
  - $A1$'s round payoff is equal to 750.
  - $A2$'s round payoff is equal to 750.
  - B's round payoff is equal to 600.
- When B accepts one of the offers made by Players A,
  - The round payoff of Player A whose offer is accepted is equal to 1000 – (his/her offer.)
  - The round payoff of Player A whose offer is rejected is equal to 0.
  - B's round payoff is equal to 200 + (accepted Player A's offer).

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