Preliminary and Incomplete

Exclusive dealing with network effects

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Abstract

This paper explores the ability of an incumbent to use exclusive deals or introductory offers to dominate a market in the face of a more efficient entrant when network effects rather than scale economies are present. When consumers can only join a single firm, the incumbent will make discriminatory offers that are anticompetitive and inefficient. Allowing consumers to multihome, we find offers that only require consumers to commit to purchase from the incumbent are not anticompetitive, while contracts which prevent consumers from also buying from the entrant in the future are anticompetitive and inefficient. The finding extends to two-sided markets, where the incumbent signs up one side exclusively and exploits the other.

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1 Introduction

In existing models of Naked Exclusion such as in Rasmusen *et al.* (1991) and Segal and Whinston (2000), scale economies allow an incumbent to exclude a more efficient rival by signing up customers to deny the rival the necessary scale to profitably enter. This paper provides an example of Naked Exclusion where such scale economies can be completely absent. Instead, our model relies on an incumbent which sells a good subject to network effects. The incumbent can sign up consumers prior to the entry of a rival firm. By attracting a sufficient number of consumers to its network, the incumbent raises the demand for its product from the remaining consumers, thereby denying a more efficient rival the ability to profitably sell to any consumers in head-to-head competition.

This simple logic is extended to take into account that in network markets consumers will often want to multihome, that is buy from both firms so as to obtain greater network benefits. When consumers can multihome, the incumbent may no longer be able to profit just by signing up consumers before the entrant competes with it. Provided it is not too costly to do so, consumers that sign with the incumbent will later also buy from the entrant, which offers a more desirable network. In order that signing up consumers in the initial stage remains profitable for the incumbent, it must instead do so exclusively. Consumers that sign with the incumbent not only have to commit to buy from the incumbent (as in the existing literature on exclusive dealing) but must also agree not to purchase from the entrant as well. Where such contracts are feasible, the incumbent will profitably sign up some of the available consumers, doing so exclusively, and then exploit those that do not sign subsequently. Such exclusive deals raise the incumbent's profit at the expense of the entrant, at the expense of those consumers not offered exclusive deals, and at the expense of efficiency.

Our main finding is that in the absence of significant economies of scale for the entrant or costs to firms of dealing with each customer, contracts in which consumers commit to purchase from the incumbent before the entrant competes in the market do not harm competition or lower welfare, while contracts which prevent consumers from also buying from the entrant in the future are anticompetitive and inefficient. We show this conclusion also holds in a two-sided market setting, where interestingly the incumbent signs up exclusively the side with *greater* network benefits first and then exploits the other side. A ban on the use of such contracts by an incumbent prior to competition from an entrant can raise consumer surplus and welfare. On the other hand, in the presence of competition, so that both firms can offer exclusive deals, such contacts are not harmful.

Throughout the paper we focus on rational consumer expectations that are based on maximum surplus in the case of coordination problems, thereby minimizing the scope for coordination failures amongst consumers. For instance, the coordination failure in the Naked Exclusion literature, in which consumers signing contracts would do better if they could coordinate on an equilibrium where they do not sign does not arise in our setting. Despite this, consumers in aggregate are still worse off as a result of exclusive deals. This reflects the ability of the incumbent to divide consumers' interests, by making an attractive offer to a group of users initially, and then exploiting the remaining users in the subsequent competition game.

Our paper connects with several related literatures. Bernheim and Whinston (1998) explain the general ability of exclusive deals to have anticompetitive effects when cross-market effects are present. Such cross-market effects naturally arise in markets with network effects, since convincing some consumers to commit to purchasing its product, a firm increases the benefit to the remaining consumers from purchasing its product as well. Our analysis highlights the role of limited offers and exclusivity conditions, which the incumbent uses to split the market in order to exploit cross-market effects, as well as the role of multihoming and consumer expectations in determining how exclusive deals work.

When multihoming is assumed to be not possible, exclusive deals can be interpreted as simple purchase commitments or introductory offers. However, these offers differ from the ones studied in the earlier models of introductory pricing in markets with network effects, such as that of Katz and Shapiro (1986). To profitably block sales by a more efficient rival, the incumbent in our model needs to offer discriminatory contracts. The simplest such contract, and the one which is the focus of our study, involves limiting the number of offers made to consumers — for example, on a first-come-first-serve basis. That is, a group of consumers are offered the low price for early purchase (or commitment to purchase), which in turn induces the remaining consumers to buy the incumbent's product in the competition stage, even if, other things equal, the entrant's network is more desirable. In contrast, Katz and Shapiro (1986) assume two different groups of consumers arrive at different times, so that discrimination between consumer groups is exogenously determined in their model.[1] Another difference is they assume both firms can make offers at each stage.

Our analysis without multihoming is also related to Jullien (2001) who endogenizes the choice of price discrimination in markets with network effects, focusing on divide-and-conquer type strategies. He shows this eliminates any inefficiency that might arise in uniform pricing due to expectations favoring one of the firms. We consider the polar case, considering the ability of an incumbent to use price discrimination to block sales by a rival firm that may have an advantage due to having a more desirable network.

None of these papers consider the possibility that consumers may buy from both firms, and therefore ignore the incentive firms may have in using exclusivity in their "exclusive deals" to rule out the possibility of multihoming. Recently, Armstrong and Wright (2006) have considered this aspect but in the context of

[1] Our model can be extended to allow new consumers to enter after the initial offers have been made. Provided there are not too many new consumers for the entrant to attract, the incumbent may still be able to prevent the entrant selling anything even if it cannot limit its introductory offers. However, the incumbent may do even better limiting the number of consumers made offers initially, so as to leave more consumers to exploit in the competition stage.

a symmetric competition game in a two-sided market. Instead, we have the incumbent making its offers first, before competing with the entrant. Another important difference is the expectations assumed. Armstrong and Wright adopt expectations that afford firms with considerable market power. Thus, in the absence of exclusive deals they find a competitive bottleneck equilibrium whereas we obtain an equilibrium more akin to the usual Bertrand competition outcome. These differences explain why they find that exclusive deals may promote efficiency, whereas we obtain the opposite result. Finally, we consider both one-sided and two-sided markets.

There are many examples of exclusive deals that arise in markets with network effects, some of which are discussed in Balto (1999) and Shapiro (1999). A common message arising from their case studies is that the harm from exclusive dealing is amplified in the presence of demand side externalities. Balto gives the example of the money transfer industry and practices of Western Union. Until 1979, Western Union operated as a regulated monopolist in the market for wire money transfers. The system was based on a network of money transfer agents, with agents benefiting from the presence of many other agents which belong to the same network. In 1979, FCC deregulated the industry and allowed entry by other money transfer networks. However successful entry took more than a decade, until the entry of Moneygram, an American Express subsidiary, in the late 1980s. According to Balto, the main reason for such belated entry was the long-term exclusive deals Western Union had in place with some of its agents. The entry attempt by Citibank, in the mid-eighties failed due to impossibility of building a large enough network of agents in the face of the large number of exclusive deals that Western Union had.[2] Thus, it seems that the combination of network effects and exclusive deals may have been a powerful barrier to entry in this industry. Our model provides a formal setting to consider such claims.

The rest of the paper proceeds as follows. Section 2 develops our basic framework. Subsequent sections consider the case of a one-sided market where multihoming is not feasible (Section 3), the case of a one-sided network where multihoming is feasible (Section 4), and the case of a two-sided market where multihoming is feasible (Section 5). Section 6 contains some brief conclusions.

2 The basic model and preliminaries

There are a continuum of consumers with mass normalized to one. Two firms, an incumbent I and an entrant E, can produce the good, each at a cost of $c \geq 0$ per unit sold. The incumbent's price is denoted p while the entrant's price is denoted q. Suppose N_I consumers buy exclusively from I, N_E consumers buy exclusively from E, and the remaining $1 - N_I - N_E$ consumers multihome. Then consumers are assumed to get net utility $v + \beta(1 - N_E) - p$ buying from I only, $v + (\alpha + \beta)(1 - N_I) - q$ buying from

[2] The successful entry of Moneygram may be attributed to its unique advantage as an American Express subsidiary. It could simply rely on the network of travel offices and money order agents of American Express which was already established.

E only, and $v + \alpha(1 - N_I) + \beta - p - q$ if they multihome. Utility is increasing in the number of other consumers buying the same good, but consumers may also get a stand alone benefit v from purchasing which satisfies $v \geq c$. We assume $\alpha > 0$ and $\beta > 0$, so that network effects are positive for both firms and higher for E than I. Due to positive network effects, efficiency is highest when all consumers buy from the same firm, and from a welfare perspective this should be the entrant.

The timing of the game is as follows. In the first stage, I makes an initial offer. Viewing this offer, consumers decide whether to accept the offer or not. Then in the second stage, I and E compete in prices. We have in mind a situation where two rivals are introducing a new network product that they have already developed, but that one firm has a headstart in reaching the market. (As an extension, we consider how our results change when E also faces a fixed entry cost.) Observing the number of consumers that have accepted offers from I in stage 1, the remaining unattached consumers then decide which firm to buy from given these prices. We assume initially that consumers cannot multihome but relax the assumption in Sections 4 and 5.

We denote (generically) I's price in stage 1 with p_X and the corresponding number of consumers accepting its offer n_X. Consumers have the choice of buying from I in stage 1 at p_X, or buying from either I or E in stage 2 at prices p and q. Thus, in the absence of a multihoming possibility, the initial offer can be given the interpretation of an exclusive deal with a price commitment, since it may be that the product is not actually consumed until stage 2. This is why we write p_X for the price in stage 1. Note full price discrimination is ruled out here since firms can only set a single price in a given stage. Rather, the only price discrimination considered is when firms limit their offers to consumers in some way. This arises when the incumbent limits the number of consumers that can take up its first stage offer and when firms make their offers contingent on consumers not also buying from the rival.

The model can be interpreted either as one in which I makes an introductory offer to preempt or influence the nature of any subsequent competition, or that I signs up consumers through exclusive deals to the same effect. However, given we subsequently allow for multihoming, we distinguish these two types of offers. Stage 1 offers require consumers to buy (or commit to buy) I's product and are referred to as introductory offers. When offers, at either stage, also require the consumer to commit not to buy from the rival firm, they are referred to as exclusive deals. Introductory offers may or may not be exclusive deals, while exclusive deals may be offered by I and E in stage 2 (as well as by I in stage 1), if allowed.

As is well known, there are usually multiple consistent demand configurations for any set of prices offered by firms in the presence of network effects. For instance, if all consumers are expected to buy from I in stage 2 then I can attract all demand at a higher price than E. However, at these prices, all consumers buying from E is also an equilibrium, say if consumers all buy from the cheapest firm. Given network effects, the number of consumers that buy from I in stage 1 can influence this set of equilibria in stage 2. Moreover, for given prices in stage 1 and expectations about the equilibrium played in stage 2, there can also be multiple equilibrium configurations in stage 1 depending on what consumers expect others to do in stage 1. This means often a unique demand function is not defined at either stage, and some rule is needed to select a unique demand configuration.

There are three commonly used rules from the literature on network effects.[3] These are often referred to as rules about how consumers form expectations. The three are: (1) expectations (stubbornly) favor firm I; (2) expectations (stubbornly) favor firm E; and (3) expectations are based on maximal surplus. More precisely, the rules correspond to: (1) select the equilibrium demand configuration at each stage which has the highest demand for firm I (and of these, the lowest demand for firm E) where demand refers to the demand from those consumers choosing between the firms; (2) the same as (1) but with I and E switched; and (3) select the equilibrium demand configuration at each point which has the highest joint surplus for those consumers choosing between the firms. Regardless of the rule used, all equilibria are subgame perfect. Throughout we will focus on the third rule since it minimizes the scope for coordination failures amongst those consumers making decisions at each stage. Thus, our analysis is not as vulnerable to the criticism sometimes leveled at the Naked Exclusion literature, that it relies on consumers receiving offers not being able to coordinate on the right equilibrium. In the competition stage, these beliefs also provide the closest analogy to the homogenous Bertrand competition assumed in the existing literature. We sometimes refer to this rule as consumers being "optimal coordinators".

Finally, since there is no natural tie-breaking rule when consumers are optimal coordinators, we adopt the standard approach of using whichever rule is necessary to avoid open set problems in defining equilibria. For instance, if consumers are indifferent between buying from I and E at the prices $p = c$ and $q = c + \alpha$, we assume consumers will buy from E since if not, E could just set a slightly lower price to attract the consumers, obtaining almost the same profit (note I cannot profitably do the same thing). Where there is no such open set problem in defining equilibria, as would be the case in the above example if $\alpha = 0$, we assume indifferent consumers choose E over I, choose to buy from a single firm rather than to multihome, and to buy from at least one firm rather than not buy at all.

3 Results with singlehoming

In this section, we consider one-sided networks and assume that multihoming, whereby consumers can buy from both firms in order to obtain maximal network benefits, is not allowed. Whether multihoming is possible or not, may come down to technical considerations. In some cases it may simply not be feasible for consumers to multihome. In other cases, it may be prohibitively expensive to do so, which will be the

[3] See Farrell and Klemperer (2006) for a discussion of the relevant literature and different rules to describe consumer expectations.

case if c is sufficiently large.[4]

Before turning to our main analysis, consider first what happens when consumers' beliefs instead follow one of the other two rules noted above. If consumers stubbornly prefer buying from I, then its ability to make introductory offers will play no role given it already enjoys expectations that stubbornly favor it and can already extract all of consumers' network benefits from buying from it. The analysis of introductory offers is not interesting under such beliefs. Alternatively, if expectations favor E, then E has considerable market power since in the absence of introductory offers it will extract all of users' network benefits. It can be shown that I can continue to use similar types of offers as those studied below in stage 1 to attract all demand, but that unlike the analysis below, this will lead to an increase in consumer surplus. This reflects that I's ability to use introductory offers in stage 1 helps offset E's market power in stage 2, leading to more symmetric competition and lower prices. By focusing on consumers that are optimal coordinators we are ruling out such a situation.

We start by characterizing the equilibrium in the second stage assuming that n_X consumers buy from I in stage 1.

Lemma 1 *Define $n_1 = \alpha/(\alpha+\beta)$. If $n_X > n_1$, then the incumbent makes all the sales in stage 2 and the equilibrium prices are given by $p = c+\beta n_X - \alpha(1-n_X)$ and $q = c$. If on the other hand, $n_X \leq n_1$, then the entrant makes all the sales in stage 2 and equilibrium prices are $p = c$ and $q = c+\alpha(1-n_X) - \beta n_X$.*

Proof. As can be seen in figure 1, provided $p \leq \beta$ there is a consistent demand configuration in which all unattached consumers buy from I in stage 2, denoted configuration I, and provided $q \leq (\alpha+\beta)(1-n_X)$ there is a consistent demand configuration in which all unattached consumers buy from E, denoted configuration E. (We indicate the region of prices where no one joins either network as configuration $\emptyset$). Subject to prices being in the range where both configurations I and E apply, consumers will buy from I in stage 2 whenever $v+\beta-p > v+(\alpha+\beta)(1-n_X)-q$, or alternatively, when $p < q+\beta n_X - \alpha(1-n_X)$. Consumers will buy from E when $p > q+\beta n_X - \alpha(1-n_X)$. When $p = q+\beta n_X - \alpha(1-n_X)$, consumers are indifferent about which firm to buy from. Provided that $n_X > n_1$, I can charge a price at least as high as E and get all the consumers. As competition will drive E's price to cost, the equilibrium is obtained when $p = c+\beta n_X - \alpha(1-n_X) > c$ and $q = c$ with all consumers buying from I. On the other hand, whenever $n_X < n_1$, E can charge a price that is higher than I's and still serve all the free consumers. In this case, equilibrium is established, when $p = c$ and $q = c+\alpha(1-n_X) - \beta n_X$ with all free consumers buying from E. Finally, if $n_X = n_1$, then both firms will compete price down to cost, with all consumers buying from E given our tie-breaking assumption. ■

[4] Clearly a sufficient condition is that $2c > v+\alpha+\beta$, so that even when consumers only pay the cost of buying from each firm (which is necessary for the firms to break even), the consumers' net surplus is negative.

The critical value of n_X defined in Lemma 1 is the value at which $\beta = (\alpha + \beta)(1 - n_X)$. For higher n_X, consumers get greater network benefits with all joining I than joining E. For lower n_X, E offers greater network benefits even though it has n_X fewer consumers. Whichever firm offers greater total network benefits captures all remaining demand in stage 2. Thus, by signing up enough consumers in stage 1, I can increase its installed base to the point it more than offsets E's advantage. The remaining consumers then prefer to join I over E. If E's network advantage measured by α is small, then I only has to sign up a small proportion of consumers to achieve this point.

Next we turn to stage 1. Consider the benchmark case in which I cannot (or does not) make offers in stage 1. Assuming $n_X = 0$ in Lemma 1 implies E will attract all consumers at a price of $q = c + \alpha$. Reflecting that expectations are neutral between firms, E is only able to extract surplus equal to its network advantage. This leaves consumers with a surplus of $v - c + \beta$. Compare this to the case in which only uniform offers in stage 1 are possible.

Proposition 1 *If consumers are optimal coordinators and the incumbent must make the same offer to everyone in the first stage, everyone buys from entrant in the second stage at the price $q = c + \alpha$. The outcome is efficient. Whether the incumbent can or cannot make introductory offers in stage 1 does not change consumer surplus or welfare.*

Proof. Consumers compare coordinating on I's introductory offer to buying from E in stage 2. If consumers reject I's offer they will get a surplus of $v - c + \beta$ in stage 2 all buying from E. If they accept I's offer they will get a surplus of $v - p_X + \beta$. Thus, they will only accept if $p_X < c$, which leaves I with no profit. Therefore, I will not make any introductory offer. From Lemma 1, E therefore makes all sales in stage 2 at a price of $q = c + \alpha$. Consumers are left with a total surplus of $CS_1 = v - c + \beta$. Since $\alpha > 0$, this is an efficient outcome, and one that does not depend on whether introductory offers can be used or not. ■

Figure 1 around here.

In Proposition 1 the entrant is only able to extract α, its network advantage. This reflects the fact consumer expectations treat the firms in a neutral way. With uniform offers in stage 1, the incumbent can only overturn the attractiveness of higher network benefit offered by the entrant's product in stage 2 by selling to consumers below cost in stage 1. When the incumbent has to make this offer to all consumers, it leaves no consumers to extract surplus from in stage 2, and therefore such introductory offers are not profitable.[5] Instead we get normal Bertrand price competition between firms and the resulting outcome

[5] If instead there were some (but not too many) new consumers in stage 2, then the incumbent could use such introductory offers to take all demand in stage 2, thereby making a positive profit. In other words it would sign up existing consumers, committing them to purchase from it at p_X, and then exploit the new consumers in stage 2.

is efficient. The incumbent can do better by restricting the number of consumers that can sign up in stage 1.

Proposition 2 *If consumers are optimal coordinators and the incumbent can limit the number of consumers buying in stage 1,* $n_X = 1/2 + \alpha/(2\alpha + 2\beta)$ *consumers will buy from the incumbent in stage 1 at the price of* $p_X = c$*, and the rest of the consumers will buy from the incumbent in stage 2 at the price* $p = c + \beta/2$*. The entrant makes no sales. The outcome is inefficient. If the incumbent cannot make limited introductory offers in stage 1, both consumer surplus and welfare will increase.*

Proof. The incumbent sets a price p_X to n_X consumers in stage 1. If they all reject, the second stage equilibrium implies all consumers get utility of $v - c + \beta$ buying from the entrant (I then gets zero profit). If instead the n_X consumers accept the offer, they get $v - p_X + \beta$ buying from I, provided $n_X > n_1$. Thus, I can attract the n_X consumers with minimal loss by setting $p_X = c$. This gives it a profit of $(\beta n_X - \alpha(1 - n_X))(1 - n_X)$, which is maximized by choosing $n_X = 1/2 + \alpha/(2\alpha + 2\beta) > 1/2$. Also note that $n_X > n_1$ so this constraint is not binding. The profit of I following this strategy is given by

$$\pi_I = \frac{\beta^2}{4(\alpha + \beta)} > 0. \tag{1}$$

This is an inefficient outcome given $\alpha > 0$. Moreover, all consumers would be better off if these limited introductory offers were eliminated, in which case the outcome in Proposition 1 would arise. Compared to the case of Proposition 1 in which consumer surplus is $v - c + \beta$, consumers who receive the introductory offer get the same surplus while the surplus of those that miss out is lower by $\beta/2$. Total consumer surplus is

$$CS_2 = v - c + \left(\frac{4\alpha + 3\beta}{4\alpha + 4\beta}\right)\beta < CS_1.$$

■

Proposition 2 shows the incumbent will prevent the efficient entrant from making any sales by selling the product to a majority of consumers at cost in the first stage via introductory offers. In fact, it will sign up more than the minimum number of consumers necessary to do so. This allows the incumbent to raise the willingness to pay from the remaining minority of consumers, making maximum profits in stage 2 by charging a high price to them. To achieve this outcome the incumbent has to compensate the consumers signing for the lower network benefits they get from its inferior network. Although consumers pay a lower price in stage 1, they obtain exactly the same surplus they would have if they bought from the entrant which offers higher network benefits. Nevertheless, the consumers who buy in stage 2 are hurt and lose $\beta/2$ each. This loss aggregated over second stage buyers is transferred to the incumbent as profits as defined in (1).

To restore efficiency, these limited introductory offers could be banned. In the model, this would be achieved by not allowing the incumbent to sell on a discriminatory basis such as limiting the number of consumers that receive any introductory offers. However, in practice the incumbent may find ways to ration demand, so that banning such offers may not be a feasible policy alternative.

While the pricing in Proposition 2 is easy to implement, the incumbent can do even better if it is able to discriminate between individual consumers in stage 1. Such fully discriminatory contracts with externalities have been studied by Segal (2003). To demonstrate how powerful such price discrimination can be, consider the extreme case where the incumbent can make sequential offers to consumers in the first stage. That is, suppose the incumbent can order consumers and make a sequence of offers, one to each consumer, in stage 1. The second stage is modelled as before.

Following the same logic as Segal and Whinston (2000), the incumbent will then be able to attract all consumers at almost the same price as if it enjoys favorable expectations, namely at $p_X = c + \beta$. The first consumer that is made an offer knows that if it rejects, I has a feasible strategy to convince all the remaining consumers to accept its offer. Thus, the first consumer is willing to pay almost $c + \beta$ to sign. In general, assume that incumbent orders the consumers by a variable $t \in [0, 1]$ in an arbitrary way and consider the pricing function of the incumbent for the consumer at t, when y preceding consumers have already accepted the deal that is given by $p_X(t, y) = \max(c, c - \alpha + (\alpha + \beta)(1 + y - t))$. It can be verified that this ensures all consumers agree to sign with the incumbent and gives it the same profits as if expectations favored it. Thus, when sophisticated exclusive deals can be made, the incumbent can obtain the same profits as if expectations favor it, leaving consumers with just the surplus $v - c$.[6]

If consumer surplus is weighted more highly than profits, this is the least desirable outcome from a welfare perspective. However, such complicated sequential contracts seem unrealistic in most applications which is why we focused on just simple limited offers that are easy to implement, and will do so in the remaining sections.

3.1 Fixed costs of entry

Before turning to allow for multihoming we consider one important extension of the analysis above. Our analysis up to this point has assumed that the entrant has no fixed costs of entry. As noted earlier, this can be interpreted as both firms having already developed the product, but that one firm (the incumbent) has a headstart in reaching the market (that is, doing deals with consumers). An alternative situation of interest is that the incumbent also has a headstart in developing the product, so that the entrant

[6] By using a sequence of offers, the incumbent eliminates the problem of multiple consistent demand configurations in stage 1. Thus, it can be shown that the same outcome can be achieved even if expectations favor the entrant, namely with the pricing function $p_X(t, y) = \max\left(c, c + \alpha(y - t) + \beta(1 + 2(y - t))\right)$.

has to decide whether to incur fixed entry costs (product development costs) after the incumbent has already had a chance to sign up consumers. The fact that the entrant may be absent in the second stage will not only alter the behavior of the incumbent in the second stage, but also influence its design of its introductory offers in the first stage.

Formally, we can add an additional (intermediate) period between stage 1 and stage 2 in which E decides whether to enter or not. We assume that entry is costly, that is E has to incur a positive fixed cost of entry, denoted by F. In addition, we restrict our attention to the case where $0 < F < \alpha$ which insures that the efficient outcome would involve entry. Otherwise the model is exactly the same as described in section 2.

Provided entry occurs, the results obtained in Lemma 1 for the second stage equilibria when consumers are optimal coordinators continue to apply. On the other hand, if E does not enter, I will have a monopoly which means it will extract all consumer surplus. Specifically, I charges the monopoly price $p = v + \beta$ and makes sales to all the remaining consumers in stage 2.

Given that E has to incur fixed costs of F and n_X people are already committed to buy from I, the following lemma characterizes E's optimal entry decision.

Lemma 2 *If n_X consumers have signed an introductory offer in stage 1, in the presence of a fixed entry cost F, entry will takes place if and only if*

$$n_X < n_1 - \frac{\sqrt{\beta^2 + 4\,(\alpha+\beta)\,F} - \beta}{2\,(\alpha+\beta)} = n_2 < n_1.$$

Proof. Entry will occur if and only if E is able to make sufficient sales in the second period to cover its fixed costs in stage 1. With entry, its profit is $(1 - n_X)(\alpha(1 - n_X) - \beta n_X) - F$, which is positive if and only if $n_X < n_2$. ■

In the absence of discriminatory offers, the incumbent either has to offer a bribe to all consumers to get them to buy (compensating them for its lower network benefits) or attract no consumers at all. Since offering a bribe to all consumers is not profitable, the incumbent cannot exploit the fact that the entrant needs to attain a minimum scale. The result in Proposition 1 continues to apply. The entrant makes all sales in stage 2 at a price of $q = c + \alpha$. Consumers are left with a total surplus of $v - c + \beta$.

In contrast, if the incumbent can limit its offers in stage 1, it can easily block entry by bribing sufficiently many consumers in the first stage.

Proposition 3 *If consumers are optimal coordinators and the incumbent can limit the number of consumers buying in stage 1, in the presence of a fixed entry cost F, $n_X = n_2$ consumers will buy from the incumbent in stage 1 at the price of $p_X = c$, and the rest of the consumers will buy from the incumbent* *in stage 2 at the monopoly price $p = v + \beta$. Entry is inefficiently foreclosed. Preventing the incumbent from making limited introductory offers in stage 1 will increase both consumer surplus and welfare.*

Proof. The incumbent needs to sell to at least n_2 consumers to block the entry of the rival firm. Any consumer in the first stage would accept I's offer if $p_X = c$. This implies aggregate profits of $(1 - n_X)(v - c + \beta)$, which is a decreasing function of n_X. Hence, I makes its introductory offers to the smallest number of consumers necessary to deter entry; that is, $n_X^* = n_2$. This gives I a monopoly position in stage 2, so it sells to the remaining $1 - n_2$ consumers at the monopoly price $p = v + \beta$. Its profit is

$$\pi_I = (1 - n_2)(v - c + \beta).$$

Since $\alpha > 0$, the foreclosure of entry here is inefficient. Moreover, all consumers would be better off if these limited introductory offers were eliminated, in which case the outcome in Proposition 1 continues to apply. Compared to the case of Proposition 1 in which consumer surplus is $v - c + \beta$, consumers who sign an exclusive deal get (essentially) the same surplus while the surplus of those that miss out is lower by the full amount $v - c + \beta$ (they get no surplus). Total consumer surplus is

$$CS_3 = n_2 (v - c + \beta) < CS_1.$$

■

Compared to the case without fixed costs, the incumbent now signs up fewer consumers. Rather than having to bribe enough consumers in stage 1 so as to be able to attract remaining consumers in stage 2 despite competition with a more efficient entrant, now the incumbent just has to focus on signing up enough consumers to deny the entrant enough profit in stage 2 to cover its fixed cost of entry. Thus, the point of signing up consumers in stage 1 is to reduce the demand for the entrant's product in stage 2, thereby denying it the sufficient scale to recover its fixed costs. This is like the standard Naked Exclusion story without network effects, but network effects magnify this reduction in demand for the entrant's product.

An interesting feature of the result above is that even if the fixed entry cost is very close to zero, the existence of such fixed costs can still matter a lot for the profitability of exclusive deals. First, the maximum number of consumers that have to be bribed is approximately n_2 which is still less than before. This reflects that the objective with $F > 0$ is just to bribe enough consumers to deter entry rather than trying to raise the willingness to pay of second stage consumers by the optimal amount. Second, by deterring entry, the incumbent gains a monopoly position in the second stage, which it can exploit by charging the remaining consumers the full amount of their surplus $v + \beta$. Previously it could only charge them $c + \beta/2$. This feature remains true even as $F \to 0$ so that small entry costs can amplify the impact of exclusive deals when there are network effects. Equivalently, the entry deterring effects of fixed cost in the standard Naked Exclusion story are magnified by network effects, making them more powerful barriers to entry.

4 Multihoming in one-sided markets

In this section, the possibility that the consumers can buy from both firms in order to obtain greater network benefits is considered. This type of behavior is commonly referred to as "multihoming". The implications of multihoming in one and two-sided markets is studied by among others, Armstrong (2006), Caillaud and Jullien (2003), Doganoglu and Wright (2006) and Rochet and Tirole (2003). When consumers multihome they are able to get the network benefits corresponding to interacting with users that can be reached from either network. The rest of the model remains the same, except we assume $v = c = 0$ for simplicity. Provided costs are low enough that multihoming is always a relevant option, the same qualitative results can be obtained allowing for small but positive values of $v > c > 0$.

As before, our focus is on the case in which the incumbent can limit the number of consumers who can obtain the first stage offers. However, unlike the case before, exclusive deals may be used at either stage to rule out multihoming. For example, the entrant can make its offers exclusive in stage 2, so that unattached consumers have to either buy from it or the incumbent, but cannot multihome. Similarly, the incumbent may make its offer exclusive in stage 1 (or stage 2) so as to prevent consumers buying from the entrant if they accept its offer. We maintain the assumption that firms do not set differential prices across consumers at either stage.[7] Instead, these offers just involve an exclusivity condition in which consumers purchasing agree not to also purchase from the rival. Notice as soon as one firm makes its offers exclusive, it rules out consumers multihoming and so the other firm's offer is also, in effect, exclusive.

To provide a benchmark for the effects of exclusive dealing, we first explore what happens when firms cannot offer such contracts to prevent consumers from multihoming. Thus, even if consumers sign with the incumbent in stage 1, they still have the possibility of also buying from the entrant in stage 2. This is the relevant alternative if exclusive deals are banned, although limited introductory offers are still possible.

Proposition 4 *When neither firm can offer exclusive deals at either stage, then no one buys from the incumbent in stage 1 and in stage 2 they all buy from the entrant only, even if the incumbent can limit the number of consumers who can obtain its first stage offers. The outcome is efficient.*

[7] Allowing for price discrimination, exclusive offers can be achieved if a firm set prices contingent on whether consumers buy from it exclusively or from both firms, with a very high price being set in the latter case.

Proof. We first show that in equilibrium, all unattached consumers buy only from E while those consumers who have bought from I multihome, buying also from E in stage 2. This then means I cannot obtain any profit from unattached consumers in stage 2, and since it can only attract consumers in stage 1 at a loss, it will choose not to make any such offers.

Assume that $n_X > 0$ consumers have accepted a non-exclusive offer from I in stage 1. In stage 2, the possible consistent demand configurations involve either all attached and unattached consumers buying from E, the unattached buying from I and the attached not buying from E, or the unattached multihoming and the attached not buying from E. We first characterize the demand as a function of both prices, and then determine the equilibrium prices in stage 2. We restrict to non-negative prices given a negative price will imply a firm makes a loss in stage 2.

Consider, first, a possible consistent demand configuration where all consumers buy from E. We call this configuration E. Given all consumers are expected to buy from E, this requires: $\alpha+\beta-q \geq \beta n_X - p$, which is the condition for an unattached consumer to buy from E rather than buying from I; $\alpha+\beta-q \geq \beta n_X$, which is the condition for an attached consumer to also buy from E rather than singlehome; and $\alpha+\beta-q \geq 0$, which is the condition that buying from E is better than not joining either network. Only the second condition is relevant since if it holds the others will also hold, given $p \geq 0$ in equilibrium. This condition can be written as $q \leq \alpha + (1-n_X)\beta$.

Next, consider a possible consistent demand configuration where the unattached consumers buy from I and the attached consumers do not buy from E. We call this configuration I. Given all consumers expect this pattern of demand, this requires: $\beta - p \geq -q$, which is the condition for an unattached consumer to buy from I rather than buying from E; $\beta \geq -q$, which is the condition for an attached consumer not to also buy from E; and $\beta - p \geq 0$, which is the condition that buying from I is better than not joining either network. Only the third condition is relevant since if it holds the others will also hold, given $q \geq 0$ in equilibrium. This condition can be written as $p \leq \beta$.

Finally, consider a possible consistent demand configuration where the unattached consumers multihome and the attached consumers do not buy from E. We call this configuration M. Given all consumers expect this pattern of demand, this requires among other conditions: $\beta n_X + (\alpha+\beta)(1-n_X) - p - q \geq \beta - p$, which is the condition for an unattached consumer to multihome rather than buy from I; and $\beta \geq \alpha + \beta - q$, which is the condition for an attached consumer not to also buy from E. These two conditions imply $\alpha \leq q \leq \alpha(1-n_X)$ which is a contradiction for $n_X > 0$. As a result configuration M is not a consistent demand configuration and so will never arise.

When both $p \leq \beta$ and $q \leq \alpha + \beta(1-n_X)$, then both configuration I and configuration E are consistent demand configurations. We thus need to use the expectations rule that consumers coordinate on the configuration which gives them highest joint surplus to determine which demand configuration will apply. Under configuration I their joint surplus is $\beta - p(1 - n_X)$, while under configuration E their joint surplus is $\alpha + \beta - q$. Thus, whenever, in addition to the above restrictions on price, $q \leq \alpha + (1 - n_X)p$, then configuration E will apply. When instead $q > \alpha + (1 - n_X)p$, then configuration I will apply. The consistent demand configurations that result from the above rules define demand uniquely for any given prices. We present how demand varies with prices in Figure 2, indicating also the region of prices where no one joins either platform, which we denote as configuration Ø.

Now consider a possible equilibrium in stage 2. Any equilibrium must involve configuration E being played. To see why note that at any point in configuration Ø, either firm has an incentive to lower its price, obtaining positive demand and profit. At any point in configuration I, the entrant can lower its price to move to configuration E and obtain a positive profit. Moreover, E cannot charge above α, otherwise I can always lower its price to move to configuration I, obtaining positive demand and profit. However, for any price $p > 0$, E has an incentive to increase its price above α. Thus, the unique equilibrium arises when $p = 0$ and $q = \alpha$ with E attracting all consumers in stage 2. (Note if I sets a negative price it will induce consumers to multihome but will make a loss from doing so.) In this proposed equilibrium I makes no profit in stage 2 and E's profit is α.

Now consider consumers deciding whether to buy from I in stage 1. If they do not do so they know from above that they can get a surplus of β buying from E in stage 2. The best each consumer can do buying from I is if they all do so, which will only make them better off if $p_X < 0$. However, this implies a loss for I, and so it will not make such an offer and no one will buy from I in either stage. ■

Figure 2 around here.

Proposition 4 shows that the entrant, with its more desirable network, can overcome an installed base advantage of the incumbent. The ability of users to multihome plays an important role here. No matter how many consumers buy from the incumbent in the first stage, in stage 2 they will want to also buy from the entrant given it offers greater network benefits. The unattached consumers have the same preference. By doing so they can obtain some additional network benefits. Moreover, provided the costs of attracting each consumer is low enough (here it is assumed to be zero), the entrant can profitably sell to these additional consumers. Hence, the incumbent cannot make a positive profit from competition with the entrant in the second stage. This in turn means there is no way in stage 2 to take advantage of signing up consumers in stage 1. It also means consumers will not pay anything to buy from the incumbent in stage 1.

Proposition 4 provides a benchmark with which to compare the effects of exclusive deals. The benchmark involves a competitive and efficient outcome. This is in contrast to our findings with singlehoming in which limited offers in stage 1 were enough for the incumbent to inefficiently take the whole market.

More generally, the logic of Proposition 4 shows price discrimination in stage 1 is futile when consumers can multihome.

We now turn to the case where both the incumbent and the entrant can employ exclusive deals in either stage. These allow the firms to make their offers conditional on consumers not buying from their rival.

Proposition 5 *When firms can employ exclusive deals, and the incumbent can limit the number of consumers who can obtain its first stage offers, the incumbent will always use exclusive first stage offers. The incumbent signs up one half of the consumers exclusively in stage 1. A ban on exclusive deals increases consumer surplus and welfare.*

Proof. The proof is long, so we present it in four steps. The first step involves characterizing the second stage equilibrium assuming I attracts no consumers in the first stage. The second step involves doing the same thing assuming I attracts some consumers exclusively in stage 1. It turns out there are then two equilibria in stage 2, and so this step also involves determining which equilibrium will be selected. Having done this, we know what agents will need to be offered to be willing to accept an exclusive deal in stage 1, and so determine the optimal exclusive offer by I in stage 1. The third step involves showing I cannot do better offering instead a non-exclusive deal in stage 1. Finally, step four concludes by summarizing the implications of the resulting equilibrium.

1. *Stage 2 equilibria when no one signs in stage 1.*

If no one signs in stage 1, then we know by the same logic as used in the proof of Proposition 4, in stage 2 E will attract all users at the price $q = \alpha$. The incumbent cannot attract any consumers by making its offer exclusive, and the entrant cannot do any better by instead making its offer exclusive.

2. *Equilibrium when some consumers sign exclusively with I in stage 1.*

Suppose I makes an exclusive offer to n_X consumers in stage 1. If consumers do not accept the offer, they all end up buying from E in the second stage to obtain a surplus of β as in step one. Therefore, to get consumers to accept its exclusive offers in stage 1, I can consider two options.

First, I can attract consumers to sign exclusively even if unattached consumers are expected not to buy from I in stage 2 provided it sets $p_X < -\beta$. However, this cannot be part of an equilibrium since if unattached consumers do not buy from I in stage 2, then I will make a loss from such an offer.

Alternatively, suppose I offers an exclusive deal with price $p_X = 0$ in stage 1, assuming it signs up enough consumers that the remaining consumers will all buy from I in stage 2 at a positive price (they may also multihome). Now consider the second stage equilibrium analysis. Here we have to consider the possibility unattached consumers might wish to multihome, so as to reach the attached consumers that are exclusively on I's network and to take advantage of the greater network benefits on E's network. However, we also have to consider the possibility either I or E will make their second-stage offers exclusive to prevent such multihoming. Recall that even if only one firm makes it offers exclusive in stage 2, then multihoming is ruled out.

There are four possible stage 2 equilibria: (i) firms both offer exclusive deals; (ii) neither firm offers exclusive deals; (iii) I makes a non-exclusive offer while E makes an exclusive offer; and (iv) I makes an exclusive offer while E makes a non-exclusive offer. We proceed to show (i) and (ii) are equilibria but (iii) and (iv) are not.

(i) When first stage consumers sign exclusive deals, and firms make their offer exclusive in stage 2, no firm can do better by making their offers non-exclusive given consumers cannot multihome when the other firm's offers remain exclusive. The competition game becomes exactly as the one analyzed in lemma 1 and proposition 2. Thus, to be able to make any sales in the second stage I needs to offer its exclusive deal in stage 1 to at least n_1 consumers. In fact, the optimal number of consumers turns out to be $n_X^* = 1/2 + \alpha/\left(2(\alpha+\beta)\right) > n_1$. This yields I the profits as given in (1).

(ii) Let us now consider the other possibility, where there is an equilibrium in stage 2 in which neither firm makes its offers an exclusive one. We will first derive equilibria assuming that both firms make non-exclusive offers and then check whether either firm would prefer to deviate by making its offer exclusive. In order to proceed we need to first derive the consistent demand configurations for each given price. Note that the consumers who bought from the incumbent in the first stage exclusively cannot do anything in the second stage. Therefore, the only consumers that can make a choice are the unattached ones. They can multihome, buy from I only, buy from E only or not buy at all.

Consider a possible consistent demand configuration where all unattached consumers multihome. Given all unattached consumers are expected to multihome, this requires: $\beta n_X + (\alpha+\beta)(1-n_X) - p - q \geq (\alpha+\beta)(1-n_X) - q$, which is the condition for an unattached consumer to multihome rather than just buying from E; $\beta n_X + (\alpha+\beta)(1-n_X) - p - q \geq \beta - p$, which is the condition for an unattached consumer to multihome rather than just buying from I; and $\beta n_X + (\alpha+\beta)(1-n_X) - p - q \geq 0$, which is the condition for an unattached consumer to multihome rather than not buy at all. The first condition requires $p \leq \beta n_X$ while the second condition requires $q \leq \alpha(1-n_X)$. Note that if these two conditions hold, the third condition will hold as well.

Next, consider a possible consistent demand configuration where all unattached consumers buy only from E. Given all unattached consumers are expected to buy from E, this requires: $(\alpha+\beta)(1-n_X) - q \geq \beta n_X - p$, which is the condition for an unattached consumer to buy from E rather than buy from I; $(\alpha+\beta)(1-n_X) - q \geq \beta n_X + (\alpha+\beta)(1-n_X) - p - q$, which is the condition for an unattached consumer to buy from E rather than to multihome; and $(\alpha+\beta)(1-n_X)-q\geq 0$, which is the condition for an unattached consumer to buy from E rather than not buy at all. It is easy to verify that all these conditions hold whenever $p\geq\beta n_X$ and $q\leq(\alpha+\beta)(1-n_X)$.

Finally, let us consider a possible consistent demand configuration where all unattached consumers buy only from I. Given all unattached consumers are expected to buy from I, this requires: $\beta-p\geq -q$, which is the condition for an unattached consumer to buy from I rather than buy from E; $\beta-p\geq\beta-p-q$, which is the condition for an unattached consumer to buy from I rather than to multihome; and $\beta-p\geq 0$, which is the condition for an unattached consumer to buy from I rather than not buy at all. These three conditions hold whenever $p\leq\beta$ and $q\geq 0$.

When multiple consistent demand configurations arise we select the configuration which maximizes the joint surplus of those consumers making a choice, in this case, the unattached consumers. As long as multihoming is an equilibrium outcome, it is the configuration which maximizes the joint surplus of unattached consumers. On the other hand, whenever multihoming is not an equilibrium demand configuration but buying just from I and buying just from E are both equilibria, then buying from I is preferred if $q>p+\alpha(1-n_X)-\beta n_X$, and otherwise unattached consumers will buy from E. The resulting consistent demand configurations that are selected are illustrated in Figure 3 for given prices.

Given these demands it is straightforward to see from Figure 3 that the unique non-exclusive pricing equilibrium in the second stage arises when $p=\beta n_X$ and $q=\alpha(1-n_X)$. At these prices and given unattached consumers multihome, if either firm sets a lower price, it cannot increase its demand, while if either firm sets a higher price, it will lose all its demand. At any other set of prices in the multihoming region, each firm has an incentive to raise its price to this level since it will not lose any demand. At any other set of prices outside the multihoming region, one of the firms always has an incentive to lower its price until it either obtains all the demand, or moves inside the multihoming region.

To show this is indeed an equilibrium, it remains to verify that neither firm can do better deviating by instead making an exclusive offer in stage 2. When one firm does this, this eliminates the multihoming outcome. However, to do better, the price offered must be higher than the price under multihoming since under multihoming both firms already sell to all unattached consumers (and so there is no point lowering price). But if either firm raises its price, it will lose all demand from unattached consumers. Thus, both firms making non-exclusive offers is indeed an equilibrium outcome in stage 2. The incumbent's profit is $\beta n_X(1-n_X)$ which is maximized by offering exclusive deals to $n_X=1/2$ of consumers in stage 1. In this equilibrium, the incumbent obtains a profit of $\beta/4$.

(iii) Now consider a possible second stage equilibrium in which I makes a non-exclusive offer while E makes an exclusive offer. Given E's offer is exclusive, multihoming is ruled out, and the outcome is described by Lemma 1. If $n_X>\alpha/(\alpha+\beta)$, then I attracts all unattached consumers in stage 2, and E

makes no profit. The entrant can always do better allowing these consumers to multihome since they are willing to pay something to make use of its superior network to connect with each other, thereby making a positive profit. If instead $n_X \leq \alpha / (\alpha + \beta)$, then E attracts all unattached consumers in stage 2 with $q = \alpha(1 - n_X) - \beta n_X$. If E instead makes its offer non-exclusive it can sell to all unattached consumers at $q = \alpha(1 - n_X)$, thereby increasing its profit. Thus, in either case, E will switch to making non-exclusive offers.

(iv) Finally, consider a possible second stage equilibrium in which I makes an exclusive offer while E makes a non-exclusive offer. Given I's offer is exclusive, multihoming is ruled out, and the outcome is again described by Lemma 1. If $n_X > \alpha / (\alpha + \beta)$ then I attracts all unattached consumers in stage 2 with $p = \beta n_X - \alpha(1 - n_X)$. If I instead makes its offer non-exclusive it can sell to all unattached consumers at $p = \beta n_X$, thereby increasing its profit. If instead $n_X < \alpha / (\alpha + \beta)$, then E attracts all unattached consumers in stage 2, and I makes no profit. The incumbent can always do better allowing these consumers to multihome since they are willing to pay something to reach its attached consumers, thereby making a positive profit. Thus, in either case, I will switch to making non-exclusive offers.

Provided I offers exclusive deals in stage 1 so that $n_X > \alpha / (\alpha + \beta)$, we have established there are two second stage equilibria, one where I and E make exclusive offers and one where I and E make non-exclusive offers. We select the equilibrium where the firms make non-exclusive offers. Regardless of whether I sets $n_X = 1/2$ or $n_X = 1/2 + \alpha / (2 (\alpha + \beta))$ in stage 1, the equilibrium where firms make non-exclusive offers in stage 2 gives each firm higher profits. Moreover, by choosing $n_X = 1/2$, I can signal it will play this equilibrium, so that by a forward induction refinement this equilibrium will be selected in stage 2. In other words, I would not set $n_X = 1/2$ if it intended to play the equilibrium with exclusive offers in stage 2 since it would then have preferred to set a higher n_X. (If $\alpha > \beta$, so that $n_X = 1/2 < \alpha / (\alpha + \beta)$, then the equilibrium where firms make non-exclusive offers in stage 2 is unique and the forward induction refinement is not needed.)

3. *The incumbent cannot do better signing consumers non-exclusively in stage 1.*

From Proposition 4, we know if I does not use exclusive deals in stage 1, then in stage 2 E will attract all users at the price $q = \alpha$. This result remains true even if firms can make their offers exclusive in stage 2. This is because E will prefer to leave its offer non-exclusive in stage 2, since otherwise consumers who sign (non-exclusively) with I in stage 1 will not be able to buy from it in stage 2 (and making its offer exclusive does not help it in any way). Moreover, if I makes its offer exclusive in stage 2, the analysis in Proposition 4 continues to apply since multihoming by unattached consumers was already ruled out there as a possible consistent demand configuration. Thus, I must make its stage 1 offer exclusive to make a positive profit.

4. *Summary of equilibrium properties.*

Compared to the equilibrium in Proposition 4, where exclusive deals were not feasible or not allowed at either stage, I's profit increases from zero to $\beta/4$ and E's profit decreases from α to $\alpha/4$. Previously, without exclusive deals, all consumers obtain the surplus of β. Now half of them get the same surplus (those signing the exclusive deal in stage 1) and the other half (that are not offered the exclusive deal in stage 1) get a surplus of only $\beta/2$. As a result of exclusive deals, consumer surplus is lower by $\beta/4$ and welfare is lower by $3\alpha/4$. ■

Figure 3 somewhere here.

Proposition 5 shows that offering exclusive deals is an effective way for the incumbent to maintain dominance even though it offers a less desirable network and even though consumers are optimal coordinators. By signing up some consumers exclusively in stage 1, the incumbent causes the remaining consumers to multihome in stage 2. They multihome so as to reach the consumers exclusively on the incumbent's network and so as to take advantage of the entrant's more desirable network. However, multihoming is not competitive from the firms' point of view, allowing the incumbent to make a positive profit in stage 2. The incumbent can extract the full network benefits that the unattached consumers get from being able to reach the signed consumers. Since there are n_X signed consumers and $1 - n_X$ unattached consumers, and since it obtains no revenue from signed consumers, the incumbent maximizes its profit $\beta n_X (1 - n_X)$ by signing half of the consumers and exploiting the other half.

The more efficient entrant is partially foreclosed from the market since it cannot sell to the half of consumers that sign exclusively with the incumbent in stage 1. The outcome is inefficient. Banning exclusive dealing in stage 1 will restore the efficient outcome. Note that if instead exclusive dealing is only banned in stage 2, when both firms are already competing head-to-head, then such a ban cannot restore the efficient outcome. In fact, the equilibrium selected in proposition 5 does not involve exclusive dealing in stage 2, so that such a ban would be futile.

In proving the proposition, the forward induction refinement was used to select the equilibria in the stage 2 subgame in which firms make non-exclusive offers. The same qualitative result holds if instead firms coordinate on the second stage equilibrium where they make exclusive offers. In fact, in this case the results are even more striking, since the incumbent will sign up more than half of the consumers exclusively in stage 1 and take the whole market exclusively in stage 2. The resulting loss in consumer surplus and welfare is even greater than before.

5 Two-sided markets

In this section, we extend the previous framework to one of a two-sided market. Many of the markets where exclusive dealing may be considered are actually two-sided markets. An important set of examples is content provision for entertainment or communication platforms such as video-games, 3G mobile telephony and pay-TV. There is little research on exclusive dealing in such two-sided markets.

An exception is the analysis in Armstrong and Wright (2006), where exclusive dealing is explored as a way of overcoming a competitive bottleneck equilibrium. Caillaud and Julien (2001) also consider an equilibrium where agents can only join platforms exclusively and in which one platform is dominant, although they do not consider whether platforms will adopt exclusivity. Our analysis differs from these papers since, like standard models of Naked Exclusion such as Segal and Whinston (2000), we allow the incumbent to sign up agents first, while introducing an advantage to the entrant in any subsequent competition. Our paper also differs in the expectations assumed. As in the one-sided case, we assume agents deciding between platforms are optimal coordinators, so that we reduce the scope for coordination failures on the part of agents.

When there are actually two types of users, each of which values the other, platforms have a natural way to segment users and price discriminate. Thus, even though we assume platforms cannot price discriminate amongst users of the same type, as long as the platforms can price differently across the two different types of users, there can be scope for exclusivity effects. Rather than endogenously determining a subset of users which receive low price offers as in our one-sided setting, where we allowed the incumbent to make limited offers, here we have two groups of users determined exogenously by their types (for example, buyers and sellers). Allowing the incumbent to set its prices first, we study whether the incumbent will sign up one side prior to the arrival of the entrant in the market.

The two types of agents are denoted B and S, which we will refer to generically as buyers and sellers, with each type valuing the number of agents of the opposite type it can interact with but not the number of the same type. The measure of buyers is set to one, as is the measure of sellers. Denote I's prices by p_B and p_S, and E's prices by q_B and q_S. As in the previous section, stand-alone benefits and costs are set to zero.[8] Suppose N_I sellers join I exclusively, N_E sellers join E exclusively, and the remaining $1 - N_I - N_E$ sellers multihome. Then buyers get $\beta_B (1 - N_E) - p_B$ joining I only, $(\alpha_B + \beta_B)(1 - N_I) - q_B$ joining E only, and $\alpha_B (1 - N_I) + \beta_B - p_B - q_B$ if they multihome. The sellers' benefits can be defined in a symmetric fashion. We adopt the same tie-breaking rule as in earlier sections, so that where indifferent,

[8] If we do not do so, there is a set of equilibrium prices in stage 2 that makes characterizing stage 1 offers more complicated. This set of equilibria converges to the equilibrium characterized here as costs vanish. The main restriction implied by this assumption is that it rules out the possibility, for sufficiently high costs, that I does not need to make its deals exclusive in order to profit from attracting users in stage 1. This alternative case remains to be analyzed.

agents will avoid multihoming and will choose E over I.

Without loss of generality, we assume that sellers value buyers more than buyers value sellers on the incumbent's network, so that there is an asymmetry in network benefits. That is, we assume $\beta_S > \beta_B$. All other assumptions are the same as in the benchmark model of Section 2. In particular, I gets to make its offers in stage 1, and both platforms then compete for any remaining users in stage 2. We continue to focus on the setting in which agents are optimal coordinators, so where there are multiple equilibrium demand configurations for given prices, we select the equilibrium demand configuration at each point which has the highest joint surplus for those agents deciding about which platform(s) to join. Finally, as in our one-sided setting, we allow multihoming and first consider the case in which platforms cannot make their offers exclusive (say because exclusive dealing is banned) and then allow them to make such offers.

Proposition 6 *If platforms cannot price discriminate amongst users of the same type and cannot make their offers exclusive at either stage, then no one will join the incumbent, and all buyers and sellers will join the entrant's platform in stage 2. The outcome is efficient.*

Proof. First consider the second stage equilibrium assuming I attracts no buyers or sellers in the first stage. Given agents are optimal coordinators, it is straightforward to show any equilibrium must involve all agents joining E's more desirable network. Given all agents join E and given our tie-breaking rule, any equilibrium must involve all agents joining E only.

Now consider such an equilibrium in stage 2 and consider the necessary restrictions on prices that are implied. The best I can offer in total is $p_B + p_S = 0$ since with lower prices it makes a loss. Moreover, if I offers a positive price on one side, it must therefore set a negative price on the other side which will attract multihoming on that side, implying it makes a loss in equilibrium. Therefore, we must have that $p_B = p_S = 0$ in any equilibrium. This implies in any equilibrium $q_B + q_S = \alpha_B + \alpha_S$. If E sets a higher total price, I can profitably undercut and obtain all users given the expectations rule we have assumed. If E sets a lower total price, E can increase its total price and still obtain all users, thereby increasing its profit.

In addition, for these prices to characterize an equilibrium, we require some constraints on individual prices so that I cannot run a divide-and-conquer strategy to profitably attract away all users. The only prices that prevent I running a profitable divide-and-conquer strategy and satisfy the above conditions are $q_B = \alpha_B$ and $q_S = \alpha_S$. If I bribes buyers, paying them some small $\varepsilon > 0$ to join and then sets $p_S = q_S - \alpha_S$, it will attract all users and obtain a profit of $q_S - \alpha_S - \varepsilon$. To make this unprofitable requires $q_S \leq \alpha_S$. By symmetry, for the buyer side, we require $q_B \leq \alpha_B$. These two constraints together with the condition that $q_B + q_S = \alpha_B + \alpha_S$ imply in any equilibrium, prices must be $p_B = 0$, $p_S = 0$, $q_B = \alpha_B$ and $q_S = \alpha_S$.

At these prices, each side prefers to join E given it expects the other side too, and together they cannot jointly do better switching to I's platform. It is also straightforward to confirm that starting from these prices, neither platform can change its prices to increase profit given the other platform's price remains fixed. Thus, we have shown these prices characterize the unique equilibrium in which all agents join E only. I makes no profit and E makes a profit of $\alpha_B + \alpha_S$.

So far we have shown that when no one signs in stage 1, there is a unique equilibrium in stage 2 in which all agents join E, characterized by the prices $p_B = 0$, $p_S = 0$, $q_B = \alpha_B$ and $q_S = \alpha_S$. Now suppose instead I makes an offer to all sellers in stage 1. If they believe it will attract all buyers in stage 2, I must offer sellers more surplus than they can get if they reject the offer. If sellers reject the offer in stage 1 they get a surplus of β_S buying from E in stage 2, as determined above. So I can attract sellers in stage 1 by charging $p_S < 0$. Having attracted all sellers in stage 1, I then competes with E for buyers in stage 2, while E also tries to attract sellers to multihome.

There cannot be an equilibrium in stage 2 in which buyers join I and sellers do not join E. This involves E obtaining no profit. The entrant can always do better. For example, it can do better by offering a small bribe to sellers so they multihome and then competing with I for buyers, obtaining all buyers exclusively at the price $q_B = \alpha_B$, thereby making a positive profit. However, there can also not be an equilibrium with just buyers or just sellers joining E (to do so, they must face a negative price for joining, but then E would make a loss). Therefore, in any second stage equilibrium, E must attract all buyers and sellers. Furthermore, I will not attract any buyers in equilibrium, since this requires that it set a negative price (and so makes a loss). One can check (using a similar analysis to above), the unique second stage equilibrium involves all agents joining E and is characterized by the prices $p_B = 0$, $q_B = \alpha_B$ and $q_S = \alpha_S$ (I's price to sellers is redundant since it has already sold to them in stage 1).

This result means I makes a loss with its introductory offer to sellers in stage 1, and so will never make such an offer in the first place. By a symmetric argument, I will not want to make an offer to buyers in stage 1. Nor can it do better making an offer to both buyers and sellers in stage 1 since if it sets a positive price to either side, that side will prefer to reject the contract regardless of whether it expects the other side to sign. Thus, the equilibrium of the full game is the same as the equilibrium of the subgame in which I attracts no users in stage 1 (as analyzed above). ■

The implication of the proposition is that absent the ability of firms to offer exclusive deals, the incumbent does not derive any advantage of being able to move first and attract users in stage 1 with introductory offers. This reflects that the entrant has a more desirable network and that agents can multihome, so that even if the incumbent could attract one group in stage 1, the entrant could still profitably attract both groups in stage 2. Competition is Bertrand-like, with the only profit being the efficiency profit that the entrant earns. Moreover, all agents join the entrant in equilibrium which is the efficient outcome. In this respect, the proposition is just the two-sided equivalent of Proposition 4.[9]

An interesting feature of the proposition is that we obtain prices in which each side just pays according to the entrant's network benefits advantage. That is, in equilibrium buyers pay α_B and sellers pay α_S. The entrant cannot charge either side (say sellers) more than the additional network benefits it delivers to them, otherwise the incumbent can profitably run a divide-and-conquer strategy, bribing buyers and charging sellers just below $q_S - \alpha_S$. This result is a natural implication of one platform having a superior network from the perspective of all users. If the platforms are symmetric, then other equilibria are possible since, for instance, sellers may multihome on one side and buyers split between the platforms on the other as in the competitive bottleneck result of Armstrong and Wright (2006). However, such equilibria are not possible here since with sellers multihoming, buyers will strictly prefer the entrant's platform, which means the incumbent cannot charge anything to sellers.

Now suppose instead exclusive dealing is possible so each platform can make its offer an exclusive one. Under such an offer, a platform will only serve users who agree not to join the rival platform. We first show that starting from the above equilibrium, platforms will want to adopt such offers, thereby unsettling the equilibrium in the previous proposition.

Lemma 3 *Starting from the unique equilibrium outcome characterized in Proposition 5, the equilibrium is undermined when platforms can offer exclusive deals.*

Proof. The equilibrium in Proposition 5 involved no one signing with I in stage 1. Instead, the equilibrium involved the entrant attracting all agents in stage 2 at the prices $q_B = \alpha_B$ and $q_S = \alpha_S$. This left buyers with the surplus β_B. Given our assumption that $\beta_S > \beta_B$, the incumbent can do better bribing buyers in stage 2 with the offer $p_B = -\beta_B$ on the grounds buyers join exclusively. Buyers' surplus is at least as high as if they do not sign regardless of what they expect sellers to do (and is higher if I also attracts sellers) and therefore buyers will accept the offer. Then the incumbent can extract all of the sellers' network benefits β_S. The incumbent's resulting profit is $\beta_S - \beta_B$, which is positive. ∎

Having shown that an equilibrium with platforms making non-exclusive offers is no longer an equilibrium when firms can attach exclusivity clauses to their offers, consider instead the equilibrium that arises when firms compete in exclusive deals.

Proposition 7 *If platforms cannot price discriminate amongst agents of the same type, and platforms can make exclusive offers at either stage, then in equilibrium sellers sign exclusively with the incumbent's*

[9] If instead the cost of attracting one side (say sellers) is sufficiently large, then the incumbent may be able to attract that side in the first stage and win the competition for the other side in the second stage, while still covering its costs. This can happen if the cost of getting sellers to multihome exceeds the efficiency benefits that can be realized by all users joining the entrant's network.

platform in stage 1 and buyers have all their surplus exploited. Banning exclusive dealing increases the joint surplus of buyers and sellers, as well as total welfare.

Proof. The proof is long, so we present it in five steps. The first step involves characterizing the second stage equilibrium assuming I attracts no buyers or sellers in the first stage. The second step involves doing the same thing assuming I attracts one of the sides exclusively in stage 1. Having done this, we know what agents will need to be offered to be willing to accept an exclusive deal in stage 1, and so we determine the outcome with the optimal exclusive offer by I in stage 1. This involves signing up sellers exclusively in stage 1. The third step involves showing I cannot do better offering a non-exclusive deal in stage 1 instead. The fourth step involves showing I achieves the same result if in addition to signing up sellers in stage 1, it signs up buyers (either exclusively or non-exclusively) in stage 1. Finally, step five concludes by summarizing the implications of the resulting equilibrium.

1. *Stage 2 equilibria when no one signs in stage 1.*

Assuming no one signs in stage 1, it is straightforward to show any equilibrium in stage 2 must involve all agents joining E's more desirable network. Lemma 3 shows that there is no equilibrium where both firms make non-exclusive offers to both sides in stage 2. Thus, in equilibrium, it must be that at least one platform makes its offer to one side exclusive in the second stage. However, this means in any equilibrium, E must attract one side exclusively. Since agents on one side only get benefits if they can interact with the other side, and given our tie-breaking rule, this implies the other side must also join E exclusively. Thus, in any equilibrium all agents must join E exclusively. We focus on a possible equilibrium in stage 2 in which both platforms make their offers exclusive. As a result, the possibility of multihoming can be ignored.[10]

For there to be such an equilibrium in stage 2, it must be that I cannot undercut in a way that it can profitably attract all buyers and sellers. There are two ways I may do this.

First, I may set prices so there are two consistent demand configurations — buyers and sellers join I, and buyers and sellers join E. If I can offer greater joint surplus to buyers and sellers, it can attract both sides. To make this unprofitable for I, the entrant needs to set its prices so that

$$q_B + q_S \leq \alpha_B + \alpha_S, \tag{2}$$

since then I has to set $p_B + p_S < 0$ to attract both sides.

[10] It remains to check if there are any other second stage equilibria where the platforms' offers are neither entirely exclusive nor entirely non-exclusive. We conjecture that such offers can be ruled out, as they were in the proof of Proposition 5, or if they cannot, that they imply an identical distribution of surplus. Even if they cannot be ruled out and imply a different distribution of the surplus amongst the various parties, then our results will continue to hold provided the exclusive equilibrium characterized below is selected in the stage 2 subgame.

The other way I may try to undermine such an equilibrium, is by using a divide-and-conquer rule in which it bribes one side to join exclusively so that the only consistent demand configuration involves both sides joining I's platform. Consider the case I bribes buyers. This requires I charge buyers less than $q_B - (\alpha_B + \beta_B)$ for joining exclusively. Buyers will then join I regardless of what they expect sellers to do. Taking this into account, sellers will join I provided the price I charges is strictly less than $\min(\beta_S, \beta_S + q_S)$. Thus, the maximum profits I can achieve with such a deviation is strictly less than $q_B - (\alpha_B + \beta_B) + \min(\beta_S, \beta_S + q_S)$. By setting

$$q_B \leq \alpha_B + \beta_B - \min(\beta_S, \beta_S + q_S), \tag{3}$$

E can ensure this deviation is unprofitable for I. Likewise, by setting

$$q_S \leq \alpha_S + \beta_S - \min(\beta_B, \beta_B + q_B), \tag{4}$$

E can ensure it is not profitable for I to deviate by bribing sellers.

Taken together, the constraints (2)-(4) imply for E to prevent I undercutting it and taking all the demand, it must set its prices to satisfy $q_B \leq \alpha_B + \beta_B - \beta_S$ and $q_S \leq \alpha_S + \beta_S - \beta_B$.

Since I attracts no users in the proposed equilibrium, in equilibrium we must also have $p_B + p_S = 0$. If I sets a higher total price, then E would have an incentive to increase its total price above $\alpha_B + \alpha_S$ without losing demand, but this contradicts the equilibrium condition (2) above. Setting a lower total price involves I playing a weakly dominated strategy which we rule out. Therefore, in equilibrium $p_B + p_S = 0$. This implies E's best response is to set $q_B + q_S = \alpha_B + \alpha_S$, which given the constraints (2)-(4), it can only achieve by setting $q_B = \alpha_B + \beta_B - \beta_S$ and $q_S = \alpha_S + \beta_S - \beta_B$. At these prices, E cannot further increase prices to increase profit without losing all demand to I, while lowering its total price will lower profits since it already attracts all demand.

The stage 2 equilibrium characterized is unique given both platforms make their offers exclusive ones. No platform can do any better making its offers non-exclusive, since agents can still not multihome when the other platform's offers are exclusive ones.

2. *Equilibrium when one side signs exclusively with I in stage 1.*

Next suppose I attracts buyers exclusively in stage 1. Sellers will get no network benefits of joining E in stage 2 and so E will not be able to profitably attract any users. The incumbent can then charge sellers β_S in stage 2. Buyers will be willing to sign in stage 1 if their surplus of $\beta_B - p_B$ (since they know sellers will join the same platform in stage 2) exceeds their surplus of rejecting the offer and receiving $\alpha_B + \beta_B - (\alpha_B + \beta_B - \beta_S) = \beta_S$ as determined from step 1 above. Thus, p_B is set in the first stage so that

$$p_B = \beta_B - \beta_S,$$

which will attract all buyers to join exclusively, giving I a profit of β_B after taking into account its price of $p_S = \beta_S$ to sellers in stage 2. By symmetry, if it makes the exclusive offer to sellers in stage 1 it will set

$$p_S = \beta_S - \beta_B,$$

with corresponding profit of β_S. Since $\beta_S > \beta_B$, I finds it more profitable to make the offers to sellers in stage 1.

3. *The incumbent cannot do better signing one side non-exclusively in stage 1.*

Now suppose I makes the offer to sellers in stage 1 without requiring exclusivity instead. Even assuming it can attract all buyers in stage 2, I must offer sellers at least as much surplus than they can get if they reject the offer, which as above is β_B. Thus, the price charged to sellers is the same as if the offer is instead exclusive. Since with exclusive deals, I already extracts the maximum amount possible from agents in the second stage, it therefore cannot do better making a non-exclusive offer in stage 1. In fact, it will do worse since if it tries to charge buyers $p_B = \beta_B$ in stage 2, E will have a profitable deviation in which it attracts both buyers and sellers following the same logic as in Proposition 6.

4. *The incumbent may also attract buyers in stage 1, but this leads to identical payoffs for all parties.*

If I also makes the offer $p_B = \beta_B$ to buyers in stage 1, either exclusively or non-exclusively, buyers will also be willing to accept it. Buyers know that sellers will sign with I regardless of what they do. If buyers reject the offer and wait till stage 2 to join I's platform, they also expect the same offer from I. Thus, they are indifferent between signing with I in stage 1 or signing with I in stage 2. Note if I tries to charge sellers any price greater than or equal to $\beta_S - \beta_B$, then whether buyers and sellers sign depends on the expectation rule which means they will not sign. If I tries to charge buyers any price greater than β_B, they will not join.

5. *Summary of equilibrium properties.*

The incumbent divides the groups' interests simultaneously by making an exclusive offer to sellers that they will accept regardless whether they think buyers will also sign, and given this they know the other group will follow suit. Thus, the equilibrium involves all sellers signing exclusively with I in stage 1 and then the incumbent exploits buyers' network benefits at either stage 1 or 2. I makes a positive profit equal to the sellers' network benefits β_S while E makes zero profit. This outcome is inefficient since without exclusive dealing the previous proposition showed the equilibrium involves all agents joining E's more efficient platform. Moreover, previously buyers obtained a surplus of β_B and sellers a surplus of β_S. Now buyers obtain no surplus while sellers obtain the surplus of $\beta_B < \beta_S$. Thus, both groups are worse off as a result of the use of exclusive dealing. The joint surplus of buyers and sellers is lower by β_S, while total welfare is lower by $\alpha_B + \alpha_S$. ■

The proposition shows that in a two-sided market where the entrant platform offers a more desirable network, if the incumbent can sign exclusive deals prior to facing competition from an entrant, it will do so by signing up the side which values the other more at no cost, and then extracting surplus from the other side. The result is both anticompetitive and inefficient. Here foreclosure is complete, in the sense the entrant does not sell to either side in equilibrium despite offering a superior platform.

The incumbent relies on dividing the interests of the two sides. In the first stage, it offers sellers a deal they cannot refuse. Regardless of what buyers do in stage 1, sellers are better off (or no worse off) signing exclusively. Sellers know that having signed exclusively with the incumbent, buyers will also join the incumbent's platform — if not in stage 1, then in stage 2. Having signed sellers exclusively, the incumbent can extract all of the buyers' surplus.

Interestingly, it is the buyers that have their surplus exploited here, even though buyers' network benefits are lower. This is the reverse of the usual pattern of prices predicted in competitive two-sided markets, in which the side with higher network benefits is charged more. The reason for this difference is due to the fact the platforms can use exclusive deals in stage 2. Specifically, note that if the incumbent's first stage offers are rejected, competition in stage 2 with exclusive deals results in the entrant attracting all agents with the prices $q_B = \alpha_B + \beta_B - \beta_S$ and $q_S = \alpha_S + \beta_S - \beta_B$. Among other things, these are the prices necessary to avoid the incumbent running a profitable divide-and-conquer strategy in stage 2, which itself involves exclusive deals. The corresponding surplus of sellers is β_B and of buyers is β_S, the reverse of the original surpluses each side gets on the incumbent's network. Thus, by signing up sellers in stage 1, the incumbent only has to offer them a surplus of β_B, which it then extracts from the buyer's side. As a result, it makes a profit of β_S, which is higher than the profit of β_B it would get if it ran the same strategy but instead signed up buyers in stage 1.

As with one-sided markets, the results show that it is the exclusive nature of the incumbent's initial offers that are anticompetitive, not the fact it commits one side to join before the entrant reaches the market. If the incumbent is not able or not allowed to prevent agents joining both platforms, then the fact that it can make introductory offers does not help it. Moreover, in the presence of competition so that both firms can offer exclusive deals, such contacts are not harmful. In fact, the profit the entrant obtains in this case is the same as when platforms cannot use exclusive deals in stage 2, namely those equal to its network benefits advantage. The only reason for the slightly different pricing strategy by the entrant is to prevent a divide-and-conquer deviation by the incumbent that itself makes use of exclusive deals. As a result, buyers pay a little more and sellers pay a little less.

In practice, platforms may only be able to offer exclusive deals to one of the two sides. This seems likely to be the case if buyers are individual consumers while sellers are firms. It is typically not feasible for platforms to monitor and enforce exclusivity contracts with households but they may be able to do so with firms. For example, Sony cannot prevent individuals from buying Microsoft X-box consoles, but it may require game developers to only produce their games for its platform. Nintendo used to offer such exclusive deals to game developers, arguably slowing down entry into the market (Shapiro, 1999). Thus, it is interesting to consider whether exclusive deals are still anticompetitive when they can only be used on one side of the market, namely the sellers' side of the market. The key difference is that in the competition stage, we need to alter the analysis so that platforms can only offer exclusive deals to sellers.

Proposition 8 *If platforms cannot price discriminate amongst agents of the same type, and platforms can make exclusive offers at either stage (but only to sellers), then in equilibrium sellers sign exclusively with the incumbent's platform in stage 1 and buyers have all their surplus exploited. Banning exclusive dealing increases the joint surplus of buyers and sellers, as well as total welfare.*

Proof. Here we just sketch the proof, since the steps are similar to those in the proof of Proposition 7. Consider the second stage equilibrium assuming I attracts no buyers or sellers in the first stage. Then given E's platform offers greater network benefits and agents are optimal coordinators, the only possible equilibrium must involve all users joining E exclusively.

Since I can use a divide-and-conquer strategy, offering a bribe to sellers if they sign exclusively, we still get the constraint that $q_S - (\alpha_S + \beta_S) + \beta_B + \min(q_B, 0) \leq 0$. On the buyers' side, the best I can do is to offer buyers a small bribe to join, and then attract sellers exclusively by setting $p_S < q_S - \alpha_S$. This gives it a profit less than $q_S - \alpha_S$, so this will be unprofitable provided $q_S \leq \alpha_S$. Since we also have that $p_B + p_S = 0$ and $p_B + p_S = q_B + q_S - (\alpha_B + \alpha_S)$, and since buyers must get a non-negative surplus, there is a set of equilibria characterized by $p_B \geq 0$, $q_S - (\alpha_B + \alpha_S) \leq p_S \leq 0$, $p_B + p_S = 0$, $\alpha_S - \beta_B \leq q_S \leq \alpha_S$ and $q_B = \alpha_B + \alpha_S - q_S > 0$ with the offer to sellers by E being exclusive.

Sellers get a surplus of between β_S and $\beta_B + \beta_S$ if they do not sign in stage 1. For them to accept an exclusive deal in stage 1 (recalling I can only offer exclusive deals to sellers), their surplus $\beta_S - p_S$ must exceed their surplus of waiting and receiving surplus of between β_S and $\beta_B + \beta_S$ in stage 2. This requires the first stage price to be in the range between $-\beta_B$ and 0. Since I extracts all of the buyers' surplus in stage 2, it will offer an exclusive deal in stage 1 which the sellers will sign. This gives I a profit of $\beta_B + p_S \geq 0$. The incumbent may also attract buyers in stage 1, but this leads to identical payoffs for all parties.

This outcome is inefficient since without exclusive dealing, the equilibrium involves all agents joining E's more desirable platform. Moreover, previously, buyers obtained a surplus of β_B and sellers a surplus of β_S. Now buyers obtain no surplus while sellers obtain the surplus of between β_S and $\beta_B + \beta_S$. Thus, buyers are worse off and sellers are better off as a result of exclusive dealing, with the joint surplus of buyers and sellers lower by between 0 and β_B, and total welfare lower by $\alpha_B + \alpha_S$. ■

Even when exclusive deals can only be employed on the sellers' side of the two-sided market, the incumbent can continue to use exclusive deals to profitably take the whole market. Such exclusive deals continue to be anticompetitive and inefficient. However, the amount sellers are charged, and the resulting distribution of surplus can be quite different compared to when exclusive deals are available on both sides, as Table 1 illustrates.[11]

Table 1. Distribution of surplus according to whether exclusive deals are feasible

	Not feasible	Feasible with both sides	Feasible with sellers
Buyer surplus	β_B	0	0
Seller surplus	β_S	β_B	$[\beta_S, \beta_B + \beta_S]$
Incumbent's profit	0	β_S	$[0, \beta_B]$
Entrant's profit	$\alpha_B + \alpha_S$	0	0
Total welfare	$\beta_B + \beta_S + \alpha_B + \alpha_S$	$\beta_B + \beta_S$	$\beta_B + \beta_S$

The reason for the different distribution of surplus reflects the different nature of competition in stage 2, in the case exclusive deals are not signed in stage 1. The fact buyers can multihome in stage 2 means the entrant cannot extract so much from sellers in the competition game, since it makes it easier for the incumbent to run a divide-and-conquer strategy on buyers. If the entrant tries to charge sellers more than the network advantage it offers them, then the incumbent can offer a small bribe to get buyers to multihome and then extract the additional surplus from the sellers. With exclusive dealing available on both sides, this deviation was not available, and the entrant charged sellers $\alpha_S + \beta_S - \beta_B$. Since sellers now expect to pay less if they reject the incumbent's first stage offer, the incumbent has to offer sellers more surplus to get them to sign in the first place.

The exact amount offered to sellers depends on the particular stage 2 equilibrium played. The weaker constraint on buyers' prices as a result of buyers multihoming means that while the total amount paid by buyers and sellers in stage 2 is determined in equilibrium, the particular amount paid by each side is not determined within the given range. At one extreme of this range, sellers are unaffected by exclusive deals, with the buyers' network benefits being extracted by the incumbent. At the other extreme, sellers obtain

[11] Table 1 summarizes the surplus of each of the parties corresponding to the three propositions in this section. These are represented by the three columns in the table indicating the extent to which exclusive deals are feasible.

the buyers' network benefits as well as their own, with the incumbent making zero profit. Regardless of which equilibrium is played, we can conclude that when exclusive deals can only be offered to sellers, sellers are better off as a result, with their gain being the incumbent's loss.

6 Concluding comments

We have studied how introductory offers, which may contain exclusivity provisions, can be used by an incumbent to weaken a more efficient rival's ability to compete in the face of network effects. By signing up some consumers early with attractive offers, the incumbent increases demand for its product from other consumers, which it exploits later on. Both consumer welfare and overall efficiency is reduced by the use of such exclusive deals. We distinguished two scenarios.

One case involved firms having positive costs of attracting consumers in which multihoming is not feasible. Then since consumers anyway buy from one or other firm, there is no role for exclusivity conditions in contracts. Rather, by getting a portion of consumers to (commit to) buy from the incumbent initially, the incumbent raises the willingness-to-pay from the remaining consumers to the point where, in head-to-head competition, the entrant obtains no demand. The incumbent chooses not to sign up all consumers, since it wants to leave some consumers to exploit in the competition stage. Unlike the standard Naked Exclusion literature, we have obtained these results without needing to assume any scale economies. Introducing even a trivial level of entry costs for the rival in our setting allows the incumbent to foreclose the entrant from the market, thereby making exclusion more profitable for the incumbent and less desirable for consumers.

The other case involved no (or more generally, low) costs of attracting consumers in which multihoming is feasible. The ability of consumers to buy from the incumbent and the entrant changes the nature of the game considerably. Offers that only require consumers to commit to purchase from the incumbent are no longer effective. Consumers will sign the contracts if they receive a bribe for doing so, but will still join the entrant's more desirable network subsequently. In the face of such multihoming, the incumbent will make its offers exclusive, preventing consumers that sign from also buying from the entrant. The incumbent optimally signs up half of the consumers exclusively, allowing the remaining half to multihome in the competition stage. Such contracts are anticompetitive and result in inefficiencies. Despite this, the entrant is only partially foreclosed from the market, since it still sells to the free consumers at a profit.

The analysis is extended to two-sided markets, where similar results are obtained. When exclusive deals are not possible, the incumbent loses out to the more desirable entrant. The incumbent signs up one side of the market exclusively so as to prevent multihoming, and extracts the full network benefits from the other side. The entrant is fully foreclosed. When sellers value buyers more than vice-versa, then it is buyers that have their surplus exploited. Finally, we find that if exclusive contracts can only be written with sellers and not buyers, sellers are the primary beneficiaries of exclusive deals rather than the incumbent. However, both are better off compared to when exclusive deals are not possible at all.

Relative to the existing literature on Naked Exclusion, our model introduces two new features — network effects and multihoming. Both effects naturally arise together as multihoming is a way for consumers to enjoy greater network benefits when networks are incompatible. It was these features, rather than the standard scale economies that lead to anticompetitive and inefficient exclusion by the incumbent in our model. Adding scale effects to the network effects we study can enable the incumbent to extract more surplus from consumers, as we found in the singlehoming setting. It remains to study the effect of scale effects when users can also multihome.

Without considering such multihoming, the "exclusive deals" studied in much of the existing literature may be better thought of as simply introductory offers. When consumers only want to purchase from one or the other firm, the incumbent has no need to introduce an exclusivity condition. This was the first case we considered, in which our model added network effects to the existing literature. Our main contribution, however, was to study what happens when consumers can multihome and firms can employ exclusivity conditions. As such, it may also be interesting to study these questions in an environment without network effects. This most naturally arises when buyers are downstream firms, who may buy from one or both of the competing upstream suppliers. Bernheim and Whinston (1998) have studied this setting when both upstream firms can offer contracts at the same time and there is a single downstream buyer. An open question remains as to what happens when one upstream firm has a first-mover advantage in offering exclusive deals to downstream firms that may wish to buy from both upstream suppliers.

7 References

Armstrong, M. (2006) "Competition in two-sided markets," *Rand Journal of Economics* forthcoming.

Armstrong, M. and J. Wright (2005) "Two-Sided Markets, Competitive Bottlenecks and Exclusive Contracts," *Economic Theory*, forthcoming.

Balto, D. (1999) "Networks and Exclusivity: Antitrust Analysis to Promote Network Competition," *George Mason Law Review* 7: 523-576.

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

Caillaud, B. and B. Jullien (2001) "Competing Cybermediaries," *European Economic Review* 45: 797-808.

Caillaud, B. and B. Jullien (2003) "Chicken and Egg: Competition among Intermediary Service Providers," *Rand Journal of Economics* 34: 309-328.

Doganoglu, T. and J. Wright (2006) "Multihoming and compatibility," *International Journal of Industrial Organization* 24: 45-67.

Farrell, J. and P. Klemperer (2006) "Lock-In and Compatibility," in *Handbook of Industrial Organization*, Volume 3. Edited by M. Armstrong and R.H. Porter. Published by Elsevier.

Jullien, B. (2001) "Competing in Network Industries: Divide and Conquer," IDEI Working Paper No. 112, 2001.

Katz, M. and C. Shapiro (1986) "Technology adoption in the presence of network externalities," *Journal of Political Economy* 94: 822-841.

Rasmusen E. B., J. M. Ramseyer, and J. J. S. Wiley (1991) "Naked Exclusion," *American Economic Review* 81: 1137-1145.

Rochet, J-C. and J. Tirole (2003) "Platform competition in two-sided markets," *Journal of the European Economic Association* 1: 990-1029.

Segal, I. (2003) "Coordination and Discrimination in Contracting with Externalities: Divide and Conquer?," *Journal of Economic Theory* 113: 147-181.

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

Shapiro, C. (1999) "Exclusivity in Network Industries," *George Mason Law Review* 7: 673-684.

Figure 1: Demand equilibrium in Lemma 1

a) $n_X \geq \frac{\alpha}{\alpha+\beta}$

b) $n_X < \frac{\alpha}{\alpha+\beta}$

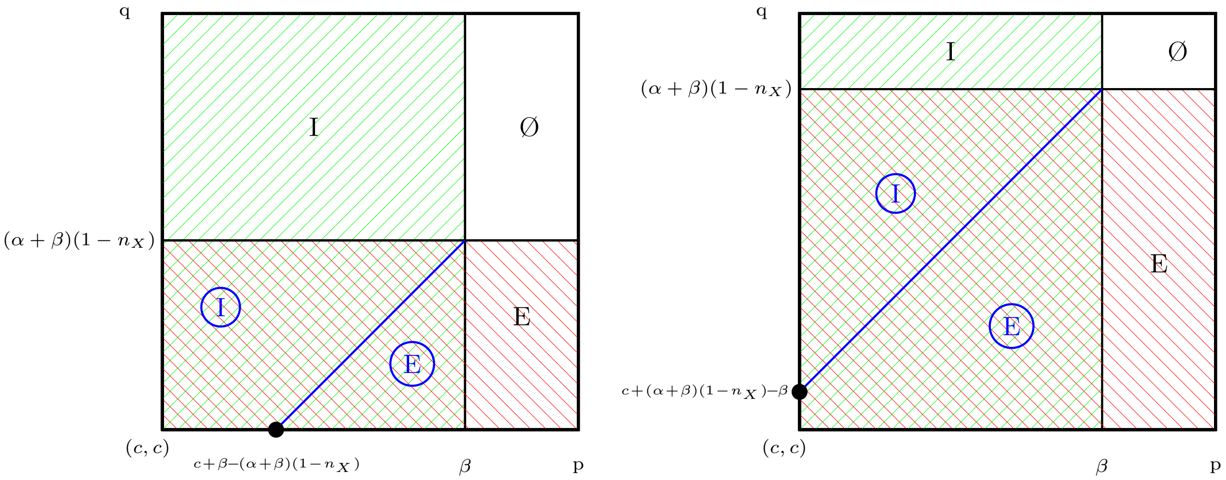

Figure 2: Demand equilibrium in Proposition 4

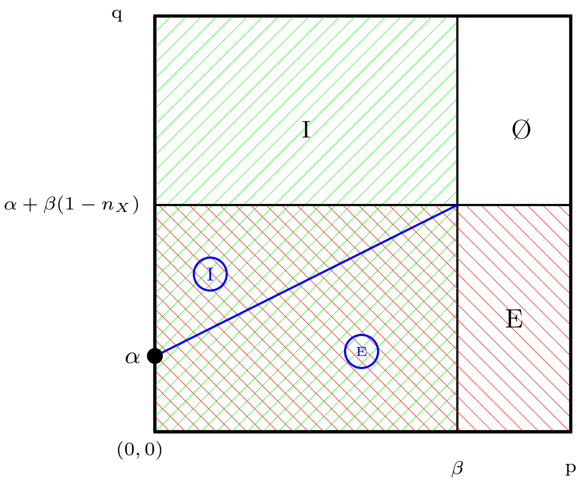

Figure 3: Demand equilibrium in Proposition 5 with non-exclusive prices