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MANUFACTURERS' DILEMMA FALLING INTO EXCLUSIVE-OFFER COMPETITION: A LABORATORY EXPERIMENT

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Manufacturers' Dilemma Falling into Exclusive-Offer Competition: A Laboratory Experiment*

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Abstract

We experimentally investigate exclusive-offer competition between two existing upstream firms. In theory, when upstream firms make exclusive offers to a downstream monopolist, both exclusion and non-exclusion can be equilibrium outcomes. By varying key parameters, we explore how bargaining power and product differentiation affect the likelihood of exclusion outcomes. We experimentally find that exclusion is more likely to be observed when the upstream firms have stronger bargaining power or when they produce more differentiated products; paradoxically, the higher upstream firms' profits from cooperatively offering unattractive exclusive contracts, the more likely they are to fall into intense exclusive-offer competition.

JEL classification codes: L12, L41, L42.
Keywords: Exclusive dealing; Exclusive-offer competition; Bargaining Power; Product differentiation; Laboratory experiment.

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1 Introduction

In vertical relations, we often observe exclusive-offer competition between existing firms. For example, in the US, PepsiCo and Coca-Cola often make exclusive offers to cinemas, restaurants, universities, and others, well known as the "cola wars."[1] Similarly, breweries often construct exclusive relationships with restaurants and bars in Japan.[2] Exclusive-offer competition is also observed in other markets, such as CPU (Taiwan Semiconductor Manufacturing Company (TSMC) vs. Samsung in the world)[3] and shipping (Nippon Express vs. Yamato Transport and Sagawa Express in Japan).[4]

In the theoretical analysis, Kitamura et al. (2025) construct a model of exclusive-offer competition and show that exclusive-offer competition makes exclusion an equilibrium outcome. The notable feature of such a result is the existence of multiple equilibria; namely, the non-exclusion equilibrium always exists whenever the exclusion equilibrium exists. To confirm the existence of exclusion outcomes, Kitamura et al. (2025) also introduce the experimental analysis in a particular parameter setting in which upstream manufacturers have relatively strong bargaining power against a downstream retailer, and manufacturers produce differentiated products. The experimental results show that the exclusion outcomes can be observed with a relatively high frequency. This study addresses a next-step experimental question: how does the level of bargaining power or product differentiation affect the likelihood of exclusion outcomes?

[1] See, for example, "Coca-Cola Lures Regal Cinemas From Rival Pepsi in Latest Steal" *The Wall Street Journal*, April 9, 2002 (link) for cinemas, "Pepsi takes on rival Coke's biggest client, landing its beverages and snacks in 20,000 Subway sandwich shops" *Fortune*, March 21, 2024 (link) for restaurants, and "'Cola Wars' Foaming On College Campuses" *Chicago Tribune,* November 6, 1994 (link) for universities.

[2] For example, 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 "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).

[4] In 2000, Nippon Express, a Japanese shipping company, wins a competition against Yamato Transport and Sagawa Express over an exclusive shipping contract with Amazon when Amazon opens Amazon.co.jp, Amazon's Japanese branch. See "Amazon Japan: Localization" *LOGI-BIZ,* May 2001, written in Japanese (link).

This study constructs an experimental setting where two upstream manufacturers can make exclusive offers to a single retailer. As a benchmark case, we use the results in the parameter set in the experiment in Kitamura et al. (2025). We then introduce several treatments that differ in the manufacturers' bargaining power and product differentiation levels. The theoretical analysis leads to two opposing predictions on how bargaining power or production differentiation affects the exclusion rate. On the one hand, as manufacturers have stronger bargaining power against the retailer or produce more differentiated products, they earn higher duopoly profits under non-exclusion outcomes, enhancing non-exclusion outcomes. On the other hand, manufacturers' stronger bargaining power or product differentiation decreases the minimum amount of exclusive offers, increasing the likelihood of exclusion outcomes.

Our laboratory experiment shows statistically significant differences in exclusion rates; we observe a higher exclusion rate when manufacturers have stronger bargaining power or produce more differentiated products. The results here imply that when we predict how the change in bargaining power and product differentiation affects the likelihood of exclusion, it seems to be better to examine how such change affects the exclusion cost for manufacturers rather than the duopoly profits expected under non-exclusion outcomes.

This study is related to the literature on anticompetitive exclusive dealing to deter socially efficient entry of a potential entrant.[5] In the 1970s, the Chicago School formally introduces a model analysis in this literature (Posner, 1976; Bork, 1978). They show that by considering the participation constraint for all members in the contracting party, exclusive contracts to deter efficient entry are never signed. After the Chicago School argument, post-Chicago economists find the market environments in which exclusive contracts are signed for anticompetitive reasons. One of the major explanations is derived by extending the single-buyer setting to a multiple-buyer setting. In this setting, exclusion occurs when the entrant faces scale economies where a certain number of buyers is required to cover its fixed costs (Rasmusen, Ramseyer, and Wiley, 1991; Segal and Whinston,

[5] For surveys, see Motta (2004), Whinston (2006), and Fumagalli, Motta, and Calcagno (2018).

2000) and when buyers compete in the downstream markets (Simpson and Wickelgren, 2007; Abit and Wright, 2008).

In contrast to the above studies, several economists show that anticompetitive exclusion can be an equilibrium outcome even in the single downstream buyer when the incumbent supplier sets liquidated damages for the case of entry (Aghion and Bolton, 1987), the entrant is capacity-constrained (Yong, 1996), upstream firms compete à la Cournot (Farrell, 2005), upstream firms can merge (Fumagalli, Motta, and Persson, 2009), the upstream incumbent makes relationship-specific investment (Fumagalli, Motta, and Rønde, 2012).[6] Sharing feature with these studies in terms of single-buyer model, Kitamura et al. (2025) introduce the alternative route to lead to exclusion outcomes by focusing on the exclusive-offer competition between existing upstream firms.

This study is also related to the literature on naked exclusion through exclusive contracts in laboratory experiments (Landeo and Spier, 2009, 2012; Smith, 2011; Boone, Müller, and Suetens, 2014).[7] All studies in this literature focus on exclusion with scale economies in multiple-buyer settings. In contrast to these studies, our laboratory experiment focuses on exclusion with exclusive-offer competition in single-buyer settings.

The remainder of this paper is organized as follows. Section 2 constructs the model. Section 3 provides experimental framework and theoretical insights. Section 4 introduces the experimental results by focusing on exclusion rates and on exclusive offers. Section 5 concludes the paper. Appendix provides supplementary information.

[6] See also the recent studies which show that exclusion can be observed when the downstream buyer bargains with the supplier sequentially (Kitamura, Matsushima, and Sato, 2017), a complementary input supplier with market power exists (Kitamura, Matsushima, and Sato, 2018), the incumbent incurs the fixed cost to stay active (Liu and Meng, 2021), the upstream firms produce durable goods (Kitamura, Matsushima, and Sato, 2023a), and the efficient entrant has alternative but inefficient distribution channels (Kitamura, Matsushima, and Sato, 2023b).

[7] Because every manufacturer prefers non-exclusion outcomes to exclusion outcomes in our experiment setting, this study's observation is related to the experimental study of Cooper et al. (1990), who show that Pareto-dominant equilibrium is not always selected in coordination games.

2 Model

This section introduces the basic model of our experiment. The model is constructed by following Kitamura et al. (2025).

2.1 Basic structure

In the upstream market, two incumbent manufacturers (players U_1 and U_2) exist. The manufacturers operate at the same marginal cost $c \geq 0$ and produce differentiated final products. In the downstream market, a downstream retailer (player D) exists. D sells the manufacturers' products. We assume that D incurs no operating cost aside from paying for the product of U_i.

The demand system has the following properties. Given the pair of manufacturers' product prices $(p_1, p_2) \in \mathbb{R}^2_+$, demand for U_1's product is denoted by $Q(p_1, p_2)$. By assuming symmetric demand, demand for U_2's product is denoted by $Q(p_2, p_1)$. When the prices of these manufacturers' products are sufficiently close, both obtain positive demand. However, when these prices differ sufficiently, the higher-priced manufacturer loses demand, while the lower-priced manufacturer obtains all demand. In addition, when U_j is excluded, demand for U_i's product does not depend on p_j, where $i, j \in \{1, 2\}$ and $i \neq j$. We denote the demand for U_i's product in the monopoly case by $Q(p_i) \equiv Q(p_i, \infty)$.

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:

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

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

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.

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

In this study, we consider product differentiation treatment focusing on the value of Π_d. We briefly explain how the level of Π_d represents the degree of product substitution between manufacturers' products. As products become more homogeneous, Π_d decreases, approaching $\Pi_m/2$ when they are perfectly homogeneous. Conversely, as products become more heterogeneous, Π_d increases, approaching Π_m when they are perfectly independent.

2.2 Timing and payoff structures

The model contains three stages. In Stage 1, U_1 and U_2 simultaneously offer D exclusive contracts with a monetary offer $x_1(\geq 0)$ and $x_2(\geq 0)$, respectively. Following the standard literature on naked exclusion, those exclusive contracts specify only those monetary offers from U_i to D. U_i chooses an offer from the feasible set defined by

$$x_i \in \{0, 1, ..., (1-\beta)\Pi_m\},$$

where $\beta \in [0, 1)$ represents D's bargaining power in Stage 2. After observing both x_1 and x_2, D decides whether to reject both offers (R) or to accept one of the offers, x_1 and x_2, ($E1$ and $E2$). Let $\omega \in \{R, E1, E2\}$ be D's decision. If D is indifferent between two exclusive offers and acceptance leads to higher profits, it accepts one of the offers with probability 1/2. In Stage 2, active manufacturers offer a two-part tariff contract $(w, \psi) \in \mathbb{R}^2_+$, which consists of a linear wholesale price w and an upfront fixed fee ψ. In Stage 3, D orders the available final products and sells them to consumers. Following Kitamura et al. (2025), 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 of β to $1-\beta$. Because we mainly focus on the exclusive-

Table 1: The subjects' payoffs in the games

	Payoffs		
D's choice	Player U_1	Player U_2	Player D
(i) Accept x_1	$\pi_{U1}^{E1} - x_1$	0	$\pi_D^{E1} + x_1$
(ii) Accept x_2	0	$\pi_{U2}^{E2} - x_2$	$\pi_D^{E2} + x_2$
(iii) Reject both	π_{U1}^R	π_{U2}^R	π_D^R

offer competition in Stage 1, we eliminate Stages 2 and 3 in our experiment by assuming rational behavior.

We now introduce the equilibrium profits.[8] First, when D accepts U_i's offer, the firms' equilibrium profits, excluding x_i, are

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

Under exclusive dealing between D and U_i, D earns $\pi_D^{Ei} + x_i$ and U_i earns $\pi_{Ui}^{Ei} - x_i$, whereas U_j earns nothing.

Second, when D rejects both exclusive offers, the resulting profits of the firms are given as

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

Note that $2\Pi_d - \Pi_m$ is interpreted as U_i's additional contribution from participating in the upstream market. Under upstream duopoly, U_i obtains its additional contribution weighted by its bargaining power $1-\beta$, and D earns the remaining industry profit after subtracting the payments for U_1 and U_2 (that is, $2\Pi_d - \pi_{U1}^R - \pi_{U2}^R$). Table 1 summarizes each player's payoff.

3 Experimental Framework and Theoretical Insights

This section introduces the experimental motivation in our experiment. We first explore the existence of an exclusion equilibrium in Section 3.1. We then provide experimental design in Section 3.2. Finally, we introduce the research questions in Section 3.3.

[8] For the precise explanation for the equilibrium profits, see Kitamura et al. (2025).

3.1 Theoretical analysis

We briefly explore the existence of exclusion and non-exclusion equilibria.

We say that U_i's exclusive offer is (strictly) acceptable for D if $x_i \geq \hat{x}$ ($x_i > \hat{x}$) in each treatment, where

$$\hat{x} \equiv \pi_D^R - \pi_D^{Ei} = 2(1-\beta)(\Pi_m - \Pi_d) + \beta(2\Pi_d - \Pi_m).$$

From the viewpoint of U_i, $\hat{x}$ is the minimum amount of an exclusive offer required to exclude U_j; namely, it can be interpreted as an exclusion cost for U_i. In an exclusion equilibrium, at least U_1 or U_2 makes an acceptable offer. By contrast, in a non-exclusion equilibrium, neither U_1 nor U_2 makes a strictly acceptable offer.

We first consider the existence of non-exclusion equilibrium where D rejects both x_1 and x_2 and each U_i earns $\pi_{Ui}^R > 0$. From the definition of $\hat{x}$, the exclusive offers must satisfy $x_1, x_2 \leq \hat{x}$. Otherwise, D has an incentive accepting either offer rather than rejecting them. Given that $x_j \leq \hat{x}$, we will verify that offering $x_i' > \hat{x}$ cannot increase U_i's profit. If $x_i' > \hat{x}$, then,

$$\pi_{Ui}^{Ei} - x_i' - \pi_{Ui}^R < \pi_{Ui}^{Ei} - \hat{x} - \pi_{Ui}^R = \pi_{Ui}^{Ei} + \pi_D^{Ei} - \pi_D^R - \pi_{Ui}^R = -\beta(2\Pi_d - \Pi_m) \leq 0,$$

implying that $\pi_{Ui}^{Ei} - x_i' < \pi_{Ui}^R$ when it chooses $x_i' > \hat{x}$. Thus, non-exclusion equilibrium always exists.

We next consider the case in which U_j offers $x_j \geq \hat{x}$ and D accepts either exclusive offer to explore the existence of exclusion equilibrium. In this case, U_i earns $\pi_{Ui}^{Ej} = 0$ if it offers $x_i < x_j$, which implies that U_i tries to exclude U_j by offering $x_i \geq x_j$ as long as it earns $\pi_{Ui}^{Ei} - x_i \geq 0$. From the participation constraints of D and U_i, the exclusion equilibrium exists if and only if $\pi_{Ui}^{Ei} \geq \hat{x}$ holds. By checking this condition, we have

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

for $\beta \leq 1/2$. Thus, the exclusion equilibrium exists when manufacturers have sufficiently strong bargaining power.

If we assume $x_i \in \mathbb{R}_+$ as in Kitamura et al. (2025), neither $x_i > x_j \geq \hat{x}$ nor $x_i = x_j < \pi_{Ui}^{Ei}$ can be achieved in the exclusion equilibrium because at least one of the manufacturers has the incentive to deviate; $x_i^* = x_j^* = \pi_{Ui}^{Ei}$ becomes the equilibrium offers. By contrast, under the assumption that we take $x_i \in \mathbb{Z}_+$ in our experiment, $x_i^* = x_j^* = \pi_{Ui}^{Ei} - 1$ and $x_i^* = x_j^* = \pi_{Ui}^{Ei} - 2$ also become the equilibrium exclusive offers, in addition to $x_i^* = x_j^* = \pi_{Ui}^{Ei}$.

We finally consider the theoretical prediction on the equilibrium outcomes focusing on exclusive offers and firms' payoffs for each treatment. If we set $\beta \in [0, 1/2]$, both a non-exclusion equilibrium and an exclusion equilibrium are attainable. The following proposition summarizes the above discussion.

Proposition 1. *For $\beta \in [0, 1/2]$, there are multiple subgame perfect Nash equilibria. In the non-exclusion equilibria, U_1 and U_2 offer $x_i^* \leq \hat{x}$; each U_i earns $(1-\beta)(2\Pi_d - \Pi_m)$ and D earns $2((1-\beta)(\Pi_m - \Pi_d) + \beta\Pi_d)$. In the exclusion equilibria, manufacturers' exclusive offers satisfy $(x_1^*, x_2^*) \in \{((1-\beta)\Pi_m, (1-\beta)\Pi_m), ((1-\beta)\Pi_m - 1, (1-\beta)\Pi_m - 1), ((1-\beta)\Pi_m - 2, (1-\beta)\Pi_m - 2)\}$; each U_i earns nothing or an expected profit, $1/2$ or 1, while D earns all or almost all of Π_m.*

3.2 Experimental Design

Under the payoff structure in Section 2, we examine behaviors in Stage 1 using four types of parameter settings. In the baseline treatment, *Baseline*, we set $\beta = 1/6$, $\Pi_m = 1200$, and $\Pi_d = 1050$, which coincides with the parameter set in the random matching treatment in Section 4 of Kitamura et al. (2025). In this study, we address two model parameters, β and Π_d.

For the comparison with *Baseline*, we introduce two β treatments and one Π_d treatment. In the strong D treatment, *Strong-D*, we set $\beta = 1/3$ and $\Pi_d = 1050$; D in this treatment has stronger bargaining power compared to *Baseline*. Regarding bargaining power, we also consider the weak D treatment, *Weak-D*, and set $\beta = 0$ and $\Pi_d = 1050$, corresponding to the extreme situation in which D has no bargaining power. These three treatments allow us to check whether the degree of bargaining power influences the likelihood of exclusion. Lastly, regarding product differentiation,

Table 2: Payoff structures in each treatment ($\Pi_m = 1200$)

			D accepts x_i			D rejects both		
Treatment	β	Π_d	U_i	U_j	D	U_i	D	$\hat{x}$
Baseline	1/6	1050	$1000 - x_i$	0	$200 + x_i$	750	600	400
Strong-D	1/3	1050	$800 - x_i$	0	$400 + x_i$	600	900	500
Weak-D	0	1050	$1200 - x_i$	0	x_i	900	300	300
Less-diff	1/6	975	$1000 - x_i$	0	$200 + x_i$	625	700	500

we introduce the less differentiation treatment, *Less-diff*, by setting $\beta = 1/6$ and $\Pi_d = 975$. This treatment corresponds to the situation in which the manufacturers' products are relatively homogeneous than those in *Baseline*. Table 2 summarizes the corresponding payoff variables in each treatment.

Using Proposition 1, we now introduce the theoretical prediction on the exclusion rate in each treatment. For the sake of notational convenience, the exclusion rate in treatment $t \in \{B, sD, wD, Ld\}$ is denoted by z_t, where B, sD, wD, and Ld indicate *Baseline*, *Strong-D*, *Weak-D*, and *Less-diff*. In Proposition 1, both exclusion and non-exclusion equilibria exist in each treatment. Based on this result, we have the following theoretical prediction on the exclusion rate; in each treatment, the exclusion rate lies anywhere between 0% and 100% (i.e., $z_t \in [0, 1]$ for all t). Table 3 summarizes the theoretical predictions on average exclusion rates, exclusive offers, and payoffs for each treatment based on Proposition 1.

Although both exclusion and non-exclusion equilibria exist in each treatment, the exclusion rate seems to vary across treatments due to the difference in D's bargaining power or product differentiation, which is our main experimental concern. We discuss how the exclusion rate depends on β and Π_d in Section 3.3.

Table 3: Theoretical prediction (Exclusion rates, offers, and (expected) payoffs)

Treatment	Exclusion rate	Exclusion (x_i, x_j)	Exclusion U_i, U_j	Exclusion D	Non-exclusion (x_i, x_j)	Non-exclusion U_i, U_j	Non-exclusion D
		$(1000, 1000)$	0	1200			
Baseline	$\in [0, 1]$	$(999, 999)$	$1/2$	1199	$\in [0, 400]^2$	750	600
		$(998, 998)$	1	1198			
		$(800, 800)$	0	1200			
Strong-D	$\in [0, 1]$	$(799, 799)$	$1/2$	1199	$\in [0, 500]^2$	600	900
		$(798, 798)$	1	1198			
		$(1200, 1200)$	0	1200			
Weak-D	$\in [0, 1]$	$(1199, 1199)$	$1/2$	1199	$\in [0, 300]^2$	900	300
		$(1198, 1198)$	1	1198			
		$(1000, 1000)$	0	1200			
Less-diff	$\in [0, 1]$	$(999, 999)$	$1/2$	1199	$\in [0, 500]^2$	625	700
		$(998, 998)$	1	1198			

All treatments here adopted the random matching protocol that nine subjects (six players U and three players D) form a matching group and rematch within it at each round.[9] The assigned role remains the same throughout the experiment.[10] Each subject plays the same game in 20 rounds without practice. At the end of each round, all 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.[11]

[9] In the experiment, 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 18–27 participants, randomly divided into two or three matching groups.

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

[11] 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.

Table 4: Summary of experimental design

	β	Π_d	Π_m	Sessions	Subjects	Groups
Baseline	1/6	1050	1200	4	108	12
Strong-D	1/3	1050	1200	4	108	12
Weak-D	0	1050	1200	4	99	11
Less-diff	1/6	975	1200	4	99	11
Total				16	414	46

The experiment was run from February 2019 to June 2024 in the ISER lab at Osaka University, with 414 students from different fields of study. Table 4 summarizes the experiments for each treatment. For *Baseline*, we conducted four sessions and recruited 108 subjects to have twelve independent matching groups. By contrast, for each new treatment, we conducted four sessions and recruited 99-108 subjects in total to have eleven-twelve independent matching groups. All sessions are computerized by zTree (Fischbacher, 2007), and the participants are recruited through the ORSEE (Greiner, 2015) at Osaka University. Sessions took about 100 minutes, and participants each earned 2747.7 Japanese Yen (JPY), on average, including 1000 JPY as a participation fee. All participants in each session received the same instructions, containing the payoff structure of U and D. Subjects were informed that monetary earnings depend on the cumulative earnings made throughout the experiment. We convert 1000 payoff points in the experiment to 170 JPY.

3.3 Experimental questions

We introduce three research questions in our experiment. We first provide the experimental motivation on profit allocation under exclusion outcomes in Section 3.3.1. We next consider the effect of bargaining power and that of product differentiation on the likelihood of exclusion in Section 3.3.2.

3.3.1 Manufacturers' offers and profit allocation

We first consider the research question on manufacturers' offers and profit allocation when exclusion occurs. In the competition phase, the incentive structure is identical to the standard Bertrand competition with discrete variable; Proposition 1 provides the theoretical prediction that manufacturers earn zero or almost zero expected profit including the payment x_i. However, such outcomes are less likely to be observed in the existing experimental studies in which realized prices are significantly above the marginal costs in two-person Bertrand competition experiments (e.g., Dufwenberg and Gneezy, 2000). Therefore, we do not necessarily expect convergence to the so-called Bertrand equilibrium.

Question 1. *The theoretical prediction implies that when exclusion occurs, D earns all or almost all industry profit; namely, it earns* 1200, 1199, *or* 1198 *in each treatment. However, some existing experimental studies imply the possibility that when exclusion occurs, D cannot earn such a profit; its earning is strictly smaller than* 1198.

3.3.2 Bargaining power and product differentiation

We consider the effect of bargaining power and that of product differentiation on the likelihood of exclusion. In each effect, we have two opposite theoretical predictions on the difference in exclusion rates. By introducing these predictions, we derive experimental questions on each effect.

Bargaining power The change of β affects not only duopoly profits under non-exclusion equilibrium but also the acceptable exclusive offer for D. By partially differentiating π^R_{Ui} with respect to β, we have

$$\frac{\partial \pi^R_{Ui}}{\partial \beta} = -(2\Pi_d - \Pi_m) < 0,$$

which implies that as manufacturers have stronger bargaining power (lower β), they earn higher duopoly profits. This effect seemingly facilitates the coordination between players U to avoid the exclusion outcome by offering low x_i; namely, the exclusion rate seems to decrease. By contrast, by partially differentiating $\hat{x}$ with respect to β, we have

$$\frac{\partial \hat{x}}{\partial \beta} = 4\Pi_d - 3\Pi_m \gtreqless 0 \text{ for } \frac{\Pi_d}{\Pi_m} \gtreqless \frac{3}{4}.$$

We have $\Pi_d/\Pi_m = 7/8$ in *Baseline*, *Strong-D*, and *Weak-D* treatments; namely, $\partial\hat{x}/\partial\beta > 0$ always holds in those treatments. This implies that as manufacturers have stronger bargaining power, the acceptable offer becomes less costly for the manufacturers because D's profit reduction under upstream duopoly is more serious than that under exclusive dealing.[12] Thus, the exclusion is more likely to be facilitated. In sum, for *Strong-D* and *Weak-D*, we have no qualitative prediction about the frequency of exclusion.

Question 2. *There are two opposite predictions on how bargaining power affects the exclusion rate. On the one hand, as manufacturers have strong bargaining power (lower β), the exclusion rate may decrease ($z_{sD} > z_B > z_{wD}$) because manufacturers earn higher duopoly profits under non-exclusion outcomes. On the other hand, as manufacturers have strong bargaining power, the exclusion rate may increase ($z_{sD} < z_B < z_{wD}$) because the acceptable offer becomes less costly for the manufacturers.*

Product differentiation Like the research question on bargaining power, we focus on manufacturers' duopoly profits and the acceptable offer. By partially differentiating π^R_{Ui} with respect to Π_d, we have

$$\frac{\partial \pi^R_{Ui}}{\partial \Pi_d} = 2(1-\beta) > 0,$$

for all β, which implies that as manufacturers produce more differentiated products (higher Π_d), they earn higher duopoly profits because the additional contribution from U_i's participation under duopoly increases. This effect encourages the coordination between players U, which decreases the exclusion rate. On the other hand, from a strategic perspective, higher Π_d also decreases the

[12] This result comes from the feature of π^R_D. The change of bargaining power affects D's profit under an upstream duopoly in two ways. First, a decrease in β directly increases U_i's profit share but decreases D's profit share. Second, because the decrease in β increases U_i's profit share, it earns higher profits $\pi^R_{Ui} = F^R_i$, indirectly decreasing D's outside option profit under the bargaining with U_j, $\Pi_m - F^R_i$ (see Section 3.1 in Kitamura et al. (2025) for the precise bargaining formulation). This indirect effect additionally decreases π^R_D and becomes stronger as manufacturers' products are highly differentiated (that is, higher Π_d/Π_m) because the higher additional contribution from U_i's participation, $2\Pi_d - \Pi_m$, increases F^R_i largely.

minimum acceptable offer;

$$\frac{\partial \hat{x}}{\partial \Pi_d} = -2(1-2\beta) < 0,$$

for $\beta < 1/2$, which implies that as manufacturers' products are more differentiated, the frequency of exclusion may increase because exclusion becomes less costly for manufacturers.[13] Thus, we have no qualitative prediction about the frequency of exclusion for the change in the degree of product substitution.

Question 3. *There are two opposite predictions on how product differentiation affects the exclusion rate. On the one hand, as manufacturers' products become more differentiated (higher* Π_d*), the exclusion rate may decrease (*$z_{Ld} > z_B$*) because manufacturers earn higher duopoly profits under non-exclusion outcomes. On the other hand, as manufacturers' products become more differentiated, the exclusion rate may increase (*$z_{Ld} < z_B$*) because making an acceptable offer becomes less costly for the manufacturers.*

4 Results

This section presents our experimental results. We first examine the exclusion rates and profit allocation in Section 4.1. We then analyze the intensity of exclusive-offer competition in Section 4.2 and provide the results of statistical tests regarding the effects of bargaining power and product differentiation in Section 4.3. We finally focus on subjects' behaviors in Section 4.4.

4.1 Outcomes: exclusion rates and profit allocation

We report the average exclusion rates and player payoffs across treatments using Table 5.

[13] This result comes from the decrease in π_D^R. We briefly explain why retailer earns lower profits under upstream duopoly when it sells more differentiated products. A decrease in the degree of product substitution affects D's profit under an upstream duopoly in two ways. First, as Π_d increases, the industry profit $2\Pi_d$ directly increases, which has an effect of increasing π_D^R. Second, because U_i's additional contribution increases, it earns higher profits $\pi_{Ui}^R = F_i^R$, indirectly decreasing D's outside option profit under the bargaining with U_j. This indirect effect decreases π_D^R and becomes dominant for lower β because the strong bargaining power of U_i increases F_i^R largely.

Table 5: Average exclusion rates and payoffs

Treatment	Exclusion rate	U_i, U_j	D	Exclusion U_i	Exclusion U_j	Exclusion D	Non-exclusion U_i, U_j	Non-exclusion D
Baseline	0.78	344	707	464	0	736	750	600
		(303)	(107)	(103)		(103)		
Strong-D	0.20	509	901	293	0	907	600	900
		(196)	(45)	(101)		(101)		
Weak-D	0.97	265	701	485	0	715	900	300
		(282)	(153)	(136)		(136)		
Less-diff	0.46	437	729	437	0	763	625	700
		(256)	(74)	(98)		(98)		

Notes: Standard deviations are provided in parentheses.

Exclusion rate We first examine the exclusion rates provided in the second column, which range from 20% in *Strong-D* to 97% in *Weak-D*. This variation indicates that the likelihood of exclusion crucially depends on specific parameters, although both exclusion and non-exclusion outcomes are predicted by the theoretical analysis. Figure 1 also shows the transition dynamics of exclusion rates over 20 rounds of play for each treatment. For *Baseline* and *Weak-D*, the exclusion rates are high and quite stable, indicating that players U have difficulty coordinating to avoid exclusion outcomes in these treatments. Conversely, in the *Strong-D* and *Less-diff* treatments, the exclusion rates slightly decrease in the first 10 rounds, but such trends do not persist. Further analysis of these differences is discussed in Section 4.3.

Profit allocation The third and fourth columns in Table 5 show the overall average payoffs, while the subsequent columns report the conditional average payoffs depending on whether an exclusion or non-exclusion outcome occurs. The payoffs in the last two columns are constant and determined by the parameter settings (as shown in Table 2).

First, we investigate Research Question 1 by examining the profit allocation in exclusion outcomes. Specifically, players D earn from 715 in *Weak-D* to 907 in *Strong-D*, which differs from

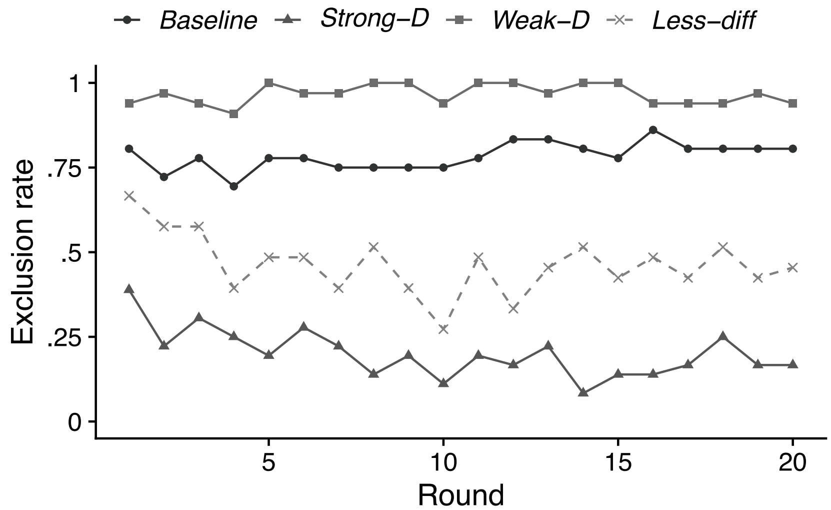

Figure 1: Transition of exclusion rates

the game-theoretic prediction that player D should earn 1200, 1199, or 1198 in the exclusion equilibrium (as shown in Table 3). Indeed, outcomes consistent with the theoretical prediction were observed only four times out of $1,652$ exclusion outcomes across all treatments.[14] On the other hand, this result aligns with findings from experimental studies on Bertrand competition with homogeneous goods, such as Dufwenberg and Gneezy (2000), where two-player Bertrand competition does not converge to the Nash equilibrium.

Result 1 (**Profit allocation**). *In contrast to the theoretical prediction, retailers hardly obtain almost all industry profits; when exclusion occurs, players D's share of industry profit in each treatment ranges from 59.6% (=* $715/1200$*) to 75.6% (=* $907/1200$*) on average.*

Next, we examine each role's overall average payoffs. The comparison of each role's overall average payoffs provides two important insights. First, for all player roles, the overall average payoffs are Pareto ranked; specifically, treatments with higher exclusion rates result in lower average payoffs for *both* players U and D, reflecting the welfare loss associated with the inefficiency of

[14] Specifically, D earned 1200 three times and 1199 once. In the Appendix, Figure A.5 presents histograms illustrating D's profit distribution in exclusion outcomes across each treatment. The figure shows that D's profits in exclusion outcomes are substantially lower than the theoretical predictions.

naked exclusion.[15]

Second, from the viewpoint of players U, the ranking of overall average payoffs (the third column in Table 5) is completely opposite to the payoff ranking for U in the non-exclusion outcomes (the eighth column in Table 5). This pattern suggests that players U are not necessarily motivated to coordinate and avoid exclusion solely by the payoffs in the non-exclusion outcome. Instead, exclusive-offer competition generates non-trivial incentives and often drives players U to pursue exclusive dealing with D, even at the expense of their joint surplus. This strategic behavior in exclusive-offer competition is further explored in the next subsection.

4.2 Exclusive-offer competition and coordination failure

In this subsection, we address the exclusive-offer competition among players U_i and U_j. Table 6 reports the descriptive statistics of players U's strategies, including the average amount of exclusive offers, the likelihood of strictly acceptable offer ($x_i > \hat{x}$), the average amount of exclusive offers given that players U_i choose strictly acceptable offers, and the percentage of cases in which their opponents U_j also choose strictly acceptable offers.[16]

Regarding the overall average amount of exclusive offers presented in the second column, it is crucial to acknowledge that these values are influenced by a variety of factors, including the varied cutoff values (i.e., the minimum acceptable offers $\hat{x}$) across treatments, as well as the likelihood and intensity of exclusive-offer competition. In particular, when the offers are strictly less than $\hat{x}$, they are irrelevant given the incentive structure of the game. Therefore, we mainly focus on the strictly acceptable offer as an intensity indicator of exclusive-offer competition below.[17]

First, we consider the likelihood of strictly acceptable offers. The third column in Table 6

[15] Note that in the *Less-diff* treatment, the parameter for the surplus in non-exclusion scenarios is set at $\Pi_D = 975$, which is lower than $\Pi_D = 1050$ in the other treatments. Despite the lower surplus under duopoly, the overall average profits in *Less-diff* are the second highest among the four treatments because of the low exclusion rate.

[16] Here, we focus on strictly acceptable offers rather than simply acceptable offers because exclusive offers equal to $\hat{x}$ are consistent with a (pure-strategy) Nash equilibrium only when they result in the non-exclusion outcome.

[17] Indeed, the conditional average offers given $x_i < \hat{x}$ range from 90 in *Weak-D* to 201 in *Less-diff*, and these values do not correlate with either the resulting exclusion rates or the size of $\hat{x}$.

Table 6: Summary of exclusive offers

			Subsample ($x_i > \hat{x}$)		
Treatment	Avg.Offer	Rate $\{x_i > \hat{x}\}$	Avg.Offer	$\hat{x}$ (fixed)	Rate $\{x_j > \hat{x}\}$
Baseline	398	0.60	533	400	0.70
	(209)		(91)		
Strong-D	192	0.09	539	500	0.22
	(190)		(50)		
Weak-D	598	0.85	681	300	0.85
	(246)		(153)		
Less-diff	354	0.31	580	500	0.64
	(233)		(70)		

Notes: Standard deviations are provided in parentheses.

shows that the likelihood of strictly acceptable offers differs among treatments in a pattern similar to the exclusion rates. Second, we focus on the average amount of strictly acceptable offers. The fourth column reports the average amounts of strictly acceptable offers and standard deviations. We observe that as players U are more likely to choose strictly acceptable offers, the gap between the conditional average offer and $\hat{x}$, as well as the standard deviation, are high. This observation suggests that treatments such as *Weak-D* or *Baseline* induce players U to be more competitive in exclusive offers. Finally, we investigate the likelihood that U_j also makes strictly acceptable offers. The last column reports the conditional probability that the opponent also engages in exclusive-offer competition. It supports such views that players U strategically choose strictly acceptable offers in response to the expectation of the opponent's competitive behaviors.

We also explore how strictly acceptable offers change over time. Figure 2 illustrates the transition of strictly acceptable offers across different treatments over 20 rounds of play.[18] Notably, *Weak-D* displays a clear upward trend in the average amount of strictly acceptable offers, indicating that exclusive-offer competition intensifies as the rounds progress. In contrast, *Strong-D*

[18] Specifically, Figure 2 shows for each treatment the transition of the conditional average of exclusive offers, given that they are strictly acceptable for D. Therefore, the graphs do not reveal information about the changes in the numbers and identities of subjects choosing such offers.

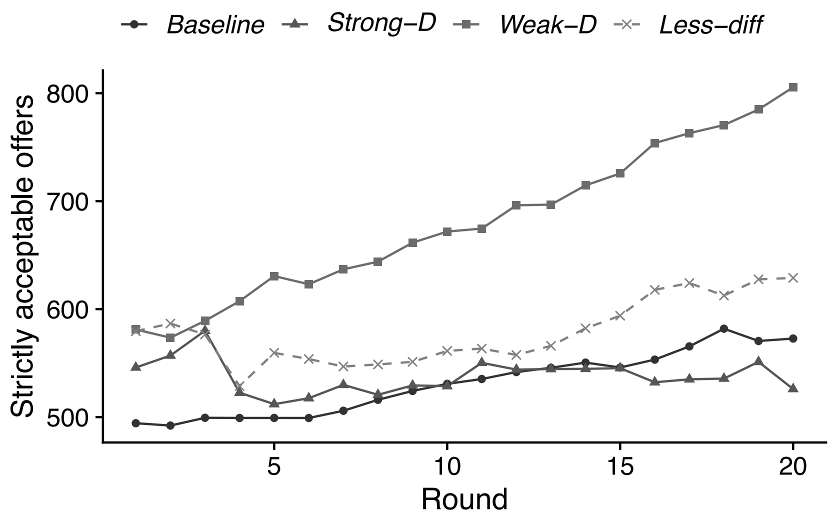

Figure 2: Transition of strictly acceptable offers

maintains a relatively flat and low amount of strictly acceptable offers throughout the experiment rounds, suggesting less competitive pressure or a different strategic approach by the players.[19] For *Baseline* and *Less-diff*, upward trends are observed, qualitatively similar to that of *Weak-D*. However, quantitatively, the slopes of the graphs for these treatments are relatively flatter, suggesting a more moderate intensity of exclusive-offer competition. Indeed, the numbers in the rightmost column of Table 6 support this differentiation in competitive intensity, as *Baseline* and *Less-diff* show similar percentages of facing competitive opponents despite considerable differences in the overall percentages of strictly acceptable offers between these treatments.[20]

4.3 Changes in bargaining power and product differentiation

This subsection explores the effects of bargaining power and product differentiation on the exclusion rates.

[19] Indeed, the rightmost column of Table 6 shows that only 22% of the opponents of those who chose strictly acceptable offers also selected competitive offers, indicating that they likely had no incentive to increase their offer based on previous round experiences.

[20] Given the experimental design differences in the range of offers available to players U (see Table 2), comparisons of the slope of the trends presented in the graphs should take these differences into account, and thus, the slopes do not solely reflect the intensity or pressure of the exclusive-offer competition.

Table 7: Pairwise Wilcoxon test on difference in exclusion rates

group1	group2	n1	n2	statistic	p	p.signif
Baseline	*Strong-D*	12	12	137.0	0.000192	***
Baseline	*Weak-D*	12	11	19.0	0.004000	***
Baseline	*Less-diff*	12	11	107.5	0.012000	**

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Bargaining power We compare three treatments concerned with bargaining power, *Strong-D* ($\beta = 1/3$), *Baseline* ($\beta = 1/6$), and *Weak-D* ($\beta = 0$) (see Table 5 and Figure 1).

We first compare the exclusion rate in *Baseline* with that in *Strong-D*. In *Baseline*, the average exclusion rate is 78%, and each round's exclusion rate is constantly higher than 75%. By contrast, in *Strong-D*, we observed a considerably low average exclusion rate (20%). The difference in exclusion rates between *Baseline* and *Strong-D* is statistically significant, based on the Mann-Whitney U test at 1% significance level (see Table 7).[21]

We next compare *Baseline* with *Weak-D*. Compared to *Baseline*, *Weak-D* constantly recorded higher exclusion rates (90.9-100%). The difference in exclusion rates between *Baseline* and *Weak-D* is statistically significant at 1% level (see Table 7).

These comparisons suggest that, as manufacturers have strong bargaining power, the likelihood of exclusion is more likely to increase. From the discussion in Research Question 2, the effect of decreasing the exclusion cost for manufacturers seems to dominate that of increasing manufacturers' profits for the non-exclusion case. Moreover, the result in *Weak-D* implies that the exclusion rate can be close to 100% if manufacturers have strong bargaining power, which confirms the existence of a market environment in which exclusion outcomes, theoretically predicted in Kitamura et al. (2025), are more likely to be observed.

Result 2 (**Bargaining power**)**.** *As manufacturers have strong bargaining power, the likelihood*

[21] To run these pairwise tests, we compute the exclusion rate for each matching group and treat it as an independent observation for the test.

of exclusion outcomes increases ($z_{sD} < z_B < z_{wD}$); the differences in the exclusion rate between Baseline and Strong-D and between Baseline and Weak-D are enough to be statistically significant.

Product differentiation We consider the effect of product differentiation on exclusion rates by comparing *Baseline* ($\Pi_d = 1050$) with *Less-diff* ($\Pi_d = 975$). Although we constantly observed exclusion rates more than 75% throughout 20 rounds in *Baseline*, we observed lower exclusion rates, fluctuating within 30–50% in *Less-diff*; thus, as manufacturers' products are more differentiated, the likelihood of exclusion increases. From the discussion in Research Question 3, the result here provides the insight into the two opposing effects of product differentiation on exclusion; the effect of decreasing the exclusion cost for manufacturers seems to dominate that of increasing manufacturers' profits for the non-exclusion case. Table 7 shows that the difference in exclusion rates between *Baseline* and *Less-diff* is statistically significant, based on the Mann-Whitney U test at 5% significance level.

Result 3 (**Product differentiation**). *Product differentiation raises the likelihood of exclusion outcomes ($z_{Ld} < z_B$); the difference in the exclusion rate between Baseline and Less-diff is enough to be statistically significant.*

Results 2 and 3 imply that when we predict how the change in bargaining power and product differentiation affects the likelihood of exclusion, it seems to be better to examine how such change affects the exclusion cost for manufacturers rather than the duopoly profits expected under non-exclusion outcomes.

4.4 Subjects' behavior

Finally, we consider the subjects' behavior. We first report retailers' responses to (x_1, x_2) in Section 4.4.1. We then focus on manufacturers' behavior, particularly when they switch from exclusion to non-exclusion strategies and vice versa in Section 4.4.2.

Table 8: Retailers' responses

Case	Total Obs	Response	Best Response	Obs	Rate
$\max\{x_1, x_2\} > \hat{x}$	1599	accept $x_i = \max\{x_1, x_2\}$	✓	1490	0.93
		accept $x_i < \max\{x_1, x_2\}$	-	14	0.01
		reject	-	95	0.06
$\max\{x_1, x_2\} = \hat{x}$	197	accept $x_i = \max\{x_1, x_2\}$	✓	87	0.44
		accept $x_i < \max\{x_1, x_2\}$	-	0	0.00
		reject	✓	110	0.56
$\max\{x_1, x_2\} < \hat{x}$	964	accept either	-	61	0.06
		reject	✓	903	0.94

4.4.1 Retailers' behavior

Table 8 summarizes retailers' behavior. Dividing all observations into three cases, we find that retailers basically choose rational behavior. When at least one of the exclusive offers is strictly acceptable ($\max\{x_1, x_2\} > \hat{x}$), 93% of players D accept the higher exclusive offer as the best response; more precisely, 1% of players D accept the lower offer and 6% of players D reject both offers. When both exclusive offers are unacceptable ($\max\{x_1, x_2\} < \hat{x}$), 94% of players D reject both exclusive offers as the best response; only 6% of players D accept one of the exclusive offers. By contrast, when the highest exclusive offer equals the acceptable offer $\hat{x}$ ($\max\{x_1, x_2\} = \hat{x}$), 44% of players D accept the higher exclusive offer while 56% of players D reject both exclusive offers.

Result 4 (**Retailers' behavior**). *Retailers usually choose rational behavior; more than 90% of players D choose the best response when at least one of the exclusive offers is strictly acceptable or both exclusive offers are not acceptable. If retailers are indifferent between accepting one of the exclusive offers and rejecting both offers (*$\max\{x_1, x_2\} = \hat{x}$*), almost half of players D accept the higher exclusive offer.*

Table 9: Response to aligned experiences

Experience	Treatment	Obs.	Observed response DtoC	no switch	CtoD
Exclusive-offer Competition	Total	1754	0.04	0.96	-
$x_i > \hat{x}, x_j > \hat{x}$	*Baseline*	568	0.04	0.96	-
	Strong-D	28	0.04	0.96	-
	Weak-D	910	0.03	0.97	-
	Less-diff	248	0.04	0.96	-
Cooperation in Non-exclusion	Total	2208	-	0.97	0.03
$x_i \leq \hat{x}, x_j \leq \hat{x}$	*Baseline*	298	-	0.94	0.06
	Strong-D	1158	-	0.99	0.01
	Weak-D	28	-	0.79	0.21
	Less-diff	724	-	0.97	0.03

4.4.2 Strategic Adaptations of Manufacturers

In this subsection, we examine the strategic behaviors of players U_i, particularly focusing on their adaptive responses based on the outcomes of previous rounds. Specifically, we classify the outcomes into four types: "Exclusive-offer Competition," where both $x_i, x_j > \hat{x}$; "Cooperation in Non-exclusion," where $x_i, x_j \leq \hat{x}$; "Defection," where $x_i > \hat{x}$ and $x_j \leq \hat{x}$; and "Defected," where $x_i \leq \hat{x}$ and $x_j > \hat{x}$.[22]

In Table 9, we examine how upstream firms react after rounds when their actions are aligned with two distinct scenarios: exclusive-offer competition and cooperation in non-exclusion. The table presents patterns of responses, computing the percentage of players who switch their strategies from competitive ($x_i > \hat{x}$) to cooperative ($x_i \leq \hat{x}$), and vice versa (*CtoD*).[23] The column labeled 'no switch' corresponds to cases where players maintain their existing strategies. Observations indicate

[22] In the Appendix, we provide an analysis based on a finer categorization that considers D's choices as well as Us' exclusive offers. In particular, we observe certain percentages of D's choices, such as rejecting strictly acceptable offers in Exclusive-offer Competition cases and accepting offers where $x_i \leq \hat{x}$ in Non-exclusion cases. However, removing such cases does not alter the main findings presented in this subsection.

[23] As used in stag hunt games, "C" stands for Cooperate (attempting non-exclusion) and "D" for Defect (attempting exclusion).

Table 10: Response to misaligned experiences

			Observed response		
Experience	Treatment	Obs.	DtoC	no switch	CtoD
Defection	Total	641	0.27	0.73	-
$x_i > \hat{x}, x_j \leq \hat{x}$	*Baseline*	251	0.26	0.74	-
	Strong-D	91	0.38	0.62	-
	Weak-D	158	0.12	0.88	-
	Less-diff	141	0.38	0.62	-
Defected	Total	641	-	0.71	0.29
$x_i \leq \hat{x}, x_j > \hat{x}$	*Baseline*	251	-	0.67	0.33
	Strong-D	91	-	0.84	0.16
	Weak-D	158	-	0.72	0.28
	Less-diff	141	-	0.67	0.33

that a significant majority of players in both scenarios largely maintain their previous strategies, with 96.2% in Exclusive-offer Competition and 97.2% in Cooperation in Non-exclusion. This tendency suggests the rationality of players within our game-theoretic framework, as unilateral deviations from established strategies are not generally profitable.[24]

Conversely, Table 10 addresses how upstream firms adjust their strategies following unilateral defections and other non-aligned cases. In these cases, one player might opt for an exclusionary strategy (i.e., a strictly acceptable offer) while the other does not, creating disequilibrium that necessitates strategic realignment. We find that players sometimes switch between competitive and cooperative strategies in response to previous round outcomes. While the percentages of strategic switches vary by treatment, they range from approximately 25% to 40%. Specifically, in *Baseline* and *Weak-D*, the likelihood of strategy switches is lower in Defection scenarios than in Defected scenarios. Conversely, in *Strong-D* and *Less-diff*, the opposite pattern emerges, with a higher probability of strategy switches in Defection cases. These findings align with the transition dynamics observed in Figure 1, showing the upward trend in *Baseline* and *Weak-D* and the downward trend

[24] Among 28 observations of Cooperation in Non-exclusion in *Weak-D*, 16 were such that $x_i, x_j < \hat{x}$ followed by *D*'s rejection but marked 18.8% of strategy switched, substantially higher than those in the other treatment.

in the remaining treatments.

Result 5 (**Manufacturers' behavior**). *The strategic responses of manufacturers to previous round outcomes reveal consistent patterns, particularly in their tendency to maintain established strategies:*

(i) *In cases where both players' offers were aligned as either competitive (strictly acceptable) or cooperative in the previous round, there is a high likelihood of persisting with the same strategy.*

(ii) *Conversely, in cases of strategic misalignment, where one player's offer was competitive (strictly acceptable), and the other's was not, there is a notable tendency for strategic adjustments.*

Despite variations in players U's strategies, exclusion rates, and payoff allocations across treatments, manufacturers' behavioral adaptations to outcomes from previous rounds exhibit remarkable consistency across different settings. This uniformity in strategic responses demonstrates the inherent rationality in manufacturers' decision-making processes. Furthermore, the observed variations in responses to misaligned experiences contribute to the differences in exclusion rates and payoff allocations between treatments, possibly reinforcing the impact of underlying conditions of bargaining power and product differentiation.

5 Concluding Remarks

This study has introduced a laboratory experiment to explore how bargaining power and product differentiation levels affect the likelihood of exclusion outcomes in the presence of exclusive-offer competition. Our experiment shows that not only bargaining power but also product differentiation significantly affects the exclusion rate; the high likelihood of exclusion outcomes is more likely to be observed when upstream manufacturers have strong bargaining power against downstream retailers or when upstream manufacturers produce differentiated products.

The results here imply that when we predict how the change of bargaining power and product differentiation affects the likelihood of exclusion, it is better to examine how such change affects the exclusion cost for manufacturers rather than the manufacturers' duopoly profits expected under non-exclusion outcomes. If the exclusion cost decreases, exclusive-offer competition heats up, and exclusion outcomes increase. From the viewpoint of manufacturers, they may face the dilemma of falling into intense exclusive-offer competition when they expect higher duopoly profits by cooperatively making unattractive exclusive offers.

Despite these contributions, several concerns suggest the need for future work. First, there is concern about communication among players. The communication between manufacturers may facilitate manufacturers' cooperation to avoid intense exclusive-offer competition. Moreover, the communication between a manufacturer and a retailer may disturb manufacturers' cooperative behavior. Second, we explore the case in which the group members are randomly determined. If the members in each matching group are fixed, the downstream retailer may take some strategic behavior against upstream manufacturers. We hope this study will assist future research in applying the experiment to these situations.

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A Appendix

Transition of overall average payoffs (*D*)

Figure A.1 illustrates the transition of *D*'s average payoffs across four treatments over 20 rounds of play. *Strong-D* is notably distinct, maintaining consistently high and stable payoffs throughout the rounds. This stability is largely attributed to the lower exclusion rates observed in this treatment, coupled with the fact that *D*'s payoff in non-exclusion scenarios is set at 900 (see Table 2). *Baseline* and *Less-diff* exhibit gradual increases over time. In contrast, *Weak-D* starts with lower payoffs but displays a steady increase, ultimately exceeding those in *Baseline* and *Less-diff* by the end of the series. In the rest of this appendix, we will examine the underlying mechanisms of these payoff transitions, such as the intensity of exclusive-offer competition and strategic decision-making dynamics.

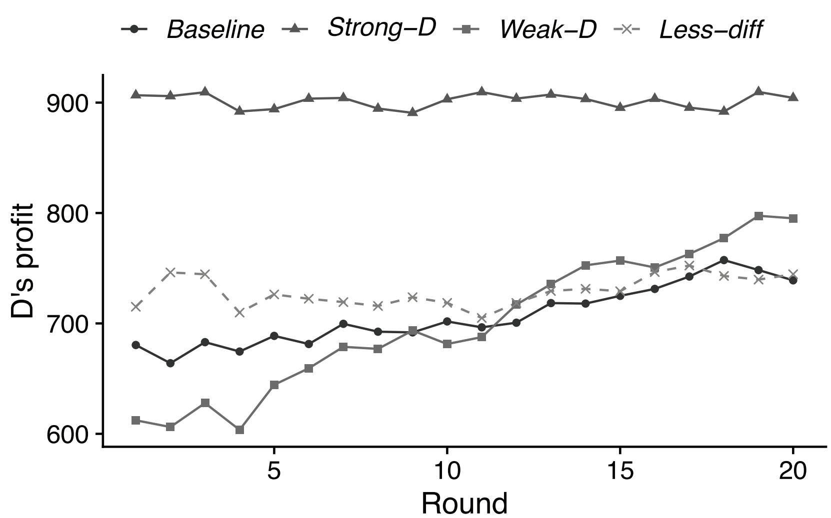

Figure A.1: Transition of *D*'s overall average payoffs

Transition of overall average payoffs (U)

Figure A.2 presents the transition of U's overall average payoffs across treatments. In *Baseline* and *Weak-D*, we observe a downward trend in U's average payoffs. This decline can be attributed to stable increases in exclusion rates, as shown in Figure 1 and to the increasing amounts of strictly acceptable offers, detailed in Figure A.4.

Conversely, *Strong-D* and *Less-diff* display moderate upward trends accompanied by substantial fluctuations. These fluctuations are driven by the large disparity in surplus between non-exclusion (600+600+900) and exclusion (1200) outcomes, which amplify the effects of changes in exclusion rates. Despite these fluctuations, the overall upward trend in these treatments is shaped by a balance between an increasing total surplus due to lower exclusion rates and the intensified competition for exclusive offers, which reduces U players' share of the surplus.

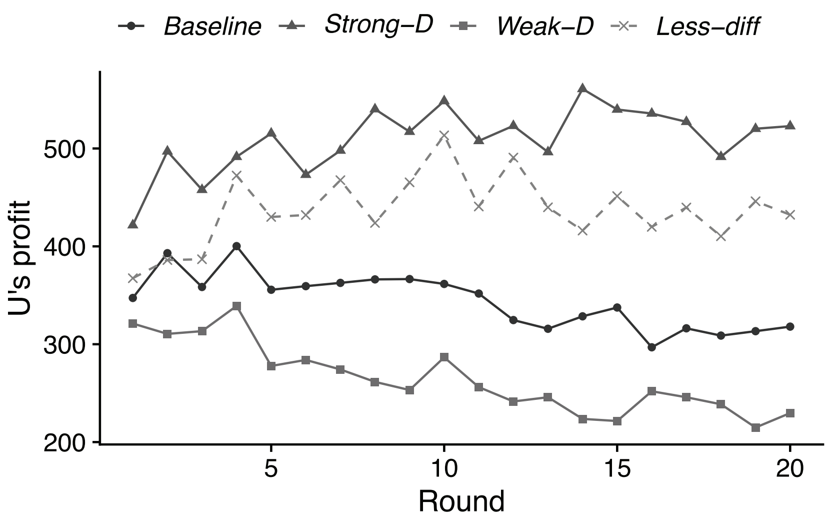

Figure A.2: Transition of U's overall average payoffs

Transition of average payoffs in exclusion (D)

Figure A.3 illustrates the transition of D's average payoffs in exclusion outcomes across four treatments over 20 rounds of play. *Strong-D* shows distinct features with consistently higher payoffs and greater variability compared to other treatments.[25] Meanwhile, *Baseline* and *Less-diff* exhibit steadily increasing payoffs. *Weak-D*, starting with the lowest payoffs, gradually increases over the rounds and eventually aligns closely with *Baseline* and *Less-diff* by the end.

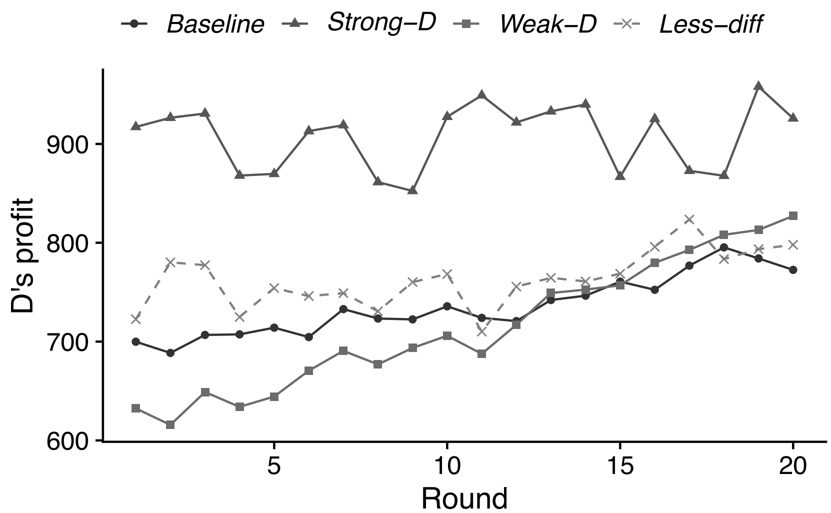

Figure A.3: Transition of D's average payoffs in exclusion

[25] This variability stems from its lower exclusion rates, which lead to a smaller number of observations for averaging, inherently increasing the fluctuation in the reported payoffs. Additionally, the high payoff levels in *Strong-D* are due to the experimental setup, where the non-exclusion payoff for D is set at 900, significantly higher than 700 in *Less-diff* or 600 in *Baseline*.

Transition of average payoffs given acceptable offers (*D*)

Figure A.4 also shows the transition of *D*'s conditional average payoff when either offer received is acceptable. Except for *Strong-D*, the graphs show the similar transition dynamic as in Figure A.3. In *Strong-D*, the cases in which *D* rejected both offers while accepting either weakly yields a higher payoff are also included in the sample.

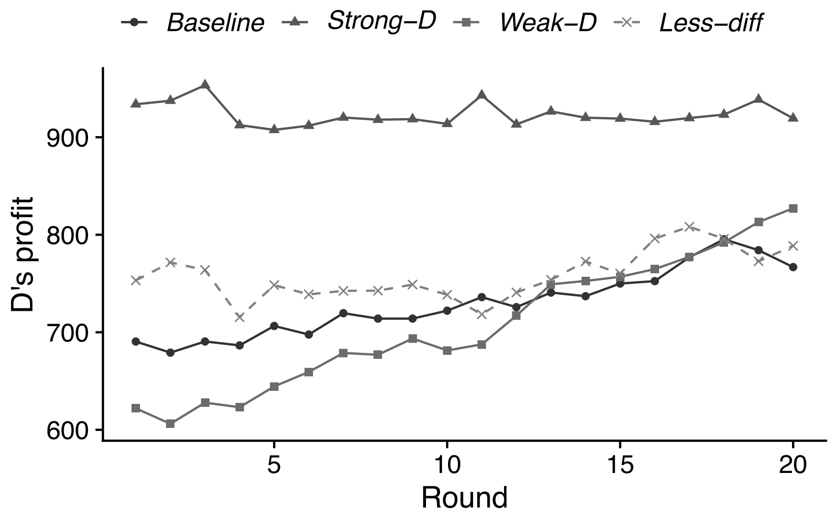

Figure A.4: Transition of *D*'s average payoffs in acceptable cases

Distribution of profits in exclusion (D)

Figure A.5 presents the histograms of D's profit in the exclusion outcomes.

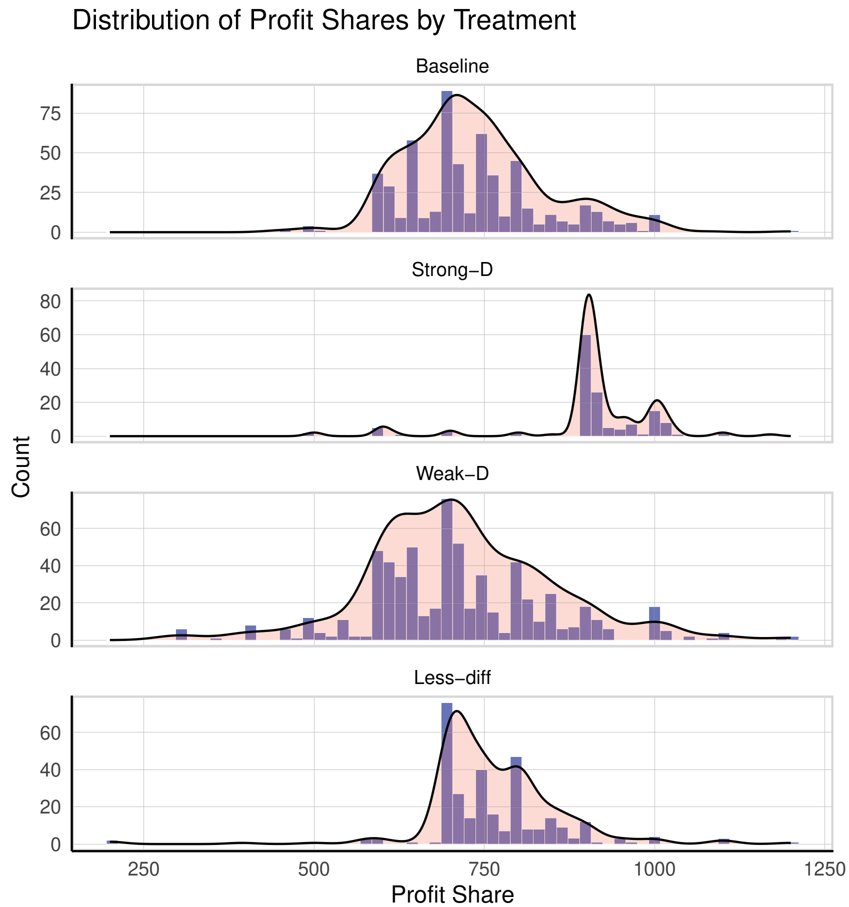

Figure A.5: Histograms of D's Profit in Exclusion Outcomes

Transition of strictly acceptable offers with normalization

To illustrate the qualitative nature of competitive dynamics in exclusive offers, Figure A.6 shows the transition of strictly acceptable offers normalized using z-score standardization.[26] Except for *Strong-D*, which maintains a consistently low rate of such offers, we observe a common trend of increasing offers by players U who made offers above the cutoff intended to exclude their opponents. This pattern highlights a progressive escalation in competitive intensity, with players U consistently attempting higher offers to outbid their competitors.

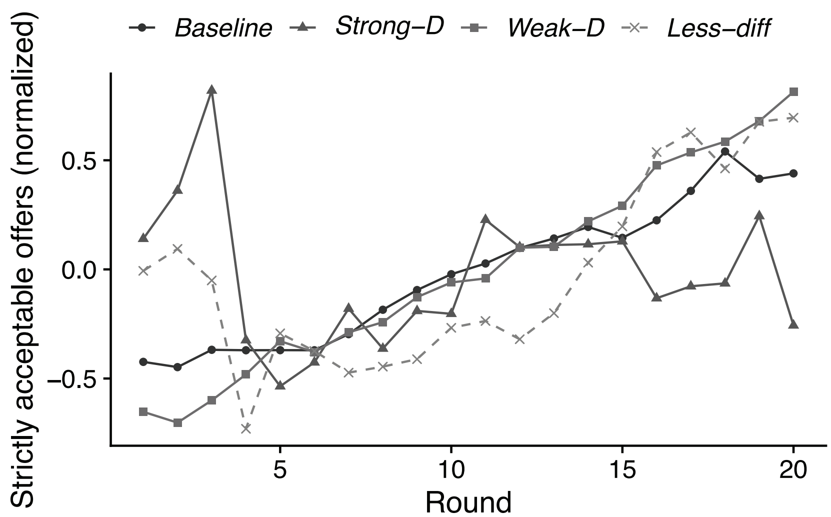

Figure A.6: Transition of strictly acceptable offers (normalized)

[26] Specifically, each offer amount is subtracted from the mean and divided by the standard deviation within each treatment. This method enhances the comparability of trends across different treatments by adjusting for differences in the scale and location of the data points. However, this normalization may mask absolute differences in offer levels between treatments and does not reflect the speed of change in offers, focusing instead on relative positioning within each treatment.

Test of the treatment differences in acceptable offers

Table A.1 shows that the difference in the likelihood that acceptable exclusive offers are made between *Baseline* and *Strong-D* is statistically significant, based on the Mann-Whitney U test at 1% significance level.

The difference in the likelihood that acceptable exclusive offers are made between two treatments is statistically significant at 1 % level (see Table A.1); players *U* in *Weak-D* made acceptable exclusive offers with higher frequency than those in *Baseline*.

Moreover, Table A.1 shows that the difference in the likelihood that acceptable exclusive offers are made between *Baseline* and *Less-diff* is statistically significant, based on the Mann-Whitney U test at 1% significance level.

Table A.1: Pairwise Wilcoxon test on difference in ratios of acceptable offers

group1	group2	n1	n2	statistic	p	p.signif
Baseline	*Strong-D*	72	72	4526.5	0.000000	***
Baseline	*Weak-D*	72	66	1566.5	0.000323	***
Baseline	*Less-diff*	72	66	3254.5	0.000161	***

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.2: Pairwise Wilcoxon test on difference in ratios of strictly acceptable offers

Control	Treatment	n1	n2	statistic	p	p.signif
Baseline	*Strong-D*	72	72	4572.5	0.00e+00	***
Baseline	*Weak-D*	72	66	1255.0	1.10e-06	***
Baseline	*Less-diff*	72	66	3371.5	2.04e-05	***

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Manufacturers responses in different categorization

Table A.3 provides manufacturers' responses to their experiences under the categorization in which acceptable exclusive offers are made to aim to exclude the rival manufacturer.

Table A.3: Response to experiences (focus on acceptable offers)

			Observed response		
Experience	Treatment	Obs.	DtoC	no	CtoD
Exclusive-offer competition	Total	2170	0.03	0.97	-
$x_i \geq \hat{x}, x_j \geq \hat{x}$	*Baseline*	764	0.04	0.96	-
	Strong-D	40	0.025	0.975	-
	Weak-D	982	0.02	0.98	-
	Less-diff	384	0.03	0.97	-
Cooperation in Non-exclusion	Total	1826	-	0.97	0.03
$x_i < \hat{x}, x_j < \hat{x}$	*Baseline*	220	-	0.96	0.04
	Strong-D	1018	-	0.98	0.02
	Weak-D	16	-	0.81	0.19
	Less-diff	572	-	0.98	0.02
Defection	Total	624	0.26	0.74	-
$x_i \geq \hat{x}, x_j < \hat{x}$	*Baseline*	192	0.23	0.77	-
	Strong-D	155	0.34	0.66	-
	Weak-D	128	0.10	0.90	-
	Less-diff	149	0.35	0.65	-
Defected	Total	624	-	0.73	0.27
$x_i < \hat{x}, x_j \geq \hat{x}$	*Baseline*	192	-	0.68	0.32
	Strong-D	155	-	0.86	0.14
	Weak-D	128	-	0.74	0.26
	Less-diff	149	-	0.64	0.36

Tables A.4 and A.5 detail the responses to misaligned experiences based on the exclusion and non-exclusion outcomes.

Table A.4: Response to misaligned experiences (exclusion outcomes)

			Observed response		
Experience	Treatment	Obs.	DtoC	no	CtoD
Defect_exclusion	Total	584	0.28	0.72	-
$x_i > \hat{x}, x_j \leq \hat{x}$	*Baseline*	235	0.26	0.74	-
	Strong-D	76	0.42	0.58	-
	Weak-D	151	0.12	0.88	-
	Less-diff	122	0.41	0.59	-
Defect_non	Total	57	0.18	0.82	-
$x_i > \hat{x}, x_j \leq \hat{x}$	*Baseline*	16	0.19	0.81	-
	Strong-D	15	0.20	0.80	-
	Weak-D	7	0.14	0.86	-
	Less-diff	19	0.16	0.84	-
Defected_exclusion	Total	584	-	0.69	0.31
$x_i \leq \hat{x}, x_j > \hat{x}$	*Baseline*	235	-	0.67	0.33
	Strong-D	76	-	0.80	0.20
	Weak-D	151	-	0.70	0.30
	Less-diff	122	-	0.66	0.34
Defected_non	Total	57	-	0.84	0.16
$x_i \leq \hat{x}, x_j > \hat{x}$	*Baseline*	16	-	0.75	0.25
	Strong-D	15	-	1.00	0.00
	Weak-D	7	-	1.00	0.00
	Less-diff	19	-	0.74	0.26

Table A.5: Response to misaligned experiences (exclusion outcomes: acceptable)

			Observed response		
Experience	Treatment	Obs.	DtoC	no	CtoD
Defect_exclusion	Total	501	0.27	0.73	-
$x_i \geq \hat{x}, x_j < \hat{x}$	*Baseline*	168	0.24	0.76	-
	Strong-D	103	0.40	0.60	-
	Weak-D	118	0.10	0.90	-
	Less-diff	112	0.38	0.62	-
Defect_non	Total	123	0.20	0.80	-
$x_i \geq \hat{x}, x_j < \hat{x}$	*Baseline*	24	0.125	0.875	-
	Strong-D	52	0.21	0.79	-
	Weak-D	10	0.10	0.90	-
	Less-diff	37	0.24	0.76	-
Defected_exclusion	Total	501	-	0.69	0.31
$x_i < \hat{x}, x_j \geq \hat{x}$	*Baseline*	168	-	0.67	0.33
	Strong-D	103	-	0.81	0.19
	Weak-D	118	-	0.73	0.27
	Less-diff	112	-	0.57	0.43
Defected_non	Total	123	-	0.90	0.10
$x_i < \hat{x}, x_j \geq \hat{x}$	*Baseline*	24	-	0.79	0.21
	Strong-D	52	-	0.98	0.02
	Weak-D	10	-	0.90	0.10
	Less-diff	37	-	0.86	0.14

Instructions for "Manufacturers' Dilemma Falling into Exclusive-Offer Competition: A Laboratory Experiment"

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March 28, 2025

Abstract

We provide the instruction for the experimental study in Kitamura et al. (2025). We introduce *Baseline* Treatment in Section 4, *Weak-D* Treatment in Section 5, *Strong-D* Treatment in Section 6, and *Less-diff* Treatment in Section 7.

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.

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- At the end of the experiment, please return these instructions to the experimenter.

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 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.

4 Specific for *Baseline* Treatment

4.1 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

4.2 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:
This means:

- When B rejects both $A1$ and $A2$'s offers,
  - $A1$'s round payoff is equal to 750.

	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

- $A2$'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).

5 Specific for *Weak-D* Treatment

5.1 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 1200 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	$0 \leq X1 \leq 1200$
$A2$	Stage 1	$0 \leq X2 \leq 1200$
B	Stage 2	Accept $A1$'s offer, Accept $A2$'s offer, Reject both offers

Table 3: Choice of each player

5.2 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:
This means:

- When B rejects both $A1$ and $A2$'s offers,
  - $A1$'s round payoff is equal to 900.

	If B accepts $A1$'s offer	**If B accepts $A2$'s offer**	**If B rejects both offers**
$A1$	$1200 - X_1$	0	900
$A2$	0	$1200 - X_2$	900
B	X_1	X_2	300

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

  - $A2$'s round payoff is equal to 900.
  - B's round payoff is equal to 300.

- When B accepts one of the offers made by Players A,
  - The round payoff of Player A whose offer is accepted is equal to 1200 – (his/her offer.)
  - The round payoff of Player A whose offer is rejected is equal to 0.
  - B's round payoff is equal to accepted Player A's offer.

6 Specific for *Strong-D* Treatment

6.1 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 800 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	$0 \leq X1 \leq 800$
$A2$	Stage 1	$0 \leq X2 \leq 800$
B	Stage 2	Accept $A1$'s offer, Accept $A2$'s offer, Reject both offers

Table 5: Choice of each player

6.2 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:
This means:

- When B rejects both $A1$ and $A2$'s offers,
  - $A1$'s round payoff is equal to 600.

	If B accepts $A1$'s offer	**If B accepts $A2$'s offer**	**If B rejects both offers**
$A1$	$800 - X_1$	0	600
$A2$	0	$800 - X_2$	600
B	$400 + X_1$	$400 + X_2$	900

Table 6: Relationship between B's decision and each player's round payoffs

- $A2$'s round payoff is equal to 600.
- B's round payoff is equal to 900.

- When B accepts one of the offers made by Players A,
  - The round payoff of Player A whose offer is accepted is equal to 800 − (his/her offer.)
  - The round payoff of Player A whose offer is rejected is equal to 0.
  - B's round payoff is equal to 400 + (accepted Player A's offer).

7 Specific for *Less-diff* Treatment

7.1 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	$0 \le X1 \le 1000$
$A2$	Stage 1	$0 \le X2 \le 1000$
B	Stage 2	Accept $A1$'s offer, Accept $A2$'s offer, Reject both offers

Table 7: Choice of each player

7.2 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:
This means:

- When B rejects both $A1$ and $A2$'s offers,
  - $A1$'s round payoff is equal to 625.

	If B accepts $A1$'s offer	If B accepts $A2$'s offer	If B rejects both offers
$A1$	$1000 - X_1$	0	625
$A2$	0	$1000 - X_2$	625
B	$200 + X_1$	$200 + X_2$	700

Table 8: Relationship between B's decision and each player's round payoffs

- $A2$'s round payoff is equal to 625.
- B's round payoff is equal to 700.

- 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).

References

Kitamura, H., Matsushima, N., Sato, M., and Tamura, W., 2025. Manufacturers' Dilemma Falling into Exclusive-Offer Competition: A Laboratory Experiment. ISER Discussion Paper 1281, Institute of Social and Economic Research, Osaka University.