Exclusive dealing with network effects*

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Abstract

This paper explores the ability of an incumbent to use introductory offers to dominate a market in the face of a more efficient rival when network effects rather than scale economies are present. Both in the case of one-sided and two sided markets, for introductory offers to be profitable when consumers can multihome, they need to be discriminatory and exclusive. In this setting, exclusivity as opposed to just commitment to purchase is critical — consumers must commit not to purchase from the rival in the future in order that introductory offers can work. The use of such contracts is anticompetitive and inefficient but does not necessarily result in complete foreclosure.

JEL: L12, L13, L42

Keywords: Exclusive Deals, Networks, Foreclosure, Two-sided markets

*We thank conference participants at the University of Toulouse for helpful comments, particularly our discussant, Mark Armstrong.

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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 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 before a more desirable rival firm reaches the market. However, this by itself is not sufficient for the incumbent to make sales. A necessary condition for the incumbent to profit from introductory offers is the ability for these to be offered in a discriminatory way. Attracting some consumers with low prices raises the network benefits the incumbent can offer to other consumers, which in turn, allows it to charge more when it competes with the entrant. However, each signed-up customer reduces the size of the customer base that the incumbent can later exploit. The incumbent therefore optimally designs an introductory offer which balances these opposing effects.

This simple logic, however, does not hold once we take into account the natural tendency for consumers in network markets to want to multihome (that is, buy from both firms so as to enjoy 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 also buy from the entrant if it offers some additional benefits.

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 but they must also agree not to purchase from the entrant later. 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.

Interestingly, such exclusive contracts may not involve complete foreclosure. In a one-sided market setting, consumers that do not sign exclusive contracts may multihome, buying from the incumbent to reach signed up consumers and buying from the entrant to take advantage of its superior network. Such multihoming results in dampened ex-post competition, which also benefits the entrant to a certain extent. This, along with the fact that signed-up consumers do not join the entrant's more desirable network, are sources of potential harm. In fact, we show a ban on the use of exclusive deals raises consumer surplus and welfare. Nevertheless, given the presence of multiple firms in the competition stage, unlike the traditional naked exclusion results, the adverse effects of exclusive deals may be more difficult for a competition authority to detect in our setting.

Our main conclusions also carry over to a two-sided market setting, where the incumbent signs up "sellers" exclusively and then exploits "buyers" who want to interact with these sellers. Here discrimination is natural given there are two different types of consumers and given that it may only be feasible to get one side of the market to sign exclusive deals (e.g. if buyers are households and sellers are firms). Buyers have all their surplus exploited while sellers benefit from exclusive deals. In our model with two-sided markets, exclusive deals always lead to complete foreclosure, reflecting that all sellers sign exclusive deals so there is no reason for buyers to multihome. Moreover, sellers may be the strongest supporters of exclusive deals in this setting.

Throughout the paper we assume consumer expectations that minimize the scope for coordination failures amongst consumers. For instance, the coordination failure in the existing naked exclusion literature, in which consumers signing contracts would do better if they could coordinate on an equilibrium that allows for entry does not arise in our setting. Despite this, consumers in aggregate are still worse off as a result of exclusive deals. In a one sided setting, this reflects the ability of the incumbent to divide consumers' interests, by making an attractive offer to a limited number of users initially, and then exploiting the remaining users in the subsequent competition stage. In two sided markets, this strategy arises even more naturally, due to the inherent segmentation of consumers into two groups.

The frequent use of exclusive contracts in markets with network effects has been documented by Balto (1999) and Shapiro (1999). They provide detailed discussions of exclusionary actions in a number of these markets, including ATM networks, computer reservation systems, credit card networks, floral delivery networks, Pay-TV, video game systems and the market for wire money transfers. Here we briefly note two such examples, both of which suggest exclusive dealing may play an anticompetitive role in network industries (the example of Pay-TV is discussed in Section 6).

The Florist Telegraph Delivery (FTD) network developed in the 1940s so that people could send flowers to distant locations through other member florists. It enjoyed the participation of the majority of large florists. To prevent florists trying to develop their own networks, FTD adopted an exclusionary rule that florists could only be members if they did not belong to any other such network. In the face of strong network effects, these exclusive membership rules made it difficult for new networks to offer their customers a comparable service. Only once the Antitrust Division and the FTD entered into a consent decree in 1956, in which the FTD dropped its exclusive membership rule, did other floral networks such as AFS and Teleflora emerge. This decree still remains in effect — in fact, in 1995 it resulted in an Antitrust Division action over FTD's incentive program "FTD only" which was also deemed to have a similar exclusivity effect.

In the video game industry, Nintendo became a hit in 1985 with its popular Nintendo Entertainment System. It, however, maintained tight control over game developers. Among other things, it required game developers to make their games exclusively available on its system for two years following their release. Developers of hit games therefore preferred to produce them for Nintendo rather than its rivals (Atari and Sega), given Nintendo's much larger installed base of users at the time. As a result, consumers had no reason to swicth to one of the rival systems. Shapiro (1999, p.4) notes that Nintendo dominated the video game business from 1985-1992 and that its "*grip on the market relaxed only after it abandoned these practices in the face of antitrust challenge*". Our models provide formal settings to consider such claims.

The rest of the paper proceeds as follows. Section 2 provides a brief discussion of how our paper relates to the existing literature. Section 3 develops our basic framework. Subsequent sections consider the case of a one-sided market where multihoming is not feasible (Section 4), the case of a one-sided network where multihoming is feasible (Section 5), and the case of a two-sided market where multihoming is feasible (Section 6). We conclude in Section 7.

2 Related Literature

Our paper connects with several related literatures. Bernheim and Whinston (1998) explain the general ability of exclusive deals to be anticompetitive when cross-market links are present. Such cross-market links 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 not to be possible, exclusive deals can be interpreted as simple purchase commitments or introductory offers. These offers are similar to those studied in earlier models of introductory pricing in markets with network effects, such as that of Katz and Shapiro (1986). They assume two different groups of consumers arrive at different times, so firms can set different prices to each cohort of consumers. In our model all consumers are present from the beginning, but we allow the incumbent to limit the number of consumers it sells to in the initial stage, thereby making the number of second-stage consumers endogenous.[1] By attracting a group of consumers at a low price to purchase first (or commit to purchase), the incumbent 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. A key difference with Katz and Shapiro's framework is that they assume both firms can make offers at each stage, whereas we allow the incumbent a first-mover advantage in attracting consumers.

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 may arise in uniform pricing due to expectations favoring one of the firms. We focus on the polar case, considering the ability of an incumbent to use its first-mover advantage to block sales by a rival firm that may otherwise have an advantage due to its more desirable network when expectations are neutral.

Clearly this polar case follows the existing literature on naked exclusion, such as in Rasmusen *et al.* (1991) and Segal and Whinston (2000), in that the incumbent has a first-mover advantage. However, these previous studies rely on scale economies, whereas we rely on demand-side network effects.[2] A key difference is that in their framework, by signing up enough consumers, the incumbent can make it unprofitable for the rival to enter.[3] As a result, the incumbent enjoys a monopoly position with respect to the remaining consumers. This makes exclusion easier than in our framework, where in the absence of any fixed costs, the rival always enters. Thus, unlike the existing literature, in our framework exclusive deals weaken the rival's ability to compete without destroying it altogether. One implication is that when we allow for consumers to multihome, exclusive deals may still allow the rival to sell to some consumers in equilibrium.

None of the models with network effects we have discussed above allow for the possibility that consumers may buy from both firms, and therefore the incentive firms may have to use 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 a symmetric competition game

[1] In the analysis of two-sided markets, the two groups (buyers and sellers) are exogenously determined.

[2] When buyers themselves are instead downstream competitors, exclusion may also be possible without economies of scale, but for quite different reasons. See Abito and Wright (2007) and Simpson and Wickelgren (2007).

[3] A less significant difference is that we assume unit demands rather than elastic demand, so that the source of inefficiency in our model arises solely from consumers buying from the less desirable network rather than from any deadweight loss of monopoly pricing.

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 platforms with considerable market power over one side. Thus, in the absence of exclusive deals, they find a competitive bottleneck equilibrium while 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.

3 The basic model and preliminaries

There are a continuum of identical consumers with mass normalized to one. Two firms, an incumbent I and an entrant E, can produce a network good, each at a cost of $c \geq 0$ per subscriber. The incumbent's price is denoted p_I while the entrant's price is denoted p_E. The incumbent offers a network which provides a benefit βx when x consumers subscribe to it.[4] Similarly, the network benefit offered by the entrant is given by $(\alpha + \beta)x$ when x consumers purchase a subscription to its network. We will assume that the entrant offers a service that yields higher network benefits when the same number of consumers subscribe to each firm. That is, we assume that $\alpha > 0$. Consumers also get a stand alone benefit v from their subscriptions which is assumed to be larger than the cost per subscriber, i.e. $v \geq c$. 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 a net utility of $v + \beta(1 - N_E) - p_I$ buying from I only, $v + (\alpha+\beta)(1-N_I) - p_E$ buying from E only, and $v + \alpha(1-N_I) + \beta - p_I - p_E$ if they multihome. Due to positive network effects, efficiency is highest when all consumers buy from the same firm. From a welfare perspective, this should be the entrant.

The timing of the game is as follows. In stage 1, I makes an initial offer to a set of the consumers and announces whether this offer is exclusive or not (that is, it prevents consumers buying from E in stage 2).[5] Viewing this offer, the consumers receiving the offer decide whether to accept it or not. In stage 2, both I and E announce their price and whether their offer is

[4] Throughout the text we will treat "buy", "purchase" and "subscribe" as synonymous. Each consumer needs to buy only one subscription from a firm to get the benefits the firm (with its particular customer base) offers. For example, this may involve having access to the firm's other customers. When consumers multihome in order to "access customers of both firms", they have to buy a subscription from each of the two firms.

[5] By allowing the incumbent to make an offer to consumers prior to the competition with the entrant, we have in mind a situation where two rivals are introducing a new network product that has already been developed, but that one firm has a head-start in reaching the market.

exclusive or not. Consumers that have not previously signed up to an exclusive deal can then buy from one or the other firm (or both, if allowed). There is no discounting and consumers only consume at one point in time.

We denote (generically) I's price in stage 1 with p_1. We allow the incumbent a limited form of price discrimination in stage 1 — we assume it can limit the number of consumers that can take up its first stage offer, which it could do with an introductory offer (say, using a first-come first-served rule). The corresponding number of consumers accepting the first stage offer of I is denoted by n_1.[6] This turns out to be sufficient to illustrate the power of exclusive deals in our framework. At the end of section 4, we will briefly discuss what happens if the incumbent can offer more sophisticated deals.

The model of singlehoming 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 in section 5, we distinguish these two types of offers. Stage 1 offers that require consumers to buy (or commit to buy) I's product are referred to as introductory offers. When offers, at either stage, also require the consumers 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 in competition games with pure network effects, there may be multiple consistent demand configurations for a given set of prices offered by firms. 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 can also be 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 that 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 in the literature on network effects. These are often referred to as rules about how consumers form expectations.[7] The three are: (1) expectations

[6] If new consumers are allowed to enter in stage 2, then such limited offers would not be necessary to obtain our qualitative results provided there are not too many new consumers for the entrant to attract. However, the incumbent may still do better by limiting the number of consumers receiving offers in the first stage.

[7] See Farrell and Klemperer (2006) for a discussion of the relevant literature and different rules to describe consumer 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. 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.[8] In the competition stage, these beliefs also provide the closest analogy to the homogenous Bertrand competition assumed in the existing naked exclusion literature. We will 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 set a slightly lower price to attract the consumers, obtaining almost the same profit (note that I cannot profitably do the same). 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.

4 Results with singlehoming

In this section, we consider one-sided networks assuming that multihoming is not allowed. Our primary purpose is to show that we can get similar, although not identical, results to those obtained in standard naked exclusion models which focus on economies of scale rather than demand-side network effects. Thus, this section is a point of connection between the existing literature and the analysis which follows in sections 5 and 6 in which buyers are allowed to

[8] Although we use a less stringent condition to define it, the optimal coordination equilibrium we focus on in our model turns out to be a coalition proof equilibrium as introduced in Bernheim *et al.* (1987).

multihome.[9]

Whether multihoming is possible or not in practice may come down to technical considerations. In some cases it may not be practical for consumers to multihome (for instance, most consumers would not consider running two separate operating systems such as Linux and Microsoft Windows). In other cases, it may be prohibitively expensive to do so, which will be the case if c is sufficiently large.[10]

We start by characterizing the equilibrium in the second stage assuming that n_1 consumers buy from I in stage 1. Figure 1 displays the different consistent demand configurations in stage 2 given n_1. Lemma 1 establishes that the points highlighted by a solid dot in figure 1 represent the equilibria of the stage 2 subgame.

Lemma 1 *Define $\bar{n}_1 = \frac{\alpha}{\alpha+\beta}$. If $n_1 > \bar{n}_1$, then the incumbent makes all the sales in stage 2 and the equilibrium prices are given by $p_I = c + \beta - (\alpha + \beta)(1 - n_1)$ and $p_E = c$. If, on the other hand, $n_1 \leq \bar{n}_1$, then the entrant makes all the sales in stage 2 and equilibrium prices are $p_I = c$ and $p_E = c + (\alpha + \beta)(1 - n_1) - \beta$.*

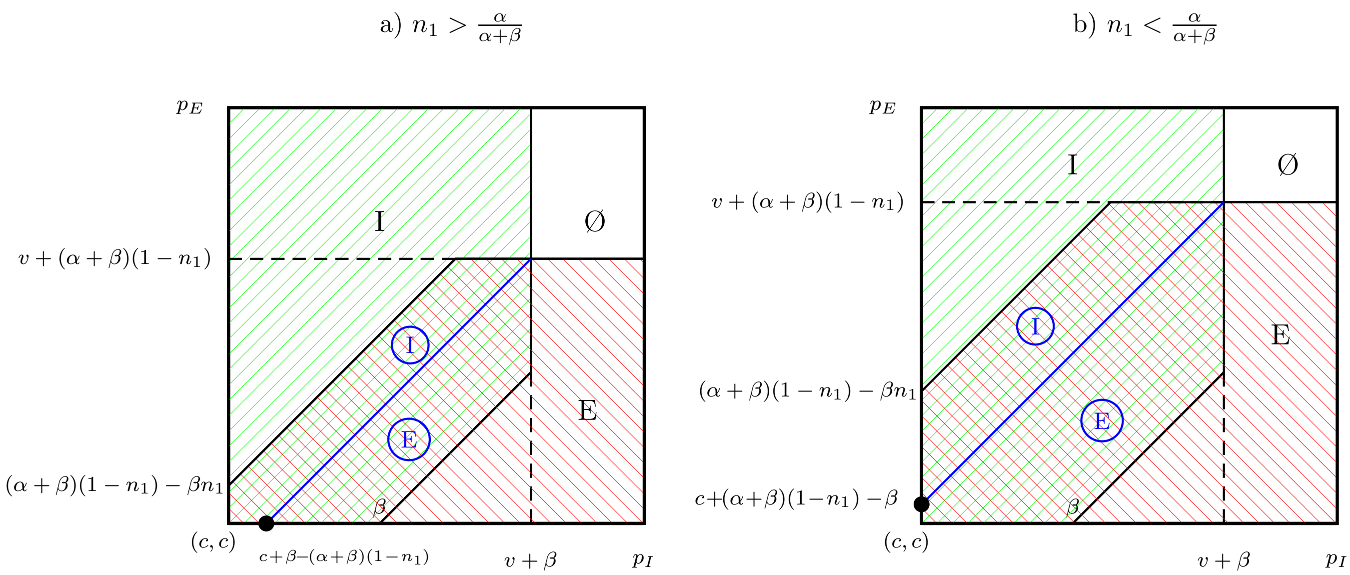
Proof.

As is illustrated in figure 1, provided $p_I \leq \min\{\beta + p_E, v + \beta\}$, there is a consistent demand configuration in which all unattached consumers buy from I in stage 2, denoted configuration I. Likewise, provided $p_E \leq \min\{(\alpha+\beta)(1-n_1) - \beta n_1 + p_I, v + (\alpha+\beta)(1-n_1)\}$, 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 firm as configuration $\emptyset$). Subject to prices being in the range where both configurations I and E apply, optimal coordination by consumers implies they will buy from I in stage 2 if $p_I < p_E + \beta n_1 - \alpha(1 - n_1)$, will buy from E if $p_I > p_E + \beta n_1 - \alpha(1 - n_1)$, and are indifferent if $p_I = p_E + \beta n_1 - \alpha(1 - n_1)$. Provided that $n_1 > \bar{n}_1$, I can charge a price at least as high as E and still get all the consumers. As competition forces E's price to cost, the equilibrium is obtained when $p_I = c + \beta n_1 - \alpha(1 - n_1) > c$ and $p_E = c$, with all consumers buying from I. On the other hand, whenever $n_1 < \bar{n}_1$, 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 $p_I = c$ and $p_E = c + \alpha(1 - n_1) - \beta n_1$ with all free consumers buying from E.

[9]Moreover, readers may find it useful to go through the proofs of lemma 1 and proposition 1 in this section, which introduce in a simple setting the more general methodology that will be used in sections 5 and 6.

[10]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 in case they multihome.

Figure 1: Demand equilibrium in lemma 1



Finally, if $n_1 = \bar{n}_1$, then both firms will compete price down to cost, with all consumers buying from E given our tie-breaking assumption. ■

The critical value of n_1 defined in lemma 1 is the value at which $\beta = (\alpha+\beta)(1-n_1)$. At this value of n_1, the line that separates the regions of prices where optimal coordinators select the incumbent or the entrant starts from the origin in both panels of figure 1. Thus, as neither firm has any competitive advantage, price competition results in marginal cost pricing as in the standard Bertrand model. For higher n_1, as in panel (a) of figure 1, consumers get lower network benefits joining E than joining I. This implies that the incumbent has a competitive advantage and can raise its price without losing demand up to the point where this competitive advantage is fully exploited — the point highlighted on the p_I axis with a solid dot. On the other hand, for lower n_1 as in panel (b) of figure 1, E offers greater network benefits, even though it has n_1 fewer consumers. Once again, the entrant can raise its price without losing demand up to the point where this competitive advantage is fully exploited — indicated by the solid dot on the p_E axis in panel (b) of figure 1. Thus, whichever firm offers greater total network benefits is able to capture all remaining demand in stage 2. Therefore, by signing up enough consumers in stage 1, I can reduce the network benefits of E's network to the point that it more than offsets E's intrinsic advantage. The remaining consumers then prefer to join I over E at equal prices. However, note that, if E's advantage is large, then I has to sign up a large proportion of consumers to achieve this outcome.

Next we turn to stage 1. In order to attract any consumers at stage 1, the incumbent must offer them at least $v + \beta - c$, which is what they can obtain waiting till stage 2 and enjoying competition between I and E. Bertrand-type competition means that the entrant is only able to extract α, its network advantage, in the case no one signs with the incumbent in stage 1. Thus, consumers will only accept an offer in stage 1 if $p_1 < c$. This leaves I with a loss in stage 1. Clearly, the incumbent will not make any introductory offers incurring a loss unless it can make some profit on consumers in stage 2. This suggests that it will not want to make an introductory offer to all consumers in stage 1 since then there will be no consumers left to exploit in stage 2. The situation where I is not allowed to limit the number of consumers receiving its first-stage offers provides a benchmark result in which (i) no one signs with I, (ii) E makes all the sales in stage 2 at a price of $p_E = c + \alpha$ and (iii) consumers are left with a total surplus of $CS_0 = v + \beta - c$. Since $\alpha > 0$, this is the first-best outcome. In contrast, the incumbent can make a positive profit by restricting the number of consumers that are allowed to sign up in stage 1.[11]

Proposition 1 *If consumers are optimal coordinators, multihoming is not allowed and the incumbent can limit the number of consumers buying in stage 1,* $n_1^* = \frac{1}{2} + \frac{\alpha}{2(\alpha+\beta)}$ *consumers will buy from the incumbent in stage 1 at the price of* $p_1 = c$*, and the rest of the consumers will buy from the incumbent in stage 2 at the price* $p_I = c + \frac{\beta}{2}$*. The entrant makes no sales. The outcome is inefficient, with consumer surplus lower than in the benchmark case without introductory offers.*

Proof.

I sets a price p_1 to n_1 consumers in stage 1. If they all reject, the second stage equilibrium implies all consumers get a utility of $v+\beta-c$ buying from E (I then gets zero profit). If instead n_1 consumers accept the offer, they get $v + \beta - p_1$ buying from I provided $n_1 > \bar{n}_1$, so that from lemma 1, I will sell to all the remaining consumers in stage 2. Thus, I can attract the n_1 consumers with minimal loss by setting $p_1 = c$. This gives it a profit of

$$\Pi_I(n_1) = (\beta - (\alpha + \beta)(1 - n_1))(1 - n_1)$$

which is a concave function of n_1 and attains its unique maximum at $n_1^* > \bar{n}_1$. The profit of I

[11] A similar result holds even with growing markets, provided that there are not more than $1 - \bar{n}_1 = \frac{\beta}{\alpha+\beta}$ new consumers in stage 2. With only a limited (but positive) number of new consumers in stage 2, lemma 1 implies the incumbent could profitably use an introductory offer even if the offer has to be made to all stage 1 consumers.

in this equilibrium is given by

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

This is an inefficient outcome given $\alpha > 0$. Moreover, all consumers would be better off if introductory offers were eliminated. Compared to the benchmark without introductory offers in which consumer surplus is $v + \beta - c$, consumers who receive the introductory offer get the same surplus while the surplus of those who miss out is lower by $\frac{\beta}{2}$. Total consumer surplus is

$$CS_1 = v + \beta - \frac{\beta^2}{4(\alpha+\beta)} - c < CS_0.$$

■

Proposition 1 shows the incumbent will prevent the efficient entrant 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 further 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 that sign 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 more efficient entrant. Nevertheless, the consumers who buy in stage 2 are hurt and lose $\frac{\beta}{2}$ each. This loss aggregated over second stage buyers is transferred to the incumbent as profits, as defined in (1).

Our proposition 1 is similar in nature to the proposition 3 of Segal and Whinston (2000), where an incumbent who can price discriminate can successfully exclude a rival even when consumers can coordinate on their most preferred outcome. In their model the incumbent sells to enough consumers so that the rival will not want to enter, and then exploits the rest of the consumers as a monopolist. In our model, the entrant is always present in the second stage, so the incumbent can only obtain its network benefit advantage as second stage profits. This makes it harder for the incumbent to benefit from exclusion in our model. The incumbent can increase its network benefit advantage only by ensuring more consumers take up its introductory offer. However, each such customer reduces the size of the customer base that it can later exploit. In our singlehoming model, the design of the introductory offer balances these opposite forces.[12]

If we add scale economies to our model, the focus becomes somewhat different. The point of signing up buyers in stage 1 will be 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 the effect of the reduction

[12]In the models with multihoming, additional considerations will come into play.

in demand for the entrant's product. Compared to the case without fixed costs, the incumbent will now make introductory offers to fewer consumers, signing up only as many buyers in stage 1 as are necessary to cause the entrant to stay out. Since the entrant already obtained no profit in stage 2 competition in our analysis without fixed costs, adding a fixed cost to the entrant's profit will mean it will stay out even if less than $\bar{n}_1$ buyers sign in stage 1.

An interesting feature of the result above is that even if the fixed cost facing the entrant is very close to zero, the mere existence of such fixed costs can still matter a lot for the profitability of the incumbent's introductory offers. 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 $c + \beta/2$. Small entry costs can therefore amplify the negative impact of introductory offers or exclusive deals on consumers when there are network effects. Equivalently, consistent with the conjecture of Shapiro (1999), 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.

While the pricing policy in proposition 1 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, with each offer in the sequence depending on the uptake of previous offers. That is, suppose the incumbent can order consumers and make a sequence of offers, one to each consumer in turn in stage 1. For simplicity, let us assume that the second stage competition 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 $p_I = c + \beta$. The first consumer that is made an offer knows that if she 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 $p_I(t, y) = \max[c, c+\beta(1+y-t)-(\alpha+\beta)(t-y)]$. 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 deals can be made, consumers are left with just the stand-alone surplus $v-c$.

If consumer surplus is weighted more highly than profits (e.g. to capture that demand is elastic in practice), this is the least desirable outcome from a welfare perspective. However, such complicated sequential contracts seem unrealistic in most applications. Instead, we restrict our attention to simple limited offers in what follows since (i) this setting captures similar insights to those obtained without limited offers but allowing for some new consumers to arrive in stage 2, (ii) this setting also captures the key insights obtained by analyzing more sophisticated forms of price discrimination, and (iii) it would be particularly difficult to prevent the incumbent from making these simple limited offers (which it could do by making an introductory offer on a first-come first-served basis).

5 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 are studied by among others, Armstrong (2006), Armstrong and Wright (2007), 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 $v > c > 0$.

There are two types of multihoming in our setting. First, attached consumers that join with I in stage 1 may also want to join E in stage 2. Second, unattached consumers may want to join both I and E in stage 2. To keep the model from getting unnecessarily complicated, we require each firm to announce a single price and whether its offer is an exclusive one or a non-exclusive one. Exclusive offers involve an exclusivity condition in which consumers purchasing agree not to also purchase from the rival. On the other hand, the non-exclusive offer of a firm does not prohibit a consumer purchasing from the other firm as well. For example, the entrant can make its offer exclusive in stage 2, so that unattached consumers have to either buy from it or from 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. Notice that as soon as one firm makes its offer exclusive, it rules out multihoming and so the other firm's offer is also, in effect, exclusive.[13]

[13]We have also explored the more general situation in which each firm can make two offers: one exclusive and one non-exclusive. This significantly lengthens the formal analysis but the qualitative results and mechanism to support them turns out to be quite similar. Details are available from the authors upon request.

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 some 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.

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

Proof.

Since the result is very intuitive, here we just provide a sketch of the proof. The supplementary appendix provides the full details.

Given E has no cost of production but offers a more desirable network, Bertrand style competition will imply everyone will buy from E in stage 2 competition. This is true, regardless of whether they have already purchased from I in stage 1. However, with everyone buying from E in stage 2, there is no reason for unattached consumers to buy from I in stage 2. In other words, all unattached consumers will buy only from E, while those consumers who have bought from I multihome, buying also from E in stage 2.

In the resulting stage 2 equilibrium, E cannot charge above α, otherwise I could always set a small enough positive price to profitably attract all buyers. However, for any price $p_I > 0$, E has an incentive to increase its price above α. Thus, the unique equilibrium (given our expectation rule) arises when $p_I = 0$ and $p_E = \alpha$. In this 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 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 $p_1 < 0$. However, this implies a loss for I, thus it will not make such an offer and no one will buy from I in either stage. In equilibrium, all consumers obtain a surplus of β buying from E in the second stage, while E earns a profit of α. Thus, the aggregate welfare is given by $\alpha + \beta$ implying an efficient outcome. ■

Proposition 2 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 a critical role here. No matter how many consumers accept an introductory offer from the incumbent in the first stage, they will also want to buy from the entrant in stage 2, given that it offers greater network benefits. By doing so they can obtain some additional network benefits. Given that the attached consumers multihome, the unattached would also prefer to subscribe to the entrant's network for a reasonable price. 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 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.

This result shows that exclusivity plays a genuine role when multihoming is possible. Due to the ability of consumers to multihome, the incumbent cannot block sales by a more efficient entrant using only introductory offers together with price discrimination. The result remains true even if the potential entrant faces a fixed cost of entry. Provided entry is efficient (which requires the fixed cost to be less than α), entry will be profitable. As we will see below, an exclusivity clause in the introductory offers is required to restore second stage profits for the incumbent. Thus, proposition 2 provides a proper benchmark with which to compare the effects of exclusive deals. This benchmark involves a competitive and efficient outcome.

We now turn to our main result in the case of one-sided markets — the case where firms can employ exclusive deals and consumers can multihome. The exclusive contracts allow a firm to make its offer conditional on consumers not buying from its rival.

Proposition 3 *When firms can employ exclusive deals, consumers can multihome 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.*

For $\alpha \leq \beta$, there are two subgame perfect exclusive dealing equilibria:

a. ***Singlehoming equilibrium:*** *The incumbent offers an exclusive deal to $n_1^* > \bar{n}_1$ consumers in stage 1. In stage 2 equilibrium prices are $p_I^* = \frac{\beta}{2}$ and $p_E^* = 0$, with both firms making their offers exclusive. The incumbent sells to all consumers.*

b. ***Multihoming equilibrium:*** *The incumbent offers an exclusive deal to half of the consumers in stage 1. In stage 2 equilibrium prices are $p_I^* = \frac{\beta}{2}$ and $p_E^* = \frac{\alpha}{2}$, with both firms making their offers non-exclusive. All unattached consumers multihome in stage 2.*

A forward induction argument selects the multihoming equilibrium in part b.

For $\alpha > \beta$, the multihoming equilibrium described in part b is the unique subgame perfect equilibrium.

A ban on exclusive deals increases consumer surplus and welfare regardless of which equilibrium is played.

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 some consumers exclusively in stage 1. It turns out that in this case there are two equilibria in stage 2. In step three, we then derive the corresponding subgame perfect equilibrium for each second stage equilibrium that could be played. When $\alpha \leq \beta$ we have to deal with multiple subgame perfect equilibria. For this case, we also present a forward induction argument which suggests the multihoming equilibrium in part b as the more reasonable outcome for the full game. This is step four. Finally, step five concludes by summarizing the implications of the resulting equilibria.

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

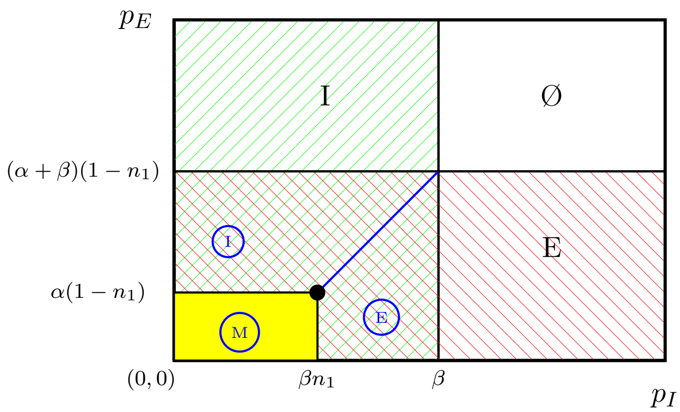
If no one signs in stage 1, then we know by the same logic as used in proposition 2, E will attract all users at the price $p_E = \alpha$ in stage 2. That logic did not rely on unattached consumers multihoming in stage 2, so exclusive deals play no role in this case.

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

Suppose that n_1 consumers have accepted an exclusive offer in the first stage. There are four possible sets of stage 2 offers which may arise in equilibrium: (i) both firms 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. It is straightforward to show that cases (iii) and (iv) can not be part of an equilibrium, since the firm which makes its offer exclusive can always profitably deviate making its offer non-exclusive and increasing its price appropriately to extract some more surplus from the consumers by allowing them to multihome. We proceed to characterize the possible equilibria arising in the subgames characterized by (i) and (ii).

(i) When first stage consumers sign exclusive deals and firms make their offers exclusive in stage 2, no firm can do better by making their offers non-exclusive given consumers cannot multihome when the other firm's offer remains exclusive. The competition game in stage 2 becomes exactly the same as the one analyzed in lemma 1 and consequently, the equilibrium outcome defined there prevails in the present case as well.

Figure 2: Second stage demand equilibrium in proposition 3 with nonexclusive offers



(ii) Let us now consider the situation in stage 2 in which neither firm makes its offer exclusive. Since only unattached consumers have a choice to make in stage 2, there are only four possible consistent demand configurations: unattached consumers multihome (configuration M) if $p_I \leq \beta n_1$ and $p_E \leq \alpha(1-n_1)$; unattached consumers buy from I (configuration I) if $p_I \leq \beta$ and $p_E \geq 0$; unattached consumers buy from E (configuration E) if $p_I \geq \beta n_1$ and $p_E \leq (\alpha+\beta)(1-n_1)$; and finally, unattached consumers do not buy from either firm (configuration Ø) when $p_I > \beta n_1$ and $p_E > 0$. Using our expectations rule, we select the configuration which maximizes the joint surplus of those consumers making a choice, in this case, the unattached consumers. Notice that whenever multihoming is an equilibrium, it also yields the highest joint surplus, and thus will be selected by optimally coordinating consumers. On the other hand, whenever multihoming is not an equilibrium and both configurations I and E are consistent demand configurations, optimal coordinators buy from E whenever

$$p_E \leq (\alpha+\beta)(1-n_1) - \beta + p_I, \tag{2}$$

and I otherwise. The selected configurations, which defines demand uniquely for given prices, are illustrated in figure 2.

Given these demands, it is straightforward to see from figure 2 that the unique equilibrium with non-exclusive offers in the second stage arises when $p_I = \beta n_1$ and $p_E = \alpha(1-n_1)$, the point highlighted with a solid dot. At these prices and given that unattached consumers multihome, neither firm can increase its demand by charging a little less, 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 equilibrium level since it will not lose any demand. For price pairs which are 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.

Another possible way for each firm to deviate would be to deviate to an exclusive offer. If, for example, E were to make its offer exclusive, while I kept its offer non-exclusive and charged the corresponding equilibrium price, E can sell to all unattached consumers by charging $p_E \leq \alpha(1 - n_1)$ from (2). Thus, E cannot increase its profits by making its offer exclusive and adjusting its price accordingly. Similarly, I should charge $p_I < \beta n_1$ in order to make exclusive sales to all unattached consumers. Hence, I cannot improve its profits by deviating to an exclusive offer either.

3. *Subgame perfect equilibria*

As we have now established, for any $0 < n_1 < 1$, there are two possible stage 2 equilibria. In one, both firms make non-exclusive offers and there is multihoming. We call this the multihoming equilibrium. On the other hand, there is another equilibrium in stage 2, which we call the singlehoming equilibrium, where both firms make exclusive offers and depending on the value of n_1, either E or I serves all of the second stage consumers. Clearly, I will not select $n_1 < \bar{n}_1$ in the first stage if it expects the singlehoming equilibrium in stage 2. In this case, we know from proposition 1 that the optimal number of consumers I will sign to exclusive deals is given by $n_1^* = \frac{1}{2} + \frac{\alpha}{2(\alpha+\beta)} > \bar{n}_1$. This yields I the profits as given in (1).

If I expects instead the multihoming equilibrium in stage 2, the exclusive deal that would induce the n_1 consumers in the first stage to accept must be priced at zero. (If consumers reject the first stage exclusive offer, they will all buy from E at a price of α and obtain a surplus of β.) In this case, the profit of I is given by $\beta n_1 (1 - n_1)$. This profit is uniquely maximized by offering exclusive deals to half of the consumers. That is, $n_1^* = \frac{1}{2}$ yielding a profit of $\frac{\beta}{4}$ to I.

In order to support either of these outcomes in equilibrium, we need to show that I does not have an incentive to offer a non-exclusive deal in the first stage. We know from proposition 2 that if I uses introductory rather than exclusive deals in stage 1, then in stage 2 E will attract all users at the price $p_E = \alpha$ yielding a profit of zero to I. 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. Moreover, the logic in proposition 2 did not rely on unattached consumers multihoming in stage 2, so exclusive deals cannot be profitably used by I in stage 2 either. Thus, I must make its stage 1 offer exclusive to obtain a positive profit.

4. *Forward induction and the multihoming equilibrium*

For sufficiently small α such that $\bar{n}_1$ is less than one half,[14] and provided I offers exclusive deals in stage 1 so that $n_1 > \bar{n}_1 = \frac{\alpha}{\alpha+\beta}$, we have established that there are two second stage equilibria in which I makes sales, one where I and E make exclusive offers (the singlehoming equilibrium), and one where I and E make non-exclusive offers (the multihoming equilibrium). Here we provide a justification to select the multihoming equilibrium.

Regardless of whether I sets $n_1 = \frac{1}{2}$ or $n_1 = \frac{1}{2} + \frac{\alpha}{2(\alpha+\beta)}$ in stage 1, the multihoming equilibrium gives each firm higher profits. Moreover, by choosing $n_1 = \frac{1}{2}$ in stage 1, I can signal it intends to play the multihoming equilibrium in stage 2. I would not set $n_1 = \frac{1}{2}$ if it had intended to play the singlehoming equilibrium in stage 2 since it would then have preferred to set a higher n_1. Given this, E should expect I to make its offer according to the multihoming equilibrium which will induce E to make a non-exclusive offer as well. Based on this forward induction argument, the subgame perfect equilibrium which involves multihoming in the second stage seems to be the more reasonable equilibrium selection.

Also note that, if $\alpha > \beta$ then $\bar{n}_1 > \frac{1}{2}$. In this case, since the multihoming equilibrium always yields higher profits to I than the singlehoming equilibrium, I will choose $n_1 = \frac{1}{2}$ and follow with the second stage non-exclusive offer with a price of $\frac{\beta}{2}$. E will best respond with a non-exclusive offer priced at $\frac{\alpha}{2}$. Thus, for $\alpha > \beta$ the unique subgame perfect equilibrium turns out to be multihoming equilibrium and the forward induction argument is not needed.

5. *Summary of equilibrium properties.*

We now compare the multihoming and singlehoming equilibria to the benchmark case, presented in proposition 2, where exclusive deals were not feasible or not allowed at either stage.

a) In the singlehoming equilibrium, $n_1^* > \frac{1}{2}$ consumers get β, and the rest get $(\alpha+\beta)(1-n_1^*) = \frac{\beta}{2}$ for a total consumer surplus of $CS_1 = \beta - \frac{\beta^2}{4(\alpha+\beta)}$. The aggregate welfare in this case is β. The incumbent's profit increases from zero to $\frac{\beta^2}{4(\alpha+\beta)}$, while the entrant's profit drops to zero from α. The aggregate welfare is lower by α.

b) In the multihoming equilibrium, I's profit increases from zero to $\frac{\beta}{4}$ and E's profit decreases from α to $\frac{\alpha}{4}$. Previously, without exclusive deals, all consumers obtained 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 $\frac{\beta}{2}$, implying a total consumer surplus of $CS_4 = \frac{3\beta}{4}$. The total welfare in the multihoming equilibrium is given by $\beta + \frac{\alpha}{4}$. As a result of exclusive deals, consumer surplus is lower by $\frac{\beta}{4}$ and welfare is lower by $\frac{3\alpha}{4}$.

[14] This will be the case if $\alpha \leq \beta$, in which case $\bar{n}_1 \leq \frac{1}{2}$.

Hence, the consumer surplus in a singlehoming equilibrium with exclusive offers is higher than that of a multihoming equilibrium since $CS_1 - CS_4 = \frac{\beta\alpha}{4(\alpha+\beta)} > 0$. In contrast, the welfare in a multihoming equilibrium is higher than the welfare of β in a singlehoming equilibrium with exclusive offers. Consequently, in both types of equilibria, the aggregate welfare is reduced when compared with an environment where exclusive deals are banned. ■

Proposition 3 shows that offering exclusive deals is an effective way for the incumbent to maintain its presence in the market even though it offers a less desirable network and even though consumers are optimal coordinators. In the equilibrium selected in proposition 3, we found that by signing up some consumers exclusively in stage 1, the incumbent causes the remaining consumers to multihome in stage 2. They multihome in order to reach the consumers who are exclusively on the incumbent's network and to take advantage of the entrant's more desirable network. Firms do not have to compete for these multihoming consumers, allowing the incumbent to make a positive profit in stage 2. This means the incumbent can extract the full network benefits that the unattached consumers get from being able to reach its signed consumers. Since there are n_1 signed consumers and $1 - n_1$ unattached consumers, and since the sale of the exclusive contracts to first stage consumers yield no revenues, the incumbent maximizes its profit $\beta n_1 (1 - n_1)$ by signing half of the consumers and exploiting the other half. As we have already noted, this outcome not only harms consumers but also transfers some rents from the entrant to the incumbent, yielding a lower aggregate welfare when compared with a market where exclusive deals are banned.

In equilibrium, 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 multihoming equilibrium does not involve exclusive dealing in stage 2, so that such a ban would be futile.

Although our foreclosure result in the multihoming equilibrium is only partial, the degree of foreclosure found would likely be sufficient for the behavior to be found illegal. In the key Supreme Court decision on exclusivity (*Tampa Electric Co. v. Nashville Coal Co.*), the court emphasized that exclusive dealing should involve a substantial share of the relevant line of commerce to be considered a restraint of trade (Balto 1999, p.552). Balto notes "*the ultimate issue in an exclusivity case is the degree of foreclosure*". Based on an analysis of cases, he argues that when exclusive contracts involve less than 30% of the market, no violation is found, while foreclosure is likely to be sufficient when it is greater than 50%, the degree of foreclosure our model predicts.

This result complements the naked exclusion literature by providing a mechanism whereby ex-ante exclusive deals are used in a market that is served by multiple firms later on. We predict an outcome which involves unattached consumers buying from both firms ex-post, making the detection of the adverse effects of exclusive deals more difficult. Even though a significant portion of the market is foreclosed to the entrant, the fact that there are multiple firms in the market could be used to argue that there is still effective competition. However, as proposition 3 shows, this interaction between firms does not yield a competitive outcome.

The game implied by our model admits two subgame perfect equilibria for sufficiently low values of α. Both of these equilibria suggest a role for exclusive deals in the first stage, although the market outcomes that follow are significantly different. For the reasons given in the proposition, we have focused on the multihoming equilibrium. On the other hand, the more traditional result of full foreclosure arises if firms instead select the singlehoming equilibrium, in which they make exclusive offers to consumers in stage 2. The outcome implied by such an equilibrium has qualitatively similar properties. Welfare and consumer surplus are both lowered by exclusive dealing. Furthermore, in such an equilibrium, welfare is also lower when compared with that of the multihoming equilibrium. However, whenever exclusive deals are not banned in stage 1, consumers are better off in an equilibrium where firms compete with exclusive offers in stage 2.

This result clearly presents a policy challenge for an antitrust agency whose mandate requires protecting consumers while maximizing some measure of aggregate welfare. Facing a fully foreclosed market in the singlehoming equilibrium, traditional antitrust policy would suggest an investigation, and most likely recommend banning such deals. But by banning second stage exclusive deals, without preventing earlier exclusive deals that are made in stage 1, would give rise to the multihoming equilibrium which raises aggregate welfare but leads to lower consumer surplus. Our results suggest that a ban on exclusive deals may need to be retroactive. For such a ban to yield benefits for consumers, agreements that were made at an earlier time should be annulled.

6 Two-sided markets

In this section, we extend the previous framework to analyze exclusive dealing in two-sided markets. Models of two-sided markets have been developed by Armstrong (2006), Caillaud and

Jullien (2001, 2003) and Rochet and Tirole (2003, 2006) among others. Many of the network industries where exclusive dealing raises concerns can actually be characterized as two-sided markets. An important set of examples is content provision for entertainment or communication platforms such as Pay-TV and video-games. The use of exclusive deals by Nintendo was noted in the introduction. By having games exclusively on its platform, Nintendo could then attract consumers more effectively. A similar case arises for Pay-TV. (A recent example from the Singaporean Pay-TV market is discussed below).

In sections 4 and 5, we have established that an incumbent needs to be able to price discriminate (at a minimum by limiting the number of consumers benefiting from exclusive deals) in order to profit from such offers. In a two sided market such discrimination is natural due to the fact (i) users are exogeneously divided into two groups and (ii) there is usually no practical or legal difficulty in charging different prices to the two groups. Thus, rather than endogenously determining a subset of users who receive low price offers in stage 1 as in our one-sided setting, platforms in a two-sided market can offer different prices to the two groups of users determined exogenously by their types (for example, buyers and sellers) even if they cannot discriminate between users of the same type.

It is also reasonable to assume platforms can only offer exclusive deals to one of the two sides. This assumption is likely to hold if one side represents individual consumers while the other represents 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, Nintendo could not prevent individuals from buying Sega's Genesis console but it could require game developers to only produce their games for its platform. We therefore assume exclusive deals can only be made on one side, which we refer to as the seller side.[15]

Our analysis of exclusive dealing in two-sided markets can be compared to the analysis in Armstrong and Wright (2007), where exclusive dealing is explored as a way of overcoming a competitive bottleneck equilibrium. Caillaud and Jullien (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.[16] Our paper also differs in the expectations assumed. As in the

[15]We have also analyzed a version of the model assuming platforms can offer exclusive deals on both sides. The qualitative results are similar to those below, except that sellers no longer benefit as much from exclusive deals, with the incumbent benefiting more instead.

[16]In a recent paper, Belleflamme and Toulemonde (2007) also develop a similar model of two-sided markets to 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.

The previous model is extended to one in which there are two types of agents, denoted B and S, which we will refer to generically as buyers and sellers. Each type values 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_I^B and p_I^S, and E's prices by p_E^B and p_E^S. The price of incumbent to side i in stage 1 is denoted by p_1^i for $i \in \{B, S\}$. As in the previous section, stand-alone benefits and costs are set to zero. 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 $\beta_B (1 - N_E) - p_I^B$ joining I only, $(\alpha_B + \beta_B)(1 - N_I) - p_E^B$ joining E only, and $\alpha_B (1 - N_I) + \beta_B - p_I^B - p_E^B$ if they multihome. The sellers' benefits can be defined in a symmetric fashion. Naturally, multihoming is only possible when the offers of both I and E are non-exclusive.

An important distinction between the two sided model we develop here and the one sided case we studied in section 5 is the fact that the firms can make their offers discriminatory on the basis of the side a consumer belongs to in the second stage. Moreover, given that these offers can be made exclusive on the seller side, firms can engage in divide and conquer type strategies in the second stage as well. This, of course, changes the nature of competition, and consequently affects the design of offers the incumbent will make in the first stage. All other assumptions are the same as in the benchmark model of Section 3.

Consider first the benchmark case in which platforms cannot make their offers exclusive, although the incumbent can still make introductory offers in stage 1.

Proposition 4 *If platforms cannot discriminate amongst users of the same type, cannot make their offers exclusive at either stage and consumers can multihome, then, in equilibrium, no one will join the incumbent's platform, and all buyers and sellers will join the entrant's platform in stage 2 even if the incumbent can make introductory (but not exclusive) offers. The outcome is efficient.*

Proof.

The logic is similar to that in proposition 2. Suppose first that I does not attract agents from either side in stage 1. Bertrand-type competition implies the only equilibrium in stage 2

one we develop. They use this to study the interplay between inter-group and intra-group externalities. However, they consider only the singlehoming case in order to focus on the effects of the different type of externalities on the equilibrium.

involves $p_I^B = p_I^S = 0$, $p_E^B = \alpha_B$ and $p_E^S = \alpha_S$, with all agents joining E only. If E were to charge more to one side, I would have a profitable divide-and-conquer strategy attracting the other side with a bribe. If I were to charge more in total, then E would want to increase its charge to at least one of the sides. If I were to set a negative price to either side, this would induce unprofitable multihoming. In this equilibrium I makes no profit and E makes a profit of $\alpha_B + \alpha_S$.

The same stage 2 outcome arises even if I attracts one side or both sides in stage 1 with introductory offers. In either case, E will induce agents to multihome but cannot charge them more than $p_E^B = \alpha_B$ and $p_E^S = \alpha_S$ to do so. I will again be left with no profit in stage 2.

Now suppose I makes an introductory offer to all sellers in stage 1. Even if the sellers believe I will attract all buyers in stage 2, I must offer sellers more surplus than they can get if they reject the offer, in which case they get β_S from E as a result of second period competition. So I can only attract sellers in stage 1 by giving a bribe to sellers. The same result holds for an introductory offer to buyers in stage 1. Moreover, as argued above, I obtains no profit in stage 2 by attracting either or both groups in stage 1. As a result, I will never make such offers in the first place. 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, involving $p_I^B = p_I^S = 0$, $p_E^B = \alpha_B$ and $p_E^S = \alpha_S$, with all agents joining E only. ■

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.[17] This reflects that the entrant has a more desirable network and that agents are not only optimal coordinators but also can multihome, so that even if the incumbent could attract one or both groups 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 the two-sided equivalent of proposition 2.[18] Now suppose platforms can offer exclusive deals to sellers.

[17] Similarly, Choi (2006) finds that concerns about the anticompetitive effects of tying may be reduced when consumers can multihome. He also considers a two-sided market context, although given his focus on tying, he treats the exclusivity of content as exogenous.

[18] If instead the platforms offer equal network benefits so that $\alpha = 0$, then other equilibria are possible. For instance, sellers may multihome on one side and buyers split between the two platforms on the other side, as in the competitive bottleneck result of Armstrong and Wright (2006). Interestingly, such equilibria are not possible here since with sellers multihoming, the entrant will always attract buyers exclusively given it offers superior benefits, which will then mean sellers are not willing to pay anything to join the incumbent.

Proposition 5 *If platforms cannot price discriminate amongst agents of the same type, can make exclusive offers at either stage to sellers, and assuming consumers can multihome, 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 surplus of buyers as well as total welfare, while sellers and the incumbent are worse off.*

Proof.

Clearly, if sellers sign exclusively with I in stage 1, then the only second stage equilibrium involves buyers joining I at a price equal to β_B, so that sellers obtain a surplus of $\beta_S - p_1^S$. To determine the price p_1^S at which sellers are willing to sign, we need to first find the second stage equilibrium when sellers do not sign with I.

Consider separately the two cases (i) $\beta_S \geq \beta_B$ and (ii) $\beta_B > \beta_S$.

(i) Suppose sellers do not sign with I in stage 1. The equilibrium in proposition 4, in which all agents join E (only) in stage 2, continues to apply. That is, prices in stage 2 are characterized by $p_I^B = p_I^S = 0$, $p_E^B = \alpha_B$ and $p_E^S = \alpha_S$. Note E does not have to impose exclusivity on sellers in stage 2 to achieve this outcome. Moreover, if I tries to deviate by attracting sellers exclusively, it will have to set $p_I^S < p_E^S - (\alpha_S + \beta_S)$. It can then extract $p_I^B = \beta_B + \min\left(p_E^B, 0\right)$ from buyers. As a result, its profit at these prices will be $\beta_B - \beta_S < 0$, so the deviation is not profitable. Corresponding surplus of the sellers is β_S. Of course, the same equilibrium also holds if E adds an exclusivity condition on sellers. With such a condition, other equilibria are also possible in stage 2. Specifically, E can charge up to β_B less to sellers and accordingly more to buyers without I being able to profitably deviate given to do so I would have to attract sellers exclusively. All these different stage 2 equilibria imply identical profits for the platforms. Thus, the range of equilibria in stage 2 (if agents do not sign in stage 1) imply that the sellers' surplus ranges from β_S to $\beta_B + \beta_S$.

As a result, to get sellers to accept an exclusive deal in stage 1, their surplus of $\beta_S - p_1^S$ must exceed their surplus of waiting and receiving between β_S and $\beta_B + \beta_S$ (depending on which equilibria is played in stage 2). This requires the first stage price p_1^S to be between $-\beta_B$ and 0. Since I extracts all of the buyers' surplus in stage 2, it is willing to offer such an exclusive deal in stage 1. This gives I a profit of between 0 and β_B. The resulting outcome is inefficient as both sides should join E's platform instead. Previously, buyers obtained a surplus of β_B and sellers a surplus of β_S. Now buyers obtain no surplus while sellers get at least as much (possibly more) surplus than before.

(ii) Suppose again sellers do not sign with I in stage 1. If $\beta_B > \beta_S$, then the stage 2 equilibrium in proposition 4 characterized by the prices $p_I^B = 0$, $p_I^S = 0$, $p_E^B = \alpha_B$ and $p_E^S = \alpha_S$ no longer applies. I can bribe sellers with the offer $p_I^S = -\beta_S$ if they join exclusively, and then extract all of the buyers' network benefit β_B. The resulting profit is $\beta_B - \beta_S > 0$. To prevent I using such a divide-and-conquer strategy in stage 2, E will charge sellers $p_E^S \leq \alpha_S + \beta_S - \beta_B - \min\left(p_E^B, 0\right)$ provided they join exclusively. We also require $p_E^S \leq \alpha_S$ to ensure I cannot profitably attract both sides (getting buyers to multihome with a small bribe and attracting sellers exclusively with $p_I^S < p_E^S - \alpha_S$). In addition, we require as before $p_I^B + p_I^S = 0$ and $p_E^B + p_E^S = \alpha_B + \alpha_S$, as well as $p_I^B \geq 0$ (if I offered a negative price to buyers they would multihome causing it to make a loss) and $p_E^B \leq \alpha_B + \beta_B$ (the buyers' participation constraints must be satisfied). Taken together these constraints imply that $\alpha_B + \beta_B - \beta_S \leq p_E^B \leq \alpha_B + \beta_B$ and $\alpha_S - \beta_B \leq p_E^S \leq \alpha_S - (\beta_B - \beta_S)$. The corresponding seller surplus ranges from β_B to $\beta_B + \beta_S$.

As a result, to get sellers to accept an exclusive deal in stage 1, their surplus of $\beta_S - p_1^S$ must exceed their surplus of waiting and receiving between β_B and $\beta_B + \beta_S$ (depending on which equilibria is played in stage 2). This requires the first stage price p_1^S to be between $-\beta_B$ and $\beta_S - \beta_B$. Since I extracts all of the buyers' surplus in stage 2, it is willing to offer such an exclusive deal in stage 1. This gives I a profit of between 0 and β_S. The remainder of the proof follows as in (i) except that now sellers are strictly better off with exclusive deals since their surplus will be at least β_B compared to $\beta_S < \beta_B$ before. This increase in seller surplus comes at the expense of I. ■

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 with sellers prior to facing competition from an entrant, it will indeed do so. 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 the fact that it offers 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, sellers are better off (or no worse off) signing exclusively. Sellers know that given they will want to sign exclusively with the incumbent, buyers will also join the incumbent's platform in stage 2. Having signed sellers exclusively, the incumbent can extract all of the buyers' surplus. As with one-sided markets, the results show that it is the exclusive nature of the incumbent's initial offers that are anti-competitive, not the fact it gets sellers on board before the entrant reaches the market. If the incumbent is not able or not allowed to prevent "sellers" joining both platforms, then the fact that it can make introductory offers does not help it.

Proposition 5 predicts that it is the incumbent and sellers (e.g. content providers) that benefit from exclusive deals, while buyers and the entrant are worse off. For instance, it implies that when Nintendo wrote exclusive deals with developers, this benefited Nintendo and the developers at the expense of consumers and its rivals. The exact distribution of surplus depends on the equilibrium selected in the second stage when no seller signs an exclusive deal in the first stage. This determines the price that must be offered to the sellers to get them to sign an exclusive contract in the first stage. The more aggressively the incumbent is expected to court sellers in the competition stage, the more surplus the incumbent must leave with sellers to get them to sign the original exclusive deal. However, the incumbent cannot commit not to compete aggressively for sellers if it does not sign them initially. It therefore ends up potentially giving away all its surplus to get sellers to sign in the first place.

The minimum surplus sellers will be left with under exclusive dealing is greater if buyers value sellers more than vice-versa. Ironically, this results from the incumbent's ability to use a divide-and-conquer strategy to attract sellers exclusively in order to exploit the more lucrative buyers. To prevent the incumbent from using this strategy, the entrant will leave sellers with at least the buyers' network benefit in the competition stage. As a result, the incumbent has to offer sellers more initially to get them to sign.

One special case of interest is when sellers receive no network benefits ($\alpha_S = \beta_S = 0$). This approximates situations where sellers care primarily about how much money they can raise selling their services to the platform, but not how many buyers they will ultimately reach. In this case, proposition 5 implies a unique equilibrium in which sellers are paid the buyers' network benefits to sign exclusively with the incumbent in the first stage. This is the most the incumbent can offer sellers for signing with it. Interestingly, this seems to fit the Pay-TV setting quite well.

For instance, recently the Media Development Authority (MDA, see *www.mda.gov.sg*) in Singapore investigated the use of StarHub's (the incumbent Pay-TV operator) practice of signing up content providers such as ESPN and HBO exclusively to its network.[19] The main potential entrant, SingTel, the largest telecommunications operator in Singapore, cited these exclusive deals for a lack of interest in entering the market. In May 2006, the MDA issued its decision that "*exclusive carriage agreements do not per se substantially foreclose potential entrants' access*

[19]One obvious difference with our model is that we assume agents are atomistic. However, since our sellers have identical interests and can coordinate, our results carry over to having just a few large sellers. In this regard, it would be interesting to consider what would happen in our model when buyers value some sellers more than others and platforms can discriminate between sellers.

to key content for the Pay-TV market in Singapore" but that it would continue to monitor such agreements.

Since that decision, the MDA worked with SingTel to help it enter the market. However, in the face of SingTel's threatened entry, in late 2006 the incumbent Pay-TV operator StarHub signed a new three-year exclusive deal with English Premier League (EPL), the most popular sports program in Singapore. According to industry insiders, the average cost to StarHub of the exclusive deal worked out to about fourteen Singapore dollars per month per (current) subscriber, not including local production and marketing expenses.[20] This was only slightly less than the price StarHub charged consumers for its entire sports package at the time, which was fifteen dollars per month. This led to claims that it was the threat of SingTel's entry that forced StarHub to pay EPL more for its exclusive deal, and as a result, StarHub would have to raise its subscription fees to consumers. Indeed, these predictions turned out to be true. In July 2007, StarHub announced it would increase its price across the board by \$4, with an additional \$10 added to its sports package. In August 2007, SingTel entered the market. Not surprisingly, there have been renewed calls for a regulatory ban on exclusive deals, especially as negotiations with some other key content providers (such as HBO) are yet to be finalized.

7 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 are reduced by the use of such exclusive deals. We distinguished between one sided and two sided markets.

We began by looking at one sided markets and established that the ability of consumers to buy from both the incumbent and the entrant (i.e. to multihome) changes the nature of the game considerably. In the face of multihoming, 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. This implies a genuine role for exclusivity in markets with network effects (which is not present in the existing models of naked exclusion or in our model without multihoming). Our model predicts that the incumbent will optimally sign up only a fraction of the available

[20]See "Pay TV: Conditions must be right for competition to work". The Straits Times. Nov. 29th, 2006 (H22).

consumers exclusively, allowing the remainder to multihome in the competition stage. Even though the entrant may be only partially foreclosed from the market, such exclusive dealing is still anticompetitive and inefficient.

The analysis is extended to two-sided markets, in which platforms seek to attract two groups of users (buyers and sellers), each of whom values the other. In this context, we allow platforms to make different offers to buyers and sellers, so a natural form of price discrimination arises. Moreover, we adopt the realistic feature that only sellers can receive exclusive deals (e.g. on the buyers' side, Nintendo cannot stop consumers from purchasing rival consoles). When exclusive deals are not offered, the incumbent loses out to the more desirable entrant. The incumbent therefore offers exclusive deals in the first stage, signing up sellers exclusively so as to prevent multihoming, and extracts the full network benefits from buyers. The more efficient entrant is fully foreclosed and welfare is lower. However, unlike the one-sided case, one group of users (i.e. sellers) can end up better off as a result of exclusive deals. This results from the incumbent's ability to run a divide-and-conquer strategy in the competition stage. To prevent this, the entrant has to leave sellers with most of the surplus in the competition stage, which dramatically improves the initial exclusive deals that the incumbent has to offer to attract sellers. In fact, sellers may be the primary beneficiaries of exclusive deals in this case.

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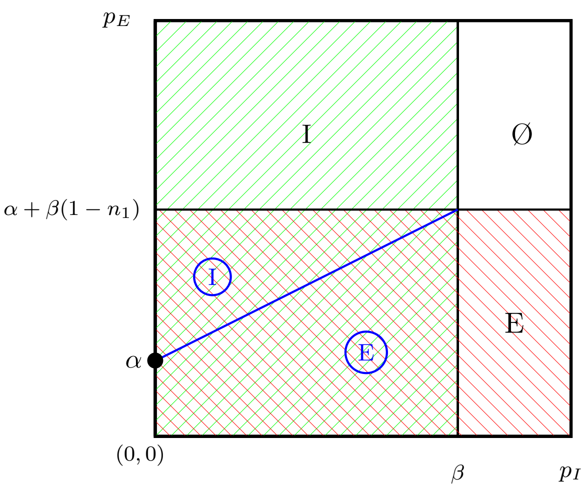
A Supplementary Appendix

A.1 Proof of proposition 2

Figure 3: Second stage demand equilibrium in proposition 2



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 $n_1 > 0$ consumers have accepted a non-exclusive offer from I in stage 1. We first characterize the demand as a function of both prices, and then determine the equilibrium prices in stage 2. We restrict our attention to non-negative prices given a negative price will imply a firm makes a loss in stage 2. Moreover, recall our assumption that $v = c = 0$. Given that both firms' offers are non-exclusive, there are five different consistent demand configurations in the second stage: (i) unattached buy from I and attached do *not* buy from E (configuration I) when $p_I \leq \beta$; (ii) unattached buy from E and attached also buy from E (configuration E) when $p_E \leq \alpha + \beta\,(1 - n_1)$; (iii) unattached multihome and attached do *not* buy from E when $p_I \leq \beta n_1$ and $p_E = \alpha\,(1 - n_1)$; (iv) unattached buy from E and attached do *not* buy from E when $\beta n_1 \leq p_I$ and $p_E = (\alpha + \beta)\,(1 - n_1)$; and (v) no one buys from either firm in stage 2 (configuration Ø) when $p_I > \beta n_1$ and $p_E > 0$.

The configurations in (iii) and (iv) yield lower joint surplus than in case (ii) for the parties making decisions, and thus can be eliminated using the expectation rule that consumers coordinate on the configuration which gives them the highest joint surplus. Both configurations I and E remain when $p_I \leq \beta$ and $p_E \leq \alpha + \beta\,(1 - n_1)$. The expectation rule implies configuration E arises if $p_E \leq \alpha + (1 - n_1)p_I$ and otherwise configuration I arises. If $p_I > \beta$ and $p_E > \alpha + \beta\,(1 - n_1)$, then configuration Ø is the only consistent demand configuration. This defines demand uniquely for any given set of prices. We present how demand varies with prices in figure 3. An important point to note is that n_1 controls the slope of the line separating the regions where consumers optimally coordinate on configuration I or E and not the intercept on the p_E axis. Even when I sells an introductory offer to all consumers in stage 1, the line will cross the p_E axis at $p_E = \alpha$ and will be just a horizontal line implying a comparative advantage for E regardless of the value of n_1.

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, E can lower its price to move to configuration E and obtain a positive profit. Moreover, E cannot charge above α in equilibrium, otherwise I can always lower its price to move to configuration I, obtaining positive demand and profit. However, for any price $p_I > 0$, E has an incentive to increase its price above α. Thus, the unique equilibrium (given our expectation rule) arises when $p_I = 0$ and $p_E = \alpha$, 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 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 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 $p_1 < 0$. However, this implies a loss for I, thus it will not make such an offer and no one will buy from I in either stage. ■