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Abstract

We present a potentially benign naked exclusion mechanism that can be applied to sequential innovation; a non-patentable original innovation by the incumbent supplier fosters derivative innovation by rivals. In the absence of an appropriate legal framework, the original innovator's equilibrium exclusivity contracts block subsequent efficient entry even if there is (leader-follower) competition in the contracting phase. However, the legal framework may maximize social welfare by imposing a ban on upfront lumps-sum payments in exclusivity contracts (by all suppliers) combined with an outright ban on exclusivity contracts by the derivative innovator. The former ban precludes the exclusion of socially beneficial derivative innovation by causing the incumbent supplier to resort to accommodation, rather than to pure exclusion, strategies. The latter ban complements the former by preventing inefficient or excessive derivative innovation.

JEL-Codes: L420, D430, D450.

Keywords: exclusivity, entry, fixed cost, lump-sum payment, sequential innovation.

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1. INTRODUCTION

In naked exclusion models an incumbent supplier exploits the presence of scale economies and fixed costs to block the entry of more efficient competitors into the market (Rasmusen, Ramseyer and Wiley (1991, 2000), Segal and Whinston (2000a)). The incumbent may offer favorable terms, — in the form of substantial upfront lump-sum payments, — to a critical mass of customers, convincing them to sign exclusivity contracts. Having lost this critical mass, potential entrants are unable to reach their minimum viable scale even if they sell to all the remaining free customers. The incumbent is thus in a position to monopolize the market and extract monopoly rents from those remaining customers. Furthermore, if a potential entrant has a sufficiently large cost advantage over the incumbent, the incumbent may choose to accommodate, rather than to block, its entry, extracting some of the surplus from the entrant's lower cost through properly designed contract termination penalties (Segal and Whinston (2000a)). In such an accommodation scheme the incumbent's profit consists of termination penalties that are collected from customers which breach their contracts with the incumbent to buy from the entrant (Aghion and Bolton (1987)).[1]

In this paper we extend the naked exclusion mechanism to examine the empirically important application of sequential, — original and derivative, — innovation. As is well-known, an original innovation by an incumbent supplier often gives rise to a superior derivative innovation by a subsequent entrant; a latecomer has the opportunity to learn from and improve on the incumbent's original innovation (e.g., Green and Scotchmer (1995), Bessen and Maskin (2009)). Several experts in management strategy stress that derivative innovation, — or creative imitation which borrows from and builds on original innovation, — may generate strong competitive advantages (e.g., Levitt (1966), Flannery (2010), Shenkar (2010)). As, for example, Levitt (1966) points out, "… by far the greatest flow of newness is not innovation at all. Rather, it is imitation."

[1] In a different vein, Innes and Sexton (1994) point out that naked exclusion may prevent inefficient entry. Fumagalli and Motta (2006) note that downstream competition may discourage naked exclusion, while in Simpson and Wickelgren (2007) downstream competition facilitates exclusion. Spector (2011) notes that exclusion is more likely if contracts can only take simple forms. Armstrong and Wright (2007) focus on the role of exclusivity contracts in preventing multihoming in two-sided markets. Stefanadis (2016) examines the impact of the potential entrant's volatility of innovation on the exclusion strategy of a non-innovating incumbent.

Furthermore, original innovation is often non-patentable and can be legally duplicated (Anton and Yao (1994, 2002, 2008), Shenkar (2010)); for example, competitors may be able to introduce similar, but not identical, products into the market, circumventing possible patent restrictions.[2] Then, the challenge on the part of the antitrust authorities is to encourage both original and derivative innovation. Preventing the stifling of derivate innovation (while also protecting original inventions) is an important policy objective since derivative innovation plays a crucial role in economic activity. In this paper we show that within an appropriate legal framework the utilization of exclusivity contracts by suppliers may achieve the important objective of protecting both original and derivative innovation; however, without such a framework, exclusivity contracts may inefficiently suppress derivative innovation.[3]

In our model the implementation of a non-patentable original innovation, as well as of subsequent derivative innovations, entails a fixed cost. Suppliers, — original (incumbent) and derivative innovators, — have the ability to put forward contact offers to customers while they are still outside the market, or before they introduce the product to which the contract applies. Furthermore, suppliers engage in leader-follower competition in the contracting phase (although our results largely carry through if the derivative innovator is unable to offer pre-entry contracts or to compete in the contracting phase). As we explain in section 2, such a setup is relevant empirically and may apply to several cases in practice. Then, in the game the incumbent supplier may choose to follow either pure exclusion or accommodation strategies. In the former the incumbent supplier's exclusivity contracts block the subsequent entry of the derivative innovator, allowing the incumbent to maintain a monopoly position. In the latter the subsequent entry of the derivative innovator is allowed so that the incumbent can collect termination penalties from customers that breach their contracts with the incumbent.

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[2] As Bessen and Maskin (2009) note, some of the most innovative industries in the last forty years, such as semiconductors, computers and software, have historically had weak patent protection. In recent years, however, software patents have grown rapidly (Bessen and Hunt (2007)).

[3] The trade-off between non-patentable original and derivative innovation is central in several exclusive dealing antitrust cases. For example, in the well-known *Standard Fashion v. Magrane-Houston* antitrust case (258 U.S. 346 (1922)), United Fashion, a clothes designer, elicited exclusivity contracts that required department stores to sell only United Fashion's patterns. After such contracts were in place, United Fashion invested in the development and introduction of new products. United Fashion thus claimed that the purpose of its contracts was the efficient protection of original innovation, while Magrane-Houston disputed this claim (Marvel (1982)). Our analysis may enhance our understanding of such cases.

In pure exclusion strategies coordinated (in a coalition-proof manner) customers are willing to consent to a sufficient number of exclusivity contracts to make the incumbent supplier's entry viable. Then, the optimal pure exclusivity scheme exactly prevents the derivative innovator from reaching its minimum viable scale once a necessary number of customers for securing the incumbent's entry accept the incumbent's contracts. Furthermore, given its lower variable cost, *ceteris paribus* the derivative innovator has a profit that is more increasing in the number of buying customers than the incumbent. Thus the derivative innovator has a stronger possibility that it can attain its entry when a small number of lucrative customers (i.e., customers with small upfront lump-sum payments) sign contracts that ensure the viability of the incumbent's entry, allowing a large number of remaining customers to buy from the derivative innovator (whose profit is especially sensitive to the number of customers). To prevent such differentiation between more lucrative and less lucrative customers in the formation of coalitions, the incumbent supplier makes uniform contract offers to all customers in its optimal pure exclusion strategy, earning a strictly positive profit.

If, on the other hand, an incumbent adopts an accommodation strategy, it earns a zero profit. Since the low-cost derivative innovator, which is rationally anticipated to enter, can make competing offers, customers refuse to unnecessarily consent to unfavorable contracts that generate excess profits for the incumbent supplier. Thus in a coalition-proof subgame-perfect equilibrium the incumbent supplier always chooses a pure exclusion strategy. Such an equilibrium is socially inefficient because the entry of the derivative innovator, whose innovation is socially beneficial, is blocked. Then, the adoption of an appropriate legal framework can protect both original innovation and derivative innovation. In particular, the antitrust authorities may maximize social welfare by imposing a ban on upfront lump-sum payments in contracts by all suppliers combined with an outright ban on exclusivity contracts by the derivative innovator.

A ban on upfront lump-sum payments precludes the exclusion of the derivative innovator. Without lump-sum payments only a small number of customers need to consent to the incumbent's contracts to ensure the viability of its entry (since each signing customer is especially lucrative). The derivative innovator can then reach its minimum viable scale by selling to the remaining customers. As a result, a prohibition on upfront lump-sum payments causes the incumbent supplier to resort to socially superior accommodation strategies, which accommodate, rather the block, derivative innovation. However, at the same time by hindering the ability of suppliers to compete for customers in the contracting phase, a ban on lump-sum payments may allow even inefficient (rather only socially beneficial) derivative innovation to occur. Then, combining a ban on lump-sum payments (by all suppliers) with an outright ban on exclusivity contracts by the derivative innovator rules out the possibility of inefficient or excessive derivative innovation (while also accommodating socially beneficial derivative innovation) and leads to an optimal social outcome.

Our analysis extends the naked exclusion literature (e.g., Rasmusen, Ramseyer and Wiley (1991, 2000), Segal and Whinston (2000a), see also note 1) to study a different issue, namely sequential innovation. It shows that within an appropriate legal framework (i.e., a ban on upfront lump-sum payments by all suppliers and an outright ban on exclusivity contracts by derivative innovators) naked exclusion mechanisms may lead to optimal social outcomes, unlike most of the literature that focuses on possible anticompetitive consequences. Furthermore, we show that in the absence of an appropriate legal framework, an incumbent supplier may exclude efficient entrants even if there is (leader-follower) competition in the contracting phase, and buyers are able to coordinate; such exclusion is often not possible in the existing literature.[4]

In a different vein, Shaffer (1991) and Marx and Shaffer (2007) examine some possible anticompetitive consequences of upfront lump-sump payments in contracts; they focus on downstream retailers' buying power as a possible cause of lump-sump payments by suppliers.[5] In this paper, on the other hand, we examine upfront lump-sum payments as a tool of naked exclusion by upstream suppliers (rather than as a result of downstream buying power), bringing out different anticompetitive effects. Furthermore, Inderst and

[4] In Bernheim and Whinston (1998) if suppliers compete in contracts, the incumbent may still deter efficient entry, but only when there are effects on non-coincident markets (other than the ones in which exclusivity contracts are employed). Furthermore, competition in contracts may not prevent inefficient exclusion if there is lack of coordination among customers (Fumagalli and Motta (2008)), or if contracts can only take very simple forms, e.g., if they cannot incorporate termination penalties and they also automatically deprive a supplier of the opportunity to later leave the market (Spector (2011)). We show that (leader-follower) competition in contracts may lead to anticompetitive outcomes even if there are no non-coincident markets, if buyers can coordinate, and if contracts are not too simple.

[5] Furthermore, the effects of upfront lump-sum payments have been discussed by the U.S. Senate (1999) and the Federal Trade Commission (2003).

Shaffer (2010) and Ide, Montero and Figueroa (2016) examine whether contract rebates and discounts may substitute for explicit exclusivity provisions. Inderst and Shaffer (2010) show that market-share-based discounts can be anticompetitive, while Ide, Montero and Figueroa (2016) find that to a large extent, rebates and discounts cannot replicate explicit exclusivity provisions. In our analysis we focus on upfront lump-sum payments, which in a sense may be considered the opposite of rebates; the former are granted to buyers *ex ante*, while the latter are granted *ex post*. Furthermore, in our analysis upfront lump-sum payments are used to complement explicit exclusivity provisions, rather than to substitute for them.

Our analysis also complements the literature on the role of exclusivity contracts in the protection of investment (Segal and Whinston (2000b), Fumagalli, Motta and Ronde (2012)).[6] In this literature an exclusivity contract between a buyer and a supplier before the latter invests may protect investment, although such protection may sometimes be too restrictive to the competition; the internal and external effects of contracting are analyzed. We extend this line of research by examining the issue of sequential innovation, where original innovation constitutes a precondition for derivative innovation. We focus on the interaction between multiple buyers (rather than on the case of one buyer as the literature) and on (leader-follower) competition between suppliers in the contracting phase (rather than only having unchallenged contract offers by the incumbent). We then bring out a novel antitrust mechanism that may maximize social welfare.

Our analysis also adds to the licensing literature that examines how an inventor may interact with potential collaborators or potential buyers, whose involvement is necessary for the commercialization of the innovation. The inventor needs to protect a non-patentable innovation from expropriation by such collaborators. For example, Anton and Yao (1994, 2002, 2008) find that the inventor may choose to reveal (at least partially), rather than conceal, its know-how before negotiating with buyers. Or, in Rajan and Zingales (2001) and Biais and Perotti (2008) an inventor or an entrepreneur may form suitable (outside or in-house) partnerships to safeguard its innovation. Unlike this

[6] In a different vein, De Meza and Selvaggi (2007) discuss relationship-specific investment that does not directly affect parties other than the contract participants.

literature, in our analysis an original innovator is threatened with expropriation by its competitors, i.e., by derivative innovators, rather than by its potential collaborators. We bring out a novel antitrust mechanism for securing the viability of both original and derivative innovation that is applicable to different circumstances than the literature.[7]

2. THE MODEL

An incumbent supplier *I* has the opportunity to implement a non-patentable original innovation and introduce a new product into the market by incurring an upfront fixed cost F ($F > 0$). Once the new product is introduced, it has a constant variable cost c ($c > 0$). The market consists of *N* identical customers. For simplicity, it is assumed that each customer has a unit demand, consuming either one or zero units of the product with a reservation value r ($r > 0$). The innovation is socially beneficial, i.e., $N(r-c)-F>0$. There is another supplier *E* that has the ability to study and improve on *I*'s original innovation after such innovation has been implemented (and *I* has entered the market). *E*'s derivative innovation leads to a product that is a perfect substitute for the product of *I*, but entails an upfront fixed cost $\underline{F}$ ($\underline{F} > 0$) and a constant variable cost $\underline{c}$ ($0 < \underline{c} < c$). *E*'s derivative innovation is socially beneficial, i.e., $N(c-\underline{c})-\underline{F}>0$. E is unable to engage in original innovation.[8]

Before deciding whether to introduce the new product into the market, incumbent supplier *I* has the opportunity to make simultaneous offers of exclusivity contracts to customers. The ability of suppliers to put forward contracts to customers while they are still outside the market, or before they introduce into the market the product to which the contract applies, is relevant to several cases in practice (Anand and Khanna (2000)).[9] Incumbent supplier *I* can offer either pure or partial exclusivity contracts (as in Segal and Whinston (2000a)). As is standard in the literature (e.g., Rasmusen, Ramseyer and Wiley

[7] There is also a large literature that examines the optimal strength of patent laws (e.g., Grossman and Lai (2004), Iwaisako and Futagami (2013), Moser (2013)). Our analysis explores a different issue than this line of research since it focuses on non-patentable innovations.

[8] Our results would be identical if derivative innovation took the form of higher quality (i.e., of a product with a reservation value $r+c-\underline{c}$), rather than of a lower variable cost $\underline{c}<c$.

[9] As, for example, Anand and Khanna (2000) empirically show, many licensing contracts are signed prior to the development of the technology to which the contract applies. Such timing, which entails pre-investment contracts, is also in the spirit of Innes and Sexton (1994), Segal and Whinston (2000b) and Fumagalli, Motta and Ronde (2012), among others.

(1991), Segal and Whinston (2000a, 2000b), Fumagalli, Motta and Ronde (2012)), pure exclusivity contracts take a straightforward form, including only an agreement not to buy from any rival (such as *E*).[10] As in the literature, *I* has the opportunity to offer an upfront lump-sum payment x_i ($x_i \geq 0$) to customer i ($i \in \{1,...,N\}$) for signing *I*'s exclusivity contract; such payments are made immediately after a contract is finalized. A partial exclusivity contract, on the other hand, also (i.e., in addition to the exclusivity requirement and to x_i) specifies a termination penalty t_i ($t_i \geq 0$) that customer i is required to pay to incumbent *I* in case the customer terminates the contract, buying from another supplier (as in Segal and Whinston (2000a)).[11]

Derivative innovator *E* can offer its own exclusivity contracts to customers before deciding whether to introduce its product into the market. *E* may put forward only pure, rather than partial, exclusivity contracts.[12] Similar to *I*, derivative innovator *E* has the opportunity to offer an upfront lump-sum payment z_i ($z_i \geq 0$) to customer i ($i \in \{1,...,N\}$) for signing *E*'s exclusivity contract. We assume that since incumbent supplier (or original innovator) *I* innovates earlier than derivative innovator *E*, *I* is also the leader in contracting, while *E* is the follower; *I* makes its contract offers to customers earlier than *E*.

However, derivative innovator *E* is still able to make contract offers to customers before the possible entry of suppliers *I* and *E* into the market. Such timing is relevant empirically because the know-how of an original innovation often leaks out to potential competitors rather promptly (Mansfield (1985)).[13] Thus derivative innovation may often occur immediately after original innovation, and the (consecutive) entry of *I* and *E* may

[10] As, for example, Segal and Whinston (2000b) explain, contracts are often incomplete in that future trade is difficult to specify in advance, impeding any contractual precommitment to future prices. Then, "the only possible term in the initial contact, aside from the lump-sum payment, is the exclusivity provision" (Segal and Whinston (2000b), p. 604-605). In our model contract incompleteness is reinforced by the feature that the contracting stage occurs before the innovation, or the investment, stage, i.e., before the product to which the contract applies is introduced into the market. Given that the quality of such a future product is largely non-contractilbe, even if precommitment to future prices was possible, precommitment to the product's "real price," or to the product's price relative to its quality, would be largely unfeasible.

[11] It is thus implicitly assumed that a pure exclusivity contract entails an infinite termination penalty.

[12] As Aghion and Bolton (1987) and Segal and Whinston (2000a) explain, partial exclusivity contracts aim to extract value from a rival's superior technology through termination penalties. Since in our model *E* has a more efficient technology than *I* , such a use of partial exclusivity contracts by *E* would be meaningless.

be considered almost simultaneous.[14] In any case, as we will see in section 4, our results largely carry through if derivative innovator E is unable to offer contracts before entering the market, — if, for example, the lag between (original and derivative) innovation and the entry phase of E is too long. In a different vein, in the phase of contract offers suppliers I and E also have the opportunity to relinquish their rights to sell to a customer, i.e., to commit unilaterally to a binding agreement never to sell to a customer. Such an arrangement effectively constitutes the opposite of an exclusive dealing contract.

After both I and E make their contract offers, customers decide whether to accept. Customers have the ability to coordinate when they decide whether to consent to I's or E's contracts; equilibrium in the customer decisions subgame is coalition-proof (similar to Segal and Whinston (2000a), for example). In particular, as Bernheim, Peleg and Whinston (1987) explain in detail, an equilibrium is coalition-proof if there exists no improving self-enforcing coalition of players that can jointly deviate (taking the actions of the remaining players outside the coalition as fixed) in a way that strictly improves the payoff of all its members. A coalition is considered self-enforcing when it is immune to such deviations by sub-coalitions (within the coalition). Thus coalition-proofness in this stage implies that customers are able to make non-binding agreements among themselves when they decide whether to accept suppliers' offers.[15]

Furthermore, after customers announce their responses (acceptance or rejection) to the proposed contracts, suppliers I and E decide whether to finalize and sign the contracts that have been accepted by customers. If a contract is finalized, the corresponding lump-sum payment to the customer is made. If, on the other hand, a contract fails to be finalized, it is canceled.[16] For simplicity, we assume that contract

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[13] As Mansfield (1985) points out, detailed information on a new product, or a new process, leaks out within approximately one year on average. However, it often leaks out in less than 6 months, although it may sometimes leak out after 18 months or even longer.

[14] For example, the well-known *Standard Fashion v. Magrane-Houston* antitrust case entails clothes design (see note 3). If we consider clothes design a rather simple form of innovation, original and derivative innovation may often occur almost simultaneously. Contemplating such timing, derivative (and original) innovators may be able to offer contracts to customers before the development of original innovation.

[15] Coalition-proofness formalizes the ability of customers to coordinate when they decide whether to accept the proposed contracts. Customer coordination (albeit not necessarily in the exact form of coalition-proofness) is a rather frequent assumption in the exclusive dealing literature (e.g., Hart and Tirole (1990), Innes and Sexton (1994), Segal and Whinston (2000a), Spector (2011)).

[16] The contract finalization stage corresponds to a supplier's ability to assess customer responses before it commits to sunk lump-sum payments to customers. Such an assessment of customer responses is important

finalization is an all-or-nothing decision; a supplier may choose to either finalize or decline to finalize all the accepted contracts. As in Rasmusen, Ramseyer and Wiley (1991) and Segal and Whinston (2000a), contract renegotiation cannot take place. Renegotiation is discussed in section 4.

We have the following game:

Stage 1: Incumbent supplier I decides whether to offer simultaneous exclusivity contracts, pure or partial, to customers. It chooses the upfront lump-sum payments, x_i ($i \in \{1,...,N\}$), for all contracts and the termination penalties, t_i, for partial contracts.

Stage 2: Derivative innovator, E, decides whether to offer simultaneous pure exclusivity contracts to customers and chooses the upfront lump-sum payments, z_i ($i \in \{1,...,N\}$).

Stage 3: Customers decide whether to accept I's and E's contracts.

Stage 4: Suppliers I and E decide whether to finalize the contracts that were accepted by customers in stage 3; contract finalization is an all-or-nothing decision. Lump-sum payments for finalized contracts are made to customers.

Stage 5: Incumbent supplier I decides whether to incur an upfront fixed cost F and introduce the new product into the market.

Stage 6: If I entered the market in stage 5, derivate innovator E decides whether to incur an upfront fixed cost $\underline{F}$ and also enter into the market.

Stage 7: Customers can purchase the product.

For simplicity, we adopt the tie-breaking convention that when a customer is indifferent between buying from I and E, it chooses to buy from low-cost supplier E. When a customer is indifferent between consenting to a contract and not in stage 3, it consents. When a supplier is indifferent between finalizing a contract and not in stage 4, it finalizes the contract. In stages 5 and 6 I enters, while E does not enter, into the market when they are indifferent. Furthermore, when I is indifferent between two strategies in stage 1, it chooses the strategy that entails larger social welfare.[17]

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in our model because contracts are signed before the fixed cost of entry is incurred. In the standard naked exclusion literature (Rasmusen, Ramseyer and Wiley (1991), Segal and Whinston (2000a)), on the other hand, a supplier is already in the market when it offers contracts.

[17] For example, such a tie-breaking convention is reasonable if supplier I can obtain even a minimum of benefits (e.g., in terms of reputation) when it follows socially superior strategies. In any case, as we will explain in section 4, our results carry through (although they become weaker) even without this convention.

3. EQUILIBRIUM EXCLUSIVITY

To solve for the equilibrium, we proceed by backward induction. The equilibrium in the subgames of stages 3, 4, 5, 6 and 7 is described in the appendix. Then, in stage 1 incumbent supplier *I* may follow either pure exclusion or accommodation strategies. In pure exclusion strategies the pure exclusivity contracts that *I* puts forward in stage 1 lead to the subsequent exclusion of derivative innovator *E* from the market; *E* decides not to enter in stage 6.[18] Pure exclusion strategies thus allow *I* to maintain a monopoly position in the market. In accommodation strategies, on the other hand, the partial exclusivity contracts that *I* puts forward in stage 1 lead to the subsequent entry of derivative innovator *E* in stage 6. Although in such accommodation strategies incumbent supplier *I* does not maintain a monopoly position, it has the opportunity to extract some surplus from derivative innovator *E* through contract termination penalties.[19]

We can see that in an exclusion subgame, — in which incumbent supplier *I* follows pure exclusion strategies in stage 1, — there is a unique optimal pure exclusion strategy for *I*. In particular, there exists a unique $x^* \in (0, r-c-F/N)$ so that *I* optimally offers uniform pure exclusivity contracts with an upfront lump-sum payment x^* to all N customers.[20] In stage 3 all N customers consent to their contracts, which are subsequently finalized in stage 4. *E*'s entry is blocked, and *I*'s equilibrium profit in the subgame is $N(r-c)-Nx^*-F>0$. We summarize in lemma 1.

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[18] In pure exclusion strategies incumbent supplier *I* has no incentive to offer any partial exclusivity contracts in stage 1. Since *E* is excluded from the market, no contracts are terminated, and no termination penalties are collected in stage 7. Partial exclusivity contracts are thus meaningless.

[19] In accommodation strategies incumbent supplier *I* has no incentive to offer any pure exclusivity contracts in stage 1. Since *E* is allowed to enter the market, pure exclusivity contracts (which do not allow the extraction of surplus from *E*) are meaningless. Similarly, a partial exclusivity contract with $t_i > r-\underline{c}$ effectively constitutes a pure exclusivity contract since it does not allow customer i to buy from *E* in equilibrium (see the appendix on the equilibrium of stage 7). Thus in accommodation strategies *I* only offers partial exclusivity contracts with $t_i \le r-\underline{c}$.

[20] When $F/(r-c) \ge N-\underline{F}/(r-\underline{c})$, we have a corner solution in which *I*'s optimal pure exclusion strategy is to offer pure exclusivity contracts with a zero lump-sum payment to all N customers (or, equivalently, to at least $N-\underline{F}/(r-\underline{c})$ customers). All customers consent to *I*'s contracts, and *I*'s equilibrium profit is $N(r-c)-F>0$. See note 40 in the appendix.

Lemma 1: In an exclusion subgame there is a unique optimal pure exclusion strategy for incumbent supplier *I* in stage 1, in which *I* offers uniform pure exclusivity contracts with a lump-sum payment x^* ($x^* \in (0, r-c-F/N)$) to all N customers. All N customers consent to such contracts in stage 3, and *I*'s profit is $\Pi_{EX}^{I}* = N(r-c) - Nx^* - F > 0$.

Proof: The proof is in the appendix.

Intuitively, coordinated customers are willing to consent to a sufficient number of pure exclusivity contracts to allow incumbent supplier *I* to recover its fixed cost, as well as its upfront lump-sum payments, and enter the market. Then, *I*'s optimal pure exclusivity scheme exactly precludes the recovery of derivative innovator *E*'s fixed cost and lump-sum payments once a necessary number of customers accept *I*'s contracts. Given *E*'s technological advantage, *ceteris paribus* *E*'s profit is more increasing in the number of buying customers than *I*'s profit since *E* obtains an additional profit of $c - \underline{c}$ per customer. Thus *E* has the strongest possibility that it can secure its entry when the smallest possible number of customers — i.e., the most lucrative customers with the smallest lump-sum payments, — consent to *I*'s contracts to ensure the viability of *I*'s entry (which is a precondition for *E*'s entry). This allows the largest possible number of remaining customers to sign *E*'s contracts, maximizing *E*'s profit (which is especially increasing in the number of signing customers) and strengthening the possibility of *E*'s entry being viable. To prevent such differentiation between more lucrative and less lucrative customers in the formation of coalitions, *I* makes uniform contract offers to all customers in its optimal pure exclusion strategy.[21]

We can also see that there exists at least one feasible accommodation strategy (and possibly multiple accommodation strategies) for incumbent supplier *I* in stage 1. Furthermore, in any accommodation subgame, — in which incumbent supplier *I* follows

[21] Uniform contract offers imply a constant lump-sum payment x^* across the board because the product is of the same reservation value, r, to all customers. If, however, there were reservation value differences, uniform contract offers would correspond to a constant $r_i - x_i^*$, $\forall i \in \{1,...,N\}$ (rather than to a constant lump-sum payment). The same line of reasoning would apply if there were differences in the variable cost of selling to various customers.

accommodation strategies in stage 1, — I's equilibrium profit is always zero, i.e., $\Pi^{I}_{AC}{*}=0$.[22] Lemma 2 follows.[23]

Lemma 2: (i) There exists at least one feasible accommodation strategy for incumbent supplier I in stage 1.
(ii) In any accommodation subgame incumbent supplier I always earns a zero equilibrium profit, i.e., $\Pi^{I}_{AC}{*}=0$.

Proof: The proof is in the appendix.

Intuitively, in any accommodation subgame customers rationally anticipate that derivative innovator E will finalize its contracts in stage 4 and enter the market in stage 6. Thus a set of contract offers by I and E in stages 1 and 2, respectively, that subsequently leads to a strictly positive profit for I cannot be an equilibrium. Given the stage-1 contract offers by incumbent supplier I, derivative innovator E has the incentive to deviate from its initial strategy in stage 2 and "steal" at least one of I's signing customers by offering the same contract terms as I to the customer. "Stealing" such a customer from I does not compromise the viability of I's entry since I's initial profit is strictly positive. It follows that in any accommodation subgame I's profit is always driven to a zero profit in equilibrium.

Lemmas 1 and 2 imply that in a coalition-proof subgame-perfect equilibrium I always decides to follow the pure exclusion strategy of lemma 1, rather than an accommodation strategy, in stage 1 since $\Pi^{I}_{EX}{*}=N(r-c)-Nx{*}-F>\Pi^{I}_{AC}{*}=0$. Since the entry of E is blocked, equilibrium social welfare, — i.e., the sum of supplier profits ($N(r-x{*}-c)-F$) and customer surplus ($Nx{*}$), — is $N(r-c)-F>0$. Proposition 1 follows.

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[22] Up to the integer constraint. The integer constraint is unimportant as long the number, N, of customers is not too small.

[23] Since in an accommodation subgame I always earns a zero profit, it may be indifferent between multiple accommodation stage-1 strategies. There may thus be several possible equilibria in an accommodation subgame that lead to different levels of welfare for E and customers (although I's profit is always zero).

<u>Proposition 1:</u> In a coalition-proof subgame-perfect equilibrium incumbent supplier *I* always follows the pure exclusion strategy of lemma 1 in stage 1. Equilibrium social welfare is $N(r-c)-F>0$.

Proof: If follows directly from lemma 1 and lemma 2.

The equilibrium outcome of the game is socially inefficient since the entry of derivative innovator *E*, whose innovation is socially beneficial ($N(c-\underline{c})-\underline{F}>0$), is blocked. Moreover, we can easily see that an outright prohibition on exclusivity contracts would reduce social welfare even further because incumbent supplier *I* would become unable to recover its fixed cost and introduce its original innovation, driving social welfare to zero (given that *I*'s entry is a precondition for *E*'s entry).[24] However, the antitrust authorities may strictly enhance social welfare by banning upfront lump-sum payments to customers in exclusivity contracts. After such a ban, lemma 2 would still hold. At the same time a ban on lump-sum payments would render *I* unable to successfully block the entry of *E*, or to earn a strictly positive equilibrium profit for that matter.[25] *I* would thus resort to accommodation strategies, offering partial exclusivity contracts that allow *E* to sell to all N customers in equilibrium, which is the first-best social outcome (since, as we explained in section 2, in case of a tie, *I* chooses the strategy that entails the larger social welfare).[26] Equilibrium social welfare would be $N(r-\underline{c})-F-\underline{F}$, which is strictly larger than equilibrium social welfare in the absence of a ban ($N(r-\underline{c})-F-\underline{F}>N(r-c)-F$). Proposition 2 follows.

[24] If *I* entered into the market in stage 5 without having any exclusivity contracts with customers, *E* would also decide to enter in stage 6. *E* would subsequently sell to all N customers at an equilibrium price c in stage 7, earning a strictly positive profit ($N(c-\underline{c})-\underline{F}>0$). Since *I* would not capture any customers, it would be unable to recover its fixed cost F. It follows that an outright ban on exclusivity contracts would cause *I* to stay out of the market.

[25] In the corner solution of note 20 a ban on lump-sum payments would have no impact on the equilibrium of the game. *I* would continue to successfully follow the same pure exclusion strategy in stage 1.

[26] Alternatively, such an outcome may be attained by allowing horizontal cooperation or mergers between original and derivative innovators. In this case, however, the market would become monopolized, driving customer welfare to zero and giving rise to the well-known dynamic losses from monopolization (which are not included in our model), such as the possibility of less innovation in the future.

<u>Proposition 2:</u> The antitrust authorities maximize social welfare if they ban upfront lump-sum payments to customers in exclusivity contracts. Then, incumbent supplier *I* resorts to accommodation strategies with partial exclusivity contracts, and equilibrium social welfare is $N(r-\underline{c})-F-\underline{F}$.

Proof: The proof is in the appendix.

Intuitively, in the presence of zero upfront lump-sum payments the entry of incumbent supplier *I* becomes viable even if a relatively small number of customers consent to *I*'s pure exclusivity contracts; each signing customer is especially lucrative for *I* (since the customer obtains a zero lump-sum payment). Thus there always exist self-enforcing coalitions of customers that can accommodate the entry of both incumbent supplier *I* and derivative innovator *E* in equilibrium; *I* is unable to successfully block the entry of *E* or to earn a strictly positive profit for that matter. It follows that by precluding pure exclusion outcomes, a prohibition on upfront lump-sum payments causes the incumbent supplier to resort to socially superior accommodation strategies which accommodate, rather than block, the entry of *E*.

So far we have assumed that *E*'s derivative innovation is always socially beneficial, i.e., $N(c-\underline{c})-\underline{F}>0$. We will now relax this assumption, reconsidering our results when such an inequality does not necessarily hold (while the remaining structure of the game is unchanged). Then, we can see that lemmas 1 and 2 and proposition 1 still carry through. A ban on upfront lump-sum payments, however, may sometimes lead to socially inefficient entry by *E*. As the above analysis indicates, such a ban leads to the entry of *E* when $F/(r-c)<N-\underline{F}/(r-\underline{c})$ (i.e., as long as we do not have the corner solution of note 20), which does not constitute a sufficient (although it is a necessary) condition for $N(c-\underline{c})-\underline{F}>0$, i.e., for *E*'s derivative innovation to be socially beneficial. In particular, a ban on lump-sum payments hinders the ability of suppliers to compete for customers in the contracting phase, which may encourage *E* to enter into the market to "steal" rents from *I*; *E*'s entry may thus become viable through the transfer of rents, rather than through the possession of a socially beneficial technology.[27]

We can see that if the antitrust authorities combine the above ban on upfront lump-sum payments (by all suppliers) with an outright ban on the offer of any exclusivity contracts by *E*, the possibility of socially inefficient entry by *E* is always ruled out. In equilibrium derivative innovator *E* never enters into the market when its innovation is not socially beneficial, i.e., when $N(c-\underline{c})-\underline{F}\leq 0$. Furthermore, in case *E*'s derivative innovation is socially beneficial ($N(c-\underline{c})-\underline{F}>0$), such a combination of antitrust policies leads to the same equilibrium outcome as in proposition 2, maximizing social welfare, which becomes equal to $N(r-\underline{c})-F-\underline{F}$ (as proposition) 2.[28] We summarize in proposition 3.[29]

<u>Proposition 3:</u> When the antitrust authorities combine a ban on upfront lump-sum payments (by all suppliers) with an outright ban on exclusivity contracts by derivative innovator *E*:

(i) If *E*'s innovation is not socially beneficial ($N(c-\underline{c})-\underline{F}\leq 0$), *E* never enters into the market in equilibrium.

(ii) If *E*'s innovation is socially beneficial ($N(c-\underline{c})-\underline{F}>0$), *I* resorts to accommodation strategies with partial exclusivity contracts in equilibrium, maximizing social welfare as in proposition 2.

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[27] For example, Innes and Sexton (1994) discuss in detail how socially inefficient entry may be motivated by the possibility of rent transfer.

[28] Lemma 2(ii) carries through after the introduction of the antitrust policies of proposition 3. Since in any accommodation subgame customers rationally expect derivative innovator *E* to enter into the market, a customer that is not pivotal for incumbent supplier *I*'s entry rejects *I*'s contract offer, avoiding the burden of the termination penalty (also given that *I* is unable to offer any upfront lump-sum payments). *I*'s profit is always zero in accommodation subgames.

[29] When $F/(r-c)\geq N-\underline{F}/(c-\underline{c})$, we have a corner solution. After the antitrust authorities apply the combination of policies of proposition 3, *I* always follows a pure exclusion strategy in equilibrium even if *E*'s innovation is socially beneficial. *I* offers pure exclusivity contracts with a zero lump-sum payment to all N customers (or, equivalently, to at least $N-\underline{F}/(c-\underline{c})$ customers). All customers consent to *I*'s contracts, and *I*'s equilibrium profit is $N(r-c)-F>0$. However, although in such a corner solution the antitrust policies of proposition 3 are followed by the subsequent exclusion of *E* from the market, they never reduce (and also never enhance) social welfare; instead, they are neutral in that they leave social welfare unchanged. The entry of *E* would be blocked anyway even without such policies (see proposition 1 and note 20).

Proof: The proof is in the appendix.

Intuitively, once derivative innovator E is in the market, it engages in standard price competition with incumbent supplier I; E takes full advantage of its lower unit cost to capture free customers and customers that have partial exclusivity contracts with I. Thus if E enters into the market without having its own contracts with customers, it can never recoup its fixed cost $\underline{F}$ if its unit-cost advantage, $c - \underline{c}$, is not sufficiently pronounced, i.e., if its innovation is not socially beneficial ($N(c - \underline{c}) - \underline{F} > 0$). As a result, banning E from offering exclusivity contracts rules out the possibility of socially inefficient entry by E. At the same time a ban on upfront lump-sum payments (by all suppliers) makes the entry of I viable even if a relatively small number of customers consent to I's pure exclusivity contracts since each customer is especially lucrative for I (similar to proposition 2). Thus the antitrust policies of proposition 3 ensure that in case E's innovation is socially beneficial, there always exist self-enforcing coalitions of customers that accommodate the entry of both I and E in equilibrium.

4. ROBUSTNESS

In the base model suppliers are unable to precommit to future prices in exclusivity contracts; this is a standard assumption in the literature (see note 10). However, our results are similar if suppliers have the ability to precommit to prices as long as such precommitment ability is sufficiently limited. In particular, in the model an upfront lump-sum payment x_i to customer i is equivalent to a precommitment to a future price $p_i = r - x_i$ (without a lump-sum payment). If the ability of suppliers to precommit to future prices was unlimited, suppliers would be able to circumvent a ban on upfront lump-sum payments and replicate the pure exclusion strategy of lemma 1 by substituting prices for lump-sum payments. Then, the antitrust policies of propositions 2 and 3 would have no impact on social welfare since the entry of E would be blocked anyway. When, on the other hand, such precommitment ability is limited so that $F < (p_i^{\min} - c)[N - \underline{F} / (p_i^{\min} - \underline{c})]$ and $F < (p_i^{\min} - c)[N - \underline{F} / (c - \underline{c})]$, — i.e., when the minimum future price, $p_i^{\min}$, to which suppliers *I* and *E* are able to commit is not too low, — propositions 2 and 3, respectively, carry through. Overall, the policies of proposition 3 weakly increase social welfare even if suppliers have precommitment ability.

In the base model there is leader-follower competition between incumbent supplier *I* and derivative innovator *E* in the contracting phase; as we explained in section 2, such a setup may often be relevant empirically. However, our results largely carry through if *E* is unable to offer exclusivity contracts to customers before entering the market, i.e., if stage 2 does not occur. For example, *E* may be unable to offer pre-entry exclusivity contracts when it faces an especially long entry phase and needs an especially long time to study and improve on *I*'s original innovation once such an innovation is introduced. As we explain in the appendix, in such an extension *I*'s optimal pure exclusion strategy follows the same logic as in the base model; *I* exactly prevents the entry of *E* once a number of customers that are necessary for the viability of *I*'s entry accept *I*'s contracts. In particular, in this extension *I* offers pure exclusivity contracts to $N - \underline{F}/(c-\underline{c})$ customers so that $\sum_{i=1}^{N-\underline{F}/(c-\underline{c})} x_i = [N - \underline{F}/(c-\underline{c})](r-c) - F$ and no offers to the remaining $\underline{F}/(c-\underline{c})$ customers. Each of the $N - \underline{F}/(c-\underline{c})$ customers consents to *I*'s contracts, and *I*'s profit is $\Pi_{EX}^{I}{**} = \underline{F}(r-c)/(c-\underline{c}) > 0$.

Furthermore, in the absence of competition in the contracting phase (and given *I*'s ability to use combinations of upfront lump-sum payments and termination penalties in its partial exclusivity contracts), *I*'s profit in accommodation strategies is not necessarily zero; lemma 2(ii) does not hold. In an optimal accommodation strategy *I* uses a combination of upfront lump-sum payments and termination penalties to extract the entire surplus from *E*'s derivative innovation through the collection of termination penalties from customers that breach their contracts with *I*.[30] *I*'s profit is $\Pi_{AC}^{I}{**} = N(c-\underline{c}) - \underline{F} - F$. Overall, *I* chooses to follow a pure exclusion, rather than an accommodation, strategy if $\Pi_{EX}^{I}{**} - \Pi_{AC}^{I}{**} > 0$. For example, *I* follows a pure

[30] The logic of such a strategy is in the spirit of Segal and Whinston (2000a).

exclusion strategy as long as E's derivative innovation is not too drastic, i.e., as long as $\underline{F}$ and $\underline{c}$ are not too small.[31]

Proposition 3 (which is now equivalent to proposition 2 since E is unable to offer exclusivity contracts anyway) largely carries through. When I favors a pure exclusion strategy ($\Pi_{EX}^{I}** - \Pi_{AC}^{I}** > 0$), a ban on upfront lump-sum payments causes I to resort to an accommodation strategy in an interior solution, maximizing (and strictly increasing) social welfare. When, on the other hand, I favors an accommodation strategy ($\Pi_{EX}^{I}** - \Pi_{AC}^{I}** \leq 0$), a ban on upfront lump-sum payments has no impact on social welfare in an interior solution since I continues to follow an accommodation strategy (and to maximize social welfare) after such a ban. Furthermore, we can examine the corner solution of note 29. Intuitively, I's and E's innovation becomes more drastic when $N(r-c)-F$ and $N(c-\underline{c})-\underline{F}$, respectively, increases. Then, if we make the assumption that I's original innovation is more drastic, or at least not much less drastic, than E's derivative innovation (i.e., $N(r-c) > N(c-\underline{c})-\underline{F}$), which is sensible empirically given that E is unable to innovate independently, a ban on upfront lump-sum payments has no impact (i.e., it never has a negative impact) on social welfare in the corner solution of note 29.[32] It follows that overall, a ban on upfront lump-sum payments in contracts often strictly increases social welfare, while it never has a negative impact on social welfare.

In the base model derivative innovator E's variable cost advantage, $c-\underline{c}$, over incumbent supplier I is a deterministic parameter. However, the outcome of the game is similar if $c-\underline{c}$ is a probabilistic parameter before the entry of E. Suppose, for example, that $\underline{c} = c - \varepsilon$, where $\varepsilon \in \{\underline{\varepsilon}, \overline{\varepsilon}\}$ and $0 \leq \underline{\varepsilon} < \overline{\varepsilon} \leq c$; nature determines the specific level of

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[31] We can see that $\partial[\Pi_{EX}^{I}** - \Pi_{AC}^{I}**]/\partial \underline{F} = (r-\underline{c})/(c-\underline{c}) + 1 > 0$ and $\partial[\Pi_{EX}^{I}** - \Pi_{AC}^{I}**]/\partial \underline{c} = N + \underline{F}(r-c)/(c-\underline{c})^2 > 0$.

[32] In the corner solution of note 29 the entry of E is blocked after a ban on upfront lump-sum payments is imposed. If $N(r-c) > N(c-\underline{c})-\underline{F}$, such a corner solution occurs only when I would favor an exclusion strategy anyway, i.e., only in the range where $\Pi_{EX}^{I}** - \Pi_{AC}^{I}** > 0$. In particular, when $F/(r-c) \geq N - \underline{F}/(c-\underline{c})$, we have $\Pi_{EX}^{I}** = N(r-c)-F$ (note 47 in the appendix), and thus $N(r-c) > N(c-\underline{c})-\underline{F}$ implies that $\Pi_{EX}^{I}** - \Pi_{AC}^{I}** > 0$ in that range of the corner solution. As a result, condition $N(r-c) > N(c-\underline{c})-\underline{F}$ ensures that a ban on upfront lump-sum payments never causes an incumbent supplier that favors accommodation strategies to resort to pure exclusion strategies, i.e., such a ban never has a negative impact on social welfare.

ε (which becomes public information) after E enters into the market. Then, the outcome of the base model remains identical if we substitute the expected value, $c-E(\varepsilon)$, of $\underline{c}$ for the deterministic parameter $\underline{c}$. Since player strategies in stages 1 through 6 are based on expected supplier profits, they remain unchanged if we substitute $c-E(\varepsilon)$ for $\underline{c}$.

Furthermore, in the base model we adopt the tie-breaking convention that when I is indifferent between two strategies, it chooses the strategy that entails larger social welfare. Our results largely carry through (although they are weaker) if we reverse this convention, assuming that I chooses the socially inferior strategy in case of a tie. Then, after the introduction of the antitrust policies of proposition 3 I offers pure (rather than partial) exclusivity contracts, capturing $F/(r-c)$ customers (and earning a zero profit except for the corner solution of note 29). E's socially beneficial innovation is implemented, which implies that the policies of proposition 3 are still social-welfare-improving. However, E sells only to the remaining $N-F/(r-c)$ customers (rather than to all customers), and thus the socially optimal outcome is not attained. The tie-breaking convention is irrelevant in the corner solution of note 29, where I offers pure exclusivity contracts, blocks the entry of E and earns a strictly positive profit.

In a different vein, in the base model renegotiation of contracts cannot take place, which is a standard assumption in the naked exclusion literature (e.g., Rasmusen, Ramseyer and Wiley (1991), Segal and Whinston (2000a)). If, on the other hand, contract renegotiation is possible, the naked exclusion mechanism of our model succeeds in attaining both the protection of original innovation and the accommodation of socially beneficial derivative innovation even without a ban on upfront lump-sum payments; the equilibrium is socially optimal even without antitrust intervention. In particular, if renegotiation is possible in stage 7, each pure exclusivity contract participant can pay an amount $r-c$ to I to breach its contract, buying from E at a price c. Rationally anticipating such renegotiation, E will always enter the market in stage 6. Furthermore, in stage 3, rationally anticipating E's entry, customers will only accept a sufficient number of contracts to make I's entry viable; I's profit will be zero (as in lemma 2(ii)). In addition, even if the antitrust policies of proposition 3 are introduced, the corner solution of note 29 is precluded; E always enters into the market. Thus the antitrust policies of proposition 3 have no impact on social welfare.

Incumbent supplier I, however, may make a credible commitment to prevent renegotiation by requiring, for example, contract participants to make a technological commitment that prevents them (through technological incompatibilities) from purchasing from other suppliers in the future. Or, the contracts may deliberately introduce legal rigidities, — such as the aid of third parties that may be entitled to payments should renegotiation occur, — that discourage renegotiation (Dewatripont and Maskin (1990)). Then, the antitrust policies of proposition 3 are necessary for the maximization of social welfare.

5. CONCLUSION

Our paper examines how benign naked exclusion mechanisms may be applied to an issue that has received considerable attention from practitioners and policy makers, namely, sequential innovation. A non-patentable original innovation by the incumbent supplier subsequently encourages derivative innovation by competitors that can learn from and improve on the incumbent's innovation. Then, an appropriate legal framework needs to protect original innovation without inhibiting derivative innovation. We show that coordinated customers are willing to accept a sufficient number of exclusivity contracts by the incumbent to ensure the viability of its entry. However, in the absence of any antitrust intervention the incumbent chooses to adopt a pure exclusion strategy that prevents the derivative innovator from reaching its minimum viable scale once a necessary number of customers consent to the incumbent's contracts; such inefficient exclusion occurs although suppliers are able to compete (in a leader-follower manner) in the contracting phase. The legal framework may maximize social welfare by imposing a ban on upfront lump-sum payments in all exclusivity contracts (to accommodate both original and derivative innovation) combined with an outright ban on exclusivity contracts by the derivative innovator (to prevent excessive entry by derivative innovators).

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APPENDIX

Equilibrium in the Subgames of Stages 3, 4, 5, 6 and 7

To solve the game we proceed by backward induction. In stage 7 a customer that is bound by a pure exclusivity contract purchases the product from its exclusive supplier (if the latter has entered the market) at the monopoly price, r. If in stage 7 only incumbent supplier *I* has entered the market, it sells to all free customers that have not signed exclusivity contracts at the monopoly price, r. If, on the other hand, both suppliers *I* and *E* have entered into the market, they compete in the stage-7 market for such free customers; in equilibrium a free customer buys from low-cost supplier *E* at a price c. Suppose now that in stage 7 a customer i has already signed *I*'s (finalized) partial exclusivity contract with a termination penalty t_i and is now offered unit prices p_i by incumbent *I* and p_i' by derivative innovator *E*. Then, customer i decides to buy from *E* if $p_i' \leq p_i - t_i$ and from *I* otherwise. Competition between *I* and *E* for such a customer drives the stage-7 price that customer i pays to *E* to $\min\{c, r - t_i\}$. Of course, in case $r - t_i < \underline{c}$, such a customer does not terminate its contract with *I*.

In stage 6 *E* enters into the market when first, *I* has entered into the market in stage 5 (which is a precondition for *E*'s entry), and second, *E* can recoup its upfront fixed cost $\underline{F}$.[33] Suppose, for example, that in stage 4 *I* and *E* finalized n^I and n^E pure exclusivity contracts with customers, respectively ($n^I + n^E \leq N$). Then, *E* enters into the market in stage 6 if $n^E(r - \underline{c}) + (N - n^I - n^E)(c - \underline{c}) > \underline{F}$. Suppose now that *I* finalized n^I partial (rather than pure) exclusivity contracts with customers in stage 4 with $r - t_i \geq \underline{c}$, $\forall i \in \{1,...,n^I\}$. Then *E* enters the market in stage 6 if $\sum_{i=1}^{n^I} (\min\{c, r - t_i\} - \underline{c}) + n^E(r - \underline{c}) + (N - n^I - n^E)(c - \underline{c}) > \underline{F}$.

Similarly, in stage 5 *I* enters into the market when it can recover its upfront fixed cost F.[34] In case *I* expects *E* not to enter in subsequent stage 6, and *E* has finalized n^E exclusivity contracts with customers, *I* expects to monopolize the remaining $N - n^E$ customers and thus decides to enter if $(N - n^E)(r - c) \geq F$. Suppose now that *I* expects *E* to enter. If *I* has finalized n^I pure exclusivity contracts in stage 4, it enters into the market in stage 5 if $n^I(r - c) \geq F$. If, however, *I* has finalized n^I partial exclusivity contracts in stage 4 with $r - t_i \geq \underline{c}$, $\forall i \in \{1,...,n^I\}$, *I* enters in stage 5 if $\sum_{i=1}^{n^I} t_i \geq F$.

In stage 4 *I* decides to finalize its contracts that have been accepted (in stage 3) by customers if first, *I* expects to subsequently enter in stage 5 (i.e., if it expects to be able to recover its fixed cost F, as we explained above), and second, *I* also expects to recoup the stage-4 upfront lump-sum payments, $\sum_{i=1}^{n^I} x_i$, that it makes to customers when contracts

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[33] Stage-4 lump-sum payments to customers by *E* are sunk and do not affect *E*'s stage-6 entry decision.
[34] Similar to note 33.

are finalized; such lump-sum payments are sunk. Similarly, E, decides to finalize the contracts that have been accepted (in stage 3) by customers if first, E expects to subsequently enter at stage 6 (as we explained above) and second, E also expects to recover the stage-4 (sunk) upfront lump-sum payments, $\sum_{i=1}^{n^E} z_i$.

In stage 3, given that customers can coordinate as in Bernheim, Peleg and Whinston (1987), a sufficient number of customers accept I's contracts so that the subsequent entry of I is ensured (if, of course, the contracts that I offered in stage 1 make such an accommodation of I's entry by at least one group of consenting customers possible). There can be no stage-3 equilibrium in which an insufficient number of customers accept I's contracts so that I's entry is rendered non-viable. In such a hypothetical equilibrium an improving self-enforcing coalition of non-signing customers would deviate, signing I's contracts and securing I's entry; otherwise, there would be no available products (by I or E), and customer payoffs would be zero. Once the entry of I is secured, a sufficient number of customers consent to derivative innovator E's contracts to ensure the subsequent entry of E provided that first, E's proposed contracts are more favorable to such customers than I's proposed contracts and second, it is indeed feasible to ensure E's entry given the proposed contracts. If, however, E is expected to stay out of the market each customer i consents to I's contract, subsequently earning a surplus $x_i \geq 0$ (as compared to a zero surplus if the customer does not consent).

<u>Proof of Lemma 1</u>

Suppose that in stage 2 E sets its lump-sum payments equal to $z_i = x_i$, $\forall i \in \{1,..., N^I\}$, and $z_i = 0$, $\forall i \in \{N^I + 1,..., N\}$. For E this is the minimum level of lump-sum payments that is necessary for eliciting contract acceptance from customers; if E offered a strictly smaller lump-sum payment to a customer, it would never convince the customer to consent to E's contract (given I's competing contracts).[35] Then, I's contracts fail to block the subsequent entry of E if and only if in stage 3 there exists a subgroup of $n \in \{0,1,..., N^I - 1\}$ customers that are able to allow the finalization of E's contracts and the realization of E's entry by consenting to E's (rather than to I's) contracts ($\sum_{i=1}^{n}(r - x_i - \underline{c}) + (N - N^I)(r - \underline{c}) - \underline{F} = \sum_{i=1}^{n}(r - x_i - c) + n(c - \underline{c}) + (N - N^I)(r - \underline{c}) - \underline{F} > 0$), while also ensuring the finalization of I's contracts and the realization of I's entry ($\sum_{i=1}^{N^I - n}(r - x_i - c) - F \geq 0$).[36]

[35] For customers $i \in \{N^I + 1,..., N\}$ we effectively have $x_i = 0$.

[36] If $\sum_{i=1}^{N^I}(r - x_i - c) - F < 0$, we may have $n < 0$. In particular, in stage 2 E may relinquish its rights to sell to $-n$ customers that were not offered contracts by I so that I is effectively granted monopoly rights over them in the stage-7 market (i.e., effectively $x_i = 0, \forall i \in \{1,..., -n\}$), allowing I's entry to become viable, i.e., $\sum_{i=1}^{N^I}(r - x_i - c) - F < \sum_{i=1}^{N^I - n}(r - x_i - c) - F = 0$ (given that I's entry is necessary for E's subsequent entry).

If such a group of n customers existed and indeed signed E's contracts, its members would have no incentive to deviate (and buy from I, rather than from E) individually or jointly since I's entry would be ensured anyway (by the $N^I - n$ customers), and according to the tie-breaking convention, if a customer is indifferent between I and E, it chooses E.[37] If a sub-coalition of those n customers deviated from buying from E, its members would be made strictly worse off. Furthermore, at least a sub-coalition of the remaining $N^I - n$ customers would indeed sign I's contracts so that I's entry is ensured; otherwise, I (as well as E) would stay out of the market, and no products would be offered to customers. Thus given the above I's and E's contract offers in stages 1 and 2, there exists at least one coalition-proof equilibrium in the stage-3 subgame that allows E to enter into the market. Similarly, in case E's entry was prevented (so that all the N^I customers signed I's contracts, and no customer signed E's contracts, expecting E to stay out of the market), at least one possible improving self-enforcing coalition, — i.e., the above group of n customers, — would have an incentive to jointly deviate and sign E's contracts, accommodating the entry of E. It follows that there exists no coalition-proof equilibrium in the stage-3 subgame that entails the exclusion of E from the market.

As a result, I's contracts are successful in blocking the subsequent entry of E if and only if there exists no such group of n customers that are able to allow the entry of both suppliers by signing E's contracts. In particular, given I's contract offers, the maximum surplus that the two suppliers, I and E, together can extract from all the N customers is $Nr - \sum_{i=1}^{N^I} x_i$; as we explained above, such maximum surplus extraction is attained when E sets its lump-sum payments equal to $z_i = x_i$, $\forall i \in \{1,...,N^I\}$, and $z_i = 0$, $\forall i \in \{N^I + 1,..., N\}$.[38] Then, if even in the presence of such maximum surplus extraction on the part of the two suppliers there exists no possible group of n customers that (by signing E's contracts) can ensure the viability of both E's and I's entry, I's contracts can successfully block the entry of E on any occasion. It follows that the entry of E is blocked if there is no group of n customers so that $\sum_{i=1}^{n}(r - x_i - c) + n(c - \underline{c}) + (N - N^I)(r - \underline{c}) - \underline{F} > 0$ and $\sum_{i=1}^{N^I - n}(r - x_i - c) - F = 0$, or so that

[37] Although all the $N - N^I + n$ customers would indeed buy from E, if $z_i = x_i < r - c$, a customer $i \in \{1,..., N - N^I + n\}$ could refuse to sign E's contract in stage 3, rationally expecting to buy from E without a contract at a lower price c in stage 7 provided that customer i's contract acceptance is not pivotal for E's entry. Such a decision (by some of the $N - N^I + n$ customers) to buy from E without a contract would not affect E's entry; the flow of customers to lower stage-7 prices would stop short of preventing E from entering since once a customer's stage-3 contract decision became pivotal for E's entry, the customer would decide to sign E's contract.

[38] If E's lump-sum payments are more generous, suppliers may extract less total surplus from customers.

$V + n(c - \underline{c}) + (N - N^I)(r - \underline{c}) - F - \underline{F} > 0$, where $V = \sum_{i=1}^{N^I}(r - c - x_i)$ and $\sum_{i=1}^{N^I - n}(r - x_i - c) - F = 0$.

In stage 3 let n^L be the number of customers that have been offered the lowest lump-sum payments x_i by *I* (i.e., *I*'s most lucrative potential contract participants) and that can accommodate *I*'s entry by consenting to *I*'s contracts, i.e., $\sum_{i=1}^{n^L}(r - c - x_i) - F = 0$. Since $\partial[V + n(c - \underline{c}) + (N - N^I)(r - \underline{c}) - F - \underline{F}]/\partial n = c - \underline{c} > 0$, the preferable (or most profitable) coalition of customers that *E* can capture in its effort to ensure the viability of its entry (without preventing the entry of *I*) is the group of $N - n^L$ customers. In particular, *E* maximizes its profit when *I* ensures the viability of its entry by selling to a small number, n^L, of lucrative customers so that *E* can sell to the largest possible number of remaining customers, thereby taking full advantage of its lower unit cost; thus *E* can earn the largest possible $(N - n^L)(c - \underline{c})$ in addition to stealing *I*'s potential rent from those $N - n^L$ customers. It follows that *I* successfully blocks the entry of *E* if and only if $V + (N^I - n^L)(c - \underline{c}) + (N - N^I)(r - \underline{c}) - F - \underline{F} \le 0$.

Thus in an exclusion subgame *I* offers pure exclusivity contracts in stage 1 so that $V + (N^I - n^L)(c - \underline{c}) + (N - N^I)(r - \underline{c}) - F - \underline{F} = 0$.[39] If in stage 3 customers rationally expect *E* to stay out of the market, all the N^I customers consent to *I*'s contracts (as we explain in the appendix on the equilibrium of stage 3), and *I*'s profit is $N(r - c) - \sum_{i=1}^{N^I} x_i - F$. Suppose now that *I* makes uniform contract offers to all N customers, i.e., $x_i = x$, $\forall i \in \{1, ..., N\}$, which implies that $n^L = F/(r - c - x)$. Then, $V + (N^I - n^L)(c - \underline{c}) + (N - N^I)(r - \underline{c}) - F - \underline{F}$, or $N(r - \underline{c} - x) - F(c - \underline{c})/(r - c - x) - F - \underline{F}$, is strictly decreasing in x (since $-N - F(c - \underline{c})/(r - c - x)^2 < 0$). Furthermore, $N(r - \underline{c} - x) - F(c - \underline{c})/(r - c - x) - F - \underline{F}$ is strictly positive when $x = 0$ and strictly negative when $x = r - c - F/N$. There thus exists a unique $x^* \in (0, r - c - F/N)$ so that $N(r - \underline{c} - x) - F(c - \underline{c})/(r - c - x) - F - \underline{F} = 0$.[40] It follows that if in stage 1 *I* offers pure exclusivity contracts $x_i = x^*$, $\forall i \in \{1, ..., N\}$, *E*'s entry is blocked (regardless of *E*'s strategy in stage 2), and all N customers sign *I*'s contracts in stage 3. In such an exclusion strategy, *I*'s profit is $N(r - c) - Nx^* - F > 0$.[41] Overall, such contract offers

[39] If $V + (N^I - n^L)(c - \underline{c}) + (N - N^I)(r - \underline{c}) - F - \underline{F} < 0$, *I* would be able to offer strictly smaller lump-sum payments to some customers (strictly increasing its profit), while still preventing the entry of *E*.

[40] When, however, $F/(r - c) \ge N - \underline{F}/(r - \underline{c})$, we have a corner solution in which *I* can block the entry of *E* by setting $x^* = 0$ (i.e., $N(r - \underline{c} - x) - F(c - \underline{c})/(r - c - x) - F - \underline{F} \le 0$ if $x = 0$).

[41] We have $N(r - c) - Nx^* - F > 0$ because $x^* < r - c - F/N$.

(i.e., $x_i = x^*$, $\forall i \in \{1,...,N\}$) constitute *I*'s optimal stage-1 pure exclusion strategy, i.e., the unique strategy that maximizes *I*'s profit while also preventing *E*'s entry.

In particular, suppose that although *I* still offers the same total amount of lump-sum payments to customers, i.e., $\sum_{i=1}^{N} x_i = Nx^*$, it does not make uniform contract offers, i.e., there exist at least two customers i and j so that $x_i \neq x_j$. This implies that n^L is strictly smaller than under the uniform contract arrangement, i.e., $n^L < F/(r-c-x^*)$. The average lump-sum payment in the group of the $F/(r-c-x^*)$ customers that have been offered the smallest lump-sum payments is strictly smaller than the average, x^*, in the group of all N customers; *I*'s entry can be accommodated if strictly less then $F/(r-c-x^*)$ customers consent to *I*'s contracts. Thus if $\sum_{i=1}^{N} x_i = Nx^*$ and *I*'s contract offers are not uniform, the entry of *E* is not blocked. Similarly, if *I* does not make contract offers to all customers, i.e., if $N^I < N$ (although we still have $\sum_{i=1}^{N^I} x_i = Nx^*$), *E* has the opportunity to relinquish its right to sell to the $N - N^I$ customers, effecting granting *I* monopoly power over them (i.e., effectively setting $x_i = 0$, $\forall i \in \{1,..., N-N^I\}$). Then, the average lump-sum payment in the group of the $F/(r-c-x^*)$ customers that have been offered the smallest lump-sum payments (including the $N - N^I$ customers for which x_i is effectively zero) is strictly smaller the average, x^*, in the group of all N customers. As before, the entry of *E* is not blocked.

Suppose now that $\sum_{i=1}^{N} x_i = Nx' > Nx^*$, and that the entry of *E* is successfully blocked.[42] *I*'s profit will be strictly smaller than in the optimal exclusion strategy, i.e., $N(r-c) - Nx' - F < N(r-c) - Nx^* - F$. Furthermore, suppose that $\sum_{i=1}^{N} x_i = Nx' < Nx^*$. Then, the above analysis implies that *I* is unable to block the entry of *E* even if *I* makes uniform contract offers $x_i = x'$, $\forall i \in \{1,...,N\}$ (and, of course, if *I* does not make uniform offers). It follows that *I*'s unique optimal exclusion strategy is offering $x_i = x^*$, $\forall i \in \{1,...,N\}$ in stage 1. Lemma 1 follows.

<u>Proof of Lemma 2</u>

(i) Suppose that in stage 1 *I* offers partial exclusivity contracts with $x_i = 0$, $t_i = r - c$, $\forall i \in \{1,...,N\}$. Suppose also that in stage 2 *E* does not offer any contracts to customers. Then in the equilibrium of the stage-3 subgame $F/(r-c)$ customers sign *I*'s contracts, while the remaining $N - F/(r-c)$ do not sign. In stage 4 *I* decides to finalize the

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[42] The above analysis implies that if $\sum_{i=1}^{N} x_i = Nx' > Nx^*$, there is at least one possible stage-1 strategy for *I* (i.e., $x_i = x'$, $\forall i \in \{1,...,N\}$) that successfully blocks the entry of *E*.

contracts (and in stage 5 I decides to enter into the market) since $t_i F/(r-c) - F = F - F = 0$. In stage 6 E also decides to enter since $N(c-\underline{c}) - \underline{F} > 0$. We can see that given the contract offers of *I* and *E* in stages 1 and 2, the unique stage-3 coalition-proof equilibrium indeed entails $F/(r-c)$ signing customers.

In particular, in stage 3 each of the $F/(r-c)$ customers that consent to *I*'s contracts earns a zero surplus, while each of the $N - F/(r-c)$ customers that do not consent earns a strictly positive surplus ($r-c>0$). Thus no sub-coalition of the group of the $N - F/(r-c)$ non-signing customers would have an incentive to deviate (and consent to *I*'s contract) since its members would be made strictly worse off, earning a zero surplus. Furthermore, even if one of the $F/(r-c)$ signing customers deviated (refusing to consent to *I*'s contract), *I* would be unable to recover its fixed cost F and would stay out of the market; no products would be offered to customers. Thus no sub-coalition of the $F/(r-c)$ signing customers would have an incentive to deviate. Similarly, in case strictly less (strictly more) than $F/(r-c)$ consented to *I*'s contracts, an improving self-enforcing coalition of customers would have an incentive to deviate by signing (not signing) *I*'s contracts so that there are exactly $F/(r-c)$ signing customers.

We can also see that given *I*'s contract offers in stage 1, *E*'s optimal stage-2 strategy is to offer no contracts to customers; *E* is unable to earn a strictly larger profit by choosing any other stage-2 strategy. In particular, to elicit contract acceptance by one of the $N - F/(r-c)$ customers that are expected to decline *I*'s contracts and buy in the stage-7 market (at a price c), *E* would have to offer a lump-sum payment $z_i \geq r-c$, which leads to a weakly smaller profit for *E* than the strategy above. Overall, it follows that if *I* offers partial exclusivity contracts with $x_i = 0$, $t_i = r-c$, $\forall i \in \{1,...,N\}$ in stage 1, the entry of both *I* and *E* is always accommodated in the equilibrium of the subgame. Thus there exists at least one feasible accommodation strategy for *I* (i.e., the above strategy) in stage 1. Lemma 2(i) follows.

(ii) Suppose that given *I*'s offers of partial exclusivity contracts in stage 1 and *E*'s offers of pure exclusivity contracts in stage 2, n customers consent to *I*'s contracts in stage 3, all contracts are finalized in stage 4, and both *I* and *E* decide to enter into the market in stages 5 and 6. Furthermore, suppose that $\sum_{i=1}^{n}(t_i - x_i) > F$, i.e., *I* earns a strictly positive profit. In such a subgame equilibrium, although each of the n customers is not individually pivotal for the finalization of *I*'s contracts and the realization of *I*'s entry (since $\sum_{i=1}^{n}(t_i - x_i) > F$), it is apparently better off buying from *I* under the terms of *I*'s offered contract than buying from *E* under the terms of *E*'s offered contract or buying from *E* without a contract at a price c in the stage-7 market.

Suppose now that in stage 2 *E* deviates by offering a contract with a lump-sum payment $z_i = \max\{r - c - t_i + x_i, x_i\}$ to one of the above n customers. In stage 3 such a customer would choose to consent to *E*'s contract since according to the tie-breaking convention, if a customer is indifferent between *I* and *E*, it chooses to buy from *E*, and *I*'s entry is ensured anyway by the remaining $n-1$ customers (given that $\sum_{i=1}^{n}(t_i - x_i) > F$). Furthermore, E's profit is increased by capturing such a customer (i.e., $r - z_i - \underline{c} = \min\{c + t_i - x_i, r - x_i\} - \underline{c} \geq 0$) as long as $t_i \geq x_i$, i.e., as long as the customer's contract with *I* was not loss-making for *I*. Thus *E* indeed has an incentive to make such a deviation in stage 2 to "steal" *I*'s non-loss-making customer, which implies that initial player strategies after stage 1 did not constitute an equilibrium. We can also see that since all other contracts offers by *I* and *E* are unchanged, the remaining $n-1$ customers indeed continue to consent to *I*'s contracts as before (since *I*'s contracts are still preferable to *E*'s contracts or to no contracts at all), ensuring the entry of *I*. Overall, it follows that there exists no possible accommodation strategy for *I* in stage 1 that leads to a strictly positive profit for *I* in the equilibrium of the subgame. Lemma 2(ii) follows.

Proof of Proposition 2

Suppose that in stage 1 *I* offers pure exclusivity contracts with $x_i = 0$, $\forall i \in \{1,...,N^I\}$, $N^I \leq N$ (since $x_i > 0$ are banned). By following the same procedure as the proof of lemma 1, we can see that *E* is always able to secure its entry. There exist feasible stage-2 strategies for *E* (e.g., offering pure exclusivity contracts with $z_i = x_i = 0$, $\forall i \in \{1,...,N\}$) so that a self-enforcing coalition of $n \leq N - F/(r-c)$ customers always ensures *E*'s entry by accepting *E*'s contracts in stage 3. Similar to the proof of lemma 2(i) $F/(r-c)$ customers consent to *I*'s contracts in stage 3, while the remaining $N - F/(r-c)$ buy from *E* (either by signing *E*'s contracts or by waiting to buy from *E* without a contract in stage 7). It follows that if lump-sum payments are banned, there are no feasible exclusion strategies for *I* in stage 1.[43] Furthermore, along the lines of the proof of lemma 2(ii), since the entry of *E* is accommodated, the equilibrium profit of *I* is zero.[44] In this subgame social welfare, — i.e., the sum of *I*'s profit ($F(r-c)/(r-c) - F = 0$), *E*'s profit ($n^E(r-\underline{c}) + [N - F/(r-c) - n^E](c-\underline{c}) - \underline{F}$, where n^E customers have finalized contracts with *E*) and customer surplus ($[N - F/(r-c) - n^E](r-c)$), — is $[N - F/(r-c)](r-\underline{c}) - \underline{F}$.

As the proof of lemma 2(i) shows, even after a prohibition on upfront lump-sum payments, there exists at least one feasible accommodation strategy (i.e., the strategy outlined in the proof of lemma 2(i)) for *I* that entails the use of partial exclusivity contracts with $t_i \leq r - \underline{c}$, $\forall i \in \{1,...,N\}$ (see note 19) and $N^I \leq N$, in which all N customers buy from *E* in equilibrium. As lemma 2(ii) also shows, in all such accommodation subgames the equilibrium profit of *I* is zero. Suppose that in such a subgame *I* and *E* finalize contracts with n^I and n^E customers, respectively. Then, social

[43] If in stage 1 $N^I < F/(r-c)$, in stage 1 *E* relinquishes its rights to sell to $F/(r-c) - N^I$ customers that were not offered contracts by *I* so that *I* is effectively granted monopoly rights over them in the stage-7 market. Since we effectively have $x_i = 0, \forall i \in \{1,...,F/(r-c)\}$), the entry of *I* is exactly ensured.

[44] If $F/(r-c) \geq N - \underline{F}/(r-\underline{c})$, we have a corner solution where *I* is able to block the entry of *E* (note 40).

welfare, — i.e., the sum of *I*'s profit $(\sum_{i=1}^{n^I} t_i - F)$, *E*'s profit $(\sum_{i=1}^{n^I}[\min\{c, r-t_i\} - \underline{c}] + \sum_{i=1}^{n^E}(r-\underline{c}) + (N - n^I - n^E)(c-\underline{c}) - \underline{F}$ and customer surplus $(\sum_{i=1}^{n^I}[r - \min\{c + t_i, r\}] + (N - n^I - n^E)(r - c)$, — is $N(r-\underline{c}) - F - \underline{F}$, which is strictly larger than social welfare in the subgame where *I* offers pure exclusivity contracts ($N(r-\underline{c}) - F - \underline{F} > [N - F/(r-c)](r-\underline{c}) - \underline{F}$). Since a ban on upfront lump-sum payments always leads to a zero equilibrium profit for *I* anyway, *I* chooses to offer partial exclusivity contracts in stage 1 so that *E* sells to all N customers in equilibrium (given that according to the tie-breaking convention, if *I* is indifferent between two strategies, it chooses the strategy with the larger social welfare). Proposition 2 follows.

Proof of Proposition 3

(i) As the appendix on the equilibrium of stage 7 implies, if in stage 6 *E* enters into the market without having any exclusivity contracts with customers, in stage 7 it obtains a price c from each free customer without any contract and a price $\min\{c, r-t_i\}$ from a customer i that has a partial exclusivity contract with *I*. Thus *E*'s profit is always weakly smaller than $N(c-\underline{c})$. It follows that if *E* is banned from offering exclusivity contracts, it never decides to enter into the market in stage 6 if $N(c-\underline{c}) - \underline{F} \le 0$.

(ii) Similar to the proof of proposition 2.

Equilibrium if Only Incumbent Supplier *I* Is Able to Offer Exclusivity Contracts

Suppose that in stage 1 *I* offers pure exclusivity contracts to $N^I \le N$ customers. Along the lines of the proof of lemma 1, let n^L be the number of customers that have been offered the lowest lump-sum payments x_i by *I* and that can accommodate *I*'s entry by consenting to *I*'s contracts, i.e., $\sum_{i=1}^{n^L}(r-c-x_i) - F = 0$. *I* can successfully block the entry of *E* if and only if $(N-n^L)(c-\underline{c}) - \underline{F} \le 0$; in this case, *I* sells to all N customers and earns a profit that is equal to $N(r-c) - \sum_{i=1}^{N^I} x_i - F = (N-n^L)(r-c) - \sum_{i=1}^{N^I - n^L} x_i$. Then, in an exclusion subgame *I* maximizes its profit if n^L is minimized subject to the constraint $(N-n^L)(c-\underline{c}) - \underline{F} = 0$, and also $N^I = n^L$, i.e., if $n^L = N - \underline{F}/(c-\underline{c}) = N^I$. Therefore, *I*'s optimal pure exclusion strategy in stage 1 entails the offer of pure exclusivity contracts to $N - \underline{F}/(c-\underline{c})$ customers so that $\sum_{i=1}^{N-\underline{F}/(c-\underline{c})} x_i = [N - \underline{F}/(c-\underline{c})](r-c) - F$ and no offers to the remaining $\underline{F}/(c-\underline{c})$ customers.[45] Along the lines of the proof of lemma

[45] It is important that *I* offers no exclusivity contracts at all, rather than contracts with a zero lump-sum payment, to $\underline{F}/(c-\underline{c})$ customers although in both cases *I* would capture a surplus $r-c$ per buying customer. If *I* offered an exclusivity contract with a zero lump-sum payment to at least one of the

1, we can see that in stage 3 each of the $N-\underline{F}/(c-\underline{c})$ customers consents to I's contracts. I's profit is $\Pi_{EX}^{I}** = \underline{F}(r-c)/(c-\underline{c}) > 0$.

Suppose now that in stage 1 I offers partial exclusivity contracts to customers, and in stage 3 customers expect that both I and E will subsequently enter into the market.[46] n^1 customers are offered $t_i \le r-c$, while $N-n^1$ customers are offered $t_i \in (r-c, r-\underline{c}]$ (and effectively $t_i = 0$ for customers that are not offered contracts). Furthermore, $x_i = \min\{t_i, r-c\}$ since for strictly smaller x_i, a customer i would refuse to accept I's contract in stage 3 (buying instead without a contract at a price c in stage 7). As the appendix on the equilibrium of stage 7 shows, the stage-7 price that customer i pays to E is $\min\{c, r-t_i\}$; E's profit is $\Pi^E = \sum_{i=1}^{N}[\min\{c, r-t_i\} - \underline{c}] - \underline{F}$. Given that all I's contracts are accepted by customers and also I's entry is secured, the entry of E is accommodated ($\Pi^E \ge 0$) if and only if $n^1(r-c) + \sum_{i=1}^{N-n^1} t_i \le N(r-\underline{c}) - \underline{F}$. In such a subgame all customers accept I's partial exclusivity contracts. In particular, along the lines of previous proofs, a sufficient number of customers always consent to I's contracts to secure I's entry. In addition, given that both the entry of both I and E is secured, each customer consents to I's partial exclusivity contract since $x_i = \min\{t_i, r-c\}$ (and in case of a tie a customer decides to consent to a contract). The profit of I is $\sum_{i=1}^{N}(t_i - x_i) - F = \sum_{i=1}^{N-n^1} t_i - (N-n^1)(r-c) - F$.

It follows that the maximum profit of I in an accommodation subgame is $\Pi_{AC}^{I}** = N(c-\underline{c}) - \underline{F} - F$ and is attained when I offers partial exclusivity contracts with $t_i \le r-\underline{c}$ and $x_i = \min\{t_i, r-c\}$ so that $n^1(r-c) + \sum_{i=1}^{N-n^1} t_i = N(r-\underline{c}) - \underline{F}$, or so that E's entry is exactly accommodated. Such a strategy allows I to extract the entire surplus from E's derivative innovation through the collection of termination penalties after customers breach their contracts with I.[47] I chooses to follow the optimal pure exclusion (accommodation) strategy when $\Pi_{EX}^{I}** - \Pi_{AC}^{I}** > 0$ ($\Pi_{EX}^{I}** - \Pi_{AC}^{I}** \le 0$).

$\underline{F}/(c-\underline{c})$ customers, such a customer would become I's most lucrative potential contract participant (given the zero lump-sum payment), replacing $n' > 1$ customers that are currently included in n^L and leading to $n^L < N-\underline{F}/(c-\underline{c})$ so that the entry of E is not blocked.

[46] For simplicity, in this section we adopt the tie-breaking convention that if I offers partial exclusivity contracts, and E is indifferent between entering the market and not, E decides to enter.

[47] When $F/(r-c) \ge N-\underline{F}/(c-\underline{c})$, we have a corner solution in I's optimal pure exclusion strategy in which I offers pure exclusivity contracts with a zero lump-sum payment to all N customers (or, to at least $N-\underline{F}/(c-\underline{c})$ customers). All customers accept, and $\Pi_{EX}^{I}** = N(r-c) - F > 0$. Furthermore, if $N(c-\underline{c}) - \underline{F} - F < 0$, we have a corner solution in I's optimal accommodation strategy, and $\Pi_{AC}^{I}** = 0$.