Exclusive Dealing and Entry, when Buyers Compete[1]

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Abstract

Rasmusen et al. (1991) and Segal and Whinston (2000) show that an incumbent monopolist might exclude entry of a more efficient competitor, by exploiting externalities among buyers. We show that their results hold only when downstream competition among buyers does not exist or is weak enough. Under fierce downstream competition, the incumbent cannot compensate a deviant buyer who buys from the more efficient entrant. Any such buyer will become more competitive and increase his output - thus triggering entry - and profits at the expense of buyers who sign an exclusive deal with the incumbent. Hence, exclusive deals cannot deter efficient entry. Aghion and Bolton (1987) show that an incumbent may use exclusive contracts to accommodate entry and appropriate - through penalties - the surplus created by the more efficient producer. We show that downstream competition may also limit the incumbent's ability to use exclusive dealing to extract rents.

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1 Introduction

For a long time, economists have been skeptical about the possibility that exclusive contracts could be used to deter entry of a more efficient seller. This view is well summarised by the influential works of Posner (1976) and Bork (1978). They argue that, in order to induce a buyer to sign an exclusive deal, the incumbent should fully compensate her for the loss she suffers from not buying from a more efficient entrant.[1] Since this loss is higher than the profit the monopolist would make if entry is deterred, it follows that the incumbent would not find it profitable to foreclose entry. Hence, efficiency considerations, rather than anticompetitive motives, will explain the use of exclusive contracts.

Since the early Eighties a number of game theoretic models have been developed to study the rationale for anti-competitive exclusive contracts. Aghion and Bolton (1987) illustrate how an incumbent and a buyer might agree on a contract which enables the incumbent to extract some of the surplus the more efficient producer brings to the market in case of entry. Exclusion does not always occur, but when it does it is inefficient. In Rasmusen et al. (1991), subsequently refined by Segal and Whinston (1996, 2000) the entrant needs to supply a minimum number of buyers to cover its fixed costs. Therefore, a buyer's decision to accept an exclusive deal from the incumbent imposes a negative externality on the other buyers. By exploiting this externality among (uncoordinated) buyers, the incumbent is able to deter entry. In Bernheim and Whinston (1998), in addition to an existing market a second market will develop over time. If entry is viable only by serving both markets, an exclusive deal with the buyer in the existing market might pre-empt entry in the second market.

A common feature of all these papers is that the exclusive contract between the incumbent and a buyer has some type of externality on (one or more) third parties. Indeed, Bernheim and Whinston (1998) show in a more general way that it is the exploitation of this externality that makes an exclusive deal profitable.

These papers assume that buyers are final consumers. However, exclusive agreements typically do not involve final consumers, but firms operating at different stages of the production process. In this paper, we consider downstream competition among buyers and we investigate whether it provides new insights.

When buyers are final consumers (or sell in independent markets), the demand and the payoff of a buyer depend exclusively on the price she pays for the good (input). When, instead, buyers compete in a downstream market, the market share of a buyer, her input demand and her profits depend on the own input price but also on the price paid by the rival buyer(s). This introduces an additional externality which may affect the implication of the analysis.

We first explore the role of downstream competition in the context of the models by Rasmusen et al. (1991) and Segal and Whinston (1996, 2000), where exclusive dealing is extremely powerful in

[1] This loss amounts to the difference between the consumer surplus under entry and the consumer surplus under monopoly, an area which equals the monopoly profit plus the monopoly deadweight loss.

deterring entry (Section 2). When buyers are competitors in the retail market, acquiring an input at lower cost from the more efficient entrant gives one buyer a competitive advantage vis-à-vis rivals: she will have a larger market share and higher profits than buyers who purchase from the incumbent. The more intense downstream competition the stronger the competitive advantage. Hence, if downstream competition is strong enough, the demand of a single buyer might allow the entrant to cover its fixed costs and the externality identified by Rasmusen et al. (1991) and Segal and Whinston (1996, 2000) might disappear. Moreover, the incumbent will have to give a high compensation to each buyer to induce her to accept the exclusive deal and it might not find it profitable to induce the buyers to sign the deal. In a way, downstream competition among buyers makes it more difficult, rather than easier, for the incumbent to induce them to sign an exclusive contract.

Therefore, our results imply that the potential for using exclusive contracts in an anti-competitive way depends on the structure and characteristics of the downstream markets.

Interestingly, Stefanadis (1998) and Simpson and Wickelgren (2001) also study the entry-deterrent role of exclusive dealing under downstream competition, but they find that downstream competition *facilitates* exclusion.

Stefanadis (1998) *assumes* that the demand of a single buyer is never enough to trigger entry (thereby not considering the effect we highlight in this paper). The exclusive contract also includes a price at which the incumbent commits to supply a signer. When buyers compete downstream, using a cheaper input than the rival is more profitable than in the case of independent downstream markets. Hence, it is easier for the incumbent to convince *one* buyer to sign the deal. It suffices to offer a price which is still lower then the rival's but higher than the post-entry equilibrium price.

Simpson and Wickelgren (2001) assume that, in the period when it enters the market, *the entrant's production must be very small*. In the following period, the entrant can compete on equal footing with the incumbent. The incumbent can elicit acceptance by both buyers and deter entry by offering exclusive contracts that commit to a discounted input price. Acceptance is a dominant strategy because rejecting, given that the rival buyer signs the deal, is very unprofitable. The entrant would sell only a negligible quantity in the first period and the buyer who rejects would have to purchase from the incumbent, thus losing the discount. Hence, she would have to compete with a rival who uses a cheaper input. In other words, downstream competition creates a strong incentive to sign the exclusive contract to obtain the discount and gain market shares at the rival's expense (and to prevent the rival from gaining market shares at the own expense).

The exclusive contracts analysed in the first part of our paper prohibit transactions with rival suppliers. As shown by Aghion and Bolton (1987), if exclusive contracts can be terminated upon the payment of a penalty, the incumbent can benefit from the presence of the entrant: it can use the penalty to appropriate the surplus the more efficient producer brings to the market. In the second part of our paper (Section 3) we study the role of downstream competition for rents extraction. We show that the additional externality introduced by downstream competition may create the scope for the entrant to deviate, if the exclusive contract is designed to extract all its rents. Moreover, the incumbent may have to share with the buyers the revenues extracted through the penalty. In other words, downstream competition may limit the incumbent's ability to entirely appropriate the surplus generated by efficient entry.

Sections 2 and 3 study how competition among buyers affects the analysis in a general model. An appendix studies two parametric examples that satisfy the assumptions made in section 2 as well as the conditions for incomplete rent extraction given in section 3.

2 Naked exclusion

Rasmusen et al. (1991) and Segal and Whinston (1996, 2000) show that an incumbent monopolist may profitably deter efficient entry by offering exclusive contracts to *uncoordinated* buyers. A crucial assumption in these works is that the entrant's minimum viable scale is large relative to the industry demand so that entry is profitable only if the entrant sells to a minimum number of buyers (higher than one). This creates the scope for entry deterrence: by signing the exclusive contract a buyer makes it more difficult for the entrant to achieve its minimum viable scale, thus imposing an externality on the other buyers. This externality is exploited by the incumbent through different mechanisms. When exclusive contracts are offered simultaneously and are constrained to be non-discriminatory, the incumbent relies on the buyers' coordination failure. When offers can be discriminatory, it is easier for the incumbent to put one buyer against the others and it can exclude even in the absence of the coordination failure. The externality among buyers is further exacerbated when offers are sequential.

Rasmusen et al. (1991) and Segal and Whinston (1996, 2000) assume that buyers are final consumers. We extend their model by considering buyers who use the input bought either from the potential entrant or from the incumbent to (transform it and) resell it in a final market. Our finding is that the nature of downstream competition affects the externality that a buyer imposes on the others by accepting an exclusive deal, thereby affecting the scope for entry deterrence. To see the intuition, suppose that buyers sell very close substitutes in the downstream market and compete in prices. Suppose also that a potential entrant is more efficient than the incumbent. In this case, buying a cheaper input than rivals provides a buyer with a strong competitive advantage. Indeed, the buyer that purchases a cheaper input would have a lower marginal cost than rivals and would hence be able to capture most of the downstream market. Hence, the input demand of a single buyer suffices to make entry profitable. This prevents the incumbent from exploiting buyers' fragmentation to exclude (i.e. it would be impossible for the incumbent to induce buyers to accept an exclusive deal). At the other extreme, suppose that downstream sellers produce goods so differentiated that their markets are almost independent. In this case, obtaining the input at a lower price than other buyers does not allow to steal much of their business. Therefore, being the only buyer to address the entrant would not determine a large enough input demand so as to make entry profitable. This case is therefore similar to the model analysed by Segal and Whinston (1996, 2000).

In what follows, we formalise the argument just described. Section 2.1 presents the model and investigates the role of downstream competition when offers are simultaneous and non-discriminatory. Section 2.2 studies the case of discriminatory offers. Sequential offers are considered in Section 2.3.

2.1 Simultaneous and non-discriminatory offers

Segal and Whinston (1996, 2000) show that, when the incumbent simultaneously offers *uniform* contracts to all the buyers, it may prevent efficient entry by exploiting the latter's *coordination failure*. Why do buyers sign these contracts if they end up with having the incumbent as the only seller in the industry and pay a higher price for the good than if entry occurred? The reason is that if all the buyers sign the exclusive contract, no one has incentive to deviate. By refusing to sign, a single buyer would not trigger entry and would have to buy the good from the incumbent anyway, at a higher price. The deviation is not profitable and all the buyers signing the exclusive contract is an equilibrium. (There is also another equilibrium, where all buyers reject the contract and buy from the entrant).

We prove in this Section that tough enough downstream competition will break this "exclusion equilibrium", since a deviation would be accompanied by a large order which would trigger entry. We keep Segal and Whinston (1996)'s setting and we introduce some additional assumptions in order to deal with the case of buyers competing in the downstream market.[2]

2.1.1 The model

We consider a market where an incumbent firm (I) produces a good at a constant marginal cost c_I. The good is used by two buyers[3] as an input to produce a final good sold in a downstream market. (We assume for simplicity that there is a one-to-one relationship between the input bought by the buyer and the output sold in the final market, and that the cost of transformation or resale for downstream buyers is zero.) A potential rival (E), which has lower marginal cost than the incumbent $(c_E < c_I)$, is willing to enter the market. To do so, it will have to pay the fixed sunk cost F.[4]

The timing of the game is as follows (see also Figure 1). At time t_0 the incumbent simultaneously offers buyers exclusive contracts (i.e. contracts that commit buyers to purchase only from it). Buyers simultaneously decide whether to accept or not. S denotes the number of buyers who accept the exclusive contract. To sign the contract, each buyer is offered a compensation x. In this Section, we focus on the case where the incumbent makes a single (non-discriminatory) offer to all buyers.

[2] The assumptions we make are satisfied for many models. In particular, as illustrated in the appendix, they hold for the linear demand class of functions proposed by Shubik and Levitan (1980).

[3] For simplicity we consider the two-buyers case. All the results can be extended to the more general case with N buyers.

[4] Rasmusen et al. (1991) and Segal and Whinston (2000) assume that the entrant and the incumbent are characterised by the same average cost function, which is decreasing up to a threshold level of production. For higher production levels, average costs are constant. Instead, we adopt the same cost structure as in Segal and Whinston (1996) - under which the same results as in Segal and Whinston (2000) are obtained - for two reasons. First, because in our view this formulation is neater. Second, because it allows us to use a common framework in the two main sections of our paper.

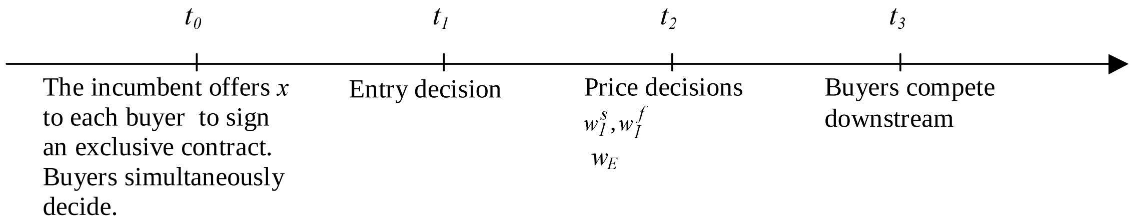

Figure 1: *Time-line.*

The exclusive contract does not include any commitment on prices.[5] At time t_1 the entrant decides on entry, after having observed S. At time t_2 active firms simultaneously name input prices. The incumbent is able to discriminate between those buyers who have signed the exclusive contract, who are offered a unit price w_I^s, and those who have not (free buyers), who are offered a price w_I^f. The potential entrant, if it has entered, can make offers only to free buyers. It offers a price w_E.[6] At time t_3 buyers compete in the final market. We do not adopt a particular demand function[7] nor do we need to specify whether buyers choose prices or quantities. We simply assume that the toughness of competition in the downstream market is captured by the parameter $\gamma \in [0, \overline{\gamma})$. This parameter can be interpreted as a measure of the degree of substitutability between the downstream products: when $\gamma = 0$ the goods produced in the downstream sector are independent, while when γ tends to $\overline{\gamma}$ they tend to perfect substitutes.[8,9] Alternatively, buyers produce the same good but they sell it in distinct (symmetric) geographical areas. In this case γ measures the degree of integration between the areas: when $\gamma = 0$ trade costs are so high that each area represents an independent market (the autarchy case) while when γ tends to $\overline{\gamma}$ trade costs are negligible and the areas tend to be perfectly integrated.

As usual, we solve the game backwards. In what follows, we characterise the equilibria in the final market, the price and the entry decision. Finally, we characterise the solution of the whole game according to the toughness of downstream competition.

2.1.2 Downstream competition

Let us denote by $q^*(w_i, w_j, \gamma)$ and $\Pi_B^*(w_i, w_j, \gamma)$ the *equilibrium* quantity sold by the i-th buyer in the final market and her respective profit (gross of the incumbent's compensation, if any), expressed as *continuous* functions of the own input cost (w_i), of the rival's input cost (w_j) and of the toughness of competition in the final market. We assume that:

[5] Moreover, as in Segal and Whinston (2000), the incumbent's offer to a buyer is not contingent on the other buyers' behaviour.

[6] We follow Segal and Whinston (2000) in assuming that price offers to buyers are restricted to be linear.

[7] However, we assume that it is such that existence and uniqueness of pure strategy Nash equilibria (at the downstream market stage of the game) are guaranteed.

[8] We want to exclude the case of *perfectly* homogeneous goods in order for Segal and Whinston's assumption that $x^*(\gamma) > 0$ for any γ to hold (see below assumption [*SW1*]).

[9] A possible alternative interpretation is that, for any given degree of product substitution, when $\gamma = 0$ firms maximise joint profits while when $\gamma = \overline{\gamma}$ there exists price competition, with intermediate degrees of competition for $0 < \gamma < \overline{\gamma}$.

[A1]: $\Pi_B^*(w_i, w_j, \gamma)$ *is weakly decreasing in the price she pays for the input* w_i *and weakly increasing in the rival's input cost* w_j*. Further, when* $w_i = w_j = w$, $\Pi_B^*(w, w, \gamma)$ *is strictly decreasing in* w.

[A2]: $q^*(w_i, w_j, \gamma)$ *is weakly decreasing in the own input cost, weakly increasing in the rival's input cost and, when* $w_i \leq w_j$*, weakly increasing in the toughness of competition in the downstream market.*

The interpretation of these assumptions is intuitive. The cheaper the own input the more a buyer sells in the downstream market, the higher her profit. The opposite holds, the cheaper the rival's input. When both buyers obtain the input at the same price, the cheaper the input the higher their individual profit. In other words, the change of the own input cost has a stronger impact than the change of the rival's.[10] Finally, when a buyer pays less for the input than her rival, her output increases with the toughness of downstream competition (because the tougher downstream competition the stronger the competitive advantage provided by obtaining a cheaper input and/or because competition increases market demand through a price reduction).[11]

2.1.3 Price decisions

At time t_2 active upstream firms set input prices, given the decisions taken in the previous stages. There are four relevant cases to study:

(i) both buyers signed the exclusive contract ($S = 2$) and entry did not occur.

(ii) one buyer only signed the exclusive contract ($S = 1$) and entry did not occur.

(iii) both buyers rejected the exclusive contract ($S = 0$) and entry occurred.

(iv) one buyer only signed the exclusive contract ($S = 1$) and entry occurred.

In case (i) the incumbent sets w_I^s in order to maximise its profit $\pi_{I|S=2}$:

$$\max_{w_I^s} 2\left[(w_I^s - c_I)\, q^*(w_I^s, w_I^s, \gamma) - x\right] \tag{1}$$

Of course, the optimal price $w_{I|S=2}^{s*}(\gamma)$ is higher than c_I. Let $\Pi_{I|S=2}^*(\gamma)$ be the incumbent's maximum profit gross of the compensation. (Throughout the paper, Π will denote gross profits, and π will denote net profits.)

If one buyer only signs the exclusive contract and entry did not occur (case ii), the free buyer must turn back to the incumbent which, in principle, can charge her a different price than the one charged to the buyer who signed. However, in this setting the incumbent has no incentive to price discriminate between buyers (it will charge the monopoly price to both of them) and the optimal input prices are the same as in case (i): $w_{I|S=1}^{s*} = w_{I|S=1}^{f*} = w_{I|S=2}^{s*}$. The only difference is that the incumbent does not pay any compensation to the buyer who did not sign.

[10] Note that we ask for weak monotonicity to cover also the very special case where wholesale prices are so different that the high cost buyer does not sell anything at equilibrium.

[11] We do not need to make any assumption on how $q^*(w_i, w_j, \gamma)$ changes when $w_i > w_j$.

If entry occurred (case iii and iv), the entrant and the incumbent compete for the free buyer(s). Given *[A1]* and that the entrant is more efficient than the incumbent, at the equilibrium it will always win the competition for the free buyer(s) by choosing a price not higher than c_I.[12] Hence, if both buyers have rejected the exclusive contract and entry occurred (case iii), the entrant chooses w_E in order to solve the following programme:

$$\max_{w_E} \left[2\left(w_E - c_E\right) q^*\left(w_E, w_E, \gamma\right) - F\right] \quad (2)$$
$$s.t.\ w_E \leq c_I$$

Let $w^*_{E|S=0}(\gamma)$ be the optimal price.[13] Of course both buyers pay less for the input if they obtain it from the more efficient entrant than if they sign the exclusive contract and the market is monopolised by the incumbent ($w^*_{E|S=0}(\gamma) < w^{s*}_{I|S=2}(\gamma)$). As in the model by Segal and Whinston (1996, 2000), by *[A1]* each buyer is better off in the former case (in the absence of any compensation).[14] Let $x^*(\gamma)$ denote each buyer's gain from efficient entry:

[SW1]: $x^*(\gamma) \equiv \Pi^*_{B|S=0}\left(w^*_{E|S=0}, w^*_{E|S=0}, \gamma\right) - \Pi^*_{B|S=2}\left(w^{s*}_{I|S=2}, w^{s*}_{I|S=2}, \gamma\right) > 0$ for any γ.

Note that, when buyers are final consumers (as assumed by Segal and Whinston, 1996, 2000), the monopoly deadweight loss implies that the maximum amount that the incumbent is willing to offer to *each* buyer is lower than her gain from efficient entry. We maintain this assumption, that in our setting is written as:

[SW2]: $\frac{\Pi^*_{I|S=2}(\gamma)}{2} \leq x^*(\gamma)$ for any γ, where $x^*(\gamma)$ is defined by *[SW1]*.

Finally, if one buyer only signs the exclusive contract and entry occurred (case iv), the incumbent chooses the price w^s_I for the "exclusive buyer" and, simultaneously, competes with the entrant for the free buyer. Let $w^*_{E|S=1}(\gamma)$ and $w^{s*}_{I|S=1}(\gamma)$ be the pair of input prices that solves the entrant and the incumbent's problems, respectively:[15]

[12] The competition for the free buyer(s) leads to multiple input price equilibria. We select the only one that is not in weakly dominated strategies.

[13] If the entrant is much more efficient than the incumbent, the constraint is not binding and $w^*_{E|S=0} < c_I$. For simplicity, we shall disregard this case in the examples treated in the appendix.

[14] In the setting of Segal and Whinston buyers are final consumers so that each buyer's gain from efficient entry simply comes from an increase in consumer surplus.

[15] Note that in Segal and Whinston (1996, 2000) the incumbent always charges the monopoly price to the buyer who signed the exclusive contract (irrespective of the behaviour of the other buyer). The reason is that buyers are final consumers so that the revenues from selling to each of them are completely independent of the price paid by any other buyer. In the present setting instead, unless products are completely independent ($\gamma = 0$), the equilibrium quantity sold by a buyer in the downstream market (and hence, his input demand) is affected by the input price paid by the other buyer. This is taken into account by both the incumbent and the entrant when choosing their input price. In particular, setting $w_{I|S=1} = w^{s*}_{I|S=2}$ is not necessarily the optimum since by decreasing the input price, the incumbent can improve the competitive position of its buyer. Hence, $w^{s*}_{I|S=1}(\gamma) \leq w^{s*}_{I|S=2}(\gamma)$.

$$\max_{w_E} \left[(w_E - c_E) q^* (w_E, w_I^s, \gamma) - F \right]$$
$$s.t.\ w_E \leq c_I$$
$$\max_{w_I^s} \left[(w_I^s - c_I) q^* (w_I^s, w_E, \gamma) - x \right].$$

Let $\Pi^*_{E|S=1}(\gamma)$ and $\Pi^*_{I|S=1}(\gamma)$ represent the upstream producers' equilibrium profit gross of the fixed costs and of the compensation.

We assume that

[A3]: The entrant's equilibrium profit $\Pi^*_{E|S=1}(\gamma)$ is strictly increasing in γ.

The rationale behind this assumption is that, since the entrant sets an input price $w_E \leq c_I$, the "free buyer" obtains the input at a lower price than the "exclusive buyer" ($w^*_{E|S=1}(\gamma) \leq w^{s*}_{I|S=1}(\gamma)$). Thus, by *[A2]*, as downstream competition intensifies, *ceteris paribus* the "free buyer" sells more and more in the downstream market. This positively affects the entrant's profit via the input demand. The examples in the appendix satisfy *[A3]* and illustrate two possible ways in which this effect can operate.

Finally, we assume that the entrant charges a weakly lower price when it serves only one buyer with respect to the case when both buyers reject the exclusive deal:

[A4]: $w^*_{E|S=1}(\gamma) \leq w^*_{E|S=0}(\gamma)$ for any γ.

The idea is that when the entrant serves only one buyer, it does not take into account the negative externality that it imposes on the other upstream producer by reducing the input price. Hence, if its constraint is binding in both cases, it charges the same price. Otherwise, it charges a lower price when it supplies only one buyer with respect to the case when it supplies both of them.

Hence, as stated by Lemma 1, when entry occurred, for a buyer it is more profitable to be the only one to obtain the input from the more efficient entrant with respect to the case when also the rival buyer does:

Lemma 1 *:* $\Pi^*_{B|S=1}\left(w^*_{E|S=1}, w^{s*}_{I|S=1}, \gamma\right) - \Pi^*_{B|S=0}\left(w^*_{E|S=0}, w^*_{E|S=0}, \gamma\right) \geq 0$ *for any* γ.

Proof. First, by [A4] $w^*_{E|S=1}(\gamma) \leq w^*_{E|S=0}(\gamma)$. Second, $w^{s*}_{I|S=1}(\gamma) \geq c_I \geq w^*_{E|S=0}(\gamma)$. By [A1], $\Pi^*_{B|S=1}\left(w^*_{E|S=1}, w^{s*}_{I|S=1}, \gamma\right) - \Pi^*_{B|S=0}\left(w^*_{E|S=0}, w^*_{E|S=0}, \gamma\right) \geq 0$. ■

Let us define the gain from entry for a buyer who is the only one to have rejected the exclusive deal as:

$$\widetilde{x}(\gamma) \equiv \Pi^*_{B|S=1}\left(w^*_{E|S=1}, w^{s*}_{I|S=1}, \gamma\right) - \Pi^*_{B|S=2}\left(w^{s*}_{I|S=2}, w^{s*}_{I|S=2}, \gamma\right) \tag{3}$$

It is easy to check that Lemma 1 implies that

$$\widetilde{x}(\gamma) \geq x^*(\gamma) > 0 \text{ for any } \gamma \tag{4}$$

where $x^*(\gamma)$ is defined by *[SW1]*. By *[SW2]*, it follows that the maximum amount that the incumbent is willing to offer to *each* buyer is also lower than $\widetilde{x}(\gamma)$:

$$\frac{\Pi^*_{I|S=2}(\gamma)}{2} < \widetilde{x}(\gamma) \text{ for any } \gamma. \tag{5}$$

2.1.4 Entry decision

Given the number of buyers who accepted the exclusionary contract S, entry occurs if and only if the entrant recovers the fixed costs:

$$\Pi^*_{E|S}(\gamma) - F > 0 \tag{6}$$

where $\Pi^*_{E|S}(\gamma)$ represents the entrant's maximum profit gross of the fixed costs when S buyers accepted the exclusive deal.

We follow Segal and Whinston (1996, 2000) in assuming that the market is viable for the entrant if all buyers reject the exclusive contract. This requires that fixed costs are sufficiently low:[16]

[SW3]: $F < \overline{F} \equiv \min_\gamma \left\{\Pi^*_{E|S=0}(\gamma)\right\}.$

Recall that the case studied by Segal and Whinston where buyers are final consumers is equivalent, in this setting, to the case where downstream markets are independent $(\gamma = 0)$. Their assumption that the demand of a single buyer does not suffice to trigger entry is translated in the following one:

[SW4] $F \geq \underline{F} \equiv \Pi^*_{E|S=1}(0).$

When downstream markets are independent, being more efficient than the rival buyer does not allow to steal any of the latter's business and/or prices in the final market are high enough so that the input demand of a single buyer is never sufficiently large to make entry profitable.

However, by *[A3]*, the tougher downstream competition the higher the entrant's profit from selling to a single buyer. This allows to identify a threshold level of the fixed costs $F' \equiv \sup_\gamma \Pi^*_{E|S=1}(\gamma)$ with $F' \in \left(\underline{F}, \overline{F}\right)$ such that the following cases can be distinguished (see also Figure 2):[17]

case 1 : *if* $F \in \left[F', \overline{F}\right)$, $\Pi^*_{E|S=1}(\gamma) \leq F$ *for any* γ.

case 2 : *if* $F \in \left[\underline{F}, F'\right)$, *by continuity of* $\Pi^*_{E|S=1}(\gamma)$ *and [A3] there exists a threshold value of the toughness of competition in the downstream market* $\gamma^*(F)$ *such that* $\Pi^*_{E|S=1}(\gamma) > F$ *if and only if* $\gamma > \gamma^*(F)$.

[16] We do not impose any restriction on $\Pi^*_{E|S=0}(\gamma)$ even if it is reasonable to expect that it is increasing in γ as in Figure 2.

[17] We are implicitly assuming that $\sup_\gamma \Pi^*_{E|S=1}(\gamma) < \min_\gamma \left\{\Pi^*_{E|S=0}(\gamma)\right\}$. If this assumption does not hold, $F' \geq \overline{F}$ and *case 2* only arises.

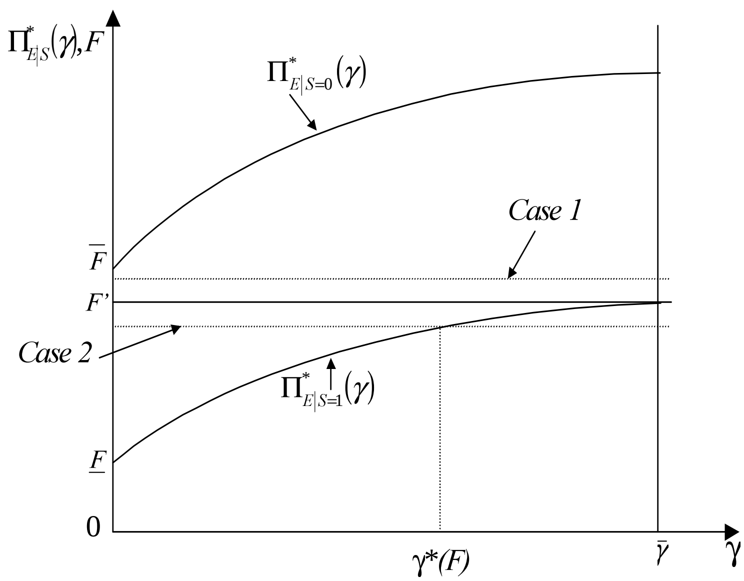

Figure 2: *Entry decision.*

In other words, if entry costs are high enough, the demand of a single buyer never suffices to trigger entry. Taking into account downstream competition does not provide additional insights with respect to the model by Segal and Whinston. By contrast, if fixed costs are not prohibitive and competition in the downstream market is sufficiently tough, the incumbent needs to lock in both buyers in order to deter entry. As the following Section illustrates, in this case the implication of the analysis can be dramatically different with respect to those obtained when buyers are final consumers.

2.1.5 Solution of the model

We now characterise the solution of the whole game. We discuss the equilibria arising when the following condition is satisfied:

$$\Pi^*_{I|S=1}(\gamma) < x^{**}(\gamma) \equiv \Pi^*_B\left(w^*_{E|S=0}, w^*_{E|S=0}, \gamma\right) - \Pi^*_B\left(w^{s*}_{I|S=1}, w^*_{E|S=1}, \gamma\right) \tag{7}$$

for any $\gamma > \gamma^*(F)$. Condition (7) simply says that, when the individual demand makes entry profitable and one buyer rejected the exclusive contract, the incumbent cannot profitably compensate the remaining buyer for the loss she would suffer accepting the exclusive deal. This allows to simplify the analysis by ruling out asymmetric entry equilibria (i.e. entry equilibria where one buyer signs the exclusive contract) without affecting the results of the analysis.

Proposition 1 shows that tough downstream competition, by making individual demand enough to trigger entry, prevents the incumbent from exploiting the buyers' coordination failure to exclude.

Proposition 1 *When the incumbent makes simultaneous offers to buyers and is unable to discriminate, the equilibria of the whole game have the following properties:*

1. *if either fixed costs are sufficiently high* $\left(F \in \left[F', \overline{F}\right)\right)$ *or they are not* $(F \in [\underline{F}, F'))$ *but downstream competition is soft enough* $(\gamma \leq \gamma^* (F))$*, both* ***"exclusion equilibria"*** *and* ***"entry equilibria"*** *exist. They can take the following forms:*

   (i) EXCLUSION EQUILIBRIA: $x \in \left[0, \frac{\Pi^*_{I|S=2}(\gamma)}{2}\right]$ *and* $S = 2$.

   (ii) ENTRY EQUILIBRIA: $x \in [0, x^* (\gamma)]$ *and* $S = 0$.

2. *if fixed costs are sufficiently low* $(F \in [\underline{F}, F'))$ *and downstream competition is sufficiently intense* $(\gamma > \gamma^* (F))$*, only* ***"entry equilibria"*** *exist. They take the following form:*

   $x \in [0, x^{**} (\gamma)]$ *and* $S = 0$.

Proof. 1. The logic of this case is the same as Segal and Whinston's where exclusion equilibria arise because the incumbent takes advantage of the buyers' coordination failure. Since the demand of a single buyer does not attract entry, no buyer has incentive to deviate from $S = 2$. Equilibria where the incumbent offers a strictly positive compensation are sustained by having the continuation equilibria following any offer $\widehat{x} \neq x$ with $\widehat{x} \in [0, x^*]$ be such that $S = 0$. However, equilibria where $S = 0$ also exist. By the assumption of non-discriminatory offers and *[SW2]*, the incumbent cannot profitably prevent these equilibria from arising.

2. In this case, "exclusion equilibria" cannot exist. Suppose $x \in \left[0, \frac{\pi^*_{I|S=2}(\gamma)}{2}\right]$ and $S = 2$. The deviation of a single buyer attracts entry. By *(5)* the incumbent cannot profitably prevent it by offering a sufficiently high compensation. The equilibria are given by $x \in [0, x^{**} (\gamma)]$ followed by $S = 0$. First, the incumbent has no incentive to deviate and offer a compensation followed by $S = 2$. It should offer at least $\widetilde{x}$ to both buyers, which is not profitable by *(5)*. Second, by *(7)*, the incumbent has no incentive to deviate and offer at least x^{**} to both buyers so that $S = 1$ follows. ■

2.2 Simultaneous and discriminatory offers

Offering discriminatory compensations[18] gives the incumbent an additional instrument to exploit the externality that a buyer exerts on the other by accepting the exclusive contract.

Let us consider first the case where the demand of a single buyer is not enough to trigger entry. The incumbent can induce both buyers to sign the exclusive contract by offering a compensation x^* to *one* of them.[19] Once this buyer is locked in by the incumbent, the remaining buyer cannot do better than accepting the exclusive contract, even for free. Hence, discriminatory offers facilitate exclusion. In particular, even if by *[SW2]* it is not profitable to offer x^* to both buyers, it may be profitable to offer it to a single buyer. If so, "entry equilibria" do not arise. If both buyers rejected the exclusive contract, the incumbent could profitably deviate offering x^* to one of them, thereby deterring entry.

[18] As in Segal and Whinston (1996, 2000) we focus on the case of observable offers.

[19] Note that when offers are constrained to be non-discriminatory, the incumbent cannot offer a compensation to one buyer only.

Tough downstream competition changes the picture when it makes individual demand large enough to trigger entry. In this case, the incumbent should secure both buyers to exclude, since a single deviant buyer would trigger entry. The possibility to discriminate its offers does not facilitate entry deterrence as both buyers should be sufficiently compensated. As already discussed for the case of uniform offers, this is too costly.

Proposition 2 *When the incumbent makes simultaneous offers to buyers and is able to discriminate, the equilibria of the whole game have the following properties:*

1. *if either fixed costs are sufficiently high* $\left(F \in \left[F', \overline{F}\right)\right)$ *or they are not* $(F \in [\underline{F}, F'))$ *but downstream competition is soft enough* $(\gamma \leq \gamma^* (F))$, *two cases may arise:*

   CASE A: $\Pi^*_{I|S=2}(\gamma) > x^*(\gamma)$

   *only **"exclusion equilibria"** exist. They take the following forms:*

   (i) $x_1 + x_2 \leq x^*(\gamma)$ *and* $S = 2$;

   (ii) $x_i = x^*(\gamma)$, $x_j = 0$ *with* $i \neq j = 1, 2$ *and* $S = 1$.

   CASE B: $\Pi^*_{I|S=2}(\gamma) \leq x^*(\gamma)$[20]

   *both **"exclusion equilibria"** and **"entry equilibria"** exist. They can take the following forms:*

   (i) EXCLUSION EQUILIBRIA: $x_1 + x_2 \leq \Pi^*_{I|S=2}(\gamma)$ *and* $S = 2$.

   (ii) ENTRY EQUILIBRIA: $x_i \in [0, x^*(\gamma)]$ *for* $i = 1, 2$ *and* $S = 0$.

2. *if fixed costs are sufficiently low* $(F \in [\underline{F}, F'))$ *and downstream competition is sufficiently intense* $(\gamma > \gamma^*(F))$, *only **"entry equilibria"** exist. They take the following form:*

   $x_i \in [0, x^{**}]$ *for* $i = 1, 2$ *and* $S = 0$.

Proof. 1. In this case the demand of a single buyer is never enough to trigger entry. If $\Pi^*_{I|S=2}(\gamma) > x^*(\gamma)$ (CASE A), an equilibrium where $S = 0$ does not exist. The incumbent could profitably deviate and offer $x^*(\gamma)$ to *one* buyer, which would be followed by $S = 2$. By exploiting the buyers' coordination failure the incumbent can indeed exclude at no cost: $x_1 = x_2 = 0$ followed by $S = 2$ is an equilibrium. Equilibria where the incumbent offers strictly positive compensations are sustained by the appropriate continuation equilibria. If instead, $\Pi^*_{I|S=2}(\gamma) \leq x^*(\gamma)$ (CASE B), it is not profitable to offer $x^*(\gamma)$ to a single buyer and the incumbent cannot prevent "entry equilibria" from arising. Coordination failures explain why "exclusion equilibria" might still arise.

2. In this case, individual demand is large enough with respect to fixed costs to make entry profitable. Hence, if $S = 0$, the incumbent should offer at least $\widetilde{x}$ to *each* buyer so that $S = 2$ follows. By condition *(5)* this is not profitable. Hence, the incumbent cannot prevent "entry equilibria" from

[20] We assume that, when indifferent, the incumbent does not deviate from the "entry equilibria". Without this assumption, all the listed ones are equilibria when $\Pi^*_{I|S=2}(\gamma) = x^*(\gamma)$.

arising. Further, as shown by Proposition 1, the incumbent cannot exploit buyers' coordination failure to exclude. Hence, "exclusion equilibria" do not arise. By *(7),* the "entry equilibria" are given by $x_i \in [0, x^{**}(\gamma)]$ followed by $S = 0$. ■

2.3 Sequential offers

When offers are sequential the incumbent has the most effective instrument to play the buyers off against each other so that in principle it is easier to exclude.

Consider the case where individual demand does not make entry profitable, and the incumbent's profit from monopolising the market suffices to compensate a buyer from the loss she suffers when efficient entry does not occur (CASE A). Let us solve the game backwards. The second buyer always accepts the exclusive contract. If the first buyer signed, entry will not occur and the buyer cannot but accept, even if she is not offered any compensation. If the first buyer did not sign, the incumbent can profitably bribe the second buyer to make her sign by offering x^*. The first buyer, anticipating that the following one will always sign, cannot but sign, even if she is not offered any compensation. Thus, the incumbent ends up monopolising the market for free, without having to rely on coordination failures.

Instead, if the incumbent cannot profitably bribe the pivotal buyer (CASE B), exclusion equilibria do not arise. The intuition is very simple. If the first buyer rejected the exclusive contract, the incumbent cannot induce the second buyer to sign by sufficiently bribing her, so that also the second buyer rejects. The first buyer, anticipating that if she rejects the second does the same (and that if she signs, so does the second buyer), rejects the exclusive contract. The incumbent cannot profitably induce her to sign. In this case sequentiality is counterproductive for the incumbent because it allows the buyers to coordinate.

Let us consider the role of downstream competition. As already discussed, tough enough competition may allow entry even if one buyer only rejects the exclusive contract. Further, rejecting when the rival buyer has signed is very profitable, for instance because using a cheaper input than the rival provides a very strong competitive advantage. This implies that if a buyer signs the exclusive contract, the other one requires a very high compensation to sign $(\widetilde{x})$. This highlights the difference with respect to the case where the demand of a single buyer does not trigger entry: in that case, if one buyer accepts the exclusive contract, the other is willing to accept for free. Since tough downstream competition makes it very costly to bribe a buyer, the incumbent cannot profitably exclude, as the following Proposition establishes.

Proposition 3 *When the incumbent makes sequential offers to buyers, the equilibria of the whole game have the following properties:*

1. *if either fixed costs are sufficiently high* $\left(F \in \left[F', \overline{F}\right)\right)$ *or they are not* $(F \in [\underline{F}, F'))$ *but downstream competition is soft enough* $(\gamma \leq \gamma^*(F))$*, two cases may arise:*

   CASE A: $\Pi^*_{I|S=2}(\gamma) \geq x^*(\gamma)$.

Only ***"exclusion equilibria"*** *exist. They take the following form:*

$x_1 = x_2 = 0$ *and* $S = 2$.

CASE B: $\Pi^*_{I|S=2}(\gamma) < x^*(\gamma)$.

Only ***"entry equilibria"*** *exist. They take the following form:*

$x_i \in [0, x^*(\gamma)]$ *for* $i = 1, 2$ *and* $S = 0$.

2. *if fixed costs are sufficiently low* ($F \in [\underline{F}, F')$) *and downstream competition is sufficiently intense* ($\gamma > \gamma^*(F)$), *only* ***"entry equilibria"*** *exist. They take the following form:*

   (i) If $\Pi^*_{I|S=2}(\gamma) - \widetilde{x}(\gamma) < \Pi^*_{I|S=1}(\gamma)$, $x_1 \in [0, x^{**}(\gamma)]$, $x_2 \in [0, x^{**}(\gamma)]$, $S = 0$.

   (ii) If $\Pi^*_{I|S=2}(\gamma) - \widetilde{x}(\gamma) \geq \Pi^*_{I|S=1}(\gamma)$, $x_1 \in [0, x^*(\gamma)]$, $x_2 \in [0, x^{**}(\gamma)]$, $S = 0$.

Proof. 1. In this case individual demand does not make entry profitable. Let us solve the game backwards. CASE A: If the first buyer rejects, the second one requires $x^*(\gamma)$ to accept. Since $\Pi^*_{I|S=2}(\gamma) \geq x^*(\gamma)$ the incumbent can profitably offer it. If the first buyer accepts, entry will not occur and the second buyer accepts even if $x_2 = 0$. The first buyer, anticipating that the second always accepts, will accept even if $x_1 = 0$. CASE B: If the first buyer rejects, the second one requires $x^*(\gamma)$ to accept. Since $\Pi^*_{I|S=2}(\gamma) < x^*(\gamma)$ the incumbent cannot profitably offer it. If the first buyer accepts, entry will not occur and the second buyer accepts even if $x_2 = 0$. Anticipating this, the first buyer requires $x^*(\gamma)$ to accept but the incumbent cannot profitably offer it.

2. Case *(i)*. Given that individual demand makes entry profitable, if the first buyer rejects, the second one requires $x^{**}(\gamma)$ to accept. By *(7)* the incumbent cannot profitably offer $x^{**}(\gamma)$ to the second buyer who, thus, does not accept. If the first buyer accepts, the second buyer requires $\widetilde{x}(\gamma)$ to sign. By $\Pi^*_{I|S=2} - \widetilde{x} < \Pi^*_{I|S=1}$, the incumbent is not willing to offer it. Thus the second buyer does not accept. The first buyer anticipates that the second buyer never accepts and requires $x^{**}(\gamma)$ to accept. The incumbent cannot profitably offer it.

Case *(ii)*. If the first buyer rejects, the analysis is the same as in case (i). If the first buyer accepts, now the incumbent is willing to offer $\widetilde{x}(\gamma)$ to the second, who accepts. Anticipating this, the first buyer requires $x^*(\gamma)$ to accept. However, conditions *[SW2]* and *(5)* imply that $\Pi^*_{I|S=2} < \widetilde{x} + x^*$, so that the incumbent cannot profitably offer $x^*(\gamma)$ to the first buyer and $\widetilde{x}(\gamma)$ to the second. ■

3 Rent extraction

The exclusive dealing arrangements analysed in Section 2 prohibit purchases from competing suppliers. In this Section we extend the set of instruments available to the incumbent and we consider contracts that include the payment of penalties (*liquidated damages*) if the customer deals with others,[21] as well as the incumbent's commitment to provide the good at a certain price.

[21] Absolute prohibition can be interpreted as the particular case where liquidated damages are very large.

Aghion and Bolton (1987) have shown that the incumbent can exploit these arrangements to benefit from the presence of the more efficient entrant. To see the intuition, imagine there exists a single buyer whose willingness to pay for one unit of a final good is given by v. The exclusive contract includes a price p_I for the good, a compensation X for the buyer if she signs the contract and a penalty d that the buyer has to pay if she terminates the contract and trades with the entrant. Assume for simplicity that the entrant does not have to incur any fixed cost to enter the market ($F = 0$).

If the buyer rejects the exclusive deal, the incumbent and the potential entrant compete to provide the good. Being more efficient, the entrant will supply the buyer charging a price than cannot exceed the incumbent's marginal cost c_I. Let $p_E = c_I$ be the optimal price.

Imagine now that the buyer signs an exclusive contract including a penalty d. The entrant can still trade with the buyer, if it offers a price such that the buyer is at least indifferent between purchasing from the incumbent at the contractual price and paying the penalty to buy from the entrant. In other words, p_E cannot exceed $p_I - d$. Of course, the entrant will never induce the buyer to break the contract if this requires offering a price below its marginal cost c_E.

In this setting, the following is an optimal contract for the incumbent: ($p_I^* = c_I$, $X^* = 0$, $d^* = c_I - c_E$). If the buyer accepts, the entrant has to offer $p_E = c_E$ to make her break the contract. In this case, it is indifferent between entering and staying out the market, so that it supplies the good at the price $p_E = c_E$. In turn, the buyer is indifferent between signing the contract and terminating it afterwards (her payoff is given by $X^* - d^* + v - p_E = v - c_I$) and rejecting the contract (her payoff is given by $v - c_I$). She signs. The incumbent does not pay any compensation and collects the penalty. Its payoff is given by $c_I - c_E > 0$. To conclude, the entrant makes zero profits and the incumbent entirely extracts the gain from efficient entry. Note that this contract is more profitable than a contract that prevents entry, for instance (p_I, $X = p_I - c_I$, $d > p_I - c_E$). To sign such a contract, the buyer must be offered a compensation that makes her indifferent between buying from the incumbent at p_I and rejecting the contract and buying from the entrant at c_I. The incumbent should thus transfer to the buyer all the profits it makes supplying the good and, whatever p_I, its payoff would be zero.

This shows that, rather than fully deterring entry, for the incumbent it can be more profitable to accommodate entry and use the liquidated damages to appropriate the surplus the more efficient producer brings to the market. In other words, in the presence of liquidated damages, by signing the exclusive contract the buyer and the seller form a coalition at the expense of the entrant.[22]

[22] Actually, Aghion and Bolton assume that when the incumbent offers the exclusive deal, the entrant's marginal cost is unknown. Only its distribution function is common knowledge. Hence, the incumbent cannot choose precisely the penalty that, according to the realisation of c_E, makes the entrant enter the market and allows the incumbent to entirely absorb the gains from efficient entry. When ex-ante choosing the penalty, the incumbent must solve the following trade-off. The higher the penalty, the higher the amount the incumbent appropriates when the entrant enters and the buyer breaks the contract. However, the higher the penalty, the lower the price that the entrant must set to induce the buyer to break the contract and thus the lower the probability of entry. Overall, in the stochastic setting exclusive dealings are shown to be inefficient, because when the incumbent can resort to them the probability of entry is lower with respect to the case when they cannot be adopted. Since the purpose of this paper is to study the impact of downstream competition on rents extracion, we abstract from the stochastic setting and we assume that the entrant's marginal cost is known to the incumbent when it chooses the contractual terms. Note that in the deterministic setting exclusive dealings are

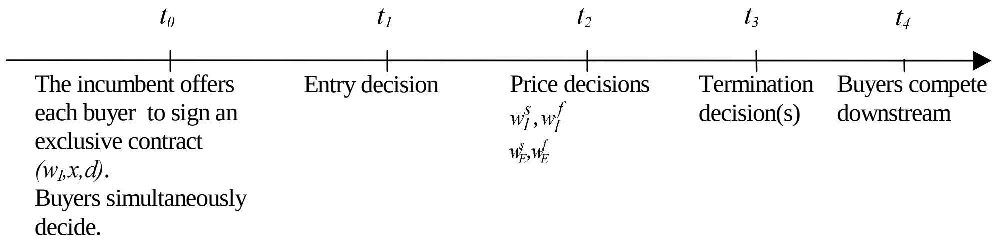

Figure 3: *Time-line when contract termination is possible.*

The model by Aghion and Bolton (1987) considers buyers who are final consumers. In this Section we want to explore whether downstream competition affects the incumbent's ability to use exclusive contracts in order to extract rents.

3.1 The model

We adopt the same setting as in Section 2. Since in our model the entrant's marginal cost is common knowledge, fixed entry costs do not play any crucial role for rents extraction. Thus, we assume that $F = 0$.[23]

The timing of the game is as follows (see also Figure 3). At time t_0, the incumbent offers buyers exclusive contracts (w_I, X, d).[24] Buyers simultaneously decide whether to accept or not. At time t_1, the entrant decides on entry. At time t_2, the incumbent sets the price w_I^f for the free buyer(s). It competes with the entrant for the free buyers, if entry occurred. In case of entry, the entrant sets the price w_E^f for the free buyer(s), if any. Moreover, it sets a price w_E^s for the buyer(s) who signed the exclusive dealing. It will trade with her (them) if she (they) decides to terminate the contract.[25] Buyers take this decision at time t_3. At time t_4 they compete in the final market.

The way in which one would like to proceed is to first identify the optimal contract, and then see if under this contract the incumbent is able to extract all the rents from the entrant. Unfortunately, it is not possible to characterise the optimal contract in the general setting we have adopted. Therefore, we content ourselves to investigate whether, when buyers interact in a downstream market, the incumbent can use exclusive contracts to entirely extract the gains associated with efficient entry (as is the case with a single buyer); or whether it has to share these rents either with the entrant or the buyer(s). To do that, we consider all the possible configurations of contracts that might allow the incumbent to

efficient.

[23] Contractual terms are chosen in order to extract rents and thus to allow entry, even if both buyers have accepted the exclusive contract. Since each buyer anticipates that entry occurs regardless of the other buyer's acceptance decision, the incumbent cannot exploit coordination failures to make buyers sign at zero cost. Instead, fixed costs play a role when there exists uncertainty about the entrant's marginal cost. See Aghion and Bolton (1987).

[24] Aghion and Bolton (1987) assume that the exclusive contract includes a price commitment. We maintain their assumption. While the main intuition holds good also when parties can renogotiate contractual prices, the analysis of time 2 pricing would be substantially more difficult. See Segal and Whinston (2000).

[25] Since the exclusive contract is observable, there is no reason to prevent the entrant from discriminating in its price offer to buyer(s) who signed the exclusive deal and those who did not.

extract the entrant's rents. Section 3.2 studies the case where both buyers sign the exclusive deal and break it $(S=2, B=2)$; section 3.3 analyses the case where both buyers sign the exclusive deal and only one terminates it $(S=2, B=1)$. Finally, section **??** studies the case where only one buyer signs and terminates the contract. Obviously, we are not interested in analysing situations where no buyer terminates the contract, because in this case no extraction of rents could occur.

3.2 Both buyers sign and break the contract

In this Section we first identify the contract (w_I^*, X^*, d^*) such that both buyers sign and terminate, and such that the incumbent extracts all the rents from the entrant; we then study whether such a contract can arise in equilibrium and whether some of the rents must be shared.

The penalty Imagine that both buyers signed a contract (w_I, X, d). They both decide to break it if (and only if) trading with the entrant, despite the payment of the penalty, is more profitable than buying from the incumbent, given that the rival buyer terminates the contract. Therefore, the entrant's price w_E^s must satisfy the following condition:

$$\Pi_B^* (w_E^s, w_E^s, \gamma) - d \geq \Pi_B^* (w_I, w_E^s, \gamma) \tag{8}$$

In order to extract all the rents from the entrant, the penalty must be such that the entrant makes both buyers terminate the contract offering the lowest possible price compatible with entry (i.e. $w_E^s = c_E$). The penalty that achieves this aim is as follows:

$$d^* = \Pi_B^* (c_E, c_E, \gamma) - \Pi_B^* (w_I, c_E, \gamma) \tag{9}$$

The compensation Both buyers sign the contract if the compensation makes accepting (and then breaking the contract) weakly preferred to rejecting, given that the rival buyer signs:

$$\Pi_B^* (c_E, c_E, \gamma) - d^* + X^* \geq \Pi_B^* \left(w_E^{f*} (w_I), w^* (w_I), \gamma \right)$$

Substituting d^* as given by (9), this requires offering at least:

$$X^* = \Pi_B^* \left(w_E^{f*} (w_I), w^* (w_I), \gamma \right) - \Pi_B^* (w_I, c_E, \gamma) \tag{10}$$

where $\Pi_B^* \left(w_E^{f*} (w_I), w^* (w_I), \gamma \right)$ is the payoff that a buyer obtains rejecting the contract. This payoff depends on the price charged by the entrant to the free buyer $(w_E^{f*} (w_I))$ and, unless downstream markets are completely independent $(\gamma = 0)$, also on the price paid by the rival buyer $(w^* (w_I))$. More precisely, $w^* (w_I) = w_I$ if the signer does not break the contract and buys from the incumbent, while $w^* (w_I) = w_E^{s*} (w_I)$ if the signer switches to the entrant.

The signer's decision depends on whether, when one buyer rejects the exclusive deal, the entrant finds it more profitable to sell only to the free buyer rather than to serve both buyers. In other words, when $S = 1$, the entrant compares the solutions to the following programmes and chooses the one that delivers the highest profits.

In order to sell also to the signer, the entrant must induce her to break the contract and, thus, must set a sufficiently low price. Therefore, if it sells to the signer as well, the entrant solves the following problem:

$$\max_{w_E^f, w_E^s} \left(w_E^f - c_E\right) q^* \left(w_E^f, w_E^s, \gamma\right) + \left(w_E^s - c_E\right) q^* \left(w_E^s, w_E^f, \gamma\right) \tag{11a}$$

$$s.t.\ w_E^f \leq c_I \tag{11b}$$

$$\Pi_B^* \left(w_E^s, w_E^f, \gamma\right) - d^* \geq \Pi_B^* \left(w_I, w_E^f, \gamma\right) \tag{11c}$$

where d^* is given by (9). Constraint (11b) captures the fact that the entrant and the incumbent compete for the free buyer. At equilibrium the entrant supplies the input charging a price (weakly) lower than c_I.

Instead, if the entrant decides to trade only with the free buyer, it chooses input prices solving the following programme:

$$\max_{w_E^f, w_E^s} \left(w_E^f - c_E\right) q^* \left(w_E^f, w_I, \gamma\right) \tag{12a}$$

$$s.t.\ w_E^f \leq c_I \tag{12b}$$

$$\Pi_B^* \left(w_E^s, w_E^f, \gamma\right) - d^* < \Pi_B^* \left(w_I, w_E^f, \gamma\right) \tag{12c}$$

Note that the entrant must charge a price (weakly) below w_I in order to induce the signer to break the contract. Thus, *ceteris paribus* the sales of the free buyer are larger when the signer sticks to the incumbent than when the signer switches to the entrant. The entrant trades off the profits it makes supplying the input also to the signer with the profits it loses cannibalising the sales of the free buyer. This trade-off does not arise when downstream markets are independent $(\gamma = 0)$.

The contractual price When both buyers sign the exclusive deal and terminate it, the incumbent's payoff is given by the penalties collected minus the compensations paid to the buyers: $2(d^* - X^*)$. Substituting for $d^*$and X^*, the incumbent's programme is obtained as:

$$\max_{w_I} 2 \left[\Pi_B^* \left(c_E, c_E, \gamma\right) - \Pi_B^* \left(w_E^{f*}\left(w_I\right), w^*\left(w_I\right), \gamma\right)\right] \tag{13}$$

$$s.t.\ X^* \geq 0,\ d^* \geq 0$$

where X^* and d^* are given by (10) and (9) respectively. (The incumbent appropriates what a buyer gains when she and her rival pay the lowest feasible price for the input (i.e. c_E) instead of deviating and paying a higher price $\left(w_E^{f*} > c_E\right)$.) Note that the incumbent has the incentive to choose the contractual price that minimises the payoff of the deviant buyer.

In order to satisfy the constraint $X^* \geq 0$, the contractual price w_I must be strictly higher than c_E. If $w_I = c_E$, when $S = 1$, the entrant should offer a price $w_E^s = c_E$ to the signer to make her terminate the contract. Therefore, $w^*(c_E) = c_E$. Since $w_E^{f*}(c_E) > c_E$, the compensation would amount to $X^* = \Pi_B^*\left(w_E^{f*}(c_E), c_E, \gamma\right) - \Pi_B^*(c_E, c_E, \gamma) < 0$.

Imagine the incumbent offers the contract (w_I^*, X^*, d^*) and both buyers sign. The most profitable price that the entrant can set to make *both* buyers terminate the contract is $w_E^s = c_E$. The entrant would enter the market but would make zero profit. Does the entrant choose this price? It does not, if it can make positive profits by offering a higher price that makes only one buyer terminate the contract. The following Lemma establishes when this is the case.

Lemma 2 *An equilibrium where the incumbent offers a contract such that both buyers sign, the entrant enters charging the price $w_E^s = c_E$ and both buyers terminate the contract does not exist if the following condition is satisfied:*

$$\Pi_B^*(c_E, w_I^*, \gamma) - \Pi_B^*(w_I^*, w_I^*, \gamma) > \Pi_B^*(c_E, c_E, \gamma) - \Pi_B^*(w_I^*, c_E, \gamma) \tag{14}$$

where $w_I^* > c_E$ is the optimal contractual price.

Proof. If both buyers sign the contract (w_I^*, X^*, d^*), the entrant can charge a price $w_E^s > c_E$ and make positive profits if (and only if) an asymmetric equilibrium (where one buyer terminates the contract and the other does not) arises in the post-entry game. In other words, this case occurs if there exists at least one price $w_E^s > c_E$ satisfying the following conditions:

$$\Pi_B^*(w_E^s, w_I^*, \gamma) - d^* \geq \Pi_B^*(w_I^*, w_I^*, \gamma) \tag{15}$$

$$\Pi_B^*(w_I^*, w_E^s, \gamma) > \Pi_B^*(w_E^s, w_E^s, \gamma) - d^*. \tag{16}$$

where d^* is given by (9) and $w_I^* > c_E$ solves (13). Substituting d^*, one can see that any price $w_E^s > c_E$ satisfies condition (16). Thus, a necessary and sufficient condition for the existence of at least one price $w_E^s > c_E$ such that an asymmetric equilibrium arises in the post-entry game is that

$$\Pi_B^*(c_E, w_I^*, \gamma) - d^* > \Pi_B^*(w_I^*, w_I^*, \gamma). \tag{17}$$

Substituting d^*, condition (14) is obtained. ■

The intuition for condition (14) is the following. The penalty d^* has been chosen so that, when the entrant offers $w_E^s = c_E$, a buyer is indifferent between paying the penalty to trade with the entrant and sticking to the incumbent, *given that the rival buyer breaks the contract*. In other words, d^* amounts to the surplus of a buyer when, instead of paying $w_I^* > c_E$ for the input, she obtains a cheaper input (she pays c_E) and thus becomes *as efficient as* the rival buyer $(\Pi_B^*(c_E, c_E, \gamma) - \Pi_B^*(w_I^*, c_E, \gamma))$. Condition (14) requires that this surplus is smaller than the surplus of a buyer when, instead of paying $w_I^* > c_E$ for the input, she pays c_E and thus becomes *more efficient* than the rival buyer

$(\Pi_B^*(c_E, w_I^*, \gamma) - \Pi_B^*(w_I^*, w_I^*, \gamma))$. If this is the case, there exists at least one price $w_E^s > c_E$ such that a buyer is willing to pay the penalty d^* and switch to the entrant, *given that the rival buyer sticks to the incumbent*; whereas a buyer is not willing to, given that the rival breaks the contract. The entrant can choose this price, an asymmetric equilibrium arises in the post-entry game and it makes positive profits.

To conclude, if condition (14) is satisfied, when the incumbent offers (w_I^*, X^*, d^*) and both buyers accept the deal, the entrant does not choose $w_E^s = c_E$, but a higher price at which it makes profits. Therefore, *if an equilibrium where both buyers sign and then break the contract exists, the incumbent must leave some rents to the entrant.* If instead condition (14) is not satisfied, the entrant chooses $w_E^s = c_E$ in the post-entry game. Its rents are completely extracted. If the price that solves (13) is such that $X^* = 0$, the incumbent appropriates all the revenues it collects through the penalties. If, instead, the price that solves (13) is such that $X^* > 0$, part of the incumbent's revenues must be shared with the buyers.

Note that, if downstream markets are independent ($\gamma = 0$), the advantage of using a cheaper input does not depend on the price paid by the rival buyer. Thus, condition (14) can never be satisfied and an asymmetric equilibrium cannot arise in the post-entry game. In that case the entrant cannot do better than choosing $w_E^s = c_E$ when both buyers sign the contract. Note also that, since the deviant buyer's payoff does not depend on the price paid by the rival buyer, the price that solves (13) is undetermined. For any w_I, the incumbent entirely appropriates the gains from efficient entry, $2\left[\Pi_B^*(c_E) - \Pi_B^*\left(w_E^{f*}\right)\right]$.[26] An optimal contract is $(w_I^* = w_E^{f*},\ X^* = 0,\ d^* = \Pi_B^*(c_E) - \Pi_B^*\left(w_E^{f*}\right))$.

3.3 Both buyers sign the contract but one buyer only terminates it

In this Section we analyse the case where both buyers sign the exclusive deal but only one buyer breaks the contract. We study whether there exists a contract that leaves the entrant without rents and whether the incumbent must share some of its revenues with the buyers.

The penalty Given a contract (w_I, X, d) and a price w_E^s, one buyer only switches to the entrant if (and only if) the following conditions are satisfied:

$$\Pi_B^*(w_E^s, w_I, \gamma) - d \geq \Pi_B^*(w_I, w_I, \gamma) \tag{18}$$

$$\Pi_B^*(w_I, w_E^s, \gamma) > \Pi_B^*(w_E^s, w_E^s, \gamma) - d. \tag{19}$$

The penalty such that the entrant offers $w_E^s = c_E$ and an asymmetric equilibrium arises in the post-entry game must be as follows:

$$\Pi_B^*(c_E, c_E, \gamma) - \Pi_B^*(w_I, c_E, \gamma) < d \leq \Pi_B^*(c_E, w_I, \gamma) - \Pi_B^*(w_I, w_I, \gamma) \tag{20}$$

[26] Moreover, if $w_E^{f*} = c_I$, and buyers are final consumers with unit demand, this surplus amounts to $c_I - c_E$. Thus, it coincides with the profit the entrant would make by entering the market in the absence of exclusive dealings. In that case, as argued by Aghion and Bolton (1987), "the main reason for signing exclusive contracts is to extract some of the surplus an entrant would get if she entered the seller's market."

When one buyer only breaks the contract, the penalty that leaves the entrant without rents must absorb the surplus of the buyer who switches to the entrant and pays c_E for the input, *given that the rival buyer does not break the contract*. Therefore, $d = \Pi_B^* (c_E, w_I, \gamma) - \Pi_B^* (w_I, w_I, \gamma)$. However, the penalty must also be high enough so that a buyer is not willing to break the contract, given that the rival does. This is possible if (and only if) the surplus of a buyer who pays c_E and thus becomes as efficient as the rival buyer ($\Pi_B^* (c_E, c_E, \gamma) - \Pi_B^* (w_I, c_E, \gamma)$) is lower than the penalty. In other words, the penalty that leaves the entrant without rents and such that an asymmetric equilibrium arises in the post-entry game exists if (and only if):

$$\Pi_B^* (c_E, c_E, \gamma) - \Pi_B^* (w_I, c_E, \gamma) < \Pi_B^* (c_E, w_I, \gamma) - \Pi_B^* (w_I, w_I, \gamma) \quad (21)$$

This is again condition (14). Note that condition (21) requires $w_I > c_E$ to be satisfied. Moreover, it is never satisfied when downstream markets are independent ($\gamma = 0$).

Therefore, if condition (21) does not hold, a non-discriminatory contract such that both buyers accept, the entrant enters and supplies the input at the price $w_E^s = c_E$, and one buyer terminates the contract does not exist.[27]

If instead condition (21) is satisfied, the incumbent will offer the following penalty:

$$d^* = \Pi_B^* (c_E, w_I, \gamma) - \Pi_B^* (w_I, w_I, \gamma) \quad (22)$$

From now on we focus on the case where condition (21) holds.

The compensation Both buyers sign the contract if (and only if) they are (weakly) better off accepting rather than rejecting:

$$\begin{aligned} \Pi_B^* (c_E, w_I, \gamma) - d^* + X^* &\geq \Pi_B^* \left(w_E^{f*} (w_I), w^* (w_I), \gamma \right) \quad (23) \\ \Pi_B^* (w_I, c_E, \gamma) + X^* &\geq \Pi_B^* \left(w_E^{f*} (w_I), w^* (w_I), \gamma \right) \quad (24) \end{aligned}$$

where d^* is given by (22). Condition (23) describes the incentives of the buyer who breaks the contract, condition (24) refers to the buyer who does not. Substituting d^*,

$$\begin{aligned} \Pi_B^* (w_I, w_I, \gamma) + X^* &\geq \Pi_B^* \left(w_E^{f*} (w_I), w^* (w_I), \gamma \right) \\ \Pi_B^* (w_I, c_E, \gamma) + X^* &\geq \Pi_B^* \left(w_E^{f*} (w_I), w^* (w_I), \gamma \right) \end{aligned}$$

The buyer who does not break the contract pays w_I for the input, while the rival trades with the entrant and pays the price c_E. If she accepts the exclusive deal, she obtains the payoff $\Pi_B^* (w_I, c_E, \gamma)$. Instead, the payoff of the buyer who breaks the contract amounts to $\Pi_B^* (w_I, w_I, \gamma)$: the penalty d^*

[27] If condition (21) is not satisfied, a contract such that $S = 2$, the entrant enters and supplies the input at the price $w_E^s = c_E$, and $B = 1$ exists if the incumbent can discriminate the penalties. However, the conclusions in terms of rents extraction are similiar to the ones obtained with non-discriminatory contracts (when they exist). For this reason we only present the case of non-discriminatory offers.

has been chosen so that breaking the contract and paying c_E for the input leaves the buyer with the same payoff as when she pays w_I, given that the rival buyer trades with the incumbent. Since it must be that $w_I > c_E$, the buyer that requires the highest compensation is the one who does not break the contract.

Therefore, the compensation that makes both buyers sign the exclusive deal is as follows:

$$X^* = \Pi_B^* \left(w_E^{f*} (w_I), w^* (w_I), \gamma \right) - \Pi_B^* (w_I, c_E, \gamma). \tag{25}$$

The contractual price When both buyers sign the exclusive deal and one breaks the contract, the incumbent's payoff is given by the profits made from providing the input to the buyer who does not break the contract, plus the penalty collected from the buyer who breaks it, minus the compensation paid to both buyers. Thus, the incumbent chooses the contractual price w_I by solving the following programme:

$$\max_{w_I} [(w_I - c_I) q^* (w_I, c_E, \gamma) - 2X^* + d^*] \tag{26a}$$

$$s.t.\ X^* \geq 0,\ d^* \geq 0 \tag{26b}$$

$$w_I > c_E \tag{26c}$$

where X^* is given by (25) and d^* is given by (22). Recall that $w_I > c_E$ is required to satisfy condition (21).

The following Lemma establishes when the incumbent must share with the buyers the revenues collected through the exclusive contracts.

Lemma 3 *When the incumbent offers a contract such that both buyers sign, the entrant enters charging the price $w_E^s = c_E$ and one buyer terminates the contract, it must share with the buyers the revenues collected if (and only if) either the optimal contractual price is $w_I^* < c_I$ or $w_I^* \geq c_I$ and $\Pi_B^* \left(w_E^{f*} (w_I^*), w^* (w_I^*), \gamma \right) > 0$.*

Proof. If the incumbent chooses a contractual price $w_I^* < c_I$, it suffers losses trading with the buyer who does not break the contract. Hence, it sells below cost to this buyer, thereby losing some of the revenues obtained through the penalty paid by the other buyer. Let us consider the case $w_I^* \geq c_I$. Note first that $w_E^{f*} (w_I^*) \leq c_I \leq w_I^*$. Second, $w^* (w_I^*) > c_E$. If the entrant does not trade with the signer after $S = 1$, $w^* (w_I^*) = w_I^* \geq c_I > c_E$. If the entrant trades with the signer, i.e. if $w^* (w_I^*) = w_E^{s*} (w_I^*)$, it must be that $w_E^{s*} (w_I^*) > c_E$. The entrant has no incentive to trade with the signer if it does not make positive profits from these sales. Thus, a buyer that rejects the contract instead of signing and sticking to the incumbent obtains a (weakly) cheaper input $\left(w_E^{f*} (w_I^*) \leq w_I^* \right)$ and competes with a rival that pays a higher price for the input $(w^* (w_I^*) > c_E)$. Recalling that condition (21) requires $\gamma > 0$, if $\Pi_B^* \left(w_E^{f*} (w_I^*), w^* (w_I^*), \gamma \right) > 0$, i.e. if rejecting the contract delivers a positive payoff, by $[A1]$ a buyer is better off in the former case: $\Pi_B^* \left(w_E^{f*} (w_I^*), w^* (w_I^*), \gamma \right) > \Pi_B^* (w_I^*, c_E, \gamma)$ and $X^* > 0$. In this case the incumbent must pay positive compensations to make the buyers sign the exclusive deal and must share with them some of the rents extracted. By contrast, if $\Pi_B^*\left(w_E^{f*}\left(w_I^*\right), w\left(w_I^*\right), \gamma\right) = 0$, also $\Pi_B^*\left(w_I^*, c_E, \gamma\right) = 0$: a buyer makes zero profits in any case and $X^* = 0$. ■

We conclude the analysis of the possible configurations of contracts considering the case where only one buyer signs and then terminates the exclusive deal.

3.4 One buyer only signs and then breaks the contract

Imagine the incumbent offers the contract (w_I, X, d) and one buyer only accepts the deal. Imagine also that the penalty is such that the most profitable price to make the signer break the contract is $w_E^s = c_E$. Does the entrant supply the signer at this price? Is the entrant left without rents? The following Lemma answers these questions.

Lemma 4 *When the incumbent offers a contract such that one buyer only signs and then terminates, it must share some rents with the entrant.*

Proof. Since one buyer rejected the exclusive deal, the entrant supplies the input to the free buyer and has to decide whether to supply also the signer at the price $w_E^s = c_E$. Note that the entrant makes no additional profit from selling the input also to the signer at a price $w_E^s = c_E$. Imagine that the contractual price is $w_I > c_E$. By $[A2]$, for any given w_E^f, the profit of the entrant is weakly higher when it supplies only the free buyer rather than when it sells also to the signer at the price $w_E^s = c_E$: $\left(w_E^f - c_E\right) q^*\left(w_E^f, w_I\right) \geq \left(w_E^f - c_E\right) q^*\left(w_E^f, c_E\right)$. The inequality is strict when $q^*\left(w_E^f, w_I\right) > 0$. By $[SW1]$, $q^*\left(c_E, c_E\right) > 0$. By continuity and $[A2]$, there exist some prices $w_E^f > c_E$ such that $q^*\left(w_E^f, c_E\right) > 0$. Hence,

$$\begin{array}{cc} \max\limits_{w_E^f}\left(w_E^f - c_E\right) q^*\left(w_E^f, w_I\right) > & \max\limits_{w_E^f}\left(w_E^f - c_E\right) q^*\left(w_E^f, c_E\right) > 0 \\ s.t.\ w_E^f \leq c_I & s.t. \quad w_E^f \leq c_I \end{array}$$

This implies that the entrant is strictly better off when it sells only to the free buyer. In other words, if an equilibrium where the contractual price is $w_I > c_E$ and one buyer signs and then breaks the contract exists, the incumbent must leave some rents to the entrant. If $w_I = c_E$, the entrant is indifferent between supplying or not the signer at a price $w_E^s = c_E$. However, the entrant makes positive profits and the incumbent has not entirely extracted its rents. Finally, if $w_I < c_E$, by $[A2]$ for any given w_E^f the entrant makes weakly higher profits serving also the signer at $w_E^s = c_E$: $\left(w_E^f - c_E\right) q^*\left(w_E^f, c_E\right) \geq \left(w_E^f - c_E\right) q^*\left(w_E^f, w_I\right)$. The inequality is strict when $q^*\left(w_E^f, c_E\right) > 0$. By the previous argument, the entrant optimally chooses to sell also to the signer at the price $w_E^s = c_E$. Also in this case, the entrant makes positive profits and the incumbent has not entirely extracted its rents. ■

3.5 Does the incumbent entirely appropiate the gains from efficient entry?

To sum up, when downstream markets are independent, the incumbent can use exclusive contracts to entirely extract the gains generated by efficient entry (leaving the entrant with zero profits and paying no compensation to the buyers). This is not necessarily the case when buyers compete in a downstream market. Building on the results obtained so far, the following Proposition identifies a sufficient condition for the incumbent to share the surplus created by the efficient producer either with the entrant or the buyer(s).

Proposition 4 *The incumbent cannot entirely appropriate the surplus generated by efficient entry if the two following conditions simultaneously hold:*

(i) $\Pi_B^*(c_E, w_I, \gamma) - \Pi_B^*(w_I, w_I, \gamma) > \Pi_B^*(c_E, c_E, \gamma) - \Pi_B^*(w_I, c_E, \gamma)$ *for any* $w_I > c_E$*;*

(ii) $\Pi_B^*(c_I, c_E, \gamma) > 0$.

Proof. Condition (i) is sufficient for condition (14) to be satisfied and hence for the incumbent not to extract all the rents from the entrant when the exclusive deal is designed to make both buyers accept and then terminate the contract.

Since $w_E^{f*}(w_I^*) \leq c_I$ and $w^*(w_I^*) > c_E$, condition (ii) is sufficient for $\Pi_B^*\left(w_E^{f*}(w_I^*), w^*(w_I^*), \gamma\right) > 0$,[28] when the exclusive deal is such that both buyers accept and one terminates the contract. Hence, the incumbent must pay positive compensations to buyers and must share some rents with them. ■

Unfortunately, it is very difficult to say anything about how the degree of competition affects conditions (i) and (ii) in general terms: while under independent goods the sufficient condition clearly does not hold (if $\gamma = 0$ (i) is false), under downstream competition ($\gamma > 0$) it is not possible to establish whether both (i) and (ii) hold or not. However, both conditions are satisfied in the examples illustrated in the appendix.

4 Conclusion

This paper has studied the effect of downstream competition on an incumbent firm's ability to use exclusive contracts to either exclude efficient entry or extract rents associated with it.

In the first part of the paper, we have extended the model by Rasmusen et al. (1991) and Segal and Whinston (2000) and have shown that unless competition in the downstream market is weak enough, the incumbent is not able to exclude entry. This implication should be taken into account in antitrust cases by competition authorities.

In the second part, we have considered exclusive contracts with price commitments and liquidated damages - along the lines of Aghion and Bolton (1987) - and have shown that under such contracts the incumbent may not be able to seize all rents associated with efficient entry if downstream competition exists.

[28] Note that condition (ii) is more likely to be satisfied the lower the difference between the entrant's and the incumbent's marginal costs.

5 Appendix

In this Section we provide two parametric examples: in the first one (Section 5.1) the toughness of downstream competition is captured by the degree of substitutability between the final products, in the second one it is captured by the degree of integration between the downstream markets (Section 5.2). For each example, first we show that the assumptions adopted in Section 2 are satisfied, and second we verify that the sufficient condition identified in Section 3 for incomplete rents extraction is satisfied.

5.1 Example 1: Product substitutability

In this Section we solve the model assuming that final consumers' preferences are represented by the following utility function first proposed by Shubik and Levitan (1980):

$$U = v\sum_{i=1}^{n} q_i - \frac{n}{2(1+\gamma)}\left[\sum_{i=1}^{n} q_i^2 + \frac{\gamma}{n}\left(\sum_{i=1}^{n} q_i\right)^2\right] + y \qquad (27)$$

where y is an outside good, q_i is the quantity of the i-th product, v is a positive parameter, n is the number of products in the industry, and $\gamma \in [0, \infty)$ represents the degree of substitutability between the n products.[29] Since the utility function is quasi-linear, the consumers' decisions on the outside good y do not affect their decisions taken with respect to the differentiated goods, so that we can develop the analysis in a partial equilibrium framework.

From the maximisation of the utility function subject to the income constraint, we can derive the inverse demand function as

$$p_i = v - \frac{1}{1+\gamma}\left(nq_i + \gamma\sum_{j=1}^{n} q_j\right) \qquad (28)$$

We focus on the case where $n = 2$ and we solve the model assuming that firms compete in quantities but the same results could be proved in the case of price competition.[30] Without loss of generality we normalise the entrant's variable cost to zero $(c_E = 0)$. Moreover, we assume that the efficiency gap between the incumbent and the entrant is not extremely large $\left(c_I \leq \frac{5v}{13}\right)$. This assumption implies that the entrant's constraint is always binding, thus making the exposition of the results neater and shorter, without any other implication. We have solved the model for higher values of c_I and nothing changes.

In the last stage of the game, simple algebra shows that:

[29] A peculiarity of this demand function is that at given prices aggregate demand does not vary with the degree of substitutability. This makes the role of the intensity of competition in the downstream market in facilitating entry deterrence come out more clearly. Note also that in this example $\overline{\gamma} = \infty$.

[30] The advantage of considering quantity competition is that $x^* > 0$ for any γ. In the case of price competition, $x^* > 0$ requires that extremely high values of γ are excluded.

$$q^*(w_i,w_j,\gamma)=\max\left\{\frac{(1+\gamma)\left[(4+\gamma)v+\gamma(w_j-2w_i)-4w_i\right]}{(4+\gamma)(4+3\gamma)},0\right\},$$

and when $q^*(w_i,w_j,\gamma)$ is strictly positive, the payoff of the buyer is:

$$\Pi_B^*(w_i,w_j,\gamma)=\frac{(4v+v\gamma+\gamma w_j-2\gamma w_i-4w_i)^2(1+\gamma)(2+\gamma)}{(4+3\gamma)^2(4+\gamma)^2}. \tag{29}$$

It is easy to check that $q^*(w_i,w_j,\gamma)$ and $\Pi_B^*(w_i,w_j,\gamma)$ are continuous and that *[A1]* and *[A2]* are satisfied. We can, thus, compute the market share of buyer i, given by:

$$\alpha_i(w_i,w_j,\gamma)=\frac{4v+\gamma(v+w_j)-2w_i(2+\gamma)}{(4+\gamma)(2v-w_j-w_i)}. \tag{30}$$

It can be checked that if a buyer uses a cheaper input than her rival ($w_i<w_j$), her market share increases with γ. This highlights the "business stealing effect": obtaining a cheaper input provides a stronger competitive advantage the tougher competition in the downstream market.

Let us study the price decisions of the incumbent and of the entrant.

When $S=2$, $w^{s*}_{I|S=2}=\frac{v+c_I}{2}>c_I$, and

$$\pi^*_{I|S=2}=\frac{(v-c_I)^2(1+\gamma)}{2(4+3\gamma)}-2x;\qquad \pi^*_{B|S=2}=\frac{(2+\gamma)(v-c_I)^2(1+\gamma)}{4(4+3\gamma)^2}+x. \tag{31}$$

When $S=0$, $w^*_{E|S=0}=c_I$, and

$$\pi^*_{E|S=0}=\frac{2(v-c_I)(1+\gamma)c_I}{4+3\gamma}-F;\qquad \Pi^*_{B|S=0}=\frac{(2+\gamma)(v-c_I)^2(1+\gamma)}{(4+3\gamma)^2}. \tag{32}$$

By using these payoffs it follows that $x^*(\gamma)>0$ for any γ (condition *[SW1]*) and that $\frac{\Pi^*_{I|S=2}(\gamma)}{2}\le x^*(\gamma)$ (condition *[SW2]*) for any γ.

Finally, when $S=1$ and entry occurred,

$$w^*_{E|S=1}=c_I;\quad w^{s*}_{I|S=1}=\tfrac{(4+\gamma)v+(3\gamma+4)c_I}{4(2+\gamma)}>c_I. \tag{33}$$

One can check that $w^{s*}_{I|S=1}(\gamma)$ is decreasing in γ and that the optimal input prices are such that $w^*_{E|S=1}(\gamma)=w^*_{E|S=0}(\gamma)<w^{s*}_{I|S=1}(\gamma)$. This confirms that $\Pi^*_{B|S=1}-\Pi^*_{B|S=0}\ge 0$ for any γ, as stated by Lemma 1. Hence, conditions (4) and (5) follow $\left(\widetilde{x}(\gamma)\ge x^*(\gamma)>0 \text{ and } \frac{\Pi^*_{I|S=2}(\gamma)}{2}<\widetilde{x}(\gamma),\ \text{for any } \gamma\right)$.

The optimal input prices allow to compute the agents' payoffs as follows, where f denotes the payoff of the ("free") buyer who addressed the entrant and s the buyer who signed the exclusive deal:

$$\begin{array}{ll} \pi^*_{I|S=1} = \frac{(1+\gamma)(v-c_I)^2(4+\gamma)}{8(4+3\gamma)(2+\gamma)} - x & \pi^*_{E|S=1} = \frac{(8+5\gamma)(v-c_I)(1+\gamma)c_I}{4(4+3\gamma)(2+\gamma)} - F \\ \Pi^{f*}_{B|S=1} = \frac{(8+5\gamma)^2(v-c_I)^2(1+\gamma)}{16(4+3\gamma)^2(2+\gamma)} & \pi^{s*}_{B|S=1} = \frac{(v-c_I)^2(1+\gamma)(2+\gamma)}{4(4+3\gamma)^2} + x. \end{array} \quad (34)$$

First, one can check that $\Pi^*_{E|S=1}$ is strictly increasing in γ (*[A3]* is satisfied). The intuition is the following. *Ceteris paribus,* as downstream competition intensifies, prices in the final market decrease and aggregate demand increases. On top of this, the "business stealing effect" allows the "free buyer" (who obtains the input at a lower price than the "exclusive buyer", $w^*_{E|S=1}(\gamma) < w^{s*}_{I|S=1}(\gamma)$), to increase her market share. Hence, as downstream competition intensifies, *ceteris paribus* the "free buyer" sells more and more in the downstream market. This increases the entrant's profit via the input demand. However, tougher downstream competition makes the incumbent decrease the price charged to the "exclusive buyer" ($w^{s*}_{I|S=1}(\gamma)$ is decreasing in γ). This negatively affects the quantity sold by the "free buyer" in the downstream market and the entrant's profit. In this model, the former effect is stronger so that $\Pi^*_{E|S=1}$ is strictly increasing in γ.

Second, it can be checked that $\widetilde{x}(\gamma)$ is strictly increasing in γ. With respect to the case where both buyers sign the exclusive deal and entry does not occur, rejecting the exclusive deal when the rival buyer signs and entry occurs provides two advantages. First, the "free buyer" pays less for the input; second, she pays less than her rival. The tougher downstream competition, the stronger the competitive advantage provided by using a cheaper input, the more profitable to reject when the rival buyer signs. Hence, the higher the gain from efficient entry for the only buyer who rejects and the more costly for the incumbent to block individual deviations.

Finally, it can be checked that $\Pi^*_{I|S=1}(\gamma) < x^{**}(\gamma)$ for any γ, so that condition (7) is satisfied.

It is now possible to identify the interval of feasible entry costs $\left[\underline{F}, \overline{F}\right)$ as indicated in Figure 2. Since $\Pi^*_{E|S=0}(\gamma)$ is increasing in γ,

$$\overline{F} = \Pi^*_{E|S=0}(0) = \frac{(v-c_I)c_I}{2} \qquad \underline{F} = \Pi^*_{E|S=1}(0) = \frac{(v-c_I)c_I}{4}.$$

Finally, note that $\lim_{\gamma\to\infty}\Pi^*_{E|S=1}(\gamma) < \Pi^*_{E|S=0}(0)$. Hence, the threshold F' (see Figure 2) always exists and can be defined as follows:

$$F' = \lim_{\gamma\to\infty}\Pi^*_{E|S=1}(\gamma) = \frac{5c_I(v-c_I)}{12}.$$

The threshold $\gamma^*(F)$ is identified by solving $\Pi^*_{E|S=1}(\gamma) = F$ for $F \in [\underline{F}, F')$, as Figure 2 illustrates.

Finally, it can be checked that only case A arises in Propositions 2 and 3 and that $\widetilde{x}(\gamma) > \Pi^*_{I|S=2}(\gamma) - \Pi^*_{I|S=1}(\gamma)$ so that only case *(i)* arises in Proposition 3.

Appendix to section 3 By (29), if $\Pi^*_B(w_i, w_j) > 0$, $\frac{\partial^2\Pi^*_B(w_i,w_j)}{\partial w_i \partial w_j} = -\frac{4(\gamma+2)^2(\gamma+1)\gamma}{(4+3\gamma)^2(4+\gamma)^2} < 0$ for any $\gamma > 0$. In other words, the higher the rival's input price, the stronger the impact on a buyer's payoff of a change in her own input price.

This implies that condition (i) in Proposition 4 is satisfied for any $\gamma > 0$.

Note that the higher γ, the higher $\left| \frac{\partial^2 \Pi_B^*(w_i, w_j)}{\partial w_i \partial w_j} \right|$. Hence, $\Pi_B^*(c_E, w_I) - \Pi_B^*(w_I, w_I) - \Pi_B^*(c_E, c_E) + \Pi_B^*(w_I, c_E)$ is increasing in the intensity of downstream competition.

Since in this example $c_E = 0$ and $c_I \leq \frac{5v}{13}$, also condition (ii) in Proposition 4 holds for any γ.

5.2 Example 2: Market integration

We consider two countries, 1 and 2, each with a population size $\frac{s}{2}$ of consumers having demand function $q = 1 - p$ for a homogenous good. This means that aggregate demand in each country k is given by $Q_k = \frac{s}{2}(1 - p_k)$. By inverting the demand functions we obtain (inverse) demand in country k as:

$$p_k = 1 - \frac{2Q_k}{s}, \ k = 1, 2. \tag{35}$$

In this model each buyer-downstream firm is located in a country (buyer-firm 1 in country 1 whereas buyer-firm 2 in country 2). These two firms do not incur trade costs when buying the input either from the entrant or from the incumbent. We normalise the entrant's variable cost to zero ($c_E = 0$) and we assume that $c_I < 15/43$. Combined with an upper bound on transport costs (see below), this ensures that exports are always feasible at equilibrium and that the entrant never sets a price below c_I (this simplifies the analysis without any further implication).

We also assume that the only cost for downstream firms is the wholesale price they pay for the input, and that they compete à la Cournot in the two markets. Hence, each firm $i = 1, 2$ sets the output q_{ik} it wants to sell in country k. There is a transportation cost t with (with $t \leq \bar{t} \equiv \frac{2}{7}(1 - c_I)$) to sell the output in the export market, modelled as an additional variable cost that a firm incurs. In this model, trade costs represent an inverse measure of competition (one can think of t as the inverse of γ, to keep in line with the previous notation). The lower t the deeper the integration between the two markets and the tougher competition between the domestic and the foreign firm. As $t \to 0$ the two national markets tend to be a unique one.

In the last stage of the game, the profit functions can be written as:

$$\Pi_i = (p_i - w_i) q_{ii} + (p_j - w_i - t) q_{ij} \tag{36}$$

with $i \neq j = 1, 2$. Taking the first-order conditions and solving the system one finds the equilibrium outputs as:

$$q_{ii}^* = \max\left\{\frac{s}{6}(1 + t - 2w_i + w_j), 0\right\} \ q_{ij}^* = \max\left\{\frac{s}{6}(1 - 2t - 2w_i + w_j), 0\right\}. \tag{37}$$

with $i \neq j = 1, 2$. Thus, when exports are feasible, the total quantity sold by buyer i in the two markets and her profits are given by

$$q^*(w_i, w_j, t) = \frac{s}{3}\left(1 + w_j - 2w_i - \frac{t}{2}\right) \tag{38}$$

$$\Pi_B^*(w_i, w_j, t) = \frac{s}{18}\left[(1 - 2w_i + w_j + t)^2 + (1 - 2w_i + w_j - 2t)^2\right]. \tag{39}$$

where $i \neq j = 1, 2$. It is easy to check that $q^*(w_i, w_j, t)$ and $\Pi_B^*(w_i, w_j, t)$ are continuous and that *[A1]* and *[A2]* are satisfied. In particular, the deeper market integration (the lower t) the more competitive a firm in the foreign market but the tougher her rival in the domestic market. Hence, the higher exports and the lower the quantity sold in the domestic market. The former effect prevails.

Let us study the price decisions of the incumbent and of the entrant.

When $S = 2$, $w_{I|S=2}^{s*} = \frac{2-t+2c_I}{4} > c_I$, and

$$\pi_{I|S=2}^* = \frac{s(2-t-2c_I)^2}{24} - 2x; \qquad \pi_{B|S=2}^* = \frac{s\left(37t^2+4+4c_I^2-4t+4tc_I-8c_I\right)}{144} + x. \tag{40}$$

When $S = 0$, $w_{E|S=0}^* = c_I$, and

$$\pi_{E|S=0}^* = \frac{sc_I(2-2c_I-t)}{3} - F; \quad \Pi_{B|S=0}^* = \frac{s\left[5t^2-2t(1-c_I)+2(1-c_I)^2\right]}{18}. \tag{41}$$

By using these payoffs it follows that $x^*(t) > 0$ for any feasible t (condition *[SW1]*) and that $\frac{\Pi_{I|S=2}^*(t)}{2} \leq x^*(t)$ (condition *[SW2]*) for any feasible t.

Finally, when $S = 1$ and entry occurred,

$$w_{E|S=1}^* = c_I \qquad w_{I|S=1}^{s*} = \tfrac{1}{4} + \tfrac{3}{4}c_I - \tfrac{t}{8} > c_I. \tag{42}$$

Note that $w_{I|S=1}^{s*}(t)$ is decreasing in t. The deeper market integration (i.e., the stronger competition), the higher the buyer's saving in trade costs. This allows the incumbent to profitably increase the wholesale price.

Further, the optimal input prices are such that $w_{E|S=1}^*(t) = w_{E|S=0}^*(t) < w_{I|S=1}^{s*}(t)$. This confirms that $\Pi_{B|S=1}^* - \Pi_{B|S=0}^* \geq 0$ for any feasible t, as stated by Lemma 1. Hence, conditions (4) and (5) follow $\left(\widetilde{x}(t) \geq x^*(t) > 0 \text{ and } \frac{\Pi_{I|S=2}^*(t)}{2} < \widetilde{x}(t), \text{ for any feasible } t\right)$.

The optimal input prices allow to compute the agents' payoffs as follows, where f denotes the payoff of the buyer who addressed the entrant and s the buyer who signed the exclusive deal.

$$\begin{aligned} \pi_{I|S=1}^* &= \tfrac{s(2-2c_I-t)^2}{96} - x; & \pi_{E|S=1}^* &= \tfrac{sc_I(10-10c_I-5t)}{24} - F \\ \Pi_{B|S=1}^{f*} &= \tfrac{s\left(100-200c_I-100t+100c_I^2+100c_It+169t^2\right)}{576}; & \pi_{B|S=1}^{s*} &= \tfrac{s\left(4-8c_I-4t+4c_I^2+4c_It+37t^2\right)}{144} + x. \end{aligned} \tag{43}$$

One can check that $\Pi_{E|S=1}^*$ is strictly decreasing in t (*[A3]* is satisfied). In this example, the mechanism behind this property is slightly different with respecto to the previous one. As market integration increases, *ceteris paribus* the "free buyer" sells more and more in the downstream market, thus increasing the entrant's profit. This is mainly due to the fact that market integration intensifies competition in the market and decreases final prices. On top of this, deeper market integration allows the incumbent to profitably increase the price charged to the "exclusive buyer" ($w_{I|S=1}^{s*}$ is decreasing in t). This positively affects the quantity sold by the "free buyer" in the downstream market and the entrant's profit.

Finally, it can be checked that $\Pi^*_{I|S=1}(t) < x^{**}(t)$ for any feasible t, so that condition (7) is satisfied.

We identify also in this case the interval of feasible entry costs $\left[\underline{F}, \overline{F}\right)$ and the threshold value F' (see Figure 2). Since $\Pi^*_{E|S=0}(t)$ is decreasing in t,

$$\overline{F} = \Pi^*_{E|S=0}\left(\overline{t}\right) = \tfrac{4s}{7} c_I (1 - c_I)\text{; and}$$
$$\underline{F} = \Pi^*_{E|S=1}\left(\overline{t}\right) = \tfrac{5s}{14} c_I (1 - c_I).$$

Finally, note that $\lim_{t \to 0} \Pi^*_{E|S=1}(t) < \Pi^*_{E|S=0}\left(\overline{t}\right)$. Hence, F' always exists and can be defined as follows:

$$F' = \lim_{t \to 0} \Pi^*_{E|S=1}(t) = \tfrac{s}{24} c_I (10 - 10c_I).$$

Since $\Pi^*_{I|S=2}(t)/2 = x^*(t)$, only case A arises in Propositions 2 and 3.

Finally, it can be checked that $\widetilde{x}(t) > \Pi^*_{I|S=2}(t) - \Pi^*_{I|S=1}(t)$: therefore, only case *(i)* arises in Proposition 3.

Appendix to section 3 In this example, when exports are feasible and thus downstream markets are interdependent, $\Pi^*_B(w_i, w_j, t) = \frac{s}{18}\left[(1 - 2w_i + w_j + t)^2 + (1 - 2w_i + w_j - 2t)^2\right]$. Since $\frac{\partial^2 \Pi^*_B(w_i, w_j)}{\partial w_i \partial w_j} = -\frac{4}{9}s < 0$, condition (i) in Proposition 4 is satisfied.

Since in this example $c_E = 0$ and $c_I < 15/43$, also condition (ii) in Proposition 4 is satisfied.

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