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Exclusive contracts and multihoming agents in two-sided markets*

Fuyuki Saruta†

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Abstract

We investigate a two-sided market model in which two platforms compete for sellers and buyers who can participate in multiple platforms (*multihoming*), and one of the two platforms can make exclusive contracts with sellers. The platform faces a trade-off when it enters into exclusivity agreements with sellers, which gives it an advantage when competing for buyers but reduces its revenue from the seller side. In addition, we expect that the existence of multihoming buyers weakens the platform's incentive to have an exclusive contract with sellers. Even when buyers can multihome, does a platform have an incentive to make exclusive contracts with sellers? If so, how does exclusive dealing affect social welfare? We obtain the following results. First, in equilibrium, the platform makes exclusive contracts with all sellers or not at all. If sellers' network externality on buyers is sufficiently large (small), it chooses fully exclusive dealing (nonexclusive dealing). Second, exclusive dealing is preferable (detrimental) to social welfare when the network externality is sufficiently large (small). Exclusive dealing encourages the multihoming of buyers, which allows agents to have more interactions on one platform and prompts more buyers to obtain stand-alone benefits from multiple platforms.

Keywords: Exclusive contracts, Two-sided markets, Multihoming, Platform competition.

JEL Classification: D43, D62, L13, L14

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1 Introduction

Competition policy for giant platform companies, such as Amazon and Google, is of interest to practitioners and researchers.[1] Such companies provide services that are essential to our daily lives and have a substantial dominance in markets. To consolidate their dominant position, platforms use a variety of conducts, one of which is exclusive contracts. Exclusive contracts or exclusivity requirements are traditional practices that have been observed not only in platform markets but also in conventional vertically related markets. In the contracts, a (dominant) firm prohibits its counterparties or customers from dealing with its rival firms in order to take advantage of competition. Examples of exclusive supply of goods in platforms include applications available on either Windows or Mac, game software that is only available on certain game consoles, artists who only distribute their music through certain music subscription services, and restaurants that only deal with certain delivery services.[2]

The impact of exclusive dealing on competition and welfare has long been an important topic in economics. First, in a simple vertically related market setting, the Chicago School (see Posner, 1976 and Bork, 1978) argued that exclusive contracts need not be of concern because they cannot prevent the entry of a more efficient entrant. Since then, many studies have challenged or supported that claim.[3] Armstrong and Wright (2007) is the pioneering work that examines exclusive dealing in a two-sided market model. They find that exclusive contracts have a significant impact on market outcomes in two-sided markets. First, exclusive contracts may improve welfare by bringing agents together on a single platform and allowing them to enjoy more interactions. When the degree of differentiation between platforms is small, exclusive contracts are welfare-enhancing. Second, whether agents can participate in multiple platforms or not will change the welfare consequences. In particular, in a competitive bottleneck setting, Armstrong and Wright (2007) show that exclusive contracts influence the distribution of the surplus dramatically; exclusive contracts improve the surplus of agents on the potential multihoming side (say seller side) who are fully exploited without exclusive agreements and diminish that of the singlehoming side (say buyer side).

[1]The application of economics to the regulation of platforms is discussed in, e.g., Evans and Schmalensee (2015) and Katz (2019).

[2]Examples of exclusive dealing in two-sided markets are introduced in Carroni et al. (2021). The legal cases in which exclusivity agreements have been dealt with are summarized in chapter 5 in OECD (2018).

[3]For more recent studies on exclusive contracts, see, e.g., Calzolari and Denicolò (2013, 2015), Kitamura et al. (2018), and Liu and Meng (2021).

Although exclusive contracts in two-sided markets and their effect on welfare have been analyzed since Armstrong and Wright (2007), the case where agents on both sides can multihome has not yet been explored. This paper aims to fill this gap by studying a platform's optimal choice regarding the number of sellers to offer exclusive contracts under assumptions under which (i) both sellers and buyers can multihome, and (ii) platforms are differentiated both from sellers' and buyers' points of view.

These two assumptions are crucial elements of our model. First, we allow agents on both sides to participate in multiple platforms. Most previous studies on exclusive contracts in two-sided markets adopt a competitive bottleneck setting, in which platforms offer exclusive contracts to sellers who can join multiple platforms, and buyers choose one platform to join. However, in reality, there are increasingly more markets where multihoming is possible on the buyer side as well as the seller side. Consumers may have apps for both delivery services Uber Eats and DoorDash on their smartphones, they may subscribe to both video streaming sites, Prime video and Netflix, buy both Nintendo and Sony game consoles, and own both Mac and Windows computers. Second, we assume platforms are differentiated from sellers' points of view in addition to those of buyers. In previous studies, sellers regard platforms as undifferentiated, and this intensifies the competition for sellers between platforms. However, in practice, game software developers will choose game consoles that have appropriate and preferable performance for each software, and restaurants will recognize the value of tools (e.g., apps that deal with orders and marketing information) available to manage delivery services. These two assumptions may affect the incentive of platforms to make exclusive contracts. Specifically, both appear to make exclusive contracts less attractive for platforms because the demands of sellers and buyers are now less elastic. We analyze whether platforms will still implement exclusive dealing in such a situation and the impact on social welfare.

Under these assumptions, we consider the following three-stage game. In the first stage, one of the two competing platforms presents an offer of an exclusive contract to an arbitrary number of sellers, and the sellers who receive the offer decide whether to accept or decline it. In the second stage, the platforms set participation fees to sellers not under exclusive contracts, and they decide which platform(s) to join. In the third stage, the platforms set participation fees to buyers, and they decide the platform(s) to join.

We specify the platform's optimal choice regarding the number of sellers to which it offers exclusive contracts. We also identify the conditions under which a platform makes exclusive contracts. Our findings are as follows. First, a platform can enter into exclusive agreement contracts with all sellers (*fully exclusive dealing*) or none at all (*nonexclusive dealing*). It chooses fully exclusive dealing when the indirect network externality on buyers is large and nonexclusive dealing when small. When it is mid-level, the platform's choice depends on the intrinsic benefits from joining platforms that buyers and sellers obtain. If sellers' intrinsic benefit is relatively low and that of buyers is relatively high, fully exclusive dealing is implemented. If the converse is true, then nonexclusive dealing is selected. This implies that a platform offers exclusive contracts to all sellers if the revenue from the buyer side is expected to be somewhat higher than the revenue from the seller side; otherwise, it will not offer any exclusive contacts.

We also demonstrate that full exclusivity may increase both total surplus and consumer surplus compared with nonexclusive dealing. Specifically, when the indirect network externality on buyers is relatively large, the total surplus and consumer surplus are improved by fully exclusive dealing. The mechanism for welfare-enhancing exclusivity is as follows. When exclusive dealing is introduced, and all sellers are gathered on one platform, more buyers select multihoming. As a whole, the platform mediates more interactions between the two sides and generates more network benefits and intrinsic values. Of course, it may also increase total transportation costs and raise prices on the buyers' side. If sellers' network externality on buyers is sufficiently large, then the welfare-enhancing effects outweigh the detrimental effects in terms of total surplus as well as consumer surplus, and vice versa.

The remainder of the paper proceeds as follows. Section 1.1 surveys the related literature. Section 2 introduces our settings. Section 3 analyzes the game and shows the results. Section 4 explores the impact of exclusive dealing on consumer surplus and social welfare. Section 5 offers concluding remarks.[4]

1.1 Related Literature

This paper mainly relates to two strands of the literature. The first concerns exclusive dealing/contracts in two-sided markets.[5] By developing the model of seminal works on two-sided markets (Armstrong, 2006; Caillaud and Jullien, 2001, 2003; Rochet and Tirole, 2003,

[4]The Mathematica file that includes all equilibrium results and mathematical proofs is available upon request.

[5]Some empirical studies deal with exclusive dealing in two-sided markets (Corts and Lederman, 2009; Landsman and Stremersch, 2011; Lee, 2013). For example, Lee (2013) estimates that the ban on exclusive dealing would increase hardware and software sales and improve consumer welfare.

2006), the achievability of exclusive dealing in two-sided markets and its welfare impacts have been examined in several papers. First, Armstrong and Wright (2007), adopting the competitive bottleneck model of Armstrong (2006), show that exclusive contracts enable a platform to attract all agents who can potentially multihome and foreclose its rival platform. They conclude that exclusive contracts reverse the welfare consequence in the competitive bottleneck equilibrium; agents on the potential multihoming side gain all the surplus. On the other hand, agents on the singlehoming side are fully extracted in the equilibrium of the exclusive contracts. Armstrong and Wright (2007) assume that platforms utilize price structures to induce exclusivity on agents; platforms set outrageous prices for multihomers and set reasonable prices for singlehomers.

Hagiu and Lee (2011) and Chica and Tamayo (2021) also assume this indirect manner of exclusive contracts and analyze exclusive dealing in two-sided markets. Chica and Tamayo (2021) construct a model where there are $n \geq 2$ differentiated platforms competing for sellers and buyers who have random utility functions. Notably, they show that, to soften the competition, platforms offer nonexclusive contracts to some sellers in addition to offering exclusive agreements to others in equilibrium. This is the opposite result to ours, where nonexclusive contracts or fully exclusive contracts are chosen in equilibrium. The direct manner of exclusive contracts is assumed in Brühn and Götz (2018) and Chowdhury and Martin (2017). Brühn and Götz (2018) allow one of two platforms to make exclusive offers to endogenous numbers of sellers before platforms move to pricing stages, which corresponds to our setting. They reveal that exclusive contracts are profitable for the platform that can offer them and detrimental to social welfare when competition between platforms is intense. The present paper differs from theirs in that we assume platforms charge fees on both sides of the market, whereas they assume buyers can join platforms for free.

The above papers assume that agents on one side multihome and agents on the other side singlehome. Doganoglu and Wright (2010) allow both sides to multihome, and show that exclusive contracts enable an incumbent to foreclose a more efficient entrant. They assume there is no horizontal differentiation between platforms and buyers do not derive stand-alone utility from platforms. Therefore, when the incumbent corrals the sellers, the buyers do not have any incentive to participate with the entrant. Some papers examine exclusive dealing allowing multihoming on both sides and the differentiation between platforms (Carroni et al., 2021; Choi, 2010; Ishihara and Oki, 2021). Choi (2010) assumes the amount of exclusive content and multihoming content on each platform is exogenously given. Carroni et al. (2021) and Ishihara and Oki (2021) endogenize the content providers' choice regarding their exclusive dealing; however, Carroni et al. (2021) focus on exclusive provision of popular content, and Ishihara and Oki (2021) analyze the monopoly content provider's incentive to supply its content exclusively to platforms. We complement these papers by examining a platform's decision on how many sellers to which it offers exclusive contracts. We contribute to the literature by characterizing the optimal choice and its welfare impact with the magnitude of network externalities and stand-alone benefits of platforms.

The second strand comprises papers on the effect of agents' multihoming on competition and welfare in two-sided markets (Athey et al., 2018; Bakos and Halaburda, 2020; Belleflamme and Peitz, 2019; Bryan and Gans, 2019; Liu et al., 2020). The present paper applies the partial multihoming equilibrium of Bakos and Halaburda (2020) to a two-sided market model where sellers and buyers arrive sequentially. The result of Bakos and Halaburda (2020) that the prices to both sides are positive in the partial multihoming equilibrium is also true in our model. Moreover, their partial multihoming equilibrium eliminates the dependency between strategic variables of two platforms, which also simplifies the derivation of equilibrium. Belleflamme and Peitz (2019) compare the price structure when agents on both sides singlehome with that when buyers singlehome and sellers partially multihome. They find that the sellers' shift from partial multihoming to singlehoming may be beneficial to buyers and harmful to sellers. They also show that platforms have incentives to induce sellers to singlehome when their intrinsic utility to join platforms is low. In our paper, exclusive contracts on the seller side may be preferable to buyers even though prices to buyers are raised. Exclusivity on the seller side urges buyers to multihome, and this may benefit buyers because they enjoy more interactions with sellers in addition to stand-alone benefits from multiple platforms.

2 Model

Consider a market where two platforms intermediate interactions between agents from two sides, $k = \{s, b\}$: the seller side and the buyer side. Each platform $i = \{1, 2\}$ sets fixed participation fees p_i to the seller side and q_i to the buyer side. Sellers and buyers are uniformly distributed respectively along a Hotelling line whose length is one, at the two extreme points of which two platforms are located; platform 1 is located at point 0 of the Hotelling line, and platform 2 is located at point 1.

We allow sellers and buyers to join both platforms (multihoming) in addition to joining only one platform (singlehoming). An agent of side k located at $x \in [0,1]$ obtains a surplus from participating in platform 1 or 2 only, or both, which are respectively

$$\begin{cases} u_k^1 = v_k + \beta_k(n_{1l} + n_{Ml}) - t_k x - f_{1k}, \\ u_k^2 = v_k + \beta_k(n_{2l} + n_{Ml}) - t_k(1-x) - f_{2k}, \\ u_k^M = (1+\theta_k)v_k + \beta_k(n_{1l} + n_{2l} + n_{Ml}) - t_k - (f_{1k} + f_{2k}), \end{cases} \tag{1}$$

where, v_k (> 0) denotes the stand-alone value, which is common to the two platforms, and $\theta_k v_k$, where $\theta_k \in (0,1)$ is the stand-alone value from a second platform; β_k (> 0) is the network effect that comes from the number of agents who join the other side of the platform; n_{il} denotes the number of side $l \neq k$ agents who join platform i only, and n_{Ml} denotes the number of side $l \neq k$ agents who multihome; t_k (> 0) is the transportation cost, f_{ik} is participation fee and $f_{is} = p_i$ and $f_{ib} = q_i$. Note that this utility function assumes that there is no "double counting" of the network effect. In other words, the agents cannot gain additional network benefits when they meet the agents on the second platform if they have met the same agents on the first platform. On the other hand, it assumes "partial double counting" of the stand-alone value of platforms; agents who multihome gain the stand-alone benefit multiplied by θ_k on the second platform.

We examine a situation in which platform 1 can present an offer of an exclusive contract to sellers. Once sellers have signed the exclusive contract with platform 1, they cannot participate in platform 2. Usually, a platform might set a special sale price for an exclusive contract or pass on a subsidy. However, for tractability, we fix the price for the exclusive contract at zero. Furthermore, we assume that platform 1 offers exclusive contracts to $\hat{n}$ sellers close to platform 1; sellers on the interval $[0, \hat{n}]$ receive the offer. The profits of platforms 1 and 2 are as follows, respectively,

$$\begin{aligned} \pi_1 &= p_1(n_{1s} - \hat{n} + n_{Ms}) + q_1(n_{1b} + n_{Mb}), \\ \pi_2 &= p_2(n_{2s} + n_{Ms}) + q_2(n_{2b} + n_{Mb}). \end{aligned} \tag{2}$$

We set the timing of the game as follows.

1. Platform 1 presents an offer of an exclusive contract to sellers who are located at

$x \in [0, \hat{n}]$ with a free participation fee. The sellers who receive the offer decide whether to accept or decline it.

2. Platforms 1 and 2 set participation fees, p_1 and p_2, respectively, to sellers not under exclusive contracts. The sellers decide which platform(s) to join.

3. Platforms 1 and 2 set participation fees, q_1 and q_2, respectively, to buyers. Buyers decide which platform(s) to join.

We assume that sellers and buyers visit the market sequentially. This timing is proposed by Hagiu (2006) to illustrate the video game markets. In stage 2, sellers compare utilities of joining platform 1, 2, and multihoming with each other given their expectations of the number of buyers on each platform. We assume that their expectations are fulfilled in equilibrium.

3 Analysis

We focus on the equilibrium where partial multihoming exists on the buyer side. We also focus on cases in which, thanks to the stand-alone value, v_b, even if platform 1 enters into exclusive contracts with all sellers in stage 1, platform 2 can still make a profit if it can acquire buyers. We solve the game by backward induction.

3.1 Stage 3

Given the number of sellers on each platform, n_{1s}, n_{2s}, and n_{Ms}, and participation fees to buyers, q_1 and q_2, we first consider the buyers' participating decisions. We also assume that all sellers are participating in at least one platform. Comparing u_b^1, u_b^2, and u_b^M, we characterize three points where indifferent buyers are located. First, the buyer who is indifferent between joining only platform 1 and multihoming is located at [6]

$$y^{1M}(q_2, n_{2s}) \equiv 1 - \frac{\theta_b v_b + \beta_b n_{2s} - q_2}{t_b}. \tag{3}$$

This y^{1M} is characterized by $u_b^1(y^{1M}) = u_b^M(y^{1M})$. Buyers who are located to the left of y^{1M} prefer joining only platform 1 to multihoming. Second, the buyer who is indifferent

[6] Here, we use y to denote the indifferent buyers because we use x to denote the indifferent sellers in the following section.

Figure 1: Partial multihoming on both sides.

between multihoming and joining only platform 2 is located at

$$y^{M2}(q_1, n_{1s}) \equiv \frac{\theta_b v_b + \beta_b n_{1s} - q_1}{t_b}. \tag{4}$$

Similarly, this is derived from $u_b^M(y^{M2}) = u_b^2(y^{M2})$. Third, the buyer who is indifferent between joining only platform 1 and joining only platform 2 is located at

$$y^{12}(q_1, q_2, n_{1s}, n_{2s}) \equiv \frac{1}{2} - \frac{(\beta_b n_{2s} - q_2) - (\beta_b n_{1s} - q_1)}{2t_b}, \tag{5}$$

which is characterized by $u_b^1(y^{12}) = u_b^2(y^{12})$. Partial multihoming arises on the buyer side when $0 < y^{1M} \leq y^{12} \leq y^{M2} < 1$. If this condition holds, buyers who are located at $y \in [0, y^{1M}]$ participate in only platform 1, buyers at $y \in [y^{1M}, y^{M2}]$ participate in both platforms, and buyers at $y \in [y^{M2}, 1]$ participate in only platform 2, which is illustrated in Figure 1. Therefore, $n_{1b} = y^{1M}$, $n_{Mb} = y^{M2} - y^{1M}$ and $n_{2b} = 1 - y^{M2}$.

Next, we consider the platforms' pricing decisions for buyers. The two platforms set q_1 and q_2, respectively. Each platform tries to maximize its profit; their maximization problems are

$$\begin{aligned} \max_{q_1} \ \pi_1 &= p_1(n_{1s} - \hat{n} + n_{Ms}) + q_1\{y^{M2}(q_1, n_{1s})\}, \\ \max_{q_2} \ \pi_2 &= p_2(n_{2s} + n_{Ms}) + q_2\{1 - y^{1M}(q_2, n_{2s})\}, \end{aligned} \tag{6}$$

and the first-order conditions are

$$\frac{\partial \pi_1}{\partial q_1} = \frac{\theta_b v_b + \beta_b n_{1s} - 2q_1}{t_b} = 0, \quad \frac{\partial \pi_2}{\partial q_2} = \frac{\theta_b v_b + \beta_b n_{2s} - 2q_2}{t_b} = 0. \tag{7}$$

Therefore, the optimal prices are

$$q_1(n_{1s}) = \frac{\theta_b v_b + \beta_b n_{1s}}{2}, \quad q_2(n_{2s}) = \frac{\theta_b v_b + \beta_b n_{2s}}{2}. \tag{8}$$

From the first-order conditions and the optimal prices, given the situation of partial multihoming, we confirm that the prices for buyers are proportional only to the number of their own exclusive sellers, n_{is}, and they do not depend on the number of multihoming sellers. Therefore, platforms have an incentive to increase their number of exclusive sellers even if they cannot collect fees from them. Substituting the above prices into (3) and (4) and $n_{1b} = y^{1M}$ and $n_{2b} = 1 - y^{M2}$, we derive the number of buyers on each platform as

$$\begin{aligned} n_{1b}(n_{2s}) &= y^{1M}(n_{2s}) = 1 - \frac{\theta_b v_b + \beta_b n_{2s}}{2t_b}, \\ n_{2b}(n_{1s}) &= 1 - y^{M2}(n_{1s}) = 1 - \frac{\theta_b v_b + \beta_b n_{1s}}{2t_b}, \end{aligned} \tag{9}$$

and $n_{Mb}(n_{1s}, n_{2s}) = 1 - n_{1b}(n_{2s}) - n_{2b}(n_{1s})$. It is notable that $\partial n_{Mb}/\partial n_{1s} = \partial n_{Mb}/\partial n_{2s} = \beta_b/2t_b$. This indicates that the exclusive sellers on each platform prompt buyers to multihome.[7]

3.1.1 Fully exclusive dealing equilibrium

If all sellers sign an exclusive contract with platform 1 in Stage 1, that is $\hat{n} = 1$, then we skip Stage 2 because platforms no longer compete for sellers. We can derive the equilibrium results by substituting $n_{1s} = 1$ and $n_{2s} = n_{Ms} = 0$ into the above prices. We call this equilibrium the *fully exclusive dealing* equilibrium. The prices are

$$q_1^F = \frac{\theta_b v_b + \beta_b}{2}, \quad q_2^F = \frac{\theta_b v_b}{2}, \tag{10}$$

where superscript F denotes the results in fully exclusive dealing equilibrium. The platforms' profits are

$$\pi_1^F = \frac{(\theta_b v_b + \beta_b)^2}{4t_b}, \quad \pi_2^F = \frac{(\theta_b v_b)^2}{4t_b}. \tag{11}$$

In this equilibrium, platform 1 attracts $(\theta_b v_b + \beta_b)/2t_b$ buyers, and platform 2 attracts $(\theta_b v_b)/2t_b$ buyers. Furthermore, because platform 1 incorporates all sellers, it can collect higher participation fees from more buyers due to the network effect, β_b.

3.2 Stage 2

As in the previous subsection, we next consider the sellers' decisions to join platforms and platforms' pricing strategies for sellers. Because $\hat{n}$ sellers have signed the exclusive

[7] This characteristic is in keeping with what is stated by Ishihara and Oki (2021).

contract with platform 1, the two platforms compete for sellers located at $x \in (\hat{n}, 1]$ in Stage 2. As in the buyers' case, we specify three indifferent sellers by comparing u_s^1, u_s^2, and u_s^M. The seller who is indifferent between joining only platform 1 and multihoming is located at

$$x^{1M} \equiv 1 - \frac{\theta_s v_s + \beta_s n_{2b}^e - p_2}{t_s}. \tag{12}$$

The seller who is indifferent between multihoming and joining only platform 2 is located at

$$x^{M2} \equiv \frac{\theta_s v_s + \beta_s n_{1b}^e - p_1}{t_s}. \tag{13}$$

Finally, the seller who is indifferent between joining only platform 1 and joining only platform 2 is located at

$$x^{12} \equiv \frac{1}{2} - \frac{\beta_s(n_{2b}^e - n_{1b}^e) - (p_2 - p_1)}{2t_s}. \tag{14}$$

In the above equations, n_{ib}^e is the seller's expectation of the number of buyers who join only platform i. We assume that the expectations are fulfilled in equilibrium; $n_{1b}^e = n_{1b}(n_{2s})$ and $n_{2b}^e = n_{2b}(n_{1s})$ in (9).

3.2.1 Nonexclusive dealing equilibrium

First, we consider the case when platform 1 does not have any exclusive contracts with sellers, $\hat{n} = 0$. As well as the buyer side, we focus on the equilibrium in which there is partial multihoming on the seller side, which arises when $0 < x^{1M} \le x^{12} \le x^{M2} < 1$. At that time, we derive n_{1s}, n_{2s}, and n_{Ms} by substituting $n_{1s} = x^{1M}$ and $n_{2s} = 1 - x^{M2}$. Specifically,

$$\begin{aligned}
n_{1s}^N(p_2) &= x^{1M}(p_2) = \frac{2t_b(t_s - \beta_s + p_2 - \theta_s v_s + \beta_s \theta_b v_b / 2t_b)}{2t_b t_s - \beta_b \beta_s}, \\
n_{2s}^N(p_1) &= 1 - x^{M2}(p_1) = \frac{2t_b(t_s - \beta_s + p_1 - \theta_s v_s + \beta_s \theta_b v_b / 2t_b)}{2t_b t_s - \beta_b \beta_s}, \\
n_{Ms}^N &= 1 - n_{1s}^N(p_2) - n_{2s}^N(p_1).
\end{aligned} \tag{15}$$

The superscript N represents results in a nonexclusive dealing equilibrium. Next, the two platforms solve their profit maximization problems taking (15) as given. Their maximization problems are

$$\max_{p_1}\ \pi_1 = p_1\{1 - n_{2s}^N(p_1)\} + q_1(n_{1s}^N(p_2))\{1 - n_{2b}(n_{1s}^N(p_2))\},$$
$$\max_{p_2}\ \pi_2 = p_2\{1 - n_{1s}^N(p_2)\} + q_2(n_{2s}^N(p_1))\{1 - n_{1b}(n_{2s}^N(p_1))\}. \tag{16}$$

The first-order conditions are

$$\frac{\partial \pi_1}{\partial p_1} = 1 - \frac{2t_b(t_s - \beta_s + 2p_1 - \theta_s v_s + \beta_s\theta_b v_b/2t_b)}{2t_b t_s - \beta_b\beta_s} = 0,$$
$$\frac{\partial \pi_2}{\partial p_2} = 1 - \frac{2t_b(t_s - \beta_s + 2p_2 - \theta_s v_s + \beta_s\theta_b v_b/2t_b)}{2t_b t_s - \beta_b\beta_s} = 0. \tag{17}$$

The best response functions of the two are irrelevant to each other. The equilibrium prices when $\hat{n} = 0$ and the numbers of sellers are as follows.

$$p_1^N = p_2^N = \frac{2t_b(\beta_s + \theta_s v_s) - \beta_s(\beta_b + \theta_b v_b)}{4t_b}, \tag{18}$$

$$n_{1s}^N = n_{2s}^N = \frac{4t_b t_s - \beta_b\beta_s - 2t_b(\beta_s + \theta_s v_s) + \beta_s\theta_b v_b}{4t_b t_s - \beta_b\beta_s}. \tag{19}$$

The equilibrium prices to buyers and the numbers of buyers are

$$q_1^N = q_2^N = \frac{(\beta_b + \theta_b v_b)(4t_b t_s - \beta_b\beta_s) - 2t_b t_s(\beta_s + \theta_s v_s)}{4(2t_b t_s - \beta_b\beta_s)}, \tag{20}$$

$$n_{1b}^N = n_{2b}^N = \frac{(4t_b t_s - \beta_b\beta_s)(2t_b - \beta_b - \theta_b v_b) + 2\theta_s v_s t_b\beta_b}{4t_b(2t_b t_s \beta_b\beta_s)}. \tag{21}$$

The equilibrium profits of platforms are $\pi_1^N = p_1^N(1 - n_{2s}^N) + q_1^N(1 - n_{2b}^N)$ and $\pi_2^N = p_2^N(1 - n_{1s}^N) + q_2^N(1 - n_{1b}^N)$.

3.2.2 Partial exclusive dealing equilibrium

Next, we consider the case when $\hat{n} \in (0, 1)$. In this case, the platforms' pricing problems become slightly complicated. Platform 1 can control x^{M2} through p_1. Depending on the mutual size relationship between x^{M2}, given $\hat{n}$, and $x = 1$, the demand function on the seller side for platform 1 will change. We focus on the equilibrium where $x^{1M} \leq x^{M2}$. As long as $\hat{n} \leq x^{1M} \leq x^{M2}$—we will confirm later that this occurs in the equilibrium—the number of sellers who participate in platform 1 is $n_{1s} + n_{Ms} = 1 - n_{2s}(p_1)$, where

$$n_{2s}(p_1) = \begin{cases} n_{2s}^N(p_1) & \text{if } p_1 \leq \dfrac{2t_b(\beta_s + \theta_s v_s) - \beta_s \theta_b v_b - 2t_b t_s}{2t_b} \equiv \bar{p}_1, \\ 0 & \text{if } \bar{p}_1 < p_1. \end{cases} \tag{22}$$

$\bar{p}_1$ is the price at which $x^{M2} = 1$; in other words, there are nonexclusive sellers on platform 2. Similarly, platform 2 can control x^{1M} through p_2, and the relationship between x^{1M} and $\hat{n}$ affects the demand for platform 2. The number of sellers who participate in platform 2 is $n_{2s} + n_{Ms} = 1 - n_{1s}(p_2, \hat{n})$, where

$$n_{1s}(p_2, \hat{n}) = \begin{cases} \hat{n} & \text{if } p_2 \leq \dfrac{2t_b(\beta_s + \theta_s v_s) - \beta_s \theta_b v_b - 2t_b t_s + \hat{n}(2t_b t_s - \beta_s \beta_b)}{2t_b} \equiv \bar{p}_2, \\ n_{1s}^N(p_2) & \text{if } \bar{p}_2 < p_2. \end{cases} \tag{23}$$

$\bar{p}_2$ is the price at which $x^{1M} = \hat{n}$. Note that platform 2 does not lower p_2 than $\bar{p}_2$ because it cannot gain more sellers from such pricing. We provide the detailed procedures for solving these pricing problems in the appendix. We summarize the subgame equilibrium with given $\hat{n}$ as the following lemma.

Lemma 1

In Stage 2, given $\hat{n}$, platform 1 and platform 2 set their participation fees and the consequent relationship between indifferent points becomes as follows.

- $(p_1, p_2) = (p^*(\hat{n}), p_2^N)$ *and* $\hat{n} < x^{1M} < x^{M2} < 1$ *when* $\hat{n} \in [0, \bar{n}_A)$,
- $(p_1, p_2) = (p^*(\hat{n}), \bar{p}_2)$ *and* $\hat{n} = x^{1M} < x^{M2} < 1$ *when* $\hat{n} \in [\bar{n}_A, \bar{n}_B)$,
- $(p_1, p_2) = (\bar{p}_1, \bar{p}_2)$ *and* $\hat{n} = x^{1M} < x^{M2} = 1$ *when* $\hat{n} \in [\bar{n}_B, 1)$,

where

$$\begin{aligned} p^*(\hat{n}) &\equiv \frac{2t_b(\beta_s + \theta_s v_s) - \beta_s(\beta_b + \theta_b v_b) - \hat{n}(2t_b t_s - \beta_b \beta_s)}{4t_b}, \\ \bar{n}_A &\equiv \frac{4t_b t_s - 2t_b(\beta_s + \theta_s v_s) - \beta_s(\beta_b - \theta_b v_b)}{2(2t_b t_s - \beta_b \beta_s)}, \\ \bar{n}_B &\equiv \frac{4t_b t_s - 2t_b(\beta_s + \theta_s v_s) - \beta_s(\beta_b - \theta_b v_b)}{2t_b t_s - \beta_b \beta_s}. \end{aligned} \tag{24}$$

3.3 Stage 1

In Stage 1, platform 1 determines the number of sellers to whom it will offer exclusive contracts. Sellers who sign the agreement can join platform 1 for free. Each seller has no incentive to decline the offer of an exclusive contract unless they are offered a negative price in Stage 2.

From Lemma 1, the profit of platform 1 varies with $\hat{n}$ as follows.

$$\pi_1(\hat{n}) = \begin{cases} p^*(\hat{n})\{1 - n_{2s}(p^*(\hat{n})) - \hat{n}\} + q_1(n_{1s}^N)\{1 - n_{2b}(n_{1s}^N)\} & \text{if } 0 \le \hat{n} < \bar{n}_A \\ p^*(\hat{n})\{1 - n_{2s}(p^*(\hat{n})) - \hat{n}\} + q_1(\hat{n})\{1 - n_{2b}(\hat{n})\} & \text{if } \bar{n}_A \le \hat{n} < \bar{n}_B \\ p^*(\hat{n})\{1 - \hat{n}\} + q_1(\hat{n})\{1 - n_{2b}(\hat{n})\} & \text{if } \bar{n}_B \le \hat{n} \le 1 \end{cases} \tag{25}$$

This profit function is continuous and $\pi_1(0) = \pi_1^N$ and $\pi_1(1) = \pi_1^F$. We use Mathematica and narrow the optimal $\hat{n}$ down to two candidates, $\hat{n} = 0$ and $\hat{n} = 1$. Platform 1's profits are

$$\begin{aligned} \pi_1(0) = \frac{1}{16t_b(2t_bt_s - \beta_b\beta_s)^2}&(2(2t_bt_s - \beta_b\beta_s)(\beta_s(\beta_b + \theta_b v_b) - 2t_b(\beta_s + \theta_s v_s))^2 \\ &+ (2t_b\beta_b(\beta_s + \theta_s v_s) - (4t_bt_s - \beta_b\beta_s)(\beta_b + \theta_b v_b))^2), \end{aligned} \tag{26}$$

$$\pi_1(1) = \frac{(\beta_b + \theta_b v_b)^2}{4t_b}. \tag{27}$$

Hereafter, to characterize platform 1's optimal choice, suppose the two sides are symmetric except for the stand-alone values of platforms and the network benefits per user on the other side; $\beta_s = 1$, $t_b = t_s = 1$, and $\theta_b = \theta_s = 1/2$. We further assume that the rest of the parameters, β_b, v_b, and v_s, take values in which partial multihoming arises on the buyer side in $\hat{n} = 0$ equilibrium and in $\hat{n} = 1$ equilibrium. With these assumptions, we summarize platform 1's choice as Proposition 1.

Proposition 1

Suppose $\beta_s = 1$, $t_b = t_s = 1$, and $\theta_b = \theta_s = 1/2$. If β_b is sufficiently low, then platform 1 does not offer exclusive contracts to sellers (nonexclusive dealing). On the other hand, if β_b is sufficiently high, then platform 1 offers exclusive contracts to all the sellers (fully exclusive dealing). If β_b is mid-level, platform 1 chooses nonexclusivity or full exclusivity depending on v_b and v_s; specifically,

- *if $\beta_b < 5 - \sqrt{21} \simeq 0.42$, then $\hat{n} = 0$ is chosen for all v_b and v_s,*
- *if $\beta_b > 2(\sqrt{2} - 1) \simeq 0.83$, then $\hat{n} = 1$ is chosen for all v_b and v_s,*
- *if $5 - \sqrt{21} \le \beta_b \le 2(\sqrt{2} - 1)$, platform 1 chooses $\hat{n} = 0$ or $\hat{n} = 1$ depending on v_b and v_s, which is illustrated in Figure 2.*

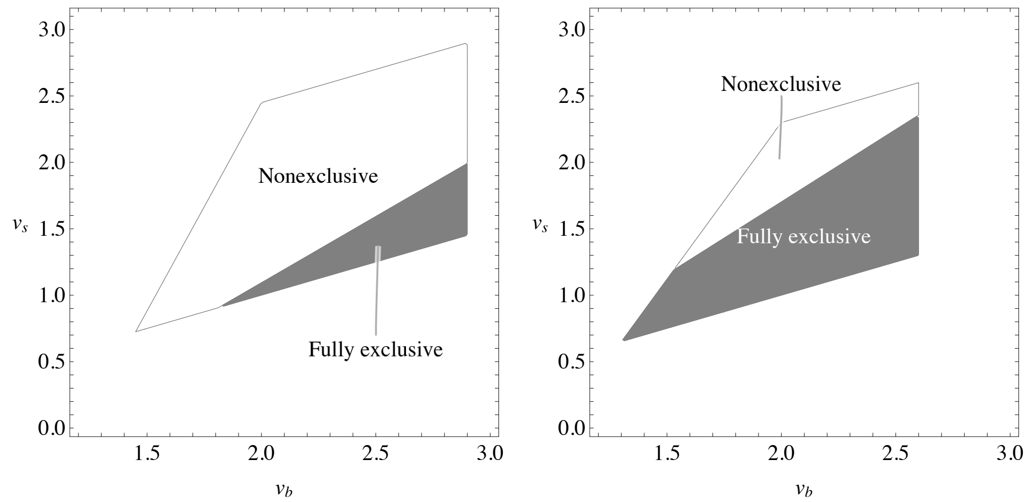

Figure 2: Optimal choices of platform 1 when $\beta_b = 0.55$ (left panel) and when $\beta_b = 0.7$ (right panel).

Fully exclusive dealing always decreases platform 2's profit.

As depicted in Figure 2, fully exclusive dealing is chosen when v_s is low, and v_b is high. This result is intuitive. Low v_s means that platforms cannot generate much revenue on the seller side, and high v_b means that the platforms can generate much revenue on the buyer side. Therefore, platform 1 gives up the revenue on the seller side and surrounds the sellers with free offers to earn the revenue on the buyer side. Sufficiently high β_b is similar to this situation; buyers come to value the number of sellers very strongly and pay high participation fees. In contrast, nonexclusive dealing is selected when v_s is high, and v_b is low. Platform 1 does not want to give up the revenue on the seller side because v_s is high. Moreover, even if platform 1 locks in sellers, it will not be able to make much money on the buyer side with low v_b. Platform 1 realizes that it is better to compete quietly at that time. When β_b is sufficiently low, nonexclusivity is profitable for platform 1 with the same logic.

Platform 2 is always worse-off with fully exclusive dealing: $\pi_2^N > \pi_2^F$. Fully exclusive dealing increases the number of multihoming buyers; however, it decreases the total number of buyers on platform 2. Moreover, it lowers platform 2's price to buyers because of the disappearance of sellers from platform 2. Fully exclusive dealing is harmful to platform 2 compared with nonexclusive dealing.

4 Welfare Analysis

Finally, in this section, we study the effects of exclusive contracts between platforms and sellers on consumer surplus (CS) and total surplus (TS). As in the previous section, we assume $\beta_s = 1$, $t_b = t_s = 1$, and $\theta_b = \theta_s = 1/2$.

First, we break down CS into seller surplus (CS_s) and buyer surplus (CS_b). In nonexclusive dealing equilibrium, these are

$$\begin{aligned} CS_s^N = & \int_0^{n_{1s}^N} \left\{ v_s + \beta_s(1 - n_{2b}^N) - t_s x - p_1^N \right\} dx \\ & + \int_{n_{1s}^N}^{1-n_{2s}^N} \left\{ (1+\theta_s)v_s + \beta_s - t_s - p_1^N - p_2^N \right\} dx \\ & + \int_{1-n_{2s}^N}^{1} \left\{ v_s + \beta_s(1 - n_{1b}^N) - t_s(1-x) - p_2^N \right\} dx, \end{aligned} \tag{28}$$

$$\begin{aligned} CS_b^N = & \int_0^{n_{1b}^N} \left\{ v_b + \beta_b(1 - n_{2s}^N) - t_b y - q_1^N \right\} dy \\ & + \int_{n_{1b}^N}^{1-n_{2b}^N} \left\{ (1+\theta_b)v_b + \beta_b - t_b - q_1^N - q_2^N \right\} dy \\ & + \int_{1-n_{2b}^N}^{1} \left\{ v_b + \beta_b(1 - n_{1s}^N) - t_b(1-y) - q_2^N \right\} dy, \end{aligned} \tag{29}$$

and consumer surplus is $CS^N = CS_s^N + CS_b^N$. Similarly, in fully exclusive dealing equilibrium,

$$CS_s^F = \int_0^{n_{1s}^F} \left\{ v_s + \beta_s(1 - n_{2b}^F) - t_s x \right\} dx, \tag{30}$$

$$\begin{aligned} CS_b^F = & \int_0^{n_{1b}^F} \left\{ v_b + \beta_b(1 - n_{2s}^F) - t_b y - q_1^F \right\} dy \\ & + \int_{n_{1b}^F}^{1-n_{2b}^F} \left\{ (1+\theta_b)v_b + \beta_b - t_b - q_1^F - q_2^F \right\} dy + \int_{1-n_{2b}^F}^{1} \left\{ v_b - t_b(1-y) - q_2^F \right\} dy, \end{aligned} \tag{31}$$

and $CS^F = CS_s^F + CS_b^F$. Comparing these, we derive the following lemma about consumer surplus.

Lemma 2

The surplus of sellers is always improved when platform 1 makes fully exclusive contracts. Moreover, with fully exclusive contracts, the surplus of buyers is improved when $\beta_b > \sqrt{14} - 2 \simeq 1.74$*; and consumer surplus is improved when* $\beta_b < 3 - \sqrt{5} \simeq 0.76$ *or* $\beta_b > \bar{\beta}_b \simeq 1.20$.

The conditions in Lemma 2 are sufficient conditions; they hold for all v_s and v_b. For the range of β_b for which no sufficient condition exists, one example is depicted in the left and center panels of Figure 3. In our model, sellers are always better-off with fully exclusive dealing. With fully exclusive dealing, the decrease in platform 1's price always counteracts the loss of the stand-alone benefits from platform 2.

Remarkably, as well as seller surplus, buyer surplus and consumer surplus might also increase with full exclusivity. There are two separate mechanisms by which exclusive dealing improves consumer surplus. The first is related to the stand-alone values. Full exclusivity increases multihomers on the buyer side and prompts them to enjoy the stand-alone value from two platforms; on the other hand, it prevents sellers from doing so. When v_b is high and v_s is low, the former effect outweighs the latter, and exclusive dealing improves consumer surplus. The second relates to the network benefits. Full exclusivity brings all sellers together and enables buyers to interact with them on one platform. When β_b is high, this effect becomes large, and exclusive dealing is welfare-enhancing. Even though fully exclusive dealing raises platform 1's price and the sum of the two platforms' prices on the buyer side, buyer surplus and consumer surplus can improve when the network benefit or the stand-alone value on the buyer side is high.

Consumer surplus is also improved by full exclusivity when β_b is sufficiently low. This is because when β_b is low, the increase in platform 1's price to buyers becomes moderate. Although the contribution of full exclusivity to the network benefits on the buyer side becomes small, the contribution to the stand-alone values and the increase in seller surplus remain. Therefore, as a whole, consumer surplus improves with full exclusivity even when β_b is sufficiently low.

Finally, we consider the effect of exclusive dealing on total surplus. We define total surplus as the sum of consumer surplus and profits of platforms. Therefore, $TS^N = CS^N + \pi_1^N + \pi_2^N$ and $TS^F = CS^F + \pi_1^F + \pi_2^F$. Comparing these reveals that total surplus increases with fully exclusive contracts when β_b is high and decrease when β_b is low.

Proposition 2

Total surplus is improved with full exclusivity when $\beta_b > \tilde{\beta}_b \simeq 1.14$. On the other hand, total surplus is worse-off when $\beta_b < 2/3$.

The conditions are sufficient conditions, and, if $\beta_b \in (2/3, \tilde{\beta}_b)$, the effect on total surplus depends on v_s and v_b as illustrated in Figure 3. Comparing Figures 2 and 3, we see that v_b (v_s) has a similar effect on platform 1's choice and the optimal choice for total

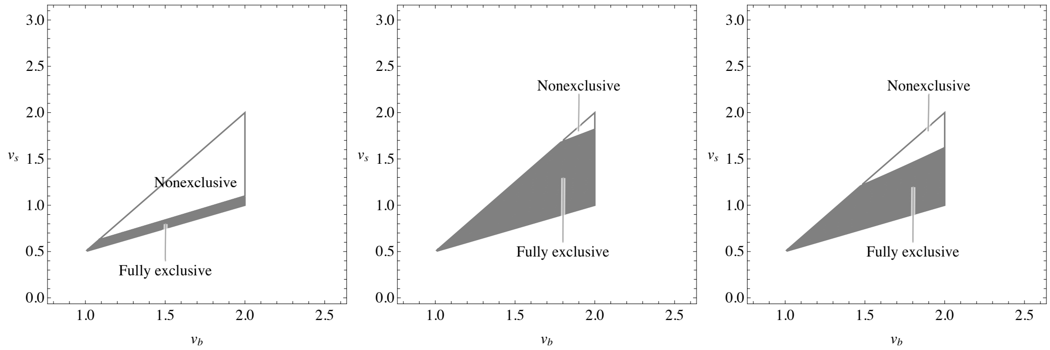

Figure 3: Preferable choices for buyers' surplus (left panel), consumer surplus (center panel), and total surplus (right panel) when $\beta_b = 1$.

surplus. Proposition 1, Lemma 2, and Proposition 2 together demonstrate that when β_b is sufficiently high, full exclusivity is preferable for total surplus and consumer surplus, and is implemented by platform 1 in practice. On the other hand, if β_b is sufficiently low, platform 1 does not make any exclusive contracts, and this selection is not preferable for consumer surplus but is preferable for total surplus.

We have assumed that $\beta_s = 1$. Therefore, Proposition 2 states that if β_b is somewhat higher than β_s, then exclusive dealing is welfare-enhancing; on the other hand, if β_b is sufficiently lower than β_s, exclusive dealing is detrimental to social welfare. Thus, when considering the regulation of exclusive contracts in two-sided markets, it might be an essential perspective that the agents on one side derive more network benefits per agent than those on the other side.

5 Conclusion

In this study, we examine the platform's decision regarding exclusive dealing with sellers and its impact on social welfare in a two-sided market model where multihoming is allowed on both sides. We show that a platform that can choose the number of sellers to whom it offers exclusive contracts will offer exclusive contracts to all sellers or none at all. Which of these strategies the platform chooses depends on several parameters. In previous studies dealing with exclusive contracts in two-sided markets, the choice of exclusive contracts is determined uniquely in the models. We contribute to the literature by characterizing the optimal choice with network effects and stand-alone values on two sides.

Our findings on the impact of exclusive dealing on social welfare have several practical implications. First, a ban on exclusive dealing might harm social welfare as well as consumer surplus. Exclusive dealing on the seller side increases the number of multihomers on the buyer side, leading to more interactions at a single platform. An increase in multihoming buyers itself also improves welfare because they derive stand-alone values from both platforms. Therefore, exclusive dealing may improve social welfare even though it may reduce the rival platforms' profit. The welfare-enhancing mechanism of exclusive dealing in our model differs from those shown in previous studies. Second, giving free rein to platforms may result in preferable consequences regarding social welfare. As expected, platforms would like to make exclusive contracts with more sellers to extract buyers' surplus when buyers greatly appreciate more sellers. This is also welfare-enhancing because buyers enjoy considerable interaction with sellers. On the other hand, when buyers do not acknowledge the value of buyers as much, platforms do not offer exclusive contracts so as to make a profit on the seller side. To make fewer buyers multihoming is efficient at that time.

These results depend on the assumption that there is multihoming on both sides. We must also consider the importance of some assumptions in our model. One is that exclusive contracts have a zero price. Exclusive contracts could be concluded at a discounted positive price or at a negative price (subsidy). We show that a platform makes fully exclusive contracts at a zero fee. Allowing the platform to set the price for exclusive dealing as it likes will contribute to the literature on price discrimination in two-sided markets as well as the literature on exclusive contracts. Another is the assumption that only one platform can make exclusive contracts. Using this assumption, we consider markets where there is a dominant incumbent and a new entrant. However, exclusive dealing can be an effective strategy not only for existing firms trying to block entry, but also for new firms attempting to enter the market. Considering a situation in which many firms can offer exclusive contracts would significantly change the form of competition, but it may be an interesting extension.

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